Climate-aware Resilience and Sustainable Critical and Interdependent Infrastructure Systems

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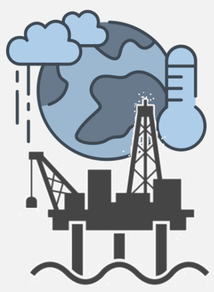
Aims and Objectives

- Methodologies and tools development to inform stakeholders about the effects of hazardous events
- Novel Tools tailored to infrastructure to reduce embodied emissions and enable higher resilience during the early design
- Support the decision-making process with broader information regarding the sustainability and resilience of renovation works

Contextual Background

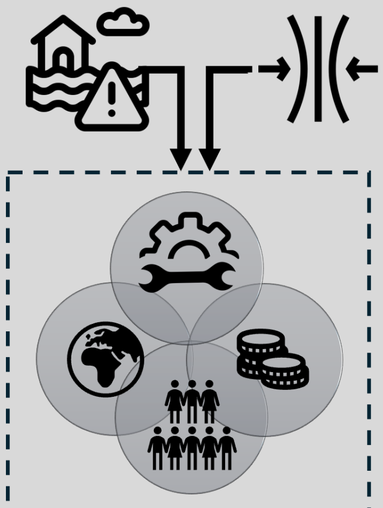
- The Paris Agreement's 1.5°C limit for global warming was recently deemed unrealistic.
- 2.0 °C should be considered. Infrastructures and the whole building environment should be concurrently prepared for climate changes
- In infrastructures, economic quality is prioritized in comparison with environmental quality

Context

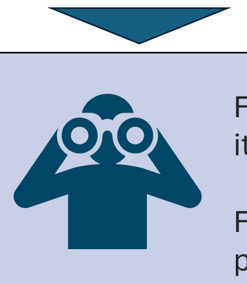


Built environment
Exposure to climate change

Challenges



- Integration of Risk Assessment due to natural hazards in life cycle-based sustainability analyses
- Integration of Resilience analyses for holistic assessment



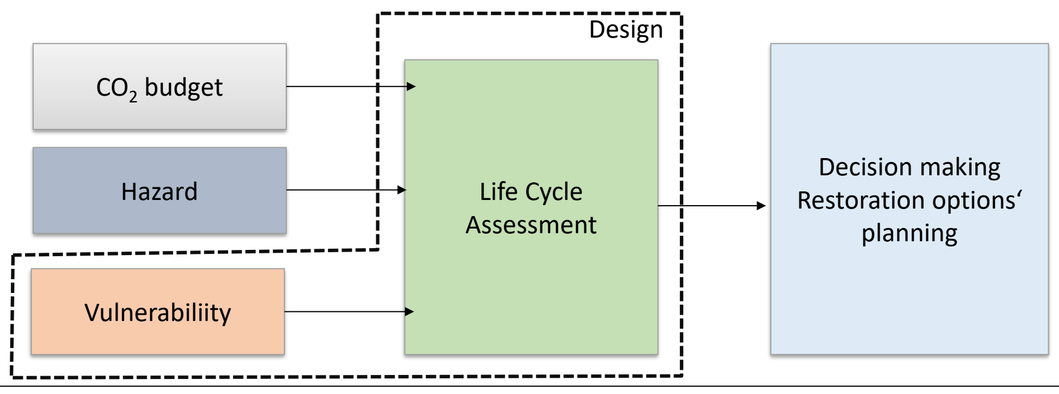
For stakeholders: Planning works on the built environment to make it resilient to climate change

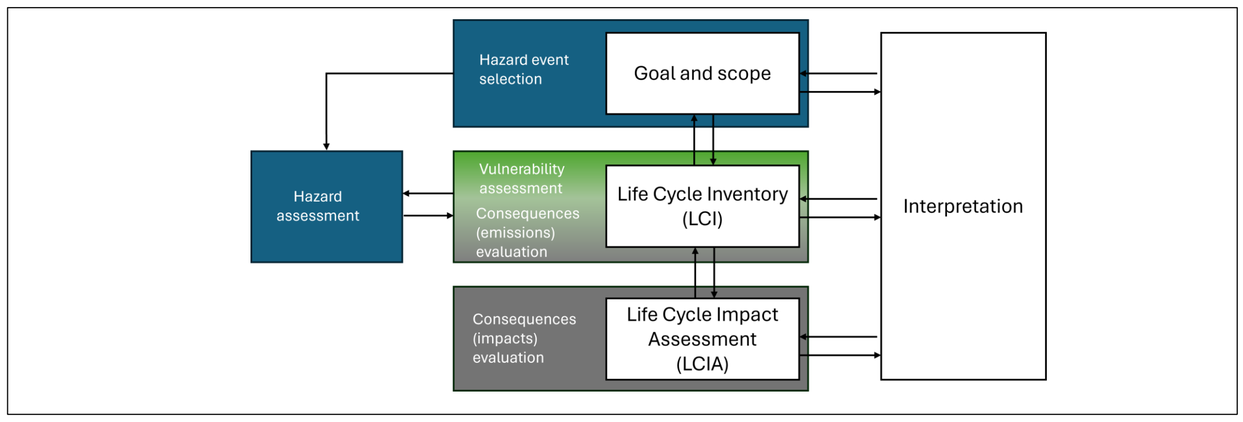
For policymakers: Feedback provision on design codes and practices

Opportunities

Methods

Development of a novel framework for the assessment of resilience and sustainability of measures aimed at infrastructure. The methodology will exploit *future-oriented* life cycle analyses [1], integrating i) Probabilistic Risk Assessment (PRA) to account for the uncertainties related to natural hazards [2] and "carbon budgets" to limit the total impacts.





Results

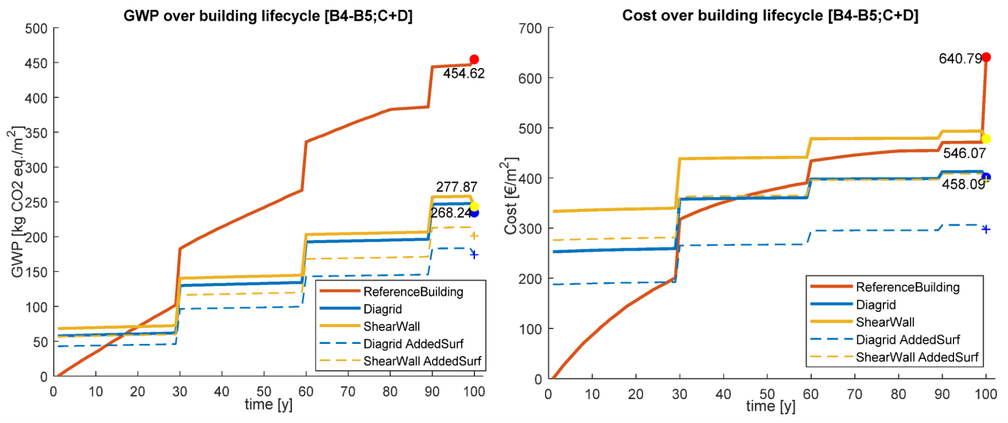
The development of the methodology is still ongoing. However, similar approaches have been tested to account for seismic hazards in buildings, including building structural performance enhancement over time [1].

In such an approach, hazard assessment and vulnerability analyses are integrated into Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) to evaluate the environmental and economic consequences when buildings are not retrofitted to resist seismic loads in prone areas. Probabilistic approaches also show the effect of uncertainties related to such future scenarios.

Source: Di Bari et al (2020) [2]

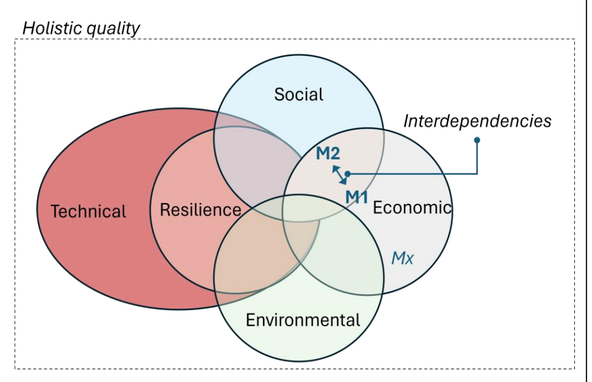
The Findings in Context

Neglecting natural hazards in sustainability assessment can mislead the decision-making process. Lifecycle environmental impacts and costs can be significantly underestimated. Not including the refurbishment of built systems restricts the range of alternatives that stakeholders can evaluate during decision-making.



Conclusions

Broader methodologies to assess the sustainability and resilience of built systems under natural hazards are necessary and will be developed in future works. Future developments will also take into account the interdependencies between sustainability and resilience metrics.



References

[1] Di Bari, R, Alaux, N, Saade MR, Hong S H, Horn R, Passer A. Systematising the LCA approaches' soup: A framework based on text mining, The International Journal of Life Cycle Assessment, *(accepted, in production).*

[2] Di Bari R, Belleri A, Marini A, Horn R, Gantner J. Probabilistic Life-Cycle Assessment of Service Life Extension on Renovated Buildings under Seismic Hazard. Buildings. 2020; 10(3):48. https://doi.org/10.3390/buildings10030048

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