Uncovering the Environmental Impact of Software Life Cycle

ICT4S 2023

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ICT environmental footprint

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Between 2.1% and 3.9% of global GHG emissions[1]

[1] C. Freitag *et al.*, "The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations", *Patterns*, vol. 2, no. 9, p. 100340, Sep. 2021.

ICT environmental footprint

84% of platinum and 70% of cobalt resources are located in high-risk contexts[1]

Credit: Dillon Marsh

[1] É. Lèbre *et al.*, "The social and environmental complexities of extracting energy transition metals", *Nature Communications*, vol. 11, no. 1, p. 4823, Sep. 2020.

ICT environmental footprint

Only 1.8 of the 9.2Mt of e-waste generated between 2014 and 2019 was officially documented as properly collected and recycled[1]

Credit: Muntaka Chasant

[1] V. Forti *et al.*, "The global e-waste monitor 2020", *United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam,* vol. 120, 2020.

Software environmental footprint

While ICT impact comes from hardware,
responsibility lies within software

Literature on software environmental footprint mostly considers:

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A single impact category, **climate change**[1, 2]

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Software usage impact, **omitting its development**[3]

[1] J. Taina, "How Green Is Your Software?", in *Software Business*, 2010, pp. 151-162.

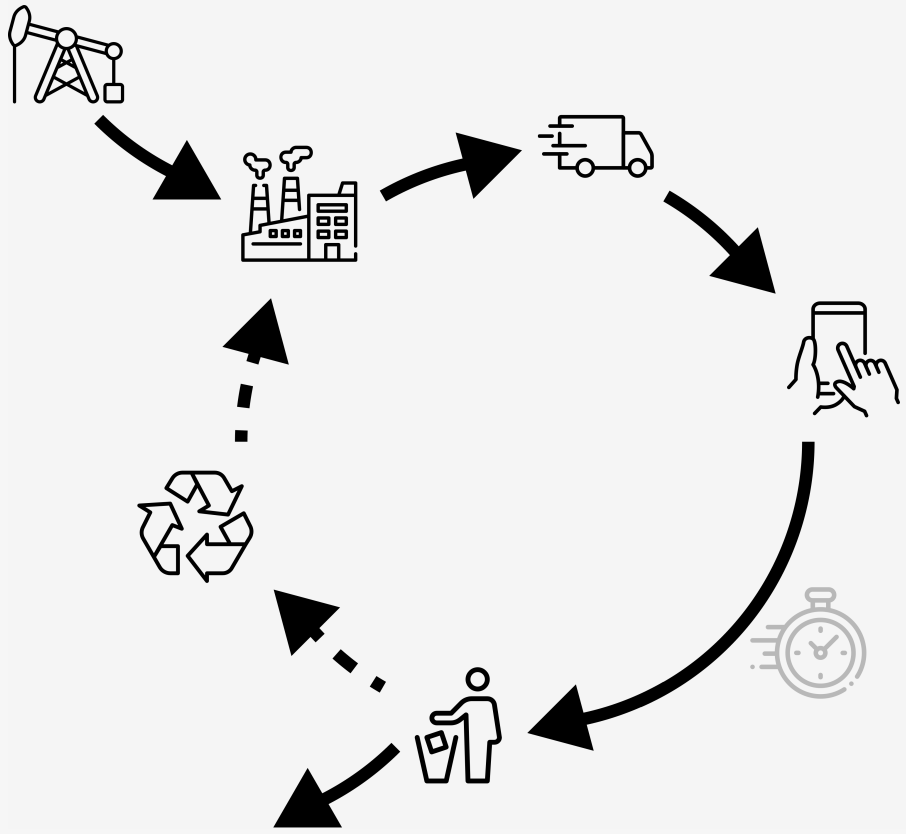
[2] E. Kern *et al.*, "Impacts of software and its engineering on the carbon footprint of ICT", *Environmental Impact Assessment Review*, vol. 52, pp. 53-61, Apr. 2015.

[3] L.1410 : Methodology for environmental life cycle assessments of information and communication technology goods, networks and services, 2014

The benefits of a life cycle perspective

Life Cycle Analysis (LCA):

The study of the environmental impacts contribution of a product or service across its entire life cycle[1]



1. ISO 14040:2006: Environmental management - Life cycle assessment - Principles and framework

The benefits of a life cycle perspective

Identify the **shifting** of a potential environmental burden:

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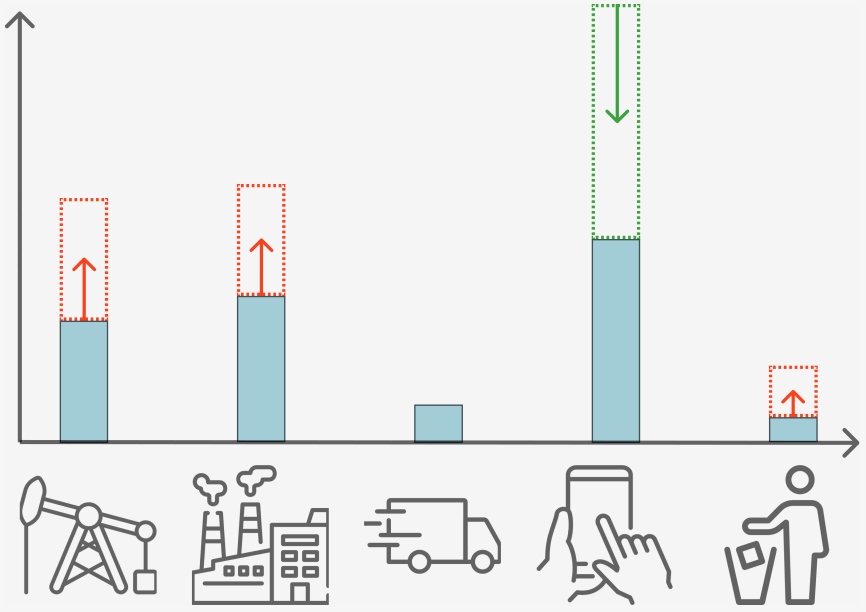

1. Between **phases**

The benefits of a life cycle perspective

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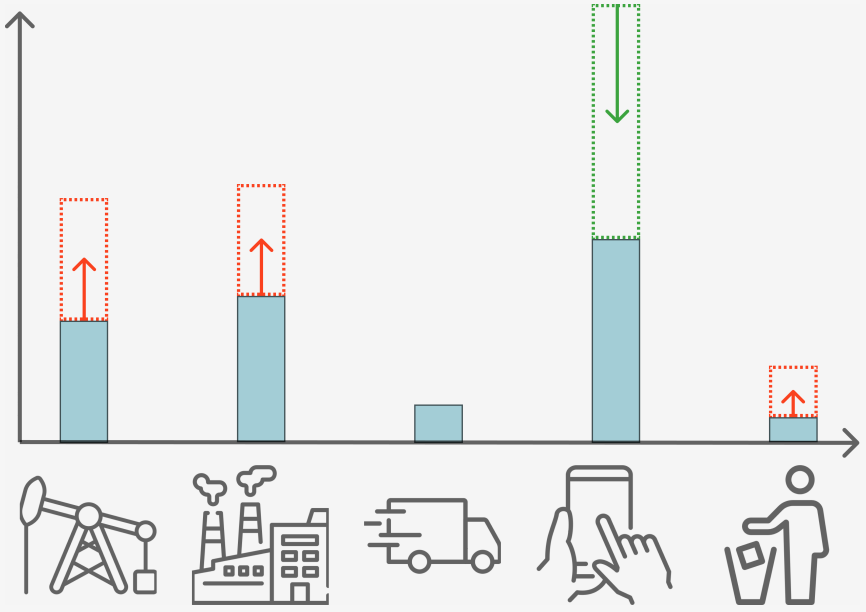

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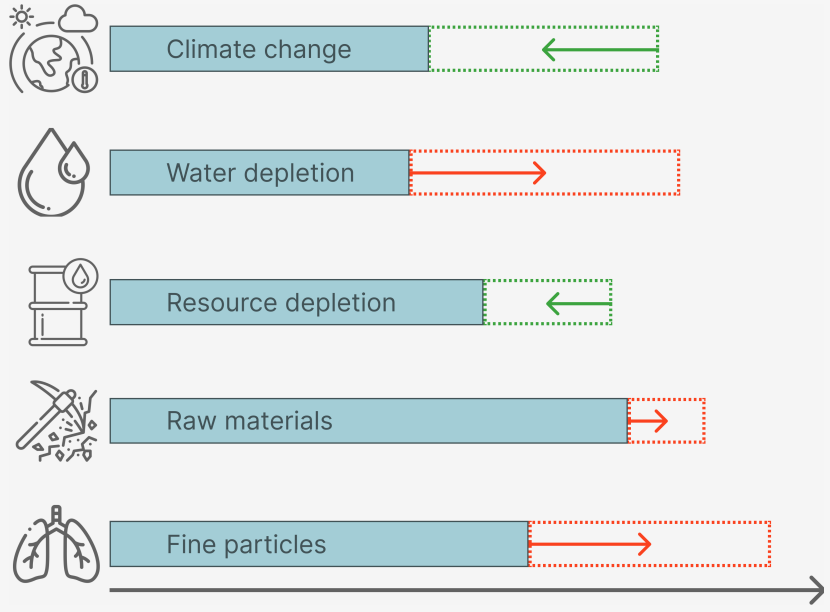
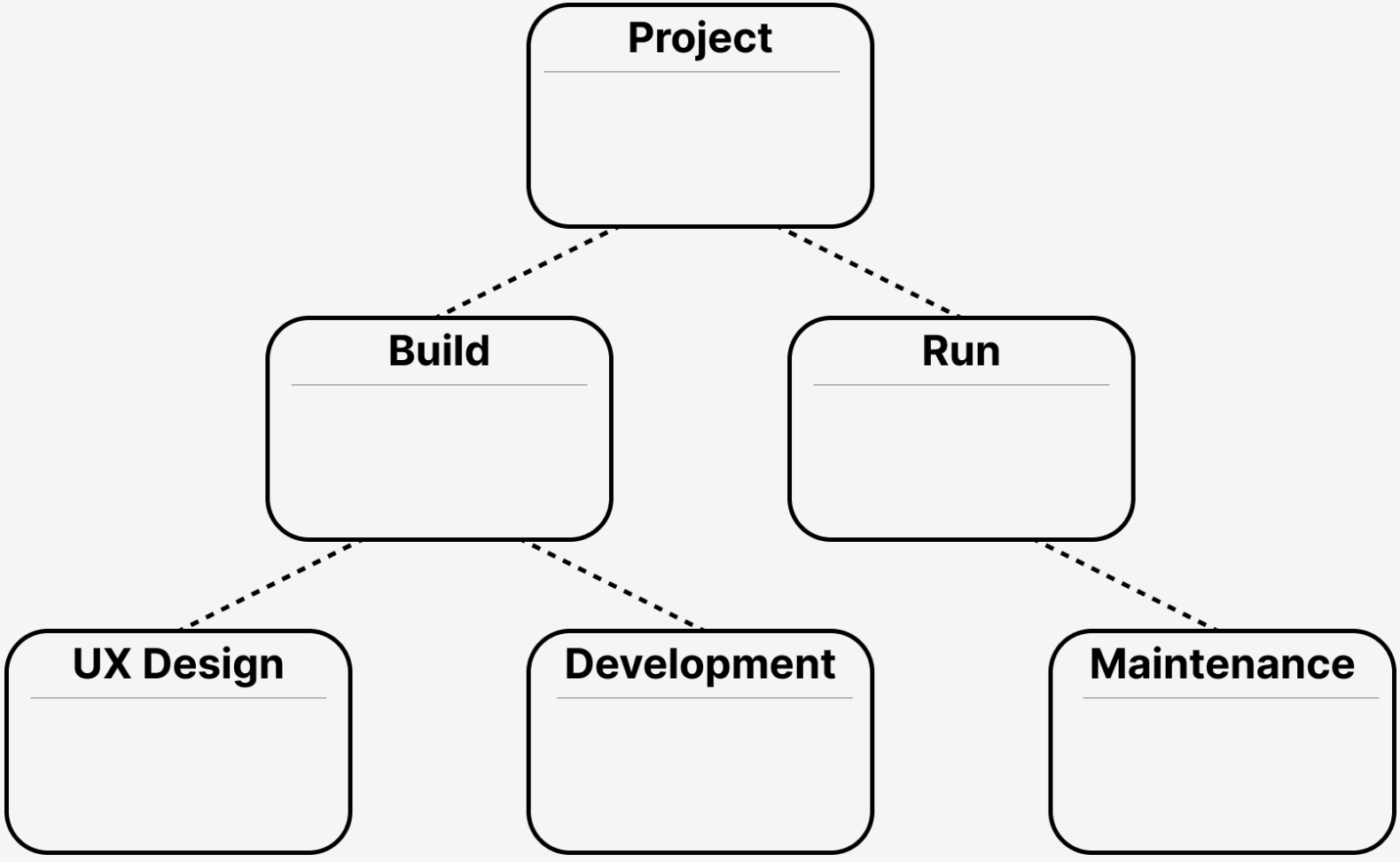


2. Between **categories**

Applying such a holistic approach to software

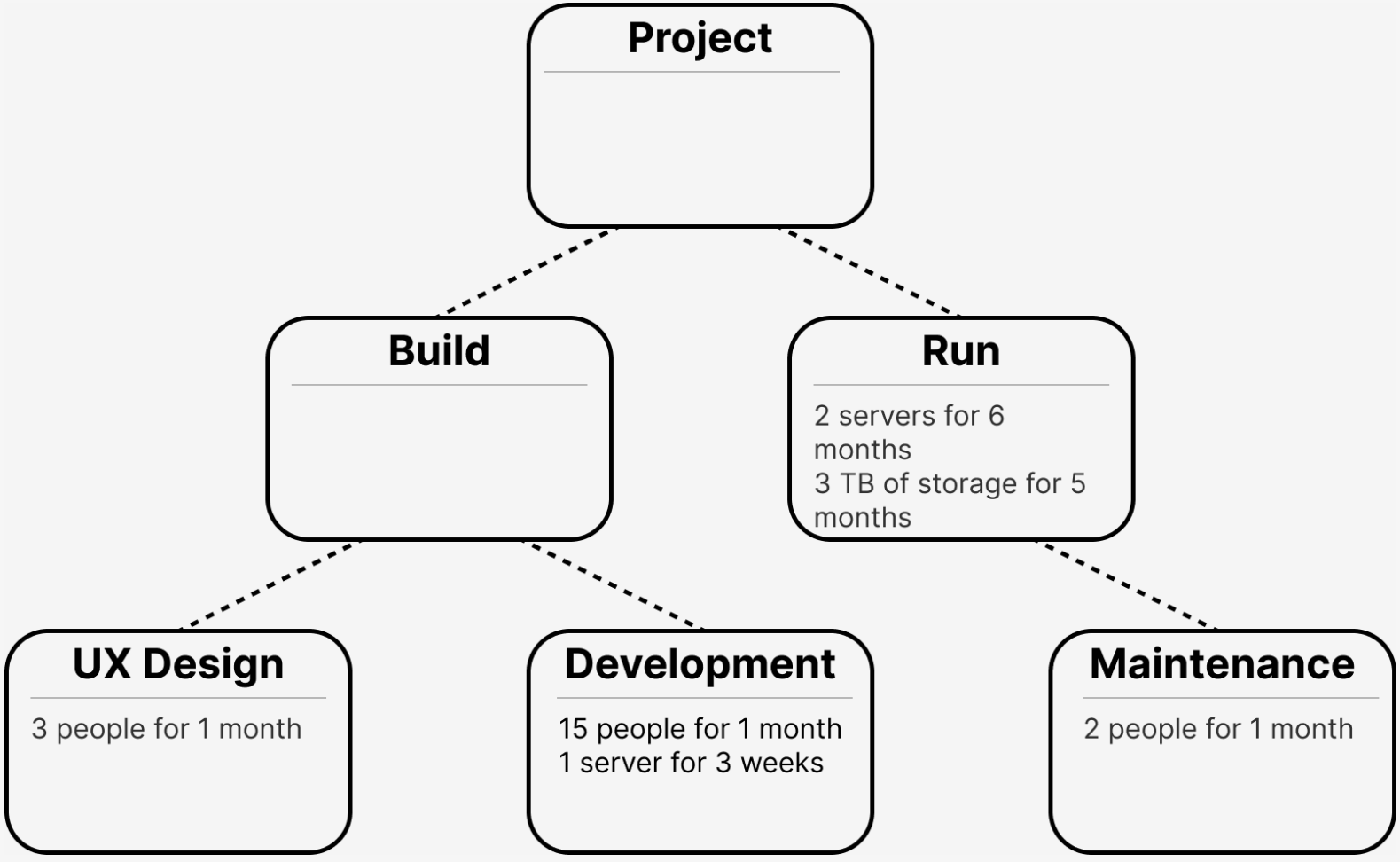
Modeling methodology

Activities



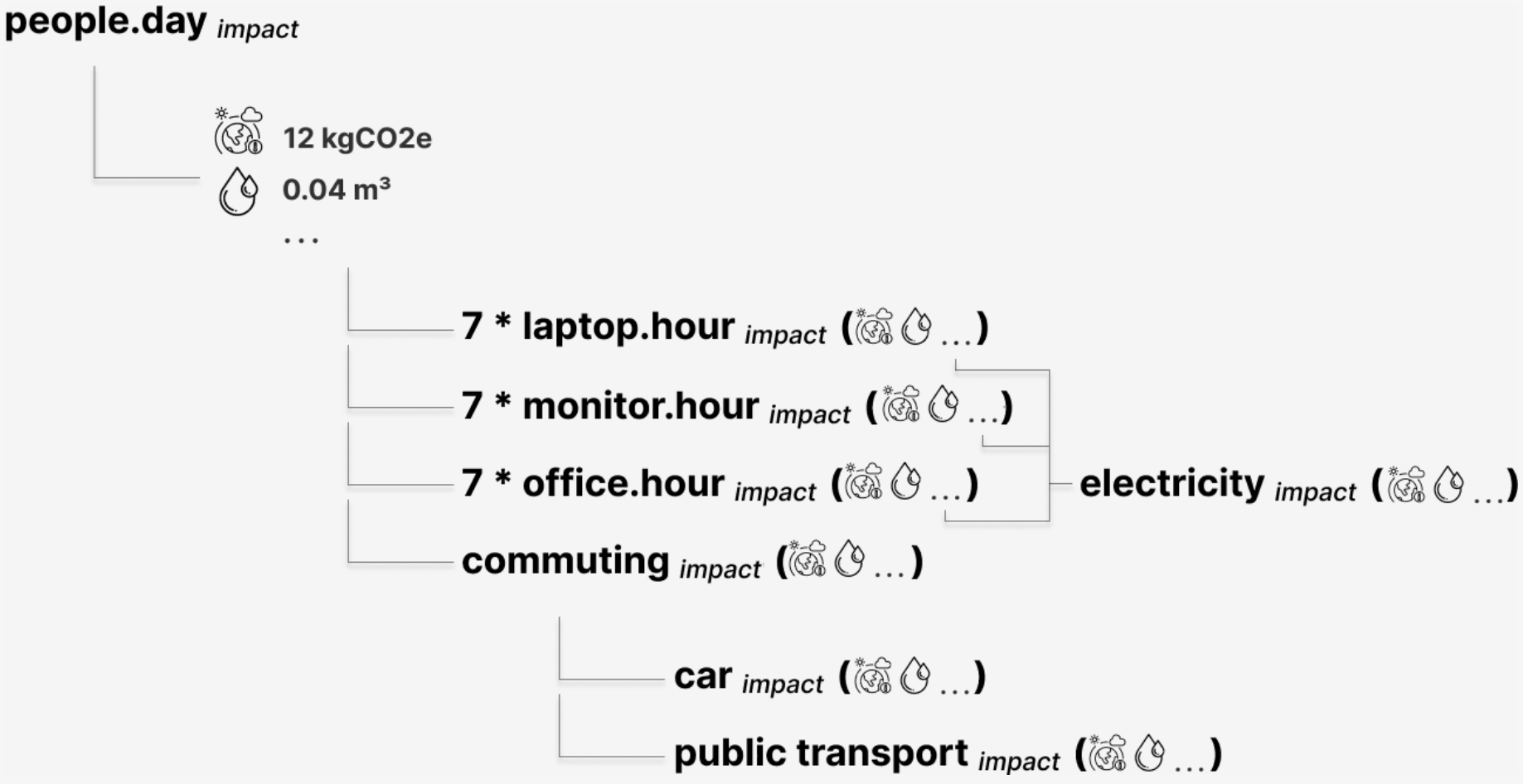
Modeling methodology

Resources



Modeling methodology

Resources environmental impact



Modeling methodology

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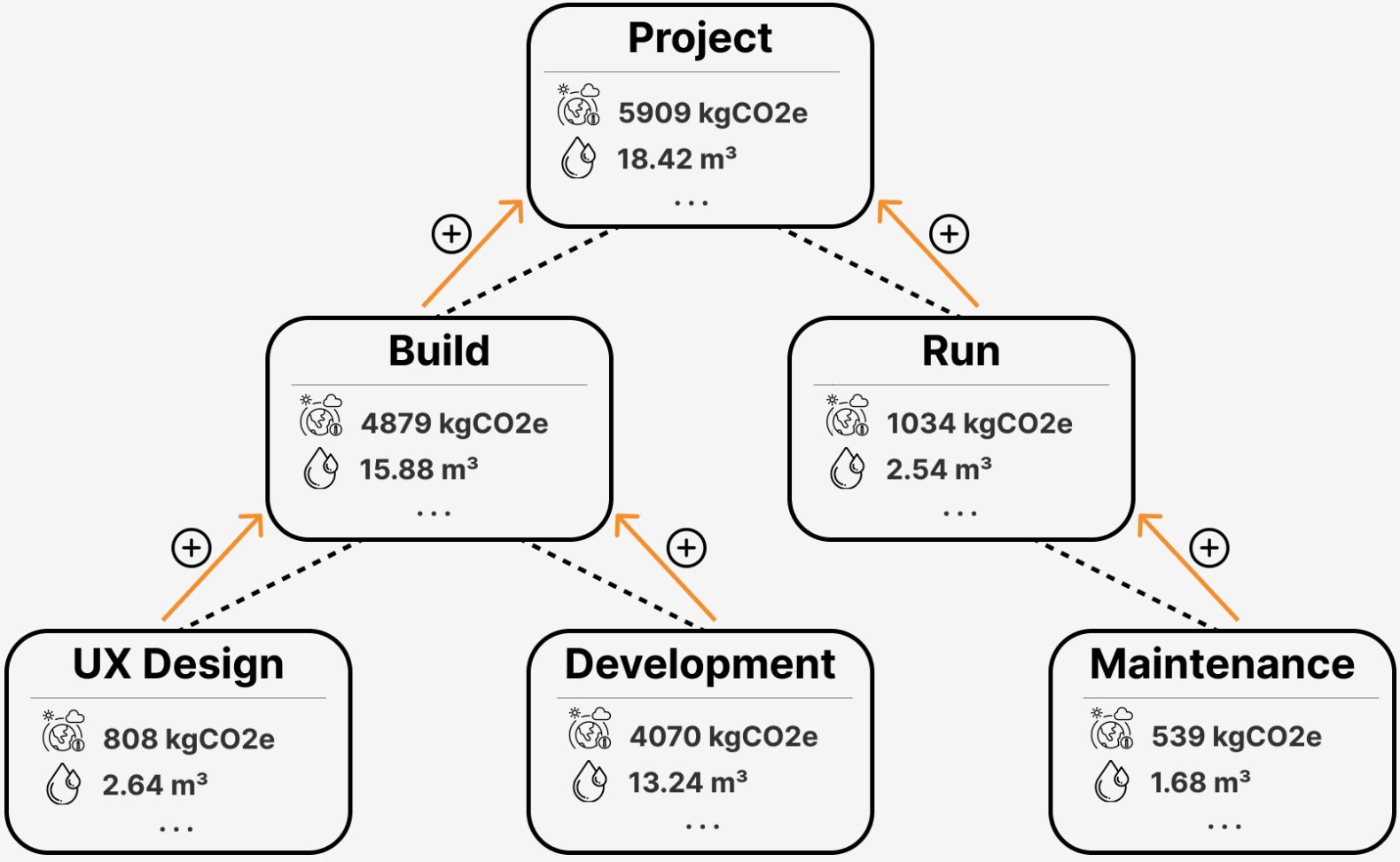

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Sample use case

GitLab project, as **representative** of software size and complexity

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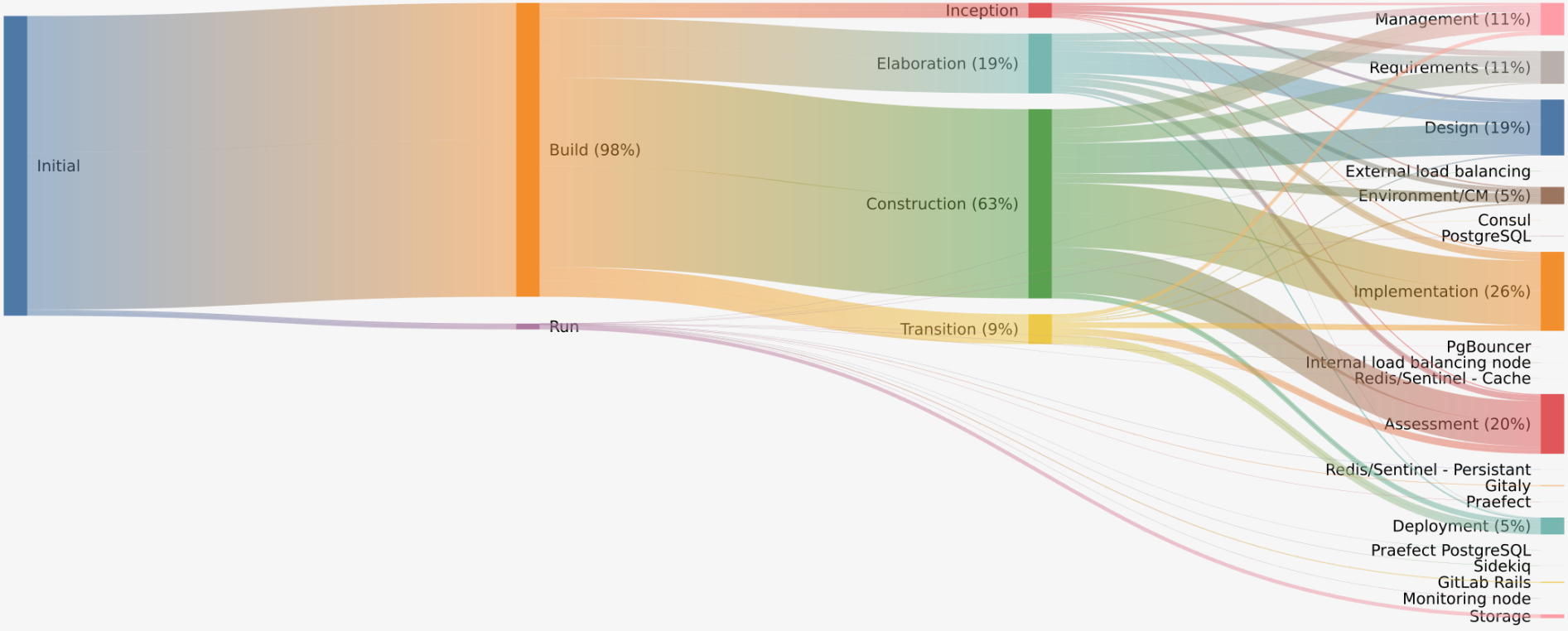
Developped and hosted in **France**

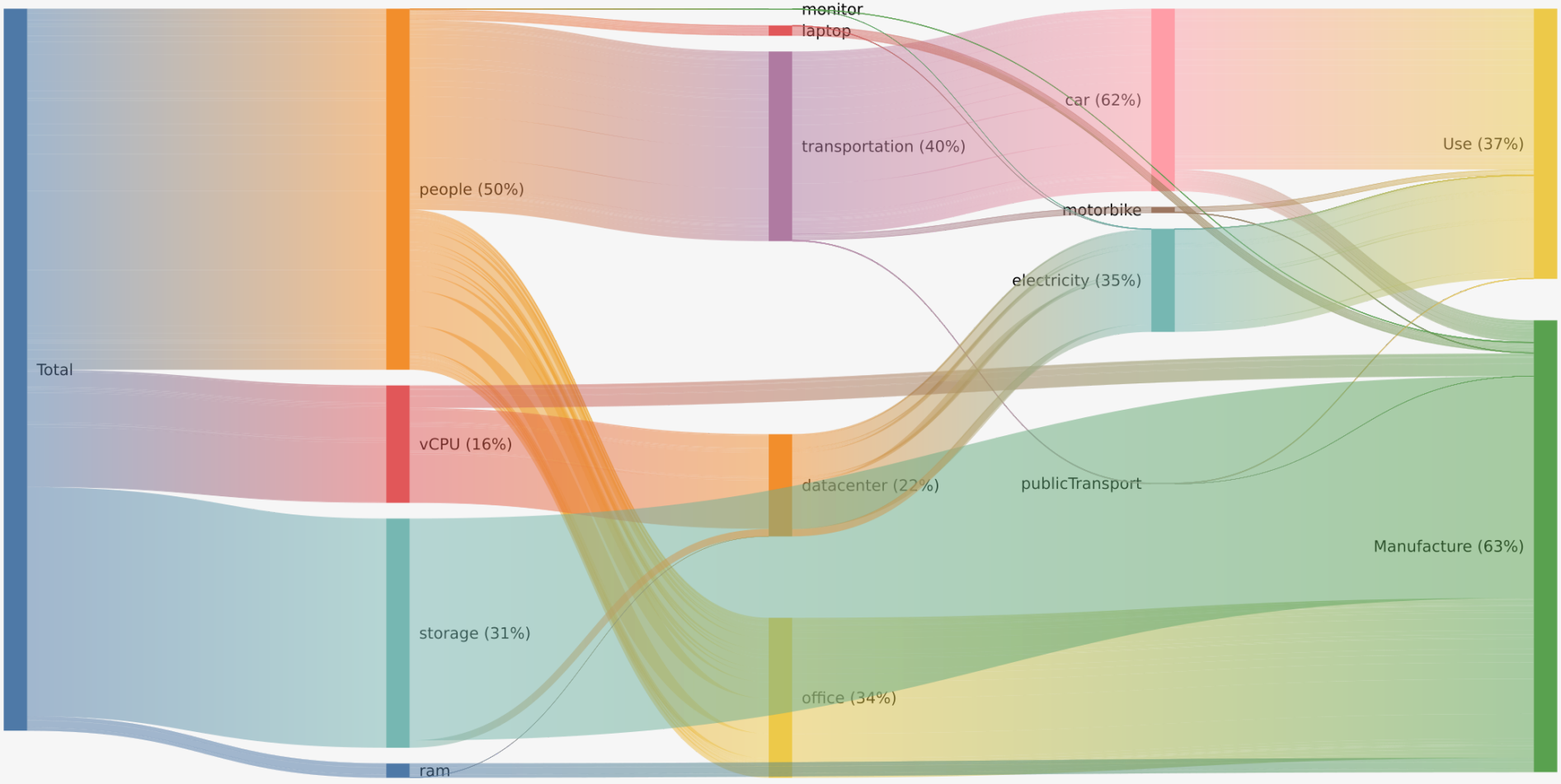
To uncover impact shifts

1. Between phases



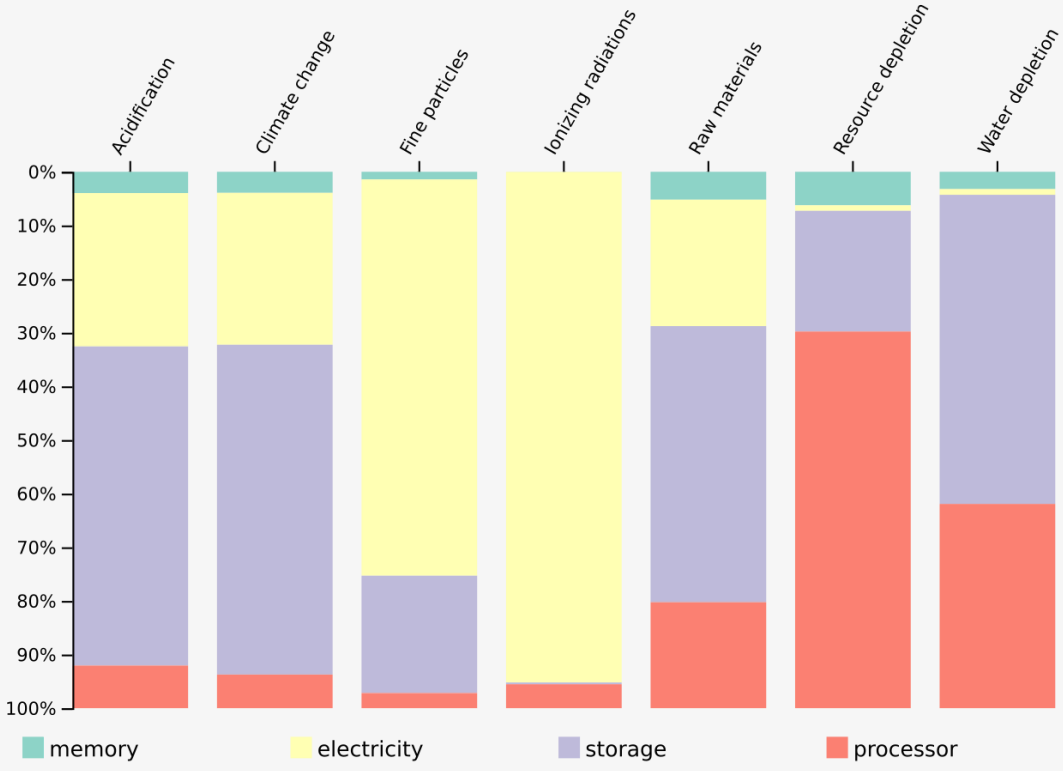
To uncover impact shifts

2. Between resources

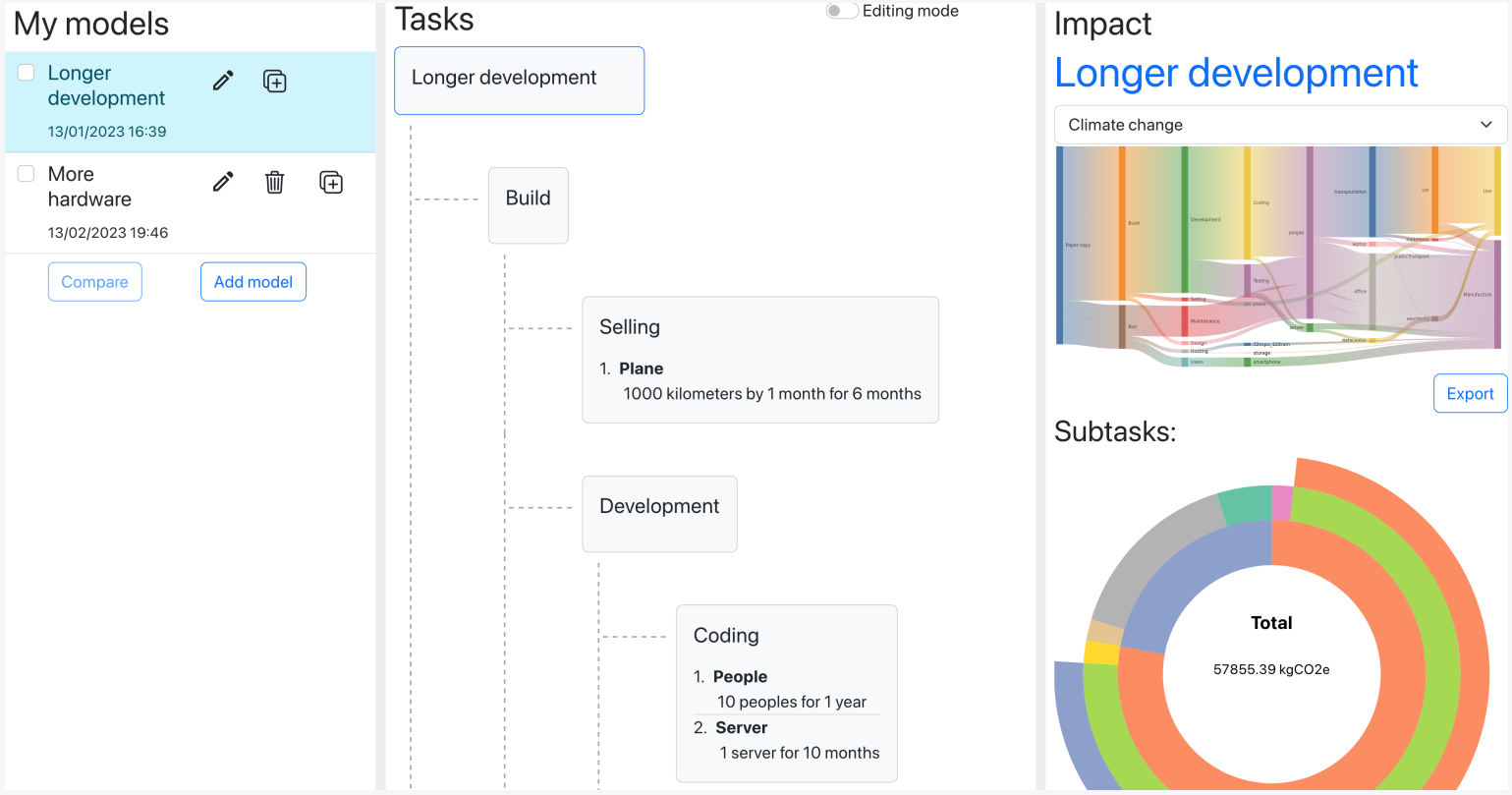


To uncover impact shifts

3. Between impact categories



Web application



Soon available under https://github.com/Orange-OpenSource

Conclusion

A **methodology** and the associated tool to model **software life cycle environmental impact**

To identify **shifts** and identify **hotspots** to take sourced decisions to **reduce software environmental impact**

The ecosystem **lacks data on the environmental footprint** of the resources it uses

Thank you