

# The COP 21 commitments, deforestation, emissions and agricultural trade in Brazil

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# Background

- Brazil was the unique developing country to commit to **absolute reductions in** GHG emissions in the United Nations conference on Climate Change in Paris (COP21).
- Ambitious commitments, which would only be mandatory for developed countries, through a mix of targets.
- Land use change and agriculture have a central role in the Brazilian intended Nationally Determined Contribution (iNDC):
  - National Policy on Climate Change,
  - Native Forests Protection Law (the Brazilian Forest Code)
  - Law of the National System of Conservation Units (Brasil, 2015).

# The Brazilian intended Nationally determined Contribution – iNDC

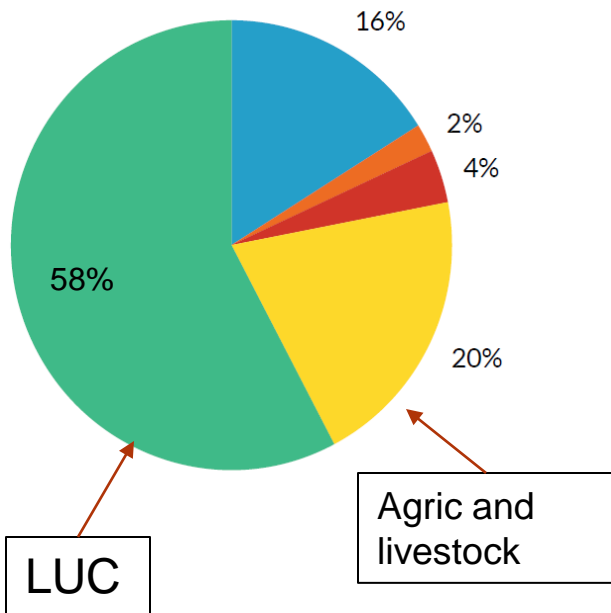
- A general reduction of 37% in GHG emissions until 2025, and of 43% until 2030, based on the 2005 emissions of 2.1 GtCO<sub>2</sub>.
- An increase to 45% of the renewable fuels share in the energy matrix until 2030, as well as other energy efficiency gains.
- The deterrence of illegal deforestation until 2030, and the restoration of 12 million hectares of forests until 2030.
- Restoration of 15 million hectares of degraded pasture until 2030.
- Other actions on agricultural lands management.

# Targets x emissions in Brazil

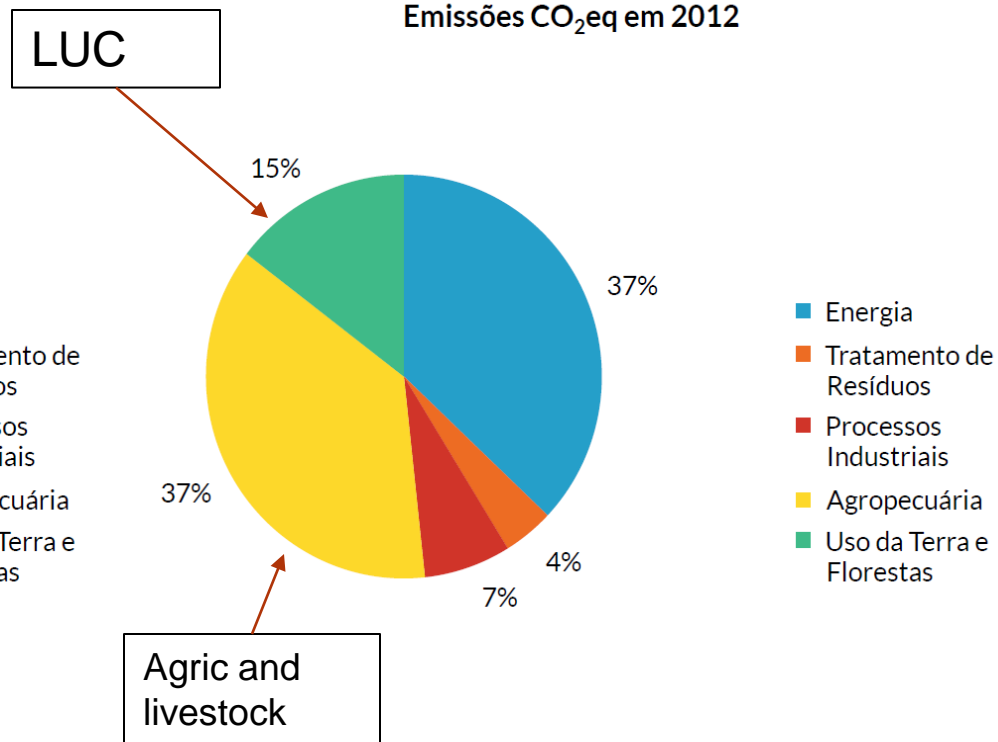
- Targets:
  - Emissions of 1.32 GtCO<sub>2</sub> eq in 2025
  - Per capita emissions: reduce from 14.4 ton CO<sub>2</sub> eq in 2004 to 6.2 ton CO<sub>2</sub> eq in 2025 and 5.4 ton CO<sub>2</sub> eq in 2030 (MCTI, 2014).
- **Enormous progress recently**: reduced emissions by 41.1% in 2012, compared to 2005:
  - Most of this reduction happened in Land Use Change and Forests (LUC, -85%)
  - **However**, agriculture (+7.4%) and energy generation (+35.9%) increased their contribution in the period

# Evolution of CO2 emissions in Brazil

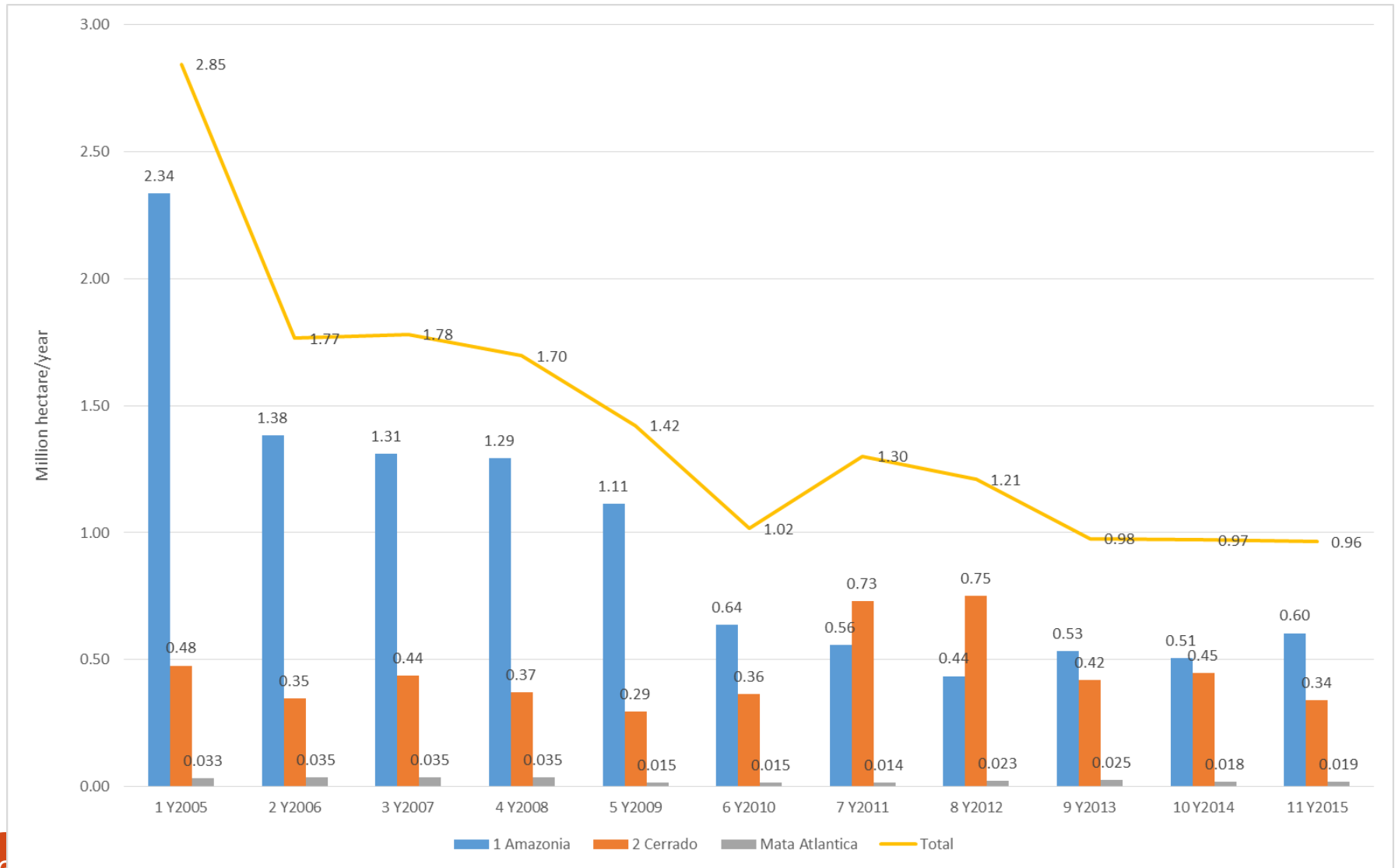
Emissões CO<sub>2</sub>eq em 2005



Emissões CO<sub>2</sub>eq em 2012



# Annual rate of deforestation (Mha/year) evolution in Brazil, by biome



# OBJECTIVE

- Evaluate Brazilian commitments do COP21, with a focus on deforestation and land use targets.
- In particular, we are interested in the trade-off between deforestation in the Amazonia x Cerrado biomes.
- Impacts:
  - External trade.
  - Distributional issues, inter-regional and inter-households.
- Contribution to the literature: new information on deforestation by biome from satellite imagery (IMAFLORA, 2017).

# Methodology: CGE model calibrated for year 2005

- Annual recursive dynamic, inter-regional, bottom-up:
  - Stock-flow relation between investment and capital stock, which assumes a 1-year gestation lag;
  - Positive relation between investment and the rate of profit;
  - Relation between wage growth and regional labor supply.
- 15 aggregated regions inside Brazil (bottom-up)
- 38 production sectors.
- 10 types of workers (wage classes)
- 10 household types (income classes)
- ILUC module: tracks land use change by state and by biome (TRANSITION MATRIX).



## Transition matrix on land use change: 1994-2002 (Agricultural Censuses)

<i>São Paulo</i>	Crop	Pasture	PlantForest	Unused	Total 1994
Crop	5.4	0.0	0.0	0.4	5.8
Pasture	1.4	6.8	0.0	0.9	9.1
PlantForest	0.0	0.1	0.3	0.1	0.6
Unused	0.0	0.0	0.0	9.3	9.3
Total 2002	6.8	6.9	0.4	10.7	24.8

<i>Mato Grosso</i>	Crop	Pasture	PlantForest	Unused	Total 1994
Crop	3.5	0.0	0.0	0.0	3.5
Pasture	3.7	17.7	0.0	0.0	21.5
PlantForest	0.0	0.1	0.0	0.0	0.1
Unused	0.8	4.0	0.1	60.4	65.3
Total 2002	8.0	21.8	0.1	60.4	90.3

The transition matrix shows Markov probabilities that a particular hectare of land used in one year for some use would be in another use next period.

# Natural forests: 6 biomes

Amazonia

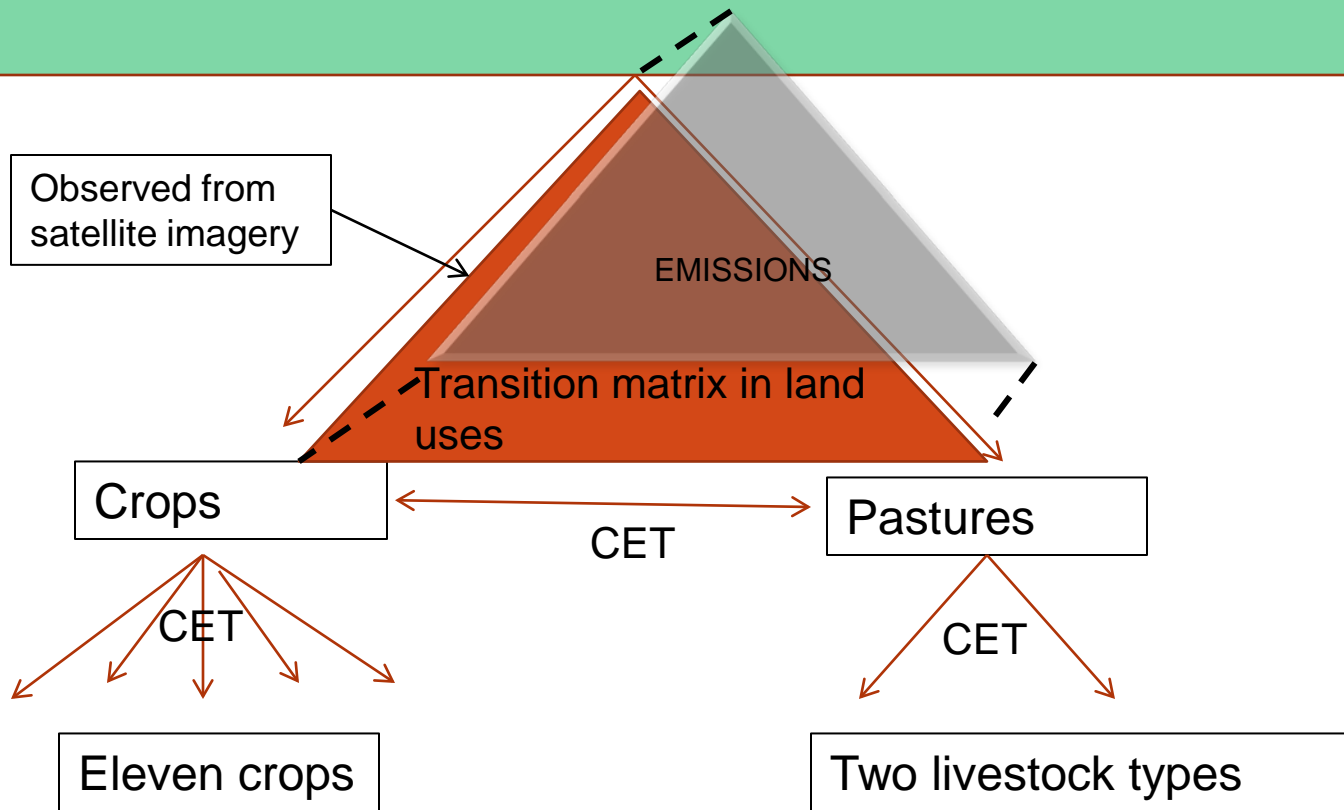
Cerrado

Caatinga

Atl. Forest

Pampa

Pantanal



Transition matrix:

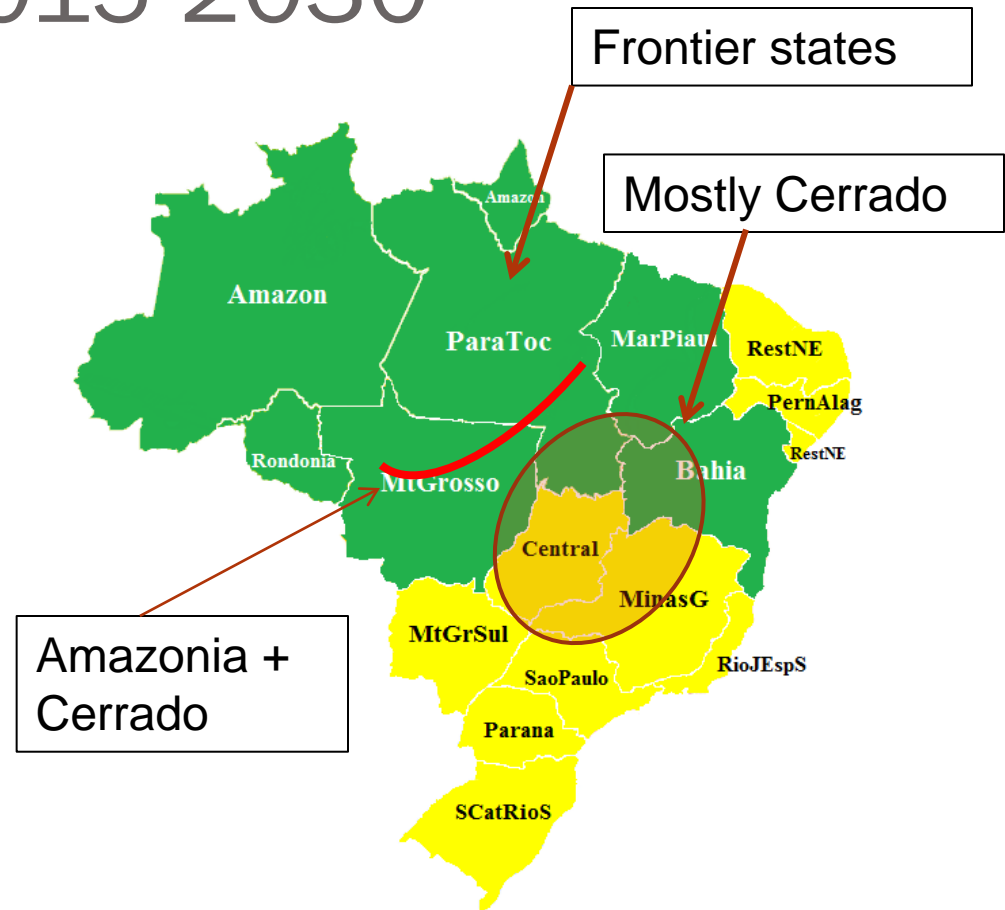
Summary of many different factors affecting deforestation.

Drives land use between years

PRIORS: Natural forest->pastures->crops

# Simulation: 2015-2030

- Baseline assumption: deforestation occurs only in states with natural land stocks (frontier states).
- Simulations: reforestation occurs in every state, according to the respective environmental debt.
- Afforestation occur in pasture areas.



# Model baseline

- BASELINE:
  - The first step: update the model's database to year 2015 through historical simulation.
  - 2016 on: 2.5% per year GDP increase until 2030
  - Annual deforestation around 0.9 Mha: 0.5 Mha in Amazonia and 0.4 Mha in Cerrado (observed trends), 0.02 Mha in Mata Atlantica:
    - Only legal deforestation
    - In each state and biome, deforestation progresses until legal stock depletion.
  - Official estimates of regional population growth rates.

# Policy simulations

		INDC targets	
	SCEN1	SCEN2	SCEN3
Actions	The deterrence of illegal deforestation until 2030	SCEN1 + land restoration (Forest Code: all APP + 50% of LR)	Exchange of deforestation in Amazonia for Cerrado
Area to be recovered (loss in pasture area)	2.25 Mha	12.3 Mha	7.3 Mha spared in Amazonia, and deforested in Cerrado

ASSUMPTION: all land restoration will occur on pasture area (Soares-Filho et al, 2014).

# Results: Percent variation from baseline, accumulated in 2030

<b>National results</b>	SIM1	SIM2	SIM3
Real Household consumption	-0.09	-0.94	-0.04
Export Volume (index)	0.27	2.26	0.17
Real GDP	-0.11	-0.99	-0.05
Aggregate employment	0	0	0
Real wage	-0.21	-2.02	-0.11

Real GDP (regional)	SIM1	SIM2	SIM3
1 Rondonia	-1.49	-2.90	-3.42
2 Acre	-1.33	-1.38	-4.38
3 Amazonas	-0.16	-0.35	-0.41
4 Roraima	-0.41	-0.70	-1.22
5 Para	-0.52	-1.07	-1.93
6 Amapa	-0.16	-0.80	-0.15
7 Matopiba	-0.11	-0.93	0.61
8 PernAlag	-0.07	-0.79	-0.02
9 RestNE	-0.07	-0.80	-0.03
10 MinasG	-0.06	-1.18	0.12
11 SaoPaulo	-0.07	-0.67	-0.05
12 RestSE	-0.04	-0.34	-0.02
13 Sul	-0.11	-1.51	-0.08
14 MtGrSul	-0.16	-1.66	0.09
15 MtGrosso	-0.38	-2.81	-0.44
16 GoiasDF	-0.15	-1.65	0.08

# Model results. Emissions, percent variation from baseline, accumulated in 2025 and 2030.

GtonCO2eq	BASE (2005)	SCEN1 (no ilegal)		SCEN2 (no ilegal + restoration)		SCEN3 (Exchange Amazon by Cerrado)	
		2025	2030	2025	2030	2025	2030
General	0.79	1.30	1.38	1.28	1.34	1.30	1.38
LUC	1.33	0.17	0.15	0.02	-0.01	0.17	1.54
Total	2.12	1.46	1.53	1.29	1.32	1.46	2.92
Var % rel 2005 (TOTAL)		-30.9	-28.0	-38.9	-37.6	30.9	-27.3
iNDC target 2025		-37	-43	-37	-43	-37	-43

Exchanging of deforestation in Amazonia for Cerrados would be disastrous for the iNDC targets

# Production and exports selected agricultural commodities

		CEN1		CEN2		CEN3	
	Export share	Production	Exports	Production	Exports	Production	Exports
Corn	0.03	-0.27	1.15	-2.28	12.71	-0.17	0.86
Soybean	0.41	0.24	0.60	2.09	5.51	0.18	0.39
Coffee	0.62	0.20	0.54	1.89	5.38	0.03	0.16
Livestock	0.01	-1.24	-14.10	-10.39	-60.67	-0.69	-16.54
Meats	0.25	-0.51	-1.12	-5.44	-12.33	-0.24	-0.57
Edible oils	0.18	-0.75	-1.42	-7.50	-15.08	-0.39	-0.73
Sugar	0.33	-0.74	-1.14	-7.62	-11.71	-0.30	-0.47
Processed coffee	0.12	-0.24	-1.82	-2.44	-18.58	-0.10	-0.77
Other food	0.07	-0.32	-0.72	-3.30	-8.09	-0.14	-0.30
Textile and apparel	0.11	0.11	1.43	1.35	15.49	0.04	0.69
Cellulose and paper	0.10	0.21	0.64	2.09	6.24	0.13	0.37

GDP reduction, loss in terms of trade, Exchange rate devaluation. Primary agricultural exports expands, processed ag commodities falls.



# Real wages and Real household expenditures

	Real wages			Poorest	Real expenditures			
	SCEN1	SCEN2	SCEN3		SCEN1	SCEN2	SCEN3	
1 OCC1	-0.41	-3.49	0.25		1 POF1	-0.28	-2.49	0.14
2 OCC2	-0.43	-3.45	0.06		2 POF2	-0.25	-2.33	-0.02
3 OCC3	-0.30	-2.67	-0.11		3 POF3	-0.21	-2.04	-0.11
4 OCC4	-0.26	-2.78	-0.01		4 POF4	-0.18	-1.82	-0.07
5 OCC5	-0.31	-2.73	-0.23		5 POF5	-0.14	-1.40	-0.10
6 OCC6	-0.28	-2.60	-0.17		6 POF6	-0.11	-1.13	-0.08
7 OCC7	-0.26	-2.44	-0.14		7 POF7	-0.07	-0.75	-0.05
8 OCC8	-0.25	-2.35	-0.18		8 POF8	-0.05	-0.42	-0.06
9 OCC9	-0.20	-1.82	-0.12		9 POF9	-0.02	-0.19	-0.03
10 OCC10	-0.19	-1.80	-0.11		Richest	0.00	-0.07	-0.01
					POF10			

# Final remarks

- The LUC targets in Brazilian INDC would be enough to meet emissions targets in 2025, but not in 2030.
- But this relies crucially on the afforestation of 12.3 Mha of forests (Forest Code): very uncertain prospect.
- If this is not met, considerable adjustment would be necessary beyond the gains in LUC.
- But...Energy supply expansion in Brazil since 2005 actually increased the share of non-renewable fuels in total, from 55.9% in 2005 to 60.6% in 2014.

# Final remarks

- Increase of agricultural primary products in total exports, and a decrease in agricultural processed products.
- Other manufactures, however, would also benefit from the policy, due to the accompanying exchange rate devaluation.
- Fall in the real wages, as well as in real household consumption, which would be concentrated in the poorest.
- Compensatory policies?

- Thank you.

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# Final remarks and warning

- The Brazilian Third Communication updated emissions estimates in 2005 from 2.1 MtCO<sub>2</sub>eq (our reference) to 2.73 MtCO<sub>2</sub>eq.
- With this, the iNDC 37% reduction in 2025 would imply an emissions level of 1.7 MtCO<sub>2</sub> eq, above the level obtained in the baseline.
- Without a revision of the absolute targets, the commitments represent an increase, instead of a decrease, of emissions in Brazil.