Greenhouse Gas Emissions in Brazil

Greenhouse Gas (GHG) Emissions by Sector

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), Brazil's 2014 GHG emissions were primarily from the energy sector (37.4%), agriculture (32.6%), and land-use change and forestry (LUCF) (22.6%).[1] Within the energy sector, 42% of emissions were from transportation, followed by electricity and heat (25%), manufacturing and construction (19%), and other sources (14%). Agriculture was the second highest source of emissions (32.6%), with enteric fermentation from livestock contributing 60%.[2] Industrial processes (IP) and waste contributed 4.2% and 3.4% respectively.[3]

Brazil's [Third National Communication](#) (TNC) to the UNFCCC, submitted in 2016, includes a GHG inventory for the years 1990-2010 and shows agriculture to have been the greatest source of emissions in 2010 (32%), followed by energy (29%), land use, land-use change and forestry (LULUCF) (28%), IP (7%), and waste (4%).[4]

GHG Emissions by Sector, 2014 (MtCO₂e)
Including Percent of Total
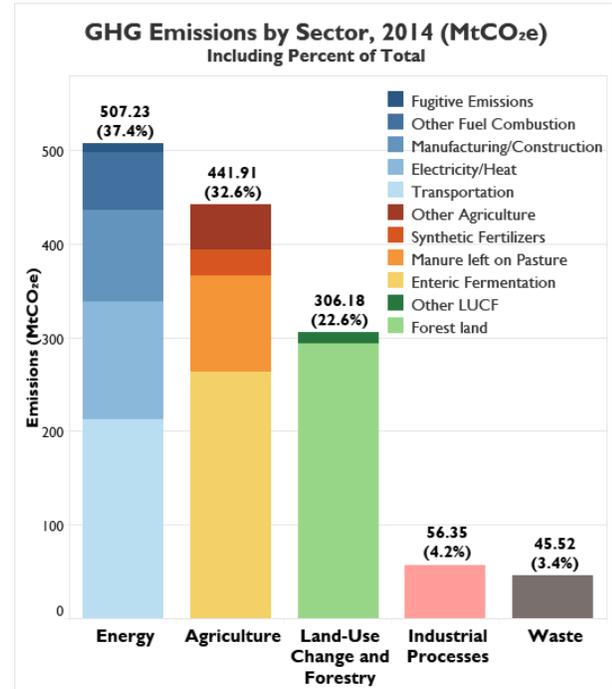
Sources: WRI CAIT 4.0, 2017, FAOSTAT, 2018
Note: Emission totals and percentages have been

Change in GHG Emissions in Brazil (1990-2014)

According to WRI CAIT data, Brazil's GHG emissions fluctuated but decreased overall by 90.47 MtCO₂e (6%) from 1990 to 2014. The average annual change in total emissions during this period was 0.1%, with sector-specific average annual changes as follows: energy (3.9%), agriculture (1.6%), LUCF (-2.7%), IP (4.4%), and waste (2.0%).[5] The change in emissions from Brazil's most significant sources is discussed below.

Energy: GHG emissions from the energy sector increased 148% from 1990 to 2014, driven by transportation emissions, followed by electricity and heat, and manufacturing and construction. The International Energy Agency attributes the growth in electricity consumption and transport fuels to strong economic growth and the emergence of a burgeoning middle class.[6] Brazil's total primary energy demand[7] has doubled since 1990, making Brazil the 10th largest energy consumer in the world and the largest in South America. Similarly, passenger vehicle ownership has tripled since 1990. However, Brazil's energy sector is among the world's least carbon-intensive, with almost 45% of primary energy and 85% of electricity coming from renewable sources, mostly large hydropower plants (80%). Due to environmental and social constraints, hydropower expansion has slowed, and other sources of power generation have been growing, such as natural gas, wind, and bioenergy. Brazil has also emerged as an important producer of oil and gas, with significant offshore discoveries and huge "pre-salt" finds below the deep-water salt layer.[8] Brazil is also the world's second largest producer of ethanol.[9] Policies such as mandatory blending levels of ethanol with gasoline incentivize the replacement of oil as a transport fuel with ethanol from sugarcane. Around 13-21% of transportation fuel consumed is from domestically produced ethanol and bioenergy accounts for more than one-quarter of primary energy demand.[10]

Agriculture: Brazil has extensive agricultural and grazing lands, with 34% of its total land area considered agricultural in 2016.[11] Agriculture is an important economic activity that contributes

to rural livelihoods and 62% of the country's exports, despite accounting for only around 5% of GDP.[12] According to WRI CAIT, agricultural emissions increased 46% from 1990 to 2014, driven by increases in enteric fermentation, manure left on pasture, and use of synthetic fertilizers. During the same period, the number of cattle increased by around 44%.[13]

LUCF: Brazil has the largest remaining tropical forest in the world and holds about one-third of all remaining rainforests.[14] WRI CAIT shows that LUCF emissions decreased 66% from 1990 to 2014, following decreases in emissions from forest land. Brazil's TNC also shows emissions from LULUCF to have decreased 59% from 1990 to 2010. During the same period, FAO data show a decline in total forest area of 0.11%, from approximately 574.8 million hectares (ha) in 1990 to 530.5 million ha in 2010.[15] The REDD Desk notes that the rate of deforestation in the Brazilian Amazon has been among the highest globally but that these rates dropped significantly, from 0.46% per year in 2005 to 0.15% per year in 2010.[16] However, deforestaion rates have again taken a turn, increasing 13.7%

GDP and Average Annual Change in GHG Emissions (1990-2014)

Agriculture, 1.6% — IP, 4.4% — Waste, 2.0% — GDP, 3.0% — Energy, 3.9% — LUCF, -2.7% — Total, 0.1%

Source: WRI CAIT 4.0, 2017

between 2016 and 2017 and reaching the highest level of the last decade in 2018.[17] Brazil has implemented three national plans to curtail deforestation: The National Plan on Climate Change, which sets an 80% deforestation reduction target by 2020 compared to 2005 levels, The Plan for Prevention and Control of Deforestation in the Amazon (PPCDAm), and The Plan for Prevention and Control of Deforestation in Cerrado (PPCerrado), which outline action plans and mechanisms to achieve the 2020 target.[18] Brazil is also a pilot country under the Forest Investment Programme of the World Bank and has received since 2008 significant national (including Petrobrás) and international aid through the Amazon Fund to invest in efforts to prevent, monitor and combat deforestation and promote preservation and sustainable use in the Brazilian Amazon.
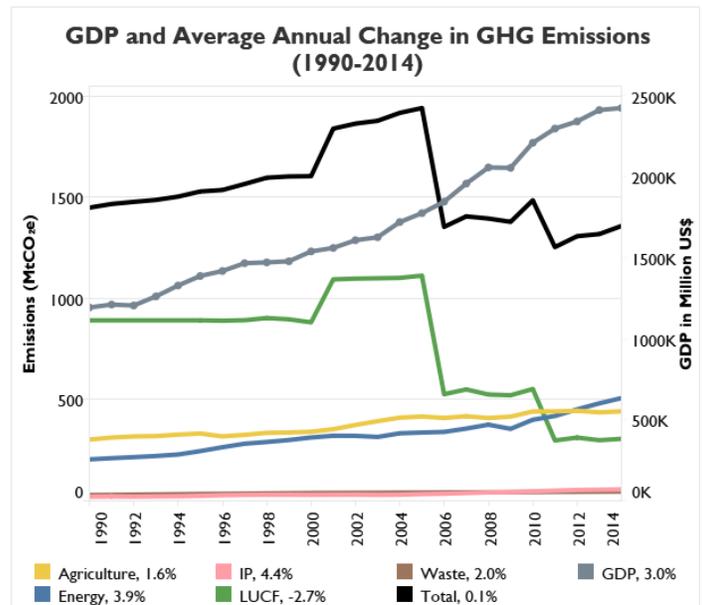
Carbon Intensity: GHG Emissions Relative to Gross Domestic Product

Brazil's economy is the largest in Latin America and the sixth largest globally, and was from 2000 to 2012 one of the fastest-growing major economies in the world.[19] According to WRI CAIT data, Brazil's GDP increased 103% from 1990 to 2014, averaging 3.0% annually. The growth rate decelerated in 2013, however, and the country entered a recession in 2014. Unlike GDP, GHG emissions decreased 6% from 1990 to 2014, averaging 0.1% annually, largely driven by emission reductions in the LUCF sector from 2004 to 2012.[20] Brazil emitted less GHGs relative to GDP than the world average but more than OECD countries.

Climate Change Mitigation Targets and Plans

In its INDC, Brazil pledged to reduce its GHG emissions by 37% below 2005 levels in 2025 and by 43% below 2005 levels in 2030. Sector specific goals to be achieved by 2030 include: increasing the share of sustainable biofuels to 18%, zero illegal deforestation in the Brazilian Amazon, restore 12 million ha of forests, enhance sustainable native forest management, achieve 45% renewables in the energy mix, and achieve 10% electricity efficiency gains.[21] Upon Brazil's ratification of the Paris Agreement in September 2016, the INDC became its first NDC. Brazil's 2018 national elections may significantly impact the country's future climate change mitigation ambition.

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[1] World Resources Institute Climate Analysis Indicators Tool (WRI CAIT 4.0, 2017). Global Warming Potentials (GWPs) are the 100-year GWPs from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR).

[2] Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Brazil, Emissions – Land use total and Emissions – Agriculture total, viewed on August 19, 2018.

[3] WRI CAIT, 2017.

[4] Third National Communication of Brazil to the UNFCCC Volume III, 2016.The TNC uses 100-year GWPs from the IPCC SAR to calculate GHGs in units of CO_2e. Brazil's Second Biennial Update Report, published in 2017, presents a bar graph of emissions showing the same ranking of emission sources as the TNC inventory. The TNC and BUR inventory results for 2010 differ slightly from the ranking of emission sources according to WRI CAIT data for 2014. Differences may be due to the TNC's use of national data whereas CAIT draws on the UN Food and Agriculture Organization (FAO) for LUCF data. Comparing different inventory years also influences differences.

[5] WRI CAIT 4.0, 2017.

[6] International Energy Agency (IEA). 2013. World Energy Outlook 2013. Chapter 2, page 69.

[7] Primary energy demand is the consumption of energy before it has been transformed to other forms of energy. For example, coal is primary energy whereas electricity generated from coal is not. See Energy Information Administration Glossary.

[8] Pre-salt oil reserves are found exceptionally deep, below the ocean under thick layers of rock and salt. A growing share of Brazil's oil production is coming from pre-salt deposits, making up approximately 47% of total output as of 2017. See EIA 2017. Brazil Overview.

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[9] Sugarcane ethanol reduces GHG emissions compared to gasoline in regards to the energy required to produce the ethanol; however, the GHG benefits are more ambiguous when land use and land use change considerations are taken into account.

[10] International Energy Agency (IEA). World Energy Outlook 2013. Part B: Brazil Energy Outlook, 2013

[11] FAOSTAT. Statistical Yearbook – Brazil, viewed March 3, 2019.

[12] Brazil's TNC, 2017. According to, the United States Department of Agriculture, Livestock and Poultry: World Markets and Trade. October 11, 2018, Brazil is the world's largest exporter of beef.

[13] FAOSTAT, 2018.

[14] The REDD Desk, 2011. Brazil: An Overview from The REDD Countries Database. The REDD Countries Database May 2011.

[15] FAO. Global Forest Resources Assessment, Global Tables, 2010. The decline in forest land left 62% of Brazil total land area as forest land in 2010.

[16] The decline in emissions can be difficult to understand, given that a decrease in forest land area seems to suggest that emissions would increase. Since forest land emissions consist of the net carbon stock change, it is the reduced rate of deforestation that has led to reduced emissions. Other sources, such as Brazil: An Overview from the REDD Countries Database (2011) and The Carbon Brief Brazil Profile (2018) discuss changes in activities that would lead to reduced emissions, such as a drop in deforestation rates.

[17] Watanabe P. and F. Maisonnave. 2018. Deforestation in the Amazon grows 14% and is the largest since 2008. (Available in Portuguese). Brazil's Ministry of the Environment states that rates have increased due to: change in political winds, favorable agribusiness exchange rates, more intense droughts and consequent fires.

[18] The REDD Desk, 2011.

[19] Keren Blankfeld, Is Brazil's Economy Getting Too Hot?. Forbes. Dec 13, 2010.

[20] WRI CAIT 4.0, 2017.

[21] Federative Republic of Brazil, 2015. Intended Nationally Determined Contribution (INDC).