

SUPER•i D3.1 Promoting feasibility assessments for the investment pipelines in 3 SUPER-i

partner countries

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D3.1 – Promoting feasibility assessments for the investment pipelines in 3 SUPER-i partner countries

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3. Executive summary

In this report we outline the energy efficiency retrofits proposed at each Super-I Project pipeline building, and identify as set of commercial and contractual arrangements through which these can be delivered. We find that across the nearly 2,000 social housing units in Denmark a set of similar upgrades is proposed, with windows to be upgraded to modern energy-efficient versions, and heat recovery to be included in most buildings. These upgrades may be funded through the country's National Building Fund (NBF); a private fund into which around a sixth of all homes in Denmark contribute, that finances renovations to (mainly social) housing, though other schemes are also available, including direct funding by the residents. Of the two Italian pipelines, one is to be extensively renovated, and the other demolished and rebuilt. There is little information on the plans for the latter, but for the former we expect significant improvement in energy use and associated emissions. There are range of support instruments in Italy, across a range of central and local governments, including the Ecobonus and Superbonus, which pay a premium on energy efficiency measures. In Slovenia, we expect the residents to fund the improvements to their walls and roof directly, but there are a range of funds available, many targeting larger developments than the 4 floor block in the pipeline.



4. Introduction

This deliverable provides an initial assessment of social housing provider needs in Denmark, Italy, and Slovenia, presenting a comprehensive overview of the technical, financial, and environmental aspects of planned Energy Efficiency (EE) retrofit projects. This deliverable addresses the common challenges and needs in the social housing sector across European countries, emphasizing the importance of standardization for successful energy efficiency (EE) investments. The study encompasses pilot project pipelines in the three partner countries, providing insights into the planned retrofit measures, budgets, and climatic conditions.

4.1. Scope of the deliverable:

This deliverable analyse the social housing developments in Denmark, Italy, and Slovenia, evaluating the existing building conditions, proposed EE improvements, and financial considerations. The objectives revolve around identifying innovative financing mechanisms for diverse retrofit projects, considering the varying climatic conditions and building types. The proposed energy efficiency improvements include window replacements, heat recovery systems, and insulation upgrades. The technical assessments aim to achieve meaningful improvements in energy performance while considering the unique features of each housing complex. The study also aims to contribute to the standardization of EE investments in the social housing sector, facilitating cross-country comparability. The partner countries share common concerns regarding affordable, accessible, and energy-efficient housing. The study highlights various housing market models, funding mechanisms, and government interventions. Each country's unique approach to social housing financing reflects the need for collaboration between the public and private sectors. This deliverable emphasizes the importance of life cycle assessment methodologies to evaluate the environmental, economic, and social impacts of retrofit strategies. LCA stages and boundaries are defined, focusing on energy consumption, CO2 emissions, and other key indicators during the building's life cycle. The LCA/SLCA findings aim to demonstrate the benefits of retrofitting in terms of resource usage, energy source savings, and improvements in environmental, economic, and social aspects.

4.2. Objectives of the deliverable:

- Evaluate and improve the energy efficiency of social housing in Denmark, Italy, and Slovenia.
- Assess the viability of existing financial instruments and propose innovative financing solutions.
- Provide a comprehensive Life Cycle Assessment (LCA) and Social Life Cycle Assessment (SLCA) to analyse the environmental, economic, and social impacts of retrofitting strategies.
- Develop pilot project pipelines for social housing associations in the three countries, considering diverse climatic conditions and building characteristics.

4.3. Main findings of the deliverable:

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• Denmark:

• The Danish pipeline comprises three social housing developments with reasonably wellinsulated buildings. The proposed improvements involve window replacement with triple glazing, heat recovery systems, and enhanced insulation on heat network pipes. The focus is on achieving modest energy efficiency gains without structural changes.

- Social housing rental accounts for 21% of the housing stock, with periodic negotiations for the National Building Fund's investment framework. A collaborative effort between the social housing sector and the government is crucial for sustainable housing expansion.
- Danish housing developments exhibit relatively high energy standards due to historical building practices and consistent improvements.
- Relies on the National Building Fund, including the Revolving Renovation Fund, basic capital loans from municipalities, state mortgage loans, and tenant deposits.

• Italy:

- The Italian pipeline targets two complexes in Trieste, emphasizing substantial improvements in thermal performance to meet regional standards. The projects aim to access national funding schemes and tax deductions, with a focus on achieving up to 40% improvement. The Superbonus program requires compliance with specific U-values for different building elements.
- With 3% social housing stock, Italy faces high demand, prompting the involvement of private capital. The recent establishment of an informal committee aims to improve strategic coordination and overcome current fragmentation in the social housing sector.
- Italian projects involve extensive renovations, including facade insulation, heating system upgrades, and the installation of solar PV systems, supported by national incentives such as Ecobonus and Conto Termico.
- Italy leverages tax deductions (Ecobonus, Superbonus), non-repayable contributions (Conto Termico), and investments from the National Energy Efficiency Fund

Slovenia:

- Slovenia's pipeline involves a single building from 2005, focusing on exterior wall and roof insulation. No changes to windows are proposed due to their relatively good performance. The retrofit aims to increase energy efficiency while maintaining the existing heating system.
- Social housing represents 6% of the housing stock, with a focus on increasing the number of public rental dwellings. The Housing Fund of the Republic of Slovenia plays a key role in implementing housing policy, requiring stable financial resources for effective execution.
- The Slovenian pipeline focuses on insulation for walls and roofs, emphasizing the Eco Fund's role in providing financial incentives for environmental investments.
- Slovenia utilizes Eco Fund, offering soft loans and grants, to promote environmental investments and address energy poverty.



5. Initial assessments of social housing provider needs

5.1. Technical

5.1.1. Denmark

The Danish pipeline comprises 3 social housing developments, Fruehoejgaard Social Housing Company, Housing Areas Børglumparken and Himmerland Boligforening Social Housing Company. Of the 15 complexes, including 1,831 units, included in the project, only the latter's Afdeling Søndergade has been built since 1979, though only 20% of the units were built since 1993. Danish building energy performance standards have been higher than most European countries since the mid 70s, so these buildings are warmer than contemporary social housing in other nations. Also, all the developments are served by heat networks, which provide energy for space heating and hot water, and decarbonisation of heat has been achieved by switching these networks from fossil fuels to biomass, without the need to remove or install devices in the blocks or individual units. While well below Denmark's current building standards, the buildings in the Danish pipeline are reasonably well insulated, summarised in the table below.

| Building Parameter | Value |
|--------------------|--|
| EPC Rating | All E or better, and only 4 worse than C |
| Windows | Double glazed PVC, around 10-15 years old |
| Walls | All buildings have cavity walls insulated with ~100mm mineral wool |

The proposed energy efficiency improvements therefore comprise no structural works or external insulation, instead they will replace the windows with more airtight triple glazing in all buildings, and:

- install a heat recovery system at Fruehoejgaard and Housing Areas Børglumparken
- Improve the insulation on the heat network pipes at Himmerland Boligforening

Modelling suggests modest improvements (up to 5%) may be achieved through the improvement to the windows; the specifics of the heat network lagging and the heat recovery technology were not available.

5.1.2. Italy

The Italian pipeline comprises two building complexes in Trieste; a set of 8 blocks built in 1951 (Boito 5), and a set of 20 towers, grouped into 3 developments comprising a total of 251 units (Montasio 31). Due to its age Boito includes very few energy saving measures; it is built over a concrete and brick floor 16 cm deep (U values of around 1.4 Wm⁻²) and comprises a stone basement and four floors built of hollow brick and covered by a simple hipped tiled roof. The windows are single-glazed wood frames with high transmittance (U-values of around 3.6Wm⁻²).



It is due to be comprehensively rebuilt, with the new building expected to use only half of the previous heating demand each year.

The buildings at Montasio comprise a reinforced concrete frame and a skin of 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 from the outside is 45 cm, giving a U-value of 1.68 Wm⁻². The towers are covered with a pitched roof, the space below which is used as an attic and not heated. The floors are made of concrete and brick, and the double glazed windows are mounted in aluminium frames. The towers are to have their heating plant and windows upgraded, and to have insulation added to all horizontal surfaces (roofs, floors) between the heated parts of the complex and the exterior/unheated parts (attic, cellar etc). Modelling suggests this will improve the thermal performance by up to 40%. These improvements will be funded in part by a national funding scheme that sets minimum thermal performance standards by climatic region; as Trieste is in Zone E - the second coldest - the requirements are relatively high. Both buildings must reach the minimum values presented in Table 1, and to benefit from significant tax deductions must improve beyond the values shown in the third column.

| | Maximum permitted U value (W/m ² K) | | W/m²K) |
|--|--|-------------------|-----------------------|
| Building element type | 2015 | 2021 ¹ | Tax Ded. ² |
| Maximum thermal transmittance of vertical opaque structures | 0.3 | 0.28 | 0.23 |
| Maximum thermal transmittance U of horizontal or inclined opaque structures | 0.26 | 0.24 | 0.2 |
| Maximum thermal transmittance of horizontal flooring opaque structures | 0.31 | 0.29 | 0.25 |
| Maximum thermal transmittance of transparent and opaque technical closures and bins. including fixtures. outwards and towards non-air conditioned environments | 1.9 | 1.4 | 1.3 |

Table 1 - Values of the characteristic parameters of the building elements in existing buildings subjected to energy redevelopment in Italian E climatic zones.

Further, one of the requirements to access the Superbonus is to present two energy performance certificates (pre-intervention or ante-operam APE and post-intervention or post-operam APE), so as to certify the improvement of the energy classification. which must be at least two letters.

5.1.3. Slovenia

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The Slovenian pipeline comprises a single building, built in 2005 and comprising 26 units over 4 floors with a total floor area of 1,806 m². Proposed works are summarised in the table below:

| | | Current State | Proposed Improvement |
|--|--|---------------|----------------------|
|--|--|---------------|----------------------|

¹ MISE. Supplemento ordinario n. 39 alla GAZZETTA UFFICIALE Serie generale - n. 162, Appendix B

² Decreto Efficienza Energetica - MEF, Allegato E, Requisiti degli interventi di isolamento termico

| Walls | blocks without thermal protection, and has a U-value of 2.0 Wm ⁻² | incorporation of insulation on the exterior of at least 14 cm |
|-------|--|---|
| Roof | Flat roof without insulation | Glass wool to a thickness of at least 20 cm will be added |

Renovation of the windows is not proposed, given their relatively good performance (due to the good fittings of the PVC frame and double glazing) our modelling suggests the return on investment would be low. No changes are proposed to the heating system, which will continue working with individual gas boilers to heat all the flats; but existing units will be replaced with more efficient models. The hot water supply will be switched from gas to smart electrical generation, using 80L thermal storage allowing generation to move to when electricity is cheap, rather than as it is needed. The main national policy driver of retrofit for energy efficiency is the government aim of reducing the share of buildings in the EPC category F and below; the pipeline building already meets this requirement, and there are no additional policies that bear on the performance requirements for the building improvement plan. As the works will be paid for from a fund paid for by a percentage of tenant rents, financing the retrofit places no performance demands to the renovation.

5.2. Financial

The partner countries³ show common features that highlight the need for successful standardisation of EE investments in the social housing stock. Despite the existence of different frameworks and types of social organisation and institutions, the common features, concerns and needs of the social housing stocks are similar. On one hand, there are many ways in which governments deal with the social housing sector and there is a wide variety of housing market models throughout the EU. For instance, the share of social housing in the EU ranges from 30% to 2%. On the other hand, affordable, accessible, and energy-efficient housing is a common concern in the EU and investments are expected to focus on long-term social infrastructures, human capital and inclusive resilient communities. For instance, as common features, the main instrument used by cities to increase affordable housing is their planning and zoning regulation (e.g. Denmark, UK), as well as funding and the use of public companies (e.g. Slovenia) or PPPs specifically set up for this purpose (e.g. Italy). The study of current projects in some partner countries and corresponding standardisation of the main elements will be a very efficient tool to extend the analysis and comparability across the EU.

5.2.1. Denmark

In this country, social housing rental accounts for **21% of the entire housing stock**. Every four years the Danish Parliament negotiates a new Housing Agreement. The latest negotiation took place in the autumn of 2019. A major point in the negotiations was the investment framework of the National Building Fund (NBF), which plays a key role in providing funds for renovation projects of social housing estates. It is expected that a growing population will result in a higher demand for social housing. This aspect, combined with the

³ <u>https://www.housingeurope.eu/resource-1323/the-state-of-housing-in-the-eu-2019</u>



agreement to reach efficiency between the Local Government Denmark, BL - *The Danish Social Housing Sector* and the Danish Government makes it compel the need for better financing conditions of sustainable housing expansion. As people increasingly want to live in big cities, it is critical to look at how cities can be expanded in a sustainable way with a mixed composition of residents. To this goal, a strong collaboration between the social housing sector and Government is essential, as well as strategic partnership across the public and private sectors.

5.2.2. Italy

In this country, in the early 1990s, competence for housing policy in Italy was transferred to the *Regions* and local authorities. The social housing stock represents only 3% of the entire housing stock. However, the demand for further social housing accommodation is high as there are almost as many households waiting to access public housing as households currently living in the sector. The 2008 national Housing Plan recognized for the first time a substantial role of private capital in contributing to increase affordable housing supply leading to the establishment of private social/affordable housing in Italy and to the entry in the sector of new players, especially dedicated banking foundations, and the creation of a new national financing platform SIF (Sistema Integrato dei Fondi) pooling a national fund, FIA, resources from Cassa Depositi e Prestiti, from the Ministry of Infrastructure and Transport and from other private investors. Furthermore, it's important to mention that cooperatives have played a significant role in the provision of housing for affordable home ownership. The European Commission highlights that as of today the social housing system remains extremely limited and 'affected by limited funding, difficult coordination between different government levels and lack of strategic overview.' Significant investment is needed to improve the quality and energy efficiency of the stock and increase supply of public housing. This requires stronger support from the central government. At the same time, the emerging *private sector social housing* shows positive results, but a more integrated strategy and coordination among the different actors is needed to overcome current fragmentation and under-supply. Therefore, the recent establishment of an informal committee bringing together the different sectors seems promising. The aim is to define objectives and common practices, build public and private partnerships, and ultimately to guarantee a strategic financial blending with a coherent revenue threshold for the actors involved.

5.2.3. Slovenia

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SLOVENIA: In 2019, social housing represented **6% of the total housing stock**. In December 2015, the Resolution on the National Housing Programme for the period 2015-2025 was adopted, which redefined the *Housing Fund of the Republic of Slovenia* as the main provider of housing policy in the country. The Fund acts as an independent legal entity and on a not for profit base. It finances and implements the national housing programme, promotes house building, and housing renovation and maintenance. Data from the Surveying and Mapping Authority of the Republic of Slovenia show that the amount of available housing for rent is not sufficient in both Ljubljana and Maribor. The Fund therefore plans to increase the number of public rental dwellings. In order to effectively and efficiently implement the targets set by the Plan, the Fund needs to be provided with additional human resources and financial resources on a stable basis. At the same time quality improvement is a priority, including optimizing procedures for the renovation and maintenance of the housing stock, and developing new technical standards for housing construction.

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5.2.4. Pilot project pipelines performed by SUPER-i partners

As a result of the close collaboration of the SUPER-i partners with social housing associations from three countries, Denmark, Italy and Slovenia who kindly provided relevant data on upcoming planned retrofit projects, three sets of pilot project pipelines have been adopted as initial case studies for the SUPER-i project. The municipalities and housing associations are proposing to conduct retrofit projects on their social housing; however, these are still early stage plans. The SUPER-i project is investigating innovative approaches for financing these projects. The pipelines of these social housing associations cover different types of measures, with a range of budgets and scales, and a variety of countries with different climatic conditions (e.g. northern countries with colder weather are more likely to have a large ongoing saving associated with building fabric insulation improvements). The retrofit projects from the three countries have been selected for use in the SUPER-i project so that the project can analyse potential innovative financing systems for a diverse range of retrofit projects, allowing widely applicable learnings to be gained. They cover projects from Denmark with its colder climate and larger requirement for heating (leading to a high benefit from retrofit measures) to Italy with a warmer climate and smaller heating requirement. Furthermore, the projects cover a range of project budgets and sizes, as seen in the table below (each row corresponding to one project as described in detail in the tables above). Project budgets range from €424,000 to €60,000,000, reflecting variations in the number of buildings and their size (total floor space) and the number and depth of interventions in consideration. Note that for Denmark and Italy, the project budgets have been estimated based on the costs of similar projects undertaken for the same social housing company in the past, however the budget for the work has not been allocated and so the SUPER-i project aims to identify suitable sources of financing for these. On the other hand, for Slovenia, the budget represents the actual budget available to the social housing company, with which they aspire to implement the interventions listed, however the SUPER-i project will use their retrofit project as a use case to identify potential alternative sources of financing. The cost of each project per floor space (€ per m²) has also been evaluated in the table, illustrating that there is a large range of project costs even when the total buildings' sizes have been taken into account. This represents the significantly varied levels of interventions proposed across the different retrofit projects, which will be extremely valuable for the SUPER-i project, allowing retrofits with different levels of intervention and consequently cost intensities to be investigated and the most suitable contexts for innovative financing to be identified. Projects vary from replacement of windows only (with a corresponding low cost per m²) compared to extensive interventions (e.g. in Denmark: insulation of roofs and walls, replacement windows and district heating pipes, in Italy: heating system refurbishment, replacement windows and LED lighting, external wall insulation, solar panels and mechanical ventilation). These deeper interventions have higher costs, but the corresponding benefits are also expected to be remarkably high, and so it is critical to reduce barriers to the implementation of such schemes through the identification of innovative financing opportunities. Specific details and data from the 3 project pipelines will be provided within deliverables D1.3 "Evaluation of existing financial schemes", and D2.2 "Social housing EE investment projects initial database".

5.3. LCA/SLCA

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The life cycle assessment (LCA), life cycle cost (LCC) and social life cycle assessment (SLCA) are methodologies that enable social housing owners and other stakeholders to understand the environmental, economic and social benefits and drawbacks of the refurbishment and renovation social housing strategies. The LCA methodology is usually used to evaluate the environmental impacts of each of the stages under consideration. According to CEN TC350 standards ²³, the following diagram comprises all the scope of the

LCA to assess the impacts of buildings life cycle (Figure 1), on the other hand Figure 2 shows all the LCA stages and boundaries for buildings refurbishment.



Figure 1- Scope of the LCA to assess the impacts of buildings life cycle Source: CEN TC350 standards^{4 5}



⁴ EN 15804:2012 + A1:2013, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products, CEN, Brussels.



⁵ EN 15978:2011, Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method, CEN, Brussels.

Figure 2- LCA stages and boundaries for buildings' refurbishment.⁶

According to the methodology followed in BuildHeat project⁴, to assess the impact on the use stage of a social residential building, the main entries have been the final energy consumption for heating, cooling, hot water and lighting in kWh per m² per year, and CO2 emissions for heating, cooling, hot water and lighting in kg CO2 per m² per year. Other important key indicators are the useful surface and the life span of the building, since the previous ratios are expressed in m² of useful surface per year. The functional unit in use is one square metre of useful residential surface. Alternatively, results can be also given in absolute terms for one building in 50-years analysis period. The aim of the LCC is to account for all of the costs that will be incurred during the lifetime of the building, considering not just the purchase price of the materials in the production phase, but the related costs of the services during the use phase. From the energy use perspective, in general terms, it is important to highlight that the operation represents between 90% to 70% of the total energy demand and carbon footprint of the average building, the rest is mainly due to the energy embodied in the material components of the building ⁴⁷. In this sense it is important not only to take into account the energy retrofitting technologies to reduce the energy consumption of the building, but also the low demanding energy production materials used for the refurbishing, though the application of an LCA shows that the environmental impact related to material use is low in comparison to achieved reductions due to energy use under business-as-usual scenarios. Construction and end of life phases have minor or even no account in the total life cycle assessment, both environmentally and economically, but it has to be taken into account, that buildings' demolition involve large quantities of materials landfilled that cannot be evaluated through these impact indicators, but with others that have to do with land use, toxicity, etc. In this sense, the Construction Products Regulation (CPR)⁸ include the basic requirement:

The construction works must be designed, built and demolished in such a way that the use of natural resources is sustainable and in particular ensure the following (which plays an important role in circular economy):

(a) reuse or recyclability of the construction works, their materials and parts after demolition;

(b) durability of the construction works;

(c) use of environmentally compatible raw and secondary materials in the construction works."

Currently, Environmental Product Declarations (EPDs) could be used to prove compliance with this basic requirement, according to the regulation⁹.

In terms of the material's environmental impact, one of the most economic but energy demanding materials is concrete due to the energy intensive process of clinker manufacturing, but also in terms of mass represents 75% of total consumption, followed by aggregate materials (65%). Massive and tall buildings usually use a lower volume of materials per square metre of useful surface but, on the other hand, require higher amounts of highly reinforced concrete in foundations, by columns and structures made of steel and wood (21 and 37.5%, respectively), increasing the environmental impact of the production phase. Following is the gypsum,



⁶ CIRCE foundation and contributors. D4.3. - LCA-LCC study for technical results and demo cases. BuildHeat project GA N. 680658, November 2018

⁷ Gilles Flamant, Waldo Bustamante, Cristian Schmitt, Victor Bunster, César Osorio,

Thermal and environmental evaluation of mid-rise social housing retrofit under different climate conditions, Journal of Building Engineering, Volume 46, 2022, 103724, ISSN 2352-7102, https://doi.org/10.1016/j.jobe.2021.103724.

 ⁸ Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, EU, Brussels.
⁹ Gervasio, H. and Dimova, S., Model for Life Cycle Assessment (LCA) of buildings, EUR 29123 EN, Publications Office of the European Union, 2018, ISBN 978-92-79-79973-0, doi:10.2760/10016, JRC110082.

where the impacts associated to its finishing are not only due to the proportion of replaced material in the 50 years of analysis but also due to the removal and transport of the deteriorated materials. Using more endurable materials would contribute to improving the environmental and economic performance of the buildings and resource consumption reduction, as buildings represent the 50% of all the materials extracted from earth ⁴⁷. With regards to primary energy sources impact, the use of natural gas for heating instead of electricity for the same energy demand is advisable as it brings a reduction of 2 to 3 times in primary energy demand and carbon footprint, and a much higher reduction in water demand. The variation in cost is also lower than electricity. Another alternative is using high efficiency heat pumps as it would have the same effect in terms of primary energy demand as the higher impact of using electricity is compensated with a lower demand. For the case of water as a resource, the water demand is mainly driven by the electricity direct consumption and embodied in material construction. Reducing energy demand, mainly electricity, will result in a lower water footprint. On the other hand, improvements should also be seen as a comfort improvement for the vulnerable families, as one kWh of heating demand saved would not only end up in an actual energy saving. With respect to SUPER-i pipelines when doing a LCA of the current situation of the nonrefurbished building the results will be compared with the new LCA data adding the energy efficiency technologies. The expected results should demonstrate lower total values for the 50 year analysis of the refurbished buildings with respect to the current building. Data for the usage phase may come from two sources, from direct energy measurements of the retrofitted buildings that enjoy the benefits of the solutions, or from energy simulations made with consistent tools. The second is preferable and corrections for the baseline variables are needed (i.e. weather, occupancy, measurement time, building usage boundary conditions). It requires a full year to gather data around the 4 seasons. In this sense, some general recommendations are included for the proposed energy efficiency improvements in the pipelines buildings of SUPER-i project⁴:

- <u>More efficient resource usage (energy and materials)</u>. This implies building the solutions with lower amounts of materials and energy, or using less impacting materials. Recycling is a good way to increase the utility of the materials, avoiding new raw materials usage. Extending the lifetime of the equipment by making more robust designs or creating appropriate repairing and refurbishment strategies also helps greatly to a lower life cycle environmental cycle. Finally, making more efficient equipment with the same inputs would not decrease the device LCA contribution but will reduce the impacts of the building where their service is going on.
- <u>Energy source saved.</u> Most savings apply to HVAC and DHW consumptions. For an average European electricity mix, the use of electricity has a greater environmental and economic impact than the original gas. This is especially important in the case of the water footprint due to the high water usage of electricity generation in most cases.
- More materials imply a higher life cycle impact to be offset by larger use-phase impact savings along the 50-year analysis.
- Lower equipment costs and longer life expectancy will positively contribute to reducing the gap of life cycle costs.
- Lower environmental burden means lower compensation costs for the society to account for regeneration of environmental balances.
- Lower use-phase costs help vulnerable families to avoid social exclusion and to fight energy poverty.



- Improvements in comfort increase the life standards of low-income families and mitigate health problems derived from energy scarcity at home.
- Successful retrofitted buildings are examples of best practices that contribute towards common European sustainability targets.

As complementary, considering environmental impact results (considering ReCiPe impact categories¹⁰), in general terms, the replacement of windows has the largest relative environmental impact followed by façades insulation. Roof insulation has a consistently low environmental impact together with the insulation of the floor or basement. Upgrade of ventilation system with heat recovery have a relatively low environmental impact across all environmental categories¹¹.

¹¹ Magnus Österbring, Érika Mata, Liane Thuvander, Holger Wallbaum, Explorative life-cycle assessment of renovating existing urban housing-stocks, Building and Environment, Volume 165, 2019, 106391, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2019.106391.



¹⁰ https://pre-sustainability.com/legacy/download/Report_ReCiPe_2017.pre-sustainability.com/

6. Selection of appropriate financial

Below we summarise the existing financial instruments for Denmark, Italy and Slovenia. An initial selection of appropriate financial instruments will be carried out within deliverables D3.2 "Implementation of financial schemes for social housing" and D3.3 "Evaluation methodology for the implementation of financial instruments" taking the existing schemes as starting point. Particular attention will be given to Public Private Partnership schemes where the ESCOs act as facilitators.

6.1. Denmark

Renovation and refurbishment – Revolving finance

In Denmark, the **National Building Fund** (NBF) is an independent institution with its own board. Around 15% – 20% of the housing stock in Denmark contributes to the fund, and its investment activity is regulated by law. In connection with the financial crisis it was used to spark Danish economy (by allowing more renovations they were channelling more resources into the construction industry and hence generating more jobs and subsequently more growth). When the original construction loans are amortized the housing departments/organizations continues their payment at first to the state and secondly to The National Building Fund. It is divided into a revolving renovation fund, the housing organisation's own disposition Fund and a fund for new construction. Within the NBF, the **Revolving Renovation Fund** (RRF) has a well-defined and limited purpose, but the tenants can also decide to renovate their houses directly.

Financing of new construction

The Municipality – Basic capital

Basic capital loans are provided by that particular municipality in which the dwellings are to be constructed. The loans are interest-free as well as amortisation-free up to 50 years after the occupancy of the property, and covers 10 per cent of the acquisition price of the dwellings. The municipalities are not allowed to take out loans to finance the basic capital.

The State – Mortgage loans

The majority of the construction costs are financed through ordinary mortgage loans on real property, on normal conditions – though social housing is ensured a certain amount of stability through a state fixed interest rate. The difference between the fixed interest and the actual interest is covered by the Government; the rest is covered by the tenants through their monthly rent. In order to swiftly and flexibly adapt the mortgages to market conditions, for the purpose of minimising state expenditures, the Minister for Social Affairs together with the Minister for Economic and Business Affairs, defines what type of loan is to be used for financing new constructions. At present new dwellings must be mortgaged with 30 year adjustable rate mortgages, and the remaining balance is refinanced annually. As a requirement, the municipality must provide a guarantee for the mortgage loans.

The tenants – Deposits

Deposits are paid by tenants upon taking up residence, and are repaid to the tenants at the end of tenancy.

6.2. Italy

As indicated by the report by **ENEA**¹² (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) "*Energy Efficiency trends and policies in ITALY*"¹³ Social Houses in Italy can benefit from the following national measures incentivising energy retrofitting work:

- **Ecobonus**: a tax deduction of 110% of the expenses incurred for energy efficiency and seismic risk reduction in Italy. This measure was applicable for expenses incurred from 1st July 2020 until 31st December 2021 and the 110% deduction could be recovered in 5 annual instalments.
- **Conto Termico** [Thermal Energy Account] this is a non-repayable capital contribution granted for implementing small energy efficiency measures and producing thermal energy from renewable sources in existing air-conditioned public buildings registered with the Land Registry.
- National Energy Efficiency Fund¹⁴: this is an investment fund targeting to invest up to €175m in energy efficiency ("EE") projects and small/medium-scale renewable energy ("RE") projects, mostly solar PV.

All over Italy, there are a number of success stories. For example, in Sicily, with the support of the Region and ENEA, the Municipality of Marsala (managed by the social housing company located in the city of Trapani) has implemented an energy efficiency programme for 80 social housing dwellings using **Public-Private Partnerships**. This EE programme has the goal to upgrade the heating and hot water systems while improving the building insulation and installing solar PVs. The project has been developed in line with the Minimum Requirements Decree: it is expected to generate energy savings of around 80% compared to the existing situation, allowing the building to achieve nZEB classification. The planned interventions are eligible for the *Conto Termico* incentive scheme.

As indicated by the report by **ENEA**¹⁵ (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) "*Energy Efficiency trends and policies in ITALY*" ¹⁶ the **Superbonus** is a new financial measure which supports structural energy efficiency refurbishment of buildings via a tax deduction at a rate of 110%. The EE measures include thermal insulation of facades and/or roofs (such as external cladding) and replacing heating systems, in combination with the installation of photovoltaic systems or micro-cogeneration systems. Beneficiaries of the Superbonus can also carry out additional energy efficiency measures on their building (such as replacing windows and doors or installing a home automation system). The Superbonus allows the beneficiary to transfer the tax credit to a third party so that energy retrofitting can be implemented also when the owner cannot afford the initial investment.

Additionally, **Public Private Partnerships** have been already successfully experimented in Italy and there is scope for further application of these schemes and a possible combination with **Green Public Procurement**¹⁷ (GPP).

In this section, we list the available funding sources to meet the investment demands for the implementation of energy efficiency renovations accessible to social housing associations for each of the SUPER-i pilot countries.

¹⁷ https://www.xpress-h2020.eu/



¹² <u>https://www.enea.it/en/enea/about-us</u>

¹³ https://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-italy.pdf

¹⁴ <u>https://www.eib.org/en/registers/all/127000349</u>

¹⁵ <u>https://www.enea.it/en/enea/about-us</u>

¹⁶ <u>https://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-italy.pdf</u>

6.3. Slovenia

Eco Fund, Slovenian Environmental Public Fund (Eco Fund), was established in 1993. Its main purpose is to promote development in the field of environmental protection by offering financial incentives such as soft loans and grants for different environmental investment projects. It began with soft loans for investments in environmental protection as a revolving fund. Perhaps the most significant aspect of Eco Fund's operating environment is the requirement that Eco Fund maintains the real value of its assets. For this reason, Eco Fund has provided support to environmental investments through soft loans and developed a strong focus on the financial sustainability of the projects it supports. In 2008, Eco Fund was granted the use of additional financial mechanisms such as grants to support environmental investments. Grants are financed mostly by fees paid by end users of energy and funds from the climate change fund (revenues from CO2 allowances). In order to reach its goals, Eco Fund prepares and carries out yearly plans which serve as a basis for the setting of public calls. Should they wish to receive a grant or a soft loan, the eligible person must send an application for a grant and/or soft loan. Since the beginning in 2008, the number of applications that Eco Fund that receives keeps rising. Eco Fund's subsidies have had a positive effect on tax revenues, diminishing of grey economy, new green jobs, sustainable development of the construction planning and business, as well as on the development of the use of strategic resources such as wood. These effects which simultaneously contribute to the fight against the environmental crisis, on the one hand, and benefit the economy, on the other, point to a positive role of Eco Fund in the process of green growth and development in Slovenia. A few years ago, Eco Fund has taken over the organization and financing of free energy advisory network offering free expert advice on how to improve energy efficiency to households. It has also taken over part of the task of energy poverty reduction by covering the entire cost of several environmental investments of households struggling with energy poverty. Currently, Eco Fund is facing new challenges such as adapting financial incentives to meet new demands of national strategies that set additional tasks for Eco Fund: more deep energy renovations vis-à-vis shallow renovations, higher number of required renovations, stimulation of the remaining, unrefurbished building stock, energy poverty reduction, development of innovative financial instruments etc.

From 1 January to 31 December 2019, a total of €62,100,057 of subsidies were paid by Eco Fund to various beneficiaries (for investments in residential buildings, construction of nearly zero-energy buildings and for electric vehicles, legal entities for electric vehicles, energy audits and energy efficiency investments, and municipalities for environmentally friendly public passenger buses in degraded areas, for charging stations for electric cars in Natura 2000 and protected areas, and for the construction of nearly zero-energy buildings and energy renovation of buildings owned by municipalities), namely:

- for energy efficiency and renewable energy measures in residential buildings, including selfsufficiency in electricity, €41,618,294,

- for the performance of energy audits in companies €35,528,
- €1,897,005 for energy efficiency investments by companies,

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- €8,797,908 for investments by municipalities in the construction of nearly zero-energy buildings,

- for environmentally friendly electric vehicles and buses, €9,415,548 and
- for charging stations for electric cars in the Natura 2000 area and protected areas €335,774.

6.4. Selection of relevant private sector actors including LFIs and IFIs

This selection will be performed after a careful collaboration between the social housing companies in charge of the SUPER-i pipelines and the overall SUPER-i partnership taking also into account the material collected during the initial regional roundtables.

6.5. Incentives for relevant stakeholders to utilise the financial instruments

Both financial (according to the specific financial schemes) and environmental impacts (both costs and benefits) of the planned EE refurbishment in the 3 pipelines will be documented in detail and discussed with the relevant stakeholders. These solutions will be weighted against the national and EU regulations in order to evaluate their actual feasibility.



7. Implementing legal frameworks between all relevant actors of the pilot projects

7.1. Denmark

In Denmark, non-profit social housing represents an essential part of the welfare system and is provided almost exclusively by registered social housing associations. They act as separate legal entities from the state and do fall under the supervision of local authorities. Consequently, there is a strong connection between these two actors and each municipality has the responsibility to assess the need for new housing within their jurisdiction¹⁸.

Both the Danish state and the municipalities support the construction of new non-profit housing by providing financial support. As a result of this supporting measure, the municipality has the right to directly allocate a certain percentage (25%) of vacant units in case of people experiencing urgent need for housing. A mix of funding measures for new non-profit social housing developments is usually applied and consist of: i) loan from a mortgage institution (86-90% of the investment cost); ii) municipal loans (8-12% of the investment cost); tenant equity (the remaining 2% covered by deposits). There is an upper limit on the cost of new non-profit housing construction in Denmark (on a per square metre basis), helping to ensure rents are kept low. The limit varies depending on housing type and region. Concerning renovation activities, the National Building Fund provides directly support covering the cost for substantial investments and in case of minor renovation activities, each housing association in operation before 1970 can access to a dedicated account in the Fund, from which they can draw money for partial financing of necessary interventions. These subsidies are granted for a maximum of two-thirds of the cost of improvements.

In addition, in 2020, the 'Green housing' agreement¹⁹ provides extra resources for the renovation of existing social housing units. An additional €2.5bn in funding has been allocated for the renovation of social housing in 2020 and 2021 aiming at renovating around 70,000 social housing units and creating 15,000 jobs.

Furthermore, the National Building Fund launched a green guarantee scheme incentivising the role of ESCOs and aiming at increasing energy renovations.

Measures tackling energy poverty

Denmark considers energy poverty as a social issue and consequently addresses energy poverty through social policy. Therefore, in the Danish energy policy no specific national objectives exist for the limitation of energy poverty. However, it is possible to find social policy instruments and measures providing financial support to energy related purposes. Some examples are presented below:

Heating supplement Old age pensioners and persons who have taken early retirement (based on rules from before 2003) can apply for heating supplement. The heat supplement is calculated based on an average of three years documented heating costs, if it exists. The calculation of the heating supplement includes costs to the actual heating of the housing and hot water.

¹⁹ https://www.trm.dk/media/xzyjw0pv/groen-boligaftale-2020-final-a.pdf



¹⁸ Cost-based social rental housing in Europe. The cases of Austria, Denmark, and Finland. <u>Cost-based social</u> rental housing in Europe | Housing Europe

Special supplementary housing benefit Persons who meet the requirements to receive social assistance (but who do not necessarily receive the support) and who have particular high housing costs or high costs to support large families can receive a special supplementary housing benefit. Before the municipality provides special supplementary housing benefit, it assesses whether a fair and cheaper housing can be found. Special supplementary housing benefit is based on the difference between what the applicant is assumed to be able to pay in housing costs and net housing costs including water, heat, gas and electricity.

Additional cash support Based on a concrete assessment the municipality can provide support to reasonable expenses if a person has experienced changes in conditions (e.g. unemployment or sickness). The support can usually only be granted if the expense is a result of a need that has not been possible to foresee. Based on a concrete assessment the municipality can, however, make an exception even though it has been possible to foresee the expense, if the expense has a crucial importance to the person's way of life. The support can for instance be given to the payment of a particularly high heating bill.

In the Energy Agreement from June 2018 it was agreed that the current Energy Savings Obligation scheme will end by 31 December 2020. The scheme has been replaced by *competitive subsidy schemes* related to private enterprises and buildings. Denmark has therefore from 2021-2030 fulfilled the saving obligations under Article 7(1) in the EED by alternative policy measures (article 7 b). The main measures to fulfil the saving obligation are: i) a competitive subsidy scheme related to private enterprises: 300 mio. DKK per year in 2021-2024; ii) a competitive subsidy scheme related to buildings: 200 mio. DKK per year in 2021-2024; iii) efficiency of existing buildings by other measures; iv) Subsidy scheme to replace oil burners with heat pumps in buildings outside the district heating and gas grids: DKK 20 million per year in 2021-2024.

The *subsidy scheme related to buildings* allocates DKK 200 million for each year in the period 2021-2024. The scheme has been implemented as a competitive based subsidy scheme aimed at achieving energy savings in buildings. Financial aid will be given to owners of buildings who have renovated their buildings in accordance with a specific list of energy savings belonging to the subsidy scheme. In order to achieve as much savings as possible the projects will compete in relation to the amount of energy savings per square meter in the application. Furthermore, the energy label for buildings is planned to be used in the scheme, and data from the label used for documentation. To help realisation of energy savings. Efficiency of existing buildings by other measures is significantly increased through the requirements to the renovation of buildings in the building codes, as well as through information campaigns regarding technological opportunities and financial measures available to building owners. Subsidy scheme to replace oil burners with heat pumps in buildings outside the district heating and gas grids allocates DKK 20 million for each year in the period 2021-2024. The scheme has the objective to replace oil burners with heat pumps in buildings in areas without access to district heating or the gas grid.

In addition, the Danish Government has developed a general concept for *Public-Private Partnerships* (PPP), which encourages public authorities to enter into partnerships with private partners in order to reduce costs and increase efficiency in the public sector. PPP-projects play an important role in construction and renovation of buildings in the public sector. The core of the concept is that construction or renovation and maintenance of public buildings is carried out by private partners, while the public pays an agreed rent for the use of the buildings based on a long-term contract. ESCO-projects can be considered as a special class of PPP-projects with focus on energy renovation. It is compulsory for local authorities to consider the use of PPP whenever they decide to carry out new construction or renovation of buildings. PPP-projects are

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supported by standard contracts and manuals, which have been developed by the Government for local authorities.

7.2. Italy

In the early 1990s, competence for housing policy in Italy was transferred to the Regions and local authorities. Since then, few things have changed. As above-mentioned, the 2008 national Housing Plan recognised for the first time a crucial role of private capital in contributing to increase affordable housing supply leading to the establishment of private social/affordable housing in Italy and to the entry in the sector of new players and the creation of a new national financing platform SIF (*Sistema Integrato dei Fondi*).

The draft national recovery and resilience plan includes a 'Safe, green and social' Programme, dedicated to public housing. 2 billion Euros have been allocated to be used for requalification of the existing public housing stock, including both energy retrofit (from class G to E) and anti-seismic measures. This would allow renovation of about one fifth of the entire public housing stock. The plan also includes the possibility to fund projects for urban renewal and increase in social affordable housing units as well as student housing.

Furthermore, a new measure called *Superbonus 110%* was implemented in July 2020 to support energy retrofit, anti-seismic renovation, installation of photovoltaic panels and structures/chargers for electric cars. It gives the possibility to deduct 110% of expenditure incurred for the type of works mentioned above from income taxes. Beneficiaries can include private households, condominiums, cooperatives, public providers, NGOs/associations. The deduction is due for interventions carried out on buildings, owned by them or managed on behalf of the municipalities, used for public housing. For these subjects, the *Superbonus* is also due for expenses incurred from January 1, 2022 to June 30, 2023 and, for interventions for which at least 60% of the total intervention work has been carried out at that date, also for expenses incurred by 31 December 2023.

Besides the measures foreseen by the recovery plan, the 'national program to enhance housing quality' (*PinQua*) was introduced in the budget law 160/2019 and aims at redeveloping and increasing the public housing stock, reducing housing problems, and redeveloping degraded spaces and places to promote greater social cohesion and quality of life. The program made available over 853 million euros for the period 2020-2030. Regions, municipalities and metropolitan areas can apply for funding under this programme.

Measures tackling energy poverty

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In Italy, there is a very articulated set of measures to combat poverty both for the used and for the instrumentation of competences between the different levels of government of the territory.

Support for paying bills

In Italy, the main tools to combat energy poverty are the *Bonus elettrico* and the *Bonus gas*. Both guarantee savings on the energy bills of low-income users, through the application of a discount on the total amount that the user would otherwise have paid. Discounts are modulated according to the number of family members. In addition, the *Bonus gas* provides for differentiated discounts according to the climatic zone in which the household resides. For the year 2020, the *Bonus elettrico* provides for discounts on the bill ranging from 125 euros per year (families with 1-2 members) to 173 euros per year (families with 4 or more members). The *Bonus gas* provides discounts on the bill ranging from ≤ 32 to ≤ 264 per year depending on the number of members of the household, the climate zone and the type of use of natural gas (domestic hot water, heating, etc.). The discount covers from 3% to 25% of the annual expenditure of a typical consumer.

For both the cases, the discounts do not depend on the level of actual consumption of the beneficiaries: these instruments therefore do not provide incentives for reducing consumption.

Incentives or direct interventions for the energy requalification of buildings

The *Ecobonus* is the main measure implemented in Italy to incentivise the refurbishment of the building stock. Taxpayers who carry out interventions that increase the level of energy efficiency of existing buildings can deduct part of the costs incurred for the works from their personal income tax or Ires debt, in the 10 years following the intervention. The amount to be deducted from taxes can vary from 50% to 85% of the expenditure based on the characteristics of the intervention. Taxpayers can assign the tax credit to suppliers and other private entities, but not to credit institutions or financial intermediaries. This is allowed only to taxpayers who are in the so-called "no tax area" who do not have a sufficient tax debt to offset the tax credit that accrue as a result of the *Ecobonus*.

The incentive is available to all natural or legal persons residing on the national territory - regardless of the level of income and assets - who own the property subject to redevelopment. The deductions provided can also be used by territorial companies for residential construction such ad regional bodies that manage public residential construction and by bodies that have the same social purposes. Deductions are intended for energy efficiency interventions carried out on buildings used for public housing.

In addition, with regard to public residential construction, there are specific tools to cover the costs of refurbishment, including energy of the buildings, in addition to the *Ecobonus*. These instruments take the form of:

- Non-repayable grants:
 - The Inter-ministerial Committee for the Economic Planning (CIPE) has allocated 350 million euros, for the years 2019-2023, to be allocated to energy and anti-seismic requalification, in favour of public residential buildings²⁰.
 - The 2020 budget law allocates 500 million per year (from 2020 to 2024) to municipalities for energy efficiency measures. Municipalities can allocate these funds to public works including interventions on public housing.
- Loans at a subsidised rate or guaranteed by the State (through specific funds):
 - The National Energy Efficiency Fund²¹ supports energy efficiency measures carried out by businesses and the Public Administration. The subsidised interventions also include improving the energy efficiency of public housing. The financial resources allocated amount to 310 million euros. The Fund supports energy efficiency interventions carried out by companies, including ESCOs, and by the Public Administration, on buildings, plants and production processes. Specifically, the supported interventions must concern: i) the reduction of energy consumption in industrial processes; ii) the construction and expansion of district heating networks; iii) the efficiency of public services and infrastructures, including public lighting; iv) the energy requalification of buildings.

 ²¹ Set up by the Ministry of Economic Development (article 15, paragraph 1, of the legislative decree of 4 July 2014, n. 102).
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²⁰ Resolution 127/2017 of the Interministerial Committee for Economic Planning.

7.3. Slovenia

Concerning the long-term renovation strategy for the national stock of residential and non-residential buildings, both public and private, there are indicative milestones of a roadmap with domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions to the European Union's energy efficiency targets.

In the past years, Slovenia set several measures aiming at improving the energy situation of vulnerable groups. Since 2015, financial incentives are available for vulnerable households to replace old solid fuel boilers with wood biomass boilers. In addition, a dedicated measure (Operational Programme for the Implementation of the Cohesion policy 2014 - 2020) was set up to support and guide households in improving the energy efficiency conditions of their home.

Eco Fund, Slovenian Environmental Public Fund (Eco Fund), was established in 1993. Its main purpose is to promote development in the field of environmental protection by offering financial incentives such as soft loans and grants for different environmental investment projects. It began with soft loans for investments in environmental protection as a revolving fund. Perhaps the most significant aspect of Eco Fund's operating environment is the requirement that Eco Fund maintains the real value of its assets. For this reason, Eco Fund has provided support to environmental investments through soft loans and developed a strong focus on the financial sustainability of the projects it supports. In 2008, Eco Fund was granted the use of additional financial mechanisms such as grants to support environmental investments. Grants are financed mostly by fees paid by end users of energy and funds from the climate change fund (revenues from CO₂ allowances). In order to reach its goals, Eco Fund prepares and carries out yearly plans which serve as a basis for the publication of public calls. Should they wish to receive a grant or a soft loan, the eligible person must send an application for a grant and/or soft loan.

A few years ago, Eco Fund has taken over the organisation and financing of free energy advisory network offering free expert advice on how to improve energy efficiency to households. It has also taken over part of the task of energy poverty reduction by covering the entire cost of several environmental investments of households struggling with energy poverty.



8. Next steps

The analysis and recommendations in this report are preliminary, and any developments or changes relevant to future work in this space will be tracked as the project progresses and the project models validated against real world results.

8.1. Monitoring actual renovation projects (to analyse the costs and time frames towards on the ground implementation)

Working with the project partners, we will track progress in deploying the retrofits, and any issues or delays encountered. This will allow us to compare the various solutions, and the approaches to their procurement, the total costs and resident satisfaction with the process. In particular, across the 3 countries, we will document:

- How the works and materials for the retrofits are procured
- The time between agreeing and commissioning the works, and to complete the works
- The impact on residents, and the effectiveness of any steps to mitigate this
- The effect of any national or regional policy, or demands stipulated by funding providers
- Any unexpected issues arising during these processes
- Residents experience of the process, and their views on the completed improvements

What data can be gathered, and therefore what inferences drawn will depend in part on the nature of the works; in the Italian Boito pipeline, the works comprise the wholesale rebuilding of the towers, so that a large range of metrics and resident feedback may be tracked across the process, whereas in the Slovenian complex, it is proposed only to upgrade the hot water system with a smart electrical version and to add external cladding to the building, so a smaller range of datapoints will be gathered in this case.

8.2. Post-renovation monitoring of data related to consumption levels of social housing tenants, and of financial information related to the pilot project of involved private sector actors (to analyse costeffectiveness)

Once project works have completed, we will assess the effectiveness and return on investment of the interventions selected for the pipelines. This will require us to track the energy usage of project homes before and after the interventions, and we will engage with the housing associations to ensure we have access to the necessary data to make these calculations in such a manner that respects resident's data privacy. Over the course of the project, we will also develop an energy saving modelling tool, which can determine the heating demand of a building in a given location from a few parameters about the building fabric and geometry. Using real energy demand data from before and after the interventions, we will calibrate this tool

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to ensure its accuracy, making more relevant for any future users. This process will also involve a weather correction, as different time periods will be compared, that we will automate and include in the tool.

