Consequential life cycle assessment of Brazilian cement industry technology projections for 2050

Vanessa Gomes; Marcelo Cunha; **Marcella R. M. Saade**; Gabriela Guimarães; Luiza Zucarato; Carolina Ribeiro; Maristela Gomes da Silva

Introduction

Brazilian cement demand

Challenge: CO_2 emissions and energy demand

*Calcination: 63%
**Fuels: 36%
Electricity: 1%

*Ggbfs & fly ash: increase challenged
**85% fuel mix – fossil-based

Brazilian Cement Technology Roadmap:
*Limestone filler and calcined clay
**45% fossil-based

Introduction

"Assessing the environmental consequences of the proposed change for the cement production technology in Brazil, by identifying the reference flows for alternative energy and virgin materials while offering wider consideration of reflections on other productive sectors"

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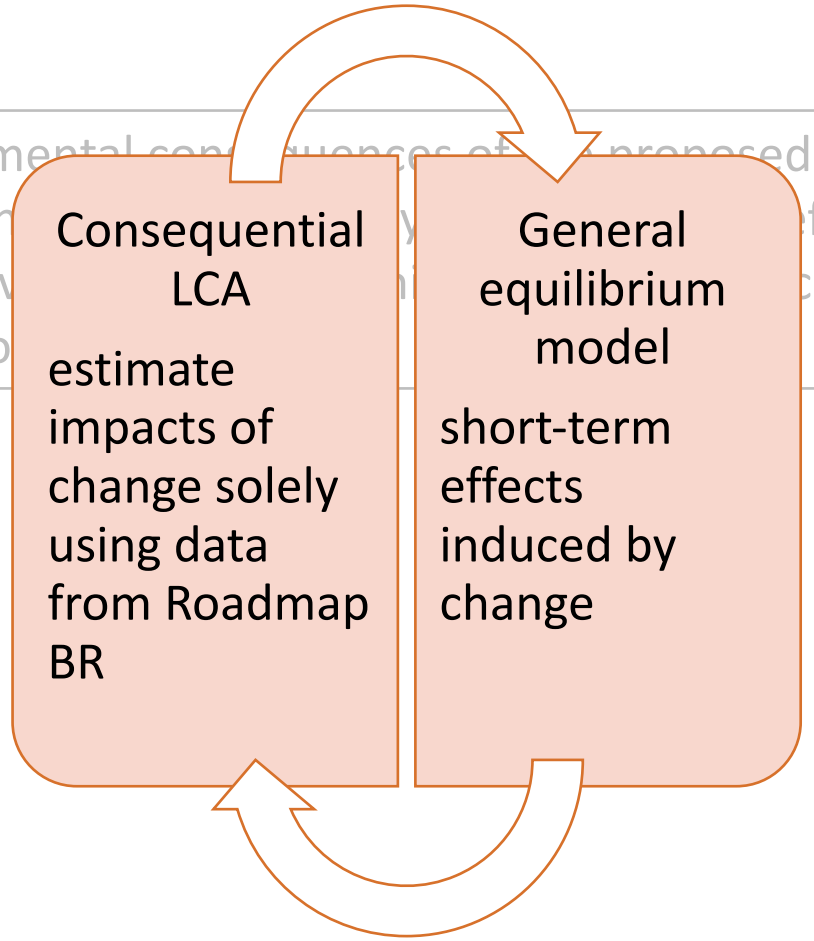


Method – consequential LCA

Goal: “estimate potential environmental impacts of two major technology changes in the Brazilian cement projected for 2050: change in cement composition (route 1) and change in the fuel mix used (route 2), relatively to cement production as per 2014 (baseline).

Foreground: primary data clinker production

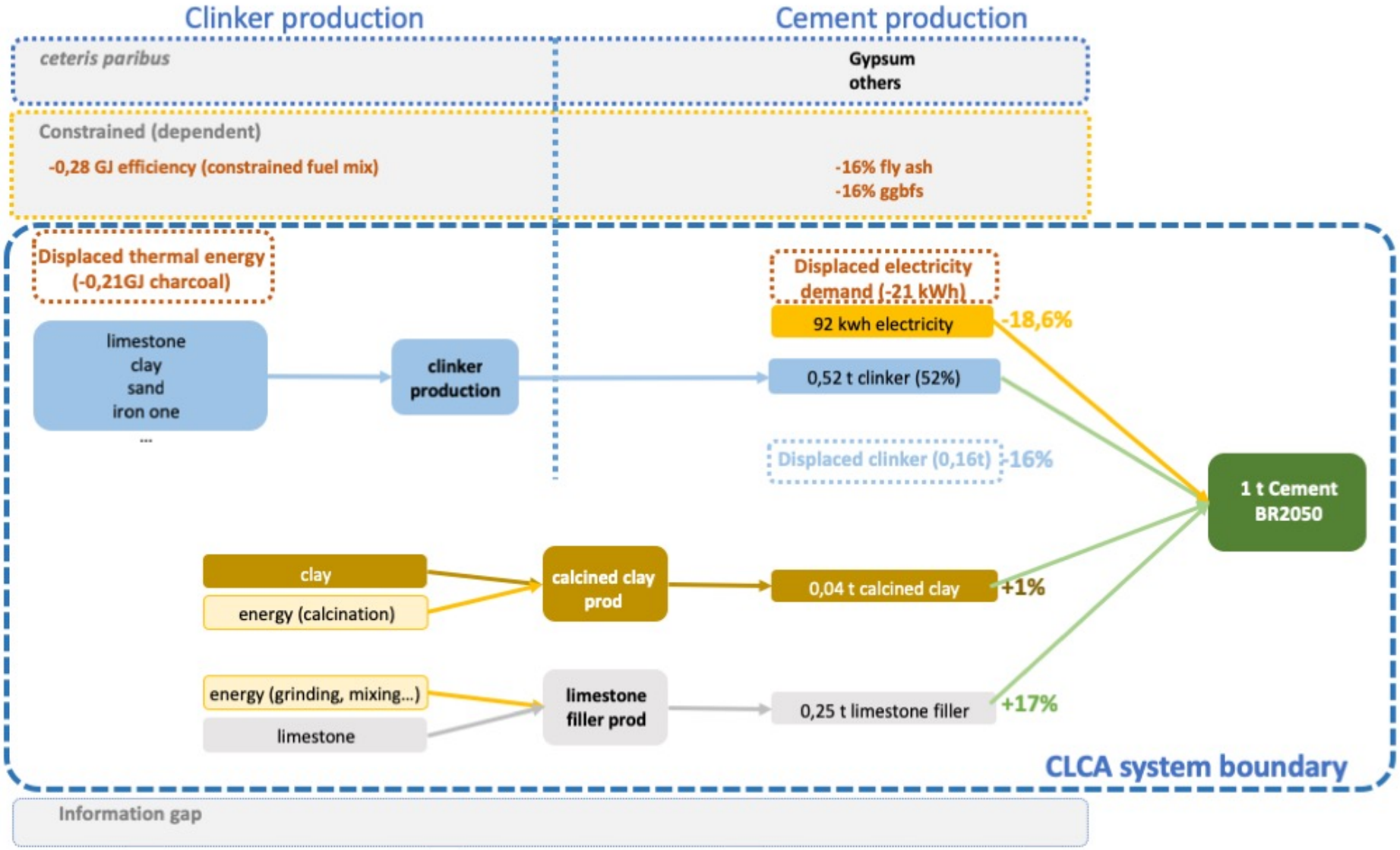
Background: ecoinvent 3.4 (consequential)

SimaPro 8.5; CML-IA baseline v3.05

Temporal scope: 2014-2050
Geography: Brazil
No changes in existing production capacity

1 ton cement

Method – consequential LCA



Method – CGE model

Classical assumptions	(i) supply of each good and each factor of production (capital and labour) is equal to its demand - clear markets
	(ii) each activity operates at zero economic profit
	(iii) families maximize their utility in the consumption of goods, subject to the restriction of their income subtracted from their savings
	(iv) firms seek to minimize their cost for a given level of production, subject to their technological constraints
	(v) the government spends its revenue (taxes collection) on the provision of public services, social security expenditures and savings formation
	(vi) it is assumed that all investment is financed by savings
	(vii) savings are made up of external savings from government and households
	(viii) external saving is given by the inverse of the trade balance, which is the difference between exports and imports

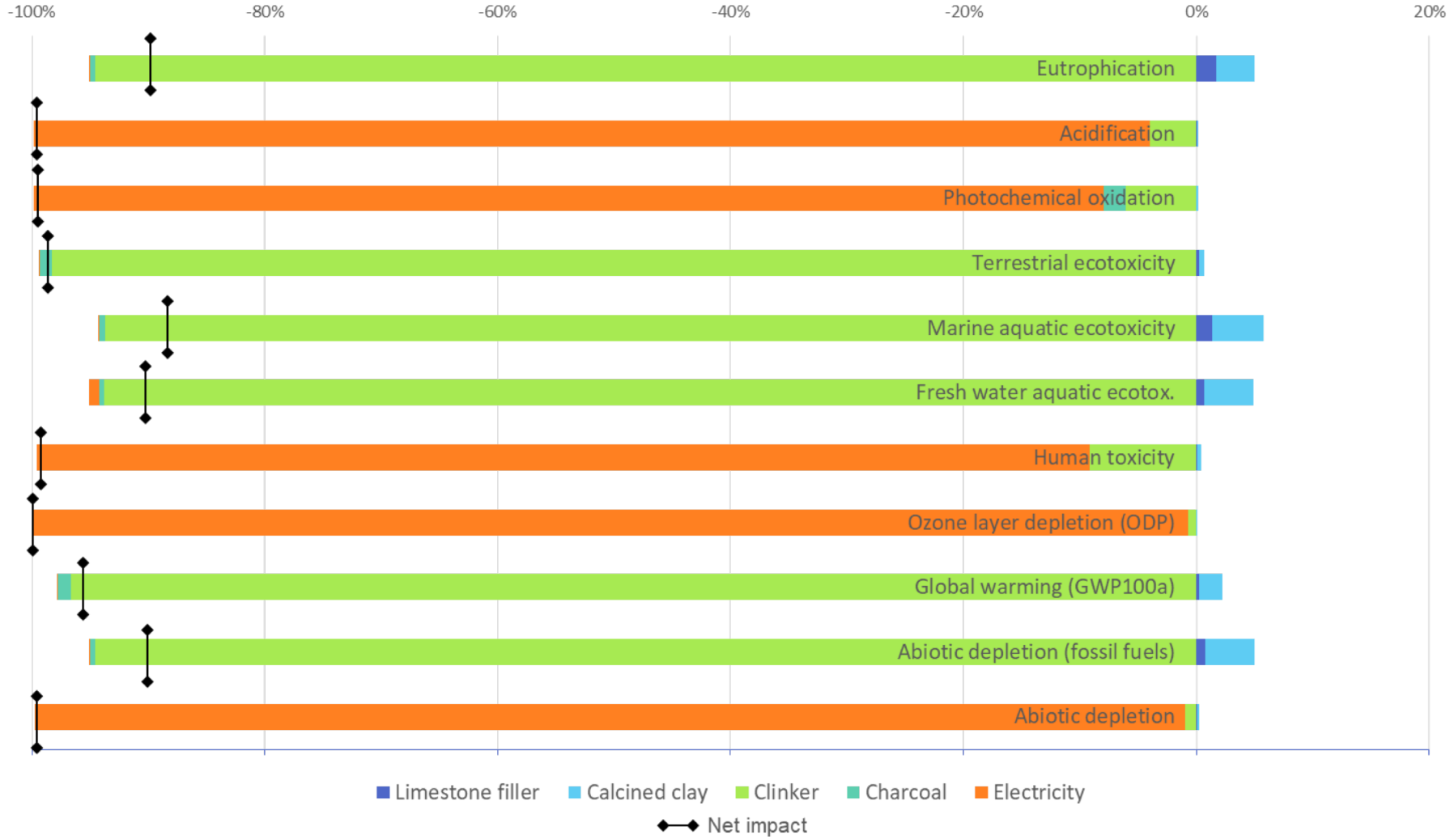
Method – CGE model

Data sources

Input-Output Matrix was estimated from the Brazilian National Accounts. A 102-sector input matrix was then derived to determine the intermediate consumption

Sectors of cement, clay and limestone production were disaggregated. Information from National Union of the Cement Industry – SNIC, and the Annual Industrial Production published by the Brazilian Institute of Geography and Statistics – IBGE

Results – consequential LCA



Results – CGE model

Sector	Change in production level
Cement	+0.0714%
Pulp and Mechanical Pulp Manufacturing	+0.0268%
Construction	+0.0233%
Other non-metallic mineral products	+0.0227%
Paints, varnishes, enamels and lacquers	+0.0119%
Manufacture of petrochemical Diesel	-0.0046%
Clay	-0.0310%
Pesticides	-0.0445%
Fertilizers	-0.0457%
Forestry	-1.1324%

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Enhanced economic efficiency, reduced cost, increased demand & production

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Suppression of charcoal

Final remarks

General outcome

CLCA: two predicted routes do not backfire – net reductions (min 80%) for all assessed impact categories.

CGE model: all 102 modelled economic sectors affected. Marginal increase (81 sectors) or decreased (20 sectors) production levels

Limitations

Representative data. No prospective modelling of Brazilian electricity grid (or other sectors) in 2050.

CLCA modelling relied on predictions already developed by the cited technology roadmap

Exploring the output of an equilibrium model without its full connection to LCA modelling

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Thank you!

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