

IEA EBC Annex 75

**Cost-Effective Building Renovation at District Level
Combining Energy Efficiency & Renewables**

13 countries are involved in the project:
AT, BE, CH, CN, CZ, DK, ES, GE, IT, NL,
NO, PT, SE

January 2018 – December 2021

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**Technical Day
24th June, 2020**

1. Project Goal

Project Goal: reach cost-effective energy and carbon emission optimization in building renovation at an urban district scale

Key question: Where is the balance point between energy efficiency measures and measures that promote the use of renewable energy?

Annex 56: At the building level

Annex 75: At the level of groups of buildings / urban districts

2. Project Idea

- At **district level** there are **specific opportunities** as well as **specific challenges** when compared to the building level
- **Finding the balance** between renewable energy supplies and energy efficiency measures for the renovation of the existing stock **is more complex at district level** than for individual buildings, but **may also bring larger benefits**

2. Project Idea

There are **several options available** that need to be explored:

Exemples:

- We can benefit from significant **economies of scale for energy efficiency measures due to aggregated demands and synergies** in construction procurement, processes and planning
The provision of low-temperature district heating systems to groups of buildings may benefit from synergies when combined with energy efficiency measures applied to the buildings envelopes
- There is also an opportunity to **benefit from centralized renewable energy approaches**
The availability of heat storage facilities that in a single building intervention is limited to the building floor space, at district level the options are wider

2. Project Idea

However, **there are** also some **challenges**:

- At the **level of individual buildings**, **synergies** between energy efficiency measures and installation of renewable energy systems **can be easily achieved** but, **at district level** such **synergies are not necessarily available** as they depend on the existing heating systems and on the synchronization of the buildings' renovation cycles

In this context, it is important **to explore the potential of cost-effective renovation interventions at district level** to accelerate the necessary transition towards low-emissions and low-energy districts

3. Annex 75 Objectives

In Annex 75:

- To define a **flexible methodology**, supported by **efficient tools**, to **identify cost-effective strategies** for **renovating urban districts** to significantly reduce carbon emissions and energy use
- To identify and document **good practice examples showing strategies** for **transforming** existing **urban districts** into low-energy and low-emissions districts
- To prepare **Guidelines for policy makers and energy-related companies** on how to **encourage the market uptake** of cost-effective strategies combining energy efficiency measures and renewable energy measures
- To prepare **Guidelines for building owners and investors** about **cost-effective district-level solutions**

<http://annex75.iea-ebc.org/>

4. Annex 75 Scope and Target Groups

Annex 75 Scope:

- Residential buildings
Single-family houses and multi-family buildings
- Non residential buildings
without complex HVAC systems

Annex 75 Target Groups:

- Policy makers
- Companies working in the field of the energy transition
- Building owners



5. Annex 75 Outputs

- **Report on Technology Overview**
- **Methodology Report on cost-efficient building renovation at district level**
- **Assessment tools**
- **Report on the application of the methodology in generic districts**
- **Report on strategy development**
- **Report on parametric assessments of case studies**
- **Online documentation of good practice examples**
- **Report on enabling factors and obstacles to replicate successful case studies**
- **Good practice guidance: Guidance for transforming existing districts into low-energy and low-emission districts**
- **Report on policy instruments, including recommendations for subsidy programmes and for encouraging market take-up**
- **Report on business models and models for stakeholder dialogue**
- **Guidelines for policy makers and energy related companies on how to encourage the market take-up of cost-effective strategies combining energy efficiency measures and renewable energy measures**
- **Guidelines for building owners/investors about cost-effective renovation strategies, including district-based solutions**

Technology Overview Report



International Energy Agency
Technology overview (EBC Annex 75)

Energy in Buildings and Communities
Technology Collaboration Programme

Report
May 2020



Figure 12. Low temperature thermal grid.

Heat pumps connected to district heating

Heat pumps are used to heat or cool from rock, soil, lake or air, and transfers it to the property's heating system. The choice of heat pump that is suitable for each application depends mainly on the application and hot water requirement needs to be covered and on the installation area.

When using heat pumps, it is important to look at the seasonal coefficient of performance (COP) value. The higher the value, the more efficient the pump. Unlike fossil fuel boilers, a heat pump requires a low temperature heat source. The water for the elements needs to have a relatively low temperature to run optimally.

Heat pumps are integrated into district heating networks.

The Stakhus area (Kylhusets Kunder) in Stockholm in Sweden, where 6% of district grids is produced by heat pumps [1], is a recent example (2018). Excess heat from the cooling processes is recycled through a 9" grid to the district heating network via three heat pumps. There are also three heat pumps (Kylmaxim) with a pipeline network, as illustrated in Figure 23, which serves a number of food industry properties in the area. The area's production capacity is 2.3MW. Heat is recovered from the cooling units' heating supply with three heat pumps. The plant is dimensioned to handle a heat output of 988kW and a heat output of 1,228kW. The non-recycled heat is led to the outdoor air via an optional closed cooling tower (kyltorn).



Figure 23. Integration of district heating and cooling in the Stakhus area in Stockholm, which combines district heating and heat pumps (varmepump). Image: oppenvarme.se

Heat pumps are provided with sub-coolers. Incoming return water first passes all through the sub-coolers. Then it is led through the condensers in series. The connection is led through the condensers in series. The connection is led through the condensers in series.

Low Temperature District Heating

Low temperature district heating systems lead to lower losses and primary energy demand.

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Cold District Heating and Cooling

Cold district heating and cooling supply systems are based on low-temperature sources (solar thermal, surface water, waste heat) and require a more complex and expensive system structure, combination with heat pumps allows for better coupling and lower distribution losses.

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The report presents an overview of the **available technologies** for **energy renovation** and **renewable energy supply** at the district level, showing:

- **Technical and economic characteristics** of the technology options, taking into account **economies of scale.**
- **Interdependencies, obstacles and success factors** for combining the technology options.
- **Available potentials**, and expected **future developments.**

Methodology Report



International Energy Agency

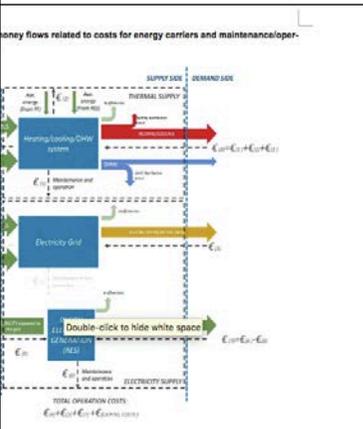
Methodology for investigating cost-effective building renovation strategies at district level combining energy efficiency & renewables (EBC Annex 75)

Energy in Buildings and Communities
Technology Collaboration Programme

Interim Report
June 2020



Money flows related to costs for energy carriers and maintenance/operational costs



...of money flows related to costs for energy carriers and maintenance/operational costs. Investment costs are not included in this overview.

...the costs of energy carriers and maintenance/operational costs, three different subsystems are considered: "thermal subsystem", comprising heating or cooling systems, hot water, "electricity grid", and "in situ electricity generation".

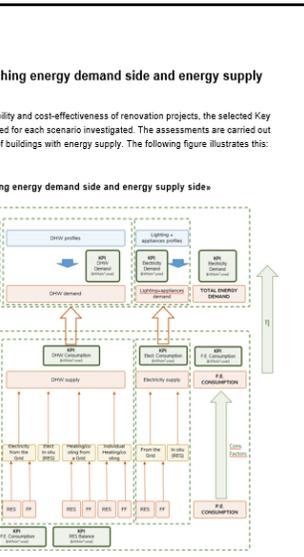
...the thermal subsystem are mainly renewable energy, or fossil fuels in the form of auxiliary energy. The outputs are the energy for the heating and cooling and for the domestic hot water supply. In both cases, this comprises useful energy and losses. Thus, energy inputs equal energy outputs, including the energy losses. In a similar way, the sum of energy costs and investment costs of a specific system will be those related to the energy carriers (C_e and C_g) and costs related to maintenance, management and operation (C_m and C_o). The sum of these costs directly affects the total operation costs associated with the thermal subsystem (C_e).

...ity from the grid, only final electricity costs are taken into consideration

...ing energy demand side and energy supply

...ility and cost-effectiveness of renovation projects, the selected Key Performance Indicators (KPIs) are used. The assessments are carried out for buildings with energy supply. The following figure illustrates this:

...ing energy demand side and energy supply side



...ing energy demand side and energy supply side when evaluating different scenarios. RES refers to renewable energy resources, FF to fossil fuels, F.E. to final energy, CHW to domestic hot water, KPI to Key Performance Indicators

...namic simulations or specific tools for evaluating the global performance, considering the demand side on the one hand, and the supply side on the other hand.

The report describes the **methodology for identification and assessment of cost-effective strategies** for renovating urban districts:

- Defines the **boundary conditions** for the assessments
- Presents the main **research questions** to be investigated
- Defines the **outputs** to be generated in the analyses

This document intends to **support decision makers** in the evaluation of the **efficiency, impacts, cost-effectiveness and acceptance** of various strategies for **renovating urban districts**

6. Outputs

Annex 75 District Calculation Tool

Online calculation tool for district heating sizing and cost-effectiveness of renovation strategies

The screenshot displays the 'Annex 75 Calculation tool' interface, which is divided into three main sections: Overview, Calculation data, and Results.

Overview: This section includes 'Assessment Information' (Contact information, Tools used), 'Location' (Country, Coordinates), 'Result overview' (a pie chart), and 'About Annex 75' (a brief description of the project's goals).

Calculation data: This section allows for the entry of information related to the district, buildings, and energy systems. It includes a 'District' section with fields for Coordinates, Climate zone, No. buildings, and Climate file. Below this are sections for 'Building types', 'Energy systems', and 'Envelope measures'.

Results: This section provides an overview of the calculation results and means to export. It features a 'Graph output' section with a scatter plot titled 'Annualized specific cost vs. specific primary energy use'. The plot shows data points for 'Renovation 1', 'Renovation 2', and 'Renovation 3'. Below the graph is a 'Tabulated results' section with a table of results and buttons for 'Export to Excel' and 'Export to JSON'.

- characteristics of the district
- characteristics of the buildings
- renovation scenarios
- cost curves
- ...

6. Outputs

Identification of Success Stories and Case Studies

Case Study - Santa Tecla neighbourhood, Braga

building typology:

Kildeparken, Aalborg

building typology (no. of dwellings):

number of dwellings (after renovation):

	Before	After
- no. of dwellings [-]	942	1,228
- total heated floor area [m ²]	96,000	120,000

renovation measures already carried out:
implementation period: 2014 - 2020

Success Stories – already finished district-based renovation projects

where **economic, technical and social factors** that enable or hinder successful renovations were identified

Case Studies – open renovation projects used to apply and test the Annex 75 Methodology

There is still the possibility to provide **guidance in choosing the most appropriate renovation strategy** especially in finding synergies and trade-offs for combining energy efficiency measures and renewable energy measures

Results obtained and lessons learned are used to prepare a **good practice guidance** for low-energy and low-emission districts

6. Outputs

Success Stories Webpage

HOME ABOUT SUBTASKS SUCCESS STORIES PUBLICATIONS PARTICIPANTS NEWS MEETINGS MEMBER AREA

HOME / SUCCESS STORIES

Success Stories

create your own.

← Coronacion ↗

Project
Coronacion

Sector
Mixed use

City
Vitoria-Gasteiz

Country
Spain

Year of Renovation
2016-2021

Highlights
The renovation of this district shows a viable way to deal with major challenges in terms of retrofitting and implementation of smart city concepts.

Google My Maps

Interactive map
integrated in the **Annex 75** website.

HOME ABOUT SUBTASKS SUCCESS STORIES PUBLICATIONS PARTICIPANTS NEWS MEETINGS

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<https://annex75.iea-ebc.org/success-stories>

6. Outputs

Workshops on Policy Instruments, Stakeholder Dialogue and Business models for upscaling District energy renovation



Workshop at Bilbao – March 2019



Workshop at Delft – October 2019



With insights from the **workshops** and **interviews**, a **report** is being prepared:

- To **give an overview** on various **policy instruments** and **business models** at the district level
- To **evaluate stakeholder's acceptance** of the proposed policy instruments
- To **illustrate the development and assessment** of **innovative local policy instruments** in selected cases
- To **give recommendations** to **policymakers** and their key partners on how they can **influence the uptake** of cost-effective low carbon renovation solutions

7. Dissemination

<http://annex75.iea-ebc.org/>



[linkedin.com/company/ebc-annex-75-project/](https://www.linkedin.com/company/ebc-annex-75-project/)



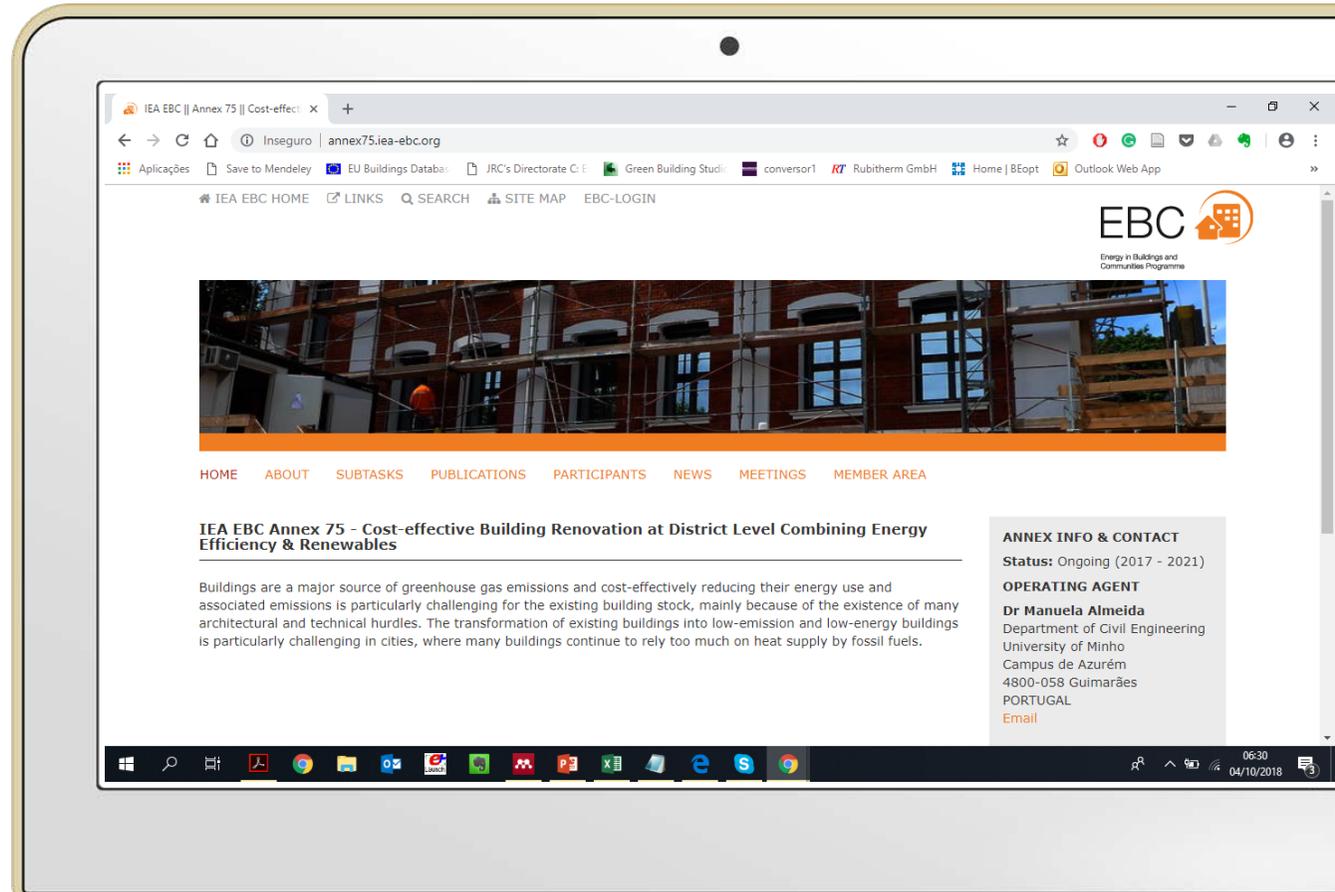
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Thank you for your attention!

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