Cost benefits analysis of a passive house

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1 Introduction

At present, the passive house concept is in great expansion in Belgium. This rapid development is partially explained by the current environmental awakening but also by the increasing need for comfortable buildings. If the primary energy and CO_2 emission savings are not to be demonstrated, the economic profitability of a residential passive house remains a controversy subject. This communication contributes to this debate through a detailed cost benefits analysis of a real residential passive house.

2 Methodology and Results

The passive house is compared to a fictitious reference house in order to determine the additional costs and the money savings on the energy consumptions. The reference house is representative of usual buildings constructed in Belgium in terms of insulation, windows, ventilation and technical equipments.

Table 1: Characteristics of the reference house and the studied passive house.

	Reference House	Passive House
Global insulation, k_s	k_s = 0.61 W/m^2/K	k_s = 0.17 W/m^2/K
Glazing type	Double glazing (U=1.6 W/m^2/K)	Triple glazing (U=0.8 W/m^2/K)
Heating	Fuel central heating	Wood pellet stove
Hot water production	Water tank coupled to the boiler (no solar collector)	Solar hot water system (5 m^2) with gas additional heating
Mechanical ventilation	Simple flux	Double flux with heat recovery
Air flow rate n_{50}	n_{50} = 9 vol/h	n_{50} = 0.5 vol/h

The cost structure is shown at Table 2. About 2/3 of the additional cost is due to the building insulation. The heating system additional cost is negative because the pellet stove of the passive house is less expensive than the central heating system. Without shading device, the summer overheating risk is higher than the maximal level authorized in Belgium (I_{overh}=17900Kh above 18°C). In order to take into account the summer comfort, an additional cost of 6861 € must be considered for efficient shading devices able to reduce the overheating indicator to the one of the reference house (9400Kh).

The passive house building is more expensive but it allows great energy savings (Figure 1). The heating consumption is reduced by a factor 10 and the hot water production consumption is also reduced by the use of a 5 m² solar collector (solar fraction of 42 %).

Table 2: Additional costs of the studied passive house in comparison with the reference house

	Initial cost [€]	Initial additional cost [€]	Additional cost /40 years [€]
Insulation	17628	11780	11780
Glazing	18184	7838	7838
Heating system	2973	-4274	-5635
Hot water prod.	9969	6364	11027
Ventilation	8773	3933	5484
Sealing	2904	2904	2904
Total	60430	28546	33398

Figure 1: Comparison of the energy consumption and cost distributions. Consumptions are estimated with the Belgian implementation of the EPBD.

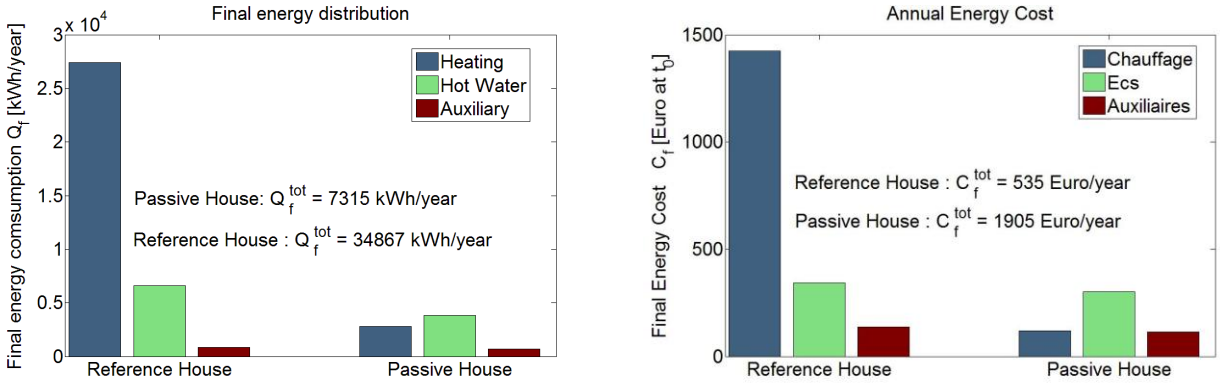

Table 3 shows the economic indicators computed on the basis of the additional-cost, the energy savings and future scenario for the energy cost increase. These results show that the investment is profitable but the payback period is quite long. It varies from 25 years if the summer comfort is neglected to 30 years if efficient sunscreens are taken into account.

The long payback period is partially due to the high prices of the triple glazing that are still an obstacle to the development of the passive house concept. The analysis shows that an additional-cost of about 100 €/m^2 for the triple glazing (compared to usual double glazing) allows to attain the same profitability than the double glazing and a payback period of 21 years for the studied house. Finally, we consider several financial incentives that are given by the Belgian authorities. In January 2008, the total of the incentives rises up to about 18300 € so that the profitability is boosted and the payback period reaches 11 years.

Table 3: Indicators computed with or without taking into account the shading devices (NPV: Net Present Value; PP: Payback Period).

	Without shading devices	With shading devices
NPV [€]	22 808	15 342
PP [years]	25	30