# $CO_2$ THE UNTAPPED RESOURCE. LIFE CYCLE ASSESSMENT OF GLUE-LAMINATED TIMBER SOLUTIONS FOR HOUSING


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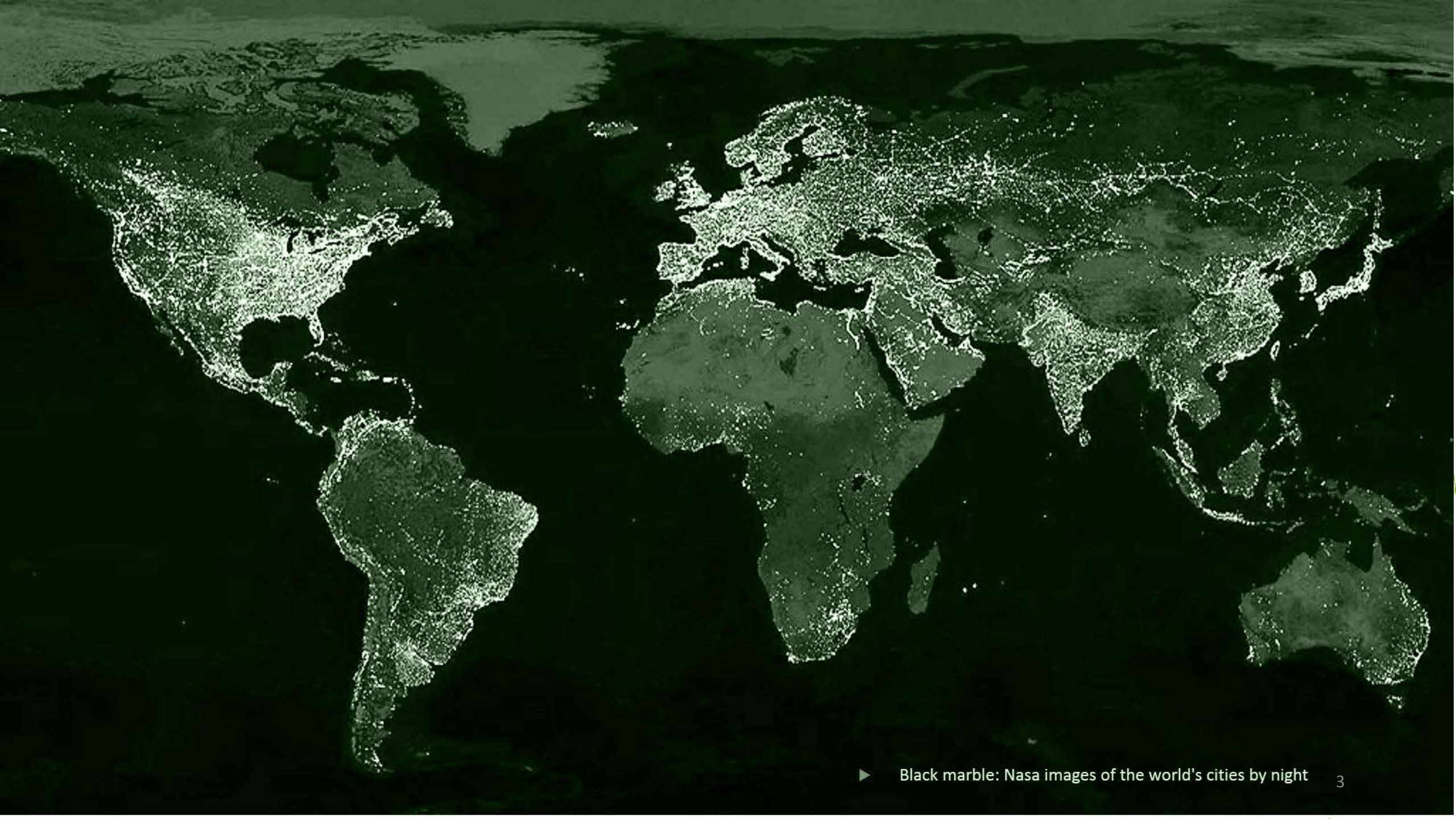
# PRESENTATION OUTLINE:

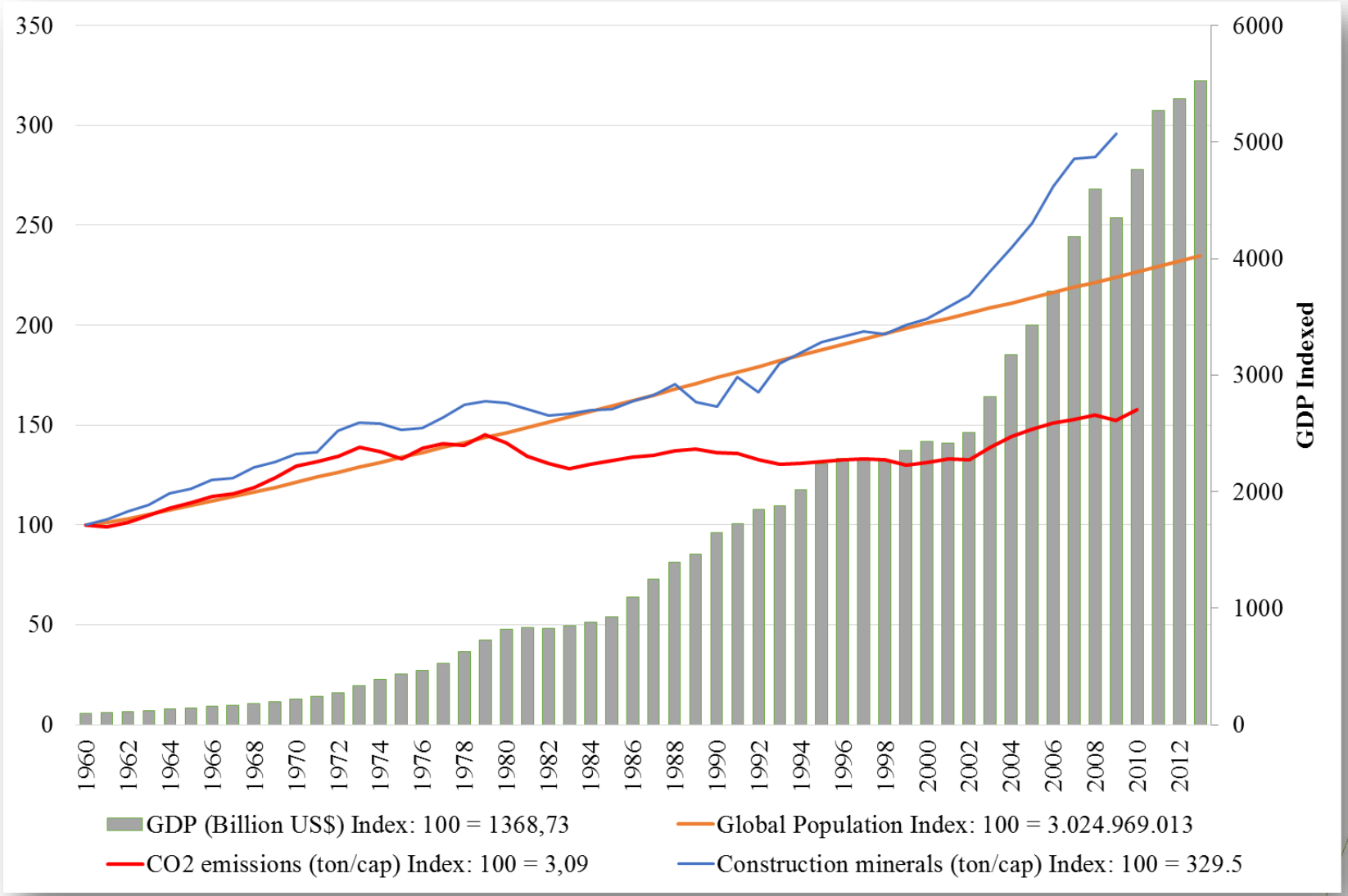
- **Background**
- **Methodology**
- **Results**
- **Conclusions**



▶ Black marble: Nasa images of the world's cities by night

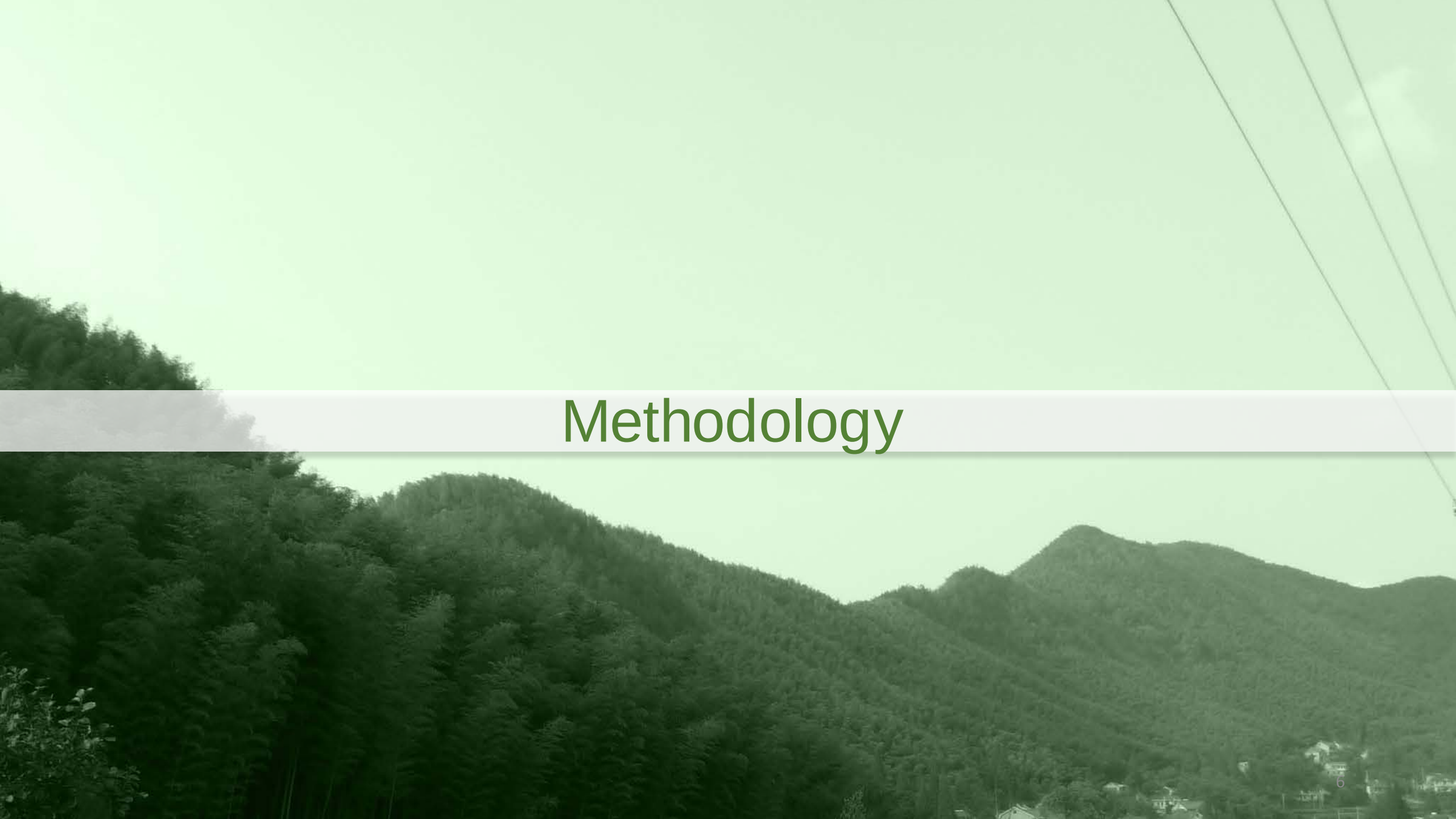
# Background – Global population

- Population growth
- 50% urban population
- GDP growth (mainly urban areas)
- Resource demand
- Extraction of construction minerals
- $CO_2$ emissions (400ppm)



# Background – Philippines

- The Philippines is a fast-growing nation counting with a population of a 100 million citizens by 2014
- The overall population density in the Philippines is 334 people/km$^2$
- More than 50% of the population lives in urban areas
- It is estimated that around 28% of the population lives below the poverty line
- Significant housing demand in urban areas
- Widespread deforestation
- The Philippines is considered as one of the countries with highest levels of natural disasters occurrences per year



# Methodology

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- Mass flow analysis

The mass flow model considers the flows of matter through the production, use, and disposal of the proposed construction materials.

- Life cycle assessment

The emission per process were calculated using LCA, considering, extraction, production, use and disposal (end of life) phases.

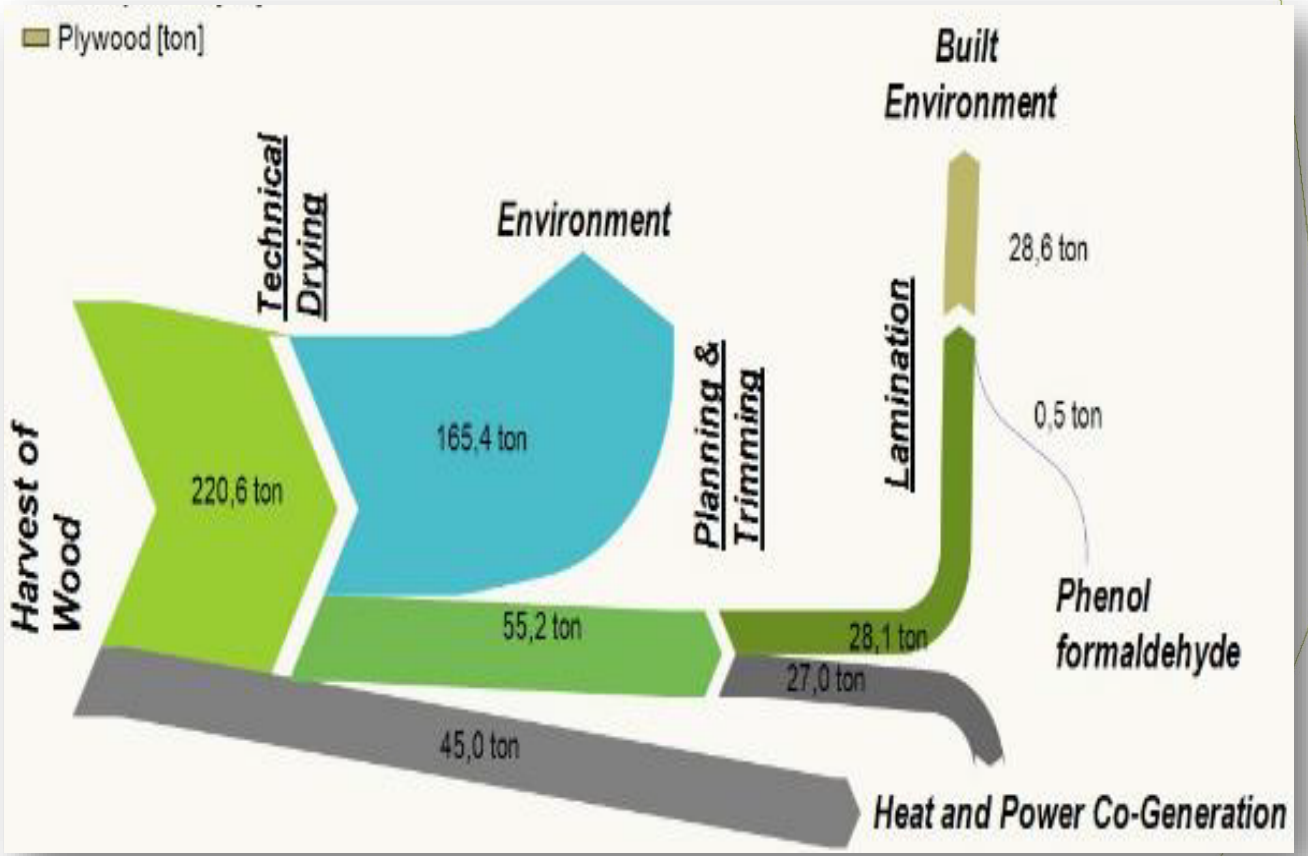
- Dynamic $CO_2$ flows

The dynamic $CO_2$ model considers all carbon dioxide inflows and outflows related to the life cycle of the timber based construction materials..

**Four phases were considered :**

- Sequestration, during the growth of plants
- Emissions, related to the processing and production of construction materials and buildings
- Storage, accounting for the life span of buildings
- Disposal, that considers the end of life scenarios for the construction materials from the demolished buildings

The emitted $CO_2$ have a negative value (-) while stored and avoided $CO_2$ are considered positive values. The $CO_2$ balance per activity are calculated by adding the $CO_2$ emissions with the $CO_2$ stored and / or $CO_2$ avoided depending on the activity

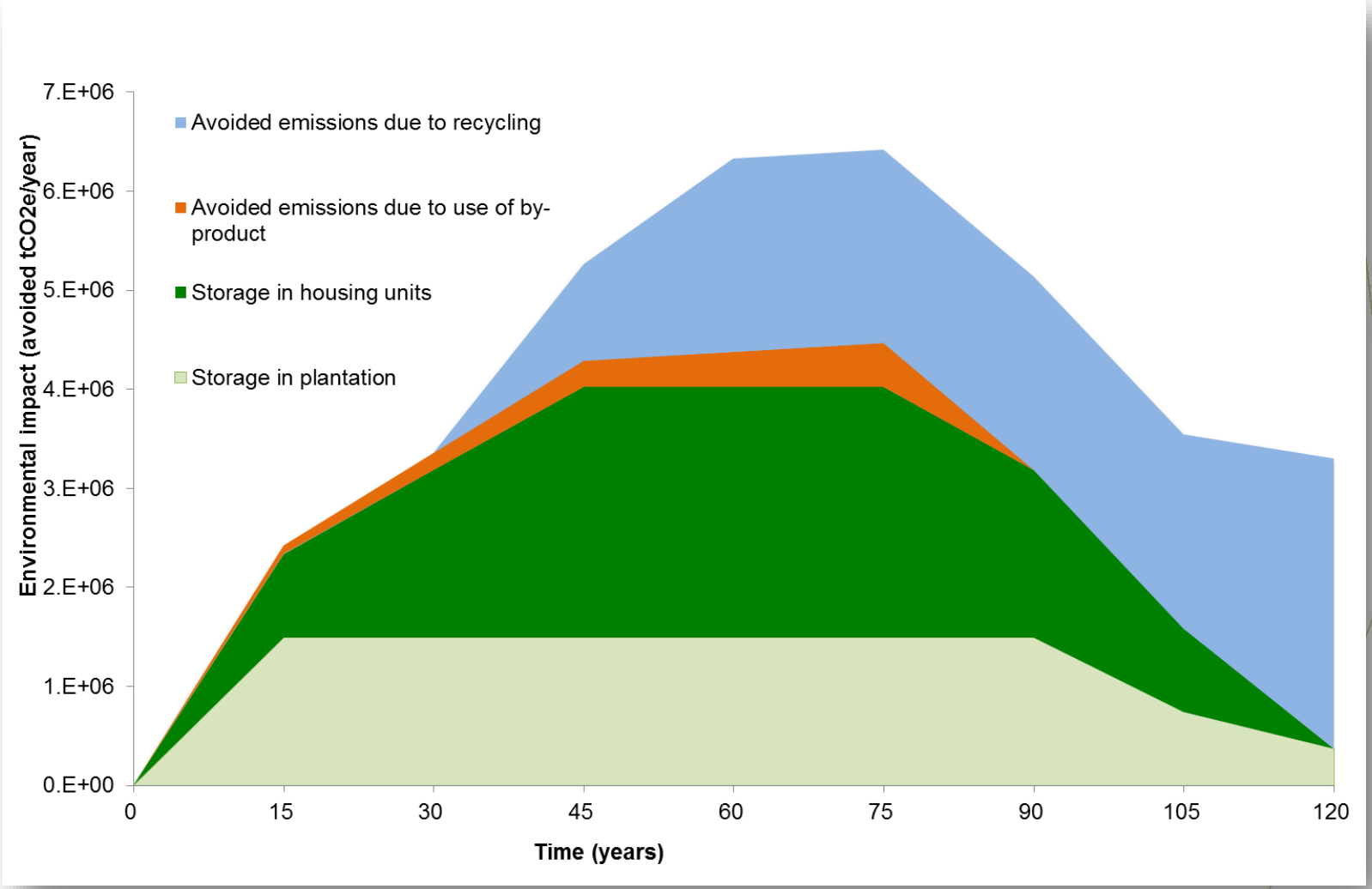



Zea Escamilla, E., G. Habert, and E. Wohlmuth, When CO2 counts: Sustainability assessment of industrialized bamboo as an alternative for social housing programs in the Philippines. **Building and Environment**, 2016. 103: p. 44-53.

# Results

# Results

- Two types of $CO_2$ temporary storages were considered: captured in standing forest and stored in buildings
- Two types avoided $CO_2$ emissions: avoided from electricity generation with materials' by-products and recycling of demolished construction materials
- The $CO_2$ captured in forest reach 1.5x106 $tCO_2Eq$ after 15 years
- Stored $CO_2$ in buildings grows steadily up to $2.5x10^6$ $tCO_2Eq$ (45 years)
- At the end of the model the temporary $CO_2$ storage disappears leaving a cumulative avoided $CO_2$ emissions of circa $1.4x10^7$ $tCO_2Eq$ over a period of 120 years.



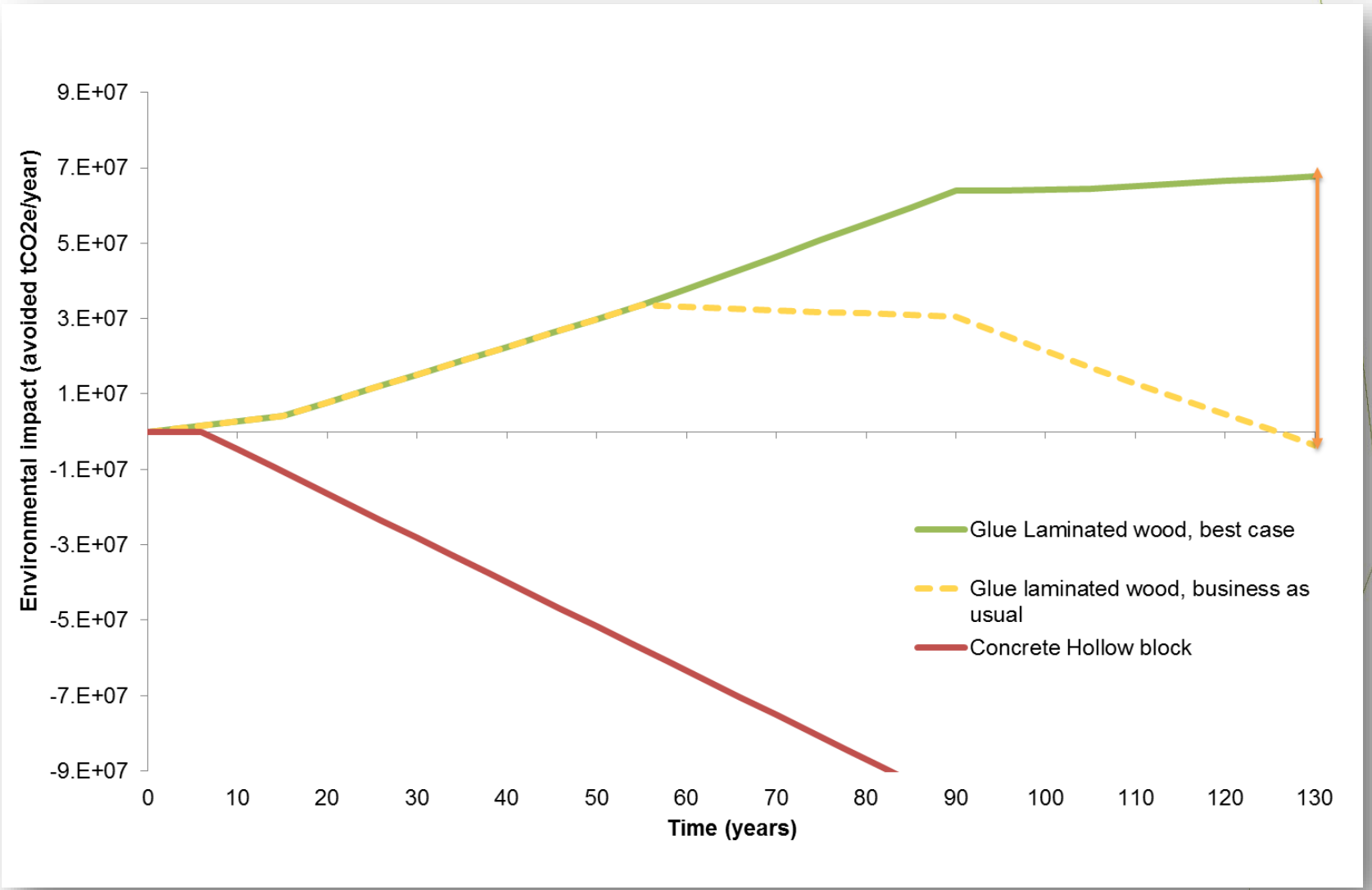
# Results – Discussion

End of life are have significant uncertainties associated to them, they represent future events that cannot be completely asserted. Two scenarios were proposed

- **Business as usual**: where the demolished construction materials will not be used for the production of electricity. Thus, no avoided $CO_2$ emissions will be considered

- **Best case:** where the demolished construction materials are considered to be used as fuel for the production of electricity.

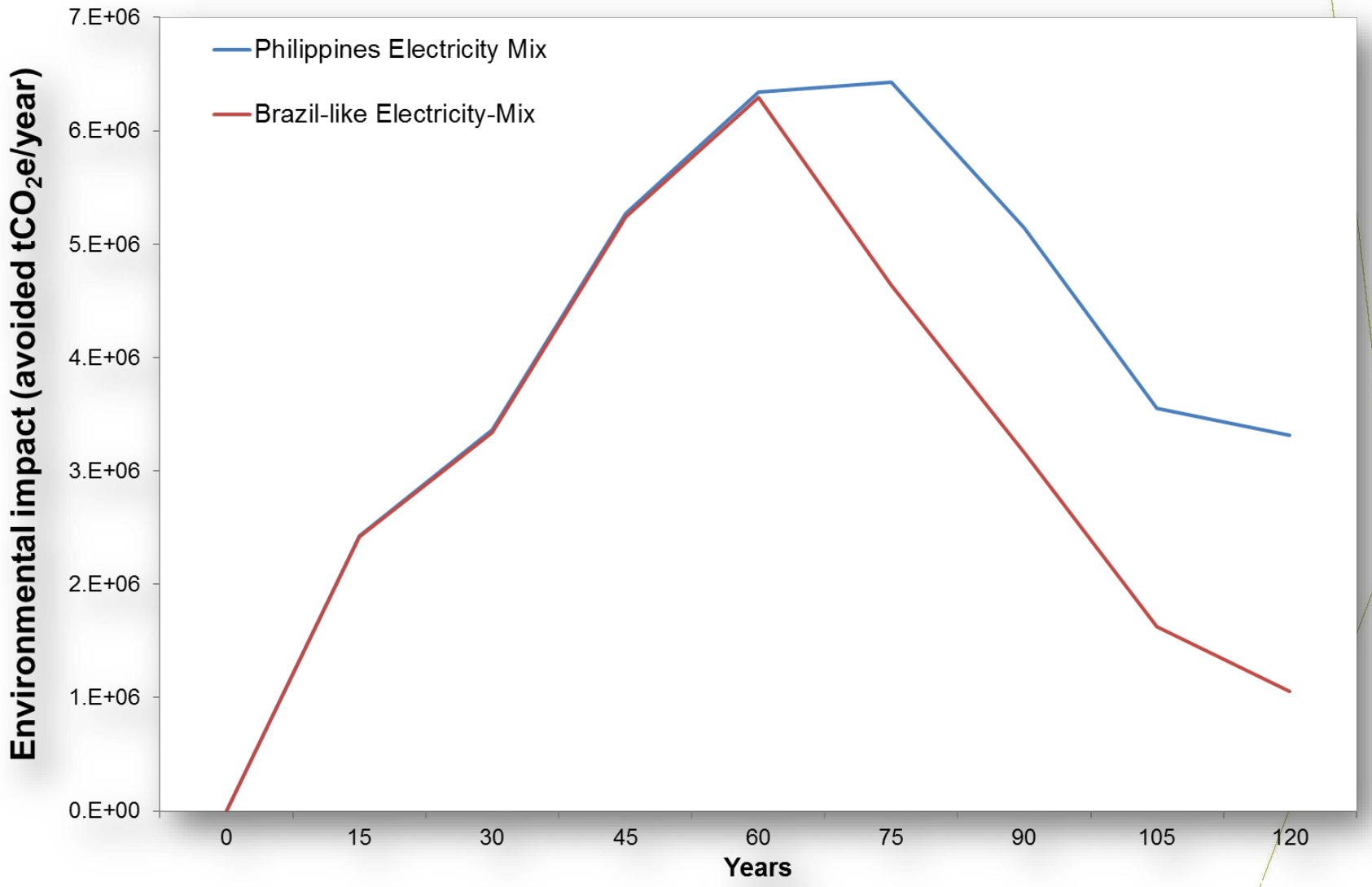
- Changes on the end of life scenario produces a variation of 80% on the results for both glue laminated bamboo and glue laminated wood



# Results – Discussion

To test the consistency of the results an electricity mix with a share of 70% hydropower, like the one found in countries like Brazil or Colombia was used

- A variation on the electricity mix significantly reduces the levels of avoided emissions
- A lower amount of $CO_2$ emissions that can be avoided from a "low $CO_2$ emitting" electricity mix
- Under this condition still a positive impact can be potentially achieved



# Conclusions

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The results shows that by managing bio-based resources it is possible not only to reduce the levels of $CO_2$ emission but also to reach positive $CO_2$ balances

- The results and sensitivity analyses showed that the used of industrialized timber solutions in housing programs can produce a positive impact on the environment, and potentially also on the economy and society.

- It is clear that the production of industrialized wood-based buildings can potential generate job positions not only on the managed forests but also on production facilities

- The implementation of an industrialized wood-based housing program provides positive impacts on the environment by capturing and avoiding over $10^8$ tons of $CO_2$ equivalent emission over a period of 130 years

- A significant revenue can potentially be created with the crediting of temporarily stored and avoided $CO_2$ emissions associated to the production and use of industrialized wood solutions

The question remains in how to quantify the added values of the industrialized wood value chain?