



**Infrastructure Layers (Transportation, Energy and Mining) - Appendix**

**Collection 5**

**Version 1**

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## **1. About the Infrastructure Layers**

The infrastructure layers available for download or online viewing on MapBiomass gather georeferenced information from infrastructures of transport (highways, railways, ports etc.), energy (hydroelectric power plants, transmission lines, refineries etc.) and mining (coal mines, uranium mines, minerals mines etc.). These layers may contribute to researches about the correlation between land use change and infrastructure. When combined with other information from MapBiomass, these layers can also assist to understand production chains or logistical routes.

## **2. Overview and Historic of Infrastructure Layers**

The MapBiomass Collection 3 (2018) incorporated into its coverage and land use map the possibility of visualizing 36 layers referring to Brazilian energy and transportation infrastructures such as highways, railways, oil refineries or power plants. These layers were collected from different references prioritizing official sources (MInfra, ANTAQ, IBGE, EPE, ANEEL etc.). The layers were also organized according to chosen categories (Transportation, Power Sector, Fossil Fuels etc.).

All these layers were revisited in the Collection 4 (2019) to check for updates and/or better references. In the following 12 layers, some adjustments or updating were made: waterways, not identified pipelines, federal highways, gas delivery points, substations, transmission lines, wind power plants, photovoltaic power plants, biomass thermal power plants, hydroelectric power plants, small hydropower plants and fossil fuel thermal power plants.

The most important changes were made on all types of power plants layers. The Collection 3 had presented data from EPE which only included information until 2016 and only listed higher power plants. The Collection 4 presented more updated and comprehensive layers from ANEEL. This change in the information source explains the variation between plants number in Collection 3 (2138) and in Collection 4 (6466).

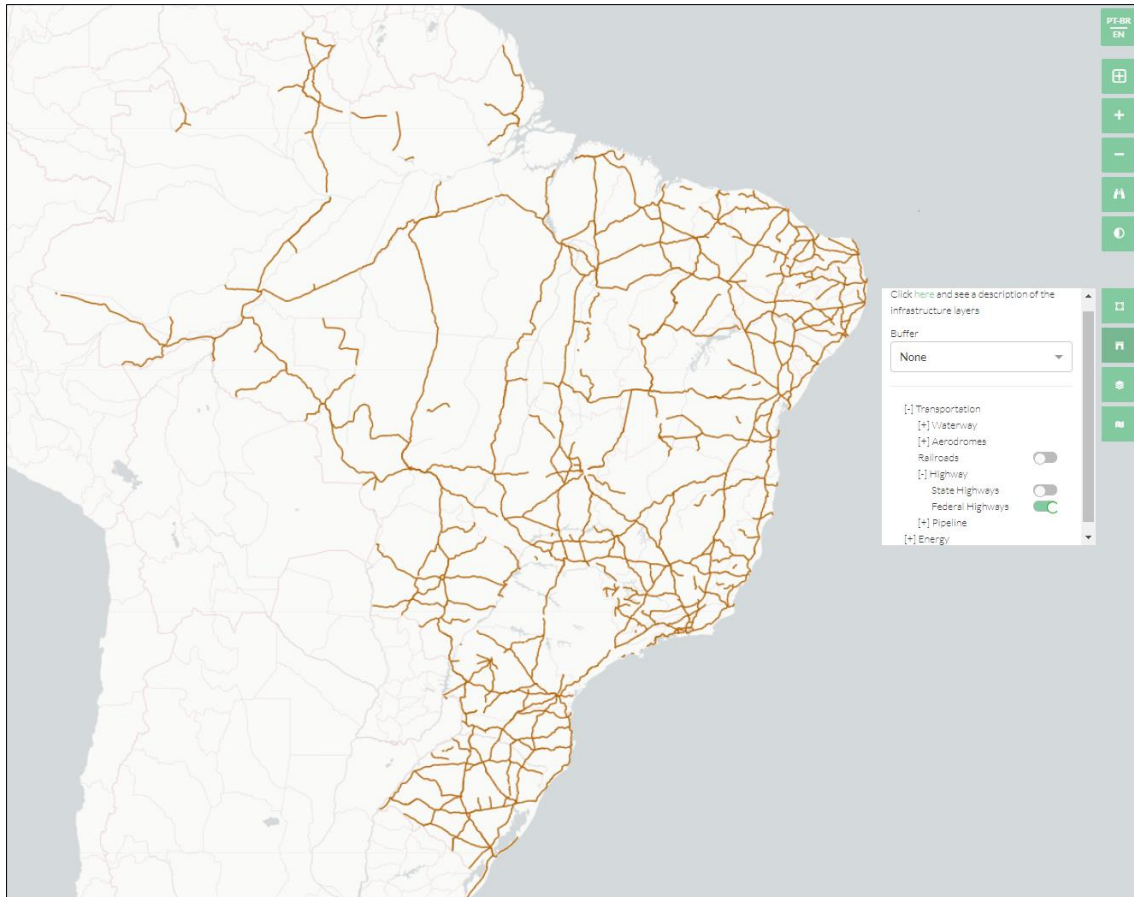
The Collection 5 (2020) maintained the same review process and 15 layers were updated: organized ports, gas pipelines, railroads, state highways, federal highways, biodiesel plants, biogas plants, substations, transmission lines, wind power plants, photovoltaic power plants, biomass thermal power plants, hydroelectric power plants, small hydropower plants and fossil fuel thermal power plants. Furthermore, there were the addition of a new layer about hydroelectric generating plants under the "Energy" category and the inclusion of "Mining" as a new category of infrastructure.

Thus, MapBiomass currently presents 40 layers of infrastructure organized as lines or points. The infrastructures installation years were added to the layers as complementary information. Buffers of 5, 10 and 20 km radius have also been generated around most of these layers. After that, land use in these polygons was calculated.

It is worth mentioning that this work of cyclical systematization and gathering of infrastructure layers is important both to understand how infrastructures influence land

use changes and to qualify decision-making processes that ensure the sustainable use of natural resources with social and economic development. This information was spread through several portals. The fact that all these data sets are now gathered in one portal (MapBiomias) also enhances their uses, enabling new analyzes, as well as motivating official organizations to improve the quality and frequency of their information.

The following figure illustrates the federal highway layer visualization through the MapBiomias online platform. Details about each one of the available layers can be found in the next topic.



**Figure 1.** Federal Highway Layer in MapBiomias (2019).

### 3. Glossary

LAYER (HIERARCHY)	DEFINITION	N. OF ELEMENTS	REF. (LAYER)	TIME DATA AVAILABLE	REF. (TIME DATA)	BUFFER	LAST UPDATE
<b>1. TRANSPORTATION</b>							
<b>1.1 Airway</b>	Area destined to aircrafts landing, taking off and moving. <i>(Ref. ANAC)</i>	2644	[1] MInfra	1925 – 2005	[9]	Yes	Collection 3
<b>1.2 Waterway</b>							
1.2.1 Lock	Hydraulic engineering device used for raising and lowering watercrafts between stretches of water of different levels in rivers or canal waterways (dams, waterfalls or rapids). Locks work as steps or lifts for watercrafts. <i>(Ref. DNIT)</i>	15	[2] ANTAQ	1958 – 2010	[10 – 15]	No	Collection 3
1.2.2 Transshipment Station	Station located outside the organized port area, exclusively used for transshipment operations of cargo destined for or coming from inland waterways. <i>(Ref. DNIT)</i>	23	[2] ANTAQ	2009 – 2016	[16]	No	Collection 3
1.2.3 Waterway	Navigable body of water within a river, lagoon or artificial channel with dimensions and parameters standardized, according to engineering criteria. <i>(Ref. DNIT)</i>	438	[1] MInfra	Not available	-	Yes	Collection 5
1.2.4 Port Facility for Tourism	Port facility operated by lease or authorization and used for boarding, landing and transit of passengers, crew, baggage, and supplies for the tourism vessels. <i>(Ref. Law N° 12.815 - 2013 - BR)</i>	2	[2] ANTAQ	2013 – 2015	[17]	No	Collection 3
1.2.5 Registered Port Facility	Installation located inside or outside the organized port area, used for the passenger transportation, or cargo storage, destined for or coming from waterway transport. <i>(Ref. DNIT)</i>	20	[2] ANTAQ	Not available	-	No	Collection 3
1.2.6 Organized Port	Infrastructure constructed and equipped to meet the needs of navigation, passengers transportation or cargo movement and storage, granted or operated by the Union, whose traffic and operations are under the jurisdiction of a port authority. <i>(Ref. DNIT)</i>	108	[3] IBGE	1856 – 1986	[18 – 36]	Yes	Collection 5
1.2.7 Private Use Terminal	Installation, not part of the assets of the public port, built by a private company or public entity for the handling or storage of third-party cargo, in addition to the own cargo, destined for or coming from waterway transport. <i>(Ref. ANTAQ)</i>	155	[2] ANTAQ	Not available	-	No	Collection 3
<b>1.3 Pipeline</b>							
1.3.1 Aqueduct	Pipeline network used for water transportation.	5	[1] MInfra	Not available	-	Yes	Collection 3
1.3.2 Gas Pipeline	Pipeline network used for gas transportation.	285	[1] MInfra	1970 – 2011	[1] [37]	Yes	Collection 5
1.3.3 Ore Pipeline	Pipeline network used for ore transportation.	5	[1] MInfra	Not available	-	Yes	Collection 3
1.3.4 Oil Pipeline	Pipeline network used for oil transportation.	370	[1] MInfra	2006	[1]	Yes	Collection 3
1.3.5 Polyduct	Pipeline network used to transport more than one product.	74	[1] MInfra	Not available	-	Yes	Collection 3
1.3.6 Not Identified	Pipeline network used to transport unidentified products.	19	[1] MInfra	Not available	-	Yes	Collection 4
<b>1.4 Railroad</b>	Rail transport system consisting of rail and other fixed installations, rolling stock, traffic equipment and everything else necessary for the safe and efficient handling of passengers and cargo. <i>(Ref. DNIT)</i>	2239	[1] MInfra	1884 – 1996	[38 – 40]	Yes	Collection 5
<b>1.5 Highway</b>							
1.5.1 State Highway	Road under state responsibility.	152656	[4] IBGE	Not available	-	No	Collection 5
1.5.2 Federal Highway	Road under federal responsibility.	5206	[5] DNIT	1996 – 2020	[5]	Yes	Collection 5

**Table 1.** Glossary – Transportation Layers.

LAYER (HIERARCHY)	DEFINITION	N. OF ELEMENTS	REF. (LAYER)	TIME DATA AVAILABLE	REF. (TIME DATA)	BUFFER	LAST UPDATE
<b>2. ENERGY</b>							
<b>2.1 Fuels</b>							
2.1.1 Fossil Fuels							
2.1.1.1 Liquid Fuels							
2.1.1.1.1 Oil Refineries and Other Processing Facilities	Facilities responsible for feedstock processing into products of interest.	22	[6] EPE	1937 – 2014	[6] [41]	Yes	Collection 3
2.1.1.1.2 Oil and Oil Products Distribution Terminal	Facilities used for receiving, shipping and storing oil and oil products. (Ref. ANP)	77	[6] EPE	1899 – 2013	[6] [42 – 45]	No	Collection 3
2.1.1.2 Gas							
2.1.1.2.1 Compression Station	Facilities responsible for compressing gas to pipeline transportation.	33	[6] EPE	1986 – 2010	[46 – 50]	No	Collection 3
2.1.1.2.2 Gas Delivery Point	Facilities responsible for decompressing natural gas for local distribution companies.	186	[6] EPE	Not available	-	Yes	Collection 4
2.1.1.2.3 Natural Gas Processing Unit	Facilities where wet natural gas heavier fractions (propane and heavier substances) are separated, generating dry or poor natural gas (methane and ethane).	14	[6] EPE	1962 – 2017	[6]	Yes	Collection 3
2.1.2 Renewable Fuels							
2.1.2.1 Biodiesel Plant	Plants for biodiesel production.	53	[6] EPE	2008 – 2017	[51]	Yes	Collection 5
2.1.2.2 Biogas Plant	Plants for biogas production.	125	[6] EPE	2004 – 2019	[52]	Yes	Collection 5
2.1.2.3 Ethanol Plant	Plants for ethanol production.	381	[6] EPE	1883 – 2017	[6]	Yes	Collection 3
2.1.3 Distribution Bases							
2.1.3.1 Liquefied Petroleum Gas Base	Installations for storage and distribution of liquefied petroleum gas (LPG).	154	[6] EPE	Not available	-	No	Collection 3
2.1.3.2 Liquid Fuel Base	Installations for fuel storage and distribution.	261	[6] EPE	Not available	-	No	Collection 3
<b>2.2 Power Sector</b>							
2.2.1 Infrastructure							
2.2.1.1 Substation	Set of machines, devices and circuits whose purpose is to modify the voltage and current levels, allowing the distribution of electric energy to diverse systems and lines. (Ref. USP)	690	[6] EPE	2004 – 2019	[53]	No	Collection 5
2.2.1.2 Transmission Line	Transmission line is a system formed by cables of conductive material, supported by towers (metallic structures), used to transmit electromagnetic energy.	1469	[6] EPE	2004 – 2018	[53]	Yes	Collection 5
2.2.2 Generation							
2.2.2.1 Renewable Generation							
2.2.2.1.1 Wind Power Plant	Power plants that transform mechanical energy from wind into electricity.	694	[7] ANEEL	1998 – 2020	[7] [54]	Yes	Collection 5
2.2.2.1.2 Photovoltaic Solar Power Plant	Power plants that transform energy from solar radiation into electricity.	3904	[7] ANEEL	2001 – 2020	[7]	Yes	Collection 5
2.2.2.1.3 Biomass Thermal Power Plant	Power plants that use biomass (e.g. sugarcane bagasse) as fuel for obtaining heat (thermal energy), generating mechanical energy and, later, electricity.	573	[7] ANEEL	1905 – 2020	[7] [54]	Yes	Collection 5
2.2.2.1.4 Hydroelectric Power Plant	Hydraulic power plants, with capacity higher than 30 MW, that transform energy from a height difference in a watercourse into electricity.	222	[7] ANEEL	1900 – 2019	[7]	Yes	Collection 5
2.2.2.1.5 Small Hydropower Plant	Medium hydroelectric plants that transform energy from a height difference in a watercourse into electricity.	475	[7] ANEEL	1900 – 2020	[7]	Yes	Collection 5
2.2.2.1.6 Hydroelectric Generating Centers	Small hydroelectric plants that transform energy from a height difference in a watercourse into electricity.	716	[7] ANEEL	1900 – 2020	[7] [54]	Yes	Collection 5
2.2.2.2 Non-Renewable Generation							
2.2.2.2.1 Fossil Fuel Thermal Power Plant	Plants that use fossil fuels to obtain heat (thermal energy), generating mechanical energy and, later, electricity.	2474	[7] ANEEL	1990 – 2020	[7] [54]	Yes	Collection 5
2.2.2.2.2 Thermonuclear Power Plant	Plants that use nuclear energy to obtain heat (thermal energy), generating mechanical energy and, later, electricity.	3	[7] ANEEL	1985 – 2000	[7]	Yes	Collection 3

**Table 2.** Glossary – Energy Layers.

LAYER (HIERARCHY)	DEFINITION	N. OF ELEMENTS	REF. (LAYER)	TIME DATA AVAILABLE	REF. (TIME DATA)	BUFFER	LAST UPDATE
<b>1. MINING</b>							
<b>3.1 Energetic Product Mine</b>	Mining facilities for coal or uranium, products used in the energy production.	14	[8] German-Brazilian Chamber of Commerce and Industry	Not available	-	Yes	Collection 5
<b>3.2 Metallic Product Mine</b>	Mining facilities for different types of minerals and metals: bauxite, cassiterite, lead, cobalt, copper, chromite, iron, lithium, manganese, niobium, nickel, gold, rare earth elements, tungsten, vanadium, zinc.	106	[8] German-Brazilian Chamber of Commerce and Industry	Not available	-	Yes	Collection 5
<b>3.3 Other Products Mine</b>	Mining facilities for different types of minerals: agalmatolite, asbestos, limestone, kaolin, diamond, feldspar, phyllite, phosphate, ilmenite, potassium, talc, vermiculite.	62	[8] German-Brazilian Chamber of Commerce and Industry	Not available	-	Yes	Collection 5

**Table 3.** Glossary – Mining Layers.

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