



Smart booklet

Retrofit of privately-owned buildings

**Privately-owned buildings
and multi-property buildings**



TABLE OF CONTENTS

The value of implementing privately-owned building retrofit for cities	3
Sharing Cities solutions	4
Considering your local context	5
Technical options	7
Funding and financing	9
Common challenges and recommendations	11

List of acronyms

nZEB	nearly Zero Energy Building
PV	Photovoltaic

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This booklet was prepared through the collective knowledge from Sharing Cities and building on the experience of the wider context of the SCC01 Lighthouse programmes involving 17 projects, 116 cities and hundreds of partners. More information about the Lighthouse programmes can be found [here](#).



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LIGHTHOUSE CITY KEY

	Lisbon
	Royal Borough of Greenwich, London
	Milan

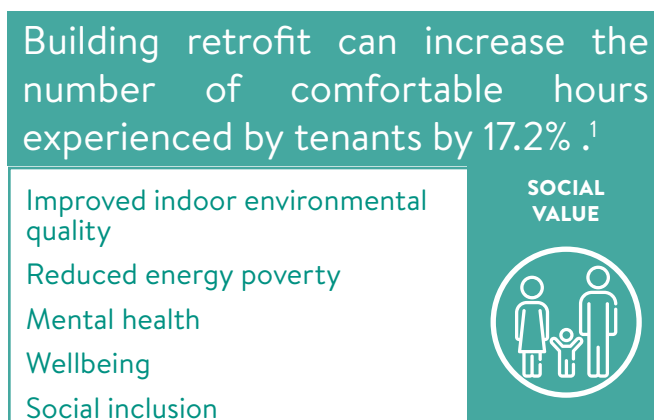
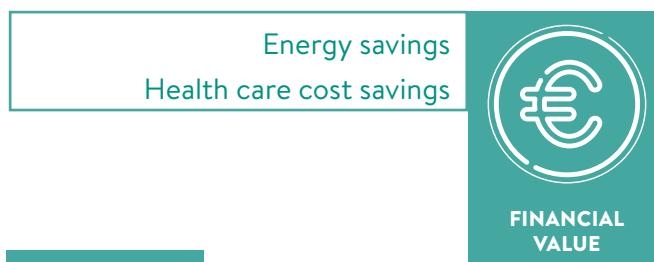
THE VALUE OF IMPLEMENTING PRIVATELY-OWNED BUILDING RETROFIT FOR CITIES

WHAT?

Energy used in buildings in cities is a major source of greenhouse gas emissions. Retrofitting of residential buildings reduces the energy consumption in these buildings and increases the level of comfort experienced by residents, some of whom may be on lower incomes. Retrofit applies measures to the building that reduce the energy needed to live comfortably in the property. Measures include roof and wall insulation, low energy lighting, photovoltaic solar panels (PV), heat pumps, and heating controls.

WHY?

The retrofitting of privately-owned residential buildings has substantial potential for energy efficiency gains and savings enabling investment to be paid back over time. Energy retrofit of the existing building stock in Europe is a very effective way to contribute to the EU's climate goals, both from an environmental and an economic point of view. It allows cities to considerably cut the CO₂ emissions from residential buildings. Building retrofit also offers improved comfort to residents in their homes, engendering greater wellbeing of occupants, and cuts energy bills, which can alleviate energy poverty. It generally contributes to the overall smart city strategy as it delivers improved energy performance, comfort, air quality, control and management.



1. Source: <https://www.sciencedirect.com/science/article/pii/S1876610217347343?via%3Dihub>

SHARING CITIES SOLUTIONS

Here are two examples of how cities in the Sharing Cities project are using this technology. These different use cases all respond to local conditions and consider financial (revenues, financial savings), environmental (air quality, reduced CO₂), social (health, safety) and economic (local business development) values.



The work involved deep retrofit of 300 dwellings in five multi-property buildings.

One of the innovations of the retrofit in Milan was the co-design process they implemented, where the majority of owners needed to agree to validate the project.

21 multi-property buildings officially confirmed their participation in Sharing Cities co-design process. The main interventions approved after the co-design process included: insulation of the opaque building envelope (i.e. walls, roof, floors), boiler replacement for the heating system (boilers were replaced by condensing boiler and heat pump), integration of PV, and new efficient lighting.



In Lisbon, selection of buildings for the pilot was based on three main criteria: the total area, the timeline for the retrofit works, and the possible legal constraints, in particular, regarding their potential for the installation of renewable energy systems. The three selected buildings are a representation of housing stock existing in the pilot area with a total floor space of between 400 m² and 1,800 m² and were chosen due to their potential to demonstrate the Sharing Cities programme ambitions.

The work was performed by a private real estate development company, Reabilita. After careful analysis, Reabilita took all the final decisions related to the retrofitting process and solutions to be implemented: replaced windows, installed efficient lighting, heating, ventilation, and air conditioning system and worked on roof insulation and a solar hot water system. Based on the energy saving retrofit measures to reduce building and apartments' energy needs, the real estate market value is now higher when selling the apartments.

CONSIDERING YOUR LOCAL CONTEXT

Your local context, including legislation and cultural conditions, affects the kind of privately-owned building retrofit that is ideal for your city, and the adjustments to the standard model that you may have to make. Here is a brief overview of key factors you will have to consider when planning your approach.

POLITICS, POLICY & REGULATION



- Political leadership
- Governance
- Smart city & data strategy
- Citizen engagement
- Legal and regulatory

60% of Milan's multi-owner buildings are rated F or G, the least energy efficient rating. The retrofit is part of the wider municipality's strategy to develop nearly-Zero Energy Building (nZEB) renovation models. In Sharing Cities, there was a co-design process where the owners contributed to identify the work to be done, and they had to approve interventions and their associated cost. This process helped to overcome challenges and difficulties normally faced when retrofitting multi-owner properties. Moreover, Sharing Cities experience laid the ground for new public tools and strategy to incentivise deep retrofitting of private buildings all around the city (e.g. BE2 Call for private buildings and condominium).

CITY 'PHYSIOLOGY'



- Climate
- Assets and infrastructure
- Natural assets
- Geography

Lisbon is characterised by a heterogenous urban network and building stock, as a result of different types of occupations throughout history. This results in a combination of a rural and industrial past with a modern and cosmopolitan city, thus presenting a set of specific challenges for the city.

ECONOMIC PERFORMANCE



Market readiness
Technology
Performance
Investment
Appetite for risk and innovation
Entrepreneur ecosystem

When contracting the work to be undertaken, cities can set very high standards to be met. This can certainly shift the focus of the market and increase energy efficiency standards in retrofit work. On the other hand, some cities will encounter difficulties to find companies able to respond to strict requirements in terms of expertise and technologies to be implemented. Cities may have to work with the supply chain to improve their skills and capacity, in part through demonstrating retrofit demand.

SOCIAL & CULTURAL CONDITIONS



Security
Lifestyles
Demography
Cultural heritage

The Milan partners developed a handbook for inhabitants as a means to accelerate behavioural change. The goals were to inform users, to describe the general benefits and to suggest correct behaviours.

In Lisbon, various material were designed to communicate and engage: leaflets for potential buyers of the retrofitted apartments, a simulator calculating the potential savings based on personal behaviour, leaflets with key messages and tips for households living in retrofitted dwellings.

TECHNICAL OPTIONS

The technical design process had to go in parallel with the co-design process. This scheme tries to represent the complexity of this ‘double-process’ in terms of numbers of meetings and parallel design activities.

Technical process



Each city will have to adopt different strategies for energy retrofit of its social housing stock to accommodate local needs. However, all retrofit work will have similar technical aims, such as reducing air penetration in buildings, preventing heat exchange through the structure of the building (wall, windows, roof, floor) and reducing the energy needs of the building.

Responding to an objective of energy positive building throughout all seasons, the retrofit strategy of a building will have to consider the points below. Any of the measures taken individually will, to a certain level, contribute to an improvement of the building's energy efficiency.

Reduction of energy needs



- » Renovation of the building envelope (building façade and the roof)
- » External or internal wall insulation
- » Air tightness (infiltration)
- » Double (or triple) glazing windows and frame with thermal barrier
- » Exterior solar shading
- » High-performance centralised heating
- » LED lamps for lighting common areas

Co-design process in Milan



The design of the overall co-design strategy, its activities and timeline were organised by Politecnico di Milano-Dastu, Poliedra, Comune di Milano, TEICOS, supported by FCC London.

The idea of co-design is based on the cooperation between technicians – engineers and architects – and owners of multi-property buildings, aimed at creating a shared solution. The objective is to minimise obstacles and barriers with clear explanations of the interventions, discussions, presentations of results with a non-technical language, to create a positive and ‘approval-oriented’ climate inside the work group before the final assembly.

In order to make a complete energy study of the building-plant system, it was necessary to acquire data relating to its energy performance (characteristics and dimensions of the envelope, type and characteristics of the heating system, domestic hot water and cooling) and to thermal and electric consumption. This data was partly provided by the building administrator and owners, and partly was measured by on-site surveys.

All the information collected was used to create the energetic model of each of the 21 buildings using EC700 Energy performance software. This software supports calculations of the building energy performance according to technical specifications.

The monitoring phase starts with the installation of monitoring systems for energy consumption and environmental comfort, that consists of a small device that measures temperature, humidity, air quality and other parameters placed in selected apartments.

Inhabitants can view their data in real time via a digital platform and be guided in the optimal management of their consumption.

Monitoring and management

- » Sustainable/smart energy management system
- » Specific monitoring system specification (technology, sensor selection, data flow, etc.) and installation
- » Monitoring plan for delivery of energy for space and water heating, electricity for household and common uses, and centralised mechanical ventilation
- » Detailed thermal comfort monitoring in reference apartments, basic thermal comfort and indoor air quality monitoring in each apartment, outdoor weather conditions
- » Centralised mechanical ventilation system with heat recovery and by-pass (to allow for free cooling in summer)



Sustainable/renewable energy sources

- » Solar panels, electricity generated by the PV systems
- » Thermal energy for sanitary hot water generated by the solar thermal system
- » Ground and air source heat pumps, water source heat pumps
- » Waste heat



Experts in EE



THE SHARED ENERGY AUDIT

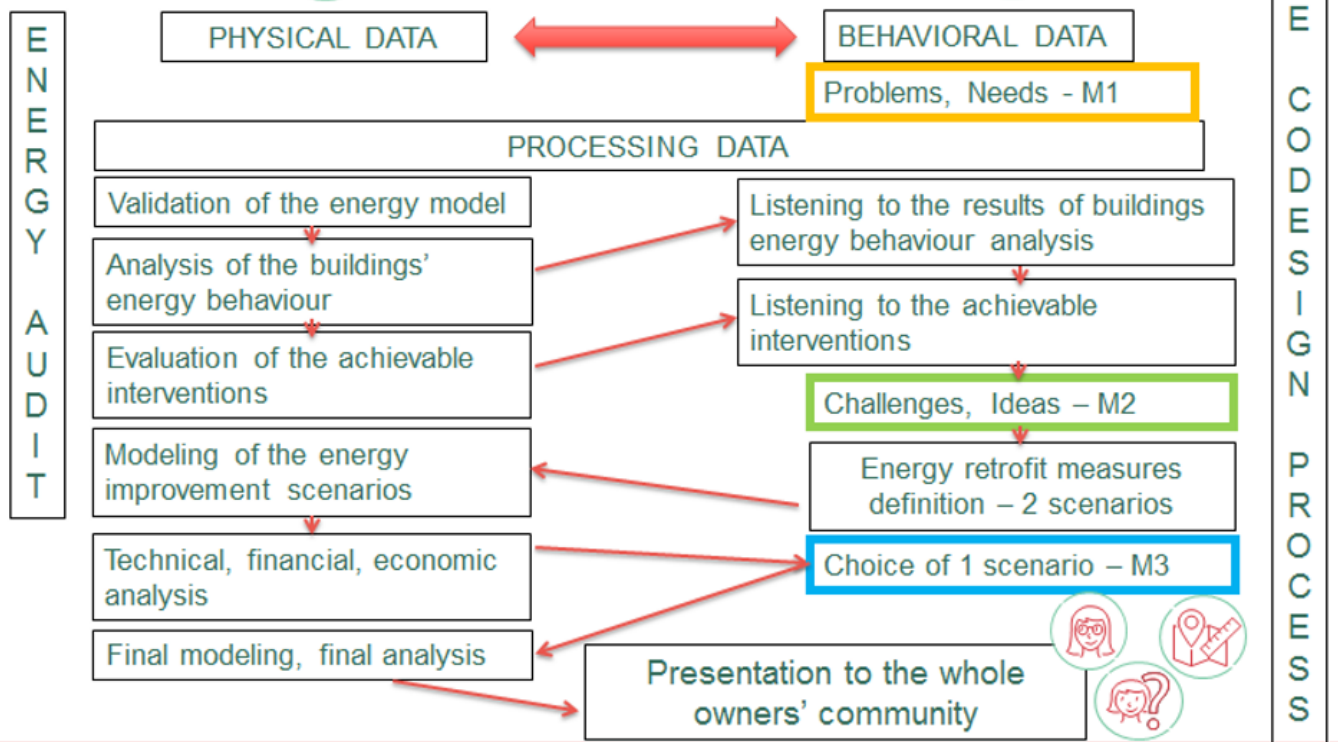
COLLECTING DATA



Energy Champions, Facilitators



THE CODESIGN PROCESS



FUNDING AND FINANCING

Building retrofit works require a high upfront investment, often with a long payback period. It is optimal to make the energy efficiency improvements at the same time as larger building renovation or regeneration works. Finding the right business models and financing options is important to enable building retrofit

work in privately-owned buildings. The long-term benefits should always be considered as the short-term benefits are often limited for the municipality. Tenants, however, should experience the benefits through improved comfort and reduced energy bills almost immediately.

Selection of a business model	Lisbon	Reabilita being a private company and sole owner of the buildings, the procurement process is not defined by any regulatory procedures. For every building, Reabilita created its own design, procurement documents and calls for tender.
	Milan	Multi-ownership private buildings As private owners of the buildings, the procurement process is not defined by regulatory procedures. For each building, Teicos collected several quotes and prepared the procurement documents on behalf of the owners.

BUDGET TO EXPECT FOR A PILOT PROJECT

Milan

In Via Verro, works have been financed by a seven-year bank loan and the Ecobonus Condomini's fiscal deduction representing 70% of the cost for energy efficiency over 10 years. Combined with other fiscal deduction, it makes a total fiscal reduction of 65%. In the table below is the financial scheme that includes the energy bill savings in 10 years as a result of the energy efficiency improvement.

Summary of cost estimation for condominium in via Verro 78BC

Total:	
Total cost of the intervention	€ 467,402.00
Total cost of the intervention (10% VAT included)	€ 514,142.20
Total fiscal deduction (65% of the total cost, VAT included)	€ 334,192.43
Number of flats	36
For one flat:	
Average investment for one flat (10% VAT included) <i>(total cost, VAT included, divided by number of flats)</i>	€ 14,281.73
Savings in energy bills for one flat over 10 years	€ 3,250.00
Fiscal deduction for one flat over 10 years <i>(total fiscal deduction, divided by number of flats)</i>	€ 9,283.12
Total expenditure for one flat over 10 years <i>(average investment for one flat, minus the savings in energy bills and the fiscal deduction)</i>	€ 1,748.60



A cost analysis has been made for one apartment over 10 years. For seven years the owner pays about €1,000 more per year than before intervention. When the loan payment ends, they will save about €1,300 during the last three years of the decade of fiscal deduction. Starting at the 11th year, savings will amount to at least €380 per year in bills, thanks to the improvement of energy efficiency of the flat.

The major part of the costs, at least 80%, is paid by the owners.

The Ecobonus, announced for the first time in the 2016 Stability Law, provides an additional important source of finance. The main goal of this law is to supply the financial support in terms of tax advantage (from 70% to 75% of tax refund within 10 years) for stakeholders involved in retrofitting projects.

SCHEME COST

Lisbon

The majority of the funds required for the retrofit works in Reabilita's buildings derive from Reabilita's own capital works budget.

Milan

Teicos, with Legambiente and the technical support of experts in acoustics, energy efficiency, fire and sustainability in construction, handled the drafting of a manual, in order to give to owners and inhabitants an instrument for a full understanding of the new performances of their house. The manual is divided into six chapters:

- » Why a user manual
- » Management of the dwelling
- » Benefits of a thermal insulation intervention
- » How to behave after the intervention
- » Let's keep saving energy
- » FAQ

It has three main objectives:

- » To inform the user about the correct management of a house, highlighting the differences between the situation before and after the intervention;
- » To describe general benefits of thermal insulation interventions;
- » To suggest correct behaviours in order to enhance benefits and to avoid unnecessary consumption.

COMMON CHALLENGES AND RECOMMENDATIONS

FLAT OWNERS' ENGAGEMENT AND COLLABORATION

Intensify engagement with tenants to make them feel part of the process and demonstrate the added value. Tailor the intervention depending on their needs and desires.

Milan has developed a promising co-creation process. Owners or tenants might be sceptical when approached by private companies, but would be more receptive to information coming from public authorities, NGOs, and universities.

Create an engagement strategy to include tenants in the process from the beginning so that they understand the benefits of retrofitting (energy savings, better quality of living, etc.) and ensure they trust the process.

Work with NGOs and universities that will bring legitimacy to the information provided by the municipality and companies.

Implement a straightforward communication scheme, involving all stakeholders, especially in multi-owner buildings.



ADAPTATION OF TENANTS' BEHAVIOUR

Tenants are important actors in the energy savings expected and can be the main reason for performance gaps and rebound effects.

Behavioural change of the building users is needed to maximise the energy efficiency benefits of a retrofit programme. Thus, there must be a proper post-retrofit engagement to avoid any performance gap between what is achievable and the reality.

Prepare a booklet for the people who will live in the newly retrofitted flat, including instructions and advice to reach the expected energy performance. In-home advice and demonstration of optimal use of measures can also be effective.



LONG-TERM PROCESS

The complexity of the work and the many administrative and financial documents can lead to a process that is several years long.

Ideally the process should start as soon as the political intention emerges. This will be a long-term process, but the delivery date should be made clear from the very beginning.

Start immediately, give time to decide, increase confidence throughout the steps, create relationships and trust.



SOCIETAL ENGAGEMENT IS VITAL FOR BUSINESS MODEL SELECTION

If some apartments from a public block have been sold to a private owner, those will have to be involved in the retrofit work that will concern the entire block, including financial participation. The public authority can in this case not spend money on the privately-owned apartment but it will require the owners to participate financially in the common effort.



FINANCIAL BARRIER

The investment costs can be high for the owners of the building or apartments.

Increase the return on investment by incorporating renewable energy installations (e.g. solar panels) or combining several forms of retrofitting (e.g. energy and structural retrofitting).

Explore the availability of subsidies and financing, such as white certificate schemes, possibility of revolving funds or low interest loans, and the involvement of private companies.



ENERGY PERFORMANCE GAP

Ensure desired end results and avoid an energy performance gap by hiring a properly skilled work force to install measures to specification.

Include energy performance in procurement and specify the expected energetic and comfort performance in tenders and contracts. If the city works with consultants, they have to be informed of the objectives so the contractor performing the work can deliver.

Make your objectives clear from the very beginning in the tender procedure and contracts. Engagement or training of installers/builders can also improve the quality of retrofit works.



SKILLS OF THE PROJECT MANAGERS

Building retrofit work is very different from maintenance of buildings and requires different expertise.

Project managers in charge of buildings are usually in charge of the maintenance of the housing stock but do not often have energy retrofit expertise, which leads to underachievement on the objectives set.

Include building retrofit expert in the relevant municipal department to ensure a better efficiency and performance of the retrofit work. Building retrofit experts can help in the decision making process and the assessment.



POLITICAL WILL

The engagement of political leaders can be difficult to support long retrofit work which will only bear fruit after several years.

Building retrofit has many benefits such as stimulating local jobs and employment, growth of local economy, contribution of local supply chain, healthier tenants, reduction of pollution, etc. Convincing is often about finding the right arguments that respond to another need or priority.

Use the Playbook on building retrofit to find all supportive arguments you will need to convince your city politicians.



About Sharing Cities

Sharing Cities is a project to improve the lives of citizens across Europe, testing smart solutions for cleaner, more efficient cities. New systems for urban energy management, building retrofit, e-mobility and smart lampposts, are cutting carbon emissions in cities as well as making everyday life more affordable, comfortable and convenient for residents. Sharing Cities is testing and evaluating these smart city solutions together with citizens and creating channels to make them more affordable and better tailored to cities' needs. They are doing this through fostering international collaboration between cities and the private sector.

Additional information on Sharing Cities can be found on the website: <http://www.sharingcities.eu>

More information

Additional information and guidance about other smart cities projects can be found on the Smart Cities Information System's website: <https://smartcities-infosystem.eu/solutionbooklets>



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