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Co_2olBricks

Climate Change, Cultural Heritage & Energy Efficient Monuments

Financial model for the refurbishment of historical buildings

1. Introduction

The initial idea of an owner to refurbish his historic building with the objective of an energy rehabilitation is normally driven by more or less soft and hard factors: preservation of the historic value, increasing the market value of the property or supporting environmental protection targets.

The next step to specify this decision is mainly the question of costs and benefits of the potential measures (just a minor group owners would not think about this). A financial plan with an evaluation of the economic efficiency has to be developed for the energy refurbishment project.

To develop a general calculation tool for this is not as easy as it seems to be at the first glance, especially with the focus on historic buildings combined with a transnational approach in the Baltic Sea Region, because

- each historic building is unique and has to be treated as such. That implies specific analysis and individual measures, for which the costs can not be estimated exactly in general.
- the availability of experts and therefore the costs for analysing and implementing varies from region to region.
- the current and the future use of the historic building has to be considered individually.
- the property markets differ strongly, not only between countries and region but also within the municipalities.

All these criteria show the need for an individual calculation. Additionally it is important to consider that a high uncertainty concerning the future energy prices exists in relation with a long term perspective of 25-30 years usual for building projects which is crucial for the evaluation of the economic efficiency.

Before this background the conclusions for the following financial model(s) are:

- It can only be a general model (like a checklist) to consider the different categories of costs and benefits.
- The result of the evaluation of the economic efficiency should - due to the uncertainty - only be seen as one element of the final decision and not as an automatism.
- Due to the special importance for historic buildings the analysis phase is being observed more detailed, than in other financial models for new or not historic buildings.

2. Preconditions and Assumptions

Generally speaking there are two different groups of property owners: The one that lives in his own house (own occupier) and the other one that is letting the building for rent (landlord). The costs are the same for both alternatives but the benefits are different. In the following sections at first the "Own occupier"-model will be specified completely and afterwards the additional or differing aspects for the "landlord"-model will be described.

2.1 Own occupier

The financial plan to evaluate the economic efficiency of the energy refurbishment consists roughly of three sections:

- Costs for the building analysis and the implementation
- Benefits from saved energy and further revenues
- Financing

2.1.1 Costs for the Building Analysis

In comparison with new buildings or buildings of no/less historic value the analysis and planning phase of a historic building has to be much more comprehensive to consider all relevant aspects and to prevent the owner from wrong, dangerous and/or expensive measures. Therefore one of the Co_2olBricks main results and recommendations is that a specific energy analysis for historic buildings has to be conducted before starting with the implementation of energy refurbishment measures.

The extent of this analysis depends obviously on the individual building. The following steps therefore present a kind of "toolbox" for the analysis phase and for the referring cost planning:

❖ **Basic Ascertainment**

- Collect together existing inventory documents (history of the building) » Register of immovable properties, plans, photographs, calculations, permits, etc.
  - ➢ 2 stages: 1. Owner; 2. e.g. Architect, art historian, conservator
- Documentation of its current status » Photos, measurement, assessment of condition by visual inspection
  - ➢ 2 stages: 1. Owner; 2. e.g. Architect, art historian, conservator
- Energy inventory » Complete building and when indicated individual elements
  - ➢ 2 stages: 1. Architect; 2. Energy Consultant

❖ **Evaluation of data and rating**

- Historical classification » Significance of the whole building and of individual elements (exterior and interior)
  - ➢ 2 stages: 1. Architect; 2. Conservator
- Examination of the structural condition of the building/ensemble » Substance of the whole and of individual elements as well as potential weaknesses

- 3 stages: 1. Architect; 2. Planner (building physicist, structural engineer, technical facility planner, building biologist, etc.); 3. Material analysis (sampling and laboratory testing)

- Energy inventory analysis » Identify vulnerabilities (weak points) and potentials
  - 3 stages: 1. Architect; 2. Energy consultant; 3. Calculations/simulations
- Target-setting » Identify priorities for renovation
  - all stakeholders

❖ **Definition and fixing of necessary and possible measures**

- all stakeholders
- For static-structural reasons (repair and maintenance)
- For building physics reasons (repair and maintenance)
- For energy reasons (modernisation)
- Further development of buildings (conversion, modernisation)

❖ **Feasibility check**

- all stakeholders
- Evaluation of the technical, economical and conservational feasibility
- Final decision of the measures to be implemented

More detailed information about the specific building analysis can be found in the Co_2olBricks publication "Analysis of existing buildings for energy-saving measures taking into account the conservation of historical value" available for download on the Co_2olBricks website: www.coolbricks.eu.

2.2.2 Costs for the Implementation

The planned costs of the implementation are a result of the analysis and planning phase. For the energy refurbishment of historic buildings the following different parts of the building can be affected:

❖ **Roof**

❖ **Windows and Doors**

❖ **Façade, Inner walls**

❖ **Floor, Ceiling**

❖ **Heating system**

❖ **Indoor Climate**

The exact costs depend on the individual planning of the specific measures in combination with the local costs for craftsmen and material. They have to be calculated in detail referring to the national regulations for architects and engineers.

To be able to evaluate the economic result of the measures it is necessary to consider **only the costs for the energy refurbishment** even if they are included in a larger context with other "normal" refurbishment measures for the building. This splitting of the costs is not useless because it is furthermore often necessary for specific public funding/ subsidies that are focusing on energy efficiency measures. In special cases moreover the additional expenses for heritage preservation have to be documented for specific funding.

2.2.3 Benefits or revenues from the energy refurbishment

The revenues of the own occupier resulting from the energy refurbishment measures in his historic building can roughly be divided in two parts:

- **Saved energy costs**
- **Public benefits**

The **saved energy costs** are a result of the saved energy (in kw/h) after the refurbishment in comparison with the state before and the price of the energy (in EURO per kw/h). Both factors are uncertain: Surveys show that the saved energy calculated in "normal" energy certificates is by trend too optimistic; but the above mentioned specific analysis with detailed calculations and simulations are more exact. The more uncertain part - which is at once crucial for the economic evaluation of the measures - is the energy price which has to be forecasted for the whole lifetime of the building measures of about 25-30 years. As this is obviously not possible, the whole economic evaluation should not be seen as an absolute decision for one refurbishment concept but to serve more as a tool to assess and compare different alternatives.

More precise to be planned are the **public benefits**. They can consist of direct subsidies that are paid in the first period of the project or of tax reductions (e.g. on income taxes) for a number of years.

2.2.4 Financing

To finance the costs for the refurbishment measures the owner has two possibilities: Financing by his own money (**equity financing**) or by money from the bank (**debt financing**). In the second case there could be some public programmes available (like in Germany) where special conditions for debts (reduced interest rates) for the energy refurbishment are being given.

For both alternatives the interest per year has to be calculated. In the case of debt financing this is clear, but for equity financing the owner has to define his own individual internal imputed interest (rate of return of an alternative investment of the available money).

2.2 Landlord

The landlord model differs from the own occupier only in the revenue section, but this is important and not simple, because several possible factors are relevant:

- The saved energy costs are a direct advantage for the tenant and not the owner.
- The increase of the living comfort of the flat/house affected by the energy refurbishment measures.

But these potential benefits are depending on the local (sometimes even quarter/district) situation of the real estate market particularly the market for flats/houses to let: Is it possible to increase the rent in an amount of the saved energy costs or even more? Can the rate of vacancies be reduced by a more attractive flat/house?

Additionally the national tenancy law has to be considered: e.g. how much of refurbishment costs are allowed to be apportioned on the rent?

2.3. Economic Evaluation

As already mentioned above there are uncertainties in several factors especially when forecasting figures over 25-30 year in advance.

Therefore the result of the economic calculations should only be used as one part of a decision making. And for this purpose it is really valuable

- to compare different **refurbishment alternatives**, for instance the refurbishment of the windows in comparison with a complete refurbishment.
- to identify the most important factors of the calculation model (**sensitivity analysis**) to be able to assess the results and to focus on the main issues.

There are several capital budgeting models to evaluate the economic value of an investment in general and also for refurbishment investments in energy efficiency measures in historic buildings too. One of the most common one is the assessment of the **payback period** which means the calculation of the period of time required to recoup the funds expended in an investment.

To assess the payback period at first one has to calculate the cash flows for the starting period (year 0), where normally the investments and the financing occurs and the following years until the end of the expected useful lifetime of the refurbishment measures (25 to 30 years). The period when the accumulated revenues are reaching the amount of investment is the payback period.

For the owner this is valuable information in two senses: First it gives an idea about the efficiency of different alternatives and secondly - even if the figures are uncertain - a hint about the time in which the investment is being amortised is being given.

3. Financial Model(s)

3.1 Own occupier- model

		year 0	year 1	year 2	year 3	...	year 30
1	**Costs**	**0**	**0**	**0**	**0**	**...**	**0**
1.1	***Analysis and Planning of the measures***	***0***	***0***	***0***	***0***	***...***	***0***
1.1.1	Basic Ascertainment						
1.1.2	Evaluation of Data and Rating						
1.1.3	Definition and fixing of possible measures						
1.1.4	Feasability check						
1.2	***Implementation energy efficiency measures***	***0***	***0***	***0***	***0***	***...***	***0***
1.2.1	Roof						
1.2.2	Windows and Doors						
1.2.3	Facade, Inner walls						
1.2.4	Floor/Ceiling						
1.2.5	Heating system						
1.2.6	Indoor Climate						
2	**Revenues**	**0**	**0**	**0**	**0**	**...**	**0**
2.1	***Saved energy cost***	***0***	***0***	***0***	***0***	***...***	***0***
2.1.1	calc. saved energy in kw/h p.a.						
2.1.2	est. price per kw/h in Euro						
2.2	***Public benefits***	***0***	***0***	***0***	***0***	***...***	***0***
2.2.1	Saved taxes (e.g. special depreciation)						
2.2.2	Direct subsidies						
3	**Financing**	**0**	**0**	**0**	**0**	**...**	**0**
3.1	***Equity Financing***	***0***	***0***	***0***	***0***	***...***	***0***
3.1.1	Equity						
3.1.2	Imputed Interest						
3.2	***Debt Financing***	***0***	***0***	***0***	***0***	***...***	***0***
3.2.1	Debt						
3.2.2	Debt Interest						
	Total (cash flow)	**0**	**0**	**0**	**0**	**...**	**0**

3.2 Landlord - model

		year 0	year 1	year 2	year 3	…	year 30
1	**Costs**	**0**	**0**	**0**	**0**		**0**
1.1	***Analysis and Planning of the measures***	***0***	***0***	***0***	***0***	*…*	***0***
1.1.1	Basic Ascertainment						
1.1.2	Evaluation of Data and Rating						
1.1.3	Definition and fixing of possible measures						
1.1.4	Feasability check						
1.2	***Implementation energy efficiency measures***	***0***	***0***	***0***	***0***	*…*	***0***
1.2.1	Roof						
1.2.2	Windows and Doors						
1.2.3	Facade, Inner walls						
1.2.4	Floor/Ceiling						
1.2.5	Heating system						
1.2.6	Indoor Climate						
2	**Revenues**	**0**	**0**	**0**	**0**	*…*	**0**
2.1	***Saved energy cost***	***0***	***0***	***0***	***0***	*…*	***0***
2.1.1	calc. saved energy in kw/h p.a.						
2.1.2	est. price per kw/h in Euro						
2.2	***Public benefits***	***0***	***0***	***0***	***0***	*…*	***0***
2.2.1	Saved taxes (e.g. special depreciation)						
2.2.2	Direct subsidies						
2.3	***Rental income***	***0***	***0***	***0***	***0***	*…*	***0***
2.3.1	Higher rent						
2.3.2	Less vacancies						
3	**Financing**	**0**	**0**	**0**	**0**	*…*	**0**
3.1	***Equity Financing***	***0***	***0***	***0***	***0***	*…*	***0***
3.1.1	Equity						
3.1.2	Imputed Interest						
3.2	***Debt Financing***	***0***	***0***	***0***	***0***	*…*	***0***
3.2.1	Debt						
3.2.2	Debt Interest						
	Total (cash flow)	**0**	**0**	**0**	**0**	*…*	**0**

3.3. Economic evaluation – payback period

	alternative 1	alternative 2	alternative 3
investment costs			
yearly cash flow			
payback period			

If the yearly cash-flows are not equal, the payback period is reached when cumulated cash-flows are exceeding the investment costs (“break-even”).