ADDRESSING THE INDIUM ANOMALY IN THE PEFCR FOR PV ELECTRICITY GENERATION

The international, not-for-profit industry coalition PVthin has the objective and purpose to strengthen global energy security and help create sustainable energy infrastructures and to promote the social, economic and environmental benefits of thin-film solar photovoltaic technologies.

In line with that objective and purpose, PVthin has been actively involved in the work of the Technical Secretariat of the PEF Pilot project on photovoltaic electricity generation. The members of PVthin and the undersigned companies representing the value chain of CI(G)S based thin-film PV technologies ask for an amendment of the methodological guidance provided for the PV PEFCR to ensure a fair and comparable assessment and evaluation of all photovoltaic technologies.

As lined out in the addendum, the current guidance on the application of the Product Environmental Footprint Methodology leads to a number of distortions in the results of the life cycle assessment of a number of photovoltaic technologies represented in the market today – that effect which we refer to as Indium Anomaly leads to non-representative results in particular with regard to CI(G)S based thin-film PV technologies.

The members of PVthin, the Technical Secretariat and the undersigned companies and organizations ask for the following adjustments in the PEFCR for photovoltaic electricity generation and in the ILCD impact assessment method:

1. **Update the characterization factor of indium based on the most recent data available;**
2. **Align the normalization data with the data used in the PEF Pilot by also including resources, which are not mined in Europe;**
3. **Assess resource depletion based on dissipative use in order to account for recovered or recycled resources.**

Addendum: Memo "Indium anomaly in the ILCD 2011 impact assessment method"

Indium anomaly in the ILCD 2011 impact assessment method

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1 Introduction

The screening study of the PEF Pilot “Photovoltaic (PV) electricity generation” revealed the dominating impact of the indium resource in the weighted results of a 3 kWp CIS PV system mounted on a slanted roof (Stolz et al. 2016; Figure 1). This result is caused by an artefact in the ILCD 2011 impact assessment method. The observed problem was first communicated to the technical helpdesk[1] in 2014, which published an issue paper (Vieira 2015). It is also addressed in the recommendations of the draft PEFCR on PV electricity (Technical Secretariat of the PEF Pilot "Photovoltaic Electricity Generation" 2016, p. 37).

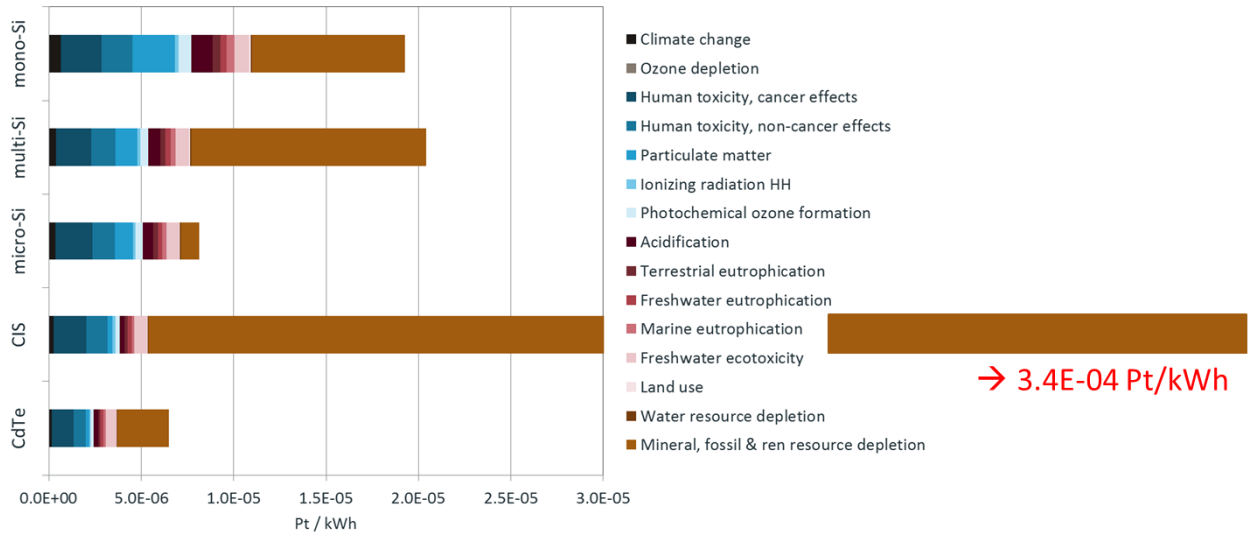

Figure 1 Cumulative weighted results of 3 kWp PV systems mounted on a slanted roof based on the PEF screening study (Stolz et al. 2016) as presented at the 2nd SC meeting in Brussels on 30.09.2015.

2 Causes and solutions

The supply chains of indium and cadmium are wrong (roughly ten times too high resource extractions of Indium and Cadmium respectively) due to wrong resource correction factors. The correct factors are listed in Table 1. Within the PV PEF pilot we are using the corrected factors but still indium dominates the abiotic resource depletion indicator.

Table 1 Proposed corrections[1] in the supply chains of indium and cadmium in ecoinvent data v2.2+.

Dataset	date	error and correct value
Leaching residues, indium rich, from zinc circuit, at smelter	18.12.2013	Resource correction, PbZn, indium, positive/GLO U new value 9.727711E-5 kg (instead of 0.0019421314711689 kg in v2.2); resulting in a resource demand of 1kg Indium-resource per kg Indium
cadmium sludge, from zinc electrolysis, at plant	18.12.2013	Resource correction, PbZn, cadmium, positive/GLO U new 0.445951kg (instead of 11.724791284268 in v2.2); resulting in a resource demand of 1kg Cadmium-resource per kg Cadmium

[1] Personal communication (Email) from Rolf Frischknecht to Annemarie Kerkhof, 17 November 2014

Using more recent USGS publications, the indium characterization factor is 5 times lower than used in the indicator recommended by ILCD 2011 (see Frischknecht & Büsser Knöpfel 2013, p. 235). Hence, updating the characterization factors would result in five times lower impacts of indium in terms of resource depletion. The characterization factor of indium according to ILCD 2011 means that the reserves last for only 10 years of annual consumption. Today, 20 years seem to be more realistic.

In the normalization according to the ILCD 2011 impact assessment method, only resources mined in Europe are included as explained by Benini et al. (2014, p. 79):
"Indium was not accounted in the inventory because the EU production of this material (mainly in Belgium, Italy, Germany and the Netherlands) is only at refinery stage (Polinares, 2012) and therefore was not considered as a resource extraction. Indium, indeed, is a typical byproduct of smelting polymetallic ores of base metals such as lead, zinc, copper and tin. Including the EU production of indium (55 tonnes in total) in the impact assessment would rise the overall result of resource depletion to 8.10E+07 kg of Sb equivalents and the contribution of indium would be 37.7%, due to the high CF of this element."

The current ADP results of CIS PV systems would be reduced by at maximum a factor 8 when combining the use of a more recent characterization factor for indium and of complementing the annual ADP normalization value with indium resource consumption.

There is an ongoing discussion on whether the assessment of resource depletion should be based on resource extraction or resource consumption ("dissipative use"). This is in analogy to the assessment of water use where the consumptive use is considered rather than the water volume withdrawn from nature. The reasoning of using the dissipative resource use as the relevant measure is described by Frischknecht and Büsser Knöpfel (2013, p. 175) and presented by Frischknecht (2014):
"The goal of the Federal Council's strategy is to close material cycles. From this, it can be deduced that resource extraction is not decisive in the material use of resources, but rather the amount of dissipatively, i.e. irrevocably, extracted and processed resources that are lost and no longer available for future use. The remaining portion, which can be recovered or recycled, is only "on loan" and may be used again in the future. Hence, resource extraction, and not dissipative use, is assessed in the way the used inventories are represented. In case studies where the use of primary resources is important, it should be ensured that only dissipative use (as described above) is assessed. The eco-factor of mineral and metal resources should therefore be applied to the difference between resource extraction and recycled resources."

3 Recommendations

The Technical Secretariat of the PEF Pilot recommends the following adjustments in the next version of the ILCD impact assessment method:

- update the characterization factor of indium based on the most recent data available;
- align the normalization data with the data used in the PEF Pilot by also including resources, which are not mined in Europe;
- assess resource depletion based on dissipative use in order to account for recovered or recycled resources.

These adjustments should be given a high priority due to the large influence of the indium anomaly on the results.

4 References

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Technical Secretariat of the PEF Pilot "Photovoltaic Electricity Generation" (2016) Product Environmental Footprint Category Rules: PRODUCTION OF PHOTOVOLTAIC MODULES USED IN PHOTOVOLTAIC POWER SYSTEMS FOR ELECTRICITY GENERATION (NACE/CPA class 27.90 “Manufacturing of other electrical equipment”).

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