The pros and cons of using Artificial Intelligence in LCA: a review of 34 LCA-based tools

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The world is becoming increasingly dynamic, and, as a result, decision-making processes within companies have had to accelerate to keep up with this pace. The importance of tools that reconcile environmental issues with the speed of response required by stakeholders emerges - whether in selecting a product with better environmental performance (as in the case of consumers) or in defining a material with a lower environmental burden (as in the case of companies). This paper revised 34 Life Cycle Assessment (LCA)-based tools in the context of integrating them into Artificial Intelligence (AI) features. Several tools were found catering to different sectors and specific environmental characteristics. These tools demonstrate applicability in sectors such as agriculture (14), multisectoral (4), industries (3), construction (2), packaging (2), transport (2), end-of-life (2) and others (5) serving as essential instruments for decision-making based on environmental data. However, it is crucial to emphasize that they do not replace comprehensive LCA studies but instead facilitate analyses and provide robust support for more informed decisions. Finally, the possibility of integrating these tools with Artificial Intelligence (AI) systems stands out for 6 tools, as they are available for download in Excel format, they can therefore be easily integrated with AI using Python libraries. Such integration, by exploring synergies between AI and be LCA tools, represents a promising strategy and constitutes the central focus of this work.

Bridging the gap: Developing a LCA methodology for software at Siemens

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With the increasing focus on sustainability, LCA has established itself as an important tool for creating transparency and as a basis for reducing environmental impacts. To date, the method has mainly been used for physical products and provides detailed information on the sources of emissions over the life cycle.

As digitalization progresses, the share of revenue generated by software is growing and so are the associated emissions. The environmental impact transparency through LCAs plays a fundamental role in the DEGREE framework, which defines clear goals and actions for Siemens sustainability ambitions. For these reasons, Siemens has taken the initiative and is researching the transfer of the LCA method to software.

When it comes to sustainable software, the Software Carbon Intensity Specification (ISO/IEC 21031:2024) is currently the most important reference. Compared to an LCA, it is a score rather than a total and therefore only a one-dimensional approach. To continue to reduce our emissions, it is crucial to understand and evaluate our software throughout its entire life cycle.

We are currently developing a LCA methodology for software based on pilot projects. Initial results show that it is difficult to make general statements about the main emission sources of a software application. This is because software architectures, functionalities and user behaviors are highly specific.

During the development phase, building energy consumption and business travel can have a big impact. During the use phase, energy consumption of end-user devices, data centres, and data transmission networks play a crucial role. Ultimately, however, the level of emissions and the influence of the single components depend primarily on the extent to which the software scales. And then there are also the embodied emissions...

We are pleased to present our methodology and look forward to exciting discussions!

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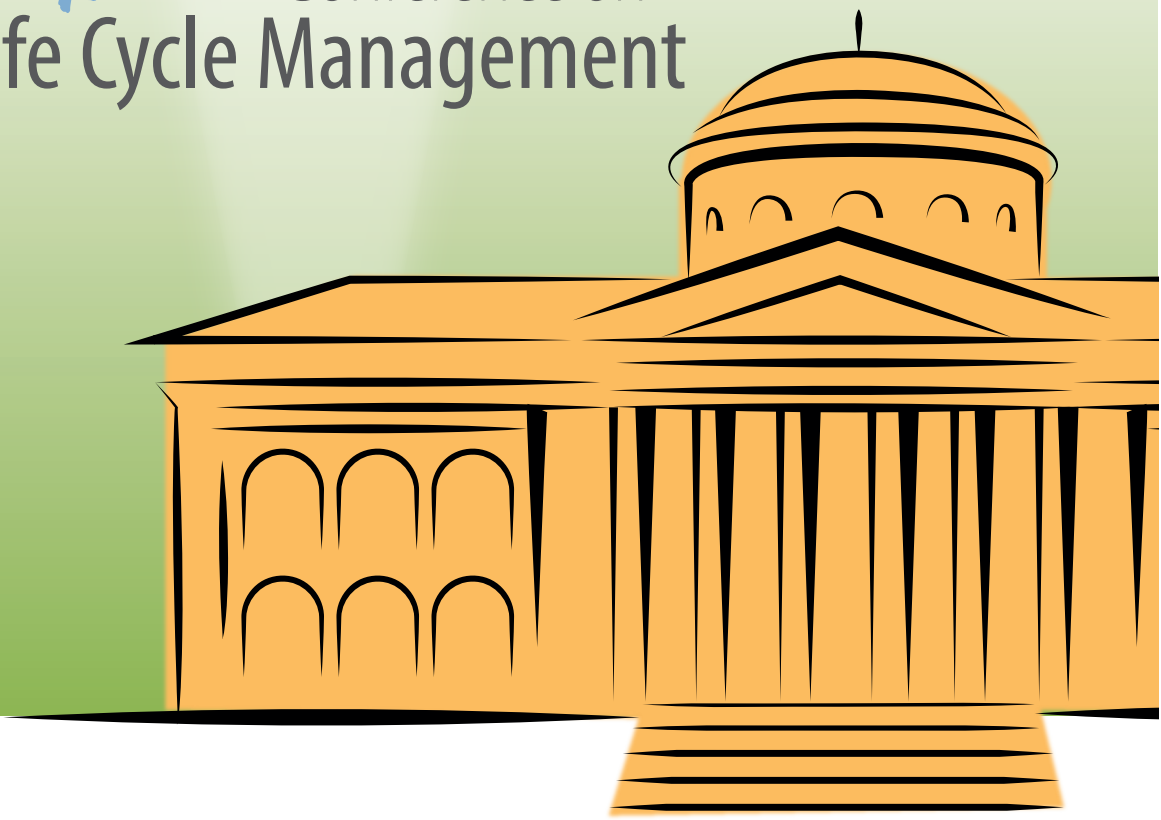

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