

Life Cycle Analysis of the Adaptive Solar Facade[☆]

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Abstract

Text

Keywords: Adaptive Solar Facade, Life Cycle Analysis

1. Introduction

In the last decades, building integrated photovoltaics (BIPV) have been adopted as part of the energy strategy towards 2050... (advantages of BIPV, potential of BIPV)

The current developments of light weight efficient thin film technologies have brought new design possibilities for architects in BIPV design... (Adaptive Building Envelopes, Envelope is the barrier between the internal and external environment, Advantages, seamless coupling with solar tracking mechanics)

The aim of this paper is to analyse the life cycle emissions of an adaptive solar facade and provide comparisons with standard shading systems and static BIPV solutions.

[☆]This document is a collaborative effort.

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2. Life cycle analysis methodology

The analysis is performed according to ISO14040, ISO14044 and ISO15804

Impact category: GWP

Functional unit: m² (shading) and kWh (PV)

$$G = \frac{\text{GWP}}{I \cdot \eta \cdot \text{PR} \cdot \text{LT} \cdot A} \quad (1)$$

Scope and system boundaries: embodied, operational, disposal

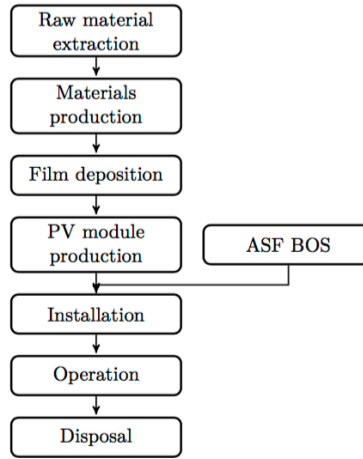


Figure 1: Thin-film incl. BOS (e.g. supporting structures and systems) analysis

Cut-off method used

Recipe midpoint H allocation method

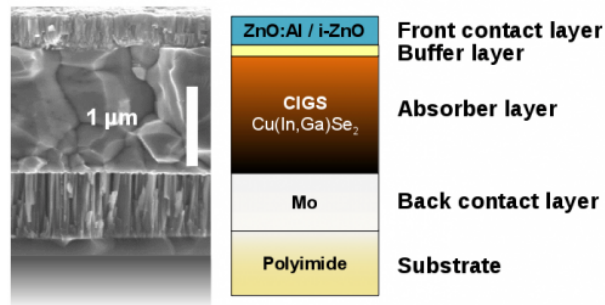


Figure 2: CIGS thin film structure MAKE OWN GRAPH, DO NOT USE THIS ONE FOR FINAL

1. Solar irradiation Zurich, Switzerland: 1240 kWh/m²/yr
2. Module efficiency CIGS: 11.5%
3. Performance ratio with optimal algorithm: 0.326¹
4. Electricity production: 46.54 kWh/m²; 417 kWh
5. Shading office room savings according to Table ?? and ??
6. Lifetime: 15 years
7. Maintenance every 5 years: 69.9 kgCO_{2eq}²
8. Disposal processes according to Appendix ??
9. Database source: Ecoinvent 3.1

¹Based on full facade area of 8.96m²; Actual PV film area only comprises of 5.76m²

²Includes: baking and vacuuming actuator, actuator silicone, actuator mold and idling hoist for 8 hours

3. Adaptive solar facade environmental profile

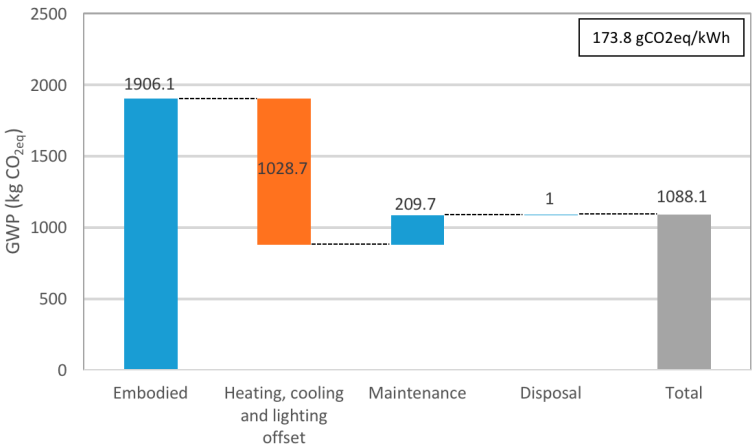


Figure 3: Build-up of total GWP of the ASF

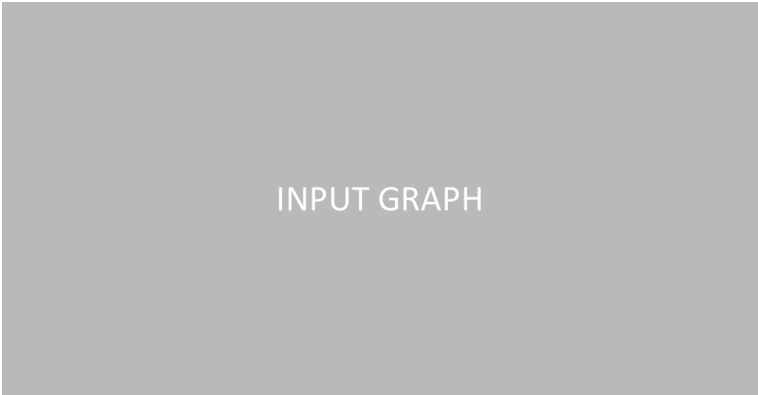


Figure 4: Monte carlo simulation based on input uncertainties

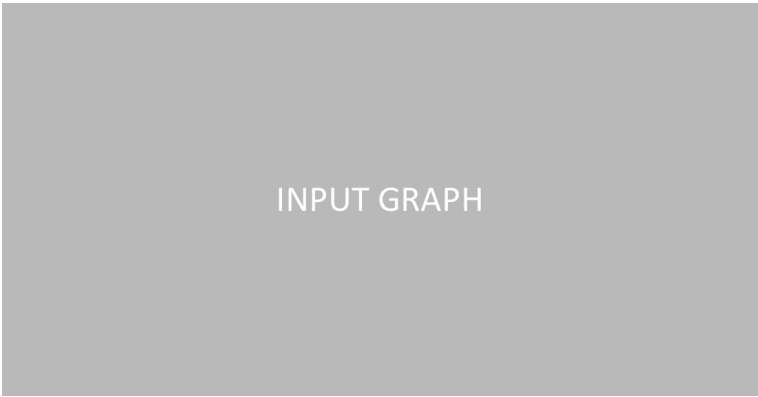


Figure 5: Sensitivity analysis based on sourcing location

4. Comparison to other technologies

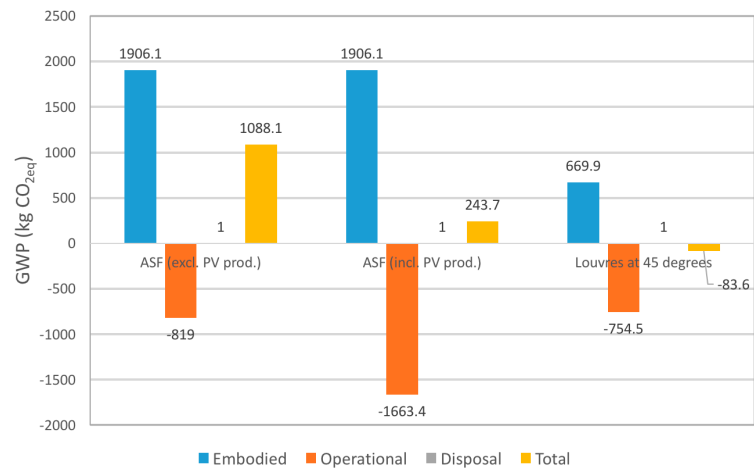


Figure 6: GWP comparison for adaptive solar facade and louvres

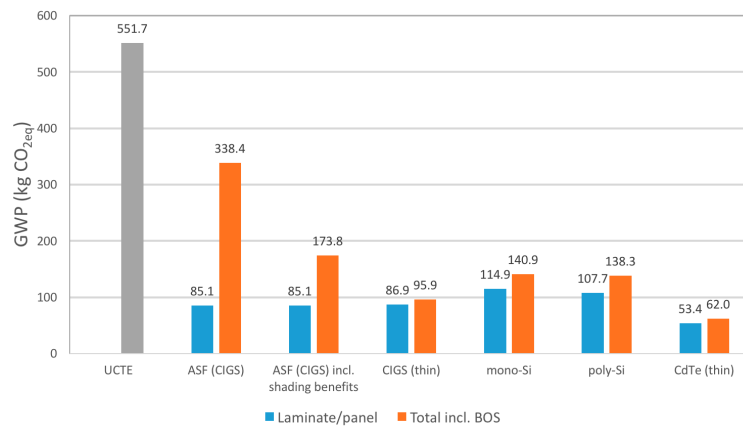


Figure 7: PV comparison for adaptive solar facade and other facade-mounted systems

5. Conclusion

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6. Acknowledgments

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