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METHODOLOGICAL INCONSISTENCIES FROM GREENHOUSE GAS ESTIMATIONS IN THE BRAZILIAN ELECTRICITY MATRIX

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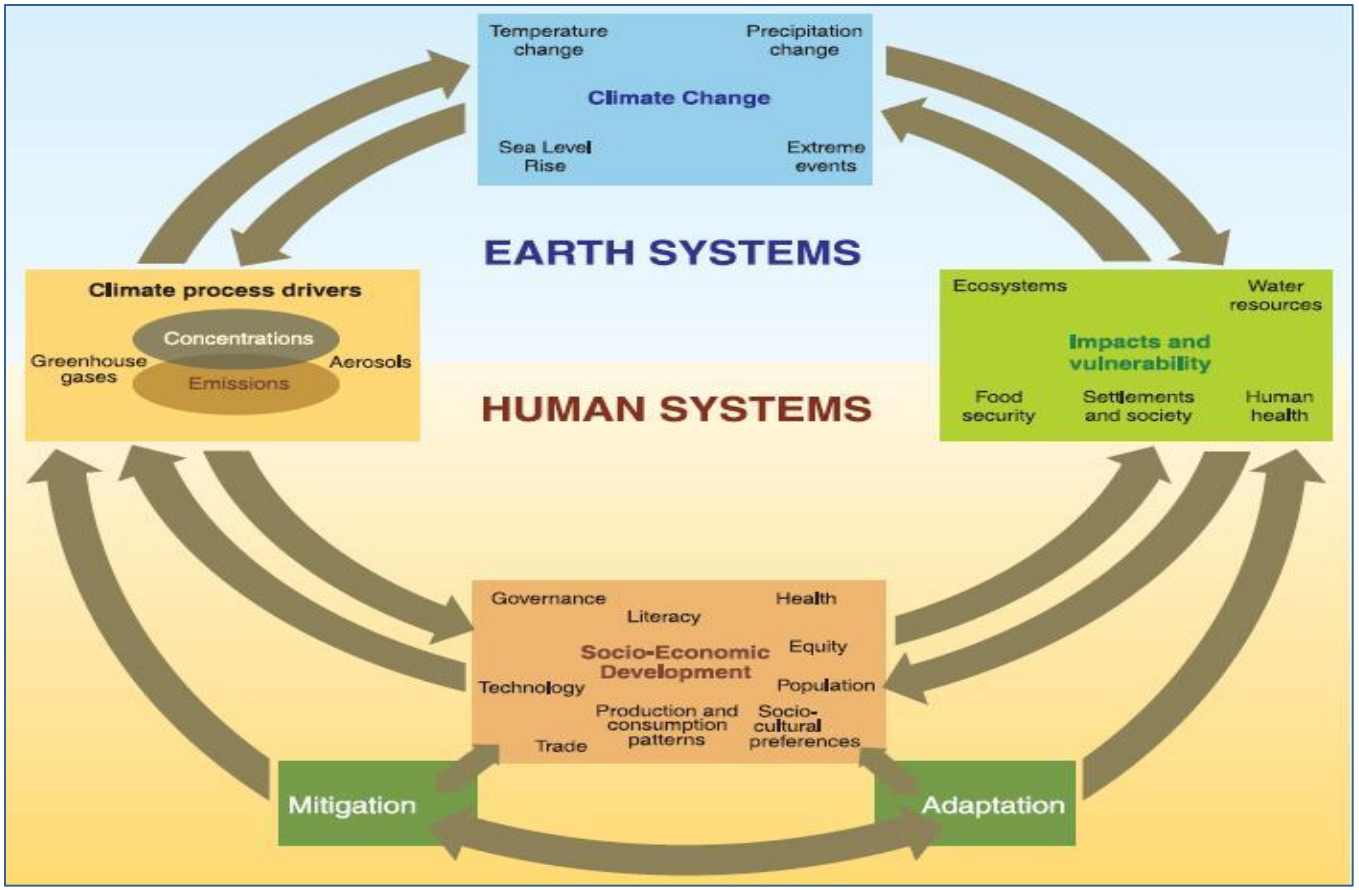
Academic Work

INTRODUCTION

Human-being, Nature and Climate Change relationship, IPCC (2007).



INTRODUCTION

Global Antrophogenic GHG emissions

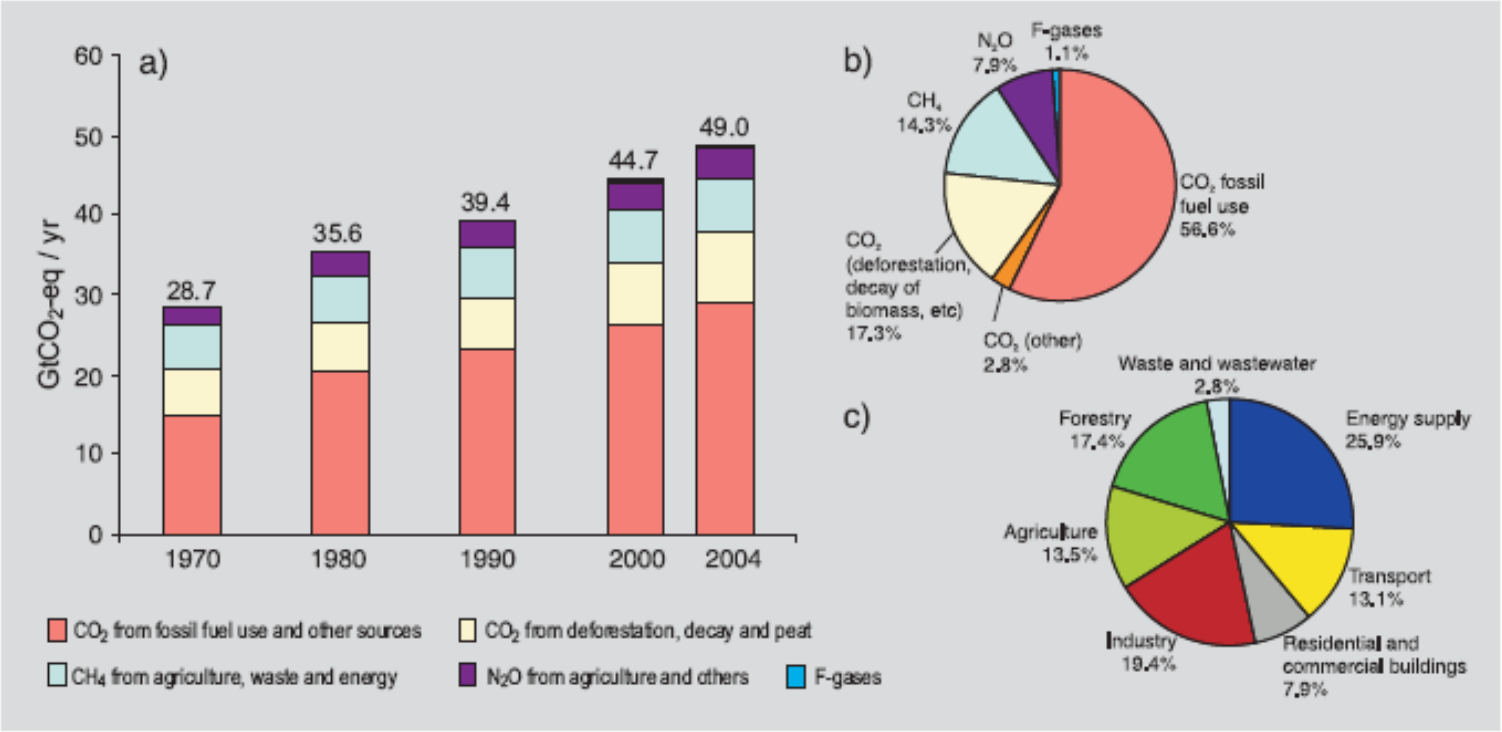


Figure 2.1. (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.[5] (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO_2-eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2-eq. (Forestry includes deforestation.) {WGIII Figures TS.1a, TS.1b, TS.2b}

IPCC (2007)

INTRODUCTION

Carbon footprint concepts

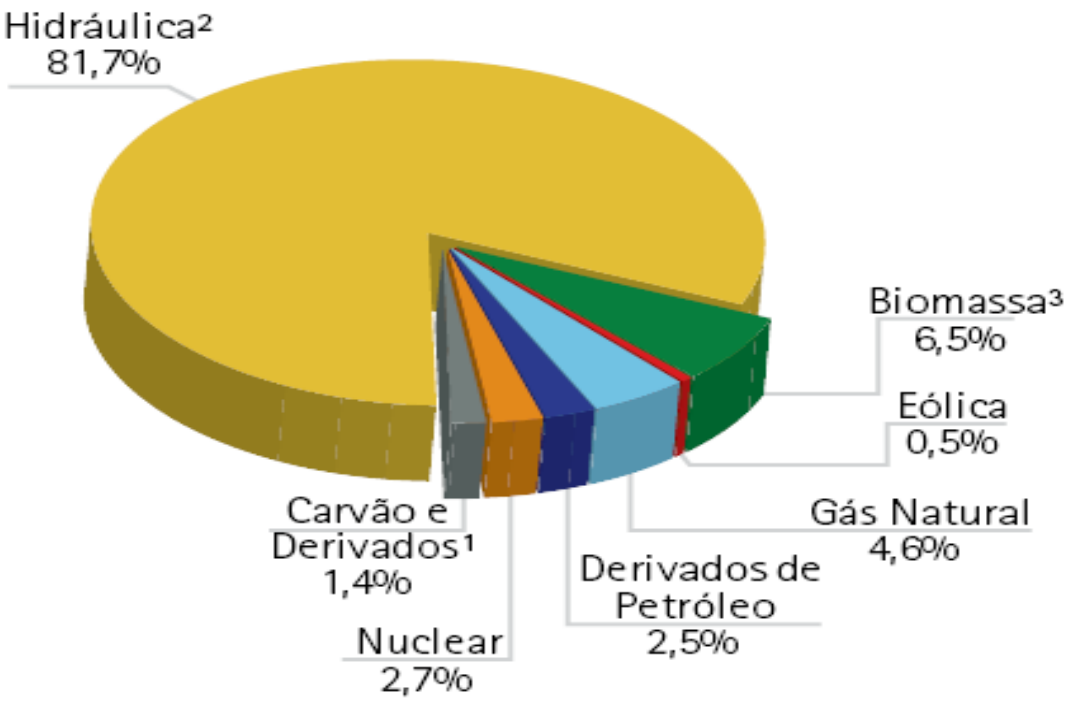
Grub & Ellis (2007)	"Carbon footprint is a measurement of the total emitted carbon dioxide through fossil fuels combustion."
Energetics (2007)	"…it is the complete measurement from direct and indirect CO_2 emissions caused by one business activity."
ETAP (2007)	"…a 'Carbon Footprint' is an impact measurement that human activities cause in the environment related to the quantity of Greenhouse Gases produced."
PAS2050 (2008)	"Carbon footprint is the total value of carbon dioxide and other Greenhouse Gases emitted during the whole life cycle of a product or a service. It is expressed by equivalents of CO_2."

Wiedmann, T. et al. (2007); PAS2050 (2008)

INTRODUCTION

- ISO 14067 Product Carbon Footprint (2013)
- World Business Council for Sustainable Development (WBCSD) together with the World Resources Institute (WRI) – GHG Protocol Product Life Cycle Accounting and Reporting Standard and Corporate Accounting and Reporting Standard: Guidelines for Value Chain (Scope 3) Accounting and Reporting
- BSI-PAS 2050 British Guide for Carbon Footprint (2011)

BRAZILIAN ELECTRICITY MATRIX



geração hidráulica em 2011: 467,0 TWh

¹ Inclui gás de coqueria
² Inclui importação
³ Inclui lenha, bagaço de cana, lixívia e outras recuperações.

BEN (2012)

JUSTIFICATION

- Climate Change, Kyoto Protocol and CDM.
- Inventories: Quantification of emissions.
- Electricity: sector relevance for the economy.

PRESENTATION STRUCTURE

- INTRODUCTION
- JUSTIFICATION
- OBJECTIVES
- METHOD
- RESULTS
- DISCUSSION
- CONCLUSION

OBJECTIVES

General

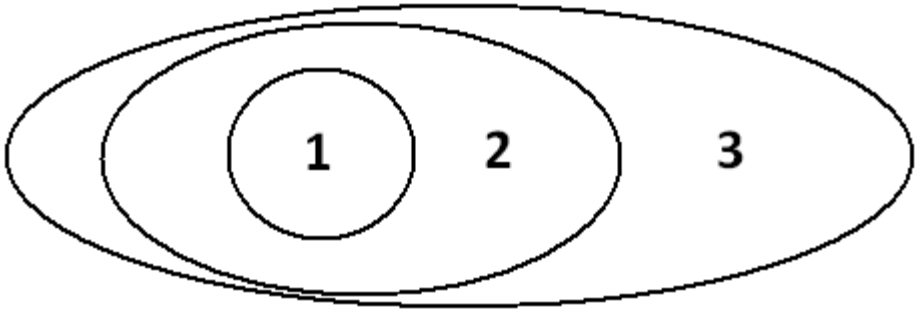
- Assess the GHG emission results from the brazilian electricity matrix.

Specifics

- Search the available data sources.
- Explain the diferences among the results found.
- Suggest improvements.

DEFINITIONS

- Scope 1 inventory – quantify only the direct emissions from a process unit.
- Scope 2 inventory – emissions related/regarded to energy acquisition.
- Scope 3 inventory – accounts for any other indirect emission caused by third parties by any means related to the product system analysed.



GHG Protocol, 2010

METHOD

It was created from conceptual information regarding GHG emissions; available data about the Brazilian electricity matrix CO_2 emissions; and consulted sources:

1. MCT (2013) – CO_2 emissions data from the National Interconnected System (SIN).
2. Coltro *et al.* (2003) – pioneer study of CO_2 emissions from Brazilian electricity sector in a Life Cycle perspective.
3. Ecoinvent (2010) – Life Cycle Inventory (LCI) from Brazilian electricity production (from cradle to grave).
4. GaBi Database (2008) – Life Cycle Inventory (LCI) from Brazilian electricity production (from cradle to grave).

RESULTS

CO_2 emission factors for usage in corporate inventories from the SIN (MCT, 2013).

Year	grams of CO_2 by energy ($g.kWh^{-1}$)
2007	29
2008	48
2009	25
2010	51
2011	29
2012	69

Factor recommended by the GHG Protocol and the most used in CDM projects.

RESULS

LCA of brazilian electricity production (Coltro *et al.*, 2003)

Atmospheric Emissions	Unit	Quantity/ 278 kWh
CH_4 -- Powerplants	g	54.80
CH_4 -- Hydro	g	484.75
CO_2 -- Powerplants	g	17,832.00
CO_2 -- Hydro	g	16,512.67
N_2O -- Powerplants	g	10.99

Name	Chemical Symbol	GWP 100-yr (IPCC, 2007)
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298

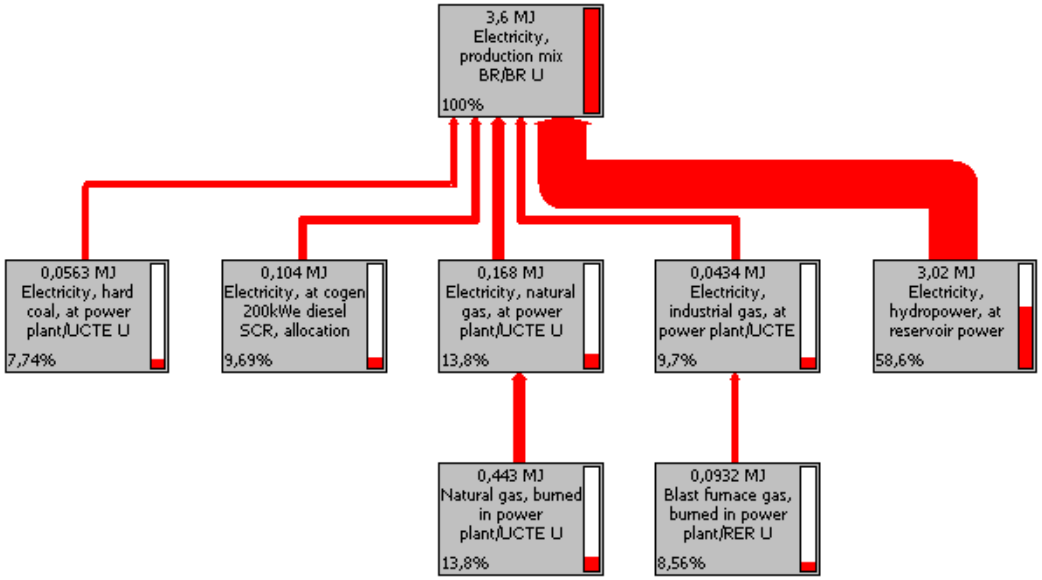
GHGs (– renewable CO_2) = 124 g CO_2/kWh

All GHGs = 184 g CO_2e/kWh

Obs: It does not account for some emissions from infrastructure and transport of products.

RESULTS

- Ecoinvent on Simapro 7.3 considers the Life Cycle of Brazilian electricity consumption. It distinguishes between low, medium and high voltages.
- The fuels, infrastructure, transport and imports (Argentina e Paraguai) are all accounted for.
- The Brazilian GHG emissions were 283 g CO_2e/kWh, using IPCC (2007) 100-yr.

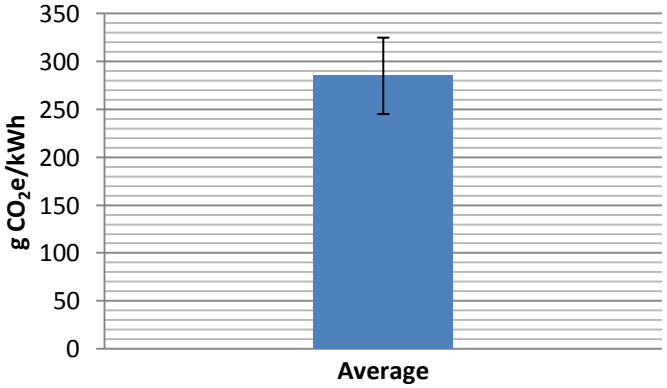


Simapro 7.3, 2013.

RESULTS

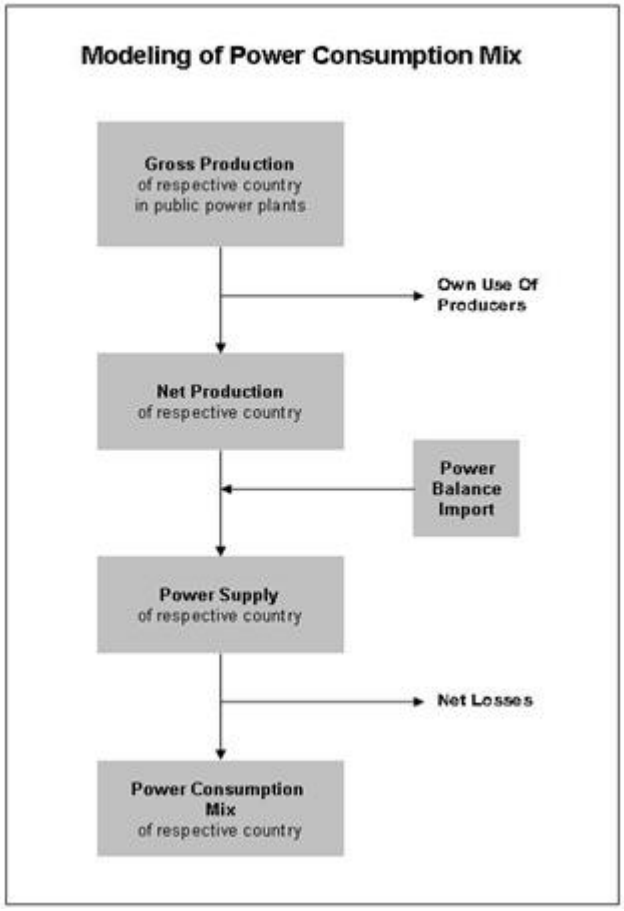
Electricity, low voltage, at grid/BR S

Methods	g CO_2e/kWh
IPCC 2007 GWP 100a V1.02	283
Greenhouse Gas Protocol V1.01 / C02 eq (kg)	290
CML 2001 (all impact categories) V2.05 / World, 1990	279
IMPACT 2002+ V2.10 / IMPACT 2002+	248
EDIP 2003 V1.02 / Default	279
ReCiPe Midpoint (E) V1.05 / World ReCiPe E	241
ReCiPe Midpoint (H) V1.05 / World ReCiPe H	283
EPD (2008) V1.03	279
BEES V4.02	278
TRACI 2 V3.03	279

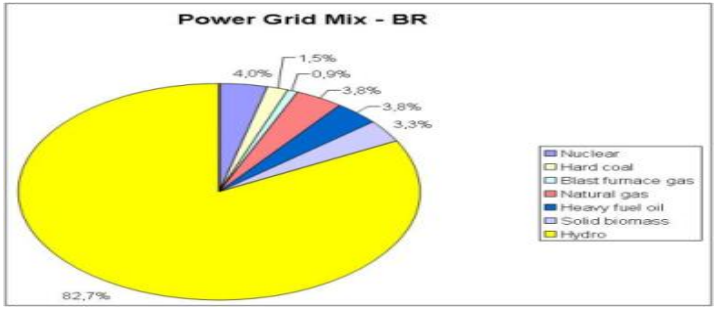


Ecoinvent v2.2 on Simapro 7.3, 2013.

RESULTS



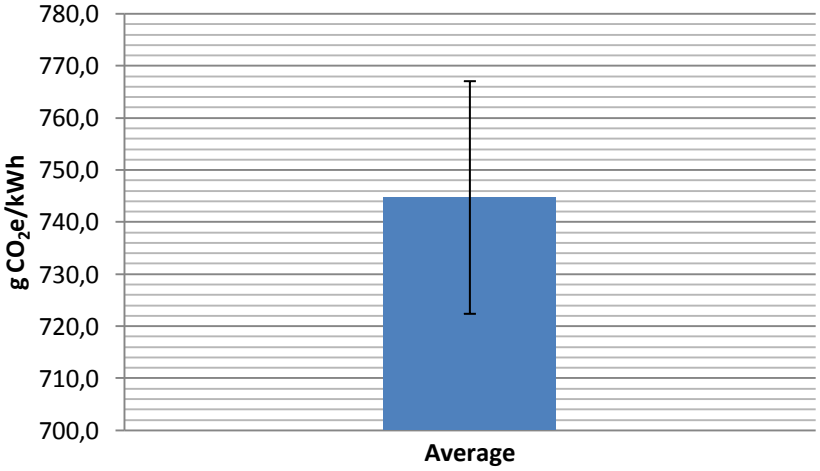
- GaBi Database (2008) on GaBi 6 ™ software considers the Life Cycle of Brazilian electricity consumption.
- The supply-chain of fuels, including their emissions and respective efficiencies, infrastructure, transport and imports.
- The GHG result was that each kWh in Brazil emmits 718 g CO_2e, using IPCC (2007) 100-yr method.



RESULTS

BR: Power grid mix PE

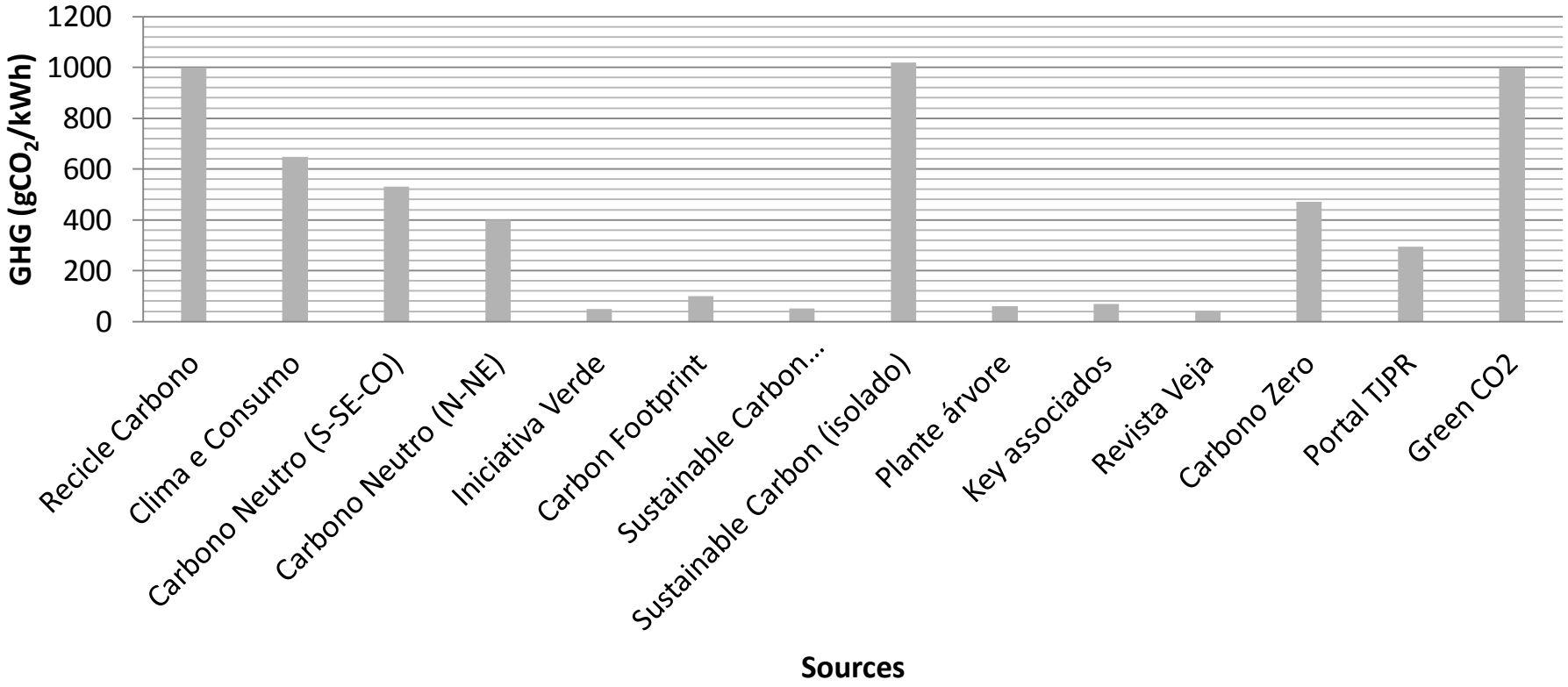
Methods	g CO_2e/kWh
IPCC	763,8
CML2001 - Nov. 2010, Global Warming Potential (GWP 100 years)	718,4
ReCiPe 1.07 Midpoint (H) - Climate change	764,7
TRACI 2.0, Global Warming Air	718,4
TRACI 2.0, Global Warming Air, excl biogenic carbon	764,7
IPCC global warming, excl biogenic carbon	764,7
IPCC global warming, incl biogenic carbon	718,4



GaBi Database, 2008 in GaBi 6, 2013.

RESULTS

Internet carbon calculators, scope not specified at all.



DISCUSSION

- The inventory scope expansion considerably increased the emission factor of the product.
- The lack of standardised methodology usage for GHG emissions bring differences in results of the same factor.
- GHG emissions should be given with discriminated Scopes and details, i.e. carbon calculators and MCT (2013).
- There were variations between the main 3 Scope emission factors. We suppose the variations are due to the hydropower inventory.

CONCLUSION

- The lack of transparancy in the inventories did not permit more interpretations.
- These issues implicate either in the environmental control policy or in the carbon market credibility.

TECLIM

CLEAN TECHNOLOGY NETWORK

Thank you for your kind attention!

ACKNOWLEDGEMENTS

CAPES

PEI

CNPq 60 ANOS

Ministério da Ciência, Tecnologia e Inovação

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

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