

International Energy Agency

Definitions and common terminology for cost-effective building renovation at district level combining energy efficiency & renewables

Energy in Buildings and Communities
Technology Collaboration Programme

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Preface

The International Energy Agency

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

The IEA Energy in Buildings and Communities Programme

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

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

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

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

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

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

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

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

The Executive Committee

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

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

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

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Abbreviations

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

Abbreviations	Meaning
EPBD	European Performance of Buildings Directive
EC	European Commission
ESCO	Energy service company
EU	European Union
FIT	Feed-in tariff
LCIA	Life Cycle Impact Assessment
OSS	One-Stop-Shop
nZEB	Nearly zero energy building
PV	PV panels
ZCRB	Zero Carbon Ready Building

Definitions

The present report provides guidance on the main concepts regarding building renovation and aims to set a common language for communication between local authorities, professionals, researchers, inhabitants and, in general, all the 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.

Anyway Renovation: Renovation measures necessary to restore a building's functionality without improving its energy performance. The anyway measures may be hypothetical if the renovations without improving energy efficiency are legally not allowed or are not practically reasonable.

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

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

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

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

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

Building renovation passport: An electronic or paper document outlining a long-term (up to 10 or 20 years) step-by-step renovation roadmap and repository or logbook for a specific building. Depending on the country or regional definition, this passport may include the most relevant building information such as original design

files, building plans, as-built files, environmental files, energy consumption and production, executed maintenance, energy audits and user-friendly information on effects and benefits of an energy renovation – for example in terms of reduced heating bills, improved comfort, and CO₂ savings (BPIE, 2019).

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

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

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

Centralised or decentralised thermal energy system: Centralised systems can either refer to a connection to an external district heating or district cooling system, covering a larger area, or to a local thermal energy production system covering only the district in question. A decentralised system refers to a single-building heating or cooling system.

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

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

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

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

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

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

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

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

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

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

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

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

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

Embodied Energy: The total energy inputs consumed throughout a product's life cycle. Initial embodied energy represents the energy used to extract raw materials, transportation to the factory, processing and manufacturing, transportation to the site, and construction. Once the material is installed, recurring embodied energy represents the energy used to maintain, replace, and recycle materials and components of a building throughout its life. One fundamental purpose for measuring this quantity is to compare the amount of energy produced or saved by the product in question to the amount of energy consumed in making it.

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

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

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

Energy Master Plan: A holistic roadmap that enables planners to work constructively toward various framing energy goals within defined community-specific constraints (Zhivov A., 2022).

Energy need (energy demand): The energy to be delivered to, or extracted from, a conditioned space to maintain the intended space conditions during a given period of time disregarding any technical building system inefficiencies (European Commission, 2021).

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

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

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

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

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

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

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

Energy tariffs: The way energy providers charge building users or renters for their effective energy use, such as electricity, gas, heating, cooling, hot water, and so on. Tariffs can be fixed or variable. A fixed-rate

tariff sets a cost of energy for a certain amount of time, typically one year or more, while variable tariffs can go up or down according to the market or establish categories defined by other parameters.

Energy use: The energy input to a technical building system providing an energy performance of buildings service intended to satisfy an energy need (European Commission, 2021).

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

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

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

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

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

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

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

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

Green certificate: A funding scheme that can be used by the promoters of building renovations that meet certain requirements of high energy efficiency. This certificate consists of an official record proving that a specified amount of renewable electricity has been generated. The certificate can be traded separately from the energy produced (EEA, 2020). Investors wishing to finance a green project apply to one of the participating banks. Qualifying projects that meet the requirements receive a green certificate. By availing themselves of an attractive, low-interest loan, investors have an affordable way to pay for sustainable measures as part

of building renovation. Since the loan is repaid, the ultimate cost to the government is the value of the subsidised interest loan, plus administrative costs. In this way, the scheme has succeeded in leveraging significant private investments in addition to public funding (BPIE, 2017).

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

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

Investors: Stakeholders that act as clients or beneficiaries of building renovation or renewable energy projects. There is a wide range of demand organisations which can be private or social, public, semi-public, or mixed, depending on the situation. For instance, private owners or assemblies of homeowners are typically in this category, as well as investment funds, housing associations, housing cooperatives and housing companies, as they may be owners of buildings to be renovated.

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

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

Life Cycle Impact Assessment (LCIA): A phase of Life Cycle Assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of a product system" (ISO 14044:2006). Impact assessment should address ecological and human health effects; it should also address resource depletion.

Linear heat density: Annual heat delivered per meter of piping for a district heating system.

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

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

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

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

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

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

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

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

Policymakers: All kinds of actors and stakeholders who define, develop, and implement policy instruments regarding building renovation or renewable energy projects. That includes all political levels: local, regional, national, and international, as well as all administrative levels and to a certain extent also administrative decision-makers.

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.

Prosumer: Individuals who consume and produce value, either for self-consumption or consumption by others, and can receive implicit or explicit incentives from organizations involved in the exchange (Lang et al., 2021).

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

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

Renewable primary energy factor: The renewable primary energy from an on-site, nearby, or distant energy source that is delivered via a given energy carrier, including the delivered energy and the calculated energy overheads of delivery to the points of use, divided by the delivered energy (European Commission, 2021).

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

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

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

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

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

Special purpose vehicle: A subsidiary company that is formed to undertake a specific business purpose or activity. SPVs are commonly utilised in certain structured finance applications and support specific transactions, including public-private partnerships and project finance (Sainati et al., 2020).

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.

Technical building system: Technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site renewable energy electricity generation and storage, or a combination thereof, including those systems using energy from renewable sources, of a building or building unit (European Commission, 2021).

Total primary energy factor: The weighted sum of renewable and non-renewable primary energy factors for a given energy carrier (European Commission, 2021).

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

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

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

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

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

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