Eco-efficiency assessment of conventional OPC/PPC replacement by LC^3 in Cuban residential buildings

Sustainable Built Environment Conference TU-GRAZ (SBE19)

Yudiesky Cancio, Sofía Sánchez, Raúl Sánchez,

Fernando Martirena (UCLV), Guillaume Habert (ETH-Zurich)

September 12th, 2019

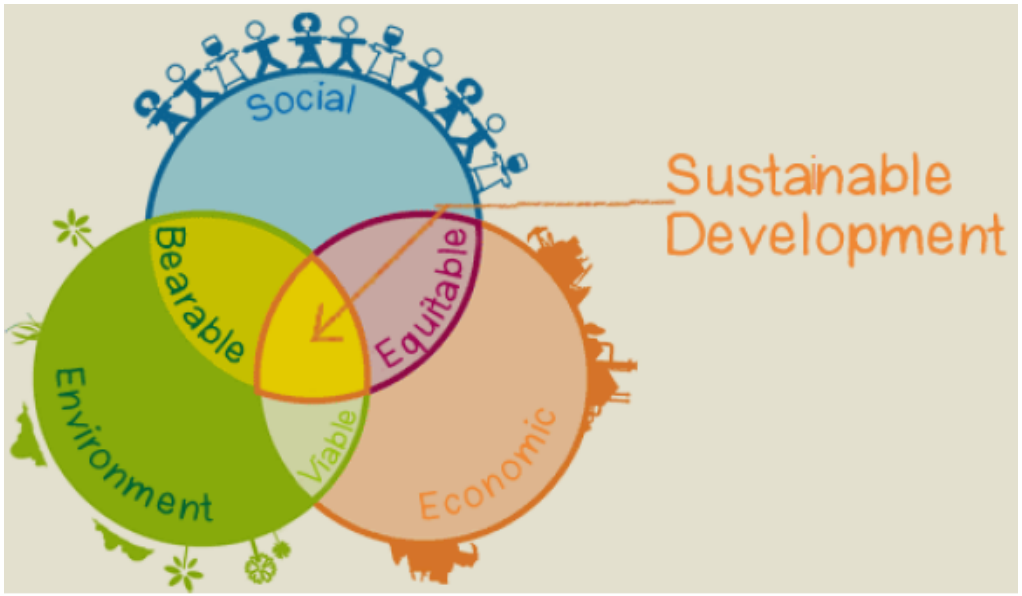
Outline

- **Introduction**
- **Objectives, methods and Data**
- **Results in a nutshell**
- **To-take key messages**

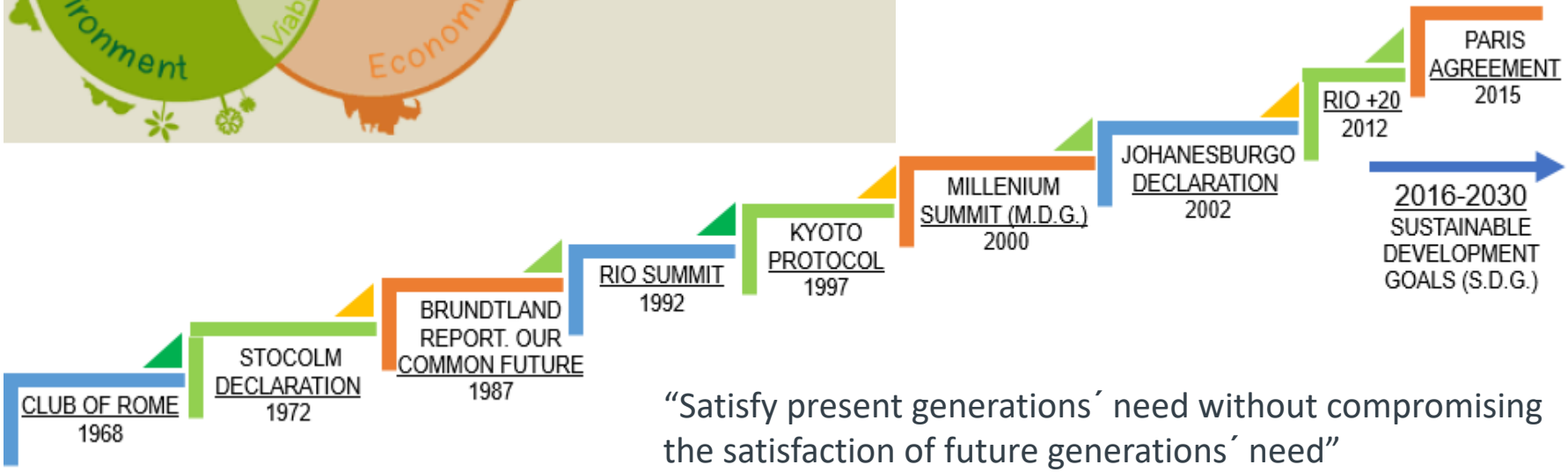
Outline

- **Introduction**
- Objectives, methods and Data
- Results in a nutshell
- To-take key messages

Contextualizing research: where do we stand?



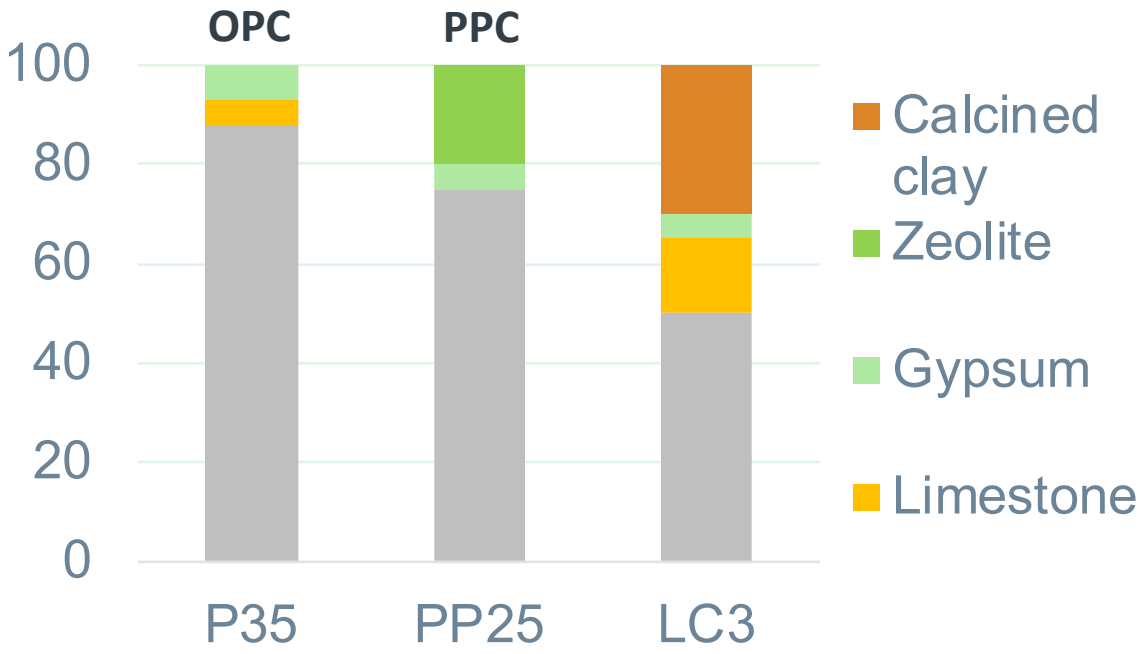
Cuba embraces sustainable development goals (S.D.G.) within its long term development strategy



"Satisfy present generations´ need without compromising the satisfaction of future generations´ need"

(Brundtland Report, 1987)

Traditional cements in Cuba vs. LC^3: composition

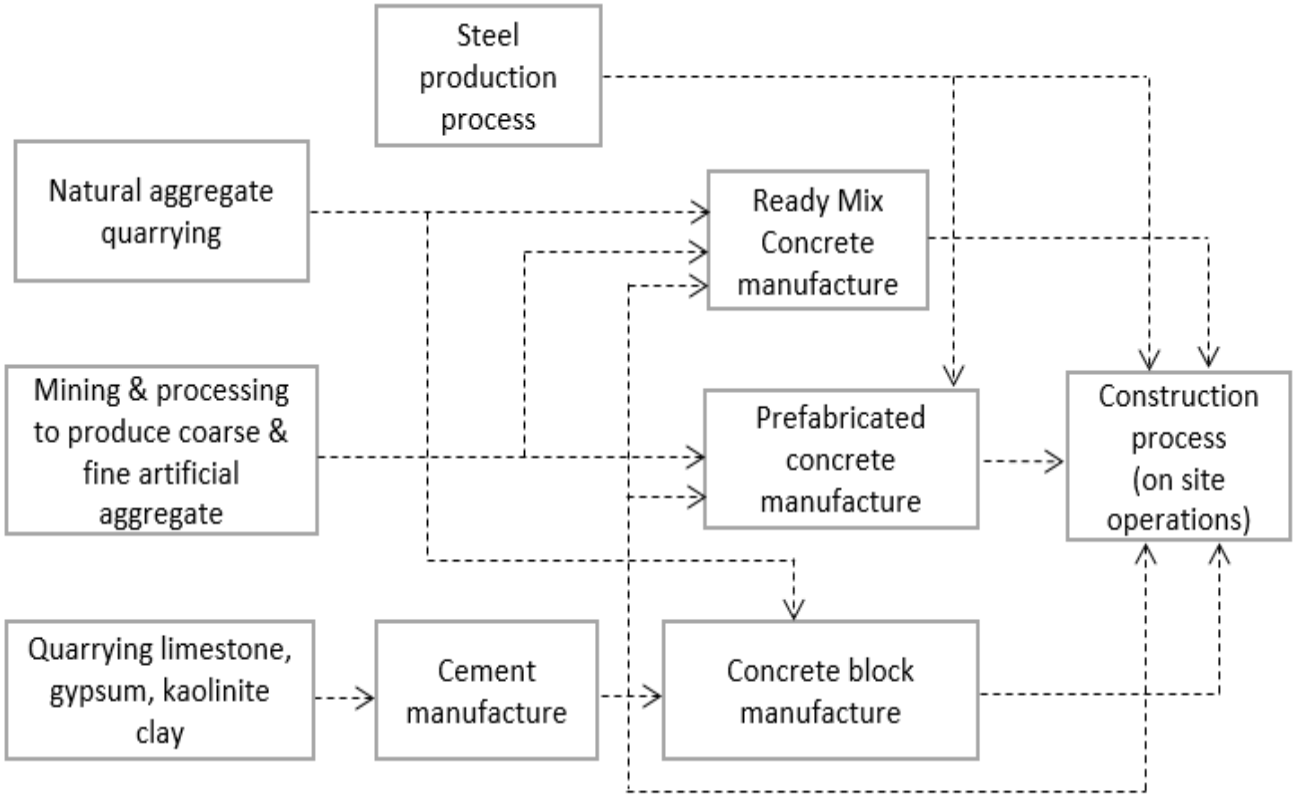


From current situation to LC^3 technology

Outline

- Introduction
- **Objective, methods and Data**
- Results in a nutshell
- To-take key messages

Purpose and methods



- Life Cycle Assessment (LCA)
- Costs in (Net Present Value)
- Eco-efficiency perspective

Construction supply chain mapping (overview)

- Damineli, Bruno. ; Kemeid, Fernanda.; Aguiar, Patricia; John, Vanderley (2010): Measuring the eco-efficiency of cement use. *Cement & concrete composites.*
- World Business Council for Sustainable Development (2000): Measuring eco-efficiency: a guide to reporting company performance.
- Schaltegger, Stefan (1998): Accounting for eco-efficiency. In *Environmental Management in Practice. Vol. I.* London.

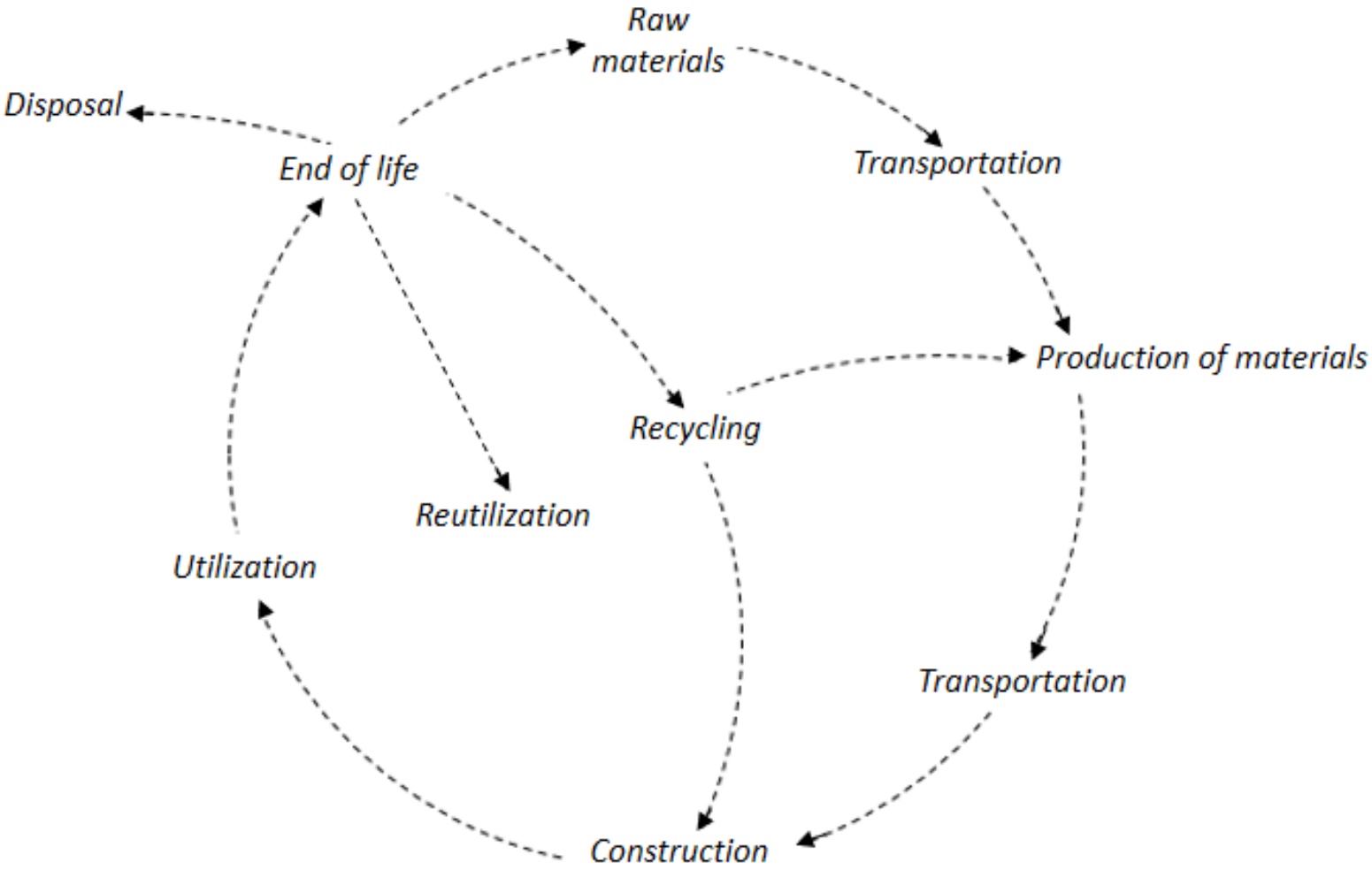
Case studies in Villa Clara province

Concrete block technique

Grand panel system

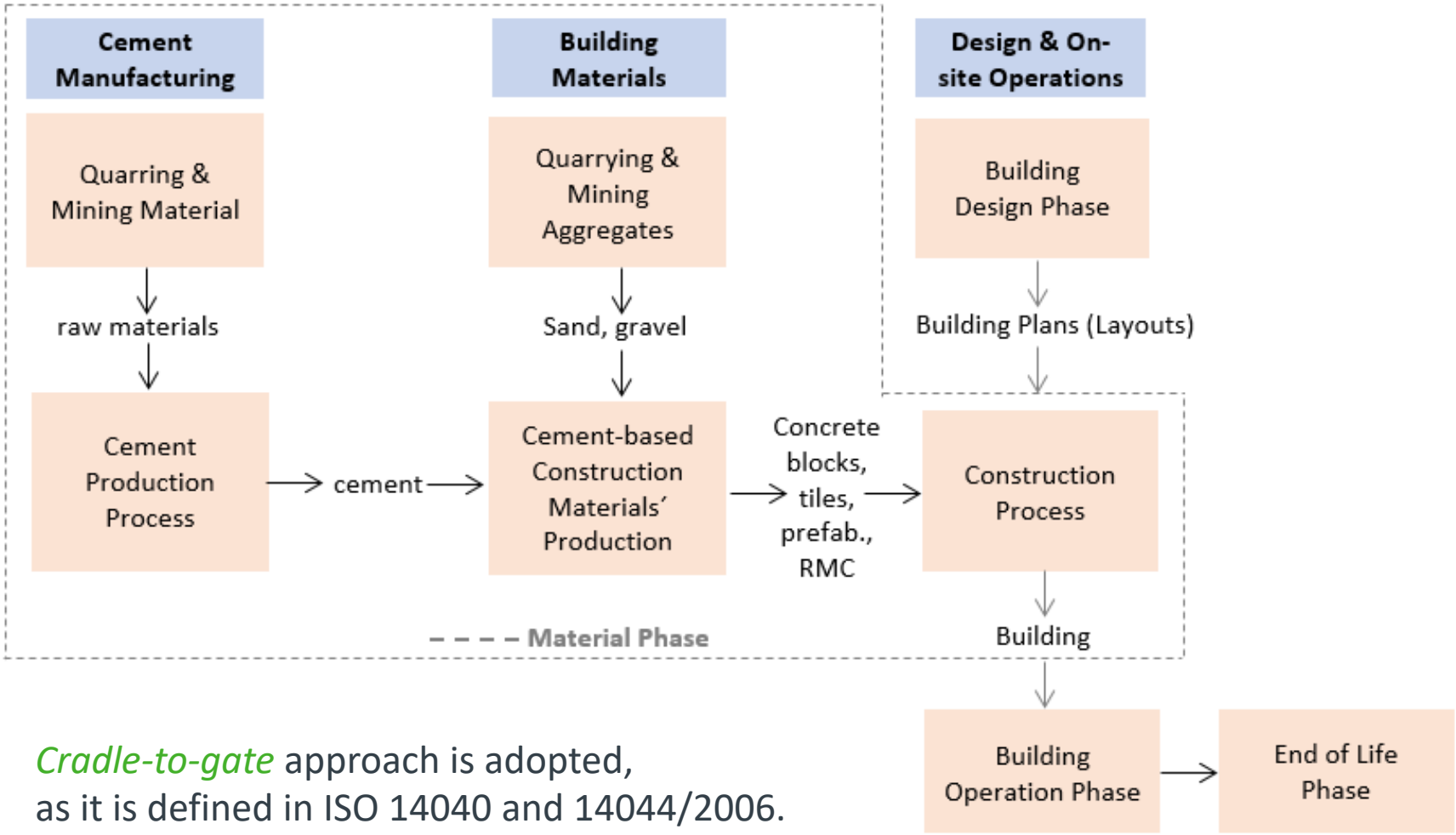
Forsa technology

From the environmental life cycle to the economic flows



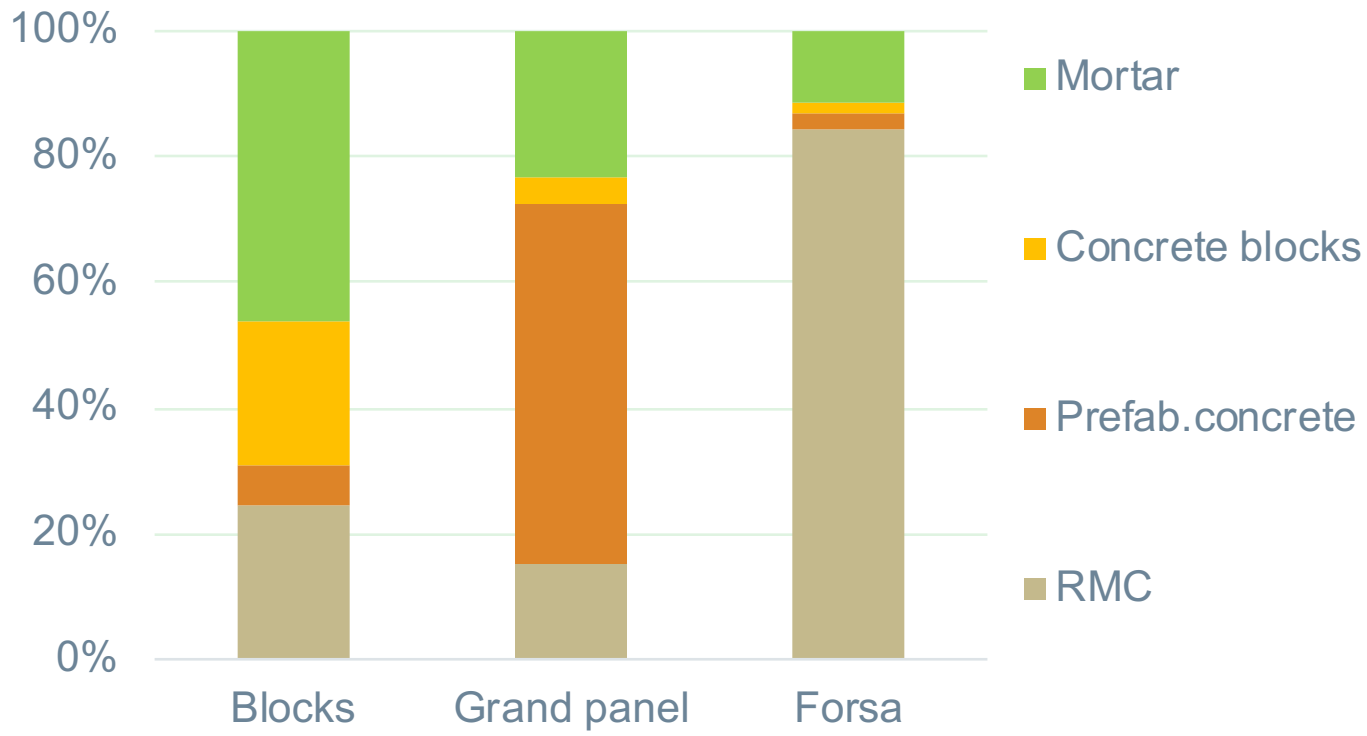
This research covers the *material phase*. Ongoing research covers the *use phase* and future work will explore *end-of-life* scenario.

System boundaries in LCA of buildings



Cradle-to-gate approach is adopted,
as it is defined in ISO 14040 and 14044/2006.

Data inventory: foreground data

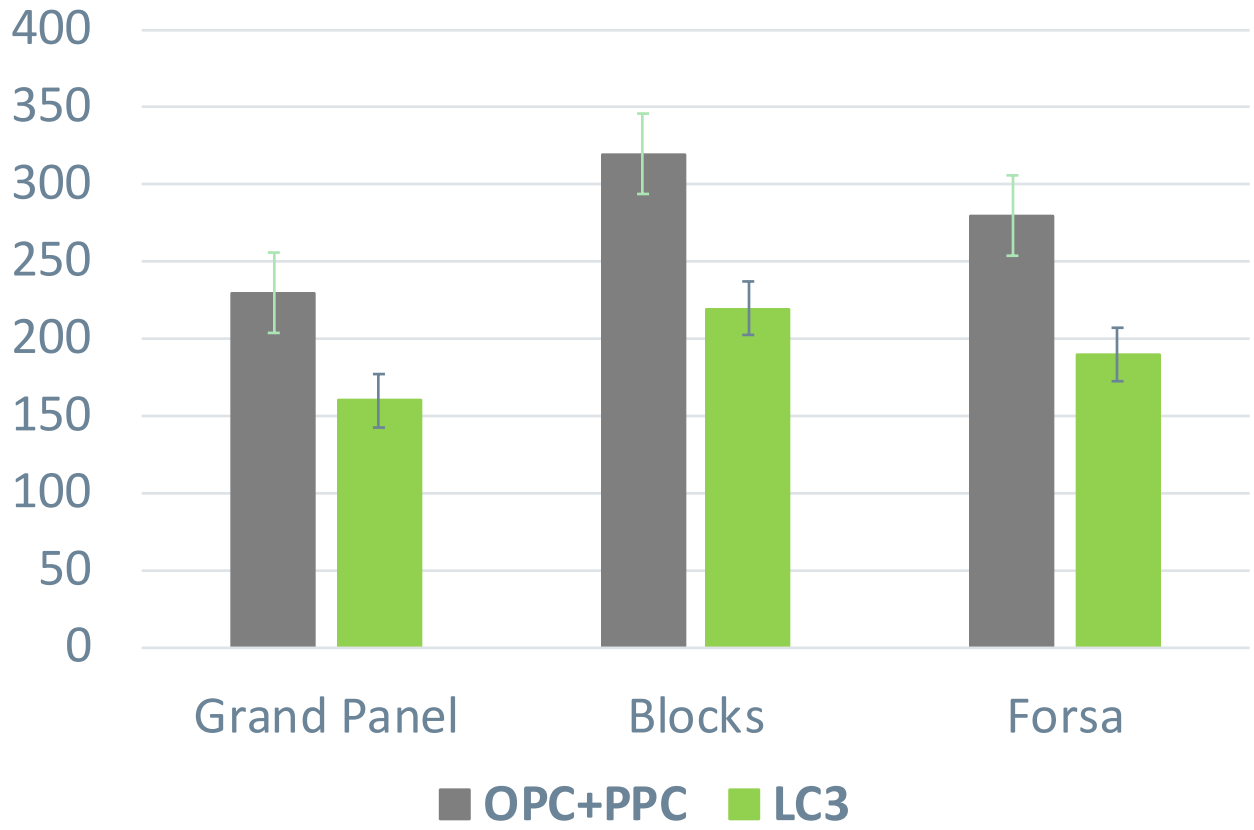


Functional unit: m^2 of usable floor area

Outline

- Introduction
- Objective, methods and Data
- **Results in a nutshell**
- To-take key messages

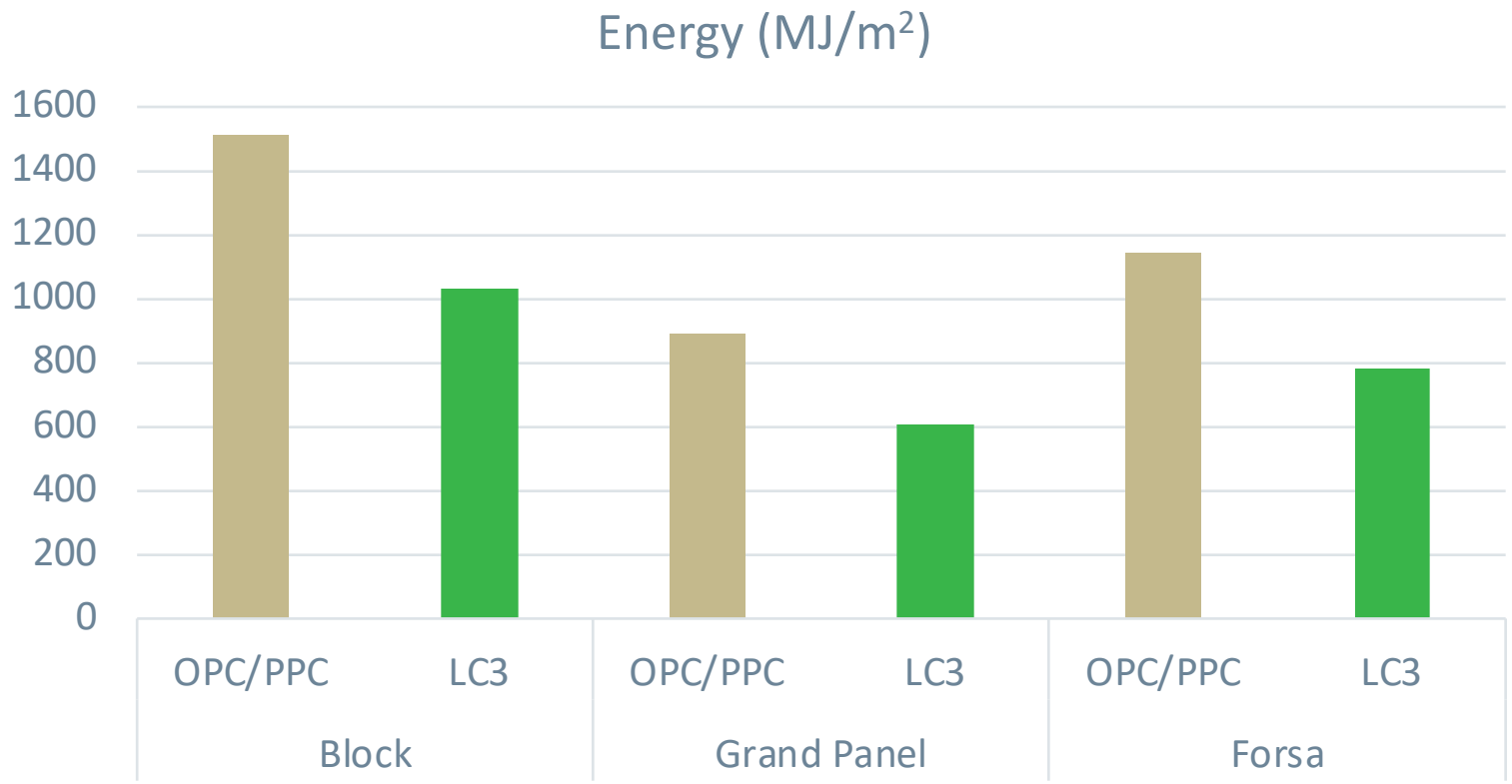
Environmental impact of cements by type of construction technology



GWP100-IPCC ($kgCO_2/m^2$ usable floor area)

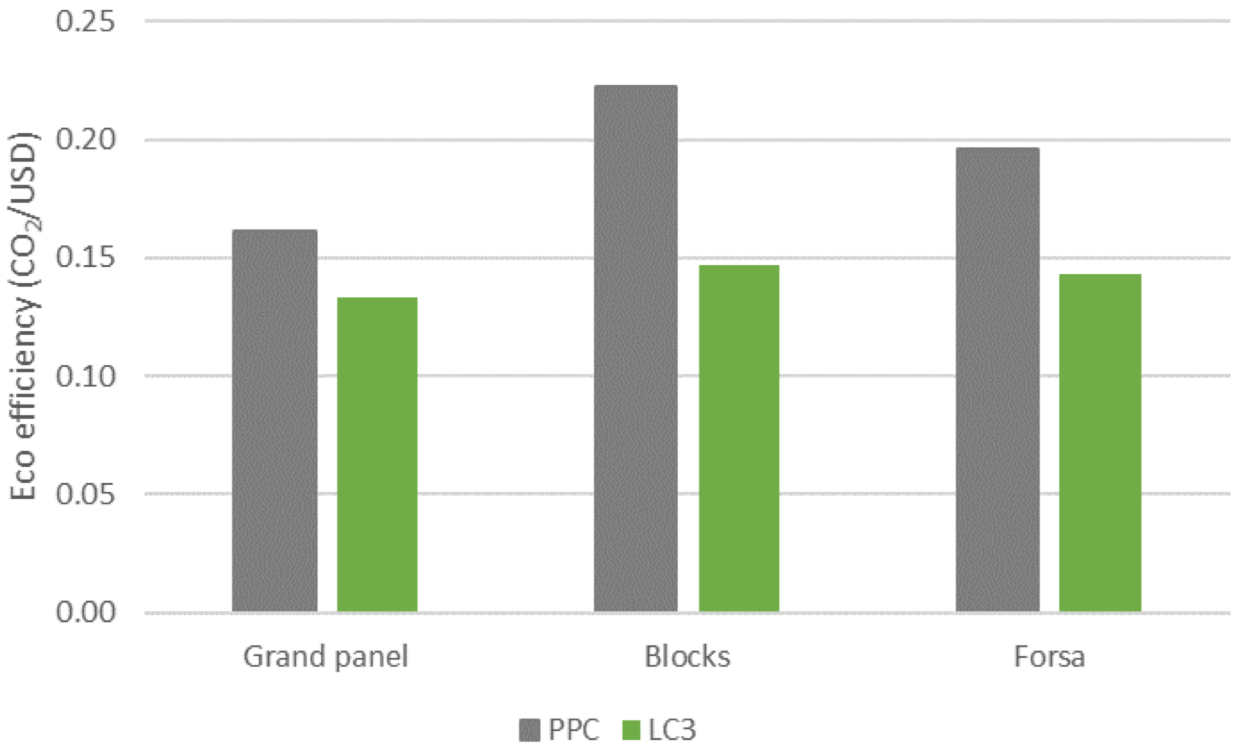
- LC^3 was found to dramatically drop emissions at housing level
- Grand Panel exhibits environmental advantage

Energy consumption efficiency



Conventional cements´ replacement by LC³ leads to reduce energy carriers around 33-37,5 %

Eco-efficiency performance of buildings: the economic impact of a cleaner technology

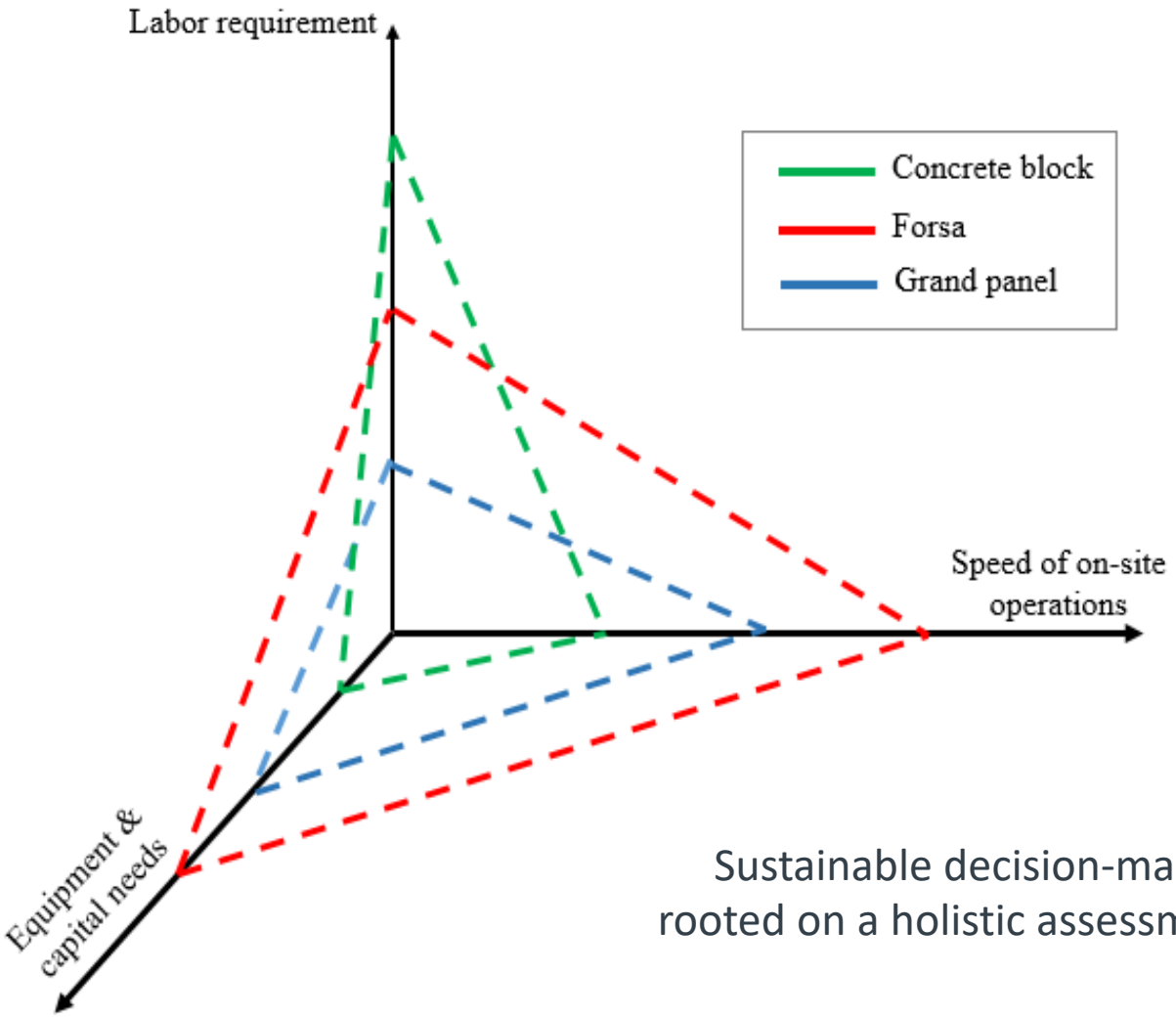


- Concrete block technology appears to be the least eco-efficient
- LC3 is greening investments

Eco-efficiency indicator as the ratio of CO_2 released vs construction costs

(CO_2 per USD)

Exploring beyond eco-efficiency: sustainability entails trade-offs



Sustainable decision-making process has to be rooted on a holistic assessment towards effective LC^3 applications

Outline

- Introduction
- Objective, methods and Data
- Results in a nutshell
- **To-take key messages**

Concluding remarks

- A low carbon cement strategy in Cuba was found to be economically beneficial and environmentally cleaner than BAU.
- Grand panel appears to be the cost-effective benchmark amongst available construction techniques in Cuba. It is not superior *per se*, though.
- Sustainable decision-making in the construction supply chain lies beyond eco-efficiency indicators. It requires a fundamental understanding of multicriteria system thinking to be aligned with case-specific policy orientation.

Thank you, for your attention

LC3 Project
Central University of Las Villas, Cuba
School of Economic Sciences
Dr. Yudiesky Cancio Díaz
Professor
+53 53764678
yudieskycd@uclv.edu.cu

Acknowledgments

The authors would like to thank the Swiss Agency for Development and Cooperation for funding LC3 project, the Cuban cement industry and the construction companies in Villa Clara for their support.