

GREENHOUSE GAS EMISSIONS INVENTORY ELETROBRAS COMPANIES

Base year 2019 | July 2020



ELETROBRAS ENVIRONMENT AREA

Environment Committee of the Eletrobras System (SCMA)

Coordinator
Aníbal Rodrigues Ribeiro Silva – Eletrobras

Executive Office
Anna Teixeira Amorim Laureano – Eletrobras

Climate Strategy Work Group – GT 3

Alexandre Mollica Medeiros (Coordenação) – Cepel
Ana Claudia Batista de Oliveira – Eletronorte
Ana Cláudia Santana de Almeida – Chesf
Anderson Braga Mendes – Itaipu Binacional
Carlos Frederico Menezes – Eletrobras
Cleber Angelo Ransolin – Itaipu Binacional
Débora Lunkes Lima – CGTEletrosul
Domingos Vanderlei Filho – Chesf
Eduardo da Costa Faria – Furnas
Eduardo Hatherly Vilas Boas – Furnas
Flávia Cruz Esteves – Eletronuclear
Gisele Lopes Calderaro – Amazonas GT
Katia Cristina Garcia – Cepel
Luciano Soares de Castro – Eletronuclear
Luis Eduardo Brose Piotrowicz – CGTEletrosul
Marisa Bender – CGTEletrosul
Moara Silva Morasche – Eletrobras
William Y. Katagiri – Eletronorte

Data compilation and processing

Alexandre Mollica Medeiros – Cepel
Juliano Abreu – Cepel

ÍNDICE

1. PRESENTATION	03
2. PREPARATION PROCESS AND PREMISES	04
3. GREENHOUSE GAS [GHG] EMISSIONS OF ELETROBRAS COMPANIES	07
4. GENERATION AND INTENSITY MATRIX OF GHG EMISSIONS	12
5. ATMOSPHERE POLLUTANTS: NO _x , SO _x AND MP	13
6. GASES OF THE MONTREAL PROTOCOL	14
7. ESTIMATE GHG EMISSIONS AND REMOVALS DUE TO ACTIVITIES THAT CAUSE CHANGE IN THE LAND USE	15
8. FINAL CONSIDERATIONS	16
9. REFERENCES	17
10. ANNEX	18

1. PRESENTATION

The global-wide climate phenomena bring along a high risk to the current and future society, and measures should be taken to try and minimize such effects. The stabilization of the amounts of greenhouse gases (GHG) in the atmosphere at a degree that prevents a harmful anthropic interference in the climate system, has been one of the most recurring concerns regarding the discussions between governments, scientific community and companies since the United Nations Framework Convention on Climate Change (executed in 1992 and enacted in Brazil by the Decree 2.652/1998).

The corporate sector has sought to take measures to minimize the climate change effects. Acknowledging one's share of responsibility is the first step. Therefore, GHG emissions inventories are necessary tools.

Aiming at fulfilling its commitment to the corporate sustainability good practices, Eletrobras has carried out the "Greenhouse Gas Emissions Inventory" since 2009, uninterruptedly. This document consists of its 12th edition.

Eletrobras' inventory and other initiatives are compatible to the National Policy on Climate Change (enacted by Law 12.187/2009 and regulated by the Decree 7.390/2009). This policy

establishes among its instruments: incentives for development of processes and technologies contributing to the GHG reduction and removal, as well as to the valorization of proposals that provide a greater energy, water and natural-resources saving, reduction of residue emissions, records, inventories, forecasts, assessments, and other studies on the GHG emissions and sources, prepared according to information and data provided by public and private entities (art. 6, XII and XIII).

Enhancing its commitment to addressing the topic of Climate Change, we aim to minimize our negative impact and contribute to the transition to a new development model based on a low carbon economy. This commitment is expressed in our Environmental Policy, in actions to manage greenhouse gas emissions, prioritizing renewable energy and low GHG projects and promoting studies.

In recent years, we have increased the share of sources with low GHG emissions in our installed capacity, which in 2019 represented around 96% of the total, contributing decisively to make the Brazilian electricity matrix one of the cleanest and most renewable in the world.

This document shows the calculation results of the GHG emissions by the companies of Eletrobras Amazonas GT, Cepel, Eletrobras CGTEE, Eletrobras Chesf, Eletrobras Eletronorte, Eletrobras Eletronuclear, Eletrobras Eletrosul, Eletrobras Furnas, Eletrobras Holding and Itaipu Binacional¹ for the year of 2019, based on each Eletrobras Company's individual information, in a continuous work throughout the year and involving employees from all the companies in the process of measurement, information submission, content discussion, calculations and edition of Eletrobras report.

The document also includes air pollutants as sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates (PM₁₀) and substances that deplete the ozone layer, related to the Montreal Protocol, besides the estimate of GHG emissions and removals due to activities that cause a change in land use.

¹ For the Itaipu Hydroelectric Dam, the inventory considers the GHG emissions corresponding to the company's share belonging to Brazil (50%).

2. PREPARATION PROCESS AND PREMISES

- The information required to the preparation of this Inventory was collected in each company by the employees directly responsible for the information, and the process was supervised by the companies' representatives in the Climate Strategy Work Group (GT3), created in the scope of the Environment Committee of Eletrobras Companies – SCMA.
- The GHG Emissions Inventory of Eletrobras Companies is based on the IPCC methodology (2006) and the GHG Protocol guidelines² (WRI, 2004), having as organizational limit those companies in which Eletrobras has operational control³.
- The emission factors of the National Interconnected System (SIN, in the Portuguese acronym), which are calculated and published by the Ministry of Science, Technology, Innovation and Communication (MCTIC⁴, in the Portuguese acronym), were considered to calculate emissions deriving from electricity consumption.
- The emissions corresponding to the losses in electric power transmissions were calculated based on the information provided by the Transmission Area of Eletrobras Holding.
- In Brazil, as it is mandatory to add an amount of sugar-cane ethanol to the gasoline and biodiesel into diesel oil, petroleum-derived fuels show a lower polluting potential than the ones used internationally. Thus, biogenic CO₂ emissions deriving from bio-fuels consumption (biodiesel, ethanol added to the gasoline and vehicular ethanol) are approached in a special chart in the Inventory, as these emissions are reabsorbed by photosynthesis in the cultivation of sugar cane, soy, and other vegetables used in the production of such biofuels. That is why, since Eletrobras Companies' GHG Inventory base year of 2013, the emission factors published in the First National Inventory of Atmosphere Emissions by Road Automotive Vehicles (Ministry of the Environment, 2011) are used for the fuel consumption of road-mobile sources (ethanol, natural gas, gasoline and diesel), replacing the IPCC.

² GHG Protocol: Global accounting reporting standard for greenhouse gas emissions, launched in 1998 and revised in 2004, internationally recognized, and today the most globally used tool by companies and governments to understand, quantify and manage their emissions..

³ When addressing operational controls, an organization accounts for 100% of GHG emissions of the units under its operational control, and does not account for those arising out of operations in which it holds only equity interests, the so called SPEss.

⁴ Available on: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_corporativos.html

- The emissions resulting from thermoelectric generation from Energy-Independent Producers (PIE, in Portuguese acronym), whose energy is purchased by the Eletrobras Eletronorte concessionaire and resold to the final customer, are quantified in scope 3 and, thus, separated from the emissions related to the Eletrobras thermoelectric plants, which are considered in scope 1.
- The value of the energetic content of consumed fuels was calculated based on the conversion factors provided for in the National Energetic Balance Sheet (base year 2018).
- The emissions of Eletrobras Companies' hydroelectric reservoirs were not considered. So far, there is no international scientific consensus regarding a methodology that allows us to calculate the GHG emission balance (or net emissions) of artificial reservoirs.
- The emissions of local-effect atmosphere pollutants, as sulfur oxides (SO_x), nitrogen oxides (NO_x) and the particulates (PM₁₀) were obtained through monitoring by the companies at their thermal power stations.
- The estimated atmosphere emission of substances that destroy the ozone layer, relating to the Montreal Protocol, was calculated by the sum of three processes: leaks in the installation process, leaks in the maintenance process, and leaks in the discharge process. All of them are related to gases used in cooling and air-conditioning equipment in the companies.
- All calculation data and memories used in GHG inventories are filed and, for each annual version, the data is verified by an independent third party. For the 2019 Inventory, base year of 2019, the assurance letter was issued on July 24, 2020, by PwC Brasil (Annex).

5 "PwC" refer to PricewaterhouseCoopers Brasil Ltda., network member of PricewaterhouseCoopers.

Figure 1 shows the GHG Inventory of Eletrobras Companies' preparation process, scope, general structure, and probate sources.

GHGs Inventory - Eletrobras Companies

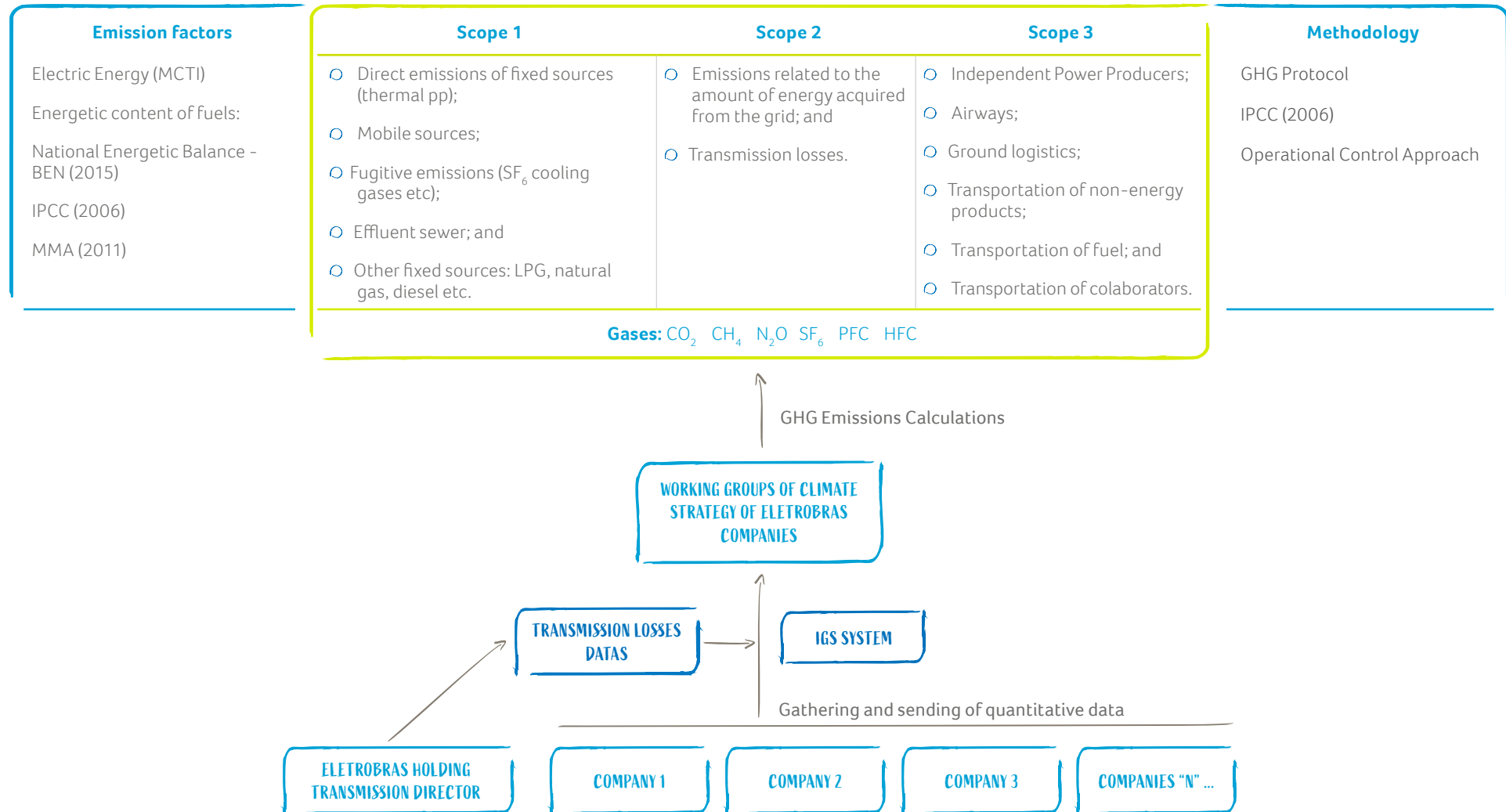


Figure 1 - Preparation Process of the GHG Inventory of Eletrobras Companies

3. GHG EMISSIONS OF ELETROBRAS COMPANIES

The GHG emissions of Eletrobras Companies for the year of 2019 are shown in Table 1, in short, and Table 2, in details. The total emission was of 5,897,384 tCO₂e, considering the scopes 1, 2 and 3.

As expected, the emissions accounted for scope 1 (88.6% of the total) predominate, followed by scope 2 (11.2% of the total) and scope 3 (0.2% of the total).

Table 1 – GHG emissions per scope – Base Year 2019 (tCO₂e)

Scope	GHG emissions	% of the total
Scope 1	5,227,207	88.6
Scope 2	659,298	11.2
Scope 3	10,879	0.2
Total	5,897,384	100

Three sources were responsible for 99% of 2019 total emission: Own Thermal Power Plants [TPP], Losses in Transmission and SF₆, with TPPs being responsible for 87.5% of the total emissions. The other sources' emissions represent 1% of the total.

The emissions that are directly under the operational control of Eletrobras Companies (scopes 1 and 2) add up 5,886,505 tCO₂e, 99.8% of the total. Whereas the emissions deriving from sources not belonging to or not controlled

by Eletrobras Companies (scope 3), which are responsibility of service and products providers, were 10,879 tCO₂e.

From the total of direct emissions (scope 1), 98.7% has origins from thermoelectric generation (own TPPs).

From scope 2, the losses in transmission represent 98.7% of the emissions and only 1.3% are emissions from the consumption of electric power itself.

The losses in the transmission systems are not manageable by the energy transmission concessionaires. The business of the Eletrobras companies which operate in the energy transmission is to keep the availability of the system under its concession. The National Operator of the System is responsible for planning and defining the system operation. The power flows and, consequently, the losses in the transmission grid derive from the operation strategies set forth by the Operator. Moreover, the equipment maintenance condition does not influence the transmission system losses, but only in the availability of such equipment.

From scope 3, air travel and transportation of employees accounted for 85% of emissions. The remaining installments represent 15% of the total scope.

Table 2 - GHG emissions by Eletrobras Companies - Base Year 2019 (tCO₂e)

Companies	Scope 1									Scope 2		Scope 3						Subtotal per company
	Fixed			Mobile			Others			Electricity Consumption	Transmission Losses	Fuels Transportation	Energy Independent Producers - PIEs	Non-Energetic Products Transportation	Air Transportation	Employees Transportation		
	Own TPPs	Generators	Others	Land	Water	Air	SF6	Cooling	Liquid Effluents									
Eletrobras Amazonas GT	2,175,732	12	20	220	11	n.a.	0	14	167	134	1,339	n.a.	n.a.	n.a.	271	175	2,178,095	
Cepel	n.a.	1	52	2	n.a.	n.a.	46	0	1	455	n.a.	n.a.	n.a.	n.a.	86	515	1,157	
Eletrobras Cgtee	1,741,124	n.a.	0	155	n.a.	n.a.	n.a.	0	40	831	n.a.	n.a.	n.a.	1,390	92	409	1,744,040	
Eletrobras Chesf	0	196	0	3,043	1	159	7,132	n.d.	10,114	561	139,886	n.a.	n.a.	n.d.	1,268	n.d.	162,360	
Eletrobras Eletronorte	0	80	40	2,717	64	n.a.	16,398	1,885	179	498	76,970	n.d.	0	0	917	388	100,136	
Eletrobras Eletronuclear	707	n.a.	72	814	13	n.a.	n.a.	4,484	75	4,419	n.a.	3	n.a.	98	154	1,660	12,500	
Eletrobras Eletrosul	n.a.	41	8	1,240	1	n.a.	4,943	344	39	89	110,673	n.a.	n.a.	126	376	167	118,048	
Eletrobras Furnas	1,242,336	49	125	2,933	1	n.a.	3,826	142	110	1,085	321,851	n.a.	n.a.	n.a.	1,009	95	1,573,562	
Eletrobras Holding	n.a.	n.a.	n.a.	16	n.a.	n.a.	n.a.	27	0	428	n.a.	n.a.	n.a.	n.a.	533	n.a.	1,004	
Itaipu Binacional	n.a.	n.a.	56	234	10	n.a.	2,596	405	1,954	80	n.a.	n.a.	n.a.	18	414	716	6,482	
Subtotal per Sources	5,159,899	379	374	11,374	102	159	34,941	7,300	12,678	8,580	650,719	3	0	1,632	5,120	4,125	TOTAL (tCO ₂ e) 5,897,384	
Subtotal per type of source	5,160,652			11,636			54,919			8,580	650,719	3	0	1,632	5,120	4,125		
Subtotal per scope	5,227,207									659,298		10,879						

Legend: n.a. – not applicable; n.d. – not available

The emissions of each type of GHG are shown in Table 3. It is verified the predominance of the emissions of carbon dioxide - CO₂ (99%) and the little significance of the emissions of sulfur hexafluoride (SF₆), nitrous oxide (N₂O), methane (CH₄) and cooling gases (HFCs and PFCs), whose added values represent 1% of the total.

Table 3 – GHG emissions per type of gas (scopes 1, 2, and 3) - Base Year 2019

Companies	CO ₂	CH ₄	N ₂ O		SF ₆		HFCs e PFCs	Total per Company	
	tCO ₂ e	tCO ₂ e	tgás	tCO2e	tgás	(tCO ₂ e)	tgás	(tCO ₂ e)	(tCO ₂ e)
Eletrobras Amazonas GT	2,175,573	1,187	47.46	1,321	4.43	0	0.00	14.4	2,178,095
Cepel	1,100	2	0.10	9	0.03	46	0.00	0.0	1,157
Eletrobras Cgtee	1,735,341	510	20.41	8,190	27.48	n.a.	n.a.	0.0	1,744,040
Eletrobras Chesf	145,040	10,124	404.97	64	0.21	7,132	0.31	n.d.	162,360
Eletrobras Eletronorte	81,601	187	7.49	65	0.22	16,398	0.72	1,885	100,136
Eletrobras Eletronuclear	7,884	82	3.30	49	0.16	n.a.	n.a.	4,484	12,500
Eletrobras Eletrosul	112,678	47	1.87	37	0.12	4,943	0.22	344	118,048
Eletrobras Furnas	1,568,180	679	27.17	736	2.47	3,826	0.17	142	1,573,562
Eletrobras Holding	972	0	0.01	6	0.02	n.a.	n.a.	27	1,004
Itaipu Binacional	1,502	1,958	78.34	20	0.07	2,596	0.11	405	6,482
Total per gas	5,829,871	14,778	591.11	10,495	35.22	34,941	1.53	7,300	5,897,384

Legend: n.a. – not applicable; n.d. – not available

The gas SF₆ is basically applied as an insulated means in high voltage breakers. As practices and resources that contribute to mitigate escaping emissions, or to the SF₆ management, we may mention: SF₆ low-pressure alarms in the breakers; annual check of the breakers gas pressure; breakers biweekly inspection; instruction for identifying SF₆ leaks; use of SF₆ detectors, and machines for the gas collection and treatment.

The escaping emissions of SF₆ held in the high voltage equipment basically derive from losses associated to: the equipment (breakers) constructive technology; severe failures, maintenance processes.

As for the constructive technology, the breakers are manufactured according to regulations that establish as acceptable/inherent a loss of 0.5 to 1.0 % in mass of SF₆ per year. As a means of relativizing the data of each transmitter, besides the absolute data emissions, it is also important to compare such number with the SF₆ mass generated in each of the companies.

In consideration of the severe failures, like explosions, it is considered that they are not totally manageable, despite the predictive and preventive maintenance technics.

As for the maintenance processes, besides complying with the equipment maintenance plan, the companies carry out complementary activities of SF₆ management.

Although the CO₂ emissions deriving from the combustion of ethanol biofuels and biodiesel are not accounted for in the GHG Inventory, due to the gas reabsorption by the photosynthesis process, the methodology used recommends the development of estimations, which are presented in Table 4. The data shows a 78.2% reduction in CO₂ emissions from the burning of biofuels ethanol and biodiesel compared to 2018.

Table 4 – CO₂ Emission by the combustion of ethanol biofuels (hydrated and anhydrous) and biodiesel (B-100)

Companies	CO ₂ emissions (tCO ₂ e)	
	2018	2019
Eletrobras Amazonas GT	43,010	7,291
Cepel	54	67
Eletrobras CGTEE	361	407
Eletrobras Chesf	769	872
Eletrobras Eletronorte	2,640	372
Eletrobras Eletronuclear	348	367
Eletrobras Eletrosul	180	219
Eletrobras Furnas	561	523
Eletrobras Holding	4	3
Itaipu Binacional	407	416
Total	48,334	10,538

The comparison of the total emissions between the years of 2018 and 2019 is presented in Table 5.

Table 5 – GHG emissions by Eletrobras Companies - in the years of 2018 and 2019 (tCO₂e)

Scope	2018	2019	Variation 2018-2019	Variation 2018-2019 %
Scope 1	5,350,290	5,227,207	- 123,083	-2.3
Scope 2	670,337	659,298	- 11,039	-1.6
Scope 3	42,813	10,879	- 31,934	-74.6
Total	6,063,440	5,897,384	- 166,056	-2.7

In consideration of the emissions accounted in each scope, in 2019 there was a reduction of 2.7% of the emissions. For scope 1, there was a decrease of 2.3% of the emissions, whereas for scopes 2 and 3 there was a reduction of 1.6% and 74.6%, respectively. The significant reduction in scope 3 emissions is related to the non-acquisition of energy from Independent Energy Producers (PIEs in portuguese), which had been the most representative source of this scope in previous years.

Table 6 shows the history of GHG emissions of Eletrobras Companies for the last five years.

Table 6 – History of the Greenhouse Gases emissions of Eletrobras companies (tCO₂e)

Companies	2015*	2016*	2017*	2018	2019
Eletrobras Amazonas GT	975,807	1,362,801	1,409,350	2,173,897	2,178,095
Cepel	1,661	1,252	1,491	1,126	1,157
Eletrobras CGTEE	2,777,601	3,076,026	1,798,525	1,621,767	1,744,040
Eletrobras Chesf	471,762	237,925	243,710	175,231	162,360
Eletrobras Eletronorte	362,369	138,775	167,494	116,095	100,136
Eletrobras Eletronuclear	19,445	14,214	16,114	12,016	12,500
Eletrobras Eletrosul	198,630	130,343	141,414	115,889	118,048
Eletrobras Furnas	2,432,683	1,795,646	1,888,927	1,835,923	1,573,562
Eletrobras Holding	1,721	1,228	1,012	891	1,004
Itaipu Binacional	9,293	9,222	10,835	10,605	6,482
Total	7,250,972	6,767,432	5,678,872	6,063,440	5,897,384

* The amounts were recalculated excluding the amounts related to the distribution companies.

According to this data, one may observe a reduction tendency of the GHG emissions of Eletrobras Companies since 2015 with a slight increase in 2018, due to an increase in the energy production of Eletrobras Amazonas GT in the Maua III TPP. In 2019 there was a reduction of around 3% in our emissions compared to the previous year.

4. GENERATION OF ENERGY AND INTENSITY OF EMISSIONS

The net production of electric power of Eletrobras Companies in 2019 was 146,018,508.46 MWh, without the Specific Purpose Entity (SPE) portion. Each company's production is shown in Table 7.

Table 7 – Net energy production by Eletrobras Companies in 2019

Companies	Net energy production (MWh)
Eletrobras Amazonas G&T	5,864,228.62
Eletrobras CGTEE	1,668,307.16
Eletrobras Chesf	20,733,523.98
Eletrobras Eletronorte	30,918,495.67
Eletrobras Eletronuclear	16,126,849.51
Eletrobras Eletrosul	2,058,553.55
Eletrobras Furnas	28,926,294.97
Itaipu Binacional	39,722,255.00
Total	146,018,508.46

The 2019–2023 Business and Management Master Plan defined as target for Eletrobras companies an emission intensity of 0.181 tCO₂e/R\$ thousand, considering the total emissions of scopes 1, 2 and 3 by Net Operating Revenue (NOR). For 2019, the intensity of emissions was 0.216 tCO₂e/R\$ thousand.

Also are presented in this document the emission intensities calculated from the total emissions of scopes 1, 2 and 3 for energy generated and the emissions of scopes 1 and 2 - without losses in relation to the net energy generated and the net operating revenue. The data referring to the net energy generated and the net operating revenue of the SPEs are not considered for calculate the intensity of emissions. The data are shown in table 8.

Table 8 – Intensity of GHG emissions by Eletrobras Companies for the years of 2018 and 2019

Emission Intensity (Scope 1, 2 and 3)	2018	2019
Per net energy produced (tCO ₂ /MWh)	0.042	0.040
Per Net Operating Revenue (tCO ₂ /NOR)	0.247	0.216

Emission Intensity (Scope 1 and 2 without losses)	2018	2019
Per net energy produced (tCO ₂ /MWh)	0.037	0.036
Per Net Operating Revenue (tCO ₂ /NOR)	0.256	0.192

It is observed that the 2019 GHG emission intensity has increased in relation to the year of 2018.

5. ATMOSPHERE POLLUTANTS (SO_x, NO_x AND PARTICULATES)

Eletrobras Companies also carries out estimations regarding the emissions of other atmosphere pollutants, as sulfur oxides (SO_x), nitrogen oxides (NO_x) and particulates (PM₁₀). These estimations are based on the monitoring carried out in the operating TPPs throughout 2019.

The emissions of SO_x, NO_x and particulates in the years of 2018 and 2019 are shown in Tables 09 and 10.

Table 9 – Emissions of sulfur and nitrogen oxides (SO_x and NO_x)

Companies	Sulfur Oxides SO _x (t)		Nitrogen Oxides NO _x (t)	
	2018	2019	2018	2019
Eletrobras Amazonas GT	6.1	18.70	1,493.6	6,286.5
Cepel	n.a.	n.a.	n.a.	n.a.
Eletrobras CGTEE	11,338	10,798	2,778.0	2,430.4
Eletrobras Chesf	0.0	0.0	0.0	0.0
Eletrobras Eletronorte	0.0	0.0	0.0	0.0
Eletrobras Eletronuclear	0.0	0.0	0.0	0.0
Eletrobras Eletrosul	n.a.	n.a.	n.a.	n.a.
Eletrobras Furnas	0.0	0.0	372.9	52.2
Eletrobras Holding	n.a.	n.a.	n.a.	n.a.
Itaipu Binacional	n.a.	n.a.	n.a.	n.a.
Total	11,344.1	10,816.7	4,644.5	8,769.1

Legend: n.a. – not applicable.

Table 10 - Emissions of particulates (PM₁₀)

Companies	Particulates PM ₁₀ (t)	
	2018	2019
Eletrobras Amazonas GT	3.7	14.95
Cepel	n.a.	n.a.
Eletrobras CGTEE	904.0	410.27
Eletrobras Chesf	0.0	0.0
Eletrobras Eletronorte	0.0	0.0
Eletrobras Eletronuclear	0.0	0.0
Eletrobras Eletrosul	n.a.	n.a.
Eletrobras Furnas	0.0	0.0
Eletrobras Holding	n.a.	n.a.
Itaipu Binacional	n.a.	n.a.
Total	907.7	425.22

Legend: n.a. – not applicable.

The SO_x and PM₁₀ emissions had a reduction of about 5% and 53%, respectively, in relation to 2018. NO_x emissions increased by 47% in relation to the previous year.

6. GASES OF THE MONTREAL PROTOCOL

Eletrobras Companies also perform estimations for the emissions of gases that destroy the ozone layer, related to the Montreal Protocol.

The total emission was calculated by the sum of three processes related to air conditioner gases of refrigeration: leaks in the installation process, leaks in the maintenance process, and leaks in the discharge process.

The emissions of gases related to the Montreal Protocol are shown in Table 11.

Table 11 - Emissions of gases that destroy the ozone layer, related to the Montreal Protocol

Companies	Gases (t) 2018			Gases (t) 2019		
	HCFC - 123	R-22	R-141b	HCFC - 123	R-22	R-141b
Eletrobras Amazonas GT	0.00	0.02	0.00	0.00	0.05	0.004
Cepel	0.00	0.13	0.00	0.00	0.06	0.00
Eletrobras CGTEE	0.00	0.08	0.00	0.00	0.25	0.00
Eletrobras Chesf	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Eletrobras Eletronorte	0.00	1.27	0.00	0.00	0.31	0.00
Eletrobras Eletronuclear	0.09	0.90	0.38	0.18	0.78	0.382
Eletrobras Eletrosul	0.00	0.14	0.00	0.00	0.07	0.00
Eletrobras Furnas	0.00	0.68	0.00	0.00	0.55	0.00
Eletrobras Holding	0.00	0.16	0.00	0.00	0.07	0.01
Itaipu Binacional	0.00	0.32	0.00	0.00	0.21	0.00
Total	0.09	3.71	0.38	0.18	2.35	0.40

Legend: n.d. - not available.

7. ESTIMATE GHG EMISSIONS AND REMOVALS DUE TO ACTIVITIES THAT CAUSE CHANGE IN THE LAND USE

In the direction of carrying out a GHG emissions balance sheet, accounting what may be considered as “emissions compensation”, it is necessary to develop a proper methodology to collect data to perform such calculation. With this purpose, in 2016, a task force was created within the Climate Strategy Work group (SCMA's GT3) to estimate the emissions and removals resulted from Eletrobras companies' activities that lead to changes in land use.

It is worth recording that such initiative still has an experimental and volunteer character. There is still a large gap for a methodological evolution and for the evolution of data collection and analysis process. However, it is considered that the results were satisfactory and are able to be presented in this document.

This portion should permanently comprise the GHG Emissions Inventory of Eletrobras Companies and the GT3 will keep its operations toward consolidating the calculation methodology and the data gathering process.

CO₂ Emissions

The CO₂ emissions considered by the activities of land use change in Eletrobras Companies are attributed to vegetation's necessary suppressions. For such, the data collected in the Suppression of Vegetation Authorizations (ASVs, in the Portuguese acronym) obtained by some of the companies throughout the year of 2019 were used as evidence. In the information about the suppressed vegetation are its area and characterization in terms of phytophysiology. The amount of carbon emitted was calculated based on the values of “total carbon storage” available in the Third National Communication (MCTI, 2016).

CO₂ Removals

The removals of CO₂ considered by the activities of land use change are a consequence of planting of tree seedlings under various programs developed by our companies. Such programs include the recovery of degraded areas and the implementation of protective belts in areas of permanent preservation on the banks of reservoirs of hydroelectric power plants. Data from the planted areas, type of trees and climate characteristics of the region were used. Finally, an average carbon stock value to be reached in a 20-year horizon and a linear growth rate for vegetation were considered.

The results are shown in table 12.

Table 12 – Pilot Project – Balance Sheet of Emissions x Removals of CO₂ in 2019

Companies	Emission (tCO ₂ e)	Removal (tCO ₂ e)	Balance (tCO ₂ e)	Balance Result
Eletrobras Chesf	18,915.32	17,209.68	-1,705.64	EMISSION
Eletrobras Eletronorte	0.00	8,794.44	8,794.44	REMOVAL
Eletrobras Eletronuclear	0.00	6.00	6.00	REMOVAL
Eletrobras Eletrosul	0.00	493.87	493.87	REMOVAL
Eletrobras Furnas	848.60	2,562.99	1,714.39	REMOVAL
Itaipu Binacional	18,827.30	6,327.40	-12,499.90	EMISSION
Total	38,591.21	35,394.37	-3,196.84	EMISSION

8. FINAL CONSIDERATIONS

This document consolidates an important account for the society of emissions and removals of greenhouse gases in the generation and transmission activities of Eletrobras Companies in 2019, as well as the historical evolution of these data. The performance of Eletrobras companies concerning the theme of climate change is monitored through indicators, goals and projects, which are presented in the Annual Report, on the websites of Eletrobras and its subsidiaries and the Business and Management Master Plan - PDNG.

We reaffirm our commitment to maintaining a continuous process of monitoring our emissions and establishing management strategies that contribute to the fight against global climate changes. These strategies are aligned with the Environmental Policy of Eletrobras Companies, with the PDNG and with the recommendations of international references in corporate sustainability that adopts approaches related to the establishment and fulfillment of goals, as well as their disclosure to society.

9. REFERENCES

ELETROBRAS, 2016. Greenhouse Gas Emissions Inventory – Base year 2015.

ELETROBRAS, 2017. Greenhouse Gas Emissions Inventory – Base year 2016.

ELETROBRAS, 2018. Greenhouse Gas Emissions Inventory – Base year 2017.

ELETROBRAS, 2019. Greenhouse Gas Emissions Inventory – Base year 2018.

ELETROBRAS, 2019. Annual Report 2018.

ELETROBRAS, 2020. Annual Report 2019.

GHG Protocol. Especificações do Programa Brasileiro GHG Protocol: Contabilização, Quantificação e Publicação de Inventários Corporativos de Emissões de Gases de Efeito Estufa, 2ª edição.

IPCC, 2006.Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy. International Panel for Climate Change.

IPCC, 2006.Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste. International Panel for Climate Change.

MCTIC, 2018. Fatores de emissão médios do sistema interligado nacional.

WRI, 2004.The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard. World Resources Institute (WRI). World Business Council for Sustainable Development (WBCSD). Revised Edition.

10. ANNEX

Independent auditor's limited assurance report on the data in the 2019 Greenhouse Gas Emissions Inventory of the Eletrobras Companies

To the Board of Directors and Stockholders

Centrais Elétricas Brasileiras S.A. – Eletrobras
Rio de Janeiro – RJ

Introduction

- 1 We have been engaged by Centrais Elétricas Brasileiras S.A. (“Eletrobras” or “Company”) to present our limited assurance report on the data in the 2019 Greenhouse Gas Emissions Inventory of the Eletrobras Companies (“2019 GHG Emissions Inventory”) for the year ended December 31, 2019. This report includes, among other information, the procedures used for determining significant quantifications, the criteria and the methodology for the preparation of the 2019 GHG Emissions Inventory and the organizational and operational parameters of the Company’s activities.

Management’s responsibility

- 2 The Company’s management is responsible for the preparation and fair presentation of the data in the 2019 GHG Emissions Inventory, in accordance with the criteria defined in paragraph 3 and parameters defined in paragraph 4 herein and for such internal control as it determines is necessary to enable the preparation of information free from material misstatement, whether due to fraud or error.

- 3 The criteria for assessment of the data in the 2019 GHG Emissions Inventory covering the Company’s activities with respect to the measurement, obtaining, compilation, calculations and estimates and the reporting of the data of emissions for 2019, were based on the following documents:
 - (a) FGV-GVCes/WRI: Brazilian GHG Protocol Program Specifications: Accounting, Quantification and Reporting of Corporate Greenhouse Gas Emission Inventories. 2nd edition and related technical notes..
 - (b) ABNT NBR ISO 14064-1: Part 1 “*Specification and guidance to organizations for the quantification and preparation of reports on emissions and removals of greenhouse gases*”, 2007..
- 4 In accordance with the criterion of FGV-GVCes/WRI, mentioned in paragraph 3, the organizational boundary of the 2019 GHG Emissions Inventory was defined based on the operational control approach. The operational parameters include the sources of scope 1 and 2 emissions, according to the Brazilian GHG Protocol Program, as well as the following emission categories of scope 3: Upstream transportation and distribution – transportation of fuel and products that are not related to electric power; Business travel – air travel; and Employee Transportation.

Independent auditor's responsibility

- 5 Our responsibility is to express a conclusion on the data in the Company's 2019 GHG Emissions Inventory, based on our limited assurance engagement carried out in accordance with Technical Communication CTO 01, "Issuance of an Assurance Report related to Sustainability and Social Responsibility", issued by the Federal Accounting Council (CFC), based on the Brazilian standard NBC TO 3000, "Assurance Engagements Other than Audit and Review", also issued by the CFC, which is equivalent to the international standard ISAE 3000, "Assurance engagements other than audits or reviews of historical financial information", issued by the International Auditing and Assurance Standards Board (IAASB). Those standards require that we comply with ethical and independence requirements, and other responsibilities, including in relation to the Brazilian Standard on Quality Control (NBC PA 01) and, therefore, the maintenance of a comprehensive quality control system, including documented policies and procedures for ethical requirements, professional standards and legal and regulatory requirements.
- 6 These standards also require the work be planned and performed to obtain limited assurance that the data in the 2019 GHG Emissions Inventory, taken as a whole, are free from material misstatements, in accordance with the criteria defined in paragraph 3 and parameters defined in paragraph 4 above.
- 7 A limited assurance engagement conducted in accordance with the Brazilian standard NBC TO 3000 and ISAE 3000 consists mainly of making inquiries of management and other professionals of the entity involved in the preparation of the information, as well as applying analytical procedures to obtain evidence that enables us to issue a limited assurance conclusion on the information taken as a whole. A limited assurance engagement also requires the performance of additional procedures when the independent auditor becomes aware of matters that lead the auditor to believe that the information taken as a whole might present significant misstatements.
- 8 The procedures selected are based on our understanding of the aspects related to the compilation and presentation of the data in the 2019 GHG Emissions Inventory, other engagement characteristics and an analysis of the areas in which significant misstatements might exist. The following procedures were adopted:
 - (a) Planning the work, taking into consideration the criteria defined in paragraph 3 and parameters defined in paragraph 4 above, the materiality and the volume of quantitative and qualitative information and the operating and internal control systems that were used to prepare the data in the Company's 2019 GHG Emissions Inventory.
 - (b) Understanding the calculation methodology and the procedures adopted for obtaining and compiling greenhouse gas emissions through interviews with the managers responsible for the preparation of the information of Eletrobras - Centrais Elétricas Brasileiras S.A., as well as the managers responsible for the preparation of the information of the following subsidiaries, whose sources of emission are considered significant in relation to the Company's total consolidated emissions: Companhia Hidro Elétrica do São Francisco - Chesf; Furnas Centrais Elétricas S.A. - Furnas; Companhia de Geração e Transmissão de Energia Elétrica do Sul do Brasil - Eletrobras CGT Eletrosul; and Amazonas Geração e Transmissão de Energia S.A. - Amazonas GT.

- (c) Applying analytical procedures and selective testing, as applicable, to quantitative information and making inquiries regarding the qualitative information and its correlation with the data in the 2019 GHG Emissions Inventory.
- 9 We believe that the evidence we obtained is sufficient and appropriate to provide a basis for our limited assurance conclusion.

Scope and limitations

- 10 The procedures applied in a limited assurance engagement are substantially less detailed than those applied in a reasonable assurance engagement, the objective of which is the issuance of an opinion on the data in the 2019 GHG Emissions Inventory. Consequently, we were not able to obtain reasonable assurance that we might become aware of all significant matters that might be identified in an assurance engagement, the objective of which is the issue of an opinion. Had we performed an engagement with the objective of issuing an opinion, we might have identified other matters and possible misstatements in the data in the 2019 GHG Emissions Inventory. Therefore, we do not express an opinion on this information.
- 11 Non-financial data is subject to more inherent limitations than financial data, due to the nature and diversity of the methods used to determine, calculate and estimate this data. Qualitative interpretations of the relevance, materiality, and accuracy of the data are subject to individual assumptions and judgments. Furthermore, we did not carry out any work on data reported for prior periods, nor future projections and goals.

- 12 The information and data with respect to the actions and activities regarding sustainability, general information and views related to climate change, the description of the managing activities related to the process for preparation of the 2019 GHG Emissions Inventory, and the description of operational activities, which are not a basis for the 2019 GHG Emissions Inventory, are not part of the scope of our work and, therefore, are not covered by our limited assurance report.

Conclusion

- 13 Based on the procedures performed, described herein, no matter has come to our attention that causes us to believe that the data in the 2019 Greenhouse Gas Emissions Inventory of the Eletrobras Companies of Centrais Elétricas Brasileiras S.A. for the year ended December 31, 2019 is not presented, in all material respects, in accordance with the criteria described in paragraph 3 and the parameters defined in paragraph 4 above.

Rio de Janeiro, July 24, 2020

PricewaterhouseCoopers
Auditores Independentes
CRC 2SP000160/O-5

Eliane Kihara
Contadora CRC 1SP212496/O-5



MINISTÉRIO DE
MINAS E ENERGIA

