Biofuels in Emerging Markets: Potential for sustainable production and consumption

Environmental and economic assessment of biofuels production in countries of Latin America, Africa and Asia

Brazilian Team:

Glaucia Mendes Souza, Heitor Cantarella, Luis Fernando Cassinelli, Luiz Horta Nogueira, Raffaella Rossetto, and Rubens Maciel Filho

Collaborators:

Jean Felipe Leal Silva, Pablo Ortiz, Nicholas Canabarro

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Potential for sustainable production and consumption

By Glaucia Mendes Souza (University of São Paulo), Rubens Maciel Filho (University of Campinas), Luiz A. Horta Nogueira (University of Campinas), Heitor Cantarella (Agronomic Institute of Campinas), Raffaella Rossetto (Agronomic Institute of Campinas), Nicholas Islongo Canabarro (University of São Paulo), Pablo Silva-Ortiz (University of Campinas), and Jean Felipe Leal Silva (University of Campinas)

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BIOFUELS BLENDING MANDATES IN EMERGING ECONOMIES

Positive institutional environment (legal framework in place)

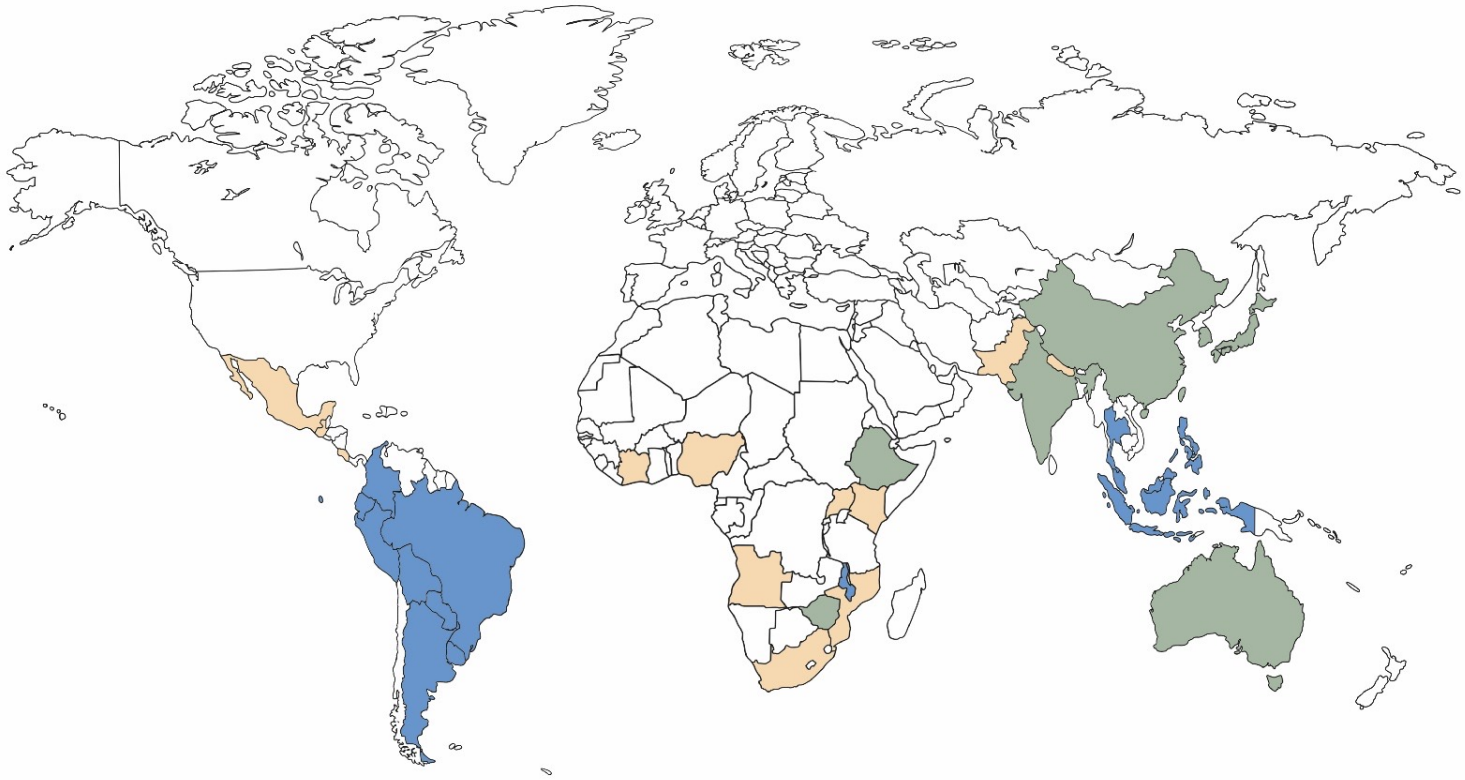
Angola
Cote d'Ivoire
Kenya
Mozambique
Nigeria
South Africa
Uganda
Nepal
Pakistan
Costa Rica
Guatemala
Mexico

Blending mandate partially implemented

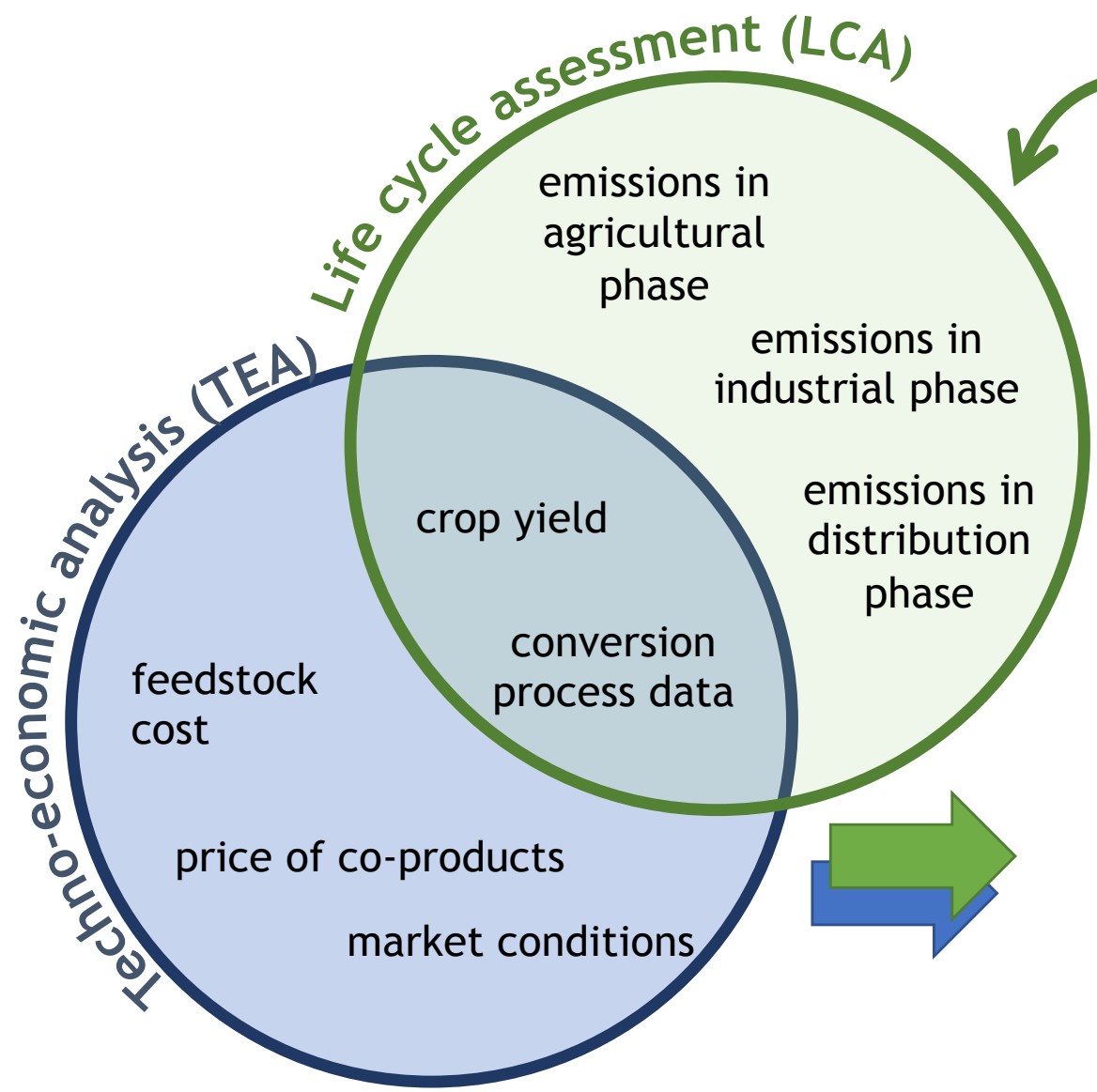
Ethiopia
Zimbabwe
Australia
China
India
Japan
South Corea

Biofuel use fully implemented

Malawi
Indonesia
Malaysia
Philippines
Thailand
Argentina
Bolivia
Brazil
Colombia
Ecuador
Paraguay
Peru
Uruguay



Developing countries with large populations, high energy demand, biofuels policies



- Cradle-to-grave, attributional LCA
- Inventory: based on literature data and ecoinvent 3.8
- Emissions allocated among products based on energy content
- Distribution: same as current fueling infrastructure

MARKET ANALYSIS:
Determine economic and environmental feasibility of replacing gasoline and diesel

Key expected results:
- GHG savings
- Required land to produce biofuels
- Fuel cost (blending mandate)

CASES EVALUATED

- Fully deployed, high TRL
- Positive energy balance
- Competitive with fossil fuel prices
- Significant reduction of GHG emissions (63 MtCO2eq/yr)
- Potential to double production with ~5% of pasturelant conversion into energy cropland

- **Other countries: next round of studies**

	Ethanol		Biodiesel		
	Corn	Sugarcane	Soybean	Palm	Rapeseed
Argentina	✓	✓	✓		
Brazil		✓	✓		
Colombia		✓		✓	
Guatemala		✓			
China	✓	✓	✓		✓
Ethiopia		✓	✓		
India		✓		✓	
Indonesia	✓			✓	
Malaysia	✓			✓	
South Africa		✓			✓
Thailand		✓		✓	

GHG EMISSIONS – Ethanol compared do gasoline

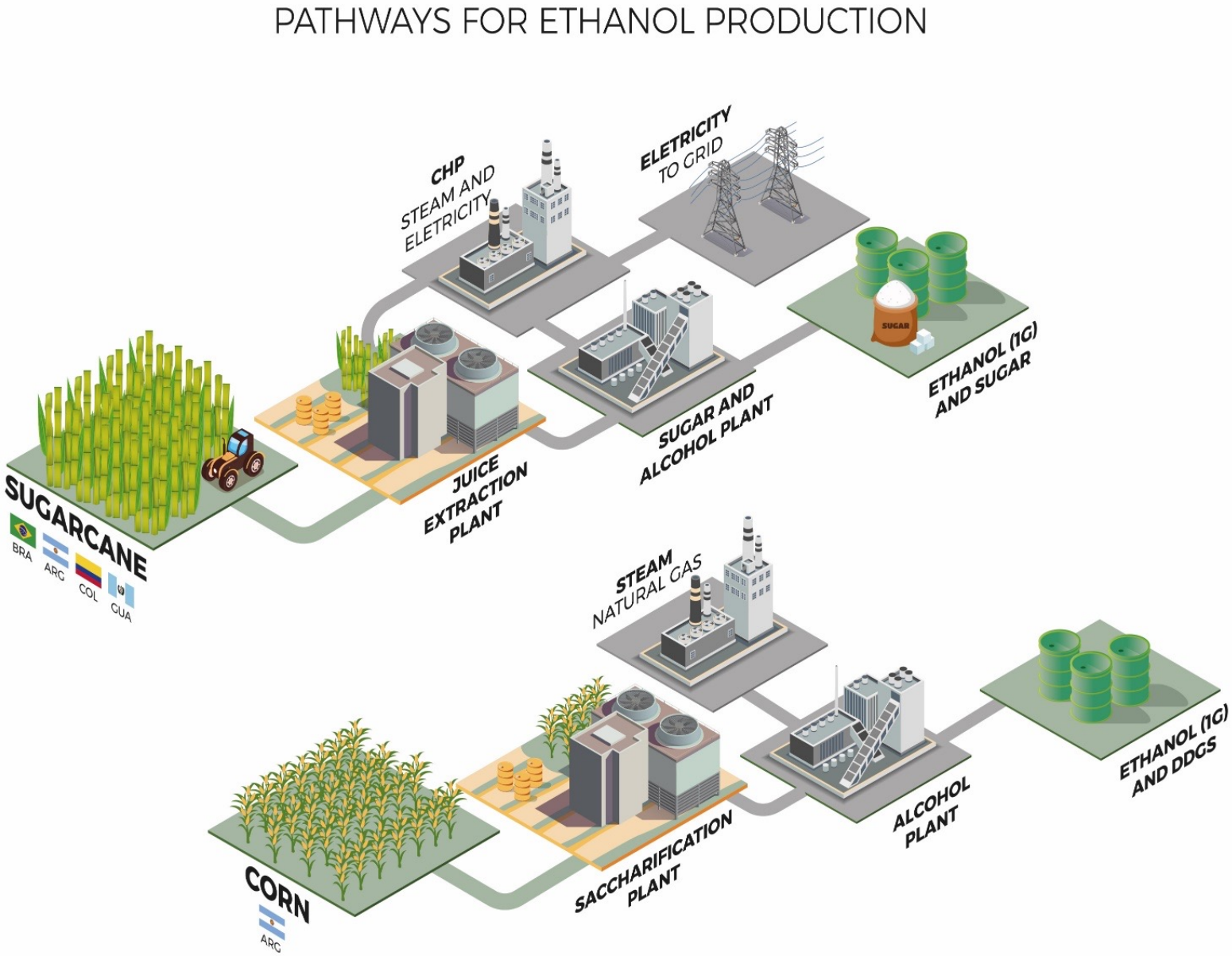
ARG ↓ 70%

BRA ↓ 67%

COL ↓ 74%

GUA ↓ 66%

ARG ↓ 37%

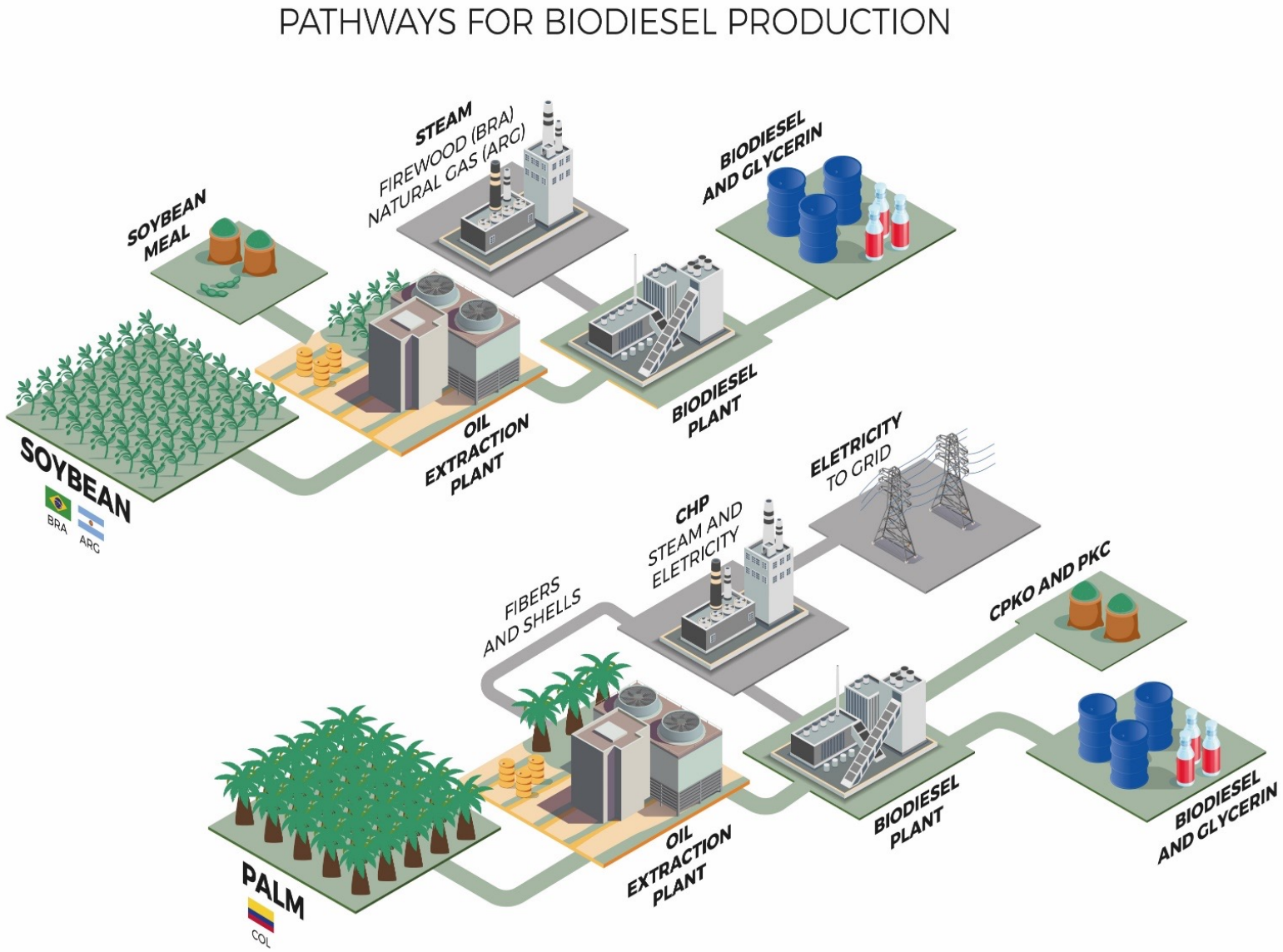


GHG EMISSIONS – Biodiesel compared do diesel

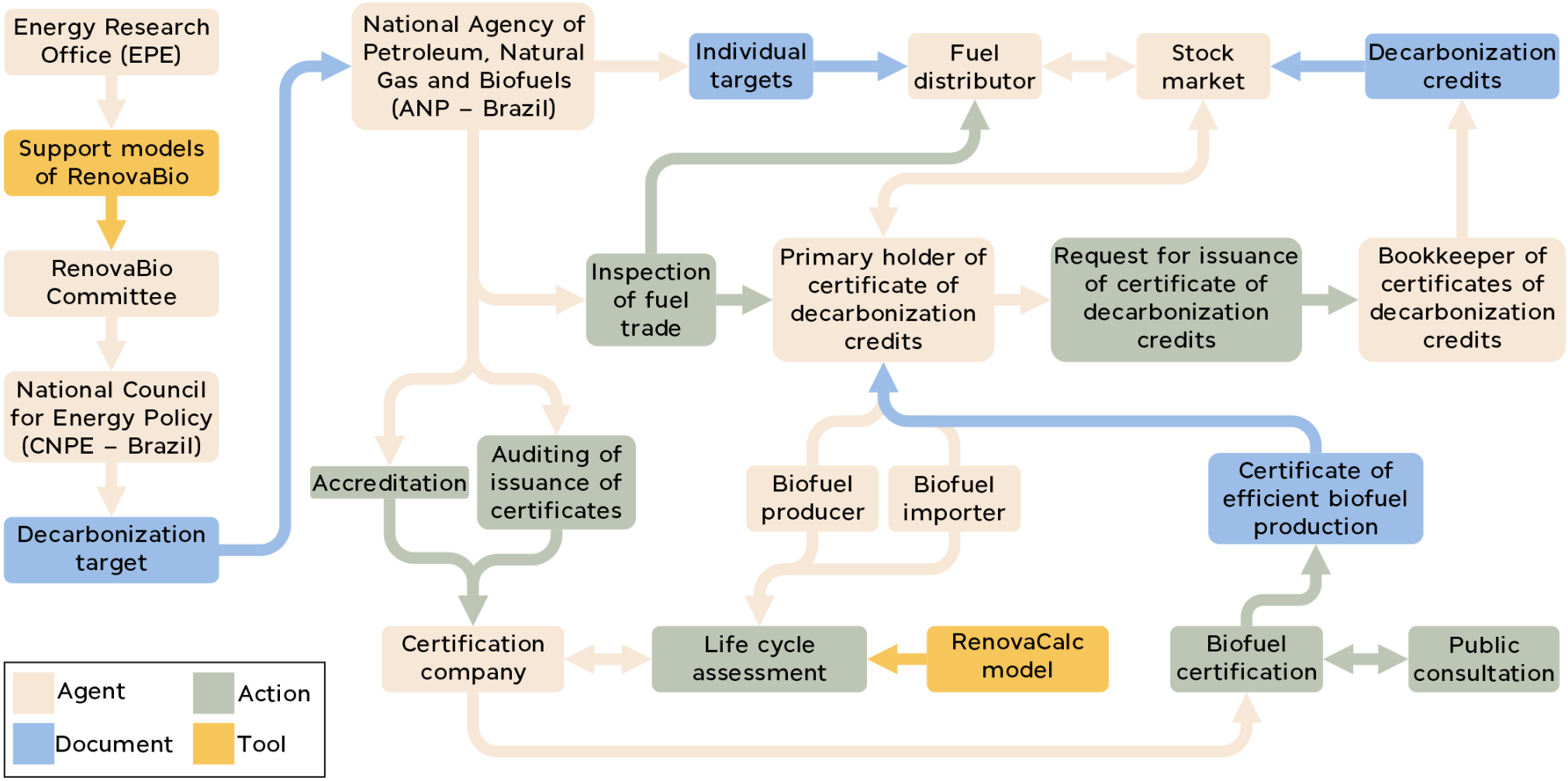
ARG ↓ **79%**

BRA ↓ **68%**

COL ↓ **84%**



RENOVABIO Policy Framework



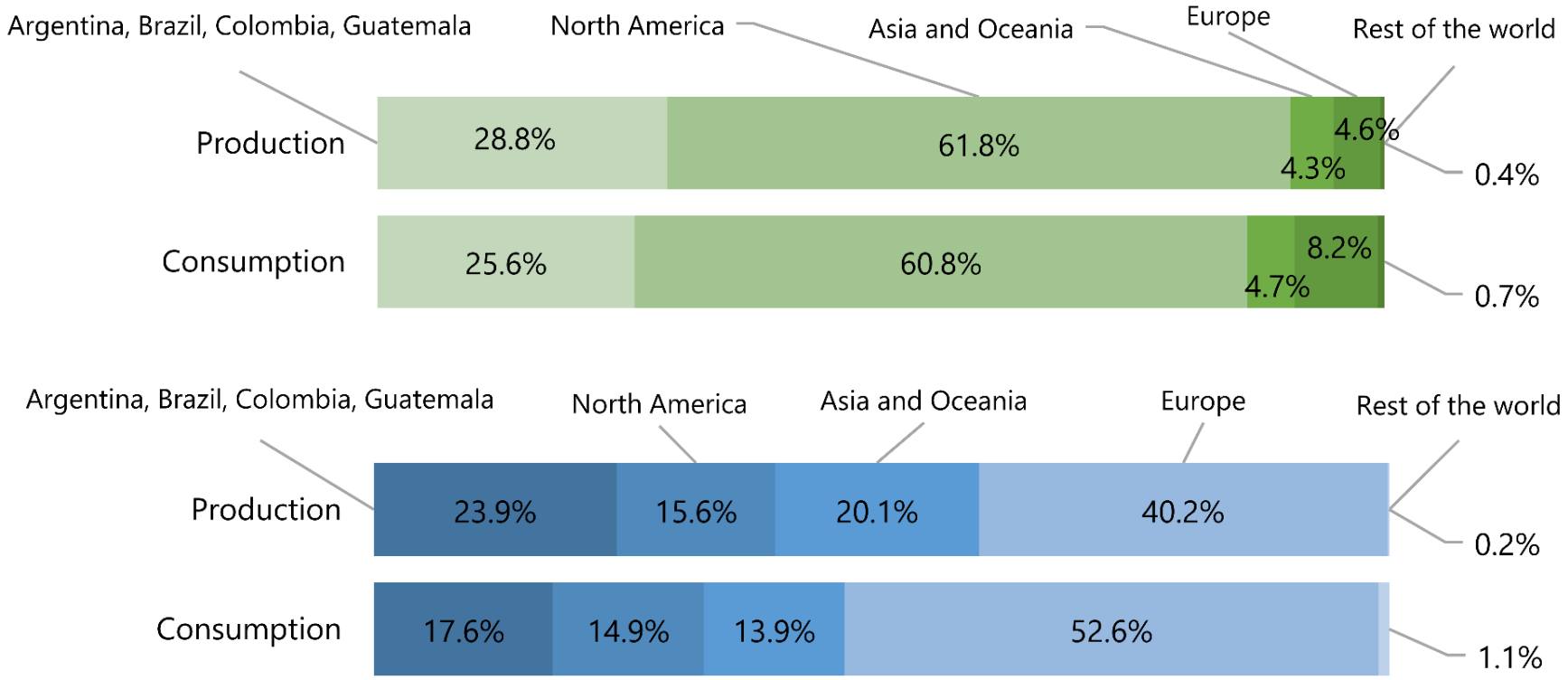
ADOPTING A LOW CARBON INTENSITY POLICY
1 ton CO2 at US$ 10 = US$ 630 million

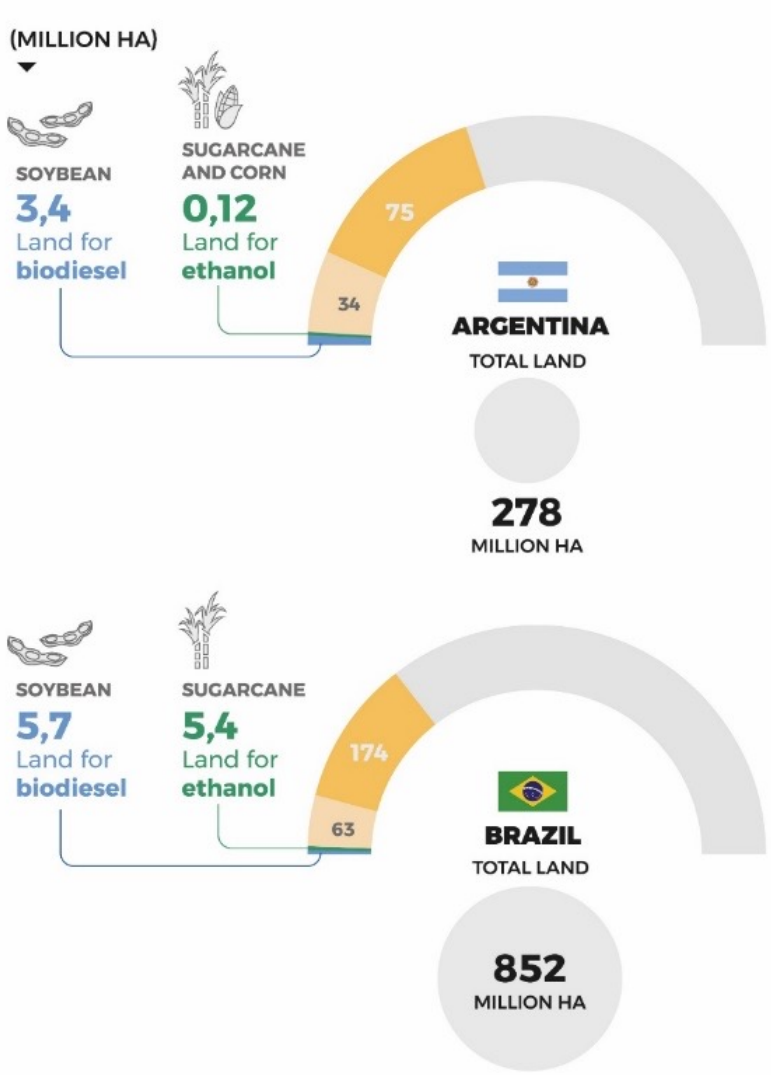
Scenarios	Annual Production (Billion L)	GHG emissions ethanol (Gg CO_2 eq)	GHG emissions Gasoline[2] (Gg CO_2 eq)	Emissions avoided by replacing gasoline by ethanol (CBIO)[3]		Value of CBIOs issued (Million US$)[4]
				(%)	Million tons CO_2eq	
Argentina[1]	1.07	910	1989	54	1.0	10.8
Brazil	35.3	20961	65427	67	44.2	442.8
Colombia	0.45	210	834	74	0.6	6.2
Guatemala	0.27	0	499	0	0	0

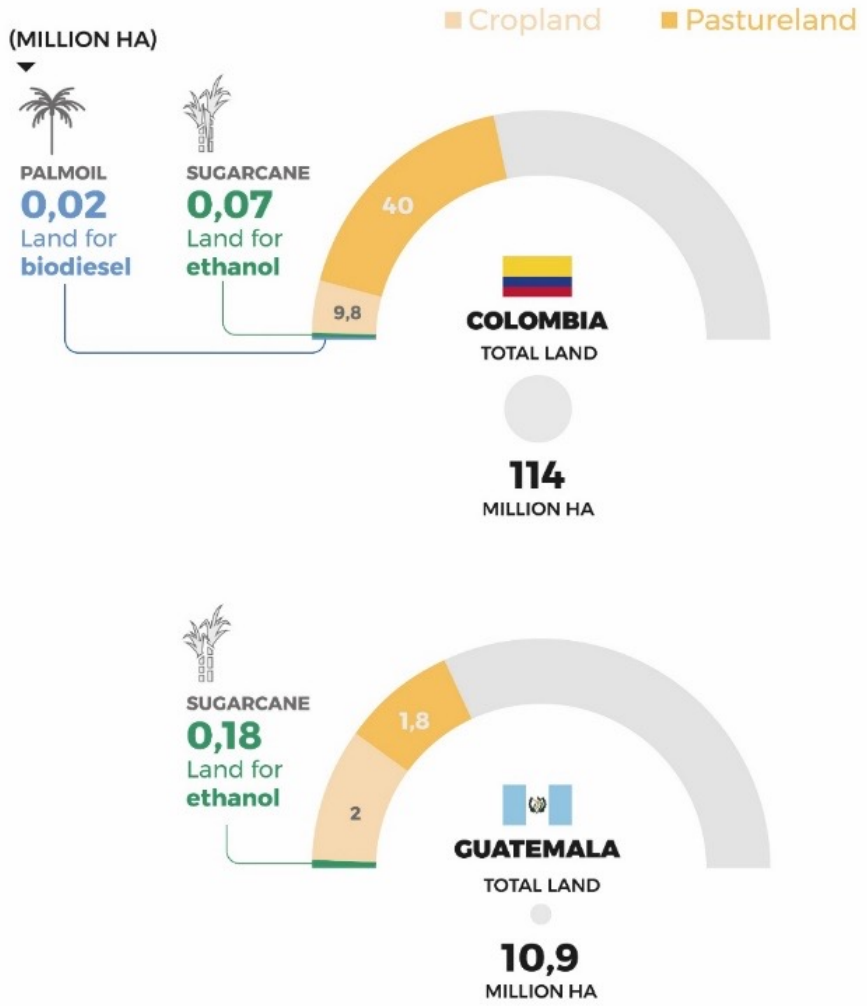
Scenarios	Annual Production (Billion L)	GHG emissions Biodiesel (Gg CO_2 eq)	GHG emissions Diesel[1] (Gg CO_2 eq)	Emissions avoided by replacing diesel by biodiesel[2]		Value of CBIOs issued (Million US$)[3]
				(%)	Million tons CO_2eq	
Argentina	2.4	1284	6013	79	4.7	47.3
Brazil	5.9	5483	16508	68	11	110.2
Colombia	0.6	283	1706	84	1.4	14.2

What is the potential for expansion and is it sustainable?

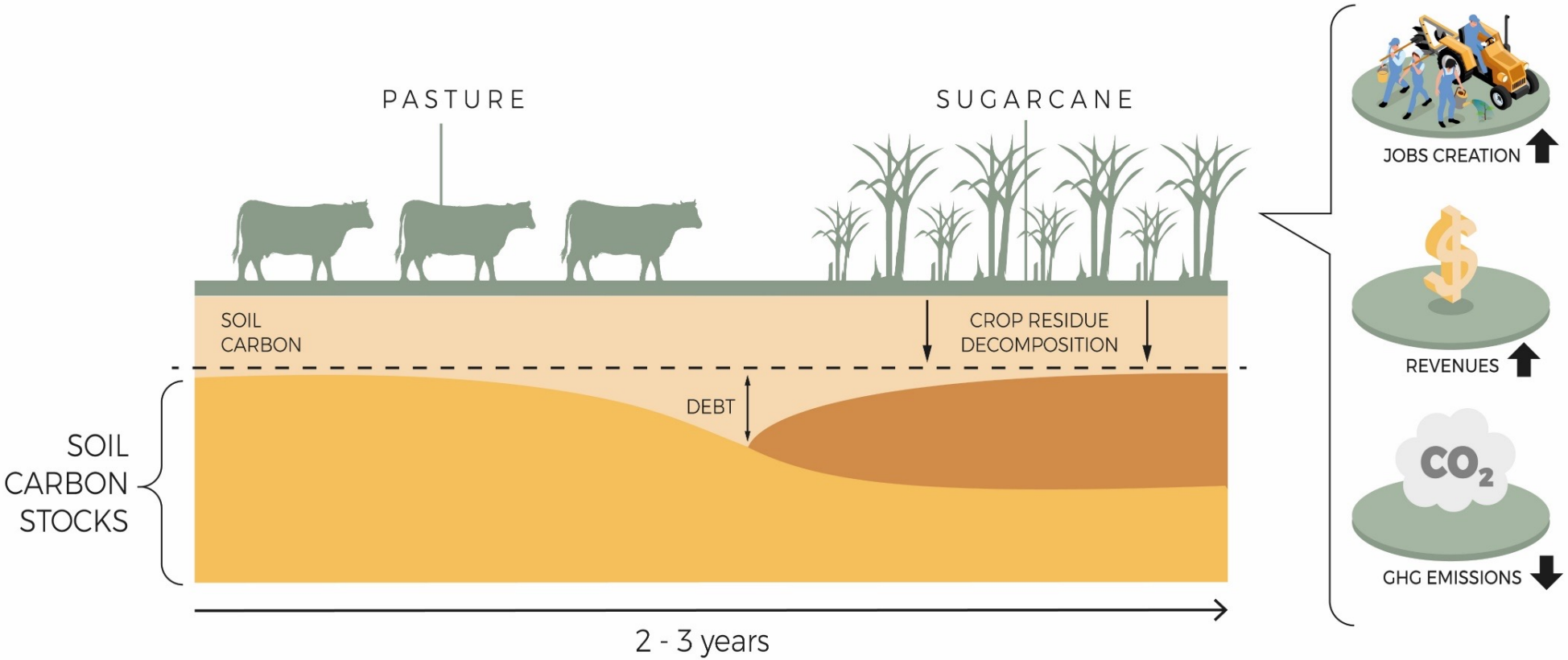
Argentina, Brazil, Colombia and Guatemala provide 29% of the global ethanol and 24% of biodiesel




(MILLION HA)
SOYBEAN
3,4
Land for
biodiesel
SUGARCANE
AND CORN
0,12
Land for
ethanol
75
34
ARGENTINA
TOTAL LAND
278
MILLION HA
SOYBEAN
5,7
Land for
biodiesel
SUGARCANE
5,4
Land for
ethanol
174
63
BRAZIL
TOTAL LAND
852
MILLION HA


Cropland
Pastureland
(MILLION HA)
PALMOIL
0,02
Land for
biodiesel
SUGARCANE
0,07
Land for
ethanol
40
9,8
COLOMBIA
TOTAL LAND
114
MILLION HA
SUGARCANE
0,18
Land for
ethanol
1,8
2
GUATEMALA
TOTAL LAND
10,9
MILLION HA

SOIL CARBON STOCKS



To duplicate the liquid biofuels Production...

Argentina → 4.5% of Pastureland

Brazil → 6.4% of Pastureland

Colombia → 0.2% of Pastureland

Guatemala → **10%** of Pastureland (only ethanol)

Cherubin et al., 2022

Table 2. Current sugarcane production and in 1% of the pasture land in selected countries of Latin America and Southern Africa.

Country	1% of pasture area (1000 ha)[a]	Sugarcane potential production (1000 t)[b]	GHG emission annually mitigated (Mt CO2/year)[c]
Latin America and the Caribbean			
Argentina	1085	86,800	9.90
Bolivia	330	26,400	3.01
Colombia	392	31,360	3.58
Costa Rica	13	1040	0.12
Cuba	28	2240	0.26
Dominican Republic	12	960	0.11
Ecuador	50	4000	0.46
El Salvador	6	480	0.05
Guatemala	20	1600	0.18
Honduras	18	1440	0.16
Mexico	2	160	0.02
Nicaragua	809	64,720	7.38
Panama	33	2640	0.30
Paraguay	15	1200	0.14
Peru	170	13,600	1.55
Venezuela	188	15,040	1.71
Subtotal	3171	253,680	28.92
Southern Africa			
Angola	571	45,696	5.21
Malawi	20	1568	0.18
Mauritius	<1	8	0.00
Mozambique	465	37,232	4.24
South Africa	888	71,016	8.10
Swaziland	11	872	0.10
Tanzania	0,3	24	0.00
Zambia	211	16,920	1.93
Zimbabwe	128	10,240	1.17
Subtotal	2295	183,576	20.93
Total	5466	437,256	49.85

Source: [a][46] for year 2015.
[b]Assuming 80 kton/ha.
[c]Assuming 0.114 t CO2eq/t cane.

Trindade et al., 2019

Thank you for your attention!

Glaucia Mendes Souza

glmsouza@iq.usp.br

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