Heat transition cooperatives: a promising implementation model to decarbonise urban districts

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Abstract
The replacement of decentral gas floor heating systems in the urban building stock poses a serious challenge for a decarbonised heat supply in Europe. For example, in Vienna almost 30 % of all flats are supplied by decentral gas floor heating systems and alternatives are rare and expensive. The available alternatives generally consist of transferring to a central low-temperature heat supply, heat pumps with deep drilling, adaptation of the distribution system and (partial) improvement of the building envelope. Due to restrictions on space in urban areas, solutions for individual buildings are often impossible, so cross-property approaches must be developed, which are also more cost-effective due to economies of scale. However, cross-property projects require a collaborative organisation to jointly implement the capital-intensive investments and manage the operation of the systems.

Against this background, the paper demonstrates that cooperatives are a promising implementation model to coordinate and balance different legal frameworks, financing conditions and interests that challenge the implementation of cross-property projects. The paper is based on the experience gathered from very different demonstration projects in Vienna, including: Multifamily building from the Gründerzeit" period, whose central heat pump solution will also supply the two neighbouring single-family houses; a joint decarbonised heat supply for neighbouring multifamily buildings constructed in the sixties, consisting of both condominium and cooperative buildings; and a suburban residential buildings cluster, including historic buildings.

From the demo experience, generic principles are derived for how cooperatives shall be established and organised to manage the financing of the decarbonisation investment, create clear responsibilities for the ongoing operation of the facility, and to meet the various requirements of private and housing laws.

The necessity of using locally available renewables in urban areas
Decarbonising the heat supply of existing buildings in urban areas is a particular challenge, especially for existing buildings that are supplied by gas-fired floor heating systems. In the city of Vienna, for example, approximately one quarter of all buildings are supplied by gas-fired floor heating systems, whereby the historic Gründerzeit buildings (constructed prior to 1919) make up about 40 % of these gas-fired floor heated buildings. It can be assumed that Vienna is a representative example of most other cities in Central Europe where the use of gas for heating is traditionally high.

Furthermore, district heating is at capacity in many cities. In the city of Vienna, the district heating system is focussing on redensification, or the closure of gaps in areas that are already supplied with district heating. For areas that are somewhat further away from existing district heating pipelines, the supply of district heating is largely ruled out. In some cases, district heating also endeavours to reduce demand in peripheral areas and does not hinder customers there if they want to disconnect. Furthermore, the current district heating system in Vienna is far from being climate-neutral and the integration of renewable heat sources is a major challenge for district heating.

Therefore, locally available renewables must be increasingly utilised. In the urban context, these consist primarily of geothermal energy, PV and – to a limited extent – solar thermal energy. However, as regards heating and hot water supply, the utilisation of these resources always requires centralised solutions. The most promising solution in most cases is the use of heat pumps based on geothermal drilling probes in combination with PV. Heat pumps, however, can only be operated efficiently if the supply temperature is significantly reduced. Therefore, the thermal performance of the building envelope needs to be good enough to allow for a supply temperature of 30 to 40 degrees for most of the year. In addition, there may be a need to adapt the heating supply system by increasing the emission surface or by improving the airflow convection in the rooms. Against this background, as a first step, this paper shows that cross-property solutions are in many cases more favourable than a building-by-building approach for technical and economic reasons. This leads to the conclusion that cooperatives as organisational models, which can take account of different interests in a well-balanced way, are well suited to advancing the heat transition. The following content will then be covered in more detail:

- The advantages of heat transition cooperatives, based on experience gained in a similar context with renewable energy supply cooperatives.
- The presentation of concrete case studies for the implementation of decarbonisation investments with the help of heat transition cooperatives.
- The derivation of a generic approach for the development of implementation concepts.
- A summary of the key success factors for consideration when designing a heat transition cooperative.

Technical and economic advantages of cross-property approaches

When preparing technical-economic decarbonisation concepts, it becomes clear that when searching for the optimum variant, extending the system boundary beyond a single building, in many cases has multiple advantages. If one or more neighbouring buildings are included in the analysis, more cost-effective solutions can very often be found.

This can be explained by the fact that many of the technical measures implemented as part of a decarbonisation project are subject to the rules of "economies of scale", i.e. these are highly capital-intensive investments, however, the costs per each additional user decrease. This applies to the costs of the entire heat pump system including the source (usually deep drilling or well drilling), as well as the installations for a central heating system. However, better prices can often also be achieved for other investment measures if larger volumes are contracted, e.g. for the necessary refurbishment of the building envelope, for the renewal of the heat dissipation system (adaptation to reduced temperature level), the exchange of the hot water system (e.g. via electric boiler), or for PV-installations.

In economic terms, the restriction on extending the system boundaries results from the costs incurred for the required heating network. If mainly neighbouring buildings are connected, these costs can often be kept very low by routing the pipes via basements or attics. However, if larger neighbourhoods are to be supplied jointly, the costs for the heating networks increase. There is therefore a trade-off between the improvement in the cost-benefit ratio that can be achieved through cross-property projects, and the additional costs that will be incurred. The extent of this trade-off stems from the heat density in a particular neighbourhood, whereby it must be taken into account that the demand for heat usually decreases in the course of implementing the decarbonisation measures.

It should also be mentioned that, in addition to economic considerations, there may be technical feasibility challenges in a building-by-building approach which can only be solved if the scope is increasing towards cross-property solutions, e.g. if there is a lack of space for drilling geothermal probes, for the heating centre, or for the necessary PV installations.

Opportunities for heat transition cooperatives

MANAGING MULTIPLE INTERESTS OF DIVERSE STAKEHOLDER GROUPS

From the social point of view, the economically favourable technical solutions which support cross-property approaches require a high level of collaboration among individuals: Cost-intensive investments must be jointly planned, financed and realised, and the constructed facilities must then be jointly operated. This requires a balanced reconciliation of interests between the stakeholder groups concerned. Table 1 summarises the key characteristics and interests of those stakeholder groups that have a significant influence on the implementation of a decarbonisation project in the urban housing stock.

ADVANTAGES OF COOPERATIVES IN MANAGING HEAT TRANSITION

Cooperatives are a well-established instrument for organising joint economic action. A cooperative is generally understood to be a voluntary association of persons in the form of membership in a company with an unlimited number of members. Their aim is to promote economic, social or cultural interests through joint business operations. Cooperatives thus represent a form of private-sector cooperation whose special feature is that its members are both owners, service partners and decision-makers in a personal union. This personal union of members and customers is known as the identity principle.

Cooperatives are subject to clear legal rules, including a requirement that the economic viability must be regularly externally audited. These rules create security both for the members of the cooperative and for business partners, such as financing banks. At the same time, cooperatives are very flexible in terms of their specific organisation, which is reflected in the articles of the cooperative.

Experience gained in renewable energy cooperatives as a useful starting point

Cooperatives have been a well-known form of organisation in the energy sector for many years. The role of renewable energy cooperatives in particular has already been analysed in detail.

Table 1. Main stakeholder groups in decarbonisation projects and their interest and characteristics.

	Stakeholder group	Main characteristics and interests
Different types of building owners	Condominiums	Often a difficult decision process emerges due to the heterogeneity of interests of co-owners, usually no investor-user dilemma (except in the case of a high proportion of subletting), social challenges (e.g. older residents)
	Private real estate owners	Increased value of the building, the possibility of passing on decarbonisation investments to residents is restricted by tenancy law (investor-user dilemma)
	Public owners (social housing)	Social protection for low-income residents, sustainability and net-zero targets, limitations of public funds
	Housing cooperatives	Increased value of the building, optimising the total cost burden (investment + operation), using available repair funds as effectively as possible
Residents		Affordability (the long-term cost burden from the investment costs should be largely covered by the expected operating cost savings), improvement of user comfort, minimise interventions inside the flats
Housing managers		Satisfaction of customers, i.e. residents or homeowners, as little additional work as possible, additional work only if it can be compensated additionally
Construction companies, technology providers		Offer based on a well-prepared project concept, if possible no involvement in the long-term decision-making processes between owners, residents and property managers

As this experience is also relevant for heat transition cooperatives, it is briefly summarised here.

Viardot et al. (2013) underline that renewable energy cooperatives differ from traditional energy supply businesses, as they conceptualise value not just in an economic sense, but also in terms of value for the members. This takes the economic form of return-on-investment value, as represented by dividend payments; alongside value from the opportunity to source energy at attractive prices; and "ideological surplus value" which refers to the psychological value buyers feel from using green energy; and finally, value in terms of the public benefit provided the cooperative (Herbes et al. 2017). These different conceptions of value are all likely to apply to heat cooperatives in similar ways as they currently apply to renewable energy cooperatives.

The relationship between cooperatives and traditional corporate businesses is also particularly interesting here, because as de Bakker et al. (2020) noted, there is an increasing pressure to move towards a more commercial business model. This may come into conflict with a traditional feature of cooperatives, their unique power structure wherein each individual involved has one vote, this is central to the organizing principles behind cooperatives as it imbues a democratic principle into the structure of heat cooperatives (Herbes et al., 2017). In this context, Bauwens et al (2016) note that this democratic principle is likely to be particularly effective in countries that have a strong culture of cooperatives, because in these countries people are more aware of their legal structure and ensuing benefits.

Having established some of the key features of cooperatives according to the literature it is now worth considering some of the theoretical approaches from the literature explaining how cooperatives work, and how this applies to heat transition cooperatives. In particular, Viardot et al. (2013) suggest that cooperatives seek to influence the behaviours of members by a process called social diffusion, whereby behaviour modifications occur when individuals model behaviours that have already been adopted by their social peers, thus heat cooperatives have the potential to draw on this 'positive peer-pressure' to enhance benefits and remove barriers.

To understand how cooperatives can remove these barriers and achieve social diffusion we must understand what the general barriers to cooperatives are according to the literature. In particular, there are three key barriers faced by cooperatives, these are:

> Risk aversion on the part of both members and management; second, concerns about the environmental impacts or the ethics of certain models that, while legal, are not felt to align with the intentions of lawmakers; finally, the lack of competencies and time of the mostly unsalaried REC management. [Herbes et al 2017]

These barriers will also clearly apply to heat transition cooperatives, alongside the cognitive barrier stemming from insufficient first or second hand experience of cooperatives.

Specific advantages of cooperatives related to heat transition projects in urban districts

Since the form of the cooperative has proven to be very successful in different contexts, including in the implementation of renewable energy investments, we assume that they are also a suitable instrument for the decarbonisation of existing urban neighbourhoods, in order to tackle organisational, financial, and legal obstacles and challenges.

The case studies below will show that heat transition cooperatives may represent an additional and complementary opportunity in the urban heat network. In this context heat transition cooperatives are owned by the building owners and residents of urban districts. They make use of the technical and economic potential for energy production from locally available renewable energy sources (especially geothermal, and solar) and achieve energy savings through tailor-made solutions on a cross-property level within the neighbourhood.

With respect to developing and implementing cross-property decarbonisation projects, cooperatives offer the following main advantages:

- **Overcoming parified ownership:** In large-volume buildings there is often a divided (parified) ownership. Neighbouring houses are usually owned by different owners or groups of owners. Cooperatives can ensure the joint ability of a larger group to act, especially in decarbonising the heating sector, using the possibilities offered by the existing legal framework.
- **Pooling financial resources:** Apartment and building owners alongside other private owners are often faced with the question of how to finance investments in decarbonisation measures. The legal form of a cooperative offers the possibility to include residents in the financing and to spread the financial burden over several properties. Depending on the assets, the costs, benefits and profits can be distributed accordingly.
- **Active involvement of those affected – commoning:** We are used to handing over the provision of basic goods to profit-oriented companies or state institutions. However, decarbonisation investment can be facilitated when those affected see themselves as part of the solution and become shapers of our living environment. Cooperatives enable the affected parties to develop, produce, manage, share and maintain energy, heat, and other resource systems themselves. In this way, the principle of "commoning" is transferred to the field of urban heat supply, considering local heat transition cooperatives as a motor on the way to a decarbonised society.

Figure 1 summarises promising use cases of heat transition cooperatives and driving forces when applying this approach in practice.

Heterogeneity of real use cases

The various demonstration projects that we are currently supporting in different contexts show a cross-section of the heterogeneity of the initial situations in technical and economic terms as well as a diversity of interests and different underlying legal frameworks. In the following section, these demo cases will be described in more detail to give a comprehensive overview of distinguishing features related to, among other things:

- Building size and structure
- Current thermal performance of the buildings
- Technical solutions for decarbonisation (although the basic concepts are similar, the detailed solutions vary considerably)
- Housing law framework
- Level of engagement of building owners and housing management companies

All demonstration projects are situated in Vienna. As a whole, they show the different housing structures of the city, such as a larger neighbourhood of terraced housing, typical apartment blocks from the sixties, a Gründerzeit style house and a historic ensemble in a suburban context.

ROW HOUSE ESTATE IN STADLAU

The estate is located in Vienna's 22nd district Stadlau and consists of a row house estate from the 1920s and a multi-storey apartment block from the 1980s. The entire estate is owned by a non-profit housing cooperative.

Both the multi-storey residential building and the row houses have already been thermally refurbished. In addition, the eight multi-storey residential buildings are already connected to the district heating system. However, the heating supply for approx. 200 row houses on the garden estate are still organised individually and are provided by decentral gas boilers. In some cases, additional heating is provided by wood-burning stoves.

In order to decarbonise the entire estate, the aim is to supply the individual terraced houses with heat via a local heating network. The heat required for this is to be generated from heat pumps using near-surface geothermal energy. The electricity supply is to be provided at least in part by photovoltaic systems. The aim is for the geothermal probes and heat pumps to be installed and operated on behalf of the cooperative. External construction companies and service providers are planned to be commissioned to construct and maintain the systems.

The estate is managed by a separate non-profit housing cooperative, which is responsible for the organisation of the whole decarbonisation project. The housing manager is also assuming an initiator's role, rendering the organisational and legal framework conditions very favourable. Above all, the financial starting

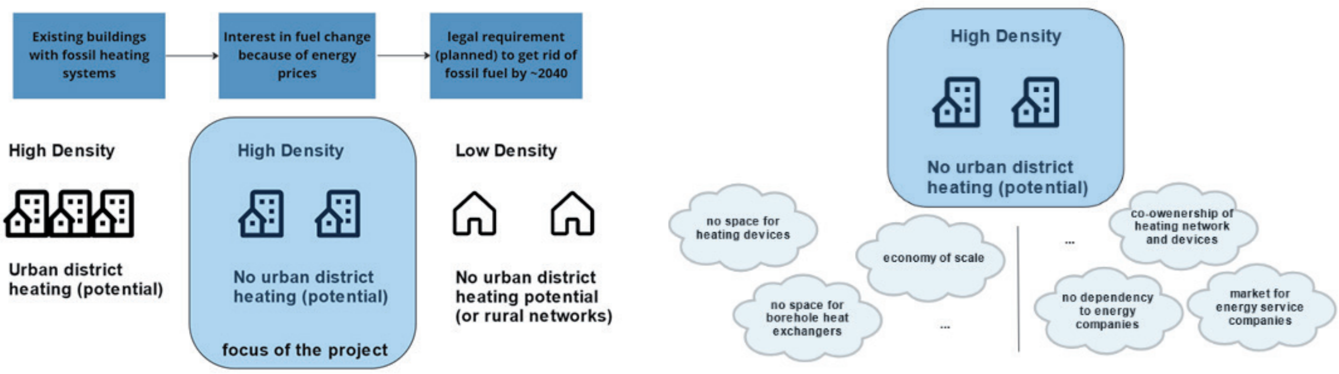

Figure 1. Promising uses cases of heat transition cooperatives and their driving forces.

position is significantly improved by the possibility of utilising the regular maintenance and improvement contribution (called EVB).

The economic conditions are favourable if a particularly high heat density is achieved by connecting the multi-storey buildings which are currently connected to district heating. In this context, questions regarding possible subsidies still need to be clarified, because the disconnection from district heating may possibly lead to an exclusion from subsidies.

As the current legal situation does not allow to force residents to switch from their current, gas-based heat supply to a renewable heat supply, a cautious process is needed to convince as many residents as possible to make the switch. An additional challenge is that the necessary geothermal drilling may also have to occur on public land (car parks and streets) due to the limited space available.

NEIGHBOURING MULTIFAMILY HOUSES IN ALSERGRUND

The two properties are located in Vienna's 9th district Alsergrund and are typical six-storey residential buildings from the sixties and seventies. One of the buildings is co-owned by a condominium owners' association. The second property is provided by a housing cooperative.

The condominium building has already been thermally refurbished, while the thermal refurbishment of the building envelope of the cooperative building is still outstanding. The existing heat supply in the apartment blocks is decentralised. The individual living spaces are heated by gas-fired combi boilers. These provide heat and hot water.

The aim is to centralise the heat supply using a water-to-water heat pump with a well system. A heat distribution network is to be set up as part of the centralisation of heat generation. A shared heating engineering room is to be used for the overall supply of both properties. From there, both properties can be supplied via the attics and the chimneys.

Both properties are managed by the same non-profit housing co-operative, the one which owns the co-operative house. It has proven to be very committed to decarbonising both buildings, as it can draw on existing expertise. The economic and financial situation is also favourable, as both properties have financial reserves, which can be used for investment, and sufficient heat density. As the housing cooperative is assuming a strong initiator role, efforts are currently being made to extend the planned heating network to three additional neighbouring buildings in the same block of flats.

This project reflects a common starting situation in urban residential areas, where legal issues in particular need to be clarified due to heterogeneous ownership structures.

SMALLER GRÜNDERZEIT STYLE HOUSE IN IGLASEEGASSE

As shown in Figure 2, this use case is a typical Gründerzeit style house. It comprises 13 flats and is currently heated by gas boilers in each apartment. The technical decarbonization concept includes the following elements:

- Thermal-energetic renovation of residential buildings (insulation, windows, flat roofs) as far as is economically feasible. There are technical restrictions due to the historic façade and the renovation of the casement windows is a particularly high-cost factor.

Figure 2. The demonstration project in Iglaseegasse is a typical Gründerzeit style house in Vienna.

- New heating system: geothermal energy by drilling 5 boreholes down to 200m; brine/water-heat pump in the cellar combined with air/water heat pump on the roof; 27 kWp photovoltaic panels on the roof and the south-facing facade, new distribution pipes to the apartments, where the existing floor heating and radiators are used; decentralized hot water preparation by electric booster boilers.

In order to improve the cost-benefit ratio of the investment, adjoining single-occupancy houses should be integrated into the new heating system with two separate geothermal boreholes, but supplied by the same heat pump.

As regards the organisational and financial concept, the buildings are owned by private owners who are living in the houses. A cooperative shall be founded by the private owners of the houses and the tenants of the apartments for the investments into the heating system (but not the thermal-energetic renovation measures), which will be financed by the cooperative using equity contributed by the members of the cooperative and by long-term bank loans. The cooperative will operate the heating system and supply the apartments and single-occupied houses with heat and electricity.

The joint economic objective of the project is that no tenant should pay more for renewable heat from the new system than they have to pay currently for the fossil gas heating of the apartment. This is a challenging objective when the considerable differences in current gas bills due to heterogeneous user patterns and different thermal performances of the individual flats are taken into account.

SUBURBAN VILLAGE KAHLENBERGERDORF

Kahlenbergerdorf is a suburban village located on the Danube, bordered by Leopoldsberg, Kahlenberg and Nussberg and is a cadastral municipality in the 19th district of Döbling in Vienna (cf. Figure 3). In this part of the city, there are almost exclusively residential buildings and apartment-like buildings. The main exceptions in terms of use are restaurants, especially wine taverns, which are located in the centre of the village.

The current heat supply is almost exclusively based on natural gas. In most cases, especially in the case of apartment buildings, heat is provided by means of floor heating. This means that the gas boiler is in the apartment, the gas pipes are included in the structure of the building and there is no water-based heat distribution within the building. The centre of Kahlenbergerdorf is located in the protected zone of Vienna. As a result, the possibilities for thermal renovation, the use of roof areas for the production of renewable energies and thus the solutions for heat dissipation in the buildings are limited.

The residents of Kahlenbergerdorf want to divest from oil and gas. On their own initiative, an association for the promotion of climate neutrality in the Kahlenbergerdörfl ("Klimadörfl") was founded. The aim is to provide the impetus for the sustainable use of resources in the areas of heat and power supply, mobility, and nutrition, and to promote good neighbourliness. With about 500 inhabitants (number growing), the Kahlenberger village is the right size to act as a pioneer and prototype of a climate-neutral village.

Various implementation scenarios have been developed for the village's phase-out of oil and gas. In the process, the original concept of a central local heating network was discarded. Instead, smaller neighbourhood clusters are currently being defined, which will represent different starting points for decarbonisation initiatives.

The residents of the Kahlenbergerdorf are currently organized as an association. Analogous to the considerations of building a central local heating network, there was also the idea of founding a cooperative that finances, builds, owns and operates the local heating network. With the current conception of the smaller neighbourhood clusters, the establishment of a cooperative no longer seems so urgent. However, a joint organization continues to bring advantages such as the communal development of know-how, and the collection of offers from companies, which generate synergy effects in the joint maintenance and operation of plants.

Figure 3. View of the suburban village Kahlenbergerdorf.

A well-structured approach to implementation concepts

Although the starting conditions for a decarbonisation project in neighbourhoods differ a lot related to the technical-economic solution, ownership, housing management, underlying regulatory frameworks, and financial basis, the implementation concepts can be developed quite homogeneously based on the approach described in detail in this section. Although the following concept development steps are listed in order, in reality, they constitute an interactive process, where the steps are closely interlinked, for example: The financial background influences the development of the most appropriate technical solution; the distribution of responsibility is based on the possibilities that are offered by the regulatory framework, which at the same time defines the possible scope for financing the project; etc. Each step takes into account the possible role which a heat transition cooperative can play in implementing a decarbonisation project at the neighbourhood level. Figure 4 summarises the single steps related to the elaboration of implementation concepts and shows some examples of feedback loops that can occur during the development process.

STEP 1: DEVELOPING THE TECHNICAL-ECONOMIC SOLUTION

To begin with, it is important to gain a basic understanding of how decarbonisation can be technically implemented in a specific neighbourhood at the lowest possible life-cycle cost. As shown in the sectionabove, the technical options in urban neighbourhoods are limited, but usually include centralisation of the heat supply with simultaneous use of heat pumps and reduction of the temperature level.

In general, the higher the heat density of a neighbourhood, the easier it is to use centralised forms of heat supply, as the unavoidable distribution losses are less significant, and the capital-intensive investments can be spread over a higher energy demand. This correlation means that cross-property solutions are generally much more cost-effective than building-by-building solutions.

Against this background, various scenarios for technical solutions often develop from the different definitions of system boundaries for the neighbourhood, i.e. the selection of those buildings that are to be integrated into the decarbonisation project. In developing these scenarios, a heat transition cooperation – or any kind of predecessor association of stakeholder groups – can play a guiding role.

STEP 2: INFORMING AND ACTIVATING THE KEY STAKEHOLDERS

Once there is clarity about the technical and economic framework conditions, the social and organisational framework conditions must be analysed, and key stakeholders must be activated. From the experience gained in our demo projects, it can be deduced that the technical and economic feasibility of a project is not a sufficient condition for its realisation. A number of other important obstacles have to be actively ad-

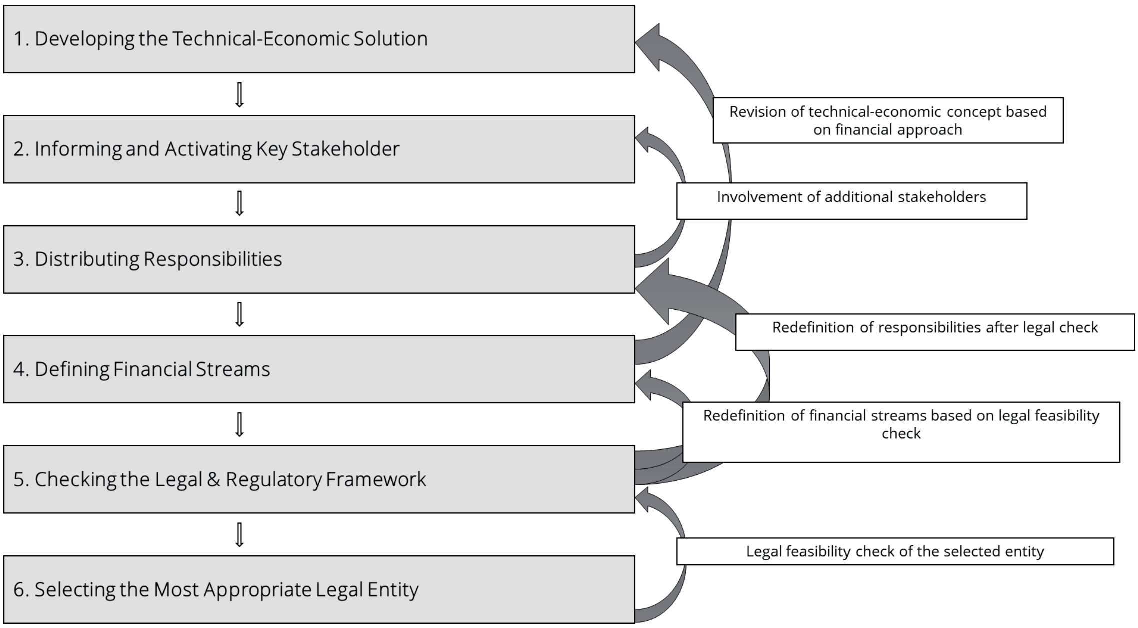

Figure 4. Steps related to the development of an implementation concept and frequent feedback loops.

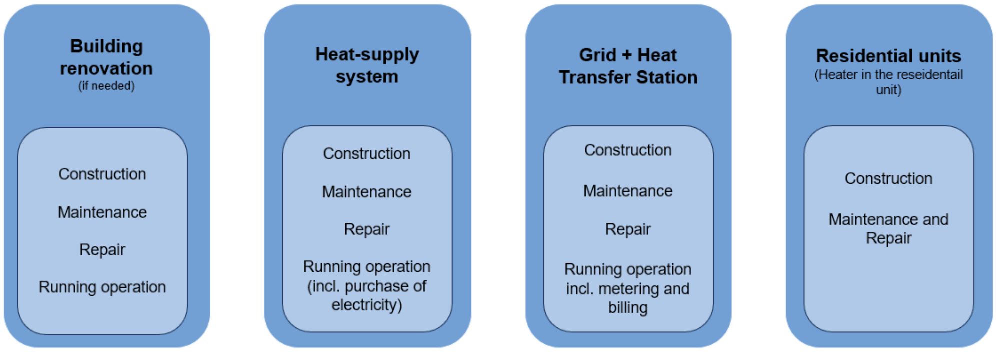

Figure 5. Categorisation system for the distribution of responsibilities in a neighbourhood decarbonisation project.

dressed together with the key stakeholders: Residents could, for example, become concerned about the impending refurbishment due to the prospect of noise and dirt; or the necessary cooperation may be strained due to negative experiences in the past; etc. Against this background, a profound stakeholder analysis is needed in this phase in order to better understand the respective interests and also the relationships and dependencies between the stakeholders: If, for example, the board of a housing cooperative is willing, this does not necessarily mean that the individual members are also open to decarbonisation and refurbishment measures. It is therefore important in this phase to get all key stakeholders on board and to increase their motivation to participate in the joint project.

STEP 3: DISTRIBUTING RESPONSIBILITIES

Once a basic scenario for the technical solution is defined, the second step is the development of a conceptual approach concerning, who will be responsible for which part of the implementation process. Figure 5 shows an ideal-typical way how to categorise the responsibilities to share, on the one hand by the technical systems and on the other by the specific activities involved in the implementation process.

Typically, the responsibilities of a heat transition cooperative will focus on the heat-supply system (e.g. a central heat pump with drilling probes) as well as on the grid for heat distribution and transfer stations (e.g. a micro-grid joining a number of properties), whereas it is usually easier if the renovation of the building envelope remains the responsibility of the respective building owner. The same applies to technical measures that need to be implemented in the flats themselves, such as replacing radiators. As a rule, these measures should remain within the responsibility of the resident, unless the building owner is responsible for them due to housing law regulations.

However, such a general division does not mean that all underlying activities must also be transferred to the responsibility of the heat transition cooperative. For example, the task of constructing heat supply and distribution can remain the responsibility of the building owner on whose land the relevant measures are carried out, and these facilities are then leased to the heat transition cooperative on a long-term basis.

STEP 4: DEFINING FINANCIAL STREAMS

In step 4 the guiding question is: who pays to whom for what from which sources? Of course, the definition of financial streams is closely related to the responsibilities which have been distributed in the step before, on the one hand, construction works (investments) must be repaid, and on the other hand, provided services must be compensated for.

In cross-property decarbonisation projects, the definition of financial streams is also a mechanism for taking into account the different interests of the stakeholder groups described above in a balanced manner. Experience from the demonstration cases shows that the one guiding question in defining financial streams is how capital-intensive investments shall be distributed in long-term repayments over 20 to 30 years. In particular, it is important to understand, which part of these investments can be repaid from the investment funds related to a building, such as reserve funds for maintenance and improvement which are (re)filled by regular payments of the residents, and which part of the investments have to be repaid by a fixed, regular payment as part of the heating tariff. Figure 6 shows this relationship regarding the repayment of investments including fixed costs for repair, maintenance and operation, but excluding costs for actual heat consumption, which are consumption-based costs.

STEP 5: CHECKING THE LEGAL AND REGULATORY FRAMEWORK

The answer to the above question on repayment of capital investments is closely related to the housing laws which are applicable to the specific decarbonisation project. One of the main purposes of housing laws is to determine what proportion of investment costs can be passed on to the resident, and in what form, and what proportion must be borne by the building owner, wherein the building owner can also be a condominium or a housing cooperative.

Against this background, the conceptual approach, which was developed in the preceding steps, is being examined with regard to its legal feasibility. In particular, the role of an intermediary entity, such as a heat transition cooperative, has to be evaluated.

STEP 6: SELECTING THE MOST APPROPRIATE LEGAL ENTITY

Although the benefits of a heat transition cooperative were initially assumed for the development of the implementation concept, it makes sense to evaluate again in a final step whether the heat transition cooperative is actually the most suitable legal form for the specific use case of cross-property decarbonisation. The following options are available as alternatives:

- Formation of an association: this legal entity is less regulated by law and therefore more flexible and cheaper to manage. However, it also provides less security for investors.
- Individual civil law agreements between the partners: this option is particularly suitable if one of the partners plays a particularly important role in the implementation and the cross-property share of the project is limited, e.g. in the case of cooperation across two to three properties. On the other hand, these structures are often cumbersome, as it is usually difficult to integrate changed requirements that may arise over time.

Critical issues and success factors

Based on the experiences gathered in the demonstration project, it has already been possible to identify key critical issues and success factors for the implementation of decarbonisation projects in a neighbourhood by means of heat transition cooperatives. These are briefly described below.

FAVOURABLE TECHNICAL AND ECONOMIC CONDITIONS

The main conditions have already been described above: Sufficient heat density; acceptable quality of the thermal quality of the buildings in order to be able to implement the reduction in the temperature level without prior comprehensive refurbishment of the existing building; shortest possible distances for network lines, etc.

INITIATOR AVAILABLE

The realisation of a cross-property decarbonisation project requires a lot of time and persuasion work, especially in the initial phase. All stakeholders must be involved and convinced of the need to convert the heat supply. Financial resources must be raised for the development of a technical concept, information must be gathered, and initial doubts must be dispelled. An initiator who drives the project forward and takes over the organisation is therefore a decisive success factor, especially in the start-up phase. Without an initiator who recognises the potential of converting the heat supply, the project cannot not be realised.

In our demonstration projects, the initiator role is assumed by various entities. One is an individual, one is an association

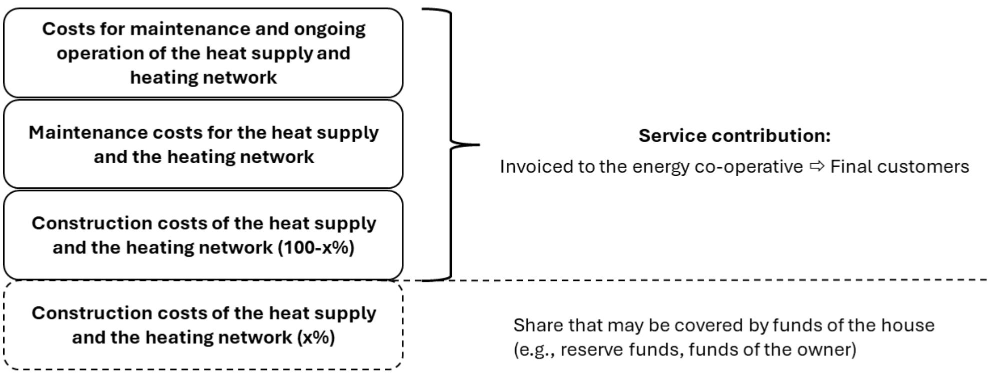

Figure 6. Financing requirements and allocation of fixed cost components of a decarbonisation project.

that may be converted into a cooperative in the next step, and two are housing cooperatives – the latter will be analysed in more detail below.

PARTICIPATION OF A HOUSING COOPERATIVE

At least for the Austrian context, we can conclude that the participation of a housing cooperative is an important success factor in terms of decision-making, know-how and financing. Above all, decision-making processes are simpler within the framework of a cooperative, as there are fewer approval requirements for investments. Therefore, the wish of a housing cooperative to decarbonise its building can become a nucleus for a cross-property project, since a housing co-operative will often already have experience in the area of financing, and/or renovation or conversion and will therefore know the relevant contact persons and have established processes.

FINANCIAL RESERVES AVAILABLE AND EASILY ACCESSIBLE

Cross-property decarbonisation projects are associated with high investment costs, which are amortised during operation through lower running costs (compared to fossil fuels) over the life cycle of at least 20 to 30 years. High one-off payments must be made at the beginning of the project and these investment costs are much easier to manage if sufficient investment reserves are available and easily accessible. In this case, the investments will be prevailingly borne by "the building", i.e. by the regular payments – in whatever form – which are gathered from residents for repair, maintenance and improvement, so that the heat tariff itself is not or is hardly burdened by the investments' repayment requirements, and is therefore favourable from the user's point of view. In this context, the more favourable the heat tariff, the higher the connection rate will be, and the higher the connection rate, the better the overall economic viability of the decarbonisation project.

PROFESSIONAL SUPPORT IN SETTING UP THE COOPERATIVE

The foundation of a heat transition cooperative – but also the further development of an existing housing cooperative – requires professional support that includes aspects of organisational development as well as community building. The focus is almost always on the owners and/or tenants, who are initially introduced to the topic of cooperatives using best practice examples. It often makes sense to set up an information platform for residents online, where all important questions and answers on the topic can be found. As not all target groups are easily accessible via the internet, it is also necessary to organise personal information events to provide knowledge about the organisational and legal framework for setting up a cooperative. An important aspect of these meetings is also getting to know each other and building community. Once it has been decided to establish the cooperative, the aim is to grow membership and to distribute the upcoming work and responsibilities across several shoulders. We encourage self-organisation in working groups and consensual decision-making wherever possible.

PUBLIC FUNDING FOR THE PROJECT DEVELOPMENT PROCESS

As described, the obstacles that arise in the course of a cross-property decarbonisation project are manifold. In order to promote the realisation of such projects, it is all the more important to support the initiators and participants, especially in the initial phase, and to offer security. Public funding of preparatory cost is a crucial factor in facilitating processes and activating initiators, including for example the following cost elements:

- Technical feasibility studies, including the calculation of any refurbishment requirements.
- Obtaining information on existing subsidies.
- Developing an appropriate implementation concept
- Initial legal advice.
- Support in setting up a cooperative as a legal entity with the capacity to act.

Public (co-)funding of these activities contributes to eliminating uncertainties – particularly in the initial phase – and significantly increases the likelihood of a project being launched.

Summary and conclusions

The decarbonisation of urban districts is certainly one of the greatest challenges for climate protection, in particular in cities like Vienna, where a considerable share of buildings is currently heated by decentral gas-fired floor heating systems. When addressing this challenge, some promising approaches and main conclusions can be derived from this paper, in detail as follows:

- There is sufficient evidence that a technical solution that encompasses several buildings has a clear economic advantage in many cases compared to an approach based on individual buildings. Such an approach can be referred to as a cross-property solution or neighbourhood approach.
- In order to exploit this economic advantage for the decarbonisation of urban districts, organisational models are needed that provide a stable framework to enable the necessary balance of interests between the individual stakeholders to be achieved in a fair manner. Here we can learn from long-term experiences which were gathered in similar contexts: The organisational form of the cooperative showed its strengths when it came to the joint arrangement of larger investments by a group of stakeholders with a variety of interests and with different starting conditions.
- The use cases for cross-property decarbonisation show that in spite of the heterogeneous starting points related to the technical-economic solution, ownership, housing management, underlying regulatory frameworks, and financial basis, the implementation concepts can be developed through a uniform six-step approach. Furthermore, they show that a number of success factors should be in place.
- One particular important success factor is the availability of public funding for the project development process, because experience shows that in the pre-investment phase the key stakeholders – building owners, residents, housing managers, and service providers – are unwilling or unable to bear the costs incurred for the implementation of the proposed six-step-approach. In many cases, this hurdle can hardly be overcome without public support. Dedicated programmes are therefore needed specifically for the project development phase.

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