ANNEX 75

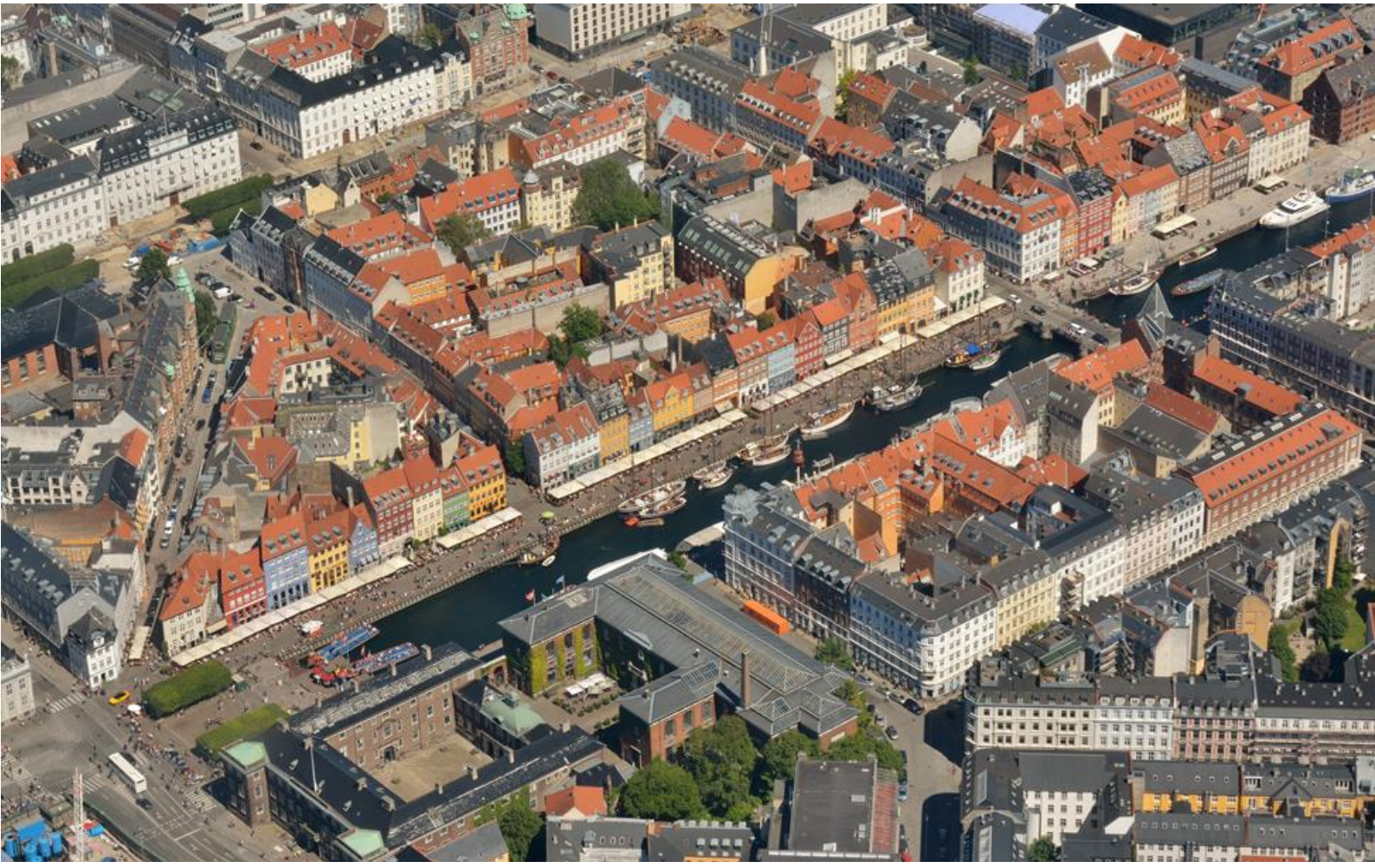
EBC
Energy in Building and Communities Programme

International Energy Agency

Barriers and drivers for energy efficient renovation at district level

Energy in Buildings and Communities Technology Collaboration Programme

May 2023



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Authors

Erik Johansson, Lund University, Sweden (erik.johansson@abm.lth.se)

Henrik Davidsson, Lund University, Sweden (henrik.davidsson@ebd.lth.se)

Contributing Authors

Erwin Mlecnik, TU Delft, the Netherlands (e.mlecnik@tudelft.nl)
Thaleia Konstantinou, TU Delft, the Netherlands (t.konstantinou@tudelft.nl)
Hauke Meyer, Deutscher Verband für Wohnungswesen, Städtebau und Raumordnung, Germany (h.meyer@deutscher-verband.org)
Juan Maria Hidalgo-Betanzos, Universidad del País Vasco UPV/EHU, Spain (juanmaria.hidalgo@ehu.eus)
Roman Bolliger & Silvia Domingo Irigoyen, INDP, Switzerland (roman.bolliger@indp.ch, silvia.domingo@indp.ch)
Matthias Haase, ZHAW, Switzerland (haam@zhaw.ch)
Bernhard Gugg, SIR, Austria (bernhard.gugg@salzburg.gv.at)
Manuela Almeida & Anita Tan De Domenico, University of Minho, Portugal (malmeida@civil.uminho.pt, anitadomenico@civil.uminho.pt)

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www.iea-ebc.org
essu@iea-ebc.org

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 renovation 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 CO_2 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
Annex 87: Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems
Annex 88: Evaluation and Demonstration of Actual Energy Efficiency of Heat Pump Systems in 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

Executive Summary

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 is to provide guidance to policymakers, companies working in the energy transition field, and homeowners for cost-effectively transforming the city's energy use in the existing building stock towards low-carbon emission and low-energy solutions.

This report aims to identify both barriers that hinder energy-efficient renovation of buildings and drivers enabling the implementation of energy and cost-effective renovation of buildings and energy supply systems at the district level.

Fifteen success stories regarding barriers and drivers were analysed in the first step. These success stories consisted of projects from seven European countries (Austria, Denmark, Italy, Portugal, Spain, Sweden and Switzerland) where energy-efficient and/or renewable energy measures had been successfully implemented at the district level.

In the next step, different stakeholders involved in energy renovations at the district level were interviewed about their experiences to identify barriers and drivers. In total, 39 in-depth interviews from eight countries (Austria, Belgium, Germany, Netherlands, Portugal, Spain, Sweden and Switzerland) were carried out. The stakeholders included policymakers, renovation solution suppliers, energy solution suppliers, clients and beneficiaries, financing intermediaries and other intermediaries. The barriers and drivers were divided into the following categories: policy, legal aspects, economic aspects, social aspects, communication, technical aspects, and knowledge and training.

Identified barriers at the policy level include lack of synchronization between national and local governments, lack of financial and human resources, lack of ambition of municipalities, and difficulty in dealing with homeowner associations and heterogenous districts with significant variations in the standard and age of the buildings. Legal barriers include obligations to comply with building construction norms also for other aspects than those related to energy when buildings are renovated or regulations protecting the cultural heritage. Economic barriers include lack of funding, market distortions, lack of financial incentives, complex rules to achieve funding for renovation work, and the resistance of private homeowners to take loans. Social barriers include difficulty in renovating areas with vulnerable low-income people and a lack of trust by citizens towards other energy renovation actors. Barriers related to communication include lack of advice, poor dialogue between stakeholders, lack of contact between building owners and energy professionals, and lack of coordination between institutions. Technical barriers include the lack of innovative technological solutions and the low energy performance of buildings, which makes it difficult to use efficient low-temperature district heating grids. Other identified barriers are the lack of knowledge and training of various energy actors.

Drivers found at the policy level indicate that municipalities have an essential role in leading by example and being a central actor in reaching many stakeholders. Municipalities can also provide different types of economic support, e.g., using available funds to provide different types of subsidies, giving bank guarantees and offering low-interest loans to their municipal housing associations. Furthermore, they may stimulate building renovation by coordinating entire district renovation processes also among private building owners. Regarding legal aspects, ambitious requirements on energy efficiency and the use of renewable energy-based heating systems can be important drivers. Such regulations may also be combined, and they are best accepted, and therefore most effective, when something is given in return for compliance with far-reaching standards. Identified economic drivers include revolving loan funds as well as economic incentives to encourage a shift to non-fossil fuels. Many economic drivers are related to economies of scale, e.g., district heating projects

may be economically advantageous compared to individual heating solutions. To promote a combination of energy efficiency and renewable energy measures, an important driver is to determine subsidies based on gross floor area instead of the capacity of heating systems. Another driver is to focus on life cycle costs instead of investment costs. Drivers related to social aspects include citizen involvement and user participation to raise the acceptance for the energy renovation, to encourage initiatives from citizens and individual building owners for building renovation projects at the district level, improving the outdoor environment and attractiveness of the district being renovated as well as ensuring the continuity of families and the social cohesion in the district. Drivers related to communication include advice and guidance to actors involved in energy renovation of buildings at the district level during the whole renovation process, organizing networking meetings among building owners, communicating and spreading information about good practise and pilot areas, good communication between the different stakeholders involved in the project as well as map-based information informing citizens on available energy options. Technical drivers include standardisation and prefab solutions and, thereby, faster and more cost-effective construction, especially if the buildings to be renovated are of a similar type. The possibility to access a large energy source or the possibility to apply advanced efficient technologies can also be a driver for building renovation at the district level. Drivers related to knowledge and training include increased knowledge and experience among stakeholders involved in different parts of the renovation project, particularly energy professionals from both the private and the public sectors.

It is concluded that local authorities are key actors. To facilitate renovation at the district level, they could act as moderators and central actors to reach many stakeholders and foster a positive attitude towards energy renovation. Similarly, housing associations can play an important role in energy renovation at the district level, acting as drivers of the renovation process and implementing a holistic renovation vision.

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Abbreviations

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

Abbreviations	Meaning
EN	European Norm
EPC	Energy Performance Certificate
ESCO	Energy service company
IEA EBC	Energy in Buildings and Communities Programme of the International Energy Agency
OSS	One-Stop-Shop
PV	PV panels
RES	Renewable energy sources
SWOT	Strengths, weaknesses, opportunities, and threats

Definitions[1]

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 IEA EBC 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.

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.

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 'CO_2 equivalent emissions'.

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).

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).

[1] A comprehensive list of all IEA EBC Annex 75 definitions can be found here: (Hidalgo-Betanzos et al., 2023) - https://annex75.iea-ebc.org/publications

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.

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

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.

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.

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.

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

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 CO_2 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.

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.

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.

1. Introduction

1.1 General context

Renovation strategies at the building level need to be derived as a combination of energy efficiency upgrades for buildings and the use of renewable energy to decarbonise the energy supply at a district or city scale. To this end, IEA EBC Annex 75 defines a methodology (see Bolliger et al., 2023) to identify which strategies are cost-effective when applying energy efficiency and renewable energy measures to achieve far-reaching reductions in carbon emissions and primary energy use in urban districts. Combining energy efficiency and renewable energy sources addresses both energy supply and demand in the built environment. In this sense, the renovation of building envelopes is an appropriate strategy to reduce demand and partly also carbon emissions, while the use of renewable energy aims at fully decarbonising the energy supply system. To this end, the EU's "Clean Energy for All Europeans package" framework highlights the need to increase energy efficiency and renewable energy uptake (European Commission, 2019).

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 guide 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 complexity of carrying out cost-effective and energy-efficient building renovation at the district level, it is important to identify barriers and drivers to suggest ways to facilitate renovation activities at the district level. It will be possible to encourage such development by diminishing the barriers and enhancing the drivers.

In this report, energy-efficient renovation refers to both energy efficiency measures and renewable energy measures.

1.2 Barriers and drivers – definition and categories

In this report, barriers are identified as factors that hinder energy-efficient renovation. Barriers are sometimes referred to as obstacles (Bjørneboe et al. 2018, D'Oca et al. 2018). Drivers, on the other hand, are identified as factors that enable and stimulate energy-efficient renovation. Drivers are sometimes referred to as enabling factors, motivators or benefits (e.g., Bjørneboe et al. 2018, Azizi et al. 2019).

Previous studies on energy-efficient renovation have identified a great number of barriers and drivers and they have often been divided into categories (e.g., Caputo and Pasetti 2017, Bjørneboe et al. 2018, D'Oca et al. 2018, Alam et al. 2019, Azizi et al. 2019). Bjørneboe et al. (2018) used the categories information (the use of communication and education to increase awareness), finance (economics, subsidies, etc.) and process (physical and social context, decision-making and regulation). Alam et al. (2019) made a review of studies on building renovation barriers and identified four categories: financial, administrative, knowledge and social. Similarly, Caputo and Pasetti (2017) identified five categories of barriers – knowledge-based, economic/financial, technical/structural/social, political and individual/psychological – and two categories of drivers – activation and depth of measures. D'Oca et al. (2018) identified three categories of barriers (as the most important): technical, financial and social.

In this report, the following seven categories were used:

– Policy
– Legal
– Economic
– Social
– Communication
– Technical
– Knowledge and training

1.3 Objective and outline of the report

This report aims to identify barriers which hinder energy renovation of buildings in urban districts and to identify drivers which enable an energy-efficient renovation at the district level. The aim is also to suggest recommendations for energy-efficient renovation strategies at the district level.

The work intends to answer the following research questions:

RQ1 What are the main barriers and drivers as regards energy efficient renovation at the district level?
RQ2 What barriers must be overcome to achieve successful energy-efficient renovation at the district level?
RQ3 What are the most important drivers enabling energy-efficient renovation at the district level?

The present study is based on two separate studies. The first is the analysis of 15 European success stories regarding energy-efficient renovation at the district level (see **Table 1** and Rose et al. 2021). The second study consists of interviews with a variety of stakeholders in eight European countries (see **Table 3**). This report includes the following parts:

– Description of the methods used for the analysis of success stories as well as interviews with stakeholders (Chapter 2).
– Identification of barriers and drivers from the analysis of the success stories (Chapter 3)
– Analysis of the interviews with stakeholders (Chapter 4)
– Identification of the most important barriers and drivers from both the success stories and the interviews with the stakeholders (Chapter 5)
– Discussion of the findings from other studies (Chapter 6)
– Recommendations on how to achieve energy-efficient renovation at the district level by minimizing the barriers and enhancing the drivers (Chapter 7)

2. Methodology

The answers to the research questions in Section 1.3 include an analysis of success stories (reported by (Domingo-Irigoyen et al., 2023)) and in-depth interviews. The interviews were held with different stakeholders involved in energy renovation at the district level. **Addendum 1** shows the questionnaire used for the interviews, and **Addendum 2** shows the analysis template.

2.1 Analysis of success stories

Key parameters for analysing the success stories were defined as a first step. A detailed data template was elaborated based on the key parameters, which included both drivers and barriers for a successful implementation. In the next step, different success stories were selected in different national contexts and data based on technical documentation and interviews of involved stakeholders were collected. Fifteen success stories were selected for further analysis. The final step consisted of performing qualitative and quantitative comparisons of the selected success stories, drawing conclusions, and extracting lessons learned. The methodology is described in detail in Bolliger et al. (2023).

For the analysis of the success stories, the following stakeholders were identified: policy actors (authorities), investors (e.g., housing associations), district-related actors (e.g., residents' organizations), energy network suppliers, renovation solution suppliers and other intermediaries. **Table 1** gives general information and coding for the 15 success stories of district-level renovation analysed. **Table 2** shows district size and principal renovation measures performed for each success story project, grouped into the three core areas defined by Domingo-Irigoyen et al. (2023).

Table 1. Summary of the 15 success stories that were analysed.

	Country	Project	Code	City	Use	Year of construction	Year of renovation
1	Austria	Strubergasse	AT	Salzburg	Residential	1950-1965	2012-2018
2	Denmark	Kildeparken	DK	Aalborg	Residential	1970s	2014-2020
3	Italy	Quartiere Giardino	IT1	Modena	Residential	–	1970
4		Quartiere Sangallo	IT2	Varese	Residential	1960-1970	2015-2017
5		Valdastico	IT3	Valdastico	Mixed	–	2014
6		Santa Marta Campus	IT4	Venice	Mixed	2nd half 17th century, 1880s & 1920s	2017
7		District Heating	IT5	Turin	Mixed	–	1982-ongoing
8	Portugal	Rainha Dona Leonor	PT1	Porto	Residential	1953	2009-2014
9		Vila D'Este	PT2	V.N.Gaia	Residential	1984-1986	2009-2015
10		Boavista	PT3	Lisbon	Mixed	1960	2013
11	Spain	Coronación district	ES1	Vitoria-Gasteiz	Mixed	1960-1970	2016-2021
12		Lourdes	ES2	Tudela	Residential	1954-1972	2010-2012
13	Sweden	Linero	SE1	Lund	Residential	1969-1972	2014-2021
14		Hagalund	SE2	Malmö	Residential	1967	2017-2018
15	Switzerland	Lake water district heating	CH	Weggis, Lucerne	Mixed	–	2016-2020

Table 2. District size and energy measures performed for each success story.

Project Code	District area (m^2)	Principal renovation measures
Northern Europe		
DK	540,000	Improved thermal envelope, renovation of existing district heating, replacement of radiators
SE1	90,300	Improved thermal envelope, renovation of existing district heating, replacement of radiators
SE2	25,000	New geothermal heat pump district heating, replacement of radiators, PV on the flat roofs
Central Europe		
AT	45,000	Improved thermal envelope, connection to a thermal solar micro-grid system
IT1	147,000	New, efficient district heating
IT2	7,500	Improved thermal envelope in part of the buildings, improved existing district heating, use of heat pumps
IT3	8,000	New biomass district heating with solar thermal
IT4	11,000	Trigeneration plant with natural gas (electricity, thermal energy, summer cooling), hot water district heating
IT5	24,000,000	New cogeneration units with a heat storage system
CH	250,000	New lake water-based district heating
Southern Europe		
PT1	19,700	Improved thermal envelope in part of the buildings, multi-split HVAC for heating and cooling
PT2	170,000	Improved thermal envelope, solar thermal for domestic hot water
PT3	55,000	Improved thermal envelope in part of the buildings
ES1	89,100	Improved thermal envelope, new biomass district heating
ES2	25,000	Improved thermal envelope, new biomass district heating, solar thermal for domestic hot water

More detailed information about these projects can be found in Rose et al. (2021) and Domingo-Irigoyen et al. (2023). The projects were subjected to a multi-perspective analysis which was used to derive the most important lessons learned. The buildings, mostly residential, were constructed from the 1950s to the 1980s and renovated in the last ten years.

The identified barriers and drivers from the success stories are presented in Chapter 3.

2.2 Interviews with stakeholders

2.2.1 Interview procedure

A questionnaire was developed to give input to different tasks in IEA EBC Annex 75. The collaboration between different subtasks enabled more stakeholders than those involved in the 15 success stories to be interviewed. In total, 39 stakeholders from 8 countries were interviewed. The questionnaire (see **Addendum 1**) served as an interview guide for the in-depth interviews. Parts of the questionnaire were, in some cases, answered by mail beforehand.

The interviews took around one hour each to perform. The interviews were coded (country, number) and anonymized. E.g., the first interviewee from Austria was denoted AT-001, the second AT-002 etc. The interview procedure is described in detail in Mlecnik et al. (2023) and Konstantinou et al. (2023).

2.2.2 Types of stakeholders interviewed

The chosen stakeholder categories for the interviews were the following:
P – Policy actors (e.g.: local or regional authority, public agency or institute ...)
R – 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…)
E – 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...)
C – Clients and beneficiaries (e.g., clients, residents, homeowner associations, community/occupants' organizations, housing associations and cooperatives: private, public, semi-public...)
F – Financing intermediaries (e.g., banks, investment funds, real estate developers, project developers, portfolio managers, ESCOs...)
I – Other intermediaries (e.g., federations, trade organizations, not-for-profit organizations, neighbourhood interest associations, neighbourhood communication agents, business model developers, consultants...)

Two stakeholder categories differed from those used in the first analysis of the success stories mentioned in Section 2.1. The stakeholder category "Investors", used when analysing the success stories, was included in the broader group "Clients and beneficiaries". Similarly, the stakeholder category "District-related actor", used when analysing the success stories, was here included in the group "Other intermediaries".

The number of interviews per stakeholder category and the number of interviews per country are shown in **Table 3**.

Table 3. Number of interviews per country and stakeholder type.

Stakeholder type	AT	BE	DE	NL	PT	ES	SE	CH	TOTAL
Policy actors	0	1	4	3	1	2	1	5	17
Renovation solution suppliers	0	1	2	2	1	0	0	0	6
Energy solution suppliers	0	0	0	1	0	1	0	1	3
Clients and 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	2	6	2	9	39

2.2.3 Analysis of the interviews

The part of the analysis template (see **Addendum 2**), which consisted of the SWOT analysis, was analysed to identify the barriers and drivers for energy-efficient renovation. For each interview, the answers, where appropriate, were copied to the SWOT analysis under one of the following categories:

– Strengths (internal)
– Weaknesses (internal)
– Opportunities (external)
– Threats (external)

The SWOT analysis divided the answers into the seven categories presented in Section 1.2 (Policy, Legal, Economic, Social, Communication, Technical and Knowledge and Training).

It should be noted, however, that it is sometimes difficult to find the right category for certain barriers and drivers. Moreover, some barriers and drivers can belong to several categories.

The categories “weaknesses” and “threats” gave input to barriers, whereas “strengths” and “opportunities” gave input to drivers. The identified barriers and drivers from the interviews are presented in Chapter 4.

2.3 Limitations

The focus of the study was mainly the residential buildings, including single-family houses and multi-family buildings such as condominiums, cooperatives and rental (social) housing. However, some districts have included ground-floor commerce and commercial and/or public buildings.

The research was mainly based on the available knowledge of the authors and experts from IEA EBC Annex 75, on the documentation of the selected success stories and information from the interviewees. The study focused on examples from Austria, Belgium, Denmark, Germany, Italy, Portugal, Spain, Sweden, Switzerland and The Netherlands. The literature research was limited to some key references.

The empirical research was limited to the available data from the analysis of the success stories as well as the opinions of the interviewees. The interviewees were selected by IEA EBC Annex 75 members assuming they have in-depth knowledge of energy-efficient renovation at the district level in their country. It should be noted that their personal opinion may not fully reflect the situation in their country. IEA EBC Annex 75 members checked the correctness of their statements, but misunderstandings cannot be completely ruled out.

3. Results from the success stories

This chapter presents the main findings from the analysis of the success stories. In Sections 3.1 and 3. 2, the barriers and drivers are identified and presented, respectively. Section 3.3 shows a summary of the most important barriers and drivers. A detailed analysis of all success stories studied in IEA EBC Annex 75 can be found in Domingo-Irigoyen (2023).

It should be noted that the stakeholder categories used in analysing the success stories were slightly different from those used in the interviews, as explained in Section 2.2.2.

3.1 Identified barriers

The analysis performed aimed to identify barriers or solutions that hindered the projects. The barriers have been divided between different stakeholders.

3.1.1 Policy actors

For policy actors, such as local authorities, a barrier was the need to comply with the new/current building regulations, especially when it comes to accessibility [SE], but also energy efficiency [PT1, SE], ventilation requirements [SE] etc., which increases the complexity of the renovation. Other barriers include the fear of conflict with the residents by causing gentrification [AT], due to which the measure/implementation may be politically sensitive. Another mentioned barrier was finding investors interested in economically supporting the project [AT, IT1, IT3].

3.1.2 Investors

A main barrier for investors to successfully implement district renovation projects is the lack of funding [IT2, IT3, PT1, PT3, ES1, ES2 and SE1]. A barrier for housing associations was that the renovation scope had to be limited to avoid monthly rent increases [SE]. Other barriers were related to a lack of personal resources, including a lack of competent technical personnel [IT1, PT1]. The poor national economy was also mentioned [PT3]. Another barrier mentioned was determining the right time to intervene to reduce service disruption [IT1]. Compliance with cultural heritage requirements, due to a historical context, was also a barrier [IT4]. Yet another barrier was the difficulty of informing people in order to decide about the intervention [ES1]. Furthermore, it was mentioned that for the rapid development of a project, it is a challenge to be sufficiently flexible and innovative to meet local authorities' requirements and manage overlapping project phases [CH].

3.1.3 District-related actors

For district-related actors, such as residents' organizations, it was considered a barrier both if tenants remained in the buildings during renovation [SE] or if they were temporarily transferred to other buildings because of the need to have the buildings vacant to carry out the renovation works [PT1, PT2]. Barriers also included the uncertainty and fears among residents for what the future will mean, e.g., high costs [AT].

Another barrier was that residents of the area were dissatisfied since the measures were decided top-down without a participatory planning stage [IT1]. Yet another barrier was that it is complicated and time-consuming to attain a high agreement regarding the decisions among the neighbours [ES2]. A barrier in one case was that the intervention schedule was limited to the summertime, to not interfere with school activities [IT3].

3.1.4 Energy network suppliers

For energy network suppliers, the barriers mentioned were that the project does not give enough profit. Thus, business as usual was considered easier and more profitable [AT, ES1], and the difficulty of managing the cash flow over the long term while valorising the savings [IT2]. The legal framework was also mentioned as a barrier [CH, ES1, PT1]. In one case, this barrier refers to inequalities in subsidies for individual building owners and district heating projects [CH], in another case to the requirement to carry out energy efficiency measures even though it was not the goal of the intervention [PT1], and in another case due to the lengthy process to approve the projects [ES1]. More project-specific barriers included the difficulty in positioning the biomass plant and the solar heating system and the grid design for connecting the more distant public buildings [IT3]. A general obstacle is the lack of knowledge for accessing large-scale renewable energy sources and combining them with efficiency measures on the building envelopes [ES1, IT3]. Furthermore, energy network suppliers often lack the resources to carry out the necessary coordination work to develop district projects [PT3, ES1, ES2].

3.1.5 Renovation solution suppliers

For renovation solution suppliers, a barrier is that inhabited objects, when resettling the tenants is not possible, make it difficult to plan and calculate and difficult to keep the time frame [AT, ES2, IT1, IT2]. Another barrier mentioned by renovation solution suppliers was that the final appearance of the renovated buildings should not be disruptive or interfere with the surrounding buildings avoiding striking differences [ES2].

For other intermediaries, a barrier is the lack of acceptance by the residents [AT]. Maintaining good communication regarding the tenants' expectations and problems is another barrier [IT1].

3.2 Identified drivers

The analysis aimed to determine what were the decisive aspects for the successful implementation of the projects. The drivers have been divided between different stakeholders.

3.2.1 Policy actors

A typical driver for policy actors, such as local authorities, was the ambition to improve the district's and its dwellings' environmental performance by reducing energy use, leading to reduced carbon emissions and operating costs [CH, ES1, IT1, IT3, PT2, PT3]. Through a district approach, the possibility to access a large renewable energy source which could otherwise not be accessed – for example, heat from a nearby lake or local renewable energy sources such as woodchips – was considered an important driver [CH, IT3]. Other common drivers were improving the outdoor environment around the buildings, e.g., green areas and playgrounds, in the district [PT2, SE] and increasing the residents' quality of life [ES1, IT1, IT3, PT2]. In one case [CH], continuous communication between the municipality and the population through presentations/articles and public events was key for success. In another case [DK], the driver was also the integration of the renovated area into the city district.

3.2.2 Investors

Typical drivers of investors, such as housing associations, were maintaining financial sustainability by increasing the residential area's value and making the housing area more attractive by improving its image [DK, ES2, PT1, SE]. As for the image improvement, the drivers could differ; in one case [PT1], the aim was to maintain the architectural and urban original characteristics. In other areas/neighbourhoods [DK, SE], the driver was to improve both the outdoor environment in the area as well as the aesthetics of the buildings. Another driver was increasing the residential density [AT].

In some cases, financial assistance, e.g., from the European Union or through carbon offset programmes, was a decisive driver/facilitator in performing/implementing the renovations (or making more interventions than what was initially planned) [ES2, SE, CH].

An important driver for the housing associations was to reduce energy demand and, consequently, operating costs which will be especially beneficial to medium and low-income families in the area [AT, ES2, IT2, IT3, PT3]. Apart from the need to improve the poor energy-environmental performance of the studied district, these areas needed maintenance in general due to the profound state of physical degradation of the buildings. Many housing associations saw the renovation as an opportunity to improve the standard of the dwellings, e.g., increase the area of the apartments to better correspond to today's needs and life patterns of the residents, reduce the running costs through energy savings and increase accessibility [DK, ES1, ES2, IT1, PT1, PT2].

If the investor of a district heating network is a public institution, this was considered to make the network operator trustworthy for building owners considering a connection to such a system [CH].

Municipalities may provide particular incentives to investors for developing district projects, for example, through a financing model that allows a private investor to retain a part of the neighbourhood's land in exchange for being responsible for the renovation of buildings [PT1].

Citizen and tenant engagement is important in allowing a project to be developed smoothly [AT, ES1, IT1, PT1, PT2].

3.2.3 District-related actors

For district-related actors, such as residents' organizations, an important driver was to improve dwellings and surroundings at a small or reasonable increase in rent, creating the least possible disturbance for the residents and ensuring the continuity of families and the social cohesion in the area [DK, ES2, PT3, SE]. From the residents' point of view, these areas often have bad interior conditions with high levels of thermal discomfort. One of the drivers for the residents was, therefore that the energy renovation would also lead to improving the quality of life of the residents by improvement of living standards – e.g., comfort and accessibility – through installing elevators, improving open space and lower operating/running costs [AT, ES2, IT1, IT3, PT2]. Individual residents of a district may also be important drivers for a district project; although their decision-making power as individual residents is small, they can have a key influence by triggering a larger project. This was observed in one case where a request from a resident to construct a lake-water heat pump for his house led to the development of an entire district heating project [CH].

3.2.4 Energy network suppliers

Drivers for the energy network suppliers included both modernization and increase/optimization of the district heating network [AT, CH, SE]. Other drivers were maintaining customer trust and satisfaction, increased profit and experience, and gaining visibility/marketing advantages [CH, ES1, IT1, IT2, IT3]. Another driver was the possibility of integrating the area into the existing energy supply network [DK]. Yet another driver was the synergy effect of also renovating other infrastructure when installing a district heating district [CH]. For an energy network operator, a driver for facilitating energy efficiency measures of buildings connected to a district heating system can be the possibility of obtaining additional connection fees when a reduction of energy needs in the network allows connecting more buildings [CH]. Furthermore, a driver from an environmental point of view can be the use of effective large-scale solutions at the district level rather than at the individual building level, for example, heat pumps that apply a refrigerant, such as ammonia, which has a low global warming potential [CH].

3.2.5 Renovation solution suppliers

For renovation solution suppliers, drivers included carrying out profitable and good quality renovation work [ES1] and implementing a good reference project to gain experience and prestige/fame [AT].

3.3 Overview of barriers and drivers

Key barriers and drivers identified from the analysis of the success stories are shown in Table 4.

Table 4. Most important barriers and drivers for different stakeholders.

Stakeholder	Barriers	Drivers
Policy actors	Comply with building regulations Finding investors	Improve the environmental performance of the district Access large renewable heat source Improve outdoor environment Continuous communication with stakeholders
Investors (e.g. housing associations)	Lack of financial and personal resources	Increase the value of the area Improve the standard of dwellings Reduce energy demand Financial assistance/subsidies Citizen and tenant engagement
District-related actors (e.g. residents' organizations)	The inconvenience for the residents	Reasonable increase in rents Maintain social cohesion in the area Improve the quality of life of residents Requests from individual residents
Energy network suppliers	Not enough profit; legal obstacles	Modernization of the district heating network Increase profit Additional connection fees enabled as efficiency measures reduce energy needs Apply efficient technologies available at large scale (district level)
Renovation solution suppliers	Difficulty in planning the work when buildings are inhabited	Profitable and good-quality renovation

4. Results from the interviews with stakeholders

In this chapter, the identified barriers and drivers based on the interviews with stakeholders are presented. It should be noted that the categorisation of stakeholders is slightly different from Chapter 3 (see Chapter 2, Methodology).

As explained in Chapter 2, the identified barriers and drivers were divided into the following categories: Policy, Legal, Economic, Social, Communication, Technical, and Knowledge and Training.

4.1 Identified barriers

4.1.1 Policy

Role of regional and national authorities

Several respondents highlighted the lack of synchronization between national and local governments [BE-001, BE-002, DE-001, DE-002]. Examples of obstacles are:

- There is no national strategy for combining energy supply (local heat strategy) and renovation at the district level [BE-001]
- There is a lack of structural financing for cities from the national level [BE-002]
- The connections between local and higher authorities and the “impulses” from regional and national authorities do not trigger a change in local thinking and acting [DE-002].
- Lack of direction from the national government [NL-007]

Another barrier is the lack of regional/national coordination, e.g., the transfer of existing solutions to other municipalities [DE-001].

The role of municipalities

Local governments, such as municipalities, are key actors in energy renovation at the district level. However, several respondents point out municipalities' weaknesses that become obstacles to the renovation process.

Several respondents point out obstacles related to municipalities’ capacity as regards the number of staff and their competence:

- Municipalities are often overburdened [DE-001] and overwhelmed by new tasks, such as energy source transition and renovation at the district level, which come on top of their compulsory tasks [DE-002]
- Municipalities often lack financial and human resources to support energy renovation [DE-002]. In small and medium-sized municipalities, there can be a lack and/or fluctuation of staff [DE-009, NL-007]
- There is a lack of staff to provide detailed advice, quickly answer questions and make information easy to find [NL-002, NL-007]
- Renovation coaching requires technical expertise not always present within local governments [BE-001]. This also concerns, for example, the carrying out of inspections to ensure the implementation of high-efficiency standards, particularly in smaller or rural municipalities [CH-007, CH-008].

Another obstacle mentioned is the silo mentality in public administration and the lack of policy and structure for the constant exchange of information between stakeholders [DE-004].

One respondent also points out that municipalities do not implement enough own projects, e.g., they do not take the opportunity to include adjacent residential buildings when they renovate their own public buildings [DE-001].

Another obstacle related to energy renovation may be that local authorities are competing to attract inhabitants to their municipality and an improvement in energy efficiency which increases the costs for the residents, could be counterproductive and repel inhabitants [DE-002].

Two respondents pinpoint that it is especially difficult for a municipality to push necessary district and energy renovation in heterogenic districts:
– Individual renovation plans vary between buildings due to the variety in age and typology [DE-003]
– Heterogeneous ownership structure in the district [DE-004]

Furthermore, one respondent highlighted that it is particularly challenging for local authorities to address the topic of energy efficiency measures in combination with renewable energy measures at the district scale, as developing a new district heating project in itself is already a complex task and adding another level of complexity with the topic of insulation measures at building envelopes would exceed the capacity of the local authority [CH-005].

A problem for small municipalities is that bigger players like energy agencies do not like to work there because of the high-hanging fruits [DE-006].

Another obstacle mentioned is the lack of power of the municipality concerning private actors. The municipality has limited influence on private actors such as private housing companies and homeowners and cannot force them to improve energy efficiency; the possibility to influence is thus limited to information and guidance [DE-003, SE-001].

Other policy aspects

Several respondents have identified the difficulty of dealing with homeowner associations when renovating at the district level [NL-001, NL-002, NL-004, NL-005]. A number of potential obstacles were mentioned:
– Many steps are needed to convince a homeowner association to accept energy renovation, and it might be required to consider psychological barriers as well [NL-001]
– The decision-making periods of homeowner associations can be long since many aspects must be covered [NL-001]
– In homeowner associations, everybody must go along [NL-002], and there may be a complicated administration of the homeowner association [NL-001, NL-004]
– Unexpected problems can arise if homeowners refuse to accept parts of the renovation measures [NL-005]

Several respondents point out obstacles related to lack of awareness [CH-001, NL-002, NL-007]. There may be resistance to making changes in general [CH-001], and buyers of houses show little interest in sustainability issues [NL-007]. There may also be a lack of attention to sustainability issues in developing district heating plans [NL-002].

Some respondents point out the lack of a holistic approach to energy renovation at the district level where other aspects than energy renovation can be challenging to include [DE-003, ES-005, NL-006]. E.g., there may not be sufficient funding for renovating the buildings' surrounding area [ES-005]. Some themes, such as avoiding fossil fuels and greening districts, may not be that well developed [NL-006].

Several respondents point out obstacles in renovation at the district level related to poor management and inadequate stakeholder dialogue [BE-002, CH-001, DE-003, ES-001, ES-002, NL-002, NL-006]. One barrier mentioned is that, as multiple parties are active in parallel with energy-saving, it becomes difficult to know who does what [NL-002]. Moreover, obstacles include diverging interests and lack of coordination between institutions [DE-003, ES-001, NL-006] and the difficulty in deciding the right timing for the intervention [CH-001, CH-008].

Mistrust towards the administration and the lack of transparency of the processes are other barriers mentioned [ES-002].

Two respondents point out that change of policy and visions after elections may be negative from a management perspective as it requires a frequent rebuilding of knowledge [BE-002, NL-003].

Several respondents pointed out conflicting interests among the stakeholders involved in the district-level renovation as obstacles [DE-003, ES-001, NL-001]. E.g., sustainable development may not be the priority for all involved actors [DE-003, NL-001].

Yet another identified obstacle is that political decision delays negatively affect technical decisions [ES-001].

One respondent points out that developing strategies is too complex to be carried out by a municipality alone. It must be carried by a coalition of citizens, companies and knowledge institutes [BE-001].

Two respondents point out the lack of long-term plans and visions related to energy renovation at the district level, something that can be affected by political changes [ES-003, NL-003].

It was also mentioned that sometimes the extent of the competencies of local authorities is not clear [CH-007].

One respondent points out that there is a lack of obligations and core task definition at the regional level and a risk of writing too many plans and acting too little [NL-003]. The same respondent points out the lack of political courage [NL-003]. Other respondents similarly mentioned that fear of a lack of acceptance by citizens is a reason for not introducing far-reaching policy measures [CH-005, CH-006].

With regard to the development of district heating, barriers pointed out were the lack of local energy plans [NL-007], lack of clear planning (when and what) and unknown target years for the implementation which hinders financial planning [NL-005].

4.1.2 Legal aspects

Laws and regulations

Several respondents stress that laws and regulations may hinder energy renovation at the district level [CH-002, CH-003, DE-002, ES-002, ES-004, ES-005, ES-006, NL-001, NL-005, NL-007]. One respondent from Germany points out that the very rigid legal framework regarding taxes, energy, tenants' law etc. may be an obstacle to renovation [DE-002]. E.g., the German heat supply regulation demands proof of cost neutrality for tenants in case of switching to contracting solutions [DE-002].

Two respondents from Spain point out that there is a legal right not to carry out measures that lead to increased costs, either for the housing association or for the residents:

– If mandatory actions such as accessibility measures exceed 12 monthly payments, the residents can vote against it [ES-004]
– If the payback time for renovation of the thermal system is longer than four years, the law of the accounting of individual use in buildings says that those measures are not necessary [ES-006]

It is also pointed out that legislation and regulations related to funding renovation measures can constitute obstacles, e.g., complex and time-consuming funding regulations [CH-002] and that legislation and regulations limit the opportunities for credit schemes for renovation measures [NL-007].

Legislation is still mainly focused on the building scale instead of the district scale, missing the opportunity for more cost-effective renovations, especially when integrating renewables on-site is an option [PT-001].

One respondent points out that listed buildings, which may not be altered without permission from the planning authority, may constitute barriers since their renovation is more complicated [CH-002]. The same respondent considers that using renewable energy is hindered due to a too complicated legal framework [CH-002].

Other barriers respondents pointed out are isolated legislation [ES-002] and that regulations arrive too late or that they are not ambitious enough [ES-006].

Ownership structure

Several respondents pointed out that the ownership structure can constitute a barrier to energy renovation at the district level [CH-002, DE-003, DE-004, NL-002]. A heterogeneous ownership structure in a district constitutes a great challenge and may require massive coordination and communication efforts, especially from the municipality [CH-002, DE-003, DE-004]

The renovation may also be hindered by the fact that in multifamily buildings, some technologies are individual property, e.g., windows and individual heat sources [NL-001].

One respondent points out that changing an ownership division contract of a homeowner association can bring extra costs [NL-002].

Other legal aspects

Several respondents pointed out that the difficulty in reaching agreements both on district and building levels can become barriers:

– To carry out changes, such as energy renovation, the national laws in Spain require approval by 60% of the residents, which complicates the decision-making [ES-004]
– It is difficult to reach agreements because in residential buildings, the ground floor shop owners also vote, and they represent a high percentage of the whole building [ES-005]
– Homeowner associations have high power, and renovation measures require 100% agreement by the homeowners [BE-002]
– Breaking up a property act can become a lengthy legal process requiring 100% agreement by all owners [NL-001]
– It is challenging to convince 100% of the residents, even in social housing [PT-001]

One respondent points out that certification, such as sustainability assessment methods, can be an obstacle in energy renovation since it makes construction more expensive. [CH-003]

Another respondent points out that when the energy for different activities is paid as a lump sum for the whole building, this does not encourage energy savings and may affect the total energy use for the building negatively [NL-005]. Furthermore, subsidies for heating systems are often linked to the capacity of the heating system; concerning heating systems, buildings which are less well insulated accordingly receive more subsidies than those which are well insulated, which can discourage energy efficiency measures [CH-005].

A respondent from Switzerland claims that when installing water-water heat pumps using a lake or the sea as the water source, the permit process can often be complicated when it comes to sensitive environments [CH-002].

Another respondent from Switzerland mentions that restrictions to pass investment costs of energy measures from owners to tenants may encourage owners to end contracts with tenants and get new tenants with new contracts [CH-005].

4.1.3 Economic aspects

Financial constraints

As expected, several respondents point out the lack of funding as a major barrier to energy renovation at the district level. Many respondents state that public authorities such as municipalities lack financial and human resources to support energy renovation [CH-002, CH-006, DE-002, DE-007, DE-009, ES-003, NL-002].

Two respondents also point out that the lack of available funds for public housing associations can be a hindrance [BE-002, ES-002]

Two respondents also mention that one barrier is that grants for energy renovation lack some stability, are not offered regularly and that there is uncertainty regarding future changes [ES-003, CH-007]. Interruptions in funding programmes due to lack of funding disappoint stakeholders and undermine subsidy programmes' success [CH-007].

Another respondent mentions that the knowledge about innovative funding schemes, such as One-Stop-Shops and energy performance contracts, is only emerging so far [BE-001]. Another respondent points out that financial Instruments develop too slowly compared to the market development [NL-003].

One respondent also mentions the challenge of making existing funding schemes known to stakeholders [CH-007]. Yet another respondent points out that the rules to achieve funding are too complex and time-consuming [CH-002].

Another risk pointed out with limited financial aid is that the best renovation measures are not chosen in the long run; instead, decisions are made according to the most profitable in the short term, which are usually not deep renovation measures. [ES-003].

It is pointed out that poor funding increases the risk of delays and consequently negatively affects project management [ES-004, NL-001].

Several respondents consider it a barrier that people do not want to take loans [NL-002, NL-005, NL-006, NL-007]. Reasons can be loan aversion [NL-007] or that a second loan can hinder the future loan capacity of households [NL-005].

Another barrier pointed out is that products such as revolving loan funds do not support people with loan aversion [NL-007].

Lack of incentives

Two respondents point out the lack of financial incentives as a barrier to energy renovation at the district level [CH-002, CH-003].

According to two respondents from Switzerland, a barrier is that the energy, in particular energy based on fossil fuels, is still too cheap and although carbon taxation will improve the financial situation – as it will make energy more expensive, which will shorten the payback time of investments – it is still not enough [CH-003, CH-008]

One respondent points out that the Swiss DGNB/SGNI certification systems are inhibited because there are no incentives to choose the holistic approach [CH-003].

Investments and payback time

Several respondents pointed out that investments are sometimes so high that the payback times are too long, which threatens the investors [ES-003, ES-004, NL-007, SE-001]. The fact that financial aid is not sufficient means that residents/owners get increased costs and will be dependent on their own savings [ES-003, ES-004]. Similarly, when the payback time for ESCO financing is too far ahead, it makes related risks less manageable [NL-007].

However, according to several respondents, there is too much focus on initial investment costs – which are high, e.g., heat pumps and renewable energy – whereas life cycle costs are not considered [CH-001, CH-002, CH-008].

The success of projects at the district level depends on the economic attractiveness of systems chosen by energy companies; sometimes, district solutions are not economically advantageous [CH-006, CH-007].

One barrier pointed out is that there is a huge up-front cost for district projects, and therefore a large risk that not enough building owners participate, which makes district projects unattractive to private companies [CH-008].

Other economic aspects

Several respondents pointed out barriers related to the economic vulnerability of homeowners:

- Energy renovation is still too expensive for many homeowners, especially senior adults/low-income persons [DE-007]. Financing high investments, such as ground source heat pumps, may constitute a barrier, particularly for senior adults [CH-006].
- There is generally a lack of investment capacity of homeowners [NL-003], and they are afraid of too high extra costs [CH-001]
- Homeowners often buy their homes at the top of the market; there is no investment margin [NL-005]
- Even if a revolving fund could help homeowners, a sufficient budget is still lacking to support homeowner associations better [NL-006]

Unfavourable economic development and an unstable housing market can constitute barriers to energy renovation at the district level [ES-001, ES-002, NL-001]. One respondent from Spain claims that a barrier is the general economic constraints in society and among local inhabitants [ES-001]. A respondent from the Netherlands points out the speculative character of the interest rate as a possible barrier [NL-001].

Another barrier mentioned is that citizens are not willing to pay for consultancy; even middle- and high-income people expect free advice [BE-002].

One barrier pointed out is the poor coupling between financial and technical guidance, especially for middle- and high-income people [BE-002].

A barrier pointed out by a respondent from Spain is that there is more demand than supply for renovation companies which has led to increasing prices [ES-005].

Another barrier mentioned is that banks are not willing to give support at a small-scale experimental stage. They only act after knowing the results of experiments and when a certain market size can be served profitably [NL-007].

Yet another identified barrier is that when energy efficiency measures are carried out on buildings, the amount of energy purchased by consumers declines, reducing revenues for the company operating the district heating system [CH-009].

A respondent from Portugal points out that a barrier is that a significant part of the population lives in energy poverty conditions [PT-001].

4.1.4 Social aspects

Several respondents pointed out that lack of affordability among residents and homeowners – especially vulnerable groups such as older adults, young families and low- and middle-income people in general – can constitute a serious barrier to energy renovation at the district level [CH-002, DE-007, ES-003, ES-005, NL-003, SE-002]. In districts with a complicated socio-economic situation, it will be difficult to carry out a renovation that increases the rent [SE-002], and the development of gas-free districts may be slowed down [NL-003].

Several respondents pointed out that energy renovation at the district level may become difficult due to the heterogeneity of the district [DE-003, ES-001, ES-002, NL-007, SE-002]. The heterogeneity can take on many different expressions, e.g., there may be many diverging interests in district development which makes it hard to unite all behind solely climate issues [DE-003], there may be a generational change in the district bringing in new people with fewer connections or roots in the community [ES-001], there may be complex and diverse user profiles having their own needs [ES-002] and among the different types of people in a district, there might be those who refuse any change [NL-007].

Several respondents pointed out that the lack of trust among citizens towards authorities and other actors involved in energy renovation at the district level constitutes a barrier [BE-002, DE-008, ES-002, ES-004, ES-006, NL-003, NL-007]. Some examples given are:

- You cannot reach people who do not trust you [BE-002]
- Village citizens are usually very sensitive to measures imposed by the government [DE-008]
- There may arise mistrust due to a lack of transparency during the renovation processes [ES-002]
- There is some distrust in public aid and in the commitment to carry out joint works [ES-004]
- The government may not be trusted by homeowners – particularly energy-vulnerable people – to share data, e.g., transfer of data to tax authorities [NL-003]
- There may be a lack of trust in energy companies and renovation suppliers [NL-007]

Another barrier to energy-efficient renovation at the district level is that many people live in the buildings to be renovated. One respondent points out that to comply with current energy regulations, it would be necessary to make a deep renovation of the building envelope of old buildings, something that will not be possible if people live there [SE-002].

One respondent points out the lack of inclusivity in neighbourhood initiatives as a barrier [NL-003].

Another barrier pointed out is that many owners hesitate to connect to a district heating system because many of them prefer to be independent [CH-008].

4.1.5 Communication

Information to residents

Several respondents pointed out the difficulty of communicating with residents in apartment buildings and homeowners as a barrier in energy renovation at the district level [BE-002, DE-003, ES-001, ES-003]. The identified possible barriers include:

– The difficulty in communicating with homeowners due to the lack of trust and the difficulty in activating neighbours despite supporting initiatives [BE-002].
– Difficulty in communicating due to heterogeneous owner structures [DE-003]
– Transmission of incoherent messages to the residents [ES-001]
– Lack of client contact centre and lack of staff to quickly answer questions and make information easy to find [NL-002]
– Finding the right timing in communication [CH-006]

Lack of advice and guidance

A barrier that many respondents highlight is the lack of adequate advice and guidance to residents [BE-002, DE-007, NL-005, NL-007], e.g.:

– Citizens are not willing to pay for consultancy; even middle- and high-income people expect free advice [BE-002]
– Poor coupling between financial and technical guidance, especially for middle- and high-income people [BE-002].
– Many people do not react to offers of paid expert advice [BE-002]
– Not enough information and advice, specifically for homeowners [DE-007]
– There are large differences in the quality of advice [DE-007]
– Lack of manpower to provide detailed advice [NL-007]
– Building owners may communicate only with a heating engineer focusing on replacing components [CH-002].

Another highlighted barrier, according to one respondent from the Netherlands, is that municipalities sometimes work with volunteers as energy coaches who may devalue the quality of the advice [NL-005].

Stakeholder dialogue

Energy renovations at the district level contain complex processes with many stakeholders involved. Several respondents pointed out the poor dialogue between stakeholders as a barrier to energy renovation at the district level [BE-001, DE-008, ES-003, ES-004, ES-005, NL-002, NL-006, NL-007, SE-002]. Barriers include:

– Lack of coupling between the local heat strategy and the renovation strategy on the higher government level [BE-001]
– Lack of information and communication between the village architect and village officials [DE-008]
– Some stakeholders lack experience working with social agents or individuals. They are not used to a direct dialogue with them [ES-003]
– The distance between the regional administration and the homeowners means that the renovation success depends on the expertise of the intermediaries [ES-004]
– Private companies alone cannot convince other districts to install new district heating [ES-005]
– Stakeholders are working separately without integration [NL-006]

– Residents receive mixed signals about the intentions in their district. There is a lack of a clear storyline for the district [NL-007]
– Communication is time-consuming when many stakeholders are involved [SE-001]
– There are different opinions, different interests and misunderstandings when there are many stakeholders, many tenants and a large amount of money involved [SE-002]
– It can become difficult to know who does what when multiple parties are active in parallel with energy-saving [NL-002]
– In complex projects, as when installing district heating, connection to the heat grid leads to a lot of discussions [NL-001]
– Some projects are initiated by a few activist persons who lack coordination skills to bring a project to the next level within a specific timeframe [NL-003]

4.1.6 Technical aspects

Calculations and data availability

Two respondents point out the difficulty of obtaining necessary technical data [DE-001, NL-003]. Moreover, existing data may not be transparent and independent data [NL-003].

Another problem is that calculation methods may not be adapted to real energy use and homeowner profiles [NL-005].

Challenges at the building level

An obstacle when performing energy-efficient renovation at the district level is the several technical weaknesses in old buildings [AT-002]. Problematic parts are thermal bridges (e.g., where there are balconies), poor sound insulation, poor fire protection and poor accessibility [AT-002]. Another obstacle may be the need to remove materials containing asbestos [NL-001].

One respondent points out a lack of innovative technological solutions regarding energy-efficient renovation at the district level [DE-003]. Another respondent stresses a lack of support for R&D to improve energy efficiency [ES-002].

Another barrier is that new installations needed to improve energy efficiency may require improvements in the structure of the building to support the weight of the installations [NL-002]. Similarly, installation of heat recovery on the exhaust air requires additional piping, which may require major interventions making the renovation too expensive [SE-001]

A respondent from Spain claims that current housing standards are insufficient, e.g., there is often poor accessibility, poor health, inadequate thermal comfort, inappropriate sizes of apartments, etc. [ES-001].

Another obstacle when improving energy efficiency, e.g., adding thermal insulation, can be the poor aesthetic appearance after the renovation [NL-002].

One respondent considers that it is not possible to carry out deep renovation, which would be needed to do a good improvement (e.g., to reach current standards) when people live in the buildings [SE-002].

If buildings are not renovated to become energy efficient, installing water-water heat pumps using a lake or the sea as the water source may require using heat pumps with too high power [CH-002].

District heating

Several respondents have identified technical barriers related to the installation of district heating when performing renovation at the district level [BE-001, DE-002, ES-003, ES-005, NL-002, NL-003]:

- The buildings are not renovated to reduce their energy demand, which prevents an efficient low-temperature heat grid [BE-001, NL-002]
- When using biomass for district heating, there may be a problem with local availability and competition of biomass use [DE-002]
- As the sector in Spain is very atomized, there are no existing networks for district heating [ES-003]
- In buildings that have individual systems for heating and domestic hot water, it may be difficult to convince the residents to switch to a centralised installation, such as a district heating [ES-005]
- People have doubts about district heating because they think they are experimental, innovative technology [ES-006]
- Insufficient district heating piping grid in the ground [NL-002]
- There may be a conflict between the short-term solution of connecting buildings to a high-temperature heat grid and the long-term solution meaning an investment in the insulation of buildings and the possibility for a low-temperature grid [NL-003]
- In some districts, there is no space for a district heating grid and moving the position of monuments is also too difficult [NL-002]
- Differences in the height level at which buildings are located provide an obstacle to connecting them to a district heating system, as additional costs are required for pumping [CH-009]

New technologies

Several respondents pointed out barriers related to the use of new technology when performing energy renovation at the district level [CH-002, DE-001, DE-002, DE-004, NL-001, NL-003], e.g., in old buildings, lack of adapted design to include water storage heat buffers or lack of suitable roofs to support solar technologies [NL-003].

One constraint can be that some actors are technology-driven, i.e., they are more interested in prestige projects like hydrogen topics rather than having a commercial approach [DE-001].

Other barriers related to new technologies and renewable energy that have been mentioned are:

- Solar thermal systems reach up to 25% of the heat supply, but there is a lack of storage systems. Here, more engagement of the energy suppliers is needed [DE-004]
- There is a lack of experience with implementing prefab solutions when renovating buildings [NL-001]
- Lack of adapted design of new houses or districts (e.g., including water storage heat buffers) [NL-003]
- There might be a psychological barrier to combining energy efficiency and renewable energy due to high investment costs [SE-002]

Project management

Several respondents pointed out barriers related to project management when carrying out energy renovation at the district level [AT-002, CH-001, DE-003, DE-004]. Examples of barriers include:

- Difficulty in establishing small local district heating grids aiming for long-term connection. Who looks for an operator? Who looks for the location? Which securities exist for an operator with an uncertain long-term connection process with private persons? [AT-002]
- As mentioned above under policy, it can be difficult to decide the right timing for interventions [CH-001, CH-008]
- If the process takes too long, some building owners will choose other solutions and not participate in the district project [CH-002].

– As mentioned above (under legal aspects), a great challenge, especially in the case of heterogenous ownership structures, is the different renovation cycles of different buildings [DE-003, CH-004]
– The management can be very complex due to the large number of stakeholders involved [ES-003]
– A respondent from the Netherlands points out that there is a lack of physical contact and communication between members of the energy cooperative and project managers [NL-002]
– Lack of a coordinated and integrated project from the initial stages, involving professionals from all the specialities [PT-001]

Other technical aspects

When installing water-water heat pumps using a lake or the sea as the water source, the distance to the lake may be long and geological and topological requirements may not be fulfilled [CH-002].

Older buildings which require high temperatures in the distribution system may not be suited for selling energy from lake water through heat [CH-009].

4.1.7 Lack of knowledge/training

Several respondents highlighted a lack of knowledge as a district energy renovation barrier. Examples include:

– Renovation coaching requires technical expertise, which is not always present within local governments [BE-001]
– Knowledge about innovative funding schemes is only emerging yet [BE-001]
– Many architects, planners and technical actors lack professional knowledge [DE-005]
– Ignorance and lack of expertise in renovation by professionals and contractors [ES-003]
– Lack of knowledge about business models, e.g., one-stop-shops and energy performance contracts [BE-001, NL-003].
– Lack of technical expertise, e.g., building physics, is poorly understood by administrative staff [NL-003].
– Lack of knowledge (education by peers), qualification and motivation of installers [NL-003]
– Lack of civil servants dealing with sustainability [NL-005]
– Homeowners' organisations lack professionalism [NL-005]
– Lack of skilled staff and client-oriented customer thinking within small and medium-sized companies [NL-006]
– Professionals involved in building design and construction often do not have enough knowledge about thermal physics and building energy efficiency [PT-001]

4.2 Identified drivers

4.2.1 Policy

Applying a holistic approach

Several respondents claim that a possible driver can be to apply a holistic view of the renovation at the district level by combining energy renovation with other cross-cutting issues to give a general improvement of the district [BE-002, DE-003, DE-004, DE-005]. This could include, e.g. providing improved social infrastructure such as greener space around the buildings and providing playgrounds and combining energy-efficient renovation measures with barrier-free modernisation for senior adults.

A more holistic approach to energy renovation, including upgrading the whole district, will create more acceptance among the public [DE-003]. Moreover, larger projects, such as renovation at the district level, enable the involvement of additional resources and experts in different fields, e.g., social aspects can be included [SE-002]. Another aspect put forward is that when there are great renovation needs within a district, this is an excellent opportunity to do a more exhaustive renovation and lower carbon emissions related to the district at the same time [SE-001].

The role of local and regional authorities as well as public housing associations

Many respondents point out that local authorities, such as municipalities, are key actors in energy renovation at the district level [BE-002, DE-001, DE-002, NL-001, NL-004, NL-006, NL-007, SE-002].

It is suggested that a district-level renovation project is likely to be more successful if the local authority is responsible for the project organization [DE-001]. An active role of the municipality is justified by the risky nature of district-level renovation projects for private actors due to the high procurement costs of related projects and the risk of failure even at an advanced stage of such projects if key building owners decide not to participate anymore [CH-008]. Similarly, it is proposed that a central coordinating actor should ensure the quality of energy coaching [BE-001], and it is suggested that the municipality should hire staff to guide the whole renovation process [BE-002, CH-002, CH-008].

It is claimed that municipalities have an important role as moderators and central actors in reaching many stakeholders [DE-002]. Here an important driver is to possess a positive attitude towards energy renovation which may help spread ideas, which is especially important in heterogeneous districts.

Necessary services in this context that local authorities can provide include bringing owners together, identifying appropriate solutions, supporting building owners in finding an appropriate common legal structure for the group of building owners concerned, and coordinating, carrying out, accompanying or supporting the evaluation of call for tenders [CH-004, CH-007, CH-008].

Municipalities could also support homeowner associations in renovation at the district level, e.g., by providing plans for transition from fossil to renewable fuels [NL-001].

Municipalities could also organize support for unburdening residents, providing bank guarantees and exercising clear communication [NL-007].

Moreover, the municipality could:
- Organise consulting services, for example, in the form of a first consulting session which is free or available at low costs [CH-004, CH-005, CH-006, CH-007, NL-004]. So far, consulting offers are mostly addressed to individual building owners. However, there is an option that related offers are also made available to groups of building owners, and such options are mentioned in individual consulting sessions.
- Carry out awareness campaigns [NL-004].
- Develop a vision, energy strategies and tools, e.g., maps for the transition to a fossil-free energy supply [NL-006].
- Provide infrastructure and necessary permissions for the renovation process when renovating at the district level [SE-002]

Several respondents emphasize the importance of adequate planning instruments –at the local or regional level – for successful renovation at the district level [AT-002, CH-002, CH-006, DE-002, NL-001, NL-006, NL-007]. Such instruments include local and regional energy plans to enable a shift from fossil fuels to carbon-free energy, e.g., a shift from natural gas to district heating or fossil-free electricity.

It is also important to work strategically on a regional level to bring together actors and to not only consider single municipalities [NL-003]. E.g., renovation instruments that have been developed by one municipality could be shared with other municipalities to save costs [NL-003]. Similarly, municipalities and provinces could spread risks by collaborating on financing initiatives [NL-007].

One respondent points out that direct cooperation with policymakers can accelerate the renovation process both locally and at a higher level [BE-002].

Interview answers from several countries show that public municipal companies, such as housing associations and developers, can play important roles in energy renovation at the district level [BE-002, CH-007, DE-004, ES-001, ES-002, ES-005, SE-001]. Some respondents claim that this is especially the case if the companies are big and if the municipality has ambitious goals as regards energy efficiency. This enables the companies/associations to act as drivers in the renovation process and to implement a holistic view of renovation at the district level [DE-004, ES-002].

Several respondents pointed out that an advantage of public companies is that the public has more trust in non-profit companies since they are more objective than private companies [BE-002, ES-001, ES-005].

Another advantage of municipal housing associations is that the municipality can influence these to be more energy efficient [SE-001].

Other policy aspects

Some respondents point out that today there is an increasing awareness among the general public about the problems caused by carbon emissions and that there is also more commitment to reduce energy use and shift to cleaner energy [DE-007, ES-001]. This is an important driver that policymakers could benefit from. E.g., this could be done by exploring suitable policy initiatives that support customer journeys [NL-006], i.e., making actors go from awareness to interest, to desire and finally to action.

Several respondents suggested that best practice examples constitute an excellent way to encourage the spread of renovation projects at the district level, either starting with single buildings and upscaling it to districts or spreading good district examples to other districts [CH-003, CH-005, DE-001, ES-006]. Municipalities and other stakeholders should inform about good practice examples. This is likely to be especially effective in small towns and villages where everyone knows each other and knowledge about good examples spreads [DE-006].

Awareness campaigns and showcases must be promoted to clearly show that energy renovation means the mitigation of anomalies and more comfortable living conditions besides the potential energy savings [PT-001].

One suggestion is creating competitions for energy-efficient renovation at the district level to achieve good publicity. Such competitions could function as a kickstarter [DE-004]. Another suggestion in the same spirit is that for publicly owned buildings, the municipality can select/award the tender with the most attractive project from an energy/environmental perspective [SE-001].

Another suggestion is that municipalities could support renovation processes for homeowner associations by providing plans for how to carry out the transition from fossil to cleaner fuels [NL-001]. In addition, grouped private homeowners may need support to counterbalance housing associations' power in districts. [NL-005]. Since many steps are needed to convince a homeowner association, there might be a need to consider other aspects not related to energy efficiency as well [NL-001].

For heterogenic districts, it is important to have a coupling between the municipalities' actions for housing associations and homeowner associations [NL-001].

One respondent suggests that municipalities' evaluation framework can be used to increase support and adapt policy instruments [BE-001].

The use of quality assurance documents is a good practice policy instrument, but it needs to be initiated early in the renovation process, and such documents can take a long time to complete, which may require help from an external actor to set it up [AT-002].

An important driver for far-reaching district renovations can also be through labelling [CH-008]. Labels make it easier for building owners to recognize whether a certain building or group of buildings complies with advanced energy standards.

Local authorities pointed out the following reasons for becoming active in promoting energy renovation at the district level:

– District projects may encourage building owners to carry out energy renovation measures which they otherwise would not do when acting alone [CH-005]
– District solutions can accelerate the transition from fossil fuels to renewable energy in big steps [CH-006]
– District solutions allow transforming entire parts of a city to sustainable energy use within each project [CH-007]

4.2.2 Legal aspects

Regulations

Many interviewees stressed the importance of a legal framework regarding energy-efficient renovations at the district level [CH-001, CH-002, CH-007, CH-008, DE-001, DE-002, DE-009, ES-004, ES-005]. Typical legal measures are requirements on energy efficiency or maximum energy use but could also include compulsory connection to district heating. Most energy regulations are on a national level, but one respondent claims that there is a need for a strong legal framework also on the regional and local levels [DE-009]. Similarly, it is suggested that regional regulations could help implement more renewable energy sources in public buildings [ES-006].

Mandatory requirements can ensure that people invest in sustainable building renovation [CH-008]. However, to work as a driver, regulations must include the operational phase and not only the construction phase to ensure building performance over time [PT-001]. Increased building regulation requirements should also specify how to apply them in renovation works, which would help to define the renovation projects [ES-004]. A special technical building code for building renovation has been suggested [ES-003].

Regulations can also be a driver for encouraging the combination of renewable energy and energy efficiency measures. Permission for constructing a new district heating system could, for example, be linked to requirements regarding the long-term reduction of the energy needs in connected buildings through efficiency measures [CH-004].

Mandatory requirements are well accepted and effective if the local authority can offer something "in return". 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 than would usually be possible [CH-003, CH-006].

However, not all respondents are in favour of regulations. One respondent points out that legal measures are very strong and that incentives are preferable [DE-001]. The same respondent argues that legal measures should only be used as a last resort and that the best would be to find a middle ground between regulatory law and incentive systems to achieve the goal and continues arguing that it could be better to reduce funding and instead simplify the renovation process including simplified regulations [DE-001].

Other legal aspects

Inspections and compulsory energy audits are legal measures that enable energy renovation at the district level. Mandatory building inspections can encourage communities to carry out renovation at the district level [ES-005, ES-006]. One suggestion is that energy audits should be carried out for both public and private buildings [ES-006].

Legal measures can also be used to encourage the use of renewable energy at the district level. E.g., a municipality can use mandatory requirements to ensure possibilities for renewable energy-based district heating systems are explored, e.g., when a building owner intends to use groundwater for energy purposes [CH-004].

Other enabling factors related to legal issues are:
– Legislation should simplify the project approval process [PT-001]
– “Green” certification should also exist at the district level, similar to the building level [CH-003]
– A legal revision of the management of apartment buildings and a change of ownership structure to a business partnership may be necessary [BE-002]
– Using standard blueprints of contracts would facilitate the district-level renovation process [NL-004]

4.2.3 Economic aspects

Financial solutions

Financial solutions are important drivers to help the market where it currently fails to enable district-level cost-effective and energy-efficient renovation. Renovation to improve energy efficiency and to apply renewable energy for producing thermal energy or electricity implies high investment costs.

Several respondents claim that using bank guarantees is a suitable financial solution that can drive energy-efficient renovation at the district level [NL-001, NL-003, NL-005, SE-001]. Such guarantees can be given on municipal, regional or national levels [NL-001]. It can be given as guarantee funds from banks to private companies [NL-001, NL-005] or municipalities to municipal housing associations [SE-001].

However, other financial solutions are also suggested:
– A cross-financing option where the housing association takes over parking management and uses parking prices to fund the renovation scheme [DE-004]
– Prefinancing by citizens can allow for a very low-interest rate [NL-002]
– Using energy performance contracts to achieve a longer payback period and to reduce public funding [ES-005]
– Offering financing arrangements and insights into cash flow provide a high percentage of energy saving to secure maximum cost savings after the renovation [NL-001]
– Resorting to one-stop-shop companies that offer financial calculation models that allow households to pay or lend according to their financial capabilities [NL-005]
– Fit-for-purpose financing products based on disposable income rather than expenses [NL-007]

– To develop and manage revolving loan funds, which can be used to support municipal housing and homeowner associations [NL-007]. Revolving funds could also aim at specific target groups such as young starters, senior adults, vulnerable households and small homeowner associations [NL-007]
– Loans that also support small measures, e.g., short-term loans, to improve energy efficiency [NL-005]
– Providing a second mortgage on top of the mortgage for buyers of residences to access money for renovation measures when applicable [NL-007]

Funding

Funding is considered a major driver for energy renovation at the district level [BE-001, BE-002, DE-001, ES-001, ES-004, NL-001, NL-003, NL-005, NL-007, SE-001].

Several respondents claim that policy measures such as strategic planning will only occur if there is both political will and sufficient funding [DE-002, DE-007, ES-001, NL-007]. Under such favourable conditions, a renovation wave can be initiated [ES-001]. Local and/or regional authorities should provide funding and define conditions and objectives for each district [NL-007]. The administration of such funding schemes could be supported by specialized NGOs [DE-005].

Municipalities could shape their own funding framework to take an active part. German examples from Munich, Aachen and Düsseldorf work well in supporting individual owners' and housing associations' investment measures [DE-001].

Local authorities can provide a concession to an energy company, granting it exclusivity to sell energy in a certain territory and securing the economic attractiveness of running a district heating system [CH-009]. Granting such exclusivity can also be used to incentivize particularly combinations of renewable energy measures and energy efficiency measures.

Several respondents mention funding from the European Union as an important support for renovation projects at the district level [BE-001, ES-001, SE-001].

One respondent suggests that grants are paid in parts according to the progress of the renovation work [ES-004]. Similarly, two respondents pointed out the possibility of coupling demands for grants (or loans) with approval of building permits and/or checking that energy efficiency is improved (conditional loans) [BE-002, PT-001].

Incentives

Several respondents pointed out economic incentives as important drivers for energy-efficient renovation at the district level [BE-002, DE-001, DE-003, NL-002, NL-005, PT-001]. E.g., incentives are needed to encourage a shift from using fossil fuels, such as natural gas, towards cleaner carbon-free energy [BE-002, CH-001, DE-001, DE-008, NL-007]. Taxes and charges on fossil fuels could incentivise people to switch to renewable energy and/or renovate their building envelopes [CH-008]. Incentives could include lower taxes on electricity and higher taxes on gas to make heat pumps and solar water heating systems more interesting [BE-002]. Incentive systems could also be used to stimulate energy-efficient renovation to achieve an impact on a large-scale [DE-001].

One suggested incentive is to provide commission for building managers based on the degree of renovation achieved [BE-002]. Other incentives that could encourage homeowners to carry out renovation include improved thermal comfort and customer fit solutions [NL-005]. Yet another suggestion is tax incentives to encourage investments in integrated district development in poor neighbourhoods [DE-003].

As one respondent points out, increasing maintenance costs and the urgent need to renovate an old building stock is an incentive and driving force to improve energy efficiency [SE-001].

Allowing the addition of storeys to existing buildings offers a lot of possibilities and can be another incentive for housing associations to carry out energy renovation [AT-002]. As mentioned above, this can be linked to requirements to comply with particularly advanced energy standards to benefit from such an option [CH-006].

Another incentive to make residents save energy is to individually account for using the building's thermal installation system [ES-006].

Several respondents pointed out the importance of providing subsidies [CH-004, CH-005, NL-001, NL-003, PT-001]. One respondent claims subsidies are important since they attract frontrunners and innovators [NL-003].

Subsidies may be provided for connections to district heating systems [CH-004, CH-005]. In addition, subsidies can be paid for replacing heating systems based on fossil fuels with systems based on renewable energy. An important aspect of promoting combinations of energy efficiency and renewable energy measures is to grant financial incentives according to the system's heating capacity and not just the gross area of the building. In this way, poorly insulated buildings are prevented from being better treated than well-insulated buildings, encouraging the application of energy efficiency measures in the building envelope [CH-005].

One respondent suggests a renovation subsidy which allows the resident to pay for only part of the total value. Once the renovation is done, the inspection checks compliance with the energy performance certificate and can further reduce the residents' payment share [PT-001]. Another respondent points out that subsidies for process guidance are crucial [NL-001].

Economies of scale

The renovation of whole districts of buildings enables them to benefit from economies of scale. Several respondents pointed out that standardized solutions, especially if the buildings to be renovated are of similar type, lead to more efficient renovation and consequently lower costs [CH-005, DE-001, SE-001, SE-002]. This can also include purchasing equipment, e.g., solar panels [BE-002]. One way can be to analyse past projects in depth to achieve synergy effects and standardisation [DE-001].

Similarly, two respondents pointed out that district heating as an energy supply will be more efficient when used on a larger scale, such as whole districts [BE-001, SE-001].

Several respondents pointed out that district heating projects may be economically advantageous compared to individual heating solutions, thereby reducing investment costs and financing needs for the building owner [CH-005, CH-006, CH-007, CH-009].

Once a district heating company is active in a place, it may acquire a "natural monopoly", i.e. it may become highly unattractive for other companies to become a competitor, as economies of scale are so large for the company already active in the area [CH-009].

Role of municipalities (and municipal housing associations)

Municipalities can provide different types of economic support that could function as drivers for energy renovation at the district level:

– Use of available funds to provide different types of subsidies [DE-001]
– Give bank guarantees to their municipal housing associations [NL-003, SE-001]. One respondent added that municipalities could help housing associations by offering low-interest loans [SE-001]
– Enable investment in solar energy by providing bank guarantees [NL-003] or funding the preparation of roofs for PV panels [DE-002]
– Create their own funding framework to support individual homeowners' and housing associations' investment measures [DE-001]
– Support homeowner associations, small and medium-sized enterprises and societal organisations [NL-006]
– Use their municipal housing associations to provide financial help for renovation to low-income groups e.g., through special credit schemes [BE-002, ES-001]
– Provide guarantees if a building owner does not repay a credit [CH-006]

Other economic aspects

There are economic advantages to applying an integrated planning and design process where several stakeholders are involved, e.g. by involving suppliers to get better prices and financial parties [NL-004].

Renovation at the district level will maintain or increase the property value of the buildings [CH-001, SE-001]. Similarly, renovation at the district level can attract new tenants to the housing association and diversify the association portfolio [DE-004].

Energy supply companies may allow a better contract with the customer, in terms of the capacity for which the customer pays, in case the energy use is reduced due to efficiency improvements of the building envelopes [CH-009].

Homeowners are a heterogeneous group that needs flexible support to transition from fossil to renewable energy sources. Several respondents pointed out that supporting this group financially, either individually or in homeowner associations, would be an important driver [DE-001, NL-005, NL-006, NL-007]. One suggestion is a special fund for transitioning from fossil to renewable energy aimed at private homeowners and small apartment buildings with only a few housing units [NL-006].

Increasing the population density, either through new buildings or additional floors on existing buildings, can be a driver, both for the housing association (more apartments) and the district heating company (more households connected to the grid) [CH-009].

The shift to renewable energy solutions constitutes an important driver since it enables the independence of increases in the prices of gas or oil [CH-006].

The success of projects at the district level depends on the marketing skills of energy companies promoting them [CH-007].

Another driver is to shift the focus of attention of building owners from investment costs to life cycle costs [CH-001, CH-008].

4.2.4 Social aspects

Affordability

Several respondents pointed out the importance that the cost of living of households is not affected too much by the energy renovation [DE-003, ES-002, NL-004, NL-005, NL-007, SE-002]. Suggestions include:

– Be transparent when communicating the renovation costs to the residents [NL-004]
– To unburden homeowners, e.g., by providing smooth financial solutions [NL-005, NL-007]

However, two respondents pointed out that cost-effectiveness is less important if improved living standards, such as improved thermal comfort, are understood. Even a slight increase in the rent can be accepted [DE-003, SE-002].

User participation

Several respondents stated that citizen involvement and user participation are important factors for a successful renovation at the district level [BE-001, DE-004, NL-003, SE-002]. Co-creation of the renovation concept together with residents is an approach that may lead to a higher degree of acceptance for the energy renovation, even for unpopular actions [DE-004, NL-003]. E.g., if the tenants could influence some things, for example, the outdoor environment, it would probably make them more favourable to the whole renovation project and increase user satisfaction [SE-002].

It is suggested to support bottom-up initiatives, e.g., by providing coaches for citizen groups, arranging inspiration meetings for the citizens in the district and person-to-person communication [BE-001].

Many respondents emphasize the importance of networking meetings among building owners as a driver for district renovations, and such activities already occur frequently, for example, in Switzerland [CH-002, CH-004, CH-005, CH-006, CH-007]. Networking meetings are important because participating in a district solution involves not only economic issues but also social issues. In particular, it is interesting to know if there is interest in sharing a heating system with neighbours [CH-008] because even if such systems have advantages, they also bring dependencies. Participants in a district heating project often share certain costs, which requires trust [CH-001].

Citizen involvement could be in the form of thematic workshops or consultations where many different district renovation issues are treated, including the design of public spaces, and all types of tenants participate in provoking discussions about the district [DE-004].

Another suggestion is to use an informal citizen representative available throughout the district renovation process, accepted as a spokesperson for all stakeholders and all sorts of issues [DE-004].

User involvement is likely to raise the acceptance of the energy renovation. One way could be to stimulate bottom-up citizen initiatives such as local ownership of renewable energy production (solar and/or wind) or jointly developing a district heating grid [NL-002, NL-003].

Other social aspects

Several respondents pointed out the importance of improving the outdoor environment in the district being renovated [BE-002, DE-004, DE-005, ES-001, SE-001]. Public spaces, such as parks and playgrounds, constitute important parts of the social infrastructure of housing areas. By improving them, social acceptance will likely be higher, and the feeling of belonging to the neighbourhood will improve and facilitate the closeness between families and social groups. Improvements in the outdoor environment include, e.g., more green spaces between buildings [BE-002] and barrier-free design for senior adults [DE-005].

Both economic and social problems may occur if people need to move out temporarily during the renovation. However, the negative effects can be reduced if the dwellers get assistance to move [AT-002]. Moreover, these households could be offered early access to the renovated flats in the district and the opportunity to stay in their new home if prefepreferred

Several respondents pointed out the importance that the actors that are involved in energy renovation at the district level are well known to the citizens, which helps create societal trust [ES-003, ES-004, NL-002, NL-004].

4.2.5 Communication

Advice and guidance

Several respondents pointed out that advice and guidance to actors potentially involved in energy renovation of buildings at the district level are crucial for a successful renovation [CH-001, CH-002, CH-004, CH-005, CH-006, DE-001, DE-006, DE-007, ES-003, NL-004, NL-006, SE-001]. The information suggested includes general information, advice on energy saving, providing contact points, showing best practice examples, consultancy offers, opportunities for obtaining subsidies and assistance with funding applications.

Initial advice, including advice on funding and guidance during the renovation process, is needed and could even be developed into an implementation approach [DE-001].

Advice aimed at homeowners could allow people to understand their own houses and establish connections with ongoing residents' initiatives [NL-006].

A possibility to increase the probability that building owners obtain advice from energy consultants is to make such advice a prerequisite for further support from authorities, for example, in the form of subsidies, as applied already by some cities and cantons in Switzerland, for instance [CH-007].

Good practice and pilot areas

Many respondents pointed out the importance of communicating and spreading information about good practices and pilot areas to accelerate the renovation process [AT-001, CH-005, DE-001, DE-003, ES-005, ES-006, NL-001, NL-005, PT-001].

Energy renovation at the district level is a complex issue, and a way to make it easier to understand is by showing case solutions with concrete and visual examples, e.g., visualisation through 3D models [DE-003].

Local case studies are important for showing stakeholders that district-level renovation is feasible and offers good results [PT-001].

Neighbourhoods and municipalities in the region can learn from each other, and good results from one project can be used to convince other potential renovation areas [ES-006].

Information to residents

It is important how residents in the district subjected to energy renovation are approached. Several respondents stressed the importance of timely informing residents about the different steps in the renovation project [AT-002, BE-002, DE-001, ES-005, NL-006]. Moreover, it is important that residents receive adequate information continuously throughout the project and that the communication be friendly and fact-oriented [AT-001].

Moreover, information to residents must come at the right moment, but only when relevant information exists. During a step-by-step implementation, the residents must be continuously informed about noise, dust, what happens when, etc. [AT-002].

One way to reach residents is door-to-door actions using smart communication such as webinars and virtual visits to demonstration houses [NL-002].

Role of the municipality

Municipalities have an important role in communicating with different stakeholders, which several respondents pointed out [CH-001, CH-002, CH-004, CH-005, CH-006, DE-002, DE-004, ES-001, NL-005]. This can be done in several ways:

- Act as moderator and central actor to reach many stakeholders [DE-002].
- Provide consulting and awareness campaigns. Such services can be in the form of web page information, telephone service and information films [NL-004, SE-001].
- Establish a steering group [DE-004].
- Use pilot areas to test different communication approaches [NL-005].
- Connect various building owners and help them implement a district heating solution [CH-004]

Some respondents refer to the communication of energy plans or other types of maps showing each building owner options available at the location of his/her building for renewable energy sources or possibilities for connection to district heating systems as important [CH-004, CH-005, CH-006].

An information point offered by a local authority for building owners may be used not only for providing advice but also for coordinating authorization procedures for building renovation with local authorities [CH-008].

Another suggestion is that a municipal company can facilitate renovations taking on the role of one-stop-shop for the building owners and promoting the coordination of local and regional institutions [ES-001].

Stakeholder dialogue – Integrated design process

Several informants pointed out the importance of having good communication between the different stakeholders involved in the project [AT-002, BE-002, CH-006, DE-002, DE-003, DE-004, ES-001, ES-003, NL-001, NL-003, SE-001]. Good dialogue is essential to build trust between municipal authorities and citizen groups [AT-001, DE-004, NL-003]. One suggestion is using informal citizen representation at the district level; without having formal rights, these people, who should be active throughout the renovation process, are accepted as spokespersons from all stakeholders and deal with all sorts of issues [DE-004]. It is also put forward that connections between various stakeholders and information sharing make it possible to learn from each other and help make better decisions [ES-003, SE-001]. Trust and interest from building owners can best be gained through early involvement and a transparent process [CH-006]. One respondent suggests an early formulation of clear goals for all project partners within a quality assurance document [AT-002]. The same respondent argues that a precise formulation of the goals within such a quality assurance document will enrich the communication externally because project partners keep communicating the co-developed goals to third parties [AT-002].

Thematic workshops, including all district renovation issues and addressing all types of tenants, could be organized [DE-004]. It is suggested that the renovation project group consists of district management, citizens representation, public administration, public companies, neighbourhood institutions etc. and that it meets regularly also after the renovation's completion [DE-004].

Meetings can bring building owners together; individual building owners may play a key role in motivating others to participate in joining district projects [CH-008].

Other actions to stimulate an integrated renovation process include:
– The need for a central coordinating actor to ensure the quality of energy coaching [BE-001]
– The need to share in networks project knowledge [NL-003]
– The need to bring together diverse actors to elaborate on other common interests related to renovation at the district level other than energy efficiency [DE-003]
– The need for a quality agreement, especially if several parties are involved [AT-002]

Other communication aspects

The region/province can play a role in sharing insights and tools with local authorities and helping municipalities carry out energy transition and heat plans, consult on local ownership of energy production and strengthen local networks [NL-003].

As pointed out earlier, (individual) homeowners are difficult to reach. Consequently, communication with this group is important, as pointed out by several respondents [NL-001, NL-005, NL-007]. This can be via the homeowner assembly management board [NL-001].

A respondent in Sweden points out that cooperation between the municipality and a district heating company that provides district heating for the whole city can make it possible to improve the energy efficiency of district heating in the entire district [SE-001].

4.2.6 Technical aspects

Advice and guidance

Several respondents include possible drivers related to technical advice and guidance when carrying out energy renovation at the district level [BE-002, ES-004, NL-001, NL-002, NL-003]. Suggested drivers related to advice and guidance include:
– Housing associations should provide involved and experienced staff to guide beneficiaries and supervise interventions [ES-004]
– Renovation consultants should offer renovation concept development. E.g., experts might assess if the heat demand is sufficiently covered by heat pumps and a geothermal source [NL-001]
– Thermographic pictures from heat cameras can be used to advise homeowners and convince citizens that there is a need to improve the building envelope [BE-002, NL-002]
– Provincial process consultants can help municipalities to make their energy transition and heat plans, consult on local ownership of energy production, strengthen local networks, etc. [NL-003]
– Renovation consultants could perform calculations to demonstrate the effect of improving energy efficiency [NL-005]

District heating

District heating is a key technology for district renovations. It is widely used in many of the countries of the respondents.

As mentioned above, district heating will be more efficient when used on a larger scale [BE-001, SE-001]. Large-scale applications will increase the chance of a successful business model [BE-001], and optimising the number of substations in the district will result in lower heat losses [SE-001].

On the other hand, several respondents pointed out the possibility for citizens to jointly develop smaller local district heat grids and establish local ownership of energy production [AT-002, NL-002, NL-003].

One suggestion is connecting residual heat from industrial areas to district heating [NL-006]. However, waste heat from municipal solid waste incineration plants can be more attractive for districts with older, poorly insulated buildings [CH-009].

In areas with existing district heating networks, the district heating supplier can install new pipes that are more energy-efficient [SE-002].

District solutions may be an option when other heating systems based on renewable energies are technically hardly feasible [CH-006, CH-007, CH-008].

Project management

Several respondents highlighted the importance of good project management as a key success factor for energy renovation at the district level. Such project management should consist of a good baseline survey, clear objectives, step-by-step implementation with continuous information to residents and monitoring whether desired goals have been achieved [AT-002].

Other suggestions for good project management include:
- Develop a platform to coordinate the renovation coaching system to assure quality [BE-001]
- Show homeowners step-by-step plans to make their homes carbon-neutral [BE-002]
- Municipal companies to hire specialized staff to guide the whole renovation process [BE-002]
- Include the contractor early in the renovation process to get their knowledge and involvement throughout the process [SE-002]

Other technical aspects

Renovation costs might decrease with the development of prefab solutions and standardization of processes [NL-001].

Already implemented projects can lead to certain standardisation and, thereby, more efficient construction. Analysing past projects in greater depth is suggested to achieve synergy effects and standardisation [DE-001].

When converting from natural gas to other energy sources, minimally invasive intervention in the housing network, such as energy supply lines and gas lines, is recommended to install new pipes without collateral damage [AT-001].

Artificial Intelligence could support fit-for-purpose (digital) analysis methods that are needed for pre-war and serial houses [NL-006].

Installation of “smart control” on the district heating and PV panels could be useful [SE-001].

Projects at the district level for heating with geothermal heat pumps may offer benefits for regenerating the heat in the ground through solar energy [CH-005].

4.2.7 Knowledge and training

Several respondents pointed out the importance of increased knowledge and experience among the stakeholders involved in different parts of district renovation [CH-008, ES-003, ES-004, ES-005, NL-001, NL-006].

Examples of such knowledge include accumulated experience among the staff of regional authorities [ES-004], training of building managers to influence decision-making [NL-001] and making residents (homeowners) understand their own house [NL-006].

Several municipal companies from different countries emphasize the importance of having well-trained, specialized staff, including a broad knowledge and experienced technicians [BE-002, ES-001, NL-006]. Such a team could support developing and communicating climate plans and tools.

Some other suggestions from the respondents related to knowledge and training are:

– It is important to make the administrative staff understand they can make a difference by changing the system [NL-003]
– Appropriate training and support programmes for heating system installers and building professionals could promote building renovation [CH-008]
– Collaboration and cross-education opportunities exist between installers of HVAC, solar energy, etc. [NL-003]
– It would be good to educate administrative staff on understanding basic building physics [NL-003]
– Building managers can be trained to influence decision-making [NL-001]

5. Most important identified barriers and drivers

This chapter summarizes the main barriers and drivers identified in Chapters 3 and 4 regarding energy-efficient renovation at the district level. The most important barriers and drivers were defined as those that were identified in several success stories (Chapter 3) and as those that were identified by several interviewees (Chapter 4).

5.1 Barriers

5.1.1 Policy

On the policy level, identified barriers included:

– Lack of synchronization between national and local governments
– Municipalities lack financial and human resources, which can result in poor technical advice and information
– Municipalities have limited possibilities to influence private actors
– Difficulty in dealing with homeowner associations due to complex administration and decision-making processes making it challenging for them to accept the energy renovations
– Heterogenous districts with great variations in the standard and age of the buildings
– Conflicting interests among the stakeholders

5.1.2 Legal aspects

Barriers related to legal aspects included:

– Difficulty complying with the building regulations regarding energy efficiency, ventilation, accessibility etc.
– Too rigid legal framework as regards taxes, energy standards, tenants' law, etc.
– Difficulty complying with cultural heritage requirements
– Lack of ambition for some legislation
– Complex ownership structure in districts

5.1.3 Economic aspects

Barriers related to economic aspects included:

– Difficulty in finding investors interested in supporting the renovation project economically
– Lack of financial resources
– Lack of financial incentives
– Too complex and time-consuming rules to achieve funding
– Lack of economic support to homeowner associations and homeowners, especially senior adults and low-income persons
– Reluctance in taking loans by private homeowners
– Energy network suppliers would not make enough profit
– Energy carriers, in particular fossil fuels, are too cheap

5.1.4 Social aspects

Barriers related to social aspects included:

– Difficulty in carrying out renovations in areas with vulnerable low-income people
– Heterogeneous districts with diverging interests and attitudes towards renovation and sustainability issues

– Lack of trust among citizens towards authorities and other actors involved in energy renovation, including lack of trust with other building owners with whom district solutions would be shared
– The necessity to temporally transfer residents to other buildings because of the renovation works

5.1.5 Communication

Barriers related to communication included:

– Poor dialogue between stakeholders and lack of coordination between institutions: difficult to know who does what
– Difficulty in communicating with residents in apartment buildings and with homeowners, e.g., due to the heterogenous ownership structure in the district
– Lack of adequate advice and guidance to residents

5.1.6 Technical aspects

Barriers related to technical aspects include:

– Lack of innovative technological solutions as regards energy-efficient renovation at the district level
– Poor energy performance of buildings hindering the use of efficient low-temperature district heating grid
– Insufficient district heating piping grid in the ground and sometimes no space for new pipes
– Difficult for residents to accept the switch to centralised installations
– Lack of storage systems for solar energy applications
– Difficult to carry out renovation and keep the time frame if tenants remain in the buildings during renovation

5.1.7 Knowledge and training

Barriers related to knowledge and training include:

– Lack of knowledge and expertise among local government officials, energy consultants, contractors, technical personnel etc.

5.2 Drivers

5.2.1 Policy

The main conclusion is that local authorities are key actors. As facilitators of renovation at the district level, they could:

– Act as moderators and central actors to reach many stakeholders
– Foster a positive attitude towards energy renovation which may help to spread ideas
– Develop visions, energy strategies and tools, e.g., heat transition maps
– Organise consulting and awareness campaigns
– Provide infrastructure and necessary permissions
– Support homeowner associations
– Improve environmental conditions around the buildings in the district and increase the quality of life of the residents

Moreover, public municipal companies, e.g., housing associations, can play important roles in energy renovation at the district level by acting as drivers in the renovation process and implementing a holistic view. If the investor of a district heating network is a public institution, the network operator is trustworthy for building owners considering a connection to such a system.

5.2.2 Legal aspects

Drivers related to legal aspects include:

– Ambitious requirements for energy efficiency
– Simplification of the project approval process
– Giving something “in return” when complying with particularly ambitious energy standards, for example, permission to build additional floor level

5.2.3 Economic aspects

Drivers related to economic aspects include:

– Funding, either as grants, subsidies or loans
– Financial assistance in connection with carbon offset programmes
– The use of bank guarantees and revolving loan funds
– Economic incentives to encourage a shift from the use of fossil fuels such as natural gas towards cleaner carbon-free energy, e.g., lower tax on fossil-free electricity and higher tax on gas
– Maintain financial sustainability by increasing the value of the residential area
– Reduce energy demand and, thereby, operating costs
– Increase profit and experience for energy network suppliers
– Make building owners focus on life cycle costs rather than on investment costs
– Determine subsidies for energy systems based on gross floor area and not the capacity of the heating system to promote the combination of renewable energy measures with energy efficiency measures

Municipalities can provide different types of economic support:

– Use of available funds to provide different types of subsidies
– Give bank guarantees to their municipal housing associations, e.g., for installing renewable energy
– Help housing associations to borrow by offering low-interest loans
– Provide financial help for renovation to low-income groups
– Give land to investors in exchange for developing district projects

Many economic drivers are related to economies of scale, including:

– Standardized solutions, especially if the buildings to be renovated are of a similar type, lead to more efficient renovation and, consequently, lower costs
– District heating projects may be economically advantageous compared to individual heating solutions
– District heating may be more efficient when used on a larger scale, e.g., by having access to more efficient energy sources than on a smaller scale

5.2.4 Social aspects

Drivers related to social aspects include:

– Citizen involvement and user participation in raising the acceptance of the energy renovation
– Requests from individual residents influencing a larger district project
– Improving the outdoor environment in the district that is being renovated
– Making the housing area more attractive by improving its image
– Ensuring the continuity of families and social cohesion in the district
– Improving the quality of life of the residents by improvement of living

5.2.5 Communication

Drivers related to communication include:

– Advice and guidance to actors involved in energy renovation of buildings at the district level during the whole renovation process
– Communicating and spreading information about good practices and pilot areas to accelerate the renovation process

– Networking meetings among building owners of a specific district
– Energy plans or other map-based information showing available options to each building owner
– Good communication between the different stakeholders involved in the project, including early involvement and transparency
– A good dialogue between municipal authorities and citizen groups to build trust
– Coupling between the municipalities' actions and homeowner associations

5.2.6 Technical aspects

Drivers related to technical aspects include:

– Standardisation and prefab solutions and, thereby, more efficient construction
– Well-trained, specialized staff with broad knowledge and experienced technicians
– To improve the general standard of the dwellings to correspond to current needs
– Modernization and optimization of the district heating network
– Possibility to connect new buildings to a district heating system due to improved energy efficiency of already connected buildings

5.2.7 Knowledge and training

– Increased knowledge and experience among different stakeholders involved in different parts of renovation at the district level

6. Discussion

This chapter discusses the findings of this study concerning other studies in the field of energy-efficient renovation.

6.1 Policy

Several respondents highlighted the important role of local authorities, such as municipalities, when carrying out energy-efficient renovation on the district level. It was put forward that housing associations can play an important role in energy renovation. However, in a study in the Netherlands, Hoppe (2012) found that although the local authorities may have an essential role at the beginning of the projects, they tend to lose influence over time to the housing association, which may lead to lower ambitions regarding energy efficiency. Another barrier (Hoppe 2012) mentioned is that goals from local authorities are too ambitious and not feasible to carry out.

In this study, some respondents mentioned that improving the indoor environment and thus making it more comfortable and healthier is a driver for energy-efficient renovation. This has also been found in several other studies, e.g., Bjørneboe et al. (2018), D'Oca et al. (2018), Azizi et al. (2019).

In this study, best practices and pilot projects have been highlighted as important drivers. Similar findings were also reported by Hoppe (2012) and Alam et al. (2019). Hoppe (2012) argues that an important driver is project-oriented learning, i.e., learning from test cases and later applying the knowledge gained on a larger scale. Even though this takes time, Hoppe (2012) argues that it increases the chances for adequately implementing energy-efficient renovation and RES.

6.2 Legal aspects

Several respondents pointed out requirements on minimum standards in building regulations as an important driver for energy-efficient renovation. However, some respondents pointed out that the requirements are sometimes not strict enough. Similarly, Person and Grönkvist (2015) argue that the development of building regulations and standards often falls behind the development of technologies, which they consider a barrier to energy-efficient renovation. They also conclude that, in the case of Sweden, building regulations are not strict enough to work as drivers for low-energy buildings. Another problem Bjørneboe et al. (2018) pointed out in their study in Denmark is that building regulations are not always enforced when it comes to renovating private homes.

When it comes to achieving energy efficiency at the district level, Conci and Schneider (2017) concluded that instead of putting requirements on the energy performance of buildings, such as minimum U-values, it would be better to put requirements on primary energy for the whole system including energy use of buildings and the energy supply in the district.

6.3 Economic aspects

Insufficient funding was identified as a major barrier towards energy-efficient renovation, and this has been confirmed by several other studies (Hoppe 2012, Persson and Grönkvist 2015, Bjørneboe et al. 2018, D'Oca et al. 2018, Alam et al. 2019). Several of the incentives suggested by the interviewees in this study have also been suggested by others, e.g., grants (D'Oca et al. 2018), revolving loan funds (D'Oca et al. 2018) and beneficial bank loans (Persson and Grönkvist 2015).

In this study, some respondents suggested that the municipality can be important in providing bank guarantees to municipal housing associations. In line with this, Hoppe (2012) argues that municipalities must provide subsidies to housing associations to cover investments for energy-efficient renovation to avoid increasing rents.

Many respondents pointed out the challenge of involving many stakeholders in energy-efficient renovation at the district level. In their study on energy efficiency at the district level, Conci and Schneider (2017) suggest that a contracting model is needed to clarify each stakeholder's role.

Many respondents pointed out the importance of using tax incentives, e.g., to encourage a shift to non-fossil fuels. In agreement with this, Conci and Schneider (2017) argue that a carbon tax will have a crucial impact on life cycle costs, making the energy renovation project more interesting economically.
The results of this study highlighted the resistance of private homeowners to take loans. Both Bjørneboe et al. (2018) and D'Oca et al. (2018) also point out this barrier, pointing at the high up-front costs and long pay-back times. In their review of EU deep renovation projects, D'Oca et al. (2018) also point out that for homeowners, energy-efficient renovation can be the second largest investment after buying their home. Moreover, D'Oca et al. (2018) found that owners can accept a pay-back time of 3–7 years.

This study identified the lack of economic support for homeowners, especially senior adults and low-income groups, as a barrier. This was also reported by D'Oca et al. (2018), who pinpointed the lack of attractive financing options for low- and medium-income homeowners who may not be eligible for regular bank loans.

Several respondents pointed out the increase in real estate value of the renovated buildings as a driver for both homeowners and housing companies, and this has been confirmed by other studies (e.g., Caputo and Pasetti 2017, Bjørneboe et al. 2018, D'Oca et al. 2018, Azizi et al. 2019).

This study highlighted the importance of considering life cycle costs and not only investment costs. Low operating costs will especially benefit low- and middle-income groups. Similarly, Bjørneboe et al. (2018) mention reduced running costs as a driver for energy-efficient renovation.

6.4 Social aspects

Several interviewees pointed out the lack of awareness among residents as a barrier. This was also highlighted by D'Oca et al. (2018), who point out training and awareness-raising activities as crucial for the acceptance of energy renovation.

This study highlighted homeowner associations' complex administration and decision-making processes as barriers to accepting energy renovation. Some respondents pointed out that often a great number of owners have to agree to be able to carry out the renovations. Similarly, D'Oca et al. (2018) point out long and complex

decision-making processes, especially for multi-owner buildings (condominiums), as a barrier, and that decision for the renovation of condominiums may require a majority (in some EU countries, even 75% or unanimity).

One of the barriers pointed out in the study was the disturbances that renovation causes for the residents. This barrier was also identified by Hoppe (2012) and D'Oca et al. (2018), who point out that a long renovation process discourages residents and owners. Hoppe (2012) claims that project delays may cause residents to want to lower their ambitions for energy-efficient renovation and RES to speed up the project.

This study found that a rent increase is a barrier, especially for low-income people. Similarly, in his study of social housing in the Netherlands, Hoppe (2012) reported that a possible rent increase was a major barrier to introducing innovative energy systems in social housing.

This study identified the lack of trust among citizens towards actors involved in energy renovation as a barrier and that user participation is needed to increase the acceptance of energy renovation. In line with this, Conci and Schneider (2017) argue that for district solutions, tenants' interest in being part of the renovation scheme is crucial and therefore it is essential that users are involved in the design of the business model.

6.5 Communication

This study revealed poor dialogue between stakeholders and insufficient coordination between institutions as barriers to energy-efficient renovation. The lack of dialogue between stakeholders was also found by D'Oca et al. (2018). Similarly, Hoppe (2012) points out the lack of trust between stakeholders as a barrier hindering or slowing decision-making.

Another identified barrier in the study was the lack of adequate advice and guidance to residents. D'Oca et al. (2018) also found that individual homeowners and users do not know where to find reliable experts and where to find advice for energy renovation. Similarly, Person and Grönkvist (2015) point out that a lack of information on energy-efficient technology often hinders consumers from changing their behaviour. D'Oca et al. (2018) suggest that providing easy-to-understand information about the renovation process from the start can facilitate decision-making when renovating multi-owned buildings like condominiums. Alam et al. (2019) suggest developing educational materials, e.g., websites with required information where successful examples are shown and new research findings are shared.

This study identified advice and guidance to involved actors throughout the renovation process as a driver for energy-efficient renovation. Similarly, D'Oca et al. (2018) argue that dissatisfaction can be largely avoided if the users and owners have been sufficiently informed about the renovation process and disruptions.

6.6 Technical aspects

This study mentioned that energy-efficient renovation measures could be aesthetically negative, as they may deteriorate the architectural appearance of buildings, e.g., when adding PV panels or when substantially increasing the wall thickness when adding insulation. However, energy renovation can also be positive as such measures may be a way to improve the appearance of run-down areas. Azizi et al. (2019) also found that aesthetic improvements can be a driver for energy-efficient renovation.

This study identified the lack of innovative technological solutions as a barrier to energy-efficient renovation. However, both Hoppe (2012) and D'Oca et al. (2018) point out that there might be scepticism towards new technology. D'Oca et al. (2018) claim that users and owners often do not trust new technologies, whereas Hoppe (2012) argues that residents may fear that new technology will bring teething troubles. Similarly, Person and Grönkvist (2015) point out that untested technologies are often seen as a risk, e.g., there is an initial cost, and functions and aesthetics of the buildings may change.

Innovative technological solutions could avoid the problem of disruption and disturbance during site works mentioned above. D'Oca et al. (2018) highlight the importance of using technology solutions that limit the intervention on site, and they claim that prefabrication can shorten the construction time considerably.

Some respondents pointed out that when a large number of identical buildings are renovated, energy-efficient renovation can become more efficient and cost-effective. Similarly, D'Oca et al. (2018) point out the replicability potential if shared technical specifications are used.

One point of view was that it might be difficult for residents to accept to switch from individual to centralised installations. This was also found by Hoppe (2012), who claimed that a strong reason for this is that the residents are afraid that the costs will not be fairly divided.

In this study, several respondents highlighted the importance of good project management as a key success factor for energy renovation at the district level. In the same way, Hoppe (2012) argues that a motivated and influential project leader within the housing association who puts effort into disseminating knowledge is a driver for successful energy-efficient renovation and RES. Moreover, Hoppe (2012) suggests that a project management group with skilled members should follow the whole renovation project.

6.7 Knowledge and training

Lack of knowledge and expertise among local government officials, energy consultants, contractors, workers etc., were identified as barriers. Similar observations have been made by Person and Grönkvist (2015), D'Oca et al. (2018) and Alam et al. (2019). Alam et al. (2019) pointed out the lack of skilled and trustworthy consultants that can make reliable assessments of energy efficiency and the lack of knowledge among building owners and property managers as barriers.

Both D'Oca et al. (2018) and Alam et al. (2019) point out training activities as crucial for the acceptance of energy renovation. Similarly, Person and Grönkvist (2015) argue that government guidance and education for all stakeholders involved in energy renovation projects can be important drivers. On this theme, Bjørneboe et al. (2018) describe a scheme in Denmark directed to homeowners offering advice and renovation plans based on the One-Stop-Shop concept, i.e., all services come from the same company or institution from initial advice to execution and follow-up. This scheme, which also helps the owner get a loan, includes educating advisors and craftsmen since they need to be certified to participate in the scheme. Bjørneboe et al. (2018) claim that trained professionals help create trust among homeowners.

7. Recommendations for energy-efficient renovation strategies at the district level

This chapter provides recommendations for energy-efficient renovation strategies at the district level based on Chapter 5 and Chapter 6 as well as considering discussions among project partners within IEA EBC Annex 75.

It should be noted that there was an overrepresentation of policy actors among the interviewees, whereas there were very few financing intermediaries and energy solution suppliers (see Table 2.2). Moreover, there are differences between countries regarding energy supply, heating systems, age and condition of the housing stock etc. It is thus difficult to draw generalized conclusions. However, it is still believed that the suggested strategies for energy-efficient renovation of buildings at the district level will be useful.

7.1 Policy and legal measures

It is recommended to apply a holistic approach to energy renovation, including upgrading the whole district, as this will create more acceptance among the public. This could include, e.g., providing improved social infrastructure, such as greener space around the buildings, playgrounds, and barrier-free modernisation to facilitate senior adults.

Municipalities should collaborate and learn from each other, possibly involving regional and/or national authorities. Renovation instruments developed by one municipality can be shared with others to save costs. Similarly, municipalities and provinces could spread risks by collaborating on financing initiatives.

Municipalities could also organize support for unburdening residents, providing bank guarantees and exercising clear communication.

Public municipal companies, e.g., housing associations, can play an essential role in energy renovation at the district level, especially if the companies are big and if the municipality has ambitious goals as regards energy efficiency and use of renewable energies; this enables the associations to act as drivers in the renovation process and to implement a holistic view on renovation at the district level. Another advantage of public companies is that citizens may have more confidence in such non-profit companies since they are more objective than private companies.

It is recommended that national, regional and local authorities use economic incentives to encourage a shift from using fossil fuels, such as natural gas, towards cleaner, carbon-free energy. Incentives could include a lower tax on fossil-free electricity and a higher tax on gas and oil to make installing heat pumps, solar thermal heating, PV panels etc., more profitable.

Policymakers should explore suitable policy initiatives that support customer journeys, i.e., making actors go from awareness to interest, to desire and finally to action.

Best practice examples constitute a good way to encourage the spread of renovation at the district level, either starting with single buildings and upscaling them to districts or spreading good district examples to other districts.

For publicly owned buildings, the municipality can select/award the tender with the most attractive project from an energy/environmental perspective.

It is recommended that local authorities give support in different ways to homeowners and homeowner associations. This can be organizational support, economic support, awareness campaigns, or advice (free of charge). Since many steps are needed to convince a homeowner association, there might be a need to consider non-energy wishes, such as the neighbourhood environment.

It is recommended that local authorities take up a leading role in coordinating entire district renovation processes also among private building owners. This may include connecting building owners, identifying appropriate solutions for a given district, supporting the creation of proper legal structures among building owners to implement a district solution, and supporting the tendering process for implementing a district solution.

Energy-efficient renovation at the district level is complex, but it has several advantages, justifying a proactive role of local authorities:

– District projects may encourage building owners to carry out energy renovation measures which they otherwise would not do when acting alone
– District solutions can accelerate the energy transition in big steps
– District solutions allow transforming entire parts of a city to sustainable energy use within each project

It is recommended to develop specific regulations for renovation. These should emphasize energy efficiency both in construction and operation to ensure low energy use over time. Furthermore, it is recommended to also include regulations regarding the use of renewable energies. However, regulations should not be too strict but have realistic and reasonable targets and should not be too complicated to apply.

For the development of new district heating projects, it is recommended to combine regulations regarding energy efficiency and renewable energy measures.

As the availability of large renewable energy sources is a key driver for building renovation projects at the district level, it is recommended that local authorities identify such potentials, make them known, and develop strategies to access them.

Moreover, building permit legislation should be elaborated at the municipal level to simplify the project approval process. In addition, it is recommended that regulations are put into place which allow homeowner associations to decide on energy-related decisions with a simple majority of homeowners.

It is recommended to introduce and promote “green” certification on the district level, similar to what exists on the building level.

7.2 Economic measures

Bank guarantees, particularly for housing associations and energy supply companies, are a suitable financial solution to encourage energy-efficient renovation at the district level. Such guarantees can be given on municipal, regional or national levels and can be given as guarantee funds by banks to private companies or from municipalities to municipal housing associations.

Other recommended financial instruments include:

– Funding schemes from national and/or regional level
– Additional funding at the local level combined with monitoring of renovation activities

– Fit-for-purpose financing products, which are based on the households' disposable income. This could be combined with individual renovation plans, especially in districts where the need for renovation varies greatly between buildings
– The use of energy performance contracts to achieve renovations also in case of a longer payback period and to reduce public funding
– To offer financing arrangements and insights into cash flow, which provide a high percentage of energy saving to secure a maximum level of energy costs after the renovation
– One-stop-shop companies offer financial calculation models allowing households to pay or lend according to their financial capabilities
– To develop and manage revolving loan funds, which can be used to support municipal housing and home-owner associations. Revolving funds could also aim at specific target groups such as young starters, senior adults, vulnerable households and small homeowner associations
– Use cross-financing options where, e.g., public housing associations take over the parking management and use this income to fund the renovation scheme

It is also recommended that the European Union stimulates renovation at the district level by either project funding or subsidies, especially in those countries within the Union that are in most need of fuel transition and/or developing energy-efficient buildings. Recommended incentives include tax incentives to encourage investments in renovating and installing renewable energy solutions.

To promote through subsidies a combination of renewable energy measures and energy efficiency measures, it is recommended to determine the extent of subsidies for energy systems or connections to district heating systems based on the gross floor area and not the capacity of the heating system to provide an incentive to reduce energy needs in combination with the installation of a new heating system or the connection to a district heating system.

Other recommended incentives include adding storeys to existing buildings (in return for compliance with improved energy standards), which would be attractive for housing associations and private housing companies, as well as individual tariffs on heating, domestic hot water etc.

It is recommended that municipalities provide different types of economic support to encourage energy renovation at the district level:
– Use of available funds to provide different types of subsidies
– Give bank guarantees, particularly to their municipal housing associations, or help housing associations borrow by offering low-interest loans
– Create their own funding framework to support individual homeowners' and housing associations' investment measures
– Enabling investment in solar energy by providing bank guarantees or by funding the preparation of roofs for PV panels
– Support to homeowner associations, small and medium-sized enterprises and societal organisations
– Use their municipal housing associations to provide financial help for renovation to low-income groups, e.g., through special credit schemes
– To support homeowners financially, individually or in homeowner associations, through a special fund for transitioning from fossil to renewable energy

Furthermore, it is recommended to make building owners shift the focus of attention from investment costs to life cycle costs.

7.3 Social aspects

Renovation at the district level means a lot of disturbance for residents and homeowners: increased costs but also inconveniences during the renovation phase. Furthermore, bringing various building owners together for common district renovation projects is a challenge.

The energy renovation must not affect households' cost of living too much. It is recommended:

– To be transparent when communicating the renovation costs to the residents and how the rents will be affected. It is important to minimize the rent increase or minimise the monthly cost in the case of ownership. However, cost-effectiveness is less important if increased living standard, such as improved thermal comfort, is understood; then, even a slight increase in the rent can be accepted.
– To unburden homeowners, e.g., by providing smooth financial solutions and fast renovation processes.

User involvement is likely to raise the acceptance of the energy renovation. If the tenants have the possibility of influencing some things, it will make them more positive about the whole renovation project. Therefore, it is recommended to encourage citizen involvement and user participation, e.g., through co-creation of the renovation concept with residents, which may lead to a higher degree of acceptance, even for unpopular actions.

Similarly, it is recommended to support bottom-up initiatives, e.g., by providing coaches for citizen groups, arranging inspirational meetings for the citizens in the district and person-to-person communication.

It is recommended to carry out networking meetings for district citizens to support inspiration and trust for possible common district renovation projects. Citizen involvement could also be in the form of thematic workshops or consultations where many different district renovation issues are treated, even the design of open spaces, and where all types of tenants participate. Furthermore, it is recommended to provide a framework which encourages initiatives by residents and individual building owners in the district that can result in improved district solutions.

Another way could be to stimulate bottom-up citizen initiatives such as local ownership of renewable energy production (solar and/or wind) or jointly developing a district heating grid. Furthermore, residents could be given a say in the choice of energy sources for district heating systems.

Having to move may have negative social consequences. If emptying the buildings to be renovated is unavoidable, it is recommended to assist residents in finding alternative housing, preferably in the same area, and offer them to move back to the same place after renovation (to have priority).

As mentioned above, improving the outdoor environment in the district being renovated is also recommended. Public spaces such as parks and playgrounds constitute important parts of the social infrastructure of housing areas, and by improving them, social acceptance will likely be higher, the feeling of belonging to the neighbourhood will improve and facilitate the closeness between families and social groups and the status of the area rises.

Moreover, the actors involved in energy renovation at the district level must be well-known to the citizens, which helps create societal trust.

7.4 Communication

It is recommended to ensure that advice and guidance are available free of charge to all interested building owners or energy professionals intending to develop district renovation projects, from initiating such projects to all phases of implementing such solutions. The guidance includes general information, advice on energy saving, providing contact points, showing best practice examples, offers for consultancy, opportunities for funding and assistance with funding applications. Both initial advice, including advice on funding, and advice during the whole renovation process are needed. It is recommended to showcase solutions with concrete and visual examples, e.g., visualisation through 3D.

It is important how residents in the district subjected to energy renovation are approached. They need to be informed in good time about the different steps in the renovation project. Moreover, residents should receive adequate information continuously throughout the project, and the communication should be friendly and fact-oriented. Information to residents must come at the right moment, but only when relevant information exists. During a step-by-step implementation, the residents must be continuously informed about noise, dust, what happens when, etc.

Municipalities and other stakeholders should inform about good practice examples. Neighbourhoods and municipalities in the region can learn from each other, and good results from one project can be used to convince other potential renovation areas. Communicating and spreading information about good practices and pilot areas is important to accelerate the renovation process.

One way to reach residents is door-to-door actions using smart communication such as webinars and virtual visits to demonstration houses.

Good stakeholder dialogue is crucial for a successful energy-efficient renovation at the district level. Municipalities have an essential role in communicating with different stakeholders. It is recommended that the municipalities:

- Establish a steering group for each district renovation project
- Connect various building owners and help them implement a district heating solution
- Take the role of both moderator and central actor to reach a large number of stakeholders
- Provide a framework allowing individual building owners to influence district renovation projects

Thematic workshops, including all district renovation issues and addressing all types of tenants, could be organized. It is recommended that the renovation project group consists of district management, citizens representation, public administration, public companies, neighbourhood institutions etc. and that they meet regularly after the renovation's completion.

It is recommended to deploy energy plans or other map-based information showing each building owner's available options for renewable energies, including possible connections to district heating systems and energy efficiency measures.

As pointed out earlier, homeowners can be difficult to reach. Consequently, communication with this group is important. Meetings can bring building owners together; individual building owners may play a key role in motivating others to join district projects, and therefore it is recommended to support such individuals in particular.

7.5 Technical aspects

It is recommended that authorities ensure that high-quality advice is provided by renovation consultants offering renovation concept development. E.g., experts might assess the available renewable energy options and the available efficiency measures, ideally in combination, and develop appropriate renovation strategies for districts.

District projects may allow the use of large renewable energy sources or particularly innovative energy solutions due to the large scale at which they are implemented. It is recommended that authorities ensure that the related knowledge is spread.

Housing associations should provide involved and experienced staff to guide beneficiaries and supervise interventions.

To convince building owners, it is necessary to perform calculations demonstrating the effect of improving energy efficiency.

Other recommendations for good project management include:
- To develop a platform to coordinate the renovation coaching system to assure quality
- Municipal companies can hire specialized staff to guide the whole renovation process
- Include the contractor early in the renovation process to get their knowledge and involvement throughout the process

Already implemented projects can lead to certain standardisation and, thereby, more efficient construction. Analysing past projects in greater depth is recommended to achieve synergy effects and standardisation. It is also recommended to develop prefab solutions and standardization of processes since such an approach has the potential to decrease costs and reduce the time of renovation, which minimises the disturbance for the residents.

In areas with existing district heating networks, the district heating supplier can install new pipes that are more energy efficient. It is recommended to connect the residual heat from industrial areas to the district heating if possible.

7.6 Knowledge and training

It is important to increase the knowledge and experience among different stakeholders involved in different parts of the renovation at the district level.

Examples of such knowledge include accumulated experience among the staff of a regional authority, training of building managers to influence decision-making and making residents (homeowners) understand their own house.

7.7 Concluding remarks

The recommendations presented here are general and based on a limited number of success stories and interview answers. The field of energy renovation at the district level, taking into account both energy efficiency measures and renewable energy measures, is still quite new and future studies should look more into adequate solutions for different contexts in various countries, regions and cities, emphasizing efficient energy supply solutions such as district heating and cooling, which are key for decarbonisation. At the district level, several stakeholders must cooperate to carry out such solutions; the stakeholder dialogue is thus very important and must be prioritized.

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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 Addendum 1 | interview guidance document

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

GUIDANCE FOR INTERVIEWING KEY ACTORS[1]

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?

Instrument	*No, not considering*	*No, but interested*	*No, but planning to*	*Yes*	*Yes, with good experiences*	*I don't know*
Enforcement of energy standards or solutions in districts	☐	☐	☐	☐	☐	☐
Inspections and energy audits in districts	☐	☐	☐	☐	☐	☐
Financial incentives created by local authorities for specific districts	☐	☐	☐	☐	☐	☐
Financial incentives for groups of homeowners	☐	☐	☐	☐	☐	☐
Creation of renovation services in districts	☐	☐	☐	☐	☐	☐
Local energy desks for awareness-raising and consultancy	☐	☐	☐	☐	☐	☐
Dedicated local website or other local media development	☐	☐	☐	☐	☐	☐
Networking meetings in districts	☐	☐	☐	☐	☐	☐

How <u>important</u> do you think it is to develop the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?

Instrument	*No, not considering*	*No, but interested*	*No, but planning to*	*Yes*	*Yes, with good experiences*	*I don't know*
Enforcement of energy standards or solutions in districts	☐	☐	☐	☐	☐	☐
Inspections and energy audits in districts	☐	☐	☐	☐	☐	☐
Financial incentives created by local authorities for specific districts	☐	☐	☐	☐	☐	☐
Financial incentives for groups of homeowners	☐	☐	☐	☐	☐	☐
Creation of renovation services in districts	☐	☐	☐	☐	☐	☐
Local energy desks for awareness-raising and consultancy	☐	☐	☐	☐	☐	☐
Dedicated local website or other local media development	☐	☐	☐	☐	☐	☐
Networking meetings in districts	☐	☐	☐	☐	☐	☐

How <u>difficult</u> do you think it is to develop the following instruments to stimulate building renovation and renewable energy in districts or neighbourhoods?

Instrument	*No, not considering*	*No, but interested*	*No, but planning to*	*Yes*	*Yes, with good experiences*	*I don't know*
Enforcement of energy standards or solutions in districts	☐	☐	☐	☐	☐	☐
Inspections and energy audits in districts	☐	☐	☐	☐	☐	☐
Financial incentives created by local authorities for specific districts	☐	☐	☐	☐	☐	☐
Financial incentives for groups of homeowners	☐	☐	☐	☐	☐	☐
Creation of renovation services in districts	☐	☐	☐	☐	☐	☐
Local energy desks for awareness-raising and consultancy	☐	☐	☐	☐	☐	☐
Dedicated local website or other local media development	☐	☐	☐	☐	☐	☐
Networking meetings in districts	☐	☐	☐	☐	☐	☐

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?

Stakeholders	*I am:*	*For district projects I already worked with:*	*Their role in this project was:*	*I think their level of influence in the project was:*
Policy actors (e.g.: local or regional authority, public agency or institute,..)	☐	☐	☐ decision-maker ☐ influencer ☐ technical advisor ☐ deliverer	☐ very low ☐ low ☐ medium ☐ high ☐ 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,..)	☐	☐	☐ decision-maker ☐ influencer ☐ technical advisor ☐ deliverer	☐ very low ☐ low ☐ medium ☐ high ☐ 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,..)	☐	☐	☐ decision-maker ☐ influencer ☐ technical advisor ☐ deliverer	☐ very low ☐ low ☐ medium ☐ high ☐ very high
Beneficiaries (e.g. clients, residents, homeowner assemblies, community/occupants' organizations, action groups, Housing associations and cooperatives: private, public, semi-public,..)	☐	☐	☐ decision-maker ☐ influencer ☐ technical advisor ☐ deliverer	☐ very low ☐ low ☐ medium ☐ high ☐ very high
Financing intermediaries (e.g. banks, investment funds, real estate developers, project developers, portfolio managers, ESCOs,..)	☐	☐	☐ decision-maker ☐ influencer ☐ technical advisor ☐ deliverer	☐ very low ☐ low ☐ medium ☐ high ☐ very high
Other intermediaries (e.g. federations, trade organizations, not-for-profit organizations, neighbourhood interest associations, neighbourhood communication agents, business model developers, consultants,..)	☐	☐	☐ decision-maker ☐ influencer ☐ technical advisor ☐ deliverer	☐ very low ☐ low ☐ medium ☐ high ☐ very high

We would like to ask you which of the following stakeholders you would like to work with to <u>better achieve a good coupling of energy-efficient renovation and renewable energies in districts</u>.

Stakeholders	*In future district projects, I would like to work with:*	*They can positively contribute to achieving (combining) district renovation & renewable energies in districts, because:*
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, one-stop-shop,..)	☐	
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,..)	☐	
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, neighbourhood interest associations, neighbourhood communication agents, business model developers, consultants,..)	☐	

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:…*

IEA EBC Annex 75 Addendum 2 | interview analysis template

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS
Analysis template

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)

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.
Acoording 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 and 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

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.eus).

Dates: Interviews between February-April 2021. Submit the analyses the latest in May 2021. First interviews results will be presented in 23-25 march meeeting.

Shall you have any doubts using this template or any suggestions, please email (Juanmaria.Hidalgo@ehu.eus)

Interview identification				Stakeholder type and description		Interviewee details (Non-publishable Private Data)	
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*

List of stakeholder types

P. Policy actor
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:..

C. Client or beneficiary/ demand actor
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:..

F. Financing intermediary
o Bank
o Investment fund operator
o Real estate development company
o Project development company
o Building portfolio manager
o ESCO
o Other:…

E. Energy solution provider
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

R. Renovation solution provider
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:…

I. Other intermediaries
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
Sweeden
Switzerland

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS
Analysis template: 2. Policy instruments (page 2 of 5)

EBC Energy in Buildings and Communities Programme
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 immportant points. Add the sources given by the interviewee (reference web sites, relevant policy or strategic documen
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): | **Code**

		Stakeholder viewpoints			Discussion			
Policy needs	**Policy instrument**	**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 importan	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)

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.eus)*

Overview table + reflection on stakeholder dialogue in projects

The interviewee is (stakeholder type): | **Code**

Stakeholder viewpoints			Discussion			
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)

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**	**Barriers**	**Opportunities to**

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
Costumer Relationships & Channels
Cost Structure
Revenue Streams
Key Activities

IEA EBC Annex 75 subtask D: STAKEHOLDERS INTERVIEWS
Analysis template: 5. SWOT evaluation (page 5 of 5)

How to fill in:
Fill in the "PESTLE evaluation" (columns C-F) with their own practice or cases. Main information in questionnaire Part II, "3. Socio-technical issues ".
Aim to integrate information from all the questionnaire, i.e. process management (development), needs from local policy, business practice and stakeholder dialogue.
It is possible that you didn't find information for all blocks; that is OK.
Complete the "Discussion" (columns G-J): 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, ...).

Questions:
Shall you have any doubts using this template or any suggestions, please email (Juanmaria.Hidalgo@ehu.eus)

SWOT Analysis table on stakeholder engagement, policy instruments and business models

The interviewee is (stakeholder type):		**Code**	

	P.E.S.T.L.E. evaluation				**Discussion**			
Analysis local contexts for energetic district renovation	**Policy/ Legal/ Environmental**	**Economic**	**Social/ Communication**	**Technical**	**Interesting quotes and sources for the report**	**Remarks by the interviewee**	**Recommendations for upscaling and combining EE+RES**	**Remarks by the interviewer**
Strengths (internal to the interviewee)								
Weaknesses (internal to the interviewee)								
Opportunities (external to the interviewee)								
Threats/Barriers (external to the interviewee)								

ANNEX 75

EBC

Energy in Building and Communities Programme

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