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Life Cycle Assessment of Steel Framing Wall Systems:

Hotspots for Environmental Improvements and Trade-offs

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Academic Work

Objective

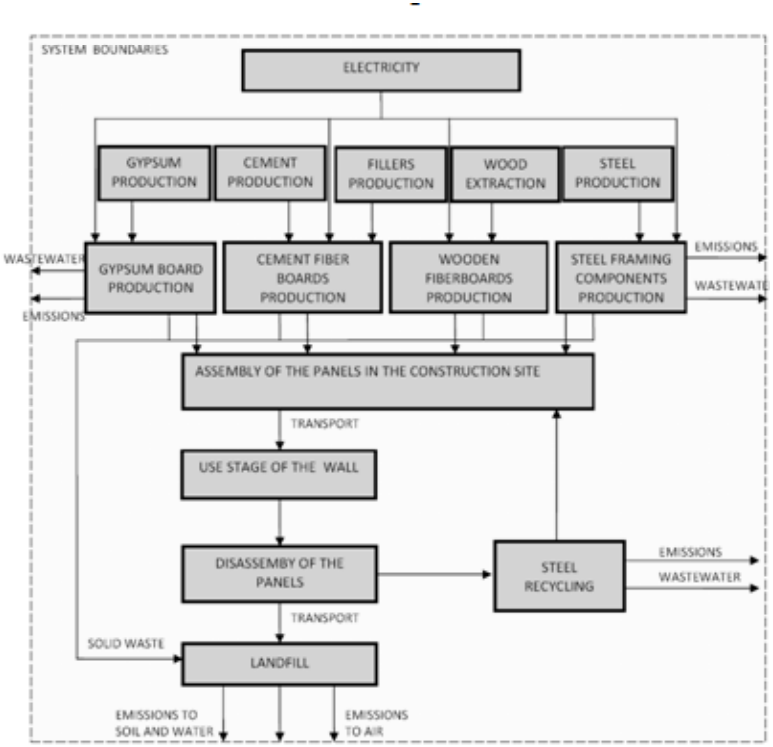
The purpose of the present paper is to identify the processes with the highest contribution to potential environmental impacts in the life cycle of the steel framing walls system with three internal dry wall panels and exterior fibre cement boards by evaluating their main emissions contributing to impact categories and identifying hotspots for environmental improvements.

Methods

- The paper is based on the LCA study of non-load-bearing steel framing walls system with three internal dry wall panels and exterior fibre cement boards.
- The processes those have demonstrated higher contribution to environmental impacts were identified in the LCIA phase and a detailed analysis was carried out on these processes.
- The methodology was guided by ISO 14044 (2006) and ILCD Handbook (EC-JRC, 2010).
- The case study have been performed by using the software GaBi 4.4 (IKP, PE, 2002), and data from the Ecoinvent 2.01 database (FRISCHKNECHT, 2005).

CASE STUDY: Objective and scope

- **Functional unit**: 1m² of non-structural external wall which provides thermal and acoustic performance as required by Brazilian standards for the city of Sao Paulo, for a period of 40 years.
- **Typology**: 15 cm steel framing wall system
  - three 1.25 cm thick internal dry wall panels,
  - 8 cm thick unventilated air chamber
  - 4 cm thick exterior cement fiber boards, filled with medium density wood fibreboard,
  - no painting on external and internal faces.
- **Cut-off criteria**: exclusion of elementary flows if their relevance was below 0.1%.



CASE STUDY: Life Cycle Inventory Analysis (LCI)

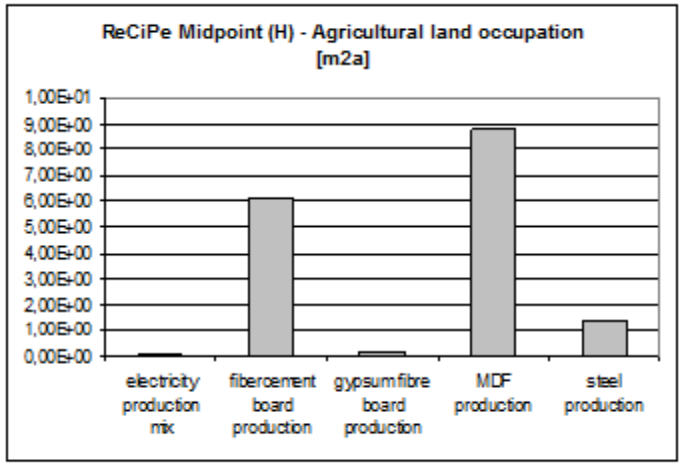
- This study was based on data from Ecoinvent 2.01 Database.
- For data collection on transportation processes a 100km-distance was considered regarding the distribution of blocks and a 10km-distance was considered for disposal of demolition rubbish.
- The energy grid mix regards Brazilian government reports and it is composed by 74% hydropower, 6,9% natural gas, 4,7% biomass, 3,6% oil products, 2,7% nuclear power, 1,3% coal, 0,4% wind power and 6,5% coming from imports (MME, 2011).

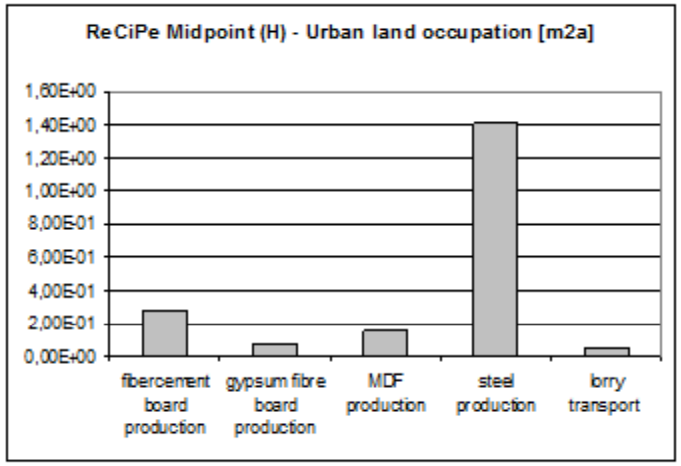
CASE STUDY: Life Cycle Impact Assessment (LCIA)

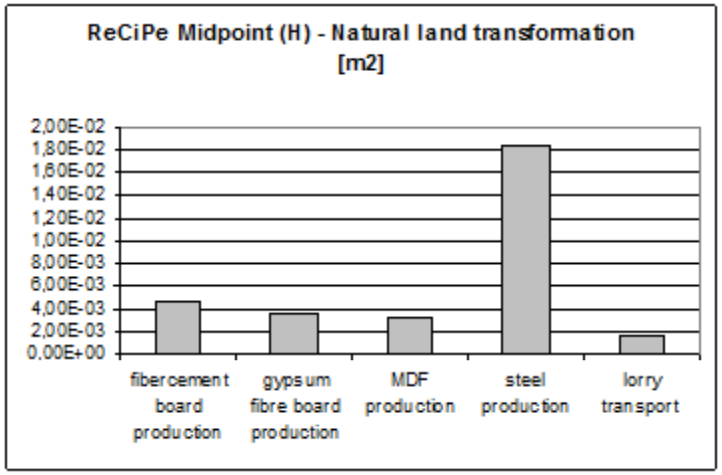
The Life Cycle Impact Assessment (LCIA) was carried out by using the ReCiPe 2008 methodology (GOEDKOOP et al., 2008), applying the midpoint impact categories, without applying normalization or weighting.

The ReCiPe methodology was chosen due to its regional scope of application directed to Europe and not to any specific country, once there is still no methodology directed specifically to Brazil or Latin America.

CASE STUDY: Results







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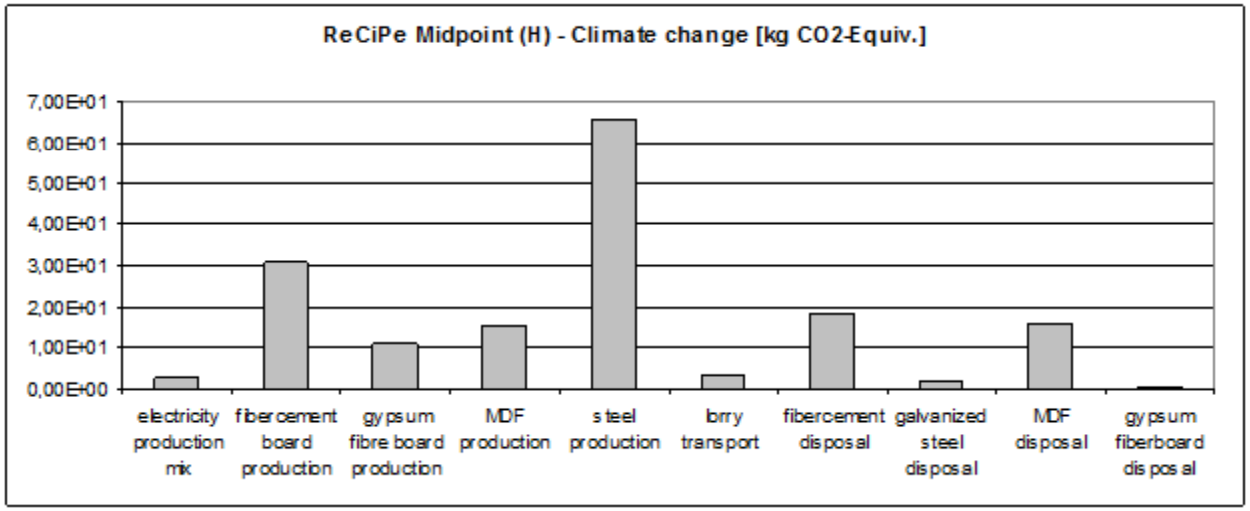

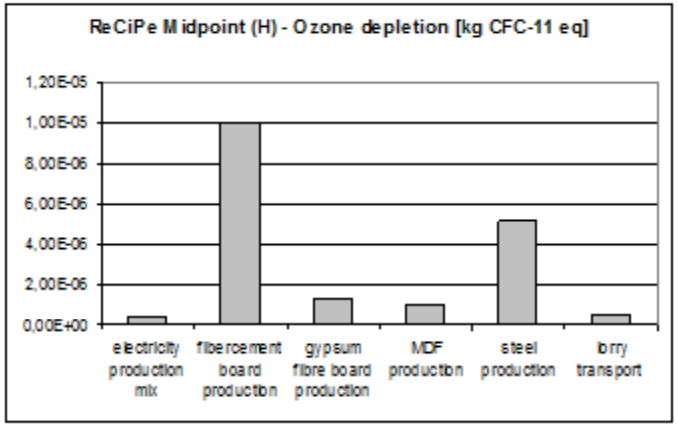

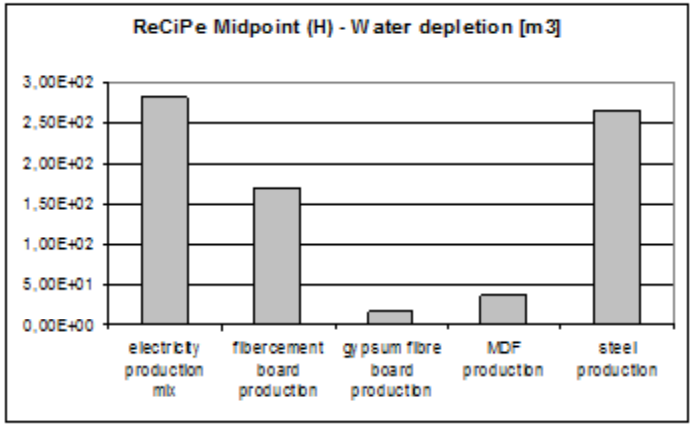

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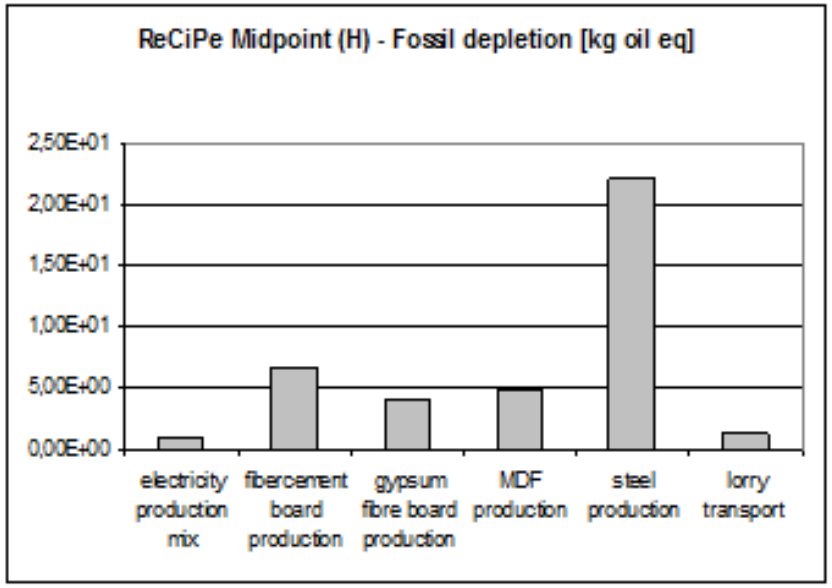

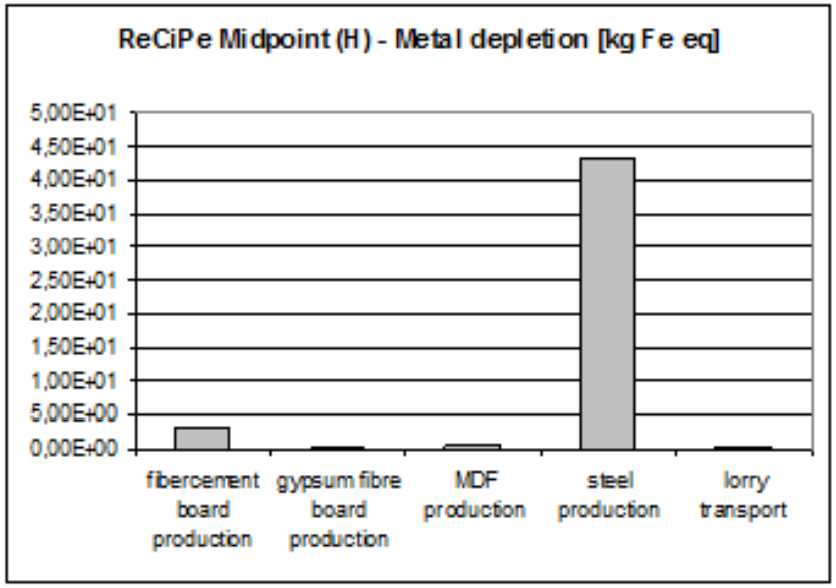

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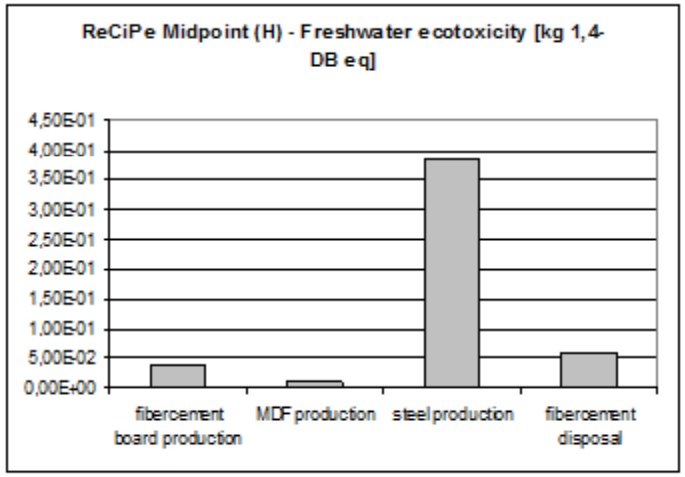

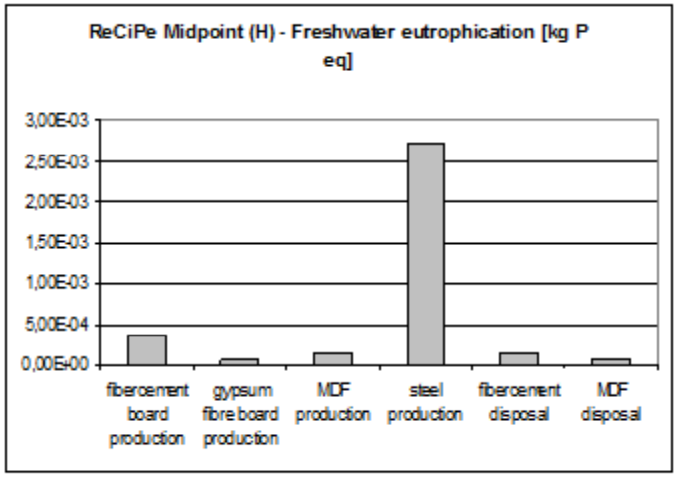

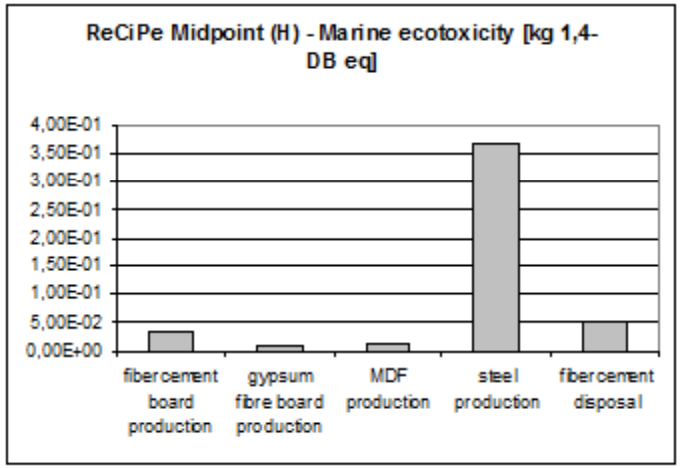

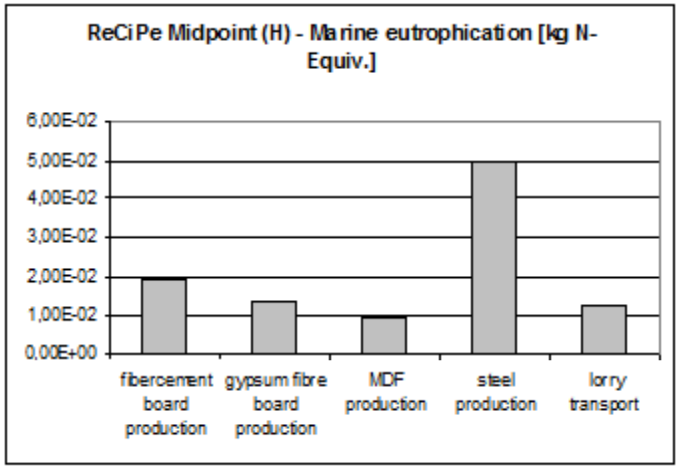

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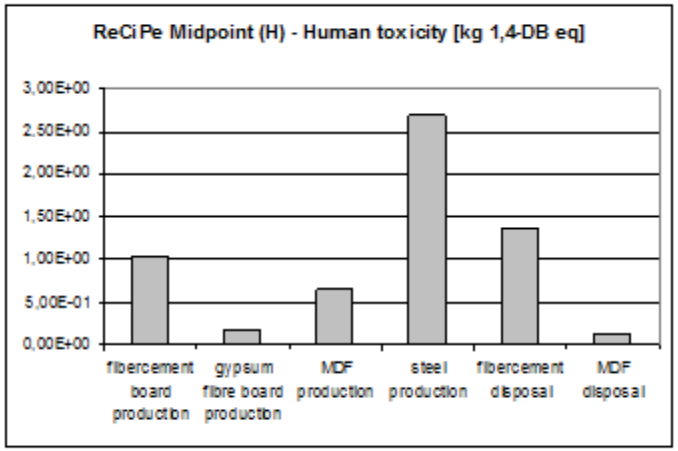

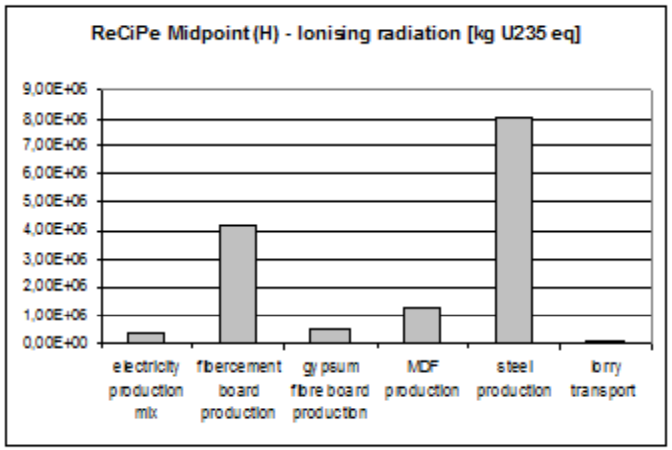

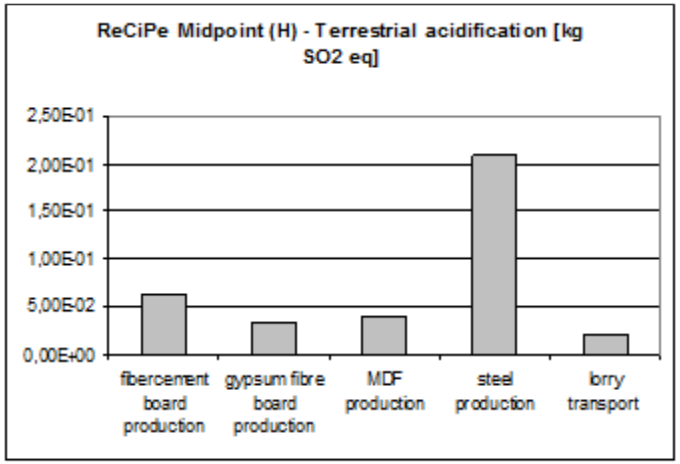

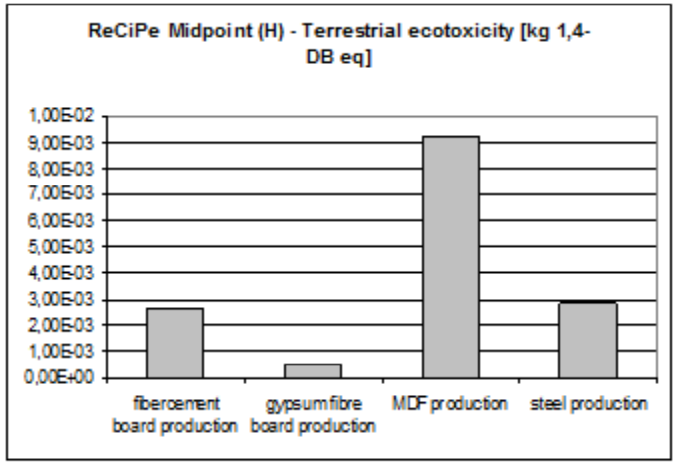

CASE STUDY: Interpretation

- The highest potential impacts can be attributed mainly to emissions coming from the **steel production processes**, for most of the impact categories, **followed by the fiber cement production** process, which also showed significant impact potential for most of the impact categories.

- **MDF production** showed to be the most impacting process in the impact categories **Agricultural Land Occupation and Terrestrial ecotoxicity**, due to the large agricultural area needed for timber growing and the toxic emissions of MDF industrial production process, respectively.

- For **Water Depletion**, the most impact process was the **Electricity production**. Although such impacts are not allocated specifically for the studied function, the high energy consumption of the **steel production** process may be considered responsible for such impact.

CASE STUDY: Interpretation

- **Hotspots** for environmental improvement are most specifically located in the **steel production process**, but **fiber cement and MDF production should also be considered** for environmental improvements.

- Other impacts which could be **indirectly identified** through the analysis of the categories Agricultural Land Occupation and Natural Land Transformation are those coming from the **timber growing and mining activities**.

CASE STUDY: Recommendations

Further research point out to the **sensitivity analysis** of the results to the use of **secondary data or primary data** and also the application of **different LCIA methodologies** will be performed in order to identify which impact categories are the most significant in the assessment of traditional wall systems and which need thus further specific development.

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Thank you!

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