



How green is a green façade?

Life cycle assessment of a façade greening at a Swiss hospital



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Introduction

With regard to the constantly growing world population, pressure on cities and urban areas is increasing. As one of the most effective measures to counteract the negative effects of urbanisation on the environment, the greening of urban areas is gaining importance in the context of urban planning. Next to the positive effects on the environment [1], green buildings are not environmentally burden-free, as their construction demands resources and leads to emissions. In this context, the question arises on how green a green building really is.

In 2022, a façade greening system was implemented on the South side of the Triemli hospital in Zurich, Switzerland. In a cooperation between the Zurich University of Applied Sciences and the City of Zurich, a life cycle assessment was carried out, to obtain knowledge about the environmental impact during the life cycle of the façade greening. The implemented system is a wall-mounted greening system with plant troughs made of stainless steel (SS) installed on each floor (see figure 1).



Figure 1. Green façade on the South side of the Triemli Hospital. Photo: Gaëtan Bally

Goal and Scope

The goal of this research was to comprehensively analyse the resource consumption and environmental impact over the life cycle of the façade greening, to identify the main influencing factors and to develop recommendations for the ecological optimisation of façade greening systems.

The foreground data for the life cycle inventory of the façade greening was based on specific information provided by the City of Zurich and partners. Due to the remaining operating time of the building in question, the operating time of the façade greening was set to 15 years. Since the average operating time of buildings and green façades is 60 years [2], an additional scenario was analysed where this average operating time was assumed. Key parameters of the façade greening are summarised in table 1.

Table 1. The key parameters of the façade greening at the Triemli hospital in Zurich, Switzerland.

Key parameter	Unit	Amount
Surface area façade	m ²	3'138
Number of plant troughs	p	209
Total run length of plant troughs	m	642
Number of seedlings (woody plant, climbing plant, underplanting)	P	4'632

Results

For an operating time of 15 years, the façade greening leads to life cycle greenhouse gas (GHG) emissions of 80.1 kg CO₂-eq. (see figure 2). The production of the façade elements was identified as the primary hotspot, with the SS plant troughs contributing 75% and the irrigation system contributing 7% to the total GHG emissions. The dismantling and disposal of the façade greening represents the second environmental hotspot, which is responsible for 8%, followed by the maintenance of the façade, which contributes 4% to the life GHG emissions.

Extending the façade's operating time from 15 to 60 years can reduce annual GHG emissions by 67% (see figure 3). Although the 60-year scenario includes replacement of façade elements, the annual emissions remain significantly lower. Comparing SS to the alternative material PE shows that PE troughs lead to slightly higher GHG emissions in the 15-year scenario, and to considerably higher emissions in the 60-year scenario.

Reason for this is that PE causes higher disposal impacts than SS due to incineration. Further, PE has an expected service life of 30 years, while SS is expected to last for the 60 years, which leads to far lower replacement impacts with SS troughs.

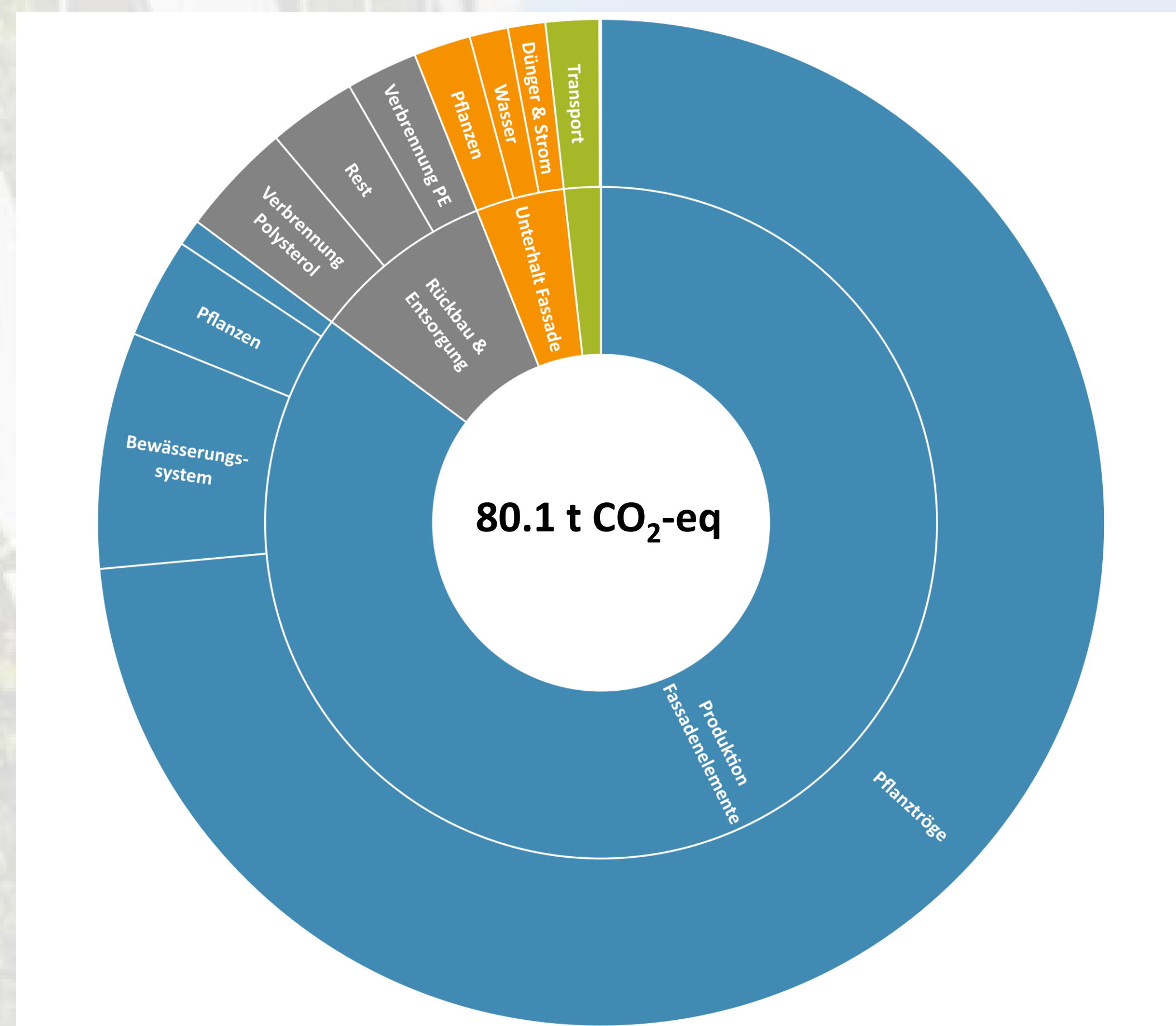


Figure 2. GHG emissions in kg CO₂-eq. of the façade greening (3'138 m² with an operating time of 15 years) during its life cycle [3], assessed with the IPCC 2021 100a method [4].

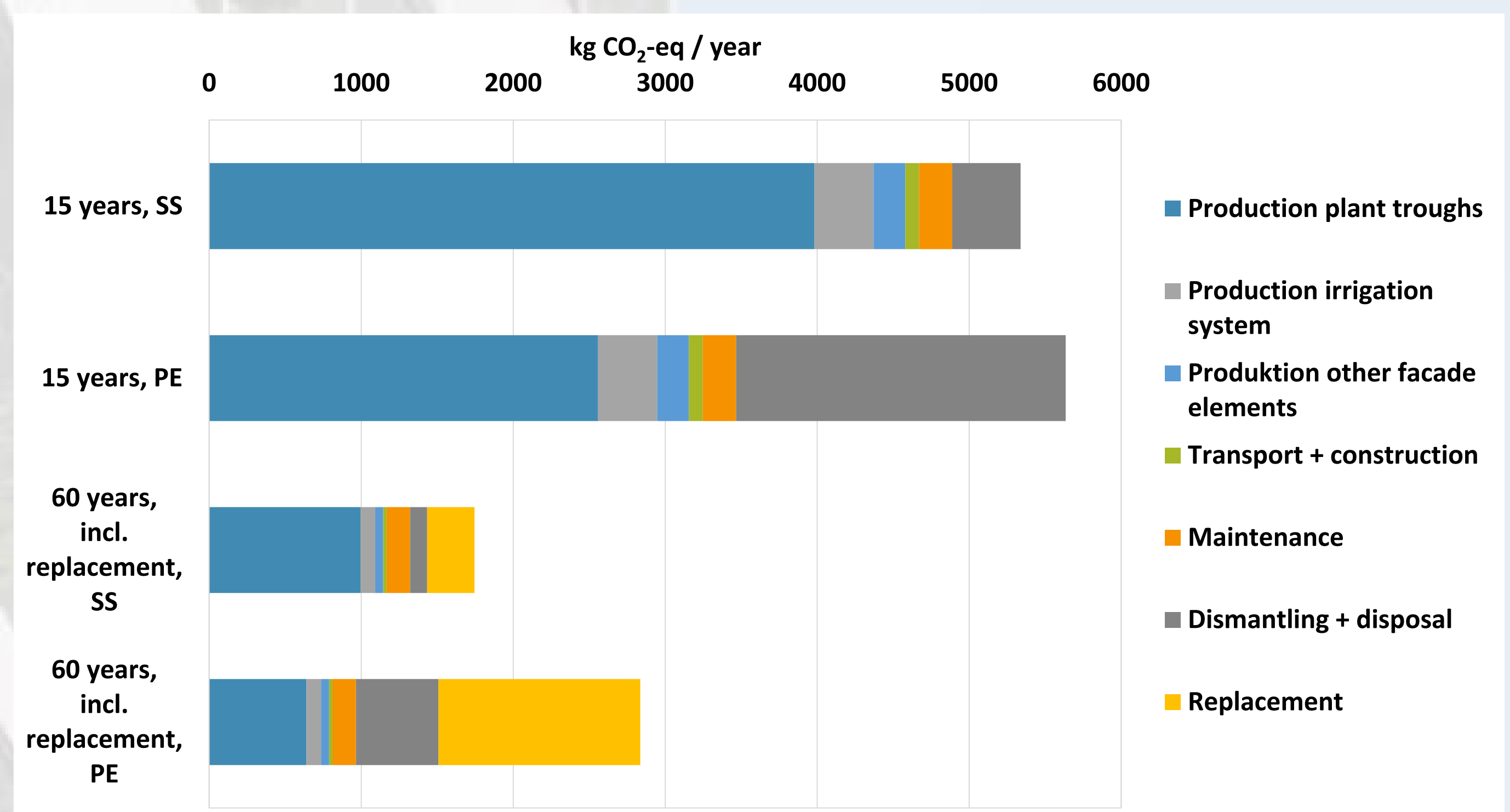
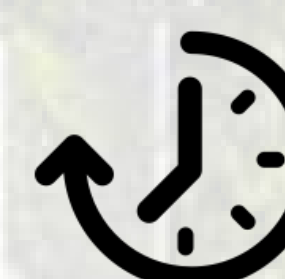


Figure 3. GHG emissions in kg CO₂-eq. per year, for a façade greening with an operating time of 15 years and an operating time of 60 years. For each operating period, one scenario with SS and PE plant troughs is shown.

Discussion and Conclusion



The plant troughs represent the primary environmental hotspot. Opting for recycled materials, reducing the number of troughs needed (e.g. ground-based greening), or direct reuse of troughs can drastically reduce environmental impacts.



Maximising the operating time of the façade greening along with all its separate components can additionally improve its life cycle environmental performance.

References

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