**Answers to the reviewer’s comments**

**We would like to thank both reviewers for providing useful comments to improve our paper. Please find our replies below each comment. New paragraphs in the manuscript have been reproduced here as well.**

Reviewer #1: The paper assesses greenhouse gas emissions of an adaptive solar façade system that combines shading with photovoltaic electricity generation. The authors also investigate how different design aspects affect the GHG emissions profile of the system.

The paper is relevant since it evaluates the environmental profile of a building-integrated photovoltaic system addressing energy efficiency in the built environment, and interesting because the authors examine a prototype rather than a hypothetical system. However, three major issues prevent me from recommending the paper for publication: the lack of multi-functionality considerations and proper system boundaries delimitation between the shading function and the PV electricity generation function; the inconsistency of geographical representativeness of data used for the electricity mix (i.e. use of average European electricity mix data instead of the Swiss mix data in the base case scenario) has a significant impact on the results, which convey a misleading message; the poor description of LCA methodology at basic level. These three major points are elaborated below followed by significant but lower priority (minor) comments.

A.1. The system under study combines a shading function with a PV electricity generation function, as the authors accurately describe right from the beginning in the Abstract, as well as later in Discussion and Conclusion. The choice of the functional unit suggests that the scope of the LCA study is the PV function. However, this is not reflected when deriving the system boundaries and modelling of the system. My argument is that the shading effect is a co-product that arises from the PV function, but it can exist in isolation from the PV function i.e. we can have an adaptive shading system with a panel and not necessarily a PV panel. This lack of multi-functionality (termed 'allocation' in ISO 14044:2006 [1]) considerations ascribes full environmental impacts (positive and negative) to the PV function, and, in my opinion, does not allow a fair and accurate assessment of the environmental performance of the PV function, especially when comparing with other PV systems.

A.2. The use of European electricity mix data gives inaccurate results, and conveys a misleading message. Since the authors assume that the system is located in Switzerland (and, for that reason, make correct use of Swiss weather file and solar irradiation data), the choice of European electricity mix data is inconsistent and flawed (p.11, l.32). As explained in the ILCD Handbook [2], "the geographical coverage of the LCI data should represent the smallest, appropriate geographical unit, depending on the goal of the LCI/LCA study and the intended applications. If e.g. the use of an energy-using consumer product in France would be the scope of the data set, the corresponding electricity market consumption mix (which is not automatically France) and French product use conditions were to be considered, i.e. not European or Global average conditions." Otherwise, there is a risk of producing inaccurate and misleading findings, as in this case where results differ significantly

when Swiss mix data is used, as shown in Figure 8. Again as explained in [2], "the use of data from one geographical area or specific supplier to another one is appropriate only if the differences in the environmental impacts have no or little relevance for the overall representativeness of the inventory."

**Thank you for pointing this out. During our first submission, we also were discussing this point, and chose the EU electricity mix as the electricity is shared across borders. Thanks to your review, we have now amended this and expanded it to three separate regions. Germany, Switzerland and Spain, where each region uses its own respective electricity mix.**

A.3. Description of the LCA methodology is flawed at basic level. For example, p.4, l.52-53 read: "the life cycle assessment is performed in three stages 1) goal, 2) scope definition, and 3) assessment." Overall, the whole paragraph (p.4, l.39-47) and section 2.1 present fundamental  errors, and do not comply with ISO 14044:2006 [1], which stipulates that "there are four phases in an LCA study: a) the goal and scope definition phase, b)the inventory analysis phase, c) the impact assessment phase, and d) the interpretation phase".

**Thank you for this point. In our initial versions our text was written as per ISO 14044:2006 with the ‘four phases of an LCA study’, however we later simplified it to increase readability. We have reverted our text to an earlier iteration which discusses each of the four phases individually.**

Minor comments:

B.1. The paper does not justify the exclusion of other environmental impacts categories from the scope of the study. The holistic nature of the LCA methodology allows quantifying potential environmental impacts and avoiding environmental burden-shifting. Unfortunately,  limiting the scope of the study to assessing GHG emissions happens too often in LCAs despite evidence in the literature that GHG accountings are not sufficient indicators for environmental sustainability [3]. In principle, all relevant environmental impact categories should be considered; otherwise, it should be clearly stated and discussed [1]. Moreover, characterising your findings as 'environmental impact/performance' is a bold generalisation that should be avoided, since the authors have limited the scope of their work to climate change impacts only.

**Agreed. We also have results for the Terrestrial Acidification Potential (AP). This has now been included in the paper.**

B.2. Several points need to be reported clearly and transparently:

a. An accurate description of the end-of-life stage is missing. For example, p.5, l.41 mentions that "the cut-off approach is used for the allocation of recycling and landfill disposal", whereas a simple internet search shows that direct landfilling is not allowed in Switzerland (<http://www.bafu.admin.ch/abfall/01495/01496/index.html?lang=en>).

**By ‘landfill disposal’, we actually meant ‘disposal’ in general. Thank you for noticing the wording.**

b. It is not justified why benefits from recycling credits are not taken into account (p.5, l.43), while recycling is central to the reduction of environmental impacts (particularly metal depletion and toxic effects) and scaling up the availability of BOS metal  components in future PV systems [4-6].

c. The "cut-off approach" is not explained (p.5, l.20, l.42) i.e. the cut-off criteria are not reported neither is the assumption that defines and quantifies them (see paragraph  4.2.3.3.3 [1]).

d. The sensitivity analysis of the electricity mix (p.13, l. 45-55) does not clearly describe the geographical coverage of your LCI data. In other words, when data for the German electricity mix is used, it is not clear whether appropriate weather file and solar irradiation data for Germany are used too. If not, the geographical coverage of the LCI data is inconsistent as highlighted earlier in A.2.

**Thank you for pointing this out. It has been amended alongside point A.2.**

B.3. A number of the Journal's requirements are not met, as described in the 'Guide for Authors' (<https://www.elsevier.com/journals/solar-energy-materials-and-solar-cells/0927-0248/guide-for-authors#40100>).

a. The graphical abstract image should be readable at a size of 5×13cm using a regular screen resolution of 96 dpi, which is not the case here. That said, I do not review the content of the graphical abstract.

**A new graphical abstract has been created which is readable at a size of 5x13 using a screen resolution of 96 dpi**

b. The highlights exceed the maximum 85 characters, including spaces, per bullet point. Again, I do not review the content of the highlights.

**Thank you for pointing this out. Somehow we misunderstood this as being 85 characters excluding spaces. We will shorten our highlights to fit the guidelines**

c. All sections should be numbered as explained in the 'Guide', which is not true for all subsections within section 2.1 (p.4, l.50), 2.2 (p.5, 40) and 2.3 (p.9, 37).

**The headings within section 2.1, 2.2 and 2.3 are not meant to be subsections but rather a description. We will be happy to create sub-subsection headings if necessary.**

d. Plus, there is a discrepancy between the title on the abstract page ("Life cycle analysis of…") and the title on p.1 of the manuscript ("Life cycle assessment of…").

**Well picked up, we realized this upon submission. Thank you for noticing. The correct title is ‘Life Cycle Assessment’, this will be clarified in our review submission**