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# Tools and procedures to support decision making for cost-effective energy and carbon emissions optimization in building renovation

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## Abstract

Many countries request to adopt measures for improving the buildings energy efficiency, for reducing the carbon emissions and for increasing the renewable energy use.

The paper presents tools and procedures to support decision making according to the IEA-EBC Annex 56 project, “Cost-Effective Energy and Carbon Emissions Optimization in Building Renovation”. The first part of the paper describes the methodology proposed by the Annex for maximizing effects on reducing carbon emissions and primary energy use while considering the cost-effectiveness of related measures that consists in comparing renovation packages based on the results of a life cycle cost assessment. The optimization process focuses on the overall added values achieved in a renovation process, which means to identify the global quality improvement and further additional benefits (here called co-benefits) like comfort improvement (thermal, natural lighting, indoor air quality, acoustics, etc.), that allow to increase the value of the building.

The second part describes the A56opt-tool, the tool developed (an excel file) as support for calculations based on the Annex 56 methodology in order to compare and to evaluate different packages of renovation measures. The kind of information needed as input, how to fill it in in the worksheet and the whole process for optimization focus on the single output of each calculation till the identification of the optimal solution are also described.

The last part presents the application of the methodology and calculation of the project in a case study, in order to show step by step the operative calculation process.

*Keywords: EPBD recast, Cost-Effective, IEA-EBC Annex 56, Optimization tool, Building renovation measures, Global cost, Primary energy use, Life Cycle Assessment.*

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## 1. Introduction

The responsibility of buildings on energy use is clearly put in evidence in the literature [1]: it is a special target in global actions for climate change mitigation to adopt measures that aim to improve the buildings energy efficiency, to reduce the carbon emissions and to increase the renewable energy use.

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