

Policy instruments for cost-effective building renovation at district level combining energy efficiency & renewables

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International Energy Agency

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Energy in Buildings and Communities
Technology Collaboration Programme

April 2023



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Preface

The International Energy Agency

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. A basic aim of the IEA is to foster international co-operation among the 30 IEA participating countries and to increase energy security through energy research, development and demonstration in the fields of technologies for energy efficiency and renewable energy sources.

The IEA Energy in Buildings and Communities Programme

The IEA co-ordinates international energy research and development (R&D) activities through a comprehensive portfolio of Technology Collaboration Programmes (TCPs). The mission of the IEA Energy in Buildings and Communities (IEA EBC) TCP is to support the acceleration of the transformation of the built environment towards more energy efficient and sustainable buildings and communities, by the development and dissemination of knowledge, technologies and processes and other solutions through international collaborative research and open innovation. (Until 2013, the IEA EBC Programme was known as the IEA Energy Conservation in Buildings and Community Systems Programme, ECBCS.)

The high priority research themes in the EBC Strategic Plan 2019-2024 are based on research drivers, national programmes within the EBC participating countries, the Future Buildings Forum (FBF) Think Tank Workshop held in Singapore in October 2017 and a Strategy Planning Workshop held at the EBC Executive Committee Meeting in November 2017. The research themes represent a collective input of the Executive Committee members and Operating Agents to exploit technological and other opportunities to save energy in the buildings sector, and to remove technical obstacles to market penetration of new energy technologies, systems and processes. Future EBC collaborative research and innovation work should have its focus on these themes.

At the Strategy Planning Workshop in 2017, some 40 research themes were developed. From those 40 themes, 10 themes of special high priority have been extracted, taking into consideration a score that was given to each theme at the workshop. The 10 high priority themes can be separated in two types namely 'Objectives' and 'Means'. These two groups are distinguished for a better understanding of the different themes.

Objectives - The strategic objectives of the EBC TCP are as follows:

- reinforcing the technical and economic basis for refurbishment of existing buildings, including financing, engagement of stakeholders and promotion of co-benefits;
- improvement of planning, construction and management processes to reduce the performance gap between design stage assessments and real-world operation;
- the creation of 'low tech', robust and affordable technologies;
- the further development of energy efficient cooling in hot and humid, or dry climates, avoiding mechanical cooling if possible;
- the creation of holistic solution sets for district level systems taking into account energy grids, overall performance, business models, engagement of stakeholders, and transport energy system implications.

Means - The strategic objectives of the EBC TCP will be achieved by the means listed below:

- the creation of tools for supporting design and construction through to operations and maintenance, including building energy standards and life cycle analysis (LCA);
- benefitting from 'living labs' to provide experience of and overcome barriers to adoption of energy efficiency measures;
- improving smart control of building services technical installations, including occupant and operator interfaces;
- addressing data issues in buildings, including non-intrusive and secure data collection;
- the development of building information modelling (BIM) as a game changer, from design and construction through to operations and maintenance.

The themes in both groups can be the subject for new Annexes, but what distinguishes them is that the 'objectives' themes are final goals or solutions (or part of) for an energy efficient built environment, while the 'means' themes are instruments or enablers to reach such a goal. These themes are explained in more detail in the EBC Strategic Plan 2019-2024.

The Executive Committee

Overall control of the IEA EBC Programme is maintained by an Executive Committee, which not only monitors existing projects, but also identifies new strategic areas in which collaborative efforts may be beneficial. As the Programme is based on a contract with the IEA, the projects are legally established as Annexes to the IEA EBC Implementing Agreement. At the present time, the following projects

have been initiated by the IEA EBC Executive Committee, with completed projects identified by (*) and joint projects with the IEA Solar Heating and Cooling Technology Collaboration Programme by (☼):

- Annex 1: Load Energy Determination of Buildings (*)
- Annex 2: Ekistics and Advanced Community Energy Systems (*)
- Annex 3: Energy Conservation in Residential Buildings (*)
- Annex 4: Glasgow Commercial Building Monitoring (*)
- Annex 5: Air Infiltration and Ventilation Centre
- Annex 6: Energy Systems and Design of Communities (*)
- Annex 7: Local Government Energy Planning (*)
- Annex 8: Inhabitants Behaviour with Regard to Ventilation (*)
- Annex 9: Minimum Ventilation Rates (*)
- Annex 10: Building HVAC System Simulation (*)
- Annex 11: Energy Auditing (*)
- Annex 12: Windows and Fenestration (*)
- Annex 13: Energy Management in Hospitals (*)
- Annex 14: Condensation and Energy (*)
- Annex 15: Energy Efficiency in Schools (*)
- Annex 16: BEMS 1- User Interfaces and System Integration (*)
- Annex 17: BEMS 2- Evaluation and Emulation Techniques (*)
- Annex 18: Demand Controlled Ventilation Systems (*)
- Annex 19: Low Slope Roof Systems (*)
- Annex 20: Air Flow Patterns within Buildings (*)
- Annex 21: Thermal Modelling (*)
- Annex 22: Energy Efficient Communities (*)
- Annex 23: Multi Zone Air Flow Modelling (COMIS) (*)
- Annex 24: Heat, Air and Moisture Transfer in Envelopes (*)
- Annex 25: Real time HVAC Simulation (*)
- Annex 26: Energy Efficient Ventilation of Large Enclosures (*)
- Annex 27: Evaluation and Demonstration of Domestic Ventilation Systems (*)
- Annex 28: Low Energy Cooling Systems (*)
- Annex 29: ☼ Daylight in Buildings (*)
- Annex 30: Bringing Simulation to Application (*)
- Annex 31: Energy-Related Environmental Impact of Buildings (*)
- Annex 32: Integral Building Envelope Performance Assessment (*)
- Annex 33: Advanced Local Energy Planning (*)
- Annex 34: Computer-Aided Evaluation of HVAC System Performance (*)
- Annex 35: Design of Energy Efficient Hybrid Ventilation (HYBVENT) (*)
- Annex 36: Retrofitting of Educational Buildings (*)
- Annex 37: Low Exergy Systems for Heating and Cooling of Buildings (LowEx) (*)
- Annex 38: ☼ Solar Sustainable Housing (*)
- Annex 39: High Performance Insulation Systems (*)
- Annex 40: Building Commissioning to Improve Energy Performance (*)
- Annex 41: Whole Building Heat, Air and Moisture Response (MOIST-ENG) (*)
- Annex 42: The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (FC+COGEN-SIM) (*)
- Annex 43: ☼ Testing and Validation of Building Energy Simulation Tools (*)
- Annex 44: Integrating Environmentally Responsive Elements in Buildings (*)
- Annex 45: Energy Efficient Electric Lighting for Buildings (*)
- Annex 46: Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo) (*)
- Annex 47: Cost-Effective Commissioning for Existing and Low Energy Buildings (*)
- Annex 48: Heat Pumping and Reversible Air Conditioning (*)
- Annex 49: Low Exergy Systems for High Performance Buildings and Communities (*)
- Annex 50: Prefabricated Systems for Low Energy Renovation of Residential Buildings (*)
- Annex 51: Energy Efficient Communities (*)
- Annex 52: ☼ Towards Net Zero Energy Solar Buildings (*)
- Annex 53: Total Energy Use in Buildings: Analysis and Evaluation Methods (*)
- Annex 54: Integration of Micro-Generation and Related Energy Technologies in Buildings (*)
- Annex 55: Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost (RAP-RETRO) (*)
- Annex 56: Cost Effective Energy and CO2 Emissions Optimization in Building Renovation (*)

Annex 57: Evaluation of Embodied Energy and CO2 Equivalent Emissions for Building Construction (*)
Annex 58: Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements (*)
Annex 59: High Temperature Cooling and Low Temperature Heating in Buildings (*)
Annex 60: New Generation Computational Tools for Building and Community Energy Systems (*)
Annex 61: Business and Technical Concepts for Deep Energy Retrofit of Public Buildings (*)
Annex 62: Ventilative Cooling (*)
Annex 63: Implementation of Energy Strategies in Communities (*)
Annex 64: LowEx Communities - Optimised Performance of Energy Supply Systems with Exergy Principles (*)
Annex 65: Long-Term Performance of Super-Insulating Materials in Building Components and Systems (*)
Annex 66: Definition and Simulation of Occupant Behavior in Buildings (*)
Annex 67: Energy Flexible Buildings (*)
Annex 68: Indoor Air Quality Design and Control in Low Energy Residential Buildings (*)
Annex 69: Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings
Annex 70: Energy Epidemiology: Analysis of Real Building Energy Use at Scale
Annex 71: Building Energy Performance Assessment Based on In-situ Measurements
Annex 72: Assessing Life Cycle Related Environmental Impacts Caused by Buildings
Annex 73: Towards Net Zero Energy Resilient Public Communities
Annex 74: Competition and Living Lab Platform
Annex 75: Cost-effective Building Renovation at District Level Combining Energy Efficiency and Renewables
Annex 76: ☀ Deep Renovation of Historic Buildings Towards Lowest Possible Energy Demand and CO₂ Emissions
Annex 77: ☀ Integrated Solutions for Daylight and Electric Lighting
Annex 78: Supplementing Ventilation with Gas-phase Air Cleaning, Implementation and Energy Implications
Annex 79: Occupant-Centric Building Design and Operation
Annex 80: Resilient Cooling
Annex 81: Data-Driven Smart Buildings
Annex 82: Energy Flexible Buildings Towards Resilient Low Carbon Energy Systems
Annex 83: Positive Energy Districts
Annex 84: Demand Management of Buildings in Thermal Networks
Annex 85: Indirect Evaporative Cooling
Annex 86: Energy Efficient Indoor Air Quality Management in Residential Buildings

Working Group - Energy Efficiency in Educational Buildings (*)
Working Group - Indicators of Energy Efficiency in Cold Climate Buildings (*)
Working Group - Annex 36 Extension: The Energy Concept Adviser (*)
Working Group - HVAC Energy Calculation Methodologies for Non-residential Buildings (*)
Working Group - Cities and Communities
Working Group - Building Energy Codes
(*) completed working group

Executive summary

IEA EBC Annex 75 investigated cost-effective strategies for reducing carbon emissions and energy use in city buildings at the district level, combining energy efficiency and renewable energy measures. Renovations at the district level 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 the renovation of residential building envelopes and renewable energy systems, specifically when addressed at the district level. Building renovation at the district level has many technological, economic and social advantages. This includes, for example, wider possibilities for using renewable energy systems (compared to building-scale restrictions), economies of scale when purchasing materials, services and management (due to aggregate energy demands), the organizational opportunity for integrated and cooperative actions and communication that can lead to additional motivation and integrated energy renovation processes. On the other hand, some specific needs must be faced to obtain an increased renovation rate, such as coordination needs (dealing with a diversity of interests related to various types of owners and buildings), communication needs (engaging multiple investors and decision-makers at the same time) and financing and assurance needs (to cover for high upfront costs and potential risks). By taking these needs into account and acting at the district level, we can enable important potentials that can increase not only the ratio but also the quality and societal acceptance of building renovations, with improved energy efficiency, more renewable energy production and a deeper decarbonisation of the building stock. Considering all the above, adopting new and better policy instruments to facilitate and support renovations at the district level is crucial.

To approach this issue, desk research was first done to investigate what policy options local authorities in multiple European countries must offer to support the district-level renovation, including energy efficiency and renewable energy systems, and what strengths and weaknesses are observed regarding the use of various types of policy instruments. This resulted in an overview and first assessment of policy options at the district level, that describes regulation options such as the 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. Although many policy instruments could increase the renovation rate and action at the district scale, there is almost no information about the efficiency and effectiveness of these instruments.

Following, empirical research investigated how eight selected promising policy instruments are assessed by stakeholders, also encompassing the 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 of implementation. Thirty-eight in-depth interviews from eight countries (Austria, Belgium, Germany, The Netherlands, Portugal, Spain, Sweden and Switzerland) were carried out. Results were also used to qualitatively analyse the possible role of national or regional authorities in supporting local authorities and district action, to provide recommendations to improve policies for combining energy efficiency and renewable energy systems at the district scale.

The desk research found 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 the district level.

First, regulations and contractual arrangements might be needed to produce a change in worst-performing segments or to ensure transition 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 a 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. In contrast, others consider top-down energy planning as a driver.

Financial incentives supporting district planning, connections to district heating systems or groups of homeowners can have an impact and are 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 in facilitating renovation at the district scale. Interviewees point out the unique role local authorities may have for launching and coordinating renovation projects at the 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 to solutions for districts and building assemblies rather than individual buildings. Authority communication channels can support awareness raising for district campaigns, but also better data tracking is needed to assess collaborative action and verify targets.

IEA EBC Annex 75 expert workshops and interviews further confirmed stakeholders' interest in using or developing regulations, such as mandatory energy standards and inspections, financial incentives for districts and groups of homeowners, renovation services and energy desks, digital communication, and network meetings in districts. Regulations are relatively less used compared to other instruments, but all instruments are generally considered important. Most of the interviewees question the ease of implementation of the instruments in the current context. Communication instruments are considered the easiest to implement and enforcement strategies are the most difficult.

Findings from the comparison between policy and non-policy actors' perspectives show that policy actors declare, in general, more experience and interest in policy instruments than non-policy actors. On the other hand, 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.

The qualitative findings from the interviews confirm that renovations at the district level, including energy efficiency and renewable energy systems, 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 district-level renovations, including energy efficiency and renewable energy systems.

Interviewees confirm that local compliance with (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 systems at the district level. However, local action can also be hindered by a lack of collaboration between policy levels and a 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 use demo districts better and 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 the district level was considered important to be assured, as well as the engagement of specific process coaches, specialized staff and consultancy desks.

To meet the objectives of the European Green Deal, all countries will need to boost their renovation rate and ensure that whenever a heating or other distribution system is replaced, a switch is made to include renewable energy systems. Policy instruments that support renovation at the district level might support the up-scaling renovation of building envelopes and renewable energy grids. There are many country and district differences regarding the existing and future action for energy renovation at the district level, including energy efficiency and renewable energy systems, regarding national and local ambitions and 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 show that next to urban planning and policy instruments at the building level, developing policy instruments that specifically focus on (activating) groups of people, such as co-owners of buildings and vulnerable target groups, might be promising. At this point, countries and districts can learn from each other's successes and failures regarding developing policy instruments to support energy grid changes and building renovations at the district level. Local authorities can be drivers of district projects. Still, they also largely depend on available national and regional structures, initiatives, support and resources. At the same time, they need to deal with a possibly inconsistent national framework for renovation at the district level.

We found that building renovations at the district level, including energy efficiency and renewable energy systems, are useful for many types of stakeholders for accelerating the energy transition. However, efforts still need to be made to make them locally, socially and economically attractive. Compared to single-building renovations, a district approach also comes with many new social challenges that can even hinder the adoption of energy efficiency and renewable energy systems, mainly when a national policy framework for district action is not yet present or fully developed. Furthermore, encouraging the development of energy grids is already a complex task, and combining 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 the adoption of energy efficiency and renewable energy systems at the district level. However,

renovations at the district level could motivate large groups of citizens, and the many new social and management challenges that come along with the district approach are also opportunities for an integrated approach and mastering different components of current urban transformation challenges.

Overall, specific policy instruments for increasing the renovation rate by including the district scale make sense for stakeholders. We hereby presented and evaluated a set of policy instruments considered promising, suitable, and important to support achieving renovations at the district level combining energy efficiency and renewable energy systems. The most promising combinations of policy instruments and integration into existing governance structures should be arranged place-by-place and to a proper extent. Countries and cities can learn from each other and accelerate building renovations, as there are already many frontrunners and good practices. Further research is needed to assess the efficiency and effectiveness of these policy instruments and governance structures to increase the renovation rate and improve energy efficiency by augmenting the number of renewable energy systems at the district scale.

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Abbreviations

Abbreviations	Countries
AT	Austria
BE	Belgium
CH	Switzerland
DE	Germany
ES	Spain
NL	The Netherlands
PT	Portugal
SE	Sweden

Abbreviations	Meaning
EC	European Commission
EPBD	European Performance of Buildings Directive
EPC	Energy Performance Certificate
ESCO	Energy Service Company
EU	European Union
FIT	Feed-In Tariff
LCIA	Life Cycle Impact Assessment
OSS	One-Stop-Shop
nZEB	nearly Zero Energy Building
PV	PV panels
ZCRB	Zero Carbon Ready Building

Definitions¹

Various IEA EBC Annex 75 reports use a common language for communication between local authorities, professionals, researchers, inhabitants and, in general, all stakeholders and international partners.

Each term is defined in the context and scope of Annex 75, namely building renovations at the district level, and combines definitions from the European legal framework, common definitions of English dictionaries, related projects, research papers, and other professional publications. The concepts are sorted alphabetically.

Actors: The persons and entities active during the planning and implementation of energy renovation processes in buildings and districts.

Assembly of homeowners/ homeowner association: An organisation managed by the persons and entities that own parts of a building or district that aims at building maintenance and/or improving the overall conditions and livelihood of the building and its environment.

Asset manager: A person or company that manages assets to achieve a specific investment goal as set out by their clients. In the context of IEA EBC Annex 75, this refers to asset managers that invest in energy efficiency with a long-term perspective related to building renovation or operation. This permits an additional financing mechanism, so building owners may obtain additional funding, outsourcing the energy management to third-party regulated asset managers. (Sesana et al., 2019) (EFAMA, 2018) (Kamelgarn and Hovorka, 2013).

Building inspection: An official visit to a building to check the building's energy performance on-site. These visits are often based on the main parameters included in the Energy Performance Certificate (EPC) of the building. The detailed level of the verification may differ by country and include other building aspects such as the structure, construction pathologies, building accessibility and indoor health conditions.

Building manager: A person or company that manages buildings, keeping owners, landlords and tenants informed about the current situation of the building, calculating the future needs and assisting during the decision-making process. They are also known as property managers, real estate managers or facility managers, when respectively properties, real estate or facilities are managed.

Building renovation: An improvement of the building envelope or the energy system of a building, at least to restore its functionality, and usually to improve its energy performance. Within IEA EBC Annex 75, building renovation is understood to refer to energy efficiency measures in buildings, particularly on building envelopes, as well as renewable energy measures in buildings, in particular for heating or cooling purposes, whether through a decentralised energy system of a building or a connection to a centralised district heating/cooling system.

¹ A comprehensive list of all IEA EBC Annex 75 definitions can be found in (Hidalgo-Betanzos et al., 2023)

Building renovation passport: An electronic or paper document outlining a long-term (up to 10 or 20 years) step-by-step renovation roadmap and repository or logbook for a specific building. Depending on the country or regional definition, this passport may include the most relevant building information such as original design files, building plans, as-built files, environmental files, energy consumption and production, executed maintenance, energy audits and user-friendly information on effects and benefits of an energy renovation – for example in terms of reduced heating bills, improved comfort, and CO₂ savings (BPIE, 2019).

Building services or Energy performance of buildings (EPB) services: Services, such as heating, cooling, ventilation, domestic hot water, lighting and others, for which the energy use is considered in the energy performance of buildings (European Commission, 2021).

Business model: A model that describes the value logic of an organisation in terms of how it creates and captures customer value, and which can be concisely represented by an interrelated set of elements that address the customer, contain a value proposition and address organisational architecture and economics dimensions (Fielt, 2014) (Seddon et al., 2004) (BPIE, 2016) (Laffont-Eloire et al., 2019).

Carbon emissions: Shorthand expression used by IEA EBC to represent all greenhouse gas emissions to the atmosphere (this means carbon dioxide, methane, certain refrigerants, and so on) from the combustion of fossil fuels and non-combustion sources such as refrigerant leakage. It should be quantified in terms of 'CO₂ equivalent emissions'.

Community organisation: A local institution integrated by people, commerce, companies, and any other agents located within a district or urban area that aims at making desired improvements to a community's social health, well-being, and overall functioning.

Cooperative: An autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise (WECEF, 2017). In this sense, an energy cooperative can be, for example, a private, non-profit company whose purpose is to deliver renewable energy or renovation services to its customers or members.

Cost-optimal level: The energy performance level which leads to the lowest cost during the estimated economic life cycle of a building (European Commission, 2010).

Customer confidence: The feeling or belief, in IEA EBC Annex 75 report, related to the building renovation project, that customers can have faith in the proposed values or rely on the ability of the service providers such as the suppliers, intermediate agents, One-Stop-Shops, ESCOs, etc.

Customer segments: Groups of customers that have common interests, characteristics or needs. Segmentation aims to identify the most relevant groups and their priorities as a tool to improve the stakeholders' dialogue and business model.

Customer value: The (expected) satisfaction the customer experiences by taking a given action relative to the cost of that action. Key customer values for building renovation are, for example, less of a burden on the client, lower life-cycle costs, guaranteed quality or energy performance agreements (Haavik et al, 2012) (Mlecnik et al. 2013) (Mahapatra et al. 2013) (Van Holm et al. 2016).

Debt financing: A financing mechanism for building renovations based on the expense of private savings or through mortgages or loans. Debt financing typically needs to be compatible with restrictions associated with the existing mortgage on the properties (Bertoldi et al., 2021).

Deep renovation: A renovation which transforms a building or building unit into a nearly zero-energy building (until 2030) or a zero-emission building (after 2030), according to the latest European Commission proposal (European Commission, 2021). The previous EU legal framework didn't define deep renovations in detail, but they were typical of more than 60% energy savings. (European Commission, DG Energy, 2014) (BPIE – Deep renovation, 2021).

Delivered energy: Energy, expressed per energy carrier, supplied to the technical building systems through the system boundary to satisfy the users, taking into account heating, cooling, ventilation, domestic hot water, lighting, appliances, etc.

Demanding actors: The stakeholder category that typically includes the client or beneficiary of building renovation or renewable energy projects. It can be a private owner or an assembly of homeowners. In this work, housing associations, housing cooperatives and housing companies are also considered as part of this category, as they own buildings to be renovated. Depending on the situation, such demand organisations can be private or social, public, semi-public, or mixed.

District: A group of buildings in an area of a town or city that has limited borders chosen for purposes of, for example, building renovation projects, energy system planning, or others. This area can be defined by building owners, local government, urban planners, or project developers, e.g. along realities of social interactions, the proximity of buildings or infrastructural preconditions in certain territorial units within a municipality. IEA EBC Annex 75 focuses on residential buildings, both single and multi-family houses, but districts with other buildings with similar characteristics, such as schools or simple office buildings without complex HVAC systems, can also be included in the district.

District heating or District cooling: A centralised system with the distribution of thermal energy in the form of steam, hot water, or chilled liquids, from a central production source through a network to multiple buildings or sites, for use in space heating or cooling, domestic hot water, or other services.

Economic aid: A funding programme offered by local, national, and other public authorities and, in some cases, also semi-private institutions, to help improve the energy efficiency, health or other conditions in residential buildings.

Energy audit: A systematic assessment of the energy needs and efficiency of a building or set of buildings. The international norm EN 16247-1: 2012 defines the procedure to analyse energy use and energy consumption within a defined energy audit scope to identify, quantify and report on the opportunities for improved energy performance. There are three main types: Walk-Through Audit (basic), Energy diagnosis (medium) and Investment Grade Audit (detailed) (Energuides BE, 2020).

Energy bill (utility bill): As a part of utility bills, the energy bills comprise the costs of the energy services supplied for building owners and tenants, such as heating, cooling, hot water, electricity, gas and others. These bills generally include the tariff standing charge, the energy use during the billing period, and energy tax and distribution costs.

Energy carrier: A substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes. An energy carrier is a transmitter of energy that includes electricity and heat, as well as solid, liquid, and gaseous fuels. The energy carriers occupy intermediate steps in the energy-supply chain between primary sources and end-user applications (IPCC, 2007).

Energy Performance Certificate: An official energy-efficiency evaluation of a building or part of a building aiming at informing building owners, occupiers, and property actors on the energy performance of their buildings so that they can compare and assess different buildings and make informed decisions. Energy Performance Certificates are often accompanied by advice and practical information on how to improve the energy efficiency of buildings and their performance class (BPIE – Glossary of Terms, 2021).

Energy Performance Contract: Agreement between the homeowner or renter and a lender to provide financing for a building energy efficiency renovation. The energy performance contracts can be tied to real energy savings, in which case the lender assumes part of the risk, or to a flat rate, in which case both parties share financial risks. This agreement usually requires the involvement of a retail energy supplier (European Commission, DG Energy, 2014).

Energy performance of a building: The calculated or measured amount of energy needed to meet the energy need associated with the typical or standard use of the building services.

Energy poverty: A set of conditions where individuals or households are not able to adequately heat or provide other required energy services in their homes at an affordable cost. (Pye et al., 2015). There are three main components: low household income; high/growing energy prices; and inefficient energy performance of buildings concerning thermal insulation, heating systems and equipment (Thomson and Bouzarovski, 2019) (EU Energy Poverty Observatory, 2020).

Energy Service Company (ESCO): A company that offers long-term services to cater to all the building renovation project needs using Energy Performance Contracts (EPCs) as a financing mechanism based on ongoing energy performance guarantees. These EPCs are based on a long-term relationship with the customer, which can include renovation project design, retrofitting works, energy systems and renewable energy systems monitoring, operation and maintenance, fuel supplies, security management, savings justifications, and utility bills management. ESCOs might offer all the project services in-house or outsource some of them (Brown et al., 2019).

Energy solution providers: Stakeholder category identifying actors that provide renewable energy systems and services to the demanding actors. They can be, for example, Distribution System Operators (DSOs), Transmission System Operators (TSOs), energy supply or renewable energy companies, energy service providers, heat grid operators, aggregators, energy monitoring providers, energy cooperatives, and so on.

Energy source: Source from which useful energy can be extracted or recovered either directly or by means of a conversion or transformation process.

Energy tariffs: The way energy providers charge building users or renters for their effective energy use, such as electricity, gas, heating, cooling, hot water, and so on. Tariffs can be fixed or variable. A fixed-rate tariff sets a cost of energy for a certain amount of time, typically one year or more, while variable tariffs can go up or down according to the market or establish categories defined by other parameters.

Equity: A type of financing mechanism for building renovations that introduces a third-party lender who pre-finances the renovation and receives a cut from the project's revenues, tying repayment to a monthly rate which gives access to energy savings.

Feed-in tariff (FIT): To promote renewable energy generation, some support schemes define fixed electricity prices paid to renewable energy producers for each unit of energy produced and injected into the electricity grid. The payment of the FIT is guaranteed for a certain period that is often related to the economic life of the respective renewable energy project (usually between 15-25 years). Another possibility is to calculate a fixed maximum number of full-load hours of renewable energy electricity production for which the FIT will be paid.

FIT is usually paid by the electricity grid, system, or market operators, often in the context of Power Purchasing Agreements (PPA) (EnergyPedia UG Nonprofit, nd).

Financial incentives: Financial instruments provided by public authorities and/or private institutions that address financial and investment gaps. Particularly, building renovations can be expensive and owners may not have the means to finance energy efficiency and renewable energy measures.

Financial intermediary: The actor or body acting as an intermediary between the supply and demand of financial products (European Commission, DG Energy, 2014).

Financing: The act of obtaining or furnishing the money required for purposes related to building renovations, such as building energy-efficient measures, renewable energies implementations or other decarbonisation measures. Energy-efficient building renovations can be expensive, and owners may not have the means to finance them. Financial instruments provided by public authorities and/or private institutions can help solve this issue and address financial and investment gaps.

Funding: The money provided, especially by an organisation or government, for purposes related to building renovations, such as energy-efficient measures or renewable energy implementations (European Commission, DG Energy, 2015).

Gentrification: A process of changing an urban area so that people of a higher social class than the original move inside an existing area. This phenomenon is often related to urban regeneration processes and may have a negative effect on the local population due to the increase in local prices of housing and community services. In certain cases, increased prices may force the existing local population to go to cheaper areas.

Grant: A type of funding given by local, regional and/or national public authorities (and, in some cases, also semi-private institutions) that the recipient does not have to repay for special purposes or requirements of energy efficiency measures and renewable energies implementation.

Green certificate: A funding scheme that can be used by the promoters of building renovations that meet certain requirements of high energy efficiency. This certificate consists of an official record proving that a specified amount of renewable electricity has been generated. The certificate can be traded separately from the energy produced (EEA, 2020). Investors wishing to finance a green project apply to one of the participating banks. Qualifying projects that meet the requirements receive a green certificate. By availing themselves of an attractive, low-interest loan, investors have an affordable way to pay for sustainable measures as part of building renovation. Since the loan is repaid, the ultimate cost to the government is the value of the subsidised interest loan, plus administrative costs. In this way, the scheme has succeeded in leveraging significant private investments in addition to public funding (BPIE, 2017).

Housing association: An association that owns, lets and manages rented housing, usually under special conditions, for people that cannot reach the market or rented housing due to vulnerability or other socio-economic situations.

Intermediaries: Stakeholders that act as a third party and interact or connect between supply and demand, for example, between demanding actors and energy and renovation solution providers. Intermediaries may have more experience and expertise compared to the homeowner, therefore being able to deliver a more comprehensively/thoroughly researched solution.

Investors: Stakeholders that act as clients or beneficiaries of building renovation or renewable energy projects. There is a wide range of demand organisations which can be private or social, public, semi-public, or mixed, depending on the situation. For instance, private owners or assemblies of homeowners are typically

in this category, as well as investment funds, housing associations, housing cooperatives and housing companies, as they may be owners of buildings to be renovated.

Land use: It refers to the socio-economic purpose of the land. Land areas can be used for residential, industrial, agricultural, forestry, recreational, transport and other purposes. Often, the same land is used for several purposes at the same time; for example, the construction can be used for commercial, recreational or residential purposes (European Commission - EUROSTAT, 2020).

Landlord: The person, institution or agent who rents a housing or building owned by them.

Local consultancy pop-up: Temporary facilities where homeowners can become acquainted with existing low-carbon technologies and get all the necessary information during their renovation process. These places aim to increase awareness of and easy access to low-carbon technologies, and they can be planned as short-term or long-term centres located in a certain place or mobile around different areas (Triple-A, 2021). Local consultancy pop-ups can have different forms, from a simple information desk up to an operational part to facilitate renovations at the district level.

Local policy: Policy developed, controlled, or enforced by local public bodies to promote building renovation in number and depth. Local policy is made by the locally elected council and is implemented by the municipal administration. A wide range of persons and entities can act within the local policy framework, such as district developers, urban planners, municipality departments and regional institutions.

Low-rent loan: A particular type of loan given by an organisation or government that facilitates low-interest financing access. Sometimes these loans can be paid back through monthly utility or energy bills. They can also be named low-interest loans.

Nearly zero-energy building (nZEB): A building with a very high energy performance, where the nearly zero or very low amount of energy required should be covered to a significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby (European Commission, 2010).

Non-renewable energy: Energy taken from a source depleted by extraction (e.g., fossil fuels).

Non-renewable primary energy factor: Non-renewable primary energy for a given energy carrier, including the delivered energy and the calculated energy overheads of delivery to the points of use, divided by the delivered energy (European Commission, 2021).

One-Stop-Shop (OSS): An office that offers a single point of contact catering to all building renovation project needs, not only as an intermediate agent but aiming to provide energy efficiency or renewable energy with an integrated solution. A typical set of services offered by the OSS includes preliminary evaluation, energy audit and scenario analysis, design, arrangement of third-party financing, procurement, outsourced manufacturing and installation, and performance testing to verify the system in operation (Haavik et al., 2012; Styczynska and Zubel, 2019).

Policy instrument: A new regulation, support scheme, communication programme or organisational service defined by policymakers. Within IEA EBC Annex 75, policy instruments intend to increase the building renovation rate (number of renovations undertaken due to economic and organisational & mobilisation potentials) and/or renovation depth (higher energy efficiency and more renewables due to the technological potentials). The instruments often serve specific purposes within a policy strategy, including multi-level actions and multi-actor governance (Rosenow et al., 2016; BPIE, 2018). For example, EU Regulations (European Commission, 2012) identify policy instruments such as (article 7): energy efficiency obligations; energy or CO₂ taxes;

grants; loans; on-bill finance; tax rebates, regulations; voluntary agreements; standards and norms (that aim at improving the energy efficiency of products and services); and energy labelling schemes.

Primary energy: Energy that has not been subjected to any conversion or transformation process. Primary energy includes both non-renewable and renewable energy. For a building, it is the energy used to produce the energy delivered to the building. It is calculated from the delivered and exported amounts of energy carriers using conversion factors. Upstream processes and related losses are considered.

Public actors: Stakeholder category for identifying policy actors on various levels and scales (municipality; county council, provincial/ regional government; federal/ national governmental body, other), as well as public agencies, such as innovation or energy agencies and public services.

Renewable energy: Energy from sources that are not depleted by extraction, such as wind power, solar power, hydroelectric power, ocean energy, geothermal energy, heat from the ambient air, surface water or the ground, or biomass and biofuels. These alternatives to fossil fuels contribute to reducing greenhouse gas emissions, diversifying the energy supply and reducing dependence on unreliable and volatile fossil fuel markets, particularly oil and gas.

Renovation: Construction activities related to interventions onto existing buildings or connected infrastructure. These interventions range from simple repairs and maintenance to adaptive conversion, transformation, and reuse. In the framework of IEA EBC Annex 75, renovation can refer to both renewal/retrofit of building envelopes and energy system changes.

Renovation solution providers: Stakeholder category that identifies actors providing renovation systems and services to demand actors. They typically include planning actors, such as urban planners, architects, landscape designers, or more general design teams, contracting and service parties, such as main contractors and subcontractors, facility managers, installers and suppliers, or more general integrated project teams and one-stop-shops, that unburden the demand actors from A to Z.

Revenue stream: The way an organisation generates revenue from value propositions successfully offered to customers within a building renovation process.

Revolving energy efficiency fund: A type of equity (financing mechanism) that offers a low but stable return on investment with good Energy, Social and Governance (ESG) ratings and binds reinvestment of the steady revenues into pre-set options. Fund equity can also be crowdsourced (Webber et al., 2015).

Social housing: A type of housing particularly oriented to vulnerable people who cannot afford the market cost of rent due to vulnerability or other socio-economic situations. It can also refer to the institutions that manage these homes and associations that own, let, and manage social housing. Social housing associations, institutions or councils can become key partners in scaling up building renovations due to their market presence as landlords of a considerable number of dwellings. Social housing might be offered by not-for-profit or market actors.

Stakeholders: The persons, homeowners, companies, public institutions and in general every agent with an interest or concern in an ongoing or future project. The stakeholders in renovation projects can be a wide and diverse list of agents, including decision-making actors and also other involved participants that can influence the success or failure of the renovation process.

Stakeholder dialogue: The process whereby a lead actor, usually a local administration, facilitates communication and interaction with stakeholders, particularly also building owners, in a certain community area/neighbourhood/district to get them going in the direction that is politically favoured i.e., climate neutrality, energy efficiency, enhanced use of renewables. This dialogue can be implemented through various formats

of information and communication and can be based either on regulations (if applicable) or on persuasion and commitment.

Subsidy: A financial incentive given by authorities to partly or fully offset the costs related to building renovation or renewable energy implementation over a lengthy period.

Tax incentive: A reduction in taxes for building owners or landlords oriented to encourage a certain level of building energy efficiency, renovations, the installation of renewable energies or other energy-efficiency measures.

Trust: A firm belief of customers and stakeholders in the reliability and truth of the building renovation project, in authorities, in other building owners for developing joint projects, or in the ability of the service providers such as the suppliers, intermediate agents, One-Stop-Shops, ESCOs, etc.

Value proposition: The way the organisation or organisations leading the building renovation project seek to solve the customer problems and satisfy their needs according to their values.

White certificate or Energy Savings Certificate: A tradable asset included in the Energy Efficiency Obligations schemes (EEOS) defined in Article 7 of the Energy Efficiency Directive 2012/27/EU (EED), which proves that a certain amount of energy savings has been achieved. It is an economic instrument for environmental protection (also known as Tradable Certificates for Energy Savings) that obliges energy companies to prove that they have undertaken activities that promote or fund energy efficiency improvements in the premises of end-use customers. Accordingly, white certificates, like the rest of EEOS, can be traded to comply with the energy reduction obligations, and it has become a significant part of the EE saving measures, especially in the industrial sector (European Commission, 2014; BPIE, 2017; Malinauskaite et al., 2019).

Zero-emission building: A building with a remarkably high energy performance, where the very low amount of energy still required is fully covered by energy from renewable sources at the building or district or community level where technically feasible (notably those generated on-site, from a renewable energy community or renewable energy or waste heat from a district heating and cooling system) (European Commission, 2021).

Zero Carbon Ready Building (ZCRB): A highly energy efficient building that uses renewable energy directly or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heat. This means that a zero-carbon-ready building will become zero-carbon by 2050, without any further changes to the building or its equipment. Zero-carbon-ready buildings should adjust to user needs and maximise the efficient and smart use of energy, materials and space to facilitate the decarbonisation of other sectors (IEA, 2021).

1. Introduction

1.1 General context

IEA EBC Annex 75 aims to investigate cost-effective strategies for reducing carbon emissions and energy use in city buildings at the district level, combining energy efficiency and renewable energy measures. The objective of the Annex is to provide guidance to policymakers, companies working in the energy transition field, and building owners for cost-effectively transforming the city's energy use in the existing building stock towards low-emission and low-energy solutions.

Given the limitations due to available financial resources and the large number of investments needed to transform the cities' energy use in buildings, identifying cost-effective strategies and policies is important for accelerating the necessary transition towards low-emission and low-energy districts.

Building renovation at the district level has many technological, economic and social advantages. These include, for example, wider possibilities for using renewables systems compared to building-scale restrictions - due to the aggregated energy demands -, economies of scale when purchasing materials, services and management, and the organizational opportunity for integrated and cooperative actions and communication that can lead to additional motivation and integrated energy renovation processes. On the other hand, some specific needs must be faced to obtain an increased renovation rate, such as coordination needs – dealing with a diversity of interests related to various types of owners and buildings - communication needs – engaging multiple investors and decision-makers at the same time - and financing and assurance needs – to cover for high upfront costs and potential risks. By taking these needs into account and acting at the district level, we can enable important potentials that can increase not only the ratio but also the quality and societal acceptance of building renovations, with improved energy efficiency, more renewable energy production and a deeper decarbonisation of the building stock. Considering all of the above, adopting new and better policy instruments to facilitate and support renovations at the district level is crucial.

1.2 Exploring policy options at the district level

IEA EBC Annex 75 focuses on the district as the implementation level for energy renovation. However, there are limited administrative structures on the district level. Policy options are, therefore, usually identified and/or executed by the municipality that encompasses the district. However, the municipal policy also largely depends on regional and national policy. In this report, we explore policy guidelines and recommendations to support local, regional and national policymakers in making better decisions for housing, energy and innovation policy when targeting districts. The policymakers should be able to choose suitable instruments that support reducing carbon emissions and climate change mitigation through energy renovations in districts.

IEA EBC Annex 75 focuses on promoting cost-effective building renovation at the district level combining energy efficiency and renewable energy systems. The present report intends to explore suitable policy instruments that can support the development of building renovation at the district level, targeting various types of stakeholders.

This report, therefore, focuses on the following objectives:

- To give an overview of various policy options that could target the district level, considering existing and emerging policy instruments with the potential to be successfully applied within that context, and how policy challenges specifically occurring in an urban context can be overcome;
- To develop, test and use a methodology which can be applied to identify best-practice policy instruments for specific districts by evaluating stakeholder's acceptance of proposed policy instruments and the effects and impacts stakeholders expect for reducing carbon emissions and energy use in buildings in cities at the district level, combining both energy efficiency measures and renewable energy measures;
- To illustrate the development and assessment of innovative local policy instruments that could target the district level for achieving energy renovations and renewable energy systems;
- To provide the necessary background for recommendations to policymakers and their key partners on how they can influence the uptake of cost-effective combinations of energy efficiency measures and renewable energy measures in building renovation at the district level (Meyer et al., 2023).

2. Research approach

2.1 Research questions and overall approach

The main research question addressed in this work is:

RQ. How can policies increase residential building renovation by combining energy efficiency and renewable energy systems at the district level?

Supporting policies can vary from state to state, and frontrunner municipalities might have more experience with local policy development for district action. Using input from various countries, we identify policies that focus on strengthening district action, either top-down or bottom-up. From the bottom-up perspective, we will explore the existence, relevance, and usefulness of policy instruments, such as regulations, incentives, organizational support and communication that can be organized locally – this means at least partly established on the neighbourhood, district, municipal or county administrations. From the top-down perspective, the report will explore how such local action can be improved by actors responsible for developing energy, housing or innovation policy at the regional or national levels.

The main question is explored with the following sub-questions:

RQ.1. What policy options do local authorities have at the district level to support renovation at the district level, including energy efficiency and renewable energy systems?

To answer this sub-question, the current report provides an inventory of local policy instruments detected in multiple European countries, providing a short definition and discussion of strengths and weaknesses for targeting renovation at the district level and/or implementing renewable energy systems in districts.

Regarding the definition of policy instruments, a distinction is made between regulations (legal requirements, urban planning obligations), financial incentives, stakeholder communication and dialogue, and organizational policy instruments that facilitate district action or respond to urban development planning measures, considering that various instruments can reinforce each other. As a part of building renovations, district heating systems and local electricity production are also considered for reducing carbon emissions in districts.

As part of the analysis for developing this inventory, 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 the 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' and aimed to identify promising policy instruments and business models for district-level energy renovation.
- Switzerland: Online seminar and workshop on combining the heating and cooling potential of lakes, rivers and the sea with energy efficiency measures in buildings at the district level, 23 September 2020. This workshop attracted regional and national stakeholders and IEA EBC Annex 75 experts to discuss a particular topic.

Furthermore, data are used from ongoing projects of IEA EBC Annex 75 members. These can include observations from in-depth interviews, workshops and participatory observations from the following projects:

- Interreg 2 Seas project Triple-A, <https://www.triple-a-interreg.eu/> (Triple-A, 2021). This project, coordinated by TU Delft, supports seven local authorities from four countries (Belgium, France, The Netherlands, UK) who aim to develop local policy instruments to create awareness for homeowners and easy access to solutions in districts.
- MMIP IEBB project Energy Cost-neutral Housing Renovation (Mlecnik, 2021; Mlecnik, 2022). In this project, TU Delft investigated stakeholder viewpoints regarding collective renovations for assemblies of homeowners.
- The German research project "3% plus-Projekt – Umsetzung des energieeffizienten Sanierungsfahrplans für kommunale Quartiere 2050" (*3% plus Project – Implementation of energy efficient renovation roadmaps for municipal districts 2050*) is funded by the German Federal Ministry for Economic Affairs and Climate Action and implemented by the German Association for Housing, Urban and Spatial Development; the B.&S.U. Beratungs- und Service-Gesellschaft Umwelt mbH and the HFT Hochschule für Technik Stuttgart. The project works closely with municipal partners in the Aachen Region and Ludwigsburg to explore strategies to mobilize energy efficiency potentials in heterogeneous districts with a district-oriented approach.

RQ.2. How are policy instruments assessed by several types of actors, particularly for upscaling residential building renovation combining energy efficiency and renewable energy systems at the district level?

To answer this sub-question, the inventory was first used for selecting the most promising policy instruments through an IEA EBC Annex 75 workshop in Delft. Based on the Delft workshop outcomes, eight key policy instruments were identified for further research, analysing actor viewpoints on these policy instruments. The research on this sub-question particularly aims to understand how several types of actors perceive promising local policy instruments in terms of importance, usefulness and ease of implementation. This information is important for local authorities, among others also, to organize effective actor and stakeholder dialogue in districts.

The research to answer this sub-question includes results from in-depth interviews (see next sub-section). In-depth interviews were held with local policy actors and frontrunners in renovation at the district level and deployment of renewable energy systems to check the applicability of policy instruments in specific districts. Some of these actors, but not all, were also related to the district success stories and case studies that were

identified in other IEA EBC Annex 75 reports. The results of the in-depth interviews were investigated quantitatively. The results are also used more qualitatively to better understand the role of national and/or regional authorities in supporting local authorities and district action. Subsequently, country perspectives were described, and recommendations were formulated to improve policies for combining energy efficiency and renewable energy systems at the district scale.

2.2 Stakeholder types, interviews, and analysis

2.2.1. Identification of stakeholder types

As part of the IEA EBC Annex 75 project, various stakeholder groups were identified that could play an important role in developing renovations at the district level, including energy efficiency measures and renewable energy systems. The following gives an overview of the key stakeholders identified by IEA EBC Annex 75 experts that might hold valuable opinions regarding (local) policy development.

P. Public actors/ Policy actors: This category includes policy actors at various levels and scales (municipality; county council, provincial/ regional government; federal/ national governing body, other), as well as public agencies, such as innovation or energy agencies and public services.

C. “Clients”, meaning Demanding actors/ Investors: This category typically includes the client or beneficiary of building renovation or renewable energy projects. It can be a private owner or an assembly of homeowners. In this work, housing associations, housing cooperatives and housing companies are considered part of this category, as they own buildings to be renovated. Such demand organisations can be private or social, public, semi-public or mixed, depending on the situation.

R. Renovation solution providers: These actors provide renovation systems and services to the demanding actors. They typically include planning actors (such as urban planners, architects, landscape designers, or more general design teams), contracting and service parties (such as main contractors and subcontractors, facility managers, installers, and suppliers), or more general integrated project teams or one-stop-shops that unburden the demand actors from A to Z.

E. Energy solution providers: These actors provide renewable energy systems and services to the demand actors. They can be, for example, Distribution System Operators (DSOs), Transmission System Operators (TSOs), energy supply or renewable energy companies, energy service providers, heat grid operators, aggregators, energy monitoring providers, energy cooperatives and so on.

F. Financing intermediaries: These actors intervene to invest or finance project developments or works regarding the renovation of buildings, installation of renewable energy systems, or more generally, redevelopment of districts. These actors can be, for example, banks, investment fund operators, real estate companies, project development companies, building portfolio managers, ESCOs, revolving fund operators, or other financing intermediaries.

I. Other intermediaries: These actors play a role in the broader market or policy development or development of citizen engagement and can, sometimes, influence project developments from their specific position. For example, federations, trade organizations, not-for-profit organizations and educational and research institutes can influence opinions and viewpoints. Additional actors are sometimes also foreseen within district projects to organize district communication, citizen engagement or feasible business models. For example, district interest organisations and communication agents and other ‘trusted’ consultants play a role in renovations at the district level and the way citizens perceive the need for taking up energy efficiency measures or renewable energy systems.

2.2.2. In-depth interviews

Actors and stakeholders that were involved in success stories or case studies, or innovators and other stakeholders who could give valuable input based on their experience regarding district approaches combining energy efficiency and renewable energy systems, were approached with a request to retrieve and assess their viewpoint. From each category, relevant stakeholders for interviewing were identified by IEA EBC Annex 75 members, based on their frontrunner experiences with district renovations including energy efficiency and renewable energy systems. A standardized questionnaire with closed and open questions was developed to fit multiple IEA EBC Annex 75 reports (C.3, D.1, D.2). The questionnaire was provided to all interviewees as support for semi-structured interviews. Such in-depth interviews were carried out on multiple topics at the same time, checking the adoption and applicability of local policy instruments (D.1), stakeholder involvement (C.3) and business models (D.2). In this report, D.1 results are used to describe and analyse stakeholder viewpoints on the applicable policy instruments and to compare policy actor and other stakeholder viewpoints on the local policy instruments. The actors who were interviewed are listed in **Table 1**. In total, 38 stakeholders from 8 countries were interviewed, covering all the above-mentioned stakeholder types.

Table 1. Interviewees in the framework of IEA EBC Annex 75 (with completed analysis).

Interview code/actor type	Interviewer	Interview date	Stakeholder description
AT-01 / C	AIT	15/03/2021	Representative social housing business group
AT-02 / I	SIR	07/06/2021	Regional planner housing institute (energy consultancy)
BE-01 / P	TU Delft	06/04/2021	Municipal project coordinator
BE-02 / R	TU Delft	23/04/2021	Director of an autonomous municipal company
CH-01 / C	ZHAW	11/02/2021	Building owner
CH-02 / P	ZHAW	10/03/2021	City representative
CH-03 / I	ZHAW	12/03/2021	Representative Green building council
CH-04 / P	INDP	20/04/2021	Employee of a city with >100'000 inhabitants
CH-05 / P	INDP	18/10/2021	Employee of a municipality with >10'000 inhabitants
CH-06 / P	INDP	07/10/2021	Employee of a municipality with >10'000 inhabitants
CH-07 / P	INDP	11/10/2021	Employee of a municipality with >10'000 inhabitants
CH-08 / I	INDP	18/10/2021	Director of a national energy programme
CH-09 / E	INDP	21/10/2021	Head of energy services in an energy company
DE-01 / R	DV	25/02/2021	Consulting and management company
DE-02 / I	DV	12/02/2021	Representative energy agency (macro-level)
DE-03 / C	DV	26/03/2021	Developer housing business group (region-owned)
DE-04 / C	DV	19/02/2021	Urban developer housing business group (city-owned)
DE-05 / R	BSU	08/01/2021	CEO of public-private NGO (renovation consultancy)
DE-06 / P	BSU	14/01/2021	Senior policy advisor local authority
DE-07 / P	BSU	13/01/2021	City civil servant (energy and climate consultancy)
DE-08 / P	BSU	15/01/2021	Deputy head office for building & construction (city architect)
DE-09 / P	BSU	01/02/2021	Senior civil servant (consultant sustainability)
ES-01 / P	UPV/EHU	09/03/2021	Representative municipal urban rehabilitation society
ES-02 / C	UPV/EHU	10/03/2021	Regional social housing provider (public institute)

ES-03 / I	UPV/EHU	05/03/2021	Representative regional energy agency
ES-04 / P	UPV/EHU	12/03/2021	Housing renovation grant manager at a regional government
ES-05 / C	UPV/EHU	08/04/2021	Representative public housing association (corporate)
ES-06 / E	UPV/EHU	14/04/2021	Representative energy, waste & water management company
NL-01 / R	TU Delft	03/11/2020	Non-profit service supplier living-cost neutral renovation
NL-02 / I	TU Delft	09/02/2021	Renewable energy cooperative
NL-03 / P	TU Delft	22/02/2021	Senior consultant regional authority
NL-04 / P	TU Delft	16/12/2020	Senior consultant municipality (energy and circular)
NL-05 / R	TU Delft	26/03/2021	One-stop-shop renovation provider
NL-06 / P	TU Delft	12/04/2021	Senior consultant municipality (sustainability)
NL-07 / F	TU Delft	19/04/2021	Revolving fund operator supporting municipalities
PT-01 / R	U Minho	29/06/2021	Civil engineer, project & real estate project manager
PT-02 / I	U Minho	05/08/2021	Qualified expert National Energy Certification System
SE-01 / P	Lund Univ.	24/11/2020	Representative municipality
SE-02 / C	Lund Univ.	19/04/2021	Representative public housing company

2.2.3. Analysis of interviews

Interviewers from multiple countries followed a guidance document (see Addendum 1) to question selected stakeholders in their own language during 1-1,5 hours. The results of the interview are analysed by the interviewee using an analysis template (see Addendum 2) provided by IEA EBC Annex 75 subtask D. Deliverable leaders collected all anonymised analysis templates and analysed the results, which are presented in this report.

The analysis for this report covers specifically:

- a quantitative assessment of the degree to which public actors and other stakeholders think the proposed policy instruments can be important, useful and easy to implement;
- a qualitative data assessment about the use of policy instruments to engage stakeholders and about the perceived successes and failures of the policy instruments;
- the viewpoints of actors and stakeholders on the adoption of future policy instruments.

2.3 Limitations of the research

The research focused on policy instruments for activating stakeholders related to renovating single- and multi-family residential buildings regarding their energy efficiency or implementing renewable energy systems in districts. Other buildings with similar characteristics, such as ground floor commercial areas and neighbouring commercial or public buildings, can be included as long as relevant and useful information related to policy development can be extracted from them.

The research is based on the available knowledge of the authors, IEA EBC Annex 75 experts, and selected interviewees on policy instruments, focusing on examples from Austria, Belgium, Germany, Portugal, Spain, Sweden, Switzerland, and The Netherlands. The literature research is limited to some key references, and a more extensive literature analysis could provide further insights.

Although multiple policy instruments were found to cover building renovations, energy efficiency improvement and renewable energy implementation, it should be noted that many instruments do not yet specifically encompass upscaling of the renovation rate or action at the district level. The research, therefore, focused on describing possible interpretations when considering building renovation at the district level, including energy efficiency and renewable energy systems. In many countries, such policy opportunities still need to be tested, particularly when assessing their efficiency and effectiveness.

Information on existing policy instruments and case studies was also sourced from European projects, IEA EBC Annex 75 workshops and literature. Although the targeted actors are the local authorities, it is important to emphasize that higher-level support is indispensable to exploit local policy instruments. The local situation cannot be seen apart from financial incentives or obligations from a higher level since these massively influence the scope for policy instruments at the local level. On the other hand, room for manoeuvring at the local level (e.g., powers/competencies or financial and human capacities) must be given to exploit the full potential of the following policy instruments.

The empirical research is limited to 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 applications, usefulness, and feasibility of policy instruments from their perspectives. It must be kept in mind that such perspectives give a comprehensive, yet not necessarily a complete picture of the situation in a country. Annex members checked the correctness of their statements; nevertheless, differences between perceptions and reality may persist, or statements may only apply to specific circumstances.

Each of the following chapters deals with one sub-question and respectively focuses on:

- an overview of policy instruments (related to RQ1) is developed in Chapter 3;
- a quantitative assessment of proposed local policy instruments by several types of actors (related to RQ2) is analysed in detail in Chapter 4;
- a qualitative analysis of the viewpoint of stakeholders on policy instruments for upscaling renovations combining energy efficiency and renewable energy systems in districts (also related to RQ2) is studied in Chapter 5;
- the needed policy development for increasing residential building renovation and renewable energy systems at the district level (RQ), is discussed in Chapters 6 and 7.

3. Policy options at the district level

3.1 Overview of policy instruments

This chapter aims to provide an overview of applicable policy instruments to support identifying and understanding local policy instruments for district redevelopment by local authorities, covering various types of ownership and buildings and existing and newly built residences.

In this framework, new policy instruments are defined by policymakers, including regulations, support schemes, communication programmes or organizational services, that, for example, intend to increase the building renovation rate (number of renovations undertaken), the renovation depth (magnitude of the energy saved) and/or the use of renewable energy systems (both at the building level and the district). There is a large variety of related policy instruments. For example, the EU Directive 2012/27/EU (article 7) considers: energy efficiency obligations; energy or CO₂ taxes; grants; loans; on-bill finance; tax rebates, regulations; voluntary agreements; standards and norms (that aim at improving the energy efficiency of products and services); and energy labelling schemes. Such policy instruments are often mixed and can include multi-level actions and multi-actor governance (Rosenow et al., 2016; BPIE, 2018).

Local authorities in their national context are responsible for local urban development and act as a formal link between small-scale neighbourhoods and wider functional areas (EU2020.de, 2020). Typically, local authorities still need a better understanding of selected policy instruments' effectiveness and the cost-efficiency of related actions, particularly at the district level. In search of suitable local policy instruments, we first identified in this report the many opportunities for local policy development that can significantly stimulate stakeholders to engage in energy-saving initiatives at the district level. In the following sections, this report provides a description per policy instrument, including:

- **Scope:** definition and applicability of the instrument from the viewpoint of the local authority,
- **Examples:** from literature and/or projects (provided by IEA EBC Annex 75 experts),
- **Assessment:** strengths and weaknesses of the instrument for achieving renovation at the district level, from the viewpoint of the local authority (provided by IEA EBC Annex 75 experts and results of IEA EBC Annex 75 workshops).

Regarding the classification of policy instruments and considering that various instruments can reinforce each other, a general distinction is made between:

- regulation options at the district level (see 3.2.),
- financial incentives created or used by local authorities (see 3.3.),
- planning and tendering for districts (3.4),
- organizing services for districts (3.5),
- communication support for districts (3.6),
- and supporting emerging private and civic initiatives (3.7.).

Alongside energy efficiency measures, district heating systems and local electricity production are considered to reduce carbon emissions and districts' primary energy use. As renovation at the district level involving energy efficiency measures or local energy grids is mostly initiated and supported by local authorities, we focus on local policy instruments in this chapter. In further chapters, we also discuss the role of the national policy compared to local policy instruments.

3.2 Regulation options at the district level

3.2.1. Enforcement of minimum energy standards in districts

Scope:

The local authority defines (future obligation of) minimum energy performance standards for buildings or a district. When defined at the district scale, these regulations can be better adapted to the reality of each case and provide more feasible objectives when compared to the standard and global regulations applicable to individual buildings. Local authorities have two potential roles here: landowners and authorities. To enforce these new regulations, they can more effectively use national or regional codes locally or impose additional obligations on their own. They may also adopt specific rules for land or buildings that are sold by the local authority. This is a common instrument for developing new buildings, but it can also be tied to the enforcement of major renovations, the replacement of heating systems, or a change of ownership. Furthermore, local authorities may, in principle, make it mandatory for buildings that have their envelope or heating systems renovated within a specific period.

Examples:

Use of national codes, regional codes, or local codes as enforcement

Local authorities can effectively communicate and control national codes or regional codes in districts. In a few countries, they can introduce their own regulations, if they are more and not less ambitious than national or regional energy standards. Local authorities know that the obligations for energy performance levels for new-built constructions are approaching nearly-zero energy levels according to the 2010 Energy Performance of Buildings Directive (EPBD), and in various countries, these obligations are also present for major renovations. Furthermore, the 2012 Energy Efficiency Directive (EED) emphasized the need to develop renovation strategies for the existing building stock, strengthening the EPBD (2018). Now it includes renovations, particularly actions to target the worst-performing segments of the national building stock, split-incentive dilemmas and market failures. The resulting legal national documents, thus, sometimes enforce obligations for “major” renovations. Usually, a threshold for “major” is identified according to the volume of the building that is being replaced. As a rule of thumb, enforcement can be an option when a local building permit is required. Otherwise, it is difficult to control renovation activities on building envelopes.

For example, in the UK developments took place when it was still an EU member. The Energy Act (2011) described various instruments that are aimed at property owners. One of these instruments is the Minimum Energy Efficiency Standard (MEES), which aims to improve the energy efficiency of the most inefficient properties. MEES was introduced in (March) 2015 in the Energy Efficiency Regulations (Private Rented Property; England and Wales). MEES came into force in April 2018, meaning that from that date any commercial property with an energy label related to the Energy Performance Certificate (EPC) lower than an 'E' cannot be rented out to new tenants. Any existing tenancy contract can only be renewed when at least an 'E' rating is obtained. Initially, MEES was applied to new lettings and lease renewals. However, as of 1 April 2023, all privately rented properties will be required to meet MEES. That means it will be illegal to let commercial and residential properties with EPCs with a rating of F or G, the lowest two EPC ratings. Further information can be found on the websites of (amongst others) the UK government (HM Government, 2017) and the Energy Saving Trust (Energy Saving Trust, 2019).

Other examples are cities in Switzerland, such as Luzern and Zürich, which have already made it mandatory, or intend to do so, that building owners switch to renewable heating systems in certain areas of the city when they replace their heating systems. Other examples of regulations found in Switzerland are a mandatory

connection to a district heating system or higher energy efficiency standards linked to the label Minergie if a district aims to benefit from an increased total building volume.

For example, since 2020, rooftop apartments cannot be rented in Flanders unless the roof is thermally insulated. In the Brussels Capital Region, solar panels on a roof will not be awarded if the roof is not sufficiently thermally insulated, thus abiding by the 'energy efficiency first' principle. In Germany, the heavily subsidized social housing sector is more engaged and/or regulated, allowing for opportunities to assure energy quality and a clear trade-off of green versus affordable housing. As another example, the Belgian social housing federation introduced progressive energy standards for newly built social housing, which also apply to major renovations. In the Spanish region of the Basque Country, the social housing sector has been obliged since March 2020 to conduct energy audits and define plans for reducing the energy use in a stock of 7700 dwellings towards a nearly zero-energy objective in 2050. In the Netherlands, the federation of social housing associations AEDES has voluntarily pledged in an Energy Agreement (Dutch Government, 2018) to reach an average B energy label at the sector level in 2021. The Dutch National Climate Agreement recently stipulated that municipalities coordinate with housing associations to establish targets and heat transition visions in districts to abandon gas use.

Contractual land use agreements

As landowners in the framework of contractual agreements with private parties - for instance, when local authorities sell their land or public buildings -, local authorities can impose minimum energy standards for buildings and renovations.

For example, the city of Antwerp, in Belgium, requires and stimulates high energy efficiency in the Cadix district redevelopment. In practice, local authorities can organize contracts in the format of sales under conditions or collaboration agreements with developers for areas of high social significance (PassREg, 2016).

Conditions for obtaining concessions to operate district heating projects

Local authorities can also steer private investors' decisions. When an entity intends to operate a district heating system, for example, it may require authorization by a local authority to be able to do that, for instance, if such a district heating system is dependent on pipes below streets or because of restrictions to use a specific energy source such as ground or lake water.

In the city of Zürich, for example, there is a requirement that groundwater district heating can only be installed if all neighbours in each connected area are invited to participate in the district heating project. Furthermore, the necessity for obtaining authorization/concession to operate a district heating system can be used by local authorities to enforce the simultaneous use of energy efficiency and renewable energy measures in connection with a district heating system.

Assessment:

Local authorities usually have limited discretionary power to set their own demands. Besides, for existing houses, sometimes standards are lacking, except for the Energy Performance Certificate.

Local authorities often rely on national developments to enforce minimum energy standards in districts. The draft for the updated EPBD is already known and foresees ambitious new restrictions, including renovation obligations for the lowest energy standards by country, the use of "on the top minimum standards", and its enforcement by local or regional authorities likely limited to a control issue. Arguments regarding necessary additional funding and lack of acceptance might become important in this context.

In the short term, in many countries, it is hardly feasible for individual homeowners of existing dwellings to face demands to reach minimum energy needs. However, there are countries such as Switzerland, where local authorities have large autonomy to define local standards. Regulatory interventions at the replacement stage of heating systems are particularly attractive, as a switch to renewable energy-based heating systems could be, in such cases, cost-effective.

Regulations also play a role in being an obstacle to renovation at district-level projects. In this case, the measure promoting renovation at the district level is the adaptation of these regulations. Acceptance of regulations can be increased if the requirement to comply with energy standards is linked to certain criteria, such as whether the required renovation is technically feasible or not significantly less cost-effective from a lifecycle perspective. This is provided, for example, in the new energy law for the canton of Zürich, Switzerland, on the replacement of heating systems.

In the private rented sector, additional regulations could be an effective instrument (see the MEES examples in the UK). However, it might be a polarizing instrument if mandatory ad hoc renovations follow from its enforcement. In this framework, the affordability of renovations, particularly for vulnerable households, may become a specific issue for debate, as legal subsidy requirements are not desired, and refinancing renovation costs through rent increases might lead to further (energy) poverty. It is noted that buildings with relatively bad energy performance are often occupied by people with relatively low income. A trade-off between better energy performance and affordable housing must be found. In this regard, an accurate assessment of this instrument also needs to differentiate between the energy performance starting points of the existing building stock in different countries. Relatively good energy performance as a starting point makes the refinance of renovations through energy savings less likely and thus more conflicting.

It is conceivable that minimum energy demands are imposed as an additional requirement related to the provision of, for example, urban land or public buildings - or as a requirement for obtaining funding or tax reduction. Raising awareness and increasing capacity with training, visits, events, and activities are essential for stakeholders to adopt buildings with an obligatory high-energy performance.

Also, trade-offs must be found between local regulations and other national or regional laws that could obstruct swift implementation. Regulations that, for example, concern protection against noise from heat pumps, regulate the need to heat domestic hot water above a certain temperature level to control *Legionella* bacteria, or regulate the extent to which the costs of energy efficiency measures can be passed to tenants who, in turn, benefit from reduced energy costs, can lead to hindrances and exceptions in implementing regulation at the district level.

Concessions for heat grids at the district level are seen as a way forward to decarbonise districts. However, such concessions might be risky as they are given for a long period and can create a lock-in effect of needing a high-temperature demand at the district level. For concessions, local authorities should contractually embed a transition pathway to low-temperature heat grids, including renewable energy sources, as well as the building renovation of the connected buildings. However, this is often not yet done. Also, heat grid developers tend to focus on more profitable newly built areas (some of which might not even need high-temperature heat) instead of the existing building stock. Furthermore, heat distribution and generation are mostly managed by a single actor, creating an unfavourable monopoly situation without price control.

It might also be worthwhile to investigate how energy performance requirements can be met at the district level instead of the building or component level to speed up energy saving at the district level. For example, districts might benefit from low-temperature heat grids, Direct Current grids, energy recovery from wastewater, heat pumps connected to water bodies or joint renewable energy production on large roof spaces. Such solutions are still considered innovative and require the identification of “experimental” zones

where regulations can be relaxed and from which local authorities can provide input to national and regional authorities on how regulations should be changed.

In short, local authorities are experienced public actors who could potentially enforce standards as part of a policy mix but are still underrated as drivers of regulatory changes. At the very least, they can help guide how to deal with regulations for building renovation, including energy efficiency and renewable energy use at the district level.

3.2.2. Inspections and audits in districts

Scope:

The local authority stimulates that the performance of housing in districts is checked regarding safety, comfort and energy. The local policy can aim to penalize owners of buildings with insufficient performance and/or use inspection data to help building owners with appropriate advice for the remediation of deficiencies. This instrument has a greater potential to detect deficiencies in low-income areas.

This regulation tool differs from the previous one because while the MEES or MEPS are based on theoretical energy performance calculations, the inspections and (energy) audits assess the real conditions and performance of each building and its users, a step further than theoretical values.

Examples:

Quality improvement of rented housing

Local authorities can undertake action (via a notification procedure) when the quality of a dwelling is such that it endangers the health or safety of its inhabitants or neighbours. Some local authorities are smart in coupling energy issues with health, allowing private rent and renewable energy systems in districts only if certain standards are achieved.

For example, various local or regional regulations require a certain level of thermal and acoustical comfort, air quality and daylight in social housing. If requirements are not met, support may be discontinued. Such regulations could potentially be improved to also cover energy efficiency.

See also the examples in 3.2.1. A poor energy label can be an indication that other quality issues also need to be addressed. Detecting districts with the poorest energy labels would favour action by the local authority to push forward building owners and housing associations in such districts. Furthermore, control sampling for certain energy labels could focus on rented housing in such districts.

Mandatory energy performance checks and certificates

In the framework of the EU Member State implementation of the Energy Performance of Buildings Directive, energy performance certificates for buildings have been introduced. Also, showing an energy performance certificate or energy label is mandatory when selling a house. The Energy Performance of Buildings Directive also mandates regular inspection of HVAC systems in larger buildings. Based on the Energy Efficiency Directive, large enterprises within the EU are required (since 2015) to carry out an energy audit every four years. In most countries, these large enterprises can use schemes offered by the government or implement Energy Management Systems (EnMS).

In practice, energy label checks can range from a voluntary approach to a more restrictive policy. For example, in the Netherlands, every homeowner received a letter from the government indicating the provisional

energy performance of their dwelling. The EPC (or label) is not based on an inspection but on publicly available data. Via a governmental web application, homeowners can add or change relevant data and establish this EPC themselves. After approval, a recognized expert assesses the data and the energy label is registered automatically. On the other hand, in Spain, many regions have implemented additional controls and/or inspections focused on the highest energy labels (A, B and C) to prevent and correct any non-accurate aspects in their EPC and promote trust in high-efficiency buildings. In general, giving subsidies for better energy performance requires a control policy. Along with official national energy labels, also voluntary labels such as the Passivhaus or Minergie standard can be requested by local authorities as an additional certificate.

In addition, in many countries, online tools are available to help homeowners inspect their homes step by step, and determine the energy performance of their dwellings and what measures can be taken to improve the situation (the so-called "do-it-yourself" home energy audit). These tools can be accessed through the websites of national, regional and local authorities.

Assessment:

When discussing these regulatory instruments, local authorities mainly point to the potential of these instruments to use them as sticks towards landlords to improve housing conditions for renters that live in inferior quality housing. The usefulness of these policy instruments was confirmed in two workshops involving experts and local authorities. During the IEA EBC Annex 75 workshop in Vitoria-Gasteiz (27-03-2019), participants confirmed that mandatory inspections and energy audits can be used to motivate holistic renovations in old residential buildings because they improve not only the detection of security issues but also Energy Efficiency (EE) and health (moisture & thermal comfort) problems. On the other hand, the disposable income of inhabitants can reduce their capacity to maintain their homes' indoor conditions and stop any renovation due to a lack of financing possibilities. Mandatory requirements thus require a holistic socio-economic approach. Understanding the customer segment (e.g., citizens living in energy poverty) in each district is key to assessing the particular needs of families in vulnerable situations and facilitating renovation. This demonstrates the potential of inspections and audits for a proper renovation strategy of a certain area.

Multiple expert participants at the IEA EBC Annex 75 workshop in Delft (25-9-2019) also agreed that inspections and audits can strengthen awareness. Random inspection of submitted certificates can enhance their credibility. Participants noted that mandatory policies can be a good way to control user behaviour, as the required investment is low. A benefit of inspections and audits can also be strengthening the building owner's position concerning the construction companies – inspections and audits may be considered as a service provided by the city to building owners to ensure they get what they paid for and that there are no efficiency losses that could be easily avoided.

However, a weakness of inspections and audits is that the execution can result in a significant effort and burden for city administrators who must maintain a legal context. Another weakness of this approach is the possible political unpopularity arising from these additional mandatory checks, understood as a 'sticks' approach. Looking at the acceptance from an owner perspective, policymakers might prefer 'carrots' to gain owners' support. Further, a solo effort at a local or district level rather than at overarching levels regarding inspections and audits, as well as minimum standards in general could be rejected because it could be seen as not treating all citizens in an equal manner (and thus advantaging specific work forces or taxpayers).

It remains questionable if statutory inspections of the energy performance of existing (private) dwellings can become obligatory in the short term. It seems unfeasible that obligatory inspections and audits can be introduced as a 'stand-alone' instrument. In most EU countries, on-site inspections of private housing are only legal if "acute danger for health" can be stated. There is also a potential trade-off and key conflict line between quality improvement through minimum standards and housing affordability. It is most likely that an obligatory

inspection can only be realised if related to financial incentives as a necessary condition for intensive support and guidance, a tax reduction, a subsidy, or a loan. Besides that, owners can be encouraged to carry out an audit via information campaigns or as part of a building renovation passport. Based on the inspection and audit results, help and support can be offered by local authorities or the market to improve building performance.

3.3 Financial incentives created by local authorities

Scope:

The local authority manages part of its budget to give financial benefits to stakeholder groups for introducing energy efficiency and renewable energies in an area. Such a budget might be directed, for example, to groups of homeowners or to support collaboration initiatives of stakeholders in specific areas. Furthermore, local authorities can use concession rights to steer tariffs on local district heating systems and set local taxes to facilitate the combination of energy efficiency and renewable energy measures at a district scale. Such measures depend on the country's legal framework and should be seen as a complementary tool to support local governance with temporary adjustments and district development with a follow-up strategy.

Examples:

We found that many examples focus on either renovating the building itself, i.e., the energy efficiency improvement or implementing renewable energy systems in or near the building. There is only limited experience with financial incentives that aim to increase the renovation rate and upscale building renovation actions to the district level. We provide a few examples that might be considered as a starting point for further development.

We illustrate several examples of local authorities creating financial incentives such as grants, subsidies, local tax reduction (for issues where local authorities collect taxes), revolving funds, (co-)financing project development, and so on. The local authority can structurally support the uptake of low-carbon technologies and concepts by energy end-users (citizens, residents) or other actors by offering financial incentives.

Local funding programmes are possible when every private owner can apply on equal terms. Examples are the Climate Protection Fund "proKlima" - operating with a partnership between the municipality of Hannover, five neighbouring municipalities the local energy supplier Stadtwerke Hannover AG - provides Euro 4,4 million annually, for supporting building energy renovation; the introduction of the Passivhaus Standard, as well as the introduction of energy-efficient technologies and renewable energy (PassREg, 2016). Conditions for obtaining a subsidy from ProKlima include: (a) the certification procedure for the Passive Houses construction method and (b) energy efficiency quality assurance for structural insulation, heating and ventilation (PassREg, 2016). As the programme already acts at a local level, it could also target to invest in collective renovations or renewable energy systems at the district scale.

Furthermore, local authorities sometimes opt to offer an additional reduction of the interest rate of national or private renovation loans, particularly for vulnerable households. For example, in the Brussels Capital Region, as part of the 2004 policy framework package, a zero-interest green social loan ("prêt vert social"), was provided to vulnerable households who wanted to thermally insulate their homes, thereby reducing energy consumption and in line with the passive standard criteria (PassREg, 2016). Such loans might be expanded to help multiple households at the same time, for example, by also providing it to homeowner associations and energy communities.

The scale of these examples is still often the building and the individual homeowner. Still, there are more and more examples of local authorities defining vulnerable areas that can access additional funding or incentives (such as the old town of Vitoria-Gasteiz, Spain). Since 2021, the Spanish building renovation grant programme (Ministry of Transport, Mobility and Urban Agenda, 2021), based on the EU rescue programme, includes significantly larger grants for district-wide renovations and financial support for the creation and maintenance of One-Stop-Shops in districts and local energy desks.

Local authorities can also reward highly energy-efficient buildings with a lower local building tax, if acceptable under national framework conditions. This type of measure also helps increase social awareness of the importance of the EPC label and energy efficiency and renewable energies. For instance, in recent years, several Spanish cities have set a 50% reduction on municipality fees for all A and B classes dwellings and small commerce. For example, in Belgium, a homeowner building a house with a higher energy standard could benefit from a reduction in federal income tax for a few years. This income tax reduction was higher, respectively, for a low-energy, passive or zero-energy house, and a certificate had to be provided by a non-profit organization or the government. Later, energy became a regional responsibility. Nowadays, the home tax baseline in the Belgian Flemish Region is lower for higher energy performance, while the federal income tax reduction was abandoned. Local authorities and real estate managers could benefit from collecting tax information to identify or push forward visible low-tax districts.

In Germany, there is an option for local governments to apply for district-oriented urban development funding (Städtebauförderung), financed by the federal and regional levels. This includes tax reduction for building investments in a priority area. However, only the implementation is local, the money is not. In Germany, there were also some experiences with using ERDF co-financing for direct funding of energy efficiency measures in private housing.

Recent initiatives to stimulate upscaling of renovation at the district level include, for example, grants for renovation coordinators that involve multiple homeowners. For example, the City of Antwerp, in Belgium, explored such opportunities for financing renovations through the revolving fund that was created for cheap loans and through group actions to reduce the investment needed for energy-saving measures (PassREg, 2015; Triple-A, 2021).

In addition, local authorities also tend to work together with banks and companies to facilitate renovation loans for homeowners' assemblies. For example, in Sweden, most municipalities offer "green" loans which are administered by the Kommuninvest, a company owned by Swedish municipalities. It is possible for municipal housing companies to get loans with low interest for green building projects, including improving the energy efficiency of existing buildings and housing districts.

Green loans might in the future also be coupled to a building instead of to individual owners, which would also benefit the uptake of renovation in buildings with multiple owners. A local authority can also support a revolving fund to renovate buildings or infrastructure to high energy standards. On top of that, the administrations responsible for giving loans can support actors by informing and consulting them on energy efficiency and renewable energies.

Along with building renovation, financial incentives can also facilitate multiple owners' placement of renewable energy production or local heat grids. For example, in the Netherlands, energy users who form a cooperative energy community can get an energy tax reduction if renewable energy systems are used locally in buildings in the same or adjacent postal code area. In the cities of Luzern and Zürich, in Switzerland, building owners receive subsidies for connecting to a district heating system. In addition, these cities provide specific financial incentives to replace a heating system based on fossil fuels before the end of its service life. This removes a potential obstacle to renovation projects at the district level associated with the asynchrony of renovation cycles for various buildings in a district.

Many financial incentives are not necessarily related to improving energy efficiency or installing renewable energy, yet they can incentivize citizens to do renovations. Renovation works, for instance, might be supported by a tax reduction compared to newly built constructions, like, for example, in Belgium or Sweden. Other typical incentives can include improving living conditions and maintenance in buildings, avoiding vacant buildings, improving houses for the elderly or caretaking, incentivizing single-parent families and splitting up existing large residential units, membership in a cooperative or providing monument care. It remains to be explored how such incentives could better work at a district level.

Financial incentives can also be related to awareness-raising, providing easy access, starting citizen initiatives, activating demonstration projects, and supporting citizen contests to compete for energy savings. Similarly, the local authority can support networks of actors to unburden citizens in the implementation of energy efficiency and renewable energies. Groups (formation) of companies can be supported with innovation grants, subsidies for consultancy/ training and to initiate collaborative initiatives (e.g., one-stop-shops, ESCOs). Local authorities can get funding themselves to develop incentives, for example by applying for European R&D projects or national innovation funding.

As the framework for financial incentives is continuously changing, it becomes paramount for local authorities to always have the latest full overview. This can be supported by national actors. For example, in the Netherlands, the Dutch Enterprise Agency developed a toolbox for construction financing that local authorities can use to compare various financial policy instruments: 16 types of funds, eight types of subsidies, four types of guarantees, ten types of loans and multiple other forms of organizing. The toolbox gives examples of these initiatives and addresses strong and weak points.

An important financial incentive to combine energy efficiency and renewable energy measures can also be appropriate tariff structures, such as connecting buildings to a district heating network. For example, the energy company ewl, in Luzern, Switzerland, allows building owners a tariff adjustment that considers the reduction in the need for capacity, if their buildings, already connected to a district heating system, have implemented efficiency measures on the building envelope, which lowers the heat need of the building. Policymakers can make such tariff structures, which favour the combination of efficiency measures and renewable energy measures, mandatory through control. They can exercise this control through a local energy company as its (co)owners, or by making related tariffs mandatory through concessions or permits that district heating companies must obtain from the city.

Assessment:

The attractiveness of incentives as local policy instruments depends highly on the national context. National regulations often limit the way local authorities can provide financial incentives. For example, they have no impact on national tax regulations, they might not be able to install subsidies related to requirements outside national or regional initiatives, and the installation of a revolving fund might need the permission of the State or region. Nevertheless, in some ways, local funding programmes are often possible. Co-funding is often limited to special budgets for public projects and initiatives where citizens are treated equally – thus making it difficult to target homeowners in specific districts. Installing low-interest rates for loans locally might be less successful in times of overall low-interest rates. Subsidies are often preferred by building companies and homeowners, but low amounts might not be incentivizing.

Given the fact that all funds are limited, it is important that clear targets are defined on what is to be achieved with subsidies, and that subsidies are subsequently designed to fit best these objectives. In such a case, when subsidies are used where they have the highest impact on desired policy targets, their impact can be maximized. Given the benefits that combinations of energy efficiency measures and renewable energy measures at the district level have, but also the complexity of implementing such combinations, it might, for example, be particularly useful to focus subsidies on promoting these combinations. Furthermore, instead of

providing subsidies to all heating installations based on renewable energies, subsidies could be designed to make a difference in cases where such a switch would otherwise not be cost-effective. However, there is a need for that subsidies to be also fair and not unnecessarily differ between various groups of homeowners. Furthermore, it must be kept in mind that subsidies may lead to distortions and have unwanted effects. For example, if the number of subsidies granted for the replacement of heating systems is a function of the capacity of the heating system, this may make energy efficiency measures to reduce the capacity of the heating system less cost-effective.

The advantage of financial incentives is that they can have a direct impact on the energy performance of a dwelling and that they can be attributed to specific (groups of) stakeholders. The disadvantage is that they only have a temporary influence and impact and that they are funded with taxpayers' money. A commonly noted danger is that grants and subsidies benefit more the actors that are comparatively knowledgeable, well-off, and sometimes inclined to undertake action anyway.

The needed finance models are quite different for individual owners or larger organizations, such as social housing or large investors (IEA EBC Annex 75 workshop in Vitoria-Gasteiz, 27-03-2019). It is crucial to design financial incentives to eliminate barriers for specific stakeholders. For example, private homeowners can struggle with both the needed advance investment and the complexity of understanding (the process of) energy renovations and attracting the right consultants and suppliers. Supply-side actors might struggle with investing in building up skills and knowledge. Developers, renters and investors might seek risk-sharing and guarantees for financial gain. Social housing associations might not be able to increase the rent after renovation, thus looking for financial compensation. In some cases, perceived transaction costs for stakeholders might even exceed the amount of money they can obtain, so those incentives are ignored. The complexity of funding programmes and the time-consuming and bureaucratic procedures to apply can also hinder homeowners' adoption of financial incentives. The needed pre-investment and amortization rates might be too high for some homeowners, even with funding. These barriers must be inventoried first on the district level before financial incentives for a district are designed and launched.

We remark that many municipalities have no option at all to set up their own funding instruments. German experiences showed that even attracting ERDF funding might be difficult because the needed municipal co-financing is too high. In general, when funding can be installed, the following applies to the regional, provincial, and local financial incentives:

- Each province, region or municipality determines, taking account of national funding programmes, which measures it subsidizes and on what conditions (usually demands on the dwelling's e.g., age or current energy performance).
- The maximum subsidy amounts vary widely among local authorities and over the years.
- In most cases, the rule applies: "first come, first served". When the available budget ceiling is reached, applications will be disregarded.

This variation is not per se a problem, except for transregional players that have to dive into all respective regulations. Important is that the district stakeholders know what is going on and what is in it for them. Variation might not bother them, and it might even be good to have more precise funding for the respective context. It is important that the information is available in a structured way that is reaching out to the specific stakeholders in 'their language'. Local authorities should avoid that actors have to apply separately at each authority level and that instruments do not address the specificities of a district.

Furthermore, it is important that subsidies are provided on a stable basis; significant variations in subsidies may create unjustified differences in the support for various building owners. Furthermore, if the availability of subsidies is not reliable, the measure is less effective. Often it takes a long time until subsidies are well-known and used.

While there are many ways to think about financial carrots created by local authorities, local authorities often struggle with a limited budget for such actions and the costly maintenance of strict control procedures. Regarding often very limited financial capacities at the local level, the possibility of combining “carrots” with national or EU programs and cooperation with financiers (development banks, and so on) is for many local authorities a more promising way than creating stand-alone instruments. Therefore, local authorities always must carefully investigate and compare viable options, considering the promotion of supra-local drivers that can incentivize citizens.

Financial incentives might work well to start up a new development or market locally, but in the longer term, the incentives are ‘project-based’ and difficult to sustain. Also, local authorities are not allowed to support specific actors or persons and they are bound to tendering agreements, which makes the installation of incentives labour-intensive. Furthermore, changes in local leadership tend to affect installed financial incentives, which makes the certainty of the continuation of these instruments less reliable.

3.4 Planning and tendering for districts

Scope:

Local authorities plan, (re)design or tender the planning or (re)design of the renovation of a district using energy and environmental performance criteria. Usually, this takes the form of public tendering of the design, but it can also include further steps such as in DB, DBM and DBFM (Design Build Finance Maintain) projects of assets partially owned by local authorities. Here we discuss the development of urban plans by the local authority itself and the tendering on design – for example, an architectural competition and initial stakeholder consultation. Performance requirements can be fixed in the planning requirements. Based on EU rules, authorities must choose public tendering for projects with building costs above a certain amount of money.

Examples:

In general, there are many examples of district redesign and related public tendering of design teams. In various countries, projects and experiments have been carried out to implement energy-neutral areas, but mainly in new development areas. The IEA EBC Annexes 51 (Reinhard, 2014) and 63 (Strasser, 2018) have compiled numerous case studies and guidelines for energy-efficient communities from the viewpoint of urban energy planning and energy strategies in communities.

The German KfW 432 programme is a tool to finance planning concepts for districts and staff for energy advice. As of 2020, the German Urban Development funding is directed to financing public planning activities, but not direct investments.

Urban planning initiatives are also increasingly emerging for integrating renewable energy supply and smart grids at a district level. For example, in the Netherlands, all municipalities must provide plans for districts to disconnect from the gas supply. Also, the German energy supplier Innogy (Smart Quart, 2020) started a project for the development of four different districts where stakeholders test the integration of district energy renovation including renewable energy supply and occasional new construction of buildings. Some of these district initiatives experiment with sector coupling, smart grids and hydrogen as an energy source for buildings.

In Switzerland, energy planning is also mandatory for many communes in one way or another. For example, in the canton of Zürich, the availability of energy planning is a pre-condition for being able to receive the European Energy Award.

New opportunities arise to extend urban planning and district redesign to existing housing districts' redevelopment roadmaps, which include energy efficiency and renewable energy systems and are supported by stakeholder consultation. For example, currently, in the Netherlands, all local authorities are required to develop heat plans for their districts. These plans must indicate which areas in the municipality will be served in the future by a (future) heat grid and/ or which areas are targeted for increased energy efficiency of houses. Within the framework of such plans, it is also possible to consider strategies for combining both energy efficiency measures and renewable energy measures in the same districts. Within the framework of Interreg projects, such strategic heat and renovation plans for districts are also being developed in other EU cities, for example, Mechelen, in Belgium. Local authorities facilitate visions, networking and learning to create support for such plans.

Assessment:

While local planning activities are common at the district level, it can be tough to steer the policy level to the tendering of renovation activities, as well as this would imply some form of ownership by or legal responsibility of the policy actor and might conflict with EU state aid law. Tendering renovation services could be an important lever for district approaches but would need to be arranged on a higher, for example, EU level. Planning can make sure that resources of renewable energy and waste heat are available in the most appropriate way. It can be a source of information for building owners, or the basis for obligations, for example, to connect to a district heating system. Furthermore, the planning can be used to oblige at least public institutions to comply with it.

While Germany shows frontrunning policy instruments for planning, these do not address energy renovation directly. However, indirectly and through the tax reductions for investments in the building structure within a funded district, energy measures are partly addressed. The intentional overlapping of funding areas and a smart choice of districts in this regard is key to success and to bridging the existing cost gap. In practice, working with several funding programs can be administratively complicated and reserved for very experienced professional actors.

In general, district (re)design is quite often used to frame the construction of new buildings and deep renovations and the planning of energy grids, for example, heat grids, with the view of preparing the sales of concessions to energy companies or cooperatives. In large-scale projects, urban planning and public tendering can help achieve energy efficiency and renewable energy goals and obtain a high degree of professionalism. Planning procedures may be highly influenced by local authorities owning land and by effective negotiations with local stakeholders.

Experiences gained in energy-neutral redevelopment projects show that in practice many issues stand in the way of the transition to energy-neutral areas. Implementing district planning and (re)design requires a mentality change in the city planning administration. A separate way of working (e.g., concerning financing, design, technology, tendering and cooperation) is needed to achieve energy goals.

Deep renovation of urban areas can potentially lead to the relocation of current, established residents and businesses. This phenomenon is known as gentrification risk. To prevent it, the initial status of renters and landlords should be evaluated in the area, addressing future scenarios, and promoting long-term agreements (IEA EBC Annex 75 workshop in Vitoria-Gasteiz, 27-03-2019).

The local authority must invest a lot in gaining the trust of residents when changes are planned in districts. In principle, open planning processes and public tendering could lead to a clear and fair process, comparison and the best price. However, it is not guaranteed that the winner of the tender will deliver the highest quality if the quality objectives were not taken along in the process.

3.5 Organizing services for districts

3.5.1. Renovation services in districts

Scope:

Local authorities (contribute to) organizing the planning or execution of renovation measures or offering services or one-stop-shops by qualified actors. For example, in the case of a one-stop-shop (OSS) or integrated home renovation service, service providers or city staff members guide the inhabitants of a district through the whole renovation process and develop and perform activities for the initiation (first-line contact), consulting services, contracting arrangements, financial planning, execution planning or follow-up of quality assurance agreements.

Examples:

There are numerous examples (see, for instance, the Interreg 2 Seas Triple-A project) where certain target groups (especially homeowners) are accompanied and supported from consultancy to the actual execution of renovation measures. In some cases, the local authorities also advise or inform owners to select and contract suppliers and service providers. They can even provide a list of actors that acquired a certain independent label or educational certificate. For example, two districts in the North of Spain created successful OSS services for district-scale interventions within an Horizon2020 funded project (OPENGELA, 2020). They visited and reviewed other OSS projects from Ireland (SuperHomes), France (SPEE Picardie and île de France Énergies), Italy (Sharing Cities) and Austria (RenoBooster) and underlined that it is very important to have a diversity of actors working under solid governance rules, establish public-private networks to share experiences and build partnerships, set a single interlocutor and offer services also for the post-rehabilitation stage. Indeed, they are replicating the concept, called “district offices”, and the lessons learned to other cities in Europe since 2021.

Traditionally, there are many examples of OSS services for building scale renovations that can possibly also be extended to cover specific districts. For instance, in Hauts-de-France / Picardie (France), homeowners can ask a public energy efficiency service to help them with energy savings and renovating their homes. The public service acts on behalf of the owner as a special assistant and uses public tenders to engage contractors and architects and unburdens homeowners for the management of subsidies and energy monitoring. The service has been promoted in specific cities using a pop-up consultancy centre (Triple-A, 2021).

In the Netherlands, local authorities experiment with achieving natural gas-free areas and, in the region of South Holland, with Next Generation Residential Areas (MRDH, 2020), a subsidy programme for testing grounds or restructuring or transforming areas. Local authorities negotiate with suppliers who are going to take care of, for example, disconnecting houses from the gas distribution network, providing alternative energy solutions in houses, and improving the energy performance of the dwellings in these areas.

The city of Zürich, in Switzerland, provides comprehensive services for building owners who intend to launch or participate in district heating projects. In particular, the city assists them in finding an appropriate legal structure, connects various building owners with each other and energy companies, and accompanies the tendering process for the implementation of a district heating system. The city of Zürich also provides specialist advice for building owners who are interested in implementing small grids connecting only two or three buildings.

In the framework of the Interreg 2 Seas Triple-A project, the city of Rotterdam, in the Netherlands, procured offers from qualified actors networks to provide consultancy in districts, as well as renovation services, designs, products and/or works to achieve (local) energy performance targets in a certain district.

In Belgium, the Flemish energy policy provides a subsidy to renovation consultants who target at least 10 homeowners together. At the same time, some provinces facilitate group buying of renovation measures such as solar panels. Belgian local authorities support both initiatives in local districts, for example by actively communicating these options in districts.

The Horizon 2020 project STUNNING provides an overview of several types of business models for one-stop-shops, as developed in numerous European projects (STUNNING, 2019; Laffont-Eloire et al., 2019). A guideline is provided for the business development of one-stop-shops by activating local actors (Haavik et al., 2012). This guideline was also used by some local authorities to facilitate local business networking.

Assessment:

Advancing services in specific districts is a work in progress in many European cities and regions. While many OSS services emerge for individual homeowners, collective action might need more focus to increase renovation rates. This comes with new challenges such as organizing collective responsibility and guarantees and sharing financing and risks.

There is a big legal and operational difference between, for example, group contracts, the funding of consultancy services and the real contracting of services like roof insulation by a public administration for a homeowner. Some countries have legal and administrative barriers to achieving operationalization beyond consultancy. For example, financial services are highly regulated, and advice provided in preparation for banking transactions may qualify as banking intermediation, a regulated profession (Milin and Bullier, 2021).

Where local authorities can provide such comprehensive energy services, it can be highly beneficial for building owners to participate in joint renovations, renewable energy systems or district heating projects. Such projects are often too complex to be handled by building owners on their own, and too risky for individual companies to pursue them. Therefore, local authorities can potentially play a key role in developing and offering such services until market readiness is achieved.

The one-stop-shop service development is innovative, which means that local authorities using such an approach are often still in the experimental stage. The tendering processes need to be “invented” within procurement legislation and be fair to (collaborating groups of) integrated home renovation service providers. This is an important item for future research. Homeowners can be the contracting party, but they might also delegate their rights to a service agency within a trust contract (Milin and Bullier, 2021). Local authorities balance a delicate edge between demand activation and supplier engagement. Local authorities often find it difficult to understand the status of public tendering to put renovation services into practical operation in districts. The tendering requirements can also easily become too complicated for traditional suppliers, so the method should target innovators and it should also target traditional suppliers to show them how innovation can benefit renovation processes.

It is feasible that building owners in streets and districts – supported by a local authority - choose their services or products collectively. A challenge for the service provider remains to provide the right information and solution per household, especially concerning homeowners at an individual level who want to choose renovation measures that differ from those of their neighbours or want to use a different timing of implementation (see also chapter 5 for practical experiences).

3.5.2. Energy advice services for citizens in districts

Scope:

The local authority sets up a physical place, for example, a local energy desk, a similar virtual contact point, or other consultancy offers to inform and consult citizens locally regarding energy efficiency and renewable energies. These places may differ regarding dimension, distribution, mobility, city and context. Consultancy can also involve a visit to the building of the citizen who contacted the service. Operational activities of such an energy desk can be related to awareness-raising, providing easy access, initiating citizen initiatives, activating demonstration projects, supporting citizen contests to compete in saving energy, and so on.

Examples:

Many energy desks can be found, and most work at the city, regional or national level. These desks might target actions in specific districts, such as appointing specific experts, voluntary 'ambassadors' or promoters per district, or creating a dependent centre in districts. We here give some examples of the status quo.

The city of Aachen, in Germany, initiated the Energy renovation NGO "Altbau plus" - which was founded by a consortium of the local energy supplier STAWAG, the local public housing company and several smaller entities - to inform and give advice about possibilities in energy renovation.

The Netherlands introduced an obligation for local authorities to either install a physical or virtual energy consultancy desk for homeowners, supported by local alliances. Furthermore, the Dutch government is initiating a web-based energy desk at a national level. The Dutch Association of Municipalities (VNG) has produced an atlas on which the energy-saving developments of private homes in 29 regions (and 390 municipalities) have been charted. For each region, the map provides insight into the regional task and objectives, the situation and the content of the regional approach.

A challenge for most energy desks is to reach out to specific districts. A more advanced example in this sense is the city of Rotterdam, in the Netherlands, which temporarily uses fixed or mobile consultancy centres to attract citizens to take renovation measures (Triple-A, 2021). For this, they work together with a market-citizen intermediary for customer management. A fixed consultancy centre is, for example, installed in a local shopping centre to inform citizens in that area. A mobile unit can be ordered to advise specific housing districts.

In Belgium, municipalities are encouraged to develop so-called "energy houses". For example, the city of Antwerp, in Belgium, has a permanent energy consultancy centre where citizens can come with their plans and drawings to discuss their renovation project with a professional "house doctor". This initiated also collective actions. However, specific districts such as the industrial belt around the city remain difficult to engage.

In France, public services play a role to host energy desks. For example, in Hauts-de-France, the Public Service for Energy Efficiency (SPEE) has a public role to help homeowners to renovate their homes to high energy efficiency. Experts from the public service engage in house visits, giving advice and offering proposals for the execution of works. Energy use before renovation and savings after renovation are monitored. The department's action trickled down into cities using pop-up consultancy centres.

In Sweden, municipalities offer energy and climate adaptation guidance, a service funded by the Swedish Energy Agency. The service is offered to individuals, public and private housing companies, housing cooperatives, and so on. The service includes guidance on how to renovate buildings, the choice of heating system, the use of solar energy, funding possibilities, and so on. Local authorities are supported with a web-based energy desk at a national level.

In Switzerland, there are energy advice services offered by public institutions at a national, canton, and local level. The city of Zürich, for example, offers several types of pre-defined consultancy options, some of which are free of charge, while others are at least subsidized. Topics are, for example, a first check on renovation options, specific advice on how to implement a heating system switch, district heating projects, micro-grids with one or two neighbours, and the elaboration of building performance certificates accompanied by advice for building owners. The city of Zürich also offers coaching services, which are defined to comprise continued support for building owners throughout the entire construction process. The city of Luzern offers consultancy on various environmental topics, including energy in buildings. In all cantons of Switzerland, there is an offer to provide advice to building owners on heating with renewable energy carriers. At the national level, there is, for example, a service to give feedback on various offers building owners may obtain on installing a PV system.

Assessment:

Depending on the local context, the formation of energy consultancy desks or similar consultancy services can be done “bottom-up” or “top-down”, based on strengthening existing local authority activities and existing local networks and their knowledge in building renovation and renewable energy. The main advantage is that it makes policy activity in this field more visible locally in districts, which might also generate more trust. To build trust, one of the biggest challenges to maintaining a local office and its consultants for years is a long-term strategy to conduct broad and deep renovations. A good approach can be also to implement networks with local neutral energy efficiency advisers, from a social organization, municipality, or NGO (IEA EBC Annex 75 workshop in Vitoria-Gasteiz, 27-03-2019).

Furthermore, it is beneficial if the consultation on the renovation options takes place in the building itself and if, subsequently to the consultation, the building owner receives a written report summarizing the findings. Energy advisors can either be directly employed by local authorities or mandated by them to provide consultation; in case of mandates, it is important that the criteria for selecting and mandating consultants are well-defined and transparent. Energy advice may not only be a tool to encourage building owners to carry out specific building renovation activities, but also to encourage, for example, heating installers to offer such services. Appropriate training of energy advisors is important to ensure the quality of the advice given. In practice, clear agreements need to be made on how clients are registered and followed up, and how data are managed.

A remaining important challenge for energy desks is to reach out to districts, particularly those in need of redevelopment, without compromising the ‘equal basis’ principle for all citizens. Furthermore, local renovation hubs and pop-up consultancy centres are still figuring out how to also engage local actors (including executors) and networks to create more efficiency and effectiveness of the consultancy desks (Triple-A, 2021).

Local activities often rely on available project funding and local authorities continuously negotiate to continue operations together with citizens and market actors.

3.6 Communication support for districts

3.6.1. Local media development

Scope:

The local authority develops or procures media and web tools to support the citizen’s renovation journey. Local media and social networks in districts are exploited to communicate support.

Examples:

While there are many examples of local media development for stimulating energy efficiency behaviour, local media do not often support communication in districts unless opinion leaders or authorities can facilitate such communication. We give some examples of media that could be used to support such communication action.

Digital means have been developed by multiple local authorities and supporting organisations, reinforced by the current pandemic. For example, Altbau Plus developed YouTube and Facebook tutorials in Germany with a wide outreach. Cities like Rotterdam, in the Netherlands, also tried to use videos and digital testimonials to target specific districts. The commune of Mettmenstetten, in Switzerland, made concrete examples of building renovation projects visible on its website on an interactive map provided by an initiative to encourage building owners to act through examples in their district.

Most digital activity at the local level tries to integrate communication about initiatives at a higher level. For example, in the Netherlands, a wide variety of subsidy schemes (and low-rented loan schemes) are available for homeowners and Associations of Apartment Owners (Homeowner Associations) that carry out measures to make their dwellings more energy efficient. These subsidy schemes are communicated by the national government, provinces and/or local authorities. Specific websites, such as the “Energiesubsidiewijzer” (Energy Subsidy Guide), allow homeowners to obtain a complete, accurate and up-to-date overview of what subsidies and loans are available, when and where, and if they are eligible. The national government also developed a web database and tool where homeowners can calculate their energy savings after renovation measures, based on the building typology and investment capacities. This database can also be integrated into local authority websites, giving it the look and feel that information and support are provided by the local authority.

There are also examples where municipalities try to specifically target customer segments that can be assigned to a certain district. For example, in the city of Mechelen, in Belgium, a specific website was developed to support homeowners in each step of their renovation journey. Similarly, in the framework of the Triple-A project (2020), seven local authorities adapted their web portals with specific web modules to have a better connection with the customer journey (Kwon and Mlecnik, 2021).

For promoting specific connections to and development of district heating projects, the city of Zürich and the commune of Köniz, in Switzerland, show interactive maps on their websites, which enable building owners to view existing and planned district heating projects, as well as the available potential for developing new district heating projects. The information is precise for each building of the city.

Assessment:

Local authority media have the advantage that a potentially trusted actor can reach a large part of the population. Also, using local authority web portals more actively is in line with the desire of many local authorities to become more oriented towards offering online services to citizens.

On the other hand, the campaigns themselves give no guarantee that citizens will take measures. Media development is often poorly evaluated regarding turnover of invested costs. For example, many local authorities still do not use a client relationship management system, so they cannot trace the effect of awareness-raising.

Some local authorities miss a coherent approach to using local media or their own website, particularly when targeting districts. For example, research showed that local authority web portal development also requires co-creation, integration with offline activities, and a strategic management plan (Kwon and Mlecnik, 2021).

Few developments target specific districts; communication can be better organized to reach specific customer segments, districts with a poor energy performance label, create local empowerment, and so on.

Providing map-based information on district heating projects and related potentials to building owners is particularly important because unless building owners know about the presence of such projects or such potential, they might not have the wish to connect to such systems or develop related projects. Furthermore, information on good examples can have an important effect on motivating building owners to take action.

Local media development is likely particularly important in larger cities, where local authorities may find it less easy to connect directly with the residents than in smaller cities. Some local authorities reported benefiting from energy efficiency communication actions in the districts by approaching citizens and networks in specific districts that previously felt 'neglected' (Triple-A, 2021).

3.6.2. Energy benchmarking in districts and contests

Scope:

Comparison of energy data by local authorities or intermediaries allows building owners to also compare their energy use, which might motivate them to establish changes. A play factor can encourage citizens to act. Similar benchmarking may also be carried out among local authorities.

Examples:

Certain local authorities use the energy data actively to benchmark the energy use of buildings. Some states, for example, Singapore, disclose energy bills. Within the Interreg 2 Seas Triple-A (2021) project, European local authorities distributed (sometimes free of charge) home energy monitoring systems to homeowners if they agreed to share and benchmark energy data.

Numerous examples exist where citizens are challenged to save energy by taking measures in their buildings. For example, in Flanders, the non-profit organisation Bond Beter Leefmilieu Vlaanderen manages within its own service portfolio the campaign Climate Streets ('Klimaatstraat'), where citizens in the same street are challenged to save as much energy as possible. In Switzerland, Austria, Germany and many other countries, more than 1500 municipalities are competing to become recognized as sustainable municipalities through the European Energy Award programme. In Switzerland and Austria, districts also "compete" for achieving the 2000-Watt standard (see 3.6.4.). Both local actions and individual homeowner actions can, thus, turn into district actions using a competition element for homeowners and district stakeholders to achieve specific goals. Similar examples can also be found in the local energy communities and renewable energy communities all around Europe, which apply benchmarking principles in districts, and often end up in renovation processes of these districts once they are aware of their potential (Mucha-Kuś et al., 2021) (Delgado-Martín and Meseguer-Sánchez, 2020).

SaaS-platforms (Software as a Service) – such as EnergielD (REScoop PLUS, 2019) – have been used by local authorities to assist citizens to compare their energy use. District citizens who want to participate fill in their energy use data monthly and the platform offers data integrations, analysis and comparison of energy use and additional recommendations.

Assessment:

Showing and comparing energy data is a low-cost activity with a great motivation effect. It can potentially provide an incentive to kick-start awareness-raising in certain districts, especially when combined with open-

door days. Based on the energy benchmarking results, help and support can be offered by local authorities, district ambassadors or market parties to improve the situation.

On the other hand, clean data and smart metering are needed. Benchmarking of energy housing is often not systematically achieved beyond individual projects. Privacy of energy data can sometimes hinder energy benchmarking, but at the district level, in some countries, it is possible to obtain average data from energy suppliers to provide baselines or monthly energy use statistics, so that inhabitants can evaluate their habits compared to a district baseline or building typology and understand the impact of building renovations.

3.6.3. Education and training for building professionals

Scope:

Through education and training, local authorities may increase the competencies of various professional actors such as building professionals, energy companies, housing associations, architects, heating installers, city staff and interested professional building owners on the topics of building renovation in districts, including combinations of energy efficiency and renewable energy systems.

Examples:

Education and training activities are nowadays often organized by professional intermediaries such as associations or NGOs. Cities may encourage participation in such education and training through disseminating information about related opportunities; they can, for example, promote education and training by offering a room for carrying out such training. Furthermore, they may ensure that their staff acquires associated knowledge through participation in such training, and they may require appropriate training, for example, for mandating energy advisors or other building professionals in their own construction projects.

Assessment:

The lack of professionals able to execute renovations is a general problem. The current construction market is saturated and demand-driven, and small enterprises usually devote little time to training. Providing more future-oriented education focusing on sustainable solutions might attract more students to choose a profession in the construction field.

Since building renovation at the district level is a complex task, particularly if it involves combinations of both energy efficiency measures and renewables, adequate education and training of various energy actors associated with building renovation are important. One of the lessons learnt from OSS pilot projects in the Basque region, Spain (OPENGELA, 2020), is how necessary it is to have well-trained staff and to share the experiences obtained in other OSSs. The city of Rotterdam also acknowledged the need to extend OSS to districts to also engage local professionals in district renovation hubs (Triple-A, 2021).

The training is more effective if it is coupled with achieving a nationally recognized certificate, quality label or education points that count for professional education. For example, a public list of trained professionals can help homeowners find suitable actors to implement renovations and renewable energy systems. It can also help local authorities refer to steps taken after a certain consultancy. Such lists have been implemented with moderate success. The main concern is that listed companies are so in demand that they are unable to respond to requests and that homeowners are unable to assess the quality of work. Local authorities or intermediaries, thus, also have a role in systematically checking the delivered quality.

Regarding education combining energy efficiency and renewable energy at the district level, there are only a few examples. Such education would need a strong emphasis on cross-disciplinary collaboration.

3.6.4. Labels for low-energy/low-emission districts

Scope:

Specific labels for low-energy/low-emission districts provide an incentive for project developers or groups of homeowners to reach related standards.

Examples:

In Switzerland and Austria, there is a label for districts which comply with the 2000-Watt standard, this means that the average annual energy consumption must not exceed 2000 Watt. The label was introduced for newly built districts, but a separate category was introduced to make the label applicable to districts too.

Assessment:

Extra costs for actors requesting it can hinder labelling. Compared to regulation, it requires extra, often voluntary, work. It is often a challenge to organize common renovation projects in districts. The instrument may, therefore, be particularly interesting for single building owners, such as a housing association, owning an entire district/group of buildings. Nevertheless, it may also incentivise groups of various homeowners to renovate a district. Except for Switzerland and Austria, these labels are still underdeveloped.

3.6.5. Local events for building owners

Scope:

Raising awareness and increasing the capacity of citizens, particularly building owners, with training, visits, events, and activities that can encourage them to renovate their buildings and participate in district projects.

Examples:

The city of Zürich, in Switzerland, regularly organizes events for groups of homeowners in a district to allow them to get to know each other better and elaborate a common vision as a basis for common renovation projects at the district level.

Similarly, other major European cities provide frameworks for citizens to find each other and discuss certain topics such as climate, sustainability, housing, and so on, or even to develop local policy itself.

Assessment:

Local participative events can be important as they can lead to higher trust among building owners in a district. Furthermore, another advantage of these meetings is the formation of group processes that can create a dynamic development towards building renovation. People are more inclined to renovate their buildings if they think or see that their neighbours are also doing so.

A drawback is that these events usually only attract the engaged customer segments and not all citizens in a district. The events typically embrace a wider scope with less focus on renovation and district-scale energy

systems, whose input would have yet to be developed. These events work best when they are timely and organized for specific customer segments.

3.7 Supporting emerging private and civic initiatives

Besides the previously listed policy instruments, emerging private and civic initiatives in the district can also lead to building renovation at the district level including energy efficiency and renewable energy systems, which, in turn, local authorities could facilitate. The following were noted as emerging key topics where local authorities might play a future role to facilitate and support actions via policy instruments. These policy options are provided for inspiration and are not regarded in detail in the next chapters of this report, as these are considered outside the scope of IEA EBC Annex 75.

3.7.1. Citizen energy cooperatives

Scope:

District residents cooperate to produce renewable heat or renewable electricity locally, implement energy efficiency measures, or jointly buy technical solutions.

Examples:

At the local level across Europe, initiatives can be identified where, at the municipal or district level, homeowners and residents are jointly trying to reduce their energy bill by targeting the joint use and/or development of local renewable energy sources. The number of citizen energy cooperatives has sharply increased during the last years.

For example, 582 energy cooperatives were counted in the Netherlands at the end of 2019, 100 more compared to 2018, and covering about 80% of all municipalities (Hier opgewekt, 2020). They develop local solar, wind, heat, mobility, and other innovative projects, and stimulate energy-saving activities.

This type of cooperative is recent in other countries, like Spain. Since the creation, in 2010, of the first Spanish energy cooperative, 'Som Energia' in Girona, the number of people interested in energy generation alternatives has increased significantly. In 2019, the largest 19 energy cooperatives created 'Union Renovables', an institution to join forces, promote cooperatives and offer energy 100% renewable in connection with the European Federation of Citizen Energy Cooperatives 'RESCOOP'.

In the city of Zürich, in Switzerland, building owners are encouraged and supported by the local authority to create energy cooperatives to launch district heating networks.

Assessment:

Energy cooperatives do not necessarily intend to serve a district or buildings within a district, as they usually deliver produced energy to the grid. Furthermore, energy cooperatives may play an increasingly significant role in igniting renovation activities and launching district heating networks. Barriers and opportunities for energy cooperatives are currently being investigated in many research projects. Besides local renewable energy provision, some cooperatives also provide energy efficiency renovation services to districts.

The first test results on REScoop members indicate that, on average, members of energy cooperatives reduce their energy consumption by 20% per year when joining a cooperative. This reduction goes up to 45% if the cooperative member is also a prosumer (REScoop PLUS, 2019). Members also claim to gain a better knowledge of energy-related topics. Energy cooperatives often point to their role in delivering National Renovation strategies.

National energy industry laws or even tax regulations are reported to form an important barrier, where also local authorities cannot help. For example, in Germany, the “Mieterstrom” (tenant electricity) tax law makes it difficult for condominiums or tenants to participate in PV installation, as it is legally seen as a commercial activity of electricity production and is, thus, taxed and legally treated that way. A barrier can also be a split-incentive problem, as it is not the tenant but the housing company that installs the PV system and, thus, can benefit from electricity production by selling it to the market. Energy cooperatives are particularly widespread in countries that offer cost-covering feed-in tariffs for electricity from renewable energy sources.

In the Netherlands, some municipalities declared specific urban areas as experimental zones, where the legal obligations can be relaxed somewhat.

3.7.2. Energy demand side management in districts

Scope:

The local energy market or an aggregator penalizes high energy use and rewards low energy use and/or renewable energy production.

Assessment:

Besides local authorities, local market players can also play an important role in steering district energy demand (see, for example, IEA EBC Annexes 67 and 82). Local energy players (aggregators, cooperatives, etc.) may be interested in providing energy demand management services to energy distribution network managers while offering energy prices to building owners in specific districts according to the availability of renewable energy in the distribution network. Local authorities play a facilitating role in developing such local smart grids, individual smart meters, and local renewable energy supply.

The Electricity Tariff Structure Review (NERA Electricity Tariff Structure, 2013), which has been carried out on behalf of the EU Commission, shows that many of the existing tariff elements have been formulated over the years according to the available technology. In particular, the developments in metering technology may facilitate a greater variety of tariff structures now or in the future. This allows for the introduction of usage tariffs (so-called Time of Use –TOU – tariffs) which vary throughout the day (or season) to more accurately reflect the costs imposed by different usage patterns by consumers.

The Clean Energy Package, proposed by the European Commission in 2016, emphasizes the importance of competitive prices, efficiency, and non-discrimination. It focuses on cost as a basis for tariffs, which should also allow consumers to feed in their generation, and pay the appropriate share of distribution system costs. The Package also acknowledges the importance of social objectives by individual Member States, while reiterating the prohibition of specific cross-subsidies.

Overall, this policy option is still barely explored at the district level.

3.7.3. Facilitation of trading of white, green and black certificates

Scope:

Not all districts or cities can achieve an elevated level of energy efficiency or renewable energy production. In theory, a well-performing district or city could trade green, white or black certificates to compensate for other districts with low performances. Certificates currently set (and traded) at a (pan) national level, might be traded at a local level. Several types of certificates are recognized:

- White certificates relate to energy efficiency (energy use reduction).
- Green certificates relate to renewable energy (RES generation).
- Black certificates relate to carbon emissions reduction.

Examples:

In Switzerland, a foundation, KLIK, was established by oil importing companies that provide funding for district heating projects in which fossil fuels are replaced by renewable energy in exchange for obtaining black certificates. These are used to meet a national obligation for oil importing companies to compensate for part of the emissions caused by fossil fuels used by vehicles. Furthermore, some companies in Switzerland can also use black certificates to compensate for emissions and achieve exemption from paying the national CO₂ levy. Such certificates can be generated through the replacement in buildings of boilers based on fossil fuels with renewable energy-based heating systems.

Assessment:

The (pan) national certificates certify that a certain pre-agreed 'sustainable goal' has been realized. They are usually tradeable and can be combined with an obligation to achieve a certain target of the related sustainable goals.

Several European countries have already implemented a white certificate scheme or are seriously considering doing so, thus, local authorities might use it as a policy instrument. A white certificate (EuroWhiteCert, 2020; Bertoldi and Rezessy, 2006; BPIE, 2010; Di Santo et al., 2018) – sometimes referred to as an Energy Savings Certificate (ESC), Energy Efficiency Credit (EEC), or white tag -, certifies that a certain pre-agreed reduction of energy consumption has been realized. These certificates can be tradable and combined with an obligation to achieve a certain energy savings target. In this system, energy producers (suppliers or distributors) must implement energy efficiency measures for the final user to meet the pre-agreed energy reduction target. Given the districts and the European Clean Energy Package, it might be conceivable that, in the long term, groups of residents of a district could come together as energy cooperatives and thus act as energy producers. If the target is met, they receive a certificate, if not, they must pay a penalty. Each certificate is unique, traceable, has the character of a 'property right' (over a certain amount of additional energy savings) and is (usually) tradable.

The characteristics of a green certificate (Alaimo, 2005) are broadly comparable with a white certificate. The main difference is that it proves that a certain amount of energy (usually in MWh's) is generated using renewable energy sources (e.g., wind, solar, geothermal, hydro or biomass). Several countries use green certificates as a means to make the support of green electricity generation closer to a market economy instead of more bureaucratic investment support and feed-in tariffs. Large companies can consider these certificates either to compensate for their energy efficiency limitations or, on the contrary, they can also lead the investment in RES and exchange renewable electricity surplus for green certificates.

Black certificates (Alaimo, 2005) concern the reduction of carbon emissions. An example can be found in Italy, where the certificates are related to the assigned number of units (AAUs) under Italy's National Plan in the EU Emission Trading System and are traded at the European level.

Until now, not much is known about the effectiveness and efficiency of these certificates and their usefulness at the local level. This research did not find any examples so far organized at a local level. However, as the example of Switzerland shows, district projects at the local level may receive support through related national programmes. On the positive side, the use of these certificates can be a means of meeting the agreed target against low costs and reducing the otherwise possible necessary government funding. It can be possible to reach stakeholders (and 'their energy-saving potential') that currently are not reached by other policy instruments. On the downside, questions come up relating to the costs of the system and its effectiveness. A risk might be that it could encourage measures to cut the low-hanging fruit, not leading to essential and structural energy savings at the district level. However, the main question (and problem) relates to the practicability of these certificates at a local level. Further fundamental research is needed to be able to recommend this policy instrument to local authorities.

3.8 Discussion

The suitable selection and design of local policy instruments will depend on the chosen approaches that are applicable in a district; the local policy programme, vision, and strategy; and available actors, stakeholders, and local networks. It is important first to assess the need for local policy instruments to support local implementation besides the already existing regional and/or national policy instruments. To develop, select or promote an (additional) local policy instrument for districts, it is important first to assess the potential, which means:

- the characteristics and motivation of the building owners in a district (according to customer segments, such as: individual or multiple homeowners; private landlords, project developers or investors; social or cooperative housing; and so on);
- the characteristics of the dwellings (particularly their typology, type of existing energy system, the status of the building envelope, and need for either deep or step-by-step renovation or maintenance);
- the applicable level of the instrument (individual buildings, cluster of buildings, street, neighbourhood, district, municipality);
- the need to support other actors and stakeholders, for example, for adopting local market supply or civic demand initiatives.

Individual policy instruments can also distinguish district types regarding building types, ownership structure, building envelope status, and energy supply system. Ideally, a matrix is developed to indicate which instruments can affect specific stakeholder groups and dwellings. For example, districts with multi-owner condominiums— who either use the apartment permanently or as a second residence or rent it out – might need a quite different policy approach compared to districts primarily with single-family homeowners occupying individual houses. A specific assessment is often needed per district to interpret all the needs and possibilities in communities.

For example, the German programme KfW 432 supports the development of energy-related concepts in the first phase, which might include different topics like environmentally friendly mobility and campaigns to save energy, as well as improving energy efficiency in existing buildings. In the second phase, energy efficiency managers are supported, who implement the measures based on the concepts, holding information meetings, creating leaflets, organizing demonstration projects and giving some energy advice to homeowners. The successes and results of the KfW 432 are mixed. Most successful initiatives occurred in districts with big

blocks of rental buildings owned by one entity, such as a public housing company, and focusing on, for example, existing or easily extensible district heating.

Besides that, the competencies, rights, and obligations of various government levels (local, provincial, regional, and national authorities) should be always taken into consideration. For instance, obligations might occur at a national level to guard the principles of legal certainty and proportionality for all citizens, which can only be restricted with appropriate justification. On the other hand, local authorities might be more ambitious than national obligations. However, depending on the country, they are not necessarily allowed to set higher requirements on the quality of buildings and for their owners, beyond what is set in the national codes and regulations. Nevertheless, local authorities can use financial instruments, planning instruments, organizational instruments, communication instruments and even new emerging types of policy instruments. Furthermore, they can make agreements in covenants or contracts or can experiment with higher building qualities in, for example, pilot projects. The necessity to quickly reduce carbon emissions to comply with the climate protection targets set by the Paris Agreement is a justification to introduce far-reaching policy instruments. The previous inventory provides inspiration and numerous examples of what municipal, city and county authorities can do besides supporting existing regional and national initiatives.

3.9 Conclusion

This chapter identified multiple ways in which local authorities can strengthen the exploitation of energy efficiency and renewable energies in districts. The result is an inventory of detected policy instruments that can inspire stakeholders to engage in residential building renovation at the district level. The following instruments were identified and described:

- Regulations:
 - o Enforcement of minimum energy standards in districts
 - o Inspections and audits in districts
- Incentives:
 - o Financial incentives created by local authorities for districts
- Planning and tendering for districts
- Organizational instruments:
 - o Creation of renovation services in districts
 - o Energy advice services for citizens
- Communication instruments:
 - o Local media development
 - o Energy benchmarking in districts
 - o Education and training for building professionals
 - o Labels for low-energy/low-emission districts
 - o Local events for building owners
- Emerging initiatives such as:
 - o Citizen energy cooperatives
 - o Energy demand side management in districts
 - o Facilitation of trading of white, green, and black certificates

Table 2 gives an overview of how local authorities can perceive opportunities and barriers related to these instruments. All the indicated policy instruments are worth exploring for future local policy development.

In practice, a locally suitable mix of these policy instruments, comprising obligations, incentives, planning, organizational support, and communication, can engage stakeholders in districts most effectively to renovate buildings to improve their energy efficiency or develop renewable energy systems at the district scale.

A preliminary version of this inventory served as a basis for carrying out our further research based on in-depth interviews, as described in the next chapters. For this purpose, the inventory was discussed with stakeholders during the second IEA EBC Annex 75 workshop in the Netherlands, where mainly local authorities participated. Together with the participants, the descriptions were refined and at the end, the participants were asked to select two regulatory instruments, two incentivizing instruments, two organizational instruments and two communication instruments that they perceived as most promising. These were selected for further examination in the in-depth interviews, the results of which are documented in the two following chapters.

Table 2. Opportunities and threats for local authorities using specific policy instruments.

Policy instruments	Opportunities for local authorities	Threats to local authorities
Enforcement of minimum energy standards in districts	<p>Necessary for activating worst-performing segments.</p> <p>Acceleration of energy transition compatible with the Paris Agreement.</p> <p>Feasible to integrate into land use agreements, contractual arrangements or concessions/permits.</p>	<p>Local authorities might not be allowed to go beyond national or regional standards.</p> <p>Standards might only apply for major renovations.</p>
Inspections and audits in districts	<p>Combining security, health and energy requirements with broader (social) housing quality checks adapted to each district's needs.</p> <p>Strengthening control of building energy labels to raise awareness.</p> <p>Service for the building owner to make sure construction is according to plans.</p> <p>Works best when coupled with an incentive, communication, or support action.</p>	<p>Large administrative burden for local authorities.</p> <p>Actions might lead to political unpopularity or unequal districts.</p> <p>Will not work well without attention to the specific characteristics of and responsibilities for districts and the socio-economic context of citizens.</p>
Financial incentives created by local authorities	<p>Incentives for stakeholders when acting at a district scale can directly impact performance.</p> <p>Collaboration opportunities with stakeholders, e.g., for establishing local funds, and risk sharing.</p> <p>Development of local demand and supply networks, e.g., upscaling with cooperatives.</p> <p>Can be targeted to specifically support a combination of energy efficiency and renewables.</p>	<p>Continuously changing framework at various authority levels; difficult for local authorities to go beyond available incentives and to target districts.</p> <p>Several types of stakeholders need specific incentives that fit with eliminating their barriers.</p> <p>Difficult to sustain and labour intensive.</p>
Planning and tendering for districts	<p>Dealing with the efficiency of buildings and energy grids at the same time.</p> <p>Information to building owners.</p> <p>Professional top-down planning.</p> <p>Performance-based tendering.</p> <p>Basis for obligations to connect to district heating or to switch to other renewable energy systems.</p>	<p>Mentality change is needed for various stakeholders.</p> <p>Possible resistance due to ineffective consultation or lack of options.</p> <p>Gentrification risk.</p>
Renovation services in districts	<p>Development of local home renovation services that unburden the homeowners, specially oriented to district-scale renovations.</p>	<p>Possible legal and administrative barriers, experimental tendering processes, requires a lot of resources.</p>

	Targeting multiple homeowners at the same time, referral to 'trusted' actors.	Service not necessarily targeting a specific district or customer segment.
Energy advice services for citizens in districts	Good at awareness-raising and providing easy access to solutions to facilitate district interventions. Local authorities can form alliances with local actors.	Possible lack of district identification and client follow-up. Lack of long-term engagement of stakeholders (often project-based initiatives) in districts.
Local media development	Information can reach a large population. Information can be targeted to customer segments and districts. Opportunities for developing e-services.	Requires permanent attention: local authorities need to continuously monitor effects and couple actions with off-line activities and strategic plans. Communication is not necessarily district-related. No guarantees that measures will be taken.
Energy benchmarking in districts and contests	Can be motivating for stakeholders to act.	Can be difficult to disclose energy data for comparison.
Education and training for building professionals	Builds capacity of various stakeholders. Can address particularly synergies between energy efficiency and renewables.	Local authority often lacks knowledge of its own and requires third-party input or cooperation. Needs to be coupled with formal recognition.
Labels for low-energy/low-emission districts	Recognition for building owners that have carried out exemplary projects. Inspiration for others.	Costs associated with the labelling process. Needs to be coupled with formal recognition.
Local events for building owners	Seeing examples on-site increases interest and acceptance. Social connections promoted. Trust in common projects increased.	Organizational efforts are needed. Timing is important.
Citizen energy cooperatives	Citizens organize their own energy production in the district. Members also reduce energy consumption.	Cooperatives have less experience combining joint energy efficiency measures and working in districts. Actions can be hindered by national energy laws and tax regulations.
Energy demand side management in districts	Development of local smart energy grids including storage.	Energy tariff systems are not yet adaptable to demand. Lack of real experiences.
Facilitation of trading of white, green, and black certificates	Exchanges for jointly achieving energy efficiency, renewable energy and carbon emissions goals. Theoretically gains in cost-effectiveness are possible.	National tools, no experience on how to deal with this on the local scale. Additionality of projects is often questionable.

4. Stakeholder viewpoints on policy instruments: score assessment

4.1 The approach of the score assessment

4.1.1. Selected policy instruments

In the previous chapter, we established an extensive overview of possible policy instruments. To explore the most promising instruments, we asked participants from the IEA EBC Annex 75 workshop in Delft to point out the two most promising policy instruments from their point of view for four categories of policy instruments (regulation, incentives, communication and organizing facilitation). The results are given in **Table 3**.

Table 3. Selected eight policy instruments for the score assessment.

Policy instruments	Scope	
Need for regulation by (local) policy actor	Enforcement of energy standards or solutions in districts	Use of minimum energy performance standards for buildings or a district, to focus, e.g., on major renovations
	Inspections and energy audits in districts	Regular inspections to detect the building performance regarding safety, health, and energy, to detect buildings with insufficient performance and oblige for remediation of deficiencies or give building owners appropriate advice
Need for incentives from (local) policy actor	Financial incentives created by local authorities for specific districts	Financial benefits given to stakeholder groups for the introduction of certain levels of energy efficiency and renewable energies in specific areas
	Financial incentives for groups of homeowners	Financial benefits given to stakeholder groups for the introduction of energy efficiency and renewable energies, without being limited to specific areas
Organizational needs from (local) policy actor	Creation of renovation services in districts	Public authorities or other qualified actors support tendering for the execution of renovation measures and services or offer one-stop-shops
	Local energy desks for awareness-raising and consultancy	Setting up a physical place to inform and advise citizens locally on energy efficiency, renewable energy and building renovations, or similar consultancy offers. Dissemination activities are often part of the service
Communication needs from (local) policy actor	Dedicated local website or other local media development	Public authority develops or procures media and web tools to support the citizen's renovation journey
	Networking meetings in districts	Public authority organizes meetings to provide information about the renovation potentials, steps, and conditions to facilitate renovations. They can be directed to certain areas or groups of homeowners and intermediate between the involved actors

Another outcome of the workshop was that participants identified the need to specifically focus policy instruments on incentives for groups of homeowners and to stress the importance of organizing network meetings in districts, which is reflected in **Table 3**.

Table 3 lists the policy instruments used as a basis for conducting the in-depth interviews. The results of these interviews are presented in this and the following chapters. In the first instance, the interviewees were asked to reflect in more detail on these selected eight most promising policy instruments (see **Table 3**) that local authorities could develop to support district-level renovations, including energy efficiency and renewable energies. For further details and examples, please read chapter 3.

Observe that there is not a lot of experience with the “emerging” instruments, so these were not withheld for further empirical research. Note that urban planning, contests, professional training, labels, local events, demand side management and certificate trading were not specifically withheld for further research on policy instruments through the in-depth interviews unless interviewees put forward these issues during the interview. Some of these issues are also addressed in other reports in the framework of other IEA EBC Annex 75 working themes (for example, the research on barriers, business models, and guidelines). Additional qualitative input on suitable policy instruments was also gathered when mentioned by interviewees.

Interviewees were asked to do a preformatted score assessment of the policy instruments listed in **Table 3**. The current chapter 4 focuses on the score assessment of the eight policy instruments based on the results of these interviews, and the following chapter 5 focuses on the qualitative assessment.

4.1.2. Questions for cumulative analysis

We asked the interviewees to score the current use, importance, and ease of use of policy instruments listed in **Table 3**, reflecting on their interests and experiences. These data were captured using a 5-point Likert scale, as shown in **Table 4**. Blank answers indicated that interviewees did not have an opinion. See also **Addenda 1 and 2** for further details of the in-depth interview steps.

Table 4. Questions for the cumulative assessment of local policy instruments for building renovation at the district scale including energy efficiency and renewable energy systems.

Questions	Scale
Q1. Do/did you already use the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?	1. No, not considering 2. No, but interested 3. No, but planning to 4. Yes 5. Yes, with good experiences
Q2. How important do you think it is to develop the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?	1. Not important 2. Somewhat important 3. Neutral 4. Important 5. Very important
Q3. How difficult do you think it is to develop the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?	1. Difficult 2. Somewhat difficult 3. Neutral 4. Somewhat easy 5. Easy

The interview data and the scores were collected using a supporting document to be filled in by interviewees identifying the above multiple-choice questions and were assembled and analysed in a spreadsheet as an analysis template (Addendum 2) and the information was processed in multiple ways to understand different actor viewpoints. To be able to operate with the gathered scores, the Likert scale values were transformed into scores and percentages (minimum score 1 as 0% and maximum score 5 as 100%). Also, the frequency or counting of each score was calculated to analyse both average values and score distribution or dispersion. The resulting data were visualised in the following ways:

- the frequencies and average scores for each policy instrument regarding the three questions (current use, importance, and ease of use) were calculated;
- the frequencies of different scores on each instrument and question were plotted to obtain a visual comparison between instruments and detect closer relationships;
- the average results were evaluated separating the scores of policy actors and non-policy actors;
- the assessment of the policy instruments was repeated in a triangular plot to observe distortions and deviations between the three questions (current use, importance, and ease of development);
- review of certain policy instruments or aspects per country, to analyse commonalities and differences.

4.1.3. Number of responses

In this analysis, we also cross-reflect the perceptions of policy and non-policy actors to assess commonalities and differences. The following graphs illustrate the distribution of responses per category of stakeholder. See also 2.2. for the definition of the stakeholder types and the characterisation of the interviewees.

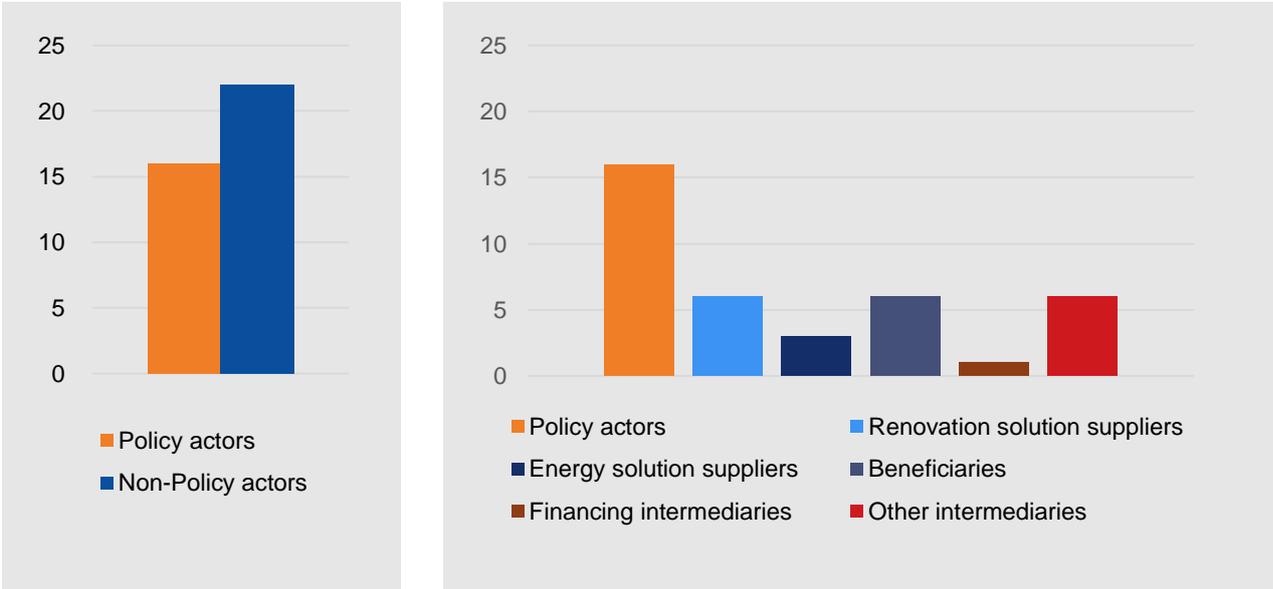


Figure 1. Number of interviewees per stakeholder group and stakeholder type.

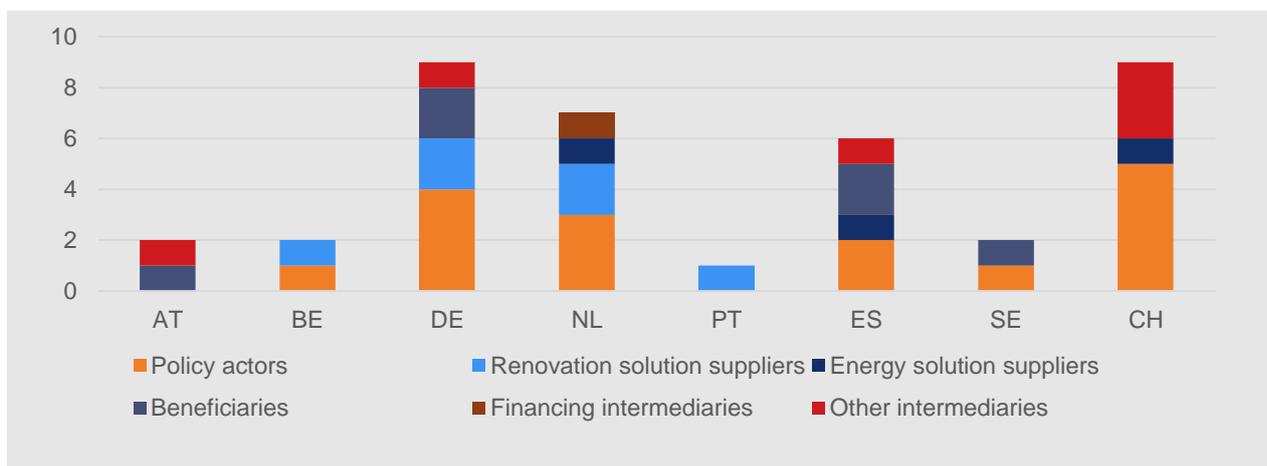


Figure 2. Number of interviewees per country and stakeholder type.

Table 5. Number of interviewees per country and stakeholder type.

Actor types	AT	BE	DE	NL	PT	ES	SE	CH	TOTAL
Policy actors	0	1	4	3	0	2	1	5	16
Renovation solution suppliers	0	1	2	2	1	0	0	0	6
Energy solution suppliers	0	0	0	1	0	1	0	1	3
Beneficiaries	1	0	2	0	0	2	1	0	6
Financing intermediaries	0	0	0	1	0	0	0	0	1
Other intermediaries	1	0	1	0	0	1	0	3	6
Total	2	2	9	7	1	6	2	9	38

4.1.4. Limitations of the interview results

There are research limitations when regarding the data and analysis.

Despite the efforts done to streamline interviews using a comprehensive analysis methodology and to include a wide variety of actors, the achieved sample size of 38 experts' in-depth interviews is a significant limitation. This makes it difficult to put results into country perspectives. The interviewees, therefore, discuss the main country results in discussion in chapter 6. However, the results and conclusions of this study are based on more than 20 different cities or regions and interviewees carefully chosen according to their experience with the topic. This variety supports, to a large degree, the relevance of the findings and resulting conclusions. The trends, commonalities and differences found and presented in the next section are, therefore, considered significant, as they reflect how to face, in many European contexts, the challenges of renovation processes according to the perception of experienced stakeholders.

Another intrinsic limitation of the study may be the neutrality of the interviewees according to their position in the context of building and renovations at the district level, meaning that the importance of the instruments can be affected by the benefits that certain stakeholder types may obtain. For example, beneficiaries may be more eager to receive additional funding and less to impose new requirements. Likewise, renovation and energy suppliers may consider mandatory inspections more important as they can lead to additional work. Regarding the language and communication limitations, in some cases, the survey questionnaire in English was translated to local languages when needed, and during the in-depth interview, any doubts and concepts were clarified. Note that this study focuses on the upscaling of building renovations and renewables at the district scale, so the geographical, business and social challenges identified in experts' experiences of reno-

variations at the district level might be different compared to the lessons learnt in the past from individual buildings renovations. The experts' diverse perspectives can help to better understand the upscaling barriers and opportunities, and results can support the identification of inter-actor collaboration needs for upscaling.

Note that the interviews were held at a time which is not necessarily like the current status quo due to highly dynamic developments of European and national frameworks, as well as external dependencies and pressures on energy, fuel use and decarbonisation regulation.

4.2 Analysis results

4.2.1. Average scores and distribution of scores

We first discuss the average scores and distribution of scores using the score assessments made by the interviewees regarding the questions in **Table 4**.

Overall, the average score regarding the “use and interest” of the eight instruments was 3.4 (scale means 3 – No but planning to; and 4 – Yes). That means that most of the interviewees have already used them or are planning to use them. The average answer to the second question, the “importance” of the development of these policy instruments, shows an average of 3.8 (scale of 3 – Neutral; and 4 – Important), which indicates an acknowledgement of their relevance for building renovations. The third question, which focused on the “ease” of development, had an average response of 2.8 (scale of 2 – Somewhat difficult; and 3 – Neutral). In other words, after having asked about their experience with these instruments and their importance, this question reflects not only the difficulty of development but also the implementation of these instruments. Most experts referred to (rather) difficult developments and implementations. The coincidence of high importance with implementation difficulty appeared for many of the analysed tools, so this can be considered a relevant aspect of the current situation, where policy instruments are needed, but there is still a lack of experience because they are hard to implement in building renovation processes.

To have a broad view of the experts' scores, a summary of all the scores per instrument and per question is presented in **Figure 3**. The coloured distribution of the responses for each policy instrument and interview question helps interpret some preliminary findings. For example, the “ease of development” suggests lower values than the other two questions, the “importance” and the “use & interest”. Also, the instruments with the lowest and highest score for each question become visible.

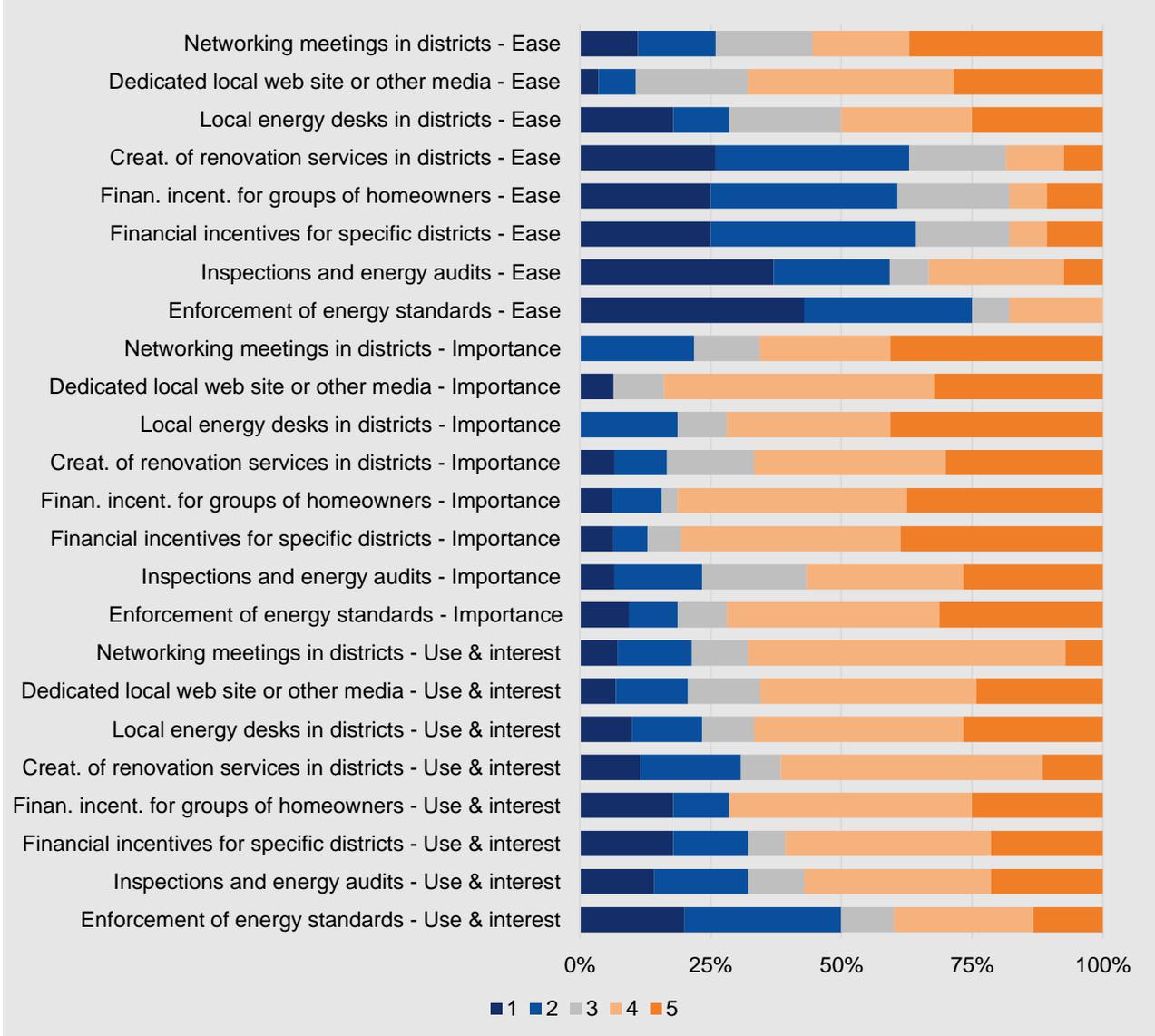


Figure 3. Summary of all scores per question and policy instrument; obtained relative frequency distribution.

Looking into each question and policy instrument in more detail, some trends are perceived. A majority scored the use of and interest in various policy instruments in a similar fashion. The analysis detects less use of the “enforcement of energy standards”, with 40% of the respondents, compared to the average 61% of use declared for all the policy instruments. Regarding the use and interest in these tools, 87% of the responses confirmed that the selected tools are perceived as useful by the interviewed experts.

On the other hand, one out of four interviewees did not know what to score, 10 on average, and this reflects a lack of knowledge about these tools. Besides, despite the consistent average values, there is a considerable dispersion of answers, as shown in **Figure 3**, and the standard deviation of these answers is around 32%. This could be explained because opinions from all the actor types are counted together. In the next section, these analyses are done more thoroughly by separating policy and non-policy actors' opinions.

The scores and analysis for the use and interest of the selected instruments are included in **Table 6**.

Table 6. Average scores on the use and interest in selected policy instruments and analysis based on the scores given by the interviewees.

Policy instruments	Av. Score Use & interest (1 to 5 scale)	Av. Score Use & interest (%)	Standard deviation (%)	Interested % (scores 2 – 5)	Already used % (scores 4 – 5)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	2.8	46%	34%	80%	40%	30	8
Inspections and energy audits	3.3	58%	34%	86%	57%	28	10
Financial incentives for specific districts	3.3	58%	35%	82%	61%	28	10
Financial incentives for groups of homeowners	3.5	63%	36%	82%	71%	28	10
Creation of renovation services in districts	3.3	58%	31%	88%	62%	26	12
Local energy desks in districts	3.6	65%	32%	90%	67%	30	8
Dedicated local website or other media	3.6	66%	30%	93%	66%	29	9
Networking meetings in districts	3.5	62%	26%	93%	68%	28	10
Total average	3.4	59%	32%	87%	61%	28	10

Regarding the perceived importance of policy instruments, all were perceived as important, with an average 71% score and 72% of the responses given as important or very important. The main indicators confirm again the selected instruments. Among the instruments, the “inspections and energy audits” are the least valued, with 57% of the responses as important or very important.

As in the previous question, there is a wide range of responses. The standard deviation of the answers is 29% and one out of five interviewees did not know what to score, 7 on average.

The scores and analysis of the importance of development for the selected instruments are included in **Table 7**.

Table 7. Average scores on the importance of the development of selected policy instruments and analysis based on the scores given by the interviewees.

Policy instruments	Av. Score Im- portance of development (1 to 5 scale)	Av. Score Im- portance of development (%)	Standard deviation (%)	High im- portance % (scores 4 – 5)	Low im- portance % (scores 1 – 2)	N° of scores in 1-5 (incl. score)	Does not know (not incl. in score)
Enforcement of energy standards	3.8	69%	31%	72%	19%	32	6
Inspections and energy audits	3.5	63%	31%	57%	23%	30	8
Financial incentives for specific districts	4.0	75%	28%	81%	13%	31	7
Financial incentives for groups of homeowners	4.0	74%	29%	81%	16%	32	6
Creation of renovation services in districts	3.7	68%	30%	67%	17%	30	8
Local energy desks in districts	3.9	73%	28%	72%	19%	32	6
Dedicated local website or other media	4.0	76%	25%	84%	6%	31	7
Networking meetings in districts	3.8	71%	29%	66%	22%	32	6
Total	3.8	71%	29%	72%	17%	31	7

Regarding their ease of development, the average score of 45% reflects that only 35% considered these tools easy or somewhat easy to develop, while 48% answered as somewhat difficult or difficult, and the rest as neutral. Also, the differences between instruments are more significant than in the previous two questions. The lowest score, indicating the hardest policy implementation, goes for the “enforcement of energy standards” with a score of 2.0 since 75% of scores are on the difficult side and only 18% on the easy side. Most interviewees found it difficult or somewhat difficult to go beyond the legal requirements, despite having just scored this tool as important when renovating buildings. On the opposite side, the tools that are perceived to be the easiest to implement with an average of 3.8 and 3.6, are “Dedicated local website or other media” and “Networking meetings in districts” respectively. The first gathers 68% of easier scores and the second 56%. To a smaller degree, the creation of “local energy desks in districts” also has a positive value, with a neutral score of 3.3, because of 50% of easier scores and 29% of harder scores.

The scores and analysis for the ease of development for the selected instruments are included in **Table 8**.

Table 8. Average scores on the ease of development of selected policy instruments and analysis based on the scores given by the interviewees.

Policy instruments	Ease of development (1 to 5 scale)	Ease of development (%)	Ease of dev., standard deviation (%)	Easier % (scores 4 – 5)	More difficult % (scores 1 – 2)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	2.0	25%	28%	18%	75%	28	10
Inspections and energy audits	2.4	36%	35%	33%	59%	27	11
Financial incentives for specific districts	2.4	35%	31%	18%	64%	28	10
Financial incentives for groups of homeowners	2.4	36%	31%	18%	61%	28	10
Creation of renovation services in districts	2.4	34%	30%	19%	63%	27	11
Local energy desks in districts	3.3	57%	35%	50%	29%	28	10
Dedicated local website or other media	3.8	71%	26%	68%	11%	28	10
Networking meetings in districts	3.6	64%	35%	56%	26%	27	11
Total	2.8	45%	31%	35%	48%	28	10

4.2.2. Cross-comparison of scores

In **Figure 4**, the three questions are compared together in a triangular plot. This cross-comparison of the data summarises the perceived importance, a somewhat lower score for the current use & interest, and clearly a lower score for how easy their development is. The irregularities in this triangular Figure 4 indicate that instruments are perceived differently regarding use, importance, and ease. This aspect is relevant because it shows the level of development of each tool, that is, the importance score sets an ambition or goal, the use & interest reflects if there is enough current experience, and finally, the ease of use indicates if this tool is already working or if it still requires further improvement to reach a good implementation.

Considering this approach, some tools are nearly equilateral (“Dedicated local website or other media”, “Networking meetings in districts”, and “Local energy desks in districts”), but others are isosceles (“Financial incentives for specific districts”, “Financial incentives for groups of homeowners”, “Creation of renovation services in districts”, and “Inspections and energy audits”,) while the last one is clearly scalene or irregular (“Enforcement of energy standards”).

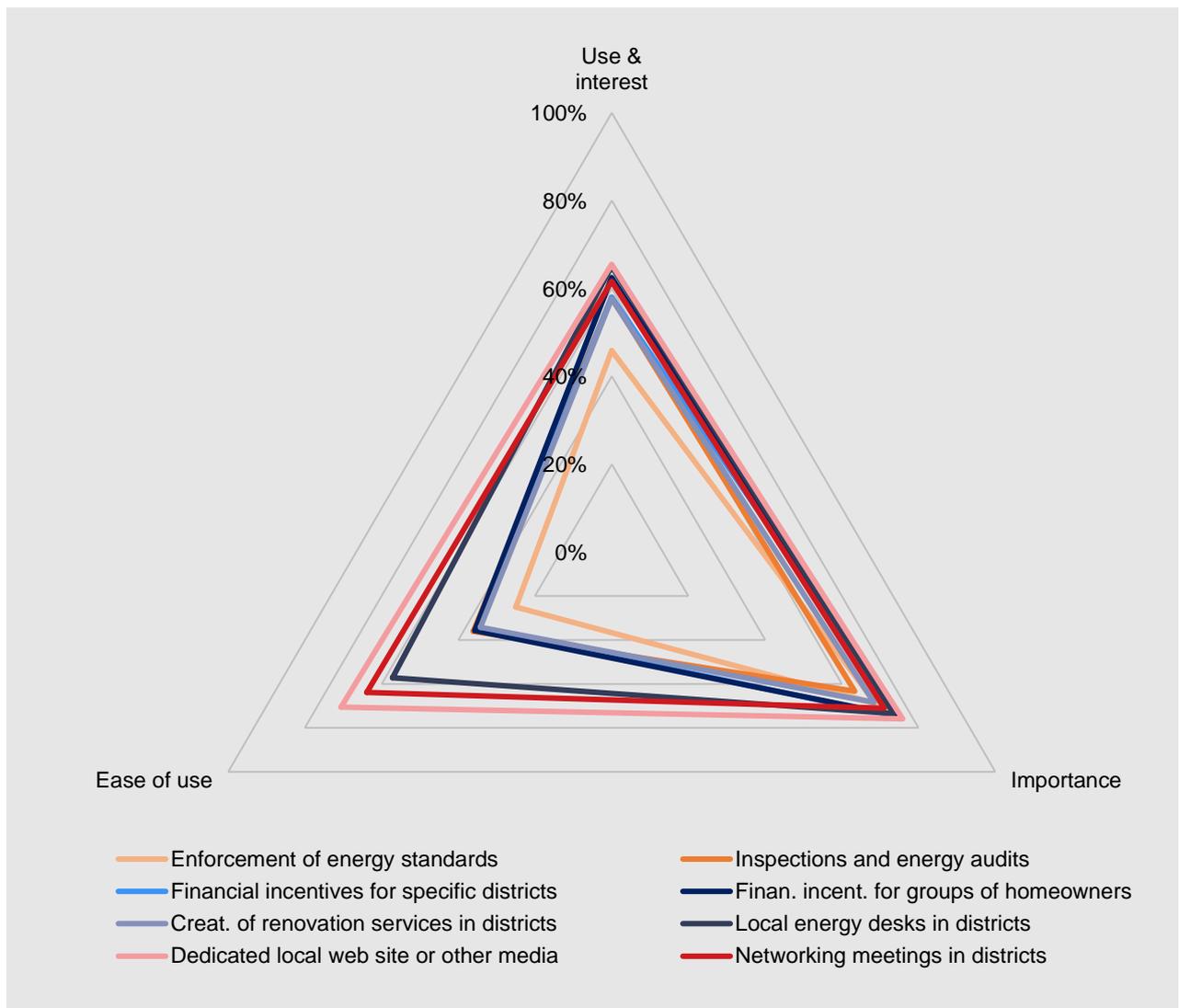


Figure 4. Cross-comparison of average scores per question and policy instrument.

4.2.3. Current use & interest for the proposed local policy instruments

This subsection reviews the experts' opinions in more detail by separating the answers from policy actors (16 interviewees) and non-policy actors (22 interviewees). This helps in understanding the present degree of the selected policy instruments used in both actor groups and reflecting on whether they are interested in or planning to implement them.

The overall results are shown in **Figure 5**, where the scores' frequency is distributed around answer 3, "Not used, but planning to" (3 on a scale of 5) to define the position of each instrument. The proposed communication tool are the most used and the least is regulations. Most interviewees are using or planning all proposed policy instruments, and some frontrunners also claim to have good experiences with them.

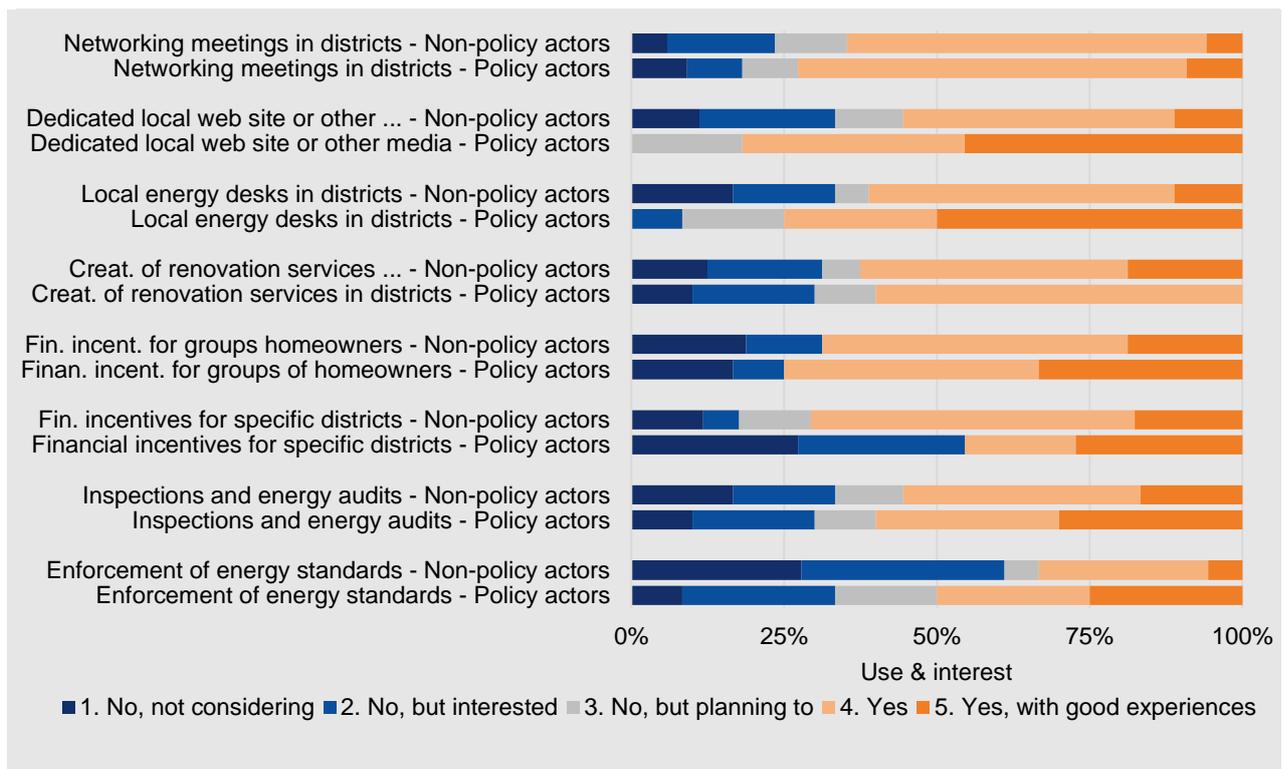


Figure 5. Current use and interest for the policy instruments, frequency distribution of scores of policy actors and non-policy actors.

When considering the stakeholders' position about the proposed policy instruments, policy actors declare higher experience using these tools and the majority are planning to use them. On the other hand, non-policy actors manifest a lower experience and interest, only in 2 out of 8 instruments did they mention more interest than the policy actors. There are some significant perspective differences, indicating a lower interest of non-policy actors regarding:

- Dedicated local website or other media: 1.1 lower than policy actors.
- Enforcement of energy standards: 0.8 lower than policy actors.
- Local energy desks in districts: 1.0 lower than policy actors.

Only in the case of "Financial incentives for specific districts" did the analysis find more experience of non-policy actors, 0.7 higher than policy actors.

Table 9. Average scores for proposed policy instrument's use and interest, comparing responses of Policy and Non-Policy actors.

Policy instruments	Use & interest	Policy actors	Non-Policy actors
Enforcement of energy standards	2.8	3.3	2.5
Inspections and energy audits	3.3	3.5	3.2
Financial incentives for specific districts	3.3	2.9	3.6
Financial incentives for groups of homeowners	3.5	3.7	3.4
Creation of renovation services in districts	3.3	3.2	3.4
Local energy desks in districts	3.6	4.2	3.2
Dedicated local website or other media	3.6	4.3	3.2
Networking meetings in districts	3.5	3.5	3.4
Total	3.4	3.6	3.2

Table 10. Average scores for proposed policy instrument's use and interest, analysis of responses by policy actors.

Policy instruments, Perceived by Policy actors	Av. Score Use & interest (1 to 5 scale)	Av. Score Use & interest (%)	Standard deviation (%)	Interested % (scores 2 – 5)	Already used % (scores 4 – 5)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	3.3	58%	33%	92%	50%	12	4
Inspections and energy audits	3.5	63%	34%	90%	60%	10	6
Financial incentives for specific districts	2.9	48%	41%	73%	45%	11	5
Financial incentives for groups of homeowners	3.7	67%	36%	83%	75%	12	4
Creation of renovation services in districts	3.2	55%	27%	90%	60%	10	6
Local energy desks in districts	4.2	79%	25%	100%	75%	12	4
Dedicated local website or other media	4.3	82%	19%	100%	82%	11	5
Networking meetings in districts	3.5	64%	27%	91%	73%	11	5
Total average	3.6	64%	30%	90%	65%	11	5

Table 11. Average scores for proposed policy instrument's use and interest, analysis of responses by non-policy actors.

Policy instruments, Perceived by Non-Policy actors	Av. Score Use & interest (1 to 5 scale)	Av. Score Use & interest (%)	Standard deviation (%)	Interest % (scores 2 – 5)	Already used % (scores 4 – 5)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	2.5	38%	33%	72%	33%	18	2
Inspections and energy audits	3.2	56%	34%	83%	56%	18	2
Financial incentives for specific districts	3.6	65%	30%	88%	71%	17	1
Financial incentives for groups of homeowners	3.4	59%	35%	81%	69%	16	0
Creation of renovation services in districts	3.4	59%	33%	88%	63%	16	0
Local energy desks in districts	3.2	56%	33%	83%	61%	18	2
Dedicated local website or other media	3.2	56%	31%	89%	56%	18	2
Networking meetings in districts	3.4	60%	26%	94%	65%	17	1
Total average	3.2	56%	32%	85%	59%	17	1

The analyses and differences between **Tables 9-11** can be seen in **Figure 6** and **Figure 7**, which facilitate the visualization of each stakeholder group's perspectives. In general, the differences between policy actors and non-policy actors are inside the standard deviation range. The policy instruments which show a clearer perspective separation are "Local energy desks in districts" and "Dedicated local website or other media" with a clear higher use & interest by policy actors.

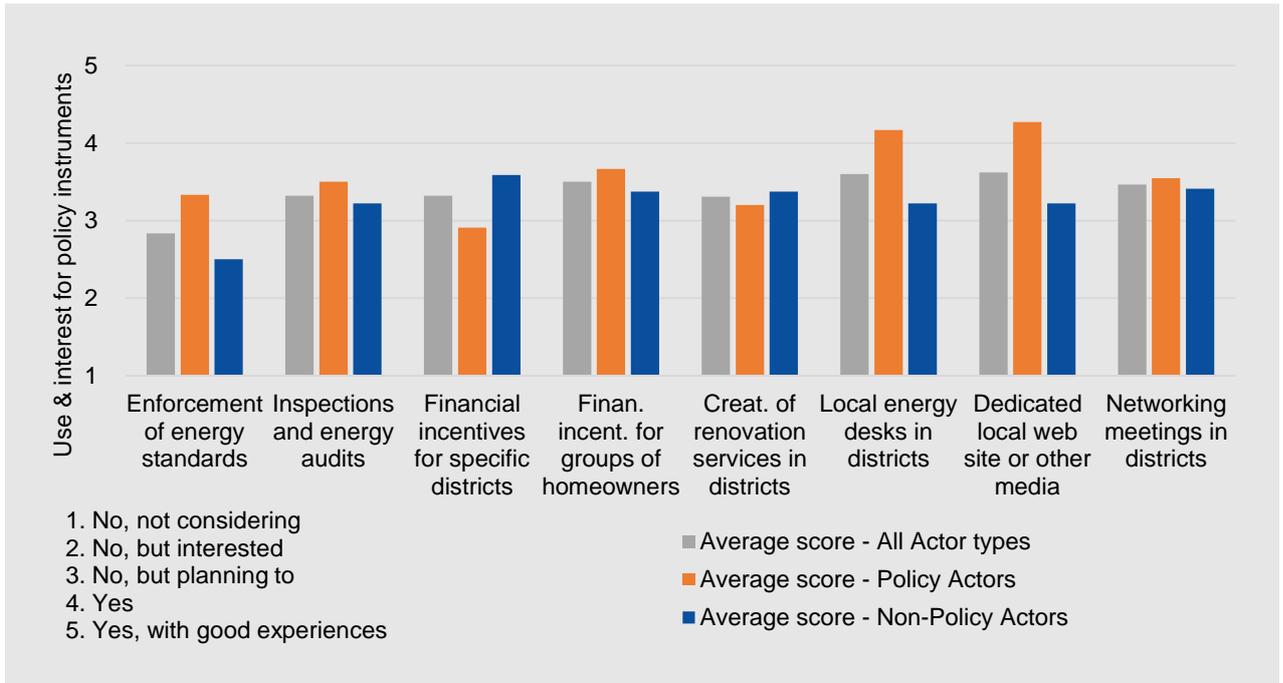


Figure 6. Stakeholder perspective on current use & interest for the proposed policy instruments.

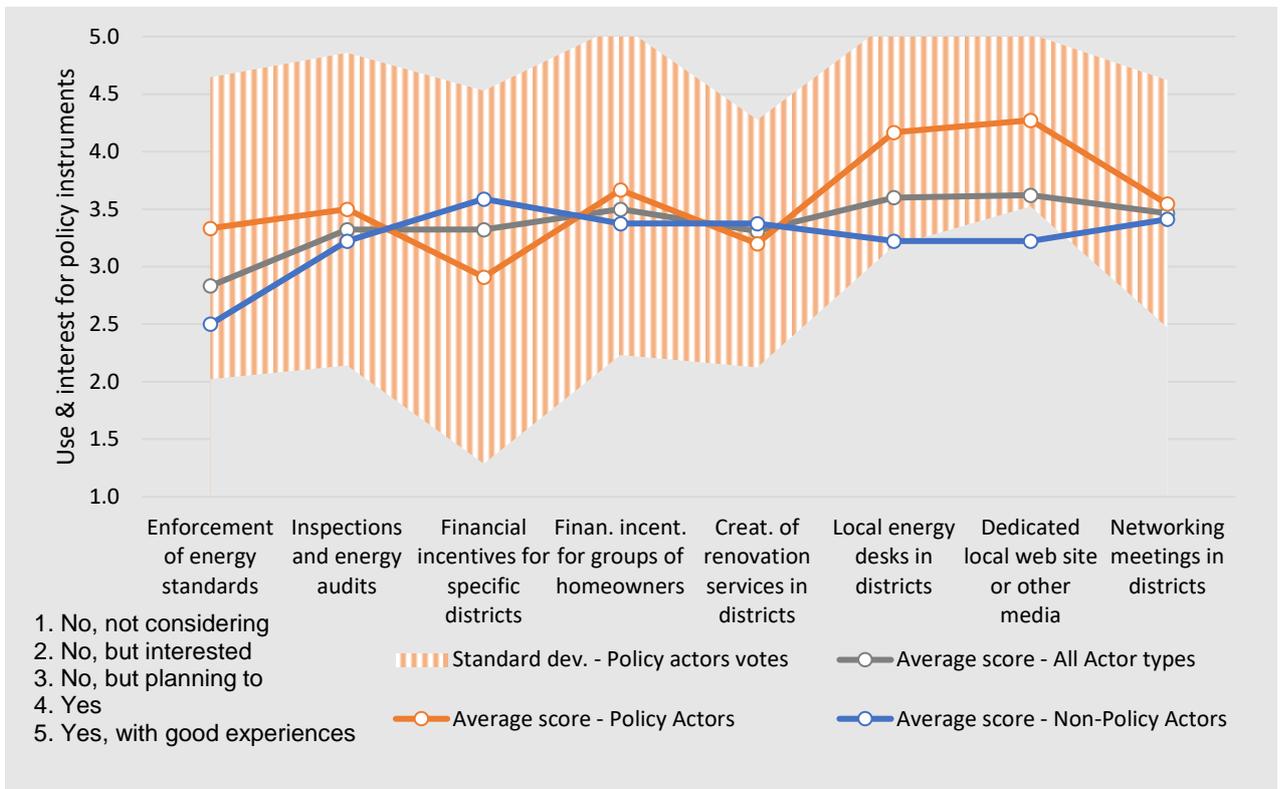


Figure 7. Stakeholder perspective on current use & interest for the proposed policy instruments, standard deviation analysis.

4.2.4. Perceived importance of local policy instruments

The interview's main results showed acknowledgement of the importance of the proposed instruments. Bearing this in mind, the analysis will focus on the low scores and the commonalities and differences between both stakeholder groups. In **Figure 8**, the scores frequency is distributed around the neutral answer (3 in a scale of 5) to more clearly perceive the importance of each instrument. All the tools have a similar score, ranging from 3.5 to 4.0. The highest importance is given to financial incentives and the lowest to regulations.

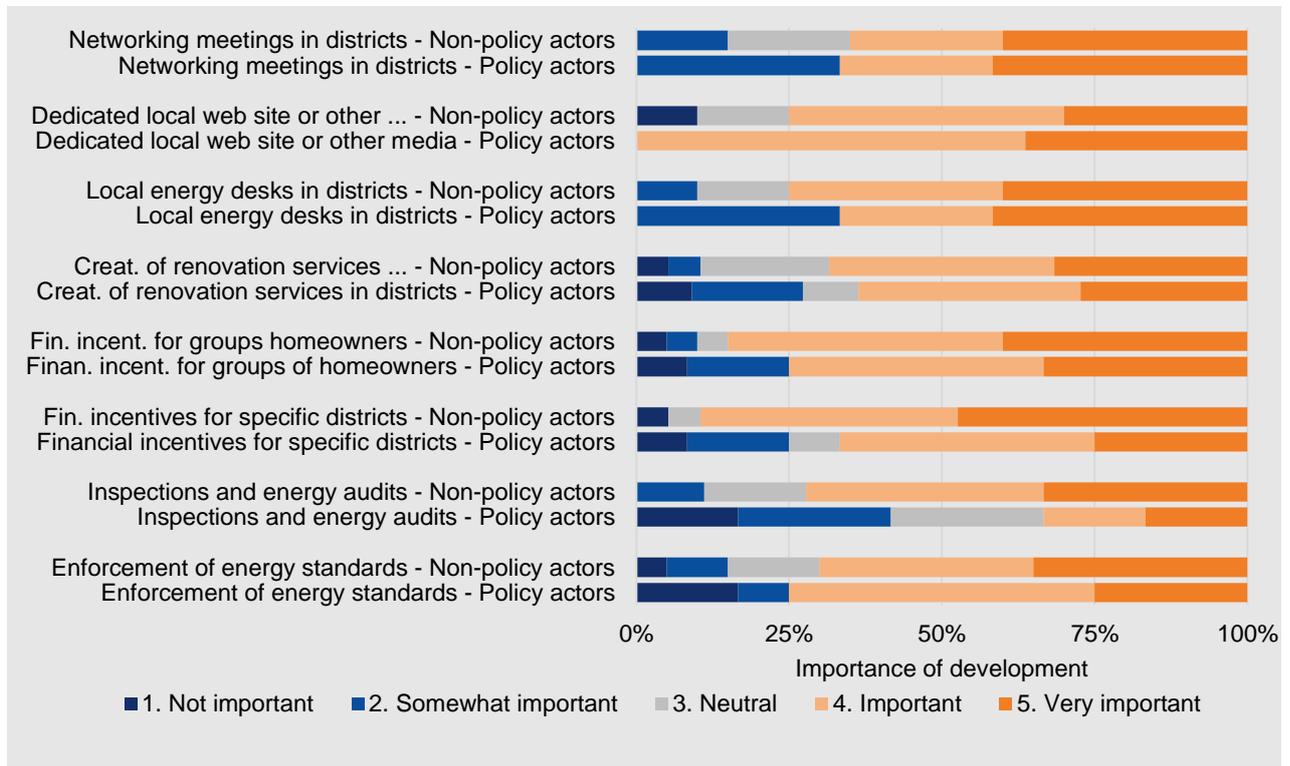


Figure 8. Perceived importance of the policy instruments, frequency distribution of scores of policy actors and non-policy actors.

When considering the stakeholders' perspectives, policy actors declare lower importance of developing these tools compared to non-policy actors. On top of that, perceptions are sometimes opposite, as seen in **Figure 9** and **Figure 10**. The main perspective differences are:

- For policy-actors, the most scored with an average of 4.4 is the "local website or other media", but non-policy actors gave this an average of only 3.9 (0.4 lower).
- For non-policy actors, there are several higher scores: financial incentives with averages of 4.3 and 4.1, and local energy desks with 4.1, but policy actors gave 3.6, 3.8 and 3.8 respectively (0.7, 0.3 and 0.3 lower). The largest difference between both stakeholder groups is perceived in inspections and energy audits, with 3.9 for non-policy actors and 2.9 for policy actors, which is 1.0 higher.
- The least important for policy actors was "inspections and energy audits" with an average of 2.9, while non-policy actors gave this an average of 3.9 (1.0 more).
- For non-policy actors, the less important ones are unclear, as all the instruments receive a high score.

Table 12. Average scores for proposed policy instrument's importance, comparison of scores given by policy and non-policy actors.

Policy instruments	Importance	Policy actors	Non-Policy actors
Enforcement of energy standards	3.8	3.6	3.9
Inspections and energy audits	3.5	2.9	3.9
Financial incentives for specific districts	4.0	3.6	4.3
Financial incentives for groups of homeowners	4.0	3.8	4.1
Creation of renovation services in districts	3.7	3.5	3.8
Local energy desks in districts	3.9	3.8	4.1
Dedicated local website or other media	4.0	4.4	3.9
Networking meetings in districts	3.8	3.8	3.9
Total	3.8	3.7	4.0

Table 13. Average scores for proposed policy instrument's importance, analysis of scores given by policy actors.

Policy instruments, Perceived by Policy actors	Av. Score Importance (1 to 5 scale)	Av. Score Importance (%)	Standard deviation (%)	High importance % (scores 4 – 5)	Low importance % (scores 1 – 2)	N° of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	3.6	65%	35%	75%	25%	12	4
Inspections and energy audits	2.9	48%	33%	33%	42%	12	4
Financial incentives for specific districts	3.6	65%	31%	67%	25%	12	4
Financial incentives for groups of homeowners	3.8	69%	32%	75%	25%	12	4
Creation of renovation services in districts	3.5	64%	33%	64%	27%	11	5
Local energy desks in districts	3.8	69%	32%	67%	33%	12	4
Dedicated local website or other media	4.4	84%	12%	100%	0%	11	5
Networking meetings in districts	3.8	69%	32%	67%	33%	12	4
Total average	3.7	66%	30%	68%	26%	12	4

Table 14. Average scores for proposed policy instrument's importance, analysis of scores given by non-policy actors.

Policy instruments, Perceived by Non-Policy actors	Av. Score Importance (1 to 5 scale)	Av. Score Importance (%)	Standard deviation (%)	High importance % (scores 4 – 5)	Low importance % (scores 1 – 2)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	3.9	71%	29%	70%	15%	20	4
Inspections and energy audits	3.9	74%	24%	72%	11%	18	2
Financial incentives for specific districts	4.3	82%	24%	89%	5%	19	3
Financial incentives for groups of homeowners	4.1	78%	26%	85%	10%	20	4
Creation of renovation services in districts	3.8	71%	27%	68%	11%	19	3
Local energy desks in districts	4.1	76%	24%	75%	10%	20	4
Dedicated local website or other media	3.9	71%	29%	75%	10%	20	4
Networking meetings in districts	3.9	73%	27%	65%	15%	20	4
Total average	4.0	74%	26%	75%	11%	20	4

The analyses and differences between **Tables 12-14** can be seen in **Figure 9** and **Figure 10**, which facilitate the visualization of each stakeholder group's perspectives. Generally, the differences between policy and non-policy actors are within the standard deviation range. There is only one policy instrument showing a clearer perspective separation, the "Dedicated local website or other media", which is clearly more important for policy actors than non-policy actors.

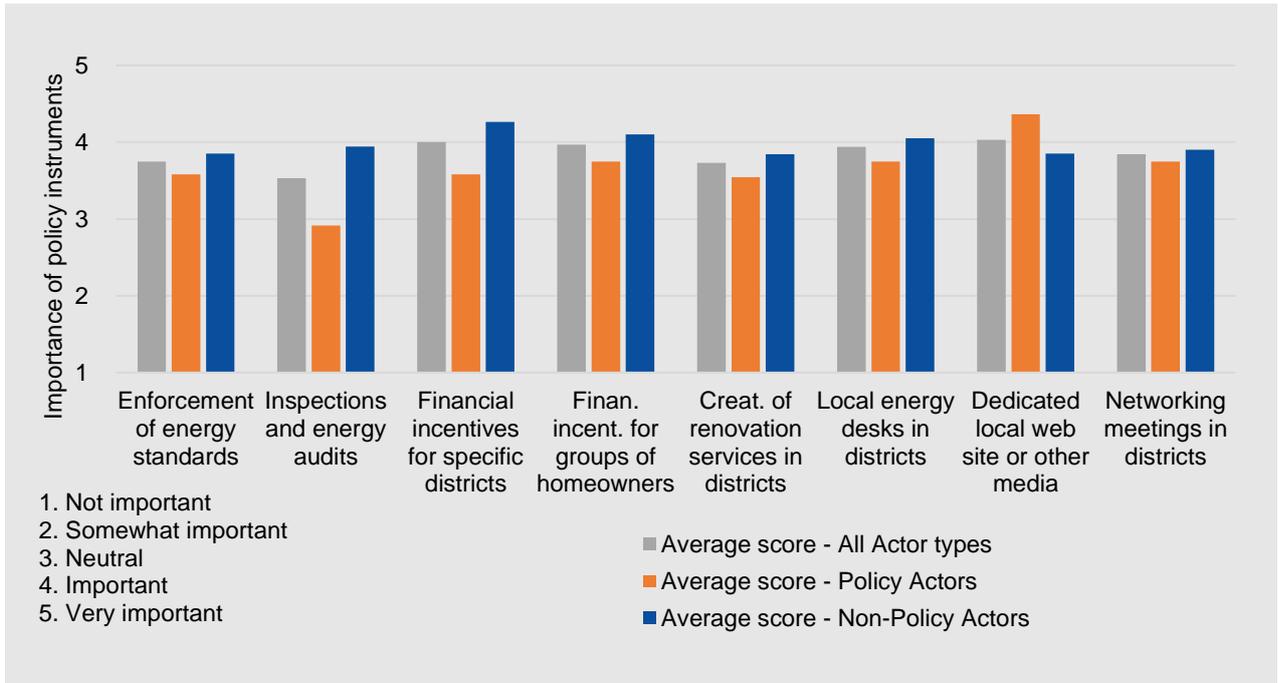


Figure 9. Stakeholder perspective on the importance of the proposed policy instruments.

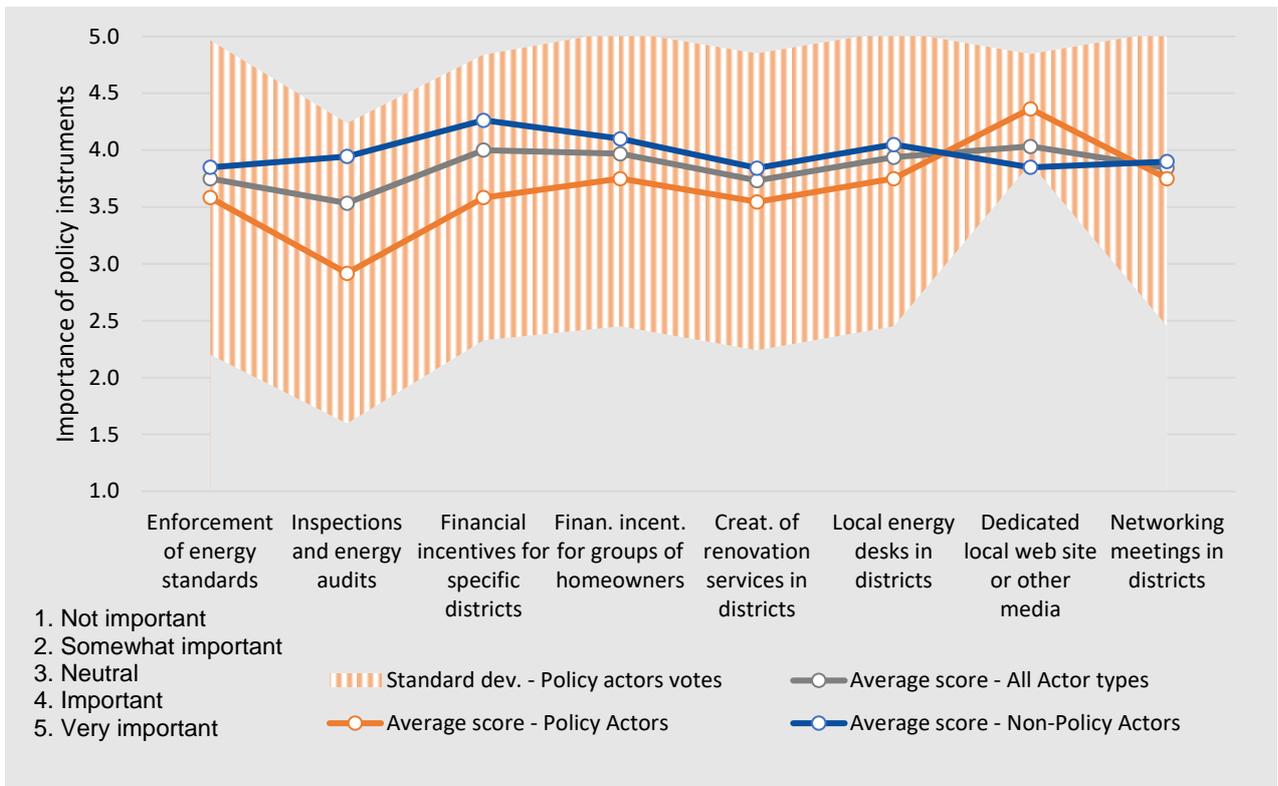


Figure 10. Stakeholder perspective on the importance of the proposed policy instruments, standard deviation analysis.

4.2.5. Perceived ease of development of policy instruments

The overall results point to (some) difficulties in implementing the proposed instruments. In **Figure 11**, the scores frequency is distributed around the neutral answer (3 on a scale of 5) and shows big differences between instruments. In their experience, the easiest instruments to apply are the communication tools which receive an average score of 3.8 and 3.6, this is a noticeably big contrast with those instruments that are perceived the hardest to develop, the regulation tools, with an average score of 2.0 and 2.4.

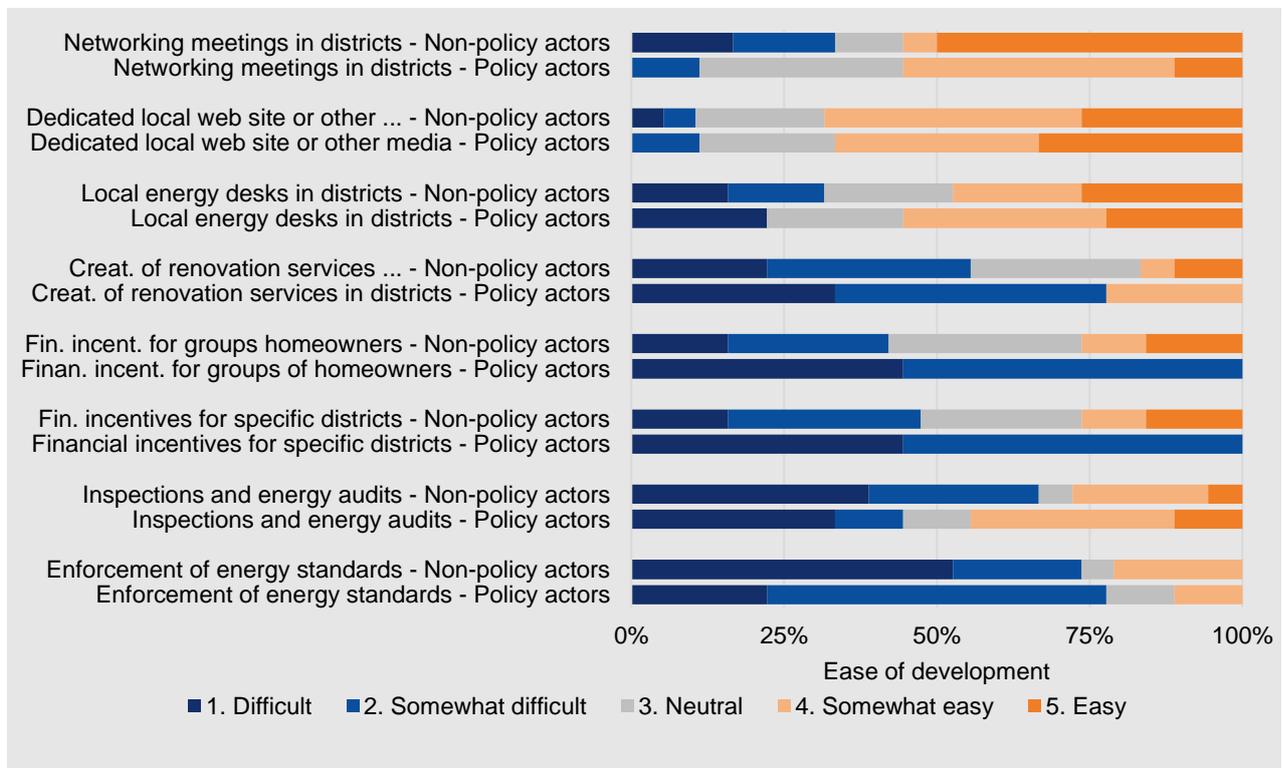


Figure 11. Perceived ease of development of the policy instruments, frequency distribution of scores of policy actors and non-policy actors.

When considering the stakeholders' perspective, policy actors consider the policy instruments more difficult to apply in comparison with non-policy actors. On top of that, some opinions differ significantly. The perspective differences when evaluating the ease of development are mainly:

- For policy actors, the hardest ones are the financial incentives, with a very low average score of 1.6, while non-policy actors value them with an average score of 2.8 (1.2 more).
- Non-policy actors perceive that the hardest ones to develop are the regulation tools, with an average score of 1.9 for "Enforcement of energy standards" and 2.3 for "inspections and energy audits", while policy actors consider them with an average score of 2.1 and 2.8 respectively (0.3 and 0.5 more).
- On the other hand, both groups consider the same ease of development for the communication tools and the "Local energy desks in districts" with an average score of 3.7 and 3.3.

Table 15. Average scores of proposed policy instruments' ease of development, comparing scores given by policy and non-policy actors.

Policy instruments	Ease of development	Policy actors	Non-Policy actors
Enforcement of energy standards	2.0	2.1	1.9
Inspections and energy audits	2.4	2.8	2.3
Financial incentives for specific districts	2.4	1.6	2.8
Financial incentives for groups of homeowners	2.4	1.6	2.8
Creation of renovation services in districts	2.4	2.1	2.5
Local energy desks in districts	3.3	3.3	3.3
Dedicated local website or other media	3.8	3.9	3.8
Networking meetings in districts	3.6	3.6	3.6
Total	2.8	2.6	2.9

Table 16. Average scores of proposed policy instruments' ease of development, analysis for policy actor scores.

Policy instruments, Perceived by Policy actors	Av. Score Ease of development (1 to 5 scale)	Av. Score Ease of development (%)	Standard deviation (%)	Easier % (scores 4 – 5)	More difficult % (scores 1 – 2)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	2.1	28%	22%	11%	78%	9	7
Inspections and energy audits	2.8	44%	37%	44%	44%	9	7
Financial incentives for specific districts	1.6	14%	12%	0%	100%	9	7
Financial incentives for groups of homeowners	1.6	14%	12%	0%	100%	9	7
Creation of renovation services in districts	2.1	28%	27%	22%	78%	9	7
Local energy desks in districts	3.3	58%	35%	56%	22%	9	7
Dedicated local website or other media	3.9	72%	25%	67%	11%	9	7
Networking meetings in districts	3.6	64%	21%	56%	11%	9	7
Total average	2.6	40%	24%	32%	56%	9	7

Table 17. Average scores of proposed policy instruments' ease of development, analysis for non-policy actor scores.

Policy instruments, Perceived by Non-Policy actors	Av. Score Ease of development (1 to 5 scale)	Av. Score Ease of development (%)	Standard deviation (%)	Easier % (scores 4 – 5)	More difficult % (scores 1 – 2)	Number of scores 1-5 (incl. in score)	Does not know (not incl. in score)
Enforcement of energy standards	1.9	24%	30%	21%	74%	19	3
Inspections and energy audits	2.3	32%	33%	28%	67%	18	2
Financial incentives for specific districts	2.8	45%	32%	26%	47%	19	3
Financial incentives for groups of homeowners	2.8	46%	32%	26%	42%	19	3
Creation of renovation services in districts	2.5	38%	30%	17%	56%	18	2
Local energy desks in districts	3.3	57%	35%	47%	32%	19	3
Dedicated local website or other media	3.8	70%	26%	68%	11%	19	3
Networking meetings in districts	3.6	64%	40%	56%	33%	18	2
Total average	2.9	47%	32%	36%	45%	19	3

The analyses and differences between **Tables 15-17** can be seen in **Figure 12** and **Figure 13**, which facilitate the visualization of each stakeholder group's perspectives. Generally, the differences between policy and non-policy actors are within the standard deviation range. The policy instruments showing a clearer perspective separation are the use of financial incentives, with lower ease of development. This underlines the higher difficulty policy actors find when providing additional financial aid.

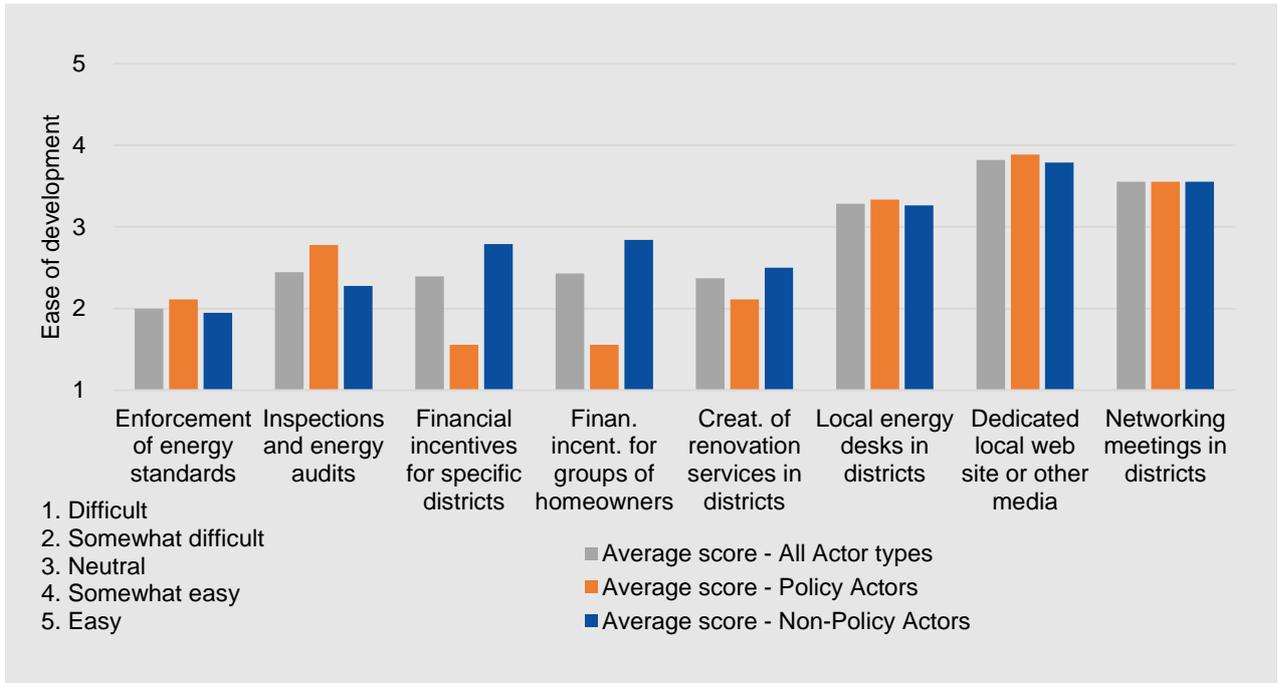


Figure 12. Stakeholder perspective on the ease of development of the proposed policy instruments.

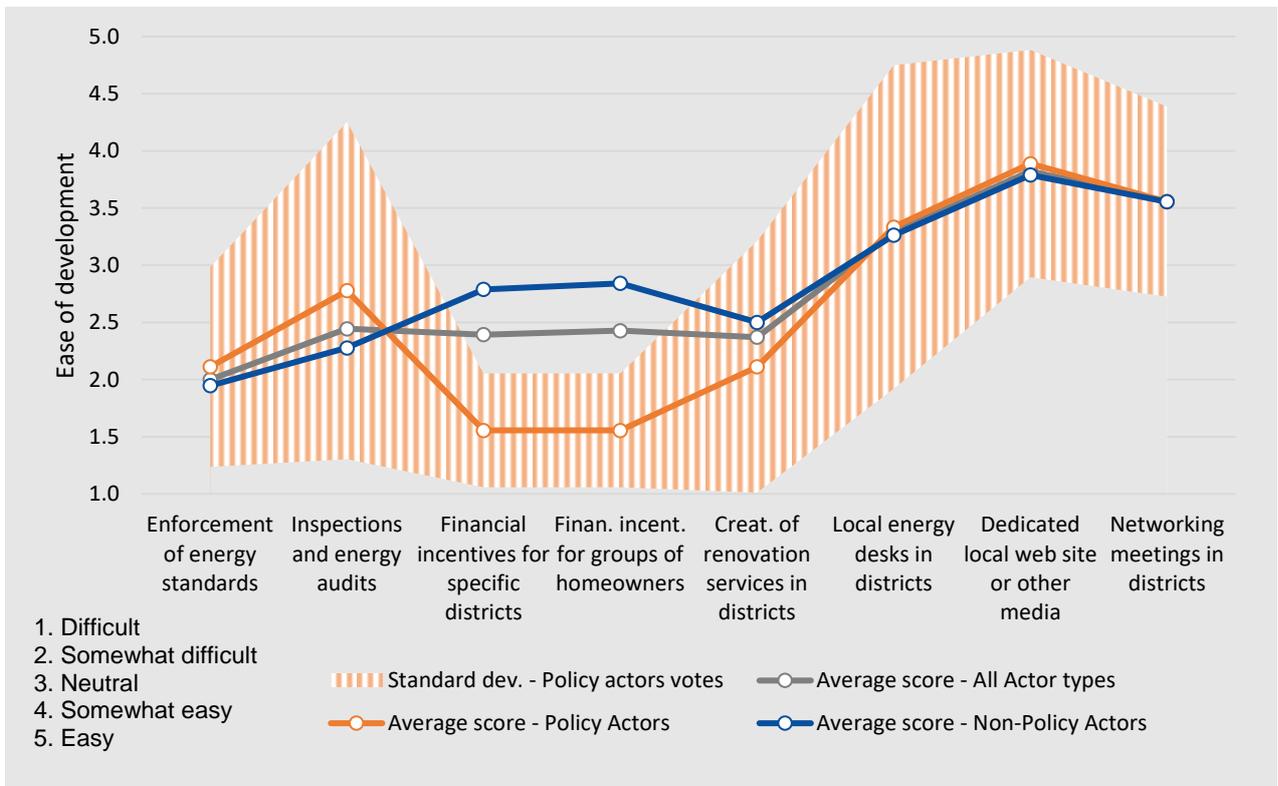


Figure 13. Stakeholder category perspective on the ease of development for the proposed policy instruments, standard deviation analysis.

4.3 Conclusion

This chapter tried to answer the question “*How are local policy instruments assessed by several types of actors?*”, partially by analysing quantitative data from questionnaires coupled with in-depth interviews. We analysed how policy and non-policy actors assessed eight types of policy instruments regarding their current use and projected future development, considering the stakeholder perceived importance and ease of development.

The analysis shows that:

- Most of the interviewees expressed having experience with the eight proposed policy instruments. Their average use score is 3.4 (on a scale of 1 to 5): 43% had used them, 19% had used them with good experiences, and 9% did not have experience but are planning to. 62% already have some direct experience and an additional 9% are planning to implement them.
- Most actors agree on the proposed policy instruments' importance in stimulating building renovation and renewable energy in districts or neighbourhoods. The average score was 3.8 (1 to 5 scale); 38% considered them important and 35% very important, that is 72% of all the answers.
- Regarding the application in practice, considerable concerns exist about the ease of development. The average ease of development score is 2.8 (1 to 5 scale), which is only 19% considering them somewhat easy and 16% easy to develop, in contrast with the 25% that considers them somewhat difficult and the 24% that see them difficult to develop.
- The cross-comparison of current use, the importance of development and ease of development showed that some of these policy instruments are perceived differently regarding the importance, use and ease of development; results point to a somewhat more difficult implementation for five out of eight policy instruments.

Findings from the comparison between policy and non-policy actors' perspectives showed:

- Regarding their experience, policy actors generally declare more experience and interest than non-policy actors. This happens in six out of the proposed eight instruments and the differences are up to 1 point score for three tools (“Enforcement of energy standards”, “Local energy desks in districts”, and “Dedicated local website or other media”). On the other hand, non-policy actors claim to have more experience and interest in “Financial incentives for specific districts”. The perspectives' differences are statistically significant for “Local energy desks in districts” and “Dedicated local website or other media”, with a clear higher use and interest by policy actors.
- Both policy and non-policy actors acknowledge the importance of the preselected instruments (see 4.1.1.). The non-policy actors consider these instruments important, while the policy actors perceive smaller importance (despite experience and interest). On top of that, stakeholders set different priorities since they chose the different top and bottom importance scores for the proposed policy instruments. This underlines the importance of integrating these different priorities of stakeholders in the renovation processes, stakeholder dialogue or business models to achieve a common goal. The perspectives' differences are statistically significant only for “Dedicated local website or other media”, as more important for policy actors.
- The ease of implementation of the instruments in the current context is clearly questioned by most of the interviewees. Even though three instruments are considered feasible (both communication tools and the “Local energy desks in districts”), the rest are considered somewhat difficult to implement (although important). Additionally, the two instruments present quite different perceptions between stakeholder types. The perspectives' differences are statistically significant for both financial incentives, as much harder to develop by policy actors. Policy actors consider it harder to develop financial incentives than non-policy

actors. To a smaller degree, the opposite perception is noted regarding “Inspections and energy audits”, where non-policy actors see them as somehow difficult to implement.

These results confirm stakeholder groups' different perspectives and perceptions when working with the selected policy instruments. This fact was commented on in diverse ways during the in-depth interviews and underlines the need for comprehensive solutions adapted to each case configuration and involved stakeholders. In the next chapter, the qualitative results of the interviews are further presented and discussed.

5. Stakeholder viewpoints on policy instruments: a qualitative assessment

5.1 Approach of the qualitative assessment

In the in-depth interviews (see 2.2. and Addendum 1), we asked interviewees to reflect qualitatively on the policy instruments proposed in Table 3. These interviews aimed to better understand policy actors' perception of the available policy instruments and identify (local) policy opportunities so that main actors could relieve barriers to upscale energy renovation at the district level combining energy efficiency and renewable energy use. While the previous chapter discussed research results by showing overarching trends and differences in perception between policy and non-policy actors, this chapter gives further insights into opportunities, barriers and solutions related to the development and use of the identified promising policy instruments.

The qualitative analysis was done using the Addendum 2 template. The results were compiled in a way to bring forward those concerns that were confirmed by multiple actors and/or various stakeholder types and/or those that appeared in multiple countries. We discuss the viewpoints regarding opportunities and barriers for regulation, incentives, and organizing facilitation and communication in districts, particularly those that were confirmed by multiple stakeholders and in multiple countries.

We remark that answers given individually can differ from answers given in a group. An indication of such an effect is that, for example, during the IEA EBC Annex 75 workshop in Delft, we asked the audience (mainly local policy actors) to assess what type of policy instrument would make stakeholders move. The workshop participants were in favour of organizational instruments and incentives and not in favour at all of the regulation and communicative steering. However, when interviewed individually, the selected interviewees also emphasized the need for more effective regulations and communication. The assessment here is based on the individual results from the in-depth interviews. The limitations of the research are further expressed in 4.1.4.

The analysis presented here complements the results from the report "Overview of available and emerging technology for cost-effective building renovation at district level combining energy efficiency & renewables" (Mørk et al., 2020) and the findings about enabling factors and barriers perceived by policy actors, as presented in complementary IEA EBC Annex 75 publications such as the report "Barriers and drivers for energy efficient renovation at district level" (Johansson et al., 2023), which used the same data for analysis to identify SWOT factors.

In the following section, we discuss the compiled interviewees' viewpoints on needed policy development, looking at the need for (1) regulations, (2) incentives and (3) organizing facilitation and communication. A country discussion reflecting more on individual viewpoints is given in the following chapter 6.

5.2 Viewpoints on needed policy development

The overarching finding from the interviews is that renovations at the district level, including energy efficiency and renewable energy systems, can benefit from adapted or improved regulations, although these might be somewhat difficult to introduce. Incentives, communication and organisation also need to be adapted to sup-

port renovations at the district level, including energy efficiency and renewable energy systems. Many respondents point out the fact that local authorities, such as municipalities, are key actors in energy renovation at the district level (BE-02, DE-01, DE-02, NL-01, NL-04, NL-06, NL-07, SE-02).

5.2.1. Viewpoints on regulations

Both the success stories and the interviews highlighted the importance of **building regulations**. Compliance with current or upcoming (national) building regulations is a key issue for local policy actors, especially when it comes to building energy performance (e.g. cases PT1, SE; BE-01), but also to related issues such as CO₂ compliance (SE-01), accessibility (case SE), ventilation requirements (case SE), energy poverty and social aspects (BE-02, SE-02, ES-01, ES-04), heat grid development (BE-02, CH-04), district performance (BE-02, DE-03, DE-04, DE-05), climate mitigation measures (BE-02), a transition from fossil fuels to renewable energy systems (NL-01), and so on. All these matters applied in the district scale interventions require detailed assessments of each district's situation and comparison with the national framework to make a proper justification of the measures that are necessary for each district to promote large renovations. In Switzerland, local authorities have large competency to introduce regulations, for example, to make switching to renewable energies mandatory, and it is mentioned that making use of such regulations is essential (CH-08). Spanish and Portuguese interviewees also mention that regulations are designed for new construction, and they ask for better regulations adapted to the building renovation conditions and to face the district scale (ES-01, ES-03, ES-04, PT-01, PT-02).

Mandatory building inspections (ES-05, ES-06) and energy audits (ES-06) and requirements for or when using renewable energy sources (for example, ground or surface water, CH-04) might be a way to enforce compliance. Quality assurance should be introduced early in the renovation process (AT-02), coupled with obtaining grants or loans (BE-01, BE-02, PT-01), and should not be forgotten in the operational phase to ensure building performance (PT-01), monitoring a sample of the renovated building (ES-01).

Interviewees point to the fact that to enforce compliance and suggest higher ambition levels, interventions are needed during 'natural moments', for example when loans are applied for (NL-03; NL-05; NL-07), when building installations are changed (ES-06), when building permits are asked for (BE-02), when grid districts concessions are given (CH-09) or when energy flexible solutions are procured (NL-02).

Interviewees also mentioned that regulations can be particularly effective and well accepted if they can be linked to something building owners obtain in return (CH-03, CH-06), such as the possibility of constructing an additional floor level if certain energy requirements are met.

Stakeholders pointed to the steering role of local authorities to plan and set up infrastructure and to facilitate renovation processes at the district level using the regulation. They can, for instance, play a regulating role when a building permit is needed for a few blocks (for example belonging to one housing company) or when a permit or concession is needed for a heating grid.

Respondents emphasize the importance of adequate **local and regional planning** for achieving renovation or heat grids at the district level (AT-02, BE-01, CH-02, CH-06, DE-02, DE-03, NL-01, NL-06, NL-07, ES-03, ES-06). For example, in the Netherlands, municipalities are responsible for developing local or regional energy plans to shift from fossil fuels to carbon-free energy, e.g., a shift from natural gas to district heating or electricity (NL-03, NL-06). Mapping the financial feasibility of connecting buildings to a heat grid per street/district (in a heat zoning map) is perceived as complex because there is a permanent tension between profitability, financing, and scattered subsidy arrangements (BE-02). The planning should also include improving the outdoor environment in the district that is being renovated (BE-02, DE-04, DE-05, ES-01, SE-01). Heterogeneous ownership structures can further complicate the task (DE-04, ES-01, ES-04, ES-06).

Strategic planning will only proceed if there is both political will, policy structure and sufficient funding (DE-02, DE-04, DE-07, ES-01, ES-03, NL-07). Authorities should provide funding and define conditions and objectives for each district: interviewees (NL-07, ES-01, ES-04) emphasize the role of local and regional authorities to organize funding; German respondents pointed mostly to the national funding due to lack of budget at the local and regional level. The administration of such funding schemes could be supported by specialized NGOs (DE-05). Energy performance contracts might be used to achieve a longer payback period and to reduce public funding (ES-05).

Stakeholders remark that to achieve successful planning, a better connection is needed between national, regional and municipal initiatives (DE-02, NL-01, ES-03), which would require better **coordination** (DE-01, DE-03, ES-01, NL-06) and regional expertise centre (NL-03, NL-05). It is particularly important to identify clear responsibilities at the various policy levels – within the municipality itself (DE-08, NL-06), as well as between local, regional and national levels (NL-03) -, to take into account differences in available resources between smaller municipalities and larger cities (DE-06, NL-03), and to avoid rebuilding of knowledge when politicians (BE-02, NL-03) or administrations and project related staff change.

For example, the region/province can also play a supportive role with legal, technical, and social experts (NL-05). Provincial consultants can help smaller municipalities to make their transition and heat plans, consult on local ownership of energy production, strengthen networks, share renovation instruments to save costs, and so on (NL-03). Municipalities and provinces can share risks by collaborating on assorted topics such as financing initiatives, providing support for unburdening residents, providing bank guarantees and developing communication (NL-07).

Interviewees stressed the importance of an overarching **vision (long-term plan) and legal framework** regarding energy-efficient renovations at the district level (BE-01, CH-01, CH-02, CH-07, CH-08, DE-01, DE-02, DE-09, ES-01, ES-03, ES-04, ES-05, NL-03, NL-05, NL-06, NL-07) and hindrances from existing laws and regulations to achieve energy renovation at the district level (CH-02, CH-03, DE-02, ES-02, ES-04, ES-05, ES-06, NL-01, NL-05, NL-07). While requirements on energy efficiency or maximum energy use in buildings are already being implemented, the legal framework for district heating and renovation is sometimes considered not strong and ambitious enough (DE-09, ES-06, NL-06). For example, energy performance certification should also be possible at the district level (CH-03) and the condominium level (BE-01). For example, there might be no clear national strategy to combine heat distribution and renovation at the district level (BE-01, NL-06). For example, cost-neutral switching to heat grids might not be achievable as required by the heat supply regulation (DE-02). For example, Spanish law makes it easier for measures that lead to excessive costs or long payback time not to be carried out (ES-04, ES-06) while there is still a lack of existing district heating networks (ES-03). For example, using surface or groundwater as a renewable heat source might conflict with regulations for sensitive or contaminated environments (CH-02). For example, long-term connections to heat grids are difficult to secure (AT-02).

Regarding building renovations, a point of concern is that legislation should simplify project approval and renovation processes (DE-01, NL-04, PT-01). In this sense, improved performance requirements and a special technical building code for building renovation are also suggested (ES-01, ES-03, ES-04), as well as standardized audit procedures (NL-04), legal blueprints for renovations at the district level (NL-04) and accepted solutions for listed buildings (CH-02, ES-05). The normalization of the legal responsibilities of homeowner assemblies to (finance) the renovation of their apartment buildings is another point of concern (BE-02, NL-01), particularly when it comes to building up reserve funds for renovations (NL-01); rearranging division deeds (NL-01); handling voting systems (BE-02, ES-04, ES-05, NL-01); organizing multi-annual maintenance plans (NL-01); harmonizing solutions for private components such as windows or individual heating systems (BE-01, NL-01); the division of fixed energy costs (NL-05).

Regarding heat grid development, there is a need to develop the necessary conditions to operate at low operational temperatures and to include the use of renewable energies (CH-04). Energy providers need to be better oriented to take into account whole areas (CH-04), effective sub-stations (BE-02), and clean energy provision contracts with transparent heat prices (NL-01, NL-05, NL-06), instead of only focusing on profitable building connections. On the other hand, they also need to be helped to be able to put distribution pipes in place (CH-04, ES-06).

Regarding the development of renewable energy grids at a district scale, an Austrian respondent notes that legal solutions are needed to minimise individual grid connection costs, for example for connecting photovoltaic systems (AT-01).

Public authorities report lacking both financial and human resources to support energy renovation (CH-02, DE-02, DE-07, DE-09, ES-01, ES-03, ES-04, NL-02). There is a need for regional authorities to support local municipalities' administration for new tasks that are not yet included in the catalogue of core tasks (BE-02, NL-03). This can be done through funding programmes especially designed to support municipalities or special budgets for special tasks via project funding and so on. We can speculate that long-term structures for long-term tasks are also needed, especially as the public sector competes with the private sector for talent and knowledge in decarbonising districts and buildings as a field of growing importance.

Resulting general recommendation:

Local authorities should strengthen their strategies, plan procedures and collaborate with multiple policy levels to ensure the districts' compliance with energy efficiency and renewable energy regulations. It makes sense for local authorities to use their competencies to the extent possible to enforce efficiency measures and a switch to renewable energies through regulations. Responsible national or regional authorities should develop a supporting legal and administrative framework to target energy renovation at the district level.

5.2.2. Viewpoints on incentives

Grants, subsidies and loans are considered major drivers for energy renovation at the district level (BE-01, BE-02, DE-01, ES-01, ES-04, NL-01, NL-03, NL-05, NL-07, SE-01) although somewhat unpredictable (ES-03), complex to obtain (CH-02), not convincing concerning the energy price (CH-03), not holistic enough compared to integrated certification systems (CH-03) or integrated guidance processes (NL-01), not focusing enough on deep renovation (ES-03) and developing too slow (NL-03). Within national restrictions, frontrunner local and regional authorities tend to shape their own (additional) funding framework.

To support district approaches, economic incentives could, for example, focus more on facilitating abandoning fossil fuel use (BE-02, CH-01, DE-01, DE-08, NL-07), incorporating changes in PV subsidy schemes (AT-01)— also to prepare joint roofing installations (DE-02, NL-03) -, to stimulate an increase in the number of renovations (DE-01, ES-01). Interviewees also point to the need to achieve highly energy-efficient buildings (NL-01, NL-07), either in one go (NL-01) or step-by-step (AT-02, BE-02, DE-01, ES-05, NL-06) using, for example, renovation passports (BE-01) or better commission fees for professional building managers or energy coaches who achieve more renovation measures (BE-02, ES-06).

Adapted federal, state, or regional incentives are also recommended to help multiple homeowners at the same time. These could be, for example, financial incentives for process guidance/ energy coaches, particularly for homeowner assemblies (NL-01; NL-05; NL-06; BE-01; BE-02, ES-01, ES-04). In this framework, various respondents point out the need to develop integrated home renovation services, not only covering initial advice but also continued advice (AT-01), financing solutions and implementation of measures (BE-01, BE-02, DE-01, NL-01).

“We don't understand why assemblies of homeowners were never financed. If you comply with certain measures (professional management, multiannual plans, eagerness) financing an assembly of homeowners is no particular risk.”

Revolving fund manager, The Netherlands

Local subsidies might also be useful to promote multiple renovation measures at the same or shared renewable energy systems (NL-02).

Solutions should address the heterogeneity of districts (DE-03, ES-01, ES-02, NL-07, SE-02) by providing solutions for **various target groups**. As most districts are also inhabited by some people living in energy poverty, low-income households or elderly people, it is necessary to pay special attention to these households as well (ES-01, ES-04). Particularly, there is a need for credit solutions for people who have insufficient access to credit (NL-05, NL-07, BE-02) and for unburdening energy renovation for vulnerable households (BE-01). Local authorities can also support vulnerable households with an ‘emergency buying fund’ for buying and renovating houses with severe structural problems (BE-01). Municipal housing associations could also play a role in providing financial help for renovation to low-income groups through special credit schemes (BE-02, ES-01).

Specific solutions are also needed to incentivize assemblies of private homeowners to support measures in multi-family apartment buildings with multiple owners (NL-01, NL-02, NL-04, NL-05, ES-03, ES-05) as the decision processes are often slow within a complicated administrative framework, while everybody needs to go along (NL-01, NL-02, NL-04, NL-05). Possible solutions would be the use of a delegated promoter (case ES), or any other intermediary that can mobilise all the stakeholders, gather the necessary information, develop renovation designs and coordinate a dialogue based on trust and a transparent approach (ES-05).

The subsidies and grants for renovation measures (BE-01) or renewable electricity systems (DE-05) also need to be accessible to groups of homeowners. Furthermore, it might be helpful to provide housing associations access to a National Energy Fund for deep renovation (NL-04), and homeowners achieving high performance a 0% interest loan (NL-07). Nevertheless, authorities should be aware that aversion to lending (NL-02, NL-05, NL-06, NL-07) and long payback times (ES-03, ES-04, NL-07) exists and that homeowners sometimes cannot obtain a second loan (NL-05, ES-01). Therefore, it might be helpful to have loans where the payment is arranged by a legal entity that represents the district or group of homeowners (BE-01, NL-01). This might be, for example, a homeowner or housing association related to multiple buildings or a special purpose financial instrument created to support district action. A public fund to cover potential risks might also be useful to agree with banks to open financial lines to all homeowners who go for deep renovations (ES-04) or to find financial arrangements that include life cycle costs (CH-02).

It is believed that **tax incentives** could make citizens switch to renewable energies or renovate their building envelopes (CH-08, ES-03). A lower electricity tax and a higher gas tax could also make the use of heat pumps and solar boilers more interesting (BE-02). Fiscal deductions or tax shifts might also be relevant to steer market prices of renewable heat and electricity (BE-02). Tax incentives - such as in the context of the German urban development funding programme - might also encourage investment in energy renovation at the districts that are endangered of “losing connection” by prioritizing a district and fostering concerted action (DE-03).

Bank **guarantees** might be a suitable driver for energy-efficient renovation at the district level (NL-01, NL-03, NL-05, SE-01). Such guarantees can be given on the municipal, regional, or national levels (NL-01) to support pre-investments by private companies (NL-01, NL-05) or municipal housing associations (SE-01). Also, investment in solar roofs could benefit from bank guarantee structures (NL-03). We remark that there might be differences in needs per country, which might also depend a lot on available legal constructs.

Most **financing** products are based on (expected) expenses of individuals and families instead of disposable income or specific target groups in a district, which might be considered a current market failure (NL-07). To address this issue, it might be worthwhile to develop and manage revolving loan funds which can be used to support municipal housing associations, assemblies of apartment building owners or specific target groups, such as young starters, elderly, vulnerable households and small homeowner associations (NL-07). To deal with the psychological barrier of high investment costs when combining measures (SE-02), new financial products could support high energy performance and cost-of-living neutral renovations, as exemplified in the Netherlands (NL-01). A revolving fund operator remarks that banks are not very willing to support local experiments: they only act when a certain market size can be served in a profitable manner (NL-07). Therefore, local authorities might play a role in actively setting up a funding structure or collaborating with actors who can do this.

Stakeholders also pointed to the need for a fund for innovative district solutions to attract frontrunners and **innovators** (NL-03), financial incentives for circular and climate-neutral districts (BE-01), and possibilities to extend buildings with additional storeys (AT-02). Knowledge about innovative funding schemes such as one-stop-shops and energy performance contracts might not be available yet to authorities (BE-01).

Resulting general recommendation:

Authorities – particularly on higher levels— could develop specific grants, subsidies, loans and tax benefits to target energy renovations including energy efficiency and renewable energy systems at the district level. Within this framework, authorities should pay attention to providing financial solutions for specific target groups, addressing market failures and developing adapted guarantee funds.

5.2.3. Viewpoints on organizing facilitation and communication

Organizing a structured **stakeholder dialogue** with diverse actors is important to share knowledge to make better decisions in district projects (AT-02, BE-02, CH-04, DE-02, DE-03, DE-04, ES-01, ES-03, ES-05, NL-01, NL-03, SE-01), particularly also to create trust (AT-01, DE-04, NL-03), establish clear goals for quality assurance (AT-02), coordinate efforts within heterogeneous ownership structures (CH-02, DE-03, DE-04, ES-05) and encourage stakeholders to think beyond business-as-usual (CH-05).

For such dialogues, a local authority is often well-connected with stakeholders (DE-02, DE-04, ES-01, NL-03, NL-05) and can take a role as an organizer, moderator and/or supporter of the process (DE-02, NL-03). Part of this process might be the organisation of thematic workshops (DE-04), the integration, coaching and commissioning of measures (BE-01, NL-01), conflict resolution (AT-01, AT-02), the engagement of building owners to act as motivators (CH-08, DE-04) and the negotiation of public actors with suppliers and financiers to achieve better prices or favourable investment conditions (NL-04, IT-01, IT-03), for example when public actors organize group purchases or contacts with homeowners who want to renovate. Preferably, stakeholder dialogues should result in project coalitions involving policy, demand, supply, and knowledgeable actors, as municipalities cannot develop district strategies alone (BE-01, ES-03).

Stakeholders see multiple benefits when **supporting inclusive bottom-up local initiatives** (BE-01, DE-04, NL-03, SE-02, ES-02, ES-05), for example for achieving CO₂ savings (NL-03; NL-05), inspiring citizens (BE-01), creating a positive attitude (SE-02), developing more effective peer-to-peer communication (BE-01, ES-

01), using spokespersons (DE-04), and creating ownership of joint renewable energy systems (NL-02, NL-03), which is still barely done in practice.

Co-creation of renovation concepts at the district level together with residents seems to be an approach that can lead to a higher degree of acceptance for energy renovation, even for unpopular actions (DE-04, NL-03). Co-creation and an integrated approach also allow to combine and co-discuss energy-related topics with other relevant topics within the district, leading to synergies and support for homeowners to invest (DE-04). Policy should support citizens to jointly develop smaller local district heat grids and establish local ownership of energy production (AT-02, NL-02, NL-03).

More local authorities are in favour of supporting bottom-up initiatives instead of regulating a top-down approach. For example, Italian stakeholders experienced that residents were dissatisfied when the measures were decided top-down without a participatory planning stage (case IT/ C.3).

Policymakers can support the development of **best practice** examples to encourage transitions from building renovation to renovation at the district level or ignite the multiplication of renovation at the district level (CH-03, DE-01, DE-06, ES-01, ES-06), even including broader integrated visions, concepts and actions (DE-04), additional sustainability themes such as avoidance of fossil fuel use and greening (NL-06), or climate adaptation measures (BE-02). Local authorities can play a role in communicating and spreading information about good practices and pilot areas (AT-01, CH-05, DE-01, DE-03, ES-05, ES-06, NL-01, NL-05). European Union funding for strategy development and actor networking can be helpful in supporting renovation projects at the district level (BE-01, ES-01, SE-01). Competitions could also function as a kick-starter (DE-04). Pilot areas also allow local authorities to test different communication approaches (NL-05). Funding for the renovation of the area surrounding buildings could be helpful (ES-05).

There is a need to **raise awareness** of homeowners (CH-01, NL-02, NL-06, NL-07, PT-01, PT-02), to increase homeowners' interest in sustainable solutions (NL-02, NL-07, ES-01, PT-01, PT-02) but also to generate **trust** in actors involved in energy renovation (BE-02, DE-08, ES-02, ES-04, ES-06, NL-03, NL-07). These are important opportunities that authorities can help to develop, either themselves or with the help of 'trusted' actors. Consulting and awareness-raising campaigns can benefit the development of district projects (ES-05), particularly by reaching out to residents in target areas, especially homeowners, to get them on board as they make investment decisions. From this viewpoint, a mix of media can be deployed, such as specific web modules (BE-01, BE-02, CH-04, NL-02, NL-04, NL-06, SE-01), telephone services (NL-04, SE-01), videos (NL-04, NL-06, SE-01), and nudging and social media (BE-02).

Recommended ways for awareness raising of residents are (web-supported) door-to-door actions (ES-05, ES-06) and (virtual) visits to demonstration houses (NL-02); using a mobile or fixed pop-up consultancy centre in a district (BE-01, BE-02, NL-06); intervening in meetings of homeowners assemblies (BE-01, BE-02, NL-01, NL-06, ES-05); explaining homeowners the results of thermography pictures (BE-01, BE-02, NL-02) or energy calculations (NL-05, NL-06); and coupling awareness raising activities with financial incentives (PT-01, PT-02) – preferably for combined measures (NL-05) – or social or networking events (BE-01, BE-02, CH-04, NL-06, ES-05).

Good project management is a key success factor for energy renovation at the district level (see also Johansson et al., 2023). This entails that district projects should be able to benefit from **process coordination and technical advice** (BE-02, CH-01, CH-04, CH-07, CH-08, ES-04, NL-01, NL-02, NL-03) of constant quality (DE-07, NL-05) and preferably one independent main contact person to avoid receiving mixed signals (NL-07). Project managers should be able to develop baseline surveys, clear objectives and step-by-step implementation plans, with continuous feedback to residents and monitoring the achievement of the desired goals (AT-02) and whether energy and financial performances are guaranteed (NL-06, NL-07). Energy advi-

sory coaches from the consumer protection service are working with certificates across the country in Germany to provide at least basic energy consultation funded by the federal government. Some Belgian cities have already developed a pool of energy coaches that can support groups of homeowners in their renovation journey, assure a certain quality (BE-01) and present step-by-step renovation plans to homeowners (BE-02). One respondent experienced that citizens are not willing to pay for consultancy, and even middle and high-income households expect free advice (BE-02), which poses a specific challenge to developing suitable self-sustaining business models.

Stakeholders also emphasize the role of energy communities in supporting district renewable energy processes (BE-02, NL-02, NL-06, ES-06), professional building managers' role in influencing decision-making (BE-01) and the coordination of integrated home services by actors that homeowners consider to be independent. These can be societal ESCOs (NL-07), local authorities (BE-01), autonomous municipal organisations (BE-02), public municipal companies (DE-04, ES-01, ES-02, ES-05, SE-01), local or regional institutes (ES-01), non-profit organisations (NL-01) or housing associations (ES-04, case ES).

To support upscaling with district processes, local authorities require additional **specialized staff** (DE-01, DE-02, DE-09, NL-07) and experienced technical managers (BE-01, BE-02, ES-01, ES-04, NL-02, NL-03, NL-06, NL-07, SE-02). Communication skills are also required (AT-01, NL-07), particularly to address homeowners using their language and value system (ES-01, ES-03, NL-06), their point in the renovation journey (NL-06) and key changing moments in life (BE-02) as a reference. Administrative staff should also be trained to understand the basics of building physics (NL-03) and should develop knowledge about building assessment (NL-03), possible renovation scenarios for different types of buildings (NL-06, ES-01, ES-05), options for standardized technological solutions (DE-01), (prefab) solutions when homeowners don't want to move out during the renovation (NL-01, SE-02), and so on. We remark that there are usually competent professional staff in the urban planning and construction departments. However, not all new tasks are implemented by civil servants. Campaigns, advice, consultancy and technical details are often outsourced to local energy agencies, NGOs and professional consultants. However, process and planning knowledge and cooperation with these actors could be a role of a neutral and overarching actor like a municipality.

An overarching recommendation is to develop or improve **local energy consultancy desks** referring to city-supported advisory/ coaching services (AT-01, CH-04, NL-02, NL-04, NL-06, ES-03, ES-04). In this framework, it is also important that authorities facilitate training, recognition, subsidies and quality assurance to process coaches (project managers, energy coaches, renovation consultants, energy communities, professional building managers, staff of local and regional bodies, and non-profit organisations).

Staff can also have specific tasks, such as guiding groups of homeowners or collective properties (NL-01; NL-02; NL-05) and supporting collective group purchases (BE-02); managing heat distribution (feasibility) plans and price setting (BE-02, CH-04, NL-01, NL-03, NL-07), local renovation strategies (BE-01) and climate adaptation plans (BE-02); and maintaining networks and training (AT-01, NL-03).

Resulting general recommendation:

To achieve district action, authorities should support stakeholder dialogues and citizen and co-creation initiatives. They can more effectively use demo districts and create homeowner awareness in target areas. Supported process coaches, specialized staff and consultancy desks can empower district action.

5.3 Conclusion

This chapter identified how several types of policy instruments (regulations, incentives, communication, and facilitation) are qualitatively assessed by stakeholders, particularly for upscaling residential building renovation combining energy efficiency measures and renewable energy systems at the district level.

Most stakeholders find that on the national level, there is no sharp vision for renovations at the district level and district energy supply. District-level action is seen as a promising approach in the hands of local policy actors, but national laws and regulations can hinder the development of renovations at the district level to some extent – or not support them enough.

The qualitative research using 38 interviews with policy and non-policy actors shows that experts and front-runners are convinced that policymakers can do more to support stakeholders in achieving district-level renovations, including energy efficiency and renewable energy systems. This includes ways to improve regulation, incentives, communication, and effectively helping with organizing such renovations at the local level.

Besides advising on national policy development, local authorities could strengthen the use of their own **regulatory policy instruments** – if applicable, for example, by organizing mandatory building inspections and energy audits – particularly during ‘natural moments’ and for buildings with expected insufficient quality, to support local compliance of building and energy regulations, to address sustainability goals, and to assure quality when incentives are being used. Local and regional authorities can also play a more active regulatory role by planning the district’s outdoor environment, setting up infrastructure, and granting permits for renovations at the district level that foresee a combination of energy efficiency measures and local renewable energy grids.

Such strategic planning requires political will, identification of specific objectives, policy actor collaboration on multiple levels, stakeholder dialogue and cooperation, expert support, sufficient funding, and human resources.

Concerning financial incentives to achieve renovations at the district level, tailored integrated grants, subsidies, loans, tax benefits, guarantee funds and/or innovation funds are needed. These incentives are particularly needed to support homeowner groups with process managers to achieve integrated building renovations by combining energy efficiency measures with renewable energy use and connection to district renewable energy grids. In this framework, particular attention is needed for developing policy instruments that fit various and often heterogeneous target groups, particularly vulnerable households and private homeowners assemblies.

From the interviews, it is also clear that local authorities can play a crucial role in **organizing district-level renovations**, including energy efficiency and renewable energy systems. They can facilitate or manage stakeholder dialogue processes, possibly benefiting from already ongoing bottom-up initiatives, to build trust in districts, establish verifiable joint goals and/or to co-create projects. Once a programme of requirements is identified, they can facilitate or assure good project management and/or performance-oriented process guidance.

Authorities can also better **communicate to achieve district-level renovations**, including energy efficiency and renewable energy systems, using European-funded demo districts as guiding examples. To increase the adoption of measures by district actors, using available media, networks, and district consulting initiatives is crucial to raise homeowners' awareness in target areas and provide them easy access to solutions.

Currently, particularly the smaller local authorities do not have sufficient staff, knowledge, and resources to address the specificities of renovations at the district level. In general, the collaboration between policy actors

at multiple levels and between policy and non-policy actors is key for achieving district renovations. Within this framework, new intermediaries or authority roles, and new initiatives or special purpose financing instruments, can emerge and play a role in achieving integrated building renovations combining energy efficiency measures and shared renewable energy systems in districts.

6. Discussion

6.1 Country perspectives

The IEA EBC Annex 75 experts were asked to provide their interpretation of the interview results per country in the framework of the national policy context. This chapter discusses their perspectives and those of the national interviewees on policy instrument development for increasing district-level renovations, including energy efficiency and renewable energy systems, based on IEA country experts' input and the analysis of specific interview results per country. As the number of interviewees per country was limited, country policy contexts and country interview results are presented here as considerations rather than a detailed analysis. Country insights were provided for Austria by Jan Peters-Anders and Bernhard Gugg, for Belgium (Flanders) by Erwin Mlecnik, for Germany by Hauke Meyer and Uta Lynar, for The Netherlands by Erwin Mlecnik, for Portugal by Manuela Almeida and Anita Tan De Domenico, for Spain by Juan Maria Hidalgo-Betanzos, for Switzerland by Matthias Haase and Roman Bolliger. Each subsection briefly describes the national context, the position of the national interviewees towards the inventoried policy instruments, and further reflections on the needs for regulation, incentives, organization and communication, as well as observations on the national upscaling of building renovation combining energy efficiency and renewable energy systems in districts. The chapter ends with a short reflection on the commonalities for European policy development.

The contributions were made at the end of 2021 and partly complemented in March and April 2022. They show a snapshot at that time which is not necessarily like the current status quo due to highly dynamic developments of European and national frameworks and external dependencies and pressures on energy, fuel use and decarbonisation regulation.

6.2 Austria

6.2.1. Policy Context in Austria

The Austrian federal government has set the goal of a climate-neutral Austria by 2040 at the latest and is committed to expanding all domestic renewable energy sources. The Renewable Energy Expansion Act provides the framework for this, which aims to achieve a 100% supply of green electricity (from the share produced nationally) by 2030. Likewise, the current government program in the building sector aims for a renovation rate of 3% of the existing stock (Bundeskanzleramt, 2020). However, the renovation rate has stagnated at 1.5% since 2015, and there is no foreseeable momentum for this to rise to the set target by the end of the government period (2020-2024). In addition, Austria has no established monitoring system for the renovation rate (IIBW, 2020). The scientific community assumed in 2008 that an energy savings potential of 28% would have been possible in the building sector by 2030 if the renovation rate had been 2% (base year 2005). At a renovation rate of 3% (base year 2005), even 50% energy savings potential would have been possible in the building sector (OEGUT, 2008). Despite the high probability of missing the target for the renovation rate, a so-called "renovation offensive" was launched in 2021/2022. This offensive includes, in particular, "get out of oil" programs for private households. In addition, "renovation checks" for detached and semi-detached houses and terraced houses will be subsidized. The same subsidies are also available for multi-party houses, which are more relevant for renovation in the context of a district. Generally, the "renovation checks" mainly cover insulation and replacing windows and exterior doors (Österreichische Bundesregierung, 2021). This restriction already shows that the district level is hardly relevant for energy-related renovation measures in Austria. One exception is the so-called "district heating connection obligations". In the

capital city of Vienna, in particular, there are district management offices that, among other things, take care of energy-related renovation management, especially in districts with old buildings (Gbstern, 2020). In general, it must be said that there are far fewer instruments at the federal level than in Germany, where spatial planning law has been strongly used for district redevelopment, the so-called "Städtebaurecht" which explicitly refers to the district level (Arl-net, 2020).

6.2.2. Perceived use and interest, importance and difficulty of proposed policy instruments

Related to use, both Austrian interviewees mentioned that overall good experiences had been made with enforcing energy standards in districts. Still, enforcement can be difficult, as stated by the first interviewee (AT-01), most of all regarding technical obstacles and the approval process. In addition, financial incentives are a widely used instrument, as well as network meetings, generally at the building scale. All other instruments have hardly been used in the second case (AT-02), but there is interest. In general, regulation, incentives, organization and communication are at least considered important. AT-01 mentioned that they do everything hands-on and decisions for renovations are prepared with the stakeholders and owners. They even help owners in the signing process of subsidies of energy supply contracts. Regarding the difficulty of implementation or execution, it stands out in one of the interviews (AT-02) that inspections and energy audits are rather difficult to establish and perform. Likewise, the use of renovation services in districts is seen as rather difficult in comparison.

Regarding renewable energy sources and PV installations on an individual level, AT-01 mentions that in the case of private individuals, bottom-up processes exist in Austria, e.g., self-assembly systems for solar thermal collectors and more recently PV. They already have a long history e.g., in Styria, and this could be a path to follow in the future too. Most recently (2022), Vienna also removed the need for approval for private PV installations, and it is hoped that this will also foster the uptake of PV and its use in combined renovation efforts.

6.2.3. Reflections on regulations and incentives

One Interviewee (AT-02) described three policy instruments:

1) Urban planning framework study: With this study, the entire area was tackled, and the existing building stock was analysed regarding its structural suitability for redevelopment, the contemporary floor plans and building standards and the potential of a holistic redevelopment. The opportunity for an energetically higher-quality redevelopment (up to a "zero-energy district") was shown.

2) A main enforcement tool was the so-called "Qualitätsvereinbarung" (English: Quality Agreement), which not only covered energy standards or solutions but a variety of qualities that needed to be achieved. The QA is not mandatory in the case of their municipality, but if set up well early in the planning phase, it has shown to be a very good tool for enforcing energy standards or solutions.

3) Smart City Master Plan: This was not yet active at the beginning of this project. Now provides clear targets and can be used by policymakers as a basis for setting the course for the longer term and short-term, project-related budget decisions.

Regarding the interview (AT-02), financial incentives were not specifically created by local authorities in the first place but through implementing an EU-Project (focused on energy solutions in renovations at the district level). Local authorities were able to create additional funding for green spaces and mobility solutions in the district, so larger-scale financial incentives by EU funding bodies initiated more local funding and incentives for better district-related topics such as green spaces. In the case of the interview AT-02, the municipality was 100% owner. After the renovation at the district level efforts, part of the building stock (about 50%, which

was newly built) went to a limited-profit housing firm. Thus, the renovation efforts were eligible for housing subsidies from the state for limited-profit housing.

"It is quite difficult to come a broadly shared understanding of qualities between stakeholders, especially if innovative aspects should be part of it. Nevertheless, if this difficult process in the beginning is finished with a signed quality document, usually in the case of our municipality that means it will be a sustainable cooperation and the qualities will be achieved in the process, due to existing trust between stakeholders."

Project Manager in Salzburg, Austria. Housing Expert; Energy consultant for households and involved in various district renovation projects

"If the total return is given, everything is ok. You have to calculate the bill with the owners first, this is where subsidies are important as an argument, then."

Austrian developer for social housing, social housing business group, is administrating 45,000 rented and 6,000 owner-occupied households.

6.2.4. Reflections on organising facilitation and communication

Regarding Austrian AT-01 and AT-02 expert opinions, high social skills and empathy-orientated communication were and are needed. It is not enough to only explain technical aspects to households, especially if a relocation effort occurs. It was, is and will be important but difficult to ensure temporary relocation efforts for households. Especially for renovation projects at the district level, this topic will always come up. Communication efforts are key. In the Austrian Case AT-02, two dedicated professionals had extensive talks and negotiations with all households, of which 337 were successfully temporarily relocated. In the case of AT-01, this is a constant process with their customers since they expressed the need to be as minimally invasive as possible, and the residents need to be picked up where they are. Communication needs to be friendly and fact-oriented. The interviewee of AT-02 mentions real difficulties for EE+RES-type renovation projects at the district level in cases where the ownership structure is heavy on single-homeownership. The reason is that for single homeowners, until late 2021, when the so-called "housing-ownership-law" was reformed, it was often impossible even to initiate such a renovation project. Getting to a decision between all homeowners for a certain type of renovation was lengthy. Often, homeowners do not have an incentive to invest, partly because they do often not live in the district themselves and have become landlords. Thus, regarding communication efforts, it is much easier to communicate EE+RES renovations to (limited profit) rental housing structures. If a potential relocation is necessary, a quality team of professionals from different backgrounds (municipality, sociologists, etc.) must communicate clearly and constantly with the households about the relocation, their temporary new home, and the return. In one case (AT-02), it was possible to connect the district to a nearby district development project and thus connect to the other project's local microgrid (connecting to a 2000 m² local thermal solar system, 2000L thermal buffer storage). The thermal buffer storage is in the open and has a big display to communicate the current storage levels to the households of two district development areas. This connection was only possible because of constant early-stage communication and a steering group established with external funding from an available EU project. Additionally, interviewee AT-02 mentions the importance of mobile energy consultancy as an alternative. Sometimes it is easier to connect to and inform households by planning little gatherings and happenings and offering food and drinks. A low threshold is important to inform within an accommodating setting. AT-01 also mentioned the existing network of energy officers in Vienna, e.g. at the Urban Innovation unit or the MA20 (Energy Magistrate of Vienna), who communicate with the stakeholders. In the case of AT-01, there are also formats like "Wir laden ein" ("We invite"), which are slowly deployed and implemented to enhance the communication process.

“It doesn’t have to be local energy desks, rather we tried to use mobile energy consultants – an already established system in Salzburg – to come to the households, ensuring a lower threshold than more formalized strategies.”

Project manager in Salzburg, Austria, Housing Expert; Energy consultant for households and involved in various district renovation projects.

6.2.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

Regarding upscaling, one Austrian case (AT-02) especially mentions the Smart City Masterplan, which can help upscaling efforts. The "Strubergasse" Project (see also the IEA EBC Annex 75 report "Investigation of cost-effective building renovation strategies at the district level combining energy efficiency & renewables – a case studies-based assessment" (Venus et al., 2023)) in a sense already helped to upscale the neighbouring "Stadtwerk-Lehen" Project and vice versa, in part because they were seen as connected within the "Smart City - Masterplan". The main driver behind this was the strategy to build access to "district heating" grids for both. Larger grid solutions such as district heating, make it easier to audit and inspect, while individual solutions for each flat are much harder to orchestrate. Inhabitants could take funds from the federal authority to switch to district heating. 50% of the households were still using coal/wood-based heating systems with very low energy costs. Households need to be able to stay informed about what a renovation means for their finances, and the project team needs to make an early commitment to keeping future energy costs as low as possible for such households.

“Very important is a constant “lobbying” from professionals to convince the political sphere to prefer limited profit rental housing (social housing) over homeownership - and private investment driven housing development in the first place, because it is later harder to renovate.”

Project manager in Salzburg, Austria, Housing Expert; Energy consultant for households and involved in various district renovation projects.

Asking one Austrian interviewee (AT-02), combined tenders for more than one household can help in combining and upscaling EE+RES.

AT-001 mentioned as a good example of incentives that it will be good to have laws in the future to define that personal use of PV comes with no grid costs (NB: this law was enforced after the interview, in July 2021) - and that incentives should be federal, and state coordinated. Subsidies already exist, but PV subsidies, for example, for the lower energy level, are very scarce in Austria.

“When one group tries to use less energy, the energy producers don’t like it. Enormous factual issues arise: e.g. infrastructure costs of gas pipelines, stability of power grids etc. The more efficient the energy supply is to become, we must always consider that we must also provide cooling in the future (not just heating). There are still few regulations. These changes must also be able to take place in a minimally invasive way.”

Austrian developer for social housing, social housing business group, that is administrating 45,000 rented and 6,000 owner-occupied households.

6.3 Belgium (Flanders)

6.3.1. Policy context in Flanders

As part of the Flemish Renovation Pact, a long-term objective has been established: by 2050 at the latest, existing residential buildings must achieve an energy performance level comparable to that of newly constructed dwellings for which permit applications were submitted in 2015. This long-term objective means that by 2050 the average figures in the EPC for the entire housing stock will need to reduce by 75%. In the next thirty years, an average of over 3% of the housing stock or over 95.000 housing units per year, must be renovated towards the 2050 objective.

In 2015, gross energy consumption in Flanders was 1.489,1 PJ, of which the residential sector was responsible for 13,7%. Compared to 1990, residential energy consumption in Flanders went down by 2,1% in 2015, but the number of residential homes increased by 24,4% in the same period. In 2016, 63% of residential homes used natural gas and 25% fuel oil. In 2017, 41,5% of homes did not have wall insulation, 14% did not have roof insulation, and 4% still had single glass windows. 58.99% of the Flemish condominiums (536.368 dwellings) have an EPC label from C to F and need to be renovated in the next 30 years. According to the Flemish Long-term renovation strategy (Flemish government, 2020), in 2018, there were 11.440 (0.4% of the residential stock) renovations that improved the EPC level by 1, and 4.600 (0.2% of the residential stock) that improved the level by 2. So, Flanders has a huge task to increase renovation rates while achieving deep renovations. A district approach is currently not emphasized in the renovation strategy. Only a few heat grid developments are emerging in the larger cities (with no specific goals to achieve low-temperature heat grids).

Energy-saving grants in Flanders are now mostly designed to fit single-family homes and are not adjusted to districts or even condominium renovation needs. An incentive installed by the energy distribution net manager Fluvius to support groups of property owners with an energy coach for renovating their homes didn't lead to the intended effect of reaching out to districts or co-owned buildings. Fluvius also offers grants to individual property owners for energy-saving matters, which cover about 7% of the investment cost. The Flemish government also offers a renovation grant that focuses on structural measures with a focus on increasing the living quality of the home (20% to 30% for vulnerable groups). However, the grant doesn't address energy renovation measures of common parts of multiple owners. Also, the Flemish incremental grant based on an improved EPC label does not fit in condominiums, where each dwelling has a different EPC. Still, each property owner must contribute the same amount to the energy renovation. Since 2021 an EPC for the common parts of a condominium is mandatory. Still, this EPC does not give a label at the condominium level; therefore, condominium associations cannot apply for the grant.

In Flanders, the available loans for condominium associations are not well known, even by cities. In Antwerp, an exemplary partnership was set up with a financial institute and insurance company to supply a condominium association loan for 20 years, the investments being part of the 'masterplan Benovatatie' approach of the city of Antwerp.

The Flemish Emergency Purchase Fund enables the financing of vulnerable target groups to buy a home on the private market because they cannot find social housing or affordable rental housing. Flemish social welfare organisations (OCMWs) can provide a loan to emergency buyers that must be repaid on a deferred basis (in principle, no repayments in the first 20 years, and afterwards the option to spread the repayment over time). So far, the Emergency Purchase fund was only consulted for single-family homes.

6.3.2. Perceived use and interest, importance and difficulty of proposed policy instruments

Two interviewees provided further insights, a city sustainability project manager for the built environment (BE-01) and an autonomous municipal company responsible for the energy programmes of a city (BE-02).

They confirmed a lack of enforcement of energy standards or solutions in districts, which they found difficult to realise in the Flemish context. Yet, they are interested in enforcing these and experiencing using district inspections and energy audits. Financial incentives are created or are being created by these local authorities with some difficulties; they mostly must rely on national initiatives for groups of homeowners. Both actors found the creation of renovation services in districts important to very important, including energy desks in districts for awareness raising (either pop-up consultancy centres or multi-employable district office spaces), dedicated local websites, local networking and local media development to support campaigns in districts.

6.3.3. Reflections on regulations and incentives

Concerning **regulations**, BE-02 sees that still a lot of action is needed to align spatial policies with climate ambitions. Permits and fiscal instruments need to be adapted accordingly and sustainability requirements need to be implemented for the sales and rent of municipal land and innovative financing. Furthermore, BE-02 develops ideas to implement quality control in municipal housing and regulations targeting second residences.

Concerning **incentives**, BE-02 supports the development of innovative financing of group purchases for solar panels and sustainable heating. BE-01 finds that the advantages of group purchasing initiatives (upscaling, trust and unburdening) may disappear when looking at the differences in execution. On the other hand, the municipality realizes that some district support initiatives can grow into more structural solutions, such as the creation of energy cooperatives. The municipality wants to better understand the dynamics in districts, particularly concerning financial incentives to achieve circular and climate-neutral districts. There is, for example, a local political will to extend energy audits to a coaching scope of homeowners' assemblies in districts. For example, a first step is still needed to offer energy renovations to apartment buildings. Regarding heat grids, energy tariffs and connection, costs are negotiable, but it is unclear to the municipality what it can get out of this. Both interviewees also see a need for additional national financing and tax shifts. The Flemish energy labels and 'renovation passport' development can be useful, but the local authority has no grip on this national development. Interviewees confirmed that current incentives for groups of homeowners failed to target districts.

"Look at the start of the Flemish grant initiative for neighbours who renovate together: within a few weeks after the launch, 'neighbours' were considered at the municipal level"

Municipal autonomous company, Belgium

6.3.4. Reflections on organising facilitation and communication

Regarding **organizational needs**, BE-01 sees that policy instruments and business models for heat and local renovation strategies are currently not combined. There is a lack of knowledge about innovative funding schemes, energy performance contracting, and a need to engage more in stakeholder dialogue. Renovation coaching requires technical expertise and (central) coordinating quality assurance, which is not always present within local governments (BE-01) but is more available in autonomous municipal companies (BE-02). BE-01 acknowledges the importance of attracting European project subsidies to generate more local support. For example, a renovation charter for apartment buildings developed in the framework of a European project helped boost a political signal. The current energy advice desks need to be reinforced to provide heating information, and BE-01 sees potential for current "energy houses" to develop as a one-stop-shop providing integrated home renovation services. According to BE-01, district-based renovation strategies need to be further developed from the viewpoint of the living environment, including its spatial structure, what people live there and what financial means they have.

Being an autonomous municipal company with a specific mission to support and implement energy measures, BE-02 sees it can gear up fast with a transparent budget and build an advantage with dedicated staff and support while maintaining direct cooperation with policymakers, not only locally but also at a higher level. For example, it could successfully organize group purchases of solar panels involving the province, count on a climate manager participating in multiple municipal management bodies, and hire specific staff to guide complete renovation processes. While the presented climate plans can be ambitious, the lack of an available budget to organize the plans can be a hindrance. For renovation advice, BE-02 sees that citizens do not react to offers of paid consultancy (it has to be free of charge) and that there is a lack of coupling of financial advice and technical guidance. BE-02 acknowledges the current difficulties in reaching out to assemblies of homeowners (split-incentives problems). BE-02 also proposed better employing a city heat director, renewable energy brokers, and local energy communities. Finally, it researches options for connecting heat grids to wastewater heat recovery and developing bidirectional charging for electrical mobility.

Regarding **communication**, BE-01 sees that municipalities are mainly translating and communicating initiatives from a higher government, such as supporting the Flemish energy loan and renovation subsidy and initiatives for vulnerable households. BE-02 emphasizes the need for integrated citizen-oriented communication. BE-01 sees a need to support dynamics in districts with instruments like mobile consultancy desks, tools to follow up on energy use, and so on. District heating and renovation also need to be better combined into one storyline (which is missing on the national level). BE-02 sees the need not only to go into more detail, such as presenting step-by-step plans to homeowners to make their home energy neutral, but also go further, for example, including climate adaptation issues as part of the district strategy. BE-02 notes that consultancy in specific districts can be more effective when coupled with district events, nudging, social media, and 'natural' moments of renovation decision-making (for example, when approaching a notary, when deciding on assembly boards of homeowners).

6.3.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

BE-01 sees that a change of attitude is needed to **combine energy efficiency and renewable energy systems**. BE-02 sees a permanent tension between profitability, financing, and scattered subsidy arrangements for the heat grid development. It is important to map the financial feasibility of connecting buildings per street/district (heat zoning map), but it is unclear which subsidy arrangement works. BE-02 sees a need for more heat grid substations also to stimulate connections of small buildings. For developing heat grids, BE-02 is in favour of working with an energy cooperative rather than a regular energy provider, as they have a mindset towards a lower margin of profitability. According to BE-01, top-down analyses (such as those for heat planning) are valuable regarding operational issues and data analysis but do not offer a vision or workable strategy.

BE-01 sees a need to develop local renovation strategies together with a local heat strategy based upon existing local and national instruments and to couple these strategies on the regional level. This requires various administrators and the city management board to work together to develop an offer for their citizens. An evaluation framework is needed to increase support and adapt policy. BE-02 perceives that national system changes and more structural financing are needed for cities to boost renovations.

BE-01 finds that (collective) initiatives are not necessarily geographical but aim to induce social cohesion in the district. Renovation can be done collectively, but the needed degree of renovation per house appears to contradict this proposition.

BE-01 already tested multiple district approaches which all got stuck due to many barriers: differences between expected goals and realisation, fragmented ownership structures, houses in various stages of renewal, limited support and financial means, a lack of will to renovate, and so on. Furthermore, BE-01 experienced

difficulties to roll out a sustainable heat grid due to scattered ownership, low heat demand, high connection costs and preferences for high-temperature heat grids. To be able to go to a low-temperature heat grid, a reduction of the energy demand of buildings and better stakeholder dialogue are needed. BE-02 expressed low belief in the district approach for renovation: in terms of percentages there is a low chance of success, and the idea mismatches the need to look at key moments in life.

"Heat grid development can be an excuse to do something with a district, couple initiatives for multiple houses and look also to reduce the heating demand."

Municipal autonomous company, Belgium

"The deeper the renovations, the more difficult it becomes to do this collectively."

Municipality project manager, Belgium

6.4 Germany

6.4.1. Policy context in Germany

The German Climate Change Act (Bundes-Klimaschutzgesetz) was introduced in December 2019 and defines the national legal goals for decarbonisation. After a supreme court decision, a revision was made in 2021 with even more ambitious goals. The law aims to reduce carbon emissions by 65% by 2030 compared to 1990 and carbon neutrality by 2045 (Bundesregierung, 2021). To achieve this goal, concrete annual reduction targets were set per sector and each responsible ministry must take immediate action if a sector target was missed. Accordingly, the building sector's permitted annual emission volume for 2030 is 70 million tons CO₂ equivalence (Bundesministerium für Wirtschaft und Energie, 2021). However, the German building sector emitted 118 million tons of CO₂ equivalence in 2020 while at the same time, the renovation rate stagnated at around 1%. To reach the reduction target, the renovation rate needs to be significantly increased to at least 1,5 and at best around 3% (Deutsche Energie-Agentur, 2019). The numbers show that targets and activities do not match yet. The difference between the current development trend and the target is even greater for the residential building sector (Stede et al., 2020: 775).

That is why the subsidies for energy renovation were topped up massively, and energy requirements for buildings were reformulated in 2020 and 2021. The instrument for the regulative component of these actions was mainly the Buildings Energy Act (Gebäudeenergiegesetz). It regulates the energy requirements for new buildings and existing buildings, and the use of renewable energies to supply heating and cooling to buildings (Federal Ministry of the Interior, Building and Community, 2020). A distinctive feature regarding district energy renovation is the innovation clause, which allows energy balancing across buildings to comply with the requirements regarding flexibility of measure combinations at the district level (Bundesministerin der Justiz und für Verbraucherschutz).

Regarding subsidies for energy renovation, the Federal Funding for Efficient Buildings program (Bundesförderung für Effiziente Gebäude) provides different funding schemes for energy renovations in residential and non-residential buildings, as well as for individual measures. Established in 2021, the funding replaces the previous programs to boost the energy transition in the building sector and facilitate access to financing (Bundesamt für Wirtschaft und Ausfuhrkontrolle). A significant increase in funding rates created a new dynamic in energy renovation activities. Homeowners receive a 5% bonus for energy renovation measures that are part of a subsidized individual renovation roadmap under the Energy Advice for Residential Buildings subsidy program. However, the Federal Funding for Efficient Buildings program does not promote district

energy renovation strategies but rather focuses on single measures or measure combinations for a single building.

The National Climate Protection Initiative supports and initiates climate protection projects in Germany. As part of the initiative, the Municipal Directive (Kommunalrichtlinie) promotes integrated climate protection concepts and climate protection managers to improve the networking of different stakeholders and topics and can be coupled with federal-state funding programs. The directive fosters integrated approaches within municipal administration and climate protection policy, which are needed for upscaling energy renovation to the district level. However, energy renovation is usually not the main field of action here, and the program can be seen as indirect support for preparing needed organisation and structures.

A more important funding program for energy renovation at the district level is the Energy-efficient Urban Redevelopment program offered by the German development bank KfW. It promotes the creation of integrated district energy concepts and the establishment of renovation management within the district to implement the concept and mobilise homeowners and stakeholders with a grant of 75% of the total costs (Kreditanstalt für Wiederaufbau, 2021). This program's funding rates were also increased following the revision of the German Climate Change Act.

Indirect district-oriented financial incentives for energy renovation activities can exist also through Urban Development Funding (Städtebauförderung). The program allows for tax reductions for investments in the legally defined so-called redevelopment areas and is accompanied by district management that (as one of many topics) could inform and mobilize homeowners and tenants regarding energy renovation issues (Bundesministerium des Innern, für Bau und Heimat).

Finally, several regional (Länder) programs sometimes complement federal funding (e.g., Energy-efficient Urban Redevelopment Program) concerning regional needs or, for instance, address mobilization and consultation activities in energy renovation. Where municipalities have spare resources, there are also special funding programs at the city level. However, these programs rarely include significant financial incentives and can be seen as rather small selective add-ons to the programs from higher administrative levels. Nevertheless, the described framework (as it was at the end of 2021) is still in a highly dynamic development process.

The new federal government of Germany announced reforms of the Buildings Energy Act and the Federal Funding for Efficient Buildings in their coalition agreement in December 2021.

Several readjustments were expected in 2022, but they could not be considered in this report and were not yet discussed or predictable during the expert interviews. Further, the war in Ukraine puts new pressure on the existing legislation and the decarbonisation strategies in Germany, as a strong political will was formulated to quickly develop scenarios and measures for more independency from fossil fuel imports from Russia. These circumstances were also not in place while the stakeholder interviews were made and analysed.

6.4.2. Perceived use and interest, importance, and difficulty of proposed policy instruments

Concerning the **use** of local policy instruments, all interviewees rated the **importance** of incentives as greater than regulation. Communication and facilitation were assessed as the most important compared to local regulation and providing local incentives.

In Germany, local communication activities were found to be promising by local policy actors (DE 05-08). However, some cities and villages struggle to finance such measures. This also applies to local financial incentives. The local policy actors also remarked that higher regulatory standards at the local level are not the key measure in boosting energy renovations. Especially in rural areas, more time and communication are necessary to promote such measures, and here a lack of knowledge, human resources and financial

resources was identified. The interviews with the intermediaries supported the findings regarding regulative measures and mentioned incentive systems as the best and strongest measures. In addition, for policy instruments to have the right steering effect, they should be more carbon-saving oriented. Thus, the interviewees see a new dynamic through carbon pricing for fossil fuels in Germany. The effects of that and the translation of the new framework into mobilization and communication strategies are still open questions, though.

6.4.3. Reflections on regulations and incentives

Concerning **regulations**, most interviewees stated that measures of that kind are less effective because they are more likely to provoke rejection and, therefore, should be seen as the last resort. That is also why some intermediaries still struggle with communicating the perspective of constantly growing-carbon pricing in their mobilization and consultation work. Ambitious regulations and minimum standards are, in the same way, expected to be followed by a potentially conflicting debate on cost-sharing and housing affordability.

Regarding **incentives**, the interviewees agreed that such measures are the most effective policy instruments because they have few unintended side effects and are more accepted. They recommended establishing funding programs on all levels (national, regional, local) and funding support for renovations at the district level. There is also a need for funding programs for local administrations to finance external support for district plans and/or additional staff (climate protection managers, renovation managers). Incentives can and should be integrated, and positive side effects for different sectors (e.g. energy renovation, green infrastructure, mobility, leisure infrastructure, etc.) should be sought out and highlighted to achieve a higher level of acceptance within a district and make the use of district synergies as a planning and action level.

6.4.4. Reflections on organising facilitation and communication

Concerning **communication**, the interviewees stated that there is a deficit of local energy and renovation advice and knowledge at the administrative level. The policy actor interviewees recommended establishing more renovation advisory options offered by the municipality to strengthen the exchange between different stakeholders. All sorts of potential renovators in a district should be addressed directly and personally and the energy renovation consultation should be provided as a low-threshold service. In Germany, civil servants are more responsible for managing activities and using external consultancy services to organize citizen participation, information campaigns and district concept planning. For this reason, the interviewees proposed local or regional energy agencies as public-private partnerships as an option to support stakeholder dialogue and to build an information infrastructure on energy efficiency and renewable energy systems.

Furthermore, there is unlocked potential in the use of digital communication. In addition, the intermediary interviewees consider broad and diverse communication and visualisation of planned or optional measures on-site important.

On the **organisational** side, political will is needed. Since an administrative equivalent for the district level is missing, this must be compensated with coordination effort. Therefore, coordinators for conversion processes on buildings, paid for by the local authority or a consortium instead of individual owners, are considered necessary to reduce barriers to implementation. Several interviewees suggested installing steering groups by municipalities with multiple departments and external stakeholders involved.

“To attract tenants in a less attractive district, energy measures and slightly lower energy prices do not help. You need to work on the whole package from energy standards, mobility services, leisure infrastructure, etc.”
City-owned urban development and housing business group, Germany

Most German respondents noticed that regulative measures are not the key to mobilising different stakeholders to do energy renovations. Rather, there should be an interplay of different actors and support programs and policy instruments to engage and motivate everyone involved.

6.4.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

Regarding **upscaling and the combination of EE+RES**, integrated thinking of politicians and administration is the precondition to implementing energy efficiency and renewable energy systems at the district level. It is useful to look for combinations of energy renovations with other district renewal processes to gather broad funding and subsidy options and acceptance within the district. Several respondents noted that combining energy efficiency and renewable energy systems with cross-cutting development issues and demonstrating good practice examples can potentially unite majorities behind projects. Although policy and decision-makers are seen as the key to renovation at the district scale, fostering mutual understanding between all stakeholders appears to be more important.

“For the municipality, visible success stories for their policies are important. The district is a very visible action level and thus always a chance for showing and communicating a bigger and consistent picture.”

City owned urban development and housing business group, Germany

The city-owned urban development and housing business group respondent noted that local administrations need visible success to gain local politicians' support (DE-04). Therefore, plans for newly built zero emissions housing might appear more attractive to the public than “invisible” renovation measures and the heating system change.

The interviewees' experiences show that district-based renovation concepts co-created with residents lead to more acceptance, even in the case of unpopular actions like removing parking lots or higher parking costs. Residents have been engaged, for instance, through thematic workshops and on-site consultancy, addressing all types of tenants or provoking discussions about the district e.g., within family structures. It was also found useful to use add-on topics for mobilization purposes, scale and synergy effects, and involve the respective stakeholders (DE-04).

Several interviewees noted that the municipal administration must take the lead in district-oriented projects, especially when a diverse set of stakeholders is involved, and establish a broad network of actors that goes beyond energy-related actors. Having a contact person at the district level and on-site consultancy and communication from the beginning and throughout the renovation process is recommended. Municipalities could set up neutral “energy advisory contact points.” These can be the starting points for establishing public, NGO and private stakeholders networks.

The civil servant interviewees confirmed that local municipalities with local public-owned energy suppliers and housing companies have better options for cooperation in renovation at the district scale. Cooperations with other professional actors (energy advisers, architects, enterprises) are important to implement district plans as a regular task for (town) planning departments since the issue is still new and not yet well established in every local administration. On the other hand, the local administration staff usually does not have broad knowledge and influence on private investors, except in special urban redevelopment areas defined by national funding. In the long term, decarbonising the energy supply at the district level will result in greater economies of scale than individual building measures. However, cooperations with utilities and energy companies continue to be a challenge. This is why heat planning with the stakeholders and municipalities involved will be the key in the future to allow for sound decision-making for homeowners regarding energy renovation measures in their respective buildings and for more coordinated action.

Municipalities need respective administrative structures and professional and competent staff to realize energy-efficient district planning approaches. The departments for construction, town planning, and environmental protection must establish processes and routines to steer and manage such energy-efficient renovation planning approaches in districts. Lighthouse projects implemented by local public housing companies can help support better administrative handling until it becomes a core competence of the municipal staff. The local municipal councils need to be the driving force behind these processes. Otherwise, civil society will not dare to go forward on its own.

Regarding the different technology options for renewable energy systems and energy efficiency, there is not one optimal combination of measures suitable for every district. There is a need to allow for central as well as small-scale, decentralised, individual perspectives to find the local optimum.

6.5 The Netherlands

6.5.1. Policy context in The Netherlands

The Dutch Climate Agreement (Klimaatberaad, 2019) aims for a carbon-neutral built environment by 2050 and has proposed an intermediate goal for 2030 to reduce carbon emissions by 49% compared to 1990. For the built environment, this implies an energy transition encompassing changes in about 7 million houses, from moderately insulated and mostly heated by natural gas, towards well insulated and supplied by sustainable heat and electricity. By 2030, 200.000 homes will have to be disconnected “regret-free” from the natural gas supply (TKI Urban Energy, 2019). The transition to gas-free districts is supported by a program gas-free districts “PAW”, which provides funding for local experiments and knowledge and learning for all municipalities (Rijksoverheid et al., 2020).

At the same time, multi-annual mission-driven innovation programs (MMIPs) support the development of integrated renovation concepts, industrialization and digitization of the renovation process and the central positioning of building owners and users during energy renovations (TKI Urban Energy, 2019; Mlecnik, 2021). This renovation development is further supported for terraced houses and apartment buildings by the IEBB program and for rental houses by the “Renovation Accelerator” (Renovatieversneller, 2020). A Human Capital Agenda for the construction (Visser et al., 2019) further supports interconnections.

The following policy instruments were identified as relevant for home improvement and are currently being used in the Netherlands (Steenbekkers et al., 2021):

- Regulating instruments such as an obligatory energy label when selling a house;
- Fiscal instruments to increase the gas price in the coming years and to reimburse VAT for solar panels;
- Investment instruments such as additional loans for home improvement, loans via a revolving heat fund and energy saving and sustainability loans from financial institutes;
- Small financial incentives, such as subsidies for energy saving in the own home (SEEH), investment subsidies sustainable energy (ISDE), a regulation reduction energy use (RRE) and lower VAT for home improvement;
- Reimbursement of produced electrical energy delivered to the grid

6.5.2. Perceived use and interest, importance, and difficulty of proposed policy instruments

The Dutch policy interviewees (NL-03, NL-04, NL-06) all confirm that the program for gas-free districts plays a significant role in local or regional governance, particularly because it puts clear responsibility at the local

level to develop the appropriate planning strategies. On the other hand, there is also a lack of upscaling of experiments (NL-05, NL-06).

The Dutch approach towards obtaining 'gas-free' districts led, amongst others, to developing regional heating strategy plans (NL-03) and municipal heat plans (NL-06). At the district level, this results in local authorities having to analyse the districts and decide, for example, on connecting a district to a (future) heat grid (NL-01, NL-02, NL-06). This development leads, amongst others, to frequent consultation with energy providers and housing associations that might be dominant in a certain district (NL6).

“National policy transforms global or national urgency into a local problem. Something is not right here.”

Manager revolving fund for local authorities, The Netherlands

Concerning the **use** of local policy instruments, all Dutch interviewees rated incentives' importance as higher than regulation. Communication and facilitation were assessed as the most important compared to local regulation and providing local incentives.

The context of the local authorities can partially explain this. Interviewees (e.g., all Dutch interviewees) remarked that compared to national authorities, local and regional authorities have limited financial means, staff, and power to regulate or provide subsidies themselves. Compared to larger municipalities, this is even more problematic for smaller municipalities (NL-03, NL-05, NL-07). Therefore, local authorities often select the 'cheapest' policy instruments, although the efficiency and effectiveness of selected policy instruments are only rarely evaluated. Sometimes regional authorities can help to support bottom-up initiatives in municipalities (NL-03).

6.5.3. Reflections on regulations and incentives

Regarding **regulations**, various stakeholders suggested improving existing and proposed obligations, by framing them better at 'natural' moments (NL-03, NL-05, NL-07), for example, when the homeownership changes or when loans are requested.

“Purchase policy doesn't hurt anyone.”

Supplier integrated renovations, The Netherlands

Multiple respondents also observed a lack of transparency regarding the identification of connection costs enforced by heat grids operators (NL-01, NL-03, NL-05), making it improbable to effectively evaluate heat plans and policy options to oblige citizens to connect to renewable energy grids. In the Netherlands, this market failure might require changes in the national Heat Law.

Concerning **financial incentives**, interviewees recommended subsidies for process guidance (NL-01, NL-05, NL-06) and combinations of renovation measures instead of scattered grants for individual measures (NL-02).

“We don't understand why assemblies of homeowners were never financed”

Manager revolving fund, The Netherlands

Regarding other financial instruments, interviewees noted a lack of:

- Financial support for community renewable energy systems (NL-02)
- Access of housing associations to national funds for deep renovations (NL-04)
- A 0% interest loan for vulnerable target groups (NL-07)
- A fund for innovative process solutions (NL-03)
- Financial support of existing assemblies of homeowners (NL-07)

- Financial guarantees for investing in collective solutions (NL-03)
- Financial guarantees for covering risks when guidance processes are aborted for groups of homeowners (NL-01)

6.5.4. Reflections on organising facilitation and communication

Regarding **communication and facilitation** by authorities and authorities helping the development, interviewees supported the ideas of:

- Local authorities supporting the deployment of locally based energy advice offices (NL-02, NL-04, NL-06)
- Local authorities supporting processes of groups of homeowners and collectives (NL-01, NL-02, NL-05)
- Local authorities supporting the communication with citizens about the development of heat plans (NL-01, NL-03, NL-07)
- Authorities supporting the development of a locally based integrated renovation offer, including the financing and guarantees for residents (NL-06, NL-07)
- Authorities facilitating ongoing initiatives that are already developed bottom-up (NL-03, NL-06)
- Authorities working together with energy communities to provide solutions (NL-06)
- Authorities supporting group buying initiatives (NL-02)
- Adapted organizational support for specific target groups such as existing assemblies of private homeowners (NL-01, NL-07)

On the other hand, they noted a lack of:

- Transparent communication about the to-be-expected heat delivery prices (NL-01, NL-03, NL-07)
- Digital communication (NL-02, NL-06)
- Regional exchange of knowledge (NL-03)
- Support for developing a societal ESCO (NL-07)

6.5.5. View on upscaling renovations at the district level combining energy efficiency and renewable energy

Regarding **upscaling and combining**, most of the Dutch respondents noticed that Dutch policy doesn't give clear guidance on how to develop energy efficiency and renewable energy in districts. In the development of heat delivery planning in districts, there is still insufficient attention for effective CO₂ reduction (NL-03) and energy efficiency and renovation (NL-06), which is observed as a lack of guidance and regulation from the national level. There is an inherent risk that high-temperature heat grids will be developed (NL-06), whereas the use of renewable energy systems within the heat grids would require lower supply temperatures. To operate at lower temperatures buildings need to become more energy efficient.

"The obligation of a connection to a heat grid is no guarantee for CO₂ saving."

Project leader local initiatives,
Province in The Netherlands

Some stakeholders (NL-03, NL-05) noted that the broader context of reducing carbon emissions should be kept and that bottom-up initiatives that reach this overall goal can be supported. Interviewees recognize a need for equal access to financing (NL-05, NL-06, NL-07) and banks' lack of adapted financing (NL-06, NL-07).

Stakeholders (NL2, NL-03, NL-05, NL-07) particularly emphasized that the current instruments do not effectively reach the homeowner at the right moment in their renovation trajectory and with a message that suits their current situation. Interviewees also remarked that policy actions towards specific target groups are missing, such as initiatives that aim to engage small assemblies of homeowners and micro-enterprises that are also present in districts (NL-07). Also, ineffective communication between various authority layers and municipal divisions can hinder prosperous development (NL-06). A divide is apparent between what smaller municipalities can do versus larger municipalities. The latter can have more means to fulfil policy duties (NL-03).

Most interviewees criticized a geographical policy approach as the best way forward, compared to, for example, reaching out to communities and collective units (NL-01, NL-02, NL-03, NL-05).

6.6 Portugal

6.6.1. Policy context in Portugal

Portugal committed in 2016 to achieving carbon neutrality by 2050. In 2019, the 2050 Roadmap for Carbon Neutrality (RNC2050, 2019) was released as a framework where the main decarbonisation vectors, policy, and implementation options were identified, and a proposal for an 'emission reduction path' has been made. According to RNC2050, carbon emissions must be reduced by 85 to 90% compared to 2005 levels for Portugal to achieve carbon neutrality. As a further development and in line with the IPCC Report on 1.5°C, the 2030 National Energy and Climate Plan (PNEC2030, 2020) was released in 2020 as "the main energy and climate policy instrument for the decade of 2021-2030, setting new national targets for renewable energies, energy efficiency and the reduction of carbon emissions, in line with the objective of carbon neutrality" (RNC 2050; p.9). PNEC2030 (2020) has set the target for the residential sector of reducing carbon emissions by 35%, compared to 2005 levels, by 2030.

Regarding the decarbonisation of the energy sector, PNEC2030 (2020) has set a target for Portugal to achieve a renewable energy share of 47% of the total energy production. Renewable energies are also forecasted to contribute to 80% of electricity generation by 2030, comprising hydroelectricity (22%), wind energy (31%), and solar energy (27%), the latter with the highest expected growth. Natural gas relevance is expected to be gradually reduced over time, although in the next two decades, it will remain high due to its role in the decarbonisation process as a backup for the electricity generation system. Coal-fired electricity production was halted in November 2021, two years earlier than the original forecast, when the last coal-fired power plant, Central do Pego, was permanently shut down. According to the Energy Observatory, currently, around 60% of the electricity produced in Portugal comes from renewable energy sources, namely hydropower, wind power, biomass, and solar power.

With regards to the building sector, it was identified by RNC2050 (2019; p.45) as "one of the most important sources of carbon emissions, accounting for 5% of Portuguese carbon emissions and about 30% of final energy consumption". Therefore, by 2050 the necessary emissions reduction in the residential sector was estimated at 97% compared to 2005, with almost 70% of space conditioning energy needs to be supplied by renewable sources. This expectation is associated with a necessary increase in thermal comfort, estimated to triple during the heating season and double during the cooling season. PNEC2030 (2020), in turn, confirms the importance of building renovation, especially aiming at nZEB (nearly zero energy buildings), and states that targets would be defined in the Long-term Building Renovation Strategy by 2050, ELPRE (2021).

ELPRE (2021) was approved in 2021, comprehending a roadmap towards energy renovation of the Portuguese building stock and setting indicative targets for 2030, 2040, and 2050 milestones. It foresees a total investment of EUR 143 thousand million in the renovation of 100% of the building stock by 2050, implying a

reduction in carbon emissions by 77% and in primary energy savings by 34% compared to 2018. In the first phase, which runs until 2030, priority will be given to the buildings with the worst performance, i.e., those built before 1990, when the first thermal regulations were implemented in Portugal.

It is important to mention that, in a general view, the Portuguese building stock does not offer comfort conditions, namely indoor air quality and thermal and acoustic comfort. According to ELPRE's analysis of the Portuguese archetypal building typologies by dynamic simulation, the building stock presents some discomfort in 95% of the year, accentuating during winter. When analysing the EPCs emitted until 2018, only 9% of the residential buildings had an A/A+ level and more than 50% of the suggested renovation measures were related to the opaque envelope. Facing this scenario, ELPRE's targets (compared to 2018) specifically for residential buildings are: primary energy reduction of 15% by 2030 and 40% by 2050; carbon emissions reduction of 16% by 2030 and 85% by 2050, with an expected rate of renovated buildings of 70% by 2030 and 100% by 2050, associated with a reduction of hours of discomfort of 26% by 2030 and 56% by 2050.

The policies defined by ELPRE (2021) to reach these targets are grouped into seven axes: building renovation; smart buildings; building policies; technical capacitation; mitigating energy poverty; communication and awareness; creation of a set of mechanisms and indexes to follow its results. They were defined based on the energy consumption profiles and thermal comfort indexes of the Portuguese building stock, the estimated costs of building renovation, and its co-benefits. The enhancement of building environmental performance associated with the principles of circular economy and efficiency of resources is expected to also play a significant role in the Portuguese economy's relaunch due to COVID-19.

Finally, also as a development of PNEC2030 (2020) and in parallel with ELPRE (2021), a Long-Term National Strategy Against Energy Poverty is in development. It underwent public consultation in 2021 and should be launched soon, based on energy-efficient housing renovation, the creation of mechanisms that facilitate access to energy services, reduction of energy costs, and awareness campaigns informing about conscious and better use of energy.

Nevertheless, although Portugal has identified opportunities and set targets in compliance with the EU policies aiming for complete decarbonisation by 2050, the implementation of a massive building renovation at the district level is still extremely challenging since the necessary conditions are not yet met. The lack of a strong positioning by the government and especially by the legislature in supporting the implementation of building renovations at the district level does not create the legal basis for it to happen soon. In addition to the absence of adequate legislation, there are no structured national or municipal plans to guide and promote the necessary massive building stock energy-efficient renovation. Portugal is also a country where district energy systems are still very incipient. Only a single experience was implemented in Lisbon more than 20 years ago and no new attempts have been made so far. Not even ELPRE (2021) considers district energy systems in its recommendations, which are limited to local solar energy production.

In conclusion, a change of scenario is only possible with faster, broader, and bolder governmental initiatives. The massive and energy-efficient renovation of the building stock, especially with zero-carbon ambitions, will only be possible with a great political ambition translated into demanding legislative support. Without this necessary commitment of governmental entities, the process will take even longer, and the ambitious but necessary targets will not be met within the already limited period.

6.6.2. Perceived use and interest, importance and difficulty of proposed policy instruments

Interviewee PT-01 considers it important to enforce energy standards but finds their implementation still difficult, especially at the district level, because the Portuguese legislation focuses on individual buildings. Nevertheless, he mentions that progress is being made in the sense that the recently transposed legislation, Decree-Law 101-D/2020 (2020), seeks to simplify the project approval process and is more demanding, leading to an improvement in the quality of buildings. In the housing context, financial incentives are now associated with energy savings through the assessment of the building design (loan approval is subject to a proven improvement in energy efficiency).

“Our legislation, technical community and all relevant stakeholders are still focused on building-level renovation. Political, financial and technical instruments are needed to support the shift to a broader neighbourhood-wide approach.”

Qualified expert National Energy Certification System and iiSBE, Portugal

On the other hand, interviewee PT-01 highlights that, in terms of the building’s service life, the current legislation concentrates only on the project. However, attention must also be given to the operational phase (which would lead to the need for regular inspection mechanisms) and this approach is critical to ensuring the success of building renovations on any scale.

Regarding renovation at the district scale, currently, there is only the Decree-Law 162/2019 (2019), which regulates renewable energy production for self-consumption, the possibility of exporting to the grid, and the creation of Energy Communities. Nevertheless, as PT-02 affirms, this is a very recent initiative whose impact is limited and insufficient, with results still to be seen. PT-02 also mentions that there are currently a few ongoing experiences to achieve nZEB (nearly zero energy buildings) at the district scale.

6.6.3. Reflections on regulations and incentives

Interviewee PT-01 mentions advances made by Decree-Law 101-D/2020 (2020), although still at the building level. Decree-Law 101-D/2020 establishes the obligation of annual inspections in residential buildings, even if still as a simplified version of those required for other building uses. Financial incentives are now associated with energy savings through the assessment of the building design (loan approval is subject to a proven improvement in energy efficiency).

The interviewees agree that financial incentives are crucial for reaching the intended high energy efficiency of the building stock. Renovation measures and RES are not affordable for a substantial share of the population in Portugal, especially due to the widespread energy poverty, which plays a strong role in maintaining inadequate building conditions and consequent lack of thermal comfort and even an unhealthy environment. Citizens simply cannot afford renovation costs or even their energy bills. According to PT-01, also due to a cultural issue, the population living in energy poverty conditions would not spend financial help on home improvements. PT-02 suggests that for this share of the population, financial incentives should be applied directly in enhancing the building envelope, leading to the so-needed mitigation of building pathologies and improvement of indoor comfort and health conditions at a lower cost. However, a different approach could be applied to those with better living conditions, who could benefit from loans and subsidies, for instance.

“Financial incentives along with awareness are key.”

Real estate project manager, Portugal

6.6.4. Reflections on organising facilitation and communication

The provision of technical support services and professional advice is also essential, both in the form of local energy desks and consultancy during the design phase, allowing the investigation of the best and most cost-effective renovation solutions. For this to happen, the technical knowledge of the entire chain of professionals involved in building design and civil construction must be improved because, as mentioned by PT-01, most

of the professionals do not have sufficient knowledge and/or interest in the subject. Better coordination and integration of the building design, involving all the specialities since the initial stages is also a goal to be achieved (PT-01 and PT-02).

From the residents' point of view, there is a lack of awareness of the relevance and benefits of building renovations and, therefore, little engagement in seeking better homes or investing in the necessary renovations, hence the need also for awareness-raising campaigns for society in general. The scenario is compounded by housing ownership, another challenging issue to be faced: as most housing is privately owned, it is difficult to get the owners to agree on a collective building renovation and even more difficult to propose a renovation at the district level (PT-02). PT-01 adds that condominium administration is usually outsourced and disconnected from the needs of the residents and the reality of building conditions, often taking uninformed actions based solely on immediate cost reduction and not on a vision of long-term high performance.

6.6.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

It is clear from the interviewees' opinions that a leap from building to district-scale renovation is urgent in Portugal. PT-02 highlights that this mindset change must reach all the stakeholders involved in building renovation, starting with legislators, who must adopt bolder and faster actions to create regulations and incentives to implement district energy renovations associated with renewable energy sources. These mechanisms must be established based on a stepwise renovation concept, where the enhancement of the building envelope is the first stage, followed by the adoption of highly efficient technical systems associated with renewable energy sources. Policies and financial instruments must also facilitate the implementation of renewable energy sources, making them more affordable and facilitating the creation of local renewable energy grids.

Nevertheless, there are still other significant obstacles to overcome for energy-efficient renovations at the district level to be achieved, such as the technical capacitation of those involved not only in the building sector but also in the renovation approval process (PT-02). In addition, it is also crucial to improve communication at all levels, especially with the final users, who, once aware of the benefits of energy renovation, including implications for their well-being and energy bills, can participate more actively in the renovation process.

6.7 Spain

6.7.1. Policy context in Spain

The Spanish National Climate Change Adaptation Plan 2021 – 2030 (PNACC, in Spanish) embraced the Paris Agreement of 2015 and set ambitious goals for this decade: CO₂ emissions reduction of 39% (significantly over the 26% of European goal), 42% renewable energies in the end-use (while, in Europe, the average is of 32%) and energy efficiency improvement up to 39,5% (compared to the European goal of 32,5%) (Ministry for the Ecological Transition and the Demographic Challenge, 2021).

However, considering the Spanish building renovation context, Spain is still far from being ready for the expected renovation ratios. In 2019, only 29.000 housing were renovated (ERESEE, 2020; in Spanish), corresponding to an annual renovation ratio of around 0,12%, instead of the objective of 250.000 houses, or 1% of the total residential stock. Despite this, it is important to acknowledge that renovation numbers have been improving in the last decade. One of the latest reports from GBC in Spain identified the three main barriers: private homeowners' economic situation, lack of awareness and access to financing (GBCe, 2016).

Many factors can explain the current situation and they are analysed in detail in the Long-term Strategy for Energy Renovation in the Building Sector in Spain (Ministry of Transport, Mobility, and the Urban Agenda, 2020). Among others, the main ones are the economic crisis of 2008 that greatly reduced the resources of families and ruined the majority of the building sector, a housing stock that is predominantly composed of multi-owned apartments, which multiplies the stakeholders for renovations (EUROSTAT, 2022), the small presence of housing associations and social housing (Housing Europe, 2021), and a building renovation sector that SME leads with limited financing capacity. All these conditions became significant barriers that slowed down the decision-making processes and, consequently, a real upscaling of the residential building renovations.

To cope with this complicated background and speed up the renovation, the Spanish strategic plans like PNAC and ERESEE indicated several measures and actions to reactivate and upscale the renovation of existing buildings and join the Renovation Wave. Among the most recent analyses, the group of experts on renovation CT-17, presented in CONAMA 2020 (one of the largest national environmental conferences), a multidisciplinary set of tools to increase the impact of building renovation in Spain, showing that it is possible to reverse the situation and achieve the building decarbonisation goals. The Spanish Long-term Renovation Strategy ERESEE 2020 has been acknowledged as the best overall strategy (BPIE, 2020) because of the excellent level of detail, the treatment of energy savings and more comprehensive benefits, and a detailed exposition of progress with implementing the previous 2017 strategy. Nonetheless, the European Commission analysed 13 NCCAPs of Member States and suggested adding more intermediate milestones in the Spanish plan to track better the renovation progress (European Commission, 2021).

Looking into the specific actions already in place, there is a new national rehabilitation funding programme named PREE, based on the FEDER programme, with grants depending on the renovation type and the owner conditions: from 35% for small renovations up to 85% for A-class renovations and vulnerable families. This programme was open from the summer of 2020 until the 31st of July 2021. The initial aim was to distribute 300 million euros, but two resolutions during 2021 enlarged the programme to 402.5 million euros to reach more building renovations with energy efficiency and/or renewable integration. The grants focus on deep renovations (A or B rating) and receive 55%, instead of the 35% for smaller renovations. An additional aid to alleviate energy poverty means that socio-economic or vulnerable cases can receive an extra 10%. Most renovations are expected to aim for comprehensive deep renovations, thus receiving grants for half of the costs or more. Another interesting programme aims to extend the Renovation Wave to small towns, up to 5.000 inhabitants. This financing tool remains open until the end of 2023 and contributes with extra 50 million euros focused on the large low-populated areas of Spain, contributing to the economy in rural areas and helping to reduce depopulation. To understand the scale of the current building renovation aid programmes (PREE and PREE5000), it is possible to compare them with the previous housing renovation programmes PAREER-CRECE and PAREER II, active from October 2013 to December 2018, which had a total budget of 404 million and helped to renovate 80.000 dwellings in 5 years. According to this, in a few years, the expectation is that renovations will increase by three to five times, especially with a deeper decarbonisation approach.

Other actions have been taken as well, like the definition of the Renovation Agent, a new legal definition for a profession that can represent the community of owners in multifamily blocks and accelerate the administrative processes. Additionally, a law of 2019 set a new regulatory frame to promote solar PV panels in buildings and regulate self-consumption (Royal Decree 244/2019).

Unfortunately, the COVID crisis has severely impacted Spain's economic and social situation. The real GDP declined by 11% in 2020 and the growth in 2021 was expected to be around 4.6%. The job conditions are also hard, with an unemployment rate of around 15% and one of Europe's highest temporary contract rates. The situation is uncertain, and regions and cities are working to make plans adapted to their contexts. The

pandemic was getting longer than expected but there was also hope coming from the Next Generation Europe recovery funds. According to the number of active aids, the renovation programs will have a larger impact on housing renovation ratios and, to some degree, also upscale the process to the district scale.

This global assessment of Spanish policy is supported by the responses given during the local expert interviews. Spanish policy interviewees (ES-01, ES-04) and non-policy interviewees (ES-02, ES-03, ES-05, ES-06) agreed on a clear need for financial support. The majority also requested more tools and better collaboration between administrations and homeowners to build trust and facilitate decision-making.

6.7.2. Perceived use and interest, importance, and difficulty of proposed policy instruments

Concerning the **use of local policy instruments**, the Spanish interviewees have experience using the majority of the questioned eight instrument types (61%). This ratio is the same for all the interviewees contacted by the IEA EBC Annex 75 study. These tools are more extended among the policy interviewees (ES-01, ES-04) than among the non-policy interviewees (ES-02, ES-03, ES-05, ES-06). However, some interesting findings can support the country's situation compared to all country interviewees.

On the one hand, Spanish interviewees indicated a lower use of communication tools (networking meetings and local media development) than other European experts and somewhat less use of facilitation tools (local energy desks and OSS), but with a smaller difference.

There is a broad use of building inspections and energy audits and a somewhat more extensive use of available financial incentives (not district-specific), but the latter one to a smaller degree. Most Spanish interviewees have underlined the use of inspections (ES-01, ES-04, ES-03, ES-05, ES-06). They explain that it was mandatory for around ten years for buildings over 50 years and has helped significantly to promote awareness and renovation potential. Also, these inspections are a prerequisite to getting financial support in newer buildings.

These usage findings are consistent with the literature assessments (GBCe, 2016; GBCe, 2018; GBC, 2020; CONAMA, 2020) and the Spanish regulation strategy (Ministry of Energy, Tourism, and Digital Agenda, 2017; ERESEE, 2020).

6.7.3. Reflections on regulations and incentives

Regarding **regulations**, the interviewees underlined the benefits of using mandatory inspections and audits. Still, they do not support the idea of strengthening the requirements more than the current building technical code.

"Technical Inspections of Buildings (ITE) in many cases have helped to tip the balance to rehabilitate."
Public Housing Association, Spain

For a decade, mandatory Technical Inspections of Buildings (ITE) have been a great tool to promote awareness and renovations, easy to apply and very useful (ES-01, ES-04, ES-03, ES-05, ES-06).

Apart from this tool, most interviewees also say that the Spanish regulation frame is not mature yet. A Regional Energy Agency reflects on how the regulation frame is still focused on new single buildings, so it is not adapted to renovation works or the larger district scale (ES-03). Also, a Municipality Urban Rehabilitation Society indicates that renovations are far beyond energy. Instead, they must acknowledge a range of priorities: building structure, accessibility, pathologies, health, energy efficiency, etc (ES-01).

"The building energy regulations are not designed from a rehabilitation perspective and the compliance in renovation projects is not properly reviewed."

Regional Energy Agency, Spain

Conversely, some respondents also support the requirements increase under certain conditions. Policy stakeholders explain that to go further with the enforcement of higher energy standards, they must be accompanied by financial measures (ES-04-P). For instance, the example of Donostia-San Sebastián (2021) city local building sustainability regulation was mentioned, which sets both framework and local services to facilitate deep renovations (Donostia-San Sebastián, 2021). Among non-policy stakeholders,

the opinions are wide. While a multinational energy management company recommends that building technical inspections should be stricter and embrace obligations to reach minimum insulation of the envelope (ES-06), others find it difficult for city councils to impose additional requirements and refer to better use of incentives like tax bonuses (ES-05).

In any case, all the Spanish interviewees perceive weak regulation towards building renovations and indicate diverse ways of extending the present renovation sector by better or more comprehensive regulation.

Concerning **financial incentives**, all interviewees acknowledged that financial support is key for renovation, but they also stated that financial incentives are the most challenging tool to apply due to their budget limitations and complex management. The policy stakeholders recommend that for municipalities to receive additional incentives, they must first define which areas or districts are the most vulnerable with local planning tools. In their experience, without extra support adapted to their particular situations, they cannot conduct any renovations (ES-01) (ES-04).

The non-policy stakeholders focused more on the difficulties, like the limitation of public funds and the uncertain evolution of the local economy (ES-02), as well as on the complex process of getting public renovation grants, often based on competition calls and with uncertain results (ES-05). Some renovation grant programs have side effects, such as lowering trust, short deadlines for submitting documents, and high competitiveness. In general, most interviewees mentioned that if it were not for the aid, it would not have been possible to do deep renovations or create a new district heating system because of the high costs and the complexity of decision-making (ES-06).

"In vulnerable districts, financial aid is vital for rehabilitation, if it does not exist, the financial situation of the inhabitants does not allow to face it."

Municipality Urban Rehabilitation Society, Spain

6.7.4. Reflections on organising facilitation and communication

Regarding **communication and facilitation**, the interviewees detected many concerns that can be summarised as trust. Trust is a key element that must be earned with transparent information adapted to their needs and a coherent message from all the administrations. From the experience of policy stakeholders, the information facilitated to the neighbours and the opening of local energy desks are parts of the same process (ES-01). This is because the explanations' closeness, clarity and pedagogy are essential in renovation projects at the district level. It is also mentioned that a technical approach to these districts improves the perception of the rehabilitation project (ES-04). Both understand that the difficulty of implementing local energy desks or conducting local networking meetings is patent in their experiences.

"Make the need come from the neighbour, that is the one who demands the project."

Multinational company of energy, waste and water management, Spain

For the non-policy stakeholders, there is mistrust towards the administration and a lack of transparency in the process (ES-02). For instance, during a renovation project at the district level, they found that neighbours saw it as something imposed, not trusting it because of the top-bottom approach. Therefore, they recommend

following a bottom-top approach with public guidance. Another interviewee commented that opening a District office was the key, but that direct reporting conducted by several door-to-door visit campaigns was also important (ES-05-C). In some cases, they openly recognised that they didn't manage to connect and show the need to rehabilitate properly. Consequently, despite all the campaigns, meetings and activities, the renovation ratios were lower than initially expected. In future projects, they will pay more attention to these aspects from the start (ES-06).

6.7.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

Regarding **upscaling and combining**, after understanding the limitations of the current regulation, some regulation changes are proposed:

- Develop local energy strategies because the local energy policies are often not defined or regulated in detail, and this slows down or even blocks renovations at the district level. (ES-05)
- Develop district-scale regulations and establish obligations to renovate, accelerate the renovation wave and make the business model of rehabilitation possible. It lacks scale, planning and new tools like the Building's Renovation Passport, which is not yet implemented (ES-03).
- Be proactive to create the need first, conducting building inspections from the public side, for free or almost. If an audit concludes the need for renovations, homeowners will understand their needs much better and even with smaller financial aid, they will accept the renovation works. (ES-06).
- These trends also perceived an important concern: forgetting that people should be the centre of renovations, not buildings. Accordingly, technical decisions must be people-oriented and not a technical or regulatory framework (ES-02).

All interviewees agree on the need for more comprehensive financial incentives:

- The costs of rehabilitation should be more balanced and consider the economic difficulties of the tender's objective (ES-02).
- Present incentives are not sufficient. General renovation grants are helpful but not enough. Other specific supports and measures are necessary to promote rehabilitation in vulnerable districts with a lower-middle income. A potential solution is finding innovative figures to manage the financing and even for the renovation works itself, such as the figure of a "delegated promoter". (ES-05)

The facilitation and communication tools are the key to the success of future district-scale renovations and renewable implementation:

- Public administrations must all go to one; for that, the OSS concept works much better, as it helps avoid partial information that could give a contradictory message or generate mistrust (ES-01).
- A municipal Rehabilitation Office is necessary, that is, a general reference for the inhabitants that can offer all the information for rehabilitation, with demonstrative projects or reliable numbers to explain examples of budgets and applicable legislation. (ES-05)
- Peer-to-peer communication is important. They better trust a message that comes from neighbours like them. It helps them better understand the potential benefits and the entire renovation process (ES-01).

"Word of mouth from someone who has already rehabilitated works very well, it is contagious."

Municipality Urban Rehabilitation Society,
Spain

- Help inhabitants visit or get to know nearby buildings that have already been renovated. (ES-01).
- Having meetings from the beginning (ES-06) would have been better.

An interesting action plan to prioritize the key actions was suggested by a policy stakeholder (ES-04): start making an urban diagnosis to detect vulnerable areas, identify the most adequate financial instruments, assess the convenience of minimum energy requirements, organize local energy desks and OSS, and finally generate reliable and useful information based on the local situation.

6.8 Sweden

6.8.1. Policy context in Sweden

The goal is that Sweden should have no net emissions of greenhouse gases into the atmosphere by 2045 at the latest. This target means that national emissions of greenhouse gases must be at least 85% lower in 2045 than in 1990 (Climate Act 2017: 720). There is also a national goal to achieve 50% more efficient energy use in all sectors by 2030 compared to 2005 (Boverket & Energimyndigheten, 2019).

In the building sector, 3% of the buildings are directly heated by gas and oil. The remainder is heated by district heating (57%), electricity (including heat pumps) (26%) and biomass (14%) (Energimyndigheten, 2019). Around 90% of multifamily buildings and around 17% of single-family buildings are heated by district heating. Of the fuels used to produce district heating, 6% are fossil (Boverket & Energimyndigheten, 2019). Electricity is 99% non-fossil (produced from hydropower and nuclear power). Consequently, the carbon emissions from the building sector are low, around 10% of the total Swedish emissions (IVA, 2020).

However, the building stock accounts for much of Sweden's total energy use. In 2017, the housing and service sector accounted for 39% of the total energy use in Sweden. Heating and production of hot water in buildings accounted for 60% of the final energy use in buildings. (Boverket and Energimyndigheten, 2019).

In Sweden, a substantial proportion of the existing buildings were built between 1940 and 1980, accounting for a significant proportion of the total energy use in the building sector. The pace of renovation of older buildings is slow, and only 15% to 25% of the buildings built before 1981 were expected to have undergone a renovation by 2020. (Boverket and Energimyndigheten, 2019). Moreover, renovation does not necessarily mean that energy efficiency is achieved at the same time. According to Boverket and Energimyndigheten (2019), the current policy instruments and the current renovation rate will result in a relatively low degree of energy efficiency in 2050.

Existing policy instruments include financial (e.g., credit guarantees, energy and carbon dioxide tax, tax reduction on renovation works), administrative (e.g., building regulations) and informative (e.g., municipal energy and climate advice and energy declarations of buildings).

To achieve the national energy efficiency target by 2030, the building stock needs to have higher energy efficiency. In addition to reducing the energy demand, such improved energy efficiency will also increase the energy system's flexibility and cut power peaks (Boverket and Energimyndigheten, 2019). Boverket and Energimyndigheten (2019) propose further investigating the following economic instruments: rent subsidy after renovation, tax-free maintenance funds and improved renovation support. Further development of the energy declaration system and stricter amendment rules to the building regulations are also considered important to achieve the goals.

There are no policy instruments for energy renovation at the district level. Moreover, the financial support for renewable energy is limited. Private homeowners can get a grant which equals 15% of the total investment costs for PV panel installation. Both homeowners and housing cooperatives get tax reductions in proportion to the surplus energy sold to the electricity grid.

6.8.2. Perceived use and interest, importance, and difficulty of proposed policy instruments

Policy instruments such as energy standards, financial incentives, energy desks and local websites were mentioned (SE-01). For example, the municipality's representative mentioned that they offer advice on energy saving via the internet or phone and that their website provides films and webinars on energy efficiency measures (SE-01). Regarding energy standards, these are issued on a national level and concern individual buildings and not districts. Moreover, improving energy efficiency to the same degree as in new buildings is difficult. The reason is that it would not be cost-effective, and deep renovation would require people to move out of the buildings (SE-02).

Local authorities create some financial incentives, e.g., the municipality can give bank guarantees to its housing company which can borrow at a very low-interest rate (SE-01). However, the municipality cannot force the private actors – i.e., private homeowners, private housing companies and housing cooperatives – to improve energy efficiency (SE-01). The interviewee from the municipality (SE-01) found it difficult to provide financial incentives for groups of homeowners and to create renovation services in districts.

6.8.3. Reflections on regulations and incentives

The interviewees mentioned incentives as important rather than regulations. According to the interviewee from the municipality, the current renovation needs of the buildings from the 1960s and 1970s are considered a good opportunity to also improve energy efficiency and install renewable energy to lower the carbon emissions related to the district (SE-01). A representative of the municipal housing company (SE-02) who was involved in renovating such an area, argued that one important incentive for the energy renovation was to lower the operational costs. However, energy renovations always need to carry their own cost, there must be a reasonable payback time (SE-02). Another incentive to carry out energy renovation at the district level is that it increases the properties' value and improves the area's status (SE-01).

6.8.4. Reflections on organising facilitation and communication

The Swedish interviewees stressed the importance of good stakeholder dialogue and communication with residents when performing energy-efficient renovation at the district level (SE-01, SE-02).

However, a disadvantage of involving many stakeholders can be that communication is time-consuming (SE-01). One interviewee stated that being part of a large EU project required more connections with different stakeholders, which led to better communication (SE-01). The large-scale renovation created the opportunity to include the contractor early in the process, enabling their knowledge and involvement throughout the process (SE-02). The fact that the municipality's district heating company was included in the project led to new and improved pipes in the ground. The involvement of many stakeholders made it possible to learn from each other (SE-01).

"There were many stakeholders, many tenants, large amount of money involved. It is important to get everyone on the same track, it requires a lot of coordination. Sometimes there are different opinions, different interests and misunderstandings."
Project manager of a municipal housing company, Sweden.

The involvement of the residents, mainly low-income people, was important to create trust and increase user satisfaction. It was a difficult period for them with disturbance during the renovation and a slight increase in the rent after the renovation. However, the fact that the tenants could influence some things, for example,

the design of the outdoor environment, probably made them more positive about the whole renovation project. (SE-02)

6.8.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

There are obviously many advantages to energy renovation at the district level. In the Swedish examples, the renovation took a comprehensive approach and became more efficient and cheaper to do (SE-02). Renovating many buildings of the same type enabled a lower price by the contractors, different resources and experts in different fields could be linked to the project and social aspects could be included (SE-02). The cooperation with the district heating company led to new and improved pipes in the ground and more substations for the district heating being installed, resulting in lower heat losses (SE-01). The larger scale of the project also made it possible to install PV cells on some of the common buildings in the district (SE-02). As regards the use of renewable energy, one interviewee, however, pointed out that there might be a psychological barrier to combining energy efficiency and renewable energy due to high investment costs (SE-02).

Now there are no policy instruments in Sweden directly aimed at energy renovation at the district level. Regarding renewable energy, there are only incentives for private homeowners but none for housing companies. Thus, there is a need to develop policy instruments for energy renovation and the installation of renewable energy at the district level.

6.9 Switzerland

6.9.1. Policy context in Switzerland

Like most other countries, Switzerland is a signatory of the Paris Agreement. Thus, the objective is to limit climate change to the extent that average global warming is kept within 1.5 °C compared to pre-industrial times. The government has explicitly communicated that it supports this target. However, national plans for reducing carbon emissions are not yet sufficient to contribute to that target in a way required on average by countries around the world to achieve.

In Switzerland, regulations on buildings are primarily the responsibility of cantons, according to the Constitution. Attempts were made to introduce nationally binding carbon emission limits for buildings. The related CO₂ law, which would have introduced such limits, was rejected by the population in a referendum score in June 2021. The law was mostly rejected for reasons other than CO₂ limits for buildings, so possibly soon, there will be an agreement at the national level to introduce them differently. Nevertheless, for now, there are no carbon emission limits on buildings, and regulations on reducing the energy use of buildings or switching to renewable energy-based heating systems exist only at the cantonal level.

The regulatory framework on buildings differs from canton to canton. In the canton with the most advanced legislation currently in force, the canton of Basel-Stadt, there is a law requiring building owners to switch to renewable energy-based heating systems unless the switch is not cost-effective or technically not feasible. Through a strong subsidy programme in combination with its Energy Act, the canton of Basel-Stadt ensures that most switches to renewable energy-based heating systems are cost-effective for the owners. The canton of Zürich has adopted a similar regulation in November 2021, which requires a switch to renewable energy-based heating systems unless this switch is not cost-effective. The canton of Glarus even goes a step further by requiring a switch to renewable energy-based heating systems without exceptions, even if it is not cost-effective, in a new law adopted in September 2021. Most cantons, however, have less stringent regulations in place. They follow the “Mustervorschriften der Kantone im Energiebereich” (MuKE), a good practice guidance for cantonal laws on energy in buildings. This guidance contains, among many other aspects, standard

values concerning the efficiencies of the building envelopes. It also recommends requiring building owners to cover at least 10% of standard energy consumption by renewable energies or to reduce energy consumption beyond the existing standards to comply with that requirement. Furthermore, it foresees the obligation to install PV panels if a roof is newly constructed or renovated, with the possibility of paying a fee for obtaining an exemption.

There is a national CO₂ levy on fossil heating fuels at CHF 120 per ton of CO₂ emissions. All cantons participate in a common subsidy programme, which is funded by a third of the revenues of the CO₂ levy. Subsidies are provided for energy efficiency measures on the building envelopes and the switch to renewable energy-based heating systems. Two-thirds of the revenues of the national CO₂ levy are reimbursed to the population and companies.

At the national level, a communication campaign is carried out to encourage building owners to switch to renewable energy-based heating systems.

Building performance certificates, Gebäudeenergieausweis der Kantone, GEAK, are harmonized across cantons. There is an offer for providing these GEAKs with an advisory report. The related offer is called GEAK Plus. Developing such a GEAK Plus is often a prerequisite for obtaining subsidies for building renovation from cantons or communes.

Labels play a significant role at the level of individual buildings. A widely supported label called “Minergie” certifies energy-performant buildings complying with standards beyond those required by law. It also contains the categories “Minergie P” for buildings achieving energy standards like the passive house standard and “Minergie A”, which, among others, produce at least as much electricity from renewable sources as they consume yearly. Many cantonal subsidy programmes are linked to the achievement of respective Minergie standards.

There is a specific federal programme that encourages groups of buildings to become energy efficient and reduce carbon emissions, entitled “2000-Watt Sites”. However, this programme has been able to certify mostly the construction of new sites so far. The branch of the programme that addresses existing buildings has so far not found widespread application.

In Switzerland, local authorities have a high degree of autonomy. The Federal Constitution and the cantonal constitutions grant local authorities the right to be autonomous to the extent that this is granted or at least not restricted by superior law. Therefore, local authorities have a large scope of competencies to promote building renovation at the district level.

6.9.2. Perceived use and interest, importance, and difficulty of proposed policy instruments

Regarding the **use of local policy instruments**, it was found that interviewees who represented local authorities had experience with most of the eight investigated policy instruments for promoting building renovation. At least one local policy actor had used each of these policy instruments. The policy instruments the largest number of policy actors had used are enforcement of energy standards, local energy desks or similar consultancy services, and dedicated local websites. The policy instruments that the smallest number of policy actors used are financial incentives for specific districts and the creation of renovation services for districts.

Regarding the **importance of local policy instruments**, it was found that all eight policy instruments investigated were, on average, rated as important rather unimportant. Enforcement of energy standards, financial incentives for specific districts and dedicated local websites were the most important, while inspections and energy audits in districts were the least important.

Regarding the **difficulty of local policy instruments**, it was found that most policy instruments investigated were considered more difficult than easy to implement. The policy instruments that were the easiest to implement are dedicated local websites, local energy desks or similar consultancy services, and district networking meetings. The policy instruments which were the most difficult to implement are inspections and audits, enforcement of energy standards, and creation of renovation services in districts.

The high perceived importance of enforcement of energy standards is noteworthy because the high rating was given even though this policy instrument is difficult to implement.

In Switzerland, local authorities have, in principle, large scope of competencies to promote building renovation at the district level. This may be the factor that can partly explain why, on average, all investigated local policy instruments were found important rather than not important.

6.9.3. Reflections on regulations and incentives

Regulations are an important policy instrument for the interviewees. This does not just concern regulations at the national or cantonal level, but also regulations at the local level. All five local authorities interviewed have already made use of the policy instrument. Most interviewees considered the policy instrument difficult or rather difficult to implement, and only a few considered its implementation to be rather easy.

Regulations differ according to the type of buildings or building areas they target, the scope of the requirements and accordingly also their impact.

Examples of regulations at the local level which allow local authorities to promote sustainable renovations at the district level beyond the national and cantonal requirements are the following:

- Higher energy efficiency standards or requirements to use heating systems based on renewable energy carriers can be implemented for buildings or areas newly built (CH-05, CH-06).
- Standards on existing buildings can be imposed at the time modernizations happen, e.g., a replacement of a heating system. Such requirements may then be applied to specific zones within the city or the entire territory of the city. Typically, such requirements are linked to specific zones as distinguished by the city energy plan. The city of Zürich intends to introduce such a requirement, for example, in certain parts of the city covered by district heating. The city of Luzern intends to introduce such a requirement in all parts of the city where geothermal heat pumps are in principle possible.
- Standards could be implemented, in principle, also requiring buildings to be energetically modernized within a given period or to switch their heating system to renewable energies within a certain period. No example of a local authority having adopted such a regulation has so far been found.
- If a building owner intends to use groundwater as a heat source, the owner may be required to invite neighbours in their district to join a small-scale district heating network to exploit groundwater heat. Such a requirement exists in the city of Zürich (CH-04).
- Building owners may be required to connect to district heating (CH-02).
- Energy needs limits could be defined per district, not just per building (CH-02).

As two of the interviewees pointed out, mandatory requirements are interesting when the local authority can offer something "in return" (CH-06 or, if there is "a negotiation" (CH-03). For example, higher energy standards can be required "in exchange" for granting the possibility to build an additional floor level in a building or to increase the building volume in other ways through utilization factors (CH-06). Complying with the higher energy standards is then not an obligation per se, yet part of an option, which only entails a requirement if the concerned building owners decide that they would like to benefit from the option provided to them. Authorities can accordingly ask for compliance with stricter requirements in return for benefitting from an exploitation bonus (CH-03).

Standards affecting only new buildings have a small impact, as new buildings are already energetically advanced and, compared to the existing building stock, only a small share of buildings is newly built each year. It makes sense, therefore, if regulations also affect existing buildings. Regulations may affect the entire territory of a commune or another type of administrative area. Regulations have potentially a large impact, as they may affect at once all buildings of a territory.

However, there is also some hesitation or opposition to introducing regulations. This may be due to a general lack of will to change (CH-01). Nevertheless, there may be specific reasons behind this hesitation. Local authorities in particular fear that for far-reaching mandatory measures, it may be challenging to find acceptance/majorities (CH-05). The opinion of the executive committees of the cities/communes in question plays a key role in this matter. For example, there is an example of a city where the executive committee was initially opposed to introducing binding standards through regulation, to avoid limiting the building owners' options too much (CH-06). Fears were that this would cost too much for building owners, that some areas might not be developed if restrictions are too high, and that binding standards would go against the liberal principles of conservative political parties.

Such fears or hesitance may partially be overcome by deciding first on the principle of introducing regulations, before deciding on the application of such principles in specific areas (CH-06). In the mentioned example, it had been easier to find endorsement in the executive committee of the commune for the principle of introducing stricter energy standards, rather than to apply it afterwards to specific areas where that principle concretely affected building owners. However, once the principle is agreed on, other players, such as the regional government or also the public, can then call for compliance with or application of that principle, thereby "forcing" the city/commune to stick to what it decided on in principle. This was the case in the commune in question. The commune had adopted the standard as a principle; however, it first did not implement it. Nevertheless, it was then forced to implement it by the superior cantonal administration.

However, the fear of lack of acceptance is likely to be driven by what policymakers consider to be the will of the scorers. Accordingly, explaining to the public and discussing with citizens the necessity of introducing regulations is a crucial factor. Such exchanges may increase the support for such measures among citizens and, as a consequence, increase also the willingness of policymakers to adopt regulations as a policy instrument with a high policy impact, once they are more confident that such measures are supported by the public.

Within this context, one factor that can increase willingness to introduce regulations is if such requirements are introduced through a score by citizens (CH-06). If there is acceptance for such a regulation by the scorers, the related requirements may have a high legitimacy and acceptance, also by building owners directly affected by them.

Another factor which could increase acceptance is if more ambitious energy standards first just apply to specific areas where new buildings are being built; the standard could then be expanded to areas with existing buildings. However, this automatically raises issues of unequal treatment of building owners; thus, it may potentially be fairer and easier to introduce regulations if they apply to the entire territory of the administrative area adopting them.

A challenge which remains, however, is that sometimes it is legally not clear how far the competencies of a local authority go. It may be, for example, unclear to what extent a city has the competence to require building owners to connect to a renewable energy-based district heating system (CH-07). Some local authorities move forward without being absolutely sure that they are legally within the scope of competencies of a local authority (CH-05, CH-07). In practice, decisions by local authorities are well accepted and seldomly challenged legally (CH-07). Nevertheless, from the point of view of local authorities, it can be understood that uncertainties concerning their legal competencies are a valid reason not to introduce certain regulations.

Contractors are not in favour of binding standards, as in the end, they need to be competitive. They want to get customers because they make a good offer, not because the state requests building owners to connect (CH-06). However, it is important to recognize that this is their perspective as market actors, who also know that they cannot rely too much on government regulations, as such regulations may change. This type of reasoning may not necessarily apply to local authorities as they are considering the public interest for introducing regulations.

Apart from legal limits, there are also other limits to regulations. Regulations are only as impactful as they are complied with.

In addition, regulations may create unnecessary opposition to the promotion of renewable energies. People are in general supportive of renewable energies; however, they may prefer to decide individually. As soon as there are mandatory requirements, opposition forms, one of the interviewees remarks (CH-09). A counter-argument to this could be that regulations are in principle a “fair instrument”, as it affects all building owners in the same way, whereas relying on voluntary measures creates differences in economic burdens for those who undertake measures to switch to renewable energies or carry out building renovation measures, and those who renounce to such measures, whereas all of them benefit from the main positive impacts of the measure, which is to make a contribution to limit climate change.

Furthermore, regulations may not be able to address all policy objectives. For example, it is considered not to be possible to require a building owner to connect to a district system if instead, they are using another type of renewable energy-based heating system. Nevertheless, a local authority may have an interest in that as many building owners connect to such a district heating system as possible. Thus, there may be interests of local authorities that cannot be enforced through regulations. An example from one of the communes from which employees were interviewed is that some building owners intend to construct geothermal heat pumps in areas foreseen to be covered by district heating; even if this technology is carbon-neutral, this solution may not be ideal in an area where a district heating system is available, as it makes the district heating system less attractive (CH-07).

Regulations are not considered to be a policy instrument that can be introduced easily. It is challenging to obtain the necessary majorities for introducing requirements. There is resistance from building owners and hesitation by policymakers out of fear of alienating scorers. However, regulations are considered to be “highly effective” (CH-07). Once introduced, it may be much easier to implement in comparison with the process for introducing the instrument (CH-05). Cantons who have been able to introduce such requirements prove that they work once introduced (CH-8). The difficulties associated with this policy instrument may, therefore, reside mainly in obtaining majorities for its introduction and not in its implementation.

“Requirements are needed, otherwise it can’t be done”

Energy programme manager, Switzerland

One of the respondents of the interviews considers that mandatory requirements are essential, otherwise, the necessary transition cannot be achieved (CH-08). This interviewee considers that regulations are necessary to ban fossil fuels and intervene in building renovations.

The main argument is that there are too many building owners who think they can do “whatever” they want. It is acknowledged that requirements are difficult to implement, though, when it comes to increasing the energy efficiency of building envelopes, as such measures are associated with high costs. The interviewee, therefore, considers that the most important measure is to make a switch to renewable energy for heating mandatory, if temperature levels permit, and to make it mandatory to renovate building envelopes, first only to the extent necessary to introduce renewable energy-based heating systems; district solutions through a connection to a district heating system may be the easiest way to comply with that requirement, yet options could be left open to make use of heat pumps or wood as other important options (CH-08).

It is worth noting that regulations may also have the opposite effect of blocking building renovation, for example by disallowing the use of solar thermal in certain areas, or through restrictive regulations regarding noise, which can prevent air-source heat pumps from being installed (CH-02). Uncertainty or a lack of knowledge about how to comply with a related regulation can also be an obstacle. A principal element for promoting building renovation is, therefore, also to remove to an appropriate extent such obstacles, make regulations easier to understand and provide information on how to comply with regulations (CH-02).

Another aspect regarding regulations is to ensure compliance with them, for example through inspections. An issue is that inspections often occur too late, at a moment when nothing can be done anymore (CH-08). The challenge is to carry out the inspections at the right time when works are ongoing. This critical moment is often missed (CH-04). Furthermore, many smaller or rural communes do not have the technological knowledge, staff or qualified specialists or financial resources to carry out inspections (CH-04, CH-07, CH-08). Communes may also fear making taxpayers angry when they ask for changes once installation has been completed. This way, it is important to make inspections at an early point of construction (CH-08). Furthermore, randomized inspections can be carried out to reduce the number of necessary resources (CH-06). The acceptance of inspections can be improved if it is emphasized that they also protect building owners from companies who do not build according to the plans and that inspections also have the function of providing advice to building owners (CH-04).

Overall, regulation is expressed as a versatile instrument with potentially high impact. Although there are often hesitations in its introduction, these can be overcome. In the future, it is expected that this policy instrument becomes even easier to implement, as renewable energy technologies become more competitive (CH-06).

It is acknowledged by stakeholders interviewed that investment costs are a barrier to renovation at the district level. **Financial incentives** may reduce or overcome this barrier by increasing the cost-effectiveness of renovation solutions at the district level, or, more specifically, by decreasing investment costs.

Investment costs are often a barrier, as young families lack the money to make such investments, and investments are also often inconceivable for older generations (CH-02).

Therefore, some stakeholders conclude that there is currently a lack of financial incentives (CH-02). Financial incentives in the form of subsidies may in principle be introduced by authorities at all levels of government, from the national to the local level. A challenge for subsidy schemes is that they may take a long time to be frequently used and successful. As one example of a city shows, a new subsidy programme did not run well at the beginning. However, the longer it was running, the more successful it became. It took ten years to make it well known and well accepted, although even now some people continue to say that they are not aware of the subsidy programme (CH-07). The introduction of the policy instrument is, thus, challenging, but easy to maintain once it is implemented (CH-05). Once successful, subsidy programmes, however, may become the victims of their own success. A potential problem with subsidy schemes is that they may run out of funding. Once the programme is interrupted due to lack of funding, this is detrimental to the success of the programme because people become disappointed (CH-07).

Concerning the promotion of renovation solutions at the district level, several types of subsidies can promote such solutions. Subsidies may be, for example, provided for connections to district heating systems (CH-04, CH-05). In addition, subsidies can be paid for the replacement of fossil fuel-based heating systems with systems based on renewable energies. Such subsidies can in principle also be paid for contracting services through which heating systems are installed by an energy company and building owners pay a regular fee for this service. A key aspect in this context is that financial incentives are provided considering the gross floor area of the buildings in question, and not directly the heating capacity of the system, so as not to treat

buildings that are not well insulated better than those that are well insulated, what could discourage energy efficiency measures in buildings (CH-05).

The cost-effectiveness of renovation solutions at the district level is a relative concept; cost-effectiveness depends on a comparison with a reference scenario, and in this scenario, costs associated with energy carriers are key. Some stakeholders point out that “energy is still too cheap” in their perspective, in particular fossil fuels (CH-03, CH-08).

Carbon taxes may increase the cost-effectiveness of renovation solutions. If energy is more expensive, investments in renovation solutions at the district level are more easily justified (CH-03). Switzerland has such a CO₂ levy. However, the level of such carbon taxes is decisive. The current level of the carbon levy, at CHF 96 per t of carbon emissions at the time of the interviews, is expressed to be low, having only a small influence (CH-08). Carbon taxes could be increased and thus become a much more powerful policy measure. “At some point, they will hurt”, if they are increased, as one interviewee points out (CH-08). However, it must be considered that more people fall into energy poverty if taxes are increased without compensation measures. This may even be counterproductive for encouraging investments in building renovation. Such carbon taxes can be introduced at the national level in Switzerland, but not at the level of individual cantons or communes. An increase in the maximum level of the carbon levy has been rejected by scorers as they rejected the carbon law. However, cantons or communes may introduce other types of levies at the cantonal level or the local level, which make renewable energy solutions more attractive, and which provide revenues that can be used for subsidies to promote renovation at the district level.

Carbon taxes or other types of energy charges may be linked to subsidy programmes, as these taxes generate revenues which can be used for a specific purpose such as subsidy programmes. Subsidies from cantons are partially financed through the own budget of the cantons, and partially through revenues from the national carbon tax. Up to a third of the revenues of the carbon tax can be used for the subsidy programme to renovate and decarbonise buildings. In addition, various local authorities have introduced or are considering the introduction of local charges on gas or electricity. Local authorities normally would not have the necessary funding for subsidy programmes unless they find such additional revenues. The possibility of introducing such charges on energy carriers is therefore an important precondition for allowing them to introduce their own subsidy schemes. In connection with district heating systems, there is another possible source of revenue for local authorities: concession fees (CH-06). However, introducing such concession fees would reduce the attractiveness of district heating solutions if they also apply to renewable energy-based district heating systems. The legal possibilities for introducing charges or concession fees for local authorities are often not clear and require clarification (CH-06).

A factor which may increase acceptance of carbon taxes is if the revenues are reimbursed to the population and companies, as this is the case for two-thirds of the revenues of the Swiss CO₂ levy. This also offers an elegant way of reducing the issue of energy poverty when taxes are increased. If all the revenues of such a levy were reimbursed to the population on a per-person basis, most people could even benefit from such a tax with reimbursement, as the median energy consumption per inhabitant is lower than the average energy consumption. In Switzerland, reimbursement is made through discounts on the bills for health insurance for citizens. Companies receive reimbursements based on the total salary indicated for their social security employees. This reimbursement creates many winners, or at least lowers the financial burden for households and companies affected by the tax. Such a redistribution is feasible at the national level but would probably be too complex to handle at the level of individual cantons or communes.

The provision of financial incentives, such as subsidies, may be linked to other policy instruments. For example, to receive building renovation subsidies, many cantons or cities require, above a certain number of subsidies, that building owners applying for subsidies also carry out an energetic assessment of their building to determine its energy performance and obtain support from a consultant for a report with recommendations.

6.9.4. Reflections on organising facilitation and communication

Regarding **facilitation**, the following was found:

Achieving a district solution for groups of buildings with various building owners is a complex task. Bringing together various owners is accordingly challenging. The ownership structure has an important impact on the complexity of the task (CH-02).

This may make it necessary that the planning and implementation of such district solutions are coordinated by local authorities (CH-02) or at least strongly supported through assorted services by local authorities, including coaching services, as one interviewee explained in detail (CH-08). The question is who would carry out the related services if local authorities do not do it. Such services are costly. For companies, the necessary effort to bring together various building owners for a district solution is immense. All this effort leads to acquisition costs for a company until the solution is implemented. This makes such efforts highly risky. At the very last moment, such projects may fail if key building owners decline to participate or withdraw. The interviewee considered that for companies, therefore, pursuing such projects often does not make sense. It is a task for local authorities to accelerate the energy transition in districts, and it is accordingly important that local authorities offer such services.

Within the planning and implementation of district solutions, timing is important – if the process takes too long, some heat consumers choose other solutions and, therefore, do not participate in the district project (CH-2).

Energy companies may also play a significant role in providing such services (CH-05, CH-08). This may be true for public energy companies and may, therefore, provide energy services in part irrespective of the economic attractiveness and high risks associated with such projects if such services are deemed important to a public good such as energy transition. In various cities, thus, local energy companies offer services to building owners to support renovation projects at the district level. If energy companies offer such services, local authorities may not consider it necessary to offer related services other than those (CH-05).

Necessary services in this context include bringing owners together, identifying appropriate solutions, and coordinating, carrying out, accompanying, or supporting the evaluation of calls for tenders (CH-04, CH-07, CH-08). So far, such district-related energy services mostly focus on district heating; for energy efficiency measures, district approaches are more challenging. In general, each owner manages them independently (CH-08).

The city of Zürich provides an example of a city that offers particularly broad support for district projects. It offers a contact point for citizens who intend to explore the possibility of district heating solutions. The city supports the process of organizing the owners among themselves. It carries out networking events for the building owners in question. It supports them in obtaining and evaluating offers for common heating solutions. Overall, it provides comprehensive support for owners interested in a district heating project.

There is also an opportunity for local authorities to cooperate with energy companies as contractors in the provision of district services to building owners (CH-07). The local authority can help, for example, to provide data on potential customers, and the energy company can then contact them individually.

"When the city hears about a renovation project, it is often too late."

City employee, Switzerland

As far as contacts with building owners are concerned, a proactive approach is necessary because, for cities, it is a challenge to know in advance when a building is going to be renovated to be able to provide inputs to building owners (CH-06). This is probably true, in particular, for district projects. Unless an energy actor such as a local authority

proactively contacts building owners, it is likely that building owners develop renovation projects on their own without considering the option of district approaches.

Interviewees underline the importance of advice to building owners. Building owners often don't consider all the facts or they are at least unsure which are the best solutions (CH-01). Various technical aspects are not easily understood by building owners, e.g., the synergies between building insulation and heating systems, the importance of making a building airtight, the necessity to accompany this with a ventilation system, and the importance of heat recovery. Most building owners do not have related knowledge of building physics.

Furthermore, there is a need to carry out life cycle cost assessments to support decisions by building owners (CH-01). As renovation solutions at the district level typically have high investment costs, yet lower energy costs, life-cycle costs may overall be favourable for renovation solutions at the district level. However, there is a lack of perception of such attractiveness of renovation solutions, as many building owners and companies simply consider investment costs, while life cycle costs are often not considered (CH-02, CH-08). This is a challenge. Renewable energy-based solutions rapidly become attractive if life cycle cost assessments are made (CH-08). This opens up the opportunity to address renovation solutions' perceived lack of financial attractiveness at the district level, shifting people's perception from investment costs to life cycle costs. Therefore, life cycle cost assessments are an important element of advice that can be transmitted to building owners.

It is considered by several interviewees as particularly important, to have at least one information point available for interested building owners where they can obtain advice. Typical offers include obtaining first advice for free or at low costs (CH-04, CH-05, CH-06, CH-07). Consultants may be employees of cities or private consultants. A pool of such private consultants may either be selected by public authorities, or public authorities may require such private consultants to have completed specific training. Consultancy support may extend over the entire duration of a renovation project (CH-04, CH-07). Such consultancy support is called energy coaching. This includes advice on calling for and comparing offers from companies. Apart from offering such services, it is also important to make such advisory points known (CH-08). Local authorities or cantonal authorities usually offer various forms of such consultancy services for building owners. However, these offers so far are mostly addressed to individual building owners. There is an opportunity for the provision of such consultancy support. Building owners are also informed about options for renovation projects at the district level.

A challenge is that not all heating installers or other building professionals support the energy transition or are sufficiently aware of innovative solutions to facilitate this transition. As building owners often contact them rather than consultants offered by public authorities, some building owners may not be properly informed about their options for renovating their building (CH-02). While this statement may be exaggerated, because in many cantons there is at least a requirement to cover 10% of previous fossil fuel consumption through renewable energy or to further reduce energy consumption by that amount through efficiency measures, this reflects the challenge that heating installers who are not supportive of the energy transition may have, causing a strongly discouraging effect on switching to heating systems based on renewable energy. One interviewee even considers that most building owners communicate with a heating engineer who simply focuses on replacing components (CH-02). Furthermore, a lack of willingness by specialist planners has been identified to implement innovative solutions (CH-03). Therefore, it may make sense to help all heating installers and building professionals consider building renovation opportunities by directly providing them with appropriate training and support programs (CH-08).

An information point offered by a local authority for building owners may be used for providing advice and coordinating authorization procedures for building renovation with local authorities (CH-8). Such information points may be one-stop-shops for citizens interested in building renovation projects (CH-01). It could be

conceived that such information points at the same time also provide support in obtaining financing for renovation projects.

One possibility to increase the likelihood that building owners will obtain advice from energy consultants is to make such advice a prerequisite for additional support from authorities, for example, in the form of subsidies, as already applied by some cities and cantons (CH-07).

Whereas advice is expressed to be of high importance, some interviewees also point out that an evaluation of the outcomes of consultancy services is now lacking (CH-06, CH-07). The extent to which energy advisors are supportive of the ambitious new energy targets is unclear. It is also unclear how suitable the options consultants describe to building owners are. Problems have occasionally occurred when building owners have obtained assessments from energy consultants based on incorrect assumptions, leading them to make questionable decisions (CH-07). Accordingly, based on evaluation results, there is probably some unused potential in making advisory services more effective.

Depending on the evaluation results, potential measures could be strengthening the training of energy advisors or involving additional independent consultants in the advisory process, even if only through random checks or general supervision.

To provide advice for district projects, some local authorities had good experiences in financing or at least supporting feasibility studies for such district projects (CH-07).

Regarding **communication**, the following was found:

Communication is an important or a very important policy instrument for interviewees. Most interviewees consider this policy instrument rather easy to implement.

Some respondents refer that it is important in this context to communicate energy plans or other types of maps that show options for renewable energy sources or possibilities for connection to district heating systems (CH-05, CH-06).

A good example of such a communication tool is the website of the city of Zürich. It offers a map where every building owner can look up their building and easily recognize whether there is already a renewable energy-based district heating system under construction or in planning for that location. Furthermore, it is indicated for each building which type of renewable energy systems can be used for heating purposes and where in principle, geothermal heat pumps are allowed. Similar maps are, in part, also available at the national level.

It is important that this information can be made available directly to citizens and is made known to the extent possible. There is often an asymmetry in access to information, the city knows more than the citizens; this asymmetry must be "levelled" (CH-06).

In addition, valuable information to communicate are advisory options and possibilities for obtaining subsidies (CH-07). Furthermore, one of the interviewees emphasized the importance of communicating good examples of already implemented renovation projects to building owners (CH-05).

"Spreading of ideas through word of mouth is important."
City employee, Switzerland

As bringing together various building owners for district projects is challenging, networking meetings among building owners can be a suitable tool. Networking meetings are important because participating in a district solution involves not only economic questions but also social questions, such as whether there is any interest in sharing a heating system with neighbours (CH-08), since, even though such systems may have advantages, they also bring interdependencies. Participants in a district heating project often share certain costs, which require trust (CH-01). Furthermore, there are associated practical issues such as heat metering

and individual cost allocations. There is also the issue of how local energy communities are perceived in a municipality by administrations. As small municipalities often do not have energy experts, there can occur misconceptions about energy communities and they can be seen as unwanted challenges or even burdens.

Various local authorities have already made use of this policy instrument (CH-02, CH-04, CH-05, CH-06, CH-07), mostly with good experiences. Participants in such meetings are building owners, a potential contractor or an energy company, and the local authority. The meetings serve to present the project and to hear the first opinions from building owners.

In organising such networking meetings, appropriate timing is important (CH-06). If communication happens too early, then information on the foreseen solution, in particular expected prices, is likely to be inaccurate, leading to disappointments; if communication occurs too late, on the other hand, some building owners already have their own solutions.

Communicating upfront about district projects and being transparent from the beginning about expected costs should be considered. District solutions are always in competition with individual systems. District heating is often not the cheapest solution. Trust and interest from building owners can best be earned through early involvement and a transparent process (CH-06).

It is often not necessary that local authorities organize such networking meetings on their own; energy companies or contractors may be in the lead, and, in such cases, local authorities can merely accompany related processes (CH-06). A key success factor of such networking meetings is whether at least one building owner is highly motivated to engage in a district solution project (CH-08).

Labels can also be an important communication tool. Labels make it easier for building owners to recognize whether a certain building or building group conforms to advanced energy standards. There is often some hesitation by planning companies to promote such labels (CH-03). This is partly understandable, as labels are a service for the building owner and imply more quality control of the companies' work. Even more important is that building owners are made aware of such labels so that they can benefit from their advantages by demanding label-compliant building renovation solutions.

6.9.5. Viewpoints on renovations at the district level combining energy efficiency and renewable energy

In general, it was considered that building renovation projects in districts which address both a switch to renewable energy-based heating systems and an improvement of the energy efficiency of building envelopes is challenging because bringing together various building owners for a district heating project is already a complex task in itself. Accordingly, it was estimated that potential synergies between both types of measures would be under-exploited without further measures.

There are various potential measures available to public authorities for promoting building renovation at the district level combining renewable energy measures and energy efficiency measures:

"The potential for synergies between switching to renewable energy-based district heating and energy efficiency measures on building envelopes is underexploited"

City employee, Switzerland

- Regulations could be introduced to ensure district heating tariff structures are attractive (CH-02). This could include measures to ensure that incentives remain to carry out energy efficiency measures in case of connection to a district heating system. Regulations could, in principle, also go further, making renovation projects combining renewable energies and energy efficiency measures mandatory.
- The construction of a new district heating system could be linked to requirements regarding the long-term reduction of energy needs in the connected buildings through efficiency measures (CH-04).

- The provision of financial incentives for renewable energy measures may be linked to energy efficiency measures or at least their consideration. To receive building renovation subsidies (above a certain number), many cantons require the building owners applying for the subsidies also to carry out an energy assessment of their buildings to determine their energy performance and to obtain consultant support for a report with recommendations.
- Such conditions can be extended to link financial support for renewable energy measures to energy assessments of the building envelope. For example, this is foreseen by the commune of Mettmenstetten. This link could be extended to grant subsidies specifically for the combination of renewable energy measures and energy efficiency measures.
- Advice given to building owners may address potential synergies between energy efficiency and renewable energy measures.
- Local authorities' proactive coaching of district projects may increase the chances that synergies between energy efficiency and renewable energy measures are used.
- Building professionals can specifically be trained to be aware of the potential of such synergies.
- At networking meetings among building owners or at other events, the benefits of combining renewable energy and energy efficiency measures may specifically be mentioned.

To determine how available renewable energy sources and waste heat can be used most efficiently, spatial energy planning is an important policy instrument. This energy planning makes sense in a scenario where the heating systems of the entire city's building stock are transformed into systems based on renewable energy.

In addition, interviewees generally emphasized the importance of strategic documents and energy planning for promoting building renovation projects at the district level. Such documents may set the overall targets. It is important that such targets exist to give a clear direction to building owners and to encourage them to participate in the energy transition. Furthermore, since renewable energy potentials from sources such as waste heat from municipal solid waste incineration plants, wastewater treatment plants, and heat from surface water or groundwater are limited, map-based planning is important to give a direction on how available resources can be used most efficiently. Energy plans in the form of maps showing which type of renewable energy source is best used at each location are important for various other types of policy instruments, such as regulations, services and advice, as well as for communication. For example, if a district heating network based on energy from a lake is foreseen in an energy plan, this helps to attract interest from building owners in such a solution (CH-07).

It was found, however, that none of the interviewees was aware, so far, of transition plans to a fully decarbonised efficient heating system for all buildings in their commune/city. Currently, energy plans are mainly focused on identifying some particularly suitable areas for district heating and on the suitability of areas for various other renewable energy options. Still, there is, in general lack of strategies and plans for achieving a heating system in cities entirely based on renewable energies.

Overall, there is a general perception among interviewees that the promotion of renovation solutions at the district level is not only a task of the national or the cantonal government but that cities have a large influence in making district projects happen (CH-07), local authorities are well positioned to interact with building owners as they are the authorities closest to them (CH-06), and cities know from their experience in contacts with citizens that they have an impact (CH-06).

6.10. A European perspective

We provide a short reflection on the previous country discussions from a European perspective. According to the Energy Performance of Buildings Directive (EPBD), all EU countries established a long-term renovation strategy to support the renovation of their national building stock into a highly energy-efficient and decarbonised building stock by 2050. The strategies must include an overview of the national building stock, policies, and actions to stimulate cost-effective deep renovation of buildings, policies and actions to target the worst performing buildings, split-incentive dilemmas, market failures, energy poverty and public buildings, as well as an overview of national initiatives to promote smart technologies and skills and education in the construction and energy efficiency sectors. However, clearly identifying how district action could lead to upscaling renovation rates is not a mandatory part of these strategies initiated on the EU level.

In March 2022, the European Commission announced its plan to repower the EU by making Europe independent from Russian fossil fuels well before 2030 (European Commission, 2022). The short-term objective is to reduce fossil gas imports from Russia by two-thirds by the end of the year. In 2021, the EU obtained 43% of its fossil gas from Russia. The EU intends to rapidly diversify gas supplies and reduce its dependence on fossil fuels faster for buildings and industry than previously planned. Gas is a fuel which is often used in cities. Therefore, reducing the use of gas brings a particularly large challenge for cities to decarbonise their energy supply quickly. In this context, district projects as an approach to decarbonise entire districts further gain importance.

Some countries explicitly indicate their target year to reach climate neutrality: Austria, for example, by 2040, Germany by 2045, and the Netherlands and Switzerland by 2050. Belgium aims for the old building stock to follow the requirements for the new buildings by 2050.

To meet the objectives of the European Green Deal, Europe will need to boost the environmental performance of buildings in its Member States. Currently, about 75% of buildings in the EU are not energy efficient, yet 85-95% of them will still be in use in 2050. Renovations are happening, but as the analysis shows, the rate is still too low in all countries. Most countries aim for a renovation rate of 3% of the existing stock, which is now only between 0,12% (Spain) and 1.5% (Austria).

All examined European countries have started programmes to increase the renovation rate, but some countries also expressed concern that they lack clear monitoring of renovation processes.

Beyond the realm of good practice guidance, some countries and regions set targets regarding renewable energy use. For example, Austria aims to achieve a 100% supply of green electricity (from the share that is produced nationally) for households by 2030. In Germany, from 2025 onwards every newly installed individual heating must run based on at least 65% renewable energy. The Netherlands experiments with disconnecting 200.000 houses from fossil fuels by 2030. In Switzerland, the cantons of Basel-Stadt, Glarus and Zürich require building owners to switch to renewable energy-based heating systems when the heating systems are replaced, unless the switch is by more than 5% less cost-effective in the case of the canton of Zürich, or entails higher investment costs in the case of Basel-Stadt, after deduction of subsidies, or is technically not feasible (Basel-Stadt, Zürich).

When this report was finalized, new reforms of the EPBD and the Energy Efficiency Directive (EED) were on the way. They are expected to reshape and influence national decarbonisation strategies again in many ways. For instance, the Minimum Energy Performance Standards (MEPS), a *de facto* energy renovation obligation for the 15% worst performing buildings per country until 2030 as well as including the building sector in the European Union Emissions Trading System are being discussed. Currently, the outcomes and effects of district energy renovation activities are unknown as the decision-making process is ongoing at the EU level.

District approaches regarding planning, regulation, or funding might help to upscale the number of renovations, including energy efficiency measures and a switch to renewable energy systems and foster an integrated approach. This switch is highly influenced by overarching legislature or strategies – be it at the national, regional, or European level. This could be through EU funding schemes and concrete legislation like in the EPBD or EED. Also, overarching strategic policy documents like the New Leipzig Charter (EU2020.de, 2020) can help. 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 points to the need for national and regional urban policies to enable stakeholder dialogue, platform action, development or reallocation of national or regional funding and incentives for innovation (EU2020.de, 2020).

Regarding the local level's room for action, we found from the previous analyses that the focus of policy instruments could also be more on activating and mobilizing co-owners of buildings and vulnerable target groups. Countries have developed support for private households with renovation advice and incentives, but this is often limited to renovation measures on building envelopes or fuel switching. Multi-family buildings are now being targeted, but the experiences are still limited. For instance, Spain developed a legal framework for process guides that can support communities of apartment owners.

Policy instruments addressing building renovation that combine energy efficiency and renewable energy measures are rarely found. Examples can be to link subsidies for connection to renewable energy systems to energy efficiency requirements or to use rules associated with concessions to stimulate both efficiency measures and the use of renewable energies. Policy instruments can be strengthened aiming to address this combination of measures.

Despite a common overarching framework, the country policy overview shows that European countries have different focuses, framework conditions and challenges in their energy renovation and decarbonisation paths. Although this must be kept in mind for comparisons, European countries can learn from each other when it comes to developing more advanced national policies for energy renovation. For example, Austrian policy shows that district management offices can take care of energy-related renovation (e.g., Vienna). Belgium shows 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 programmes show that a switch to renewable energy-based heating systems can often be cost-effective for the owners. Also, more advanced voluntary energy performance labels can be used, such as Minergie for buildings or 2000-Watt areas for districts. 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 a superior law. Swiss communes and cities have far-reaching competencies, such as making a switch to renewable energies mandatory, which is often not the case in other countries.

This small and incomplete overview gives an idea of the wide variety of instruments already established and well-tested across Europe and how they can be used for upscaling building renovations at the district scale in the next years.

7. Conclusion

This report aimed to answer the question of how policies can increase residential building renovation at the district level by combining energy efficiency and renewable energy measures. To answer this question, this report provided desk research and quantitative and qualitative analysis of the results of 38 interviews with policy and non-policy experts and frontrunners from eight European countries (Austria, Belgium, Germany, The Netherlands, Portugal, Spain, Sweden, and Switzerland).

Policies are key to enabling and fostering energy renovation processes at the district level and increasing the renovation rate. The district-level approach can increase the implementation of energy efficiency and renewable energy systems, improve investment opportunities with economies of scale, bring forward process innovations, exploit urban possibilities and activate stakeholders in renovation processes including energy efficiency and renewable energy systems. Policies directly or indirectly affect a multitude of stakeholders and interests. These interests and motivations might conflict, increasing the complexity of policy and energy renovation action. Our research was limited, as the varying interdependencies of stakeholders and framework conditions influence the effects of policy instruments and their concrete design. Target groups have been looked at in a rather general way, and the study focused on the experiences of experts pointed out by Annex members as relevant to the topic. The main outcome of this research is that authorities get an overview of possible policy instruments that could fit into their own policy mix to stimulate upscaling of building renovations at the district level. The new insights focus on the necessary intermediate level between planning energy systems and renovating individual buildings, thus identifying opportunities on the nexus between urban planning and housing, energy and innovation policy.

There are currently many country differences regarding policy instruments for renovation at the district level including energy efficiency and renewable energy systems, which are influenced by national ambitions and supporting structures, as well as the existing possibilities and resources of local authorities to develop local policies and act at the district level. Local authorities are indeed considered key actors in facilitating renovations at the district level, including energy efficiency and renewable energy systems. Local action must be supported by better collaboration between policy levels and supporting national legislation, as local authorities depend on available national and regional structures, initiatives, support, and resources. The report shows the need for local authorities to coordinate the use of district-related policy instruments by using the competencies of various departments and the need to support municipalities, particularly those with limited means.

While previous IEA EBC Annexes 52 (Reinhard, 2014) and 63 (Strasser, 2018) pointed to urban planning solutions and energy strategies in communities, IEA EBC Annex 75 focused on upscaling energy-efficient building renovation and installation of renewable energy at the district level. We found that transparent policy strategies at the district level and synergies between energy-efficient building renovations and renewable energies at the district level are often missing. The research shows that many countries lack policy instruments to support building renovation at the district level, including energy efficiency and renewable energy systems. National, regional and local authorities value using a mix of policy instruments to achieve district-level renovations, including energy efficiency and renewable energy systems. Currently, there is an emphasis on the “softer” instruments, such as organizing services and communication support for districts, possibly coupled with financial incentives created by local authorities and district planning and tendering. Local regulations are sometimes also considered, but the local authorities are often limited in their possibilities to develop local regulations and governance.

In many European countries, examples were found of several types of policy instruments, which have been implemented successfully for many years.

The investigation confirms a highly diverse interest of stakeholders to use or develop specific policy instruments further. Depending on the country context, the characteristics of districts, respective actor groups or the starting conditions or quality of building stock and existing legislation, specific policy instruments were explored further for supporting renovation at the district scale including energy efficiency and renewable energy systems. Promising instruments are, for example, the control of energy standards (particularly for districts with low energy performance); financial incentives for districts and groups of homeowners; renovation services and energy desks; digital communication and network meetings in districts. All these instruments are generally considered important. Overall, the findings confirm that upscaling renovations to the district level can benefit from adapted or improved regulations, incentives, communication and facilitation to better support district-level renovations, including energy efficiency and renewable energy systems. Countries can learn from each other's successes and failures regarding the development of such policy instruments to support renovation at the district level.

Policy actors, particularly local authorities, emphasize their potential key role in facilitating joint energy renovations or district energy systems. Local authorities can play an important role by developing communication campaigns, target area analyses, local energy desks, or renovation services for owners of multi-family buildings and by developing (the approval of) district renewable energy infrastructure. On the other hand, non-policy actors also point to the need for better regulation, process guidance and simplified procedures.

Regarding communication and facilitation, interviewees emphasized the need to organize structured stakeholder dialogues and transparent negotiations that engage citizens in co-creation activities. Dedicated district process guides could manage a stakeholder dialogue process to align the needs and motivations of various and often heterogeneous actors like investors, (home)owners, landlords, social housing associations, renovation project developers, energy distribution grid managers, energy cooperatives and local communities, non-profit organizations, and so on. Authorities can also make better use of demo districts and create homeowner awareness in target areas. Overall quality-oriented project management of renovations at the district level is important to be assured, as well as the engagement of specific process coaches, specialized staff and consultancy desks. The key is to provide value with an integrated proposal that can unburden citizens within the district as much as possible, making them understand the process and evaluate options, manage the process, finance the renovation and deliver a result.

The need for specific grants, subsidies, loans, financial guarantees, and tax benefits for district energy renovation also came forward, especially to address energy efficiency measures and decarbonisation measures that are not (yet) cost-efficient, to address trade-offs between decarbonisation and affordable housing or to allow for financial solutions for specific target groups, such as vulnerable households and assemblies of homeowners.

National financial incentives, like in Germany (KfW 432), could also support district planning in achieving integrated energy efficiency and renewable energy goals. Furthermore, specific funds might be needed for managing stakeholder collaboration, supporting the professionalisation of energy cooperatives and covering innovation and process risks of integrated home renovation suppliers.

Regulations and contractual arrangements might be needed to produce a change in worst-performing segments that differ a lot from country to country. If they were allowed to go beyond national standards, local authorities could, for example, enforce minimum energy performance standards (MEPS) for the worst-performing buildings using district inspections and audits to support achieving better energy labels. Local compliance with (national) regulations can be strengthened, and local and regional plans and infrastructure might help the development of support renovations at the district level, including energy efficiency and renewable

energy systems. Authorities can, for example, have an important impact by making a switch to renewable energies mandatory when a heating system is replaced.

The many new social and management challenges that come with the district approach are opportunities for an integrated approach and mastering different components of current urban transformation challenges. Renovations at the district level could motivate large groups of citizens. However, some risks can hinder adopting energy efficiency and renewable energy systems at the district level, such as ineffective multi-level governance, a low advantage for some stakeholders, lack of good examples, an incompatible legal or national framework, a single focus on individual buildings, and high complexity.

We hereby presented and evaluated a set of policy instruments that can be considered promising, suitable, and important to support achieving renovations at the 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. Nevertheless, countries and cities can learn from each other and accelerate building renovations, as there are already many frontrunners and good practices.

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Addenda

The following two Addendums can be consulted for an improved understanding of the working method that served as the basis for the analysis of sub-tasks C and D of IEA EBC Annex 75, contributing particularly to these reports:

- Barriers and drivers for energy efficient renovation at district level
- Policy instruments for cost-effective building renovation at district level combining energy efficiency & renewables
- Business Models for cost-effective building renovation at district level combining energy efficiency & renewables

IEA EBC Annex 75 Addendum 1: interview guidance document

This document was used by all interviewers in multiple countries to approach interviewees with the same questions, in a comparable way.

IEA EBC Annex 75 Addendum 2: interview analysis template

This document was used by the interviewers to provide an analysis of all interviews in a similar fashion.

IEA EBC Annex 75 ENERGY EFFICIENCY AND RENEWABLE ENERGIES AT DISTRICT LEVEL

GUIDANCE FOR INTERVIEWING KEY ACTORS¹

INTRODUCTION TEXT FOR WEB QUESTIONS & MAILING

TIP:

Clarify in advance the topic of the interview. Select stakeholders that are either relevant to exemplary district projects or to gathering opinions from types of stakeholders about district renovation and renewable energy in districts. You can find an actor list in the Annex of this questionnaire: think about having an approach for collecting multiple viewpoints from civic/demand, public/policy and private/supply actors. The following text can be used for the first contact.

Dear *(stakeholder)*,

The (insert your institute) is engaged in various research projects related to managing energy transitions in residential target areas. In this framework, we would like to invite you to respond to some questions.

We particularly want to know your view on instruments and projects that are being developed or planned in your local authority to support energy renovations and renewable energy systems in districts.

Purpose of this knowledge request:

Your knowledge supports the [IEA EBC Annex 75 project “Cost-effective Building Renovation at District Level Combining Energy Efficiency & Renewables”](#). The IEA EBC Annexes are international groups of independent researchers, voluntarily organized in a task force on energy-related issues. The aim of this project 75 is amongst others to recommend policy instruments and business models to stakeholders.

The information gathered by this questionnaire and the interview will be used only for the purposes of the IEA EBC ANNEX 75 project, namely, to provide guidance to various types of stakeholders for upscaling building renovations and renewable energy at the district level.

¹ This guidance document was produced in the framework of the IEA EBC Annex 75 by Erwin Mlecnik and Thaleia Konstantinou (TU Delft, The Netherlands) in collaboration with Juan Maria Hidalgo-Betanzos (Universidad del País Vasco UPV/EHU, Spain); Hauke Meyer (Deutscher Verband für Wohnungswesen, Städtebau und Raumordnung e. V.) & Uta Schneider Gräfin zu Lynar (B&SU Berlin, Germany); Erik Johansson & Henrik Davidsson (Lund University, Sweden), and Ricardo Manuel Mafra Barbosa (University of Minho, Portugal).

Privacy:

(Insert your institute and regulations) takes the utmost care with personal data and in doing so acts within the law, including the General Data Protection Regulation (GDPR). All collected data will respect your privacy according to the Global Data Protection Regulation. You can read our privacy statement on (add a link to your institute regulations).

For this request we collect no specific personal data from you; only your experience and informed opinion as an expert is asked for. We will take care your statements are anonymized, taking into account only the location and your actor category.

In case you have any doubts about this, or if you want to review your statements, please contact your official country IEA EBC ANNEX 75 partner (write your name) for further information.

Next steps:

To prepare for our meeting we would like you to fill in the following:

Your agreement to participate:

I understand the purpose of the interview and I have read and agree with the privacy statement provided by the interviewer. Yes No

Please provide us with the following information before the interview:

Your affiliation:

Municipality, city, county or region:

Country:

Which project or (policy or business) instrument related to energy renovations or renewable energies in districts are you the proudest of and would you like to discuss during our interview?

We would like to prepare our interview a bit according to this. Do you have any background documents on this, such as reports, web links, and so on? Please mention them here.

We are looking forward to your reply.

Yours sincerely,

*(your name)
(your institute)*

TIP:

After receiving a confirmation, **ASK THE INTERVIEWEE TO FILL IN THE FOLLOWING TABLES**. If they don't respond before the interview, aim for a reply during or after the interview. Translate the tables if you think this will lead to a better response. If you have specific local authority initiatives in mind, you can slightly change the wording in Table 1 if needed. If you know some details of existing projects, you can already partially fill in Table 2 before sending.

You can do the follow-up interview in your own language (translate the tables if you think it is appropriate); we will collect the data later in English. Check in advance with the interviewee if you want to focus on a particular project, policy instrument or business model.

IEA EBC Annex 75: Interview Tables

Part 1:

Before our interview, we would like you to reflect on the situation in your region, particularly how your local authorities and other stakeholders support district renovation projects in your municipality, city or region. Can you please fill in the following tables?

LOCAL POLICY INSTRUMENTS

Our interview will deal, amongst others, with how local authorities could better achieve energy-saving targets. Before our interview, we would like to ask you about how you think your municipality, city or region is using instruments to achieve building renovations and renewable energy in districts or neighbourhoods.

Do/did you already use the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?

<i>Instrument</i>	<i>No, not considering</i>	<i>No, but interested</i>	<i>No, but planning to</i>	<i>Yes</i>	<i>Yes, with good experiences</i>	<i>I don't know</i>
Enforcement of energy standards or solutions in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspections and energy audits in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives created by local authorities for specific districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives for groups of homeowners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creation of renovation services in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Local energy desks for awareness-raising and consultancy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dedicated local website or other local media development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Networking meetings in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How important do you think it is to develop the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?

<i>Instrument</i>	<i>No, not considering</i>	<i>No, but interested</i>	<i>No, but planning to</i>	<i>Yes</i>	<i>Yes, with good experiences</i>	<i>I don't know</i>
Enforcement of energy standards or solutions in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspections and energy audits in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives created by local authorities for specific districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives for groups of homeowners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creation of renovation services in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Local energy desks for awareness-raising and consultancy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dedicated local website or other local media development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Networking meetings in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How difficult do you think it is to develop the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?

<i>Instrument</i>	<i>No, not considering</i>	<i>No, but interested</i>	<i>No, but planning to</i>	<i>Yes</i>	<i>Yes, with good experiences</i>	<i>I don't know</i>
Enforcement of energy standards or solutions in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspections and energy audits in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives created by local authorities for specific districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives for groups of homeowners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creation of renovation services in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Local energy desks for awareness-raising and consultancy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dedicated local website or other local media development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Networking meetings in districts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please mention here the initial ideas you would like to share during the interview, particularly about the development of policy instruments:

Please add your comments here

STAKEHOLDER INVOLVEMENT IN PROJECTS

Our interview will explore your project experiences and wishes considering stakeholder collaboration for achieving district renovation goals. We would like to ask you which of the following stakeholders you already worked with for developing specific projects regarding energy efficiency and renewable energies in districts?

<i>Stakeholders</i>	<i>I am:</i>	<i>For district projects I already worked with:</i>	<i>Their role in this project was:</i>	<i>I think their level of influence in the project was:</i>
Policy actors (e.g.: local or regional authority, public agency or institute,..)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> decision-maker <input type="checkbox"/> influencer <input type="checkbox"/> technical advisor <input type="checkbox"/> deliverer	<input type="checkbox"/> very low <input type="checkbox"/> low <input type="checkbox"/> medium <input type="checkbox"/> high <input type="checkbox"/> very high
Renovation solution suppliers (e.g. planning and construction parties, urban planners, architects, design team, general contractors, products suppliers, ESCO, contractor, energy monitoring, facility manager, installation provider, one-stop-shop,..)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> decision-maker <input type="checkbox"/> influencer <input type="checkbox"/> technical advisor <input type="checkbox"/> deliverer	<input type="checkbox"/> very low <input type="checkbox"/> low <input type="checkbox"/> medium <input type="checkbox"/> high <input type="checkbox"/> very high
Energy solution suppliers (e.g. distributor system operators, energy supply companies, energy agencies, renewable energy companies, heat grid operators, aggregators, service providers, net managers, energy monitoring providers, energy cooperatives,..)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> decision-maker <input type="checkbox"/> influencer <input type="checkbox"/> technical advisor <input type="checkbox"/> deliverer	<input type="checkbox"/> very low <input type="checkbox"/> low <input type="checkbox"/> medium <input type="checkbox"/> high <input type="checkbox"/> very high
Beneficiaries (e.g. clients, residents, homeowner assemblies, community/occupants' organizations, action groups, Housing associations and cooperatives: private, public, semi-public,..)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> decision-maker <input type="checkbox"/> influencer <input type="checkbox"/> technical advisor <input type="checkbox"/> deliverer	<input type="checkbox"/> very low <input type="checkbox"/> low <input type="checkbox"/> medium <input type="checkbox"/> high <input type="checkbox"/> very high
Financing intermediaries (e.g. banks, investment funds, real estate developers, project developers, portfolio managers, ESCOs,..)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> decision-maker <input type="checkbox"/> influencer <input type="checkbox"/> technical advisor <input type="checkbox"/> deliverer	<input type="checkbox"/> very low <input type="checkbox"/> low <input type="checkbox"/> medium <input type="checkbox"/> high <input type="checkbox"/> very high
Other intermediaries (e.g. federations, trade organizations, not-for-profit organizations, neighbourhood interest associations, neighbourhood communication agents, business model developers, consultants,..)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> decision-maker <input type="checkbox"/> influencer <input type="checkbox"/> technical advisor <input type="checkbox"/> deliverer	<input type="checkbox"/> very low <input type="checkbox"/> low <input type="checkbox"/> medium <input type="checkbox"/> high <input type="checkbox"/> very high

We would like to ask you which of the following stakeholders you would like to work with to better achieve a good coupling of energy-efficient renovation and renewable energies in districts.

<i>Stakeholders</i>	<i>In future district projects, I would like to work with:</i>	<i>They can positively contribute to achieving (combining) district renovation & renewable energies in districts, because:</i>
Policy actors (e.g. local or regional authority, public agency or institute,..)	<input type="checkbox"/>	
Renovation solution suppliers (e.g. Planning and construction parties, urban planners, architects, design team, general contractors, products suppliers, ESCO, contractor, energy monitoring, facility manager, installation provider, one-stop-shop,..)	<input type="checkbox"/>	
Energy solution suppliers (e.g. distributor system operators, energy supply companies, energy agencies, renewable energy companies, heat grid operators, aggregators, service providers, net managers, energy monitoring providers, energy cooperatives,..)	<input type="checkbox"/>	
Beneficiaries (e.g. clients, residents, homeowner assemblies, community/occupants' organizations, action groups, Housing associations and cooperatives: private, public, semi-public,..)	<input type="checkbox"/>	
Financing intermediaries (e.g. banks, investment funds, real estate developers, project developers, portfolio managers, ESCOs,..)	<input checked="" type="checkbox"/>	
Other intermediaries (e.g. federations, trade organizations, not-for-profit organizations, neighbourhood interest associations, neighbourhood communication agents, business model developers, consultants,..)	<input type="checkbox"/>	

Part 2: INTERVIEW (OPEN QUESTIONS GUIDED BY EXPERT INTERVIEWER)

TIP:

In the questions, we generally ask about perceived opportunities and barriers. We have integrated various aspects of opportunities and barriers in various places in this questionnaire. This includes:

- policy/ legal/ environmental issues (section 1);
- economic/ financial issues (section 2);
- technical/ social/ communication/ collaboration issues (section 3);

The interviewer is not required to make separate questions for each type of barrier but is asked to keep these various viewpoints in mind all the time, as they will be used for analysis afterwards.

1. POLICY INSTRUMENTS (D.1)

TIP:

If applicable, refer to the local policy instrument(s) the interviewee is proud of. Alternatively, focus on a policy instrument the interviewee wants to explore or has experience with within a district project.

TIP:

Note that the term 'local authority' can refer to various types of local policy actors, such as district governors, municipal council members, city mayors, responsible actors from various departments (urbanism, planning, housing,...), county representatives, elected ambassadors, regional and national liaisons. Similarly 'local authority region' refers to the geographical area they have a say in or influence on.

We would like to ask you a few questions about your experiences regarding (the development of) policy instrument XXX (fill in the policy instrument from previous answers or use "policy instruments" in general) to support renovations of residential buildings and renewable energy systems.

1.1 Can you tell us something about the external opportunities you see for using XXX to activate residential building renovations/ renewable energies in districts?

1.2 Can you tell us something about the external barriers and threats you see for using XXX to activate residential building renovations/ renewable energies in districts?

1.3 Can you tell us something about the strengths you see for using **XXX** to activate residential building renovations/ renewable energies in districts within your organisation?

1.4 Can you tell us something about the weaknesses you see in using **XXX** to activate residential building renovations/ renewable energies in districts within your organisation?

TIP:

Repeat these four questions for each policy instrument **XXX** that you think is new for this city or region.

TIP:

Check the table below to check if certain aspects are missing in the answers to previous questions. If applicable ask follow-up questions like “Do you also perceive opportunities and barriers related to P/E/S/T issues?”

	Policy/ Legal/ Environmental	Economic/ Financial	Social/ Communication	Technical/ Management
Strengths (internal to the interviewee)				
Weaknesses (internal to the interviewee)				
Opportunities (external to the interviewee)				
Threats/Barriers (external to the interviewee)				

1.5 (optional questions for local authorities)

So far, how have various policy instruments been connected to energy planning or other overarching strategies supporting the renovation of residences in districts?

1.6 *What kind of barriers do/did you encounter in COMBINING energy efficiency and renewable energies in residential districts?*

1.7 (optional questions for local authorities)

How do you think have currently implemented policy instruments encouraged or hindered the optimal combination of energy efficiency measures and renewable energy measures in residential districts?

1.8 *How do you see the further development of policy instruments (regulations, incentives, organization, communication) in your municipality/ city/ region related to this combination effort?*

2. RENOVATION FINANCING AND BUSINESS MODEL (D.2)

TIP:

If you want to discuss specific business or financing initiatives, rephrase a bit according to the specific business model or policy instrument you want to discuss.

2.1 What was/is your main driver to carry out or support district renovation or renewable energy project(s)? (main value proposition)

2.2 Can you tell us how the financing of (supporting) district renovation or renewable energy project(s) was structured in your project, or how you think this can be done?

TIP:

Ask more specific follow-up questions to go deeper or give clues if applicable, for example: How did/do you finance your own contribution and partners in a project? Did/do energy tariffs or financial energy savings play a role in the costing structure?

2.3 (optional question)

How did/do you solve financing challenges to go through with (supporting) district renovation or renewable energy project(s)?

2.4 (optional question)

How do you think that current financing models or tariff structures encourage or hinder the optimal combination of energy-efficient renovation and renewable energy measures in residential districts?

TIP:

Ask more specific follow-up questions to go deeper or give clues if applicable, for example: How did/does the business model of stakeholders play a role? How could financing structures, business models or energy tariff structures be improved according to your opinion?

2.5 *How did/do various types of stakeholders (such as homeowners, suppliers, policy actors, and so on) participate in the decision-making?*

TIP:

Use the filled-in table for the interviewee to comment upon.

2.6 (optional question)

How do you think that decision-making processes can be improved to achieve an optimal combination of energy efficiency and renewable energy measures in residential districts?

TIP:

Ask more specific follow-up questions to go deeper or give clues if applicable, for example: Does the current decision-making hinder this development? Is there a need for incentives, regulation, communication, and organization?

2.7 *Can you tell us your insights regarding the contracting arrangements between various types of stakeholders (such as homeowners, suppliers, policy actors, and so on) and/or how you think they could be improved?*

2.8 (optional question)

Can you tell us something about how you imagine future business models for (combining) energy efficiency and renewable energy measures in residential districts?

2.9 (optional question)

What opportunities and/or challenges do you see for innovative financial structures, such as Energy Performance Contracts (EPCs) and investment funds for energy efficiency and renewable energy measures in residential districts?

2.10 (optional question)

Which parties were or could be involved in setting up innovative financial structures, and for what purpose?

2.11 In general, what do you think can be new promising ways of financing, contracting and stakeholder engagement to encourage/facilitate the optimal combination of energy efficiency measures and renewable energy measures in residential districts?

TIP:

This question can be optional if you already covered combination issues in the previous optional questions.

3. SOCIO-TECHNICAL ISSUES (D.2 & C.3)

We would like to ask you a few questions about the technical and social issues you encounter in achieving renovations of residential buildings and renewable energy systems in districts.

3.1 Can you tell us something about the technical opportunities and barriers you encounter(ed) for achieving residential building renovations and renewable energies in districts?

TIP:

Ask more specific follow-up questions to go deeper if applicable, for example: What is/was your experience with implementing technological innovations?

3.2 Can you tell us something about the project management opportunities and barriers you encounter(ed) for achieving residential building renovations and renewable energies in districts?

TIP:

Ask more specific follow-up questions to go deeper if applicable, for example: How do/did you manage changes of ambitions during a project?

3.3 Can you tell us something about the opportunities and barriers you encounter(ed) for activating homeowners in districts?

TIP:

Ask more specific follow-up questions to go deeper if applicable, for example: How do/did you make sure all end users are informed or engaged?

3.4 Can you tell us something about the opportunities and barriers you encounter(ed) in supplying solutions in districts?

TIP:

Ask more specific follow-up questions to go deeper if applicable, for example: How do/did you involve local small and medium-sized enterprises? Do/did you work with prefabricated solutions?

3.5 Can you tell us something about the opportunities and barriers you encounter(ed) in activating local authorities for district projects?

TIP:

Ask more specific follow-up questions to go deeper if applicable, for example: Do/did they set up specific initiatives or communication for supporting a project?

3.6 (optional question)

Can you tell us something about the opportunities and barriers you encounter(ed) for collaborating with multiple stakeholders at the same time to activate residential building renovations and renewable energies in districts?

TIP:

Ask more specific follow-up questions to go deeper if applicable, for example: How do/did you manage their expectations?

3.7 Can you tell us something about the strengths and weaknesses you see for yourself to activate residential building renovations and renewable energies in districts?

3.8 What kind of barriers and opportunities did you notice regarding stakeholder dialogue or management when addressing the combination of energy-efficient renovations and renewable energies in residential districts?

3.9 Can you tell us something about how you imagine improved stakeholder dialogue or management to combine residential building renovations and renewable energy systems in districts? What could be your role in this?

TIP:

Check this table to understand if you covered most aspects until now. If needed, ask additional questions, for example about what the interviewee thinks are their own strengths and limitations to solve certain barriers.

	Policy/ Legal/ Environmental	Economic/ Financial	Social/ Communication	Technical/ Management
Strengths (internal to the interviewee)				
Weaknesses (internal to the interviewee)				
Opportunities (external to the interviewee)				
Threats/Barriers (external to the interviewee)				

4. FINAL REMARKS

4.1 Do you have any other concerns, remarks or issues you want to share regarding developing or combining energy-efficient renovations and renewable energy systems in districts in a cost-efficient manner? For example, regarding policy instruments, business models, stakeholder dialogue, future initiatives, improvement of success, and cost-efficiency of actions, ...?

4.2 (optional question)

Are there perhaps documents or web links you would like to share for our report?

4.3 Can you give us the contact details of persons we should contact to discuss innovative developments in more detail?

Can we contact you in case we need further clarification Yes No

Would you like to subscribe to the EBC Annex 75 newsletter to be kept informed about the project results? Yes No

If your answer is Yes, what e-mail address would you like to be contacted at?

Thank you for your collaboration!

Annex: TYPE OF INTERVIEWEE

TIP:

In IEA EBC Annex 75, we aim to interview multiple stakeholders that are involved in a district project or that can provide an expert view on the topic of cost- and energy-efficient district renovation. We aim to include and compare various stakeholder perspectives in our follow-up reporting.

The previous questionnaire integrates these perspectives and supports at the same time C.3, D.1 and D.2. For example, for assessing policy instruments (D.1.), we target public actors that facilitate the adoption of (district) renovations - such as local authorities -, but we would also like to compare with the viewpoints of civic (e.g. homeowner assemblies or housing stakeholders) and private stakeholders, or collaborations thereof that play a role for developing policy instruments.

For assessing business models (D.2.), we target mainly suppliers, but we would also like to compare with the viewpoints of demand and policy actors and intermediaries that play a role in business development.

For assessing project management (C.3.), we target mainly project managers, but we would also like to compare with the viewpoints of clients, (sub)contractors, and other parties that might play a role in project management such as controllers and facilitators.

The questionnaire integrates these perspectives and fits different types of actors you might encounter during snowball sampling. Researchers working on these deliverables aim to share questionnaire results in a format that is anonymized.

Check here how the interviewee identified their affiliation:

- *Policy actor*
 - *Municipality or city*
 - *County council*
 - *Provincial/ regional government*
 - *Federal/ national government body*
 - *Other, namely:...*
- *Public agency or institute*
 - *Innovation agency*
 - *Energy agency*
 - *Public service*
 - *Educational institute*
 - *Research Institute*
 - *Other:...*
- *Renovation solution provider*
 - *Planning and construction party*
 - *Urban planner*
 - *Architect*
 - *Design team*
 - *General contractor*
 - *Subcontractor*
 - *Supplier of products or technologies*
 - *Supplier of concepts or systems*
 - *Facility manager*
 - *Installer*
 - *One-stop-shop*
 - *Other:...*

- *Energy solution provider*
 - *Distribution system operator (DSO)*
 - *Transmission system operator (TSO)*
 - *Energy supply company*
 - *Energy service provider*
 - *Renewable energy company*
 - *Heat grid operator*
 - *Aggregator*
 - *Energy monitoring provider*
 - *Energy cooperatives*
 - *Other:...*

- *Financing intermediary*
 - *Bank*
 - *Investment fund operator*
 - *Real estate development company*
 - *Project development company*
 - *Building portfolio manager*
 - *ESCO*
 - *Other:...*

- *Client or beneficiary/ demand actor*
 - *Private owner or assembly thereof*
 - *Private owner*
 - *Homeowner assembly*
 - *Housing cooperative or co-housing*
 - *Other:...*
 - *Housing association or company*
 - *Private housing actor or real estate company*
 - *Public or social housing actor*
 - *Semi-public or mixed*
 - *Other:...*

- *Other representative expert*
 - *Federation*
 - *local authorities*
 - *suppliers*
 - *contractors*
 - *architects*
 - *homeowners*
 - *renters*
 - *building owners*
 - *other:...*
 - *Trade organization*
 - *Not-for-profit organization*
 - *Neighbourhood interest association*
 - *Private actor contracted as intermediary process actor*
 - *Neighbourhood communication agent*
 - *business model developer*
 - *consultant*
 - *Other:...*

Dear ANNEX 75 partners,

We are contacting you to invite you interviewing stakeholders that may have experience with district renovations and EE+RES combinations.

To organise the process and facilitate the further analysis we have created this [analysis template](#). In our March meeting we will show some examples and give additional information. As you know, among the ANNEX 75 tasks we are conducting some interviews to local experts and key stakeholders to gather useful experiences and insights: particularly valuable for C3, D1, D2 and D3 deliverables. Regarding the timeframe, these interviews are expected to be done before summer.

Now that templates of the interview and analysis are available, we invite you to read them and join this valuable task for StC and StD. If you have any doubts let us know.

The foreseen recommended steps are the following:

Step 1 – Download the questionnaire guidance and analysis templates (version of 2021):

The last version of 2021 consists of a guidance word file and an analysis excel file which may help you during all the process: preparing the interview, leading the questions and getting more information out of the discussed topics. These templates show the type of outcomes we expect from these interviews, the details that are more important from their experience in renovations at district scale or combining EE+RES.

Regarding the Data Protection, each institution and country may adapt the template. We have included a general base and, in a separate file, a more detailed example from TU Delft.

The original template is in English, but you may need to translate it to the local language. If you do so, please upload to Teams the new language version, this may help the other colleagues. So far, English and Spanish versions are available.

See the attached files, or find it in the Teams folder:

[https://teams.microsoft.com/_#/files/General?threadId=19%3Ac2cfc77f7d804471a64dbdbba45a68a2%40thread.tacv2&ctx=channel&context=2_Interview%2520Templates%2520\(guidelines%2520%252B%2520Analysis\)&rootfolder=%252Fsites%252FTriple-AWP1-4team%252FGedeelde%2520documenten%252FGeneral%252F2_Interview%2520Templates%2520\(guidelines%2520%252B%2520Analysis\)](https://teams.microsoft.com/_#/files/General?threadId=19%3Ac2cfc77f7d804471a64dbdbba45a68a2%40thread.tacv2&ctx=channel&context=2_Interview%2520Templates%2520(guidelines%2520%252B%2520Analysis)&rootfolder=%252Fsites%252FTriple-AWP1-4team%252FGedeelde%2520documenten%252FGeneral%252F2_Interview%2520Templates%2520(guidelines%2520%252B%2520Analysis))

Step 2 – Find potential experts and interesting stakeholders.

To confirm their availability and explain the goal of the interview, you can share the template with the potential interviewee. The interview template is divided in: Part I Interview preparation; and Part II. Interview questions.

If possible, we recommend asking them to fill in the Part I beforehand, with a double aim: to understand their overall experiences and to get their acceptance of Data protection before the interview.

According to your institute's ethical rules and GDPR, inform the interviewee about the project and how you will treat the data and ask for explicit written consent (example attached).

Step 3 – Register your interview in the interview overview table:

After their acceptance, register it in the common table. The file will be updated with your contributions and show all the interviewed stakeholders. It is available in Teams:

https://teams.microsoft.com/l/file/A12B1096-0BAC-41FA-88BF-E230B94ADA90?tenantId=096e524d-6929-4030-8cd3-8ab42de0887b&fileType=xlsx&objectUrl=https%3A%2F%2Ftud365.sharepoint.com%2Fsites%2FTriple-AWP1-4team%2FGedeelde%20documenten%2FGeneral%2F1_List%20of%20interviews%20and%20codes%2FIEA%20EBC%20Annex%2075_STD_Stakeholder%20Interview%20List.xlsx&baseurl=https%3A%2F%2Ftud365.sharepoint.com%2Fsites%2FTriple-AWP1-4team&serviceName=teams&threadId=19:c2cfc77f7d804471a64dbdbba45a68a2@thread.tacv2&groupId=ee6b88c2-7056-42a0-9526-4171ca00de58

Step 4 – Conduct the interview:

To obtain better results with the interview, please read the templates carefully, including the tips in word document and the analysis template where all the concepts are crossed and evaluated.

If the interviewee allows it, you can record it in voice or video, to check and complete your notes during the analysis.

Please use one separate file per each interview, including all the answers and notes.

Step 5 – Analyse the gathered information:

Create a new file for each interview analysis. The file name must include the interview code in the beginning (example: "ES-002 interview final.xlsx")

Please follow the template to complete the analysis and be concise. This may facilitate future analyses and so get more outcomes from this work.

It is recommended to make the analysis shortly after the interview. If possible, just after the interview or few days later.

Once the analysis template is finished, please make a final review to detect missing aspects. Be aware that some interview questions can be connected to several analysis sheets (pages).

Step 6 – Send the final analysis file:

Send the final analysis file (excel format, 5 pages) to the coordinator (juanmaria.hidalgo@ehu.eus).

The coordinator will update the status of your finalised interview analysis in the common overview table and send you a confirmation.

All the files of the analysis will be located in this shared Teams folder:

https://teams.microsoft.com/_#/files/General?threadId=19%3Ac2cfc77f7d804471a64dbdbba45a68a2%40thread.tacv2&ctx=channel&context=General&rootfolder=%252Fsites%252FTriple-AWP1-4team%252FGedeelde%2520documenten%252FGeneral

Once again, thank you for your contribution and shall you have any doubts, please contact us for further explanations.

We look forward to hearing from your interviews.

Best regards,

StD interview team

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS

Analysis template: 1. Identification



Annex 75

Template to be completed for each interview

- Objectives:** Follow a common methodology for the interview analyses, to provide better information to StC and StD deliverables and improve the ANNEX75 outcomes.
- Instructions:** Download this template and create a new file for each interview analysis. File name must include the interview country code in the beginning (example: "ES-002 interview final.xlsx")
Please follow the template 5 pages to complete the analysis and be concise. This may facilitate future analyses and so get more outcomes from this work.
It is recommended to make the analysis shortly after the interview. If possible, just after the interview or few days later.
Once the analysis template is finished, please make a final review to detect missing aspects. Be aware that some interview questions can be connected to several analysis sheets (pages).
Send the final analysis file (excel format, 5 pages) to the coordinator (juanmaria.hidalgo@ehu.es).
- Dates:** Interviews between February-April 2021. Submit the analyses the latest in May 2021. First interviews results will be presented in 23-25 march meeting.
- Shall you have any doubts using this template or any suggestions, please email (Juanmaria.Hidalgo@ehu.es)*

Interview identification	Stakeholder type and description	Interviewee details (Non-publishable Private Data)
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Country	Interviewer name, affiliation	Date of interview	Interview code	Stakeholder type	Description	Interviewee affiliation	Institute or company name

Example

The Netherlands	Erwin Mlecnik, TU Delft	3/11/2020	NL-001	R. Renovation solution provider	Non-profit service supplier for living-cost neutral renovation of apartment buildings	DIRECTOR	INSTITUTION NAME
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List of stakeholder types

- | P. Policy actor | C. Client or beneficiary/ demand actor | F. Financing intermediary | E. Energy solution provider | R. Renovation solution provider | I. Other intermediaries |
|--|---|---|--|--|--|
| <ul style="list-style-type: none"> o Municipality or city o County council o Provincial/ regional government o Federal/ national government body o Other, namely:... o Public agency or institute: Innovation agency, Energy agency, Public service, Educational institute, Research institute, Other:.. | <ul style="list-style-type: none"> o Private owner or assembly thereof: Private owner, homeowner assembly, housing cooperative or co-housing, other:.. o Housing association or company: Private housing actor or real estate company, public or social housing actor, semi-public or mixed, other:.. | <ul style="list-style-type: none"> o Bank o Investment fund operator o Real estate development company o Project development company o Building portfolio manager o ESCO o Other:... | <ul style="list-style-type: none"> o Distribution system operator (DSO) o Transmission system operator (TSO) o Energy supply company o Energy service provider o Renewable energy company o Heat grid operator | <ul style="list-style-type: none"> o Planning and construction party, o Urban planner o Architect o Design team o General contractor o Subcontractor o Supplier of products or technologies o Supplier of concepts or systems o Facility manager o Installer o One-stop-shop o Other:... | <ul style="list-style-type: none"> o Federation of local authorities, suppliers, contractors, architects, homeowners, renters, building owners, other:... o Trade organization o Not-for-profit organization o Neighborhood interest association o Private actor contracted as intermediary process actor: Neighborhood communication agent, business model developer, consultant, other:... o Other:... |

Country list:

- Austria
- Belgium
- China
- Czech republic
- Denmark
- Germany
- Italy
- The Netherlands
- Norway
- Portugal
- Spain
- Sweedden
- Switzerland

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS

Analysis template: 2. Policy instruments (page 2 of 5)



Annex 75

How to fill in: Fill in the "Stakeholder viewpoints" (columns D-F) using the pre-defined ratings and drop-down menus. Main information in questionnaire Part I, "Local policy instruments". Complete the "Discussion" (columns G - J) and summarize the key points. Information in questionnaire Part II, "1. policy instruments". Please include any interesting: quotes, remarks, recommendations for upscaling district renovations and combining EE + RES. Quotes (ask permission to use) or remarks may be used later in the report to emphasize important points. Add the sources given by the interviewee (reference web sites, relevant policy or strategic documents). Please consider adding any valuable related information and remarks from all the interview, obtained during other questionnaire sections as well (for example Part II, "1. policy instruments")

Questions: *Shall you have any doubts using this template or any suggestions, please email (Juanmaria.Hidalgo@ehu.eus)*

Overview table + reflection of stakeholder on different policy instruments

The interviewee is (stakeholder type):		Stakeholder viewpoints			Discussion			
Code		Use	Importance	Difficulty	Interesting quotes and sources for the report	Remarks interviewee	Recommendations for upscaling and combining EE+RES	Remarks interviewer
Need for regulation by (local) policy actor	E.g. enforcement of energy standards or solutions in districts							
	E.g. inspections and energy audits in districts							
Need for incentives from (local) policy actor	E.g. financial incentives created by local authorities for specific districts							
	E.g. financial incentives for groups of homeowners							
Organizational needs from (local) policy actor	E.g. creation of renovation services in districts							
	E.g. local energy desks for awareness raising and consultancy							
Communication needs from (local) policy actor	E.g. dedicated local web site or other local media development							
	E.g. networking meetings in districts							

Please use these Ratings for the answers:

Use rating (1-5):	Importance rating (1-5):	Easiness rating (1-5):
1. No, not considering	1. Not important	1. Difficult
2. No, but interested	2. Somewhat important	2. Somewhat difficult
3. No, but planning to	3. Neutral	3. Neutral
4. Yes	4. Important	4. Somewhat easy
5. Yes, with good experiences	5. Very important	5. Easy
X. I don't know	X. I have no opinion	X. I have no opinion

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS

Analysis template: 3. Business models and stakeholder dialogue (page 3 of 5)



Annex 75

How to fill in:

Fill in the "Stakeholder viewpoints" (columns C-E) using drop-down menus. Main information in questionnaire Part I, "Stakeholder involvement in projects".
 Complete the "Discussion" (columns F-I): interesting quotes, remarks, recommendations for upscaling district renovations and combining EE + RES.
 Quotes (ask permission to use) or remarks may be used in the report to emphasize points. Add also the sources given by the interviewee (web sites, policies, documents, ...).
 Please consider adding any valuable related information and remarks from all the interview (for example Part II, 2. Renovation financing and BM)

Questions:

Shall you have any doubts using this template or any suggestions, please email (Juanmaria.Hidalgo@ehu.es)

Overview table + reflection on stakeholder dialogue in projects

The interviewee is (stakeholder type):		Stakeholder viewpoints		Discussion		Code	
For district projects the interviewee already worked with:	Their role in this project/s was:..	I think their level of influence in the project was:..	Remarks interviewee on having worked together with this stakeholder	Remarks interviewee on working together with this stakeholder in the future	Other remarks interviewee	Remarks interviewer	
Policy actors (e.g.: local or regional authority, public agency or institute,..)							
Renovation solution suppliers (e.g. planning and construction parties, urban planners, architects, design team, general contractors, products suppliers, ESCO, contractor, energy monitoring, facility manager, installation provider, ..)							
Energy solution suppliers (e.g. distributor system operators, energy supply companies, energy agencies, renewable energy companies, heat grid operators, aggregators, service providers, net managers, energy monitoring ..)							
Beneficiaries (e.g. clients, residents, homeowner assemblies, community/occupants' organizations, action groups, Housing associations and cooperatives: private, public, semi-public,..)							
Financing intermediaries (e.g. banks, investment funds, real estate developers, project developers, portfolio managers, ESCOs,..)							
Other intermediaries (e.g. federations, trade organizations, not-for-profit organizations, neighborhood interest associations, neighborhood communication agents, business model developers, consultants,..)							

Please use these Ratings for the answers:

- Role in this project (1 Level of influence (1-5):**
- | | | |
|-----|----------------------|--------------|
| Yes | 1. Decision maker | 1. Very low |
| No | 2. Influencer | 2. Low |
| | 3. Technical advisor | 3. Medium |
| | 4. Deliverer | 4. High |
| | | 5. Very high |

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS

Analysis template: 4. Business models (page 4 of 5)



Annex 75

How to fill in: Fill in the "BM definition" (column D). See the tips and information sources given (column C). Main information in questionnaire Part II. "2. Renovation financing and BM"
 Complete the "Discussion" (columns E-I) with interesting quotes, remarks, recommendations for upscaling renovations and combining EE + RES.
 Quotes (ask permission to use) or remarks may be used in the report to emphasize points. Add also the sources given by the interviewee (web sites, policies, documents, ...).
 Please consider adding any valuable related information and remarks from all the interview (for example Part I, Stakeholder involvement in projects to detect key partnerships).

Questions: *Shall you have any doubts using the business model template or any suggestions, please email (T.Konstantinou@tudelft.nl)*

Overview table + reflection on stakeholder dialogue in business models

The interviewee is (stakeholder type):				Code			
		BM definition	Discussion				
Analysis of Business Model elements	Tips to fill in these elements / concepts	Main aspect	Describe how the interviewee experienced this aspect	Interesting quotes and sources for the report	Remarks by the interviewee	Recommendations for upscaling and combining EE+RES	Remarks by the interviewer
BM archetype	What is the (nearest) BM archetype? See further details in Table 2 below. If unsure, contact D2. Information: Questions 2.8 and 2.9						
Customer segment	Who benefit/use/pay for the renovation/RES? The main decision-maker is often the main costumer sergment. Information: Part I table						
Value Proposition	What is the value to the costumer? how to solve problems and satisfy customer needs. Information: Question 2.1, and Part I table						
Key Partnerships	who partners in the business model? Such as a general contractor, a service company,... Information: Questions 2.7 and 2.10.						
Costumer Relationships & Channels	How is the value proposition delivered to customers? Communication, distribution, sales... How are relationships forged and sustained? Information: Questions 2.7, 2.11 and 2.10.						
Cost Structure	What is the value proposition cost? Renovation and RES investment (context of Annex75) and other costs... Information: Question 2.2 the cost can be funded By financing mechanisms, such as Dept or Equity.						
Revenue Streams	How does the organisation generate revenues? How the investment is paid back. Information: Questions 2.2, 2.4 and 2.7.						
Key Activities & Resources	How is the value proposition achieved? The activities and resources required to offer and deliver the value.						

Table 2. Summary of the Business Models archetypes, highlighting the barriers they pose to upscale to district, as well as opportunities to overcome those barriers

BM	Value Proposition	Financing mechanism	Barriere	Opportunities to
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archetype	value proposition	financing mechanism	barriers	overcome barriers
Atomised market	Single measure. Emphasis on energy cost savings.	· Homeowner pays for entire cost structure, payback through energy savings.	· Relies on individual funding and initiative · Fragmented and uncoordinated problem solving	· Awareness raising · Financial incentives for renovation
Market intermediation	Single measure. Emphasis on energy cost savings. Expert advice and reduced time investment for homeowner.	· Access to finance through debt.	· Relies on individual funding and initiative · Additional interface can add to cost and time. · Less opportunities for innovation and integrated solutions	· Awareness raising · Financial incentives for renovation · Intermediary builds trusted relationships suppliers, to provide integrated solutions
One-stop-shop	Multiple measures. Emphasis on energy cost savings, comfort and environmental performance.	· Homeowner pays for entire cost structure, through own debt. · Payback through energy savings, potential extra revenue from sale of self-generated energy. · One-stop-shop interface is also adequate for equity financing	· Lack of awareness for the integrated service benefits · High investment costs, due to complex and expensive solutions, and expert consultations	· Awareness raising and coordinated renovation projects · Development of integrated, modular, scalable solutions.
ESCO (Energy Service Company)	Multiple measures. Emphasis on energy services (eg. Indoor temperature, hot water volume, ...), cost savings, comfort and environmental performance.	· Organisation pays upfront (lender), charges homeowner with monthly rate based on historic energy consumption, captures energy savings and potential extra revenue from sale of self-generated energy	· Complex financial structure · Long term loans tied to energy savings	· Financial attractive for home-owners

Options for BM dropdown menus:

BM archetypes	Atomised	Market Intermediary	One-stop-shop	Energy service contracts	
Customer segments	Policy actor (eg. municipality, government)	Client or beneficiary/ demand actor (eg. Private owner, Homeowner assembly, Private, or public or social housing actor)	Renovation solution provider (eg. General contractor, one-stop-shop, Supplier of products or technologies)	Energy solution provider	Financing intermediary (eg. investor fund, bank) Other: please describe here the customer in more detail.

- Value Proposition
- Key Partnerships
- Customer Relationships & Channels
- Cost Structure
- Revenue Streams
- Key Activities

ANNEX **75**



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