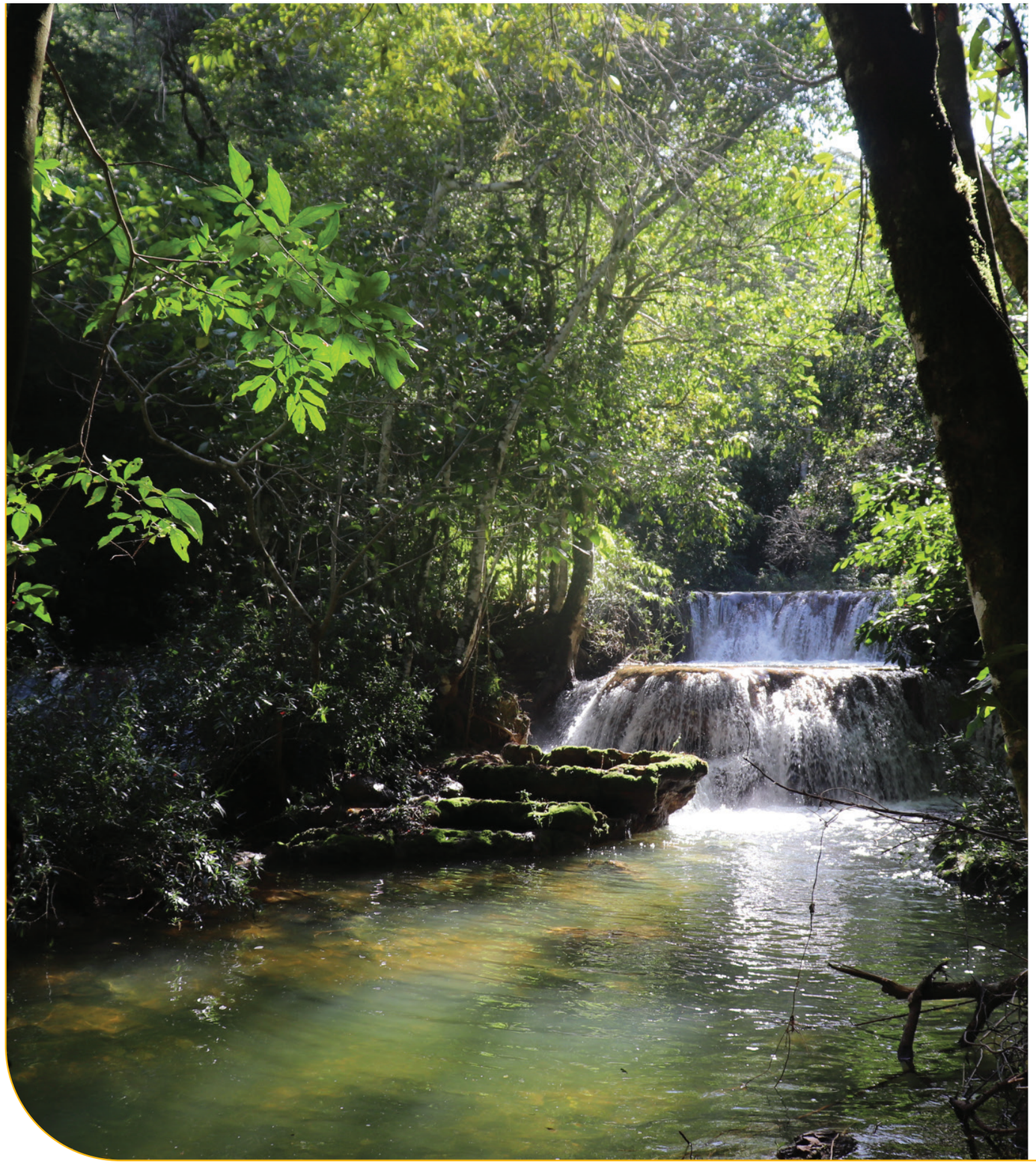
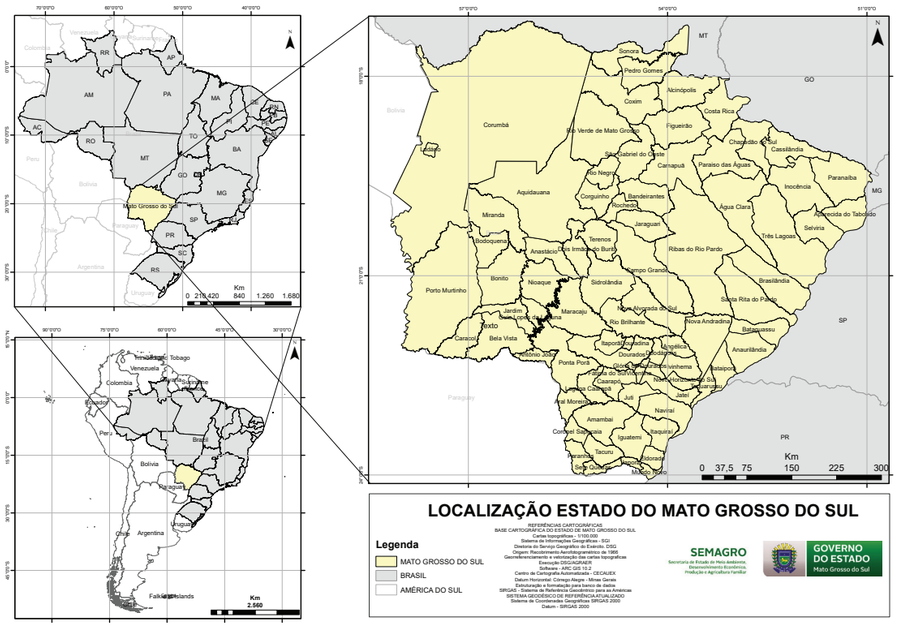
INVENTORY OF GREENHOUSE GAS EMISSIONS IN THE STATE OF MATO GROSSO DO SUL

2017 - 2018

Executive Summary

MATO GROSSO DO SUL CARBONO NEUTRO





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Executive Summary

SEMAGRO
Secretaria de Estado de Meio Ambiente, Desenvolvimento Econômico, Produção e Agricultura Familiar

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Mato Grosso do Sul

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Vice-Governor of the State of Mato Grosso do Sul

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Superintendency of Science and Technology, Production and Family Agriculture of the State of Mato Grosso do Sul

Bruno Gouvea Bastos
Superintendency of Industry, Commerce and Services of the State of Mato Grosso do Sul

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1

PRESENTATION

Climate change is a pervasive global threat to biodiversity, ecosystems and ecosystem services. Collectively, these impacts alter the benefits and services that natural ecosystems can provide to society, threatening its survival (Weiskopf et al., 2020).

The impacts and risks of climate change are therefore becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously, and multiple climate and non-climate risks will interact, resulting in overall risk and cascading risks across sectors and regions. Some responses to climate change result in new impacts and risks. If global warming transiently exceeds 1.5°C in the next few decades or later (exceeding this period), then many systems will face additional severe risks, compared to remaining below 1.5°C. Depending on the magnitude and duration, some impacts will cause the release of additional greenhouse gases and some will be irreversible, even if global warming is reduced (IPCC Sixth Assessment Report, 2022).

To consciously deal with this challenge, Mato Grosso do Sul launched in 2016 the State Program MS State Carbon Neutral, bringing as its main goal to neutralize greenhouse gas emissions by 2030, being the Climate Inventory one of the main planning instruments of the Program, provided in art. 3 of State Decree No. 15.798, of November 3rd, 2021.

Thus, the Mato Grosso do Sul State Government, through SEMAGRO, presents the results of the 1st Inventory of Anthropic Emissions and Removals of Greenhouse Gases (GHG) from the state territory for the period 2017 to 2018.

Central to any climate change study, the emissions inventory is one of the first steps in developing low-carbon strategies, which seeks to identify and quantify anthropogenic primary sources and sinks of greenhouse gases at regional and national scales. The inventory is therefore a planning tool to help the state to assess emission sources, set reduction targets, prioritize mitigation actions, and track performance.

To ensure that Mato Grosso do Sul's emissions inventory is comparable to those of other Parties of the UNFCCC (United Nations Board Convention on Climate Change), the estimates presented here were calculated using methodologies consistent with those recommended in the 2006 IPCC Revised Guidelines for National Greenhouse Gas Inventories (IPCC/UNEP/OECD/IEA).

TERRITORIAL DIMENSION AND SOCIO-ENVIRONMENTAL CHARACTERISTICS OF THE STATE OF MATO GROSSO DO SUL

Mato Grosso do Sul has an area of 357,145.4 km², which corresponds to 18% of the central western region of Brazil, bordering Paraguay and Bolivia and bordering the States of Paraná, São Paulo, Minas Gerais, Goiás and Mato Grosso. From a hydrographic point of view, it is located between two basins: the Paraguay River and the Paraná River. Its territory includes the biomes Cerrado (61%), Pantanal (25%), and the Atlantic Forest (14%) (Mato Grosso do Sul, 2015). In terms of vegetation, it consists mainly of Cerrado physiognomies, in addition to seasonal forests, Chaco and Pantanal (Sartori et al., 2009).

Currently, 27 Full Protection Conservation Units (UCs) are part of the state's territory (three under federal jurisdiction, eight under state jurisdiction and 16 municipal), totaling an area of 567,352.60 hectares, which represents 1.59% of its area protected by UCs. Added to the Private Natural Heritage Reserves - RPPNs (39 state and 12 federal) conceptually recognized as Full Protection, the state totals 1.99% of its area with units of this group of protected areas from the most restrictive group. Of the Sustainable Use categories, MS has 39 UCs (one federal, three state and 36 municipal) covering 4,077.39 hectares, which represents 11.42% of the area protected by UCs in this group, predominantly in the Environmental Protection Areas category, the vast majority being municipal. Of the exploitable area, approximately 84% is used for agricultural activities: 84.18% for livestock and 14.59% for agriculture (IBGE, 2006).

From a geomorphological point of view, the state territory is made up of two continuous geographic strips, the Pantanal plains, characterized by a large wetland area with a predominance of natural vegetation in a territorial extension of approximately 89 thousand km², contrasting with the plateau part, which is characterized by a high level of anthropization, where there is a predominance of large mechanized areas for the exploitation of beef cattle and agriculture with a high degree of technification.

2

GENERAL METHODOLOGICAL ASPECTS OF THE STATE INVENTORY

This first Greenhouse Gas Inventory in MS presents emissions for the years 2017 and 2018. The preparation of this Inventory met the Guidelines for National Greenhouse Inventories - IPCC 2006. In addition, we used the Fourth National Communication of Brazil to the United Nations Board Convention on Climate Change, published by the Ministry of Science, Technology, Innovation and Communications (MCTIC), as a reference of a more regionalized application of the IPCC methodology.

The IPCC methodologies for quantifying emissions are divided into three levels (or Tiers) that correspond to the methodological complexity and representation of the particularities of each country. Tier 1 is considered the basic method, using standard emission factors (default) indicated by the IPCC methodology itself; Tier 2 is intermediate; and Tier 3 is more demanding in terms of nationally or regionally obtained data requirements. Tiers 2 and 3 are considered the most accurate estimation methods. For this Inventory, Tiers 1 and 2 were used, whose application for the various categories can be understood in the sectoral details presented.

2.1. MAIN INVENTORIED GREENHOUSE GASES

The greenhouse gases estimated in this Inventory were carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), which account for more than 99% of emissions in carbon equivalent (CO_2eq). Other gases, such as carbon monoxide (CO), nitrogen oxides (NOx) and other non-methane volatile organic compounds (NMVOC), are indirect GHGs whose anthropogenic emissions have been included wherever possible, as encouraged by the UNFCCC.

2.2. THE GAS EQUIVALENCE METRIC

According to the UNFCCC, the Inventory results must be presented in absolute units of gas. Each greenhouse gas has an associated Global Warming Potential (GWP). GWP is a measure of how many times more heat a given amount of a greenhouse gas retains in the atmosphere than the same amount of CO_2, over a given time horizon. It is expressed as a factor which, multiplied by the mass of the gas, results in a CO_2 equivalent mass (CO_2 eq). In this Inventory we use the Global Warming Potential using the IPCC Fourth Assessment Report (AR4) related to CO_2 (Table 1).

Gás	GWP values for 100-year time horizon
Carbon Dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

Table 1. IPCC Fourth Assessment Report (AR4) related to CO_2.

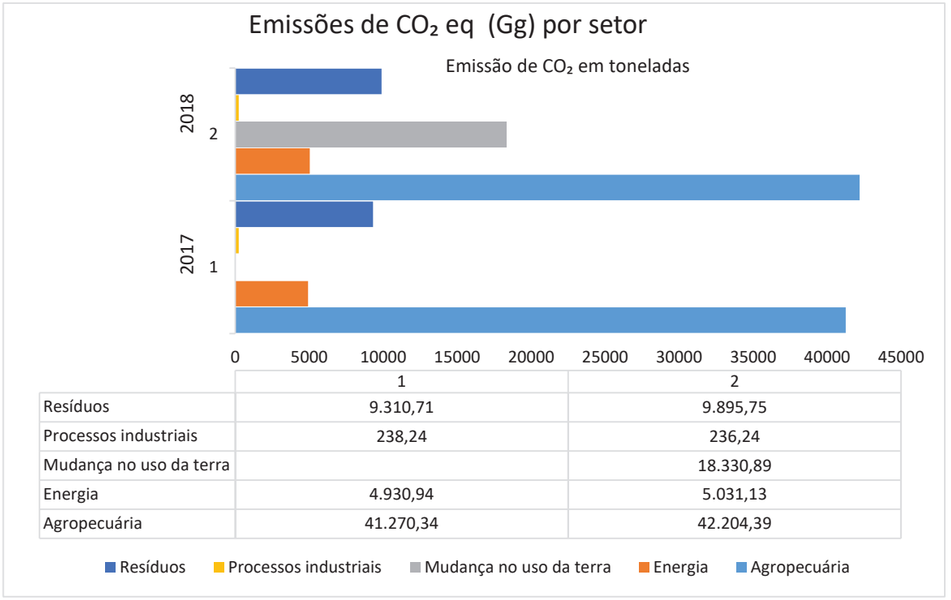
2.3. INVENTORIED SECTORS

The Inventory is organized according to the 2006 IPCC Guidelines, covering the following sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture and Livestock; Land Use Change and Forestry (LULUCF); and Waste. Greenhouse gas removals are accounted for only in the LULUCF sector, as a result of the increase in carbon stock through, for example, vegetation growth.

3

INVENTORIED SECTORS

The total greenhouse gas emissions of MS in the year 2018 was 75,698.40 (Gg) CO_2 equivalent, with emphasis on the Agriculture and Livestock sector that contributed 55.75% of total emissions, the Land Use Change sector with 24.22% the Waste sector 13.07% and the Energy sector with 6.65%. The Industrial Processes sector had a smaller share of emissions,representing 236.24 and 0.31%, respectively (Figure 1A and 1B). Methane was the most representative gas in total emissions (Figure 2 and 3).



	1	2
Resíduos	9.310,71	9.895,75
Processos industriais	238,24	236,24
Mudança no uso da terra		18.330,89
Energia	4.930,94	5.031,13
Agropecuária	41.270,34	42.204,39

Figure 1A. Total CO_2 eq. emissions by sector in the years 2017 and 2018.

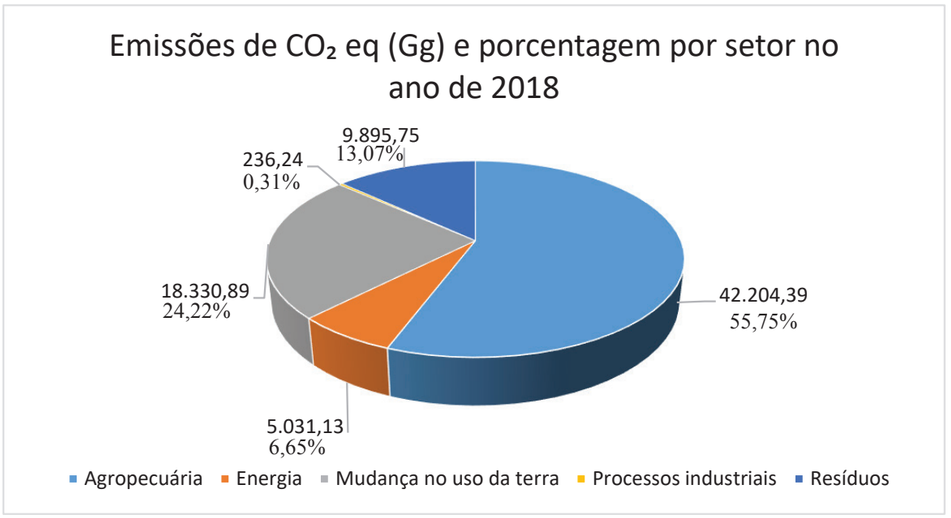


Figure 1B. Total CO_2 eq emissions in the year 2018.

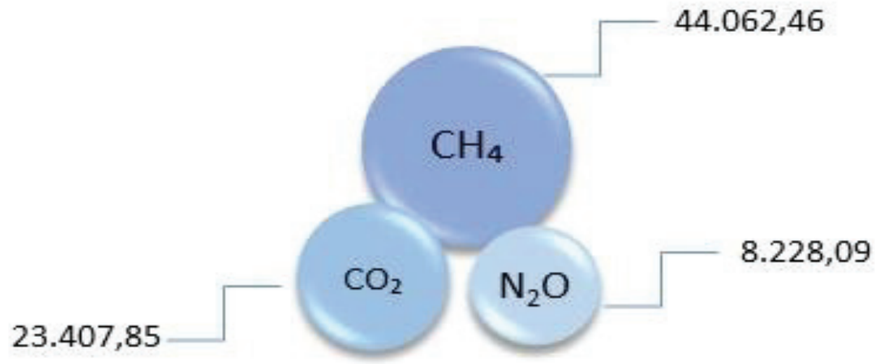


Figure 2. Total emissions (Gg CO_2 eq) of the gases CO_2, CH_4 e N_2O in 2018.

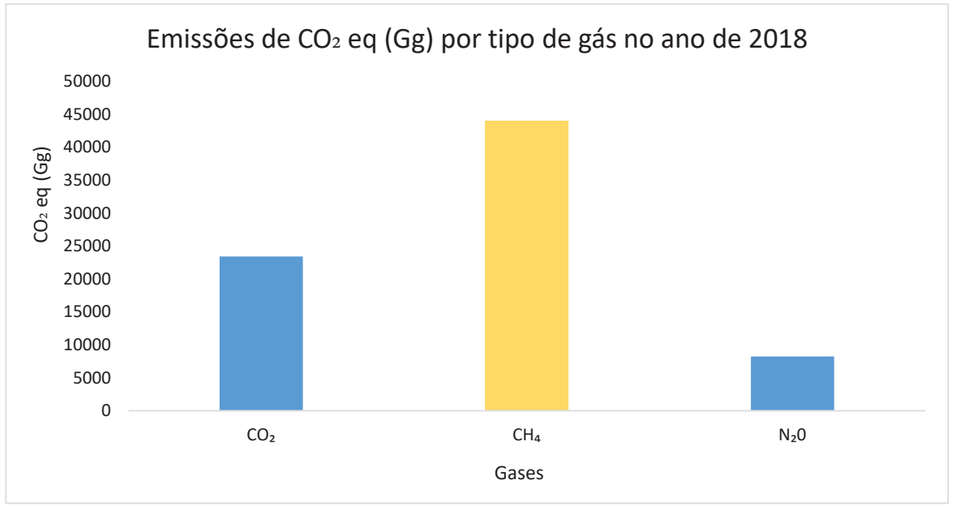


Figure 3. CO_2 eq emissions (Gg) by type of gas in the year 2018.

3.1 ENERGY SECTOR

Emissions from the energy sector come from the burning of fuels in activities such as transportation, industry, and electricity generation; in addition to so-called fugitive emissions, caused by the escape of greenhouse gases during fuel production (such as methane leakage in natural gas exploration). In 2018 this sector contributed 6.65% of total CO_2 eq emissions in the state territory. The main emissions of the sector come from transportation, which contributes 58.45% of emissions, followed by agriculture and cattle ranching, which represents 27.60% (Figure 4 and 5).

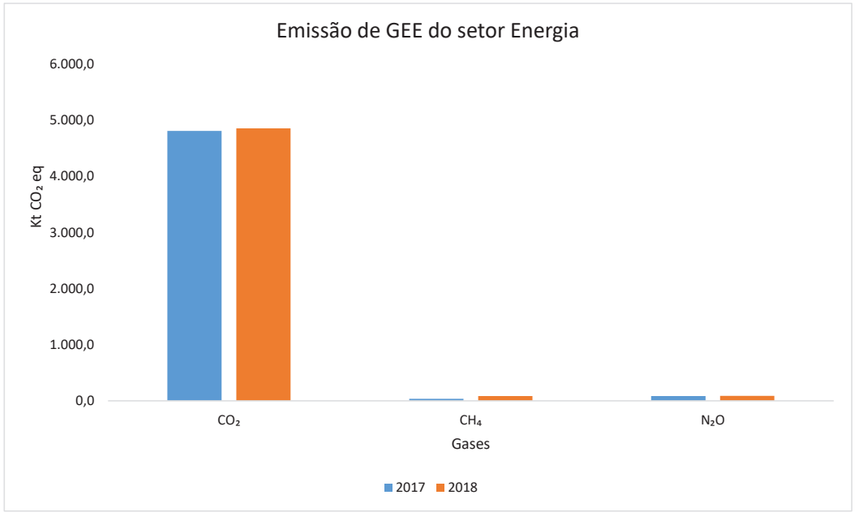


Figure 4. Greenhouse gas emissions from the Energy sector in the years 2017 and 2018.

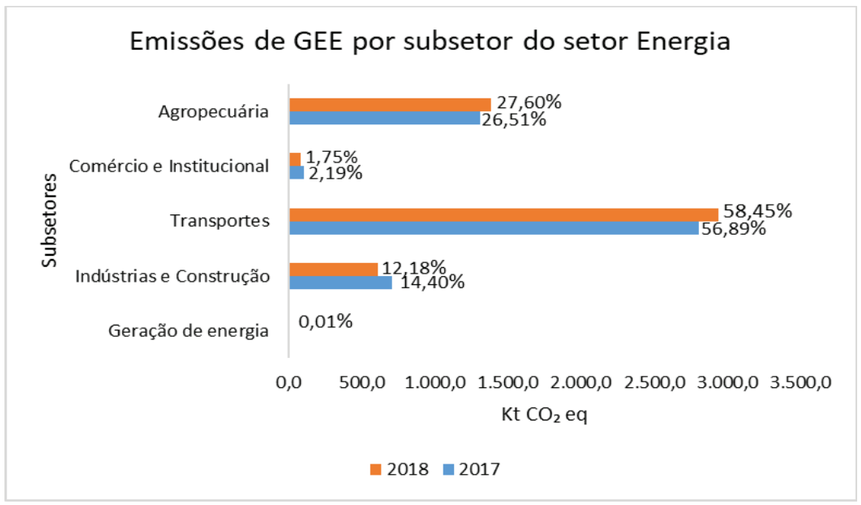


Figure 5. Greenhouse gas emissions by subsector of the Energy sector in the years 2017 and 2018.

3.2. INDUSTRIAL PROCESSES SECTOR

The Industrial Processes and Product Use (IPUP) sector accounts for emissions from physical or chemical transformations of materials in industry. In 2018, this sector contributed only 0.31% of the total emissions in Mato Grosso do Sul, which corresponds to 236.24 $KtCO_2$ eq. The representative activity of the emissions is cement production that emitted 94.02% of the total CO_2 eq in 2018, and iron production 5.98% of the total in the year 2018 (Figure 6 and 7).

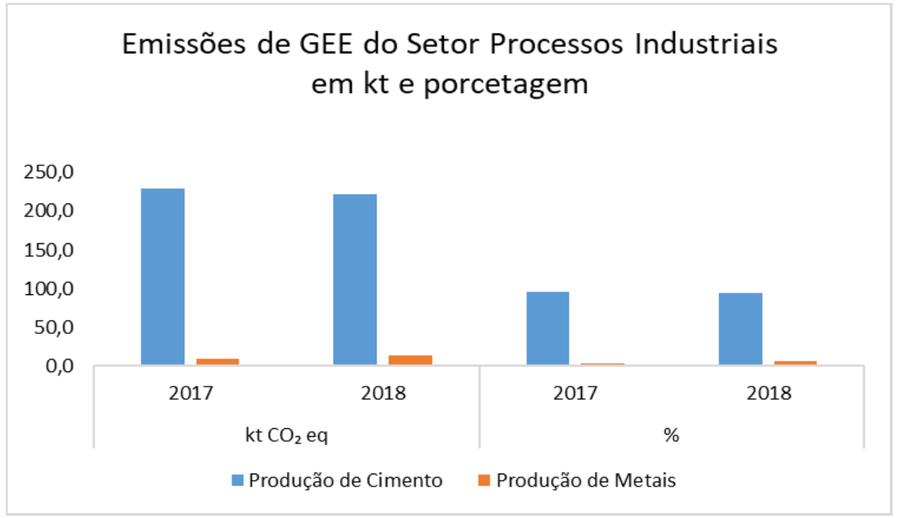


Figure 6. Greenhouse gases emissions from the Industrial Processes sector in Kt and percentage in the years 2017 and 2018.

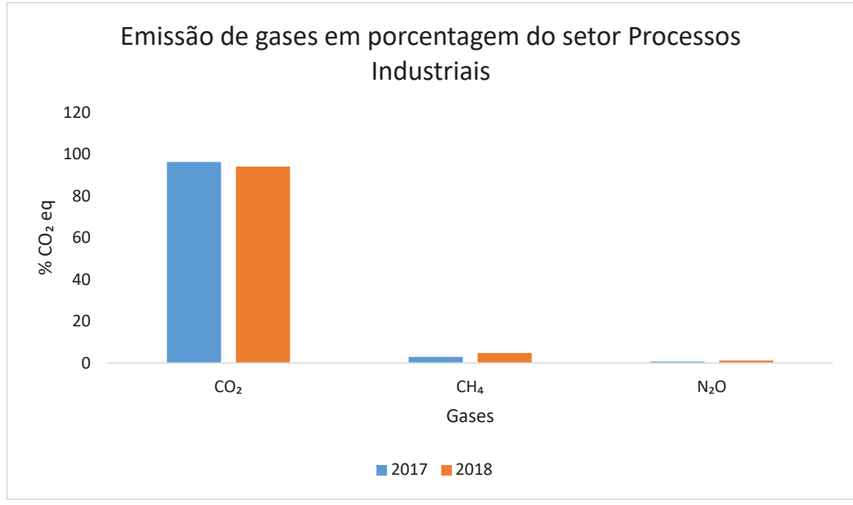


Figure 7. Gas emissions as a percentage from the Industrial Processes sector in 2017 and 2018.

3.3.1. AGRIBUSINESS SUBSECTOR

The Agribusiness subsector led the emissions of CO_2 eq. corresponding to 41,270.34 Gg in the year 2017 and 42,204.39 Gg in the year 2018, in a proportion of 55.75% of the total emitted in the state territory. This expressive value of emissions is directly related to the size of the animal population in this period and especially when taken into consideration the animals that make up the categories of beef cattle farming in MS, with a population of 20,886,365 individuals in the year 2017 and 21,307,988 in the year 2018, which corresponds to 99% of the total emissions of the subsector (Figure 9). In the context of this subsector, enteric fermentation contributed the highest emission values. Thus, CH_4 emissions generated by ruminant digestion account for almost 90% of the sector's emissions (Figure 8).

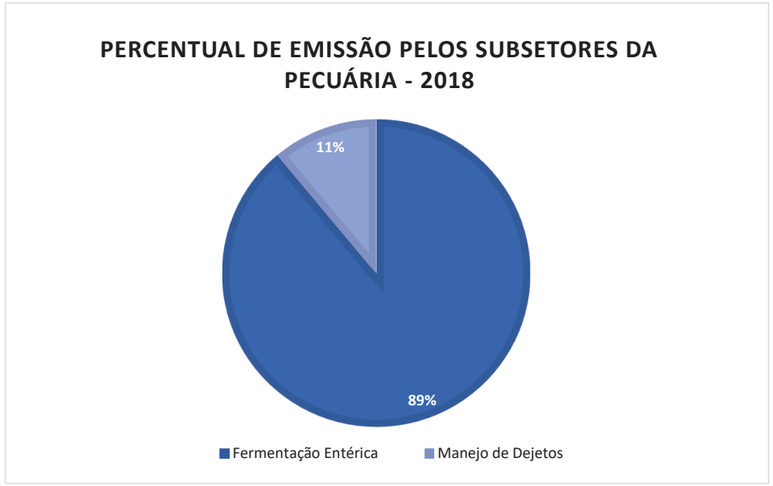


Figure 8. Percentage of emission by livestock subsectors in the year 2018.

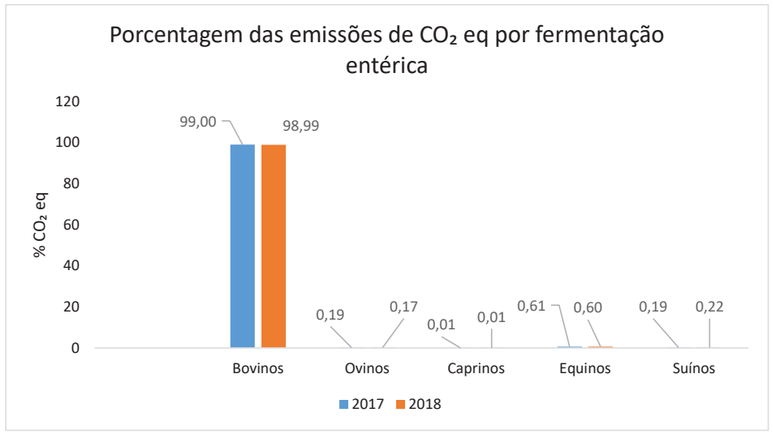


Figure 9. Percentage of CO_2 eq emissions by enteric fermentation in the years 2017 and 2018.

3.3.2. SUBSECTOR - MANURE AND SOIL MANAGEMENT

In the manure management subsector the CO_2 eq. from bovine manure used as fertilizer stands out, corresponding to 74.90% in 2017 and 71.06% in 2018 of the emissions of this subsector (Figure 10).

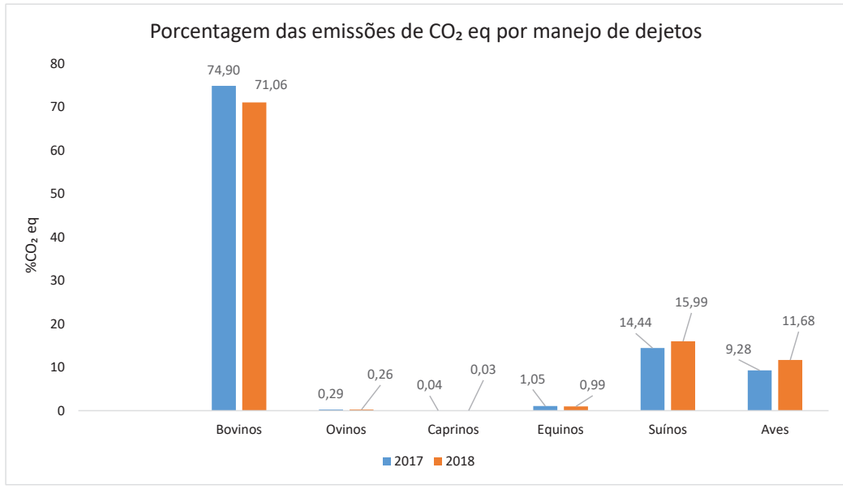


Figure 10. Percentage of CO_2 eq emissions by manure management in the years 2017 and 2018

Also noteworthy is the proportion of CO_2 equivalent emitted by N_2O mineralization that corresponds to 19.75% in the year 2017 and 19.40% in the year 2018 of the total emissions of the managed soils and manure management subsectors.

When analyzing only the managed soils subsector, mineralization stands out in the share of emission sources with 36.79% in 2017 and 37.96% in 2018, respectively. Emissions from soybean, corn and urea residues in Kt, in percentage of CO_2eq, also stand out (Figures 11, 12 and 13).

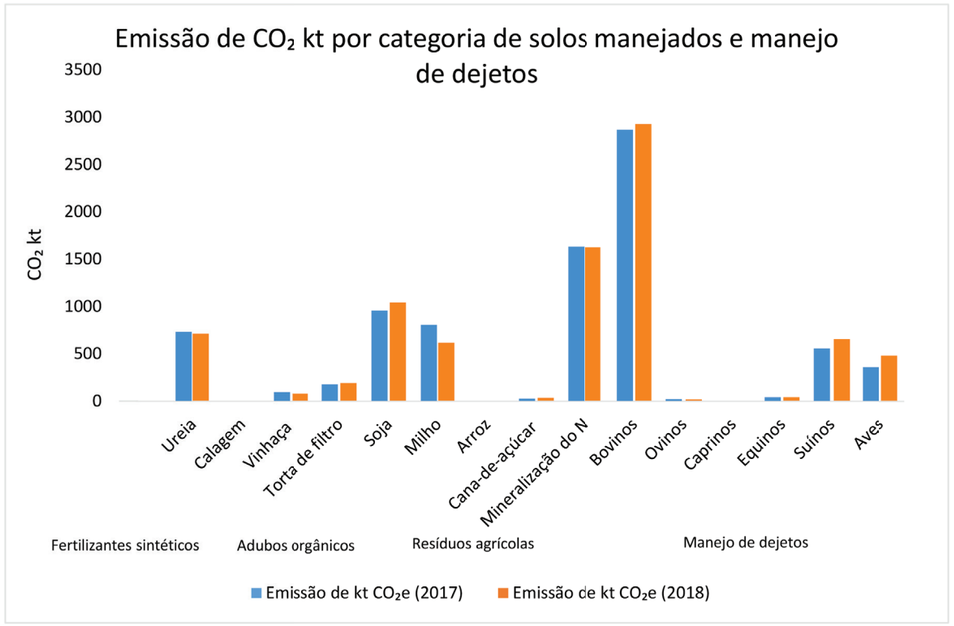


Figure 11. CO_2 emissions (Kt) by category of managed soils and manure management in the years 2017 and 2018.

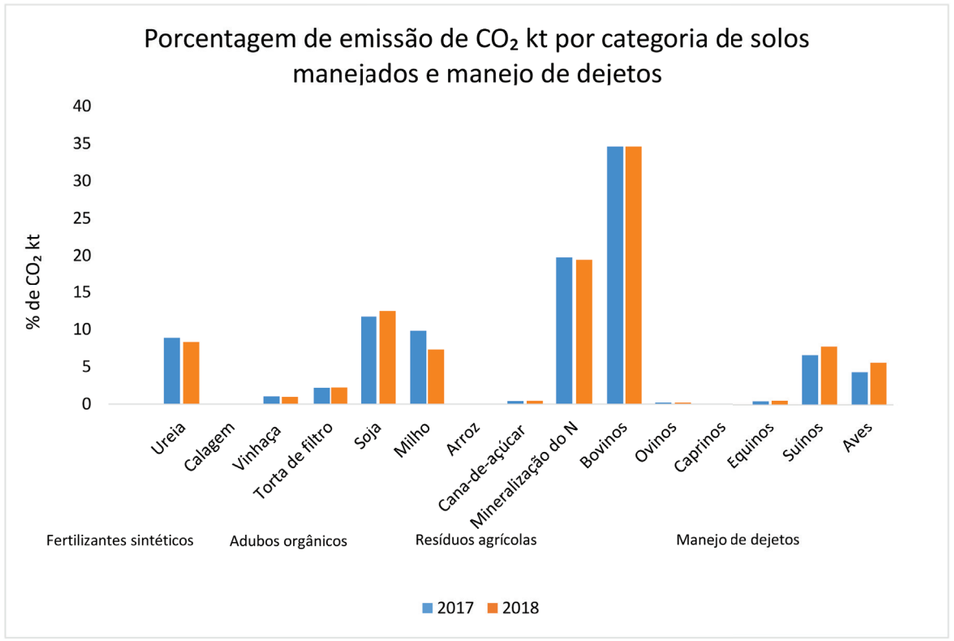


Figure 12. Percentage of CO_2 emissions (Kt) by category of managed soils and manure management of the years 2017 and 2018.

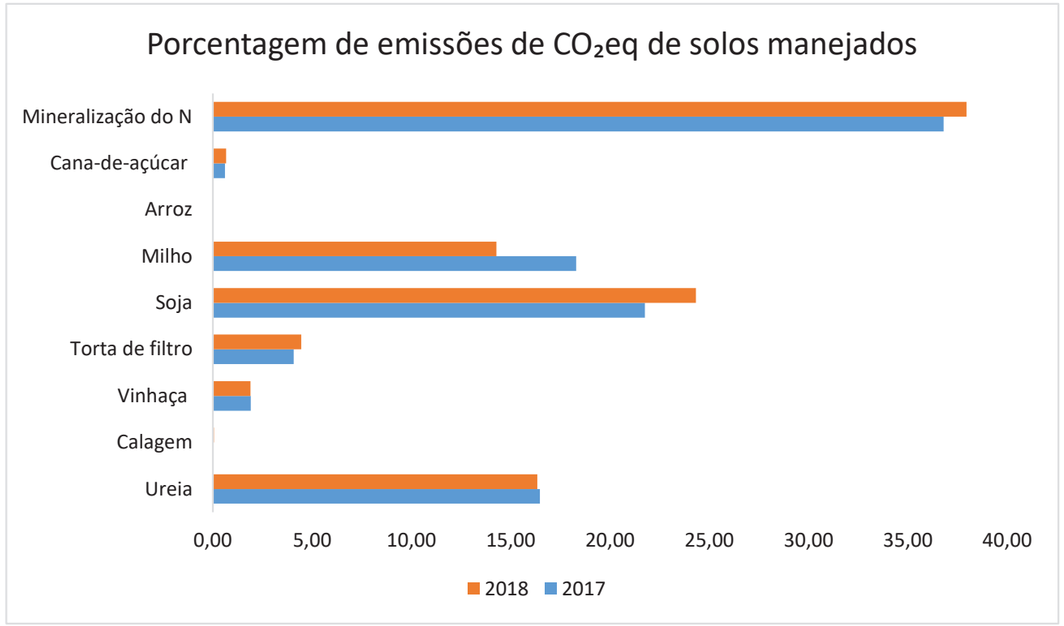


Figure 13. Percentage of CO_2 eq emissions of managed soils in the years 2017 and 2018.

3.3.3. LAND USE CHANGE AND FOREST SUBSECTOR

The Land Use, Land Use Change and Forest (LULUCF) sub-sector presents the gross and net Greenhouse Gases emissions related to the processes of change in the existing above and below soil biomass and organic matter stocks, as well as emissions from burning forest residues.

To generate the sector's estimates, two main pieces of information are required: land cover and land use maps and information on carbon stocks and increments by vegetation class and land use.

STATE BIOMES

Mato Grosso do Sul has in its territory three biomes of great ecological, economic, social, and cultural importance: Cerrado, Atlantic Forest, and Pantanal that occupy, respectively, an area of 61%, 14%, and 25% of the state territory (Figure 14). These biomes are composed of different types of physiognomic and geomorphologic formations, with high rates of diversity and the provisioning of important ecosystem and economic services such as the maintenance of climatic stability, pollination of native and agricultural crops, preservation of biodiversity, carbon stock, among others (MMA, 2002). Besides the biogeographical differences that define these biomes, there are specific conditions regarding the types of vegetation, soils, climatic conditions and human pressure. (Figure 14).

These characteristics influence the existing carbon stocks and, consequently, the contribution of each biome to the country's emissions (Seeg 9, 2022). In this sense, to better address the specificities of each biome with regard to emission and removal factors and present the activity data in a regionalized manner, the estimates of emissions and removals of land use and land cover categories, consider the different state biomes.

The Pantanal biome has the largest area of native vegetation among the state biomes, with 85.5% natural vegetation and 14.5% anthropic formations. The Cerrado biome with 27,77% natural vegetation, and 72,23% anthropic vegetation. The Atlantic Forest, with only 18.72% of natural vegetation (Figure 15).

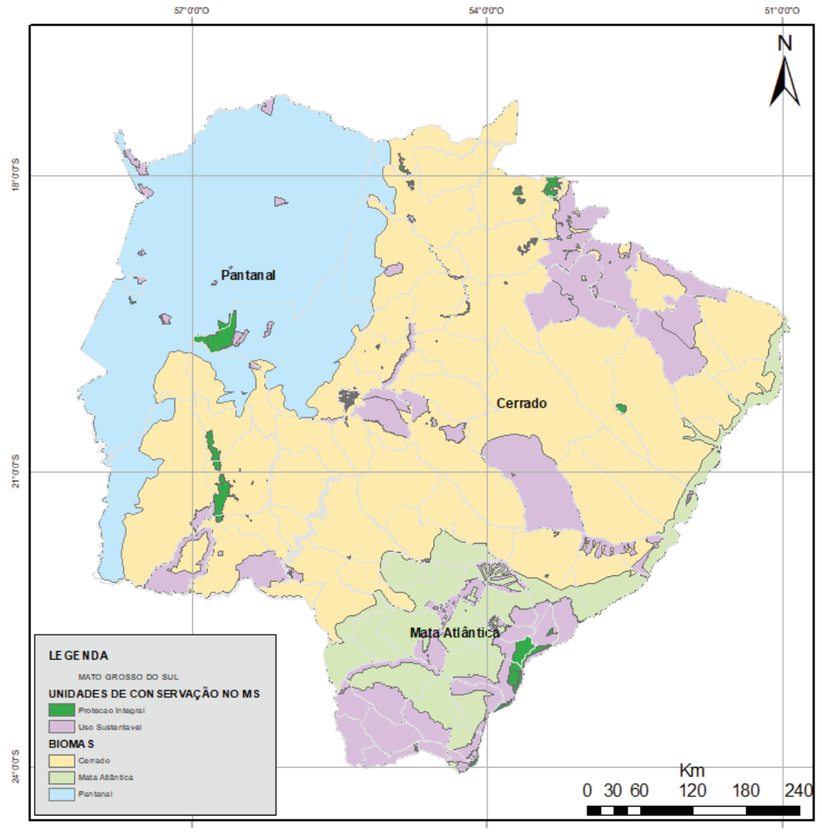


Figure 14. Composition of biomes and Conservation Units in the state of Mato Grosso do Sul.

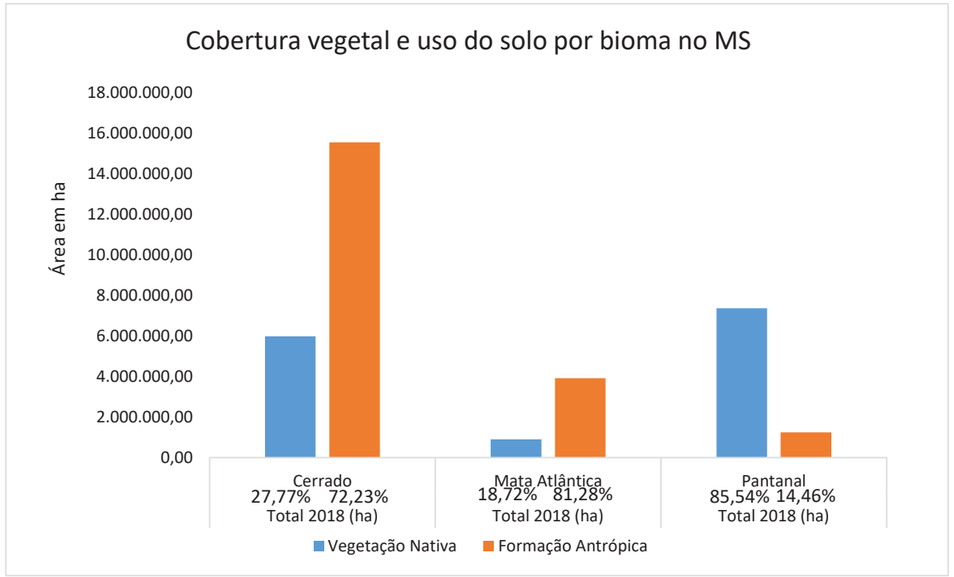


Figure 15. Vegetation cover and land use by biome in the state of Mato Grosso do Sul in the classifications "native vegetation" and "anthropic formation".

Land use change represents 24.22% of the total CO_2 equivalent emissions in MS, totaling 18,330, 89 Gg. The Cerrado Biome is the one that contributed with the highest percentage of Emission, which corresponds to 76% of the total emissions of the sector (Figure 16). In terms of land use change between 2017 and 2018, the main conversion for the Cerrado biome was from Forest Formation to Agricultural Mosaic, which totaled 10.14% and Forestry to Agribusiness Mosaic Uses which accounted for 10.06% of the total use changes. For the Pantanal biome the main conversion was Forest Formation to Pasture which represented 8.61% of the total changes. For the Atlantic Forest biome the main conversion was Forest Formation to Pasture, which represented 2.58% of the total changes in the biome. (Figure 17 A). The conversion of annual crops to pasture and pasture to forestry also stands out as the main component of removal (Figure 17 B).

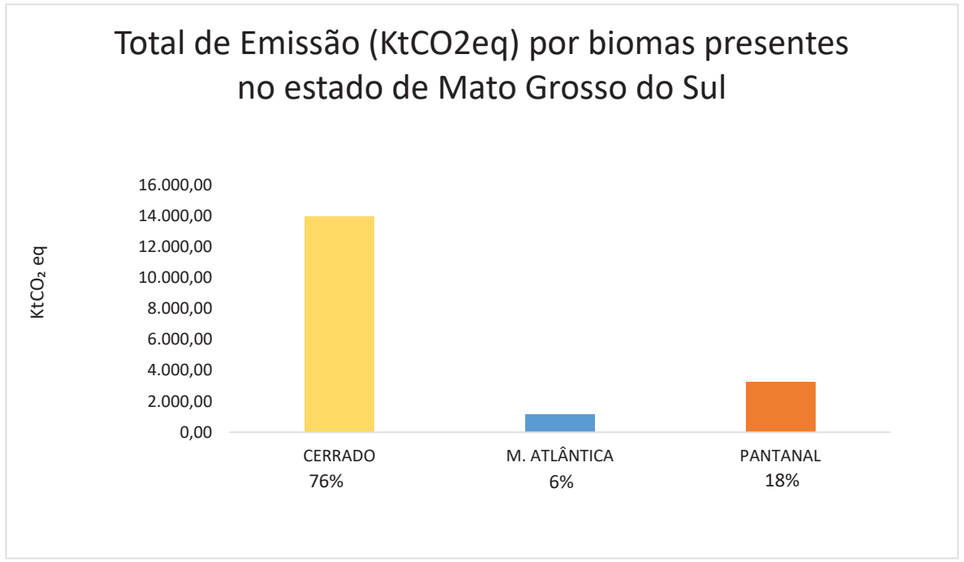


Figure 16. Total emission (Kt CO_2eq) by biomes present in the state of Mato Grosso do Sul.

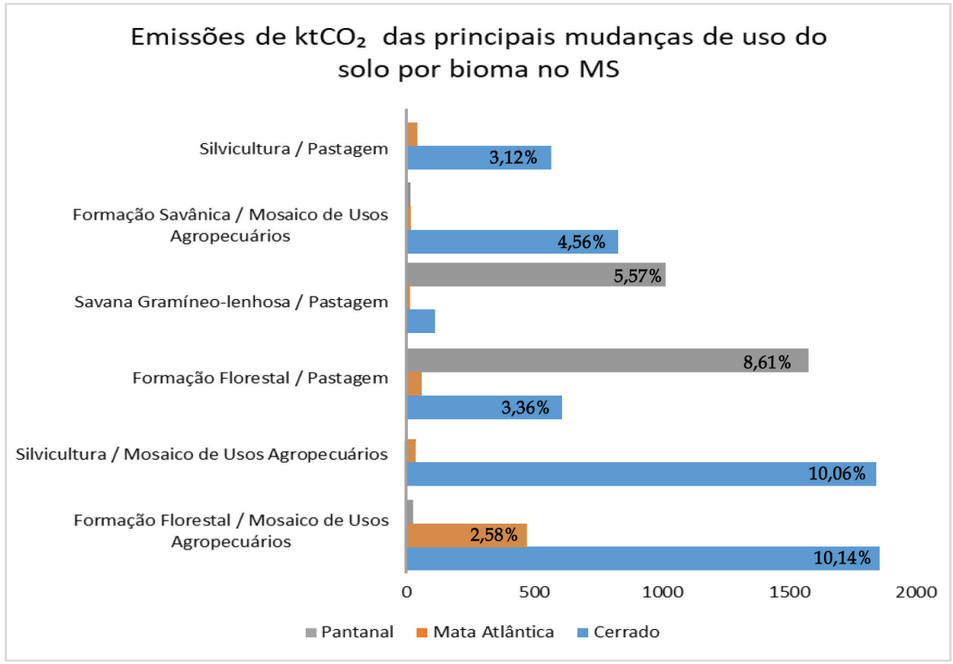


Figure 17 A. KtCO_2 emissions of the main land use change by biome in Mato Grosso do Sul.

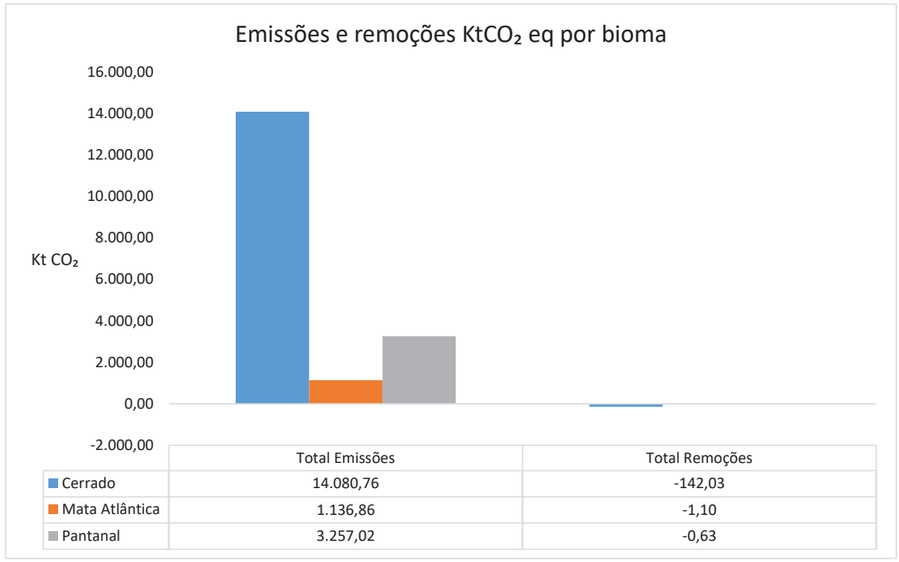


Figure 17 B. Emissions and removals KtCO_2 eq by biome in the state of Mato Grosso do Sul.

3.4. WASTE SECTOR

This sector accounted for 13.07% of the total emissions in Mato Grosso do Sul, which corresponds to 9,310.71 Gg of CO_2 eq in the year 2017 and 9,895.75 Gg of CO_2 eq in the year 2018. The state report for this sector includes emissions from the final disposal of solid waste in landfills and dumps, incineration and open burning, as well as the dumping of wastewater that has or has not undergone any treatment process.

The main gas emitted by the sector is methane (CH_4), the predominant participation of which 92% comes from the final disposal of solid waste and the treatment and discharge of industrial wastewater (Figures 18 and 19).

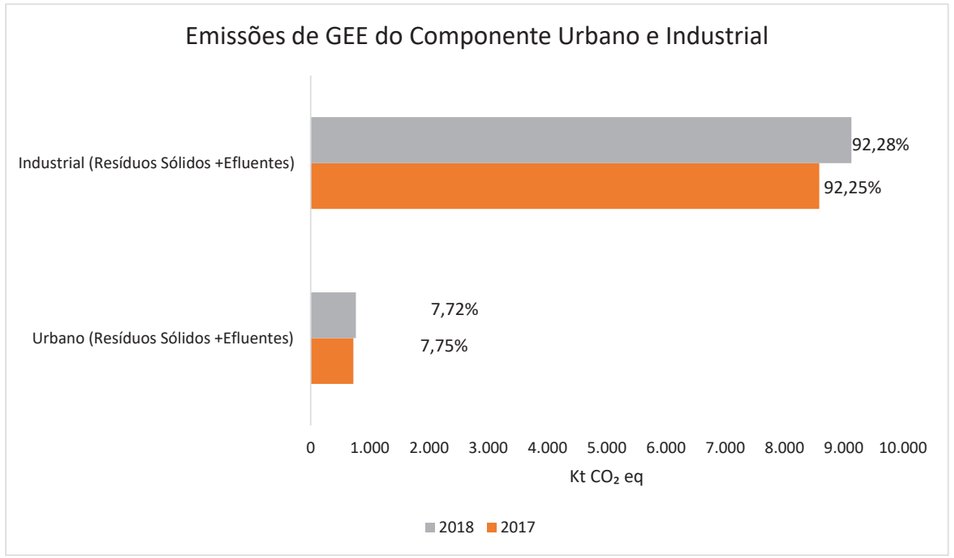


Figure 18. Greenhouse gas emissions from the Urban and Industrial Component for the years 2017 and 2018.

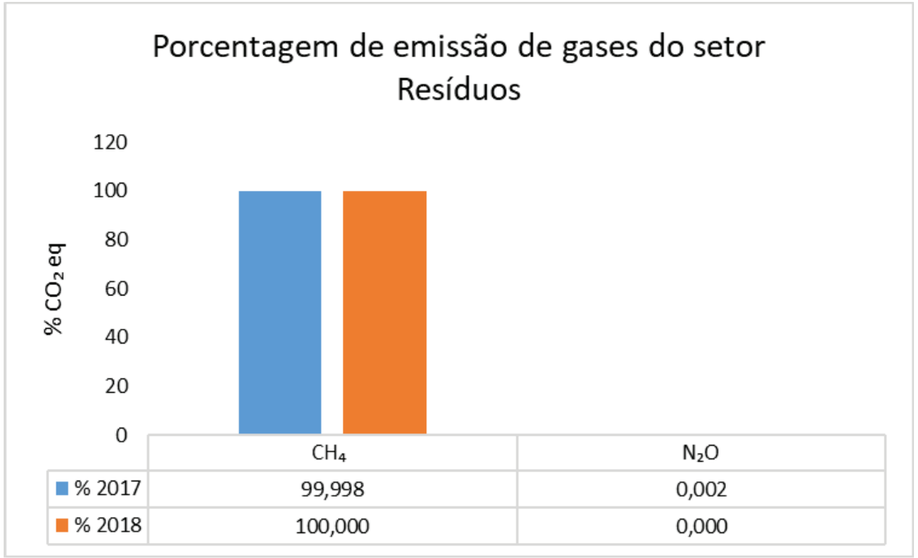


Figure 19. Percentage of gas emissions of the Waste sector in the years 2017 and 2018.

4

FUTURE CONSIDERATIONS AND PERSPECTIVES

The State Policy for Climate Change in Mato Grosso do Sul ProClima is based on three major axes: Sustainable Development - Biodiversity - Climate Change, which are interconnected, and therefore require a cross-cutting management. The main guiding instruments and basis for building ProClima in the context of state policies are: Economic instruments, Budgetary mechanisms, Communication, Inventory of greenhouse gases, Voluntary public registry of greenhouse gases and the Climate Agreement.

Therefore, this first State greenhouse gas inventory focused on the years 2017 and 2018, consists of one of the main planning tools of ProClima MS, which proposes, besides identifying the emissions of greenhouse gases in MS, to guide, in a didactic way, mitigation and adaptation strategies at regional level, in order to promote sustainable development with emission reductions. It is characterized as a dynamic initiative, which will be constantly updated to review the existing actions and projects and include other actions that contribute to building a future with socioeconomic development that is neutral in greenhouse gas emissions. In this first edition, potential and existing state programs and projects were identified, which strengthen and seek solutions in the inventoried sectors, segmented in the themes of Energy, Waste, Agriculture and Livestock, and Changes in Land Use and Forests.

The results indicate that agribusiness raising are leading the way in CO_2 eq emissions, with a proportion of 55.75% of total emissions in Mato Grosso do Sul. To neutralize the methane from enteric fermentation, one of the main measures is the adoption of crop-livestock-forest integration systems (ILPF). Mato Grosso do Sul already ranks 1st in the country in areas with ILPF. According to data from the ILPF Network Association, the state already has 3.3 million hectares of cattle raising areas in pastures shaded by eucalyptus, or alternating soy and corn with brachiaria or other grasses, representing a 17.2% advance in the last two years of the ILPF system in the state's rural properties. The outcome is the result of state investment in research and innovation, which has allowed the intensification of livestock with the adoption of good production practices and new technologies. State programs such as Sustainable and Organic Meat of Pantanal are produced through integration systems. Recently implemented by SEMAGRO these programs offer incentives to producers with tax exemptions. The reduction of the Value-Added Tax on Sales and Services (ICMS) can reach 50% in the production of sustainable meat and 67% in organic production.

It is also noteworthy in the contributions in emissions is the Land Use Change sector, which represents 24.22% of the total CO_2 eq emissions in MS. The main conversion that generated emissions for the Cerrado biome was forest formation for agribusiness mosaic, and for the Pantanal biome the conversion of forest to pasture. The goal of zero "illegal deforestation" by 2030 is an important and strategic challenge, which requires strengthening environmental monitoring systems via satellite. Another important action is to accelerate the environmental regularization of rural properties, through the Rural Environmental Registry (CAR) and the adhesion of landowners to the Environmental Regularization Program (PRA), to restore native vegetation. Considering that 98% of the rural properties in the state have already adhered to the CAR, the new stages of diagnosis of the areas that require restoration are already in the planning and prioritization phase.

The State Program of Payment for Environmental Services (PSA), implemented in 2021, is also expressed as relevant in the efforts to restore and protect the ecosystem services associated with biodiversity, climate and carbon stocks within the Watersheds of the Formoso and Prata Rivers in the municipalities of Bonito and Jardim, contributing to the implementation of more sustainable land uses and the adoption of conservationist practices, aiming at greater productivity, restoration of pastures and conservation of the remnants of native vegetation. The expansion of PES projects greatly favors the restoration of native vegetation, stimulating the voluntary adhesion of rural producers.

Considering CO_2 eq. removals, the main conversions in the land use change subsector occurred in the conversions from annual crops to pasture and pasture to forestry, mainly focused on the Cerrado biome. In the last decade the areas of forests planted with eucalyptus and rubber trees in Mato Grosso do Sul grew at very expressive annual rates, respectively 14% and 18%. The State Plan for Sustainable Development of Planted Forests of Mato Grosso do Sul played a relevant role in the replacement of degraded pasture areas and containment of exploitation of the Cerrado to meet the productive demand.

Regarding the energy sector, our contributions reach only 6.65% of total emissions. The production of Electric Energy in the State is totally renewable, with predominance for sugarcane, of the 3,081 MW, produced in 2019, divided in 71 plants, with sugarcane bagasse biomass as the main producing source, representing 37.48%. While the 44 hydroelectric plants produced 541 MW, participating with 22.83%. The total demand of the state is 1110 MW and only 36% of the installed capacity is used in the state (SEMAGRO, 2020).

The significant contribution of the waste sector represented 13.07% of total emissions in MS. In this sense, it is worth noting that since 2017, the state has already been implementing several strategies of the programs provided in the State Plan for Solid Waste - PERS, through training actions for public managers of the state and municipalities, the improvement of solid waste management through the ICMS Ecological - Urban Solid Waste component, the completion of the planning phase of the State System of Solid Waste Management Information relating to the deployment and implementation of reverse logistics of packaging in general. The adoption of Cleaner Production practices in the State's industries, the stimulation of research, development and the use of methane gas reuse technologies in effluent treatment stations, as well as the reuse of these after treatment, and also the promotion of research, development and the use of production technologies that use less inputs, are also recommendations that can gradually provide the reduction of greenhouse gas emissions.

The State Ecological ICMS Program, a mechanism for sharing tax revenues belonging to municipalities, has become one of the drivers for the correct Management of Municipal Solid Waste in MS. Since the publication of Semade Resolution 22/2015, which disciplined criteria and procedures for the participation of municipalities in the apportionment of the ICMS Ecological rate for the Urban Solid Waste component, there was growth and economic and social increase in solid waste management policies.

Here are some premises that bring new perspectives and consolidate the state climate change policy:

• Carbon Markets is a way to bring finance to the forest; either to keep it standing or to recover it;

• Mato Grosso do Sul, in the national context has enormous potential for Nature Based Solutions projects, we have to open ourselves to this new path;

• It is a brand new, booming market with diverse players and the quality of these players should be checked. The price of the credits will be guided by quality.

• The voluntary market is expected to grow 15 times by 2030, when it could be worth $50B (Taskforce on Scaling Voluntary Carbon Markets),

• We have an important way to educate and understand the subject to avoid creating myths and half-truths;

• Brazil is in a moment of regulatory expansion that will guide the growth of this market, accompanying this process in favor of socio-environmental integrity will be determinant for the success of this market.

INSTITUTIONAL SUPPORT

RICARDO

WAY CARBON

MATO GROSSO DO SUL CARBONO NEUTRO

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SEMAGRO
Secretaria de Estado de Meio Ambiente, Desenvolvimento Econômico, Produção e Agricultura Familiar

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