Initiative for Climate Action Transparency – ICAT –

Report with set of MRV indicators to track down the emissions pathway that is relevant to each type of state

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Deliverable #8

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Disclaimer

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1. Introduction

Centro Brasil no Clima (CBC), with technical support from Centro Clima/COPPE/UFRJ, and institutional support from the Brazilian Forum on Climate Change (FBMC), has already completed the first phase of a project establishing indicators to monitor the implementation of Brazilian NDC[1], the ICAT1 project. ICAT 2 project focuses on the MRV (measuring/monitoring, reporting, and verification) process of Brazilian NDC at the subnational level. It will be based on the key achievements and lessons learned, from a technical point of view, in the ICAT 1 project.

ICAT 1 Project had the objective to develop a methodology to estimate the effect of different sets of mitigation actions (grouped in mitigation scenarios) in terms of avoided GHG emissions to help MRV of the progress achieved in the implementation of quantified Brazilian NDC commitments. The project elaborated three indicators: absolute emission indicators, emission driver indicators, and intensity indicators.

To broaden national efforts toward achieving the NDC targets, the ICAT 2 Project will help subnational governments understand how they can contribute to achieving the NDC commitments, prioritizing actions and capacities at the state level. This new phase builds on the ICAT 1 Brazil project and will provide sets of state-level MRV indicators, promoting a sectoral mitigation approach to be implemented across the country. At the same time, the project will support stakeholders, such as the Ministry of Science, Technology, and Innovations (MCTI), local governments, and civil society, to monitor and report Brazilian emissions and mitigation efforts.

For this purpose, the project has engaged with three states as pilot cases. Rio de Janeiro, Minas Gerais, and Amazonas were selected following a kick-off workshop involving stakeholders from many states. The pilot cases aim to develop a process for estimating their potential contribution to the NDC and provide emissions indicators to monitor their emissions trajectories. In addition, it will provide the basis for expanding these analyses to other states in the future.

In this second phase, the project goal is to estimate the potential of three selected states to contribute to Brazilian NDC targets and build MRV indicators (measuring/monitoring, reporting, and verification) to follow up the progress towards this end. The project uses the scenario-building methodology. This tool helps to map possible pathways into different plausible futures. A scenario is a set of hypothetical events for the future constructed to clarify a possible chain of causal events and their decision points (Kahn & Wiener, 1967). They are not predictions but rather similar to simulations of some possible futures. They are possible future stories, an alternative future resulting from a combination of trends and policies. For example, the development of scenarios allows new insights into the opportunities and risks involved in making decisions about climate change policies that would have significant consequences for developing a region over the next few decades.

The first step (Output 3) assessed historical sectoral GHG emissions of Rio de Janeiro, Minas Gerais, and Amazonas states.

Output 5 assessed the current emissions trends from these states up to 2030 (Reference Case Scenario) and evaluated their contribution to the Brazilian NDC targets. Based on preliminary

[1] Indicators for Progress Monitoring in the Achievement of NDC Targets in Brazil, ICAT/Centro Clima/CBC (2019).

results of an undergoing study(DDP-BIICS project), the assessment was based on information provided by the state administrations and GHG emissions projections for Brazil up to 2050.

The Reference Scenario considers the pre-NDC Brazilian commitments to the UNFCCC and the current mitigation actions supporting the achievement of NDC targets. This assessment allows a more realistic assumption of a baseline for 2025 and 2030 and the actual effort needed to meet NDC targets.

The Mitigation Scenario (Output 6) assesses the mitigation actions that could be implemented in the three selected states to increase mitigation levels and their potential contribution to meet Brazilian NDC targets. The quantified mitigation actions are grouped in a mitigation scenario with emissions estimated up to 2030. The report accounts for GHG emissions from the three states in the following sectors: AFOLU, Transport, Industry, Other Sectors of Energy Use, Energy Supply, and Waste.

This report includes MRV indicators (Output 7) to track down the GHG emissions pathways relevant to each state and consistent with the national indicators proposed in Phase 1 of the ICAT Project in Brazil. Historical indicators were elicited from data obtained in the inventory reports carried out by the states themselves in the case of Rio de Janeiro and Minas Gerais and SEEG (Greenhouse Gas Emissions Estimation System) for the State of Amazonas. In some exceptions, we used data from public databases, like the Brazilian Statistic Agency (IBGE) or the SEEG. Furthermore, the projected indicators use the emissions values calculated on reference and mitigation scenarios.

The effect of mitigation actions translates into the level of GHG emissions in each sector. Therefore, monitoring these indicators will assess the progress made in each sector for achieving the NDC targets.

2. General Assumptions

Initiatives at the subnational government level still lack a monitoring system to track the pathways of multiple mitigation actions either in a reference case or in a more ambitious mitigation scenario. Therefore, this project developed a methodology to calculate the effect of different sets of mitigation actions in distinct levels of penetration (according to each scenario) to help MRV (measuring/monitoring, reporting, and verification) the implementation progress of quantified mitigation actions in each selected state to contribute to the achievement of Brazilian NDC targets.

The state inventory reports carried out by Rio de Janeiro and Minas Gerais provided the historical sectoral GHG emissions information required as the basis for the estimates. For the Amazonas states, the values come from the SEEG (Greenhouse Gas Emissions Estimation System) database. Historical data for Rio de Janeiro covers 2005-2015, Minas Gerais 2005-2014, and Amazonas 2005-2018.

The reference scenario assesses the current emissions trends from these states up to 2030, and it considers the pre-NDC Brazilian commitments to the UNFCCC and the current mitigation actions. Besides the historical emissions data, the assessment made use of the emissions growth rates of each economic sector in Brazil modeled in both the ICAT 1 project, for 2015 - 2018 (MG and RJ) and in the DDP-BIICS project, for 2019 until 2050 (more methodological information and assumptions on Output 5). The scenario already considers the economic impacts of the Brazilian most severe recession in history, as the substantial GDP decline from 2015 to 2020 due to a political-economic crisis and the COVID-19 pandemic.

The Mitigation Scenario considers the mitigation actions that could be implemented in the three selected states to increase their mitigation levels. The projections for the Mitigation Scenarios were calculated based on the percentage change in emissions from Scenario C to Scenario A (policy scenario) in the ICAT 1 project. The percentage was applied to the ICAT 2 Reference Scenario to estimate the Mitigation Scenario values for each state. The quantified mitigation actions are grouped in the Mitigation Scenario, with emissions estimated up to 2030 (more methodological information and assumptions in Output 6). The sectoral structure for estimating GHG emissions and removals and the subsectors and categories followed the 2006 IPCC guidelines. It has been rearranged to reflect the structure of Brazil's economic sectors, considering the availability of data from each state inventory (see Output 6).

The MRV (measuring, reporting, and verification) indicators framework for monitoring NDC targets at the state level in this project was drawn up from these scenarios and comprehends absolute GHG emission and intensity indicators. They are tools to track the evolution of emissions over time. The follow-up of this set of emissions indicators will allow the state planner to check where (in which sectors and subsectors) additional mitigation actions are needed to contribute to the country to meet NDC targets. The indicators reveal sectors and subsectors that need attention and, consequently, a review of plans and programs to reduce sectoral and subsectoral emissions to expected levels.

The Reference and Mitigation GHG emissions scenarios are based on the same economic scenario for Brazil up to 2030 as in the DDPBIICS project (more methodological information and assumptions in outputs 5 and 6). In addition, some quantitative assumptions about demographic growth, state GDP growth rates, among other parameters, use data from Fundação João Pinheiro (FJP, 2021) in the case of Minas Gerais, CEPERJ (2021) in Rio de Janeiro, and Instituto Brasileiro de Geografia e Estatística (IBGE, 2020) in the three selected states.

Table 1 is a board panel to track the achievement of NDC Targets; the main emission indicators framework is presented in this synthesis of MRV Indicators:

Table 1. Main emission indicators framework

<table>
<tr><th colspan="2">AFOLU</th><th>Transportation</th><th colspan="3">Industry</th><th colspan="2">Energy Supply</th><th colspan="2">Waste</th></tr>
<tr><th>LULUCF</th><th>Agriculture</th><th>Road</th><th>Energy + IPPU</th><th>Energy</th><th>IPPU</th><th>Fuel Combustion</th><th>Fugitive Emissions</th><th>Solid Waste</th><th>Wastewater Treatment and Discharge</th></tr>
<tr><td>Gross Emissions</td><td>Livestock</td><td>Railways</td><td colspan="3">Cement</td><td>Energy Sector Consumption</td><td>E&P</td><td>Urban</td><td>Domestic</td></tr>
<tr><td>Deforestation and other land use changes</td><td>Enteric Fermentation</td><td>Airways</td><td colspan="3">Iron and steel</td><td>Power Plants</td><td>Oil Refining</td><td>Other</td><td>Industrial</td></tr>
<tr><td>Forest residues</td><td>Manure management</td><td>Waterways</td><td colspan="3">Non-Ferrous/Other Metallurgical</td><td>Other energy consumption sectors</td><td>Other</td><td></td><td>Other</td></tr>
<tr><td>Removals</td><td>Crop Systems</td><td></td><td colspan="3">Chemical</td><td>Residential</td><td></td><td></td><td></td></tr>
<tr><td>Planted Forests</td><td>Agricultural Soils</td><td></td><td colspan="2">Food and Beverage</td><td></td><td>Commercial & Public</td><td></td><td></td><td></td></tr>
<tr><td>Restoration of Native Forest</td><td>Zero Tillage</td><td></td><td colspan="2">Pulp & Paper</td><td></td><td>Agriculture</td><td></td><td></td><td></td></tr>
<tr><td>Recovery of Degraded Pasturelands</td><td>Carbon in Soil</td><td></td><td>HFCs</td><td></td><td>HFCs</td><td>Other</td><td></td><td></td><td></td></tr>
<tr><td>Livestock-Forest Systems</td><td>Other</td><td></td><td colspan="3">Other</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Protected Areas and Indigenous Lands</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Secondary forests</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Other</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

3. State of Rio de Janeiro

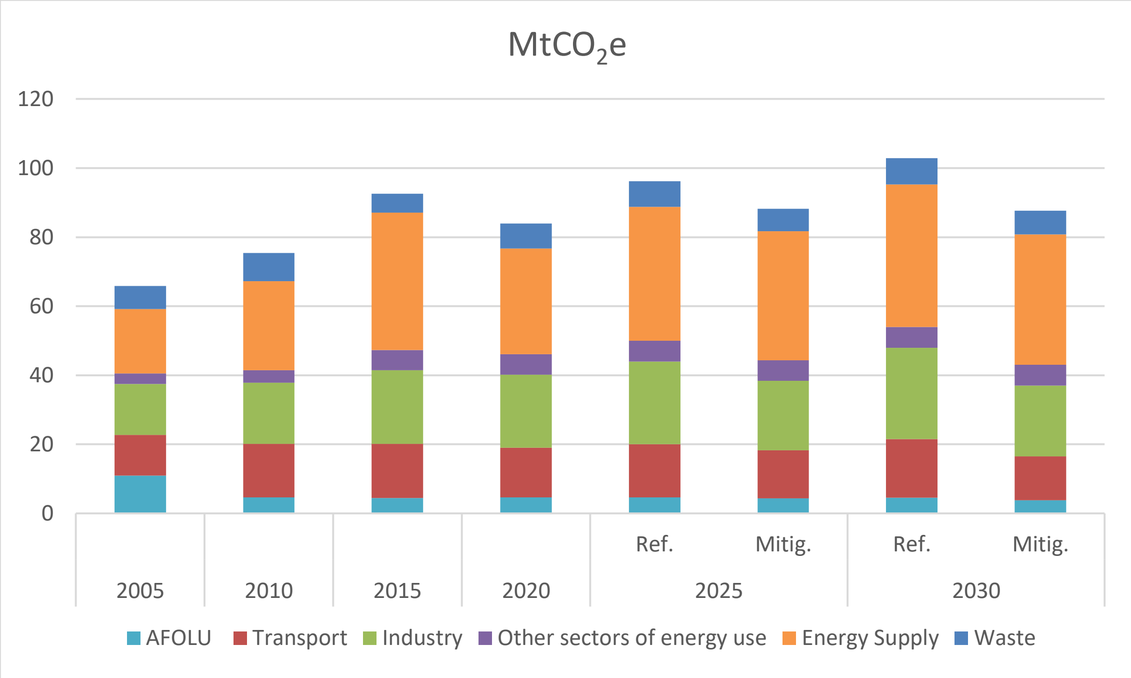
3.1. Absolute GHG Emissions

Total emissions from the State of Rio de Janeiro reached 103 Mt CO_2e in 2030 in the Reference Scenario and 88 Mt CO2e in the Mitigation Scenario. Therefore, emissions in the Reference Scenario increase 56% and the Mitigation Scenario 33% from 2005 until 2030. In 2030, the main source of emissions is the energy supply sector, followed by Industry, Transport, Waste, other sectors of energy use, and AFOLU. AFOLU is the less emitting sector because of deforestation reduction and carbon removals by increasing protected areas. The sector with the most significant potential for increasing emissions, considering 2005 until 2030 and the selected mitigation measures, is the Energy supply sector. Conversely, the sector with the most considerable potential for reducing emissions is AFOLU (Table 2 and Figure 1).

Table 2. Emissions of the State of Rio de Janeiro by sectors in 2005-2030 (Mt CO_2e and %) – Reference and Mitigation Scenarios.

Sector	2005	2010	2015	2020	2025		2030		2005-2025		2005-2030	
	MtCO$_2$e								%			
Scenario					Ref.	Mitig.	Ref.	Mitig.	Ref.	Mitig.	Ref.	Mitig.
AFOLU	11	5	4	5	5	4	5	4	-1%	-7%	-2%	-18%
Transport	12	16	16	14	15	14	17	13	31%	19%	44%	8%
Industry	15	18	21	21	24	20	27	20	62%	36%	79%	38%
Other sectors of energy use	3	4	6	6	6	6	6	6	98%	98%	100%	100%
Energy Supply	19	26	40	31	39	37	41	38	108%	100%	121%	102%
Waste	7	8	5	7	7	6	8	7	11%	-2%	14%	4%
Total	66	75	93	84	96	88	103	88	46%	34%	56%	33%

Note: Historical emission data from 2005 to 2015 and projections from 2016 to 2030.



Note: Historical emission data from 2005 to 2015 and projections from 2016 to 2030.

Figure 1. Emissions of the State of Rio de Janeiro by sectors in 2005-2030 (Mt CO_2e and %)– Reference and Mitigation Scenarios.

3.2. Comparative Analysis of Reference and Mitigation Scenarios – Avoided Emissions

A comparative analysis of the avoided emissions between scenarios and sectors is presented in Table 3. In 2030, economy-wide emissions in the Mitigation Scenario are 15% lower than in the Reference Scenario, mainly thanks to the strong mitigation efforts in the industry (40% of the total reduction).

Table 3. Comparative Analysis of GHG Avoided Emissions Across Scenarios and Sectors (Mt CO_2-eq**)** – Reference and Mitigation Scenarios.

GHG Emissions in Reference Scenario – GHG Emissions in Mitigation Scenario	2025	2030
	MtCO₂e	
AFOLU	**0,3**	**0,7**
Land Use, Land Use Change and Forestry	0,1	0,1
Cropping Systems	0,01	0,1
Livestock	0,2	0,6
Transport	**1,5**	**4,2**
Industry	**3,9**	**6,0**
Other sectors of energy use	**0**	**0**
Energy Supply	**1,5**	**3,5**
Fuel combustion	1,5	2,5
Fugitive emissions	0,004	1,0
Waste	**0,9**	**0,7**
Solid Waste	0,5	0,2
Wastewater Treatment and Discharge	0,2	0,2
Total	**8,0**	**15,2**

3.3. Evaluation of aggregated values and intensity indicators of Rio de Janeiro

Table 4 shows the indicators used to assess the evolution of emissions. It shows the total emissions that grew at the Reference Scenario 56% and the Mitigation Scenario 33% in 2005-2030. During this period, GDP grew 72%, resulting in a decrease in the indicator of the carbon content of GDP even in the reference scenario (reduced 9% in the Reference scenario and 23% in the Mitigation Scenario). On the other hand, the population grew only 16%, so total per capita emissions and sectoral per capita emissions increased except for the per capita emissions in the waste sector.

Table 4. Emission and economic indicators of the State of Rio de Janeiro – Reference and Mitigation Scenarios.

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)		2030 state targets
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	
Economy Wide	Total emissions (Mt CO_2e)	66	75	93	84	96	88	103	88	46%	34%	56%	33%	
	Total emissions without LULUCF (Mt CO_2e)	60	76	93	84	96	89	103	88	62%	49%	73%	48%	
	GDP (Million R$ 2015)	478,186	632,465	659,139	636,283	726,920	726,920	822,443	822,443	52%	52%	72%	72%	
	Carbon intensity of GDP (t CO2e/Million R$ 2015)	138	119	140	132	132	121	125	107	-4%	-12%	-9%	-23%	< 2005
	Carbon intensity of GDP without LULUCF (t CO_2e without LULUCF emissions/Million R$)	125	119	141	132	133	122	125	107	7%	-2%	1%	-14%	
	Population (Million people)	15.6	16.3	16.8	17.4	17.8	17.8	18.1	18.1	14%	14%	16%	16%	
	Per capita emissions (total t CO2e/inhab.)	4.2	4.6	5.5	4.8	5.4	5.0	5.7	4.8	28%	17%	34%	14%	
	Per capita emissions without LULUCF (t CO_2e without LULUCF emissions/inhab.)	3.8	4.6	5.5	4.9	5.4	5.0	5.7	4.9	41%	30%	49%	27%	
Energy Supply and Other Energy Indicators	Total energy supply (Mt CO_2e)	19	26	40	31	39	37	41	38	108%	100%	121%	102%	
	Emissions from total energy supply over GDP (t CO_2-eq/Million R$ 2015)	39	41	60	48	53	51	50	46	37%	31%	28%	17%	
Transport	Transport emissions (Mt CO_2e)	12	16	16	14	15	14	17	13	31%	19%	44%	8%	-30% compared to 2010
	Transport emissions/GDP (t CO2e/Million R$ 2015)	25	25	24	23	21	19	21	15	-14%	-22%	-16%	-37%	
Industry	Industry emissions – energy and IPPU (Mt CO_2e)	15	18	21	21	24	20	27	20	62%	36%	79%	38%	
	Industry Value Added (Million R$ 2015)	132,033	159,141	131,279	99,137	188,315	188,315	213,061	213,061	43%	43%	61%	61%	
	Industry emissions/GDP (t CO2e/Million R$ 2015)	31	28	32	33	33	28	32	25	7%	-11%	4%	-19%	
	Industry emissions/VA of Industry (t CO2e/Million R$ 2015)	112	111	163	213	127	107	124	96	14%	-5%	11%	-14%	

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)		2030 state targets
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	
Other energy demand sectors	Commercial and Public emissions (Mt CO_2e)	0.7	1.0	2.4	2.2	2.1	2.1	2.0	2.0	190%	190%	175%	175%	
	Commercial and Public emissions/GDP (t CO2e/Million R$ 2015)	1.5	1.6	3.6	3.5	2.9	2.9	2.4	2.4	91%	91%	60%	60%	
	Households emission (Mt CO_2e)	2.0	2.3	3.4	3.4	3.6	3.6	3.8	3.8	81%	81%	91%	91%	
	Households per capita emissions (t CO2e/inhab.)	129	142	201	198	204	204	212	212	58%	58%	64%	64%	
	Agriculture energy emissions (Mt CO2e)	0.27	0.29	0.13	0.21	0.19	0.19	0.18	0.18	-29%	-29%	-35%	-35%	
AFOLU	AFOLU net emissions (Mt CO_2e)	11.0	4.7	4.4	4.7	4.6	4.3	4.6	3.8	-58%	-60%	-59%	-65%	
	AFOLU net emissions/VA of Agriculture (kt CO_2e/Million R$ 2015)	5.1	2.2	1.5	1.7	1.6	1.5	1.4	1.2	-68%	-70%	-72%	-76%	
LULUCF	LULUCF net emissions (Mt CO_2e)	6.3	-0.2	-0.4	-0.3	-0.3	-0.4	-0.3	-0.4	-105%	-106%	-105%	-106%	
	LULUCF net emissions/GDP (t CO2e/Million R$ 2015)	13.1	-0.3	-0.6	-0.5	-0.4	-0.6	-0.4	-0.4	-103%	-104%	-103%	-103%	
	LULUCF net emissions/VA of Agriculture (Kt CO_2e/Million R$ 2015)	2.88	-0.09	-0.13	-0.11	-0.10	-0.14	-0.09	-0.11	-104%	-105%	-103%	-104%	
Agriculture	Agriculture Emissions (crops & livestock) Mt CO_2e	4.7	4.9	4.8	5.0	4.9	4.7	4.8	4.2	4%	1%	3%	-12%	
	Total agriculture emissions (Crops, Livestock and energy emissions – Mt CO_2e)	5.0	5.1	5.0	5.2	5.1	4.9	5.0	4.3	2%	-1%	1%	-13%	
	Value Added of Agriculture (Million R$ 2015)	2,171	2,157	3,014	2,773	2,826	2,826	3,198	3,198	30%	30%	47%	47%	
	Total agriculture emissions/VA of Agriculture (kt CO_2e/Million R$ 2015)	2.3	2.4	1.7	1.9	1.8	1.7	1.6	1.4	-22%	-24%	-32%	-41%	
	Livestock Emissions / VA of Agriculture (kt CO_2-eq/ Million R$ 2015)	1.8	1.8	1.3	1.4	1.4	1.3	1.2	1.0	-23%	-26%	-33%	-43%	

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)		2030 state targets
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	
Waste	Total Waste Emissions (Mt CO_2e)	6.6	8.1	5.5	7.2	7.4	6.5	7.6	6.9	11%	-2%	14%	4%	
	Urban Solid Waste emissions (Mt CO_2e)	5.0	6.1	3.1	4.8	4.9	3.7	4.9	3.6	-2%	-26%	-1%	-28%	
	Total waste Per capita emissions (t CO2e/inhab.)	0.43	0.50	0.32	0.42	0.41	0.36	0.42	0.38	-3%	-15%	-2%	-11%	
	Urban Solid Waste per capita emissions (t CO_2e/inhab.)	0.32	0.37	0.18	0.28	0.27	0.21	0.27	0.20	-14%	-35%	-15%	-38%	- 65% compared to 2005
	Urban wastewater emissions (Mt CO_2e)	1.04	1.08	1.31	1.34	1.38	1.31	1.40	1.33	33%	26%	34%	28%	
	Urban wastewater per capita emissions (t CO_2e/inhab.)	0.07	0.07	0.08	0.08	0.08	0.07	0.08	0.07	16%	10%	15%	10%	- 65% compared to 2005
	Industry emissions – solid waste and wastewater (Mt CO_2e)	0.37	0.57	1.05	1.08	1.14	1.52	1.26	1.97	211%	317%	244%	441%	

4. State of Minas Gerais

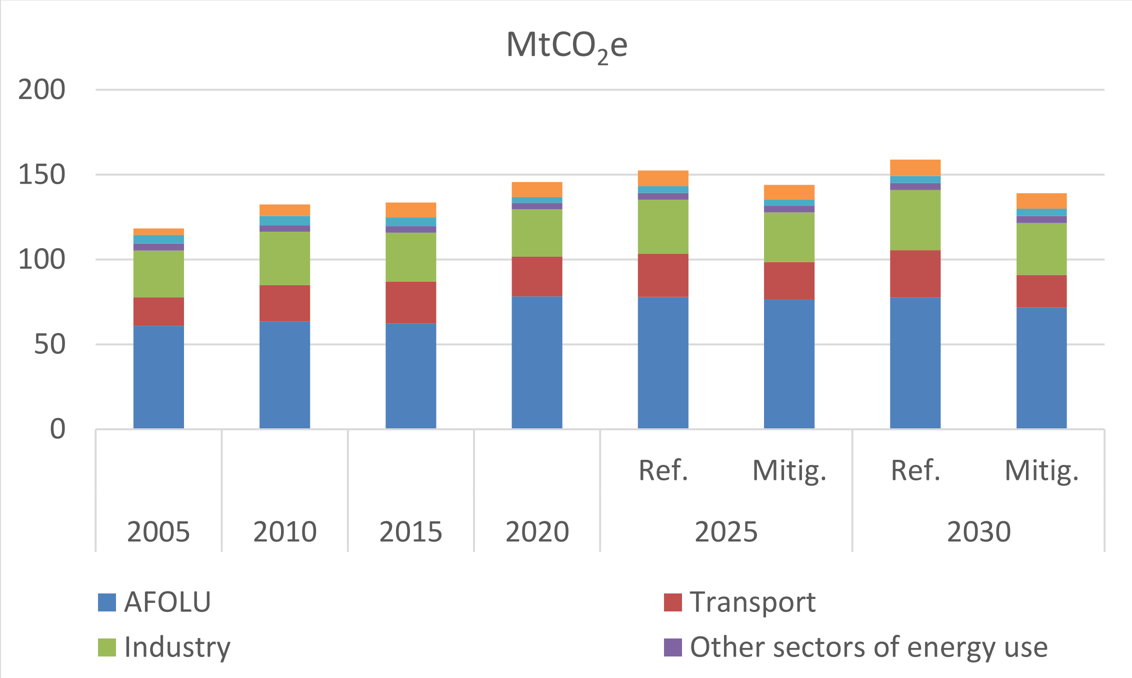
4.1. Absolute GHG Emissions

Total emissions from the State of Minas Gerais reached 159 Mt CO_2e in 2030 in the Reference Scenario and 139 Mt CO_2e in the Mitigation Scenario. Therefore, emissions in the Reference Scenario increases 34% and the Mitigation Scenario 18% from 2005 until 2030 (Table 5 and Figure 2). In 2030, the primary source of emissions is the AFOLU sector, followed by Industry, Transport, Waste, energy supply, and other energy use sectors. In AFOLU, agriculture is the most emitting subsector, with livestock as the primary source of emissions in both Scenarios. In both scenarios, from 2005 to 2030, emissions increase in all sectors, except in the energy supply sector that reduces 17%. Waste is the sector that emissions grew the most from 2005 to 2030. There is a significant increase in waste emissions due to improved collection and treatment of urban solid waste and wastewater, which is associated with the expansion of basic sanitation services.

Table 5. Emissions of the State of Minas Gerais by sectors in 2005-2030 (Mt CO_2e and %)– Reference and Mitigation Scenarios.

Sector	2005	2010	2015	2020	2025		2030		2005-2025		2005-2030	
	$MtCO_2e$								%			
Scenario					Ref.	Mitig.	Ref.	Mitig.	Ref.	Mitig.	Ref.	Mitig.
AFOLU	61	64	62	78	78	77	78	72	23%	21%	22%	13%
Transport	17	21	25	23	25	22	28	19	53%	32%	67%	17%
Industry	28	32	29	28	32	29	35	31	15%	5%	28%	10%
Other sectors of energy use	4.2	3.7	3.7	3.7	3.9	3.9	4.2	4.2	-6%	-6%	1%	1%
Energy Supply	5.1	5.5	5.3	3.5	4.0	3.8	4.2	4.2	-22%	-25%	-17%	-17%
Waste	3.8	6.8	8.7	8.8	9.2	8.5	9.6	9.2	142%	123%	154%	142%
Total	118	132	134	146	152	144	159	139	29%	22%	34%	18%

Note: Historical emission data from 2005 to 2014 and projections from 2015 to 2030.



Note: Historical emission data from 2005 to 2014 and projections from 2015 to 2030.

Figure 2. Emissions of the State of Minas Gerais by sectors in 2005-2030 (Mt CO_2e and %)– Reference and Mitigation Scenarios.

4.2. Comparative Analysis of Reference and Mitigation Scenarios – Avoided Emissions

A comparative analysis of the avoided emissions across scenarios and sectors is presented in Table 6. In 2030, economy-wide emissions in Mitigation Scenario are 12% lower than in the Reference Scenario, mainly thanks to the strong mitigation efforts in Transport and AFOLU (43% and 31% of the total reduction, respectively).

Table 6. Comparative Analysis of GHG Avoided Emissions Across Scenarios and Sectors (Mt CO_2e) – Reference and Mitigation Scenarios.

GHG Emissions in Reference Scenario – GHG Emissions in Mitigation Scenario	2025	2030
	MtCO₂e	
AFOLU	**1,3**	**6,1**
Land Use, Land Use Change and Forestry	0,01	0,1
Cropping Systems	0,2	1,5
Livestock	1,1	4,5
Transport	**3,5**	**8,4**
Industry	**2,7**	**4,8**
Other sectors of energy use	**0**	**0**
Energy Supply	**0,2**	**-0,02**
Fuel combustion	0,2	0,0
Waste	**0,7**	**0,4**
Solid Waste	0,5	0,2
Wastewater Treatment and Discharge	0,2	0,2
Total	**8**	**20**

4.3. Evaluation of aggregated values and intensity indicators of Minas Gerais

Table 7 shows the indicators used to assess the evolution of emissions. It shows the total emissions that grew at the Reference Scenario 34% and the Mitigation Scenario 18% in 2005-2030. During this period, GDP grew 100%, resulting in an intensive decrease in the indicator of the carbon content of GDP even in the Reference Scenario (reduced 33% in the Reference scenario and 41% in the Mitigation Scenario). On the other hand, the population grew only 15%. Hence, total per capita emissions and waste per capita emissions increased in 2030, but per capita emissions in the Households sector and without LULUCF emissions decreased.

Table 7. Emission and economic indicators of the State of Minas Gerais– Reference and Mitigation Scenarios.

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)	
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.
Economy Wide	Total emissions (Mt CO_2e)	118	132	134	146	152	144	159	139	29%	22%	34%	18%
	Total emissions without LULUCF (Mt CO_2e)	100	114	120	117	123	115	130	110	23%	15%	30%	10%
	GDP (Million R$ of 2015)	333,815	493,652	519,331	515,557	588,996	588,996	666,395	666,395	76%	76%	100%	100%
	Carbon intensity of GDP (t CO_2e/Million R$ 2015)	355	268	257	282	259	244	238	209	-27%	-31%	-33%	-41%
	Carbon intensity of GDP without LULUCF (t CO_2e without LULUCF emissions/Million R$ 2015)	300	232	231	226	210	195	195	166	-30%	-35%	-35%	-45%
	Population (Million people)	19.3	20.0	20.6	21.3	21.8	21.8	22.2	22.2	13%	13%	15%	15%
	Per capita emissions (total t CO_2e/inhab.)	6.1	6.6	6.5	6.8	7.0	6.6	7.2	6.3	14%	7%	16%	2%
	Per capita emissions without LULUCF (t CO_2e without LULUCF emissions/inhab.)	5.2	5.7	5.8	5.5	5.7	5.3	5.9	5.0	9%	1%	12%	-5%
Energy Supply and Other Energy Indicators	Total energy supply (Mt CO_2e)	5.1	5.5	5.3	3.5	4.0	3.8	4.2	4.2	-22%	-25%	-17%	-17%
	Emissions from total energy supply over GDP(t CO2e/Million R$ 2015)	15.2	11.2	10.2	6.8	6.7	6.5	6.3	6.3	-56%	-58%	-59%	-58%
Transport	Transport emissions (Mt CO_2e)	17	21	25	23	25	22	28	19	53%	32%	67%	17%
	Transport emissions/GDP (t CO2e/Million R$ 2015)	49.8	43.1	47.7	45.2	43.2	37.2	41.8	29.1	-13%	-25%	-16%	-42%
Industry	Industry emissions – energy and IPPU (Mt CO_2e)	28	32	29	28	32	29	35	31	15%	5%	28%	10%
	Industry Value Added (Million R$ 2015)	92,214	142,378	119,301	114,866	158,315	158,315	179,119	179,119	72%	72%	94%	94%
	Industry emissions/GDP (t CO_2e/Million R$ 2015)	83	64	56	54	54	50	53	46	-35%	-40%	-36%	-45%
	Industry emissions/VA of Industry (t CO2e/Million R$ 2015)	301	221	242	244	202	185	198	171	-33%	-39%	-34%	-43%

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)	
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.
Other energy demand sectors	Commercial and Public emissions (Mt CO_2e)	0.10	0.11	0.10	0.09	0.09	0.09	0.08	0.08	-13%	-13%	-17%	-17%
	Commercial and Public emissions/GDP (t CO2e/Million R$ 2015)	0.30	0.22	0.19	0.18	0.15	0.15	0.12	0.12	-51%	-51%	-59%	-59%
	Households emission (Mt CO_2e)	2.43	1.85	1.79	1.81	1.92	1.92	2.03	2.03	-21%	-21%	-16%	-16%
	Households per capita emissions (kg CO_2e/inhab.)	126	93	86	85	88	88	91	91	-30%	-30%	-28%	-28%
	Agriculture energy emissions (Mt CO_2e)	1.6	1.8	1.8	1.8	1.9	1.9	2.1	2.1	18%	18%	27%	27%
AFOLU	AFOLU net emissions (Mt CO_2e)	61.0	63.6	62.3	78.3	78.0	76.7	77.7	71.6	28%	26%	27%	17%
	AFOLU emissions/VA of Agriculture (kt CO_2e /Million R$ 2015)	3.23	2.65	2.55	3.05	2.69	2.64	2.36	2.18	-17%	-18%	-27%	-33%
LULUCF	LULUCF net emissions (Mt CO_2e)	18.1	18.1	13.8	28.9	28.9	28.9	28.9	28.8	60%	60%	60%	59%
	LULUCF net emission/GDP (t CO_2e/Million R$ 2015)	54.2	36.7	26.6	56.1	49.1	49.1	43.4	43.2	-9%	-9%	-20%	-20%
	LULUCF emissions/VA of Agriculture (t CO2e/Million R$ 2015)	958	753	565	1126	996	995	880	875	4%	4%	-8%	-9%
Agriculture	Total agriculture emissions (Crops & Livestock – Mt CO_2e)	42.9	45.5	48.5	49.4	49.1	47.8	48.8	42.8	14%	11%	14%	0%
	Total agriculture emissions (Crops, Livestock and energy- Mt CO_2e)	44.5	47.3	50.3	51.2	51.0	49.7	50.8	44.9	14%	12%	14%	1%
	Value Added of Agriculture (Million R$ 2015)	18,888	24,021	24,439	25,690	29,044	29,044	32,860	32,860	54%	54%	74%	74%
	Total agriculture emissions (includes energy emissions)/VA of Agriculture (kt CO_2e/Million R$)	2.36	1.97	2.06	1.99	1.76	1.71	1.55	1.37	-26%	-27%	-34%	-42%
	Livestock Emissions / VA of Agriculture (kt CO2e/Million R$ 2015)	26.7	27.6	29.1	29.9	29.5	28.4	29.2	24.7	11%	6%	9%	-8%

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)	
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.
Waste	Waste Emissions (Mt CO_2e)	3.8	6.8	8.7	8.8	9.2	8.5	9.6	9.2	142%	123%	154%	142%
	Per capita waste emissions (Total t CO_2e/inhab.)	0.20	0.34	0.42	0.41	0.42	0.39	0.43	0.41	113%	97%	120%	110%
	Total solid Waste emissions (Mt CO_2e)	1.3	3.3	4.4	4.5	4.6	4.1	4.7	4.5	244%	207%	253%	236%
	Total solid waste per capita emissions (t CO_2e/inhab.)	0.07	0.17	0.21	0.21	0.21	0.19	0.21	0.20	204%	171%	206%	191%
	Total wastewater emissions (Mt CO_2e)	2.5	3.5	4.2	4.3	4.6	4.3	4.9	4.7	86%	77%	99%	91%
	Total wastewater per capita emissions (t CO2e/inhab.)	0.13	0.17	0.21	0.20	0.21	0.20	0.22	0.21	64%	56%	73%	66%

5. State of Amazonas

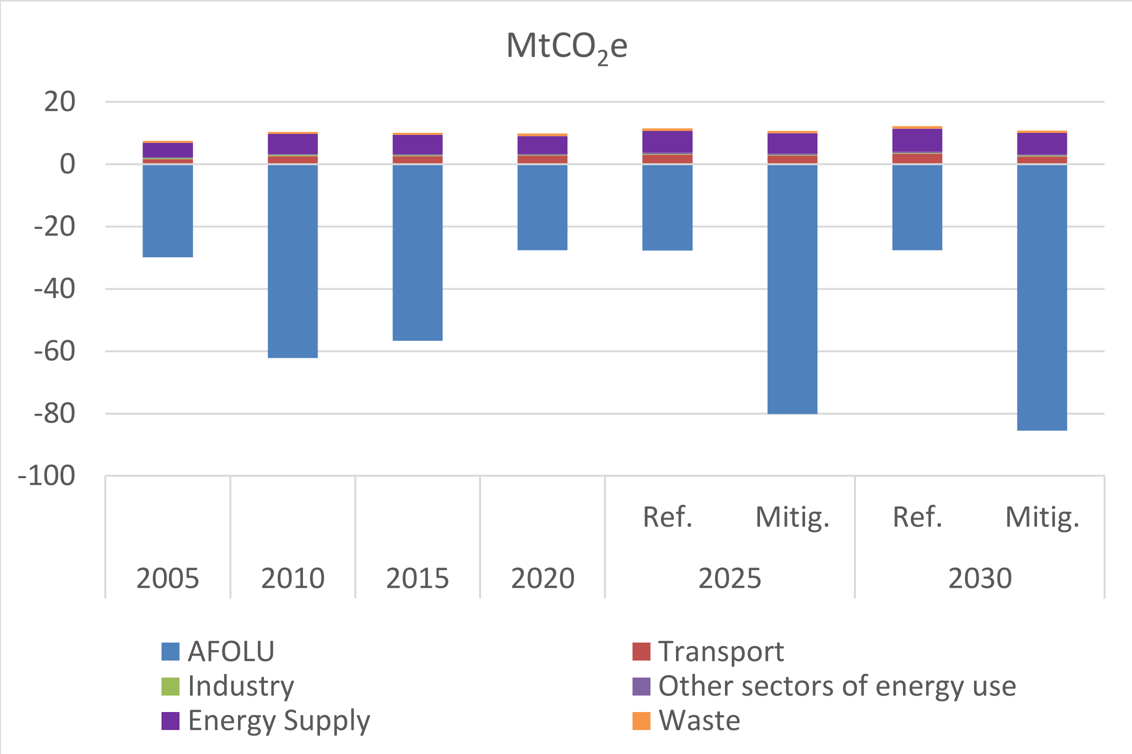
5.1. Absolute GHG Emissions

Total emissions from the State of Amazonas reached -15 Mt CO_2e in 2030 in the Reference Scenario and -75 Mt CO_2e in the Mitigation Scenario. Therefore, emissions in the Reference Scenario increase 31%. In other words, there was a reduction in removals from -22 MtCO_2e in 2005 to -15 Mt CO_2e in 2030. In the Mitigation Scenario, there is a reduction of 233% in net emissions from 2005 to 2030, with more carbon removals in 2030 than in 2005 (Table 8 and Figure 3). In 2030, the main source of emissions is the AFOLU sector, followed by energy supply, Transport, Waste, Industry, and other energy use sectors. AFOLU is the most emitting sector due to deforestation and other land use changes. However, it is also the sector with the most carbon removals with increased protected areas and indigenous lands.

Table 8. Emissions of the State of Amazonas by sectors in 2005-2030 (Mt CO_2e and %)– Reference and Mitigation Scenarios.

Sector	2005	2010	2015	2020	2025		2030		2005-2025		2005-2030	
	MtCO_2e								%			
Scenario					Ref.	Mitig.	Ref.	Mitig.	Ref.	Mitig.	Ref.	Mitig.
AFOLU	-30	-62	-57	-28	-28	-80	-28	-85	56%	-29%	56%	-37%
Transport	2	3	3	3	3	3	3	3	96%	76%	113%	59%
Industry	0.4	0.4	0.3	0.19	0.22	0.21	0.24	0.22	-44%	-46%	-37%	-43%
Other sectors of energy use	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	70%	70%	79%	79%
Energy Supply	4.8	6.5	6.3	5.8	7.0	6.7	7.4	7.0	48%	40%	56%	46%
Waste	0.5	0.6	0.6	0.8	0.8	0.7	0.8	0.7	53%	31%	56%	32%
Total	-22	-52	-47	-18	-16	-69	-15	-75	28%	-210%	31%	-233%

Note: Historical emission data from 2005 to 2018 and projections from 2019 to 2030.



Note: Historical emission data from 2005 to 2018 and projections from 2019 to 2030.

Figure 3. Emissions of the State of Amazonas by sectors in 2005-2030 (Mt CO_2e and %)

5.2. Comparative Analysis of Reference and Mitigation Scenarios – Avoided Emissions

A comparative analysis of the avoided emissions between scenarios and sectors is presented in Table 9. In 2030, economy-wide emissions in Mitigation Scenario are 385% lower than in the Reference Scenario, mainly thanks to the strong mitigation efforts in AFOLU (98% of the total reduction), particularly in LULUCF (90% of the total reduction).

Table 9. Comparative Analysis of GHG Avoided Emissions Across Scenarios and Sectors (Mt CO2-eq) – Reference and Mitigation Scenarios.

GHG Emissions in Reference Scenario – GHG Emissions in Mitigation Scenario	2025	2030
	MtCO₂e	
AFOLU	**52**	**58**
Land Use, Land Use Change and Forestry	48.18	53.2
Cropping Systems	4.2	4.3
Livestock	0.1	0.3
Transport	**0.3**	**0.9**
Industry	**0.01**	**0.02**
Other sectors of energy use	**0**	**0**
Energy Supply	**0.4**	**0.5**
Fuel combustion	0.4	0.5
Waste	**0.1**	**0.1**
Solid Waste	0.1	0.1
Wastewater Treatment and Discharge	0.02	0.02
Total	**53**	**59**

5.3. Evaluation of aggregated values and intensity indicators of Amazonas

Table 10 shows the indicators used to assess the evolution of emissions. It shows that the total emissions that grew at the Reference Scenario 31% and the reduction at the Mitigation Scenario 233% in 2005-2030. During this period, GDP grew 80%, increasing the indicator of the carbon content of GDP in the reference scenario (62%) and an intense decrease in the mitigation scenario (85%). The population grew 49%, so in the reference scenario so total per capita emissions, per capita emissions without LULUCF, households per capita emissions, and waste per capita emissions increased in 2030. On the other hand, in the mitigation scenario only per capita emissions in the Household sector, and waste per capita emissions increased in 2030, while total per capita emissions, and per capita emissions without LULUCF emissions decreased.

Table 10. Emission and economic indicators of the State of Amazonas– Reference and Mitigation Scenarios.

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)	
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.
Economy Wide	Total net emissions (Mt CO_2e)	-22	-52	-47	-18	-16	-69	-15	-75	28%	-210%	31%	-233%
	Total emissions without LULUCF (Mt CO_2e)	14	22	20	20	22	17	22	16	50%	15%	55%	13%
	Total emissions without Removals (Mt CO_2e)	75	68	74	108	110	57	110	56	47%	-23%	47%	-25%
	GDP (million R$ of 2015)	60,220	85,588	86,568	83,939	95,896	95,896	108,497	108,497	59%	59%	80%	80%
	Carbon intensity of GDP (t CO_2e/million R$)	-372	-605	-538	-212	-169	-724	-142	-688	55%	-95%	62%	-85%
	Carbon intensity of GDP without LULUCF (t CO_2e without LULUCF emissions/million R$)	240	259	227	239	226	173	206	150	-6%	-28%	-14%	-38%
	Carbon intensity of GDP without removals (t CO_2e/million R$)	1,241	789	854	1,286	1,142	598	1,016	517	-8%	-52%	-18%	-58%
	Population (million people)	3.2	3.6	3.9	4.2	4.5	4.5	4.8	4.8	41%	41%	49%	49%
	Per capita net emissions (total t CO_2e/inhab.)	-7.0	-14.6	-12.0	-4.2	-3.6	-15.4	-3.2	-15.6	49%	-121%	54%	-123%
	Per capita emissions without LULUCF (t CO_2e without LULUCF emissions/inhab.)	4.5	6.2	5.1	4.8	4.8	3.7	4.7	3.4	7%	-18%	4%	-25%
	Per capita emissions without removals (t CO_2e without LULUCF emissions/inhab.)	23	19	19	26	24	13	23	12	4%	-45%	-1%	-50%
Energy Supply and Other Energy Indicators	Total energy supply (Mt CO_2e)	4.8	6.5	6.3	5.8	7.0	6.7	7.4	7.0	48%	40%	56%	46%
	Emissions from total energy supply over GDP (t CO_2e / Million R$)	79	76	73	69	73	69	68	64	-7%	-12%	-13%	-19%
Transport	Transport emissions (Mt CO_2e)	1.6	2.6	2.6	2.7	3.1	2.8	3.4	2.5	96%	76%	113%	59%
	Transport emissions/GDP (t CO_2e /million R$)	26.4	30.2	29.6	32.7	32.4	29.1	31.1	23.3	23%	10%	18%	-12%

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)	
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.
Industry	Industry emissions - energy and IPPU (Mt CO_2e)	0.39	0.40	0.29	0.19	0.22	0.21	0.24	0.22	-44%	-46%	-37%	-43%
	Industry Value Added (million R$ 2015)	21,678	30,221	24,231	24,261	29,351	29,351	33,208	33,208	35%	35%	53%	53%
	Industry emissions/GDP (t CO_2e/million R$)	6.5	4.6	3.3	2.3	2.3	2.2	2.3	2.0	-65%	-66%	-65%	-68%
	Industry emissions/VA of Industry (t CO_2e/million R$)	17.9	13.1	11.9	8.0	7.5	7.1	7.4	6.7	-58%	-60%	-59%	-63%
Other energy demand sectors	Commercial and Public emissions (Mt CO_2e)	0.076	0.028	0.023	0.030	0.028	0.028	0.027	0.027	-63%	-63%	-65%	-65%
	Commercial and Public emissions/GDP (t CO_2e /million R$)	1.26	0.33	0.27	0.36	0.30	0.30	0.25	0.25	-77%	-77%	-80%	-80%
	Households emission (Mt CO_2e)	0.13	0.22	0.25	0.26	0.28	0.28	0.29	0.29	105%	105%	117%	117%
	Households per capita emissions (kg CO_2e/inhab.)	42	61	65	62	61	61	61	61	46%	46%	45%	45%
	Agriculture energy emissions (Mt CO_2e)	0.002	0.034	0.047	0.054	0.058	0.058	0.061	0.061	2783%	2783%	2947%	2947%
AFOLU	AFOLU net emissions (Mt CO_2e)	-30	-62	-57	-28	-28	-80	-28	-85	7%	-168%	8%	-186%
	AFOLU gross emissions (Mt CO2e)	67	57	64	98	98	47	98	45	46%	-31%	46%	-33%
	AFOLU emissions/VA of Agricultured (kt CO_2e /million R$)	-15.9	-19.9	-9.8	-6.0	-4.6	-13.4	-4.1	-12.7	71%	15%	74%	20%
LULUCF	LULUCF net emissions (Mt CO_2e)	-37	-74	-66	-38	-38	-86	-38	-91	-3%	-134%	-2%	-147%
	LULUCF emission/GDP (t CO_2e /million R$)	-612	-864	-765	-451	-395	-897	-348	-838	35%	-47%	43%	-37%
	LULUCF emissions/VA of Agriculture (t CO_2e /million R$)	-19,554	-23,708	-11,433	-8,180	-6,346	-14,424	-5,590	-13,473	68%	26%	71%	31%
Agriculture	Total agriculture emissions (Crops & Livestock-Mt CO_2e)	7.0	11.8	9.6	10.2	10.2	5.9	10.1	5.5	46%	-16%	45%	-22%
	Total agriculture emissions (Crops, Livestock, and energy- Mt CO_2e)	7.0	11.8	9.7	10.3	10.2	5.9	10.2	5.5	47%	-15%	46%	-21%

Annual indicators		2005	2010	2015	2020	2025		2030		2005-2025 (%)		2005-2030 (%)	
						Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.	Cen. Ref.	Cen. Mit.
	Value Added of Agriculture (million R$ 2015)	1,884	3,120	5,793	4,624	5,965	5,965	6,749	6,749	217%	217%	258%	258%
	Total agriculture emissions (includes energy emissions)/VA of Agriculture (t CO_2e /million R$)	3,696	3,780	1,668	2,226	1,715	994	1,506	819	-54%	-73%	-59%	-78%
	Livestock Emissions / VA of Agriculture (t CO_2e/ Million R$)	961	651	340	450	345	331	301	253	-64%	-66%	-69%	-74%
Waste	Waste Emissions (Mt CO_2e)	0.5	0.6	0.6	0.8	0.8	0.7	0.8	0.7	53%	31%	56%	32%
	Per capita waste emissions (Total t CO_2e/inhab.)	0.16	0.18	0.15	0.19	0.18	0.15	0.17	0.14	9%	-7%	5%	-12%
	Total solid Waste emissions (Mt CO_{2e})	0.29	0.34	0.32	0.40	0.40	0.30	0.41	0.30	37%	3%	38%	1%
	Total Solid Waste per capita emissions (kg CO_2e/inhab.)	92	97	82	94	89	67	85	62	-3%	-26%	-7%	-32%
	Total wastewater emissions (Mt CO_2e)	0.23	0.29	0.25	0.39	0.40	0.38	0.41	0.39	74%	65%	79%	71%
	Total wastewater per capita emissions (kg CO_2e/inhab.)	72	83	63	92	89	84	86	82	24%	18%	20%	14%

6. Conclusion

Rio de Janeiro's absolute GHG emission indicators reveal that, in 2030, the most significant emissions come from the energy supply sector (41 MtCO_2e in the Reference Scenario and 38 MtCO_2e in the Mitigation Scenario), followed by the industry sector (27 MtCO_2e in the Reference Scenario and 20 MtCO_2e in the Mitigation Scenario) and by the transport sector (17 MtCO_2e in the Reference Scenario and 13 MtCO_2e in the Mitigation Scenario). These sectors contribute the most to emissions variation from 2005 to 2030: energy supply (additional 23 MtCO_2e in the Reference Scenario and 19 MtCO_2e in the Mitigation Scenario), followed by industry (12 MtCO_2e in the Reference Scenario and 6 Mt CO2e in the Mitigation Scenario) and transport (5 Mt CO_2e in the Reference Scenario and 1 Mt CO_2e in the Mitigation Scenario). Household emissions (1.8 MtCO_2e in the Reference and Mitigation Scenarios) also stand out in absolute GHG emissions increase between 2005 and 2030. The absolute GHG emissions indicator that increases the most is solid waste and industrial wastewater (244% in the Reference Scenario and 441% in the Mitigation Scenario) and commercial and public emissions (175% in the Reference Mitigation Scenarios). However, they represent a low percentage of total state emissions.

Regarding the variation in the emission intensity indicators, from 2005 to 2030, the most relevant are households per capita emissions (increased 64% in the Reference and Mitigation Scenario), Commercial and Public emissions/GDP (increased 60% in the Reference and Mitigation Scenario), and per capita emissions without LULUCF (increased 49% in the Reference and 27% in the Mitigation scenarios).

In both scenarios, Rio de Janeiro meets the overall mitigation target of reducing the carbon intensity of GDP in 2030 to a level below 2005 (9% in the Reference Scenario and 23% in the Mitigation Scenario). However, the state needs to increase its mitigation efforts to reach the sectoral mitigation targets. For example, the waste sector target for 2030 is to reduce 65% of per capita solid waste and wastewater emissions compared to 2005. However, in our simulations, it reaches only a 15% and 38% reduction in per capita urban solid waste emissions and increases 15% and 10% of per capita wastewater emissions in Reference and Mitigation Scenarios, respectively. Another target is to reduce the transport emissions by 30% in 2030 compared to 2010, but despite all transport mitigation measures, the Mitigation Scenario would reduce only 18%, while the Reference Scenario 9%.

Minas Gerais' absolute GHG emission indicators show that by 2030 the most important sources are net AFOLU emissions (77 MtCO_2e in the Reference Scenario and 71 MtCO_2e in the Mitigation Scenario being LULUCF responsible for 29 MtCO_2e in each scenario), followed by industry (35 MtCO_2e in the Reference Scenario and 31 MtCO_2e in the Mitigation Scenario) and transport (28 MtCO_2e in the Reference Scenario and 19 MtCO_2e in the Mitigation Scenario). These sectors contribute the most to the emissions variation from 2005 to 2030: AFOLU (16 MtCO_2e difference in the Reference Scenario from 2005 to 2030 and 11 MtCO_2e in the Mitigation Scenario), followed by transport (11 Mt CO_2e in the Reference Scenario and 3 MtCO_2e in the Mitigation Scenario) and industry (8 MtCO_2e in the Reference Scenario and 3 MtCO_2e in the Mitigation Scenario). In addition, the waste sector (5.8 MtCO_2e in the Reference and 5.4 in Mitigation Scenarios) also stands out regarding the absolute GHG emissions difference in this period. In relative terms, and considering the waste's subsectors, from 2005 to 2030, the absolute GHG emissions indicator that increases the most are total solid emissions (253% in the Reference

Scenario and 236% in the Mitigation Scenario) and total wastewater emissions (99% in the Reference and 91% in the Mitigation Scenario).

The variation in the emission intensity indicators, from 2005 to 2030, that stands out are total per capita solid waste emissions (increased 206% in the Reference and 191% in the Mitigation Scenario) and total per capita wastewater emissions (increased 73% in the Reference Scenario and 66% in the Mitigation Scenario). There is a significant increase in waste emissions due to improved collection and treatment of urban solid waste and wastewater in Minas Gerais.

The absolute GHG emissions indicators for Amazonas that most contribute to the state emissions in 2030 are the energy supply (7.4 Mt CO_2e in the Reference Scenario and 7 Mt CO_2e in the Mitigation Scenario), followed by transport (3 Mt CO_2e in the Reference Scenario and 3 Mt CO_2e in the Mitigation Scenario) and waste (0.8 Mt CO_2e in the Reference Scenario and 0.7 Mt CO_2e in the Mitigation Scenario). However, analyzing gross emissions indicators, the AFOLU sector is the one that contributes the most to the state emissions (98 Mt CO_2e in the Reference Scenario and 45 Mt CO_2e in the Mitigation Scenario).

In the reference scenario, these sectors contribute the most to emission variation from 2005 to 2030: AFOLU (35 MtCO_2e difference), followed by energy supply (0.9 MtCO_2e difference) and transport (0.8 Mt CO_2e difference). In the mitigation scenario, AFOLU net emissions and transport emissions reduce from 2005 to 2030, so the sectors that contribute the most to emissions variation in that period are: Energy Supply (0.5 MtCO_2e difference), other energy demand sectors, and waste (both 0.1 MtCO_2e difference). In terms of percentage variation from 2005 to 2030, the absolute GHG emissions indicators that stand out are agriculture energy emissions (2947% variation in both scenarios), households (117% variation in both scenarios), transport (113% in reference scenario and 59% in mitigation scenario). However, they represent a small share of emissions.

The considerable variation in the emission intensity indicators, from 2005 to 2030, is the carbon intensity of GDP (increased 62% in the Reference and reduced 85% in the Mitigation Scenario), per capita net emissions (increased 54% in the Reference and reduced 123% in the Mitigation Scenario), LULUCF emissions/VA of Agriculture (increased 71% in the Reference and 31% in the Mitigation Scenario), and total wastewater per capita emissions (increased 20% in the Reference and 14% in the Mitigation Scenario).

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