BUILD UP

The European portal for energy efficiency and renewable energy in buildings

WEBINAR
Building Renovation at District Level: Combining Energy Efficiency & Renewable Energy Sources

10th October 2023 / 11.00H – 12.15H CET
## AGENDA

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<td>Roman Bolliger, Project Manager at INDP, Switzerland</td>
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<td>Barriers and Drivers for energy efficient renovation at district level</td>
<td>Erik Johansson, Associate Professor at Lund University, Sweden</td>
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<td>BUILD UP</td>
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<td>Thank you from BUILD UP</td>
<td>BUILD UP</td>
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IEA EBC Annex 75

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

January 2018 – June 2023
13 participant countries | AT, BE, CH, CN, CZ, DK, ES, GE, IT, NL, NO, PT, SE

IEA EBC Annex 75
Brief Overview

Manuela Almeida | Operating Agent
University of Minho, Portugal

Webinar
10 October 2023
Investigate cost-effective strategies for reducing carbon emissions and energy use in buildings at the district level, combining energy efficiency measures and measures that promote the use of renewable energy.

Provide guidance to policymakers, companies working in the field of the energy transition, as well as building owners, to cost-effectively transform the existing building stock into low-emission and low-energy solutions.

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

Residential Buildings and non residential buildings without complex HVAC systems.
Renovation at district level

Opportunities and Challenges

• **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

• **It was important to explore the potential of cost-effective renovations at district level** to **accelerate the transition towards low-emissions** and low-energy districts
Objectives

- Give an overview of existing and emerging technology options for cost-effective renovation strategies
- Define a methodology, supported by one or more tools, to identify cost-effective strategies for the renovation of urban districts combining energy efficiency measures and renewable energy measures
- Identify and document good examples as well as explore case studies, highlighting the strategies for an effective transformation of existing districts into low-energy and low-emission districts
- Provide guidelines for policymakers and energy-related companies on how to encourage the market uptake of cost-effective strategies combining energy efficiency measures and renewable energy measures
- Provide guidelines for building owners and investors on cost-effective district-level solutions
IEA EBC Annex 75

Outputs

- Technology Overview
- IEA EBC Annex 75 Methodology
- IEA EBC Annex 75 online Supporting Tool
- Application of the methodology in generic districts
- Strategy development for low-carbon renovation of districts
- Good practice examples (available online)
- Parametric assessments of case studies
- Barriers and drivers for energy-efficient renovation at district level
- Good practice guidance for low-carbon renovation of districts
- Policy instruments to support district renovations
- Business models and models for stakeholder dialogue
- Guidebook for policymakers and energy-related companies
- Guidebook for building owners and investors

https://annex75.iea-ebc.org/publications
IEA EBC Annex 75

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

Optimisation methodology and strategy development for building renovation at district level combining energy efficiency and renewable energy systems

presented by Roman Bolliger, INDP, Switzerland, on behalf of IEA EBC Annex 75 team of researchers

Webinar on BUILD UP platform
10 October 2023
Objectives

URBAN DISTRICT

Renewable energy measures

Energy efficiency measures
Selected research questions

• What are cost-effective combinations between renewable energy measures and energy efficiency measures to achieve far-reaching reductions in greenhouse gas emissions and primary energy use in urban districts?

• Under which circumstances does it make sense to use available renewable energy potentials in cities at a district level, and under which circumstances are decentralised renewable energy solutions, in combination with energy efficiency measures on the buildings’ envelopes, more advantageous?

• To what extent does the cost-effectiveness of renovation measures on the building envelopes in the case of a district heating system based on renewable energies differ from the cost-effectiveness of such measures in case of a decentralised use of renewable energy sources for heating in each individual building?
Renewable energy measures

District heating system:
- Lake water heat pump
- Groundwater heat pump
- Geothermal heat pump
- Wood energy
- Lake water + decentralized heat pumps
- ...

Individual heating systems:
- Air source heat pumps
- Geothermal heat pumps
- Wood energy
- ...

Solar energy

Energy efficiency measures

Measures on building envelope:
- Insulation of wall
- Insulation of roof
- Insulation of cellar ceiling
- New windows
- ...

Technology Collaboration Programme
by IEA
This building needs renovation

«anyway» renovation as the reference case
- New coverage
- New painting

energy efficient renovation with renewable energy heating in comparison to reference
- New coverage and roof insulation
- New painting + façade insulation
- Heat pump

Image source: Ott et al. 2017
Methodology (III)

District heating system

A  Heat source intake
B  Centralized heat generator
C  Pipes / Distribution System
D  Individual heating substation
Case study Luzern, Switzerland (I)

Image source: Google Maps
Characterization of building envelopes with energy performance certificates

<table>
<thead>
<tr>
<th>Bauteilkategorie, Bild</th>
<th>Beschreibung</th>
<th>Mögliche Verbesserungen</th>
<th>Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wände gegen aussen / ≤ 2 m im Erdreich</td>
<td>Wände im EG gegen Keller und Nebenräume sind mindestens gedämmt</td>
<td>Bei einer Sanierung Dämmung auf heutigen Standard ergänzen</td>
<td></td>
</tr>
<tr>
<td>Fenster und Türen</td>
<td>Fenster und Türen sind mit 2-fach Wärmedämmung in Kunststoffrahmen</td>
<td>Fenstereinsatz durch modernes 3-Fach Verglasung</td>
<td></td>
</tr>
<tr>
<td>Boden gegen aussen / ≤ 2 m im Erdreich</td>
<td>Boden gegen Eingangsbereich sind nur minimal gedämmt.</td>
<td>Aussen­dämmung von unten nach­fransen</td>
<td></td>
</tr>
<tr>
<td>Wärmedämmung (linear und punktförmig)</td>
<td>Balkone sind durchbewölbelt.</td>
<td>Längerdauerige Abdämmung der Balkone und Ersatz der Dämmstoffe (Vergütung möglich) oder neue Balkonüberdachung (ohne Vergütung)</td>
<td></td>
</tr>
</tbody>
</table>

**Bewertung**

- sehr energieeffizient: A
- energieeffizient: B
- mittel: C
- wenig energieeffizient: D

**Effizienz Gebäudehülle**

- E: sehr energieeffizient
- F: energieeffizient
- G: mittel

**Effizienz Gesamtenergie**

- A: sehr energieeffizient
- B: energieeffizient
- C: mittel
- D: wenig energieeffizient
## Case study Luzern, Switzerland (III)

<table>
<thead>
<tr>
<th>Renovation package</th>
<th>Scope of included energy efficiency measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Refurbish wall/roof + windows; or wall, roof an windows, without improving energy efficiency</td>
</tr>
<tr>
<td>V1</td>
<td>Insulation of exterior wall with 4 – 11 cm rock wool</td>
</tr>
<tr>
<td>V2</td>
<td>Insulation of exterior wall with 12 – 21 cm rock wool</td>
</tr>
<tr>
<td>V3</td>
<td>V2 + insulation of cellar ceiling with 3 – 12 cm PUR</td>
</tr>
<tr>
<td>V4</td>
<td>V2 + insulation of cellar ceiling with 9 – 19 cm PUR</td>
</tr>
<tr>
<td>V5</td>
<td>V4 + insulation of roof with 2 – 13 cm EPS</td>
</tr>
<tr>
<td>V6</td>
<td>V4 + insulation of roof with 12 – 24 cm EPS</td>
</tr>
<tr>
<td>V7</td>
<td>V6 + new windows with U-value 1.3 W/(m²K)</td>
</tr>
<tr>
<td>V8</td>
<td>V6 + new windows with U-value 0.8 W/(m²K)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of heating system</th>
<th>Heating system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Oil and gasheatings</td>
</tr>
<tr>
<td>Decentralized renewable</td>
<td>Air source heat pump</td>
</tr>
<tr>
<td></td>
<td>Geothermal heat pump</td>
</tr>
<tr>
<td>Centralized renewable</td>
<td>Lake water with centralized heat pump</td>
</tr>
<tr>
<td></td>
<td>Lake water with decentralized heat pumps</td>
</tr>
<tr>
<td></td>
<td>Centralized geothermal heat pump, regeneration with solar energy</td>
</tr>
</tbody>
</table>
Case study Luzern, Switzerland (IV)

Efficiency measures on building envelopes with air-source heat pumps

<table>
<thead>
<tr>
<th>Reference</th>
<th>new heating only</th>
<th>M1: wall 4-11 cm</th>
<th>M2: wall 12-21 cm</th>
<th>M3: M2 + cellar 3-12 cm</th>
<th>M4: M2 + cellar 9-19 cm</th>
<th>M5: M4 + roof 2-13 cm</th>
<th>M6: M4 + roof 12-24 cm</th>
<th>M7: M6 + windows U-value 1.3</th>
<th>M8: M6 + window U-value 0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary energy use per year [kWh/(a*m²)]</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
</tr>
<tr>
<td>costs per year [EUR/(a*m²)]</td>
<td>5</td>
<td>15</td>
<td>25</td>
<td>35</td>
<td>45</td>
<td>55</td>
<td>65</td>
<td>75</td>
<td>85</td>
</tr>
</tbody>
</table>

Graph showing the relationship between primary energy use and costs per year for different building envelope configurations.
Case study Luzern, Switzerland (V)

Efficiency measures on building envelopes with lake-water centralized heat pump

<table>
<thead>
<tr>
<th>Costs per year [EUR/(a*m²)]</th>
<th>Primary energy use per year [kWh/(a*m²)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
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<tr>
<td>10</td>
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<td>15</td>
<td>15</td>
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<td>20</td>
<td>20</td>
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<td>25</td>
<td>25</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>

- Reference
- "new heating only"
- M1: wall 4-11 cm
- M2: wall 12-21 cm
- M3: M2 + cellar 3-12 cm
- M4: M2 + cellar 9-19 cm
- M5: M4 + roof 2-13 cm
- M6: M4 + roof 12-24 cm
- M7: M6 + windows U-value 1.3
- M8: M6 + window U-value 0.8
Case study Luzern, Switzerland (VI)

Efficiency measures on building envelopes with various heating systems

![Graph showing costs per year vs. primary energy use per year for different heating systems.]

- Reference: oil/gas heating
- Decentralised air-source heat pumps
- Decentralised ground-source heat pumps
- Lake water DH with centralised heat pump
- Cold lake water DH with decentralised heat pumps
- DH system with centralised ground source heat pump
Efficiency measures on building envelopes with air-source heat pumps

<table>
<thead>
<tr>
<th>Costs per year [EUR/(a*m²)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
</tr>
<tr>
<td>New heating only</td>
</tr>
<tr>
<td>V1</td>
</tr>
<tr>
<td>V2</td>
</tr>
<tr>
<td>V3</td>
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<tr>
<td>V4</td>
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<tr>
<td>V5</td>
</tr>
<tr>
<td>V6</td>
</tr>
<tr>
<td>V7</td>
</tr>
<tr>
<td>V8</td>
</tr>
</tbody>
</table>

25.9  26.4  25.8  25.4  25.4  25.3  24.6  24.4  28.6  28.9
Case study Luzern, Switzerland (VIII)

Efficiency measures on building envelopes with lake-water centralized heat pump

<table>
<thead>
<tr>
<th></th>
<th>Reference</th>
<th>New heating only</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
<th>V7</th>
<th>V8</th>
</tr>
</thead>
<tbody>
<tr>
<td>costs per year [EUR/(a*m²)]</td>
<td>25.9</td>
<td>29.4</td>
<td>28.4</td>
<td>27.9</td>
<td>27.8</td>
<td>27.6</td>
<td>26.1</td>
<td>26.0</td>
<td>29.9</td>
<td>30.2</td>
</tr>
</tbody>
</table>

Technology Collaboration Programme by IEA
Cost savings through energy efficiency measures with various types of heating systems

- Reference: oil/gas heating
- Decentralised air-source heat pumps
- Decentralised ground-source heat pumps
- Lake water DH with centralised heat pump
- Cold lake water DH with decentralised heat pumps
- DH system with centralised ground source heat pump
Comparison between heating systems, without energy efficiency measures on building envelopes

<table>
<thead>
<tr>
<th>Heating System</th>
<th>Costs per year [EUR/(a*m²)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference: oil/gas heating</td>
<td>25</td>
</tr>
<tr>
<td>Decentralised air-source heat pumps</td>
<td>30</td>
</tr>
<tr>
<td>Decentralised ground-source heat pumps</td>
<td>25</td>
</tr>
<tr>
<td>Lake water DH with centralised heat pump</td>
<td>30</td>
</tr>
<tr>
<td>Cold lake water DH with decentralised heat pumps</td>
<td>25</td>
</tr>
<tr>
<td>DH system with centralised ground source heat pump</td>
<td>35</td>
</tr>
</tbody>
</table>
Comparison between heating systems in combination with their optimal packages of energy efficiency measures on building envelopes

- Reference: oil/gas heating
- Decentralised air-source heat pumps
- Decentralised ground-source heat pumps
- Lake water DH with centralised heat pump
- Cold lake water DH with decentralised heat pumps
- DH system with centralised ground source heat pump

Cost-effectiveness of various heating systems, with energy efficiency measures on building envelopes
Conclusions of case study

• For all investigated renewable energy systems, energy efficiency measures on building envelopes are at least as cost-effective as with a fossil fuel based heating system

• For individual heating systems and for district heating systems, the same package of efficiency measures on the building envelopes is most cost-effective

• The cost-effectiveness of various investigated heating systems is relatively similar.

• Synergies between efficiency measures on building envelopes and the use of renewable energies are larger for district heating systems compared with decentralized energy efficiency systems
## Strategy development

### Strategy distinction

<table>
<thead>
<tr>
<th>Starting condition</th>
<th>Production and distribution concept</th>
<th>Heating/cooling technology</th>
<th>Ambition level</th>
<th>Energy efficiency measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (Decentral)</td>
<td>Central (district level)</td>
<td>District Heating (City level)</td>
<td>Related to anyway renovations</td>
<td></td>
</tr>
<tr>
<td>S2 (Central – fossil)</td>
<td>Decentral (building/sub-station level)</td>
<td>Biomass boiler</td>
<td>Additional renovation measures</td>
<td></td>
</tr>
<tr>
<td>S3 (Central – RES)</td>
<td>Individual (end user level)</td>
<td>Heat pump (GSHP/WSHP/ASHP)</td>
<td>Local production (PV, solar thermal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electric heaters</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Image source: Walnum et al. 2023
Selected conclusions for strategy development (I)

• There are no one-fits-all solutions. Each district has to be investigated individually, taking into account its specificities.

• The best solutions depend on the starting situation of the district:
  • insulation levels and associated energy needs
  • availability of existing district heating system, installed heating/cooling systems
  • available energy sources
  • possibilities for integrating renewable energies
Selected conclusions for strategy development (II)

• Synergies between energy efficiency measures and renewable energy based heating systems occur for all types of heating systems. The same package of renovation measures on building envelopes usually most cost-effective.

• Key factor for synergies: possibility to lower the temperature of the grid due to energy efficiency measures on the building envelopes, with solutions for safety of domestic hot water from health perspective.
• The difference in cost-effectiveness between centralised and decentralised solutions is often small; economies of scale vs. losses due to distribution / less efficient heat pumps at high temperatures + more planning and higher risks.

→ There is often no clear economic case for choosing centralised approaches.

• However, there may be other good reasons for preferring centralised approaches:
  • make use of a large heat source or of a seasonal thermal storage
  • have more flexibility
  • reduce the burden on the electricity grid
  • provide a heating solution also to buildings for which a switch to a decentralised system based on renewable energies is a big challenge.
  • ...

• If policy makers would like to see district projects be implemented to harness these benefits, policy measures are necessary, because the market all by itself is unlikely to deliver district solutions to a large extent.
Further information

https://annex75.iea-ebc.org

EBC Annex 75 Tool:
https://annex75.bim.energy/

Contact:
roman.bolliger@indp.ch
Tel. +41 41 210 07 10
Barriers and drivers for energy efficient renovation at district level

Authors:
Erik Johansson & Henrik Davidsson, Lund University, Sweden
Research approach

Energy-efficient renovation at district level

RQ 1: What are the main barriers and drivers?

RQ 2: What barriers must be overcome to achieve successful renovation?

RQ 3: What are the most important drivers enabling renovation?
Research approach

Method

• Analysis of 15 success stories – recent renovation projects at district level
• 38 interviews with different stakeholders
Research approach

Method

- Analysis of 15 success stories – recent renovation projects at district level
- 38 interviews with different stakeholders

Countries involved

- Success stories: 7 countries
- Interviews: 8 countries
- Representing northern, central and southern Europe
Research approach

Type of stakeholder

- **Policy actors**
  (authorities, public agencies, etc)

- **Renovation solution suppliers**

- **Energy solution suppliers**

- **Clients and beneficiaries** (investors, residents, homeowner & housing associations, etc)

- **Financing intermediaries**
  (banks, real estate developers, etc)

- **Other intermediaries**
  (neighbourhood associations, consultants, etc)
Research approach

Type of stakeholder

- Policy actors
  (authorities, public agencies, etc)
- Renovation solution suppliers
- Energy solution suppliers
- Clients and beneficiaries
  (investors, residents, homeowner & housing associations, etc)
- Financing intermediaries
  (banks, real estate developers, etc)
- Other intermediaries
  (neighbourhood associations, consultants, etc)

Categories of barriers and drivers

- Policy aspects
- Legal aspects
- Economic aspects
- Social aspects
- Communication
- Technical aspects
- Knowledge and training
Results – main barriers
Results – main barriers

Policy aspects

• Lack of synchronization between authorities at local, regional and national level

• Local authorities lack financial and human resources and technical expertise, especially small municipalities

• It is often difficult for municipalities to influence private actors and homeowner associations
Results – main barriers

Policy aspects

• Lack of synchronization between authorities at local, regional and national level
• Local authorities lack financial and human resources and technical expertise, especially small municipalities
• It is often difficult for municipalities to influence private actors and homeowner associations

Legal aspects

• Too rigid legal framework (energy requirements, tenant laws, etc)
• Complex ownership structure in districts
Results – main barriers

Economic aspects

- Lack of financial incentives, especially at district level
- Lack of financial support to low-income people
- Private homeowners do not want to take out loans
Results – main barriers

Economic aspects

- Lack of financial incentives, especially at district level
- Lack of financial support to low-income people
- Private homeowners do not want to take out loans

Social aspects

- Risk that low-income people need to move from the district (being vulnerable to increase of costs)
- Lack of trust in authorities and other actors involved in energy renovation
Results – main barriers

Communication

- Poor dialogue and coordination between stakeholders
- Lack of adequate advice and guidance
Results – main barriers

Communication

- Poor dialogue and coordination between stakeholders
- Lack of adequate advice and guidance

Technical aspects

- Difficult for residents to switch from individual to centralised installations
- Great variation in technical condition of buildings in the district
Results – main barriers

Communication

- Poor dialogue and coordination between stakeholders
- Lack of adequate advice and guidance

Technical aspects

- Difficult for residents to switch from individual to centralised installations
- Great variation in technical condition of buildings in the district

Knowledge and training

- Insufficient knowledge and expertise among several stakeholders (authorities, consultants, contractors, ...)

Results – main drivers
Results – main drivers

Policy aspects – the role of local authorities/municipalities:

- Act as coordinating actors to reach many stakeholders
- Develop visions, energy strategies and tools
- Organise consulting and awareness campaigns
- Improve the outdoor environment in the districts
- Facilitate necessary permissions
- Provide funding framework for homeowners and housing associations
Results – main drivers

Economic aspects

- Use of bank guarantees and revolving loan funds
- Economic incentives to encourage a shift to carbon free energy
- Financial help to low-income groups
- Economy of scale: change from individual heating of each building to district heating
Results – main drivers

Economic aspects

• Use of bank guarantees and revolving loan funds
• Economic incentives to encourage a shift to carbon free energy
• Financial help to low-income groups
• Economy of scale: change from individual heating of each building to district heating

Social aspects

• Citizen involvement and user participation to raise acceptance
• Facilitate for residents to stay in the district to maintain social cohesion
Results – main drivers

Communication

• Advice and guidance to involved actors during the whole renovation period
• Stakeholder dialogue throughout the project, eg thematic workshops
• Dialogue between local authorities and citizen groups to build trust
Results – main drivers

Communication

• Advice and guidance to involved actors during the whole renovation period
• Stakeholder dialogue throughout the project, eg thematic workshops
• Dialogue between local authorities and citizen groups to build trust

Technical aspects

• Standardization and prefab solutions at district level, especially when many buildings are of a similar type
Results – main drivers

Communication

• Advice and guidance to involved actors during the whole renovation period
• Stakeholder dialogue throughout the project, eg thematic workshops
• Dialogue between local authorities and citizen groups to build trust

Technical aspects

• Standardization and prefab solutions at district level, especially when many buildings are of a similar type

Knowledge and training

• Training of key actors involved in different parts of the renovation
Recommendations/conclusions
Recommendations/conclusions

• Holistic approach to district renovation, combining energy renovation with upgrading of the district (improved outdoor environment and social infrastructure) – this will help creating trust.
**Recommendations/conclusions**

- **Holistic approach** to district renovation, combining energy renovation with upgrading of the district (improved outdoor environment and social infrastructure) – this will help creating trust.

- **Local authorities** should have a leading role in coordinating district renovation including:
  - communicating with different stakeholders
  - identifying appropriate solutions for a given district,
  - support the creation of appropriate legal structures.
Recommendations/conclusions

- **Holistic approach** to district renovation, combining energy renovation with upgrading of the district (improved outdoor environment and social infrastructure) – this will help creating trust.

- **Local authorities** should have a leading role in coordinating district renovation including:
  - communicating with different stakeholders
  - identifying appropriate solutions for a given district,
  - support the creation of appropriate legal structures.

- **Public housing associations** can play an important role in energy renovation at district level especially if the municipality has ambitious goals as regards energy efficiency and use of renewable energies.
Recommendations/conclusions

- Already implemented projects can lead to certain standardisation and thereby more efficient construction, to achieve synergy effects, prefab solutions and standardization of processes.
• Already implemented projects can lead to certain standardisation and thereby more efficient construction, to achieve synergy effects, prefab solutions and standardization of processes.

• Best practise examples constitute a good way to encourage the spread of renovation at district level, either starting by single buildings and upscaling it to districts or to spread good district examples to other districts.
Further information

- Johansson E & Davidsson H (2023): Barriers and drivers for energy efficient renovation at district level, IEA EBC Annex 75
- Rose J et al (2021): Building renovation at district level – Lessons learned from international case studies, Sustainable cities and Society, 103037
- Domingo-Irigoyen S (2023): Success stories of cost-effective building renovation at district level combining energy efficiency and renewables, IEA EBC Annex 75
Q & A

moderated by BUILD UP
Attendee poll

moderated by BUILD UP
Policy instruments for building renovation at district level combining energy efficiency and renewable energy systems

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Introduction

**EU Energy Performance of Buildings Directive:** need for increasing renovation rates, minimum building energy performance standards and long-term renovation strategies

**EU Renovation Wave:** placing an integrated participatory and neighbourhood based approach at the heart of renovation

**New Leipzig Charter:** the district as an important level for integrated urban transformation

Renewable energy systems at district scale are better developed than renovations at district scale

Policy instruments are needed to achieve breakthroughs regarding building renovation at district scale

⇒ Stronger **steering and shaping role for Local Authorities** for upscaling the number of renovations including energy efficiency measures, combined with a switch to renewable energy systems
Research Question: How can policies (deployed at local level) increase residential building renovation and renewable energy systems at district level?

- Catalogue of policy instruments
- 3 international workshops & 38 in-depth interviews from 8 countries, using a standardized questionnaire
- Quantitative assessment on the degree stakeholders think proposed policy instruments can be useful, important and easy to implement
- Qualitative assessment about the use of policy instruments to engage stakeholders and about the perceived successes and failures of the policy instruments
Catalogue of policy instruments

- Regulations
  - Enforcement of minimum energy standards in districts
  - Inspections and audits in districts

- Incentives
  - Financial incentives created by local authorities for districts

- Planning and tendering for districts

- Organizational instruments
  - Creation of renovation services in districts
  - Energy advice services for citizens

⇒ opportunities / barriers

- Communication instruments
  - Local media development
  - Energy benchmarking in districts
  - Education and training for building professionals
  - Labels for low-energy/low-emission districts
  - Local events for building owners

- Emerging initiatives
  - Citizen energy cooperatives
  - Energy demand side management in districts
  - Facilitation of trading of white, green and black certificates
Example top-down: Local authority planning

**Opportunities:**
Dealing with efficiency of buildings and energy grids at the same time
Professional top-down planning
Performance-based tendering
Legal basis

**Barriers:**
Mentality change needed for various stakeholders
Participation processes are still needed
Possible resistance due to ineffective consultation or lack of options
Gentrification risk
Ex. bottom-up: District advice desk

Opportunities:
Focus on unburdening the homeowners
Targeting multiple homeowners at the same time, referral to 'trusted' actors
Individual awareness raising, providing easy access to solutions
Alliances to connect supply and demand

Barriers:
Procurement barriers, experimental tendering processes, resource-intensive
Service not necessarily targeting a specific district or customer segment
Possible lack of client follow-up
Lack of long-term engagement of stakeholders (often project-based initiatives)
Stakeholder viewpoints on policy instruments

**Use & interest:**
62% interviewees have direct experience and 9% more are planning to apply them.

**Importance:**
72% value them as important or very important to stimulate building renovation and renewable energy in districts or neighbourhoods.

**Ease of development / implement:**
only 25% consider them easy or somewhat easy, while 49% find them somewhat difficult or somewhat difficult to develop.
Stakeholder viewpoints on policy instruments

1. Not important
2. Somewhat important
3. Neutral
4. Important
5. Very important

- Enforcement of energy standards
- Inspections and energy audits
- Financial incentives for specific districts
- Financial incentives for groups of homeowners
- Creation of renovation services in districts
- Local energy desks in districts
- Dedicated local web site or other media
- Networking meetings in districts

Standard dev. - Policy actors votes
Average score - All Actor types
Average score - Policy Actors
Average score - Non-Policy Actors
Discussion

Countries can learn from each other’s successes and failures

AT: district management offices take care of energy related renovations (Vienna)

BE: ‘neighbour grant’ didn’t lead to expected outcome

CH: cantonal subsidies (and obligations) for switching to renewable energy based heating systems; voluntary energy performance labels (Minergie, 2000-Watt areas)

GE: combination of KfW 432 grant with Städtebauförderung & regional & local add-ons

NL: responsibility of local authorities for developing district heat plans

ES: policy for rehabilitation of rural areas

Local Authorities can be drivers of district projects but largely depend on available (sometimes inconsistent) national and regional structures, initiatives, support and resources
Conclusion

A district scale approach can lead to upscaling of energy renovations, but comes with important local and social challenges, that can be addressed with various types of policy instruments.

The proposed policy instruments are generally considered useful and important for accelerating building renovations at district scale combining energy efficiency and renewable energy systems:

- Put emphasis on making the local implementation of these instruments easier.
- National policy to alleviate possible barriers.
- Empower or unburden Local Authorities.
Thank you

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International Energy Agency
Policy instruments for cost-effective building renovation at district level combining energy efficiency & renewables (Annex 75, D.1.)

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Business models for cost-effective building renovation at district level combining energy efficiency & renewables

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Introduction

The role of Business models for energy renovation

Barriers

- Financial
  - Access to finance
    - Payback expectations / investment horizons
  - Competing purchase decisions
  - Price signals

- Institutional and administrative
  - Regulatory & planning issues
    - Institutional
    - Structural
    - Multi-stakeholder issues

- Awareness, advice and skills
  - Information barrier
    - Awareness of potential/benefits
  - Skills & knowledge related to building professionals

- Separation of expenditure and benefit

Barriers to renovation identified by the BPIE survey “European buildings under the microscope. *Figure from: BPIE, 2011*
Introduction

The role of Business models for energy renovation

Barriers to renovation identified by the BPIE survey “European buildings under the microscope. Figure from: BPIE, 2011
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Goals

• Identifying the **key characteristics of business models** are important to upscale business from building to district level.

• Gain insights about the opportunities that BMs offer for the **different stakeholders**, in order support the **implementation** of the renovation and the **stakeholder dialogue**.

• Give recommendations to **stakeholders** about BM to support the **uptake of cost-effective combinations of energy efficiency measures and renewable energy measures** in building renovation at district level.
Research Approach

Q 1: Are the current practices in BM for building renovation and energy supply applicable to district renovation?

Q 2: Who are the main stakeholders and what is their role in the BM for district renovation to combine energy efficiency and RES?

Q 3: Which BM characteristics are important to upscale district renovation to combine energy efficiency and RES?
Key findings

Catalogue of Business models

Characterised by:
- Management of the process
- Role of the beneficiary
- Involvement of intermediaries
- Service and product provided
- Benefits distribution
Key findings

Catalogue of Business models

Key considerations in combining building renovation and energy supply business models

- Stakeholders mapping
- Value creation
- Combine costumer segments
- Main driver: renovation or energy supply
Key findings

Catalogue of Business models

Key considerations in combining building renovation and energy supply business models
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Stakeholders’ views
- Role and Level of influence
- BM achetypes, Customer segment,
- Value proposition, activities, partnerships, cost and revenue
- Opportunities for upscaling
**Conclusion**

Current practices in BM for building renovation and energy supply applicable to district renovation

- No specific business models for energy supply applied to renovation of districts → New possibilities for new players
- Large-scale renovation BM with a *single point of contact* for all project’s needs
- Renovation project already apply RES, eg PVs, however the small scale and not always combined as a BM
- ESCOs primarily using Energy Performance Contracts (EPCs) as a financing mechanism, has advantage in offering integral solution and services, while unburden the beneficiaries from initial investment. The integral solution can incorporate energy supply and RES as well
Conclusion

**Main stakeholders and what is their role**

- **Policy actors** and beneficiaries are the main decision makers, and as a consequence their influence is very high.
- **Energy suppliers** are also considered as decision makers.
- **Intermediaries** are present in the process, but their influence is medium.
- The influence of **financial intermediaries** is high.

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*Figure 11. Role of the stakeholder types, obtained relative frequency distribution of all votes.*

*Figure 12. Perceived influence of the stakeholder types, obtained relative frequency distribution of all votes.*
Conclusion

BM characteristics for upscale

Value
- Integral approach offering beyond energy efficiency technical solution
- One main point of reference
- Offer services including communication and financing
- Consider the role of the prosumer as beneficiary

Partnerships
- Include both renovation and energy actors
- Policy partners need to be involved, to support communication and trust building. See it as part of district development
- Innovation in the business model and the improved energy efficiency opportunity to consider also the managing of energy and not only providing energy.

Financing
- Policy actors support with subsidies and co-financing
- Energy performance contracts that combine solution, offer high savings, unburden the beneficiaries
Recommendations

- District heating often involves public interest and coordination/initiation by the municipality. Need to examine possibilities for combination with renovation
- Subsidies for integral solutions and funds to co-finance
- Policy partners can give guarantees and increase trust
Recommendations

- District heating often involves public interest and coordination/initiation by the municipality. Need to examine possibilities for combination with renovation
- Subsidies for integral solutions and funds to co-finance
- Policy partners can give guarantees and increase trust
- Innovation clusters → sector coupling (building+energy)
- Offer both technical solution and process, in terms of communication, consulting and financing
- Guarantees to support the financing, long-term relation with the beneficiaries
- Combine energy renovation with other measures on building and district
- Energy companies should be part of the dialogue
- Long term planning and active participation
Business models for cost-effective building renovation at district level combining energy efficiency & renewables

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IEA EBC Annex 75

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

January 2018 – June 2023
13 participant countries | AT, BE, CH, CN, CZ, DK, ES, GE, IT, NL, NO, PT, SE

IEA EBC Annex 75
Main Findings and Recommendations

Manuela Almeida | Operating Agent
University of Minho, Portugal

Webinar
10 October 2023
IEA EBC Annex 75

Decarbonisation of the Economy

- Urgency in accelerating building renovation rates towards decarbonisation
- Renovate at district or neighbourhood level is a promising approach

Climate Goals

- Annex 75 focused on investigating cost-effective strategies for reducing carbon emissions and energy use in urban districts, with an emphasis on combining energy efficiency and renewable energy measures
- Annex 75 proved that district-level building renovation is a viable option as well as combining energy efficiency measures and renewables at a district scale
- But, success depends on a holistic approach that encompasses cost-effectiveness and co-benefits serving the public interest and improving residents' quality of life
- A framework is urgently needed that includes cooperation, information, capacity building, incentives and adapted regulations

Energy Transition
Has the potential to accelerate building renovation

May allow economies of scale for energy efficiency measures due to aggregated demands and synergies in construction procurement, processes and planning

Allows benefiting from centralised renewable energy approaches enabling to explore additional heat sources and overcome space/noise restrictions in decentralised systems

Offers an opportunity to address transversal issues:
Urban planning, housing affordability, energy grid integration (mobility, accessibility, green and blue spaces, culture and leisure, etc.)

Has the potential to improve the overall quality of life of the residents, which contributes to their acceptance of the renovation process
Synergies between energy efficiency measures and the installation of renewable energy systems at district level may be significant, but difficult to achieve as they entail an additional level of complexity and depend on the synchronization of the buildings’ renovation cycles.

Districts are complex structures with several actors involved, sometimes with conflicting goals. At district level coordination and communication are crucial.

Building renovation at the district level is associated with:

- High upfront costs and long payback time
- High risks of not being implemented due to a potential withdrawal of some building owners that are at different stages
There are no ready-made or one-fits-all solutions. Each district has to be analysed individually, taking into account its specificities.

The best solutions depend on the starting situation of the district (as the insulation level, installed heating/cooling systems, available energy sources and the possibilities for integrating renewable energy).

Co-benefits should be considered when deciding on the best solution to be implemented.

Not just the technical and economic aspects matter in a district energy renovation.

Social, legal and planning issues are equally important, and communication with different stakeholders is crucial.

Policy measures are necessary to make use of opportunities offered by district projects, as often they are not more cost-effective than single-building projects.
IEA EBC Annex 75

Recommendations to Policymakers

- Develop a long-term vision and a strategic plan for district-level renovations aligned with energy and climate goals and policies.
- Adapt laws and regulations to stimulate building energy renovation at the district level.
- Create a certification scheme also at the neighbourhood and district levels.
- Promote the use of renewable energy sources, including financial incentives and unburden local collectives to make RES and energy storage systems more accessible.
- Promote a holistic approach linking buildings renovation to urban planning.
- Provide financial support to increase the cost-effectiveness of district-level renovation projects.
- Deploy financial measures and business models to promote zero-carbon renovations.
- Provide information and guidance for the different stakeholders by creating awareness campaigns, education and training programs, energy advice centres, labelling schemes, best practice guides, supporting and easy-to-use tools, etc.
- Promote stakeholder engagement and collaboration in district-level renovation projects by creating platforms for dialogue, consultation and participation, fostering trust and transparency among the parties, and addressing the social and cultural aspects of the projects.
- Support innovation and research on district-level renovation by funding pilot projects, demonstration cases, technology development and testing, data collection and analysis, etc. that can show the benefits and potential of district-level renovation.
District approaches have a significant potential for cost-effectively decarbonising the building sector, as they can offer synergies and solutions that are not possible at the individual building level.

However, district projects are more complex and require tailored strategies, technology combinations, policy frameworks, integrated thinking, and cooperation between different stakeholders.

International, national and local policymakers have to provide clear and appropriate framework conditions to make use of related opportunities and to achieve the energy transition in the building sector at a pace compatible with the decarbonisation goals.
Recommendation

- Guide for Policymakers and Decision-Makers
- Short Guide for Policymakers
- Short Guide for Investors and Decision-Makers

https://annex75.iea-ebc.org/publications
Online success stories: Interactive map integrated in the Annex 75 website

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

Various Reports on Annex 75 website

https://annex75.iea-ebc.org
Thank you for your attention!

IEA EBC Annex 75

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

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Q & A

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Thank you!