Meeting the NEEDS of European Environmental Sustainability Assessment: The Case of PV

Rolf Frischknecht[1], Matthias Stucki[1], Wolfram Krewitt[2]
[1]ESU-services Ltd., Kanzleistrasse 4, CH – 8610 Uster
www.esu-services.ch
[2]German Aerospace Center (DLR), Pfaffenwaldring 38-40, D-70569 Stuttgart

Introduction

Most LCAs carried out today rely on background databases containing LCI data that were compiled in the last few years. This can be viewed as a reasonable approach for assessments relating to today's situation. However, mixing LCI data from databases representing today's situation with LCI data of systems and technologies that will be realised in some decades can lead to results that do not represent the environmental impact of possible future situations. This is crucial for technologies with low or zero direct emissions such as photovoltaic or solar thermal power plants where improvements in other parts of the economy have a direct impact on their performance.

Procedure

Commodities and services adapted according to the future scenarios shown in Tab. 1:

- **Materials:** aluminium, copper, nickel, iron, steel, MG-silicon, zinc, clinker, flat glass
- **Transport Systems:** lorries between 16t and 40t, 3.5t van
- **Electricity Mix:** UCTE (European) mix
- **Electricity Generation:** advanced fossil, fuel cell, offshore wind, photovoltaics, solar thermal, biomass, advanced nuclear, wave energy

Name	Time	Technology development	electricity mix
TODAY	2000	current state	current European electricity mix (UCTE)
2025 RO, 440ppm	2025	realistic optimistic	440ppm CO_2 cap
2050 RO, 440ppm	2050	realistic optimistic	440ppm CO_2 cap
2050 VO, RENEW	2050	very optimistic	increased renewables and energy efficiency
2050 PE, BAU	2050	pessimistic	business as usual

Tab. 1: Excerpt of calculated future scenarios

ecoinvent database: detailed documentation and unit process data (Fig. 1); Only most relevant datasets forecasted into the future; Changes **firstly** propagated into all other datasets of the **background database** and **secondly** into the **systems to be evaluated**; Calculations done with **Umberto®** .

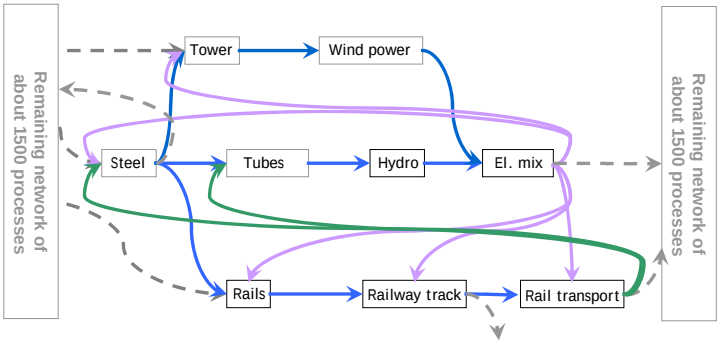

Fig. 1: Cross linking of unit process datasets with the advantage of interdependency and feedback loops.

Selected Results

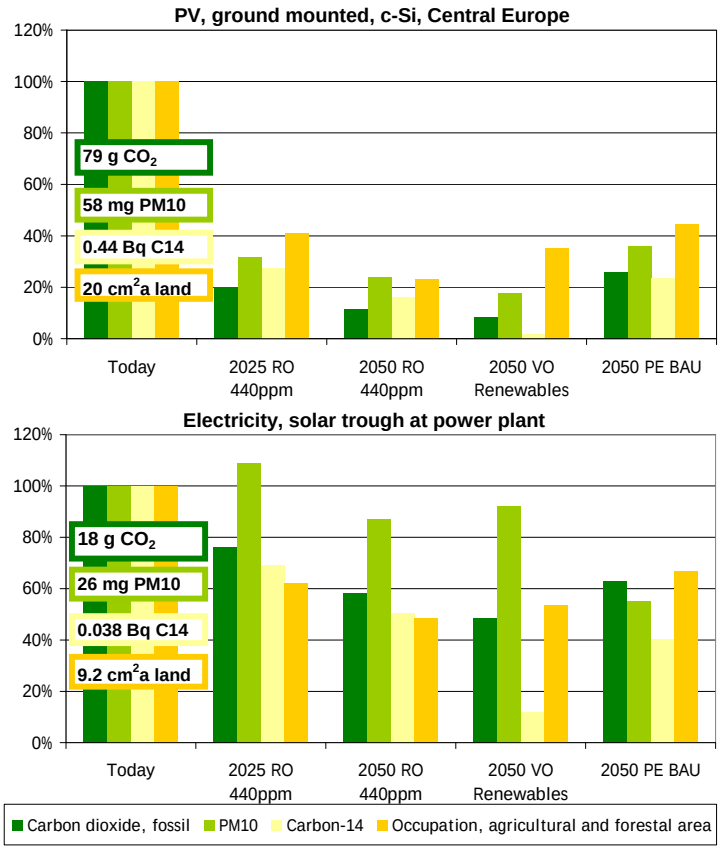

Fig. 2: Environmental impacts from the life cycle of one kWh electricity from photovoltaic and solar thermal power plants

The **future background data** lead to:
- **CO_2:** reduction of up to 91% and 51%
- **PM 10:** reduction of up to 82% and 45%
- **Carbon-14:** reduction of up to 98% and 88%
- **Agricultural and forestal land occupation**: reduction of up to 77% and 52%

Important for PV:
- developments in **materials**
- changes in **electricity mix**

NEEDS LCI database: **www.needs-project.org**

Conclusions

- **Life cycle thinking** is indispensable! Technology development matters!
- Consistent future background data: **improves accuracy of results of future solar energy systems**
- **Solar energy policy:** consider future situations!
- **Unit processes database**: straightforward scenario modelling

Credits

European Commission, 6th framework program Research teams of NEEDS Research stream 1a. Peter Viebahn (solar thermal power plant data), Paolo Frankl and Simona Lombardelli (photovoltaic data).