

# **DDP** BIICS

## **IMAGINE - Brazil**

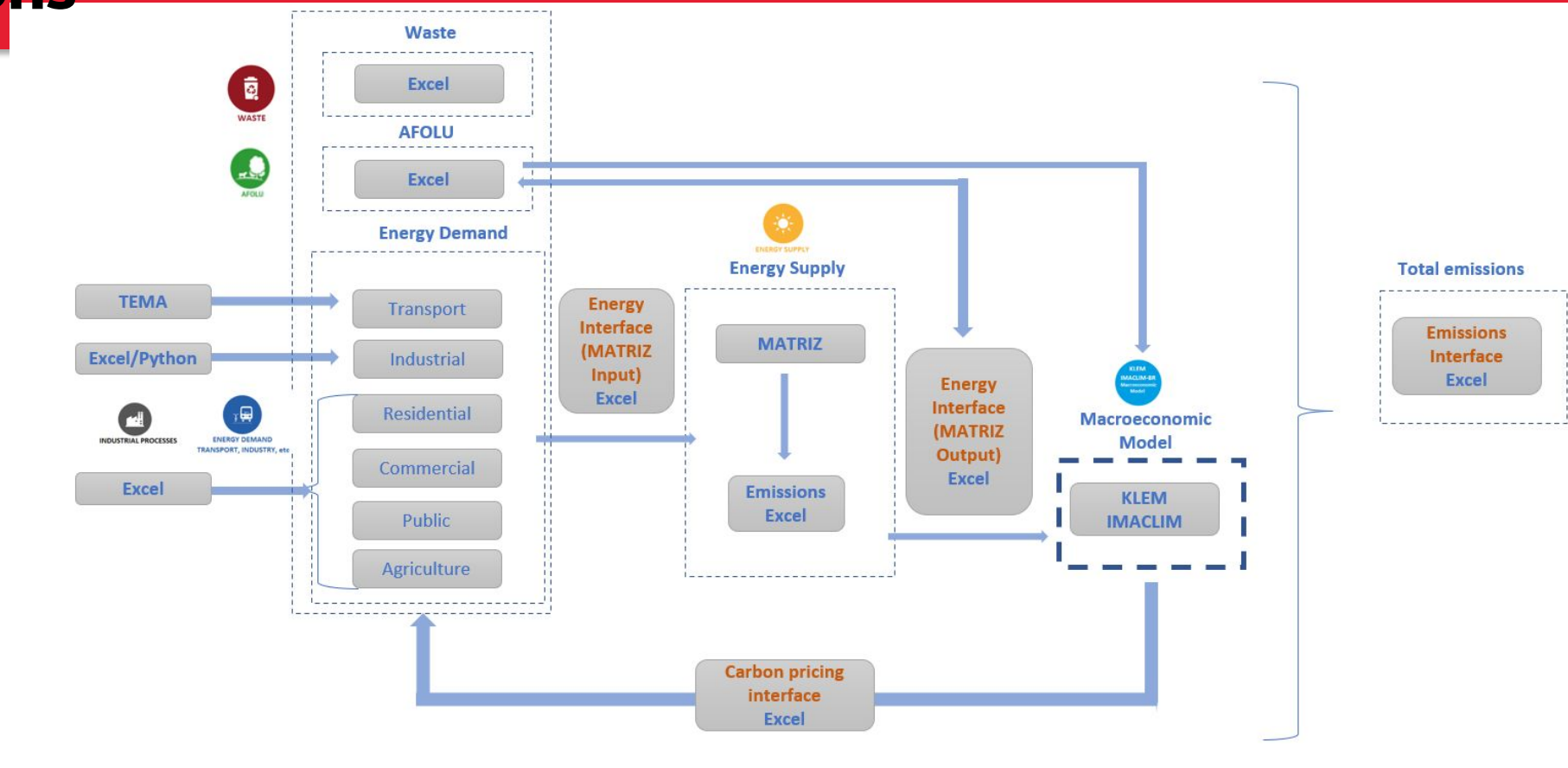
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**Prof. Emilio Lèbre La Rovere**  
**Centro Clima / COPPE / UFRJ**

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- **Objective:** Contribution to new (more ambitious) Brazilian NDCs and to the preparation of a LTS (LEDS).
- **Background:** bottom-up sectorial modelling of emission scenarios from 1991 to 2011 (based upon energy scenarios since the 70's).
- New generation of IES Brasil studies (Economic and social implications of low-carbon scenarios in Brazil) = **DDPP1, IES Brasil 2030, DDPP2, IES Brasil 2050, Brasil Zero Carbon in 2060, ICAT, PMR Brasil, DDP-BIICS, IMAGINE** made possible by:
  - ✓ - the development of a **CGE model** in 2011-2015, **IMACLIM-BR** (adapted from **CIREN's IMACLIM**) -> modelling framework integrating bottom-up sectorial models & a CGE model;
  - ✓ - use a stakeholders' driven approach through the convening of a **Scenario Building Team** gathering experts from the government, business sector, NGOs, academy, trade unions, to select pertinent scenario assumptions, mitigation actions and costs, validate the results, identify decarbonization barriers and suggest instruments to overcome them.
- **IMAGINE Project:** Update of DDP-BIICS 2050 after economic recession and COVID-19:
  - ✓ **NGPS 1** – New Government Policy Scenario 1 - NGPS1\_Brazil (limited success in halting deforestation). It does not meet NDC targets by 2025 (1.32 Gt CO<sub>2</sub>e) and by 2030 (1.2 Gt CO<sub>2</sub>e) with no further ambition (ongoing policies) up to 2050;
  - ✓ **NGPS 2** – New Government Policy Scenario 2 - NGPS2\_Brazil (= NGPS1 but with success in halting deforestation). It nearly meets the 2025 NDC target and meets the 2030 target;
  - ✓ **DDS** – Deep Decarbonization Scenario with additional actions getting to net zero GHG emissions by 2050, using available technologies only (no CCS, just EOR; increasing share of oil&gas production to exports, average oil price of 66.7 US\$/bbl in 2025-2050).

# Modelling architecture of Brazilian economy and GHG emissions



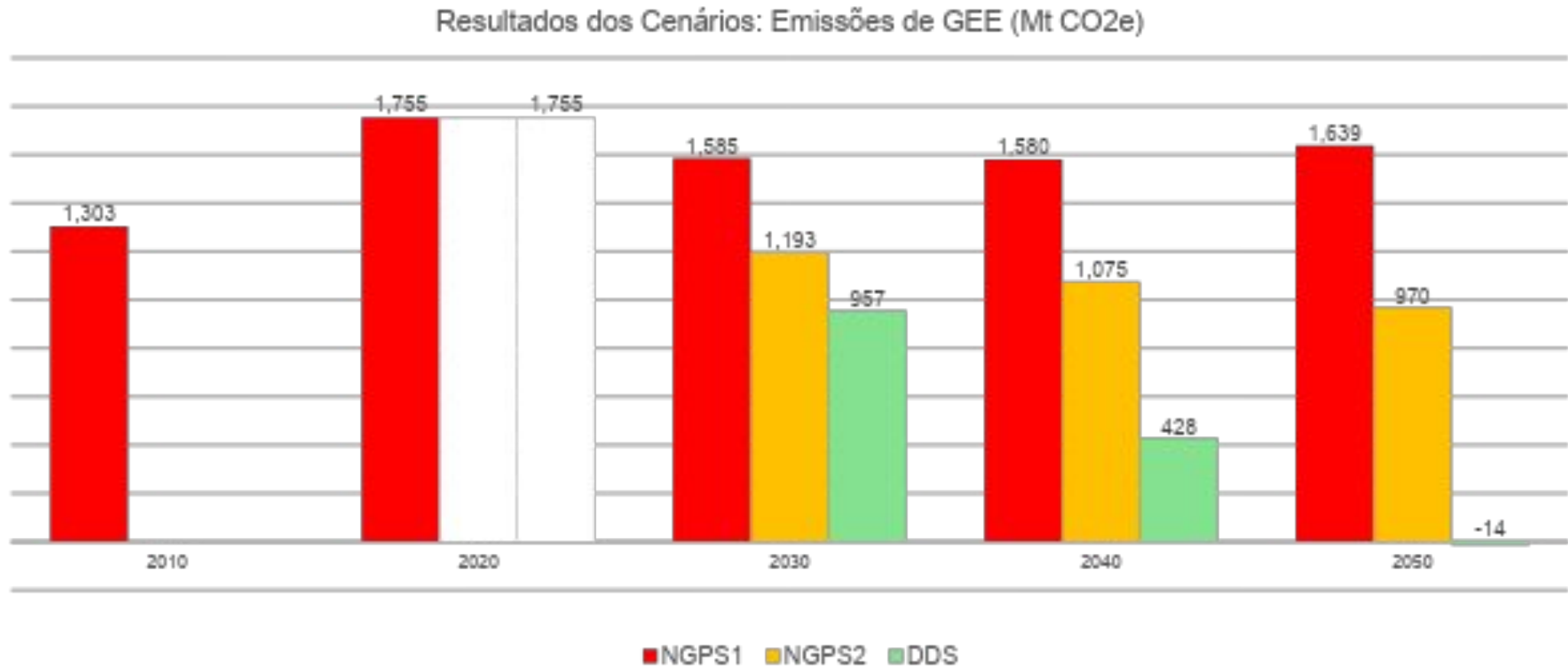
Source: Adapted from

Wills, W., La Rovere, E.L., Groterra, C., Napolini, G.F., Le Treut, G., Gherzi, F., Lefevre, J., Dubeux, C.B.S., 2021. Economic and social effectiveness of carbon pricing schemes to meet Brazilian NDC targets.

Climate Policy, 2021, 22(1), pp. 48–63. <https://doi.org/10.1080/14693062.2021.1981212>

- Curbing down annual deforestation rates from 2020 to 2050 across all Brazilian biomes (and especially in the Amazon and “Cerrado” – the savannah plains in Central Brazil), and maintenance of low deforestation rates after 2050.
- The increase of protected areas (Conservation Units and Indigenous Lands), the restoration of native forest (private and public areas) and forestry are the main potential carbon sinks in Brazil. Along with reducing deforestation, Nature Based Solutions - NBS are responsible for most of the mitigation in the DDS, allowing to compensate for a substantial share of other sectors’ GHG emissions.
- Setting a price on emissions from all sectors but agriculture, LULUCF and waste, applied through a cap-and-trade scheme; it starts with 2 USD/tCO<sub>2</sub>e in 2030; 31 USD/tCO<sub>2</sub>e in 2040 and 44 USD/tCO<sub>2</sub>e in 2050; allowing the use of a limited amount of forest offsets in cap-and-trade systems; using most of the carbon tax proceeds to incentive employment and a small share to compensate low-income households.
- Improvement of quality of life of the vast majority of the population thanks to the co-benefits of DDS: ecosystem services, lower air pollution in cities, better sanitation infrastructure, etc.

# Total GHG Emissions in Brazil, 2010-2050, NGPS1, NGPS2 & DDS (in MtCO<sub>2</sub>eq)



# CO<sub>2</sub> and non-CO<sub>2</sub> Emissions in Brazil, 2010-2050, NGPS1, NGPS2 & DDS (in MtCO<sub>2</sub>eq)

Mt CO <sub>2</sub> eq	2010	2020	2025 (a)	2030	2035 (b)	2040	2050
NGPS1 CO <sub>2</sub>	691	1.112	981	850	816	781	737
NGPS1 non-CO <sub>2</sub>	612	644	689	734	766	798	902
NGPS1 GHG Total	1.303	1.755	1.670	1.584	1.582	1.580	1.639
NGPS2 CO <sub>2</sub>	691	1.112	785	458	367	276	68
NGPS2 non-CO <sub>2</sub>	612	644	689	735	767	798	902
NGPS2 GHG Total	1.303	1.755	1.474	1.193	1.134	1.075	970
DDS CO <sub>2</sub>		1.112	697	283	18 -	246 -	657
DDS non-CO <sub>2</sub>		644	659	675	674	674	644
DDS GHG Total		1.755	1.356	957	692	428 -	14

(a) Interpolation between 2020 and 2030

(b) Interpolation between 2030 and 2040

# Emissions in Brazil, 2010-2050, NGPS1, NGPS2 & DDS (in Mt CO<sub>2</sub>eq)

Mt CO <sub>2</sub> eq	2005 (a)	2010 (b)	2020 (b)	2025 (c)	2030	2035 (d)	2040	2050	2050-2020
<b>LULUCF</b>									
NGPS1	1,580	246	637	478	319	268	216	104	-84%
NGPS2				282	73	181	289	565	-189%
DDS				230	177	434	690	1,085	-270%
<b>Agriculture</b>									
NGPS1	520	550	562	596	630	650	670	743	32%
NGPS2				580	598	606	615	603	7%
DDS									
<b>Transport</b>									
NGPS1	139	173	184	196	209	213	217	232	26%
NGPS2				174	164	152	140	110	-40%
DDS									
<b>Industry</b>									
NGPS1	141	157	158	172	186	205	225	267	69%
NGPS2				168	178	186	195	213	35%
DDS									
<b>Energy supply and other energy demand</b>									
NGPS1	115	108	118	122	125	118	111	127	7%
NGPS2				107	96	87	78	60	-49%
DDS									
<b>Waste</b>									
NGPS1	67	69	96	106	116	128	140	167	75%
NGPS2				97	99	95	91	85	-11%
DDS									
<b>Total</b>									
NGPS1	2,562	1,303	1,755	1,670	1,584	1,582	1,580	1,639	-7%
NGPS2				1,474	1,193	1,134	1,075	970	-45%
DDS				1,356	957	692	428	- 14	-101%
NDC absolute targets (Gt CO <sub>2</sub> eq)				1.32	1.2			0.0	
NDC % reduction of 2005				-48.4%	-53.1%				

- (a) Original data from the 4th National Communication
- (b) Data from the 4<sup>th</sup> National Communication adjusted for new population of recent census and 2023 energy balance
- (c) Interpolation between 2020 and 2030
- (d) Interpolation between 2030 and 2040

## Main synergies and trade-offs with country non-climate objectives

Scenario	2015	2020	NGPS (2030)	NGPS (2050)	DDS (2030)	DDS (2050)
Population	191	201	213	219	213	219
GDP (Billion 2015 USD)	1,896	1,891	2,454	3,636	2,481	3,691
GDP variation in relation to NGPS	-	-	-	-	1,1%	1,5%
GDP per capita (Thousand 2015 USD)	9.94	9.41	11.52	16.60	11.65	16.85
Trade Balance (% of GDP)	-0.4%	-0.2%	-0.8%	1.2%	0.2%	-0.1%
Unemployment rate (%)	9.5%	8.1%	7.4%	8.1%	6.9%	7.2%
Price index in relation to NGPS (NGPS=1)	-	-	-	-	1.03	1.07
Disposable income_HH1 (2015=1) (poorest 20% of households)	<b>1.00</b>	<b>1.03</b>	<b>1.40</b>	<b>2.26</b>	<b>1.44</b>	<b>2.44</b>
Disposable income_HH2 (2015=1) (40% of households)	1.00	1.04	1.38	2.13	1.42	2.23
Disposable income_HH3 (2015=1) (30% of households)	1.00	1.01	1.27	1.87	1.29	1.92
Disposable income_HH4 (2015=1) (richest 10% of households)	1.00	1.00	1.29	1.90	1.31	1.95



## Priority short-term policies and actions

- Resuming policies successfully adopted in the recent past (2004-2012) to sharply reduce annual deforestation rates: both command-and-control and economic instruments.
- Developing smart financial mechanisms to foster the funding of investments in mitigation actions, and mainly in forest cover restoration and low-carbon infrastructure.
- Carbon Pricing: provide a long-term, stable signal to induce economic agents to choose low-carbon technologies through a well-structured cap-and-trade scheme for Industry and a carbon tax on other regulated sectors. A significant share of avoided emissions can be obtained at negative or very low costs.
- Relying in the AFOLU sector to reduce and capture the largest share of emissions in the first half of the century to achieve net-zero target by 2050 helps to reduce overall costs for Brazil and provides sufficient time for disruptive technologies to be economically viable.
- Substantial support of Annex I countries to foster financial flows targeted at mitigation actions in non-Annex I countries, including both the climate finance tools within UNFCCC (GCF, SDM) and international financial initiatives to channel private capital to low-carbon investments: key enabler of de-risking low carbon projects

## Investments patterns for DDS pathways

□ A significant share of avoided emissions can be obtained at negative or very low costs. Costs for a given mitigation option may vary throughout the three decades due to increasing economies of scale and variations in cost assumptions (e.g., decreasing costs for electric vehicles and renewable electricity).

Additional mitigation investment in DDS compared to NGPS 1 and 2, per economic sector, per decade

Sectoral investment (2015 USD billion)	2021-2030	2031-2040	2041-2050
AFOLU	1.3	5.0	10.3
Transport	5.5	16.1	21.6
Industry	0.9	4.3	9.9
Energy Supply	0.1	0.8	1.3
<b>TOTAL</b>	<b>7.8</b>	<b>26.2</b>	<b>43.1</b>

# Key Findings, Reflections, improvements and challenges

- **Key Findings**

- DDS is just one among many pathways for Brazil to reach climate neutrality by 2050.
  - Underlying assumption: use of available technologies only; huge mitigation potential at low costs in Brazil even before the deployment of technological “*breakthroughs*”.
  - Sharp reduction of annual deforestation rate and native vegetation restoration in public and private areas have a significant abatement potential and lower costs than mitigation actions in other sectors.
  - A pathway towards net-zero GHG emissions in 2050 can be reached with a carbon price of 2, 31 and 44 USD/t CO<sub>2</sub>eq, respectively, in each decade.
  - DDS allows to reach carbon neutrality while keeping slightly better economic and social development results than in NGPS (smart recycling of carbon pricing revenues).
- From forecasting to **backcasting**: milestones for **MRV** -> embedding climate change in routine management.
  - **Modelling**: co-benefits (SDGs), climate finance (capital costs), employment & labor market.
  - **Challenges**: Zero deforestation in the Amazon and Atlantic Forest biomes and low deforestation rates in the other biomes; International oil prices; Political acceptability.