

Inventory of Greenhouse Gases Year 2017

Cemig - Companhia Energética de Minas Gerais



Summary





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1. Cemig

Cemig completed, in 2017, 65 years of operation. Since its foundation, on May 22, 1952, the Company has assumed the role of bringing the collective welfare to the regions where it operates innovatively and sustainably. This determination led to its position as the most significant power distributor in lines extension and networks, and one of the most significant power generation and power transmission in the country.

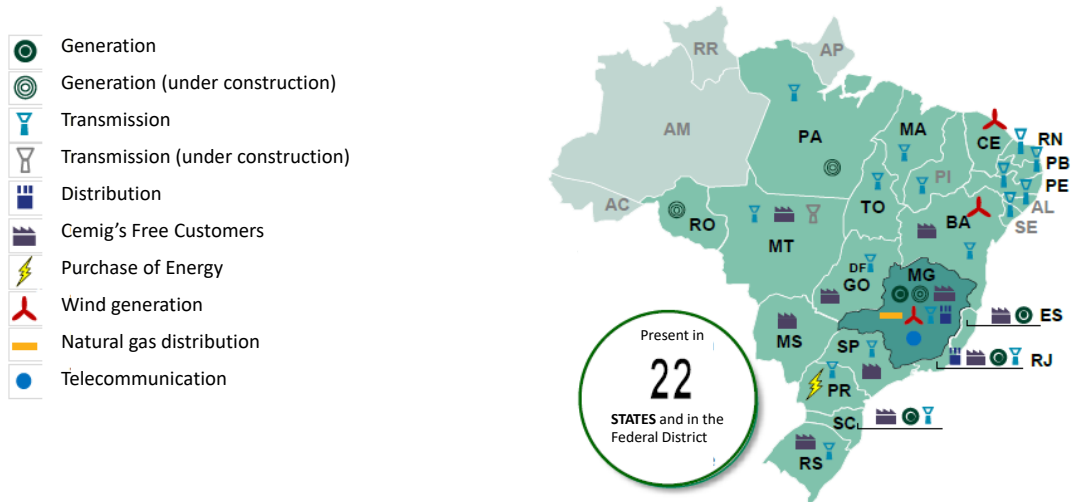
The Company operates in the areas of exploration and distribution of natural gas and data transmission, but the main business areas of Cemig are the generation, transmission, and distribution of electricity and energy solutions (Chart 1).

Chart 1 - Main business areas of Cemig

			
Generation	Transmission	Distribution	Natural gas
Installed capacity: 5,727 MW	Extension of lines: 6,673 km	Extension of grids: 512,572 km	1.3 billion m ³ of gas sold

Cemig has 5,864 direct employees (base December / 2017). The group consists of the holding, Companhia Energética de Minas Gerais - Cemig, the wholly-owned subsidiaries Cemig Geração e Transmissão S.A. (Cemig GT) and Cemig Distribuição S.A. (Cemig D), totalling 175 Companies, 15 Consortia and 2 FIPs (Investment Funds in Shares), resulting in assets present in 22 Brazilian states and the Federal District. The Figure 1 shows the location of Cemig's activities, according to the main activity segments.

Figure 1 - Map of geographical location of the Company's main activities



For a more detailed description of Cemig's business, access [here](#).

See the [complete organization chart](#) of the companies of Cemig Group.

2. About the inventory

In line with corporate document guidelines "[Commitment to Climate Change](#)," Cemig invests in initiatives that position it positively in the efficient management of its impacts and its exposure to the risks of global climate change.

Accordingly, the Company contemplates in its strategy actions and initiatives necessary to prevent and minimize impacts from its activities, develop measures to adapt it to changes in the climate to mitigate its risks, and the subjects are widely communicated and disclosed to society and its shareholders.

In this sense, Cemig quantifies its emissions and makes public for the seventh consecutive time its Inventory of Greenhouse Gas, recognizing its share of responsibility in the theme and identifying opportunities to reduce emissions and costs, adequately managing its risks related to climate changes. It should be noted that these last seven inventories were submitted to an independent verification conducted, in this case, by Bureau Veritas Certification (Annex 1 - Verification Statement, page 31).

This inventory, for 2017, was prepared according to these guidelines:

- ABNT NBR ISO 14064-1. Specification and guidance to organizations for quantification and reporting of emissions and removals of greenhouse gases.
- Specifications of the Brazilian Program GHG Protocol - Accounting, Quantification, and Publication of Corporate Inventory of Greenhouse Gas Emissions - Second Edition.
- Intergovernmental Panel on Climate Change (IPCC) 2006, 2007, IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme.
- "The Greenhouse Gas Protocol - a Corporate Accounting and Reporting Standard - Revised Edition."
- Corporate Value Chain (Scope 3) Accounting and Reporting Standard - Supplement to the GHG Protocol Corporate Accounting and Reporting Standard (WRI/WBCSD).

3. Applied methodology

For the calculation of GHG emissions the "Estimating tool of greenhouse gases for intersectorial sources" was used (GHG Protocol Tool, Brazilian version, "Ferramenta_GHG_Protocol_V2018.1.4").

The choice of the calculation methodology was mainly based on the internal evaluation of data availability and the specific emission factors, to present more transparent and consistent results with the reality of the electric sector, in line with the Brazilian fact. Specific national GHG emission factors recognized by the applicability principle, followed by the emission factors of the Intergovernmental Panel on Climate Change (IPCC) (1996, 2001, 2006, 2007) were adopted. The data referenced for the calculation of Scopes 1, 2 and 3 were collected through a centralized approach to those responsible for its management, and the following means of calculation were used:

- Existing records in the ERP System¹ of Cemig
- Records in corporate operating and control systems
- Invoices
- Contracts
- Registration worksheets

It should be noted that the areas responsible for the information are certified in internationally referenced management standards such as NBR ISO 9001: 2008 and/or NBR ISO 14001: 2004 and the Level 1² EMS (SGA Nível 1) that Cemig has developed for facilities whose license has not yet been issued by the environmental agency. All these certifications are audited internally and by the third party certifying organization.

Considering the need to adapt its processes to the new versions of ISO 14001:2015 and ISO 9001:2015 standards, Cemig developed the ISO 2015 Standards Transition project, which, in addition to being broadly restructuring the entire ISO and OHSAS Certification System, is expanding and consolidating the quality management guidelines, through the vision of interdependent processes. The ISO 2015 Standards Transition Project aims at a more significant alignment between the Management Systems and the strategic directions, introducing in the Management System the need for more substantial leadership commitment, analysis of the organization context, alignment of the Management System to the strategic planning, risk mentality at all stages of the processes, stakeholder consideration, change management, and organizational learning.

In order to define, in a corporate way, how the regulatory requirements are applied and met by Cemig, the documentation of the Company Management System

¹ ERP = Enterprise Resource Planning. It is a kind of business management system (e.g. SAP and others) used by large corporations.

² Level 1 EMS (SGA Nível 1): Certification of Environmental Management System in NBR ISO 14001 is only possible for areas that have environmental license and, since many facilities were built before the environmental legislation, currently they are in corrective licensing process with environmental agencies. These facilities had good Environmental Management practices, but were prevented from getting ISO 14001 certification. Thus, Cemig developed the SGA Level 1 as a step towards ISO 14001 certification. In fact, over time, the facilities that have been obtaining the Environmental Operating License, after the first external audit, were recommended for ISO 14001 certification, showing the accuracy of the SGA Level 1 practices.

underwent an intense process of reflection and updating, at which time it was possible to involve the main stakeholders and elaborate a new Quality Manual, published corporately as an Organization Instruction, and its complementary documents, which specify the most relevant topics for the Systems and guide compliance with the requirements required by the standards through Cemig's practices. In an additional way, an online training was developed aiming at presenting in a transparent, objective and playful manner the contents of the new corporate documentation and enabling all employees to meet the normative requirements of NBR ISO 9001:2015, NBR ISO 14001:2015 and OHSAS 18001:2007, thus increasing the commitment of all with the Management Systems and certified processes of the organization. The project began in 2015, and the completion is scheduled for September 2018.

Due to the complexity of collecting some data for the calculation of emissions, additional clarification is necessary for these cases, as described below.

To estimate the percentage of SF₆ losses, the factor 0.5%³ per year was used for Cemig Distribuição equipment and 1%⁴ per year for Cemig Transmissão equipment, acceptable bibliographic data for the Company's industry.

Regarding the calculation of the distance between airports in the category "Business Trips - Scope 3", SABER Red Workspace, version v.2.10.1, developed by SABER Inc. was used.

Cemig receives the calculations of losses of energy in the Transmission, amounts calculated externally and attributed to its responsibility, counted by the CCEE (Electric Power Commercialization Chamber). For calculations of energy losses in the Distribution, Cemig derives the data according to the Procedures for Distribution of Electrical Energy in the National Electrical System - PRODIST, Module 7 - Calculation of Losses in Distribution.

³ German Voluntary Self-Commitment Treaty (2005) available at http://vik.de/tl_files/downloads/public/sf6/SV-SF6.pdf

⁴ SF₆ Emission Estimation and Reporting Protocol for Electric Utilities (Final Version) prepared by Greenhouse Gas Division of Environment Canada and Canadian Electricity Association, available at http://publications.gc.ca/collections/collection_2013/ec/En4-229-2008-eng.pdf

4. Period covered

The quantification of emissions from activities directly and indirectly developed by Cemig corresponds to the period between January 1, 2017, and December 31, 2017. The historical base year chose and referenced for the calculations, including for the establishment of the corporate emission reduction target of Scope 1, was 2014, since it presented power generation at the Igarapé Thermoelectric Plant.

5. Organizational and geographical boundaries

For reporting purposes, in this inventory, Cemig adopted the Operational Control approach, i.e., quantified the emissions of companies in which Cemig holds 100% of the control. All these companies are in Brazilian territory. As a clarification, all international trips considered for calculation of the emissions have sections beginning or ending in Brazil.

The fifteen companies wholly owned by Cemig, covered by this inventory, are listed in Table 2⁵.

⁵ The Company Usina Térmica do Barreiro S.A. was not included in this inventory due to the termination of the Cemig - Vallourec agreement for the operation of this plant in December 2016.

Table 2 - Companies entirely controlled by Cemig

1	Cemig Geração e Transmissão S.A. (Cemig GT)
2	Cemig Distribuição S.A. (Cemig D)
3	Rosal Energia S.A.
4	Sá Carvalho S.A.
5	Efficientia S.A.
6	Cemig PCH S.A. ⁶
7	Horizontes Energia S.A. ⁷
8	Cemig Telecomunicações S.A.
9	Cemig Geração Camargos S.A.
10	Cemig Geração Itutinga S.A.
11	Cemig Geração Salto Grande S.A.
12	Cemig Geração Três Marias S.A.
13	Cemig Geração Leste S.A.
14	Cemig Geração Oeste S.A.
15	Cemig Geração Sul S.A.

⁶ Four Small Hydroelectric Plants (SHP) operated by Cemig GT. The emissions are accounted for by Cemig GT.

⁷ Small Hydroelectric Plant operated by Cemig GT. The emissions are accounted for by Cemig GT.

6. Operational limits and emission sources

Table 3 lists the sources of greenhouse gas emissions and their respective categories.

Table 3 - Emission sources and category

SCOPE 1	
Emission Sources	Category
Fuel consumption of the corporate fleet	Mobile combustion
Fuel consumption in aircraft and small vessels	Mobile combustion
Emergency generators	Stationary combustion
Fuel used in Igarapé Thermoelectric Plant	Stationary combustion
SF ₆ emissions from electrical equipment	Fugitive emissions
Fertilizers used in the production of seedlings and in plantations	Agricultural activities
Fuel used in forklifts and autoclaves	Stationary combustion
SCOPE 2 ("location" approach)	
Emission Sources	Category
Consumption of electricity in administrative and operational units	Purchase of electricity
Technical losses of electricity in Transmission and Distribution systems	Purchase of electricity
SCOPE 3	
Emission Sources	Category
Outsourced transportation of materials, solid waste, and equipment	Upstream Transportation and Distribution
Air travel	Business travel
Gasoline, alcohol and diesel consumption by distribution contractors	Downstream Transport and Distribution
Electricity consumption by final consumers	Use of goods and services sold
Outsourced transportation of employees	Employees commuting

It should be noted that in this inventory, the contribution from reservoirs of hydroelectric power plants to climate change was not evaluated due to the lack of a scientific conclusion about its relation with the greenhouse gases emissions, and methodologies and conceptual models universally accepted and credible are not available to quantify the GHG emissions in reservoirs.

7. GHG emissions

Table 4 shows the details of the emissions of Scope 1, Scope 2 and Scope 3, allowing, also, the historical analysis of the last ten years (2008/2017). Comments on emissions performance are described in subsequent items.

Table 4 - GHG emissions history - Scopes 1, 2 and 3 - 2008 to 2017

Year	Scope 1 (t CO ₂ e)	Scope 2 (t CO ₂ e) ("location" approach)	Scope 3 (t CO ₂ e)
2008	287,307	282,439	ND
2009	111,758	390,039	ND
2010	59,642	295,478	4,937,535
2011	24,384	168,189	5,202,775
2012	53,567	436,750	5,341,863
2013	156,618	608,971	7,658,967
2014	617,717	858,014	11,332,770
2015	164,537	809,583	9,629,715
2016	15,462	552,805	6,065,110
2017	48,849	664,413	7,007,448

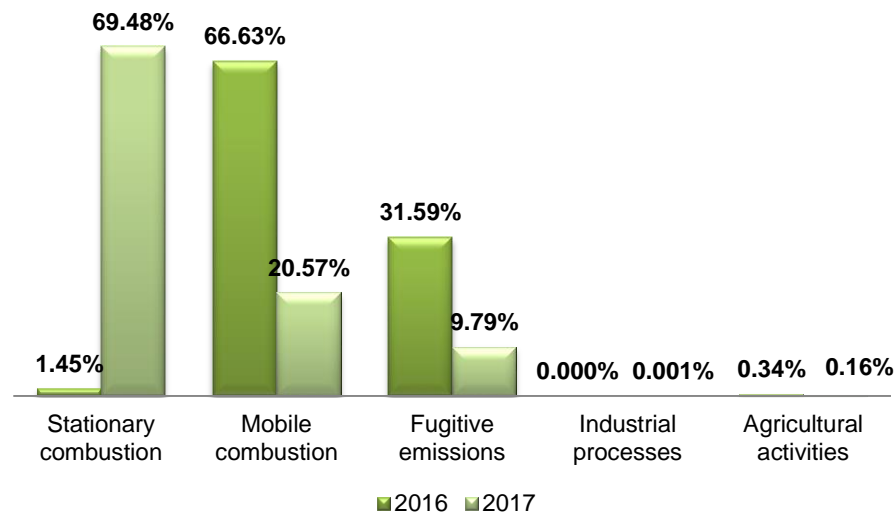
7.1 Scope 1 emissions

Scope 1 emissions in 2017 were: 10,048 tCO₂e, from the fleet of vehicles, boats and aircraft; 4,781 tCO₂e, of fugitive emissions of SF₆ gas, present in electrical equipment; 33,846 tCO₂e, from the Igarapé Thermal Power Station; 25 tCO₂e, of the use of emergency generators; 70 tCO₂e, from the use of forklifts and autoclaves; 78 tCO₂e, from the use of fertilizers; and 1 tCO₂e, from the use of sodium carbonate (Na₂CO₃) for water treatment in the Igarapé Thermal Power Station.

The intensity of Cemig's direct emissions was 0.002476 tCO₂e/MWh.

Figure 2 shows the emission sources of Scope 1 by type of source and the contribution concerning the total, referring to 2016 and 2017.

Figure 2 - Direct emissions by source type between 2016 and 2017, Scope 1



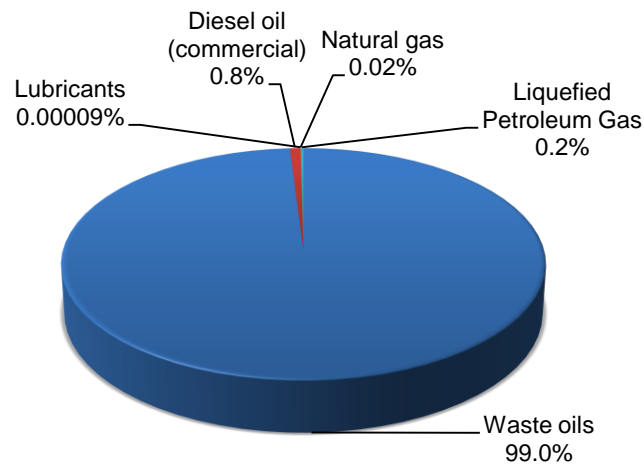
7.1.1 Stationary combustion

These stationary emissions originate mainly from the Igarapé Thermal Power Station (99.7%), forklifts and autoclaves (0.2%) and emergency generators (0.1%). The Igarapé Thermal Power Station (installed capacity 131 MW) operates to meet the contingencies of the Brazilian Interconnected Electric System and, in 2017, was responsible for 69.3% of Cemig Scope 1 emissions.

To better compare the data, it should be noted that Scope 1 emissions in 2016 did not account for the Igarapé Thermal Power Station consumption since the plant was not dispatched. It is important to note that the energy dispatch decision in Brazil (composition of hydrothermal generation every week) is made by the National Electric System Operator (ONS) based on prospective analyzes forecast of future inflows scenarios, the expected growth of consumption of energy and definition of expansion schedule of new power plants. In periods of favourable hydrology and high levels of water storage in the reservoirs of the system, the generation of the decision in thermal power plants is minimized, giving priority to the hydroelectric generation.

Figure 3 shows the GHG emissions per fuel used.

Figure 3 - Stationary combustion emissions, Scope 1

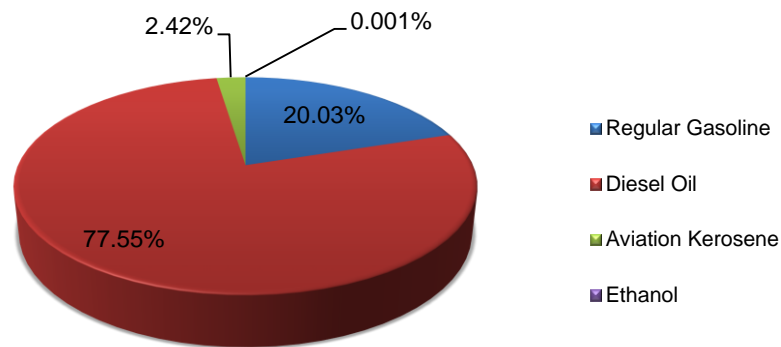


7.1.2 Mobile combustion

To reduce emissions from mobile combustion processes through measures of logistical optimization, fleet management, and renewal, and reduction in the stretches travelled, Cemig obtained a cumulative decrease of 29.7% in emissions in the 2010-2017 period. Compared to 2016, emissions from the fleet were reduced from 10,302 tCO₂e to 10,048 tCO₂e in 2017, a reduction of 2.5%, precisely due to the measures that have been adopted for more efficient fleet management.

These emissions refer to the consumption of gasoline, ethanol, diesel, and aviation fuel of Cemig fleet. As shown in Figure 4, the most significant contribution (77.55%) to mobile combustion emissions comes from diesel vehicles.

Figure 4 - Emissions by fuel used, Scope 1



7.1.3 Fugitive emissions

Cemig's fugitive emissions originate from the SF₆ gas used in electrical equipment as an insulator or to extinguish electric arcs in the Transmission and Distribution of electricity. In 2016, SF₆ fugitive emissions were 4,884 tCO₂e and in 2017, 4,781 tCO₂e, a decrease of 2.1%, mainly due to the reduction in the number of SF₆ replacement interventions in Cemig D.

7.1.4 Industrial processes

The emissions contemplated in this topic come from the water treatment process at the Igarapé Thermal Power Station due to the use of barley (Na₂CO₃). The value for 2017 was 1 tonne of CO₂e.

7.1.5 Agricultural activities

Emissions from Cemig's agrarian activities come from the use of organic or chemical fertilizers in the production of seedlings of native species and others for urban afforestation, planting of riparian forests and as nutrients used for fish farming. Compared between 2016 and 2017, the figures went from 53 tCO₂e to 78 tCO₂e, a 47.5% increase, due to the increase in these activities.

7.2 Scope 2 emissions

The emissions of Scope 2 ("location" approach) are related to the electricity consumption used in industrial and administrative facilities, from the National Interconnected System (SIN or Sistema Interligado Nacional), and energy losses in Transmission and Distribution (T&D) in the electrical system, the latter being the main source of emissions of the Company. As described in the Methodology item, energy losses are calculated by an energy balance, accounted according to standard Aneel procedures. As a comparison, it is worth mentioning that Scope 2 emissions are strongly influenced by changes in the SIN emission factor⁸, which varies as a function of higher or lower dispatch of thermal power plants during the year (Table 5).

Table 5 - History of the Emission Factors of the National Interconnected System

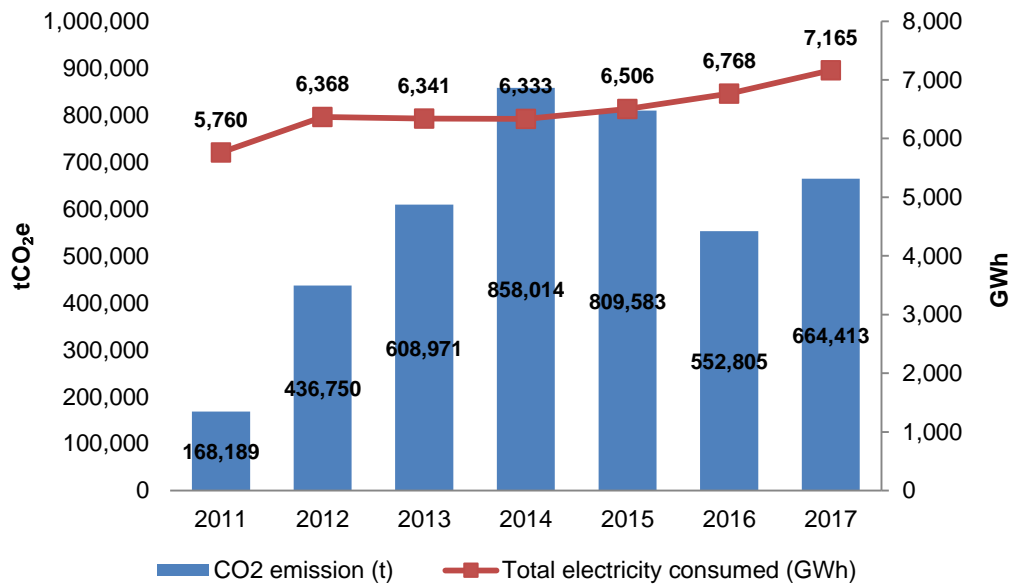
Year	Annual average (tCO ₂ e/MWh)
2011	0.0292
2012	0.0686
2013	0.0960
2014	0.1355
2015	0.1244
2016	0.0817
2017	0.0927

Out of the total Scope 2 emissions in 2017, 0.6% of them, equivalent to 4,059 tCO₂e, resulted from energy consumption, and 99.4%, equivalent to 660,354 tCO₂e, resulted from total losses.

The total emissions of Scope 2, Figure 5, increased from 552,805 tCO₂e to 664,413 tCO₂e between 2016 and 2017 (variation of 20.2%), as a result of the increase in electrical energy losses and the SIN factor.

⁸ http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_corporativos.html

Figure 5 - Indirect emissions from electricity consumption, Scope 2



The main actions taken to minimize emissions related to energy losses in T&D are described in the Corporate targets item.

7.3 Scope 3 emissions

Cemig seeks the continuous improvement of the inventory of Scope 3 emissions, introducing new emission sources, always according to the assessment of the level of availability, quality, veracity and traceability of such data from third parties. Table 6 shows Scope 3 emissions per emission activity.

Table 6 - GHG Emissions in tCO₂e per emission activity of Scope 3

GHG Emissions (tCO ₂ e)	2011	2012	2013	2014	2015	2016	2017
Transport of Materials, Equipment and Waste (Upstream Transportation and Distribution)	1,618	2,874	1,194	817	373	548	575
Business travels	1,786	1,953	1,691	1,361	1,138	846	822
Outsourced Transportation of Employees (Commuting)	ND	ND	841	586	600	591	494
Sale of Energy (Use of goods and services sold)	5,199,371	5,321,724	7,643,677	11,324,277	9,614,752	6,049,885	6,985,687
Operation and maintenance services of Cemig Distribuição (Fuel consumption of contractors) (Downstream Transport and Distribution)	ND	15,313	11,563	5,729 *	12,851	13,241	19,871

* 2014 was atypical, with low adherence of third parties in the data reporting.

The main emission source of Scope 3 is the consumption of electricity by end consumers. In 2017, Cemig recorded a 1.8% increase in total sales, which generated a 15.5% increase in indirect emissions, a fact also highlighted by the rise in the SIN emission factor from 0.0817 tCO₂e / MWh in 2016 to 0.0927 tCO₂e / MWh in 2017. The SIN emission factor was used because energy provided by Cemig for the Interconnected System composes this calculation made by the Ministry of Science and Technology, although the Company's emission factor is less than the Brazilian Matrix emission factor.

Representing 0.012% of indirect emissions, business travel accounted for 822 tCO₂e. The reduction of 2.9% in the respective emissions compared to 2016 was a consequence of the decrease in the use of this service.

Out of the other emission sources, 575 tCO₂e came from the transport of materials, equipment, and waste; and 494 tCO₂e, from the transportation of employees, there was an increase of approximately 4.9% and a reduction of about 16.4% compared to 2016, respectively

Emissions from the vehicles of contractors of operating and maintenance services for Cemig Distribuição totalled 19,871 tCO₂e in 29 contractors, out of 40 invited to participate in 2017, being 17 contractors and 23 subcontractors. It is important to emphasize that the participation and the contribution with information by the

contractors are voluntary. The Company continues to engage its suppliers concerning climate issues.

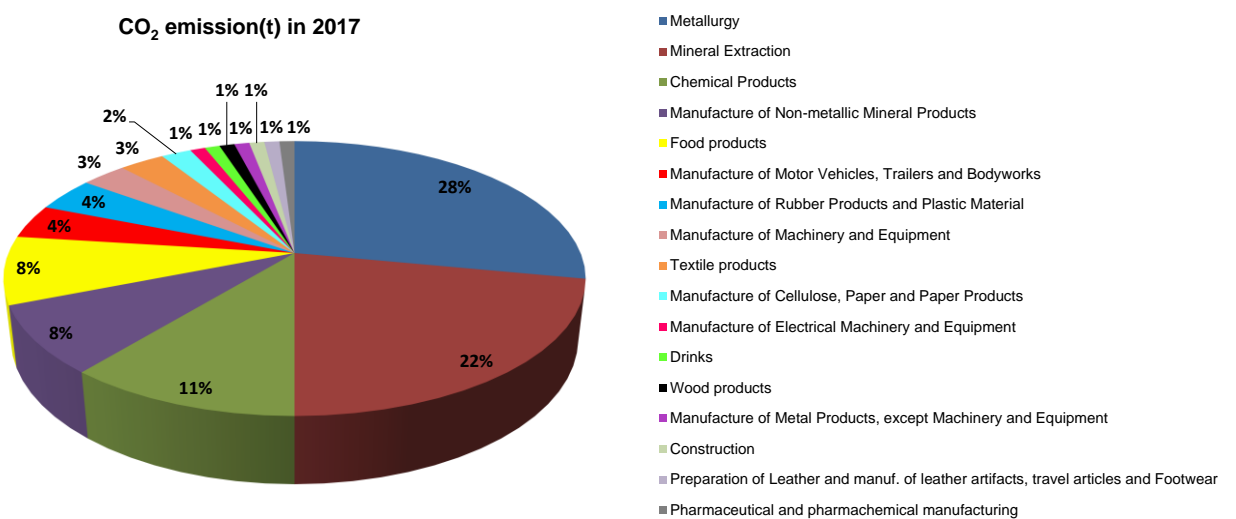
7.3.1 Emissions from energy consumption by third parties

The energy sold by Cemig corresponds to the sale of power to captive consumers and free customers, in Minas Gerais concession area and outside the State; the sale of energy to other agents of the electricity sector in the Regulated Contracting Environment (ACR or Ambiente de Contratação Regulada) and the Free Contracting Environment (ACL or Ambiente de Contratação Livre); and sales in Proinfa (Programme of Incentives for Alternative Electricity Sources) and CCEE (Electric Energy Commercialization Chamber), eliminating the intercompany transactions in the Cemig Group.

Out of all sectors to which Cemig sells energy, the industrial area is the most significant consumer. Figure 6 presents a qualitative analysis of CO₂ emissions from the consumption of electricity sold by Cemig. In order to calculate these emissions, the energy consumption of the sector and the emission factor of the National Interconnected System were used.

The CO₂ emission made by the Metal Industry accounted for 31% of total emissions from industrial customers in 2017 (Figure 6).

Figure 6 - Percentage of the emission of CO₂, by Industrial Class, in 2017



8. Total emissions

Table 7 shows Cemig's total emissions, broken down by each company included in this inventory.

Table 7 - Emissions broken down by company (tCO₂e)

GHG Emissions (t CO ₂ e)	Scope 1					Scope 2 ("location" approach)
	CO ₂	CH ₄	N ₂ O	SF ₆	Total (t CO ₂ e)	CO ₂
Cemig Geração e Transmissão S.A. ³	34,430	341	638	870	36,279	562
Cemig Distribuição S.A.	8,413	25	160	3,911	12,509	663,831
Rosal Energia S.A. ¹	9	0	0	0	9	0
Sá Carvalho S.A. ¹	6	0	0	0	6	0
Efficientia S.A. ²	3	0	0	0	3	0
Cemig Telecomunicações S.A.	41	0	2	0	43	20
Total	42,902	366	800	4,781	48,849	664,413

¹ These Plants consume the energy generated by them.

² It uses the facilities of Cemig Distribuição S.A.

³ The emissions of the new Special Purpose Companies (SPEs) are included in the amounts referring to Cemig GT, namely: Cemig Geração Camargos S.A.; Cemig Geração Itutinga S.A.; Cemig Geração Salto Grande S.A.; Cemig Geração Três Marias S.A.; Cemig Geração Leste S.A.; Cemig Geração Oeste S.A.; Cemig Geração Sul S.A.

From the data presented, Cemig GT (74.3%) and Cemig D (25.6%), together, account for 99.9% of total Scope 1 emissions, mainly caused by fossil fuels from the Igarapé Thermal Power Station in Cemig GT and the fleet of own vehicles in Cemig D. In relation to Scope 2 emissions, Cemig D is responsible for 99.9% of the total emissions caused by the losses in the distribution system.

Table 8 shows the summary of emissions of Scope 1, 2 and 3 per type of gas.

Table 8 - Consolidated emissions data for all GHG and Scopes

Emissions in metric tons of CO ₂ equivalent (tCO ₂ e)			
GHG (t)	Scope 1	Scope 2 ("location" approach)	Scope 3
CO ₂	42,902	664,413	7,007,031
CH ₄	366	0	48
N ₂ O	800	0	369
SF ₆	4,781	0	0
Total	48,849	664,413	7,007,448

9. Scope 1, quantified separately for each GHG

Table 9 shows direct GHG emissions, broken down by greenhouse gas, in tCO₂e.

Table 9 - GHG emissions in tons of GHG gas and metric tons of CO₂ equivalent (tCO₂e)

GHG	In metric tons of each gas (t)	Global Warming Potential ¹	In metric tons of CO ₂ equivalent (tCO ₂ e)
CO ₂	42,902	1	42,902
CH ₄	14.7	25	366
N ₂ O	2.7	298	800
HFCs	-	12,000 - 14,800	-
PFCs	-	7,390 - 12,200	-
SF ₆	0.2	22,800	4,781
Total	42,920	-	48,849

¹Source: Intergovernmental Panel on Climate Change - IPCC (2007)

10. Corporate targets

Aware of its commitment to mitigate its greenhouse gas emissions that contribute to global climate change, Cemig has set a corporate goal for reducing direct emissions (Table 10).

Table 10 - Corporate target for reducing direct emissions

Scope	% reduction compared to the base year	Metric	Base year	Base year emissions (tCO ₂ e)	Target year
1	8%	tCO ₂ e	2014	617,717	2021

In 2017, Cemig's direct emissions totalled 48,849 tCO₂e, representing a reduction of 92.1% compared to direct emissions in 2014, the base year of the target.

With the same intention, Cemig defined a target for reducing electricity consumption (Table 11).

Table 11 - Corporate target for reducing electricity consumption

Scope	% emission of the Scope	% reduction compared to the base year	Metric	Base year	Organizational boundaries	Target year
2	0.8%	4%	GJ	2011	Cemig GT and Cemig D	2020

Between 2011 and 2017, electricity consumption was reduced by 7.1%, from 168,740 GJ in 2011 to 156,773 GJ in 2017.

Another target defined internally by Cemig is related to the management of total electricity losses in Transmission and Distribution (Table 12).

Table 12 - Corporate target for reducing total electricity losses

Scope	% emission of the Scope	Percent target	Metrics	Base year	Organizational boundaries	Target year
2	99.4%	To remain below the index of 10.79% of total electricity losses	% reported losses	2013	Cemig GT and Cemig D	2017

The total losses were 14.24% in 2017, and the Company has made efforts to improve manageable factors to achieve the target.

Total distribution losses (IPTD) are segmented into technical losses (PPTD), and non-technical losses (PPNT) or commercial losses and are calculated by the difference between what was billed and the amount of losses in the basic network, as determined by CCEE. The technical losses are inherent to the transportation of energy along the equipment and transmission and distribution lines. They are influenced, among other factors, by the conditions of dispatch of the plants, by the level of works of reinforcement in the electric system, by the behaviour of the consumer market and by the adoption of specific measures for reduction. Non-technical losses are related to deficiencies or irregularities in the measurement and billing of consumer units as well as to the existence of clandestine connections in

the network of the distributor. The control of non-technical losses is fundamental to minimize the Company's financial losses, which are, in part, passed on to consumers' tariffs during the tariff review process.

Regarding the calculation of the loss indicators, the IPTD in 2017 was 14.24% in relation to the total energy injected into the distribution system, an increase of 0.78 p.p. in relation to 2016, and the regulatory target established for the end of 2017 of 10.92%. The Total Losses of the Distribution are composed of the Technical Losses plus the Commercial Losses (Non-Technical Losses). The Technical Loss Index in 2017 was 8.98% compared to the total energy injected into the distribution system (reduction of 0.11 p.p. compared to the value realized in 2016) for a regulatory target of 7.84%. On the other hand, non-technical losses (PPNT) were 5.26% for a 3.08% target.

The increase noted in Non-Technical Losses is a reflection of the unfavourable macroeconomic scenario experienced in the country in recent years, with high unemployment and high inflation rates and changes in the electricity sector due to the Provisional Measure 579 (converted into Law No. 12.783 of 2013), culminating in successive tariff readjustments (approximately 46% for the residential class in 2014 and 2015). These factors drove the increase in electricity frauds in Cemig concession area, especially between 2014 and 2016.

With regard to the Management of Commercial Losses, in 2017, approximately 99 thousand inspections were carried out in consumer units. This action provided the recovery and energy increment of 47.7 GWh and 96 GWh, respectively. These amounts of energy correspond to aggregate revenues for the Company of R\$ 39.1 and R\$ 46.1 million, respectively. Therefore, in 2017, the regularization process in consumer units provided an additional revenue for the Company of R\$ 85.2 million.

11. GHG emissions from biomass

The "neutral carbon" emitted in biomass burning is reported separately, according to the guidelines of the GHG Protocol. For the fossil fuels with the addition of bio-fuels, the values indicated by the National Petroleum Agency (ANP), compiled in the Calculation Tool of the Brazilian Program of the GHG Protocol, were adopted. In 2017, the average addition of ethanol (anhydrous) to gasoline sold in Brazil was

27% and 8% of biodiesel to diesel.

Table 13 shows emissions from biomass consumption.

Table 13 - Emissions of biogenic CO₂ (tCO₂e)

Scope 1	1,140
Scope 3	2,068
Total	3,208

12. GHG removals and reductions

Cemig undertakes some actions that indirectly contribute to the GHG removal, however, due to its peculiar characteristics related to the quantification of emissions and its low level of assertiveness and integrity, at this moment, the Company chose not to quantify them.

The following are some of the initiatives that contribute to the GHG removal:

- With the formation of large reservoirs of hydroelectric plants, it creates at its banks, a large perimeter usually lacking forest formations. When present, these existing formations consist of species adapted to a drier environment and, therefore, poorly adapted to high soil moisture due to the elevation of water table level and fluctuations of the reservoir level. This new environment conformation creates the need for deployment, recovery, and conservation of riparian forests surrounding the reservoirs for maintenance of ecological processes. For nearly 30 years Cemig has been developing, in partnership with universities, several types of research that have supported the programs of implantation of riparian forests around its reservoirs. Through Research and Development (R&D) Programs, the Company has sought to study and propose innovations in light of the technological challenges of the electricity sector. The partnership with the surrounding rural producers has been fundamental to the success of these actions. In 2017, 11.6 hectares were reforested along the banks of Cemig reservoirs. The Company deactivated the forest nurseries and the forest seed laboratory. The acquisition of

seedlings currently occurs to meet specific internal demands of projects in conjunction with municipal governments and other institutions.

- Between 2012 and 2016, a Research and Development (R&D 484) project was developed, in partnership with the Federal University of Ouro Preto - UFOP, in order to evaluate the effectiveness and sustainability of the riparian forests of Volta Grande HPP, in the conservation of ecological processes and biodiversity. In this work, the ecosystem services provided by the riparian forests of the Volta Grande HPP reservoir were identified. Among these services, we can mention the conservation of natural ecosystems and the supply of goods and services, such as water and food. In addition to the wood provided by the forest, it still provides seeds, fruits, medicinal plants and ornamentals, fibers and dyes. The forests also contain organisms that play essential roles in the maintenance of the environment and also provide other services of immense influence on climate, hydrological cycles, biodiversity, water and air quality and soil fertilization.

The main results obtained by the R&D 484, which evaluated the last 30 years of the project of implantation of riparian forests in the Volta Grande HPP, allow listing the following conclusions:

- The reforested areas around the reservoir, although not recovered for the specific purpose of recovering biodiversity, ecological processes and ecosystem services, present today this set of elements that are important for their own "survival" and longevity;
- These areas house relatively high biodiversity, compared to other fragments in the same region, although the similarity of composition, structure, and dynamics are below what would be considered ideal;
- The restoration process of riparian forests has already achieved several benefits, including erosion control, maintenance of soil fertility and hydrological cycles;
- It is remarkable the increase in plant biodiversity and fauna, biodiversity of aquatic invertebrates, vegetation productivity and carbon sequestration, which brings direct benefits to human life;
- The presence of a more significant number of animal species can be considered an essential tool for the conservation and restoration of riparian

forest fragments because of the ecosystem services provided by these animals;

- Studies have shown that several species of birds, mammals, and invertebrates, such as ants and beetles, act as dispersers of fruits and seeds and decomposers of organic matter, contributing to the enrichment of the flora.

For more details on the 484 R&D project visit: <http://www.prociliar.ufop.br/>

Click [here](#) to access Cemig's Biodiversity Report 2016, published every two years.

The strategy to reduce GHG emissions is based on ten principles outlined in the document "[Commitment to Climate Change](#)", in which three main initiatives stand out: 1. Generation of energy by renewable sources; 2. Fleet management; and 3. Expansion of the renewable matrix and maintenance of assets.

The following are some of the corporate initiatives that contribute to the GHG reduction:

Scope 1

- Defined as a corporate strategic driver, the promotion of the use of renewable energy sources is also oriented to offer greater diversification of the generating park, with new sources such as wind, solar and other possibilities pointed out by the research and innovation of the Company.
- Recent R&D projects present results that can be used on a large scale by the Company in the medium and long-term, among them: i) generation of electricity in solar plants connected to the electrical system, know-how being pioneered by Cemig through the projects Solar Power Plant of Sete Lagoas and Mineirão Solar, this one already inaugurated; and ii) development of PVT (photovoltaic-thermal) solution to increase the efficiency of solar plants.
- The fuel consumption of the Cemig D and Cemig GT's vehicles fleet was reduced in 4%, representing a savings of approximately R\$ 5.2 million for the Company between 2016 and 2017. Comparing the years 2012 and 2017, Cemig decreased its annual consumption by about 15%, which represents a

reduction in the use of more than half a million liters. This reduction in consumption is due to the modernization of the vehicles fleet, due to the "Fleet replacement program" developed in 2016-2017 and to the constant optimization of the Company's vehicles fleet. The optimization of the fleet in this period was possible, mainly, because all vehicles currently in operation are equipped with an electronic management system, allowing a constant evaluation of their use. Between 2012 and 2017 there was a reduction of 644 units of the fleet. Moreover, the Company adopted S10 Diesel as the main fuel used, instead of the common Diesel (S500), previously used. All the pickup trucks (Cemig's and leased ones), which used the common Diesel, were replaced by pickup trucks that use the S10 Diesel. In total, 1,112 pickup trucks went into operation in this condition. Today, Cemig has 1,115 vehicles powered by S10 Diesel.

- Investments in training, equipment, change of methodology and processes focused on the mitigation of SF₆ losses, either by eliminating leaks or by eliminating losses in the maintenance process.
- In addition, it should be noted that Cemig assesses the risk of the increase in carbon emissions in its energy matrix by carrying out environmental due diligence related to the acquisition and/or merger of new assets, or considering the risk in the calculation of the economic and technical feasibility of new projects through sensitivity analysis. This initiative has helped the Company in decision making, considering the climate strategy in the expansion of its business.

Scope 2

- Establishment of corporate targets to reduce electricity consumption at Cemig, as described in Corporate targets item.
- In 2017, in order to curb the increase in Commercial Losses and educate the population about the various damages caused by the irregularities, Cemig promoted several inspections at strategic points in Belo Horizonte and in the interior of the Minas Gerais State, with simultaneous media interaction and publicity of news by different means of communication (written media, radio

and television broadcast). "Anti-fraud in connections" operations were also organized to remove clandestine connections.

- In addition, improvements were made to the software for the selection of inspection targets (SGC/SAP/SAS/MECE), improvements in the quality of the irregular consumption collection process, and the screening of medium and large-sized consumer revenues, whereas Cemig since 2012 has a dedicated telemetry structure, based on its Integrated Measurement Centre, which enables the remote monitoring of approximately 13 thousand large customers, representing about 45% of the Company's revenues.
- Another critical action to mitigate Commercial Losses relates to the program to modernize the measurement facility of consumers throughout the Minas Gerais State. In 2017, from that program, about 30 thousand old and/or depreciated meters have been replaced by new meters with electronic technology, which allow more accurate measurement and are less susceptible to theft of energy. There were also meters installed in 1,032 feeders of the concessionaire's park.

Scope 3

The Energy Efficiency Projects included in the Cemig's [Smart Energy Program](#) are relevant instruments for the reduction of indirect emissions of third parties, by providing a reduction in the electric energy consumption of end consumers by the replacement of obsolete electrical equipment, with high consumption levels, and environmental education initiatives. In 2017, these projects avoided the emission of 2,219 tCO_{2e}.

- The incentivized projects implemented by Efficientia in 2017 avoided the emission of 5,005.8 tCO_{2e} / year in customers in the industrial and commercial sectors. Efficientia is an Energy Saving Company (ESCO), which acts in the development and feasibility of technological solutions that promote the efficient use of energy and the consequent reduction of greenhouse gas emissions in the facilities of medium and large-size customers, from commercial, industrial and service sectors.

13. Exclusions

The inventory sought to account for all significant sources of emissions from Scope 1 and Scope 2. The solid wastes disposal (organic matter) and the effluents generated in operation, which are treated and destined by third parties, were not included in Scope 3.

14. Recalculation

There was no need to recalculate previous years reported in the last inventories since Cemig did not present significant changes in its structure, capacity and emission sources in 2017.

15. Uncertainties and quality of the report

Cemig has sought to build on the best methodologies, references, and tools for the calculation of GHG emissions, publicly available, to guarantee an excellent quality of the report and reduce as much as possible the level of uncertainty of this inventory. Concerning the determined data, in opting for the centralized approach, Cemig understands that it reduced the risk of duplication of calculations, estimates and possible errors in formulas and calculations.

Another fundamental element to ensure the quality of its inventory is the fact that the information sources used are covered by the Company Management System, which is based on ISO 9001 - Quality Management System, ISO 14001 - Environmental Management System and OHSAS 18001 - Occupational Health and Safety Management System, which guarantee processes and procedures oriented to the quality, reliability and tracking of the information determined. Standards to ensure critical analysis, treatment and information management, as well as regulatory requirements to ensure higher reliability in results, are described in the Management Systems Manual, and the General Procedures prepared and approved at the corporate level. Finally, all data used, their sources and methodology of collection and procedures, to guarantee the integrity of the information, were verified by an independent third party.

The uncertainty level of an inventory is given by errors introduced in the calculation

of these emissions, whether in the quantification of the activity of a source or by the emission factor used. The activity of a source is the data that expresses the intensity of that source. For example, the consumption of fossil fuel by the thermal power plant or the fleet is a function of the activity of this source, and inaccuracies related to this data increase the uncertainty percentage of the emission calculation of this source. This inaccuracy is usually given by the sum of the inaccuracies of the equipment that measures the activity of the source. In the case of fuel consumption, this uncertainty is given by the uncertainty of the equipment that measures the quantity in liters that were actually consumed and the burning efficiency of that fuel. Failures in data collection are associated with the quality of the inventory, much more than the uncertainty of the calculation.

Similarly, the inaccuracy in the emission factor of the fuel burn also increases the uncertainty of the final calculation. The final uncertainty is predominantly determined by the uncertainty of the activity and the uncertainty of the emission factor.

In order to estimate the uncertainty of Cemig's GHG inventory, "GHG Protocol Short Guidance for Calculating Measurement and Estimation Uncertainty for GHG Emissions" were used, with an uncertainty level of +/- 4.6%.

It is understood that this calculation of uncertainty follows the recommendations of the Guidance mentioned above, but it should be noted that it contains errors and inaccuracies regarding the way in which it was carried out, i.e., it considers general factors, not the actual inaccuracies, which would be laborious and costly to do to obtain a more accurate value. However, the data serves as a general indicator that the inventory follows the good practices recommended by the GHG Protocol, resulting in adherent information and with the quality expected by the methodology adopted.

16. Responsible for the preparation

Companhia Energética de Minas Gerais - Cemig

Responsible: Superintendence of Corporate Sustainability

Technical support: Keyassociados Consultoria e Treinamento Ltda.

Date: April, 2018

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17. Annex 1 - Verification Statement



STATEMENT

The Bureau Veritas Certification, established at Avenida Alfredo Egídio de Souza Aranha, 100, 4th floor, Torre C, Vila Cruzeiro, São Paulo/SP, enrolled in the National Registry of Legal Entities under No. 72.368.012/0002-65, states for the proper purposes that Companhia Energética de Minas Gerais - Cemig, established at Av. Barbaena, 1200, Santo Agostinho, Belo Horizonte, Minas Gerais, enrolled in the National Registry of Legal Entities under No. 17.155.730/0001-64, in the city of Belo Horizonte, Minas Gerais, is authorized to publish in all its titles and sites the excerpt from the Verification Statement as written below: "Bureau Veritas Certification, based on the processes and procedures described in its Verification Report, adopting a reasonable level of confidence, declares that the Greenhouse Gas Inventory - 2017, inventoried by Companhia Energética de Minas Gerais - Cemig, is accurate, reliable and error-free or distortion-free and is an equitable representation of GHG data and information over the reference period, for the defined scope; it was prepared in accordance with the specifications of NBR ISO 14064-1 and the Brazilian GHG Protocol Program, and was verified according to the requirements of NBR ISO 14064:2007 part 3: Specification with guidance for the validation and verification of greenhouse gas assertions, and the Specifications of the Brazilian GHG Protocol Program."

Emissions Verified: Scopes 1, 2 and 3 (in tCO₂e)

Approach	Scope 1	Scope 2	Scope 3	Total
Operational control	46,849	664,413	7,007,448	7,720,710

São Paulo, May 16th, 2018.

Bureau Veritas Certification

Rubens da Silva Ferreira
Lead Verifier





The Directors
Companhia Energética de Minas Gerais – Cemig
Av. Barbacena, 1200 – Bairro Santo Agostinho
Minas Gerais – MG, Brasil
30190-131

May 16th, 2018

To whom it may concern,

The purpose of this letter is to clarify matters set out in the assurance report. It is not an assurance report and is not a substitute for the assurance report.

This letter and the verifier's assurance report, including the opinion(s), are addressed to you and are solely for your benefit in accordance with the terms of the contract. We consent to the release of this letter by you to CDP in order to satisfy the terms of CDP disclosure requirements but without accepting or assuming any responsibility or liability on our part to CDP or to any other party who may have access to this letter or our assurance report.

In accordance with our engagement contract with you dated August 29th, 2017 (the "contract") and for the avoidance of doubt, we confirm that our Brasil-ver/BR. 1305039report ver. 01 to you dated 06/05/2018 (the "assurance report") incorporated the following matters:

1. Boundaries of the reporting company covered by the assurance report and any known exclusions. ^{*1}

*1 Optional field

CDP verification template

Company operations in: Brazil, comprising the following companies:

- Cemig Geração e Transmissão S.A. (Cemig GT)
- Cemig Distribuição S.A. (Cemig D)
- Rosal Energia S.A.
- Sa Carvalho S.A.
- Effolentia S.A.
- Cemig PCH S.A.
- Horizontes Energia S.A.
- Cemig Telecomunicações S.A.
- Cemig Geração Camargos S.A.
- Cemig Geração Itutinga S.A.
- Cemig Geração Salto Grande S.A.
- Cemig Geração Três Marias S.A.
- Cemig Geração Leste S.A.
- Cemig Geração Oeste S.A.
- Cemig Geração Sul S.A.

2. Emissions data verified - broken down by Scope 1, Scope 2 and Scope 3 categories with figures given; option to include other relevant data that has been verified with figures.

Scope 1: 48,849 tCO₂e

Scope 2: 664,413 tCO₂e

Scope 3: 7,007,448 tCO₂e

Total: 7,720,710 tCO₂e

3. Period covered (e.g. '12 months to DD MM YY')

01/01/2017 to 31/12/2017

4. Verification standard used

ISO 14064-3: Specification with guidance for the validation and verification of greenhouse gas assertions.

5. Assurance opinion (Incl. level of assurance and any qualifications)

CDP verification template

Based on the process and procedures conducted, and according to the Bureau Veritas Certification verification statement dated of May 16th, 2018, there is no evidence that the GHG assertion

- is not materially correct and is not a fair representation of GHG data and information, and
- has not been prepared in accordance with the related International Standard on GHG quantification, monitoring and reporting, or to relevant national standards or practices,
- has been prepared in accordance with the related International Standard on GHG.

6. Verification provider and accreditations (if relevant)

BVQI do Brasil Sociedade Certificadora Ltda.

7. Lead verifier name and relevant accreditations/professional membership (if relevant)

Rubens da Silva Ferreira - GHG Lead Verifier.

8. This letter should be prepared on the verifier's letterhead or include the signature of the lead verifier (or authorized signatory/ organization responsible for issuing the assurance report / statement) in the box below.

