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Designing sustainable technologies, products and policies:
from science to innovation

Quantifying the importance of comprehensive life cycle and impact coverage for photovoltaic systems

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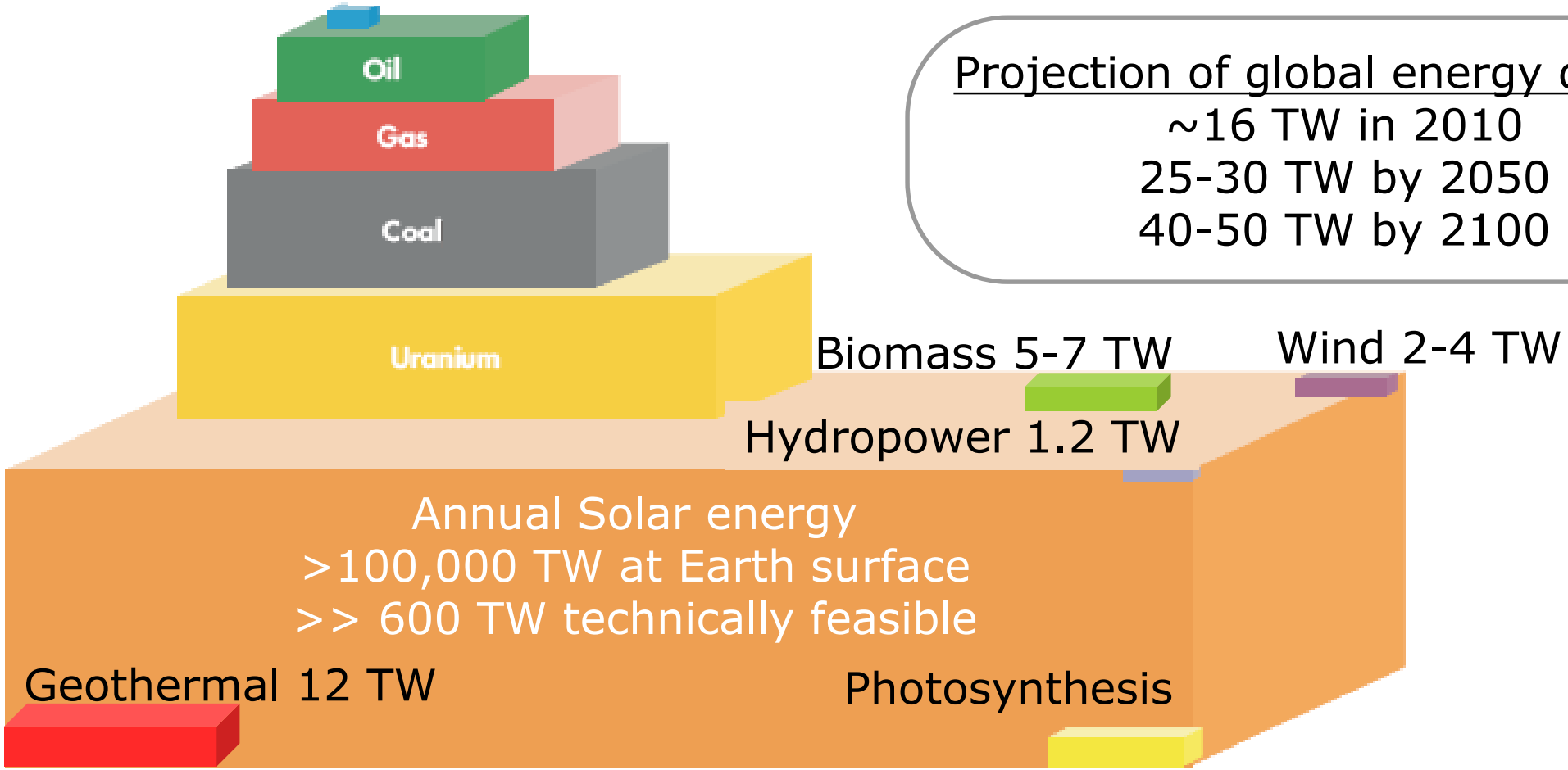
Background and motivation

- How important are photovoltaics (PV) for future energy systems?
- What are **thin-film** photovoltaics?

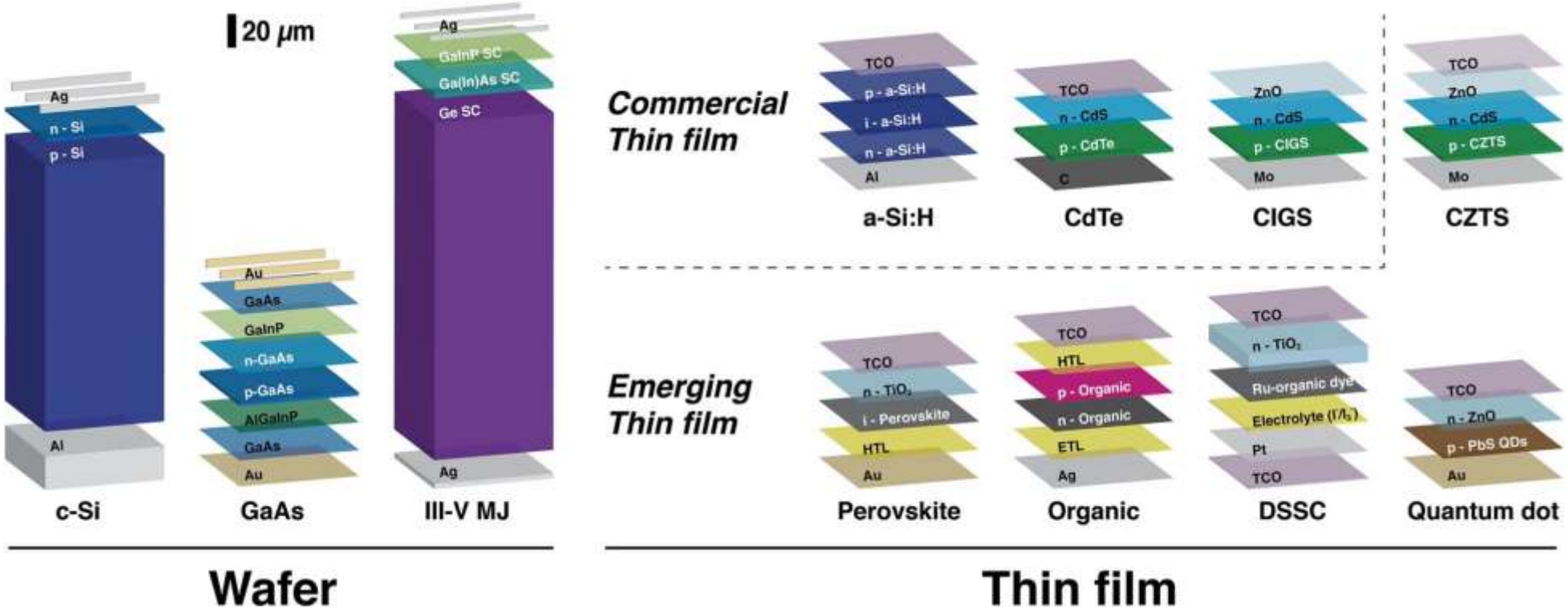
Photovoltaics will play a key role in the future



International Energy Agency, Energy Technology Perspectives 2008

Three generations of photovoltaic technologies

- Typically divided into wafer-based and thin-film
- **Thin-film** PV (2nd & 3rd generation PV) aim to lower material use and costs



Jean et al. Energy Environ Sci 2015;8:1200–19. doi:10.1039/C4EE04073B

Previous review papers of LCA studies covering thin-film photovoltaics

Identified gaps:

1) focus on **GHG emissions** and **energy-related indicators** (e.g. Cumulative Energy Demand and Energy Payback Time)

2) insufficient reporting of which parts of the **PV system's life cycle** were considered by the LCA studies under review

Work on reviewing LCA studies of thin-film PV

Solar Energy Materials & Solar Cells 156 (2016) 2–10

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journal homepage: www.elsevier.com/locate/solmat

Ecodesign perspectives of thin-film photovoltaic technologies: A review of life cycle assessment studies

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- In total, 46 LCA studies of thin-film PV were collected

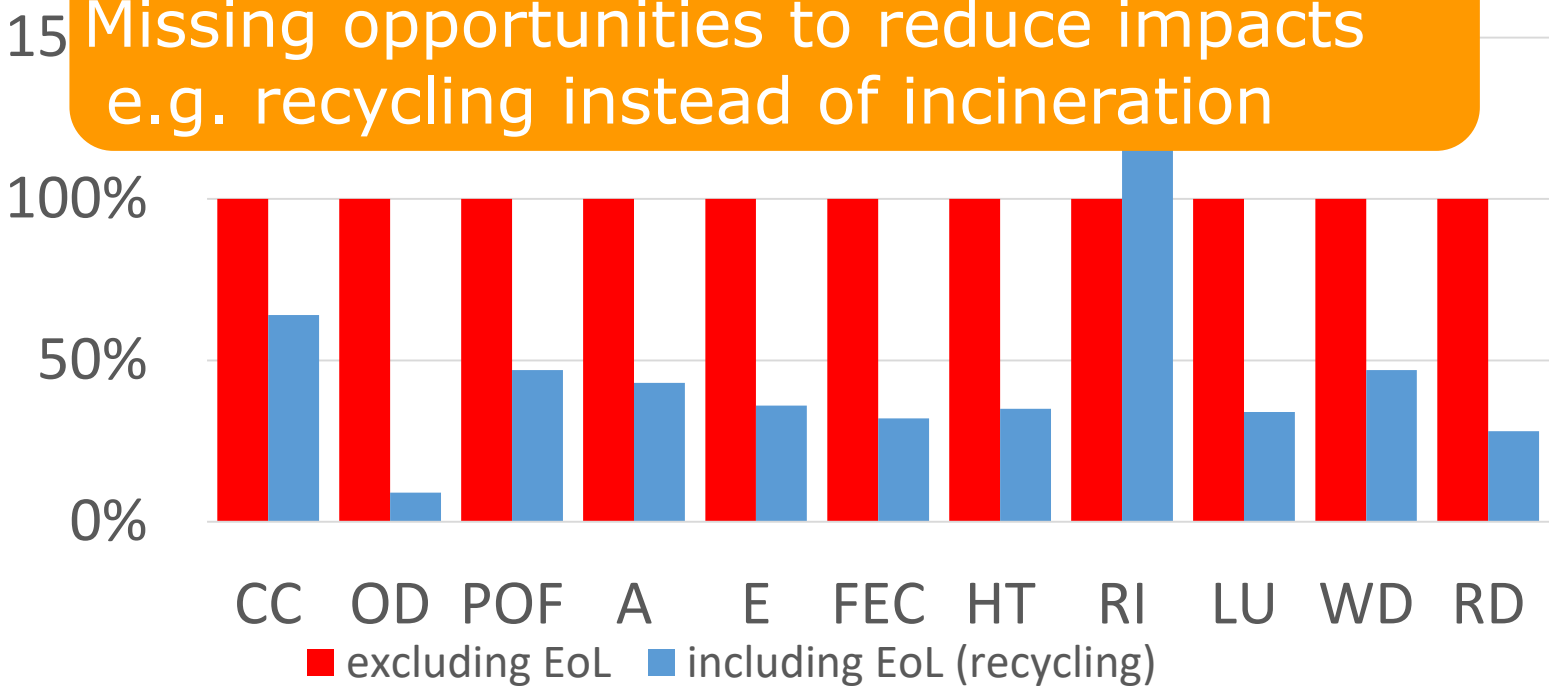
LCA studies nearly systematically disregarded the EoL stage

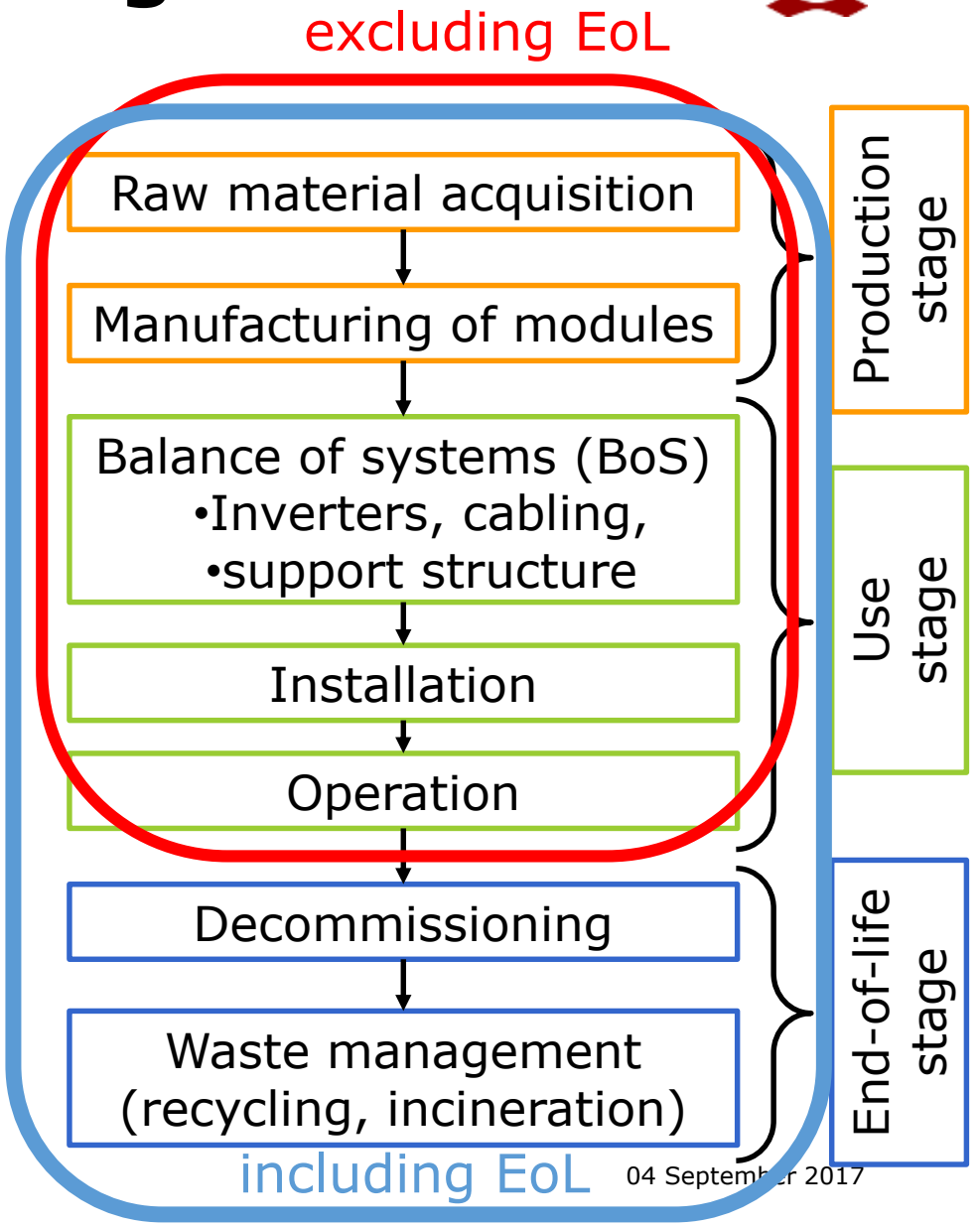
- 28 / 46 studies used their LCA results for ecodesign

Importance of full life cycle coverage

- Example: LCA study of **organic PV**
- Comparison of results **with and without EoL**
- Lower by 36-91% in 15 IC (RI higher by 51%)

Risk of burden shifting among LC stages
Missing opportunities to reduce impacts
e.g. recycling instead of incineration

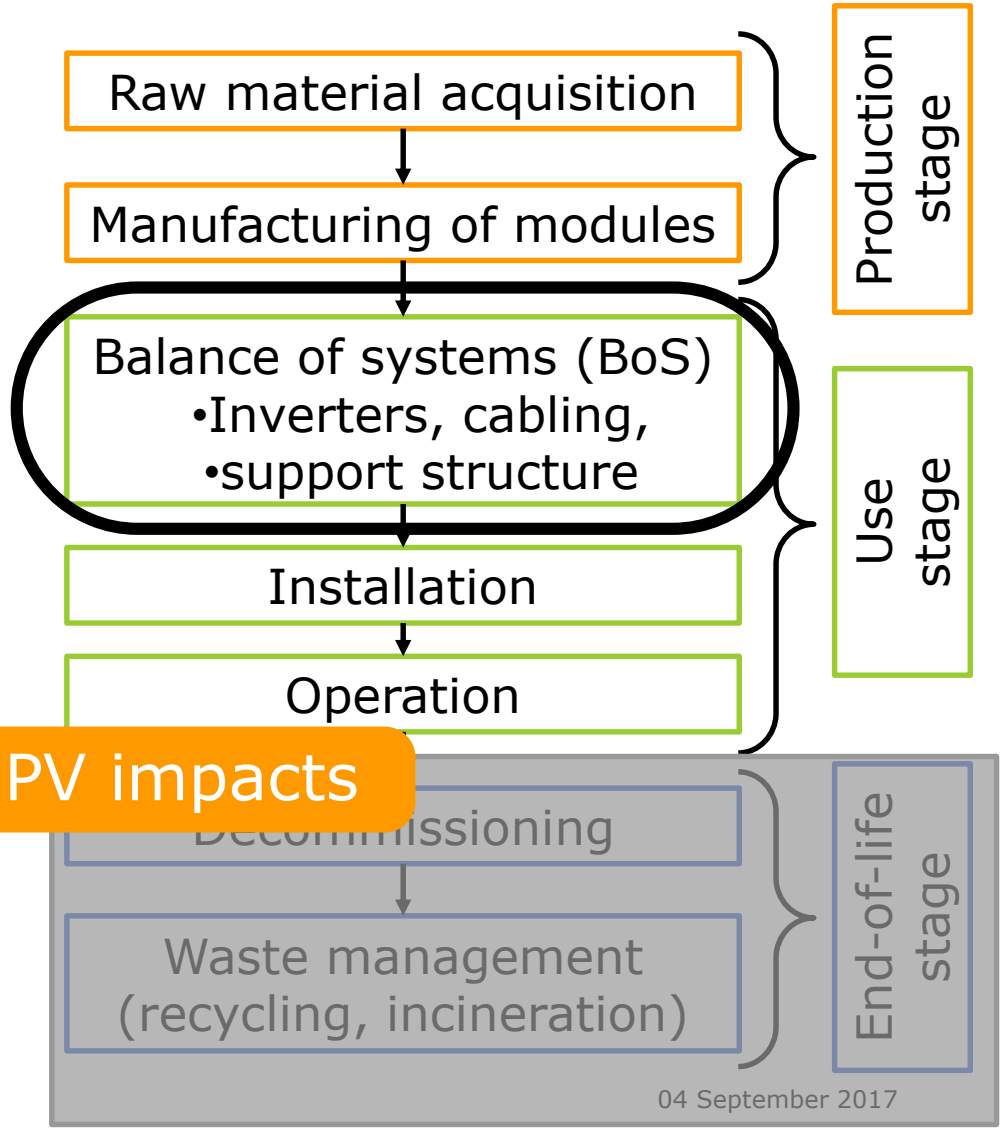




Espinosa et al. Energy Environ Sci 2015;8:2537–50. doi:10.1039/C5EE01763G.

Importance of full life cycle coverage

- The **contribution of BoS** was quantified for 10 LCA studies (that omitted the EoL)
- Contribution of BoS ranged between 3-95% depending on the impact category

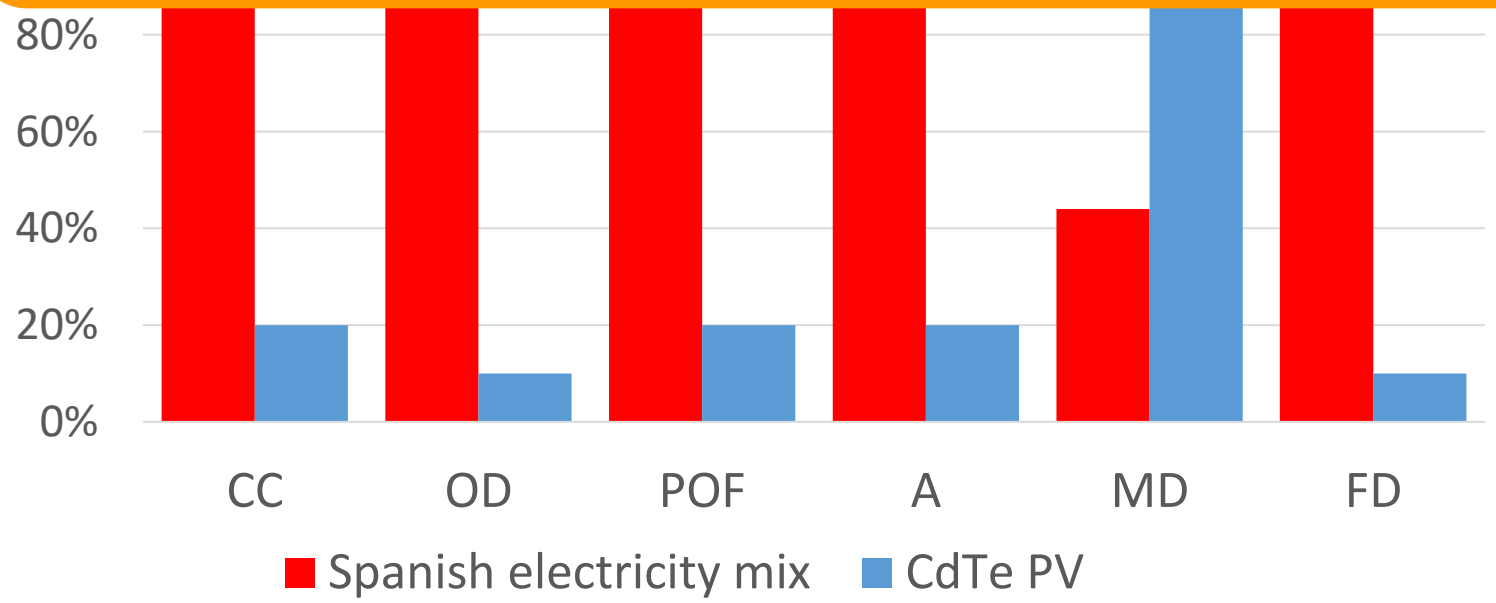


Significant contribution of BoS components to PV impacts

Importance of impact coverage

- Example: LCA study of **CdTe PV**
- Comparison of PV impacts with the **Spanish electricity mix**
- PV impacts lower by 60-90% for 9 IC; Metal Depletion impacts higher by 56%

Risk of burden shifting among impact categories, when LCA studies limit their scope on climate change



Serrano-Luján et al. Prog Photovoltaics Res Appl 2015;23:253–64. doi:10.1002/pip.2415.

Conclusions & recommendations

LCA studies nearly systematically disregarded EoL

Risk of burden shifting among LC stages
Missing opportunities to reduce impacts
e.g. recycling instead of incineration

Significant contribution of BOS components to PV impacts

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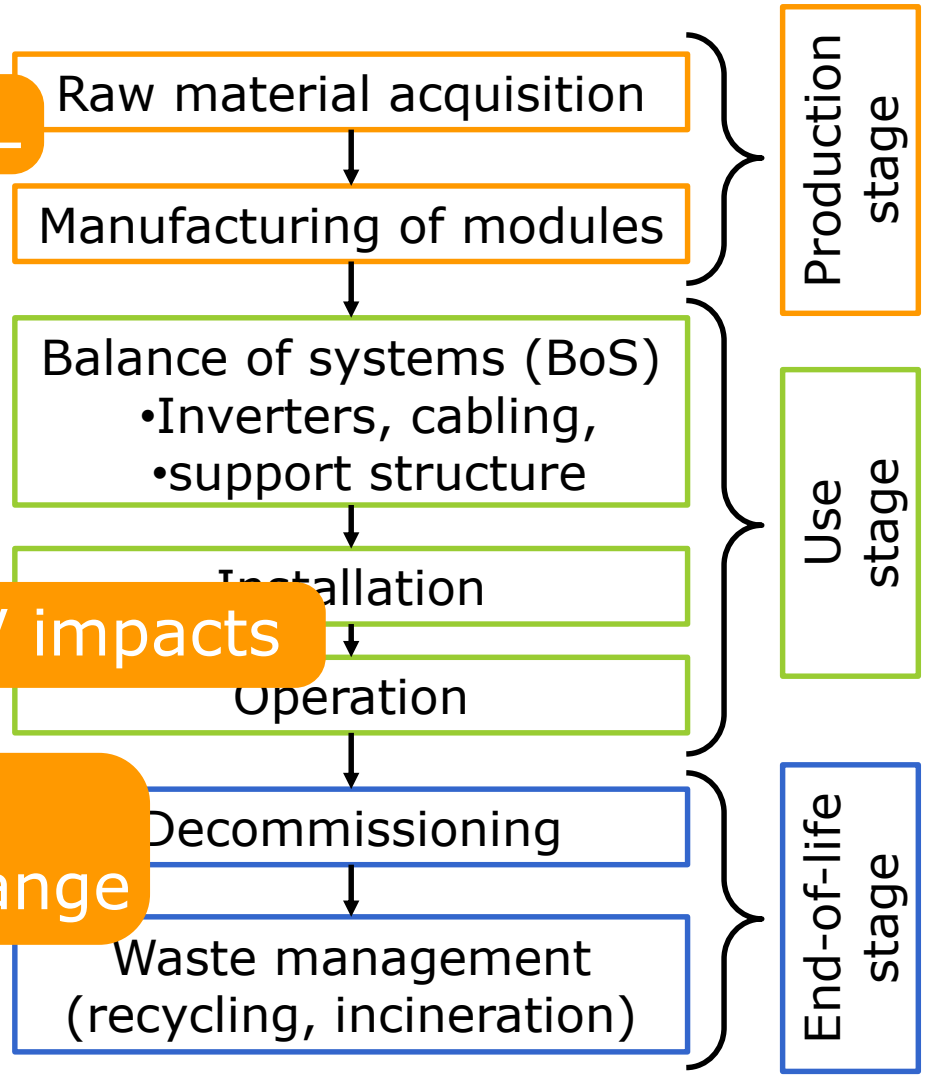

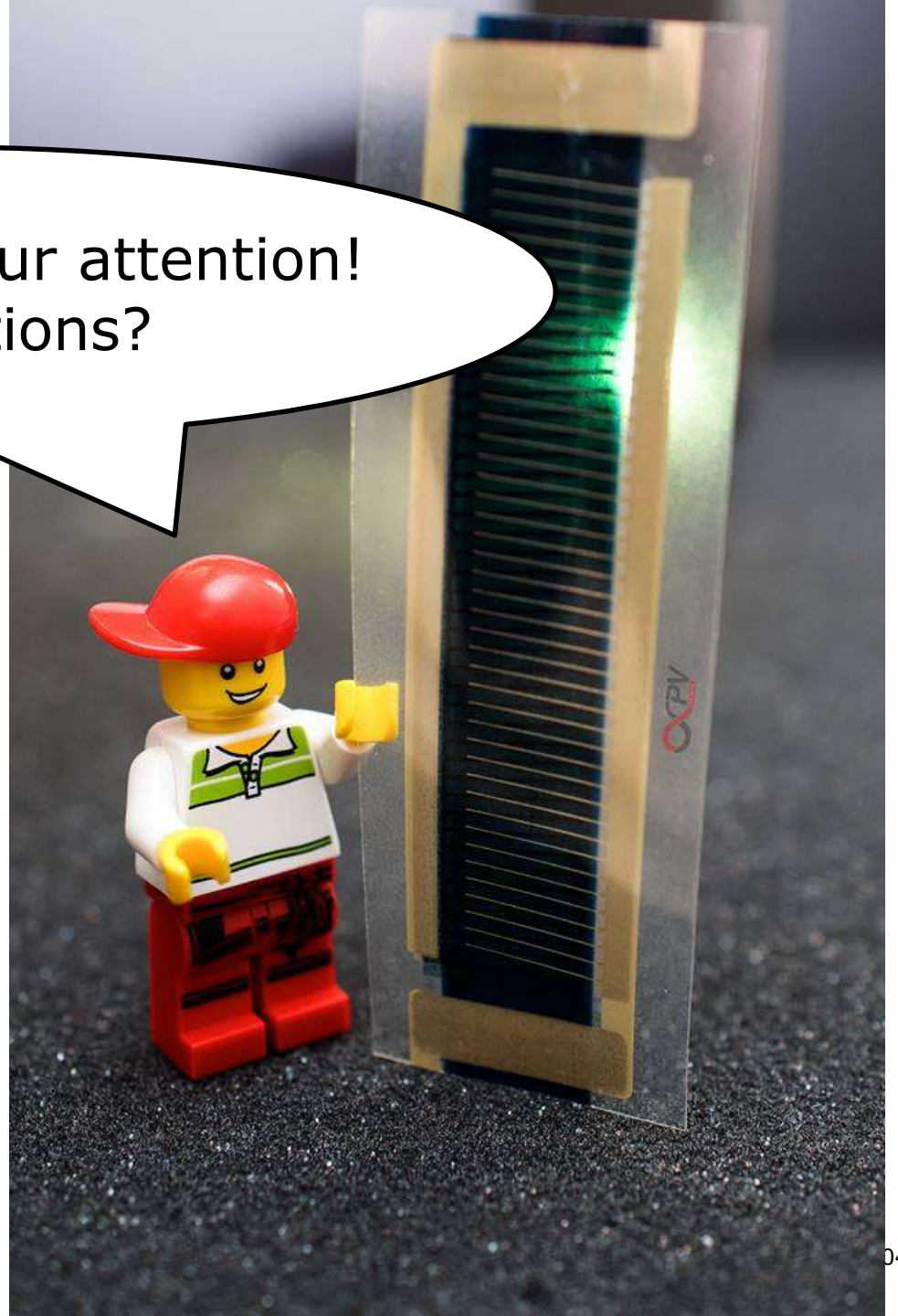

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