

JSACE 1/34

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Modernist  
Districts:  
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SOFTacademy  
Project

Received  
2023/11/17

Accepted after  
revision  
2024/01/23

# Revitalizing Modernist Districts: Neighbourhood Level Mass-Renovation with SOFTacademy Project

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<https://doi.org/10.5755/j01.sace.34.1.35646>

## Abstract

This article discusses the neighbourhood-level renovation potential in Tallinn's modernist privately owned apartment blocks, with the aim of addressing the global need for deep renovation. The analysis considers international directives, national policies and municipal objectives, highlighting the focus of current renovation initiatives on apartment buildings. The discourse drives the ongoing conflict between energy-focused renovation and the preservation of spatial quality, relevant especially for the countries that favour partial renovation over the complete transformation of a building. It analyses the emerging impact of the New European Bauhaus (NEB) initiative, emphasizing the need to balance technical energy investments with cultural and aesthetic considerations in wider neighbourhoods.

Shifting the focus to Tallinn, the article deals with the challenges of modernist mass production housing districts, recognizing their technical structure, current decay and socio-economic limitations. The European Renovation Wave strategy and upcoming energy efficiency requirements are seen as catalysts for neighbourhood revitalization, prompting the exploration of innovative models to transform these neighbourhoods into liveable and functional spaces. The discussion unfolds within the NEB compass, emphasizing the core values of beauty, sustainability, and cohesion.

Practical considerations for the transformation of Tallinn districts are discussed, including spatial regulations, the complexity of ownership and the different perspectives of apartment owners. As a solution, the SOFTacademy approach is introduced, proposing a collaborative model establishing both the hardware and software elements for NEB driven renovation of neighbourhoods. In terms of hardware solution, prefabrication and modularity is used both for renovating the buildings as well as reinventing the courtyards around them. While the physical rejuvenation of the neighbourhoods is the key to NEB transformation, the shift depends as much from the software solutions.

The results outline a process for initiating neighbourhood-level renovations, emphasizing the importance of consulting with owners, creating blueprints, and entering into cooperative agreements.

**Keywords:** neighbourhood renovation; apartment buildings; renovation wave; New European Bauhaus; prefabricated serial renovation, energy efficiency, refurbishment, dwellings.



## Multidimensional drivers and barriers of renovations

From a global to local scale, the urgency of building renovation is emphasized by international directives, national policies, thematic contexts such as heritage, municipal objectives, and local considerations (Broer et al., 2018; *Renovation wave*, n.d.; Tugran et al., 2021). The objectives of building renovation typically encompass extending the lifespan of buildings and enhancing residents' quality of life, with a focus on improving indoor climates and reducing energy consumption (Staniaszek et al., 2020). Apartment buildings are particularly targeted by renovation policies due to the widespread impact of the benefits they bring (Hirvonen et al., 2022; Mikulić et al., 2020).

When giving a rationale for any renovation intervention, we should assess their expediency, efficiency, and intensity – justifying if we do the right thing, with the right resources, with the right pace (Vooglaid, 2019). This is valid for single renovation projects, but even more relevant for more general policies. Present technical understanding of renovating individual apartment buildings and their components is relatively comprehensive. Renovation barriers that hinder modernisation of residential buildings are mapped (Lihtmaa, 2018) and some externalities of energy policy are stressed (Lihtmaa et al., 2018). Based on that, regulatory frameworks, policy incentives have been established for evaluating compliance with standards and national objectives. Assessment reports show that renovation incentives are paramount for mass adoption of major deep energy renovations. Nonetheless, we continue to fall short of the necessary pace required to meet renovation goals. The current annual renovation rate of 1% is evidently inadequate (Kurnitski et al., 2020), prompting us to explore ways to enhance renovation intensity and efficiency.

Debate over the possible conflict over spatial quality lost with renovations driven by improvement of the energy performance is not new, especially for the countries that support partial renovations and energy efficiency measures for single apartments rather than require deep renovations of complete buildings (Pacheco et al., 2013). With the raise of the New European Bauhaus (NEB) initiative (European Commission, 2021), more attention has been given to the spatial quality we can achieve with renovation projects. Both critique about the missed opportunity of grant-funded renovations being mostly technical energy investments as well as ideas to overcome this problem have risen (Karro-Kalberg, 2022). In 2021 statement was issued by European Council of Architects for *"Making the Renovation Wave a Cultural Project"* (The New European Bauhaus Making the Renovation Wave a Cultural Project, 2021). Also, there is discussion whether renovation will become the future specialization for architects (Souza, 2021). **It is well understood, that focusing on implementing energy renovations can lock-in possible future investments that could improve living quality in the buildings in question.**

Ideas for modular renovations responding to the growing demand of living space in the originally space-saving apartments have been drafted (EKA, 2023). Plenty of ideas are available on how to reinvent the modest architecture of the mass produced apartment buildings. Some quite ambitious pilots have been implemented in parts of Europe. Much spoken renovation case of Tour Bois-le-Prêtre condominium in Paris (Lacaton et al., 2011a, 2011b), delivered additional space of 35,6 m<sup>2</sup> to every apartment. The Golden Gate building of Gellerup in Aarhus cut an opening to pervade a highway through an apartment building (Transform Architects, 2019). While these examples are somewhat opposite in terms of resident-centred design then the common aspect for both projects was that intervention was possible as both buildings were owned by City Housing Utilities and not by private individuals. **Architectural changes initiated by individual privately owned building units may face obstacles due to the urban coherence dictated by the comprehensive city planning.**

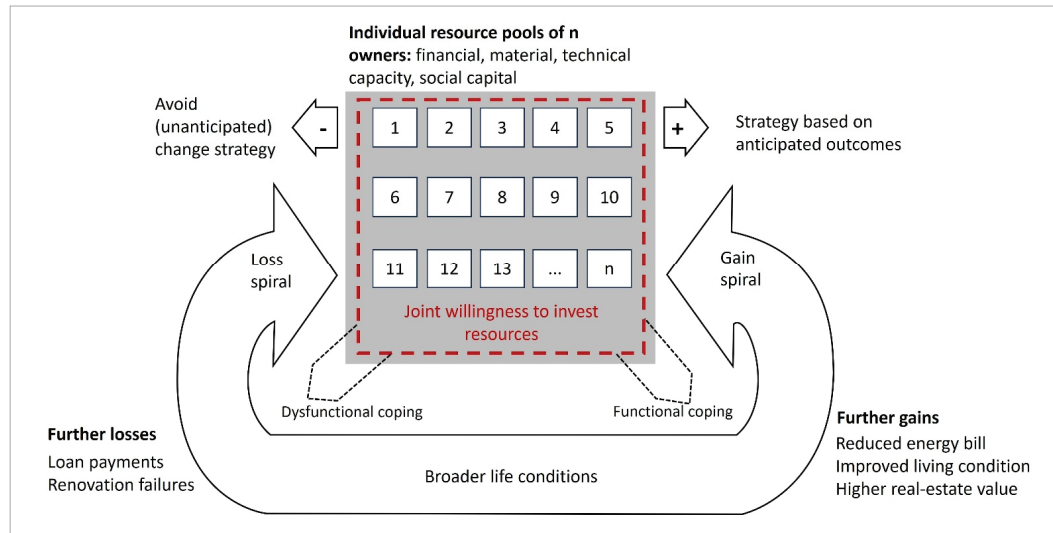
Responsibility arises from decision-making. Renovation decisions of private apartment buildings are made in real-life situations that require choices being made by a group of individuals, each of them having own practical considerations and constraints as well as basic motivation to con-

## Introduction

serve resources (Fig. 1). According to theory of Conservation of Resources (CoR), individuals are inherently driven to acquire, safeguard, nurture, and sustain various resources, including physical objects, personal aspects, conditions, and energy (Hobfoll et al., 2007). Stress ensues when these resources face threats, depletion, or when efforts to acquire resources do not yield the expected returns following resource investment. When making joint decisions in apartment buildings, not all individual owners contribute to the strategic decision making process, large part of owners are satisfied with coping to the majority.

**Fig. 1**

Individual resource conservation in making joint renovation decisions (based on Buchwald et al., 2009)



When aiming towards facilitating decision making, we must first identify the problem by describing the current situation, recognizing the disparity between reality of available resource pool and the desired outcome. The result of this process is a crucial foundation for making smarter decisions. Understanding what facilitates or impedes development and change is essential. To effect change, a shift in paradigm is often necessary, allowing for more adaptable arrangements based on the evolving environment.

When aiming to accelerate the pace of renovation and enhance architectural quality, it is necessary to expand renovations to the level of the neighbourhood (Lihtmaa & Kalamees, 2023) and tailor the process for the context. The neighbourhoods in question need to be seen as interconnected social-ecological-technological systems, where transformations depend on their impact on sustainable service delivery; the significance of grassroots initiatives in kickstarting urban changes; and the potential for governance, under specific circumstances, to align these initiatives (Krueger et al., 2022).

### Transformation potential for modernist apartment building districts in Tallinn, Estonia

Mass-produced housing has been attributed to centrally planned countries, which were ruled by Communist parties Europe (Hess et al., 2019). While this is true, the modernist ideas to optimal housing are well spread also elsewhere of Europe, thereby forming one of the most prevalent examples of twentieth century architecture and urbanism (Dragutinovic, 2023). Modernist housing districts that were crafted through prefabricated mass-construction technologies prioritized functionality, cost efficiency and working range of cranes over human-centric design concepts. Today the technical designed service life of these modernist mass-produced residential buildings with initial designed life span of 50 years, is close to be over and their energy performance leaves much to be desired (Ilomets, 2017; Kuusk, 2015).

The devaluation of such districts is a globally felt challenge (Dragutinovic, 2023). It is typical that now these unrenovated buildings accommodate the most economically disadvantaged residents, whose capacity and willingness to carry out even small repairs, is limited. The fact that typically these neighbourhoods are monofunctional and lack public and private services, amplifies the challenge. All this leads to negligence and overall devaluation of the districts.

Still, at the present time such districts are home to a significant portion of the population, housing for example roughly half of Tallinn's residents in Estonia (Alver et al., 2021). Considering this scale, it is impossible to solve such housing challenge with total renovation of these districts. With the respect to socio-economic constraints as well as planetary boundaries it is not feasible to replace these districts with new construction, especially in the Estonian context, where majority of housing stock is privately owned. Nearly all (~96%) of Estonia apartment buildings belong to private apartment owners, who are organized through apartment associations and housing co-operatives, which raises various socio-economical and technical constraints (Lihtmaa, Soonik, et al., 2023).

The European Renovation Wave Strategy and yet more rigour requirements expected soon to be enforced for building energy performance (*Revision of the Energy Performance of Buildings Directive*, n.d.) build a significant momentum for revitalizing these neighbourhoods. Until recently, the residents of apartment buildings have initiated renovation projects mostly for cutting the cost of heating and improving thermal comfort in the apartments. Also, the state subsidies for renovation projects have been optimized to energy savings, and even so fail to deliver sufficient funds to achieve the long-term objectives for serving the "efficiency first" principle for built environment (Kurnitski et al., 2020).

It is much to expect that renovation market and apartment building associations as procurers lead the change towards significant leap in living environment. While the Estonian renovation grants have required to engage a qualified architect to every subsidized renovation, then 2023 marks the year where the subsidized renovations needed to deliver solutions responding to NEB principles (Riigi Teataja, 2023), making such transformations also eligible to be partly funded by the national renovation grants. Nevertheless, the resulting projects have remained modest regarding this. Mainly due to solvency of procurers.

However, it is obvious that the costly energy retrofits even when performed as deep renovations, would lock-in the reinvention of the living conditions in these districts for a long time. Therefore, adequate models are needed how to transform the monofunctional residential districts to meaningful and attractive spaces with diverse functions, but with consideration to the individual resident-owners needs and opportunities.

### **New European Bauhaus (NEB) compass framework**

The NEB Compass (Fig. 2) serves as a guide for the development of New European Bauhaus projects, providing the basis for more in-depth assessment tools (EC, 2023). It articulates the three core values of the initiative and outlines the trajectory for a project to embody the essence of being truly NEB. This involves exemplifying beautiful, sustainable, and together at different levels of ambition, elaborating on the key principles of participatory processes, multi-level engagement, and a transdisciplinary approach. The Compass emphasizes the capacity of NEB projects to test and promote new visions and processes with a long-term perspective, drawing on existing theories and models while remaining adaptable to the experimental nature of the initiative.

Importantly, the NEB solutions that undergo testing via NEB compass through interaction with the community, need to demonstrate a commitment to learning from experience and continuous improvement.

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## **Materials and methods**

Fig. 2

New European Bauhaus (NEB) compass values



When placing neighbourhood-level timber-based prefabricated renovations to the NEB value compass, we first need to understand the intervention level as well as weigh the potential gains to be considered as ambition. Parallely we must acknowledge the constraints that hinder the planned change.

### Potential gains of neighbourhood-level renovation for Estonian residential districts

As for now, the residential renovation (Kuusk et al., 2016a) and the development of renovation solutions (Kalamees et al., 2016; Kertsmik et al., 2023; Kuusk et al., 2016) has primarily focused on individual buildings, but the concept of neighbourhood-level renovation could be the key for transforming ageing mass-construction into modern homes (Lihtmaa & Kalamees, 2023). However, the term area-based renovation lacks a clear definition (Lihtmaa & Truu, 2023). Disagreements persist regarding the issues it should address and how to define the area it encompasses. Defining the area, whether it's a neighbourhood, block, subdistrict, or district, is a topic of discussion. The parties involved in neighbourhood-renovation hold diverse perspectives, ranging from enhancing spatial quality to energy efficiency, sometimes without architectural changes. Due to the limited experience with neighbourhood-level renovation, we must rely on preconditions and expectations from market participants (Lihtmaa & Kalamees, 2023) for ideating the potential gains.

- **Larger volume → more attractive for large companies → higher quality.** It's evident that this approach involves larger construction volumes, making it potentially more attractive to larger companies capable of ensuring higher quality. In more peripheral areas, simultaneous renovation of multiple buildings is often the only way to pique the interest of companies at a reasonable cost.
- **Scale effect → reduced costs.** The group renovation approach is also expected to reduce construction expenses, as construction companies can work with larger volumes through procurement, eliminating the need to manage construction at multiple locations. The benefits extend across the entire supply chain, with building material producers also benefiting from economies of scale. In standard apartment buildings, designing and prefabricating modules in a factory can further reduce on-site operational costs.
- **Efficient site management → Minimized disturbance/disruption.** Neighbourhood-based group renovation can allow for more efficient use of the space between buildings during construction, resulting in less disruption to residents and a reduced environmental footprint.
- **Collective action → Increased social capital.** In the past, each building attempted to address its issues independently. However, neighbourhood-based renovation offers a unique opportunity to reconsider and improve the function and design of semi-public spaces, providing residents with enhanced communal areas. This contributes to increased social capital and collective action within the community. Also, the reinvention of districts by expanding or transforming existing buildings, currently requires the consent of all apartment owners.

Joined forces can in such cases deliver better results as overcoming such barriers often involves community outreach and a shift in mentality towards embracing innovation and long-term benefits over short-term gains.

**Concurrent renovation of multiple buildings requires rounding off space in between them** → **unique potential to reinvent the district.** Until now the renovations have been driven by improvement of indoor climate and energy performance and lengthen the service life, neighbourhood-based renovation necessitates the stronger involvement of urban planners, architects and landscape architects. Not only can they contribute to the architectural design of buildings, but moreover enhance the spaces between them and assist in solving the challenges related to improved urban living. This approach goes beyond technical modernization and enables the creation of architectural solutions that better unify the entire area compared to renovating each building individually.

Currently we lack specific evidence to what extent such gains can be achieved in practice. While there are residential neighbourhood renovation initiatives existing in other countries (ANRU, 2023; Jay et al., 2018) the contexts in which they are implemented differ from Estonian. The first serious attempt to scale up renovations to neighbourhood level in Estonian settings could be H2020 project Open LAB that focuses on local energy production within a neighbourhood in cities of Tartu, Genk and Pamplona (Kalms et al., 2023). To achieve positive energy balance within the neighbourhood, major deep energy renovations of buildings are essential. Currently the Open LAB projects is on the initial phase and results are not yet delivered.

### **Practical considerations for transforming the neighbourhoods of privately owned apartment buildings in Tallinn**

While the deep renovation subsidized by Estonian state requires employment of architect (level 7) as well demands following New European Bauhaus principles (Riigi Teataja, 2023), the design solutions are constrained not only by the awareness and financial capacity of the building association in question, but also spatial regulations of cities. For example, in Tallinn, the existing spatial regulations established in the Comprehensive plan of Mustamäe district (TLA, 2006) regulate clearly in which extent the buildings forming currently a coherent urban fabric can be altered. The comprehensive plan requires that renovation and reconstruction solutions for the apartment buildings (incl. enclosing balconies, insulating gable walls, reinventing façade design) needs to harmonize with existing overall appearance of buildings in the targeted block. Also, the solutions that significantly change the façade or building volume must be developed for all buildings in the directly connected area. It also states that, the public space between residential buildings may only be used for the establishment of urban landscaping facilities serving the residents of the respective block or micro-district (e.g., walkways, recreational areas, playgrounds, gazebos, etc.). When some might argue that the comprehensive plan is dated, it is well valuing the spatial quality of district as a whole and literally provides an enabling framework for the neighbourhood renovations, **however such regulation leaves spatial transformations unobtainable for all single renovation projects led by private apartment owners.**

In the context of apartment buildings, the transformation of privately owned apartment buildings hinges on the diverse perspectives on spatial quality of hundreds of individuals owning the apartments. When considering the fact that agreement needs to be established for a group of buildings, the hundreds need to be multiplied. Among the apartment owners in residential complexes of Mustamäe micro-districts, older and vulnerable individuals dominate (Heidmets et al., 2012). A significant portion of the owners are retirees living either alone or with one or two companions in their apartments. Approximately half of the apartments have been acquired through privatization or inheritance. It must be understood that significant number of elderly residents of the buildings have

been owning the apartments since the buildings were erected and might have positive perception towards the original design. The solvency of the owners also plays a significant role in understanding the constraints for the possible change. The possible added value achieved with reconstruction must be jointly agreed in conditions in which most owners are not willing to increase their monthly communal payments.

Moreover, the revitalisation of buildings is constrained by questions of land ownership. Most apartment buildings decided to minimise the property at the time of land reform in Estonia, which resulted a situation in which building associations own only few meters of land around the building and the rest belongs to the city. Even simple solutions like expanding balconies or erecting elevator shafts would require either establishment of long-term servitude or privatization of municipal land. Both highly regulated in city of Tallinn, whereas now the comprehensive plan also comes to play and would restrict any other uses than the urban landscaping facilities described above. The ownership questions arising with expansion, are not only constrained to occupying neighbouring properties. When the floor area of the building changes, the shared property of each individual owner will as well. According to Estonian legislation, this would require unanimous agreement between the owners which has to be verified by a notary public.

## Results and Discussion

### **Setting an ambition for renovating apartment building neighbourhoods to ecosystems for better living**

When translating New European Bauhaus (NEB) values to concurrent renovation initiatives of modernist apartment buildings, the NEB acronym could be paraphrased as Neighbourhoods as Ecosystems for Better living. Renovation must not only tackle the buildings, but affect the whole neighbourhood, with courtyards as well nudge cohesion in currently very individualistic living environments. To achieve the NEB renovation, the ambition (Table 1) needs to acknowledge the opportunities and needs as well as the expediency, efficiency, and intensity of the action.

### **SOFTacademy approach**

To achieve a NEB transformation in Mustamäe context, a SOFTacademy pilot has been launched. Related to the ambition described in Table 1, we aim to apply the principles and conditions of a SOFT city (Sim, 2019). A “soft city” prioritizes urban design and architectural interventions that fosters human interactions and comfort. This approach advocates for diversity, detail and density achieved with thoughtful urban planning for sustaining a resilient built environment and culture. Our effort encompasses both the “hardware” (physical space elements and devices) and the “software” (governance, technologies, models) necessary to enhance neighbourhood-level renovations. As ever, the objectives for transforming “hardware” dictate the “software” also in SOFTacademy.

The SOFTacademy project, to be launched in March 2024 (EUI, 2023), is aimed at creating and demonstrating a model for urban governments to expedite private renovation initiatives while enhancing the overall urban quality of life. Considering the scale of the renovation challenge in Tallinn, with approximately 3,500 privately owned apartment buildings requiring renovation, the model we propose must harmonize the concept of an efficient prefabricated modernist city with the current urban expectations. We introduce a collaborative renovation model that involves co-creating neighbourhoods using “prefabricated elements” for both buildings and the spaces in between. This approach allows for the transformation of outdoor areas based on shared values and promotes future-ready homes that align with goals such as carbon neutrality, circularity, accessibility, affordability, and liveability.

The logic of this intervention, as well as the digital tools developed as part of the “software” solution, can be adapted, and applied to any mass-produced, monofunctional apartment building district seeking a transformation that goes beyond mere energy retrofit. This approach aims to imbue

NEB	Ambition	Objectives	Intervention level
BEAUTIFUL	to activate	Acknowledge original built heritage of Mustamäe and planning regulations. Consider community values, identity and traditions.	B / CY
		Consider sensory perceptions (visual, auditory, tactile, and olfactory) and emotional sensibility of residents (incl. Individuals with special needs)	CY / A
		Rejuvenate the local place-based charm (composition, material compatibility, colours). Promote aesthetic choices for functional urban components (from garbage stations to stormwater management).	B / CY / A
	to connect	Create places to bring people together (gazebos, joint indoor spaces etc.)	B / CY
		Support collective action (community gardens, shared activities for all age groups)	CY / A
		Allow process encounters, discoveries	CY / A
	to integrate	Allow communities to define the desired outcome. Assist owners in defining the leap in living quality in buildings. Support communities in agreeing the character of communal areas.	B / CY
		Restructuring values: support behavioural change towards sustainability (waste management, mobility, community participation).	CY / A
		Consider long-term potential for the district	B / CY
SUSTAINABLE	to repurpose	Prolonging the use of existing buildings by renovation	B
		Decreasing the use of energy, integration of renewable energy sources.	B
		Repurposing with natural materials or other less harmful resources: applying life cycle thinking in planning the renovations.	B
	to close the loop	Industrialized renovation to optimize resource use and minimize waste	B
		Evaluating tradeoffs between sustainability measures	B / CY
		Avoid future waste by constructing for disassembly	B / CY
to regenerate	Enhancing urban biodiversity: preserving the canopy cover, replacing lawn-deserts and expanding parking with diverse urban ecosystem (eg. permeable pavements, multi-strata greenery, enhanced green corridors etc).	CY	
	Carbon storing: Valorizing wood as a building material	B / CY	
TOGETHER	to include	Improve accessibility (to buildings, to outdoor activities, to mobility options) for the residents	B / CY
		Preserve affordability of living in the neighbourhood.	B / CY
		Consider the needs of vulnerable groups (families with small children, elderly residents, residents with special needs)	B / CY / A
	to consolidate	Offer equal resources and opportunities for neighbourhoods across the city: sharing solutions for similar challenges.	A
		Overcoming barriers, developing policies for societal development and collective growth	A

Table 1

Ambition on the value poles in the NEB' compass (EC, 2023). Intervention potential considered – building (B), courtyard (CY) and activity (A) level



these areas with a sense of place and identity by improving the outdoor microclimate, enhancing biodiversity, accommodating community functions, altering the scale of buildings, and creating a cozier and more human scale living environment.

Funding for this model's demonstration will be a blend of SOFTacademy resources, state-paid subsidies, and ongoing innovation projects (H2020, LIFE IP) that focus on upscaling prefabricated renovations. The ambition for the pilot is constrained with mundanities such as project duration (03/2024- 01/08/2027), obviously budget limits and already acknowledged barriers the project needs to overcome. Therefore, SOFTacademy pilot will not only serve as demonstration for some of the possible gains of the neighbourhood renovation, but also pave the way for the follow-up projects. Having the lighthouse located in the Akadeemia (Academy) street gives additional significance to this aspect.

### **Process to prepare a neighbourhood level intervention**

The process of neighbourhood-level renovation differs from conventional renovations. A 10-step process of conventional renovations of single apartment buildings is well outlined in Estonia (KredEx, 2023). The streamline order for neighbourhood level is still in the making, but the experiences of SOFTacademy allow to outline the following additional steps that are needed as preparation.

- \_ Consulting owners on their willingness, capacity, and expectations.
- \_ Drafting initial design, incl. rough budgeting. Clarifying the process, incl. expected duration, possible inconveniences.
- \_ Official agreements of private owners to initiate renovation process.
- \_ Signing multilateral collaboration agreement to plan and implement the neighbourhood renovation. The collaboration agreement needs to engage all property owners (incl. city government).
- \_ Preparation of joint procurement tender with considerations to responding the requirements of different financial incentives supporting renovation.

For the pilot action this is expanded by setting the correct foundation on city governance level:

- \_ Establishing the municipal task force covering the following competences from governance domains of city asset management; legal consultants (jurisdiction of ownership, issues of fund blending, municipal regulations etc); housing management; spatial planning and landscape architecture.
- \_ Building municipal capacity in renovation, ideally engaging experts from renovation one-stop-shop.

### **Enabling the transformations and bridging barriers across city**

Renovation and redesign of existing neighbourhoods is a complex social challenge for residents and for the municipality as well. Even when partly financed by public funds, the share that is left to be paid by the private owners can be a gamechanger. Considering also other renovation barriers (Lihtmaa, 2018) we could observe yet another layer of complexity that local authority with its partners must address. Therefore, parallelly to transforming the targeted neighbourhood, we expect to develop, test and anchor "software" solutions to facilitate follow-up NEB renovations in Tallinn.

"Software" solutions are required in different levels, including very local scale in SOFTacademy neighbourhood as well as in the central governance level in Tallinn (and Estonia). In local contexts the unwritten bundle of social norms, habits and traditions that have shaped the preferences and pathways of the urban living in the targeted district cannot be altered with top-down vision of a city government nor by creative ideas of architects and urbanists, the transition can be achieved with multilateral collaborative efforts. Local software will include a variety of initiatives starting from

increasing community awareness and establishment of neighbourhood rules and ending with agreeing new maintenance practices and why not introduction of community events.

In city government level facilitating services are required to assist neighbourhoods and communities to initiate renovation projects. Building the “software” in Tallinn means not only solving system failures hindering renovations, but also raising the technical capacity within the city to support private renovations. Here, SOFTacademy will serve as a sandbox for setting up the Tallinn Renovation Accelerator Service (TRAS), expected to operate as one-stop-shop for the owners. A variety of local city based one-stop-shops exist, also some equipped with digital tools. TRAS has the ambition to bring together a set of different enabling digital decision-making tools facilitating the renovation process and assisting cities in aligning private renovations with holistic urban development objectives.

Building on the unique digital twin of buildings Estonia, the renovation strategy tool and spatial configuration system to be developed, will assist evidence-based decision making (Table 2).

Software solutions	Target audience	Purpose
Design criteria for beautiful, sustainable and inclusive renovated districts	Shared interest of public authorities, professional clusters and communities.	Defining urban planning goals related to renovation. Translating the Davos quality system and soft city conditions into locally understood design criteria. Amending comprehensive plans of mass-constructed monofunctional residential districts.
Renovation strategy tool (ReSto)	Public authorities and communities	Alignment of private renovations with urban development objectives. Clustering simultaneous projects for amplified effect. Evidence based decision-making. (Arumägi et al., 2023)
Facilitation system and digital catalogue for community-level configuration of neighbourhoods	Communities, designers	Digital visualisation tools coupled with digital twin, serving as a common language able to cross the cultural, social, linguistic barriers and facilitating evidence-based renovation decisions both for buildings and outdoor space.
Cocreation initiative, community actions	Communities	Building cohesion, strengthening social capital and supporting collaborative efforts.

Table 2

“Software” solutions to be developed within the project for the Tallinn Renovation Accelerator Service

While neighbourhood-based renovations extend the revitalisation to the surroundings of the buildings, it is also critical to address infrastructure that is built underground. Depreciated pipes and cables must be renovated in time to avoid works that could destroy fresh landscaping within buildings after otherwise successful neighbourhood renovation.

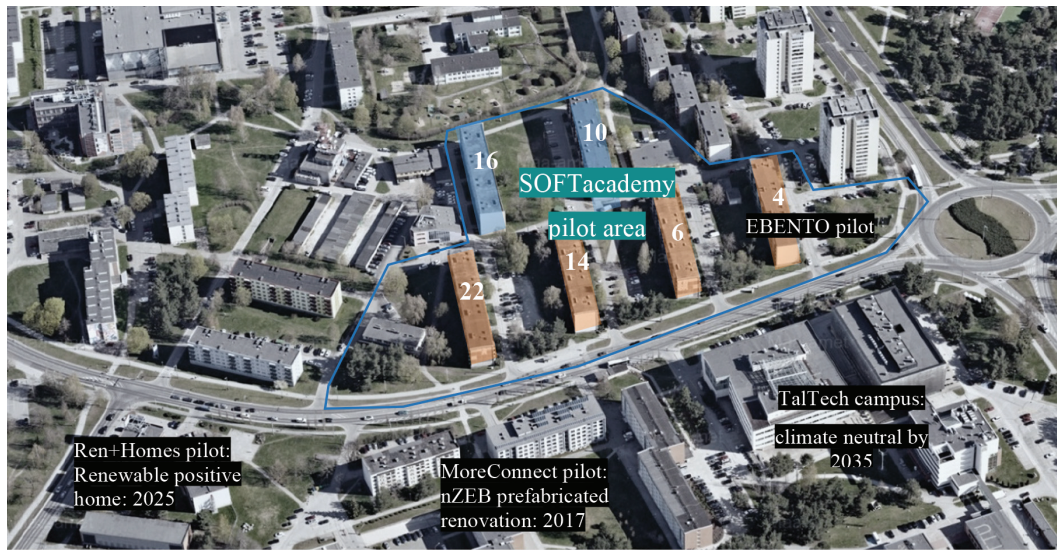
### Case area

To test a model for supporting transformation of the **monofunctional residential districts to meaningful and attractive spaces with diverse functions** and assist decision-making of various actors enabling the model, a case area was selected in Tallinn. Tallinn is useful case for innovation demonstration as the capital is one of few a growing region in Estonia that has demand for renovated dwellings in addition to newbuilds (Lihtmaa et al., 2020).

The lighthouse neighbourhood consists of four five-story buildings and is located on Akadeemia Street, in close proximity to the campus of Tallinn University of Technology (Fig. 3). The demonstration site consists of 4 almost identical five-storey buildings, and the public space around them (owned by the city). Just across the street from the lighthouse neighbourhood, is located the first

Fig. 3

Lighthouse neighbourhood in SOFTacademy project (blue line). Project funds will be invested to added-value renovation of 4 buildings (orange shading, Akadeemia street 4, 6, 14 and 22), 2 buildings in the neighbourhood having the same typology are to be observed as reference buildings (blue shading, Akadeemia street 10, 16)



Estonian pilot for prefabricated renovation finalized in 2017 (Hamburg et al., 2020; Kuusk et al., 2019).

This neighbourhood is part of Mustamäe district which was the first mass-produced housing project for Tallinn and Estonia after second World War during Soviet occupation. All buildings erected to the neighbourhood represent the same Soviet building typology (1-464) Fig. 4. While some buildings have applied partial repairs, most suffer for more significant deterioration.

Fig. 4

The 5-storey apartment buildings in the focus of the reinvented neighbourhood each housing 80 apartments



## Conclusions

It is evident that carbon neutrality in buildings requires much larger intensity of renovations to deliver climate targets. This renders the energy policy as driving force for buildings sector. Mass-renovation of such buildings that were one mass-constructed seems rational and promises the intensity needed. Combining energy targets with aspirations for spatial quality in renovations could be the key to modernizing outdated monofunctional residential estates that are in urgent need of upgrades.

Urban transformations, especially in neighbourhoods where residents have a significant stake, require a comprehensive, multi-scale approach to understanding the social-ecological-technological systems. It requires a collaboration between different urban stakeholders, including national

and local governments, the private sector, and civil society. However, individual private citizens still occupy a central role in the decision-making process.

To effectively organize neighbourhood revitalization, a comprehensive suite of software is essential. This should include various tools, beginning with decision support tools that assist private owners in assessing the cost-to-benefit ratio, as well as evidence-informed policies and reprogrammed incentives at the municipal level. An energy efficiency calculator can help determine the overall energy efficiency of the area, while a photovoltaic (PV) electricity tool considers factors such as orientation and neighbouring buildings to provide a more accurate estimate of electricity production. Additionally, a tool for coordinated construction planning for apartment buildings can assist construction companies in delivering more informed and targeted proposals, potentially reducing costs and mitigating risks. Lastly, a landscaping catalogue for apartment associations is necessary to aid private owners in implementing solutions that align with biodiversity and climate adaptation goals.

## Acknowledgements

This work has been supported by the European Commission through the projects SOFTacademy, EBENTO, LIFE IP BUILDEST.

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