

International workshop within the framework of IEA EBC Annex 75

IEA EBC Annex 75 | Cost-effective Building Renovation at District Level Combining Energy Efficiency & Renewables

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Conference website: <https://sbe22delft.com/>

Workshop announcement: <https://www.eventure-online.com/eventure/login.form?Ub080a93b-8ed0-4978-901a-20c0dd685f69>

The expected housing Renovation Wave requires breakthroughs in renovation at district level, particularly regarding cost-effective strategies, policy instruments and business models. In this session international contributors will present the main outcomes from the IEA EBC Annex 75 project, showing the development of building renovation at district level and providing guidance to policy makers and all actors involved in the renovation chain for improving their strategies for the implementation of energy saving and renewables in urban districts. Session supported by the Dutch Enterprise Agency (RVO).

Speakers:

- Manuela Almeida, Operating Agent IEA EBC Annex 75, Building Renovation at District Level – main challenges and recommendations, University Minho, Portugal
- Roman Bolliger, leader IEA EBC Annex 75 Subtask B, Optimization methodology and strategy development for building renovation at district scale combining energy efficiency and renewable energy systems, INDP, Switzerland
- Erwin Mlecnik, leader IEA EBC Annex 75 Subtask D, Policy instruments for building renovation at district scale combining energy efficiency and renewable energy systems, TU Delft, The Netherlands
- Thaleia Konstantinou, leader IEA EBC Annex 75 D.2 Business Models, Characteristics of business models for building renovation in districts combining energy efficiency and renewable energy systems, TU Delft, The Netherlands

Moderator:

-Henk Visscher, TU Delft

Panel:

- Manuela Almeida, University Minho, Portugal
- Daniël Van Rijn, Energy Innovation in the Built Environment, Netherlands Enterprise Agency, The Netherlands
- Zeno Winkels, Woonbond, The Netherlands

Minutes International workshop within the framework of IEA EBC Annex 75

On 12 October 2022 IEA EBC Annex 75 held a **Workshop** at the **SBE22 conference in Delft** on Cost-effective Building Renovation at District Level Combining Energy Efficiency and Renewable Energies.



Renovation at district level may bring larger benefits than at individual level. It has the potential to accelerate buildings renovation, and may allow economies of scale for energy efficiency measures due to aggregated demands and synergies in construction procurement, processes and planning. It gives the opportunity of benefiting from centralised renewable energy approaches and offers an opportunity to address transversal issues, such as housing affordability, energy grid integration and urban planning (mobility, accessibility, culture and leisure, green and blue spaces, etc.). It has the potential to improve the overall quality of life of the residents, which contributes to their acceptance of the renovation process.

Renovation at the district level is also challenging. Synergies between energy efficiency measures and the installation of renewable energy systems at district level are difficult to achieve as they depend on the existing heating systems and 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 and high risks of not being implemented due to a potential withdrawal of some building owners that are at different stages.

In general Annex 75 found that 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 system, available energy sources and the possibility of integrating renewable energies). Co-benefits should be considered when deciding on the best solution to be implemented. It is clear that 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 essential to implement district energy renovations because the market by itself is unlikely to deliver district solutions to a large extent.

IEA EBC Annex 75 developed the following general recommendations:

- Adapt laws and regulations to stimulate building energy renovation at the district level
- Create a certification scheme also at the district level
- Make the implementation of RES mandatory whenever a heating system or district grid is replaced and when there are adequate conditions for renewables integration
- Promote a holistic approach linking buildings renovation to urban planning, energy grid development and carbon reduction goals
- Assure quality in procurement, design and execution by facilitating easy-to-use and reliable tools
- Provide a single point of contact offering integrated solutions and services
- Deploy financial measures and business models to promote zero-carbon renovations
- Create financial incentives and unburden local collectives to make RES and energy storage systems more accessible
- Facilitate specialised training for the whole chain of the building sector professionals, building owners and local administration staff
- Provide transparent communication

All outputs are now being finalized and further information can be found at <http://annex75.iea-ebc.org/>.



Roman Bolliger from INDP in Switzerland further elaborated on the optimization methodology and strategy development for building renovation at district scale combining energy efficiency and renewable energy systems. IEA EBC Annex 75 examines amongst other:

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? In particular: What are cost-effective strategies to combine district-level heating or cooling based on available environmental heat, solar energy, waste heat or natural heat sinks, with energy efficiency measures on the buildings' envelopes?

How do related strategies compare in terms of cost-effectiveness and impact with strategies that combine a decentralized switching of energy carriers to renewable energies with energy efficiency measures on the buildings' envelopes? In particular: Under which circumstances does it make sense to use available renewable energy potentials in cities at a district level, and under which circumstances are decentralized renewable energy solutions, in combination with energy efficiency measures on the buildings' envelopes, more advantageous?

The proposed methodology balances renewable energy measures related to solar energy and district and individual heating with energy efficiency measures on building envelopes, using the 'anyway' renovation as the reference case. For example, regarding district heating system choices, one might consider heat source intakes, centralized heat generators, the distribution system and individual heating substations. The methodology is exemplified with a case study in Luzern where building envelopes were characterized with energy performance certificates and various renovation packages and heating systems were considered, amongst other air-source heat pumps and lake-water centralized heat pumps. The calculations show that 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 and 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.

Studies on various case study districts in Austria, Italy, Norway, Spain, Switzerland, Sweden and the Netherlands show that results will highly depend on the chosen case study. Annex 75 gives insights into the possible strategy development per district based on technology parameters. The difference in cost-effectiveness between centralised and decentralised solutions from a life cycle perspective is

often small. Centralised systems benefit from economies of scale but they are also associated with losses due to distribution. Furthermore, the temperature in the district heating system has to be higher than in individual heating systems, making heat pumps operate less efficiently. The scale of centralised solutions also brings the need for more planning. This brings both costs and risks. Accordingly, there is often no clear economic case for choosing centralised approaches. However, there may be other good reasons for preferring centralised approaches, such as making use of a large heat source or of a seasonal thermal storage, having more flexibility, reducing the burden on the electricity grid, or providing a heating solution also to buildings for which a switch to a decentralised system based on renewable energies is a big challenge.

One can further consider additional conclusions for strategy development:

- Synergies between energy efficiency measures and renewable energy-based heating systems occur for all types of heating systems. There are even indications that such synergies are higher for district heating systems than for individual heating systems.
- An important factor concerning synergies between energy efficiency measures on building envelopes and renewable energy systems in district approaches is the possibility of lowering the temperature of the grid due to energy efficiency measures on the building envelopes. This does require a solution for how to generate hot water while maintaining its safety from a health perspective, even at lower temperatures. Such solutions exist, yet require careful examination.
- Significant energy efficiency measures are usually particularly cost-effective for building envelopes in poor condition. It is important to utilize the opportunity for energy efficiency measures on building envelopes when renovations are needed anyway.
- If a thermal network exists and is in good condition, it is usually most cost-effective to continue utilizing it.
- For decentralised solutions, heat pumps are a solution which is often cost-effective and widely available.
- If policy makers would like to see district projects be implemented to harness those additional benefits, policy measures are necessary, because the market all by itself is unlikely to deliver district solutions to a large extent.

The IEA EBC Annex 75 tool is available on <https://annex75.bim.energy/>.



Following a previous (awarded) paper presentation at the SBE conference, **Erwin Mlecnik** from TU Delft, The Netherlands, presents the IEA EBC Annex 75 work on Policy instruments for energy-efficient renovations at district level. Following the Renovation Wave and EU Leipzig Charter, Annex

75 proposes a stronger steering and shaping role for Local Authorities (LAs) for upscaling the number of renovations including energy efficiency measures and a switch to renewable energy systems. LAs can be drivers of district projects but largely depend on available (sometimes inconsistent) national and regional structures, initiatives, support and resources.

Policy instruments are investigated for both local as well as national applications. These can take various forms, such as regulation, incentives, communication, facilitation and organisation. Various examples are given.

For example, LA planning and performance-based tendering allow professionals to deal with the efficiency of buildings and energy grids at the same time. LA planning, grid concessions, performance contracting and land use agreements can be a basis to introduce obligations to renovate, connect to district heating or switch to renewable energy systems and low-temperature heat grids. Enforcement of minimum energy standards will be needed to activate the worst performing segments. Inspections and audits should detect housing of poor quality and include control of energy labels.

Regulations and urban planning with limited consultation might be unpopular. These instruments will work better when also coupled with incentives, communication and support. Specific incentives for stakeholders can directly impact performance, development of local demand and supply networks and stakeholder collaboration. Incentives can also target support for combining energy efficiency and renewable energy systems. Integrated Home Renovations Services can unburden homeowners and target multiple homeowners at the same time. Local media and e-services can be exploited in a more targeted fashion to reach specific customer segments and districts. Awareness-raising events and demos can lead to social connections and trust in provided solutions. Authorities can further make use of energy benchmarking in districts, citizen contests, energy labels for districts, citizen energy cooperatives, energy demand side management in districts and facilitation of white, green and black certificates.

In practice, each policy instrument also can come with hindrances. For example, LAs are often not allowed to work outside the national regulation and incentives. Standards might only apply for major renovations. Various types of stakeholders need specific incentives that fit eliminating their barriers. The efficiency and effectiveness of policy instruments need to be evaluated. The homeowner renovation journey needs to be followed up. Customer relations need to be managed in a local system. Timing of awareness raising in districts is key. Professional education and training need to address local market shortages. In the framework of Annex 75 there seems to be a need for experimental districts where requirements are relaxed regarding grid development and constrained regarding energy performance after renovation. Adequate staffing of local authorities is also needed.

Regarding policy development, countries should learn from each other's successes and failures. For example, in Austria, district management offices take care of energy-related renovations (Vienna). In Belgium, a 'neighbour grant' didn't lead to the expected outcome of neighbours in a district doing joint renovations; it was reconverted to a grant for an energy coach who consults groups of homeowners. In Switzerland, cantonal subsidies (and obligations) for switching to renewable energy-based heating systems and voluntary energy performance labels (Minergie, 2000-Watt areas) can inspire us. In Germany, a combination of the KfW 432 grant with the Städtebauförderung and

regional and local add-ons led to some success. In the Netherlands, innovation policy facilitates integrated renovation concepts. In Spain, policy for rehabilitation of rural areas can be exemplary.

In conclusion, the 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 energy renovations. Policy efforts need to make them locally, socially and economically attractive. National policy can better support district action and empower Local Authorities. The IEA reports show promising policy, management and business opportunities for an integrated approach to mastering different components of current urban transformation challenges.



Thaleia Konstantinou from TU Delft, The Netherlands, explained the results of the Annex 75 work on business models (BMs) for cost-effective building renovation at district level combining energy efficiency and renewable energy systems. The goals of the work were to identify the key characteristics of business models that are important to upscale business from building to the district level, and to gain insights about the opportunities that BMs offer for the different stakeholders, in order support the implementation of the renovation and the stakeholder dialogue. This results in 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. The research comprised the development of BM archetypes for renovation (atomised market, market intermediation, one-stop-shop and ESCO) and for energy supply (district heating BMs, going green BMs, building energy communities BMs, lock-in oriented BMs, complementarities-oriented BMs and efficiency-oriented BMs). Stakeholder viewpoints on BMs combining building renovation and energy supply at district level were evaluated, taking into account their role and level of influence.

Policy actors and beneficiaries are the main decision makers, and as a consequence, their influence is very high. But 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. Policy actors see the beneficiaries as the most influential. Non-policy actors see the influence of policy actors as high to very high.

The BM work finds that current practices in BM for building renovation and energy supply can apply to district renovation. However, there are no specific business models for energy supply applied to the renovation of districts. This offers new possibilities for new players. There is a need for large-scale renovation employing BM models that offer a single point of contact catering to all of the project's needs. Renovation projects are already applying RES, for example PVs, however the scale is small and is not always combined as a BM. ESCOs that primarily use Energy Performance Contracts as a financing mechanism, have an advantage in offering integral solutions and services, while unburdening the beneficiaries from an initial investment. The integral solution can incorporate energy supply and RES as well.

Tips are given for BM characteristics for upscaling such as the customer value, partnerships and financing. Values can focus on providing an integrated approach offering beyond an energy efficiency technical solution using one main point of reference and offering services including communication and financing. This can include considering the role of the prosumer as beneficiary. Partnerships can include both renovation and energy actors. Policy partners need to be involved, to support communication and trust building for district development. Innovation in the business model for improving energy efficiency should also consider the managing of energy and not only providing energy. Regarding financing, policy actors can support it with subsidies and co-financing. Energy performance contracts should combine solutions, offer high savings, and unburden the beneficiaries.

Resulting recommendations for policy actors echo the work on policy instruments. Building renovation with the integration of energy supply and RES should be an integral part of the city and district urban development and aligned with the policy actors' objectives. District heating often involves public interest and coordination/initiation by the municipality. There is a need to examine possibilities for combination with renovation. Since renewable energy business models are highly dependent on the regulatory framework, policymakers have a direct influence on their future development. Subsidies for integral solutions and funds to co-finance are recommended. Municipalities can give guarantees and increase trust: policy partners need to be involved in the BM for those roles.

There are various resulting recommendations for investors as well. Based on the most promising BM a possibility is to set up (or use existing) innovation clusters and to look into sector coupling (building and energy). Competitive BMs can offer both technical solutions and processes, in terms of communication, consulting and financing. Guarantees are to be arranged to support the financing and a long-term relationship with the beneficiaries has to be established. The investment goal is to combine energy renovation with other measures on building and district, taking into account also the role of policy actors, such as municipalities. Stakeholder dialogue AND partnerships are needed between Municipalities, Owners, Investors, and Suppliers. Energy companies should be part of the dialogue.

A report will be available on the Annex website.



The presentations were followed by a panel debate moderated by **Henk Visscher**, TU Delft, The Netherlands with participants **Manuela Almeida**, **Daniel Van Rijn** from the Dutch Enterprise Agency, The Netherlands and **Zeno Winkels** from Woonbond, The Netherlands, who reflected on the recommendations given from the presentations.

Panellists find it important to find a better interaction between the house and the district, but this also comes with challenges. For example, the Dutch tenant unit negotiated about the speed of renovation and concluded that rents must stay low. More focus is needed on the side benefits of energy efficiency. All parties in a district should have the will and the financial power. Good examples are crucial. Showcases for district heating need whole districts as a showcase.

Regarding obstructing regulations, different stakeholders have different viewpoints. Public and panellists argue that it should be able to enforce measures, or to certify at the district level. A voluntary basis is not enough.

The Netherlands will not upgrade its energy network for gas use, which is a top-down decision. Legislation on the pricing of heat should protect the client. Respondents agree that is important to give some power to the local government.

Concessions in a district offer no choice in energy source. Would it be possible to give participants an option to choose for a certain renewable energy source? In each case, an open heat network is needed.

There are also demographic challenges. Some people might not be at home during the day in certain districts. Heat grids may not be needed in certain districts. Some districts might have mainly large families. This is an interesting point for further research. People can change, so an elaborate optimization maybe is not needed. Sensitivity studies are needed.

Sharing energy between buildings should be made possible. In Spain, there is an example of a medical centre sharing energy with housing. There are no such cases in the Netherlands because of its legal framework. There are even barriers to share energy amongst residents within apartment buildings. It needs to be investigated what has to change to have buildings share energy. At the same time energy cooperatives could provide support. Rules and standards are needed for energy communities.

There is often a lack of trust in having a common heating system. A strong single point of contact is needed, which can be organized by local authorities.

Also the development of positive energy districts encounters governance barriers. Municipalities could start exploring possible governance models.

An example in Wageningen showed that citizens (condominium associations) created their own heat grid supplying 450 houses. The process took 6 years. Now 2 years execution are planned, combined with a renewal of the wastewater system. A problem remains that heat grids produce heat at high temperature, the ambition should be clear to lower the temperature. This requires regulation as the connected buildings will need an energy label A or B to reduce the temperature. Renovation is now a missing factor when developing heat grids. If you want to have a low-temperature heat system you have to renovate your house. Energy efficiency measures increase the efficiency of district heating system heat pumps.

In conclusion it can be said that incentives are not there for district heat companies and building owners to renovate. Policy instruments and business models should be developed further. In the Netherlands we still need better real case studies and good examples that can speed up the process. There is a growing interest for district approaches. Top-down and bottom-up can both be supported. Housing Europe is also looking for lighthouse projects of renovation at district scale including social innovation.