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Evaluation of energy retrofit in buildings under conditions of uncertainty: The prominence of the discount rate

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1 Evaluation of energy retrofit in buildings under conditions of uncertainty: the 2 prominence of the discount rate

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10 Abstract

11 A growing literature has focused on the economic viability of building energy retrofit. As
12 regards the valuation tools, the Life-Cycle Cost (LCC) method has established itself among
13 the leading approaches. The results are usually affected by a core of influential, uncertain
14 parameters: energy supply cost and energy price changes. Monte Carlo (MC) simulation may
15 be integrated with LCC analysis to deal with that uncertainty. In this study, we apply an LCC
16 and MC-based analytical model to a case study. Several retrofit scenarios are defined to
17 improve the poor energy performance of a public housing building. The less investment-
18 intensive alternative enable to achieve a 27% energy saving in comparison to the building as
19 is, while the more investment-intensive alternative allows reducing consumptions by about
20 two-thirds. We find that the scenarios characterized by lower upfront costs are more likely to
21 show lower LCCs, regardless of the energy price. The novelty of this study lies in the fact that
22 we show the prominence of the discount rate, which is a remarkable source of additional
23 uncertainty. We find that the discount rate affects the results four times as much as the energy
24 price; therefore, its estimation is critical to the soundness of thermos-economic evaluations.

25

26 Keywords

27 Residential buildings; energy efficiency; uncertainty; Life-Cycle Cost; Monte Carlo
28 simulation; discount rate.

29

30 Nomenclature

31 *Roman letters*

32 Bc Building costs (Euros)

33 e Energy inflation rate (%)

34 i Year

35 Ic Investment costs (Euros)

36 Irr Internal rate of return

37 Lcc Life-cycle cost (Euros)

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