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D3.11 Country specific guideline packages for selected financial solutions and optimal leverage ratios

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Executive Summary

In this document we outline the insights into the support for energy efficiency improvements in social housing across Europe, covering discussion on the policy and support landscape, and how this affects which improvements can be viably financed under the relevant support mechanisms in Denmark, Italy and Slovenia. The building physics modelling is carried out using the tools developed for this project, and the case for each intervention is assessed individually, and the financial case for each is presented alongside the go/no-go decision for each upgrade.

Italy

In Italy, the super-I partner building at Montasio comprises 3 housing blocks on the outskirts of Trieste, comprising around 260 apartments. Improvements to the walls, roof, floors and windows were proposed, the estimated savings are shown below. The costs of each intervention is [1,941,742 EUR for walls, 693,723 EUR for windows, 453,121 EUR for roofs and 290,408 EUR for floors], following review of the economics of each, the most economically viable EE intervention is walls with risk adjusted extra return 2.413, followed by roofs with risk adjusted extra return 2.141, windows 2.087 and floors with 1.917.

	Fuel Saving [kWh]	**Cost Saving [€]**	**Emissions Saving [kg CO_2]**
walls	404,953	20,248	74,916
windows	144,677	7,234	26,765
roofs	94,499	4,725	17,482
floors	60,565	3,028	11,204
All interventions jointly	**704,695**	**35,235**	**130,369**

The lack of funds to invest in social housing, and the difficulties associated with implementing a model through which energy savings repay retrofit of social housing are themes we have seen throughout our engagement with the housing associations throughout this project.

Denmark

3 building associations, who between them operate 17 buildings across the country, participated in the SUPER-i project. Given the historically high building standards imposed across the country, the improvements proposed across these pipelines are expected to improve thermal performance by 10 to 20% individually. We find that Danish associations predominantly choose energy efficiency interventions for windows, followed by walls, floors, and roofs. The average investment cost per

building for implementing energy efficiency interventions is €506,618. Specifically, the cost for window upgrades averages €202,585 per building, wall improvements cost €156,040 per building, floor enhancements are €90,712 per building, and roof improvements amount to €57,280 per building.

Slovenia

Only a single building comprises the Slovenian pipeline; a 4-storey 26 unit. Improvements to the walls and roof were proposed; these would save around €3,300 and €2,100 per year in fuel costs respectively. The total investment estimated for implementing the energy efficiency (EE) interventions in the building is €220,000. Specifically, the costs are as follows: wall improvements at €120,000, roof refurbishment at €60,000, and floor enhancements at €40,000. For the Slovenian housing association, the most economically feasible EE intervention is wall improvement, which has the highest risk-adjusted extra return of 1.996. This is followed by roof improvements with a risk-adjusted extra return of 1.789, and floor enhancements with a risk adjusted extra return of 1.6.

super-i Workshops

That a number of largely risk-free interventions with payback periods of around 15 years were not implemented accords with the views of housing associations canvassed as part of the project across Europe; no model has emerged to access these energy savings in privately owned, rented or social housing, and government funds for social housing retrofit are often highly bureaucratic and/or not well tailored to the complexities of upgrading social housing. Although the situation facing social housing varies across Europe, there are significant commonalities in the challenges faced, which are summarised below.

Field	Issue	Potential Mitigation
Finance	Energy retrofit (in most cases) does not increase the income for building managers, leading to principal-agent problems.	
	The low cost of gas (or the district heating), decrease the value of energy efficiency retrofits	Impose environmental levies on gas.
	The lack of a mechanism to fund energy efficiency improvements from future savings.	
Tenants' Needs	Mixed tenure and ownership buildings pose a particular challenge as building scale works will need agreement from other tenants.	Intelligently designed policy instruments may partly mitigate this issue.
	Energy poverty often exists at higher rates	Incentives targeted at

	in social housing than in the general population.	improving build fabric as a means of addressing fuel poverty.
Regulation	Support frameworks, and their approaches to renovation are often narrowly targeted	Frameworks should consider not just energy efficiency but also safety, comfort, and neighbourhood context.
	Backlog or bureaucracy in support payments or subsidies for PV make these investments less attractive.	Streamline processes and increase rates.
Data use and Innovation	Use of innovative techniques, such as prefabrication, could increase delivery rates and/or reduce costs.	
	There is a lack of data on energy use, which can make investment in reducing use opaque, and the value difficult to demonstrate.	Accurate, time-resolved energy use (and other) data could help unlock investment in energy efficiency.
Supply chain	Significant upskilling is required in most member states to deliver a workforce capable of delivering net zero social housing.	Substantial investment in training and supply chain development.

Optimal leverage ratios

This document investigates the optimal leverage ratios for social housing associations in Italy, Denmark, and Slovenia, specifically in the context of energy efficiency projects. Using the Weighted Average Cost of Capital (WACC) method, the study evaluates the leverage ratios over a 25-year period, from 2024 to 2048. The findings reveal that Denmark exhibits the highest optimal leverage ratios, indicating a strong financial market conducive to debt financing. Italy also demonstrates relatively high leverage ratios, benefiting from favourable borrowing conditions and tax benefits. Conversely, Slovenia shows lower leverage ratios, reflecting a more conservative approach to debt financing due to higher borrowing costs and less developed capital markets. The leverage factors, which measure private investment attracted per unit of public investment, highlight the effectiveness of public investment strategies, with Denmark again leading, followed by Italy and Slovenia.

Introduction

Social housing plays different roles across Europe, with each member state's stock facing different challenges to reach net zero status over the next 25 years. However, there are several common themes that we have identified:

- through the workshops run as part of the super-I project in which we've engaged with housing providers across member states, and
- through techno-economic analysis of the energy efficiency interventions proposed by the project partners

many relating to lack of clear policy support, insufficient funding and complex regulation. In this document we outline the findings from the super-I workshops and how the case for individual energy improvements have had to be assessed by the project partner housing associations, and our insights into the landscape for energy efficiency retrofits across Europe. Furthermore, social housing associations are crucial in providing affordable housing, particularly as the demand for energy-efficient homes increases. Financing these energy efficiency projects is a significant challenge, necessitating a careful balance between borrowed funds and equity capital. This document focuses on determining the optimal leverage ratios for such projects in Italy, Denmark, and Slovenia. By analysing these ratios, we aim to offer insights into how these associations can strategically utilise leverage to enhance their energy efficiency initiatives. The study employs the WACC method to examine the relationship between leverage ratios and economic conditions over a 25-year span, providing a comprehensive overview of the financial environments and market conditions in these countries.

1. Technical Analysis of the Interventions

As part of the Super-i project, we have developed a flexible building physics model and a data template which allows Housing Associations to provide the relevant information on their buildings and the proposed interventions. This model allows us to estimate the thermal efficiency savings associated with each intervention individually, and the overall set of proposed interventions.

Each intervention will reduce the energy demand for space heating by a given amount, and as the interventions are proposed to different building components, their energy savings can be added in series. Each intervention is associated with a cost; in the following section we present how these compare to the savings calculated here. It may be that some interventions are considerably more cost effective than others, and analyses such as these could in future be used to prioritise, or select from a subset of interventions. Of course other relevant considerations, such as disruption to residents or improvements to ventilation are not included in this analysis.

Below we outline the proposed interventions, the associated individual and overall improvement to the thermal efficiency of the building.

Italy

Two developments in Trieste are included in the Italian pipeline; a 3 tower project of around 250 flats at Montasio, and 4 eight-flat units at Boito. The latter are to be demolished and rebuilt, and plans for the new development were not available, as such we calculated a saving based on similar towers being built to modern standards, though this is unlikely to be representative of the new scheme.

Montasio

At Montasio, substantial improvements are proposed to all features - the roof, walls, floor and windows; the model inputs calculated and the data provided are shown below. The U-values were calculated by looking up the transmittance values of the materials provided in the CIBSE guide[1], and multiplying by the thickness of the material.

Component	Description Provided By HA	Inferred U-value [W/m²k]	Description of Proposed Improvements	Inferred U-value [W/m²k]
Walls	Reinforced concrete frame and infill in brick blocks plastered on the inside and tiled with terracotta tiles on the outside. The thickness of the perimeter wall delimiting the air-conditioned rooms	1.68	External wall insulation - horizontal opaque structures insulated to delimit the heated volume from the external environment and from the non-heated environments such as cellar rooms, stairwell/atrium, technical rooms with the exception of those with particular classification of resistance to fire.	0.45

[1] CIBSE Domestic Heating Design guide, 2021

	from the outside is 45 cm		The floors between heated and unheated rooms will be insulated until an average transmittance of approximately 0.45 W/m^{2}K	
Windows	Double glazed, aluminium frames	2.55		1.00
Roof	Pitched and the attic is not heated.	1.69		0.45
Floor	Concrete and masonry	1.25		0.45

The savings in fuel, costs and emissions are shown below.

	Fuel Saving [kWh]	**Cost Saving [€]**	**Emissions Saving [kg CO_2]**
improve the wall U-value from 1.68 to 0.45	404,953	20,248	74,916
improve the window U-value from 2.55 to 1.0	144,677	7,234	26,765
improve the roof U-value from 1.69 to 0.45	94,499	4,725	17,482
improve the floor U-value from 1.25 to 0.45	60,565	3,028	11,204
All interventions jointly	**704,695**	**35,235**	**130,369**

Given the walls form the largest portion of the building fabric, these improvements make the largest contribution to the energy savings. The windows also contribute significantly, reducing energy use by 15%. The improvements to the roof and floor make more modest improvements, given the shape of the towers, of around 10% and 5% respectively.

The combined improvement set reduces the overall energy demand by over 55%, worth around €28,500 in avoided gas costs in a typical year, or around €35 per residence.

Denmark

The Danish pipeline comprises 17 low rise buildings across towns in the north and centre of the country. There are 3 housing associations involved, who have provided different levels of information about their buildings. The Himmerland Boligforening housing association has provided the most complete information, allowing the most representative calculation of U-values

Building	Walls	Windows	Roof	Floors
Afdeling 20 Hvalpsundvej, Aalborg	Exterior walls are made of approximately 280 mm thick concrete sandwich elements with grooves surface. Elements consist of approx. 100 mm back plate, 125 mm insulation and 55 mm front plate, according to the drawing materials.	Windows are wood / aluminium elements fitted with 2-layer energy windows with warm edges from 2009	Roof constructions are made as lattice rafter construction with roofing existing of corrugated asbestos sheets. The roof slope is approx. 20 °. According to the drawing material, horizontal ceilings are insulated with 175 mm insulation	Floors / terrain decks are made as wooden floors on joists of 80 mm concrete. The terrain covered is insulated according to the drawing material with 170-210 mm Leca nuts under the concrete.
Afdeling 21, Næssundvej, Aalborg	Exterior walls consist of 300-325 mm cavity walls with bricks in the facade and with full-wall rear wall elements. The cavity is insulated with 75-100mm according to the drawing material.	Windows are wood / aluminium elements fitted with 2-layer energy windows with warm edges from 2011	Roof constructions are made as lattice rafter construction with roofing existing of corrugated asbestos sheets. The roof slope is approx. 40 °. Horizontal ceilings are insulated according to the drawing material with 200 mm insulation.	Floors / terrain decks are made as wooden floors on joists of 80 mm concrete. The terrain covered is insulated according to the drawing material with 170 mm Leca nuts under the concrete.
Afdeling 23, Vildsundvej, Aalborg	Exterior walls are predominantly consisting of approximately 325 mm cavity walls with bricks in the façade and with full-wall rear wall elements. The cavity is insulated according to the drawing material with 75-100 mm insulation.	Windows are wood / aluminium elements fitted with 2-layer energy windows with warm edges from 2010.	1 and 2 storey dwellings made as a lattice girder construction with roofing consisting of roofing felt with mouldings, slope is ~35 °. Horizontal ceilings are insulated with 195 mm insulation, sloping ceilings are with 200 mm insulation.	Floors / terrain decks are made as wooden floors on joists of 80 mm concrete. The terrain covered is insulated according to the drawing material with 170 mm Leca nuts under the concrete.
Afdeling 24, Oddesundvej, Aalborg	Exterior walls are made as approx. 280 mm thick concrete sandwich elements with groove surface. Elements are according to the drawing material consisting of approx. 100 mm back plate, 125 mm insulation and 55 mm front plate.	Windows are wood / aluminium elements fitted with 2-layer energy windows with warm edges from 2009	Roof constructions are made as lattice rafter construction with roofing consisting of corrugated asbestos sheets. The roof slope is approx. 20 °. According to the drawing material, horizontal ceilings are insulated with 175 mm insulation.	Floors / terrain decks are made as wooden floors on joists of 80 mm concrete. The terrain covered is insulated according to the drawing material with 170-210 mm Leca nuts under the concrete.
Afdeling 40, Fredrik Bajersvej, Aalborg	Exterior walls are made as a 310 mm cavity wall. Walls consist externally of brick and inside of aerated concrete.	Windows are wood / aluminium elements fitted with 2-layer energy windows from 2006	Roof constructions are made as lattice rafter construction with roofing existing of corrugated eternit slabs. Roof slope is	Wooden floors on joists of 80 mm concrete, partly as tile floors on screed / concrete. For wooden floors, the terrain

	The cavity is insulated with 100 mm mineral wool according to the drawing material.		approx. 22 °. According to the drawing material, the ceilings are insulated with 170 mm insulation.	deck is insulated with 50 mm insulation between joists, tile floors are insulated with 50 mm insulation below concrete.
Afdeling 35, Runddyssen, Svenstrup	Exterior walls are made as a 310 mm cavity wall. Walls consist of bricks and inside of aerated concrete. The cavity is insulated with 100 mm mineral wool according to the drawing material.	Windows and patio doors / lots are plastic elements fitted with 2-layer double glazing	Roof constructions are made as lattice rafter construction with roofing existing of corrugated Eternit slabs. Roof slope is approx. 20 °. Horizontal ceilings are insulated with 170 mm insulation according to the drawing material.	Terrain decks / floors are made of concrete with screed floors and insulated with 50 mm mineral wool between joists.
Afdeling 36, Runddyssen, Svenstrup	Exterior walls are made as a 310 mm cavity wall. Walls consist externally of brick and inside of aerated concrete. The cavity is insulated with 100 mm mineral wool according to the drawing material.	Windows and patio doors / lots are plastic elements fitted with 2-layer double glazing	Roof constructions are made as a lattice rafter construction with roofing existing of corrugated eternit slabs. Roof slope is approx. 20 °. Horizontal ceilings are insulated with 170 mm insulation according to the drawing material.	Terrain decks / floors are made of concrete with screed floors and insulated with 50 mm mineral wool between joists.
Afdeling 37, Hellekisten, Svenstrup	Exterior walls consist of approx. 310 mm thick walls with 100 mm rear wall lightweight concrete and 110 mm brick formwork. Exterior walls are according to the drawing material insulated with approx. 100 mm insulation between front and rear wall.	Windows are wood / aluminium elements mounted with 2-layer energy windows with warm edges.	Roof constructions are made as lattice rafter construction with roofing existing of corrugated asbestos sheets. Roof slope is approx. 45 °.	Floors / terrain decks are made as wooden floors on joists of 80 mm concrete. According to the drawing material, the terrain deck is made with 50 mm insulation over concrete and 150 mm capillary-breaking layer under the concrete

The housing association at Ater Di Trieste Azienda provided more high level data on the principal insulation of each building feature, shown below. Our calculations are therefore based on the U-value of only the lowest thermal conductance material in each component, which will slightly overestimate the heat losses before and after retrofit.

Building Name	**Description of Walls**	**Description of Windows**	**Description of Roof**	**Description of Floor**
Afdeling Søndergade	125 mm rockwool	2-layer thermoplastic	175 mm rockwool.	150 mm leca (lightweight expanded clay aggregate)
Vaevergaarden	125 mm rockwool.	2-layer thermoplastic	200 mm rockwool.	125 mm leca
Storgaarden	100 mm rockwool.	2-layer thermoplastic	200 mm rockwool.	150 mm leca
Afdeling 9	125 mm rockwool.	2-layer thermoplastic	250 mm rockwool.	260 mm leca
Hammerthor	125 mm rockwool.	2-layer thermoplastic	250 mm rockwool.	160 mm polystyrene
Frisenborgparken	125 mm rockwool.	2-layer thermoplastic	200 mm rockwool.	50 rockwool + 150 leca

The housing association at Børglumparken did not provide any data, as such their building has not been included in the analysis.

The fuel savings by component are shown below:

	Component	**Fuel Saving [kWh]**	**Cost Saving [€]**	**Emissions Saving [kg CO_2]**
Housing Areas Borglumparken	Walls	268,252	13,413	49,627
	Window	152,010	7,600	28,122
	Roof	148,132	7,407	27,405
	Overall	**568,394**	**28,420**	**105,153**

Afdeling Sondergade	Walls	49,095	2,455	9,082
	Window	27,820	1,391	5,147

	Roof	28,846	1,442	5,336
	Overall	105,760	5,288	19,566

Vaevergaarden	Walls	811,913	40,596	150,204
	Window	769,709	38,485	142,396
	Roof	768,440	38,422	142,161
	Overall	**2,350,062**	**117,503**	**434,761**

Storgaarden	Walls	739,454	36,973	136,799
	Window	709,450	35,473	131,248
	Roof	692,058	34,603	128,031
	Overall	2,140,963	107,048	396,078

In the Danish case, where the buildings have been built to high thermal efficiency standard, and are relatively recent; as such the improvements to the building fabric make modest differences; walls between 20 and 25%, roofs a further 10 to 15%, and windows similarly between 10 and 15%.

Slovenia

The Slovenian pipeline comprises a single building, with 26 units over 4 floors. The addition of insulation to the walls and roof is proposed, though no detail has been provided. As such, a central value of 0.45W/m^{2}K has been used to give indicative results.

Component	**Description Provided By HA**	**Inferred U-value [W/m²k]**	**Description of Proposed Improvements**	**Inferred U-value [W/m²k]**
Walls	Brick. In the apartments the partitions are brick, thick 10 and 20 cm, and the walls between	2.0	Insulation on facade and roof. Electric appliances on existing radiator systems or at least make systems for	0.45

	the flats and towards the corridor are made of brick blocks 38 cm thick or prefabricated structures from gypsum boards 20 cm thick.		electric appliances for hot water, heating appliances will stay the same. No improvements to windows, or lighting.	
Windows	PVC, double glazing, good fittings	1.2		1.2
Roof	The construction of the roof over the attic is sloping, the sloping roof is insulated with thermal insulation made of glass wool.	2.0		0.45
Floor	Reinforced concrete floor	1.0		1.0

	Fuel Saving [kWh]	Cost Saving [€]	Emissions Saving [kg CO_2]
improve wall U-value from 2.0 to 0.45	66,768	3,338	12,352
improve roof U-value from 2.0 to 0.45	41,915	2,096	7,754
Overall Improvement Package	**108,683**	**5,434**	**20,106**

2. Financial Analysis

Social housing associations play a vital role in providing affordable housing options for individuals and families with limited incomes. As the demand for energy-efficient housing continues to grow, these associations are faced with the challenge of financing and implementing energy efficiency projects to meet sustainability goals while maintaining affordability. One key factor in successfully undertaking such projects is determining the optimal leverage ratio, which balances the use of borrowed funds and equity capital to maximise returns. This section explores the concept of the optimal leverage ratio for social housing associations in the context of energy efficiency projects. It aims to analyse various approaches to determining this ratio. By understanding how social housing associations can strategically utilise leverage, this section contributes valuable insights into enhancing energy efficiency initiatives within the affordable housing sector.

Calculating the optimal leverage ratios using the WACC method for SUPER-i Six countries:

The analysis of optimal leverage ratios for Italy, Denmark, and Slovenia is based on the Weighted Average Cost of Capital (WACC) method, which examines the relationship between leverage ratios and economic environments over a 25-year period. This analysis uses datasets from Nasdaq and the London Stock Exchange Group (LSEG) as inputs. The leverage ratios are explored both annually and over five-year medians, providing insights into the financial and economic implications for each country.

Italy

Annual Optimal Leverage Ratio

The optimal leverage ratio for Italy fluctuates annually but generally remains withinbetween (0.739 and 0.795). The relatively high leverage ratio suggests that Italian social housing companies can benefit significantly from debt financing. This indicates that these companies may find an optimal balance between debt and equity financing for energy efficiency projects within this range. The high leverage ratio signifies that debt plays a crucial role in the capital structure of Italian firms, influenced by:

- **Lower Borrowing Costs**: Periods of low interest rates make debt financing advantageous for funding investments and expansion projects.
- **Tax Benefits**: Italy's corporate tax laws and regulations regarding debt interest deductibility incentivize the use of debt financing for energy efficiency renovation projects, providing tax shields that lower effective tax rates and increase profitability.
- **Industry Composition**: The capital-intensive nature of social housing companies in Italy inherently requires higher levels of leverage.

Five-Year Median Optimal Leverage Ratio

Over a five-year period, the median optimal leverage ratio is 0.767, reflecting economic stability and long-term financial planning. The fluctuations in annual optimal leverage ratios are influenced by changes in economic conditions, such as nominal interest rates, inflation rates, and yearly variations in the S&P 500 growth rate, which impacts the cost of equity.

Five year median leverage factor:

The analysis of leverage factors, which indicate the amount of private investment generated for each 1 EUR of public investment in energy efficiency (EE) renovations, provides valuable insights into the effectiveness of public investment strategies in Italy, Denmark, and Slovenia. The data spans five-year periods from 2024 to 2043, as well as an overall average for the entire period. For Italy, the leverage factor shows strong initial values in the first two periods, with 3.158 for 2024-2028 and 3.889 for 2029-2033. This indicates that for every 1 EUR of public investment, private investments of approximately 3.158 EUR and 3.889 EUR are attracted. Such strong initial leverage could be attributed to favourable economic conditions and strong incentives for private investment in EE renovations. However, the leverage factor decreases in the later periods to 2.354 for 2034-2038 and 2.335 for 2039-2043. This decline suggests that private investment may taper off due to factors such as market saturation or changing economic conditions. The overall average leverage factor for the 20-year period is 2.832, which still indicates a robust multiplier effect of public investments in Italy.

Denmark

Annual Optimal Leverage Ratio

Denmark's optimal leverage ratio ranging between (0.796 and 0.868) is higher compared to Italy, suggesting that Danish social housing companies have more favourable conditions for accessing debt financing. The higher leverage ratio in Denmark can be attributed to several factors:

- **Developed Financial Market**: Denmark's well-developed financial markets and robust banking system provide easier access to debt financing at competitive rates, facilitating investment opportunities in energy efficiency projects.
- **Investor Preferences**: Danish investors may have a higher risk tolerance and view debt financing positively, particularly if social housing companies can generate returns exceeding the cost of debt.
- **Regulatory Environment**: Denmark's supportive regulatory framework enhances capital market development and corporate borrowing capabilities.

Five-Year Median Optimal Leverage Ratio

The five-year median optimal leverage ratio (0.832) highlights a consistent and higher reliance on debt financing in Denmark. This consistency underscores the efficiency of the financial system and the strategic use of leverage by Danish social housing companies.

Five year median leverage factor:

Denmark exhibits the highest leverage factors among the analyzed countries, beginning with 4.175 for 2024-2028 and peaking at 4.374 for 2029-2033. This high leverage indicates a strong response from private investors, with private investments of approximately 4.175 EUR and 4.374 EUR for every 1 EUR of public investment. Despite a significant dip to 2.326 for the 2034-2038 period, potentially reflecting market adjustments or saturation, the leverage factor rebounds to 3.346 for 2039-2043. With an overall average leverage factor of 3.893, Denmark demonstrates a highly effective public investment strategy that successfully leverages almost 4 EUR of private investment for every 1 EUR of public investment.

Slovenia

Annual Optimal Leverage Ratio

Slovenia's optimal leverage ratio ranges between 0.694 and 0.728, is lower compared to Italy and Denmark, indicating a more conservative approach to debt financing. Slovenian companies may prefer equity financing or face limitations in accessing debt markets due to higher borrowing costs or risk perceptions. Factors contributing to this conservative stance include:

- **Risk Aversion**: Slovenian social housing companies exhibit lower risk appetite, influenced by historical experiences and cautious financial management practices.
- **Capital Market Constraints**: Slovenia's less developed capital markets and banking infrastructure limit access to debt financing, resulting in higher borrowing costs.
- **Government Policies**: Policies and regulations in Slovenia may prioritize financial stability and prudent risk management, discouraging excessive leverage.

Five-Year Median Optimal Leverage Ratio

Over a five-year period, the median optimal leverage ratio in Slovenia reflects a conservative financial strategy, emphasizing stability and cautious growth. The lower median value indicates tighter credit conditions and a preference for equity financing due to regulatory constraints and higher borrowing costs.

Five year median leverage factor:

Slovenia presents a more conservative leverage factor, starting at 2.676 for 2024-2028 and slightly decreasing to 2.501 for 2029-2033. This indicates that for every 1 EUR of public investment, private investments of approximately 2.676 EUR and 2.501 EUR are made. The leverage factor declines further to 1.452 for 2034-2038 and 1.531 for 2039-2043, suggesting a cautious approach by private investors, possibly due to higher perceived risks or less favourable economic conditions. The overall average leverage factor of 2.267 indicates moderate effectiveness of public investments in attracting private capital in Slovenia.

To conclude, the optimal leverage ratios for Italy, Denmark, and Slovenia provide valuable insights into each country's financial environment, access to capital, and market conditions. A higher optimal leverage ratio suggests a more developed financial market with lower borrowing costs, allowing companies to leverage more for growth and investment. Conversely, a lower optimal leverage ratio indicates tighter credit conditions, higher borrowing costs, or a preference for equity financing due to lower risk tolerance or regulatory constraints. These ratios help in understanding the financial strategies and corporate behaviours within the social housing sector in each country. Furthermore, the leverage factors for each country reveal varying levels of private investment response to public funding in EE renovations. Italy shows strong initial leverage that tapers off in later years, with an overall average leverage factor of 2.832. Denmark has the highest leverage factors, indicating robust private investment response, with an overall average leverage factor of 3.893. Slovenia, with more conservative leverage factors, indicates moderate private investment response, with an overall average leverage factor of 2.267. These insights highlight the differing financial environments and the varying effectiveness of public investment strategies in leveraging private capital across Italy, Denmark, and Slovenia.

Optimal Leverage Ratio						
Year	**Italy**	**Denmark**	**Slovenia**	**UK**	**Spain**	**Belgium**
2024	0.759	0.807	0.730	0.820	0.730	0.731
2025	0.744	0.777	0.689	0.792	0.704	0.704
2026	0.762	0.963	0.900	0.927	0.817	0.829
2027	0.807	0.830	0.728	0.843	0.736	0.749
2028	0.715	0.704	0.591	0.727	0.626	0.639
Median (2024-2028)	**0.759**	**0.807**	**0.728**	**0.820**	**0.730**	**0.731**
2029	0.734	0.814	0.714	0.809	0.704	0.717
2030	0.658	0.603	0.497	0.644	0.547	0.560
2031	0.821	0.850	0.775	0.870	0.762	0.775
2032	0.811	0.816	0.731	0.841	0.734	0.747
2033	0.795	0.789	0.698	0.816	0.711	0.724
Median (2029-2033)	**0.795**	**0.814**	**0.714**	**0.816**	**0.711**	**0.724**
2034	0.825	0.868	0.768	0.874	0.766	0.779
2035	0.826	0.861	0.765	0.871	0.763	0.776
2036	0.655	0.642	0.539	0.669	0.571	0.584
2037	0.702	0.699	0.592	0.721	0.621	0.634
2038	0.681	0.691	0.591	0.711	0.611	0.624

Median (2034-2038)	**0.702**	**0.699**	**0.592**	**0.721**	**0.621**	**0.634**
2039	0.700	0.770	0.605	0.747	0.645	0.658
2040	0.790	0.858	0.767	0.859	0.752	0.765
2041	0.717	0.802	0.689	0.791	0.687	0.700
2042	0.669	0.669	0.554	0.687	0.589	0.602
2043	0.632	0.614	0.512	0.644	0.547	0.560
Median (2039-2043)	**0.700**	**0.770**	**0.605**	**0.747**	**0.645**	**0.658**
Median (2024-2043)	**0.739**	**0.796**	**0.694**	**0.800**	**0.704**	**0.711**

Five year Optimal Leverage Ratio						
Year	Italy	Denmark	Slovenia	UK	Spain	Belgium
2024-2028	0.759	0.807	0.728	0.820	0.730	0.731
2029-2033	0.795	0.814	0.714	0.816	0.711	0.724
2034-2038	0.702	0.699	0.592	0.721	0.621	0.634
2039-2043	0.700	0.770	0.605	0.747	0.645	0.658
2024-2043	0.739	0.796	0.694	0.800	0.704	0.711

Leverage factor: private investment for each 1 EUR investment by public sector						
Year	Italy	Denmark	Slovenia	UK	Spain	Belgium
2024-2028	3.158	4.175	2.676	4.561	2.706	2.715
2029-2033	3.889	4.375	2.501	4.437	2.461	2.622
2034-2038	2.354	2.326	1.452	2.584	1.636	1.729
2039-2043	2.335	3.346	1.531	2.954	1.821	1.927
2024-2043	2.832	3.893	2.267	4.012	2.377	2.455

3. Workshop summary

Many of the proposed interventions assessed in the early project stages above were ultimately not pursued, due principally to difficulties raising the necessary capital. During the project, we held a series of workshops across European member states, to assess the scale of the challenge to improve the energy efficiency of social housing, map the policy and financial drivers, and understand the barriers to delivering a net-zero social housing stock by 2050, or in line with the relevant national target. The findings of these workshops are presented below by member states.

Scotland

4.1m of the 5m social homes across the UK need substantial retrofit by 2050 - and the policy set devised by the SG to drive retrofit of social housing the Energy Efficiency Standard for Social Housing (EESSH), the first version of which was published in 2019 and updated in 2023. The latter set a target for all homes to reach EPC B by the end of December 2032, a more ambitious target than the analogous E&W target - all homes to EPC C by 2030. He discussed the barriers to this retrofit, and how the allocated funding compares with the estimates of the total demand, calculated by the CCC. He noted that 17% of residents in social housing in the UK are in fuel poverty, and that some additional funding can be leveraged in these cases.

The policy document EESH2 is to be published later in the year; there is still some uncertainty around the policy targets that this will make into statute, as will the final version of the Heat in Buildings[2] bill, an initial version of which requires all local authorities to produce a local heat and energy efficiency strategy (LHEES) by the end of 2023, and allocates £1.8bn to support delivery of low carbon heating. The Green Heat Task Force was set up under the Heat in Buildings bill, whose remit is to develop a portfolio of innovative financial solutions for building owners to ensure that by 2045 Scottish homes no longer contribute to climate change, as part of the wider transition to net zero. A summary of the key barriers and drivers is shown below.

Investing in energy efficiency in social housing

SOCIAL HOUSING MANAGERS	
Obstacles	***Possible solutions***
Mixed tenure buildings pose a particular challenge as building scale works will need agreement from other tenants and building owners, and other building owners may have to part fund the works	Requires clear, long-term policy commitment and financial support from the central government.

[2] https://www.gov.scot/policies/energy-efficiency/the-heat-in-buildings-programme/

Even though some funding is available, it is usually much below what is needed. Across the UK for example, about £4 billion is available until 2033 for social landlords for decarbonisation. CCC modelling estimates £3-8 billion needed for energy efficiency alone by 2030.	
Similar to E&W, the workforce and supply chains needed to carry out the required work are not fully developed.	
Where smart technologies are installed, such as cogeneration, or smart ventilation, residents are often unaware of how to use them.	Making awareness raising and educational resources available.

FINANCIAL INSTITUTIONS	
Obstacles	***Possible solutions***
Heat networks could represent a guaranteed income stream, and could be simply financed.	Mandate the use of heat networks in housing of a particular density.

ESCOs	
Obstacles	***Possible solutions***
The ESCo model is not common in Scotland, and HAs and LAs are not accustomed to using them.	Awareness raising

LOCAL AUTHORITIES	
Obstacles	***Possible solutions***
No major funding streams are specifically available to LAs to meet energy efficiency or fuel poverty targets in their areas.	Increase funding pots available to local authorities through central government
Low property values often lead to social housing being sold by councils, so it is lost to private renting where policy is less able to drive retrofit	Funding to support these at-risk properties

England and Wales

The Scale of the Challenge

Getting a home to EPC C in GB typically involves fitting insulation, but does not require low carbon heat, heat networks or cogeneration, though some HAs are looking at these options. Heat network feasibility assessments are required in densely populated areas, particularly in central London.

Across the HAs we spoke to, around 20% of homes do not meet this target, and the cost of meeting that target is around £30,000 to £40,000 per dwelling, SHDF covers around £10,000 - 15,000 of this. Getting to net zero will require further improvements of at least as much again, as deep decarbonisation measures will be needed in many cases.

Around 15 to 20% of the UK population live in social housing. There are a large range of providers, most of which are private firms. The key government target is EPC C by 2030, though this target is not mandated – it is specified as a target in the 2014 Fuel Poverty act and "generally accepted" as a target, though funding to meet the target is available under the Social Housing Decarbonisation Fund, which allocates tens of millions in each funding round. This funding does not specifically target fuel poverty, and housing associations may have to do this targeting themselves.

Support

Not all HAs draw on these funds; SHDF matches HA funding – providing up to half of the costs of each renovation. In the current inflationary environment, actual costs may exceed modelled costs for particular retrofits, and the SHDF input does not increase, so that HAs can end up paying 70 or 80% of the cost of a measure. Inevitably, this means fewer measures are implemented, and the demand for new homes makes other demands on the capital resources of GB housing associations. Economies of scale are also difficult to access, and retrofits are often done flat by flat, rather than block by block; SHDF funding is available only up to EPC C, and therefore where a block has a mix of EPC C and below flats, measure such as cladding which would improve the thermal performance of the entire building are not eligible for support.

The Recycled Capital Grant is also available to HAs and has lower administrative overheads, but as it sits on the balance sheet it doesn't move the P&L.

Some housing associations felt that in addition to the absence of clear policy targets to get to net zero housing, and the issues with funding and supply chains, the issue had fallen down the political priorities. An election in early July is expected to bring in a new government, there was some cautious optimism that net zero and housing would become more politically relevant. Some also felt that the relevant set of regulations was changing too fast, and that having got to grips with operational and embodied carbon, now e.g. ecological compliance requirements were making this task more complicated.

Supply Chain

The supply chain is also not well developed, and a huge upskilling programme is required, there does not appear to be the required level of support for this. Heat pumps and district heat are particular areas where there is insufficient expertise, the new heat network regulations and zoning were raised as helpful policies.

Residents

Contracts with residents are an issue; some developers had looked at Energiesprong, but could not demonstrate to an adequate standard that there would be a benefit to residents. Residents in some cases turn down improvements to their homes – in these cases the same measures can usually be fitted to other properties in the HA portfolio. Often residents prioritise lack of disruption over marginal energy savings, especially where they are home during the day.

Business Models

The ESCo model is not widely used in E&W, and housing associations are not familiar with instances where this model has been successfully deployed.

Some of the HAs we spoke to issue sustainable bonds, which fund energy efficiency measures across their portfolios.

Belgium

The Belgian roundtable brought together senior personnel from Housing Europe and representatives from social housing organisations across 3 three regions of Belgium. After setting the scene on policy and funding across Belgium, key discussion points covered:

- Challenges in achieving energy renovation targets within budget constraints
- The need for stable, long-term financing to support renovation projects
- Administrative burdens associated with EU funding and lack of consistency/coordination between the different tools available
- The impact of market conditions on renovation costs and project implementation
- The importance of tenant support and engagement in renovation projects
- Regulatory and urban planning challenges in implementing energy renovation measures
- Innovative approaches to renovation, such as prefabrication and energy communities

The interface between finance and social housing was also discussed; the associated administrative burden and the need for innovative financing solutions to support large-scale renovation projects. The importance of the relationship between tenants and housing associations was also highlighted - in Wallonia, 2% of the renovation budget is allocated for tenant support - and the Modul'Air project model of engaging tenants in the renovation process and addressing their specific needs was highlighted. The ESCo model was mentioned, but few examples are available in Belgium: "To our knowledge there are currently almost no examples of ESCOs working in renovation of social housing in Brussels".

Spain

The Spanish workshop brought together []. As at other workshops, the topics covered included:

The interaction between social housing managers and financial institutions, interaction between social housing managers and social housing tenants and the interaction between social housing managers and ESCOs. The findings are summarised below.

Financing

While there is recognition of the importance of energy efficiency in social housing, the availability of loans at rates in line with market rates has varied. In some cases, financial institutions have offered competitive rates, particularly when the energy efficiency project has been well-structured and demonstrated a clear path to cost savings over time. However, securing these loans often requires a rigorous process of presenting a comprehensive project plan that outlines the expected energy savings, return on investment, and the ability to repay the loan. Additionally, the specific financing requirements and loan conditions can vary widely among institutions, which can make it challenging to navigate the lending landscape. Nonetheless, the growing emphasis on sustainability and energy efficiency in housing has created opportunities for collaboration between social housing managers and financial institutions, and innovative financing models are emerging to address these challenges more effectively. These investments are seen as contributing to environmental sustainability and improving the living conditions of residents, aligning with our institution's commitment to responsible lending. While the profitability of such loans may not always match traditional lending products, they offer a stable and predictable return on investment over the long term. The riskiness of providing these loans is often mitigated through careful project assessment, including energy audits and feasibility studies. Additionally, many energy efficiency projects in social housing are structured with performance-based contracts, where the repayment is tied to demonstrated energy savings. This approach reduces the risk for both the housing manager and the financial institution, ensuring that loans are repaid as the expected energy efficiencies are achieved.

Relationship with Tenants

Stakeholders agreed that it was crucial to engage tenants throughout the process, explaining the benefits of energy-efficient upgrades, addressing their concerns, and minimising disruptions to their daily lives. Open and clear communication is key, as tenants may have questions about the scope of work, timelines, and how the refurbishment will impact their living conditions. Additionally, ensuring that tenants are comfortable and informed about the project fosters a sense of cooperation and ownership in the process. There was however an acknowledgement that some tenants may initially resist changes or have concerns about potential inconveniences. Therefore, creating a dialogue and offering support can help alleviate these concerns and build trust. Ultimately, successful interactions with tenants during energy efficiency refurbishment projects can lead to improved living conditions, reduced energy costs, and a more sustainable housing environment, benefiting both the tenants and the broader community.

Social housing firms stated “we have consistently communicated all the benefits stemming from energy efficiency refurbishment to our tenants. This comprehensive communication includes highlighting the financial benefits, such as lower energy bills, which directly impact their household budgets, providing relief from rising energy costs. We also emphasise the health benefits associated with improved indoor air quality and thermal comfort, as well as reduced exposure to potential hazards like mould or drafts. Increased comfort is another significant aspect we stress, emphasising how energy-efficient upgrades can lead to more pleasant living conditions, with consistent temperatures and improved insulation. Finally, we ensure tenants are aware of the positive environmental impact, including reduced greenhouse gas emissions and a smaller carbon footprint, aligning with our commitment to sustainability."

Role of ESCos in Spain

The ESCo model is more established in Spain than other European states; social housing associations have worked actively with ESCOs on several energy-efficient refurbishment projects. These collaborations involve comprehensive energy audits to identify areas for improvement, including insulation upgrades, window replacements, and heating system enhancements. ESCOs have played a crucial role in project implementation, providing expertise in energy-efficient technologies and project management. Financial support arrangements have also been established, often involving shared savings models where the ESCO's compensation is tied to actual energy cost reductions achieved.

Italy

Two workshops were held in Italy over the course of the project; one in Palermo on the 19th of May 2024, and a second held in Trieste - where the Italian super-I participant housing associations are based - on 14th June the same year. The summary of the topics discussed, and the proposed solutions, are presented below.

Palermo

Obstacles	***Possible solutions***
Sectoral and party logics influence the approach to overcoming criticism and implementing interventions.	Collecting contributions from local actors and strengthening the participation of stakeholders, to co-design the interventions starting from concrete outputs coming from the communities directly involved and impacted.
Lack of a proper general vision to tackle environmental and territorial decadence.	Creation of new models of metropolitan and urban welfare, as well as encouraging new models of management that supports social inclusion.
Scarce perceived social justice and solidarity, and need to tackle energy poverty.	Promoting dialogue and cooperation between public and private actors, in order to co-design human centred energy efficiency interventions and

	renovations in disadvantaged districts (in the design phase by the public authorities, but also in the implementation phase by the enterprises).
	Human-wellbeing oriented perspective in the design and implementation of the renovation, in order to rebuild people's trust in public authorities.
	Designing tailored projects with a strong social focus based on a need analysis.
Lack of perception of economic benefits from the energy efficient renovation for the community.	Involving the local communities in maintenance jobs, allowing people to be involved both in the design phase of the interventions, but also in the aftermath, with long-lasting benefits for the community. Furthermore, the self-maintenance approach guarantees timely small maintenance and guardianship of the communal areas of the districts.
	Increased value of the building as a result of EE requalification, improving the social image of the district and revitalising its economy.
	The participation of the communities to the investment (e.g. Crowdfunding) has proved to be successful in improving social acceptance.
	Using of the "keep it local" approach, involving the community in the decision making process and the local SMEs in the supply chain.
Community involvement for maintenance jobs is not present in the current procurement codes.	The proposed solution is to insert the preference for local manpower in the writing phase of the procurement codes. Existing doubt: concerns about the limitations on free competition obtained by including within the procurement code the preference towards local communities for maintenance work, as well as a possible lack of experienced manpower.

Public interventions unclear in terms of their sustainability in the future.	Integrated approach (economic, environmental, and social) to be adopted in the construction sector (also at the national level), for the requalification of marginalised districts and building.
Uncertainty from social housing organisations (SHO) about the best financial solution for energy efficiency (EE).	For large operations, the PPP proved to be the most concrete hypothesis, since it allows the Public Body to concentrate on defining the objectives to be achieved in terms of public interest and quality of the services offered, leaving the costs and related risks of planning, construction, implementation and financing to the private partner.
Scarce use or misuse of Public Funding.	Development of specific implementing regulations for the use of Public Funds at disposal of the Region, and tailored policies for a better use of money, also streamlining the authorisation process and the bureaucratic procedures.
Scarce use or misuse of real estate assets.	Redevelopment and reorganisation of the assets intended for public and social residential construction, increasing their amount by putting back into use decommissioned properties and housing.
Existing doubt: a PPP contract for energy efficiency may NOT provide guaranteed savings in consumption.	The PPP procedures are complex but can be managed in a fairly short time, even if it is essential for the future to move to a more complete contractual structure such as that envisaged by Repower EU.
Community disconnected and not interested in the future of the district	Supporting the local social promotion associations and organisations as facilitators of the dialogue of the community with the public authorities.
	Promoting the use of digital tools to encourage the participatory approach.

Doubts on how to effectively involve legally white-listed enterprises (not involved in criminal affairs)	Promoting both legal and operational protocols to tackle infiltration by organised crime.
Lack of perception of the social benefits of the interventions.	Improvement of accessibility and safety to communal places and living services, also through the installation of new urban-local equipment.
	Interventions in areas accessible to all, such as green areas and communal spaces, and advertising on the benefits for people's health, coming, e.g., from improved air quality.
	Promotion of awareness-raising actions towards both benefits and conscious use of energy resources by the inhabitants.

Trieste

Obstacles	
Bureaucracy and slow processes: the bureaucratic process for the approval and implementation of SH projects is often very long and complex, often because of the multiplicity of bodies involved in the processes.	The RAP proposal for the NHP suggests: • Creating a unique regulatory text on SH: reorganisation of the regulatory framework for both Public Residential Building (public housing - the rent is determined by income and the characteristics of the accommodation) and Social Residential Building (all other types of social housing). • Rationalising the system of constraints in projects financed through the Italian National Resilience and Recovery Plan (NRRP).
	The MIT tables for NHP suggests: • Streamlining the bureaucratic procedures.

<table>
<tr><td rowspan="3">Insufficient funding: in recent years, funding for SH has been reduced, making it difficult to start and complete new projects. New forms of financing, new tools and new ways of implementing interventions are therefore needed.</td><td>The RAP proposal for the NHP suggests:
Rationalisation of financial resources for the implementation of Public and Social Housing programs.
Flexibility of the rental fund for private market tenants.
Support for rentals, reorganisation and integration of existing tools-
Elimination of the Municipality Property Tax on public SH.</td></tr>
<tr><td>FEDERCASA proposal for NHP suggests:
To plan public financing funds for the construction of SH, or a Fund to cover the guarantee of Financing at the European Investment Bank/Italian Deposits and Loans Fund, assumed by the Ex-IACP (Independent Institute for SH) on projects with economic-financial plans capable of repaying the financing by making the best use of the BIM tool, or urban planning compensations in the urban planning Conventions that lead to the same result.
National financing for the renovation of unused SH to be renovated, refinancing Art. 4 L. n. 80/2014.
To verify the actual effectiveness of the F.I.A. (Housing Investment Fund) and the reintroduction of a Guarantee Fund that can represent an element of endorsement for the bank guarantee.
To provide facilitated paths for restructuring (PPP), access to Regional or State guarantees that can allow financing even in capital but without interest, subsidised prices for Services and energy supplies. All this to make the SH system able to support itself in a complementary manner to the non-repayable financing (in any case necessary).</td></tr>
<tr><td>The MIT tables for NHP suggests:
PPP
Allocation of public resources to reduce construction costs
Use of patient capital.
Refinancing of the rental support fund.
Tax incentives and corrections</td></tr>
<tr><td>Age of buildings: a significant part of the public building stock is old and of poor construction quality, requiring heavy and very costly renovations, both in terms of financial resources</td><td>The RAP proposal for the NHP suggests:
To maintain, improve and recover the existing public housing stock.</td></tr>
</table>

and construction times.	
Management and maintenance: the age of the buildings is often exacerbated by insufficient maintenance due to limited resources and inefficiencies in property management	The RAP proposal for the NHP suggests: ● To maintain, improve and recover the existing public housing stock.
	FEDERCASA proposal for NHP suggests: ● To define qualitative and quantitative standards for Public Service performance. ● To compensate for arrears with ordinary maintenance work that allows vulnerable individuals who have lost their jobs to carry out community service work in compensation for rent payments in SH. ● To manage maintenance for public bodies: the former IACP (Independent Institute for SH) companies have accumulated a great deal of experience and capacity in the maintenance and management of properties. The idea would be to assign direct contracts that would guarantee the bodies income to be allocated to the management and maintenance of SH.
Access to housing: the criteria for allocating housing are very complex and result in long waiting lists for obtaining SH, with a very high demand compared to the available supply.	The RAP proposal for the NHP suggests: ● To promote the increase in the public housing stock, including through the purchase of existing housing stock, building replacement and enhancement interventions. ● To support rentals, reorganisation and integration of existing tools. FEDERCASA proposal for NHP suggests: ● To provide access to the databases of the Courts, Revenue Agencies and Motor Vehicles to be able to carry out checks on the conditions of the assignees. ● To plan a significant increase in public and social housing (for at least 250,000 units), through the use of abandoned public areas or through the demolition and reconstruction, with volumetric increase, of SH buildings that have reached the end of their building life. It is necessary to have the capacity to plan urbanistically in this direction. ● To refinance the National Innovative Program for the Quality of Living (PINQuA), to allow the implementation of all projects admitted to the ranking that contemplate the construction of new SH housing. ● To act also at a European level (FEDERCASA adheres to Housing Europe) and build a path that allows for the diversion of large amounts of funding from the European Central Bank to projects of great economic value that can be joined by Regions or even

	Nations. With coordination at the European Community level, it would be possible to collect projects in homogeneous territories, channel them into different geographical sectors and proceed with their financing. The coverage in terms of guarantees for projects of this size would come from the individual States or (depending on their size) also from the individual Regions.
	The MIT tables for NHP suggests: ● Offering public housing and social housing.
Illegality: SH buildings can be subject to illegal occupation, further complicating management and planning.	The RAP proposal for the NHP suggests: ● Integrating Housing and Social policies. ● Fighting against growing energy poverty in SH. FEDERCASA proposal for NHP suggests: ● Activating social management would improve interpersonal relationships between residents and create the conditions for compliance with the rules (arrears, use of shared spaces, illegal occupations, condominium and neighbourhood dimension).
Legislation: the regulatory framework on SH is often complex and difficult to interpret, making it difficult to apply the rules. Legislation on public procurement, and the resulting digitalisation of procurement processes, has in fact made the workload of public contracting authorities more difficult.	The RAP proposal for the NHP suggests: ● Creating a unique regulatory text on SH: reorganisation of the regulatory framework for both Public Residential Building (public housing - the rent is determined by income and the characteristics of the accommodation) and Social Residential Building (all other types of social housing). ● Changing the non-economic relevance of SH (transition from SIEG - Services of General Economic Interest to SINEG - Non-Economic Services of General Interest). FEDERCASA proposal for NHP suggests: ● To choose a uniform legal nature of public bodies and public companies. ● To choose whether or not to maintain the civil ownership of the SH. ● To modify and integrate the definition of SH. ● To frame the public SH as a Service of General Interest and not as, currently, a Service of General Economic Interest (current definition) similarly to the Private SH. This would also determine the general condition for addressing the issue of Municipality Property Tax and, above all, clarifying the distinction between public and social residential housing with respect to the issues of verifying the presence of undue State aid.

	● To introduce by law a structured social management of the inhabitants and not simply a mediation of conflicts. ● To have the management and maintenance of the properties used for student accommodation, also in light of the investment that the State has in place to increase the SH endowment. ● Within the national legislation, although not interfering with the Region's delegation for housing, it is necessary to open an *ad hoc* window that regulates public SH.
Social impact: failure to involve local communities in project planning and implementation can lead to resistance and social conflict.	The RAP proposal for the NHP suggests ● The promotion of urban regeneration, therefore reducing social marginalisation phenomena. ● Integrating Housing and Social policies. ● Fighting against growing energy poverty in SH.
	FEDERCASA proposal for NHP suggests: ● Funding a social management of the SH residents, to ensure inclusion and reactivate community dimensions in residential contexts and with the neighbourhood in which the home is located, in order to improve interpersonal relationships between residents and create the conditions for respecting the rules. ● Activating social management offices in the former ATER and networking them with the territory (social services, health services, law enforcement and volunteer organizations), to be able to offer accompaniment to Housing and the management of fragility. ● Social sustainability also passes through a protection system that must be guaranteed (in a targeted and detailed manner, but necessary to identify needs, determine people's necessities and intervene in a direct and immediate manner).

At Trieste, the specific italian PPP policy instrument was discussed, and the following points raised:

- **Contractual and regulatory complexity of PPP contracts:** very complex and require advanced legal and technical skills to be negotiated and managed correctly, professionalism not always present within the host companies. Furthermore, the Italian legislation on PPPs can be fragmented and subject to frequent changes, making it difficult for the parties involved to manage the projects.
- **Risk of inadequate risk transfer in PPP contracts:** often, risks are not equally distributed between the public and private partners, with the risk that the public body ends up assuming most of the financial and operational responsibilities, also due to a difficulty in assessing in advance the risks associated with the PPP.
- **Financial sustainability of PPP:** it can be compromised if the expected revenue flows have not been properly assessed. Furthermore, there is a problem of access to credit for private companies, especially in unstable economic contexts such as those that have characterised the last period.

- **Transparency and governance in PPPs:** lack of transparency in PPP negotiation and management processes can lead to suspicions of corruption and conflicts of interest. Furthermore, governance structures and monitoring mechanisms are often not robust enough to ensure that projects are executed efficiently and in accordance with agreements.
- **Operational effectiveness and maintenance of PPP contracts:** the quality of SH buildings and services can vary significantly, with the risk that expected standards are not met. Furthermore, PPP contracts must include clear provisions for the long-term maintenance of buildings, but this aspect is often overlooked or underestimated.
- **Risk of project failure:** PPP projects can be subject to significant delays and cost overruns, which undermine their effectiveness, and are also subject to the risk of failure of the private partner, resulting in the public body having to take control of the project, with additional costs and risks.

Denmark

Two workshops were held in Denmark during the project; in Copenhagen in May of 2023, and Aarhus in September of the same year. The findings are summarised below.

Challenge	*Possible solutions*
High initial investment costs for energy renovations	Energispring suggests exploring financing options such as ESCO models or seeking government grants and incentives to offset these costs.
Limited knowledge and awareness among residents and tenants	Energispring emphasizes the importance of education and knowledge sharing through communication material to inform and engage residents in energy-saving practices. Clear information and incentives can encourage behavioral changes.
Technical complexities and outdated infrastructure	Energispring recommends working closely with utility companies e.g., HOFOR to assess and upgrade the building's technical systems, improving energy efficiency and reducing heat consumption.
Lack of motivation and commitment from housing associations	Energispring proposes setting clear green objectives and integrating sustainability into the CSR profile of housing associations. This can be achieved through knowledge sharing, benchmarking, and showcasing successful case studies.
Make operational success visible to residents	Energisprong suggests informing residents about operations with communication material.
Strengthen the competence level of the operating employees	Energispring has identified the need for training operation employees otherwise the process will be costly and inefficient.

Challenge	Possible solutions
Lack of ownership	KAB points to the importance of raising awareness of energy consumption and its impact on both the environment and cost savings to encourage a larger degree of ownership. KAB proposes to promote awareness about the importance of energy management and its impact on both the environment and cost savings is crucial. KAB believes that by fostering a sense of responsibility, engagement, and empowerment the staff members and residents will become active participants in achieving energy efficiency goals and creating a sustainable future.
A continuous new roll of staff members	KAB identifies having the right people and providing adequate training to new staff members. KAB aims to foster a sense of ownership and encourage active participation to give them a voice and involve them in energy-saving initiatives.
No prior experience with CTS	Training program for employees. KAB recommends involving the right people and providing adequate training to new staff members on the usage of the data management software.
Time management	Management tools.

Regarding challenges in reducing the energy consumption in buildings.	• Lack of support within the management for implementing energy measures. • ESCO is complex and bureaucratic aspects are obstacles. • ESCO needs municipal approval. The municipality supervises the financing in social housing companies, and there must be a motivation if, for example, suspensions are used for financing. • More guidance - there are many rules to interpret. And more flexibility in how funding is handled. • Obtaining finances to carry out the energy renovations. • Getting the residents involved often requires a rent increase.
Targets for energy consumption.	• A barrier is a lack of knowledge and too abstract a process.

	• A barrier is to know who is responsible for what energy consumption. • The majority have set goals to reduce energy consumption.
Who regulates your central heating systems?	• Staff members that are trained to use the central heating system.
Do you work with data in your organization - heating data, weather data, etc.?	• Approx. 50% of represented social housing companies work with energy consumption data and data on energy costs related to energy poverty. • Engineering companies work with energy consumption data and data on energy-saving measures. • The majority work with data, either through CTC facilities or larger energy management systems.
Energy management, and systematically work with data in relation to energy management.	• Social housing companies work with energy consumption data and data on energy costs related to energy poverty. • Engineering companies work with energy consumption data and data on energy-saving measures.
Sources for financing energy improvements?	• Landsbyggefonden (The National Building Fund) finances building renovations including building energy-saving measures. • ESCO financing for energy saving/RES investment as a supplementary financing source, supplementary to LBF financing with a focus on energy measures without building renovation and "fast track financing" of energy measures. • Around 90% work with self-financing through banks and mortgage credit and financing through LBF. • A minor share has received EU grants, and/or tried ESCO financing models.

Slovenia

One workshop took place in Slovenia; the topics raised by the attendees, and the proposed solutions, are presented below.

Investing in energy efficiency in social housing

SOCIAL HOUSING MANAGERS	
Obstacles	*Possible solutions*
Energy retrofit of the building has no impact on increasing owner's revenues from rental income (limited motivation to invest)	Reducing the requirements for energy performance of buildings which will lead to a greater number of smaller investments in the energy rehabilitation of the building
The amount of grant receipt also depends on the form of ownership of the company (public enterprise vs. private limited company)	Change of legislation and/or regulations.
Energy-efficient building renovations can be expensive and due to the limited amount of financial resources difficult decision between building new residential buildings or energy rehabilitation of existing ones	More grants Educating tenants on reducing consumption and promoting energy renovations
Lack of interest in energy renovations due to low dedicated grants	More dedicated grants

FINANCIAL INSTITUTIONS	
Obstacles	*Possible solutions*
Lack of interest in financial services due to fragmented ownership issues and many unreceptive and unfamiliar owners	Simpler procedures Promoting energy renovations
Large volume of applications for photovoltaic system subsidies - processing of applications takes time	Less administration

ESCOs	
Obstacles	*Possible solutions*
It is difficult to get enough consents to begin the restoration process due to fragmented ownership issues and many less receptive landlords.	More dedicated grants
Some neighbourhoods have low-income residents who are unable to afford to pay for energy-efficient building renovations	Educating owners on reducing consumption and promoting energy renovations More dedicated grants

HOUSEHOLD ORGANISATIONS	
Obstacles	***Possible solutions***
High complexity of implementation as a result of multiple stakeholders/owners of buildings.	

LOCAL AUTHORITIES	
Obstacles	***Possible solutions***
Years ago lack of interest in energy renovations due to low prices of district heating (in the municipality of Velenje)	More dedicated grants
Lack of interest in energy renovations due to legal administrations.	Changes of legislations, less administration

Conclusions

The role, size and build quality of social housing across Europe vary significantly across Europe; as such, so does the task of delivering net zero social housing. Several common themes emerged across our discussions however, and are identified below:

Support and Financing

- Limited financial resources and thin operational margins for social housing companies.
- The importance of stable, long-term financing and simplified administrative procedures

Data use and Innovation

- Innovative approaches, such as prefabrication and energy communities, may accelerate renovation and improve outcomes.
- There is a need for flexibility in renovation strategies and the importance of engaging tenants throughout the process were emphasised.
- The importance of accurate data in decision-making and optimization of renovation strategies.
- Use of smart sensors and monitoring systems for real-time performance tracking, and data-driven energy performance contracting could unlock new value streams.

Supply chain

- There is a lack of skilled providers of retrofit services and, in many member states, firms that can fit low-carbon technologies such as heat pumps. In some
- High upfront costs for sustainable technologies (e.g., geothermal heat pumps)
- Need for innovative financing models, such as split incentive schemes, next to government investment
- Potential for new value streams through accurate energy performance data
- Exploration of collective tendering and financing mechanisms for private homeowners

4. Conclusion

Super-i has explored the support, drivers and barriers to energy efficiency investment in social housing across Europe, and seen how these apply in the field to the improvements proposed at the project partner housing associations. We find that, while there is significant variation in the policy landscape and the nature of the challenge to deliver net zero social housing across Europe, there are many structural issues that are slowing the rate of investment in social housing.

Included in these are a range of principal-agent problems, where the incentives of tenants and housing associations are difficult to align, and future savings cannot be banked to fund current investments. Further, improving building fabric and fitting low-carbon technologies in the sector is difficult to scale, given the variety across the sector in each member state. Across the super-I project, we found housing associations would typically fit only a subset of the proposed interventions, due to high installation costs, and lack of a market mechanism to fund up-front costs from future savings.

The findings on optimal leverage ratios provide valuable insights into the financial strategies of social housing associations in Italy, Denmark, and Slovenia. Denmark's higher leverage ratios indicate a robust financial market with favourable conditions for debt financing, which significantly boosts private investment in energy efficiency projects. Italy, with its high leverage ratios, also benefits from advantageous borrowing conditions and supportive tax policies, though its leverage factors decline over time. Slovenia's lower leverage ratios suggest a cautious approach to debt financing, constrained by higher borrowing costs and less developed capital markets. Overall, the leverage factors highlight the varying effectiveness of public investment in attracting private capital, with Denmark showing the highest effectiveness, followed by Italy and Slovenia. These insights are crucial for policymakers and social housing associations aiming to optimise their financial strategies for energy efficiency projects.