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Managing the life cycle of production equipment: What does it matter?

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INTRODUCTION & OBJECTIVES
- Robots are an important part of the workforce in some manufacturing sectors
- The automotive industry is highly automated, especially car body shops (>90% automation)
- Automated production equipment has been used for decades, assessment of its sustainability started more recently
- Aim of this work: to assess a more environmentally friendly production practice from different perspectives, using the carbon footprint of an industrial robot installed at an automotive manufacturer as a case study

DISCUSSION & CONCLUSION
- A considerable (~25%) reduction in the carbon footprint (CF) of a robot, was found to be a minor (<0.5%) reduction in the CF of the manufactured product: the car
- Manufacturing is part of a larger system that ultimately results in meeting a market demand
- Therefore, in LCM practice for production equipment, it is recommendable to relate efforts to the manufactured product
- This approach has two advantages:
  - avoid sub-optimization of manufacturing systems and tools
  - focus efforts there, where it matters most

RESULTS: CARBON FOOTPRINTS from DIFFERENT PERSPECTIVES

Improved energy management of a typical industrial robot used in the automotive industry reduces electricity consumption

Zooming out: Consequences of the new robot energy management for the CF of a cell with 3 robots located in the carbody shop

Zooming out even more: The body shop, where the cell is located, is part of the life cycle of the manufactured product: the car

METHOD

Robot and cell were modelled in GaBi 6.4, using the ecoinvent 2.2 database

<table>
<thead>
<tr>
<th></th>
<th>Robot</th>
<th>Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>System description</td>
<td>Robot of 1350 kg (210 kg payload), operated in Germany in 14 weekly shifts, 48 weeks per year, for 6 years</td>
<td>Cell with 3 robots (2 handling, 1 clinching) + 1 gluing station operated in Germany. Same shift system and lifetime as robot</td>
</tr>
<tr>
<td>LCI – Materials &amp; Manufacturing</td>
<td>Materials + masses provided by robot producer, energy for processing materials estimated</td>
<td>List of components provided by OEM, materials + masses estimated</td>
</tr>
<tr>
<td>LCI – Use</td>
<td>Typical electricity consumption + maintenance guidelines provided by robot producer</td>
<td>Measured electricity consumption (1 day) provided by OEM. No other processes modelled</td>
</tr>
<tr>
<td>LCI – End-of-Life</td>
<td>Modelled according to industrial standard for electronic waste (IEC TR 62635)</td>
<td></td>
</tr>
<tr>
<td>LCIA method</td>
<td>IPCC Global Warming (incl. biogenic carbon), as implemented in GaBi 6.4</td>
<td></td>
</tr>
</tbody>
</table>

Carbon footprints of body shop, car manufacturing and car: literature data

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