

Greenhouse Gases Inventory

Year 2016

Cemig - Companhia Energética de Minas Gerais



Sumamry






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1. Cemig

Cemig completed 64 years of operation in 2016. Since its foundation, on May 22nd, 1952, the Company has assumed the role of bringing the collective welfare to the regions where it operates in an innovative and sustainable way. This determination led to its position as the largest power distributor in lines extension and networks, and one of the largest power generation and power transmission companies in the country.

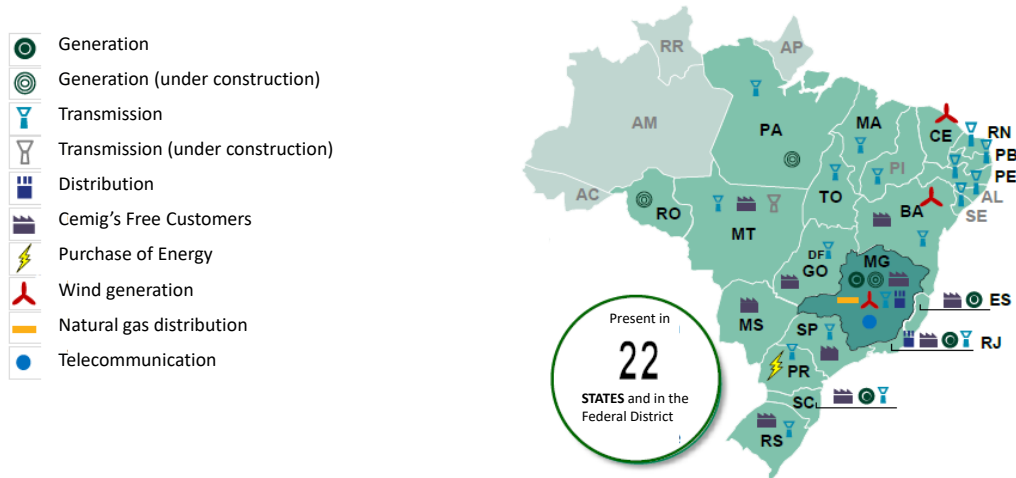
The Company operates in the areas of exploration and distribution of natural gas and data transmission, but the main business areas of Cemig are generation, transmission and distribution of electricity and energy solutions (Table 1).

Table 1 - Main business areas of Cemig

				
Generation	Transmission	Distribution	Natural gas	Commercialization
Installed capacity: 7,862 MW	Extension of lines: 8,341 km	Extension of grids: 515,069 km	1.066 million m ³ of gas sold	22% of market share

Cemig has 7,119 direct employees (base December 2016). 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), totaling 234 Companies, 18 Consortia and 2 FIPs (Equity Investment Funds), resulting in assets present in 23 Brazilian States, including the Federal District. 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 [full organization chart](#) of the Cemig Group companies.

2. About the inventory

In line with the guidelines of the corporate document "[Commitment to Climate Change](#)", Cemig invests in initiatives that positively position it in the efficient management of its impacts and its exposure to the risks of the 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 climate changes in order to minimize its risks, and the related subjects are widely communicated and disclosed to society and its shareholders.

In this sense, Cemig quantifies its emissions and makes public for the sixth consecutive time its Inventory of Greenhouse Gases, 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 six inventories were submitted to an independent verification conducted, in this case, by Bureau Veritas Certification (Annex 1 - Verification Statement, page 30).

This inventory, for 2016, was prepared according to these guidelines:

- ABNT NBR ISO 14064-1 - Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.
- Specifications of the GHG Protocol Brazilian Program - Accounting, Quantification and Publishing Corporate Inventories 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 Program.
- “The Greenhouse Gas Protocol - a Corporate Accounting and Reporting Standard – Reviewed 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_V2017.3".

The choice of the calculation methodology was mainly based on the internal evaluation of data availability and the specific emission factors, in order to present more transparent and consistent results with the reality of the electric sector, in line with the Brazilian reality. 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 Cemig's ERP system¹
- Records in operating and corporate 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 SGA Level 1² that Cemig has developed for units whose license has not yet been issued by the environmental agency. All these certifications are audited internally and by third party certifying organization.

Cemig is in the process of adapting its Management System to the requirements of ISO 14001:2015 and ISO 9001:2015. The ISO 2015 Standards Transition Project aims to better align management systems and strategic guidelines by introducing the risk management mentality, stakeholder requirements analysis, organizational learning, change management and greater engagement of the leadership, at all levels, into the management system. The project started in 2015 and is expected to be completed in September 2018. It consists of several stages, including training of people involved, review of all management system documentation, redefinition of certification scopes, review of the system for measuring results and conducting audits.

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

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

² SGA Level 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.

For the estimation of the loss percentage of SF₆, the factor of 0.5%³ per year was used for Cemig Distribuição equipment and 1%⁴ per year for Cemig Transmissão equipment, bibliographic data acceptable to the operation sector of the Company.

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

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

4. Covered Period

The quantification of emissions from activities directly and indirectly developed by Cemig corresponds to the period between January 1st, 2016 and December 31st, 2016. The historical base year chosen 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 with departure or arrival in Brazil.

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

The nine companies totally controlled by Cemig, referred to in this inventory, are listed in Table 2⁵.

Table 2 - Companies totally 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	Usina Térmica do Barreiro S.A.
9	Cemig Telecomunicações S.A.

⁵ The new Special Purpose Companies (SPEs) were also included in this inventory, 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.

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 greenhouse gas emission sources 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
Fuel used in the startup and operation of the process gas thermal plant (Barreiro TPP)	Stationary combustion
Machinery and equipment	Stationary combustion
SF ₆ emissions from electrical equipment	Fugitive emissions
Fertilizers used in the production of seedlings and in plantations	Agricultural activities
Fuels used in forklifts and cranes	Stationary combustion
SCOPE 2	
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 Transportation 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 nine years (2008/2016). Comments on emissions performance are described in subsequent items.

Table 4 - GHG emissions history - Scopes 1, 2 and 3 - 2008 to 2016

Year	Scope 1 (t CO ₂ e)	Scope 2 (t CO ₂ e)	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

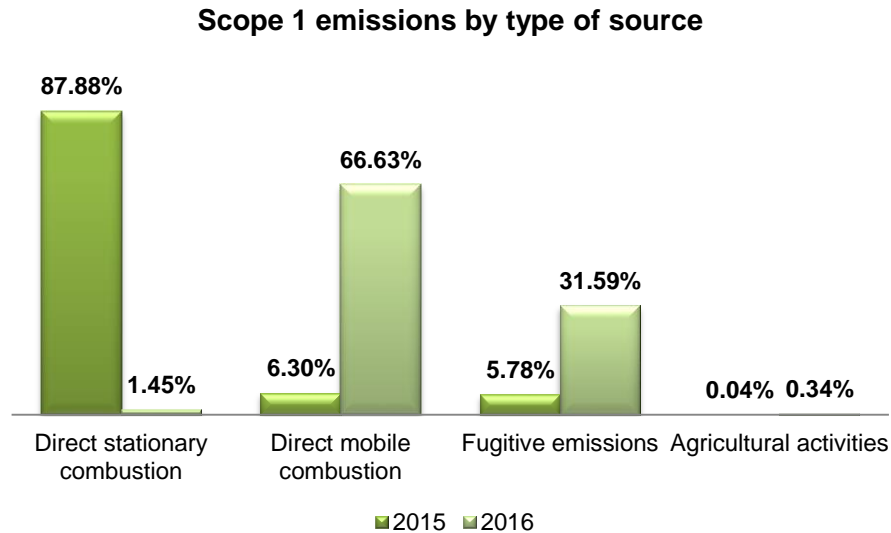
7.1 Emissions of Scope 1

The following were the emissions of Scope 1 in 2016: 10,302 tCO₂e, from the fleet of vehicles, boats and aircrafts; 4,884 tCO₂e of fugitive gas emissions SF₆, present in electrical equipment; 96 tCO₂e, from the start of the Barreiro Thermal Power Plant; 27 tCO₂e, from the use of emergency generators; 101 tCO₂e, from the use of machinery and forklifts; and 53 tCO₂e from the use of fertilizers.

The intensity of Cemig's direct emissions was 0.000664 tCO₂e/MWh.

Figure 2 shows the emission sources of Scope 1 by type of source and the contribution in relation to the total, referring to 2015 and 2016.

Figure 2 - Direct emissions by source type between 2015 and 2016, Scope 1



7.1.1 Stationary combustion

These stationary emissions originate mainly from machinery and equipment (45%), from the start of Barreiro Thermal Power Plant (43%) and from emergency generators (12%). In 2016, the Igarapé Thermoelectric Plant (131 MW), which operates to meet the contingencies of the Brazilian Interconnected Power System, was not dispatched, consequently, it did not generate emissions.

It should be noted 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 of forecast of future inflows scenarios, expected growth of energy consumption and definition of expansion schedule of new power plants. In periods of favorable hydrology and high levels of water storage in the reservoirs of the system, the generation decision in thermal power plants is minimized, giving priority to the hydroelectric generation.

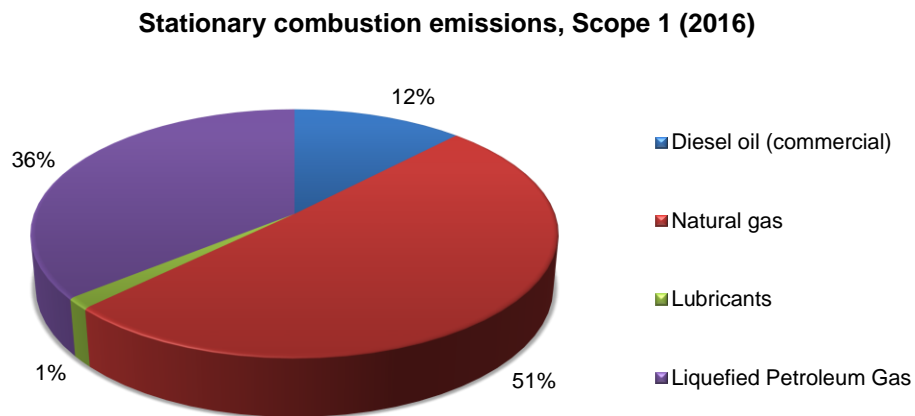
The other thermal plant, Barreiro TPP (12.9 MW), uses as main fuels blast furnace gases, tar and other waste gases generated in the steelmaking processes. The consumption of fossil fuel, natural gas (NG), in Barreiro TPP, occurs at the start of the machinery or, eventually, in the reduction of the supply of blast furnace gases by the steel mill. The consumption of NG in Barreiro TPP decreased from 4,880,800 Nm³ in 2015 to 46,375 Nm³, representing a decrease of 99.05%, due to the shorter

operating time of the plant, 713.95 hours in 2016 versus 6,641.62 hours in 2015, because of the shutdown of one of the blast furnaces by Vallourec. The Cemig - Vallourec contract for the operation of Barreiro TPP was terminated in December 2016, therefore, this Thermoelectric Plant will no longer be part of Cemig's GHG inventory, as of the next edition.

It should also be noted that the reused gases from the steelmaking process burned at Barreiro TPP are not accounted for here, since they are generated in Vallourec's production process and recorded in the inventory of that company. Complementary to this fact, these gases are generated due to the use of charcoal produced by planted forests, i.e., wood of sustainable origin, and, therefore, these emissions are considered neutral.

Figure 3 shows the GHG emissions per fuel used.

Figure 3 - Stationary combustion emissions, Scope 1

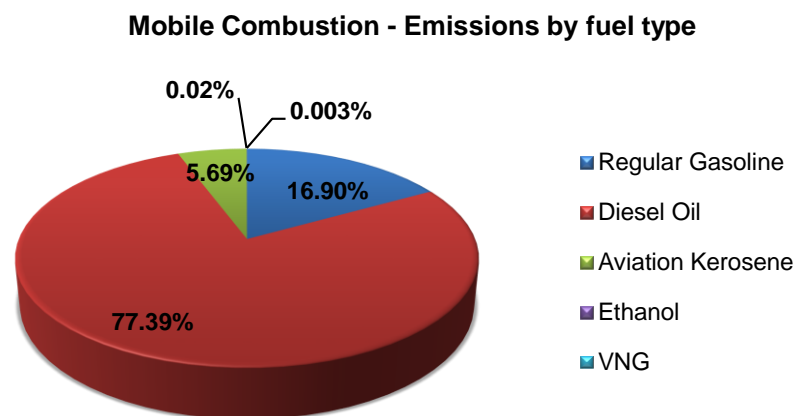


7.1.2 Mobile Combustion

In order to reduce emissions from mobile combustion processes through measures of logistical optimization, fleet management and renewal, and reduction in the stretches traveled, Cemig obtained a cumulative reduction of 28% in emissions in 2010-2016 period. In relation to 2015, the emissions from the fleet were reduced from 10,371 tCO_{2e} to 10,302 tCO_{2e} in 2016, a reduction of 0.7%, due to the measures that have been adopted for a more efficient management of the fleet.

These emissions refer to the consumption of gasoline, ethanol, diesel, Vehicular Natural Gas and aviation fuel of Cemig fleet. As shown in Figure 4, the largest contribution (77.39%) 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 2015, fugitive emissions related to SF₆ decreased from 9,514 tCO_{2e}, to 4,884 tCO_{2e} in 2016, a decrease of 48.7%, mainly due to the reduction in the number of interventions with replacement of SF₆ in the equipment of Cemig D.

7.1.4 Agricultural activities

Emissions from Cemig's agricultural activities come from 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. Comparing 2015 and 2016, the amounts went from 57 tCO₂e to 53 tCO₂e, a variation of 6.9%, due to the decrease in these activities.

7.2 Emissions of Scope 2

The emissions of Scope 2 are related to the electricity consumption used in industrial and administrative facilities, from the National Interconnected System (SIN), 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 for according to standard Aneel procedures. As a comparison, it is worth mentioning that emissions of Scope 2 are strongly influenced by changes in the electricity emission factor of SIN⁸, which varies as a function of greater or lesser dispatch of thermal power plants throughout the year (Table 5).

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

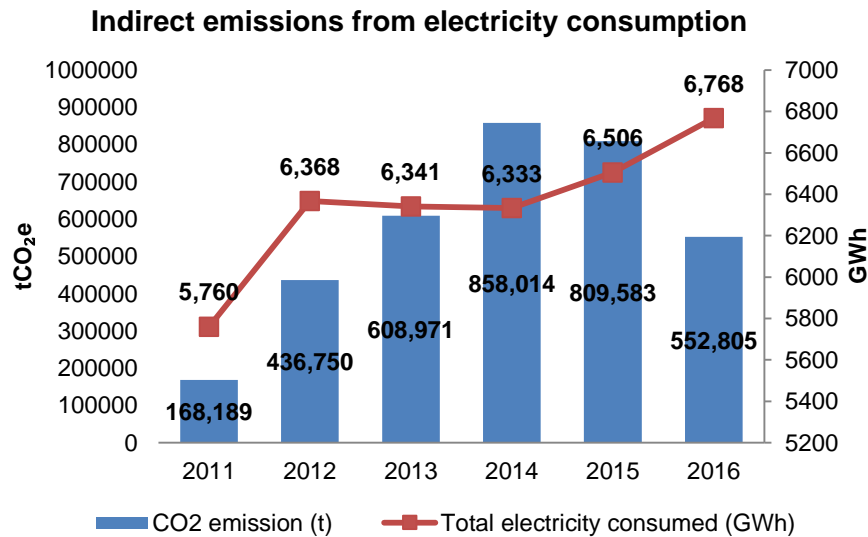
Year	Annual average (tCO ₂ e/MWh)
2011	0.0292
2012	0.0686
2013	0.0960
2014	0.1355
2015	0.1244
2016	0.0817

Out of the total emissions of Scope 2 in 2016, 0.6% of them, equivalent to 3,566 tCO₂e, as a result of energy consumption, and 99.4%, equivalent to 549,239 tCO₂e, as a result of technical losses.

⁸ <http://www.mct.gov.br/index.php/content/view/321144.html#ancora>

The total emissions of Scope 2, Figure 5, decreased from 809,583 tCO₂e to 552,805 tCO₂e between 2015 and 2016 (31.7%), as a result of the reduction of electricity losses and the SIN factor.

Figure 5 - Indirect emissions from electricity consumption, Scope 2



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

7.3 Emissions of Scope 3

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
Transport of Materials, Equipment and Waste (Upstream Transportation and Distribution) (Commuting)	1,618	2,874	2,035	1,403	974	1,138
Business travels	1,786	1,953	1,691	1,361	1,138	846
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
Operation and maintenance services of Cemig Distribuição (Fuel consumption of contractors) (Downstream Transportation and Distribution)	ND	15,313	11,563	5,729*	12,851	13,241

* 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 2016, Cemig recorded a 4.2% reduction in total sales, which generated a 37.1% decrease in indirect emissions, a fact also highlighted by the reduction of the SIN emission factor from 0.1244 tCO₂e/MWh in 2015 to 0.0817 tCO₂e/MWh in 2016. It was used the SIN emission factor because energy provided by Cemig for the Interconnected System composes this calculation made by the Ministry of Science and Technology, although the Company emission factor is lower than the Brazilian Matrix emission factor.

Representing 0.014% of indirect emissions, business travels accounted for 846 tCO₂e. The reduction of 25.6% in the respective emissions in relation to 2015 was a consequence of the reduction in the use of this service.

Out of the other emitting sources, 548 tCO₂e came from the transport of materials, equipment and waste; 591 tCO₂e, from the transport of employees, there was an increase of approximately 46.6% and a reduction of approximately 1.5% in relation to 2015, respectively.

Emissions from the vehicles of the contractors that provided operating and maintenance services for Cemig Distribuição totaled 13,241 tCO₂e in 21 contractors, a total of 25 with contracts in force in 2016, invited to participate. It is important to emphasize that the participation and the contribution with information by the contractors are voluntary. It should be noted that the Company continues to engage its suppliers in relation to climate issues.

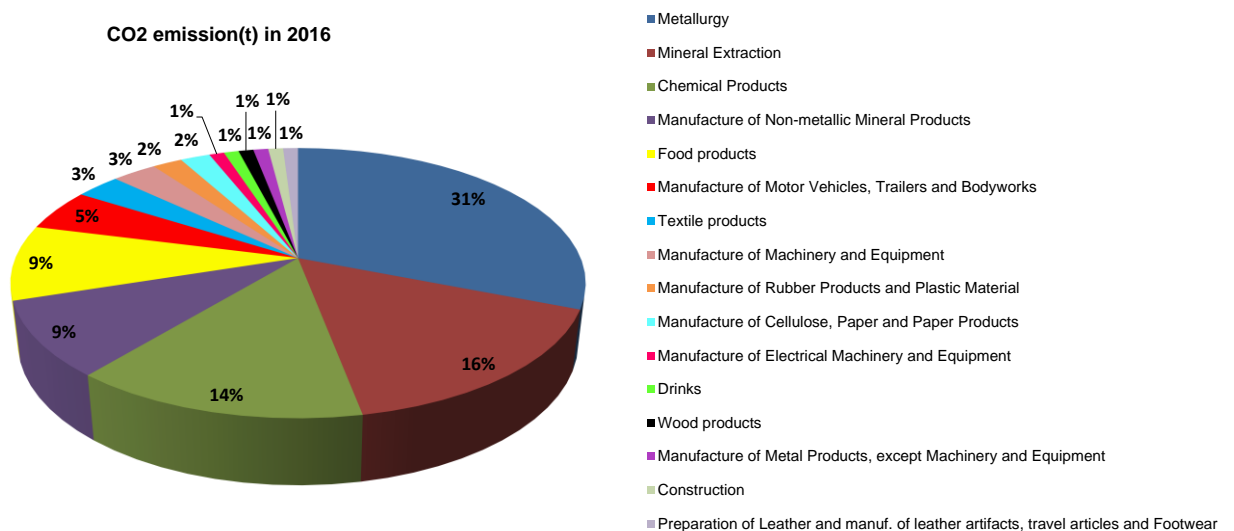
7.3.1 Emissions from energy consumption by third parties

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

Out of all sectors with which Cemig sells energy, the industrial sector is the largest consumer. Figure 6 presents a qualitative analysis of CO₂ emissions from Cemig's electricity consumption. 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 2016 (Figure 6).

Figure 6 - Percentage of CO₂ emissions by Industrial Class, in 2016



8. Total Emissions

Table 7 shows Cemig's total emissions, detailed for the nine companies included in this inventory.

Table 7 - Emissions broken down by company (tCO₂e)

GHG emissions (t CO ₂ e)	Scope 1					Scope 2
	CO ₂	CH ₄	N ₂ O	SF ₆	Total (t CO ₂ e)	CO ₂
Cemig Geração e Transmissão S.A.	1,578	6	81	695	2,360	527
Cemig Distribuição S.A.	8,602	24	158	4,189	12,973	552,260
Rosal Energia S.A. ¹	7	0	0	0	7	0
Sá Carvalho S.A. ¹	5	0	0	0	5	0
Efficientia S.A. ²	4	0	0	0	4	0
Usina Térmica do Barreiro S.A.	96	0	0	0	96	0
Cemig Telecomunicações S.A.	16	0	1	0	17	18
Total	10,308	30	240	4,884	15,462	552,805

¹ These Plants consume the energy generated by them.

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

From the data presented, Cemig GT (15.3%) and Cemig D (89.9%), in total, account for 99.2% of the total emissions of Scope 1, mainly caused by consumption by the fleet of its own vehicles in Cemig D and GT. Regarding emissions of Scope 2, Cemig D is responsible for 99.9% of total emissions, caused by 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	Scope 3
CO ₂	10,308	552,805	6,064,812
CH ₄	30	0	35
N ₂ O	240	0	263
SF ₆	4,884	0	0
Total	15,462	552,805	6,065,110

9. Scope 1, quantified separately for each GHG

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

Table 9 - GHG emissions in tons of GHG and in 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	10,308	1	10,308
CH ₄	1.2	25	30
N ₂ O	0.8	298	240
HFCs	-	12,000 – 14,800	-
PFCs	-	7,390 – 12,200	-
SF ₆	0.2	22,800	4,884
Total	10,310	-	15,462

¹ Source: 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 target 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 2016, Cemig's direct emissions totaled 15,462 tCO₂e, representing a reduction of 97.5% in relation to direct emissions in 2014, 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 2016, electricity consumption was reduced by 7.3%, from 168,740 GJ in 2011 to 156,373 GJ in 2016.

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

Table 12 - Corporate Target for Reducing Total Energy 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 energy losses	% reported losses	2013	Cemig GT and Cemig D	2017

The total losses were 13.46% in 2016, and the Company has made efforts to improve manageable factors in order 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 loss 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 behavior 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 losses indicators, the IPTD in 2016 was 13.46% in relation to the total energy injected into the distribution system, an increase of 0.94 p.p. in relation to 2015, and the regulatory target established for the end of 2016 was 10.79%. The Total Losses of the Distribution are composed by the Technical Losses plus the Commercial Losses (Non-Technical Losses). The Technical Losses Index in 2016 was 9.09% in relation to the total energy injected into the distribution system (reduction of 0.37 p.p. compared to the value realized in 2015) for a regulatory target of 7.84%. On the other hand, the PPNT (non-technical losses) was 4.37% for a target of 3.03%.

This increase was driven by an unfavorable macroeconomic scenario, with inflation and unemployment rising, associated with tariff readjustments of approximately 46% for the residential class in 2014 and 2015. In addition to this scenario, there was a reduction in the execution of inspection services in consumer units.

Regarding the management of Commercial Losses, in 2016 approximately 26 thousand inspections were carried out in consumer units, providing recovery and energy increment of 36 GWh and 80 GWh, respectively. Despite the reduction in the number of inspections made in relation to 2015, the energy incorporated with the regularizations remained stable, due to the good volume of charges made in 2016 and the contribution in the increase of energy due to the inspections made in 2015. These amounts of energy correspond to aggregate revenues for the Company of R\$

30 and R\$ 36 million, respectively. Therefore, in 2016, the regularization process in consumer units provided additional revenue for the Company of R\$ 66 million.

11. GHG emissions from biomass

The "neutral carbon" emitted on biomass burning is reported separately, according to the guidelines of the GHG Protocol. For the fossil fuels with the addition of biofuels, the values indicated by the National Agency of Petroleum (ANP) were used, compiled in the Calculation Tool of the GHG Protocol Brazilian Program. In 2016, the average addition of ethanol (anhydrous) to gasoline marketed in Brazil was 27% and 7% of biodiesel to diesel.

Table 13 shows emissions from biomass consumption.

Table 13 - Emissions of biogenic CO₂ (tCO₂e)

<i>Scope 1</i>	<i>1,181</i>
<i>Scope 3</i>	<i>1,390</i>
Total	2,571

12. GHG Removals and reductions

Cemig undertakes some actions that indirectly contribute to the removal of GHG, 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 reduction of GHG:

- The Riparian Reforestation Program, which is a cooperative action between the Company, the rural owners of the areas around reservoirs, considered Permanent Preservation Areas (APP), and the Public Prosecutor's Office. The owners are encouraged by Cemig to preserve these areas and promote riparian reforestation. In order to do so, the Company provides the seedlings and accounts for the implementation costs; in turn, the owners make the areas available and commit themselves to their proper maintenance. In 2016,

Cemig recovered approximately 46 ha of riparian forests around its reservoirs, in partnership with the rural owners of the Permanent Preservation Areas.

- The Company manages two forest nurseries, located in the environmental stations of Itutinga and Volta Grande, where seedlings are also produced for urban afforestation, as well as a seed laboratory, located in Belo Horizonte. In addition to producing seedlings of urban afforestation in compliance with agreements with municipal governments, Cemig's nurseries also produce seedlings of native species for reforestation of riparian forests around their reservoirs, tributary rivers and springs, in partnership with farmers.
- 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, can be mentioned 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 and ornamental plants, fibers and dyes. The forests also contain organisms that play important 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 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 such a set of elements that are important for their own "survival" and longevity;

- These areas house a 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 greater number of animal species can be considered an important 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 R&D 484 project, visit: <http://www.prociliar.ufop.br/>

Access here Cemig 2016 Biodiversity Report.

The strategy for reducing GHG emissions is based on ten principles outlined in the document "[Commitment to Climate Change](#)", in which three main initiatives stands out: 1. Energy generation from 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 reduction of GHG:

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 researches, and innovation of the Company.
- Recent R&D projects present results that can be used in 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 which

has been pioneering developed by Cemig through the projects Sete Lagoas Solar Power Plant and Mineirão Solar, the latest already inaugurated; and ii) development of PVT (photovoltaic-thermal) solution to increase the efficiency of solar plants.

- Considering Cemig D and Cemig GT's fleet of vehicles, its fuel consumption was reduced by 1.22%, representing an economy of approximately R\$ 1.6 million for the Company between 2015 and 2016. Comparing the years 2012 and 2016, Cemig has reduced its annual consumption by 10.16%, i.e., there has been a reduction in consumption of more than one million liters. This reduction in consumption is due to the updating of the vehicles fleet, resulting from the "Fleet Optimization Program", made in 2015. The optimization of the fleet was possible because all vehicles replaced since 2010 had Electronic Management System installed. This tool has been allowing constant monitoring in the use of vehicles. Between 2012 and 2016, there was a reduction of 630 vehicles. In addition, in 2016, with the implementation of the new fleet replacement program, about 93% of the pickup truck fleet started to use Diesel S10, which contains low sulfur content.
- 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 economical 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 target item.

- In 2016, 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 Minas Gerais State, with simultaneous media and publicity of news by different means of communication (written media, radio and television broadcast).
- 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 Center, which enables the remote monitoring of approximately 13 thousand large customers, representing about 45% of the Company's revenues.
- Another important action to mitigate Commercial Losses relates to the program to modernize the measurement park of consumers throughout the Minas Gerais State. In 2016, as of this program, approximately 215 thousand obsolete and depreciated meters were replaced by new meters, with electronic technology, allowing a more precise measurement, reducing the susceptibility to the accomplishment of the energy theft in these equipment.

All these actions avoided the emission of 3,197.4 tCO₂.

Scope 3

- The Energy Efficiency Projects included in 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 electric equipment, with high consumption levels, and environmental education initiatives. In 2016 these projects avoided the emission of 738 tCO_{2e}.
- The incentivized projects implemented by Efficientia in 2016 prevented the emission of 147.18 tCO_{2e}/year in customers of the industrial and commercial sectors. Efficientia is an Energy Services Company (ESCO), which acts in the

development and viability of technological solutions that promote the efficient use of energy and the consequent reduction of greenhouse gas emissions in the installations of medium and large-size customers, from commercial, industrial and service sectors.

13.Exclusions

The inventory sought to account for all major sources of emissions from Scope 1 and Scope 2. The solid wastes (organic matter) and the effluents generated in the 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 2016.

15.Uncertainties and quality of the report

Cemig has sought grounds 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. In relation to the verified 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 sources of information 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 verified. Standards to ensure critical analysis, treatment and management of information, as well as regulatory requirements to ensure greater reliability in results, are described in the

Management Systems Manual and in the General Procedures, prepared and approved at the corporate level. Finally, all data used, their sources and methodology of collection and procedures, in order to guarantee the integrity of 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 an activity data of this source, and inaccuracies related to this data increases 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 was 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 imprecision in the emission factor of the fuel burning 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" was used, with an uncertainty level of +/- 4.7%.

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 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 preparing this report

Companhia Energética de Minas Gerais - Cemig

Responsible: Superintendence of Corporate Sustainability

Technical support: Keyassociados Consultoria e Treinamento

Date: April, 2017

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17. Annex 1 - Verification statement



STATEMENT

Bureau Veritas Certification, established on Avenida Alfredo Egídio de Souza Aranha 100, 4th floor, tower C, Vila Cruzeiro, São Paulo, SP, entered with the CNPJ (National Register of Legal Entities) under number 72.368.012/0002-65, states for appropriate action that CEMIG – Companhia Energética de Minas Gerais, established on Av. Barbacena, 1200 – 17th floor, wing A1, Belo Horizonte, Minas Gerais, entered in the CNPJ (National Register of Legal Entities) under number 17.155.730/0001-64, in the city of Belo Horizonte, Minas Gerais, is authorized to publish in all their titles and websites the words of the Statement of Conformity according to the wording below: "Bureau Veritas Certification, based on the processes and procedures described in its Verification Report, adopting a reasonable level of confidence, states that the Inventory of Greenhouse Gases - year inventoried 2016 of CEMIG – Companhia Energética de Minas Gerais, is precise, reliable, free of errors or distortions and has an equitable representation of GHG data and information related to the reference period for the defined scope; it was prepared in accordance with the specifications of NBR ISO 14064-1 and with Brazilian Program GHG Protocol and verified according to specifications of 'NBR ISO 14064:2007 part 3 – Specification with guidance for validation and verification of greenhouse gas assertions; and specifications of Brazilian Program GHG Protocol.'

Verified emissions:

Scopes 1, 2, and 3 (in tCO₂e)

Approach	Scope 1	Scope 2	Scope 3	Total
Operational Control	15,462	552,805	6,065,110	6,633,377

São Paulo, April 25th, 2017


 Bureau Veritas Certification

