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Adaptive reuse of buildings: Eco-efficiency assessment of retrofit strategies for alternative uses of an historic building

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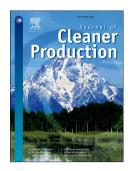
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## ACCEPTED MANUSCRIPT

- 1 Adaptive reuse of buildings: eco-efficiency assessment of retrofit strategies for alternative uses
- 2 of an historic building
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- Word count: 7493 words (with references)
- 8 Abstract
- 9 Adaptive reuse is a process of retrofitting old buildings for new uses. Existing residential buildings in
- European cities are often being retrofitted to be adapted as office buildings whilst keeping its historical value.
- 11 The main goal of this article is to perform an eco-efficiency assessment for an historic building to assess
- 12 alternative retrofit strategies and uses, including investigate how occupancy influences the economic and
- environmental life-cycle performance of retrofit strategies. A life-cycle model was implemented to a single-
- family house from the beginning of the 20<sup>th</sup> century retrofitted to be used as an office building. Nine
- occupancy scenarios combined with alternative insulation levels were defined. The occupancy scenarios are
- defined by level of occupancy (office use, and low and high residential occupancy) and set-points (18°C, 20°C
- and 22°C for heating combined with 23°C, 25°C and 27°C for cooling). The insulation levels comprise
- alternative roof insulation levels (0, 40, 80 and 120 mm) and exterior-wall inside insulation levels (0, 40 and
- 19 80 mm). Eco-efficiency assessment shows that higher comfort conditions result in better eco-efficient results
- in all types of occupancy. Retrofit strategies with more than 80 mm of roof insulation are not eco-efficient. In
- summary, different retrofit strategies should be adopted to maximize savings and minimize environmental
- 22 impacts depending on the type of use and occupancy level. Therefore, it is crucial to take into account both the
- 23 economic and environmental perspective to support a comprehensive retrofit decision process.
- **Keywords:** Building retrofits, Environmental impacts, Life-cycle assessment, Life-cycle cost assessment,
- 25 Occupancy pattern, Thermal insulation

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