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Toward the eco-design of emerging technologies for energy and the industry of the future: how to integrate upscaling in life cycle assessment?

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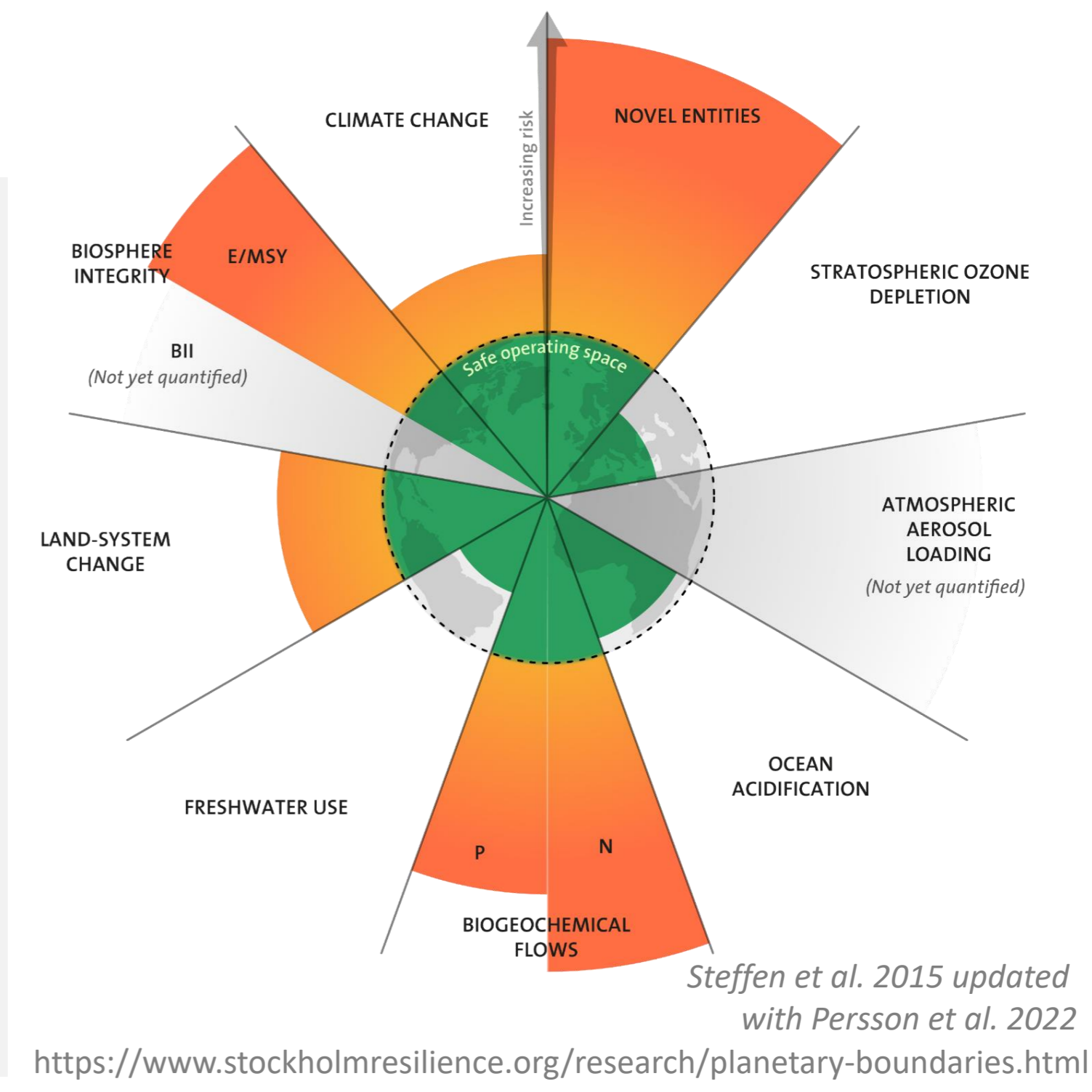
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Context: An environmental sustainability framework

The planetary boundaries framework shows the current unsustainability of our societies: **6 of the 9 limits guarantying a safe operating space (SOS) for humanity have been crossed in 2022.** Facing this massive issue, institutions all over the world address the necessity to build collectively the transitions toward sustainability: IPCC/IPBES reports, European Commission reports, SNBC and RTE/ADEME scenarios in France. In engineering, scientific methods to support the anticipation capacity of product designers in an upscaling context are lacking.



Therefore, designers should be better equipped to follow sustainable strategies by assessing the sustainable potential of an emerging technology before its upscaling in an environmental perspective.

State(s) of the Art and research questions

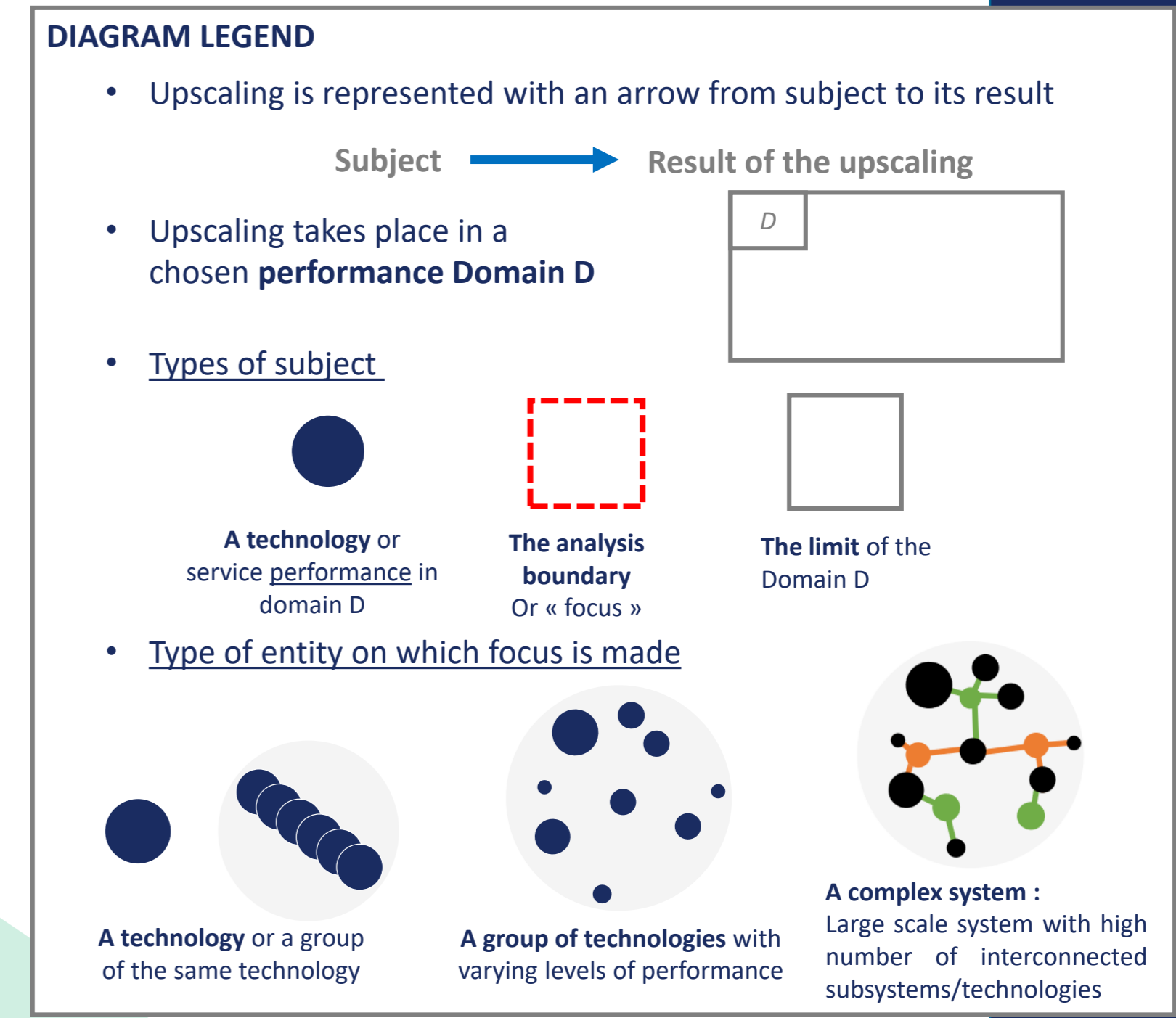
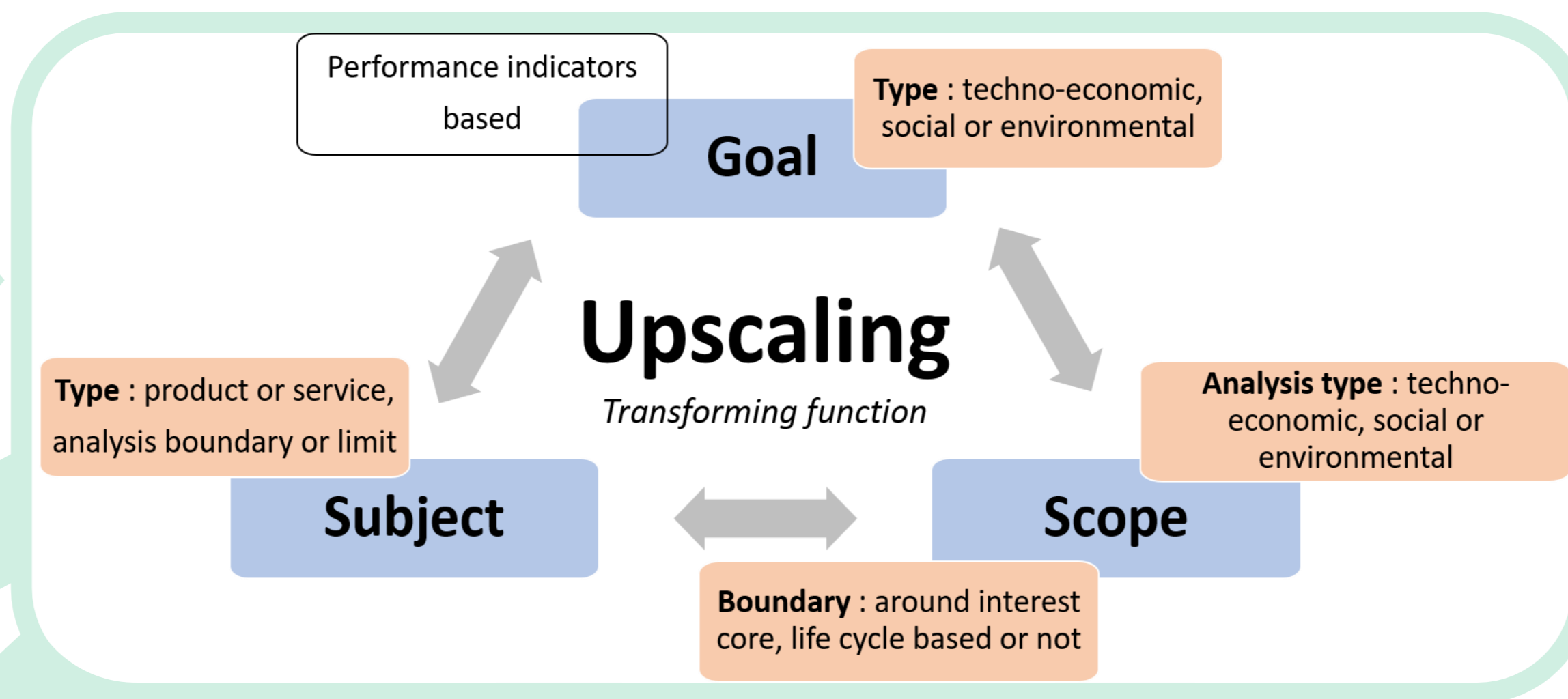
The term “**upscaling**” is polysemic in the literature: A characterization requirement.

RQ 1 : What is an upscaling and how to environmentally assess it?

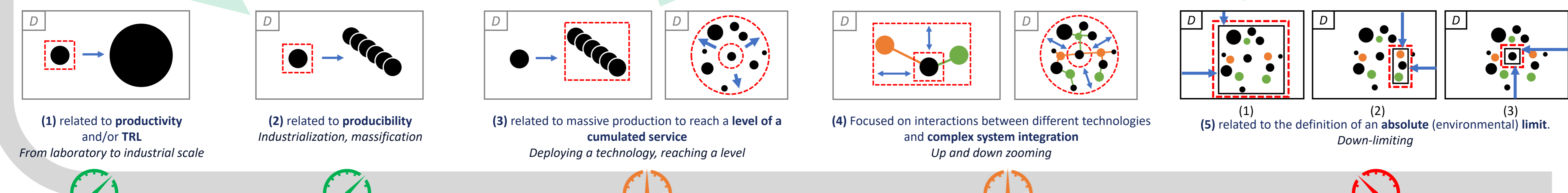
Characterization framework

Riondet L, Rio M, Perrot-Bernardet V, Zwolinski P. 2022. For an upscaling assessment integration in product. 32th CIRP Design Conference.

Maturity of the definition and assessment methodologies for designers



5 archetypes of upscaling have been identified in the literature.



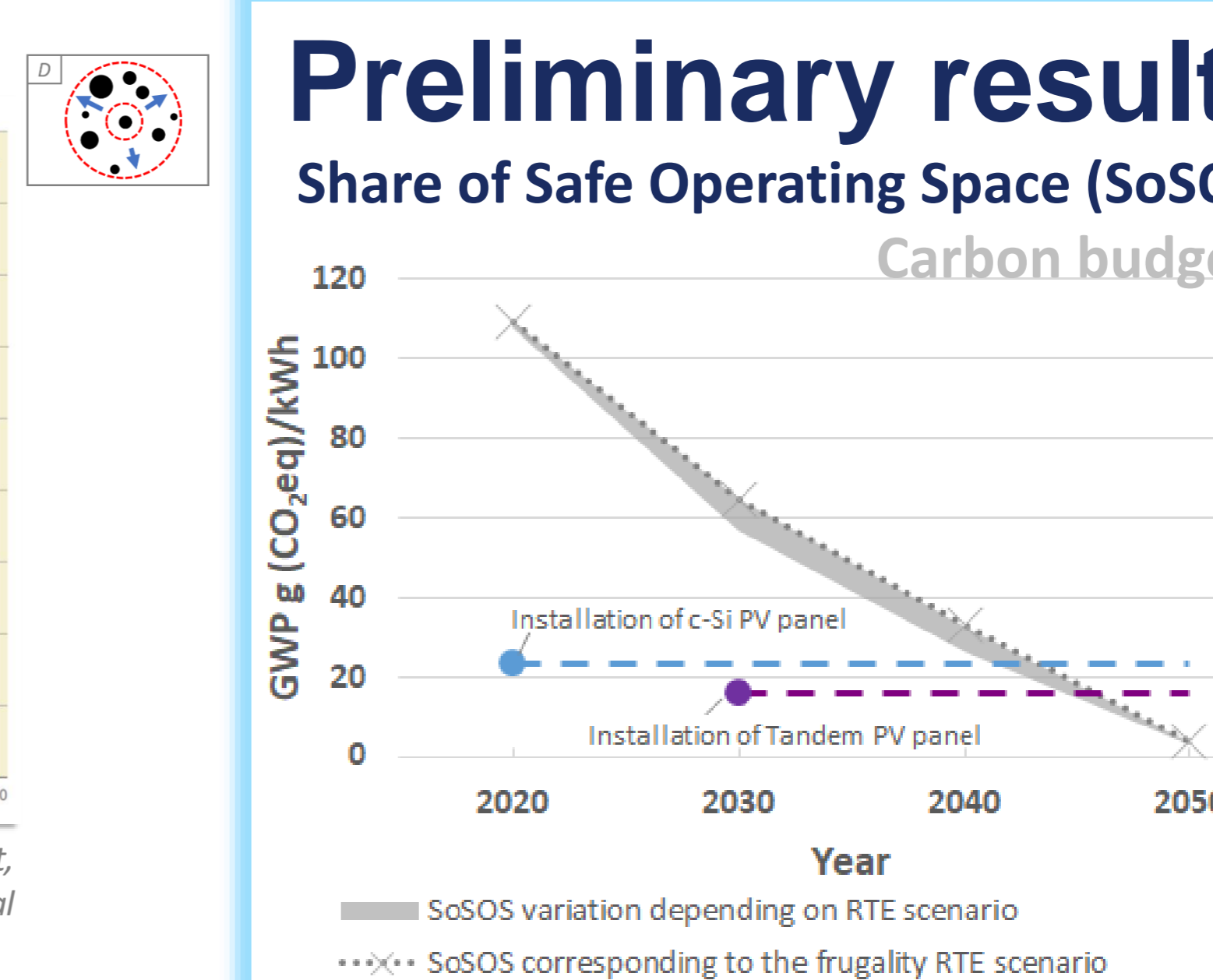
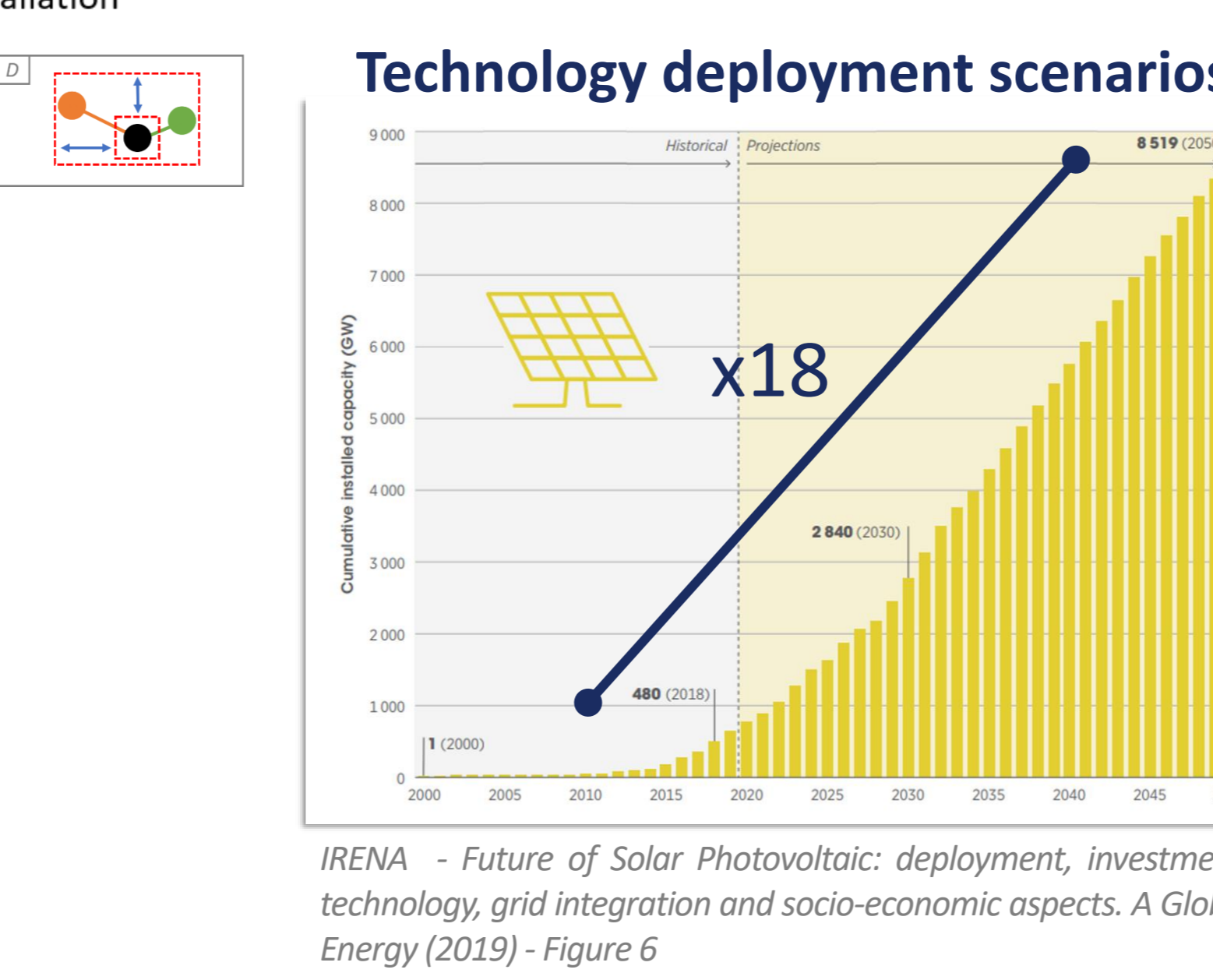
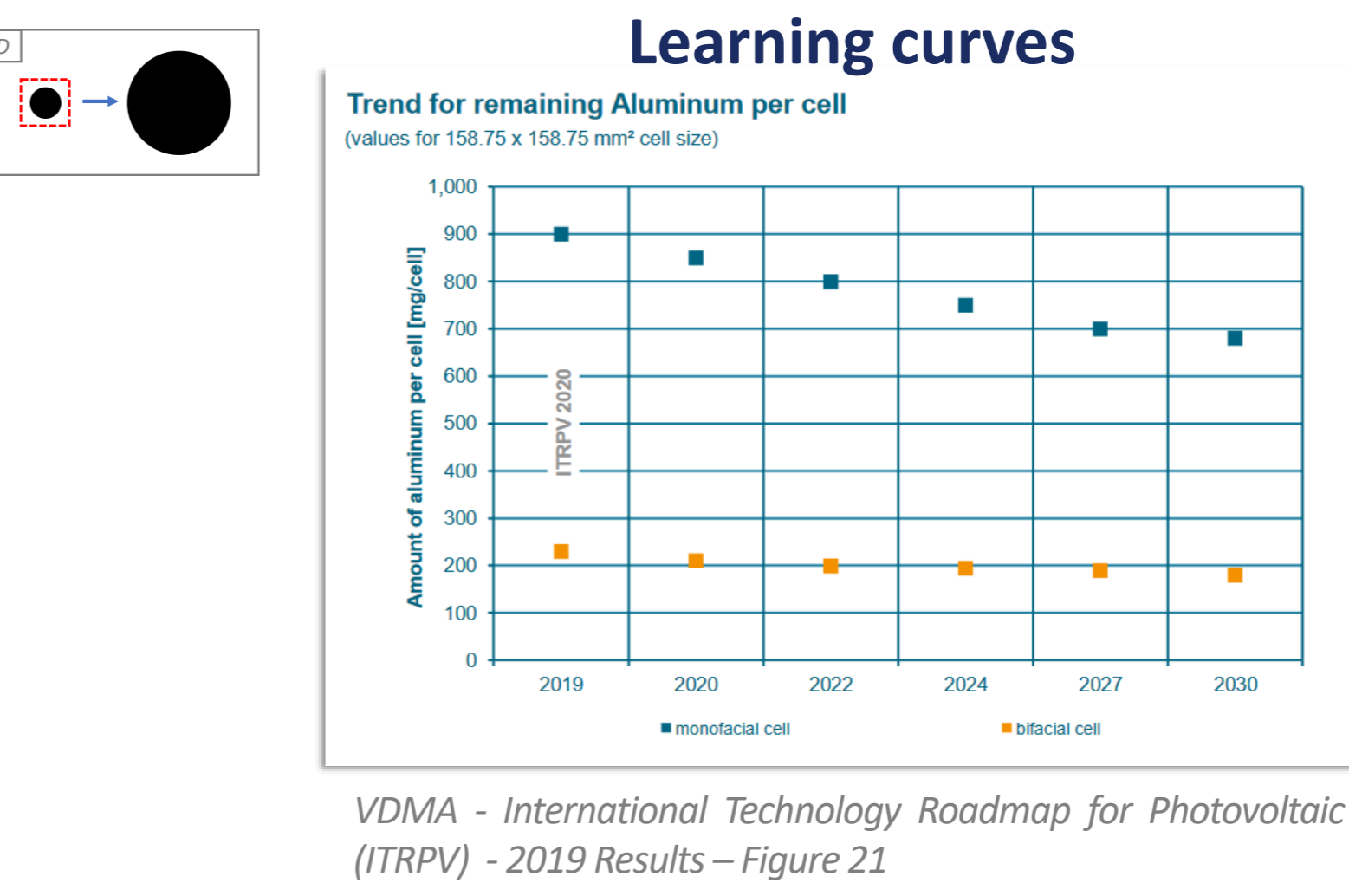
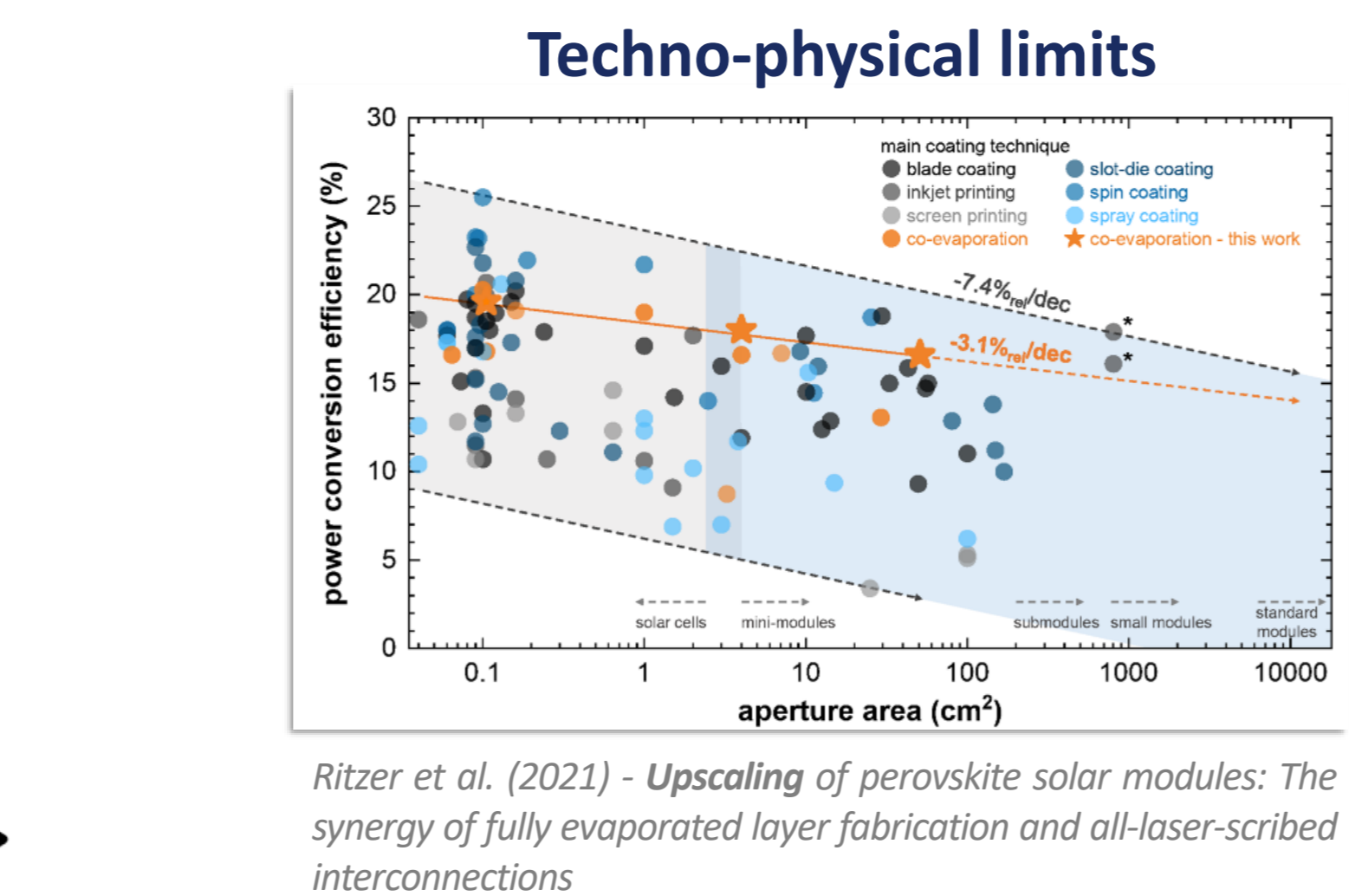
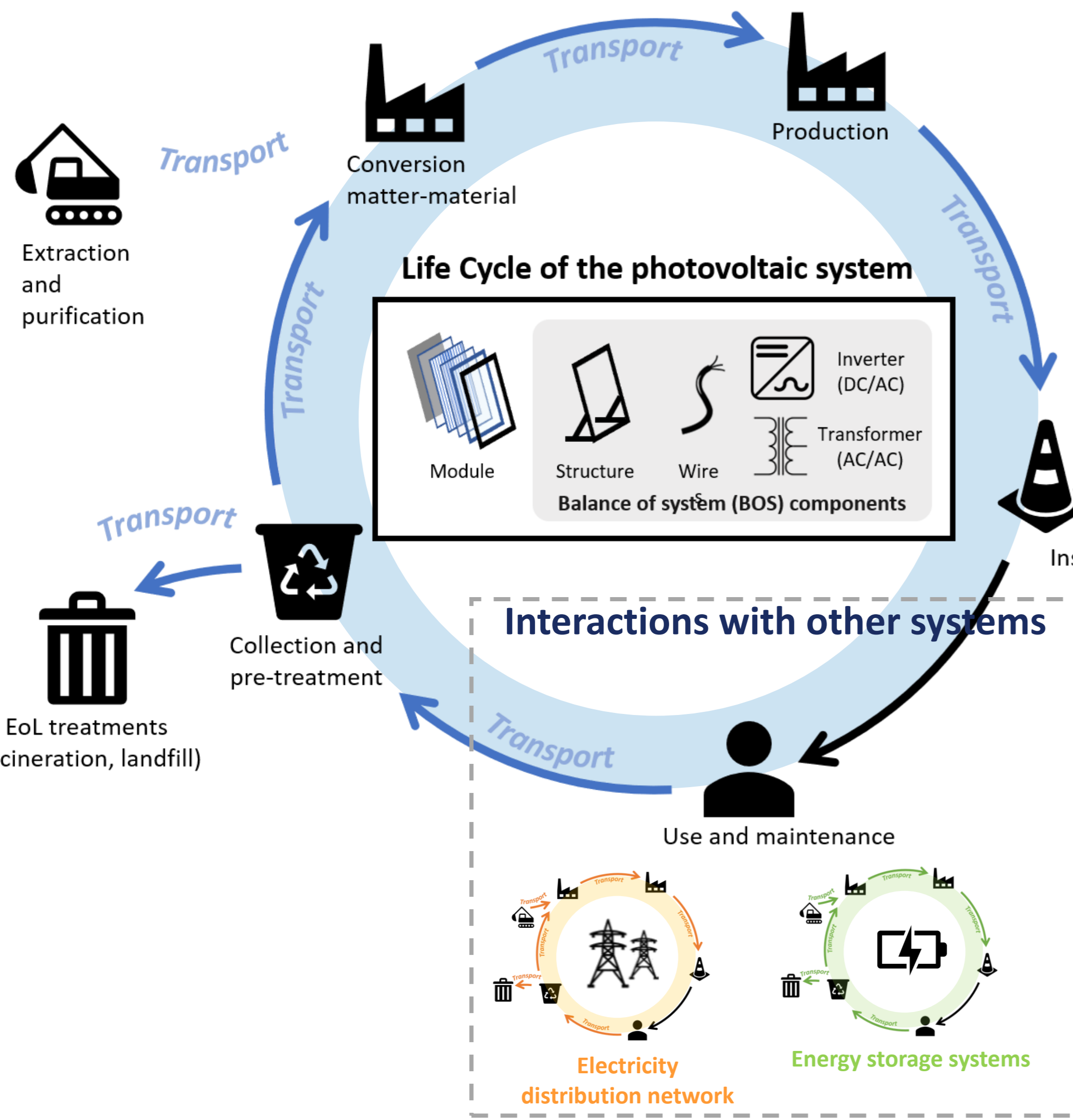
Paper Riondet et al. (2023) in preparation. Upscaling of emerging technologies and environmental assessment: review and perspectives for designers and LCA practitioners.

RQ 2 : How to integrate the upscaling assessment expertise in the design process? Eco-design approach !

SubRQ1.1: What should be the scope of such a prospective analysis ?

SubRQ1.2: What are the prevalent phenomena to focus on? Which metrics/indicators to describe them?

Case study: LCA applied to the upscaling of photovoltaic systems



Perspectives

- Application of different LCA modes (dynamic, prospective, absolute, regionalized) to assess the upscaling of PV systems,
- Validation of the LCA methodology (scope, metrics),
- Development of a designer-oriented tool on

Riondet L, Rio M, Perrot-Bernardet V, Zwolinski P. In preparation (2023). Assessing energy technologies sustainability: upscaling photovoltaics using absolute LCA. 30th CIRP Life Cycle Engineering Conference.

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