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# A structured approach to guide technological developments towards sustainability

## Context and concept

### Motivations

- Sustainability is attracting increasing interest, but various concepts and terms with different definitions are used when referred to the technology domain

### Approach

- Visual framework that helps to position and drive research projects and technology developments towards sustainable innovation
- Contribution to the coherence of concepts related to sustainability

### Initial version of the framework published in:

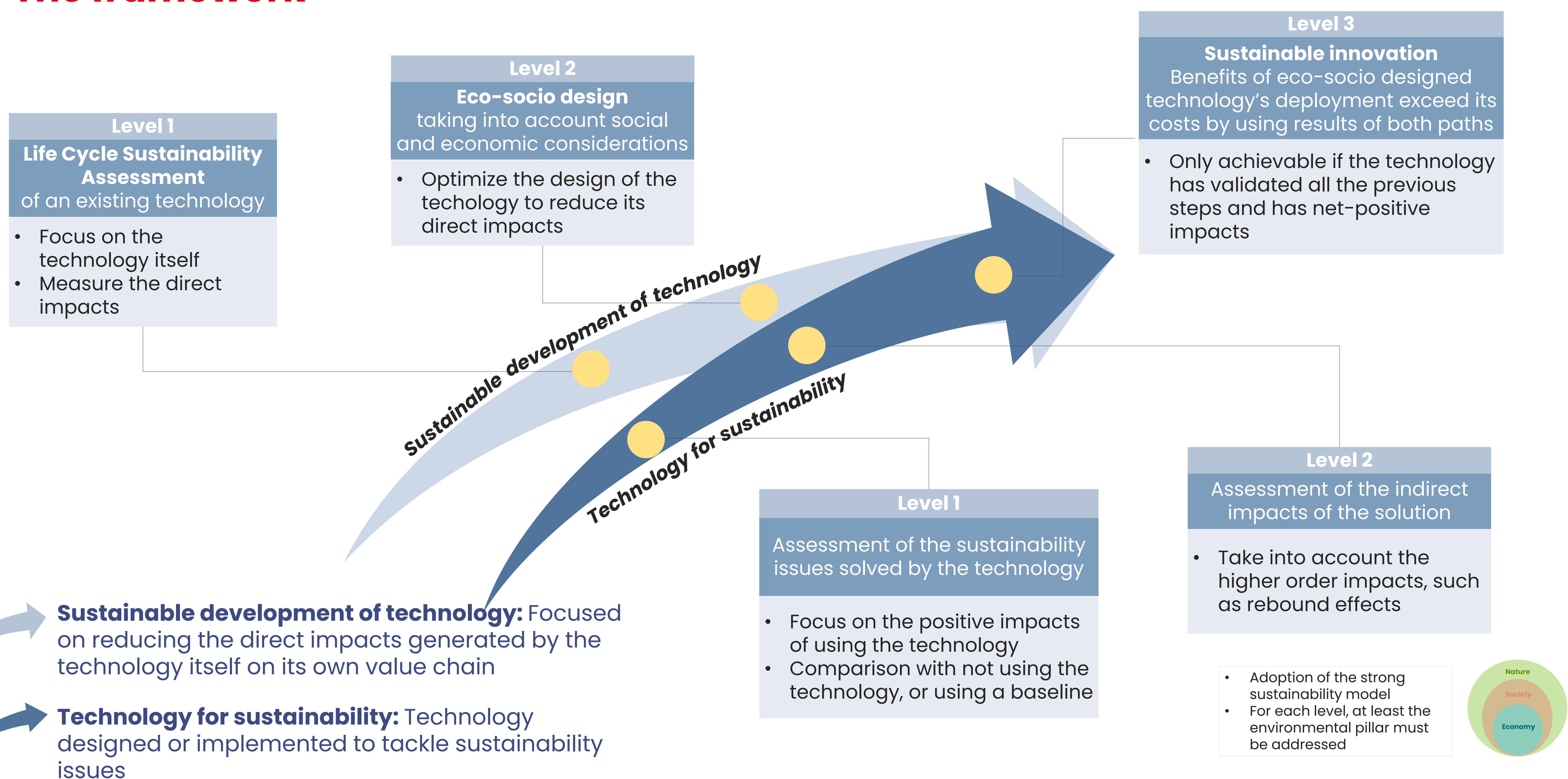
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**Sustainable technology and Technology for sustainability: The paths towards Eco-innovation**

Electronics Goes Green 2024



## The framework



## Case study: AI for heat pump control

### The AI4HP project

Introduction of an innovative incremental AI algorithm in the command system of a heat pump to forecast hot water needs depending on dynamic factors

Coordinator: Lilli Frison (Fraunhofer ISE)  
Incremental AI: Marina Reyboz (CEA-LIST)  
Laboratory tests: Hugues Bosche (EDF R&D)



Level	Sustainable development of technology	Technology for sustainability	Sustainable innovation
Level 1	LCA of the AI algorithm (highly parametric because the algorithm is not fully specified at the current development status)	Use of the parametric LCA developed in Level 1 for design space exploration: <ul style="list-style-type: none"><li>Should the algorithm run on the cloud or embedded in HP?</li><li>Design of a lightweight AI</li></ul>	Using results of both paths, demonstrate that environmental benefits of eco-designed technology's deployment exceed its costs
Level 2	1. Compare the AI algorithm with baselines in terms of forecast accuracy and potential energy savings. 2. Verify those projections with laboratory tests, then real-world tests	Exemple of identified higher order effects: <ul style="list-style-type: none"><li>Rebound effect: if AI-controlled HP saves energy, it saves money, which could boost HP deployment</li></ul>	

## TRL integration

- Framework-based sustainability analysis extended to integrate Technology Readiness Level
- Adoption of four groups of TRL based on the application environment

TRL 1-2: Research (Documentary environment)

TRL 3-4: Development (Laboratory environment)

TRL 5-6: Demonstration (Representative environment)

TRL 7-9: Deployment (Customer operational and final environment)

### Example

TRL 1-2	Level 1	
	Sustainable development of technology	Technology for sustainability
	Exploratory LCA with data from published articles and databases	<ul style="list-style-type: none"><li>Evaluation of the emissions within the application domain</li><li>Consequence tree analysis</li></ul>

