



Smart booklet

Retrofit of publicly-owned buildings

Services buildings



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List of acronyms

HVAC	Heating, Ventilation and Air-Conditioning
LED	Light-Emitting Diode
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

A red line-art icon of a castle or fortress with multiple towers and battlements, enclosed in a green circle.	Lisbon
A red line-art icon of a bridge with two towers, enclosed in a green circle.	Royal Borough of Greenwich, London
A red line-art icon of a church or cathedral with multiple spires, enclosed in a green circle.	Milan

THE VALUE OF BUILDING RETROFIT FOR CITIES

WHAT?

Energy used in buildings is a major source of greenhouse gas emissions, and services buildings are no exception. Services buildings cover a large range of buildings that are often owned by the municipality: schools, city halls, public libraries, etc. The municipality defines the retrofit measures and directly finances them. Through deep energy renovations, retrofitting reduces the energy needs of these buildings and increases comfort experienced by users. It results in better quality of life for building users and increases productivity.

WHY?

Energy retrofit of the existing building stock is a very effective way to contribute to the EU's climate goals, both from an environmental and an economic point of view. It contributes to the overall smart city strategy as it delivers improved energy performance, comfort, air quality, control and management.

A demonstration from the municipality using its own assets encourages developers, other building owners, and stakeholders to replicate similar solutions.

Energy savings (cost & environmental) Health cost savings	 FINANCIAL VALUE
Energy retrofit of Lisbon's City Hall, including the installation of an energy management system, has reduced energy bills by around 40%. The City Hall is amongst the five highest energy consuming buildings owned by the municipality. Reducing consumption was therefore a financial priority. The City Hall is a heritage building within the historic Lisbon downtown area, which presented challenges for retrofitting energy saving measures while preserving its unique and culturally important features.	

ECONOMIC VALUE 	District attractiveness and resilience Increase productivity Reduction of energy import dependency Improved social welfare
Services buildings are, on average, 40% more energy intensive than residential buildings, with most EU countries presenting an energy consumption of about 200 and 300 kWh per m², against the average of 180 kWh per m² in residential buildings.¹ Renewables are easily integrated in services buildings due to their energy consumption profile.	

Improve indoor environmental quality Mental health Wellbeing Reduction of air pollution New business opportunities Employment creation Increase of GDP Positive impacts in public finance	 SOCIAL VALUE
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 ENVIRONMENTAL VALUE	Emissions savings Air quality Carbon savings Improve comfort levels (for buildings users)
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1. Source: <https://ec.europa.eu/energy/en/eu-buildings-factsheets-topics-tree/energy-use-buildings>

SHARING CITIES SOLUTIONS

Here is an example of how Lisbon is using this technology in the Sharing Cities project. This business case responds to local conditions and considers financial (revenues, savings), environmental (air quality, reduced CO₂), social (health, safety) and economic (local business development) values.



Two service buildings were renovated: Lisbon City Hall, in the heart of the historical area, and a school, together representing 6,766 m².

The Lisbon City Hall is one of the most iconic buildings of the city. Due to its architectural and artistic value, it is a classified building. Thus, it presents interesting regulatory challenges and limitations that had to be assessed before the implementation process.

The decision to conduct an energy efficiency oriented retrofit in this building aimed at a living example of how a working public service building

can improve its energy behaviour and still maintain the architectural features of historic town halls. Therefore, within the scope of Sharing Cities, the Lisbon City Hall building intends to provide a useful example, offering high replication potential to other cities that have similar historic buildings and analogous challenges.

In the elementary school (EB1 Engenheiro Duarte Pacheco), interventions focused on an evaluation from a community perspective, and also involved the Digital Social Market implemented in the city.



CONSIDERING YOUR LOCAL CONTEXT

Your local context, including legislation and cultural conditions, affects the kind of retrofit process 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.

Political will is the starting point. It has to be followed by the setting of clear goals. But an equally important element would be to ensure continuity in the political interest and in the management of these projects between one administration and another. Therefore, the process should start by ensuring political will and should include technical and social experts creating an educational and informational process toward deep energy retrofit.

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



POLITICS, POLICY
& REGULATION

SOCIAL &
CULTURAL
CONDITIONS



Security
Lifestyles
Demography
Cultural heritage

Lisbon City Hall is classified as cultural heritage for its architectural and artistic value, which required very specific authorisations to perform the work and improve its energy performance while preserving the architectural features.

ECONOMIC
PERFORMANCE



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

Economic impacts include new business opportunities, employment creation, increase of gross disposable income, positive impacts in public finance, reduction of energy import dependency, and improved quality of life. Although most of these benefits are difficult to estimate and evaluate, they might represent, in the long run, some of the most important effects of energy retrofit.

Regarding market readiness:

In Lisbon City Hall, the existing windows had to be fully recovered using specialised techniques. In addition to the complexity associated with these works, this created significant limitations in terms of procurement, because the number of companies with capabilities for this kind of work is extremely limited, and in terms of implementation timing, since it requires a much longer implementation period.

TECHNICAL OPTIONS

The selection of solutions is a challenging task. This is due not only to the wide range of solutions available on the market, but also to conflicting priorities, such as budget constraints, building requirements, or comfort, energy and environmental goals. For this purpose, there is currently a very significant set of tools and methods supporting all stages of the decision process.

For the Lisbon City Hall, the selected solutions were mostly aimed at increasing the efficiency of existing equipment. The selection process had to consider the constraints created by existing regulations, but also the limitations linked to existing technology. For instance, due to the characteristics and artistic features of the exterior façades and interior walls, no suitable solution has been identified to improve the building's insulation. However, the City Hall being a historic building, its construction methods present specific characteristics, such as thick walls. This feature makes the specific case of insulation not appealing.

Regarding the building's envelop, windows were restored, as they presented considerably deteriorated conditions. In terms of equipment, the heating, ventilation and air conditioning (HVAC) system was replaced, and all existing lights were switched to LED. Concerning the power generation, a photovoltaic solar panel (PV) system was installed.

For the city hall:

- » Window refurbishment
- » HVAC replacement
- » PV panels
- » LED lighting
- » Smart meters
- » Energy management



The replacement of the windows and the installation of the PV panels required the approval of the National Directorate General for Cultural Heritage. In this respect, specific procedures were required to allow compliance with existing regulations. Thus, instead of simply replacing window frames with PVC or aluminium, the existing elements had to be fully recovered through a special technique. The required skills to perform such a recovery induced significant limitations in terms of procurement. Regarding the PV system, the main limitation was related to PVs' potential impact on panoramic views. As many of Lisbon's buildings have balconies with a view of the roof of the building in question, the cultural heritage directorate was strongly reluctant to allow PVs to be placed there. However, after a long and complex licensing process, with several changes to the initial project, an agreement between all sides was found.



Windows refurbishment
upgrade windows to reduce thermal leaks and improve comfort.



HVAC replacement
improve efficiency and management through automated demand response.



Photovoltaic panels
the installation of a photovoltaic system to produce renewable energy.



LED lighting
improve energy efficiency of communal lighting by installing LED bulbs.



Smart meters
the installation of energy smart meters to provide more information.



Energy Management
integrating the different energy vectors, optimising operation and energy use.

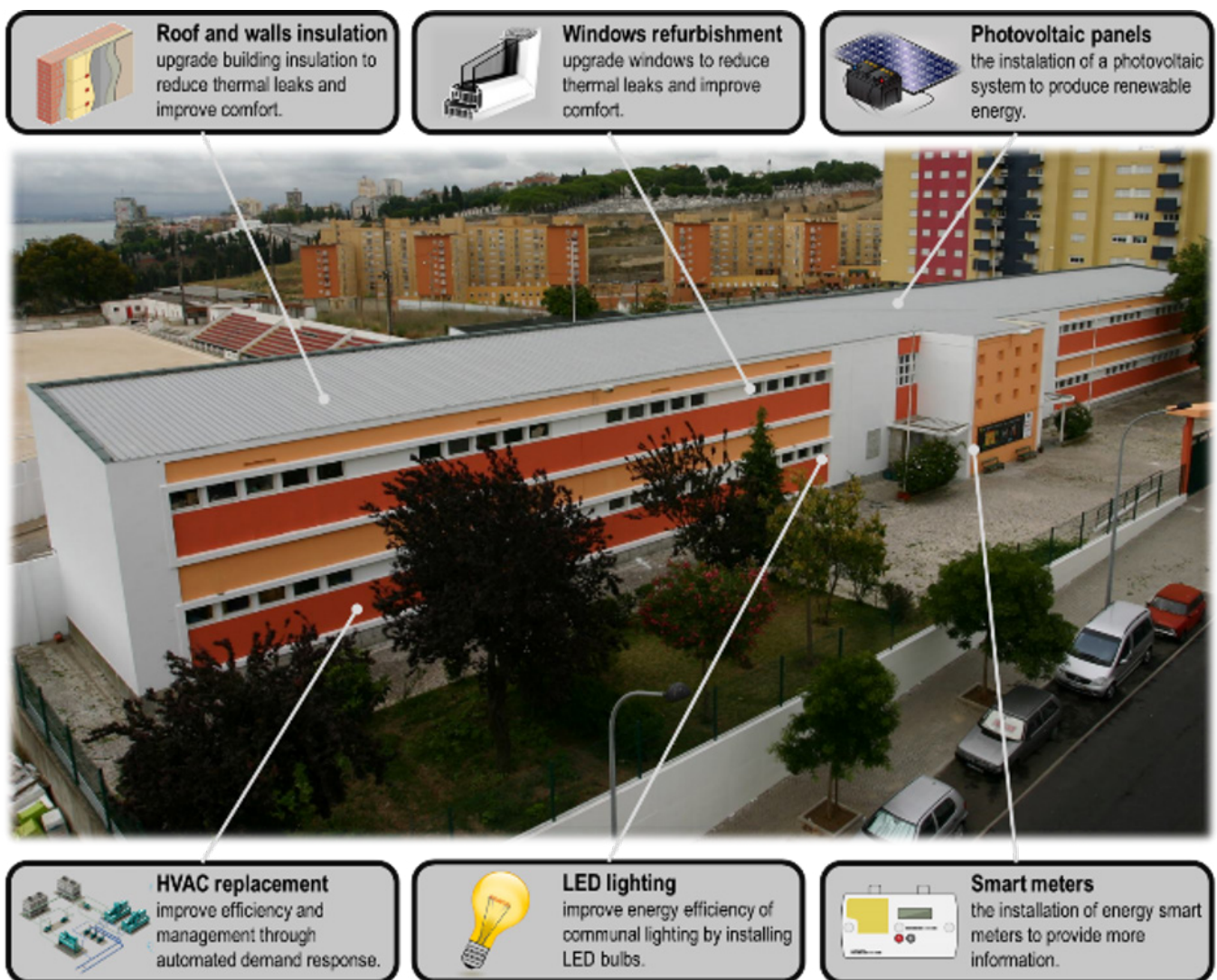
In the elementary school, EB1 Engenheiro Duarte Pacheco, the main objective of the intervention was to improve the working conditions, as well as the physical and visual quality of the school environment. In this sense, the goal was to adapt the different characteristics, building elements, spaces and intended uses to improved thermal and acoustic comfort conditions.

For the school:

Resulting from the simulations conducted, the selected solution included:



- » upgrade building insulation, including the underside of the existing rooftop, which contained asbestos;
- » replacement of all windows and shading elements;
- » replacement of the existing HVAC system with a more efficient one;
- » replacement of existing lights to LED;
- » installation of a PV system, exploring the local production of energy capacity.



FUNDING AND FINANCING

OWNERSHIP

Both buildings are owned by the municipality.

SELECTION OF A BUSINESS MODEL

The municipality transformed general maintenance and retrofit activities into energy efficiency renovations, including the integration of renewable energy sources, and directly financed them. Energy cost savings resulted from reduction of buildings' energy needs.

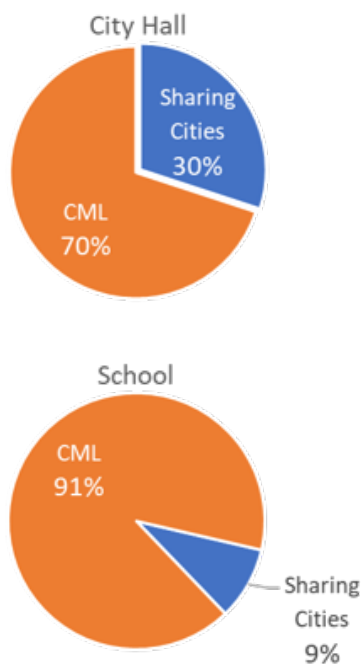
BUDGET FOR LISBON'S PROJECT

- » City Hall: ~€600,000
- » School: €1.7 million

SCHEME COST

Overall, the majority of the funds required for the services building retrofit works derives from the city's own funds, internal to the municipality, with a portion being provided by the Sharing Cities programme, through special unit costs (9% for the school and 30% for the city hall). A breakdown of the provision of funding for the two buildings is presented below.

Breakdown of funding by funding source and building



COMMON CHALLENGES AND RECOMMENDATIONS

RESPECT HUMAN DECISION-MAKING TIME

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

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.



ASSESS THE SAVINGS THAT CAN BE ACHIEVED FOR THE MUNICIPALITY

High investment costs for public/municipal owners of the building.

A detailed analysis of the pros and cons arising from the available solutions (i.e. cost/benefit analysis) should be performed at the very beginning, supporting the selection of the solutions to be implemented.

Explore the availability of subsidies and financing (local/national/European funding and grant schemes), such as white certificate schemes, the possibility of revolving funds or low interest loans, and the involvement of private companies and local stakeholders.

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



SPECIFY CLEAR OBJECTIVES PRIOR TO THE WORK

Ensure desired end results and avoid an energy performance gap.

Ensure the required expertise is present not only during the design stage but also during the implementation, to monitor that the projected solutions are implemented according to the defined specifications. Having a properly skilled work force avoids any discrepancies between what was designed and specified with what is actually done.

Search for expertise and support amongst private companies, local universities and specialised agencies.



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 of the objectives set. Some experts on building retrofit can be integrated into the relevant municipal department to help in the decision-making process and the assessment.

This will guarantee better efficiency and performance of the retrofit work.



POLITICAL WILL

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

Building retrofit has many benefits, such as improving comfort levels and satisfaction, creating local jobs, contributing to the local supply chain, improving health and working conditions, reduction of pollution, and more. Getting the political level on board is often about finding the right arguments that respond to another need or priority.

Use the Building Retrofit Playbook to find all supportive arguments you will need to convince your city politicians.



PROTECTION OF PANORAMIC VIEWS AND MAINTENANCE OF ORIGINAL TRAITS OF CLASSIFIED HERITAGE

Design restrictions placed to preserve an area's character and heritage influence solutions (such as external wall insulation and solar PV) can be applied.

Municipal buildings are often part of local heritage and have regulatory constraints on what changes can be made to them. It is important to factor this into your retrofit plans from the beginning, and explore the range of energy efficiency and renewable energy measures that can be installed within these constraints. As more historical buildings are being renovated, a greater number of suitable products come onto the market.

Engage and ensure the participation of heritage management bodies from the very beginning of the project. The process for the selection of solutions to be applied should also be (sufficiently) flexible to accommodate different interests.



COOPERATION IS KEY

Close cooperation between all the participants is essential.

The budget management adds complexity to the intervention processes in municipal buildings, as it often requires the involvement and agreement of various departments.

For this reason, a strong engagement and collaboration strategy have been implemented during the different stages of the project, involving multiple project teams.

These teams have been composed not only of different municipal departments, such as those responsible for housing/building repairs and maintenance, or departments of energy, capital projects, mechanical and electrical engineering, but also a wide range of external actors, including specialists, consultants and suppliers.

Cooperation is key and the benefits resulting from the involvement and interaction of multiple project teams are important to achieve the desired results.



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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