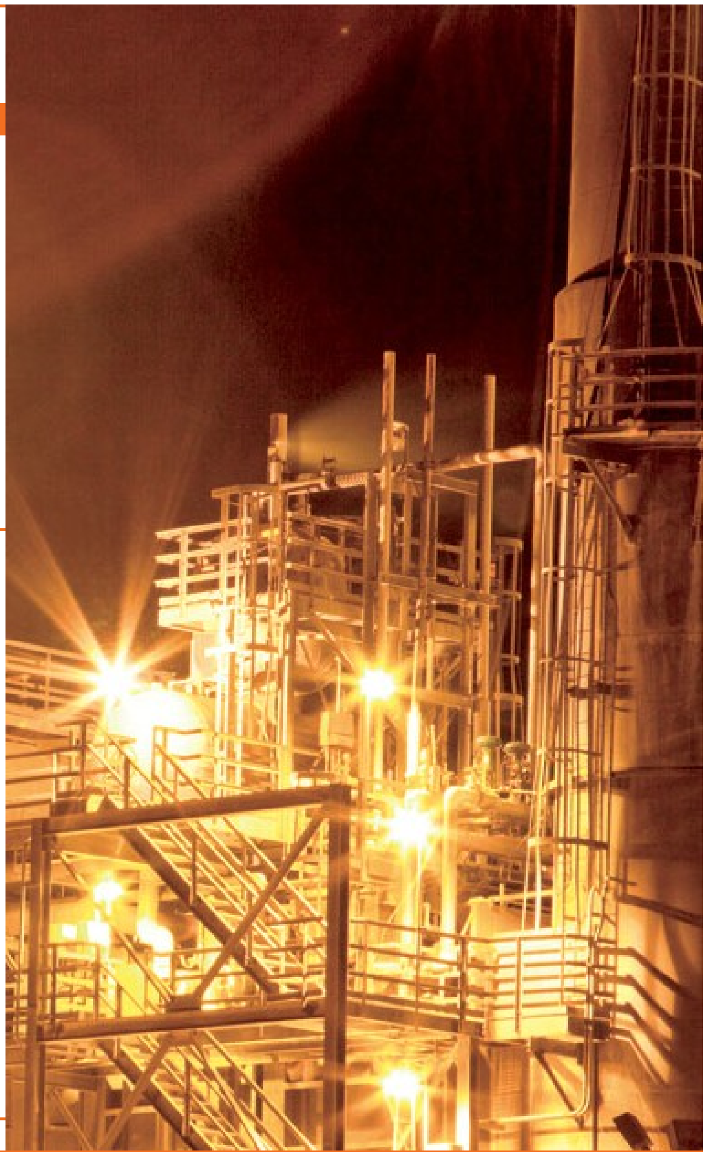
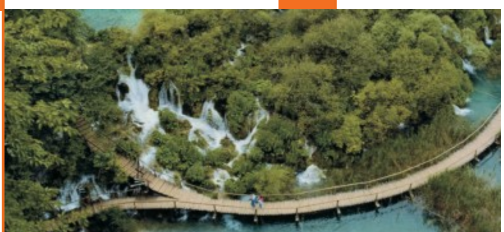


GREENHOUSE GAS INVENTORY VERIFICATION OF THE TRACTEBEL ENERGIA - 2015

➤ GHG Verification Statement



ENGIE Tractebel Energia

WHEN YOU NEED TO BE SURE

SGS

Declaração BR16/9364

Greenhouse Gas Verification Statement

The inventory of Greenhouse Gas emissions in 2015 of

Tractebel Energia S.A.

Rua Paschoal Apóstolo Pítsica, N° 5.064
Florianópolis – SC, CEP: 88025-255

has been verified in accordance with ISO 14064-3:2007 as meeting the requirements of

ISO 14064-1:2007

For the following activities

Operation of electricity generation plants and electric power commercialization agent.

Authorized by

Vanda Nunes
Director
Date: April 7th, 2016

SGS ICS Certificadora Ltda
Av. Andrômeda, 832 - 5º andar - Barueri/SP - CEP 06473-000
Telefone 55 11 3883-8880
Fax 55 11 3883-8899
www.br.sgs.com

This Statement is not valid without the full Greenhouse Gas Assertion and the verification scope, objectives, criteria and findings available on pages 2 to 4 of this Statement.

SGS has been contracted by Tractebel Energia S.A. (hereinafter referred to as "CLIENT"), Rua Phascoal Apostolo Pítsica, 5.064 – Florianópolis – SC – CEP: 88025-255, for the verification of direct and indirect Greenhouse Gas emissions in accordance with ISO14064 and GHG Program.

ISO 14064-3: 2007

as provided by Tractebel Energia S.A. (hereinafter referred to as "RESPONSIBLE PARTY"), Rua Phascoal Apostolo Pítsica, 5.064 – Florianópolis – SC – CEP: 88025-255, in the Greenhouse Gas (GHG) Assertion in the form of inventory covering GHG emissions of the period 2015.

Roles and responsibilities

The management of Tractebel Energia S.A. is responsible for the organization's GHG information system, the development and maintenance of records and reporting procedures in accordance with that system, including the calculation and determination of GHG emissions information and the reported GHG emissions.

It is SGS's responsibility to express an independent GHG verification opinion on the GHG emissions as provided in the GHG Assertion for the period 2015.

SGS conducted a third party verification of the provided GHG assertion against the principles of ISO 14064-1: 2007 and ISO 14064-3: 2007 and Programa Brasileiro GHG Protocol in the period 2015. The verification was based on the verification scope, objectives and criteria as agreed between Tractebel Energia S.A. and SGS on 28/03/2016.

Level of Assurance

The level of assurance agreed is that of reasonable assurance.

Scope

Tractebel Energia S.A. has commissioned an independent verification by SGS ICS Certificadora Ltda of reported GHG emissions of 2015 arising from "Operation of electricity generation plants and electric power commercialization agent" activities, to establish conformance with ISO 14064 principles within the scope of the verification as outlined below.

The data and information supporting the GHG assertion were calculated based on monitored and historical data.

This engagement covers verification of emission from anthropogenic sources of greenhouse gases included within the organisation's boundary and is based on ISO 14064-3:2007.

- The organizational boundary was established following operational control approach and equity share.
- Title or description activities: Operation of electricity generation plants and electric power commercialization agent.
- Location/boundary of the activities: Location of the units of the company in Annex A.
- Physical infrastructure, activities, technologies and processes of the organization: Offices and Electricity Units Genertaion, according to Annex A.
- GHG sources, sinks and/or reservoirs included: scope 1, scope 2, scope 3.
- Types of GHGs included: CO_2; CH_4; N_2O; HFCs; PFCs; SF_6 and NF_3.
- Directed action: N.A.
- GHG information for the following period was verified: 2015.

- Intended user of the verification statement: Tractebel Energia S.A., ISE – Índice de Sustentabilidade Empresarial, between others.

Objective

The purposes of this verification exercise are, by review of objective evidence, to independently review:

- Whether the GHG emissions are as declared by the organisation's GHG assertion
- The data reported are accurate, complete, consistent, transparent and free of material error or omission.

Criteria

Criteria against which the verification assessment is undertaken are the principles of ISO 14064 and Programa Brasileiro GHG Protocol.

Materiality

The materiality required for the verification was considered by SGS to 5%, based on the needs of the intended user of the GHG Assertion.

Conclusion

Tractebel Energia S.A. provided the GHG assertion based on the requirements of ISO14064-1: 2007 and GHG Protocol. The GHG information for the period 2015 disclosing emissions of **6.150.621,41** metric tonnes of CO2 equivalent (operational control) and **6.150.308,17** metric tonnes of CO2 equivalent (equity share) are verified by SGS to a reasonable level of assurance, consistent with the agreed verification scope, objectives and criteria.

SGS

GHG Emissions per type of gas and source of Tractebel Energia S.A. – Operational Control

Scope 1	CO2	CH4	N2O	HFC	PFC	SF6	CO2e
Stationary combustion	6,043,850.26	401.00	131.90				6,093,182.65
Mobile combustion	621.24	0.12	0.04				637.11
Processes	5,345.05	0.00	0.00	0.00	0.00	0.00	5,345.05
Fugitive emissions	9.74	0.00	0.00	0.02	0.00	0.01	226.73
Agricultural activities	0.00	0.00	0.02				5.73
Solid wastes	0.00	0.27	0.02				12.61
Scope 1 Total	**6,049,826.30**	**401.39**	**131.99**	**0.02**	**0.00**	**0.01**	**6,099,409.88**
Scope 2							
Purchased electricity from the grid	**18,751.32**						**18,751.32**
Scope 3							
Fuel and energy-related activities not included in Scopes 1 and 2	39.83	0.00	0.00	0.00	0.00	0.00	39.97
Transport and distribution (upstream)	19,473.69	1.36	1.06				19,824.84
Waste generated in operations	32.41	30.96	0.12				807.45
Business travels	903.59	0.04	0.04				915.34
Employees transportation (home-work)	449.28	0.05	0.03				458.34
Transport and distribution (downstream)	10,234.13	0.64	0.55				10,414.26
Total Scope 3	**31,132.92**	**33.06**	**1.80**	**0.00**	**0.00**	**0.00**	**32,460.21**
Total emissions	***6,099,710.53***	***434.44***	***133.78***	***0.02***	***0.00***	***0.01***	***6,150,621.41***

(Source: Spreadsheet of GHG Emissions per type of gas and source of Tractebel Energia S.A. – Operational Control).

GHG Emissions per type of gas and source of Tractebel Energia S.A. – Equity Share

Scope 1	CO2	CH4	N2O	HFC	PFC	SF6	CO2e
Stationary combustion	6,043,859.73	377.31	128.74				6,091,658.38
Mobile combustion	641.99	0.13	0.04				658.51
Processes	5,345.05	0.00	0.00	0.00	0.00	0.00	5,345.05
Fugitive emissions	10.00	0.00	0.00	0.02	0.00	0.01	236.13
Agricultural activities	0.00	0.00	0.03				8.30
Solid wastes	0.00	0.28	0.02				12.89
Total Scope 1	**6,049,856.78**	**377.71**	**128.84**	**0.02**	**0.00**	**0.01**	**6,097,919.26**
Scope 2							
Purchased electricity from the grid	**19,709.00**						**19,709.00**
Scope 3							
Fuel and energy-related activities not included in Scopes 1 and 2	39.83	0.00	0.00	0.00	0.00	0.00	39.97
Transport and distribution (upstream)	19,575.95	1.37	1.07				19,929.93
Waste generated in operations	32.41	31.31	0.12				816.05
Business travels	968.59	0.04	0.04				981.16
Employees transportation (home-work)	488.77	0.05	0.03				498.53
Transport and distribution (downstream)	10,234.13	0.64	0.55				10,414.26
Total Scope 3	**31,339.68**	**33.42**	**1.81**	**0.00**	**0.00**	**0.00**	**32,679.90**
Total emissions	***6,100,905.45***	***411.13***	***130.65***	***0.02***	***0.00***	***0.01***	***6,150,308.17***

(Source: Spreadsheet of GHG Emissions per type of gas and source of Tractebel Energia S.A. – Equity Share).

SGS's approach is risk-based, drawing on an understanding of the risks associated with reporting GHG emissions information and the controls in place to mitigate these. Our examination includes assessment, on a test basis, of evidence relevant to the amounts and disclosures in relation to the organization's reported GHG emissions.

We planned and performed our work to obtain the information, explanations and evidence that we considered necessary to provide a reasonable level of assurance that the GHG emissions for the period 2015 are fairly stated.

We conducted our verification with regard to the GHG assertion of Tractebel Energia S.A. which included assessment of GHG information system, monitoring and reporting plan/protocol. This assessment included the collection of evidence supporting the reported data, and checking whether the provisions of the protocol reference, were consistently and appropriately applied.

In SGS's opinion the presented GHG assertion:

- is materially correct and is a fair representation of the GHG data and information, and
- is prepared in accordance with ISO14064-1: 2007 on GHG quantification, monitoring and reporting.

This statement shall be interpreted with the GHG assertion of Tractebel Energia S.A. (Relatório Inventário de Emissões de Gases de Efeito Estufa do ano de 2015 Versão 3, 05/04/2016) as a whole.

ANNEX A – LIST OF UNITS INCLUDED IN THE SCOPE

OFFICE/UNIT	ADDRESS
Sede da Tractebel Energia **SEDE**	**Rua Paschoal Apóstolo Pítsica, 5064** **Bairro: Agronômica** **CEP:88.025-255** **Florianópolis – SC**
Escritório da Tractebel Energia de São Paulo **Escritório SP**	**Alameda Santos, 905 – 4º andar** **Bairro: Cerqueira César** **CEP: 01.419-001** **São Paulo – SP**
Complexo Termelétrico Jorge Lacerda **CTJL**	**Av. Paulo Santos Mello, 555** **Bairro: Centro** **CEP: 88.745-000** **Capivari de Baixo – SC**
Usina Termelétrica Charqueadas **UTCH**	**Rua Geólogo White, s/nº** **Bairro: Centro** **CEP: 96.745-000** **Charqueadas – RS**
Usina Termelétrica Alegrete **UTAL**	**Rua João Galant, s/nº** **Bairro: Ibirapuitã** **CEP: 97.546-330** **Alegrete – RS**
Usina Termelétrica William Arjona **UTWA**	**Rodovia BR 060, s/nº** **Estrada Vicinal – Distrito Imbirissu** **CEP: 79.115-540** **Campo Grande – MS**
Usina Termelétrica Ibitiúva Bioenergética **UTIB**	**Fazenda Piratininga, s/nº** **Bairro: Pitangueiras** **CEP: 14.750-000** **Pitangueiras – SP**

Usina Termelétrica Ferrari/Ferrari Termoelétrica S/A **UTFE**	**Fazenda da Rocha, s/nº** **Bairro: Zona Rural** **CEP: 13.631-301** **Pirassununga – SP**
Unidade de Cogeração Lages **UCLA**	**Rua Vivandério Santos do Vale, s/nº** **Bairro: Caroba** **CEP: 88.516-600** **Lages – SC**
Usina Hidrelétrica Itá **UHIT**	**Volta do Uvá** **CEP: 99.770-000** **Aratiba – RS**
Usina Hidrelétrica Machadinho **UHMA**	**Linha São Paulo, s/nº** **CEP: 89.667-000** **Piratuba – SC**
Usina Hidrelétrica Salto Santiago **UHSS**	**Rodovia BR 158, Km 441,5** **CEP: 85.568-000** **Saudade do Iguaçu – PR**
Usina Hidrelétrica Salto Osório **UHSO**	**Rodovia PR 475, Km 3** **CEP: 85.575-000** **São Jorge D'Oeste – PR**
Usina Hidrelétrica Passo Fundo **UHPF**	**Usina Hidrelétrica Passo Fundo, s/nº** **CEP: 99.645-000** **Entre Rios do Sul – RS**
Usina Hidrelétrica Cana Brava **UHCB**	**UHE – Cana Brava** **Zona Rural** **Bairro: Cana Brava** **CEP: 73.790-000** **Cavalcante – GO**
Usina Hidrelétrica São Salvador **UHSA**	**Rod. TO 387 PRN São Salvador** **Km 40 à Esquerda + 20 Km** **Bairro: Zona Rural** **CEP: 77.360-000** **Paranã – TO**

Usina Hidrelétrica Estreito **UHET**	**Rodovia BR 230, Km 8, s/nº** **Zona Rural** **CEP: 65.975-000** **Estreito – MA**
Usina Hidrelétrica Ponte de Pedra **UHPP**	**Estrada UHE – Ponte de Pedra, s/nº** **Zona Rural** **CEP: 78.790-000** **Itiquira – MT**
PCH Areia Branca **PHAB**	**Fazenda Cachoeira Bonita, s/nº** **Santo Antonio do Manhuaçu** **Bairro: Zona Rural** **CEP: 35.321-000** **Caratinga – MG**
PCH José Gelásio **PHJG**	**Rodovia BR 163 Km 102, s/nº** **Ribeirão de Ponte de Pedra** **Bairro: Zona Rural** **CEP: 78.740-275** **Rondonópolis – MT**
PCH Rondonópolis **PHRO**	**Rodovia BR 163 Km 102, s/nº** **Ribeirão de Ponte de Pedra** **Bairro: Zona Rural** **CEP: 78.740-275** **Rondonópolis – MT**
Usina/Central Eólica Beberibe **UEBB**	**Fazenda Uberaba, s/nº - Praia das Fontes** **CEP: 62.840-000** **Beberibe – CE**
Usina/Central Eólica Pedra do Sal **UEPS**	**Praia Pedra do Sal, s/nº** **Bairro: Zona Rural** **CEP: 64.200-000** **Parnaíba – Piauí**

Usina/Central Eólica Guajirú **UEGU**	**Sítio Manguinhos, s/nº** **Bairro: Manguinhos** **CEP: 62.690-000** **Trairi – CE**
Usina/Central Eólica Mundaú **UEMU**	**Fazenda Boca da Mata, s/nº** **Bairro: Zacarias** **CEP: 62.690-000** **Trairi – CE**
Usina/Central Eólica Fleixeiras I **UEFL**	**Sítio Canaã, s/nº** **Bairro: Canaã** **CEP: 62.690-000** **Trairi – CE**
Usina/Central Eólica Trairi **UETR**	**Sítio Estrela, s/nº** **Bairro: Sítio Estrela** **CEP: 62.690-000** **Trairi – CE**
Usina/Central Eólica Tubarão **UETB**	**BR 101, s/nº - Km 329** **Bairro: Revoredo** **CEP: 88704-700** **Tubarão – SC**
Usina Fotovoltaica Cidade Azul **UFCA**	**BR 101, s/nº - Km 329** **Bairro: Revoredo** **CEP: 88704-700** **Tubarão – SC**

REPORT

INVENTORY OF GREENHOUSE GAS EMISSIONS

2015 YEAR

Tractebel Energia S/A

Adelino Ricardo Jacintho Esparta
Technical Director

05/04/2016

Version 3

Rua Padre João Manoel, 222
01411-000 · São Paulo · SP
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tel 55 (11) 3063-9068
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1. Abbreviations and Acronyms

AMA	Environmental Organizational Unit of Tractebel Energia
AR4	4th Assessment Report published by the IPCC (Fourth Assessment Report: Climate Change, 2007)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CEUT	Tractebel Energia Utilities Center
CH_4	Methane
CO_2	Carbon dioxide
UNFCCC	United Nations Framework Convention on Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DENORRIS	Legal Affairs Organizational Unit
DOC	Degradable Organic Carbon
DOP	Organizational Unit of Production Operation for Tractebel Energia
DPS	Organizational Unit of Documentation, supplies and services of Tractebel Energia
GEE	Greenhouse Gas
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
MAP	Ministry of Agriculture, Livestock and Supply
MCTI	Ministry of Science, Technology and Innovation
MDL	Clean Development Mechanism
N_2O	Nitrous oxide
NF_3	Nitrogen trifluoride
OMM	World Meteorological Organization ("WMO")
PFCs	Perfluorocarbons
UNEP	United Nations Environment Programme

RC	Responsible for collecting data from the greenhouse gas inventory of Tractebel Energia
CERs	Certified Emission Reduction (CER)
SAR	IPCC - Second Assessment Report: Climate Change, 1995
SEPRO	Energy Production Sector of Tractebel Energia
SESMT	The Security Industry and Occupational Medicine of Tractebel Energia
SF_6	Sulphur hexafluoride
NIS	The National Grid
TMSH	Organizational Unit Maintenance of Hydroelectric Central of Tractebel Energia
TMSS	Central organizational unit of Tractebel Energia Systems Maintenance
TMST	Central maintenance organizational unit of thermal power plants of Tractebel Energia
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

2. Summary of 2015 Results

Greenhouse Gas Emissions (tCO_2e)		
	Operational Control	Corporate Participation
Emission sources	**2015**	
Scope 1		
Stationary combustion	6,093,182.65	6,091,658.38
Mobile combustion	637.11	658.51
Processes	5,345.05	5,345.05
Fugitive emissions	226.73	236.13
Agricultural activities	5.73	8.30
Solid wastes	12.61	12.89
Total Scope 1	**6,099,409.88**	**6,097,919.26**
Scope 2		
Purchased electricity from the grid	**18,751.32**	**19,709.00**
Scope 3		
Fuel and energy-related activities not included in Scopes 1 and 2	39.97	39.97
Transport and distribution (upstream)	19,824.84	19,929.93
Waste generated in operations	807.45	816.05
Business travels	915.34	981.16
Employees transportation (home-work)	458.34	498.53
Transport and distribution (downstream)	10,414.26	10,414.26
Total Scope 3	**32,460.21**	**32,679.90**
Total emissions	**6,150,621.41**	**6,150,308.17**
Biomass emissions (tCO_2)	**1,102,109.56**	**1,025,261.65**
Non-Kyoto gases (tCO_2e)	**374.67**	**438.35**

Note: the results of GHG emissions by gas type and source of Tractebel Energia in the Operational Control approach and corporate participation are in Annex I.

3. Introduction

In the same way that Tractebel Energia prioritizes and develops projects from renewable sources (including under the Clean Development Mechanism – CDM) and Research and Development (R&D), since 2010, the company has been developing its annual inventory of greenhouse gases (GHG) in line with its policy on climate change.

This is a major strategic corporate tool in the context of climate change, which allows the company to know its processes better, evaluate and improve its management system, particularly in relation to GHG emissions.

The inventory incorporates 27 plants in operation during 2015, located in 12 Brazilian States, as well as their administrative headquarters and its Office of Energy Trading located in Florianópolis (SC) and São Paulo capital, respectively, totaling 29 organizational units considered in this study.

This inventory was developed based on principles and guidelines established by the accounting and quantification specifications of the Brazilian GHG Protocol Program and in accordance with ISO 14064-1.

In its constant reach for the highest sustainability standards and considering the inventory an important management tool, Tractebel Energia has entered its collecting GHG data in its in its Integrated Management System, applying it to all its operational plants and their offices.

In 2016, following the example of the previous years and through external verification/audit, the company aimed at attesting to the quality and credibility of its 2015 GHG inventory and its associated quality management information system. Tractebel Energia hired SGS, a renowned company in the country for verification of GHG inventory in the energy sector and accredited for this purpose by INMETRO.

This report presents the Tractebel Energia GHG inventory for the year 2015, showing the GHG emissions of the company as a whole and its organizational units – plants in operation (27) and their offices (2) – in Scopes 1, 2 and 3 Scopes, as well as other important information related to them.

4. Tractebel Energia S.A.

Corporate name: Tractebel Energia S.A.

CNPJ (Corporate Taxpayer Registry): 02.474.103/0001-19

Economic Sector: Electricity and Gas

Subsector: Electricity, gas and other utilities

Scope: Electricity-generating plants operation and marketing of electric power.

Address: R. Paschoal Apóstolo Pítsica, nº 5064, 88025-255, Florianópolis, SC

Website: http://www.tractebelenergia.com.br/

Institutional information:

Tractebel Energia operates in the electricity-generating plants operation, as well as an active agent in marketing. The largest private energy-generating of Brazil, the company is headquartered in Florianopólis, Santa Catarina, and its plants are installed in five regions of the country, specifically in the States of Rio Grande do Sul, Santa Catarina, Paraná, São Paulo, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Goiás, Tocantins, Maranhão, Piauí and Ceará.

In 2015, Tractebel Energia had a generator Park with 27 (twenty-seven) plants in operation: 7 (seven) of wind, 9 (nine) hydropower plants, 3 (three) small hydropower plants, 1 (one) solar plant and 7 (seven) thermal power plants, and (3) three of its thermal power plants are operated with biomass (bagasse from sugar cane and wood waste).

Tractebel Energia is controlled by Engie Brazil, previously known as GDF SUEZ Energy Latin America Participations Ltd. (a subsidiary of ENGIE group, a world leader in energy), which owns 68.71% of its share capital.

Based on the vision of being the best energy company in Brazil in a sustainable way, Tractebel Energia, aligned with its policy on climate change, held its first inventory of greenhouse gas emissions in 2011 – concerning the company's operations in 2010 – by following the principles of the GHG Protocol. The company aims at identifying the sources of GHG emissions, quantifying emissions and using the inventory as a tool for management and decision-making.

5. Company in charge and professionals involved in the preparation of the inventory

The EQAO is the company in charge the preparation of the GHG inventory of 2015 for Tractebel Energia, which received all the necessary information for the preparation of the GHG Inventory of 2015.

The item 5.1 presents the EQAO professionals involved in the work. There are also presented the Tractebel Energia professionals who provided and centralized information on Tractebel Energia, which include representatives of the AMA and RCs of the plants and offices.

In addition to these professionals, there was significant participation of Tractebel Energia representatives of DOP, DPS, DJU and power plants, SEPRE, SESMT, CEUT and administrative sectors, as well as the TMSH, TMST and TMSS.

5.1. Responsible-EQAO

Those responsible for the preparation of the inventory of Tractebel Energia 2015 by the EQAO are:

- Adelino Ricardo J. Esparta-Director and founding partner of EQAO – Coordinator of GHG Inventory;
- Karen Midori Nagai - EQAO Projects Analyst.

5.2. Responsible-Tractebel Energia (AMA and RCs)

The following professionals of Tractebel Energia contributed to the data collection for the preparation of the GHG inventory for the year 2015.

Table 1 – Responsible for the data collection for the preparation of the GHG inventory of Tractebel Energia in the year 2015

Corporative sector	Coordinator_Tractebel Energia	Job title	Subst. Coordinator_Tractebel Energia	Job title
AMA	Lígia Bittencourt da Silva	Environmental Specialist	Ilmar Goltara Gomes	Environmental Technician
Power plant/Office	**RC**	**Job title**	**Subst. RC**	**Job title**
Head Office	Leticia Pivetta Camisão	Supply Analyst	Milena Pamplona	Supply Analyst
SP Office	Simone Fretin	Administrative Assistant	Gabriel Mann dos Santos	TCE Manager
UEBB	Liliana Dutra dos Santos	Chemical Engineer	Enio Lima	Infrastructure Assistant
UEPS	Liliana Dutra dos Santos	Chemical Engineer	Marcio Mauriz	Infrastructure Assistant
UEFL	Liliana Dutra dos Santos	Chemical Engineer	Clecio de Lima Silva	Civil Technician
UEGU	Liliana Dutra dos Santos	Chemical Engineer	Clecio de Lima Silva	Civil Technician
UEMU	Liliana Dutra dos Santos	Chemical Engineer	Clecio de Lima Silva	Civil Technician
UETR	Liliana Dutra dos Santos	Chemical Engineer	Clecio de Lima Silva	Civil Technician
UTFE	Liliana Dutra dos Santos	Chemical Engineer	Reginaldo Costa Brutti	Shift Chief
UCLA	Liliana Dutra dos Santos	Chemical Engineer	Geovane Soares	Utilities Technician
UTIB	Liliana Dutra dos Santos	Chemical Engineer	André Gomig	Power Plant Coordinator
CTJL	Liliana Dutra dos Santos	Chemical Engineer	Eduardo Guedes dos Santos	Utilities Technician
UTWA	Liliana Dutra dos Santos	Chemical Engineer	David Dilson Ferreira Paim	Shift Chief
UTCH	Rita Tissot	Environmental Process Coord.	Simone Da Silva Guimarães	Utilities Technician
UTAL	Rita Tissot	Environmental Process Coord.	Simone Da Silva Guimarães	Utilities Technician

Power plant/Office	RC	Job title	Subst. RC	Job title
PHAB	Claudiano do Amaral Souza	Environmental Analyst	Marcos Damont	PHAB Coordinator
PHJG	Claudiano do Amaral Souza	Environmental Analyst	Rogério Suematsu	PHJG Manager
PHRO	Claudiano do Amaral Souza	Environmental Analyst	Rogério Suematsu	PHRO Manager
UHPP	Claudiano do Amaral Souza	Environmental Analyst	Rogério Suematsu	UHPP Manager
UHCB	Andreia Ramos S. Szortyka	Environmental Analyst	Simone Rodrigues Gonçalves	Environmental Analyst
UHSA	Andreia Ramos S. Szortyka	Environmental Analyst	Adriano Diniz Baldissera	Environmental Analyst
UHET	Andreia Ramos S. Szortyka	Environmental Analyst	Simone Rodrigues Gonçalves	Environmental Analyst
UHSO	Anderson Gibathe	Environmental Technician	Clovis Agripino Tosin da Silva	Environmental Process Coord.
UHSS	Anderson Gibathe	Environmental Technician	Clovis Agripino Tosin da Silva	Environmental Process Coord.
UHPF	Sérgio Luiz Souza	Environmental Process Coord.	Felipe Salvador Soares	Environmental Analyst
UHIT	Sérgio Luiz Souza	Environmental Process Coord.	Felipe Salvador Soares	Environmental Analyst
UHMA	Sérgio Luiz Souza	Environmental Process Coord.	Felipe Salvador Soares	Environmental Analyst
UFCA	Liliana Dutra dos Santos	Chemical Engineer	Eduardo Guedes dos Santos	Utilities Technician
UETB	Liliana Dutra dos Santos	Chemical Engineer	Eduardo Guedes dos Santos	Utilities Technician

6. Methodology

For the preparation of the GHG emissions inventory, GHG Protocol guidelines, specifications of the Brazilian GHG Protocol Program and ISO 14064:2007 were considered. IPCC (2006) methodologies and guidelines were also used in the preparation of this inventory in order to meet specificities of emission sources from Tractebel Energia. Details regarding bases and references used are described in section 6.4.

6.1. Included Gases

This report presents the results of the greenhouse gas inventory of Tractebel Energia S/A regarding its operations in 2015. For effect, five gases and the two families of internationally recognized gases as greenhouse gases were considered, as presented in the Kyoto Protocol:

- ✓ Carbon dioxide (CO_2);
- ✓ Methane (CH_4);
- ✓ Nitrous oxide (N_2O);
- ✓ Sulphur hexafluoride (SF_6);
- ✓ Nitrogen trifluoride (NF_3);
- ✓ Hydrofluorocarbons (HFCs);
- ✓ Perfluorocarbons (PFCs).

Emissions of CH_4, N_2O, SF_6, NF_3, HFCs and PFCs are expressed as CO_2e, whereas the respective global warming potential ("GWP") of each gas, according to the IPCC reports and the ASHRAE. The GWP of each gas is presented in annex VIII.

In the case of Tractebel, the gases identified are: **CO_2, CH_4, N_2O, SF_6 and HFC (HFC-134A, R-410A and R-407C)**. It is worth mentioning that **HCFCs emissions (HCFC-22 or R-22)** were also identified, which are not considered by the Kyoto Protocol. However, R-22 emissions were reported separately in this report.

6.2. Boundaries of the GHG Emissions Inventory

The first step for preparing an inventory is to set boundaries for identifying GHG emission sources for accounting. The selected boundaries used for emissions accounting of Tractebel Energia are described below.

6.2.1. Organizational Boundaries

The demarcation of the organizational boundaries can be performed considering 2 (two) approaches: Operational Control of the company on the issuing source or ownership of the company. The first approach includes all GHG sources in inventory under control of the company; the second considers only those which the company has equity interest, in proportion.

Table 2 - Summary of organizational boundaries

Approach	Criterion	Accounting for GHG emissions
Operational Control	Authority over the emission source, i.e. the authority to introduce and implement operating policies.	It is considered the emission in case the company has control of the source (100%); otherwise, disregard the source (0%).
Corporate participation	Percentage of ownership.	The amount of GHG emissions is proportional to the percentage of the property.

In the case of Tractebel Energia S/A, the inventory was performed considering the two approaches presented above. In this sense, the following emissions power plants/offices in operation of Tractebel were considered.

Table 3 - Generator Park of Tractebel Energia S.A.

Plants/ Offices	Acronym	Fuel/ River	State	Total installed capacity (MW)	Institution that has Operational Control	Corporate participation Tractebel
Beberibe Wind Power Plant	UEBB	Wind	CE	26	Tractebel Energia	100%
Fleixeiras I Wind Power Plant	UEFL	Wind	CE	30	Tractebel Energia	100%
Guajirú Wind Power Plant	UEGU	Wind	CE	30	Tractebel Energia	100%
Mundaú Wind Power Plant	UEMU	Wind	CE	30	Tractebel Energia	100%
Pedra do Sal Wind Power Plant	UEPS	Wind	PI	18	Tractebel Energia	100%
Tubarão Wind Power Plant	UETB	Wind	SC	2,1	Tractebel Energia	100%
Trairi Wind Power Plant	UETR	Wind	CE	25	Tractebel Energia	100%
Cana Brava Hydropower Plant	UHCB	Tocantins	GO	450	Tractebel Energia	100%
Estreito Hydropower Plant	UHET	Tocantins	MA/TO	1.087	Estreito Consortium	40,07%
Itá Hydropower Plant	UHIT	Uruguai	SC/RS	1.450	Itá Consortium	68,99%
Machadinho Hydropower Plant	UHMA	Pelotas	SC/RS	1.140	Machadinho Consortium	19,29%
Hydropower Plant Passo Fundo	UHPF	Passo Fundo	RS	226	Tractebel Energia	100%
Ponte de Pedra Hydropower Plant	UHPP	Correntes	MT/MS	176	Tractebel Energia	100%
Salto Osório Hydropower Plant	UHSO	Iguaçu	PR	1.078	Tractebel Energia	100%
Salto Santiago Hydropower Plant	UHSS	Iguaçu	PR	1.420	Tractebel Energia	100%
São Salvador Hydropower Plant	UHSA	Tocantins	TO	243	Tractebel Energia	100%
Areia Branca Small Hydropower Plant	PHAB	Manhuaçu	MG	20	Tractebel Energia	100%
José Gelazio da Rocha Small Hydropower Plant	PHJG	Ribeirão Ponte de Pedra	MT	24	Tractebel Energia	100%
Rondonópolis Small Hydropower Plant	PHRO	Ribeirão Ponte de Pedra	MT	27	Tractebel Energia	100%
Alegrete Thermoelectric Power Plant	UTAL	Fuel oil	RS	66	Tractebel Energia	100%

Plants/ Offices	Acronym	Fuel/ River	State	Total installed capacity (MW)	Institution that has Operational Control	Corporate participation Tractebel
Charqueadas Thermoelectric Power Plant	UTCH	Coal	RS	72	Tractebel Energia	100%
Ferrari Thermoelectric Power Plant	UTFE	Sugarcane bagasse	SP	80.5	Tractebel Energia	100%
Ibitiúva Thermoelectric Power	UTIB	Sugarcane bagasse	SP	33	Tractebel Energia	69,26%
Jorge Lacerda Thermoelectric Complex	CTJL	Coal	SC	857	Tractebel Energia	100%
Lages Cogeneration Unit	UCLA	Wood waste	SC	28	Tractebel Energia	100%
William Arjona Thermoelectric Power Plant	UTWA	Natural gas and diesel oil	MS	190	Tractebel Energia	100%
Cidade Azul Photovoltaic Power Plant	UFCA	Sun	SC	3	Tractebel Energia	100%
Office of Tractebel Energia in São Paulo	ESP	-	SP	-	Tractebel Energia	100%
Tractebel Energia Headquarters (Office of Florianópolis)	headquarters	-	SC	-	Tractebel Energia	100%

6.2.2. Operational Boundaries

Operational boundaries involve the identification of GHG emission sources associated with the company's operations, including organizational boundaries. These emissions are classified as direct or indirect, as described below.

Table 4 – Scopes of GHG emissions

Scope	Coverage
Scope 1: **Direct emissions**	Sources of emissions owned or controlled by the company.
Scope 2: **Indirect emissions**	Emissions generated in the production of electricity and/or heat consumed by the company.
Scope 3: **Other indirect emissions**	Sources of emissions not owned or controlled by the company. The inclusion of these emissions is optional.
Biomass emissions	CO_2 emissions generated in the combustion of biomass.

The flowchart below illustrates emissions considered under Scopes 1, 2 and 3.

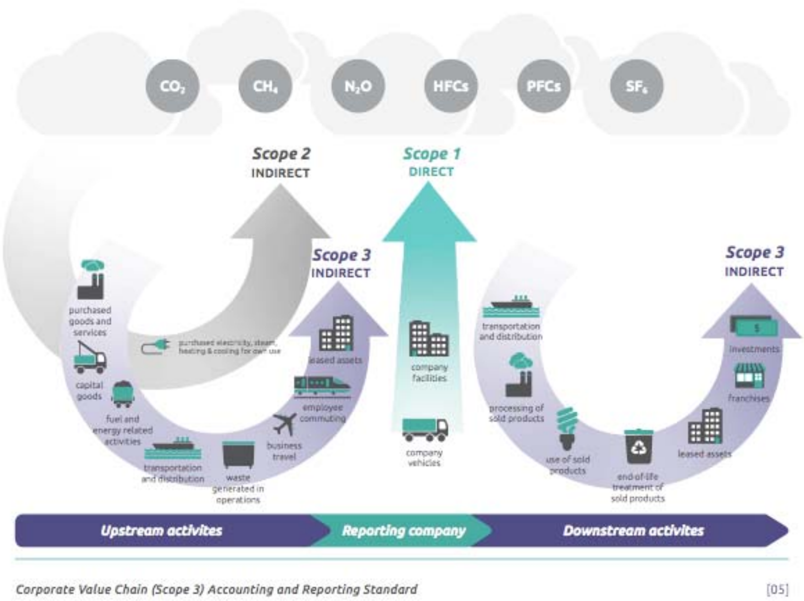


Figure 1 – Illustrative Flowchart of emission categories

Source: GHG Protocol (2011)

According to the GHG Protocol Scope 3 emissions are not mandatory and should not involve a full review of the GHG life cycle of all the company's operations. Generally, only significant emissions of this Scope are reported in the inventory.

For the reporting of greenhouse gas emissions, the GHG Protocol defines the following sources:

Table 5 - Sources of GHG emissions outlined in the GHG Protocol

Scope	Emission source	Definition
Scope 1	Stationary Combustion	Stationary combustion for generation of electricity, steam, heat or energy with the use of equipment in a fixed location.
	Mobile Combustion	Mobile combustion transportation and off-road vehicles, such as those used in construction, agriculture and forestry.
	Fugitive emissions	Unintended releases of substances such as sulphuric hexafluoride (SF6) in electrical equipment, hydrofluorocarbons,(HFCs) during the use of refrigeration and air-conditioning equipment and leak of methane (CH4) in the transport of natural gas.
	Industrial processes	Non-combustion emissions because of physical or chemical processes.
	Agricultural activities	Emissions from agricultural activities such as fertilizer use, burning vegetation and/or agricultural residues.
	Solid wastes	Emissions from waste disposal in landfills, incineration or composting.
	Effluents	Emissions from anaerobic treatment of liquid effluents.
Scope 2	Purchase of electric energy	Emissions resulting from the acquisition of electric energy.
	Purchase of thermal energy	Emissions resulting from the acquisition of thermal energy.
Scope 3	Transport and distribution (upstream)	Emissions from transport and distribution of products purchased or acquired by the Organization, by means of vehicles hired by the organization.
	Solid wastes from the operation	Emissions from waste disposal on landfills, composting and/or treatment or incineration.
	Wastewater generated in the operation	Emissions from anaerobic treatment of liquid effluents.
	Business travels	Staff transport emissions for activities related to the Organization's Business, such as aircraft, trains, buses, cars and boats.
	Transport and distribution (downstream)	Emissions from transport and distribution of products sold by the Organization through vehicles not hired by the organization.
	Fuel and energy-related activities not included in Scope 1 and 2	Fuel-related emissions that do not fall into the previous categories.
	Employees transportation (home-work)	Emissions arising from the displacement of employees between their homes and the workplace.

For Tractebel Energia, the following sources were identified:

Table 6 – GHG emission sources - 2015 Inventory

Scopes	Emission sources		Plant/ Office
Scope 1	Stationary combustion	Boilers installed in thermal power plants	UTCH, CTJL, UTIB, UCLA, and UTFE
		Combustion chambers of gas turbine power plant	UTWA
		Diesel group of emergency (emergency generators with diesel engine)	UHCB,, UHSO,, UHPP UHET UHSS, UHSA, PHAB, PHJG, PHRO, UTCH, UTIB, UCLA and HEADQUARTERS
		Instruments for boiler firing	UCLA
		Forest chipper	UCLA
		Spillway diesel group	UHMA, UHIT and UHPF
		Acetylene cylinders for welding	CTJL, UHSA, UHMA, and UCLA
	Mobile combustion	Vehicles owned and control of Tractebel (cars and boats)	UHCB, UHET, UHIT UHMA, UHPF,, UHPP, UHSO, UHSS, UHSA, UEBB, UEPS, UETR, PHAB, PHJG, PHRO, UTAL, UTCH, UTIB, CTJL, UCLA, UTWA headquarters and ESP
		Lifting and transportation equipment (wheel loaders and forklifts)	CTJL, UCLA, UETR
	Processes	Flue gas desulphurization (desulphurizer)	UTCH
	Fugitives	Air-conditioned	UHSO, CTJL and UCLA
		SF_6 equipment	UHET and UEBB
		Fire extinguishers with CO_2	UHET, UHSO, UHSS, UHSA, UEBB, UEPS, UEFL, UEGU, UEMU, UETR, UFCA, UTAL, UTCH, CTJL, UTIB UCLA, UTFE, UTWA, and HEADQUARTERS
Scope 1	Fugitives	CO_2 cylinders for cleaning in welding process	UHSO, UCLA, UTCH, UTWA
	Agricultural activities	Use of fertilizers	UHCB,, UHPF,, UHET UHIT UHPP, UHSO, UHSS, UTIB,

Scopes	Emission sources		Plant/ Office
			UEBB and CTJL
	Solid Wastes	Aerobic composting	PHAB, PHJG, UHIT, UHSS, UHPP and CTJL
		Waste disposed in landfills	UHET
Scope 2	Purchased energy	Electricity consumption from the grid	All
Scope 3	Fuel and energy-related activities not included in Scope 1 and 2	Stationary combustion equipment outsourced that the company has no control (compressors)	UHSS
	Fuel and energy-related activities not included in Scope 1 and 2	Trimmers/chainsaws	UHSS and UHSO
	Transport and distribution (upstream)	Vehicles rented or hired under third-party control used to transport people, raw materials and/or products/by products funded by the company (cars, ships and locomotives)	UHCB, UHET, UHIT UHMA, UHPF,, UHPP, UHSO, UHSS, UHSA, UEBB, UEPS, UETR, PHAB, PHJG, PHRO, UTCH, CTJL, UTIB and UCLA
	Business travels	Air travel	UEBB, UEPS, UETR, UHCB, UHET, UHIT UHMA, UHPF,, UHPP, UHSO, UHSS, UHSA, UTAL, UTCH, CTJL, UCLA, UTWA, thirst and ESP
		Any travel of employees in leased vehicles	UEBB, UEPS, UETR,, UHCB,, UHET UHMA, UHIT, UHPF, UHPP, UHSO, UHSS, UHSA, UTAL, UTCH, CTJL, UCLA and HEADQUARTERS
Scope 3	Solid wastes	Waste disposed in landfills	UHCB, UHET, UHMA, UHIT, UHPF, UHSO, UHSS, UHSA, UEBB, UEPS, UETR, UTAL, UTCH, UCLA, UTIB, CTJL, UTFE, UTWA, and HEADQUARTERS
		Aerobic composting	UETR, UHPF and seat
		Incineration	UTFE, UETR
	Employees transportation	Vehicles used to transport home-work	PHJG, PHRO, UHCB, UHET, UHMA, UHIT, UHPF,

Scopes	Emission sources		Plant/ Office
	(home-work)		UHPP, UHSO, UHSS, UHSA, UEBB, CTJL, UCLA and UTWA
	Transport and distribution (downstream)	Rented or hired vehicles used to transport people, raw materials and/or products/by-products not funded by the company	UTCH and CTJL
Biomass emission	CO_2 emissions generated in the combustion of biomass	Combustion of biodiesel, ethanol, wood waste and bagasse of sugar cane	UTIB, UCLA, UTFE and other power plants with diesel oil consumption, gasoline and ethanol (mobile and stationary combustion)

GHG emissions from hydroelectric reservoirs were not considered. According to ELETROBRÁS (2012), there is no "scientific consensus on methodology that allows to estimate GHG emissions in these reservoirs and to calculate the balance of emissions (or net emissions) of water bodies".

In the case of gases not listed in the Kyoto Protocol, but regulated by the Montreal Protocol, there is only one gas identified in power plants of Tractebel, R-22. This gas was used in 2015 in the following plants: CTJL, UTCH, UTIB, UHPF, UHSA, UHPP, UHCB and PHJG.

GHG emissions due to electricity consumption are mainly associated to ancillary services provided by Tractebel Energia to SIN, including, in minor scale, consumption in its offices in Florianópolis (head office) and São Paulo, facilieties and/or equipment located at the power plant, when the same it is not operational, utilities located outside the power plants and, eventually, to support some power plants operation.

Ancillary services are additional services provided by generation agents, which encompasses the control of primary and secondary power, and its reserve powers, the readiness reserve, reactive support and self-establishment of generating units, as regulated by ANEEL Resolution Nr. 265/2003.

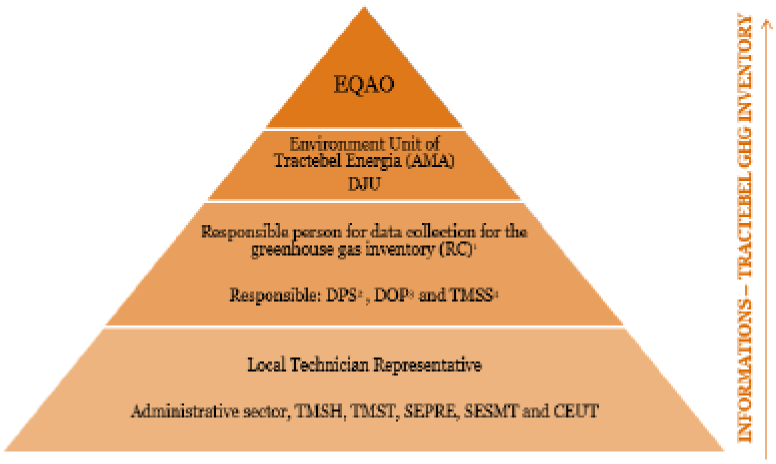
Ancillary services ensure the quality and safety of the energy generation, contributing to SIN reliability. They are provided according to the Ancillary Service Agreement (“CPSA” from the Portuguese Contrato de Prestação de Serviços Ancilares) established between the generation agent and the National Electric System Operator (“ONS” from the Portuguese Operador Nacional do Sistema Elétrico), which sets forth the terms and conditions to provide reactive support to SIN through generating units operating as synchronous compensators connected to the SIN.

6.3. Data Collection

Data collection should cover all sources of greenhouse gas emissions within the operational boundaries of the organization. In the case of Tractebel, data collection was carried out according to the Work Instruction “Instrução de Trabalho - Meio Ambiente – IT-MA-GE-006”. The purpose of this Instruction is to determine a data collection system based on documented evidence to ensure the quality of the GHG emissions inventory of Tractebel Energia. For each unit, responsibilities, representatives and data collection procedures, as well as the frequency of collection of such data, are defined.

This instruction is in accordance with the emission sources identified in Table 5 and categorizes the data collection by air conditioning, power consumption, stationary combustion, mobile combustion, fire extinguisher and with CO_2 cylinder, fertilizers, processes, waste, SF_6 and air travel, according to the Table 6 above.

Therefore, the data collection was performed according to the flow of information below:



1 - Liliana, Claudiano, Sérgio Luiz, Andréia, Anderson, Rita, Leticia and Simone.

2 - Milena

3 - Maioral/Maira.

4 - Santos/Marcelo

Figure 2 - Flow of information for the preparation of the GHG inventory of Tractebel Energia S/A

As shown in Figure 2, the Administrative Sector, TMSH, TMST, SEPRO, SESMT CEUT provide information and the technical manager, or directly to the RC, in case the plant/Office does not have a Local Technical Representative.

The Local responsible technician collects the data of emission sources of GHGS, identified in accordance with the statement of Work IT-MA-GE-006, by completing the form "FR-Inventory data collection".

After filling out the form, the person responsible for collecting (RC), who also receives data from the DPS, DOP and TMSS, forwards the form to the Organizational Unit. This Organizational Unit, which also receives information from the DJU on corporate participation in company plants, after evaluation, forwards the worksheets collection all plants and offices for EQAO (consulting) for carrying out other works for the inventory preparation.

6.4. Bases and References

For the preparation of the inventory of GHG emissions, therewere considered GHG Protocol guidelines, the specifications of the Brazilian GHG Protocol Program and ISO 14064:2007:

- "The Greenhouse Gas Protocol – a Corporate Accounting and Reporting Standard – Revised Edition"-WRI/WBCSD, 2011;
- "Verification Specifications of the Brazilian GHG Protocol program – second edition ' – WRI/FGV, 2011;
- "Accounting, quantifying and publication of Corporate Inventories of greenhouse gas emissions, first edition"-WRI/FGV, 2012;
- "ISO 14,064:2007 management system of Greenhouse Gases"-International Organization for Standardization (International Organization of Standartization), 2007.

Scoring methodologies are based mainly on documents published by the Intergovernmental Panel on climate change:

- "IPCC Guidelines for National Greenhouse Gas Inventories"-IPCC, 1996;
- "IPCC Guidelines for National Greenhouse Gas Inventories"-IPCC, 2006.

Other references used are described in Section 11 of this report.

For accounting emissions of each power plant, the calculation tool was used "Ferramenta_GHG_Protocol_v2016.1.xlsx" provided by the Brazilian GHG Protocol Program. Therefore, data monitored by Tractebel Energia offices/plants was used for the calculation of emission factors and, for cases in which no data was available for the calculation of emission factors, default emission factors provided in the program tool were used.

Tables 54 to 60 (Annex II- Emission Factors) detail the main emission factors used in the inventory from 2015.

According to the article of Kalkreuth (2005), coal from the State of Rio Grande do Sul, Charqueadas power plant, is classified as sub-bituminous. Thus, the CO_2, CH_4 and N_2O emission factors of used for UTCH were reviewed, as shown in table 58, Annex II - Emission Factors. This revision was necessary, since the Brazilian GHG Protocol program considers CO_2, CH_4 and N_2O emission factors for bituminous coal only. In the following table can be observed methodologies and references of the emission factors presented above for each emission source found.

Table 7 – Considered methodology and sources of emission factors

Emission source	Methodology	Source of emission Factors
Direct and indirect stationary combustion	- IPCC 2006-vol. 2 Energy-Cap. 2 Stationary combustion; 2016 Brazil GHG Protocol tool	- National 2015 energy balance (BEN 2015); - IPCC 2006-vol. 2 Energy-Cap. 2 Stationary combustion; - Ministry of Science and Technology. Second National Communication of Brazil to the United Nations Framework Convention on climate change. Brasília: MCT, 2010.
Direct and indirect mobile combustion	- IPCC 2006-vol. 2 Energy-Cap. 3 Mobile combustion; 2016 Brazil GHG Protocol tool	- National 2015 energy balance (BEN 2015); - IPCC 2006-vol. 2 Energy-Cap. 3 Mobile combustion; - The National Oil and Gas Agency (ANP).
Processes	- Stoichiometric calculation of gas desulphurization gypsum	- GDF Suez Group-Local GHG Emissions Reporting-Instruction-7/28/2014.
Fugitives	- IPCC 2006-vol. 2 Energy-Cap. 4 Fugitive emissions; 2016 Brazil GHG Protocol tool	- Climate Change 2007: Working Group i: The Physical Science Basis (IPCC 2007), item 2.10.2 Direct Global Warming Potentials, table 2.14; - ASHRAE Standard 34.
Agricultural activities	- IPCC 2006-vol. AFOLU 4-Cap. 11 N2O emissions from managed soils, and CO2 emissions from lime and urea application;	- IPCC 2006-vol. AFOLU 4-Cap. 11 N2O emissions from managed soils, and CO2 emissions from lime and urea application; - Climate Change 2007: Working Group i: The Physical Science Basis (IPCC 2007), item 2.10.2 Direct Global Warming Potentials, table 2.14.
Energy purchased	- 2016 Brazil GHG Protocol tool	- CO2 emission factors of the NIS to corporate inventories – Ministry of Science and Technology (MCTI 2016).
Business travels	- IPCC 2006-vol. 2 Energy-Cap. 3 Mobile combustion;, 2016 Brazil GHG Protocol Tool	- IPCC 2006-vol. 2 Energy-Cap. 3 Mobile combustion;, 2016 Brazil GHG Protocol Tool; - 2016 Government GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors. FINAL. (DEFRA 2015).
Solid wastes	- IPCC 2006-vol. Waste 5-Cap. 3 Solid waste disposal/Cap. 4-Biological treatment of solid waste; - 2016 Brazil GHG Protocol tool	- IPCC 2006-vol. Waste 5-Cap. 3 Solid waste disposal/Cap. 4-Biological treatment of solid waste.
CO_2 emissions generated in the combustion of biomass	- GHG Protocol - 2016 Brazil GHG Protocol tool	- 2012 National energy balance (BEN 2012); - The national oil and Gas Agency-ANP. - Ministry of science and technology. Second National Communication of Brazil to the United Nations Framework Convention on climate change. Brasília: MCT, 2010.

Regarding the waste sent to the landfill, which was recorded in the collection data form as "sludge (water treatment station)", the rate of Degradable Organic Carbon (DOC)[1] of 0.05 was used, the specific of sewage sludge as provided by IPCC (2006), since the tool of the "Brazilian GHG Protocol Program" does not consider this classification. The sewage sludge sent to landfill was identified in UHCB, UHET, UHIT, UHPF, UHSA, UHSS, CTJL, UTCH, UTWA, UCLA and UTFE plants.

Data monitored by Tractebel Energia of net calorific value (NCV) was considered for accounting GHG emissions when available, as shown in table 59 of Annex II.

The percentage of nitrogen contained in fertilizers was also monitored by UHIT, resulting in 2.0% for organic fertilizers and 9.0% for synthetic fertilizers. In cases where no information on the percentage of nitrogen in the organic fertilizer and/or synthetic was available, it was considered the default value of 1% for organic fertilizers and 45% for synthetic fertilizers, as shown in Annex III, in "(a) Use of fertilizer."

Additionally, other GHG accounting methodologies were used in cases where these have not been provided by the tool of the "Brazilian GHG Protocol Program." The methodologies and assumptions adopted for the accounting of GHG emission sources not covered by the program, referring to the use of fertilizer, desulphurization, use of acetylene and incineration are described in Annex III-Additional Methodologies.

6.5. Methodological changes in comparison with 2014 year

Structural changes of an inventory organization and methodological accounting can influence significantly impact the calculation of emissions, making I difficult to monitor emissions over time and, consequently, comparison during years. Thus, this section aims at the identification of corporate, operational and methodological changes between 2014 and 2015.

In 2015, the Tubarão wind power plant started operation as a result of a R&D project, 100% owned by Tractebel Energia. Thus, this plant has been included in the GHG Inventory in the year of 2015, which does not contributed significantly to the company's GHG emissions, whereas its ource of emission is due to the electricity consumption of the grid only.

Regarding other operating units, no changes in societal structure in relation to 2014 were identified. Also, there were no significant operational changes.

In 2015, no changes regarding fuels used in stationary and mobile in the operations of Tractebel Energia, then, fuels are the same in 2015.

The only additional emission source in relation to 2014 is the incineration of chemical waste, also identified in 2012 year. This source was included in Scope 3 for UETR and UTFE. UTIB also monitored data of wood waste incineration, however such emission source was not considered in this inventory, based on the recommendation

[1] Fraction of organic carbon present in the material that degrades in given conditions of temperature and humidity.

of IPCC that establishes that CO_2 emissions from combustion of biomass materials for non-energy purposes (i.e. papers, food and wood waste), should not be included while accounting emissions.

Additionally, emissions from waste disposal of São Paulo were conservatively counted based on the paper consumption in 2013 and 2014. Whereas these emissions are not significant, in relation to the emissions from the office and Tractebel Energia as a whole (0.01 tCO_2e in 2013 and 0.04 tCO_2e in 2014), paper consumption was excluded in this inventory.

According to the Brazilian GHG Protocol program, emission factors, considered variables, are those that change with a monthly or annual frequency, as is the case of the CO_2 emission factor of the National Interconnected System, the percentage of biodiesel added to diesel oil and ethanol in gasoline. Therefore, these parameters impact the results of GHG emissions annual accounting. Evolution of annual average emission factor of SIN, percentage of biodiesel added to diesel oil and ethanol added to gasoline in the period from 2012 to 2015, can be observed in table 60, Annex II-emission Factors.

7. Inventory Results

7.1. Operational Control

In this section, we present the GHG emissions based on the Operational Control approach of Tractebel Energia. Thus, GHG emissions were considered plants/offices which Tractebel Energia has Operational Control: CTJL, UTCH, UTWA, UHPF, UHSO, UTIB, UCLA, UTFE, UHSS, UHPP, UTAL, UHCB, UHSA, PHJG, PHAB, PHRO, UEBB, UEFL, UEGU, UEMU, UEPS, UETB, UETR, UFCA and offices of Florianópolis and São Paulo.

Tables 63 to 68 tables of Annex IVdetail the Representation of each emission source for each power plant controlled by Tractebel Energia in its Scope, as well as for Tractebel Energia as a whole. The detailed results of GHG emissions are presented in the sections below.

7.1.1. Total Emissions

During 2015, the plants/offices in Tractebel Energia operation issued 6.150.621,41 tCO_2e, considering the Scopes 1, 2 and 3, as shown in the sections below.

Total GHG emissions of Tractebel Energia for gas type and source in the Operational Control approach are presented in annex I of this report.

7.1.1.1. Scope 1

Scope 1 emissions of 2015 year represented 99.17% of total emissions, resulting in **6,099,409.88 tCO_2e**. Stationary combustion emissions accounted for 99.9% of the total emissions from Scope 1.

Table 8 – Scope 1 GHG Emissions – Operational Control

Emission sources	tCO_2e
Stationary combustion	6,093,182.65
Mobile combustion	637.11
Processes	5,345.05
Fugitive emissions	226.73
Agricultural activities	5.73
Solid wastes	12.61
Total Scope 1	**6,099,409.88**

7.1.1.2. Scope 2

For Scope 2 emissions, only emissions due to electricity purchased from the grid was identified. Considering the year of 2015, **18,751.32 tCO_2e** were issued, representing 0.30% of the total emissions of Tractebel Energia.

As mentioned in section 6.2.2, in some plants of Tractebel Energia, part of the energy consumed is from the National Interconnected System (SIN) and the other part is generated by the project itself. Some power plants of the company perform as a synchronous compensator of the SIN in order to promote the stability of the system, as it was the case of hydropower plants of Passo Fundo, Salto Santiago and Salto Osório, and, to a lesser intensity, the Cana Brava hydroelectric power plant[2] in 2015. This function makes it mandatory, in some cases, the energy consumption of the SIN by these power plants.

Some facilities also have an internal generator for emergency cases. However, the fuel consumption for this generator is a Scopo 1 emission. Therefore, only emissions due to energy consumption from the grid are considered in Scope 2 emissions.

7.1.1.3. Scope 3

Scope 3 emissions, for the year of 2015, represented 0.53 percent of total emissions, resulting in **32,460.21 tCO_2e**, as the sources presented in the table below.

Table 9 – Scope 3 GHG Emissions – Operational Control

Emission sources	tco2e
Fuel and energy-related activities not included in Scope 1 and 2	39.97
Transport and distribution (upstream)	19,824.84
Waste generated in operations	807.45
Business travels	915.34
Displacement of employees (home-work)	458.34
Transport and distribution (downstream)	10,414.26
Total Scope 3	**32,460.21**

It is worth mentioning that in the category of "transportation and distribution (upstream)", transport services rented or hired by Tractebel Energia are considered. Major emissions in this category are due to the transport of coal in UTCH. Downstream transport and distribution are considered services contracted or owned

[2] List of plants providing ancillary services is available at: < http://www.ons.org.br/download/contratos_ancilares/Andamento%20dos%20CPSAs-27-09-13.pdf >.

by third parties not contracted/paid by Tractebel Energia, and the transportation of ashes in CTJL is the main source of emissions in this category.

7.1.1.4. Biomass Emissions

According to the GHG Protocol, CO_2 emissions from biomass combustion shall be reported separately because the CO_2 released on combustion of biomass from the CO_2 captured of the atmosphere as a result of the process of photosynthesis and, thus, it can be considered "neutral". It is worth mentioning that CH_4 and N_2O emissions cannot be considered neutral as these gases are not removed from the atmosphere in the growth of the biomass.

In the case of Tractebel Energia, CO_2 emissions from biomass are from wood waste combustion in boilers (UTE Lages), bagasse (UTE and UTE Ibitiúva Ferrari), combustion of ethanol (also as percentage added to commercial gasoline) and use of biodiesel (also as a percentage added to the diesel oil). Therefore, CO_2 emissions from the combustion of biomass resulted in **1,102,109.56 tCO_2** from Scope 1 and 3 according to the table below.

Table 10 - Emissions from combustion of biomass of Tractebel Energia among Scopes 1 and 3

Scope	Emission sources	tco2e
Scope 1	Stationary combustion	1,099,252.91
	Mobile combustion	140.77
Scope 3	Fuel and energy-related activities not included in Scope 1 and 2	2,67
	Transport and distribution (upstream)	1,889.08
	Business travels	22.89
	Displacement of employees (home-work)	81.83
	Transport and distribution (downstream)	719.41
Total		**1,102,109.56**

7.1.1.5. Emissions of Non-Kyoto Gases

In the same way that the combustion of biomass, the CO_2 emissions of gases not listed in the Kyoto Protocol should be reported separately. In the case of Tractebel Energia, 0.21 t of HCFCs (R-22) were issued, which corresponds to **374.67 tCO_2e**. Such gas is used in refrigeration equipment and air conditioning installed in units of Tractebel Energia.

7.1.2. Emissions by Power Plant/Office

GHG emissions of Tractebel Energia, per Scope and plant/Office, are presented in the following table.

Table 11 -Tractebel Energia GHG emissions by Scope and plant/Office Operational Control (tCO_2e)

Plants/Offices	Scope 1	Scope 2	Scope 3	Total emissions	Biomass emissions	Percentage of participation of GHG emissions
CTJL	4,971,560.84	8,289.22	15,155.49	4,995,005.55	1,791.45	81.2114%
UTWA	567,105.56	53.79	22.02	567,181.37	16.44	9.2215%
UTCH	538,521.21	1.98	13,999.42	552,522.61	1,143.57	8.9832%
UTFE	11,779.33	96.75	249.51	12,125.59	589,368.07	0.1971%
UCLA	4,934.80	137.15	1,386.55	6,458.50	259,424.97	0.1050%
UHSO	52.14	5,298.14	71.24	5,421.52	22.97	0.0881%
UTIB	5,007.13	102.09	5.12	5,114.34	250,120.75	0.0832%
UHSS	19.91	2,603.50	360.48	2,983.89	84.83	0.0485%
UHPF	17.91	1,730.16	150.38	1,898.45	16.65	0.0309%
HQ	46.91	230.05	675.97	952.93	18.30	0.0155%
UEBB	182.75	1.24	12.73	196.72	3.05	0.0032%
UETR	86.94	11.72	77.69	176.35	7.76	0.0029%
UHSA	25.68	0.01	101.29	126.98	26.94	0.0021%
UHPP	15.52	14.84	74.43	104.78	31.94	0.0017%
UHCB	29.97	28.24	37.26	95.46	17.16	0.0016%
UTAL	3.20	82.08	6.48	91.76	1.37	0.0015%
PHAB	8.30	14.76	27.08	50.14	3.00	0.0008%
PHJG	1.47	2.00	18.00	21.46	3.83	0.0003%
UEPS	8.94	1.78	8.49	19.20	2.31	0.0003%
PHRO	0.60	0.04	18.00	18.64	4.09	0.0003%
UEGU	0.08	15.47	0.00	15.55	0.00	0.0003%
UETB	0.00	11.20	0.00	11.20	0.00	0.0002%
UEFL	0.08	9.43	0.00	9.51	0.00	0.0002%
UFCA	0.05	7.91	0.00	7.96	0.00	0.0001%
UEMU	0.08	6.48	0.00	6.57	0.00	0.0001%
ESP	0.46	1.29	2.59	4.34	0.11	0.0001%
Total emissions	***6,099,409.88***	***18,751.32***	***32,460.21***	***6,150,621.41***	***1,102,109.56***	***100.0%***
%	**99.17%**	**0.30%**	**0.53%**	**100.00%**	**-**	**-**

According to the table above, CTJL is responsible for 81.2% of total emissions of power plants/offices in operation of Tractebel Energia.

In the following sections are presented the GHG emissions of the plants/offices of Tractebel Energia.

7.1.2.1. Wind Power Plants

The wind farms issued a total of 435.10 tCO_2e as described below.

→ **Beberibe (UEBB)**

The UEBB issued a total of 196.72 tCO_2e during 2015, distributed among the Scopes 1, 2 and 3, as shown below.

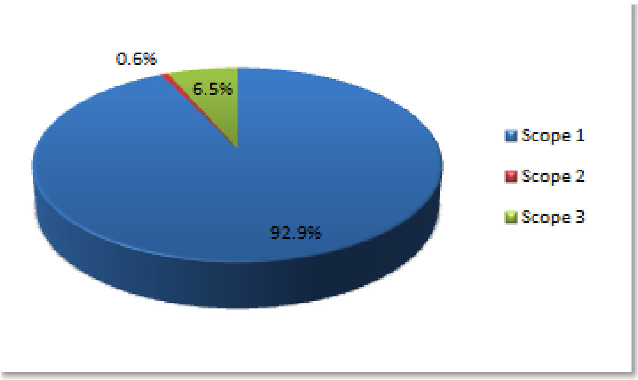


Figure 3 – Representation of the UEBB GHG emissions per scope

Detailed emissions by source type in Scope 1 and 2 are presented in the Figure below.

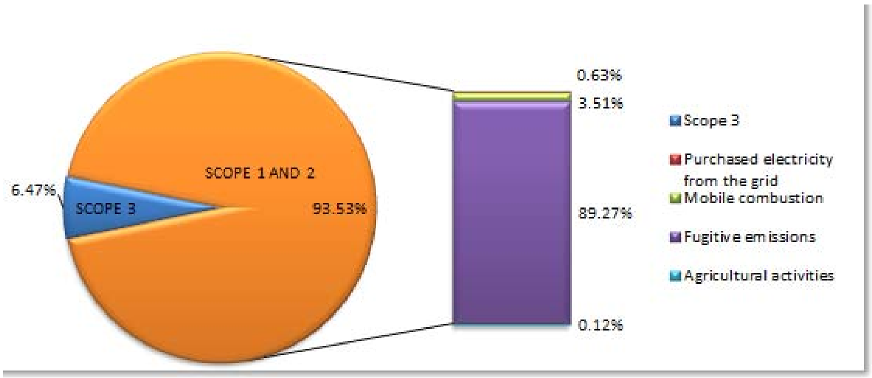


Figure 4 - Representation of the UEBB GHG emissions by source

Emissions from combustion of biomass resulted in 3.05 tCO_2. No non-Kyoto gas emissions (R-22) were issued in UEBB.

The greenhouse gas emissions are detailed in the table below.

Table 12 -GHG emissions of the UEBB (in tonnes)

Emission sources	CO2	CH4	N2O	SF6	CO2e	CO2 from biomass
Scope 1						
Stationary combustion	0.00	0.00	0.00		0.00	0.00
Mobile combustion	6.79	0.0004	0.0004		6.91	0.48
Processes						
Fugitive emissions	0.05	0.00	0.00	0.01	175.61	
Agricultural activities	0.00	0.00	0.0008		0.23	0.00
Solid wastes	0.00	0.00	0.00		0.00	0.00
Total Scope 1	6.84	0.0004	0.001	0.01	182.75	0.48
Scope 2						
Purchased electricity from the grid	1.24				1.24	
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	6.22	0.002	0.001		6.50	1.55
Waste generated in operations	0.00	0.04	0.00		1.05	0.00
Business travels	1.34	0.0002	0.0001		1.36	0.11
Employees transportation (home-work)	3.65	0.001	0.0004		3.82	0.91
Transport and distribution (downstream)	0.00	0.00	0.00		0.00	0.00
Total Scope 3	11.20	0.05	0.001	0.00	12.73	2.58
Total emissions	**19.29**	**0.05**	**0.002**	**0.01**	**196.72**	**3.05**

→ Fleixeiras (UEFL)

The UEFL issued a total of 9.51 tCO_2e during the year 2015 due to CO_2 refill of fire extinguisher (fugitive emissions from Scope 1) and electricity purchase from the grid (Scope 2). No CO_2 emissions were issued as result of biomass combustion[1] or use of non-Kyoto gases in this plant.

[1] It is important to mention that CO_2 emissions from biomass include not only the burning of bagasse of sugar cane or wood waste in electricity generation, as well as the percentage of ethanol added to gasoline and the percentage of biodiesel added to diesel oil.

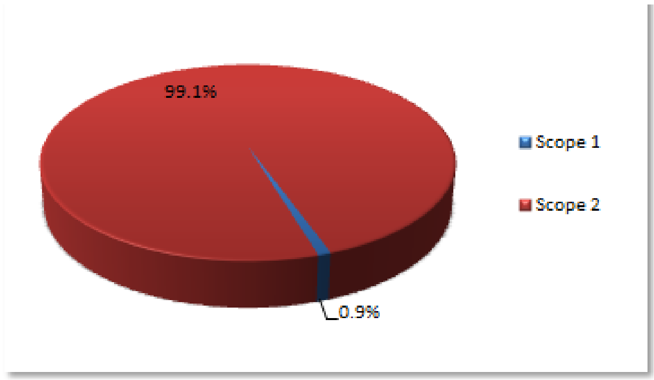


Figure 5 - Representation of the UEFL GHG emissions by scope

→ **Guagiru (UEGU)**

Similar to UEFL, UEGU issued a total of 15.55 tCO_2e during the 2015 year due to fugitive emissions (Scope 1) and electricity purchase from the grid (Scope 2). There were no CO_2 emissions from the combustion of biomass or use of non-Kyoto gases in this plant.

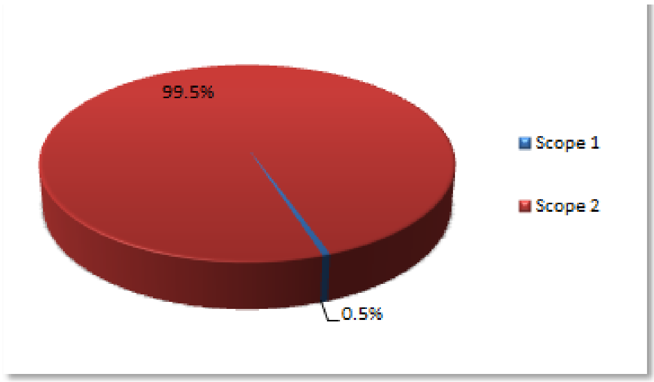


Figure 6 - Representation of GHG emissions of UEGU by scope

→ **Mundaú (UEMU)**

As well as the UEFL and UEGU, UEMU plant issued 6.57 tCO_2e in 2015 due to fugitive emissions and consumption of electricity. There were no CO_2 emissions from the combustion of biomass or use of non-Kyoto gases in this plant.

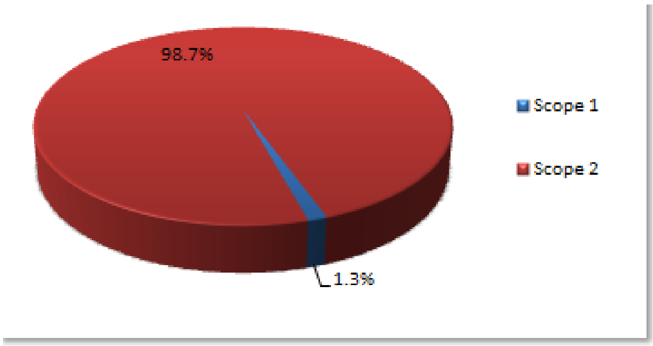


Figure 7 - Representation of GHG emissions of UEMU by scope

→ **Pedra do Sal (UEPS)**

The UEPS issued a total of 19.20 tCO_2e during 2015 year. The distribution of GHG emissions among scopes is presented below.

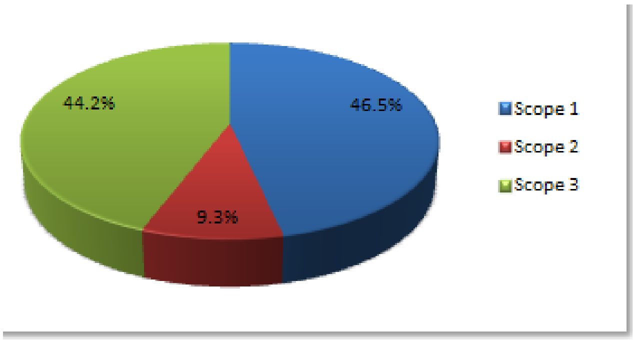


Figure 8 - Representation of the UEPS GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

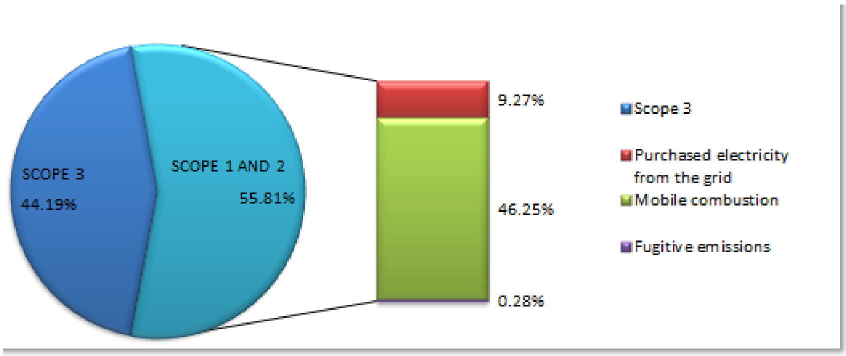


Figure 9 - Representation of UEPS GHG emissions by source

Emissions from combustion of biomass resulted in 2.31 tCO_2. There were no emissions of non-Kyoto gases on UEPS.

The greenhouse gas emissions are detailed in the table below.

Table 13 – GHG emissions of UEPS (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	0.00	0.00	0.00	0.00	0.00
Mobile combustion	8.73	0.0005	0.0005	8.88	0.61
Processes					
Fugitive emissions	0.05	0.00	0.00	0.05	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	8.78	0.0005	0.0005	8.94	0.61

Scope 2					
Purchased electricity from the grid	1.78			1.78	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	6.44	0.003	0.001	6.74	1.61
Waste generated in operations	0.00	0.05	0.00	1.26	0.00
Business travels	0.47	0.00	0.00	0.48	0.09
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	6.91	0.05	0.001	8.49	1.69
Total emissions	**17.47**	**0.05**	**0.001**	**19.20**	**2.31**

→ **Trairi (UETR)**

The UETR issued a total of 176.35 tCO_2e during 2015, distributed as shown in the figure below.

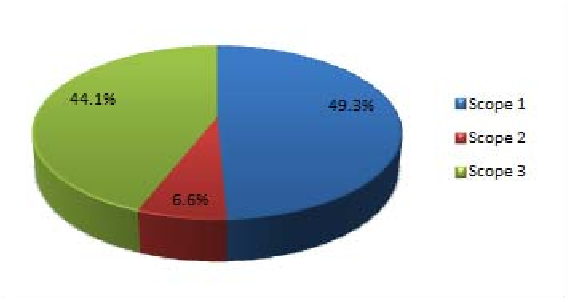


Figure 10 - Representation of UETR GHG emissions by scope

Detailed emissions by source type from Scope 1 and 2 are presented in the Figure below.

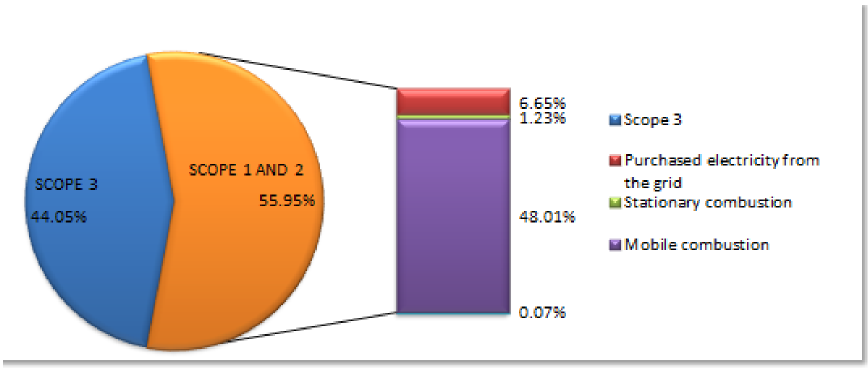


Figure 11 - Representation of UETR GHG emissions by source

Emissions from combustion of biomass resulted in 7.76 tCO_2. There were no emissions of non-Kyoto gases in UETR.

The greenhouse gas emissions are detailed in the table below.

Table 14 - GHG emissions of UETR (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	2.15	0.00009	0.00002	2.16	0.14
Mobile combustion	83.01	0.01	0.005	84.66	7.03
Processes					
Fugitive emissions	0.12	0.00	0.00	0.12	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	85.29	0.01	0.005	86.94	7.17
Scope 2					
Purchased electricity from the grid	11.72			11.72	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	3.93	0.0002	0.0002	4.00	0.28
Waste generated in operations	14.96	1.83	0.0008	61.02	0.00
Business travels	12.51	0.0005	0.0005	12.66	0.31
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	31.39	1.8340	0.0015	77.69	0.58
Total emissions	**128.40**	**1.84**	**0.006**	**176.35**	**7.76**

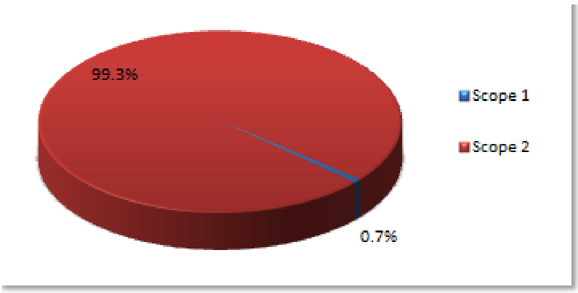
→ Tubarão (UETB)

The UETB issued a total of 11.20 tCO_2e during the 2015 year exclusively due to electricity consumption of the grid. There were no CO_2 emissions resulting from the combustion of biomass or use of non-Kyoto gases in this plant.

7.1.2.2. Photovoltaic Power Plants

→ **Cidade Azul (UFCA)**

Tractebel Energia has 1 (one) photovoltaic power plant – Cidade Azul (UFCA) – which was responsible for issuing 7.96 tCO_2e in 2015 due to refilling of fire extinguisher with CO_2 (fugitive emissions from Scope 1) and electricity purchase from the grid (Scope 2).



There were no CO_2 emissions from biomass or due to the use of non-Kyoto gases.

7.1.2.3. Small Hydropower Plants

The small hydropower plants of Tractebel Energia issued a total of 90.24 tCO_2e during the 2015 year as described below.

→ **Areia Branca (PHAB)**

The PHAB issued a total of 50.14 tCO_2e during 2015, distributed among the scopes below.

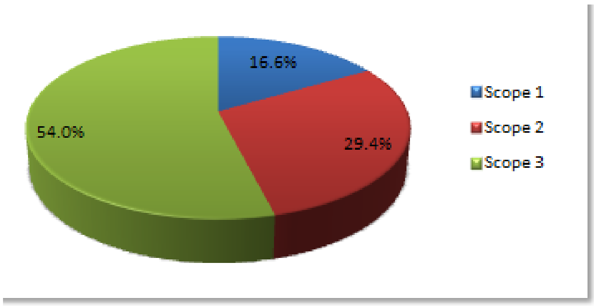


Figure 12 - Representation of the PHAB GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

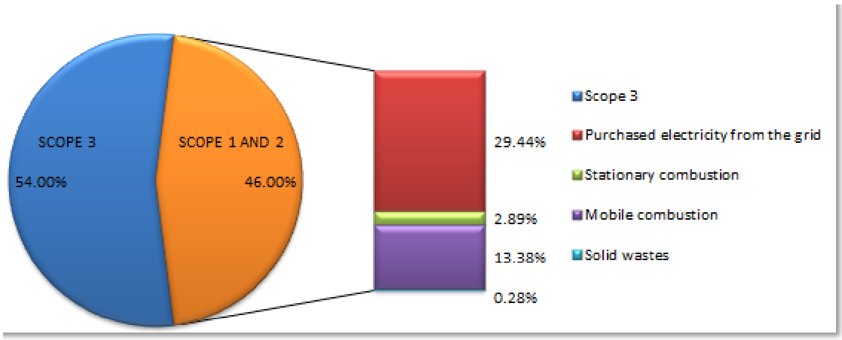


Figure 13 – Representation of PHAB GHG emissions by source

Emissions from combustion of biomass resulted in 3.00 tCO_2. There were no non-Kyoto gases emissions (R-22) on PHAB.

The greenhouse gas emissions are detailed in the table below.

Table 15 - GHG emissions of PHAB (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	1.45	0.0001	0.00001	1.45	0.10
Mobile combustion	6.58	0.0006	0.0004	6.71	0.58
Processes					
Fugitive emissions	0.00	0.00	0.00	0.00	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.003	0.00	0.14	0.00
Total Scope 1	8.02	0.004	0.0006	8.30	0.68
Scope 2					
Purchased electricity from the grid	14.76			14.76	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	26.54	0.003	0.002	27.08	2.33
Waste generated in operations	0.00	0.00	0.00	0.00	0.00
Business travels	0.00	0.00	0.00	0.00	0.00
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	26.54	0.003	0.002	27.08	2.33
Total emissions	**49.32**	**0.01**	**0.002**	**50.14**	**3.00**

→ **José Gelazio da Rocha (PHJG)**

The PHJG issued a total of 21.46 tCO_2e during 2015, distributed in scopes as follows.

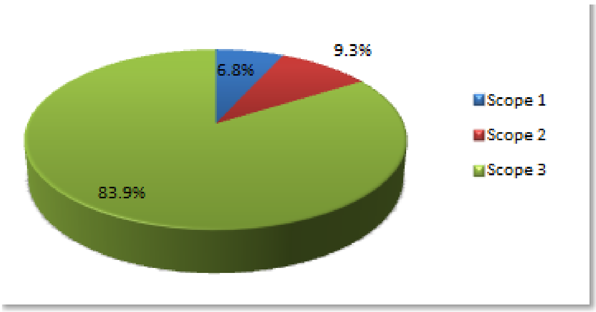


Figure 14 - Representation of GHG emissions of PHJG by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

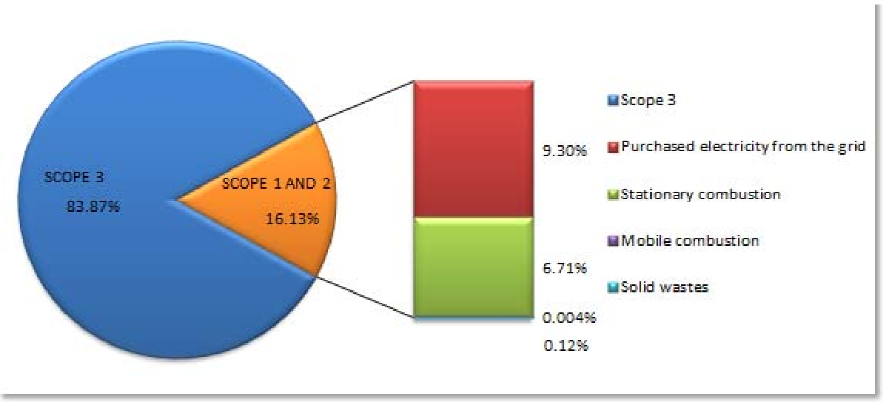


Figure 15 – Representation of PHJG GHG emissions by source

Emissions from combustion of biomass resulted in 3.83 tCO_2. Additionally, 6.55 tCO_2e have been issued as a result of the use of 0.004 t R-22 (non-Kyoto gas) in 2015.

The greenhouse gas emissions are detailed in the table below.

Table 16 - GHG emissions of PHJG (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	1.43	0.0001	0.00001	1.44	0.10	
Mobile combustion	0.00	0.000025	0.000001	0.00	0.10	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		6.55

Agricultural activities	0.00	0.00	0.00	0.00	0.00	
Solid wastes	0.00	0.001	0.00	0.03	0.00	
Total Scope 1	1.43	0.00063	0.00005	1.47	0.19	6.55
Scope 2						
Purchased electricity from the grid	2.00			2.00		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	17.10	0.004	0.002	17.65	3.07	
Waste generated in operations	0.00	0.00	0.00	0.00	0.00	
Business travels	0.00	0.00	0.00	0.00	0.00	
Employees transportation (home-work)	0.34	0.0002	0.00002	0.35	0.57	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	17.43	0.004	0.002	18.00	3.64	0.00
Total emissions	**20.87**	**0.005**	**0.002**	**21.46**	**3.83**	**6.55**

→ **Rondonópolis (PHRO)**

The PHRO has issued a total of 18.64 tCO_2e during 2015.

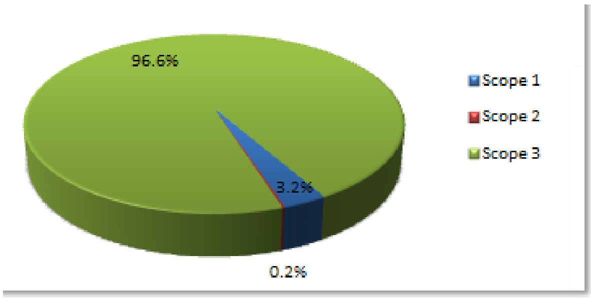


Figure 16 - Representation of the PHRO GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

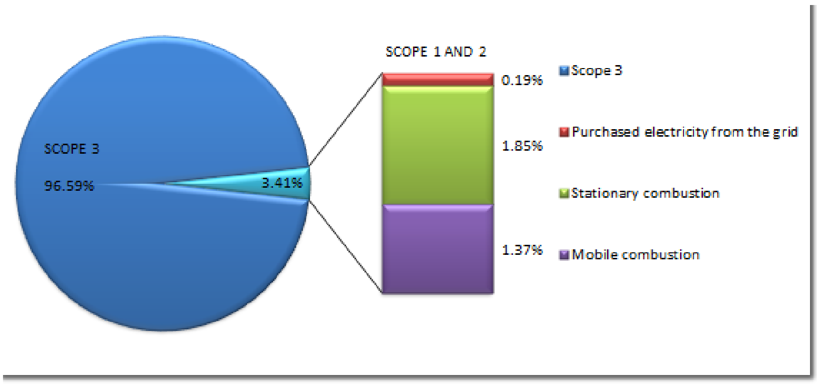


Figure17 - Representation of the PHRO GHG emissions by source

Emissions from combustion of biomass resulted in 4.09 tCO_2. There were no non-Kyoto gases emissions (R-22) in the PHRO.

The greenhouse gas emissions are detailed in the table below.

Table 17 - GHG emissions the PHRO (in tonnes)

Emission sources	**CO2**	**CH4**	**N2O**	**CO2e**	**CO2 from biomass**
Scope 1					
Stationary combustion	0.34	0.00002	0.000003	0.34	0.02
Mobile combustion	0.25	0.00013	0.00002	0.26	0.43
Processes					
Fugitive emissions	0.00	0.00	0.00	0.00	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	0.59	0.0001	0.00002	0.60	0.45
Scope 2					
Purchased electricity from the grid	0.04			0.04	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	17.10	0.004	0.002	17.65	3.07
Waste generated in operations	0.00	0.00	0.00	0.00	0.00
Business travels	0.00	0.00	0.00	0.00	0.00
Employees transportation (home-work)	0.34	0.0002	0.00002	0.35	0.57
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	17.43	0.004	0.002	18.00	3.64
Total emissions	**18.06**	**0.004**	**0.002**	**18.64**	**4.09**

7.1.2.4. Hydroelectric Power Plants

The hydroelectric power plants of Tractebel Energia issued a total of 10,631.10 tCO_2e during the 2015 year as described below.

The performance of the plants, in particular, UHPF, UHSO and UHSS, as synchronous compensator, contributed significantly to their Scope 2 emissions.

→ **Cana Brava (UHCB)**

The UHCB issued a total of 95.46 tCO_2e during 2015.

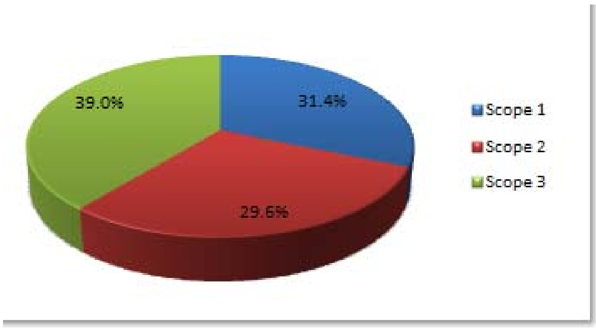


Figure18 - Representation of UHCB GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

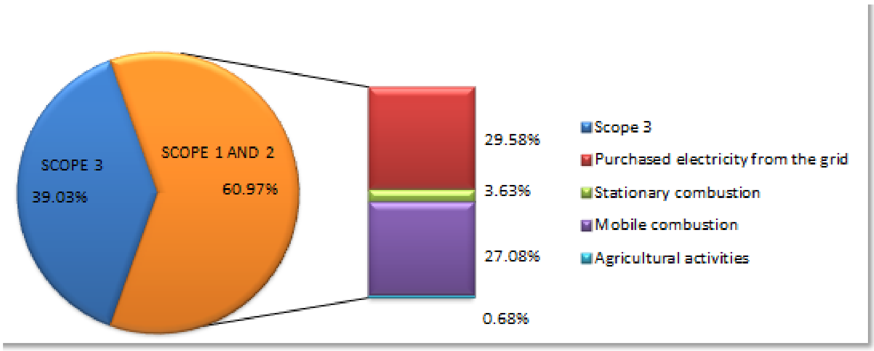


Figure19 - Representation of UHCB GHG emissions by source

Emissions from combustion of biomass resulted in 17.16 tCO_2. Regarding to non-Kyoto gases emissions of UHCB, 0.03 t R-22 were issued, resulting in 62.99 tCO_2e.

The greenhouse gas emissions are detailed in the table below.

Table 18 – GHG emissions from UHCB (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	3.46	0.0002	0.00003	3.47	0.23	
Mobile combustion	25.25	0.004	0.002	25.85	9.07	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.03
Agricultural activities	0.00	0.00	0.002	0.65	0.00	
Solid wastes	0.00	0.00	0.00	0.00	0.00	
Total Scope 1	28.71	0.005	0.004	29.97	9.31	0.03
Scope 2						
Purchased electricity from the grid	28.24			28.24		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	16.52	0.004	0.001	17.03	7.21	
Waste generated in operations	0.00	0.23	0.00	5.70	0.00	
Business travels	7.03	0.00	0.00	7.11	0.14	
Employees transportation (home-work)	7.28	0.0005	0.0004	7.41	0.51	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	30.83	0.23	0.002	37.26	7.86	0.00
Total emissions	**87.78**	**0.24**	**0.01**	**95.46**	**17.16**	**0.03**

→ **Passo Fundo (UHPF)**

The UHPF issued a total of 1,898.45 tCO_2e during 2015.

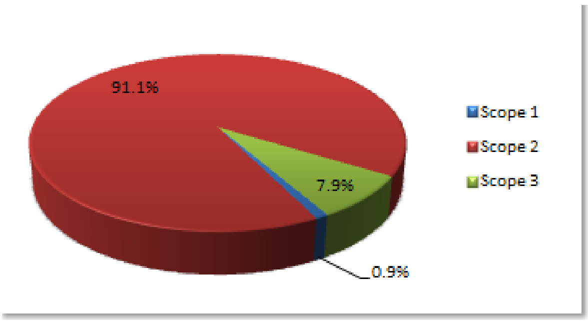


Figure 20 - Representation of UHPF GHG emissions by scope

According to the figure above, the most significant emission source of UHPF is the consumption of electricity (Scope 2), due to the plant's performance as synchronous compensator of SIN. Therefore, emissions by source type are presented in the figure below, with the exception of Scope 2 due to their high representation.

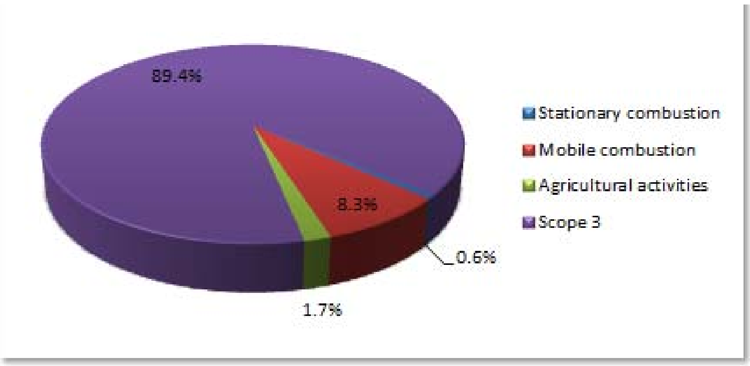


Figure 21 - Representation of UHPF GHG emissions by source (except Scope 2)

Emissions from combustion of biomass resulted in 16.65 tCO_2. The non-Kyoto gases emission of UHPF resulted in 12.85 tCO_2e from the use of 0.01 t R-22.

The greenhouse gas emissions are detailed in the table below.

Table 19 - GHG emissions of UHPF (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0.98	0.00004	0.00001	0.98	0.07	
Mobile combustion	13.70	0.002	0.001	13.99	5.27	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.01
Agricultural activities	0.00	0.00	0.01	2.940	0.00	
Solid wastes	0.00	0.00	0.00	0.00	0.00	
Total Scope 1	**14.68**	**0.002**	**0.011**	**17.91**	**5.34**	**0.01**
Scope 2						
Purchased electricity from the grid	**1,730.16**			**1,730.16**		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	13.36	0.0029	0.0011	13.77	2.03	
Waste generated in operations	0.00	0.11	0.00	2.64	0.00	
Business travels	0.44	0.0001	0.00004	0.46	0.06	
Employees transportation (home-work)	131.21	0.01	0.01	133.52	9.22	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	**145.01**	**0.12**	**0.008**	**150.38**	**11.32**	**0.00**
Total emissions	**1,889.85**	**0.12**	**0.02**	**1,898.45**	**16.65**	**0.01**

→ **Ponte de Pedra (UHPP)**

The UHPP has issued a total of 104.78 tCO_2e during 2015.

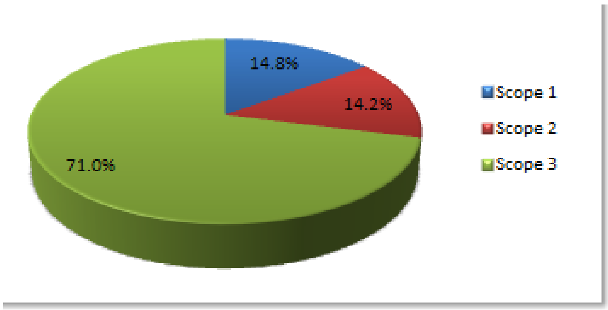


Figure 22 - Representation of UHPP GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

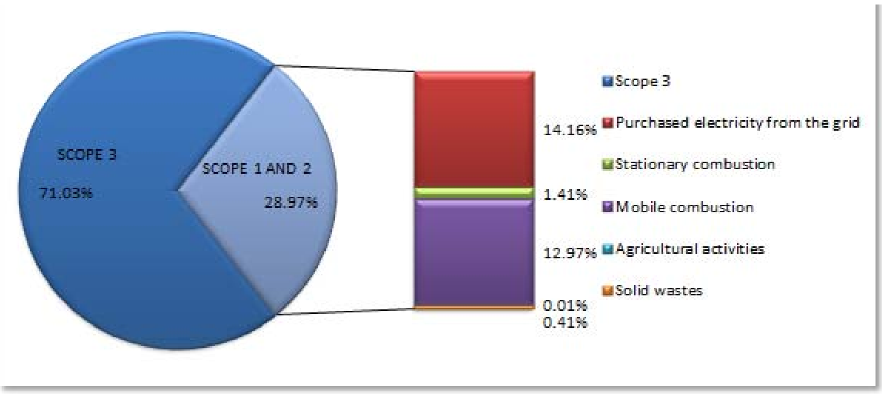


Figure 23 - Representation of UHPP GHG emissions by source

Emissions from combustion of biomass resulted in 31.94 tCO_2. The non-Kyoto gas emissions of UHPP resulted in 3.62 tCO_2e, due to the use of 0.002 t R-22.

The greenhouse gas emissions are detailed in the table below.

Table 20-GHG emissions of UHPP (in tonnes)

Emission sources	CO_2	CH_4	N_2O	CO_2e	CO_2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	1.47	0.0001	0.00001	1.47	0.10	
Mobile combustion	13.23	0.004	0.001	13.60	11.38	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.002
Agricultural activities	0.00	0.00	0.0001	0.02	0.00	
Solid wastes	0.00	0.01	0.00	0.43	0.00	
Total Scope 1	14.70	0.01	0.002	15.52	11.48	0.002
Scope 2						
Purchased electricity from the grid	14.84			14.84		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	58.43	0.01	0.005	60.17	11.25	
Waste generated in operations	0.00	0.00	0.00	0.00	0.00	
Business travels	12.99	0.001	0.001	13.17	0.40	
Employees transportation (home-work)	0.97	0.003	0.0002	1.09	8.81	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	72.38	0.02	0.006	74.43	20.45	0.00
Total emissions	**101.93**	**0.03**	**0.01**	**104.78**	**31.94**	**0.002**

→ **Salto Osório (UHSO)**

UHSO issued a total of 5,421.52 tCO_2e during 2015.

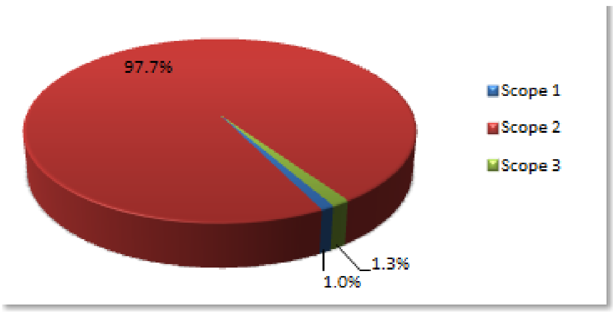


Figure 24 - Representation of UHSO GHG emissions by scope

Detailed emissions by source type are presented in the Figure below. Since Scope 2 emissions (electricity consumption of the grid, mainly on the basis of performance as synchronous compensator) represent more than 98% of the total emissions from this power plant, these emissions are excluded in the figure below to view other emissions sources.

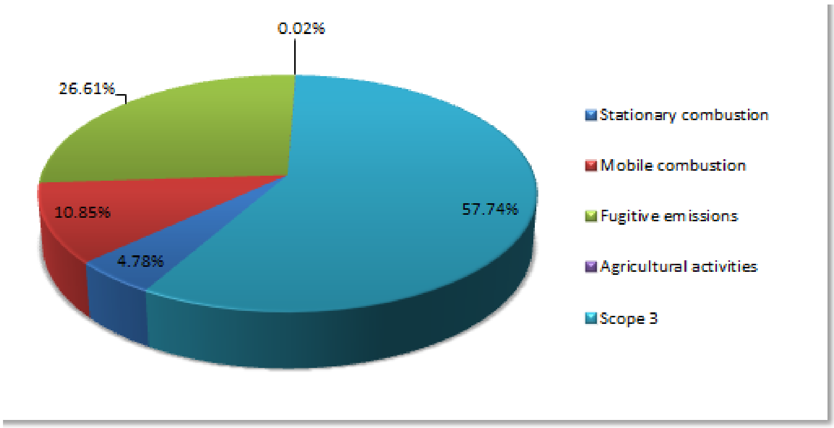


Figure 25 - Representation of UHSO GHG emissions by source (except Scope 2)

Emissions from biomass combustion resulted in 22.97 tCO_2. There were no non-Kyoto gas emissions (R-22) in the UHSO.

The greenhouse gas emissions are detailed in the table below.

Table 21 - GHG emissions of UHSO (in tonnes)

Emission sources	CO2	CH4	N2O	HFC	CO2e	CO2 from biomass
Scope 1						
Stationary combustion	5.87	0.0003	0.0001		5.90	0.84
Mobile combustion	13.07	0.003	0.001		13.39	9.81
Processes						
Fugitive emissions	3.03	0.00	0.00	0.02	32.83	
Agricultural activities	0.00	0.00	0.0001		0.03	0.00
Solid wastes	0.00	0.00	0.00		0.00	0.00
Total Scope 1	21.97	0.004	0.001	0.02	52.14	10.65
Scope 2						
Purchased electricity from the grid	5,298.14				5,298.14	
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00

Transport and distribution (upstream)	8.53	0.002	0.001		8.83	1.88
Waste generated in operations	0.00	0.42	0.00		10.62	0.00
Business travels	5.51	0.00	0.00		5.66	0.68
Employees transportation (home-work)	45.16	0.006	0.003		46.13	9.75
Transport and distribution (downstream)	0.00	0.00	0.00		0.00	0.00
Total Scope 3	59.20	0.43	0.004	0.00	71.24	12.31
Total emissions	**5,379.31**	**0.44**	**0.00**	**0.02**	**5,421.52**	**22.97**

→ Salto Santiago (UHSS)

The UHSS issued a total of 2,983.89 tCO_2e during 2015.

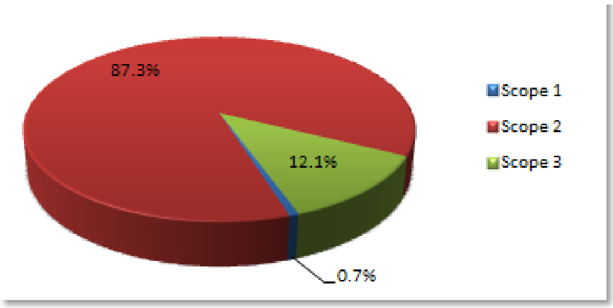


Figure 26 - Representation of UHSS GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

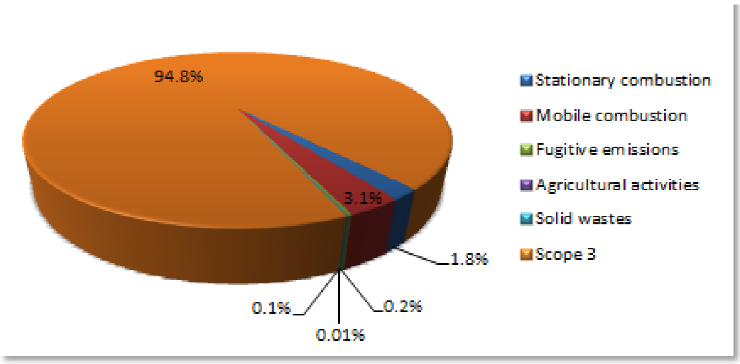


Figure 27 - Representation of UHSS GHG emissions by source

Emissions from combustion of biomass resulted in 84.83 tCO_2. There were no non-Kyoto gas emissions (R-22) in UHSS during 2015.

The greenhouse gas emissions are detailed in the table below.

Table 22 – GHG emissions of UHSS (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	6.63	0.0003	0.0001	6.66	1.29
Mobile combustion	11.52	0.01	0.001	11.93	22.15
Processes					
Fugitive emissions	0.83	0.00	0.00	0.83	
Agricultural activities	0.00	0.00	0.0001	0.02	0.00
Solid wastes	0.00	0.01	0.00	0.47	0.00
Total Scope 1	**18.99**	**0.02**	**0.002**	**19.91**	**23.44**
Scope 2					
Purchased electricity from the grid	**2,603.50**			**2,603.50**	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	39.83	0.002	0.0003	39.97	2.67
Transport and distribution (upstream)	121.78	0.029	0.01	125.57	25.46
Waste generated in operations	0.00	0.70	0.00	17.43	0.00
Business travels	20.25	0.00	0.00	20.68	1.62
Employees transportation (home-work)	153.91	0.02	0.01	156.83	31.63
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	**335.77**	**0.75**	**0.02**	**360.48**	**61.39**
Total emissions	**2,958.26**	**0.76**	**0.02**	**2,983.89**	**84.83**

→ São Salvador (UHSA)

The UHSA isssued a total of 126.98 tCO_2e during 2015.

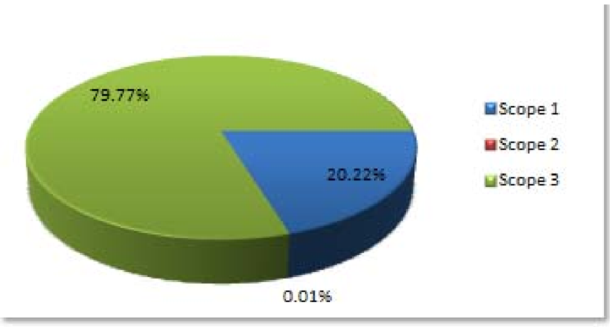


Figure 28 – Representation of the UHSA GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

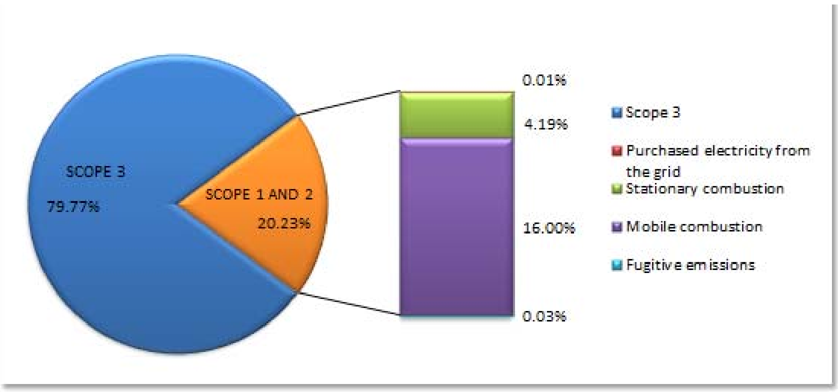


Figure 29 – Representation of UHSA GHG emissions by source

Emissions from combustion of biomass resulted in 26.94 tCO_2. The non-Kyoto gas emissions resulted in 38.64 tCO_2e due to the use of 0.02 tR-22 in UHSA.

The greenhouse gas emissions are detailed in the table below.

Table 23 - GHG emissions the UHSA (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	5.30	0.0002	0.00005	5.32	0.36	
Mobile combustion	19.81	0.01	0.001	20.32	15.27	
Processes						
Fugitive emissions	0.03	0.00	0.00	0.03		0.02
Agricultural activities	0.00	0.00	0.00	0.00	0.00	
Solid wastes	0.00	0.00	0.00	0.00	0.00	
Total Scope 1	25.15	0.01	0.001	25.68	15.63	0.02
Scope 2						
Purchased electricity from the grid	0.01			0.01		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	71.52	0.01	0.01	73.50	9.59	
Waste generated in operations	0.00	0.11	0.11	2.84	0.00	
Business travels	7.07	0.001	0.001	7.21	0.50	
Employees transportation (home-work)	17.43	0.001	0.001	17.74	1.23	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	96.02	0.13	0.121	101.29	11.32	0.00
Total emissions	**121.18**	**0.13**	**0.12**	**126.98**	**26.94**	**0.02**

7.1.2.5. Thermoelectric Power Plants

The thermoelectric power plants of Tractebel Energia issued a total of 6,138,499.73 tCO_2e, in which 6,114,801.30 tCO_2e are arising from the operation of thermoelectric power plants operated with fossil fuels, as described below.

→ **Alegrete (UTAL)**

The UTAL issued a total of 91.76 tCO_2e during 2015. This low emission compared to the previous years occurred because this power plant did not operate during 2015.

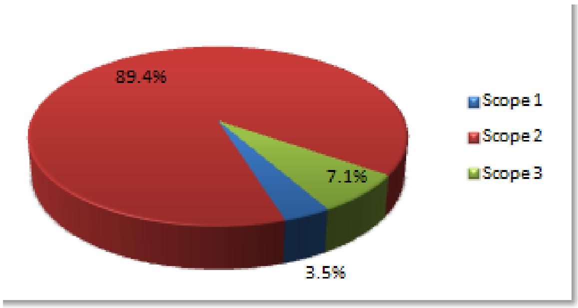


Figure 30 - Representation of UTAL GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

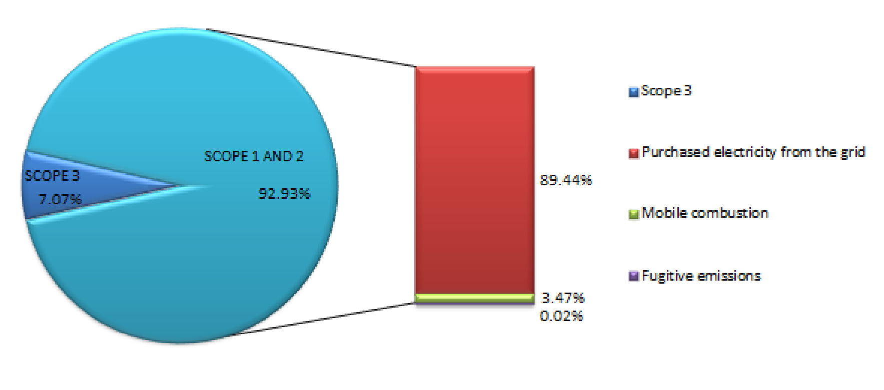


Figure 31 - Representation of UTAL GHG emissions by source

Emissions from the combustion of biomass resulted in 1.37 tCO_2. There were no non-Kyoto gas emissions (R-22) the UTAL in 2015.

The greenhouse gas emissions are detailed in the table below.

Table 24 – GHG emissions from UTAL (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	0.00	0.00	0.00	0.00	0.00
Mobile combustion	3.06	0.001	0.0003	3.19	0.67
Processes					
Fugitive emissions	0.02	0.00	0.00	0.02	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	3.08	0.001	0.000	3.20	0.67
Scope 2					
Purchased electricity from the grid	82.08			82.08	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	0.00	0.00	0.00	0.00	0.00
Waste generated in operations	0.00	0.04	0.00	1.01	0.00
Business travels	5.33	0.0011	0.0004	5.48	0.70
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	5.33	0.04	0.0004	6.48	0.70
Total emissions	**90.48**	**0.04**	**0.001**	**91.76**	**1.37**

→ Charqueadas (UTCH)

The UTCH issued a total of 552,522.61 tCO_2e during 2015.

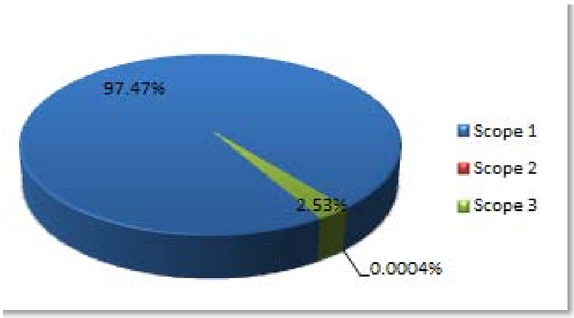


Figure 32 - Representation of UTCH GHG emissions by Scope

Scope 1 emissions of UTCH represent 97.47% of total emissions. Only stationary combustion results in 533,157.25 tCO_2e, i.e. 96.50% of total emissions from Scope 1.

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

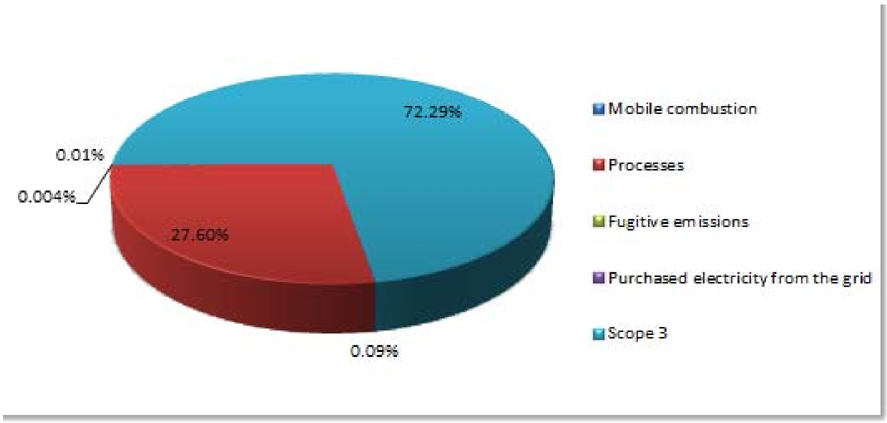


Figure 33 - Representation of UTCH GHG emissions by source

Emissions from combustion of biomass resulted in 1143.57 tCO_2. Emissions from the use of R-22 resulted in 0, 02t, i.e. 27.15 tCO_2e.

The greenhouse gas emissions are detailed in the table below.

Table 25 -GHG emissions of UTCH (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	530,554.06	5.59	8.27	533,157.25	176.66	-
Mobile combustion	17.65	0.004	0.001	18.19	2.66	
Processes	5,345.05	0.00	0.00	5,345.05	0.00	-
Fugitive emissions	0.72	0.00	0.00	0.72		0.02
Agricultural activities	0.00	0.00	0.00	0.00	0.00	
Solid wastes	0.00	0.00	0.00	0.00	0.00	
Total Scope 1	535,917.49	5.60	8.27	538,521.21	179.33	0.02
Scope 2						
Purchased electricity from the grid	1.98			1.98		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	11,597.36	0.73	0.62	11,801.48	815.24	
Waste generated in operations	0.00	1.49	0.00	37.23	0.00	
Business travels	24.60	0.002	0.001	25.05	1.47	
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00	
Transport and distribution (downstream)	2,098.72	0.13	0.11	2,135.66	147.53	
Total Scope 3	13,720.67	2.35	0.74	13,999.42	964.24	0.00
Total emissions	**549,640.14**	**7.95**	**9.01**	**552,522.61**	**1,143.57**	**0.02**

Relevant UTCH upstream emissions from transport (transport services rented/paid by Tractebel Energia) refer to the consumption of diesel oil used for the transportation of coal produced by COPELMI, which represents more than 90% of total diesel oil consumed for this category. In the case of downstream transport (transport services not paid by Tractebel Energia), it includes emissions due to the use of diesel for transport of ash and gypsum. The dry ash transport represents approximately 70% of total diesel oil consumed in this category.

→ **Jorge Lacerda (CTJL)**

The CTJL issued a total of 4,995,005.55 tCO_2e during 2015, 99.53% from Scope 1, 0.17% from Scope 2 and 0.30% from Scope 3. Only stationary combustion emissions from Scope 1 resulted in 4,971,379.21 tCO_2e.

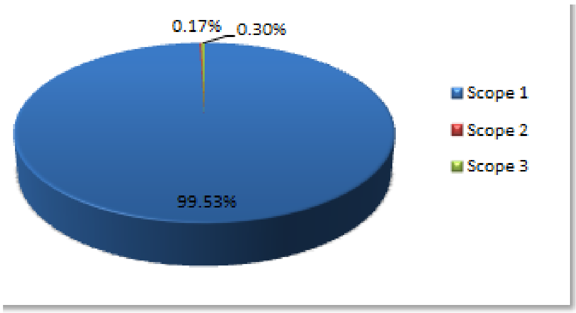


Figure 34 - Representation of CTJL GHG emissions by scope

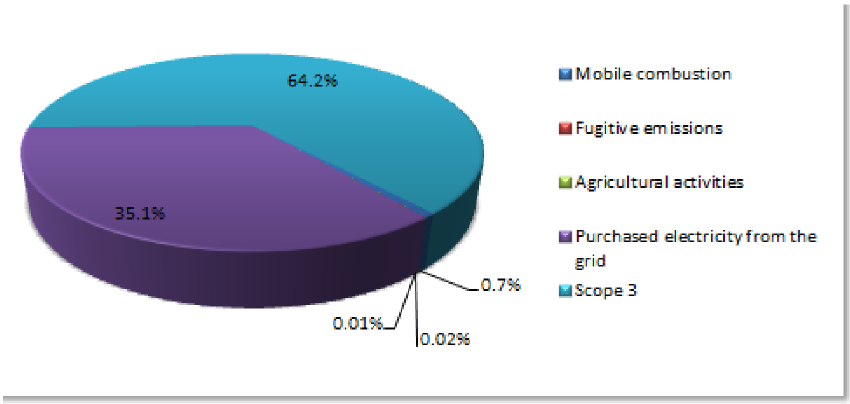


Figure 35 - Representation of CTJL GHG emissions by source (except stationary combustion)

Emissions from combustion of biomass resulted in 1,791.45 tCO_2. The non-Kyoto gases emissions of CTJL resulted in 0.12 tR-22 (i.e. 208.39 tCO_2e), due to small leaks of this gas in the air conditioning equipment located at the power plant.

The greenhouse gas emissions are detailed in the table below.

Table 26 - GHG emissions of CTJL (in tonnes)

Emission sources	CO_2	CH4	N2O	HFC	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1							
Stationary combustion	4,946,724.73	52.85	78.30		4,971,379.21	742.30	
Mobile combustion	158.44	0,05	0,01		163.50	23.97	
Processes							
Fugitive emissions	2,96	0,00	0,00	0.001	5,16		0,12
Agricultural activities	0,00	0,00	0.005		1.427	0.000	
Solid wastes	0,00	0,24	0,02		11.54	0,00	
Total Scope 1	**4,946,886.13**	**53.14**	**78.34**	**0.001**	**4,971,560.84**	**766.27**	**0,12**
Scope 2							
Purchased electricity from the grid	**8,289.22**				**8,289.22**		
Scope 3							
Fuel and energy-related activities not included in Scope 1 and 2	0,00	0,00	0,00	0,00	0,00	0,00	-
Transport and distribution (upstream)	6,204.58	0,40	0,34		6,314.87	442.96	
Waste generated in operations	0,00	15.14	0,00		378.49	0,00	
Business travels	131.04	0,01	0,01		133.26	6,88	
Employees transportation (home-work)	49.39	0.003	0.003		50.26	3,47	
Transport and distribution (downstream)	8,135.41	0,51	0,44		8,278.61	571.88	
Total Scope 3	**14,520.41**	**16.07**	**0,78**	**0,00**	**15,155.50**	**1,025.18**	**0,00**
Total emissions	**4,969,695.76**	**69.21**	**79.12**	**0.001**	**4,995,005.55**	**1,791.45**	**0,12**

Relevant upstream transport emissions refer to the use of diesel oil for transport of coal by Tereza Cristina Railroad. Relevant emissions of downstream transportation (transport services not contracted/paid by Tractebel Energia) refer to the consumption of diesel oil used for transportation of ashes carried out by Votorantim Cimentos.

→ **Willian Arjona (UTWA)**

The UTWA issued a total of 567,181.37 tCO_2e during 2015, in which 99.99% of total emissions refer to the Scope 1, 0.01% to Scope 2 and 0.004% to Scope 3.

Detailed emissions by source type of Scope 1 and 2 are presented in Figure 36, with the exception of the stationary combustion considering the significant representation of this emission source.

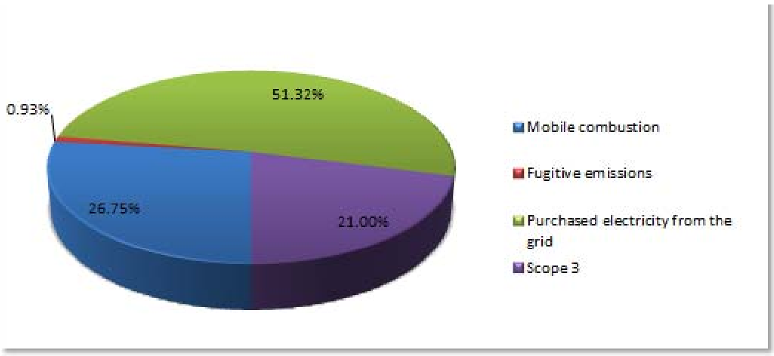


Figure36 – Representation of UTWA GHG emissions by source (except stationary combustion emissions)

Only stationary combustion of Scope 1 represents 567,076.55 tCO_2e, i.e. 99.98% of the total GHG emissions of UTWA.

Emissions from combustion of biomass resulted in 16.44 tCO_2 and there were no emissions of non-Kyoto gases (R-22) in 2015.

The greenhouse gas emissions are detailed as follows.

Table 27 - GHG emissions of UTWA (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	566,523.10	10.10	1.01	567,076.55	1,45
Mobile combustion	27.21	0,01	0.00	28.04	5,11
Processes					
Fugitive emissions	0,98	0,00	0.00	0,98	
Agricultural activities	0,00	0,00	0.00	0,00	0,00
Solid wastes	0,00	0,00	0.00	0,00	0,00
Total Scope 1	566,551.29	10.11	1.01	567,105.56	6,56
Scope 2					
Purchased electricity from the grid	53.79			53.79	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0,00	0,00	0.00	0,00	0,00
Transport and distribution (upstream)	0,00	0,00	0.00	0,00	0,00
Waste generated in operations	0,00	0,76	0.00	18.89	0,00
Business travels	0,91	0,00	0.00	0,92	0,00
Employees transportation (home-work)	2,03	0,00	0.00	2,21	9,88
Transport and distribution (downstream)	0,00	0,00	0.00	0,00	0,00
Total Scope 3	2,94	0,76	0.000	22.02	9,88
Total emissions	**566,608.02**	**10.86**	**1.01**	**567,181.37**	**16.44**

Biomass power plants

Lages (UCLA), Ferrrari (UTFE) and Ibitiúva (UTIB) thermoelectric power plants totaled 23,698.43 tCO_2e in 2015, as described below.

→ **Lages (UCLA)**

UCLA issued a total of 6,458.50 tCO_2e during 2015.

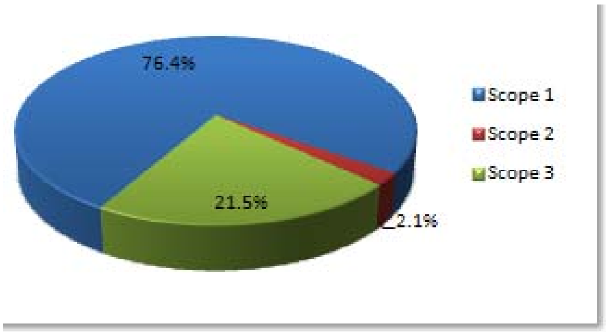


Figure 37 - Representation of UCLA GHG emissions by scope

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

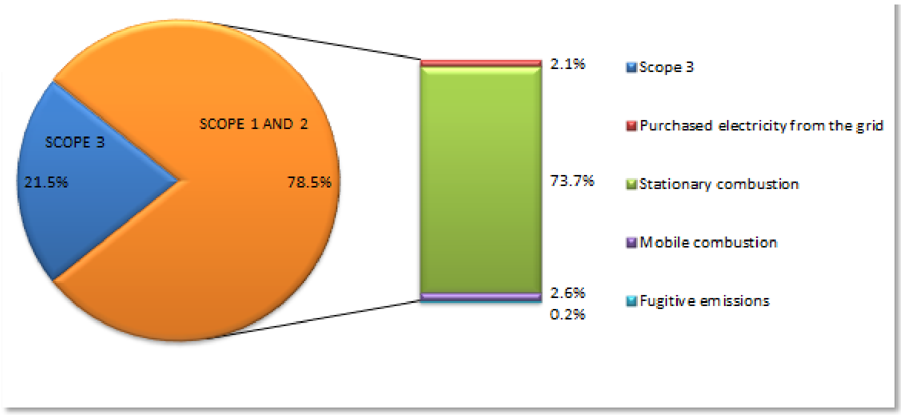


Figure 38 - Representation of UCLA GHG emissions by source

Emissions from combustion of biomass resulted in 259,424.97 tCO_2. There were no emissions of non-Kyoto gases in 2015.

The greenhouse gas emissions are detailed in the table below.

Table 28 – GHG emissions from UCLA (in tonnes)

Emission sources	CO2	CH4	N2O	HFC	CO2e	CO2 from biomass
Scope 1						
Stationary combustion	5.67	73.41	9.79		4,758.00	259,313.97
Mobile combustion	164.05	0.01	0.01		167.00	13.44
Processes						
Fugitive emissions	0.36	0.00	0.00	0.01	9.80	
Agricultural activities	0.00	0.00	0.00		0.00	0,00
Solid wastes	0.00	0.00	0.00		0.00	0,00
Total Scope 1	**170.08**	**73.43**	**9,80**	**0,01**	**4,934.80**	**259,327.41**
Scope 2						
Purchased electricity from the grid	**137.15**				**137.15**	
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0,00	0,00	0,00	0,00	0,00	0,00
Transport and distribution (upstream)	1,304.30	0,08	0,07		1,327.25	91.69
Waste generated in operations	0,00	0,60	0,00		14.94	0,00
Business travels	5,57	0.001	0.0004		5,71	0,60
Employees transportation (home-work)	37.57	0.007	0.003		38.64	5,28
Transport and distribution (downstream)	0,00	0,00	0,00		0,00	0,00
Total Scope 3	**1,347.44**	**0,69**	**0,07**	**0,00**	**1,386.55**	**97.56**
Total emissions	**1,654.67**	**74.11**	**9,87**	**0,01**	**6,458.50**	**259,424.97**

→ **Ferrari (UTFE)**

The UTFE issued a total of 12,125.59 tCO_2e during 2015, distributed in Scopes 1, 2 and 3 according to the data below.

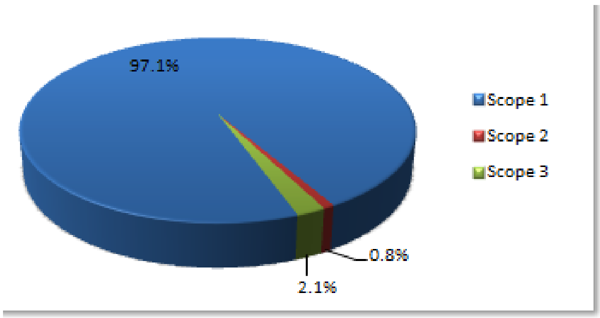


Figure39 - Representation of UTFE GHG emissions by scope

Scope 1 included stationary combustion emissions and fugitive emissions (CO_2 recharge of fire extinguishers). Scope 2 considered emissions from the use of electricity and Scope 3 emissions include emissions of waste generated in operations (waste destined for landfill and incineration).

Detailed emissions by source type of Scope 1 and 2 are presented in the Figure below.

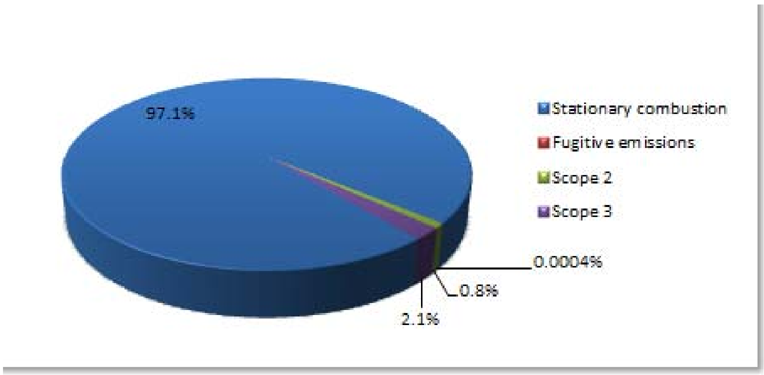


Figure 40 – Representation of UTFE GHG emissions by source

Emissions from the combustion of biomass resulted in 589,368.07 tCO_2. There was no use of R-22 in 2015 and, therefore, non-Kyoto gases emissions are zero.

The greenhouse gas emissions are detailed in the table below.

Table 29 – GHG emissions from UTFE (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	0.00	181.97	24.26	11,779.27	589,368.07
Mobile combustion	0.00	0.00	0.00	0.00	0.00
Processes					
Fugitive emissions	0.05	0.00	0.00	0.05	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**0.05**	**181.97**	**24.26**	**11,779.33**	**589,368.07**
Scope 2					
Purchased electricity from the grid	**96.75**			**96.75**	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	0.00	0.00	0.00	0.00	0.00
Waste generated in operations	17.45	9.28	0.00	249.51	0.00
Business travels	0.00	0.00	0.00	0.00	0.00
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	**17.45**	**9.28**	**0.00**	**249.51**	**0.00**
Total emissions	**114.26**	**191.25**	**24.26**	**12,125.59**	**589,368.07**

→ **Ibitiúva (UTIB)**

The UTIB issued a total of 5,114.34 tCO_2e during the year 2015 distributed according to the following Figure.

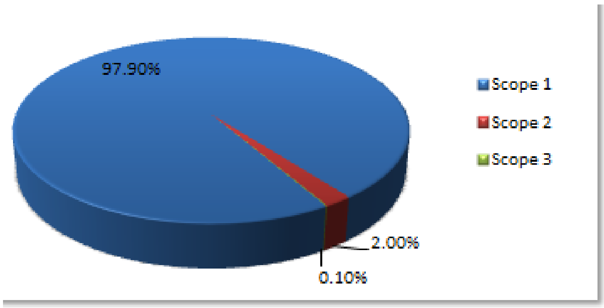


Figure 41 - Representation of UTIB GHG emissions by scope

Stationary combustion emissions from Scope 1 represented 4,990.24 tCO_2e (97.57% of the total) mainly due to CH_4 and N_2O emissions resulting from the combustion of bagasse. CO_2 emissions resulting from this combustion are classified separately "biomass emissions" – for being a renewable fuel, totaling 249,646.34 tCO_2. Therefore, UTIB issued a total of 250,120.75 tCO_2 biomass emissions distributed in Scope 1 and 3, considering combustion of bagasse and mobile from the use of ethanol and biodiesel (also as a percentage added on gasoline and diesel oil, respectively).

Detailed emissions by source type – except the stationary combustion emissions due to their high representation comparing to other sources – are presented in the figure below.

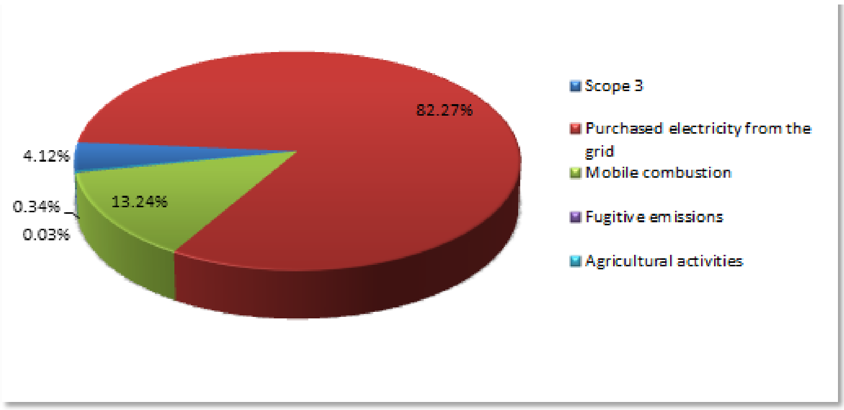


Figure 42 - Representation of UTIB GHG emissions by source (except stationary combustion)

Additionally, a total of 14.48 tCO_2e were issued from the use of 0.008 tR-22 in 2015.

The greenhouse gas emissions are detailed in the table below.

Table 30-GHG emissions of UTIB (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0,74	77.08	10.28	4,990.24	249,646.34	
Mobile combustion	16.10	0.002	0.001	16.43	4,53	
Processes						
Fugitive emissions	0,04	0,00	0,00	0,04		0.008
Agricultural activities	0,00	0,00	0,00	0,42	0,00	
Solid wastes	0,00	0,00	0,00	0,00	0,00	
Total Scope 1	16.88	77.08	10.28	5,007.13	249,650.88	0.008
Scope 2						
Purchased electricity from the grid	**102.09**			**102.09**		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0,00	0,00	0,00	0,00	0,00	-
Transport and distribution (upstream)	0,00	0,06	0.004	2,75	469.87	
Waste generated in operations	0,00	0,09	0,00	2,37	0,00	
Business travels	0,00	0,00	0,00	0,00	0,00	
Employees transportation (home-work)	0,00	0,00	0,00	0,00	0,00	
Transport and distribution (downstream)	0,00	0,00	0,00	0,00	0,00	
Total Scope 3	**0,00**	**0,16**	**0.004**	**5,12**	**469.87**	**0,00**
Total emissions	**118.97**	**77.24**	**10.28**	**5,114.34**	**250,120.75**	**0.008**

7.1.2.6. Offices

Tractebel Energia offices issued a total of 958.56 tCO_2e, as described below.

→ **Florianópolis (SC) - HEADQUARTERS**

Tractebel Energia's headquarters, located in Florianopolis, has issued a total of 952.93 tCO_2e during 2015.

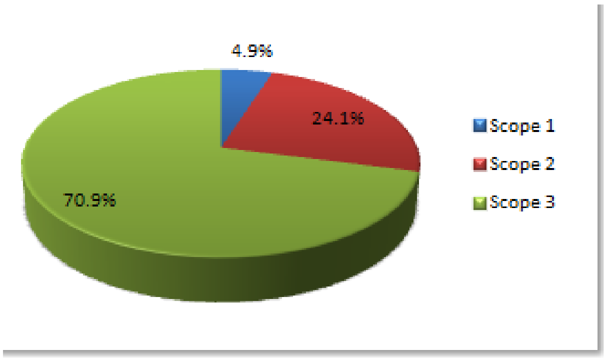


Figure 43 - Representation of GHG emissions from the headquarters, in Florianópolis, per scope

The major GHG emissions, at the headquarters of Tractebel Energia, was due to business travels, representing 70.7% of the total emissions from the head office (from those 94.2% are from air travels).

Detailed emissions by source type are presented in the Figure below.

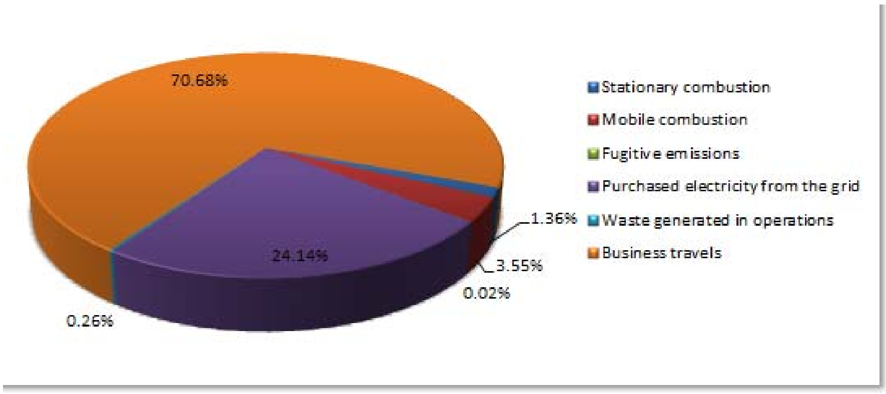


Figure 44 - Representation of GHG emissions by source of Tractebel Energia's headquarters

Emissions from combustion of biomass resulted in 18.30 tCO_2. There were no non-Kyoto gas emissions (R-22) in Florianópolis headquarters in 2015.

The greenhouse gas emissions are detailed in the table below.

Table 31 – GHG emissions from Headquarters in Florianópolis (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	12.88	0.001	0.0001	12.92	0.86
Mobile combustion	32.34	0.013	0.0039	33.82	8.09
Processes					
Fugitive emissions	0.17	0.00	0.00	0.17	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	45.39	0.014	0.004	46.91	8.95
Scope 2					
Purchased electricity from the grid	230.05			230.05	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	0.00	0.00	0.00	0.00	0.00
Waste generated in operations	0.00	0.07	0.00	2.44	0.00
Business travels	665.96	0.02	0.02	673.52	9.34
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	665.96	0.09	0.03	675.97	9.34
Total emissions	**941.41**	**0.10**	**0.03**	**952.93**	**18.30**

→ São Paulo (SP) - Office

The São Paulo Office of Tractebel Energia issued a total of 4.34 tCO_2e during 2015.

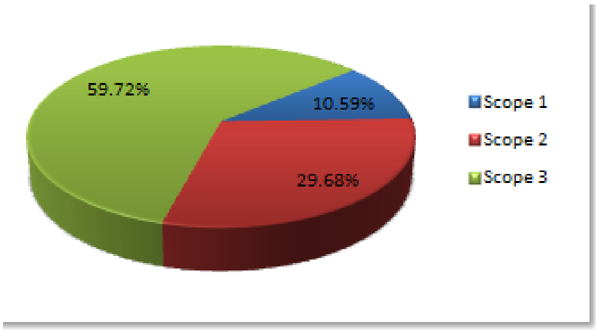


Figure 45 - Representation of GHG emissions from the Office, in Sao Paulo, by scope

For each scope, there is only one source in the case of the Sao Paulo Office. Therefore, mobile combustion from Scope 1 represents 10.6% of the total emissions of the Office, the electricity consumption of Scope 2 represents 29.7% and business travels represent 59.7%.

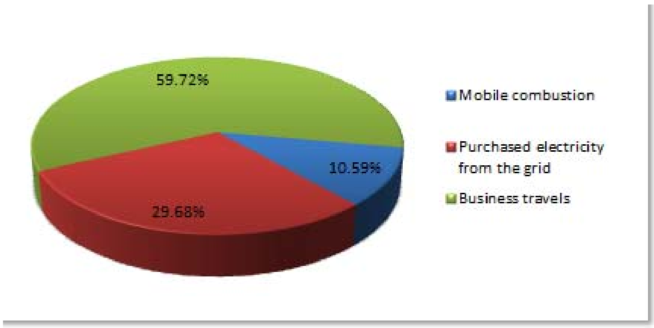


Figure 46 - Representation of GHG emissions from the Office, in Sao Paulo, per scope

Emissions from combustion of biomass resulted in 0.11 tCO_2 and there were no emissions from the combustion of biomass or non-Kyoto gases, such as R-22.

The greenhouse gas emissions are detailed in the table below.

Table 32 – GHG emissions from Office in São Paulo (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass
Scope 1					
Stationary combustion	0.00	0.00	0.00	0.00	0.00
Mobile combustion	0.44	0.0002	0.0001	0.46	0.11
Processes					
Fugitive emissions	0.00	0.00	0.00	0.00	
Agricultural activities	0.00	0.00	0.00	0.00	0.00
Solid wastes	0.00	0.00	0.00	0.00	0.00
Total Scope 1	0.44	0.00	0.00	0.46	0.11
Scope 2					
Purchased electricity from the grid	1.29			1.29	
Scope 3					
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	0.00	0.00	0.00	0.00	0.00
Waste generated in operations	0.00	0.00	0.00	0.00	0.00
Business travels	2.57	0.00004	0.0001	2.59	0.00
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	2.57	0.0000	0.0001	2.59	0.00
Total emissions	**4.30**	**0.0002**	**0.0001**	**4.34**	**0.11**

7.2. Corporate Participation

In this section, we present the emissions based on the Corporate Participation approach of Tractebel Energia. The results of the GHG calculation are detailed in the sections below.

In addressing Corporate Participation UHET, UHMA UHIT plant are also considered, for which = Tractebel Energia has equity share, but no Operational Control.

Table 69 of Annex IV – Representation of Emission Sources (item b) details the representation of each emission source in addressing Corporate Participation, as well as for Tractebel Energia as a whole.

7.2.1. Total Emissions

During 2015, Tractebel Energia has emitted a total of **6,150,308.17 tCO_2e** among Scopes 1, 2 and 3, as shown in the sections below.

Total GHG emissions of Tractebel Energia, for gas type and source on Corporate Participation approach, are presented in Annex I of this report.

7.2.1.1. Scope 1

Scope 1 emissions for the 2015 year accounted for 99.1%, resulting in 6,097,919.26 tCO_2e, which stationary combustion emissions have significant representation, as shown in the following table.

Table 33 – Scope1 GHG emissions – Corporate Participation

Emission sources	tCO_2e
Stationary combustion	6,091,658.38
Mobile combustion	658.51
Processes	5,345.05
Fugitives	236.13
Agricultural activities	8.30
Solid wastes	12.89
Total Scope 1	6,097,919.26

According to Scope 2, only emissions due to purchased electricity from the grid were identified. Considering the year of 2015, a total of 19,709.00 tCO_2e were issued, representing 0.3% of the total emissions of Tractebel Energia.

The emission contribution of this Scope, due to the performance of hydropower plants of the company as synchronous compensator of the National Interconnected System, can also be seen on the Corporate Participation Approach, in which Itá and Machadinho hydroelectric power plants provide ancillary services, besides of Cana Brava, Passo Fundo, Salto Santiago and Salto Osório[1].

7.2.1.3. Scope 3

Scope 3 emissions for the 2015 year represented 0.5%, resulting in **32,673.80 tCO_2e**, as the sources presented below.

Table 34 – Scope3 GHG emissions – Corporate Participation

Emission sources	tCO_2e
Fuel and energy-related activities not included in Scope 1 and 2	39.97
Transport and distribution (upstream)	19,929.93
Solid wastes	816.05
Business travels	981.16
Employees transportation (home-work)	498.53
Transport and distribution (downstream)	10,414.26
Total Scope 3	**32,679.90**

7.2.1.4. Biomass Emissions

CO_2 emissions from biomass combustion of Tractebel Energia totaled **1,025,261.65 tCO_2**.

7.2.1.5. Non-Kyoto gases

Emissions of gases not listed in the Kyoto Protocol of Tractebel Energia totaled 438.35 tCO_2e, due to use of 0.24 t R-22.

7.2.2. Emissions from plant/Office

GHG emissions of Tractebel Energia, per scope and power plant, are presented as follows.

[1] List of plants providing ancillary services is available at: <http://www.ons.org.br/download/contratos_ancilares/Andamento%20dos%20CPSAs-27-09-13.pdf>.

Table 35-Tractebel Energia GHG emissions by Scope and power plant - Corporate participation (tCO2e)

Plants/ Offices	Scope 1	Scope 2	Scope 3	Total emissions	Biomass emissions	Percentage of participation of GHG emissions
CTJL	4,971,560.84	8,289.22	15,155.49	4,995,005.55	1,791.45	81.2155%
UTWA	567,105.56	53.79	22.02	567,181.37	16.44	9.2220%
UTCH	538,521.21	1.98	13,999.42	552,522.61	1,143.57	8.9837%
UTFE	11,779.33	96.75	249.51	12,125.59	589,368.07	0.1972%
UCLA	4,934.80	137.15	1,386.55	6,458.50	259,424.97	0.1050%
UHSO	52.14	5,298.14	71.24	5,421.52	22.97	0.0882%
UTIB	3,467.94	70.71	3.54	3,542.19	173,233.63	0.0576%
UHSS	19.91	2,603.50	360.48	2,983.89	84.83	0.0485%
UHPF	17.91	1,730.16	150.38	1,898.45	16.65	0.0309%
SEDE	46.91	230.05	675.97	952.93	18.30	0.0155%
UHMA*	2.56	931.91	16.12	950.59	2.87	0.0155%
UHET*	32.06	53.09	112.20	197.35	17.09	0.0032%
UEBB	182.75	1.24	12.73	196.72	3.05	0.0032%
UETR	86.94	11.72	77.69	176.35	7.76	0.0029%
UHSA	25.68	0.01	101.29	126.98	26.94	0.0021%
UHIT*	13.94	4.07	92.95	110.96	19.25	0.0018%
UHPP	15.52	14.84	74.43	104.78	31.94	0.0017%
UHCB	29.97	28.24	37.26	95.46	17.16	0.0016%
UTAL	3.20	82.08	6.48	91.76	1.37	0.0015%
PHAB	8.30	14.76	27.08	50.14	3.00	0.0008%
PHJG	1.47	2.00	18.00	21.46	3.83	0.0003%
UEPS	8.94	1.78	8.49	19.20	2.31	0.0003%
PHRO	0.60	0.04	18.00	18.64	4.09	0.0003%
UEGU	0.08	15.47	0.00	15.55	0.00	0.0003%
UETB	0.00	11.20	0.00	11.20	0.00	0.0002%
UEFL	0.08	9.43	0.00	9.51	0.00	0.0002%
UFCA	0.05	7.91	0.00	7.96	0.00	0.0001%
UEMU	0.08	6.48	0.00	6.57	0.00	0.0001%
ESP	0.46	1.29	2.59	4.34	0.11	0.0001%
Total de emissões	***6,097,919.26***	***19,709.00***	***32,679.90***	***6,150,308.17***	***1,025,261.65***	***100.0%***
%	***99.15%***	***0.32%***	***0.53%***	***100.00%***	***-***	***-***

* Plants in which Tractebel Energia does not have 100% equity interest

In the following sections, GHG emissions by Tractebel Energia power plant/Office are presented.

7.2.2.1. Wind Power Plants

Since Tractebel Energia has 100% share of wind farms of Beberibe (UEBB), Flexeiras (UEFL), Guagiru (UEGU), Mundaú (UEMU), Pedra do Sal (UEPS), Trairi (UETR) and Tubarão (UETB), the GHG emissions of these units on Corporate

Participation approach are equal to the Operating control. Thus, the results of emissions of these units are described in section 7.1.2.1.

7.2.2.2. Photovoltaic Power Plants

Whereas Tractebel Energia has 100% share of the photovoltaic plant Cidade Azul (UFCA), the GHG emissions from this power plant in Corporate Participation approach are equal the Operating control. Thus, the results of the UFCA emissions are described in section 7.1.2.2.

7.2.2.3. Small Hydropower Plants

Similarly to the wind power plants, Tractebel Energia has 100% share of Areia Branca (PHAB), José Gelazio da Rocha (PHJG) and Rondonópolis (PHRO) small hydropower plants.

Therefore, GHG emissions of these plants on the Corporate Participation approach are equal the Operating control. The results these plants emissions are described in section 7.1.2.3.

7.2.2.4. Hydroelectric Power Plants

Tractebel Energia S.A. has 100% equity share of Cana Brava (UHCB), Passo Fundo (UHPF), Ponte de Pedra (UHPP), Salto Osório (UHSO), Salto Santiago (UHSS) and São Salvador (UHSA) hydroelectric power plants. Then, emission results of these power plants are described in section 7.1.2.4.

GHG emissions of Tractebel Energia, regarding its participation in Estreito (UHET), Ita (UHIT) and Machadinho (UHMA) plants, are described below.

→ **Estreito (UHET)**

Considering the Corporate Participation of Tractebel Energia of 40.07% on this plant, UHET issued 197.35 tCO_2e during 2015. The distribution of emissions among scopes can be seen in the figure below.

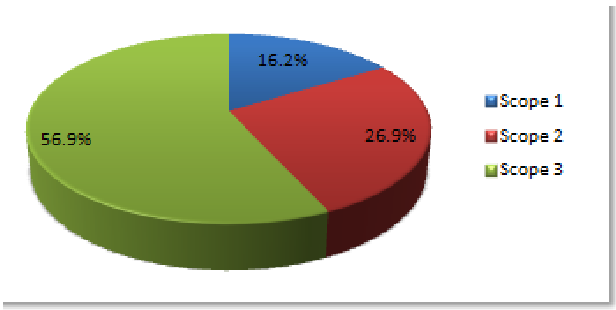


Figure 47 – Representation of GHG emissions of UHET by Scope

The representation of emissions by source type of Scope 1 and 2 is shown in figure below.

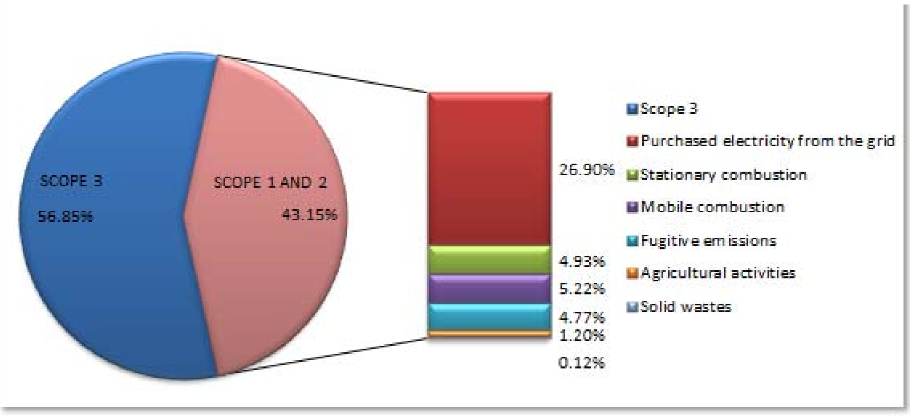


Figure 48 – Representation of GHG emissions from source UHET

Biomass emissions resulted in 17.09 tCO_2 and 39.45 tCO_2e due to non-Kyoto gas use in 2015 (equivalent to 0.02 tR-22 consumption). The greenhouse gas emissions are detailed as follows.

Table 36 - GHG emissions of UHET (in tonnes)

Emission sources	**CO2**	**CH4**	**N2O**	**CO2e**	**CO2 from biomass**	**Non-Kyoto gases**
Scope 1						
Stationary combustion	9.69	0.0004	0.0001	9.72	0.65	
Mobile combustion	10.00	0.003	0.001	10.31	5.13	
Processes						
Fugitive emissions	0.28	0.00	0.00	9.42		0.02
Agricultural activities	0.00	0.00	0.01	2.37	0.00	
Solid wastes	0.00	0.01	0.00	0.24	0.00	
Total Scope 1	19.97	0.01	0.01	32.06	5.78	0.02
Scope 2						
Purchased electricity from the grid	53.09			53.09		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	57.24	0.02	0.01	59.22	10.35	
Waste generated in operations	0.00	0.03	0.00	0.65	0.00	
Business travels	48.77	0.001	0.002	49.32	0.74	
Employees transportation (home-work)	2.96	0.0002	0.0002	3.01	0.21	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	108.97	0.04	0.01	112.20	11.30	0.00
Total emissions	**182.03**	**0.06**	**0.02**	**197.35**	**17.09**	**0.02**

Total emissions of UHET (100%) can be seen in Annex VII to this report.

→ **Itá (UHIT)**

Considering the Corporate Participation of Tractebel Energia of 68.99% on UHIT, this power plant issued 110.96 tCO_2e during 2015, in which most of the emissions are concentrated in Scope 3 as can be observed in the following figures.

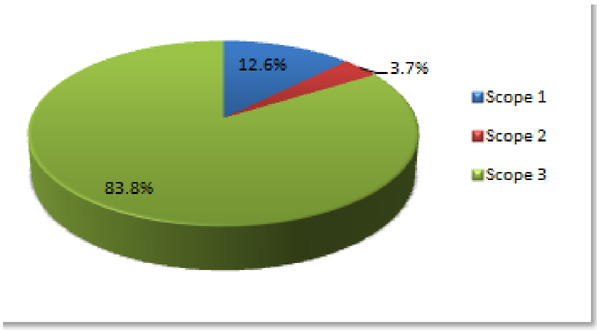


Figure 49 - Representation of GHG emissions the UHIT per Scope Corporate Participation

The representation of emissions by source type of Scope 1 and 2 is shown in Figure below.

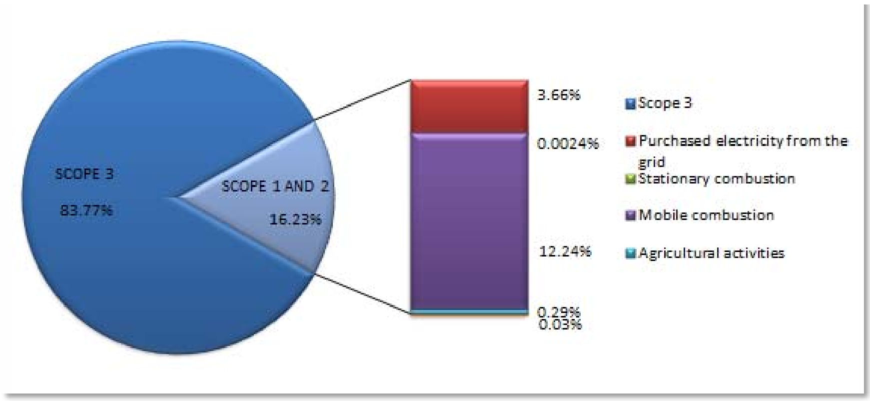


Figure 50 - Representation of GHG emissions the UHIT by source

Biomass emissions resulted in 19.25 tCO_2 and 23.85 tCO_2e of the non-Kyoto gases (equivalent to the use of 0.01 tR-22). The greenhouse gas emissions are detailed in the table below.

Table 37- GHG emissions the UHIT (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0.003	0.00	0.00	0.003	0.0002	
Mobile combustion	13.20	0.00	0.001	13.58	8.45	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.01
Agricultural activities	0.00	0.00	0.001	0.32	0.00	
Solid wastes	0.00	0.0008	0.00006	0.04	0.00	
Total Scope 1	13.20	0.004	0.002	**13.94**	8.45	0.01
Scope 2						
Purchased electricity from the grid	4.07			4.07		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	39.66	0.01	0.00	41.15	8.01	
Waste generated in operations	0.00	0.28	0.00	6.96	0.00	
Business travels	16.02	0.001	0.001	16.29	0.82	
Employees transportation (home-work)	28.06	0.002	0.002	28.55	1.97	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	83.74	0.29	0.01	92.95	10.80	0.00
Total emissions	**101.01**	**0.30**	**0.01**	**110.96**	**19.25**	**0.01**

The total emissions of the UHIT (100%) can be seen in Annex VII of this report.

→ Machadinho (UHMA)

Considering the Corporate Participation of Tractebel Energia of 19.28% on this plant, UHMA issued 948.46 tCO_2e during 2015. The distribution of emissions among the scopes can be observed in the following figure.

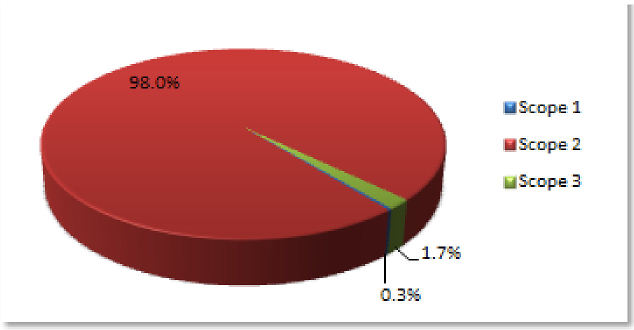


Figure 51 - Representation of GHG emissions of per Scope UHMA - Corporate Participation

The representation of emissions by source type of Scope 1 is shown in the figure below. Scope 2 emissions were not included in the figure below, due to its greater representation of these emissions in comparison to other sources.

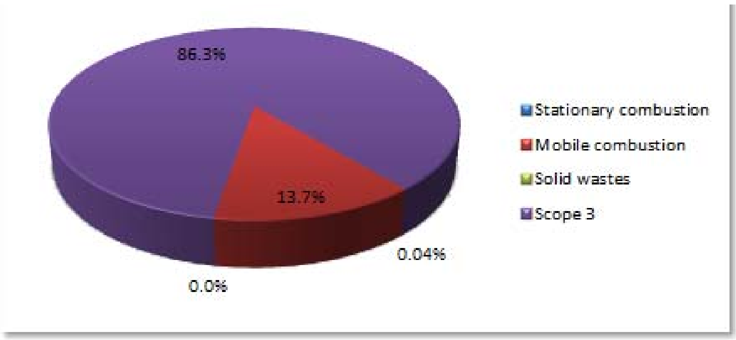


Figure 52 - Representation of GHG emissions from source UHMA (except Scope 2) - Corporate Participation

Biomass emissions resulted in 2.87 tCO_2 and non-Kyoto gases in 4.83 tCO_2e (equivalent to use of 0.003 tR-22) in 2015. The greenhouse gas emissions are detailed in the table below.

Table 38 - GHG emissions of UHMA (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0.01	0.00	0.00	0.007	0.00	
Mobile combustion	2.50	0.001	0.000	2.56	1.20	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.003
Agricultural activities	0.00	0.00	0.00	0.00	0.00	
Solid wastes	0.00	0.006	0.00	0.16	0.00	
Total Scope 1	2.50	0.007	0.00	2.72	1.20	0.003
Scope 2						
Purchased electricity from the grid	931.91			931.91		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	5.37	0.00	0.001	5.57	1.06	
Waste generated in operations	0.00	0.00	0.00	0.00	0.00	
Business travels	0.21	0.00002	0.00001	0.21	0.01	
Employees transportation (home-work)	8.48	0.001	0.000	8.63	0.60	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	14.05	0.002	0.001	14.41	1.66	0.003
Total emissions	948.46	0.01	0.001	950.59	2.87	0.003

Total emissions of UHMA (100%) can be seen in Annex VII to this report.

7.2.2.5.Thermoelectric Power Plants

Tractebel Energia S.A. has 100% equity share of thermoelectric power plants, Alegrete (UTAL), Charqueadas (UTCH), Ferrari (UTFE), Jorge Lacerda (CTJL), Lages (UCLA) and William Arjona (UTWA). Thus, emissions from these plants are described in section 7.1.2.5.

Ibitiúva power plant emissions (UTIB) are described below.

→ **Ibitiúva (UTIB)**

Considering the Corporate Participation of Tractebel Energia of 69.26% in UTIB, this plant issued 3,542.19 tCO_2e during 2015. The distribution of emissions among the scopes can be seen in the figure below.

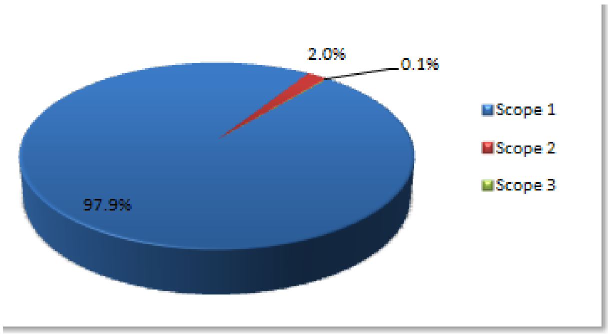


Figure 53 - Representation of GHG emissions of UTIB per Scope Corporate Participation

The representation of emissions by source type of Scope 1 and 2 is shown in the following figure, with the exception of the stationary combustion due to its high representativity in relation to other sources.

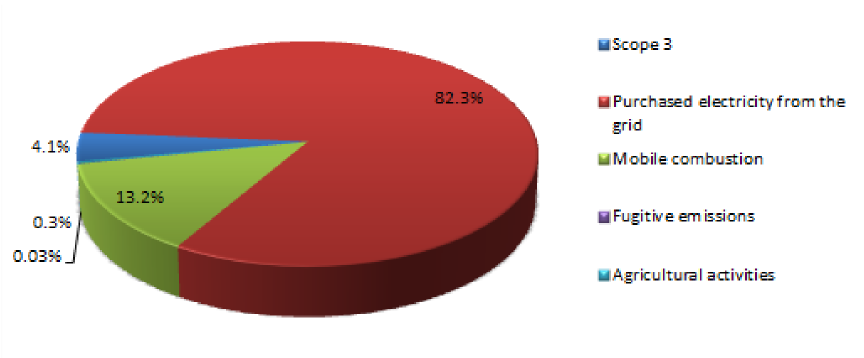


Figure 54 – Representation of GHG emissions of UTIB by source (except stationary combustion)

Biomass emissions resulted in 173,233.63 tCO_2 and the non-Kyoto gases emissions resulted in 10.03 tCO_2e due to the use of 0.006 tR-22.

The greenhouse gas emissions are detailed in the following table.

Table 39 - GHG emissions of UTIB (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0.51	53.38	7.12	3,456.24	172,905.06	
Mobile combustion	11.15	0.001	0.001	11.38	3.14	
Processes						
Fugitive emissions	0.03	0.00	0.00	0.03		0.006
Agricultural activities	0.00	0.00	0.00	0.29	0.00	
Solid wastes	0.00	0.00	0.00	0.00	0.00	
Total Scope 1	11.69	53.39	7.12	3,467.94	172,908.20	0.006
Scope 2						
Purchased electricity from the grid	70.71			70.71		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	0.00	0.04	0.003	1.90	325.43	
Waste generated in operations	0.00	0.07	0.00	1.64	0.00	
Business travels	0.00	0.00	0.00	0.00	0.00	
Employees transportation (home-work)	0.00	0.00	0.00	0.00	0.00	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	0.00	0.11	0.003	3.54	325.43	0.000
Total emissions	82.40	53.50	7.12	3,542.19	173,233.63	0.006

7.2.2.6. Offices

Whereas the headquarters in Florianópolis and São Paulo Office is 100% from Tractebel Energia, emissions of these offices are equal to emissions presented in the section 7.1.2.6.

8. Emission Analysis

8.1. Operational Control Vs. Corporate Participation

GHG emissions under the Operational Control approach resulted in 6,150,621.41 tCO_2e and under the Corporate Participation approach, 6,150,308.17 tCO2e, resulting in a difference of 313.25 tCO_2e more to Operational Control approach.

In the table below, the results may be observed by plant and total of each approach.

Table 40 – Comparison of emissions for each power plant in the in the Operational Control and Corporate Participation approaches

Plants/Offices		Operational Control		Corporate Participation	
		tco2e	%	tco2e	%
Beberibe	100%	196.72	0.0032%	196.72	0.0032%
Fleixeiras I	100%	9.51	0.0002%	9.51	0.0002%
Guajirú	100%	15.55	0.0003%	15.55	0.0003%
Mundaú	100%	6.57	0.0001%	6.57	0.0001%
Pedra do Sal	100%	19.20	0.0003%	19.20	0.0003%
Tubarão	100%	11.20	0.0002%	11.20	0.0002%
Trairi	100%	176.35	0.0029%	176.35	0.0029%
Cana Brava	100%	95.46	0.0016%	95.46	0.0016%
Estreito	40.07%	-	-	197.35	0.0032%
Itá	68.99%	-	-	110.96	0.0018%
Machadinho	19.29%	-	-	950.59	0.0155%
Passo Fundo	100%	1,898.45	0.0309%	1,898.45	0.0309%
Ponte de Pedra	100%	104.78	0.0017%	104.78	0.0017%
Salto Osório	100%	5,421.52	0.0881%	5,421.52	0.0882%
Salto Santiago	100%	2,983.89	0.0485%	2,983.89	0.0485%
São Salvador	100%	126.98	0.0021%	126.98	0.0021%
Areia Branca	100%	50.14	0.0008%	50.14	0.0008%
José Gelazio da Rocha	100%	21.46	0.0003%	21.46	0.0003%
Rondonópolis	100%	18.64	0.0003%	18.64	0.0003%
Alegrete	100%	91.76	0.0015%	91.76	0.0015%
Charqueadas	100%	552,522.61	8.9832%	552,522.61	8.9837%
Ferrari	100%	12,125.59	0.1971%	12,125.59	0.1972%
Ibitiúva	69.26%	5,114.34	0.0832%	3,542.19	0.0576%

Plants/Offices		Operational Control		Corporate Participation	
		tco2e	%	tco2e	%
Jorge Lacerda	100%	4,995,005.55	81.2114%	4,995.005.55	81.2155%
Lages	100%	6,458.50	0.1050%	6,458.50	0.1050%
William Arjona	100%	567,181.37	9.2215%	567,181.37	9.2220%
Cidade Azul	100%	7.96	0.0001%	7.96	0.0001%
São Paulo	100%	4.34	0.00007%	4.34	0.0001%
Florianópolis	100%	952.93	0.0155%	952.93	0.0155%
Total		**6.150.621,41**	**100%**	**6.150.308.17**	**100%**

8.2. Uncertainty Assessment

Uncertainty of GHG inventories are related to estimation on activity data and emission factors used in calculations. In order to reduce the impact on the final result, recommended data from official sources and internationally approved methodologies were used, as well as data collected based on documented evidence provided by Tractebel Energia. Details regarding the methodology applied can be observed in Annex V. The uncertainty analysis for each of the plants and offices of Tractebel Energia in 2015 is presented in table 41. It is important to mention that the uncertainty analysis was performed based on 100% emissions for which Tractebel Energia owns 100% of Operational Control.

Therefore, for UHET, UHIT and UHMA, total emissions of power plants were considered, although Tractebel Energia does not have 100% of the equity interest. Such an approach does not influence the outcome, since total emissions are used to indicate the range of uncertainty in relation to total emissions of power plants only.

Table 41 – Uncertainty analysis for the plants/offices of Tractebel Energia

Plants/Offices	Indirect measurements	Direct measurements	Aggregate uncertainty	Reliability rating
UHPP	+/- 4.1%	+/- 0.0%	+/- 4.1%	High
PHRO	+/- 4.8%	+/- 0.0%	+/- 4.8%	High
UHET	+/- 5.1%	+/- 4.9%	+/- 4.9%	High
UTCH	+/- 4.9%	+/- 27.7%	+/- 4.9%	High
UHCB	+/- 5.0%	+/- 0.0%	+/- 5.0%	High
CTJL	+/- 5.1%	+/- 8.9%	+/- 5.1%	Good
UHSA	+/- 5.5%	+/- 5.0%	+/- 5.5%	Good
UHSS	+/- 6.4%	+/- 30.0%	+/- 6.4%	Good
UHPF	+/- 6.4%	+/- 0.0%	+/- 6.4%	Good
UTAL	+/- 6.5%	+/- 5.0%	+/- 6.5%	Good
UHIT	+/- 6.9%	+/- 0.0%	+/- 6.9%	Good
UHMA	+/- 6.9%	+/- 0.0%	+/- 6.9%	Good
UHSO	+/- 6.9%	+/- 36.4%	+/- 6.9%	Good
UEFL	+/- 7.0%	+/- 30.0%	+/- 6.9%	Good
UEGU	+/- 7.0%	+/- 30.0%	+/- 6.9%	Good
UEMU	+/- 7.0%	+/- 30.0%	+/- 6.9%	Good
UFCA	+/- 7.0%	+/- 15.0%	+/- 7.0%	Good
UETB	+/- 7.0%	+/- 0.0%	+/- 7.0%	Good
UEPS	+/- 7.1%	+/- 5.0%	+/- 7.1%	Good
PHAB	+/- 8.1%	+/- 0.0%	+/- 8.1%	Good
UCLA	+/- 9.1%	+/- 4.8%	+/- 9.1%	Good
PHJG	+/- 9.5%	+/- 0.0%	+/- 9.5%	Good
UEBB	+/- 8.6%	+/- 15.0%	+/- 13.4%	Good
SEDE	+/- 14.6%	+/- 15.0%	+/- 14.6%	Good
UTFE	+/- 15.4%	+/- 30.0%	+/- 15.4%	Fair
UTWA	+/- 15.8%	+/- 4.8%	+/- 15.8%	Fair
UETR	+/- 17.6%	+/- 30.0%	+/- 17.6%	Fair
ESP	+/- 18.4%	+/- 0.0%	+/- 18.4%	Fair
UTIB	+/- 29.7%	+/- 15.0%	+/- 29.7%	Fair
TOTAL	**+/- 4.4%**	**+/- 11.6%**	**+/- 4.4%**	**High**

The values shown as "+/- 0.0%" (zero) in the direct measurements of the table above indicate that there were no direct emissions in the plant/office – due to emissions of refrigerants gases or CO_2 fire extinguishers. Therefore, "+/- 0.0%" does not indicate the absence of uncertainty, but that there were no direct emissions involved in the operations of the plants/offices.

Since the range of emission factor uncertainty used for each type of source is equal to all the plants/offices of Tractebel Energia, the difference between the final results of uncertainty for each plant/Office are based on the evidence presented of data activity.

The total aggregate uncertainty assessment was performed considering the weighted average emissions of power plants/offices, resulting in +/-4.4%, that is, a high rating ("high"). Such analysis was performed to give more emphasis to the data of the plants/offices that have higher emissions, avoiding discrepancies in the final results.

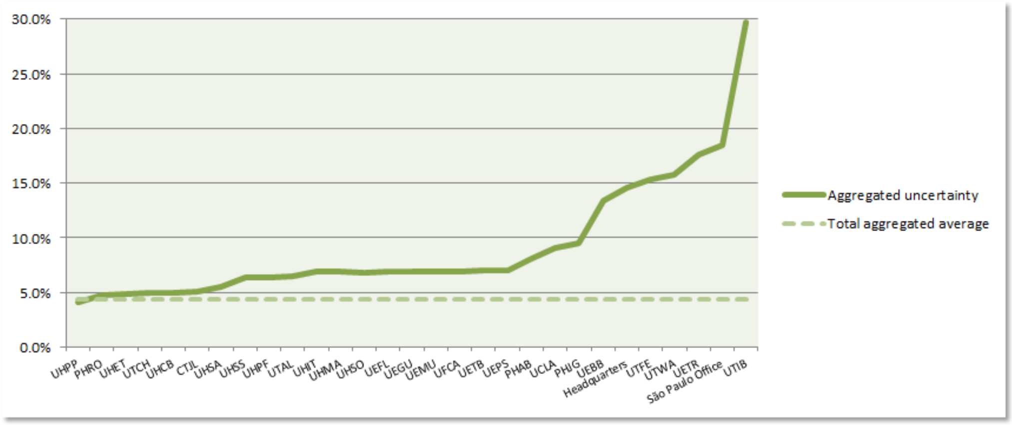


Figure 55 - Graphic of uncertainty for power plants and offices of Tractebel Energia in relation to total aggregated average

As shown in the table and the figure above, the power plant/Office that has the best classification is the UHPP (+/-4.1%, “high” classification). This result demonstrates that this plant considered data based on the most reliable evidence to compose the collection data sheet, and thus, it presents low level of uncertainty of data collected. On the other hand, the power plant/office that presents the greatest uncertainty of data is the UTIB (+/- -29.7%, "fair"), mainly due to the stationary combustion data controls.

The analysis of uncertainty for each plant/office, can be seen in Annex V.

8.3. Evolution of Emissions

The Base Year is the year of reference for the analysis/comparison of GHG emissions over time. Therefore, the establishment of the Base Year should be based on the year in which the company has reliable activity data, emission factors and methodologies considered.

The Base Year considered in this analysis is 2010. So, results of the inventories presented in the reports provided by Tractebel Energia of 2010 to 2015 were considered for the analysis of the evolution of GHG emissions of Tractebel Energia, as presented in the following sections.

8.3.1. Total Emissions

Total GHG emissions of Tractebel Energia in 2015, under the Operational Control approach, resulted in a reduction of 4.11% compared to the previous year, passing from 6,413,949.50 tCO_2e in 2014 to 6,150,621.41 tCO_2e in 2015, in which there was a reduction of Scopes 1 and 2, and increase of Scope 3 emissions.

In relation to the base year – 2010 – 2015 emissions resulted in a reduction of 4.47%. In table 42, emissions are presented over the 6 (six) years inventoried.

Table 42 – Tractebel Energia GHG emissions by Scope in tCO_2e – Operational Control (2010-2015)

Scopes	2010	2011	2012	2013	2014	2015
Scope 1	6,341,616.50	3,855,253.37	5,317,179.39	6,452,290.19	6,363,385.37	6,099,409.88
Scope 2	8,672.42	4,709.46	18,489.06	18,847.60	18,711.25	18,751.32
Scope 3	88,271.76	27,805.29	27,078.33	27,996.44	31,852.87	32,460.21
Total	**6,438,560.68**	**3,887,768.12**	**5,362,746.78**	**6,499,134.27**	**6,413,949.50**	**6,150,621.41**

Considering the period from 2010 to 2015, the year 2013 more issued GEE, followed by the year of 2010.

It is worth noting that the power generation system in Brazil, based on large hydro is subject to seasonality, depending on the availability of "raw material" (water), causing periodic variations of energy made available annually in the distribution network of the SIN. The thermals in the country come to supply this deficiency, since, basically, are not affected by this problem or weather variations, which can affect other types of power plants. In 2013, following the example of other years, there was an increase in thermal energy demand, leading to greater generation of thermal power plants of Tractebel Energia, such as fossil fuels, logging, increased CO_2 emissions by "stationary combustion" and, consequently, a higher result for the company as a whole.

Whereas the Scope 1 GHG emissions account for more than 98% of the total emissions of Tractebel Energia in the period from 2010 to 2015, these emissions are responsible for the significant variation of total in the period.

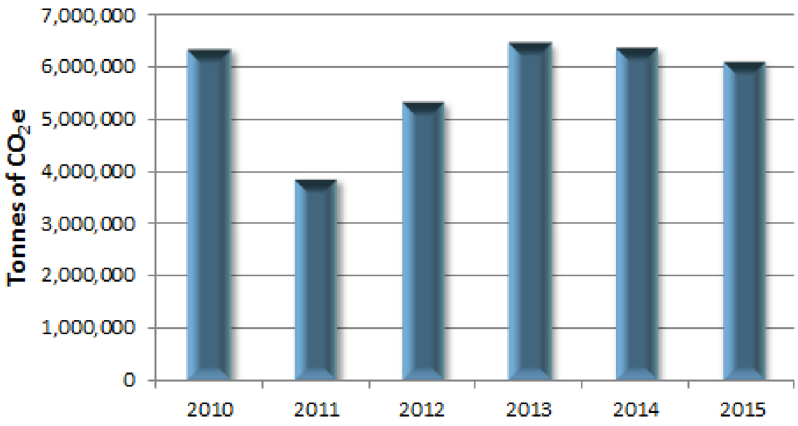


Figure 56-Scope 1 - Emissions Evolution of Tractebel Energia – Operational Control (2010-2015)

According to the Figure above, there was a reduction of 5.47% Scope 1 emissions from 2014 to 2015. For the same period, there was also a reduction of GHG emissions of 0.21% in Scope 2 and an increase of 1.91% in Scope 3.

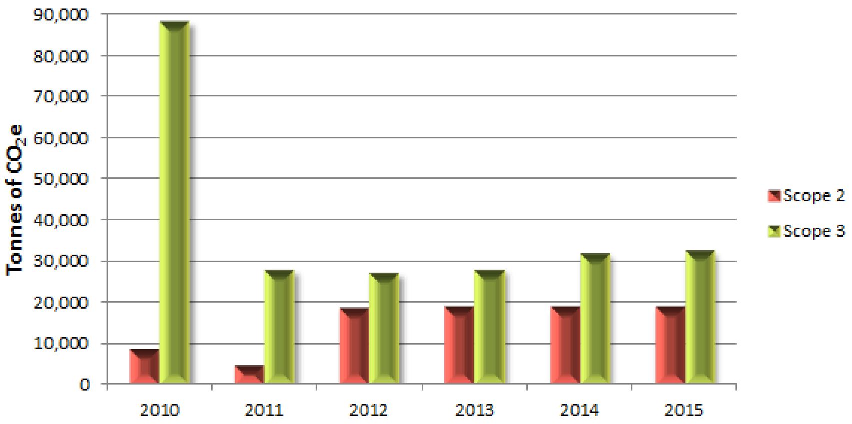


Figure 57-Evolution of emissions of Scope 2 and 3 of Tractebel Energia – Operational Control (2010-2015)

The variation of results the Scope 2 is part explained by variation in the electricity consumption of the network and by the variation of the CO_2 emission factor of SIN, as shown in figure below.

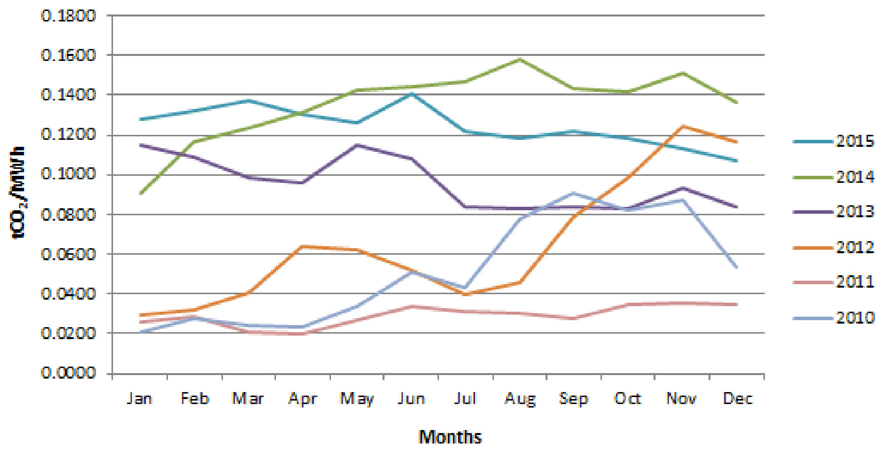


Figure 58 - CO2 emission Factor monthly NIS in tCO2/MWh (2010-2015)

Source: MCTI (2016)

From 2014 to 2015, the annual average CO_2 emission factor of the SIN decreased by 8.15%, from 0.1355 tCO2/MWh for 0.1244 tCO_2/MWh. This explains, in part, the reductions in emissions of Scope 2 of Tractebel Energia.

Another factor that implies Scope 2 emissions result in Operational Control approach is the consumption/Purchased electricity from the grid, which in large part is due to the acting of some of the company's plants as the synchronous compensator of SIN – UHCB, UHPF, UHSO and UHSS.

With regard to CO_2 emissions from biomass combustion in 2015, there was an increase of 17.07% of emissions in comparison to 2014.

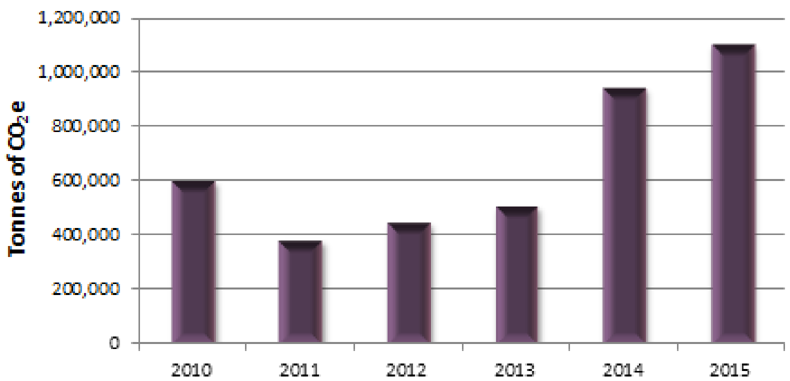


Figure 59-trends in emissions from combustion of biomass of Tractebel Energia – Operational Control (2010-2015)

The CO_2 by biomass combustion is related to the use of biomass (bagasse and wood waste) for boilers, biodiesel (also as a percentage added to the diesel oil) and ethanol (also as a percentage added to gasoline).

The parameters that could affect the emissions related to the use of biomass are: (i) CO2 emission factor of fuel, (ii) percentage of adding ethanol to gasoline and biodiesel in the diesel oil and (iii) amount of fuel used for both mobile and stationary combustion.

Between 2010 and 2015, there was no change in the CO_2 emission factors in the fuels used by Tractebel Energia. However, there was an increase in the percentages of ethanol added to gasoline and biodiesel diesel oil, according to the table below.

Table 43 - percentage of ethanol added to gasoline and biodiesel in diesel oil (2010 – 2015)

Parameter	2010	2011	2012	2013	2014	2015
% ethanol in gasoline	23.8%	23.8%	20.0%	23.3%	25.0%	26.6%
% biodiesel in diesel	5.0%	5.0%	5.0%	5.0%	5.7%	7.0%

Source: ANP (2015), BRAZIL (2015)

In this way, the increase in CO_2 emissions from biomass should both by increasing the percentage of ethanol to gasoline and diesel oil and biodiesel part by increased biomass combustion, especially due to the operation of UCLA, UTFE and UTIB. For all these plants, there was an increase in emissions of biomass: 3.75% for UCLA, 18.35 percent to 31.03% and UTFE to UTIB.

With respect to non-Kyoto gases (R-22), there was an increase of 34.10% of emissions from 279.39 tCO2e (0.15 tR-22) in 2014 to 374.67 tCO2e (0.21 tR-22) in 2015. Whereas there has been no change in the GWP of R-22 gas, this increase is due solely to increased consumption of R-22.

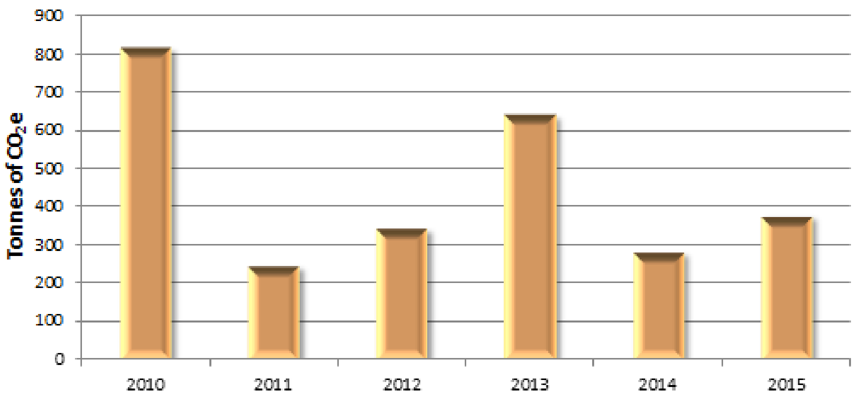


Figure 60- evolution of non-Kyoto gases (R-22) of Tractebel Energia Operational Control (2010-2015)

The evolution of GHG emissions under the Corporate Participation approach is intrinsically related to the Operational Control approach, in which emissions vary in proportion to the shareholding of Tractebel Energia in plants. Thus, the principle can be stated that there has been a reduction of total GHG emissions in addressing Corporate Participation.

Additionally, wind power Tubarão (UETB) was included in the generator Park of Tractebel Energia, which has 100% Ownership and Operational Control. However, their emissions are not significant for affecting global emissions of Tractebel Energia (addition of 11.20 tCO_2e in emissions in 2015).

Table44 -Tractebel Energia GHG emissions by Scope in tCO2e Corporate Participation (2010-2015)

Scopes	2010	2011	2012	2013	2014	2015
Scope 1	6,340,417.05	3,852,561.53	5,315,652.34	6,450,744.91	6,363,393.22	6,097,919.26
Scope 2	9,099.45	4,894.53	19,660.30	20,168.44	19,670.31	19,709.00
Scope 3	88,849.50	27,938.42	27,218.02	28,321.21	32,170.20	32,679.90
Total	**6,438,365.99**	**3,885,394.48**	**5,362,530.66**	**6,499,234.56**	**6,415,233.72**	**6,150,308.17**

Considering the data presented above, there was a reduction of emissions of Tractebel Energia in 2015 compared to the previous year to 4.13%, similar to the increase in the Operational Control approach (4.11%) reduction.

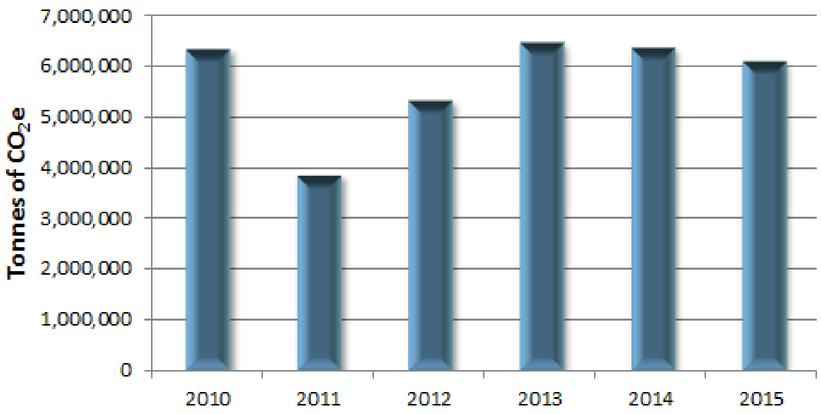


Figure 61 - Scope1Emission Evolution of Tractebel Energia Corporate Participation

With respect to the Scope 1, there was a reduction of 5.47%, exactly equal to the increase for this Scope in the Operational Control approach.

Scope 2, there was a decrease of 0.20% in emissions from electricity consumption, against the 0.21 percent reduction in the Operational Control approach.

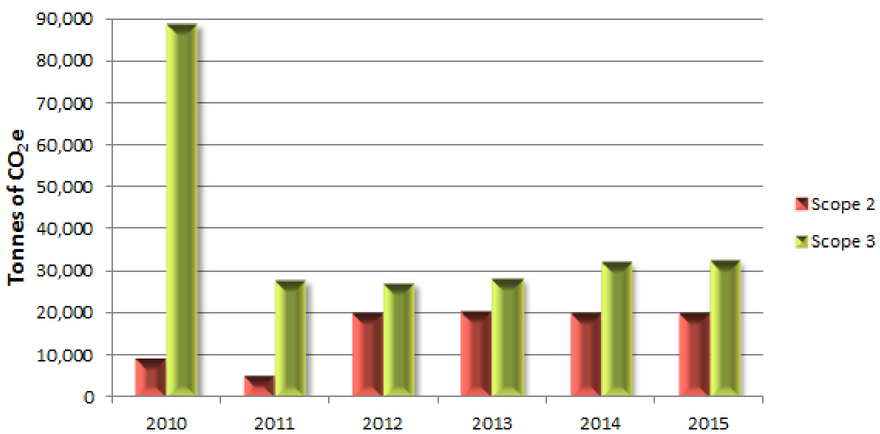


Figure 62 - Evolution of emissions forScopes 2 and 3 of Tractebel Energia Corporate Participation

With respect to the Scope 3, there was an increase of 1.58% of emissions in 2015 compared to the previous year, similar to the increase in the Operational Control approach (1.91%).

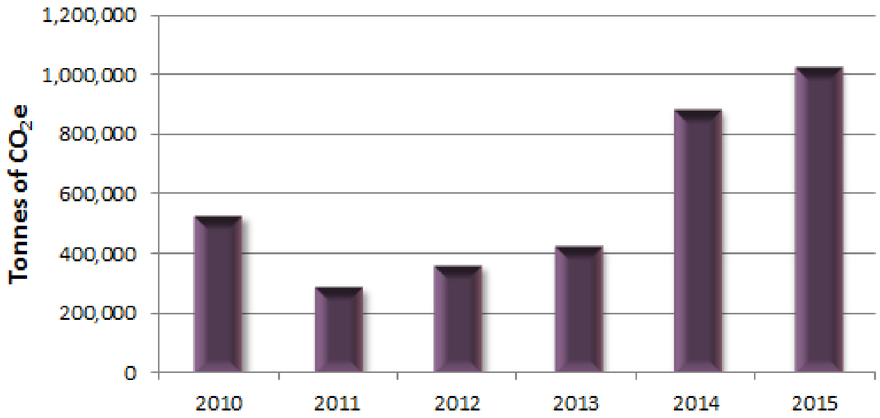


Figure 63-evolution of emissions from the combustion of biomass of Tractebel Energia-Corporate Participation

CO_2 emissions from biomass combustion increased by 16.15% from 2014, increasing from 882,667.28 tCO_2 to 1,025,261.65 tCO_2.

With respect to non-Kyoto gases emissions in 2015 from 325.59 tCO_2e to 438.35 tCO_2e, i.e. an increase of 34.63%.

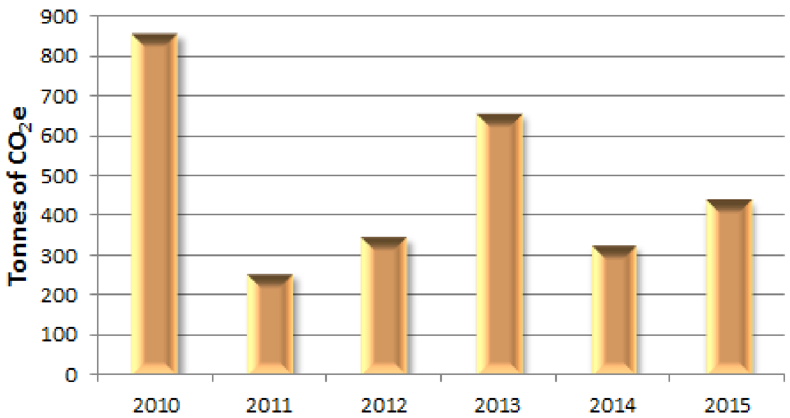


Figure 64-evolution of non-Kyoto gases of Tractebel Energia Corporate Participation

8.3.2. Emissions from plant/Office

The evolution of emissions for each plant/Office of Tractebel Energia is presented below. Important to mention that, for the years 2010 and 2011, it has not been possible to identify the emissions of CO_2 from the combustion of biomass and of CO2e for non-Kyoto gases for plant/Office (summary accounting of 2010 and 2011 did not include these emissions from plant/Office). In this way, it has not been possible to analyse the evolution of these emissions for each plant/Office of Tractebel Energia.

The analysis did not include emissions from UETB, since this plant was included in the generator Park of Tractebel Energia in 2015 and, in this way, there is no history of this power plant emissions.

8.3.2.1. Wind Power Plants

→ **Beberibe (UEBB)**

The GHG emissions in 2015 UEBB have resulted in an increase of 946.0% over the previous year.

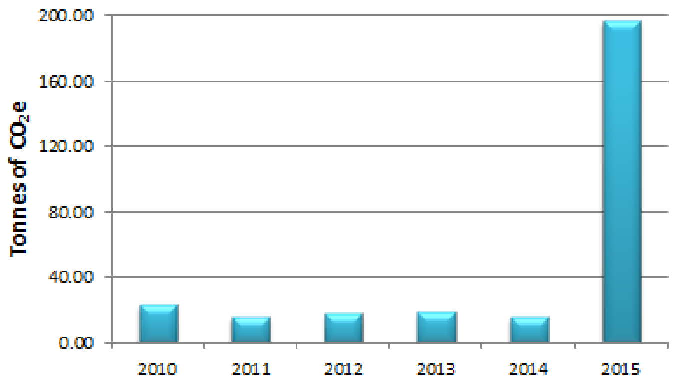


Figure 65 – Evolution of GHG emissions at UEBB in tCO_2e

This significant increase is explained by the use of 7.7 kg of SF_6, resulting in the emissions of 175.56 tCO_2e in Scope 1, as can be seen in the following graph.

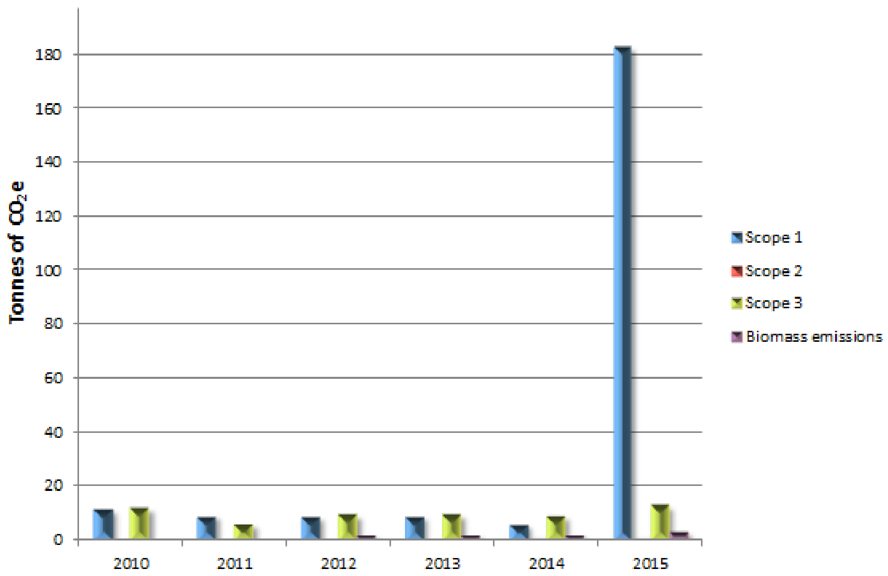


Figure 66 – Evolution of GHG emissions at UEBB in tCO_2e

Although only 7.7 kg of SF_6 were used, the GWP of this gas is 22,800 greater than CO_2. In this way, the use of SF_6 contributed to the increase of 3,071.8% of the Scope 1 emissions in 2015.

Scope 3 emissions also increased in 2015 from 8.88 tCO_2e in 2014 to 12.73 tCO_2e in 2015 (43.3% increase). Scope 2 emissions have been reduced 6.3% compared to 2014.

Biomass emissions increased by 69.4% compared to 2015.

→ **Flexeiras (UEFL)**

The UEFL presented higher GHG emissions in 2015.

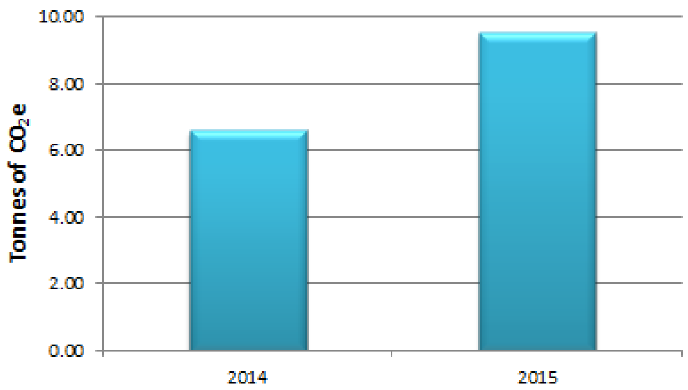


Figure 67 - Evolution of GHG emissions at UEFL in tCO2e

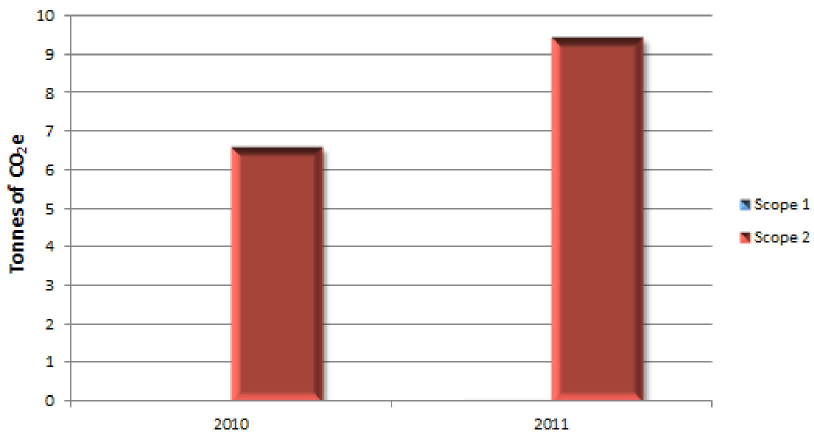


Figure 68 - Evolution of GHG emissions at UEFL by scope in tCO_2e

As shown in the figures above, there were emissions in Scope 1 due to the use of CO_2 for the refilling of fire extinguishers only, and Scope 2 due to the electricity consumption of the network.

UEFL GHG emissions increased 44.5% over the previous year. Such an increase is related to the increase in emissions in Scope 2 by 43.2% and and the emissions of CO_2 in fire extinguishers.

Emissions of GHG in Scope 3 and CO_2 emissions from biomass were not identified in the analysis period.

→ **Guagiru (UEGU)**

As of the UEFL, UEGU presented higher GHG emissions in 2015. Scope 1 emissions (use of CO_2 for fire extinguisher recharge) are smaller than the Scope 2 emissions (electricity use from the grid) that are very low in the chart below.

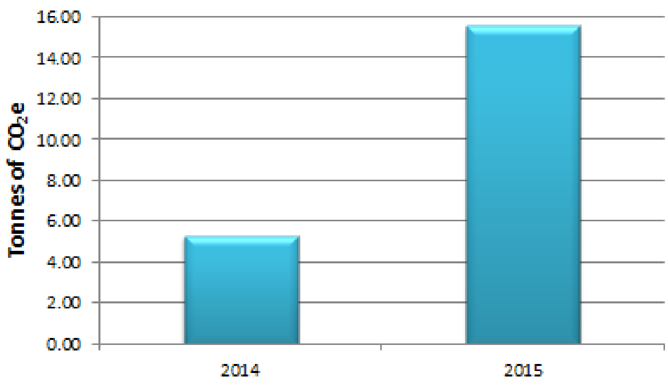


Figure 69 - Evolution of GHG emissions at UEGU in tCO_2e

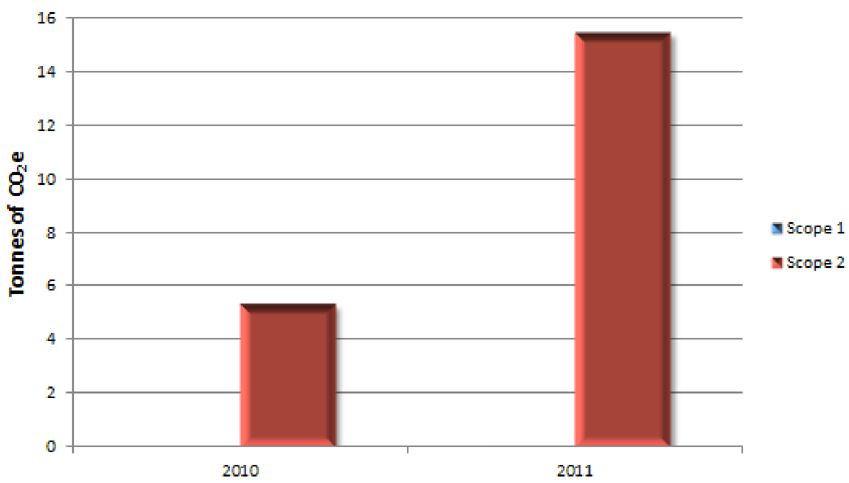


Figure 70 - Evolution of GHG emissions at UEGU by scope in tCO_2e

The GHG emissions by UEGU increased 192.5% compared to 2014. Such an increase is due to the increase in emissions of Scope 2 by 190.9% and the emission of CO_2 from fire extinguishers in Scope 1.

Similar to UEFL, GHG emissions in Scope 3 and CO_2 emissions from biomass were not identified in the analysis period.

→ **Mundaú (UEMU)**

Unlike the UEFL and UEGU, the total GHG emissions in UEMU reduced by 19.6% compared to 2014, due exclusively to the Scope 2 emissions reduction by 20.6%. The emission reduction was notbetter due to refilling CO_2 on fire extinguishers.

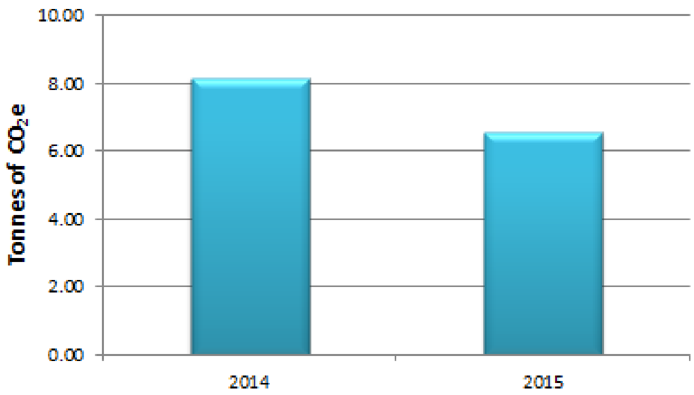


Figure 71 - Evolution of GHG emissions at UEMU in tCO2e

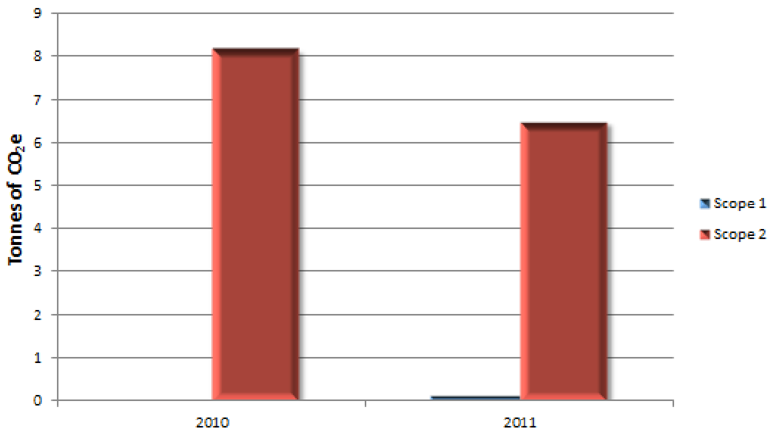


Figure 72 - Evolution of GHG emissions at UEMU by scope in tCO2e

GHG emissions in Scope 3 and CO_2 emissions from biomass were not identified in the analysis period.

→ **Pedra do Sal (UEPS)**

Total GHG emissions of UEPS in 2015 resulted in a decrease of 4.0% compared to the previous year. Such a reduction is due to lower emissions in all scopes. Scope 1 emissions reduced 4.5%, Scope 2 emissions by 14.7% and Scope 3 by 0.9%.

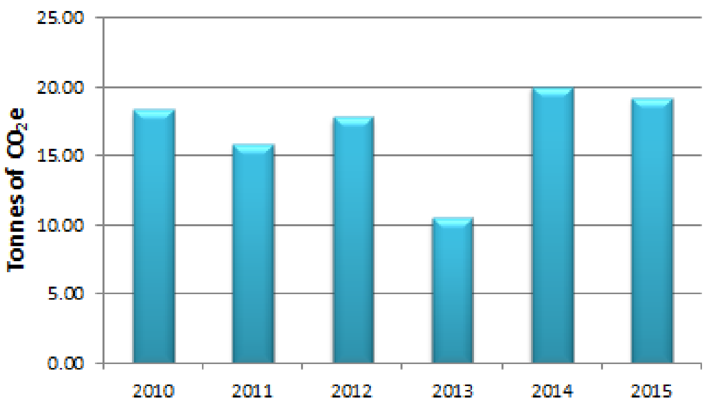


Figure 73 - Evolution of GHG emissions at UEPS in tCO2e

It is important to mention that the significant increase in emissions of Scope 3 in 2014 is due to the emissions from transportation and distribution (upstream) and travel on business.

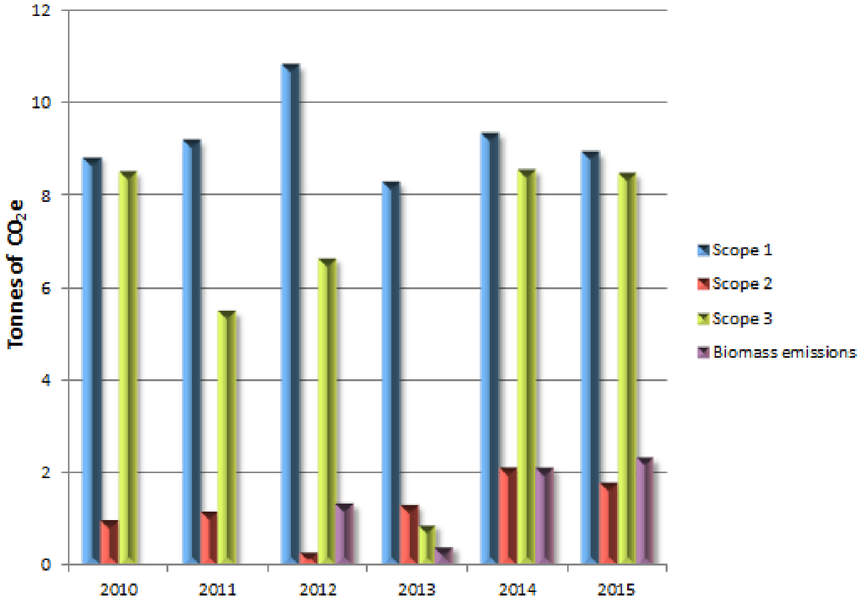


Figure 74 - Evolution of GHG emissions at UEPS by scope in tCO_2e

On the other hand, CO_2 emissions resulting from the combustion of biomass increased 9.4% in 2015.

→ **Trairi (UETR)**

In 2015, the UETR has increased its emissions in 106.4% over the previous year, due to the increase in emissions in all scopes: 17.5% increase on emissions from Scope 1, 144.4% from Scope 2 and 1,067.6% from scope 3. Similarly, the emissions from the CO_2 combustion of biomass also increased to 34.2%.

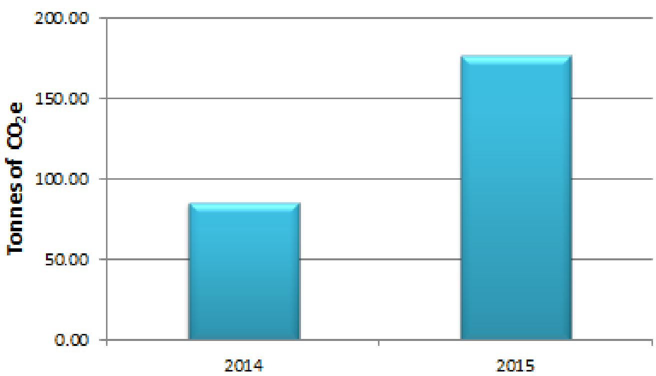


Figure 75 - Evolution of GHG emissions at UETR in tCO_2e

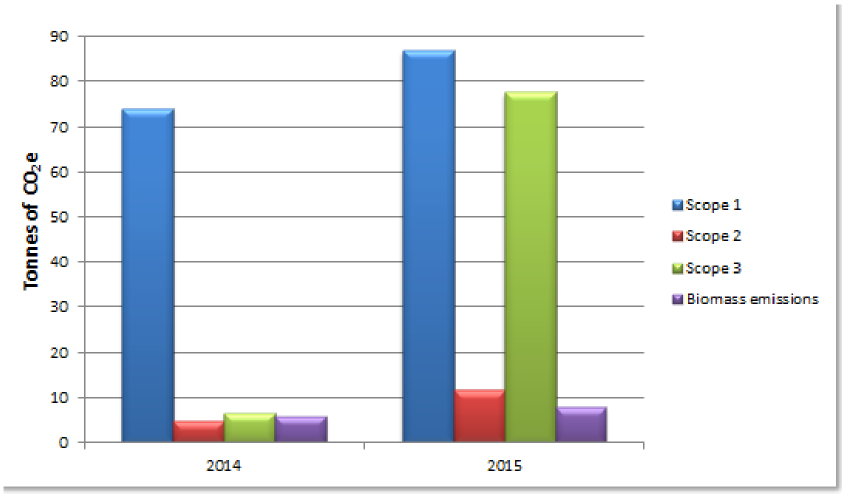


Figure 76 – Evolution of GHG emissions at UETR by scope in tCO_2e

8.3.2.2. Photovoltaic Power Plant

→ **Cidade Azul (UFCA)**

The UFCA started its operations in 2014, and therefore the emissions had their emissions examined that year. Whereas emissions in Scope 3 and CO_2 emissions of biomass were not identified, only emissions from Scope 1 and 2 were analyzed.

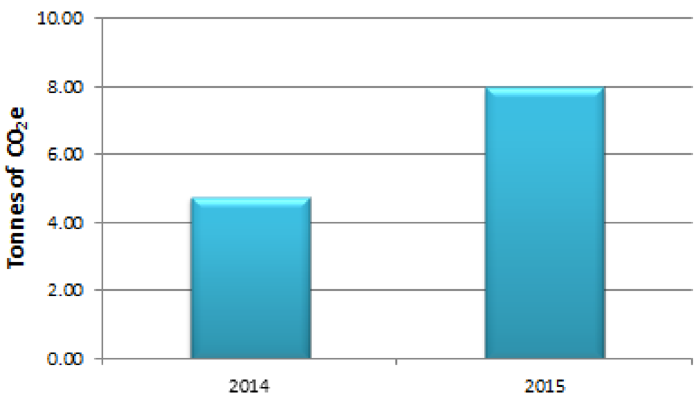


Figure 77 - Evolution of GHG emissions at UFCA in tCO2e

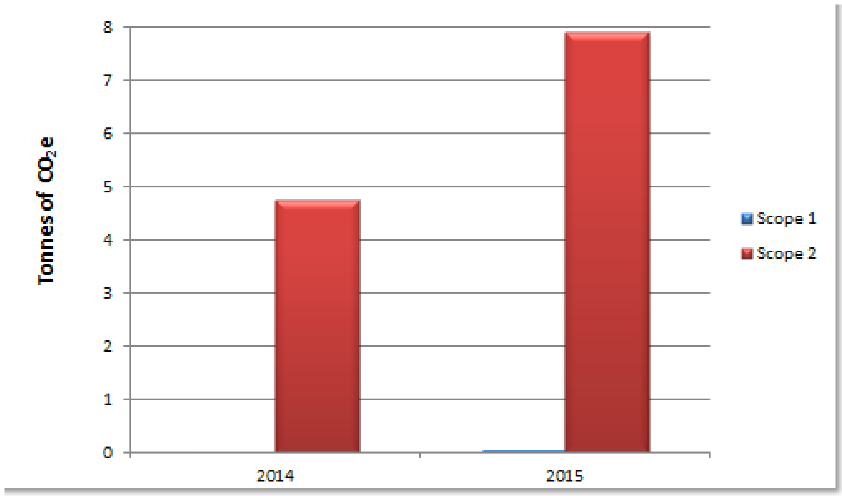


Figure 78 - Evolution of GHG emissions at UFCA by scope in tCO2e

In 2015, the only emission sources identified in UFCA were the use of network electricity (Scope 2) and CO_2 recharging in fire extinguishers (Scope 1).

During the two-year operation period, it was only in 2015 that emission was registered due to the recharge of fire extinguishers, which contributed to the increase in total GHG emissions, this year (2015), to the UFCA.

Scope 2 emissions increased by 66.9%, from 4.74 tCO_2e to 7.96 tCO_2e.

8.3.2.3. Small Hydropower Plants

→ **Areia Branca (PHAB)**

The GHG emissions in 2015 at PHAB resulted in an increase of 14.0% compared to the previous year, with significant increase of 254.9% of emissions in Scope 2.

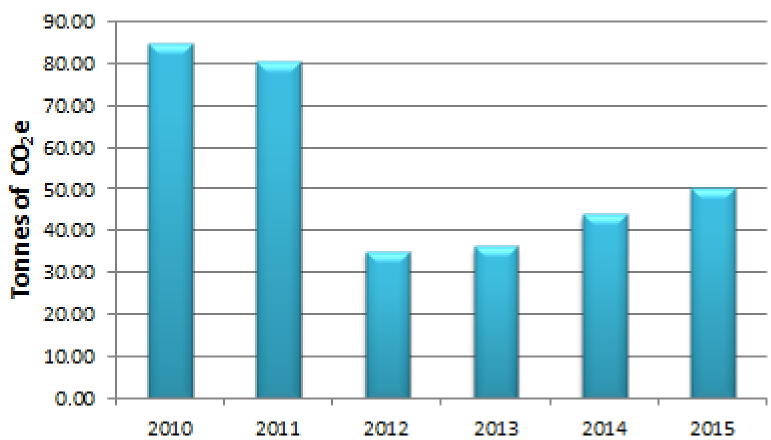


Figure 79 – Evolution of GHG emissions at PHAB in tCO_2e

Although the reduction in Scope 1 emissions (28.1%) and Scope 3 (4.2%) have occurred, this increase in Scope 2 emissions has led to increased GHG emissions from this power plant, as a whole, in 2015 compared to 2014.

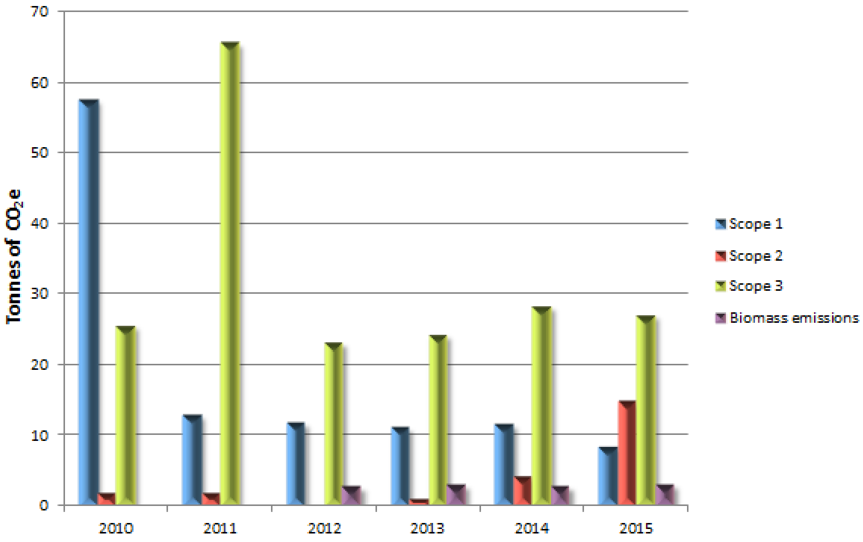


Figure 80 - Evolution of GHG emissions at PHAB by scope in tCO_2e

→ **José Gelazio da Rocha (PHJG)**

Total GHG emissions of PHJG reduced by 6.2% in 2015 compared to the year 2014. It is the fourth consecutive year that the PHJG reduces their total emissions.

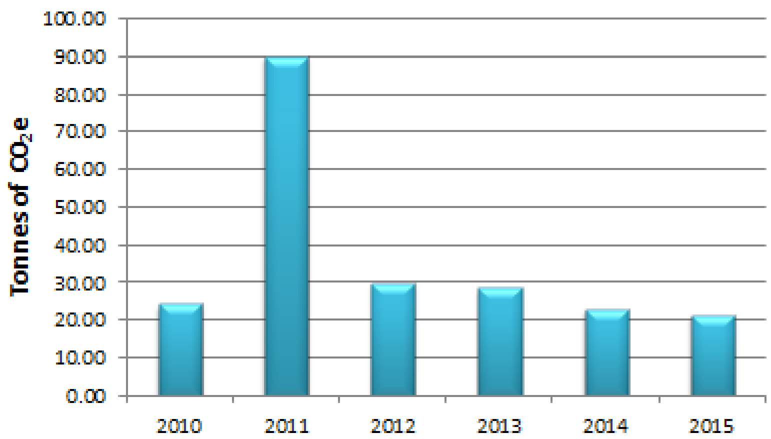


Figure 81 - Evolution of GHG emissions at PHJG in tCO2e

In 2015, an increase of 144.8% for Scope 1 and 78.8% for Scope 2. Similarly, CO_2 burning emissions from biomass of were reduced by 44.2% in relation to 2014. On the other hand, Scope 3 emissions reduced by 14.9% compared to the previous year. Considering the greater Representation in Scope 3 emissions, the increase in these emissions have contributed to reduce the total emissions of PHJG, despite the increase in emissions in Scopes 1 and 2.

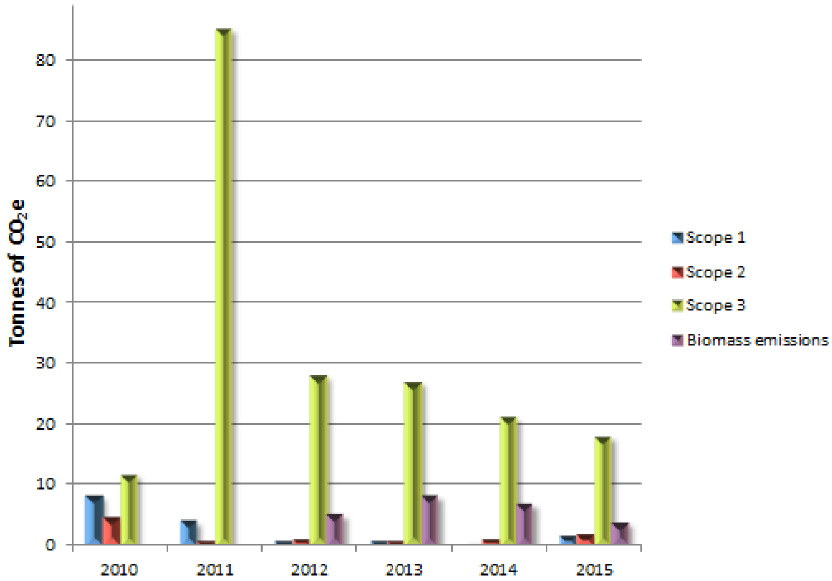


Figure 82 – Evolution of GHG emissions at PHJG by scope in tCO2e

→ **Rondonópolis (PHRO)**

The GHG emissions decreased by 19.1% in PHRO in 2015, showing reduction in all scopes. Scope 1 emissions were reduced by 57.9%, Scope 2 by 92.3% and Scope 3 by 14.9%. Similarly, biomass emissions reduced by 42.5%. This is the second consecutive year that the PHRO reduces their total emissions.

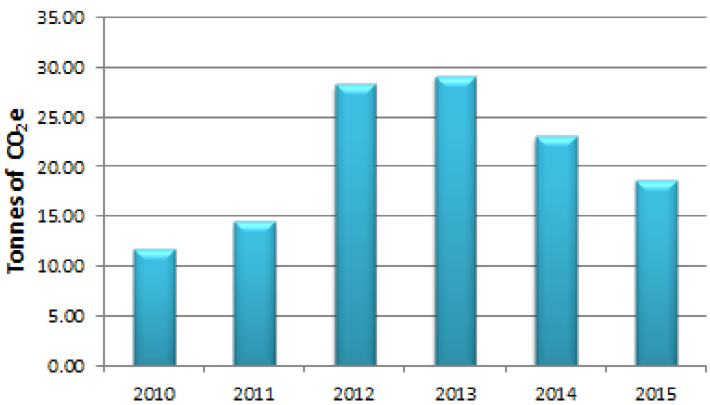


Figure 83 - Evolution of GHG emissions at PHRO in tCO2e

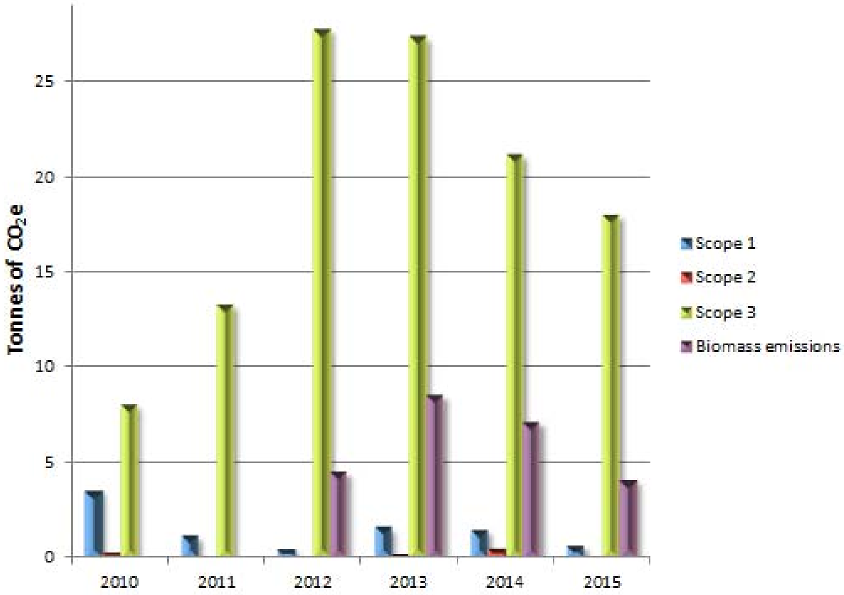


Figure 84 - Evolution of GHG emissions at PHRO by scope in tCO2e

8.3.2.4. Hydroelectric Power Plants

→ **Cana Brava (UHCB)**

GHG emissions of UHCB had a reduction from 550.58 tCO_2e in 2014 to 95.46 tCO2e in 2015, i.e., the emissions were reduced in 82.7% compared to 2014. This reduction is associated with the decrease in Scope 2 emissions by 94.2%, from 487.51 tCO_2e to 28.24 tCO_2e. The increase or reduction of emissions of Scope 2 of UHCB is related to their increased (such as occurred in 2014) or decreased (in 2015) ability to act as synchronous compensator of SIN. Similarly, Scope 1 emissions were reduced by 12.1%.

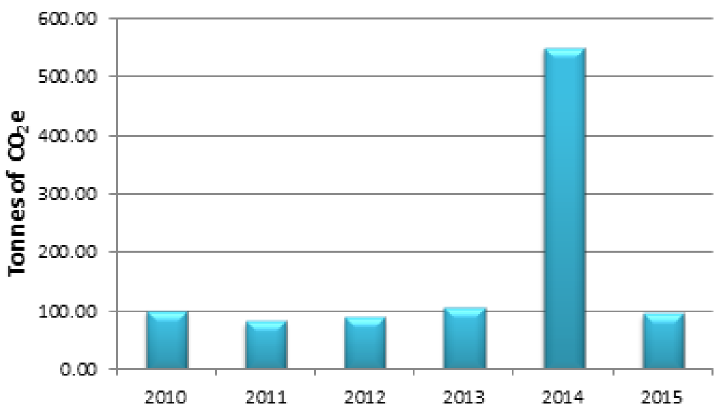


Figure 85 – Evolution of GHG emissions at UHCB in tCO2e

On the other hand, Scope 3 emissions and combustion of biomass increased by 28.5% and 9.0%.

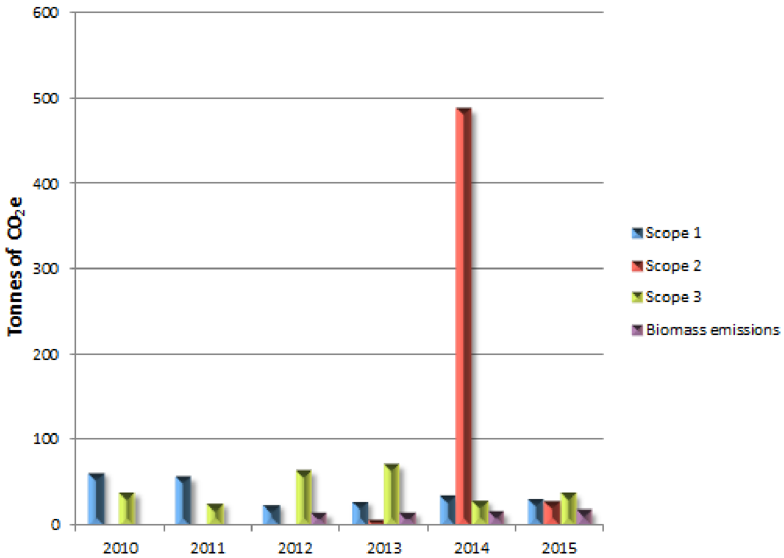


Figure 86 - Evolution of GHG emissions at UHCB by scope in tCO2e

→ **Estreito (UHET)**

Considering the Corporate Participation approach, GHG emissions at UHET in 2015 reduced in 4.4%. This variation is due to the reduction of 26.1% in Scope 1 and 18.8% in Scope 3. On the other hand, emissions in Scope 2 increased 113.1%.

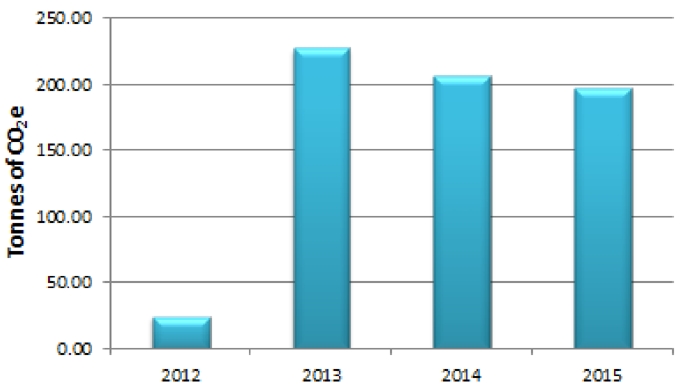


Figure 87 - Evolution of GHG emissions at UHET in tCO_2e - Corporate Participation

Biomass emissions have reduced 15.5% when compared to 2014 year.

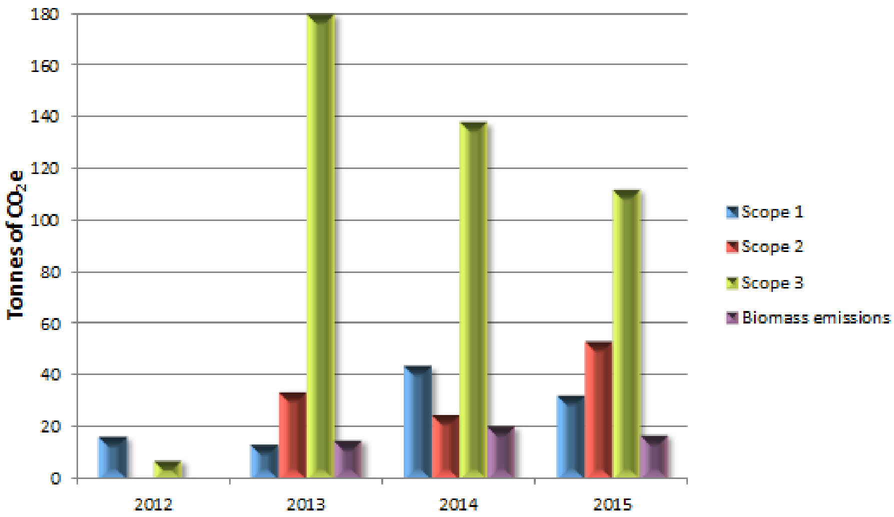


Figure 88 - Evolution of GHG emissions at UHET by scope in tCO2e - Corporate Participation

→ **Itá (UHIT)**

Considering the Corporate Participation approach, emissions of the UHIT reduced in all scopes in 2015. The total emissions reduced by 45.0% compared to 2014.

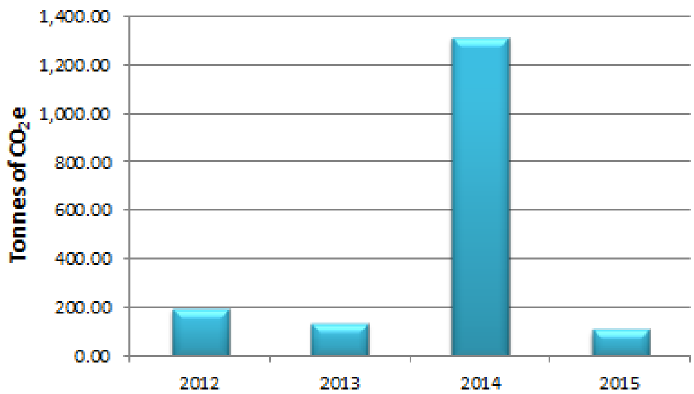


Figure 89 - Evolution of GHG emissions at UHIT in tCO2e - Corporate Participation

Scope 1 emissions reduced in 98.8% due solely to no emission of SF_6. Emissions from Scopes 2 and 3 reduced 18.7% and 45.0% in 2015. Similarly, biomass emissions also were reduced to 5.7%.

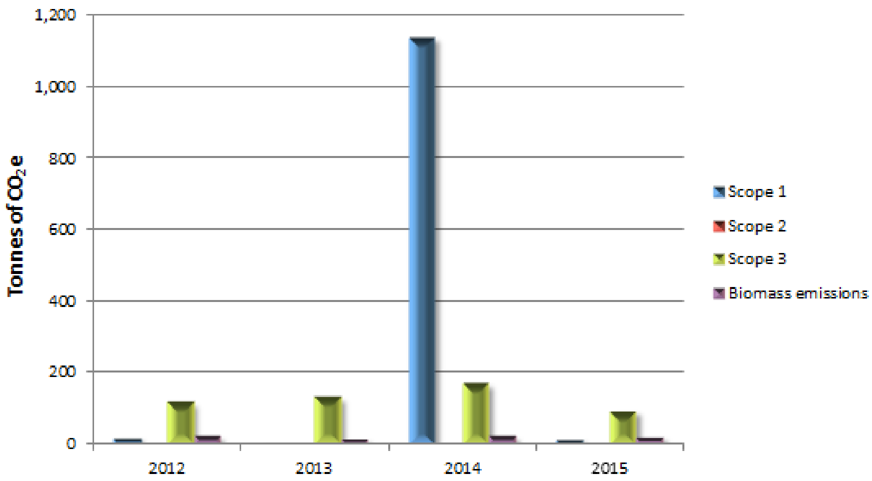


Figure 90 - Evolution of GHG emissions at UHIT by scope in tCO2e -Corporate Participation

Since the ownership of Tractebel Energia has not changed between 2012 and 2015, there was no impact on emissions variation of that order.

→ **Machadinho (UHMA)**

As for UHET and UHIT, the corporate participation of UHMA also suffered no alteration. Thus, there was no impact on emissions variation of that order.

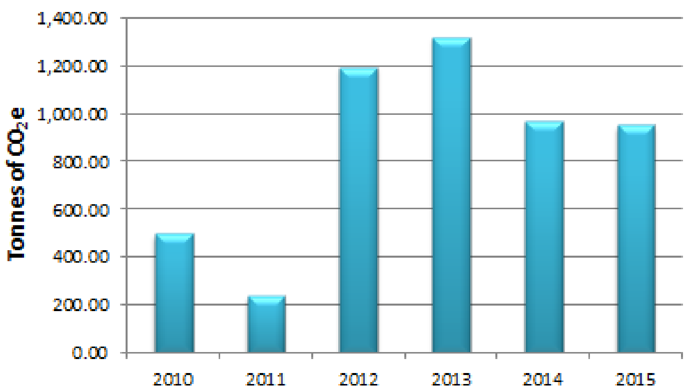


Figure 91 - Evolution of GHG emissions at UHMA in tCO2e - Corporate Participation

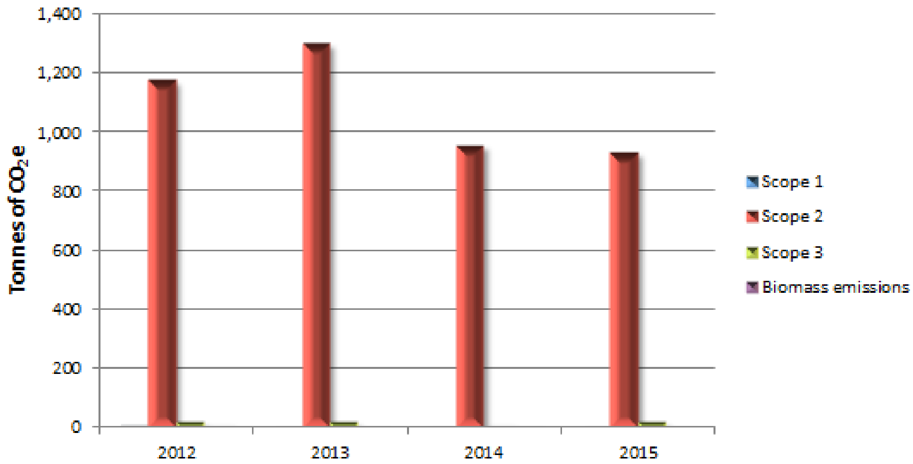


Figure 92 - Evolution of GHG emissions at UHMA by scope in tCO2e - Corporate Participation

In 2015, the total emissions of UHMA reduced 2.2 percent in 2014, due to emission reductions in Scopes 1 and 2 by 36.1% and 2.6%. On the other hand, Scope 3 emissions and combustion of biomass increased by 49.9% and 48.7% in 2015.

→ **Passo Fundo (UHPF)**

GHG emissions of UHPF increased by 187.3% over the previous year, mainly due to increased emissions in the scope 2 by 201.0% - about 3 times greater than 2014 emissions (due to increased performance of power plant in 2015, as synchronous compensator). Similarly, Scope 3 emissions and combustion of biomass increased by 146.4% and 38.9%.

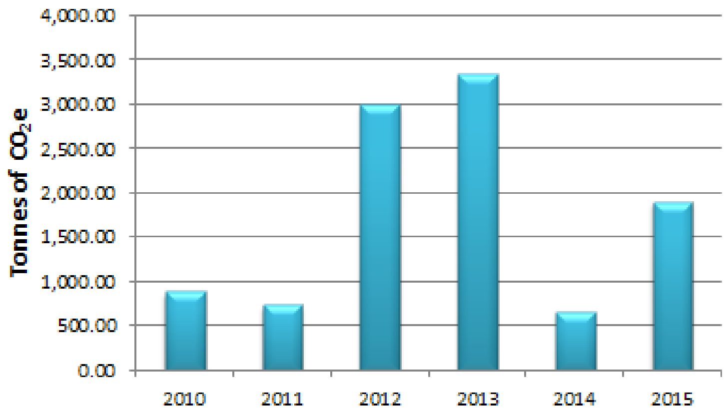


Figure 93 - Evolution of GHG emissions at UHPF in tCO2e

Unlike Scopes 2 and 3 and CO_2 emissions from biomass, Scope 1 emissions reduced to 28.4% in 2015, due primarily to emission reductions from mobile combustion.

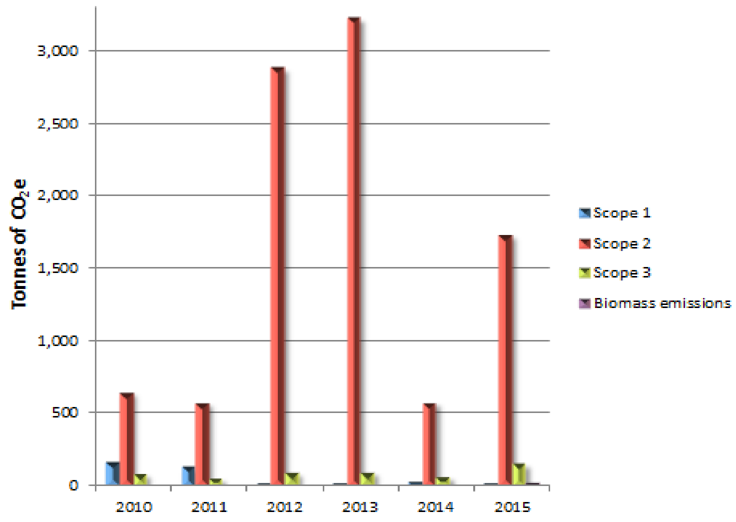


Figure 94 - Evolution of GHG emissions at UHPF by scope in tCO2e

→ Ponte de Pedra (UHPP)

The GHG emissions at UHPP increased by 14.7% in 2015 compared to the previous year. The evolution of the total emissions and by scope, during the period from 2010 to 2015, can be seen in the following figures.

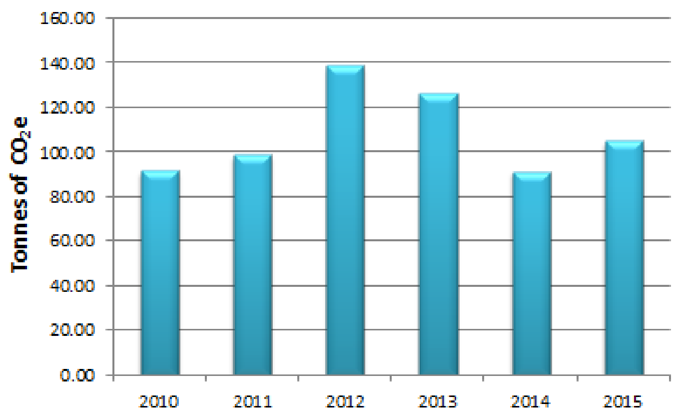


Figure 95 - Evolution of GHG emissions at UHPP in tCO2e

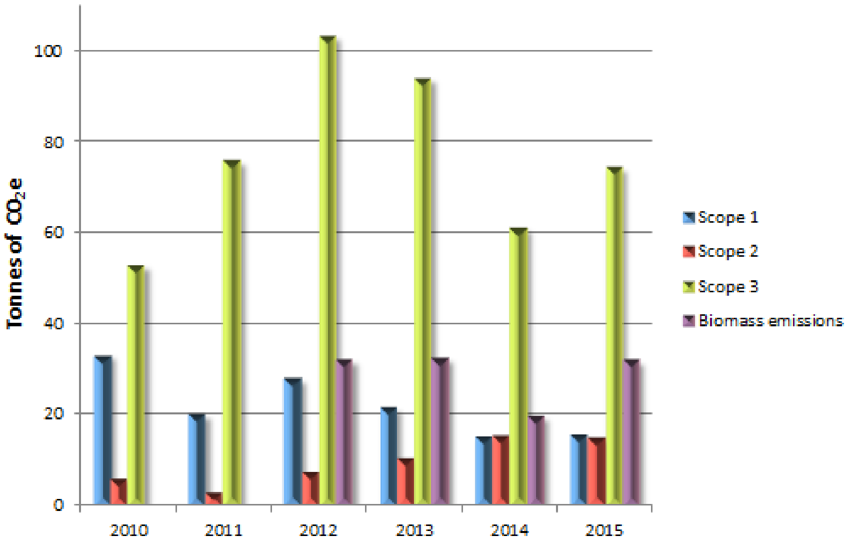


Figure 96 - Evolution of GHG emissions at UHPP by scope in tCO2e

The figure above shows that there was an increase in emissions in Scopes 1 and 3, and biomass combustion – 2.3%, 21.9% and 62.4% – and Scope 2 emissions had a reduction of 2.0%.

→ **Salto Osório (UHSO)**

In 2015, the UHSO reduced their emissions by 8.6% compared to the previous year, ranging from 5,928.66 tCO_2e to 5,421.52 tCO_2e.

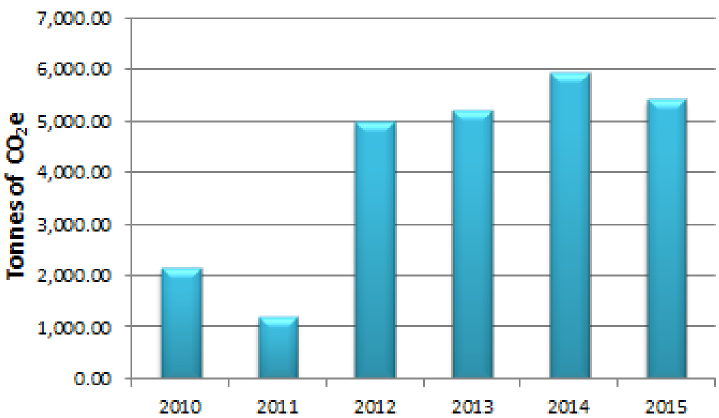


Figure 97 – evolution of GHG emissions at UHSO in tCO2e

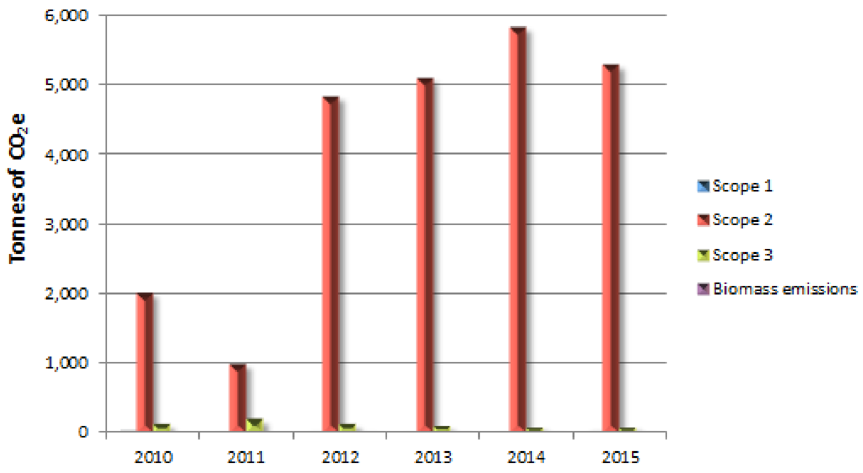


Figure 98 – evolution of GHG emissions at UHSO by scope in tCO2e

The emission variation of UHSO is due mainly to reduction in Scope 2 emissions in 9.2% – the most significant emissions from this power plant (due to the plant's performance as synchronous compensator). In this way, any variation in scope 2 has an influence on total emissions from this power plant.

Scope 3 emissions and biomass combustion were also reduced by 5.0% and 3.1%, unlike Scope 1 emissions, which increased by 232.5% – due mainly to emissions from use of R-407 with a GWP of 1774 tCO_2/tR-407 c.

→ **Salto Santiago (UHSS)**

The UHSS registered a 6.0% reduction in emissions in 2015.

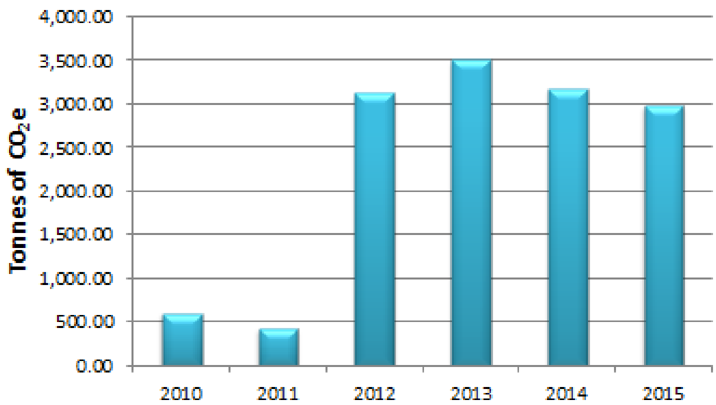


Figure 99 - Evolution of GHG emissions at UHSS in tCO2e

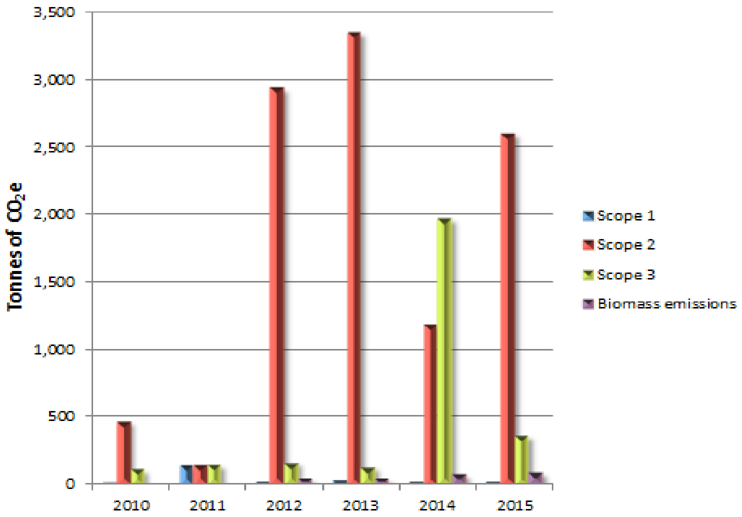


Figure 100 - Evolution of GHG emissions at UHSS by scope in tCO2e

There was a significant increase of 120.2% in Scope 2 emissions (depending on the plant to act as synchronous compensator) compared to the previous year, as shown in the figure above. However, Scope 3 emissions were reduced in 81.7%. This reduction in Scope 3 is due mainly to a decrease in the use of diesel oil in the air compressor for painting and sandblasting the Proteman contributing to the reduction of the total emissions of UHSS.

Scope 1 emissions and biomass also increased by 17.5% and 16.9%.

→ **São Salvador (UHSA)**

In 2015, emissions from UHSA resulted in an increase of 29.8%, as shown in the chart below.

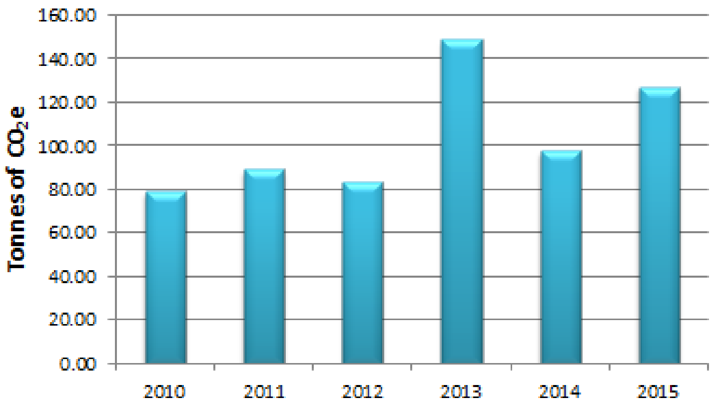


Figure 101 – Evolution of GHG emissions at UHSA in tCO2e

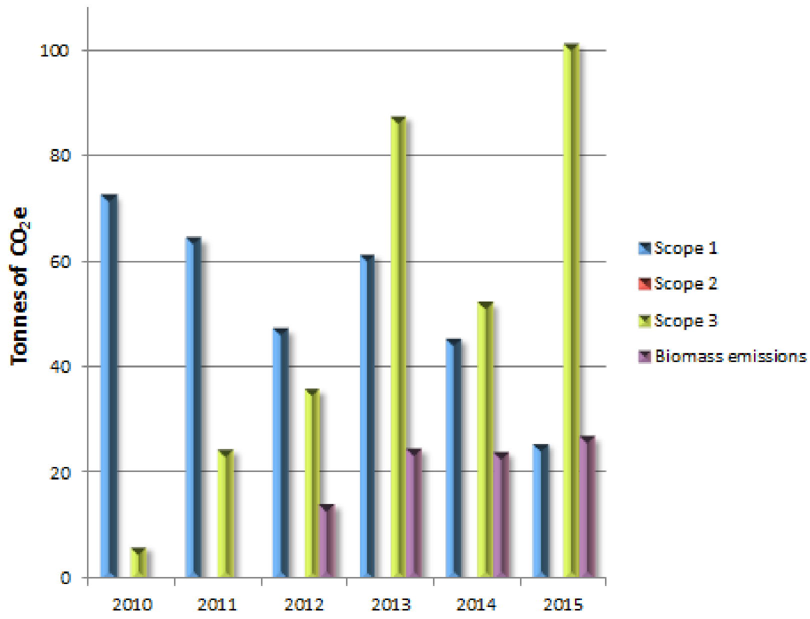


Figure 102 – Evolution of GHG emissions at UHSA by scope in tCO2e

Scope 3 emissions increased 93.7% in 2015 – due mostly to increased mobile combustion emissions – contributing to the increase in total emissions of the power plant. Similarly, the emissions from the CO_2 combustion of biomass also increased at 12.4%.

The emissions from Scope 1 and 2, on the other hand, reduced in 43.5% and 68.9%.

8.3.2.5. Thermoelectric Power Plants

Since most of the emissions from thermoelectric power plants are from stationary combustion, GHG emission at Scope 1 was considered separately from other scopes for most cases presented below, aimed at the non-distortion of the graphics.

→ **Alegrete (UTAL)**

In 2014, UTAL drastically reduced emissions, ranging from 28,844.79 tCO_2e in 2013 to 141.75 tCO_2e in 2014 (99.5% reduction). Similarly, in 2015, emissions were reduced by 35.3%, resulting in 91.76 tCO_2e. This significant reduction is due to stationary combustion emissions reduction at Scope 1, once the UTAL was not operational in 2014 and 2015.

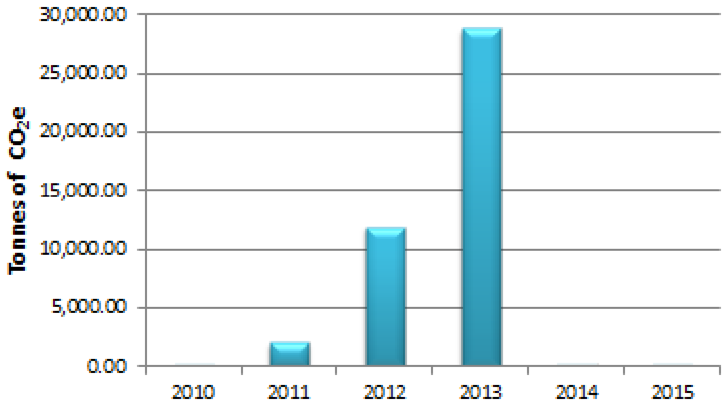


Figure 103 - Evolution of GHG emissions at UTAL in tCO2e

In 2015, emissions of all scopes were also reduced by 83.7% in Scope 1, 27.3% in Scope 2, and 28.7% in Scope 3 and 31.4% in emissions from combustion of biomass.

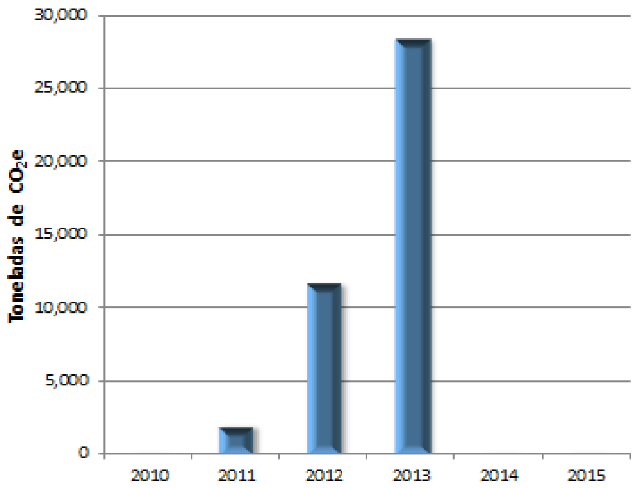


Figure 104 - Evolution of GHG emissions in Scope 1 at UTAL in tCO2e

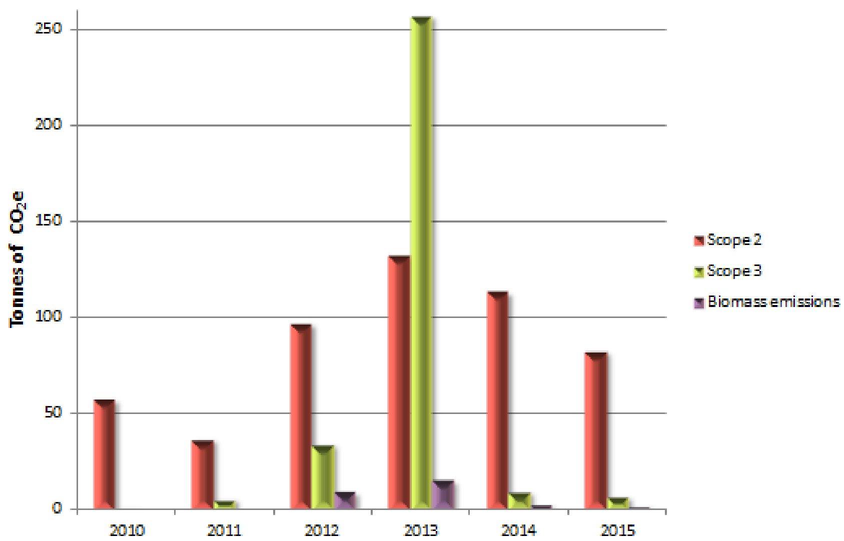


Figure 105 - Evolution of GHG emissions in Scopes 2 and 3 at UTAL in tCO2e

→ Charqueadas (UTCH)

GHG emissions at UTCH reduced 5.2% in relation to 2014.

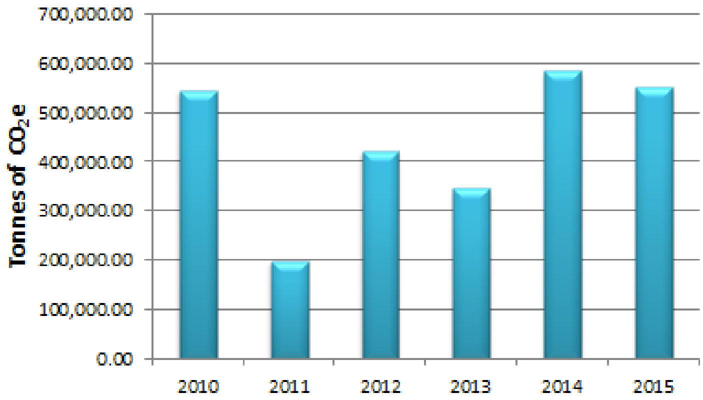


Figure 106 - Evolution of GHG emissions at UTCH in tCO2e

This reduction was influenced by the decrease in Scope 1 (5.5%) and Scope 2 (97.5%) emissions. Considering the greater representativity of the stationary combustion emissions within scope 1 – 96.5% of the total emissions in 2015 – the reduction in this source contributed to overall emissions reduction at UTCH.

On the other hand, Scope 3 emissions and combustion of biomass increased by 7.5% and 27.7%.

The charts below illustrate the variation of emissions during the period from 2010 to 2015.

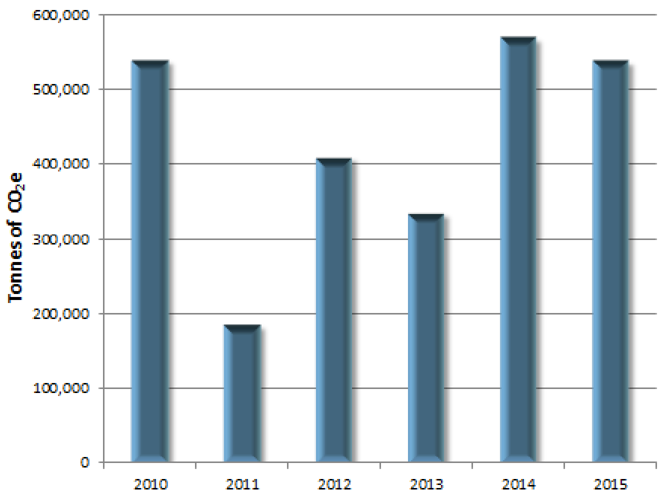


Figure 107 - Evolution of GHG emissions in Scope 1 at UTCH in tCO2e

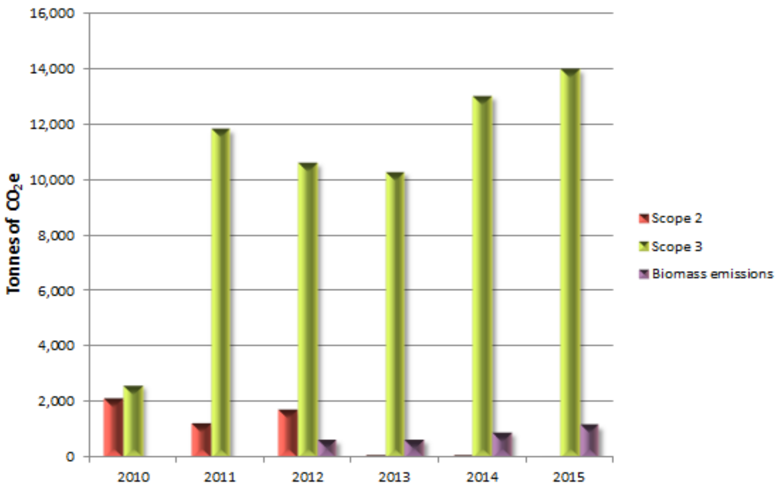


Figure 108 – Evolution of GHG emissions in Scopes 2 and 3 at UTCH in tCO2e

→ **Jorge Lacerda (CTJL)**

GHG emissions of CTJL reduced by 3.3% in 2015, from 5,165,813.58 to 4,995,005.55 tCO_2e.

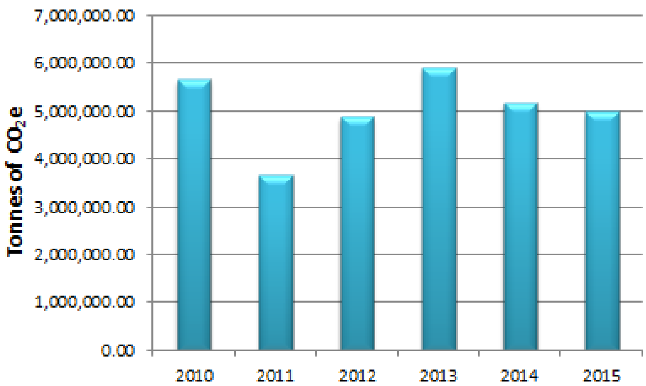


Figure 109 - Evolution of GHG emissions at CTJL in tCO2e

This reduction was due almost exclusively to a -3.3% variation of the stationary combustion emissions and of Scope 1, due to reduced consumption of coal and diesel fuel for boilers.

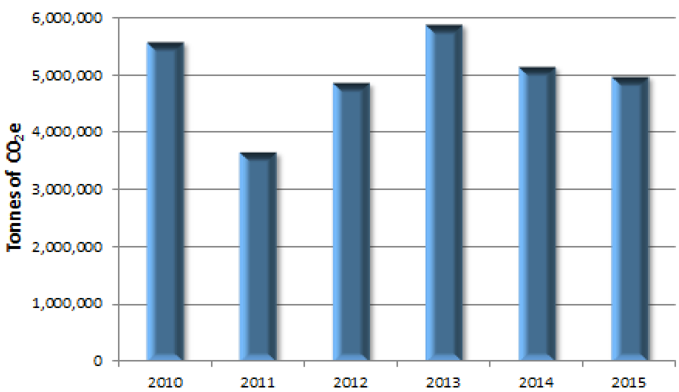


Figure 110 - Evolution of GHG emissions in Scope 1 at CTJL in tCO2e

Scope 2 emissions also decreased in 15.3% and Scope 3 increased 3.2%. Biomass emissions increased by 42.1%.

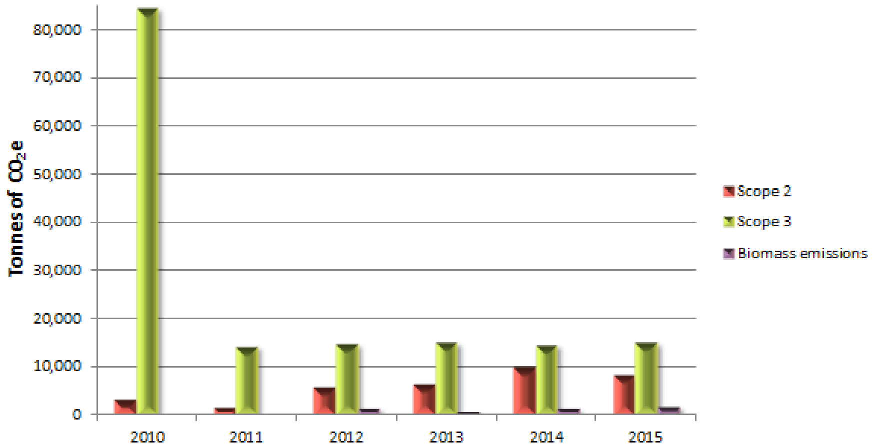


Figure 111 - Evolution of GHG emissions in Scopes 2 and 3 at CTJL in tCO2e

→ **Willian Arjona (UTWA)**

In the case of UTWA, there was a 10.5% reduction of emissions in comparison to 2014. 2014 was the year in which the UTWA issued more GHG from 2010 to 2015.

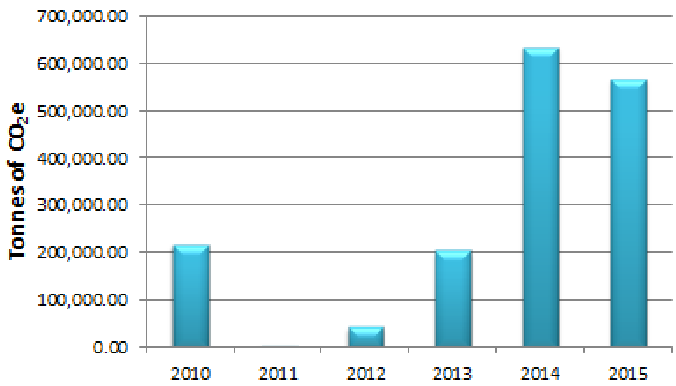


Figure 112 - Evolution of GHG emissions at UTWA in tCO2e

In 2011, the stationary combustion of GHG emissions were significantly low (880.12 tCO_2e) and so, these emissions were not reproduced in the chart below.

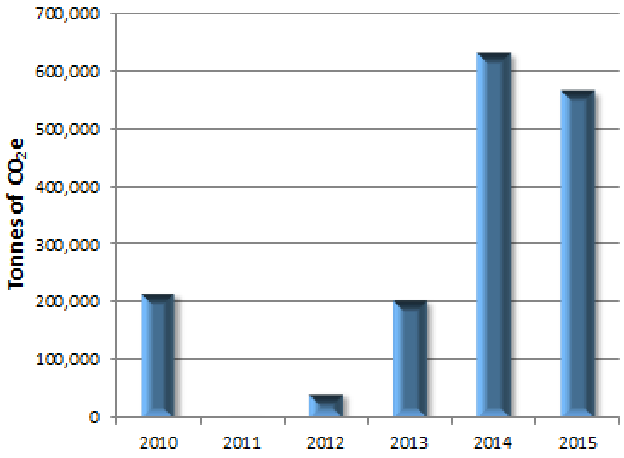


Figure 113 - Evolution of GHG emissions in Scope 1 at UTWA in tCO2e

Scope 1 emissions reduced to 10.5% in 2015, unlike what happened to Scopes 2 and 3, and biomass combustion, which had an increase 83.1%, 5.9% and 187.9%.

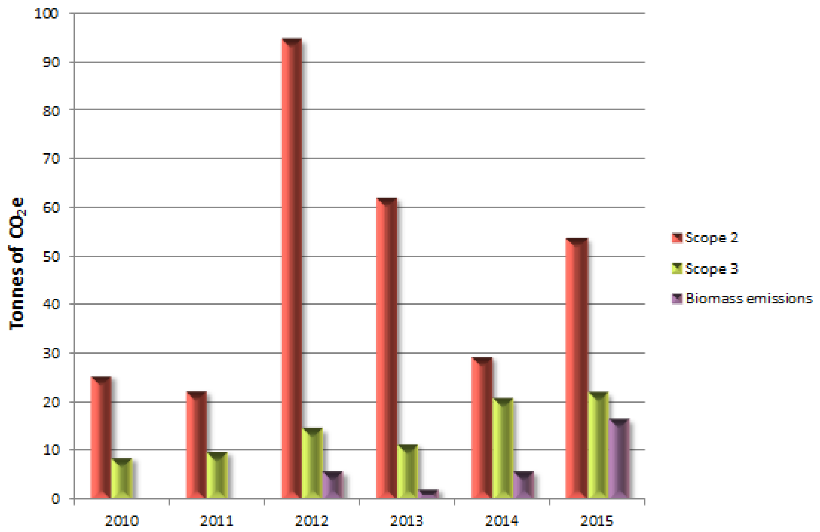


Figure 114 - Evolution of GHG emissions in Scopes 2 and 3 at UTWA in tCO2e

Biomass power plants

→ **Ibitiúva (UTIB)**

Considering the total emissions of UTIB, there was an increase in all scopes, resulting in 30.4% increase of global emissions in relation to the year 2014.

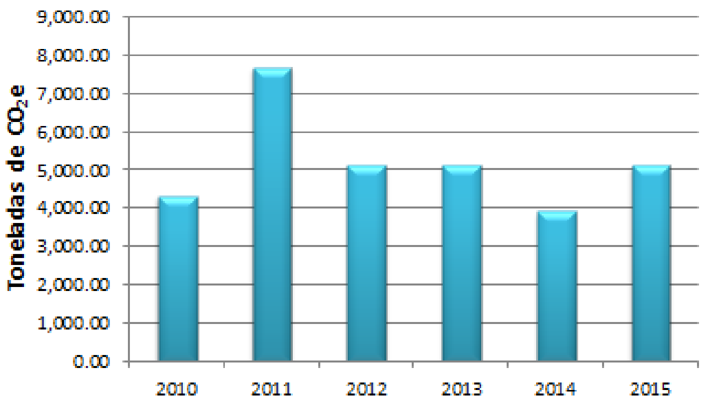


Figure 115 - Evolution of GHG emissions at UTIB in tCO2e – Operational Control

To Scope 1, there was a variation of 30.7%, 12.1% in Scope 2 and 151.7% in Scope 3.

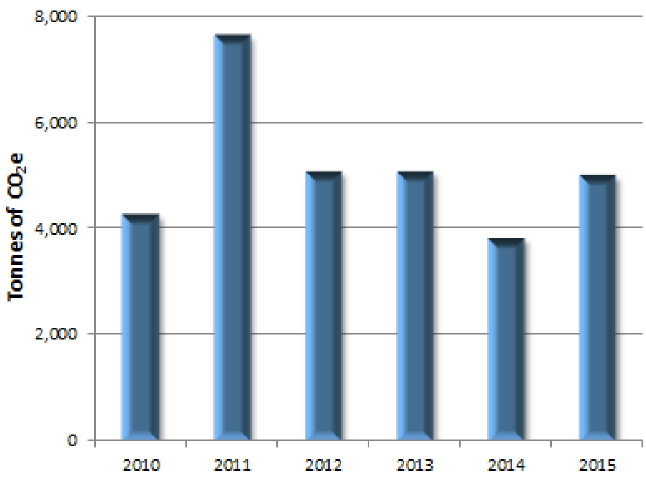


Figure 116 – Evolution of GHG emissions in Scope 1 at UTIB in tCO2e – Operational Control

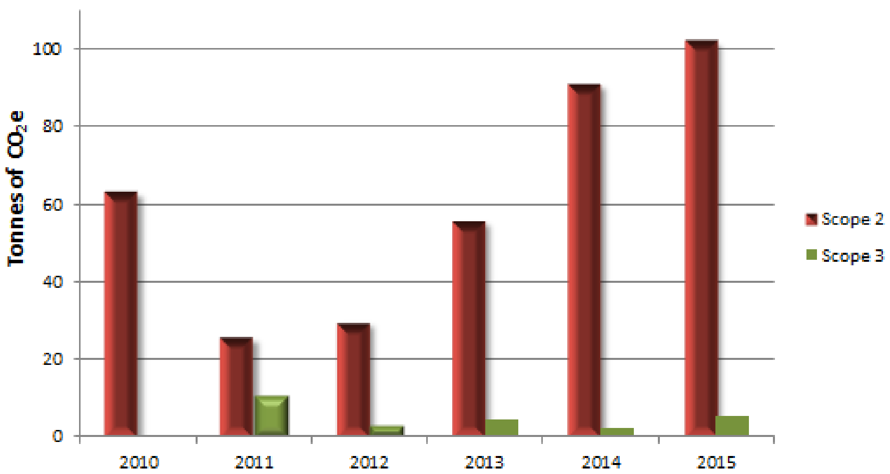


Figure 117 - Evolution of GHG emissions in Scopes 2 and 3 at UTIB in tCO2e – Operational Control

In the case of biomass emissions, CO_2 emissions increased by 31.0% in 2015 compared to the previous year.

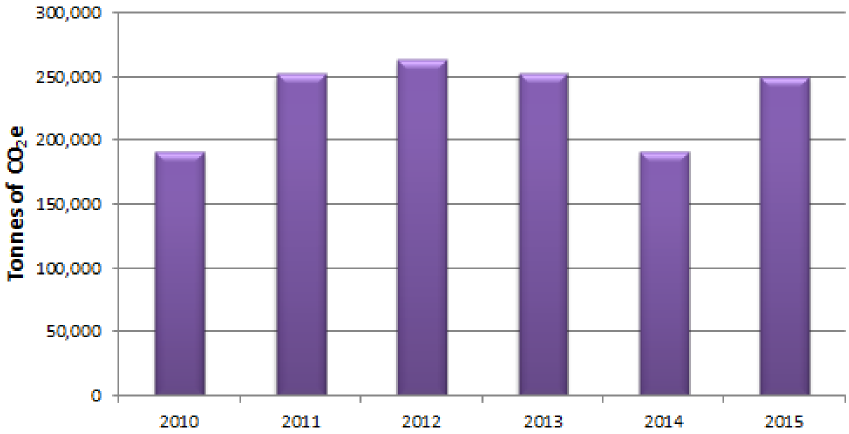


Figure 118 - Evolution of biomass emissions at UTIB in tCO2e – Operational Control

As there was no change in the shareholding structure of Tractebel Energia between 2014 and 2015, the same emission variations were noted for the approach of corporate participation. However, it is worth mentioning that, in 2011, Tractebel Energia ranged from 64.14% to 69.26% in equity interest. The following images illustrate the variation of emissions on corporate participation over the years.

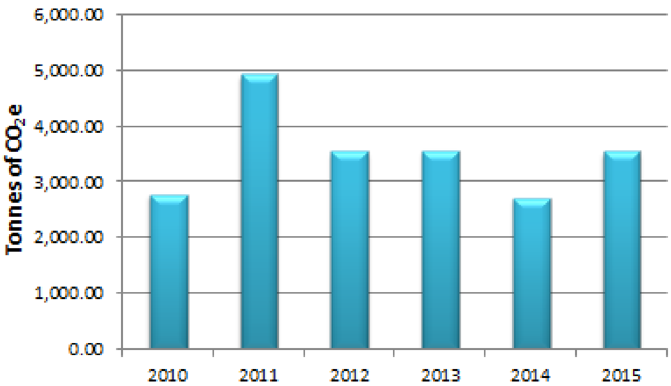


Figure 119 - Evolution of GHG emissions at UTIB tCO2e – Corporate Participation

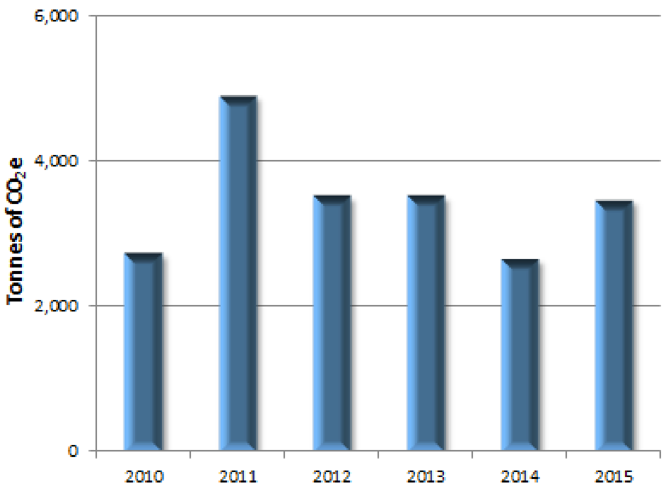


Figure 120 – Evolution of GHG emissions in Scope 1 at UTIB in tCO2e – Corporate Participation

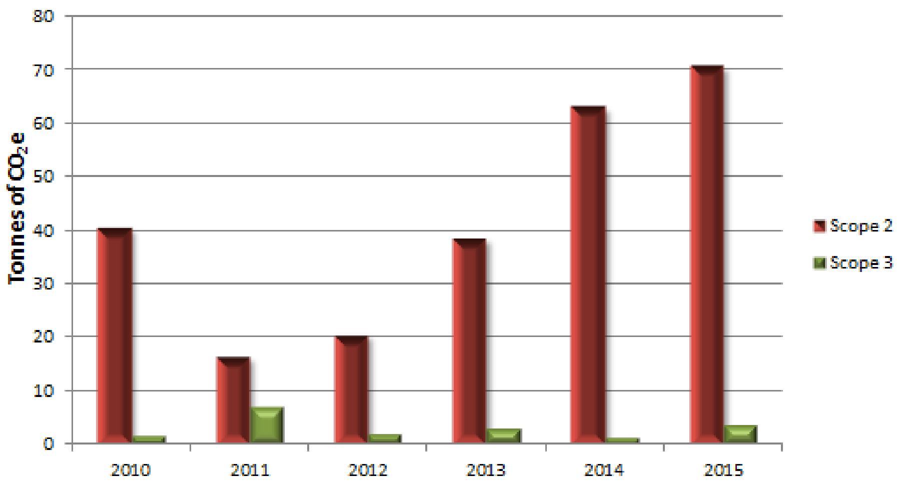


Figure 121 – Evolution of GHG emissions in Scopes 2 and 3 at UTIB in tCO2e – Corporate Participation

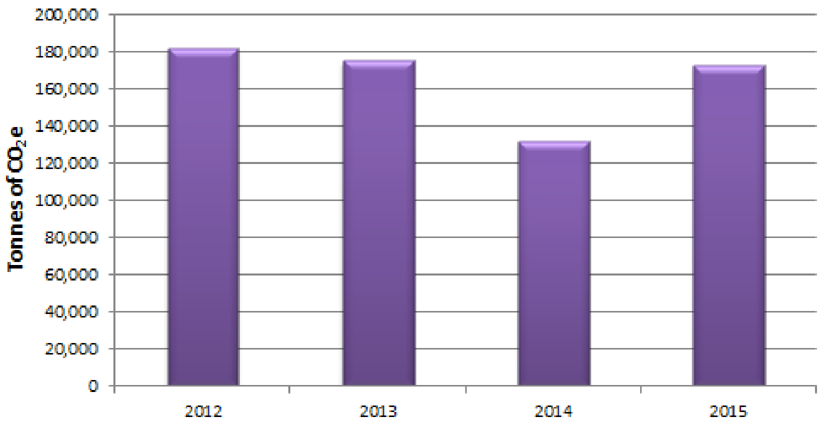


Figure 122 - Evolution of biomass emissions at UTIB in tCO2e – Corporate Participation

→ **Lages (UCLA)**

In 2015, the UCLA recorded a 5.3% increase in GHG emissions compared to the previous year.

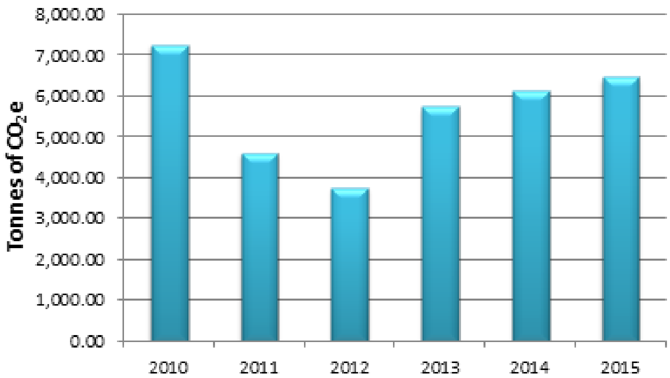


Figure 123 – Evolution of GHG emissions at UCLA in tCO2e

Scope 1 emissions increased by 3.9%, and Scope 3 by 11.8%. Scope 2 emissionsdecreased in 4.8% compared to the year 2014

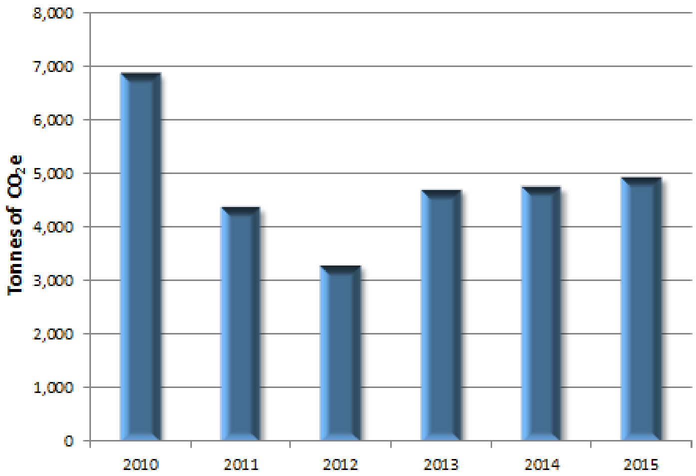


Figure 124 - Evolution of GHG emissions in Scope 1 at UCLA in tCO2e

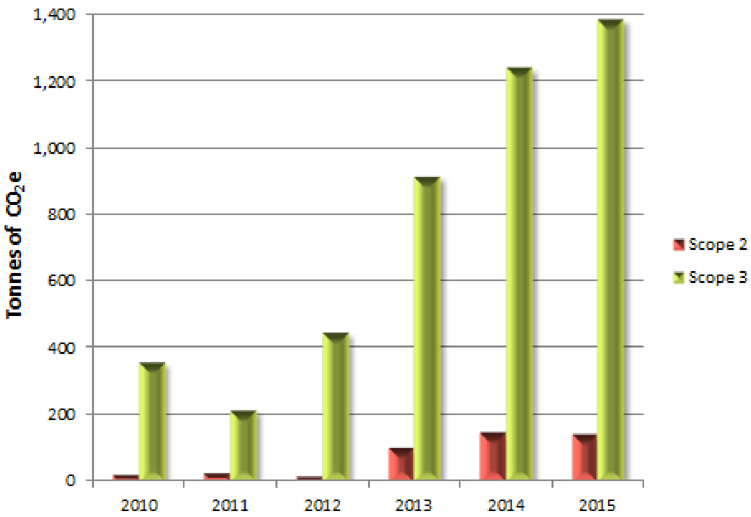


Figure 125 - Evolution of GHG emissions in Scopes 2 and 3 at UCLA in tCO2e

Considering biomass emissions, there has been an increase of 3.8% in 2015.

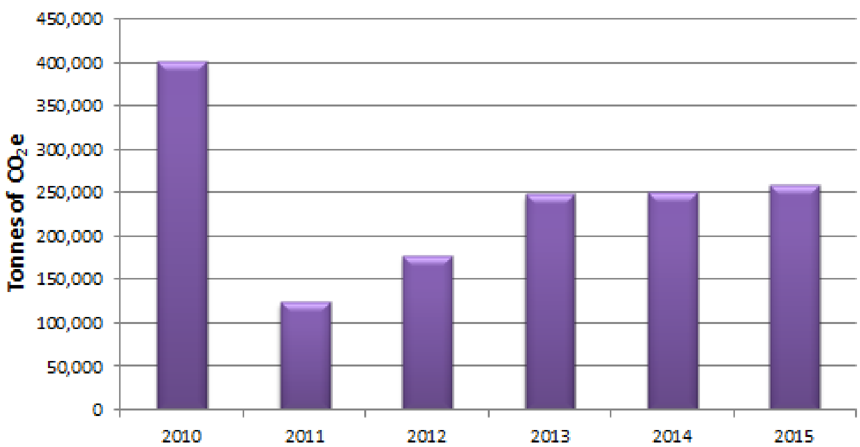


Figure 126 - Evolution of biomass emissions at UCLA in tCO2e

→ **Ferrari (UTFE)**

In 2015, the UTFE emissions increased by 20.9%, registering an increase in all scopes.

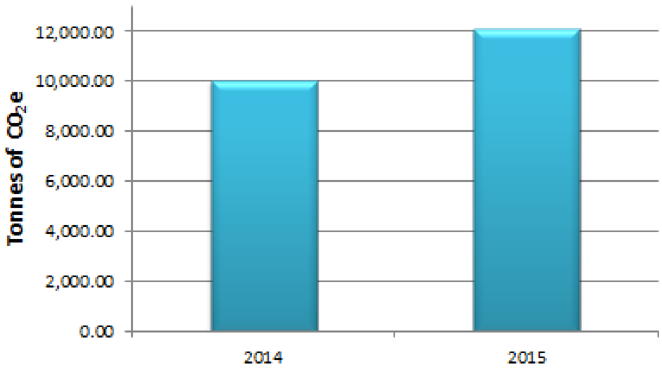


Figure 127 – Evolution of GHG emissions at UTFE in tCO2e

Whereas the UTFE was acquired by Tractebel Energia in 2014, the emission registration starts from this year, as in Scope 1 emissions chart below.

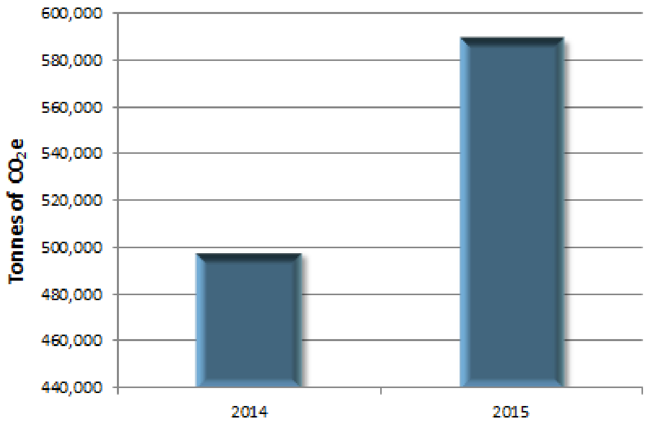


Figure 128 – Evolution of GHG emissions in Scope 1 at UTFE in tCO2e

Scope 1 emissions increased by 18.3% over the previous year, on the basis of increased consumption of bagasse. It is important to mention that only the CO_2 emitted in the combustion of biomass is classified as "biomass emissions", and emissions of CH_4 and N_2O resulting from this combustion must be classified within their particular scopes.

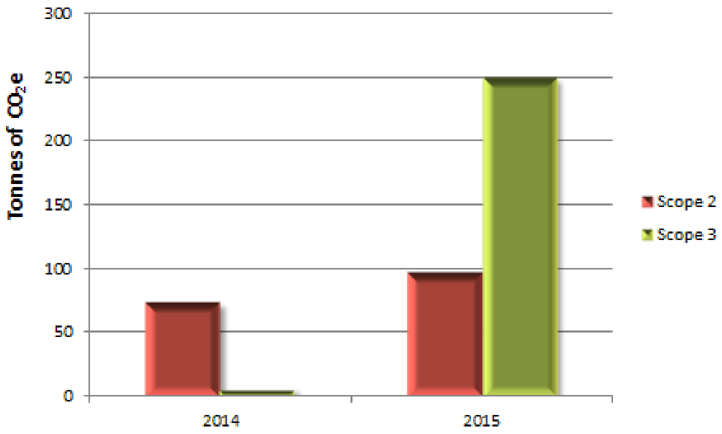


Figure 129 - Evolution of GHG emissions in Scopes 2 and 3 at UTFE in tCO2e

Scope 2 emissions increased by 31.7%. The increase (4,235.8%) in Scope 3 emissions due to higher emissions from waste management (landfill and incineration) in 2015. In 2015, UTFE residues were accounted for, in conjunction with the residue of sugar and ethanol plant Ferrari-Agro (responsible for the management of their waste as well as the UTFE), since this plant (sugar and alcohol Ferrari-Agro) had no available waste accounting, of the two plants in separate (Ferrari Agro and UTFE residues of 2015). This joint accounting led to a larger issue, in 2015, of waste intended for landfill and incineration.

For biomass emissions, there has been an increase of 18.3% from 2014.

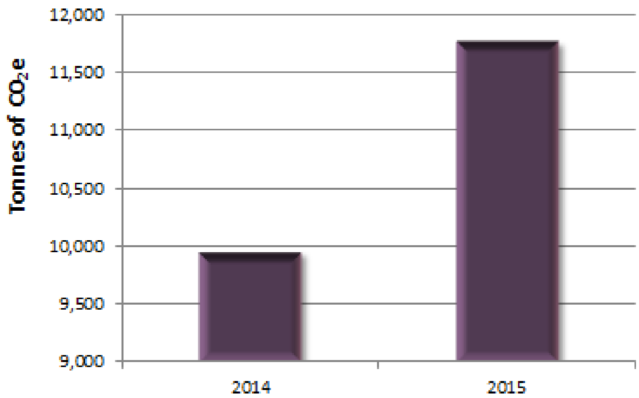


Figure 130 - Evolution of biomass emissions at UTFE in tCO2e

8.3.2.6. Offices

→ **Florianópolis (SC)**

Tractebel Energia's headquarters in Florianópolis issued a total of 952.93 tCO_2e in 2015, which resulted in an increase of 11.8% compared to the previous year.

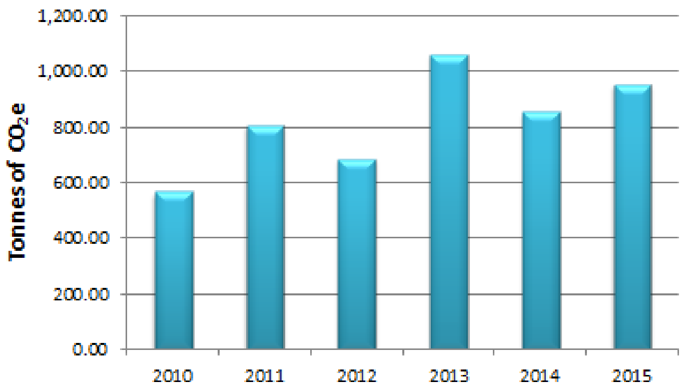


Figure 131 - Evolution of GHG emissions from the headquarters in Florianópolis in tCO2e

As expected, the largest GHG emissions of Tractebel Energia's headquarters are issued from Scope 3, and represented 60 to 88% of the total emissions in the period from 2010 to 2015.

Comparing 2015 emissions over the previous year, there was an increase of 30.3% at Scope 3 emissions, and reductions of 34.7% in Scope 1, 12.2% in Scope 2, and 4.2% in emissions from biomass combustion.

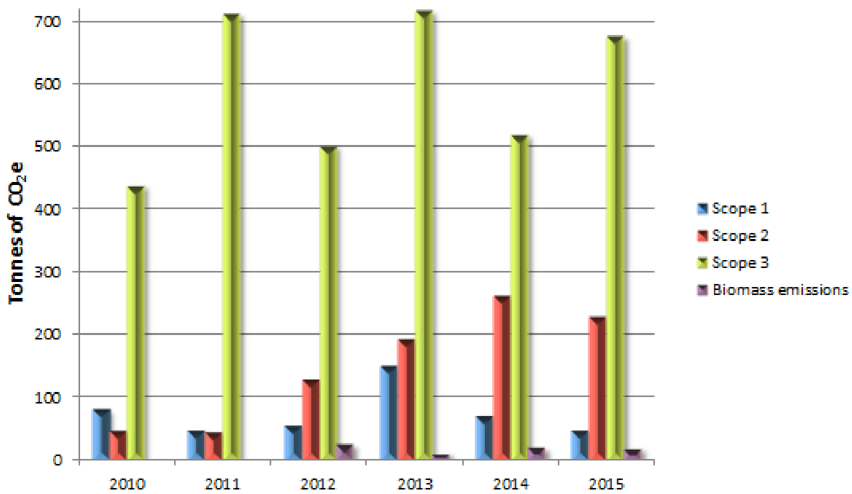


Figure 132 - Evolution of GHG emissions per scope from the headquarters in Florianópolis in tCO2e

→ **São Paulo (SP)**

Total GHG emissions from the Sao Paulo Office did not suffer much variation during the period from 2010 to 2015, appart from 2014 in which there was no record of mobile combustion emissions within Scope 1 and low emissions related to business travel in Scope 3. Thus, emissions increased by 54.8% in 2015 due to low emission in 2014. Anyway, 2015 emissions remain on average emissions for the period.

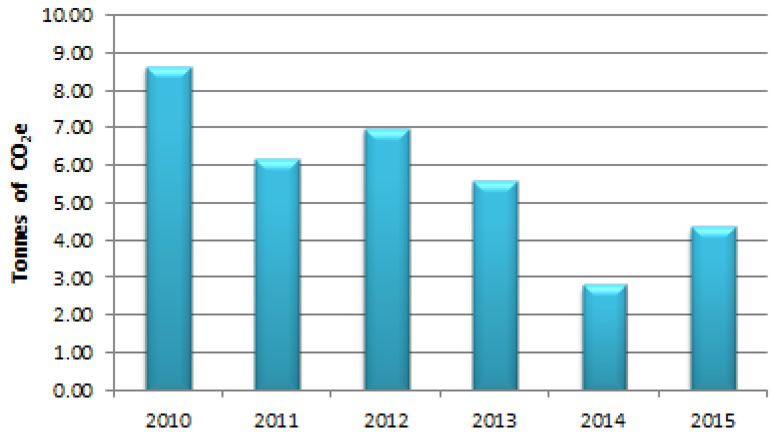


Figure 133 - Evolution of GHG emissions from the Sao Paulo Office in tCO2e

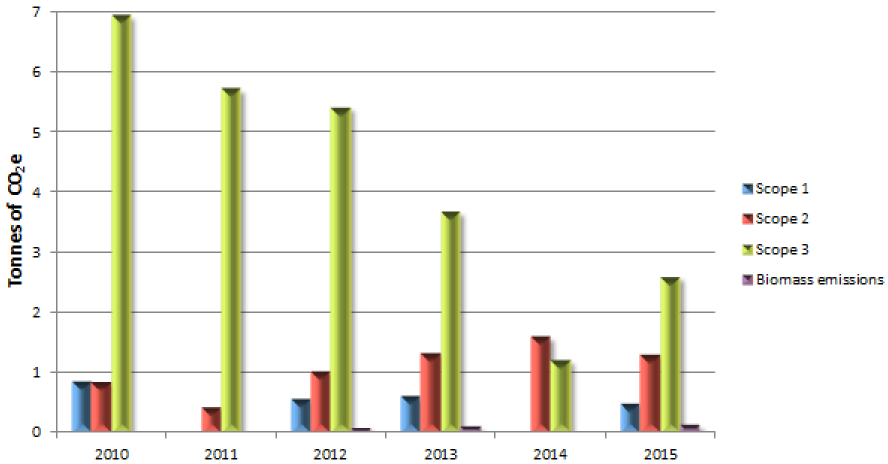


Figure 134 - Evolution of GHG emissions from the Sao Paulo Office by scope in tCO2e

The emissions on Scopes 1 and 3 increased: 100.0% for Scope 1 and 114.6% for Scope 3. For Scope 2, emissions reduced in 19.3%. Biomass emissions were again detected in 2015, with values close to those recorded in the years 2012 and 2013.

8.4. Emissions Balance

To balance GHG emission of Tractebel Energia, GHG emissions were identified in section 7 of this report and actions promoted at Tractebel Energia to reduce GHG emissions.

The identified activities that reduce emissions from Tractebel Energia are: renewable energy generation and CO_2 sinkholes due to the development of forest plantation.

The results of emission reduction from these activities can be seen in the following tables:

Table 45 - GHG emission Balance of Tractebel Energia – Operational Control

Plants/Offices	CO2 emissions (tCO2e)	Emission reduction (tCO2e)		Total Balance (tCO2e)
		Planting	Net power generation DEL-REC	
CTJL	4,995,005.55	3,422.54	-	4,995,005.55
UTWA	567,181.37	-	-	567,181.37
UTCH	552,522.61	-	-	552,522.61
UTFE	12,125.59	-	87,280.66	-75,155.06
UCLA	6,458.50	-	56,369.53	-49,911.03
UHSO[1]	5,421.52	552.67	2,735,712.97	-2,730,844.12
UTIB	5,114.34	-	64,768.28	-59,653.94
UHSS[1]	2,983.89	1,366.43	2,340,660.38	-2,339,042.92
UHPF[1]	1,898.45	-	-	1,898.45
SEDE	952.93	-	-	952.93
UEBB	196.72	63.28	42,756.87	-42,623.43
UETR	176.35	187.36	56,661.70	-56,672.71
UHSA	126.98	4,187.29	-	-4,060.30
UHPP	104.78	-	426,159.08	-426,054.29
UHCB[1]	95.46	2,025.89	-	-1,930.42
UTAL	91.76	-	-	91.76
PHAB	50.14	-	11,483.67	-11,433.52
PHJG	21.46	-	31,548.14	-31,526.68
UEPS	19.20	-	32,826.07	-32,806.87
PHRO	18.64	-	36,552.82	-36,534.18
UEGU	15.55	-	69,911.76	-69,896.21
UETB	11.20	-	1,199.42	-1,188.23
UEFL	9.51	-	62,105.29	-62,095.77
UFCA	7.96	-	1,664.32	-1,656.36
UEMU	6.57	-	51,793.82	-51,787.26
ESP	4.34	-	-	4.34
Total	***6,150,621.41***	***11,805.46***	***6,109,454.77***	***29,361.18***

[1]Power plants acting as synchronous compensators and, therefore, the net generation considered is “DEL”.

Table 46 – GHG emission balance of Tractebel Energia - Corporate Participation

/Plants Offices	CO2 emissions (tCO2e)	Emission reduction (tCO2e)		Balance sheet total (tCO2e)
		Planting[1]	Net power generation DEL-REC	
CTJL	4,995,005.55	3,422.54	-	4,995,005.55
UTWA	567,181.37	-	-	567,181.37
UTCH	552,522.61	-	-	552,522.61
UTFE	12,125.59	-	87,280.66	-75,155.06
UCLA	6,458.50	-	56,369.53	-49,911.03
UHSO[1]	5,421.52	552.67	2,735,712.97	-2,730,844.12
UTIB[2]	3,542.19	-	44,858.51	-41,316.32
UHSS[1]	2,983.89	1,366.43	2,340,660.38	-2,339,042.92
UHPF[1]	1,898.45	-	-	1,898.45
SEDE	952.93	-	-	952.93
UHMA[2]	950.59	-	571,477.98	-570,527.39
UHET[2]	197.35	0.00	-	197.35
UEBB	196.72	63.28	42,756.87	-42,623.43
UETR	176.35	187.36	56,661.70	-56,672.71
UHSA	126.98	4,187.29	-	-4,060.30
UHIT[2]	110.96	0.00	2,746,796.44	-2,746,685.48
UHPP	104.78	-	426,159.08	-426,054.29
UHCB[1]	95.46	2,025.89	-	-1,930.42
UTAL	91.76	-	-	91.76
PHAB	50.14	-	11,483.67	-11,433.52
PHJG	21.46	-	31,548.14	-31,526.68
UEPS	19.20	-	32,826.07	-32,806.87
PHRO	18.64	-	36,552.82	-36,534.18
UEGU	15.55	-	69,911.76	-69,896.21
UETB	11.20	-	1,199.42	-1,188.23
UEFL	9.51	-	62,105.29	-62,095.77
UFCA	7.96	-	1,664.32	-1,656.36
UEMU	6.57	-	51,793.82	-51,787.26
ESP	4.34	-	-	4.34
Total	***6,150,308.17***	***11,805.46***	***9,407,819.42***	***-3,269,316.71***

[1]Power plants acting as synchronous compensators and, therefore, the net generation considered is "DEL".
[2]Power plants in which Tractebel Energia does not have 100% equity interest

[1] The emission reduction from not voluntary planting resulted in 26,802.44 tCO_2: 5,052.64 tCO_2 due to planting made by UHPF, 4,738.31 tCO_2 from UHET and 17,011.50 tCO_2 from UHIT.

As shown in the tables above, all units that generate net renewable energy were able to reduce emissions more than they issue. Such reductions, although not certified, reflect, according to the methodology applied, the contribution of these plants for the reduction of greenhouse gas emissions.

In addition to the initiatives presented above, it is worth noting that Tractebel Energia also develops other actions to reduce CO_2 emitted to the atmosphere, as described below.

The company is developing a Research and Development Project (R&D) that will reduce CO_2 emissions related to the use of coal using co-firing technology (dual fuel) rice straw will be a fuel supplement in place of coal in thermoelectric plants. If it turns out to be viable, this will lead to GHG emission reductions in its main source. The company also invests in research and development on technologies for developing solar and wind power generation. Through this initiative, it was possible the implementation of photovoltaic plant at Cidade Azul in 2014 and the Tubarão wind power plant in 2015.

Another action that reduces GHG emissions developed by Tractebel Energia is the use of teleconference technology. The company encourages this practice that saves greenhouse gas emissions, time and financial resources, although the GHG emission reductions with the use of this technology is not controlled.

The company also promotes reduction of CO_2 emissions using the ashes produced in cement industry. In addition, Tractebel Energia also carries out projects to improve the energy efficiency of its power plants, thus reducing their GHG emissions per MWh generated.

GHG accounting methodologies and detailed results obtained for Tractebel Energia's plants are described in Annex VI.

8.5. Indicators

From the result of emissions at Tractebel Energia, it is possible to elaborate indicators to identify whether changes in GHG emissions over the years are associated with an increase in productivity or a loss of efficiency in the process.

In the following tables, emission indicators for net electricity generation and total gross and scope are presented.

Table 47 - 2015 GHG emissions indicators for Tractebel Energia

Power Plants	Total emissions		
	tco2e/MWh NET (DEL)	tco2e/MWh NET (DEL-REC)	tco2e/MWh in the rough
CTJL	1.10387	1.12033	1.00657
UTWA	0.52593	0.52600	0.51966
UTCH	1.95440	1.95443	1.55056
UTFE	0.05877	0.05899	0.03971
UCLA	0.04885	0.04902	0.04367
UHSO	0.00085	0.00085	0.00084
UTIB	0.03338	0.03353	0.03075
UHSS	0.00043	0.00043	0.00043
UHPF	0.00176	0.00176	0.00175
UHMA	0.00071	0.00071	0.00071
UHET	0.00011	0.00011	0.00011
UEBB	0.00226	0.00226	0.00219
UETR	0.00153	0.00153	0.00147
UHSA	0.00011	0.00011	0.00010
UHIT	0.00002	0.00002	0.00002
UHPP	0.00011	0.00011	0.00010
UHCB	0.00002	0.00002	0.00002
UTAL	-	-	-
PHAB	0.00186	0.00187	0.00181
PHJG	0.00029	0.00029	0.00029
UEPS	0.00029	0.00029	0.00028
PHRO	0.00022	0.00022	0.00022
UEGU	0.00011	0.00011	0.00010
UETB[1]	0.00442	0.00457	0.00442
UEFL	0.00008	0.00008	0.00007
UFCA[1]	0.00232	0.00236	0.00232
UEMU	0.00006	0.00006	0.00006
Total	***0.1635***	***0.1637***	***0.1592***

[1]The indicator in gross MWh was conservatively calculated based on the net generation (del), since there is no metering of gross generation in this power plant and the energy consumption is from the grid only.

Table 48 – 2015 GHG emissions indicators per scope

Power Plants	By scope in tCO2e/MWh NET (DEL-REC)			By scope in tCO2e/MWh GROSS			By scope in tCO2e/MWh NET (DEL)		
	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3
CTJL	1.11508	0.00186	0.00340	1.00184	0.00167	0.00305	1.09869	0.00183	0.00335
UTWA	0.52592	0.00005	0.00002	0.51959	0.00005	0.00002	0.52586	0.00005	0.00002
UTCH	1.90491	0.00001	0.04952	1.51126	0.00001	0.03929	1.90487	0.00001	0.04952
UTFE	0.05730	0.00047	0.00121	0.03858	0.00032	0.00082	0.05709	0.00047	0.00121
UCLA	0.03745	0.00104	0.01052	0.03336	0.00093	0.00937	0.03733	0.00104	0.01049
UHSO	0.00001	0.00083	0.00001	0.00001	0.00082	0.00001	0.00001	0.00083	0.00001
UTIB	0.03282	0.00067	0.00003	0.03010	0.00061	0.00003	0.03268	0.00067	0.00003
UHSS	0.00000	0.00037	0.00005	0.00000	0.00037	0.00005	0.00000	0.00037	0.00005
UHPF	0.00002	0.00161	0.00014	0.00002	0.00159	0.00014	0.00002	0.00161	0.00014
UHMA	0.000002	0.00070	0.00001	0.000002	0.00069	0.00001	0.000002	0.00070	0.00001
UHET	0.00002	0.00003	0.00006	0.00002	0.00003	0.00006	0.00002	0.00003	0.00006
UEBB	0.00210	0.00001	0.00015	0.00203	0.00001	0.00014	0.00210	0.00001	0.00015
UETR	0.00075	0.00010	0.00067	0.00073	0.00010	0.00065	0.00075	0.00010	0.00067
UHSA	0.00002	0.00000001	0.00008	0.00002	0.00000001	0.00008	0.00002	0.00000	0.00008
UHIT	0.000002	0.0000006	0.00001	0.000002	0.000001	0.00001	0.00000	0.00000	0.00001
UHPP	0.00002	0.00001	0.00007	0.00001	0.00001	0.00007	0.00002	0.00002	0.00008
UHCB	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
UTAL	-	-	-	-	-	-	-	-	-
PHAB	0.00031	0.00055	0.00101	0.00030	0.00053	0.00098	0.00031	0.00055	0.00101
PHJG	0.00002	0.00003	0.00024	0.00002	0.00003	0.00024	0.00002	0.00003	0.00024
UEPS	0.00013	0.00003	0.00013	0.00013	0.00003	0.00012	0.00013	0.00003	0.00013
PHRO	0.00001	0.0000004	0.00021	0.00001	0.0000004	0.00021	0.00001	0.00000	0.00021
UEGU	0.000001	0.00011	-	0.000001	0.00010	-	0.0000006	0.00011	-
UETB[1]	-	0.00457	-	0.00000	0.00442	0.00000	-	0.00442	-
UEFL	0.00000	0.00007	-	0.000001	0.00007	-	0.000001	0.00007	-
UFCA[1]	0.00002	0.00234	-	0.00002	0.00230	-	0.00002	0.00230	-
UEMU	0.000001	0.00006	-	0.000001	0.00006	-	0.000001	0.00006	-
Total	***0.1623***	***0.0005***	***0.0009***	***0.1579***	***0.0005***	***0.0008***	***0.1621***	***0.0005***	***0.0009***

It is important to note that UTAL did not generate energy in 2015 and, therefore, it has not been possible to calculate the emissions from generated energy.

The indicators for stationary combustion of thermal power plants were also calculated, as show at the table below, considering its significant participation in emissions from these plants.

Table 49 - GHG emissions indicators from stationary combustion for fossil fuel power plants[2]

Power plants	tCO2e/MWh NET DEL-REC	tCO2e/MWh NET DEL	tco2e/MWh in the rough
CTJL	1,115	1,099	1,002
UTCH	1,886	1,886	1,496
UTWA	0,526	0,526	0,520

Table 50 - GHG emissions indicators from stationary combustion for biomass thermoelectric power plants[3]

Power plants	Net Energy DEL-REC		Net Energy DEL		Gross Energy	
	GEE	Biomass Co2	GEE	Biomass Co2	GEE	Biomass Co2
UCLA	0.00004	1.96817	0.00004	1.96136	0.00003	1.75326
UTIB	0.03271	1.63653	0.03257	1.62952	0.03000	1.50080
UTFE	0.0001	2.86700	0.0001	2.85637	0.00004	1.93030

The table below presents the evolution of tCO_2e/MWh of Tractebel Energia from 2010 to 2015 in the approaches of Operational Control and Ownership. The energy considered in the calculation of the indicator is the raw energy generated.

Table 51 - Evolution of emissions per energy generated from Tractebel Energia in tCO_2e/MWh (2010-2015)

Approach	Measure Unit	2010	2011	2012	2013	2014	2015
Operational Control	tCO2	6,438,560.68	3,887,768.12	5,362,746.78	6,499,134.27	6,413,949.50	6,150,621.41
	tCO2/MWh	0.2354	0.1503	0.2187	0.2356	0.2308	0.2115
Corporate Participation	tCO2	6,438,365.99	3,885,394.48	5,362,530.66	6,499,234.56	6,415,233.72	6,150,308.17
	tCO2/MWh	0.1868	0.1129	0.1796	0.1821	0.1715	0.1592

[2] The considered sources for indicator calculations are boilers and gas turbine (UTWA). For the calculation, CO_2 from biomass were excluded due its renewable component (biodiesel as percentage added in the diesel oil).
[3] The considered sources for the calculation of indicators are boilers.

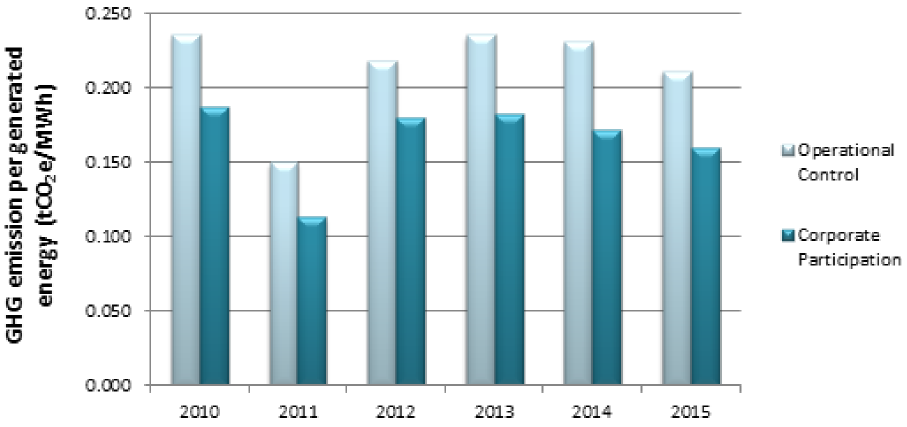


Figure 135 - Evolution of emissions per energy generated from Tractebel Energia in tCO2e/MWh (2010-2015)

9. Emission Reduction Opportunities

The biggest source of greenhouse gases detected in this inventory is the stationary combustion, responsible for over 99% of emissions. Therefore, emission reduction efforts must be focused on this activity. To this end, it is suggested investments in Research and Development (R&D) projects for the replacement of the fossil fuel used in thermal power plants for biomass. Moreover, the continous investment in improvement of efficiency of boilers used in order to decrease the fuel consumption can be an alternative environmentally and economically attractive.

In addition, it was observed that, in terms of installed power, 86.6% of the plants in operation come from renewable sources. The prioritization of investment in renewable energy projects such as hydropower plants, wind, solar and biomass is important and it should aim at renewable energy certificates and/or carbon credits.

Considering the other emission sources not as representative, some initiatives aiming at reducing emissions can be considered. In the case of the transport of employees, raw material and residues, an alternative would be the use of biofuels, such as ethanol and biodiesel, the use of gasoline and diesel. In the case of transport of employees and directors, the teleconference system should be maintained for the reduction of the number of air travel, which also involves a possibility of reducing costs and improving efficiency and management.

Another important point is the awareness and sensitizing employees to emission reduction initiatives. For this, it is proposed the development of training and lectures, as well as the dissemination of posters stimulating sustainable attitudes. The contractors to provide services or raw material to Tractebel Energia also must be engaged to perform attitudes aiming this initiative. It is suggested that, to the extent possible, Tractebel Energia request these companies to report their emissions of greenhouse gases, as well as to present an emissions reduction plan.

Another measure would be to increase the area for planting seedlings, a practice that is already used in some power plants. Another way to neutralize these unavoidable emissions is by obtaining carbon credits in the voluntary market.

10. Suggestion for Improvement

Considering the principles for accounting and inventory of the GHG Protocol – relevance, completeness, consistency, transparency and accuracy –some points were identified for improvement of future inventories:

- Consideration of a greater number of data and information on the basis of documents that have lower level of uncertainty, such as invoices, ensuring data accuracy and targeting future audits;
- Preparation of procedures and automated/systematic internal controls aimed at obtaining faster and consistent data and information;
- Detail of sources of emission in the worksheets collection, mostly stationary and mobile combustion, for the correct identification of emission sources associated with each plant/Office of Tractebel Energia.

We suggest that these procedures and controls should consider:

- Monitoring of data and information regarding mobile combustion, such as routes, distances, spending on fuel consumption, fuel type, among others, reducing the reliance on data and third-party controls;
- Monitoring of information on third-party treatment of Tractebel Energia waste pits.

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Annex I. Total emissions by gas type and source

Tractebel Energia emissions by gas type and source in the approaches of Operational Control and Corporate Participation are presented below.

Table 52 - GHG emissions by gas type and source of Tractebel Energia - Operational Control

Scope 1	CO2	CH4	N2O	HFC	PFC	SF6	CO2e	Biomass CO2
Stationary combustion	6,043,850.26	401.00	131.90				6,093,182.65	1,099,252.91
Mobile combustion	621.24	0.12	0.04				637.11	140.77
Processes	5,345.05	0.00	0.00	0.00	0.00	0.00	5,345.05	0.00
Fugitive emissions	9.74	0.00	0.00	0.02	0.00	0.01	226.73	0.00
Agricultural activities	0.00	0.00	0.02				5.73	0.00
Solid wastes	0.00	0.27	0.02				12.61	0.00
Scope 1 Total	**6,049,826.30**	**401.39**	**131.99**	**0.02**	**0.00**	**0.01**	**6,099,409.88**	**1,099,393.68**
Scope 2								
Purchased electricity from the grid	**18,751.32**						**18,751.32**	
Scope 3								
Fuel and energy-related activities not included in Scopes 1 and 2	39.83	0.00	0.00	0.00	0.00	0.00	39.97	2.67
Transport and distribution (upstream)	19,473.69	1.36	1.06				19,824.84	1,889.08
Waste generated in operations	32.41	30.96	0.12				807.45	0.00
Business travels	903.59	0.04	0.04				915.34	22.89
Employees transportation (home-work)	449.28	0.05	0.03				458.34	81.83
Transport and distribution (downstream)	10,234.13	0.64	0.55				10,414.26	719.41
Total Scope 3	**31,132.92**	**33.06**	**1.80**	**0.00**	**0.00**	**0.00**	**32,460.21**	**2,715.88**
Total emissions	***6,099,710.53***	***434.44***	***133.78***	***0.02***	***0.00***	***0.01***	***6,150,621.41***	***1,102,109.56***

Table 53 - GHG emissions by gas type and source of Tractebel Energia-Corporate Participation

Scope 1	CO2	CH4	N2O	HFC	PFC	SF6	CO2e	CO2 from biomass
Stationary combustion	6,043,859.73	377.31	128.74				6,091,658.38	1,022,512.27
Mobile combustion	641.99	0.13	0.04				658.51	154.16
Processes	5,345.05	0.00	0.00	0.00	0.00	0.00	5,345.05	0.00
Fugitive emissions	10.00	0.00	0.00	0.02	0.00	0.01	236.13	0.00
Agricultural activities	0.00	0.00	0.03				8.30	0.00
Solid wastes	0.00	0.28	0.02				12.89	0.00
Total Scope 1	**6,049,856.78**	**377.71**	**128.84**	**0.02**	**0.00**	**0.01**	**6,097,919.26**	**1,022,666.44**
Scope 2								
Purchased electricity from the grid	**19,709.00**						**19,709.00**	
Scope 3								
Fuel and energy-related activities not included in Scopes 1 and 2	39.83	0.00	0.00	0.00	0.00	0.00	39.97	2.67
Transport and distribution (upstream)	19,575.95	1.37	1.07				19,929.93	1,764.06
Waste generated in operations	32.41	31.31	0.12				816.05	0.00
Business travels	968.59	0.04	0.04				981.16	24.46
Employees transportation (home-work)	488.77	0.05	0.03				498.53	84.60
Transport and distribution (downstream)	10,234.13	0.64	0.55				10,414.26	719.41
Total Scope 3	**31,339.68**	**33.42**	**1.81**	**0.00**	**0.00**	**0.00**	**32,679.90**	**2,595.21**
Total emissions	***6,100,905.45***	***411.13***	***130.65***	***0.02***	***0.00***	***0.01***	***6,150,308.17***	***1,025,261.65***

Annex II. Emission Factors

Table 54 - 2015 emission factors for stationary combustion

Fuel	Units	CO_2 (kg/un.)	CH_4 (kg/un.)	N_2O (kg/un.)	CO_2e emission factor (kg/un.)
Acetylene	kg	3.4	0.00000	0.00000	3.38
Steam coal 3100 kcal/kg-UTCH	Tonnes	1,211.6	0.01261	0.01891	1,217.60
Steam coal 4500 kcal/kg-CTJL	Tonnes	1,683.3	0.01779	0.02669	1,691.70
Liquefied petroleum gas (LPG)	Tonnes	2,932.5	0.04647	0.00465	2,935.02
Natural Gas-UTWA	m^3	1.5	0.00003	0.000003	1.47
Gasoline	Liters	2.2	0.00010	0.00002	2.25
Fuel Oil-CTJL	Liters	3.1	0.00012	0.00002	3.09
Diesel Oil-UTCH/CTJL/UTWA/UCLA/UTIB	Liters	2.2	0.00009	0.00002	2.22
Ethanol	Liters	1.5	0.00006	0.00001	1.48
Bagaço de Cana - UTIB	Tonnes	702.2	0.21679	0.02891	716.20
Bagaço de Cana - UTFE	Tonnes	692.4	0.21378	0.02850	706.24
Biodiesel	Liters	2.3	0.00010	0.00002	2.36
Firewood for Direct-Burn UCLA	Tonnes	738.8	0.20916	0.02789	752.33

Table 55 - 2015 emission factors for mobile combustion by fuel type

Fuel	Units	CO2 (kg/un.)	CH4 (kg/un.)	N2O (kg/un.)	CO2e emission factor (kg/un.)
Commercial gas	liters	2.21	0.0008	0.00026	2.09
Diesel (commercial)	liters	2.60	0.0001	0.00014	2.63
Natural Gas for Vehicles (Ngv)	m^3	2.00	0.0034	0.00011	2.12
Liquefied petroleum gas (LPG)	kg	2.93	0.0029	0.00001	3.01
Ethanol	liters	1.46	0.0004	0.00001	1.47
Biodiesel	liters	2.43	0.0003	0.00002	2.45

Table 56 – 2015 emission factors for air travel

Air distance	kg CO2/passenger x km	kg CH4/passenger x km	kg N2O/passenger x km	kg CO2e/passenger x km
Short distance (d < 500 km)	0.144425926	0.0000022	0.0000048	0.1459
Average distance (500 ≤ d < 3700 km)	0.082287037	0.0000000	0.0000027	0.0831
Long distance (d ≥ 3700 km)	0.096046296	0.0000004	0.0000032	0.0970

Table 57 - 2015 emission factors of SIN

Month	CO_2 emission factor (tCO_2/MWh)
January	0.1275
February	0.1321
March	0.1369
April	0.1301
May	0.1258
June	0.1406
July	0.1221
August	0.1183
September	0.1217
October	0.118
November	0.1127
December	0.1075
Average	0.1244

Table 58 - Emission factors for CO_2, CH_4 and N_2O from the energy sector for coal bituminous steam and sub-bituminous (in kg/TJ)

Gas	Tarmac Inventory of 2012	Sub-bituminous Inventory of 2013 to 2015
GIVE	94,600	96,100
CH_4	1	1
N_2O	1.5	1.5

Source: IPCC (2006)[1]

[1] IPCC (2006). Guidelines for National Greenhouse Gas Inventories-Volume 2-Energy. Chapter 2, page 2.16.

Table 59 - lower calorific value (PCI) monitored by Tractebel Energia

Power plants	Fuel	GJ/t
UTE Charqueadas	Steam coal 3100 kcal/kg	12.6
	Commercial diesel	35.5
UTE Ferrari	Bagasse-sugar	7.1
UTE Ibitiúva	Commercial diesel oil	35.5
	Bagasse	7.2
UTE Jorge Lacerda	Steam coal 4500 kcal/kg	18.3
	Fuel oil	39.8
	Commercial diesel	35.5
UTE Lages	Commercial diesel	35.5
	Wood residue for direct burning	7.0
UTE Willian Arjona	Dry natural gas	35.4
	Commercial diesel	35.5

Table 60 - Evolution of annual average emission factor of SIN, percentage of biodiesel added to diesel and ethanol added to gasoline (2012-2015)

Parameter	2012	2013	2014	2015
CO2 emission factor of SIN (tCO2/MWh)	0.0653	0.0960	0.1355	0.1244
% ethanol in gasoline	20%	23%	25%	26,6%
% biodiesel in diesel	5%	5%	5.67%	7.0%

Source: MCTI (2015) and ANP (2015)

The emission factors presented in tables 55 to 60 above are average annual values and, therefore, their application does not reflect accounted emissions in this inventory. Emissions related to fuel consumption were accounted on montly basis values of CO_2 emission factors of SIN, percentage of ethanol added to gasoline and biodiesel added to diesel oil.

Annex III. Additional Methodologies

(a) Use of fertilizers

GHG emissions from the use of fertilizers are essentially related to the generation of nitrous oxide (N_2O). Nitrous oxide is produced during denitrification, microbial process when anaerobic bacteria use nitrate (NO3-) as a final electron acceptor in substitution to oxygen (O_2). This process occurs under conditions of anoxia, being favored by the availability of carbon and the presence of NO3- from the mineralization of soil organic matter and the application of organic and mineral fertilizers.

The methodology used to estimate emissions of N_2O from agricultural soils following the IPCC (2006). Direct emissions of N_2O from agricultural soils, according to the more general method ("Tier 1"), are calculated by the following formula[2]:

$$N2O_{Direct}\text{-}N = N2O - N_{Ninputs} + N2O\text{-}N_{OS} + N2O\text{-}N_{PRP}$$

Where:

$N2O_{Direct}\text{-}N$ = Annual direct emissions of N_2O from agricultural soils, in kg N-N_2O yr^{-1}

$N2O\text{-}N_{Ninputs}$ = Annual direct emissions of N-N_2O-N of N applied as fertilizer to the soil, in kg N-N_2O- yr^{-1}

$N2O\text{-}N_{OS}$ = Annual direct emissions of N-N_2O organic soil grown in kg N-N_2O yr^{-1}

$N2O\text{-}N_{PRP}$ = Annual direct emissions of N-N_2O of manure intentionally applied to the soil, in kg N-N_2O yr^{-1}

Assuming no application of manures and, either growing in organic soils, only the portion of N applied as fertilizer to the soil will be considered.

$$N2O\text{-}N_{Ninputs} = (F_{SN} + F_{ON} + F_{CR} + F_{SOM}) \times EF1$$

Where:

F_{SN} = Annual amount of N in synthetic fertilizer nitrogen applied to the soil, in kg N yr^{-1}

F_{ON} = Annual quantity of N in manures, compost, sewage sludge and other additions of organic N applied to the soil, in kg N yr^{-1}

F_{CR} = Quantity of N in crop residues that return annually to the soil, in kg N yr^{-1}

F_{SOM} = Quantity of N in mineral soil that is mineralized, in kg N yr^{-1}

EF1 = Direct N_2O emission factor applied to the quantities of N added to soils, in kg N yr^{-1}

The amounts of nutrients and fertilizers specifications in Brazil follow the requirements of the Normative Statement of the Ministério da Agricultura, Pecuária e

[2] N2O = N-N2O × 44 ÷ 28

Abastecimento number 5 of February 23, 2007 (reviewed by IN-MAP 21/2008), with significant variations depending on the type of fertilizer used. For example, bone flour autoclaved (1%), ammonium sulphate (20%), urea (45%), anhydrous ammonia (82%), etc.

To calculate F_{SN} and F_{ON}, the percentage of nitrogen present in fertilizer provided by Tractebel Energia was considered, and when the information was not available, the inventory of 2010 and 2011 was used to provide it, i.e. 1% for organic fertilizers, as normative instruction of the Ministry of Agriculture, Livestock and Supply no. 25, July 2009, and 45% for synthetic fertilizers considering the concentration of urea nitrogen, the most used synthetic fertilizer in Brazil.

For EF1 (2006), according to IPCC (2006), when there is an absence of a local emission factor, the standardized value of 0.01 must be used.

For Tractebel Energia inventory, it is reasonable to assume that $F_{CR} = F_{SOM} = 0$; therefore direct emissions related to the use of fertilizers are directly proportional to the amount of N applied as fertilizer to the soil:

For the conversion of emissions of N_2O-N to N_2O emissions the following equation is considered:

$$N2O_{emissions} = N2O\text{-}N \times 44/28$$

Thus, the final equation is:

$$N2O_{emissions}\ (kg_{N2O}) = (FSN + FON) \times 0.01 \times 44/28$$

(b) Desulphurization process

The process of desulphurization is used for UTE Charqueadas. For the accounting of emissions the emission factor used by the ENGIE Group of 0.2558 tCO2e/t of plaster produced was considered (stoichiometric ratio of plaster, and CASO4.2H2O, and CO2 in the process).

Table 61 - The desulphurization process emissions based on the amount of plaster UTCH produced in 2015

Month	Amount of plaster produced (t)	CO2e(t) emissions
January	1,628.40	416.54
February	1,186.52	303.51
March	1,705.04	436.15
April	2,001.00	511.86
May	952.33	243.61
June	748.38	191.44
July	2,774.44	709.70
August	2,527.69	646.58
September	1,707.43	436.76
October	2,132.10	545.39
November	1,872.30	478.93
December	1,659.81	424.58
Total	**20,895.44**	**5,345.05**

(c) Use of acetylene

Acetylene (C_2H_2) is commonly used for welding due to the low cost and power, and its combustion emits CO_2. Whereas some plants of Tractebel use acetylene for welding due to equipment maintenance, that source should be considered for GHG emissions inventory.

The balanced equation of combustion process of acetylene is presented below:

$$C_2H_2 + 5/2\ O_2 \longrightarrow 2CO_2 + H_2O$$

In this way, for the combustion of 1 (one) acetylene binding, 2 (two) molecules of CO_2 are emitted, i.e. for every 26g C_2H_2 burnt, 88g CO_2 are emitted. Thus, the emission factor considered for the use of acetylene is $88gCO_2/26gC_2H_2$ = 3.385 gCO_2/gC_2H_2.

(d) Incineration

Waste incineration is defined as the controlled combustion of solid and liquid waste within facilities. According to the IPCC (2006), during the incineration and open burning of waste, CO_2, CH_4 and N_2O are emitted. The quantities issued to each gas depends on the type of waste, burning temperature, type of incineration/technology, management practices, among others.

Generally, CO_2 is emitted in greater quantity for both incineration and burning out in the open. CH_4 is emitted from the incomplete burning of the waste combustion/and is relevant in the case of open burning. N_2O is emitted between temperatures ranging between 500 and 950ºC. So, regarding incineration emissions are calculated according to the equation below:

$$Emissions_{res} = CO_{2Emissions} + CH_{4Emissions} + N2O_{Emissions}$$

According to a more general method (Tier 1), CO_2 emissions can be estimated according to the equation below.

$$CO_{2Emissions} = \sum (SWi \times dmi \times CFi \times FCFi \times OFi) \times 44/12$$

Where:

$CO_{2Emissions}$ =	Annual CO_2 emissions, Gg/year
SWi =	Total amount of solid waste type i (wet weight) incinerated or burnt in the open (fraction)
dmi =	Dry matter content in the waste (wet weight) incinerated or burnt in the open (fraction)
CFi =	Carbon fraction in dry matter (total carbon content) (fraction)
FCFi =	Fraction of fossil carbon in the total carbon (fraction)
OFi =	Oxidation factor (fraction)
44/12 =	Conversion factor from C to CO_2
i =	Type of waste incinerated/burnt out in the open: urban solid waste, industrial waste, sewage sludge, hazardous waste, clinical waste, other (must be specified).

Whereas the incinerated waste is classified as "chemical waste" by Tractebel, the type of waste (i) which best fits to this classification is "clinical waste" ("clinical waste"), defined by the IPCC as chemical and pharmaceutical waste. In addition, as there is no detailed information available for the calculation of CO_2 emissions, the default data provided by IPCC (2006) are given in the table below.

Table 62 - Emission factor for CO2 emissions generated in the incineration

Parameter	Given the IPCC default
(i)	Clinical waste (chemical and pharmaceutical)
CFi	60%
FCFi	40%
OFi	100%

Source: IPCC (2006)

As there is no information available about the fraction of dry matter in the waste incinerated (dmi) and there is no default data provided by the IPCC, the value considered was 100% dry in the residue by conservatism.

In the case of the calculation of emissions of CH_4 and N_2O, values of aggregated CH_4 and N_2O in the residue and, therefore, the detailing of the type of technology used (solid incineration, semi continuous, and fluidized bed incineration plants). As there is no detailed information about the type of technology used, emissions of these gases were regarded as 0 (zero) in this inventory.

Annex IV. Representation of Emission Sources

a) Representation of emission sources - Operational Control

Table 63 - Representation of the sources of emissions in each scope for the wind power plants – operational control

Emission sources	UEBB	UEFL	UEGU	UEMU	UEPS	UETR	UETB
Scope 1							
Stationary combustion	0.00%	0.00%	0.00%	0.00%	0.00%	2.49%	0.00%
Mobile combustion	3.78%	0.00%	0.00%	0.00%	99.40%	97.38%	0.00%
Processes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fugitive emissions	96.09%	100.00 %	100.00 %	100.00 %	0.60%	0.14%	0.00%
Agricultural activities	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Solid wastes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Scope 2							
Purchased electricity from the grid	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Scope 3							
Fuel and energy-related activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Transport and distribution (upstream)	51.07%	0.00%	0.00%	0.00%	79.39%	5.15%	0.00%
Waste generated in operations	8.23%	0.00%	0.00%	0.00%	14.91%	78.55%	0.00%
Business travels	10.72%	0.00%	0.00%	0.00%	5.70%	16.30%	0.00%
Employees transportation (home-work)	29.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 64 - Representativeness of the sources of emissions for each scope to the hydropower plants – operational control

Emission sources	UHCB	UHPF	UHPP	UHSO	UHSS	UHSA

Scope 1						
Stationary combustion	11.58%	5.49%	9.50%	11.31%	33.46%	20.72%
Mobile combustion	86.25%	78.10%	87.61%	25.68%	59.90%	79.15%
Processes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fugitive emissions	0.00%	0.00%	0.00%	62.96%	4.19%	0.13%
Agricultural activities	2.17%	16.41%	0.10%	0.05%	0.11%	0.00%
Solid wastes	0.00%	0.00%	2.80%	0.00%	2.34%	0.00%
Scope 2						
Purchased electricity from the grid	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00%	0.00%	0.00%	0.00%	11.09%	0.00%
Transport and distribution (upstream)	45.71%	9.15%	80.84%	12.39%	34.83%	72.57%
Waste generated in operations	15.30%	1.75%	0.00%	14.90%	4.83%	2.81%
Business travels	19.10%	0.30%	17.70%	7.94%	5.74%	7.12%
Employees transportation (home-work)	19.89%	88.79%	1.47%	64.76%	43.51%	17.51%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 65 - Representativeness of the sources of emissions in each scope to the SHPS and the photovoltaic plant – operational control

Emission sources	PHAB	PHRO	PHJG	UFCA
Scope 1				
Stationary combustion	17.48%	57.38%	98.20%	0.00%
Mobile combustion	80.83%	42.62%	0.06%	0.00%
Processes	0.00%	0.00%	0.00%	0.00%
Fugitive emissions	0.00%	0.00%	0.00%	100.00%
Agricultural activities	0.00%	0.00%	0.00%	0.00%
Solid wastes	1.69%	0.00%	1.73%	0.00%
Scope 2				
Purchased electricity from the grid	100.00%	100.00%	100.00%	100.00%
Scope 3				
Fuel and energy-related activities not included in Scope 1 and 2	0.00%	0.00%	0.00%	0.00%
Transport and distribution (upstream)	100.00%	98.06%	98.06%	0.00%
Waste generated in operations	0.00%	0.00%	0.00%	0.00%
Business travels	0.00%	0.00%	0.00%	0.00%
Employees transportation (home-work)	0.00%	1.94%	1.94%	0.00%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	0.00%

Table 66 - Representativeness of the sources of emissions in each scope to the thermoelectric fossil fuel – operational control

Emission sources	UTAL	UTCH	CTJL	UTWA
Scope 1				
Stationary combustion	0.00%	99.00%	100.00%	99.99%
Mobile combustion	99.53%	0.00%	0.00%	0.00%
Processes	0.00%	0.99%	0.00%	0.00%
Fugitive emissions	0.47%	0.00%	0.00%	0.00%
Agricultural activities	0.00%	0.00%	0.00%	0.00%
Solid wastes	0.00%	0.00%	0.00%	0.00%
Scope 2				
Purchased electricity from the grid	100.00%	100.00%	100.00%	100.00%
Scope 3				
Fuel and energy-related activities not included in Scope 1 and 2	0.00%	0.00%	0.00%	0.00%
Transport and distribution (upstream)	0.00%	84.30%	41.67%	0.00%
Waste generated in operations	15.54%	0.27%	2.50%	85.81%
Business travels	84.46%	0.18%	0.88%	4.16%
Employees transportation (home-work)	0.00%	0.00%	0.33%	10.03%
Transport and distribution (downstream)	0.00%	15.26%	54.62%	0.00%

Table 67 – representativity of the sources of emissions in each scope to the thermoelectric plants to biomass – operational control

Emission sources	UTFE	BON RE	UCLA
Scope 1			
Stationary combustion	100.00%	99.66%	96.42%
Mobile combustion	0.00%	0.33%	3.38%
Processes	0.00%	0.00%	0.00%
Fugitive emissions	0.00%	0.00%	0.20%
Agricultural activities	0.00%	0.01%	0.00%
Solid wastes	0.00%	0.00%	0.00%
Scope 2			
Purchased electricity from the grid	100.00%	100.00%	100.00%
Scope 3			
Fuel and energy-related activities not included in Scope 1 and 2	0.00%	0.00%	0.00%
Transport and distribution (upstream)	0.00%	53.72%	95.72%
Waste generated in operations	100.00%	46.28%	1.08%
Business travels	0.00%	0.00%	0.41%
Employees transportation (home-work)	0.00%	0.00%	2.79%
Transport and distribution (downstream)	0.00%	0.00%	0.00%

Table 68 - Representativeness of the sources of emissions in each scope to the offices and Tractebel Energia – operational control

Emission sources	ESP	HEADQUARTERS	Tractebel
Scope 1			
Stationary combustion	0.00%	27.55%	99.90%
Mobile combustion	100.00 %	72.09%	0.01%
Processes	0.00%	0.00%	0.09%
Fugitive emissions	0.00%	0.36%	0.00%
Agricultural activities	0.00%	0.00%	0.00%
Solid wastes	0.00%	0.00%	0.00%
Scope 2			
Purchased electricity from the grid	100.00 %	100.00%	100.00%
Scope 3			
Fuel and energy-related activities not included in Scope 1 and 2	0.00%	0.00%	0.12%
Transport and distribution (upstream)	0.00%	0.00%	61.07%
Waste generated in operations	0.00%	0.36%	2.49%
Business travels	100.00 %	99.64%	2.82%
Employees transportation (home-work)	0.00%	0.00%	1.41%
Transport and distribution (downstream)	0.00%	0.00%	32.08%

b) Representation of emission sources-Corporate Participation

Table 69 - Representativeness of the sources of emissions in each scope to UHET, UHMA, UHIT and Tractebel Energia-Corporate Participation

Emission sources	UHET	UHMA	UHIT	Tractebel
Scope 1				
Stationary combustion	30.32%	0.26%	0.02%	99.90%
Mobile combustion	32.15%	99.74%	97.40%	0.01%
Processes	0.00%	0.00%	0.00%	0.09%
Fugitive emissions	29.37%	0.00%	0.00%	0.00%

Agricultural activities	7.40%	0.00%	2.32%	0.00%
Solid wastes	0.76%	0.00%	0.26%	0.00%
Scope 2				
Purchased electricity from the grid	100.00%	100.00%	100.00%	100.00%
Scope 3				
Fuel and energy-related activities not included in Scope 1 and 2	0.00%	0.00%	0.00%	0.12%
Transport and distribution (upstream)	52.78%	34.53%	44.27%	60.99%
Waste generated in operations	0.58%	10.64%	7.49%	2.50%
Business travels	43.96%	1.32%	17.53%	3.00%
Employees transportation (home-work)	2.68%	53.51%	30.72%	1.53%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	31.87%

Annex V. Uncertainty assessment methodology and results by plant/Office

The evaluation of uncertainty of the 2015 GHG inventory of Tractebel Energia was held for each of its plants/offices. To this end, we used the tool provided by the GHG Protocol "ghg uncertainty.xls" (GHG Protocol, 2003) which considers the Gaussian method, which requires that the distribution of measurement data converges to a normal distribution and that the individual uncertainties are less than 60% of the expected average.

The classification of uncertainties is divided into 2 (two) categories:

(i) Direct measurements: based on the amount of GHG monitored;

(ii) Indirect measurements: based on data of the monitored activity and emission factor.

Direct measurements identified for Tractebel Energia refer to fugitive emissions, i.e. CO2 fire extinguishers or gases used in refrigeration and air conditioning equipment. The other emissions were classified as indirect measurements, since there is no monitoring or direct verification of greenhouse gases.

For the classification of uncertainty of emission factors, the "GHG Protocol Guidance on Uncertainty Assessment in GHG Inventories and Calculating Statistical Parameter Uncertainty" and IPCC (1996) were used, as shown in the table below.

Table 70 - Value and reference of the emission factor uncertainty

Emission source (indirect measurements)	Level of emission factor uncertainty (CI expressed as ± percentage)	Reference
Stationary combustion	+/- 5.0%	GHG Protocol (2003)
Mobile combustion	+/- 5.0%	GHG Protocol (2003)
Electricity consumption	+/- 7.0%	IPCC (1996)
Air travel	+/- 9.0%	DEFRA (2012)
Desulphurization process	+/- 15.0%	GHG Protocol (2003)
Waste (landfill/compost/incineration)	+/- 30.0%	GHG Protocol (2003)
Use of fertilisers (organic/synthetic)	+/- 30.0%	IPCC (2006)

In the case of the uncertainty of the activity data, the GHG Protocol table below was used as a reference.

Table 71 - Classification of uncertainty for measurements

Classification	Level of uncertainty
High	≤ 5%
Good	≤ 15%
Fair	≤ 30%
Poor	> 30%

Source: GHG Protocol (2003)

As the statement of Work "Environment – IT-MA-GE-006" established by Tractebel Energia for the collection of data, the nature of the "evidence" is one of the data to be included. Based on the nature of the evidence of the data provided by Tractebel Energia, the following classification was established.

Table 72 - classification of activity data uncertainty

Nature of evidence	Given uncertainty	Classification of uncertainty	Reference
EMS-power measurement system	+/- 0.20%	High	ONS (2011). 12.2 Check submodule. 2.0/2011. Accuracy class of energy meters.
SCO-fuel system (bagasse)	+/- 0.50%	High	Operations manual Bextra. Average balance of error UTIB.
SCO-fuel system (coal)	+/- 1.00%	High	"IT-CA-UTCH-015. Dynamic Balance measurement Bextra. UTCH scale (1%).
SCO-fuel system (fuel oil)	+/- 1.00	High	It was considered the largest uncertainty among the ones reported to the SCO.
SCO-fuel system (diesel oil)	+/- 1.00	High	It was considered the largest uncertainty among the ones reported to the SCO.
SCO-fuel system (natural gas)	+/- 0.50%	High	Meter calibration certificate of UTWA issued by IPT.
SCO-fuel system (wood)	+/- 1.00%	High	Certificate of conformity of UCLA scale issued by Toledo of Brazil
Other reports of the information system of Tractebel Energia	+/- 5.00%	High	GHG Protocol (2003)

Nature of evidence	Given uncertainty	Classification of uncertainty	Reference
Purchase invoice	+/- 5.0%	High	GHG Protocol (2003)
Waste disposal certificate (with the quantities intended for) or weighing tickets	+/- 5.00%	High	GHG Protocol (2003)
Supplier report	+/- 15.0%	Good	GHG Protocol (2003)
Internal Control sheet (signed by the responsible manager)	+/- 30.0%	Fair	GHG Protocol (2003)
Internal Estimate	+/- 40.0%	Poor	GHG Protocol (2003)
Other evidence*	+/- 40.0%	Poor	GHG Protocol (2003)

* The classification of this uncertainty depends on the type of evidence considered. In General, it is considered +/-40% of uncertainty.

The values indicated in the tables 70 and 72 were unchanged in 2015. In this way, the changes in uncertainty of the plants/offices between 2014 and 2015 are exclusively due to the nature of the evidence considered to the data submitted to the GHG inventory and not the value of the uncertainty of the emission factor (table 70) or the review of the evidence considered uncertainty factor (table 72).

In the figures below we present the analysis of uncertainty of GHG emissions.

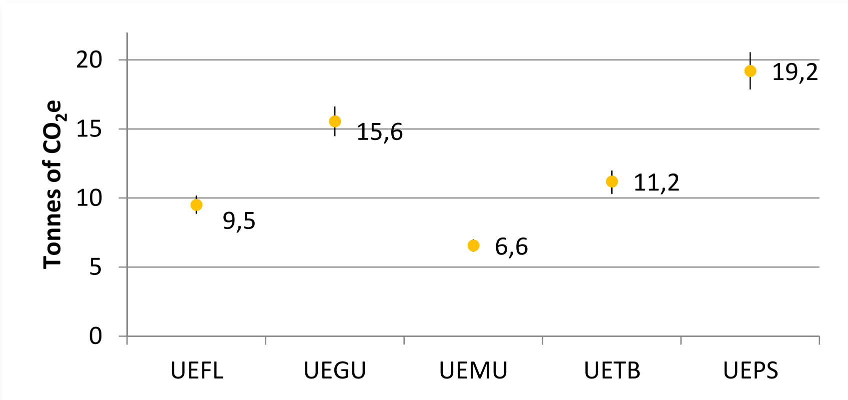

Figure 136 – Uncertainty analysis of GHG emissions of wind power plants, UEGU, UEFL UEMU, UETB and UEPS

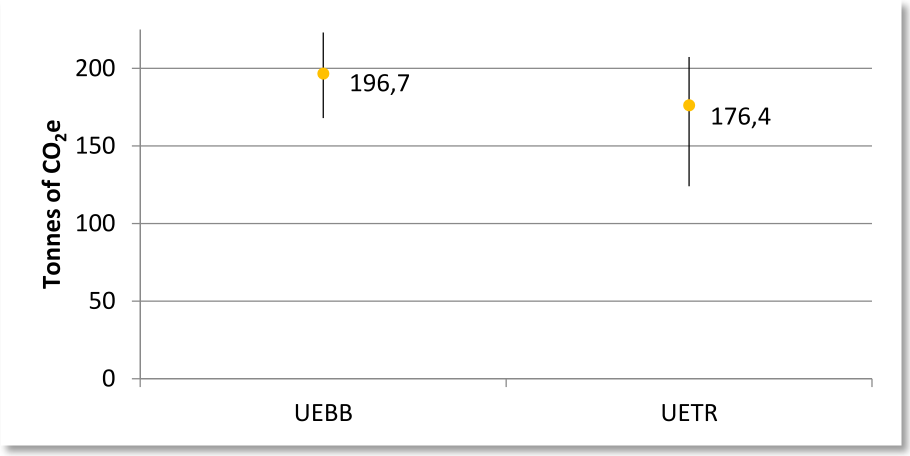

Figure 137 – analysis of uncertainty of GHG emissions of the UEBB and wind UETR

The UEFL, UEGU and UEMU have the smallest uncertainty intervals among the wind power plants (+/-6.9%). The UETB introduces uncertainty of +/-7.0%, followed by UEPS (+/-7.1%), UEBB (+/-13.4%) and UETR (+/-17.6%)

With respect to PCHs, the PHRO has lower uncertainty (+/-4.8%), followed by PHAB (+/-8.1%) and PHJG (9.5%).

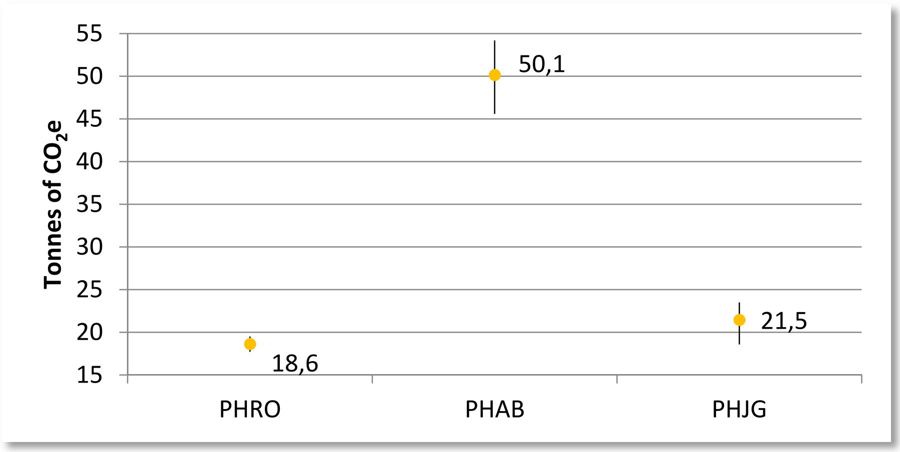

Figure 138 – Analysis of uncertainty of GHG emissions of SHP

With respect to the offices of Tractebel Energia, the figure below can give the false impression that there is no uncertainty for GHG emissions from the Sao Paulo Office (ESP). However, this misunderstanding is because ESP GHG emissions are very small. In fact, the uncertainty of the emissions of the Sao Paulo Office is +/-18,4% and headquarters in Florianópolis is +/-14.6/%, respectively.

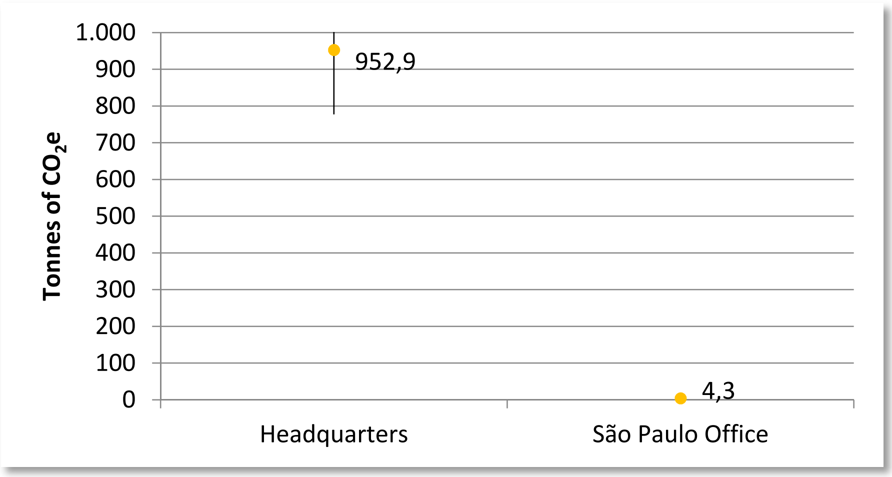

Figure 139 – Analysis of uncertainty of GHG emissions of Tractebel Energia Offices

The dams have significant differences in emissions and thus were assessed separately in the following graphs.

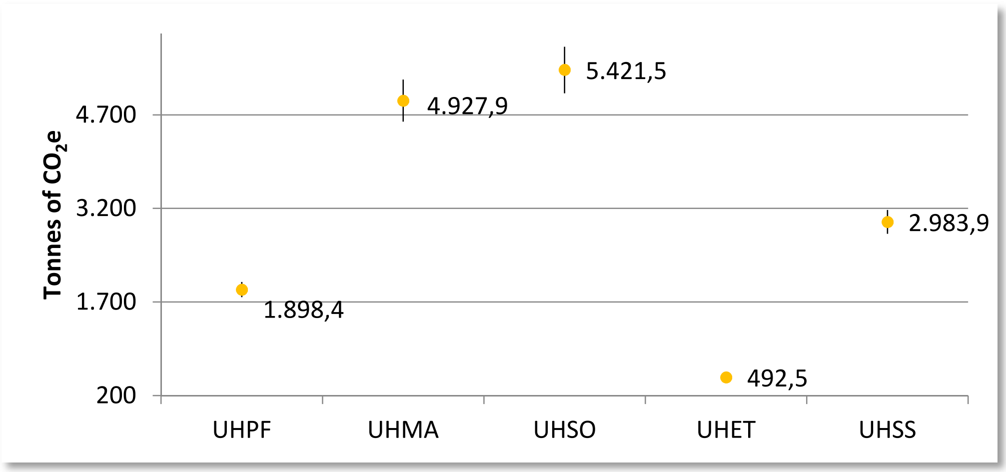

Figure 140 – Analysis of uncertainty of GHG emissions of UHPF, UHSO, UHMA UHET and UHSS power plants

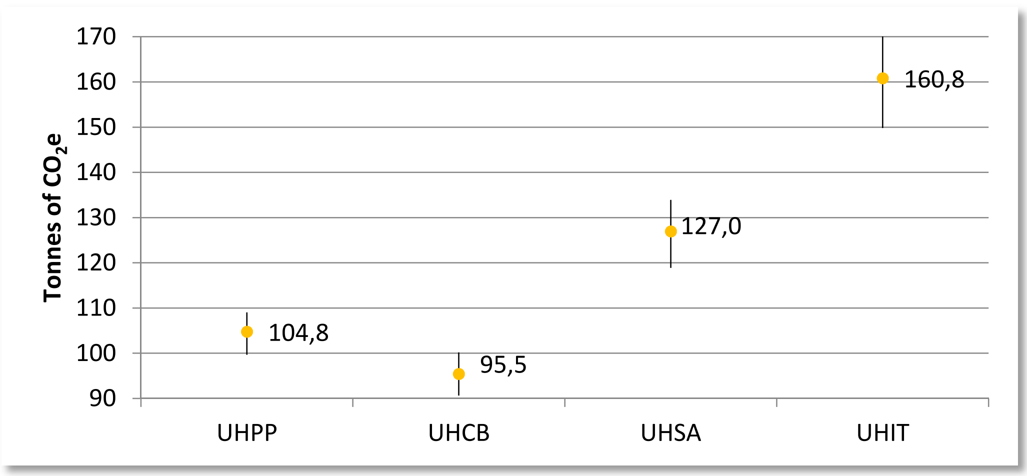

Figure 141 – Analysis of uncertainty of GHG emissions of UHCB, UHSA UHPP and UHIT power plants

The UHPP is the plant that has less uncertainty about the dams and other power plants of Tractebel (+/-4.1%), followed by UHET (+/-4.9%). The UHCB features +/-5.0%, followed by the UHSA (+/-5.5%), UHSS and UHPF (both with +/-6.4%), UHIT (+/-6.8%), UHMA and UHSO (both with +/-6.9%).

Because they have significant difference in emissions, the thermoelectric power plants were also analysed separately, as shown in the figures below.

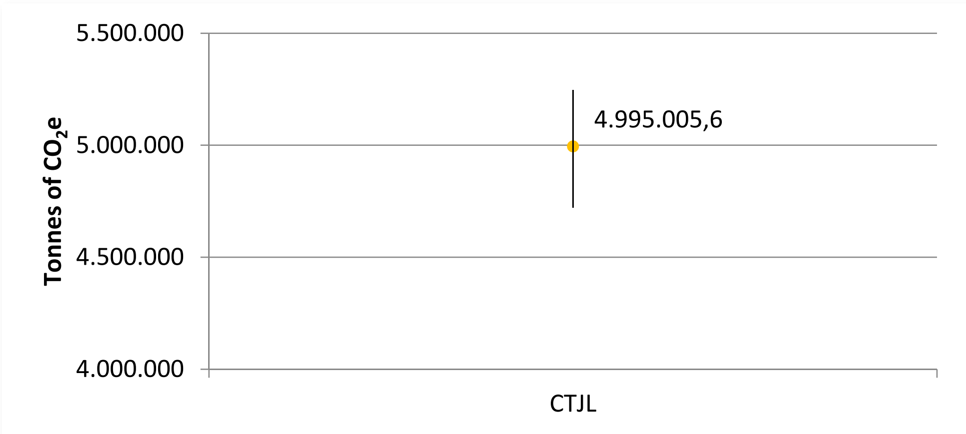

Figure 142 – Analysis of uncertainty of GHG emissions at CTJL

The CTJL is responsible for 81.2% of Tractebel Energia GHG total emissions. In this way, the uncertainty of +/-5,1% has significant impact on emissions, ranging from 4,721,879.39 to 5,247,582.02 tCO_2e.

The UTWA and UTCH also exhibit relatively high emissions resulting in 15.8% and 4.9%, respectively, of Tractebel Energia total emissions. Aggregate uncertainty +/-4,9% of UTCH results in a range of emissions between 525,158.84 to 579,721.00 tCO_2e. The UTWA for having an aggregate uncertainty higher than that of UTCH (+/-15.8%), presents the largest emissions of uncertainty range: 467,331.39 to 656,841.16 tCO_2e.

The uncertainties of the emissions from thermal power plants in order of increasing uncertainty are: +/-4.9% for UTCH, +/-5.1% for CTJL, +/-6.5% for UTAL, +/-9.1% for UCLA, +/-15.4% for UTFE, +/-15.8% for UTWA and +/-29.7% for UTIB.

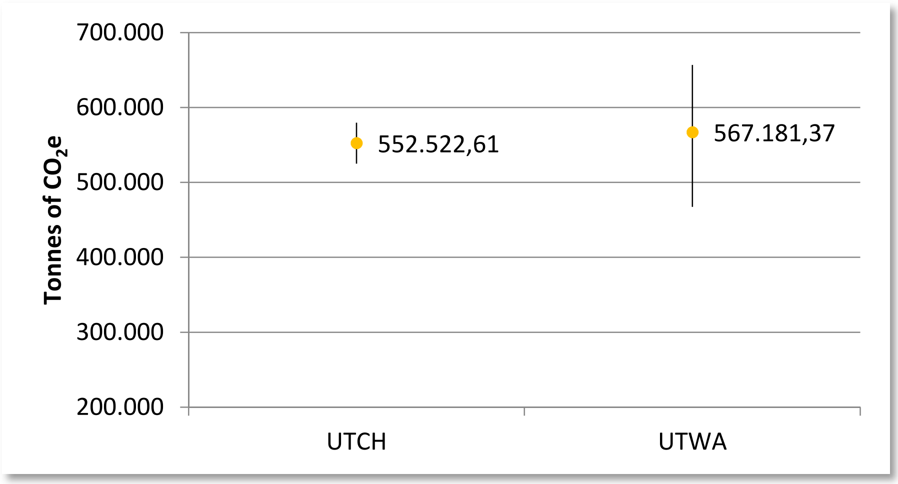

Figure 143 – Analysis of uncertainty at UTCH and UTWA plants for GHG emissions

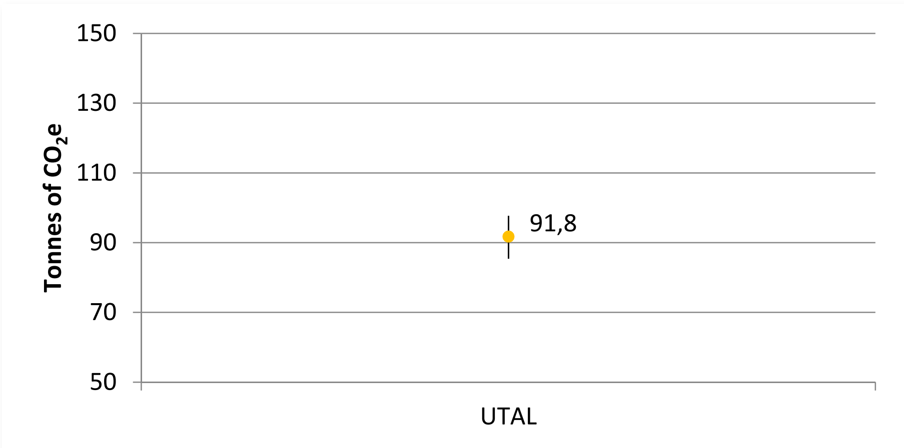

Figure 144 - Analysis of uncertainty of GHG emissions at UTAL

One of the thermoelectric plants moved by biomass, UCLA is the one that offers lower level of uncertainty (+/-9.1%), followed by UTFE (+/ -15.4%) and UTIB (+/ -29.7%).

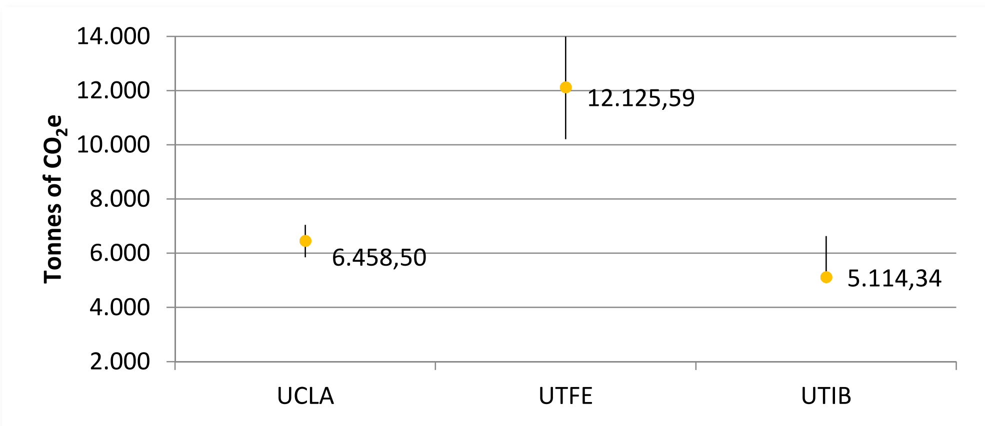

Figure 145 – Analysis of uncertainty of GHG emissions at UCLA, UTIB and UTFE

The UFCA presented an uncertainty of + -7.0% of emissions in 2015. Considering the minor issue compared to the other group's plants, their emissions showed little variation (from 7.4 to 8.5 tCO_2e).

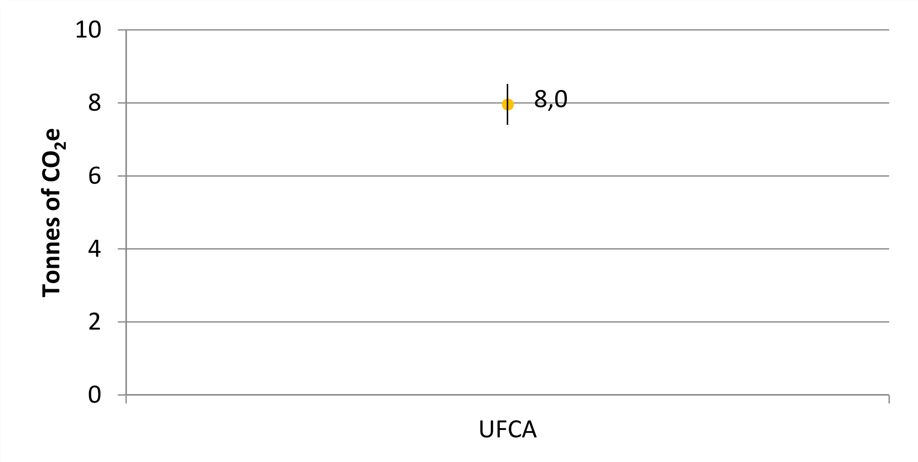

Figure 146 – Analysis of uncertainty of GHG emissions at UFCA

Annex VI. Methodology calculation of emission Reduction

a) Generation of Renewable Energy

Wind, hydropower and biomass power plants, when in operation, provide reductions in greenhouse gas emissions through the supply of clean, renewable energy to the National Interconnected System (SIN).

The methodology used to calculate GHG emission reductions for renewable electricity generation is based on the methodology ACM0002 "Consolidated Methodology for grid-connected electricity generation from renewable sources" (UNFCCC, 2014). In this way, the plants were placed within the minimum criteria of applicability of this methodology, based on renewable energy generation and reservoir area of hydropower plants.

This methodology has been made available by the Executive Board for the Clean Development Mechanism (CDM) of the Kyoto Protocol, in which emission reductions of projects that generate renewable electricity and are connected to the grid can be accounted for from the determination of a baseline. In General, we can use the equation summarized below.

$$Er_y = BE_y = EG_{PJ,y} \text{ X } EF_{grid,CM,y} \,´$$

Where:

Er_y = Reduction of emissions in a year (tCO2e per year)

Be_y = The baseline emissions in a year (tCO2e per year)

$EG_{PJ,y}$ = Net electricity generation produced and supplied to the grid in a year (MWh/year)

$EF_{grid,CM,y}$ = CO2 emission factor on combined margin for energy generation projects connected to the network a the year (tCO2e per year)

The calculation for $EF_{grid,CM,y}$is according to the equation below:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} + W_{BM}$$

Where:

$EF_{grid,OM,y}$ = CO2 emission factor of operating margin in a year (tCO2e per year)

W_{OM} = Weight of the emission factor of the operating margin (%)

$EF_{grid,BM,y}$ = CO2 emission factor from the edge of construction in a year (tCO2e per year)

W_{BM} = Weight of the emission factor of the building margin (%)

The CO2 emission factors of the operation and construction of the national interconnected system are published by the inter-ministerial Global climate change Commission (ICGCC) and, thus, the data provided by this institution was used. For operating margin, the average monthly factor for the year 2015 was considered.

However, whereas the margin for the year 2015 had not been published until the time of preparation of this report, the margin value provided by MCTI construction for 2014 was considered.

For the weights of the emission factors, the methodology ACM0002 factors was considered, i.e. 50% of operating margin and construction for hydroelectric projects and 75% operating margin and 25% for wind and photovoltaic projects. So, they considered the CO2 emission factors of the network, as below.

Wind and solar projects

0.2963 x 25% + 0.5580[13] x 75% = 0.4926 tCO2/MWh

Hydroelectric and biomass projects

0.2963 x 50% + 0.5580[22] x 50% = 0.4272 tCO2/MWh

In addition, the methodology ACM0002 provides for methane emissions, depending on the size of the reservoir of hydroelectric projects. So, for projects at power density greater than 4W/m^2, and less than or equal to 10W/m^2, methane emissions for reservoirs must follow the equation below:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000}$$

Where:

$PE_{HP,y}$ = Project emissions from water reservoirs of hydroelectric plants in a year (tCO2e);

EF_{Res} = Default emission factor for emissions from reservoirs-default value as the methodology is 90Kg CO2e/MWh;

TEG_y = Total electricity produced by the activity of the project, including the electricity supplied to the network and the electricity supplied at internal loads, in a year (MWh) – gross energy.

Considering the net electricity generation data provided by Tractebel Energia and the SIN CO_2 emission factor provided by MCTI, as well as the plants within the minimum power density criteria set out in the methodology[14], it was possible to calculate GHG emission reductions according to the tables below.

[3] Annual average for CO2 emission factor of the SIN operation provided by MCTI. The data was inserted only for example. The emission reduction calculations consider the monthly average of this emission factor.

[14] Hydropower plants are considered eligible for power density (installed capacity divided by the area of reservoir) above 4 W/m^2. Hydroelectric projects that have power density greater than 4W/m^2, and less than or equal to 10W/m2, must redeem methane emissions from the reservoir in the total emissions reductions from renewable electricity generation.

Table 73 - Monthly wind emission reduction estimate for renewable energy generation (tCO_2e)

Months	UEBB	UEFL	UEGU	UEMU	UEPS	UETR	UETB
January	4,120.01	6,593.20	6,017.94	5,258.34	3,490.71	5,711.15	0,00
February	2,573.87	3,877.23	3,956.44	3,075.49	1,962.59	3,438.41	0,00
March	2,099.12	2,375.93	2,432.05	1,851.38	1,287.59	2,011.11	11.59
April	1,559.84	1,818.64	2,333.11	1,468.04	952.62	1,761.37	55.93
May	3,177.38	4,165.26	5,346.55	3,157.94	1,883.73	3,894.72	98.33
June	3,162.05	4,435.08	5,655.13	3,402.43	1,895.58	4,213.79	175.09
July	3,714.36	5,839.96	6,627.54	4,579.51	2,667.25	5,420.89	127.16
August	4,789.67	7,655.68	8,667.65	6,734.58	3,448.79	6,714.96	185.46
Septembe r	5,090.96	7,918.63	8,022.05	6,398.37	4,013.22	6,739.93	115.20
October	4,966.33	6,328.07	7,037.09	5,987.18	4,091.06	6,075.10	182.07
November	3,541.81	5,475.13	6,763.19	4,933.14	3,597.53	5,515.76	139.39
December	3,961.47	5,622.50	7,053.04	4,947.42	3,535.40	5,164.52	109.21
Total	42,756.87	62,105.29	69,911.76	51,793.82	32,826.07	56,661.70	1,199.42

Table 74 - Monthly SHPS and photovoltaic power plant emission reduction estimate for generation of renewable energy (tCO_2e)

Months	UFCA	PHAB	PHJG	PHRO
January	181.52	1,001.66	3,354.42	3,709.62
February	166.24	1,686.29	3,743.79	4,175.74
March	166.13	1,235.46	3,759.59	5,170.26
April	140.15	1,167.56	3,463.94	4,080.80
May	117.06	1,594.42	3,343.66	3,546.56
June	121.12	997.28	2,422.08	2,721.65
July	110.54	547.55	2,238.74	2,482.47
August	158.86	409.40	1,582.40	1,826.31
September	111.07	550.96	1,596.53	1,838.80
October	109.66	281.31	1,685.11	1,938.16
November	128.16	488.05	1,946.17	2,455.99
December	153.82	1,523.72	2,411.71	2,606.46
Total	1,664.32	11,483.67	31,548.14	36,552.82

Table 75 - Estimated monthly emission reduction of thermal power plants for generation of renewable energy (tCO2e)

Months	UCLA	UTIB	UTFE
January	4,015.13	1,929.02	0,00
February	4,513.86	0,00	0,00
March	5,900.73	0,00	0,00
April	5,088.42	2,587.38	4,519.55
May	5,633.77	6,357.29	8,408.92
June	6,414.24	7,718.02	10,625.44
July	4,046.63	7,788.79	13,289.15
August	5,011.57	8,686.16	13,130.43
September	1,776.12	7,416.75	11,012.11
October	5,300.54	7,897.85	11,790.59
November	3,633.71	6,830.04	10,251.23
December	5,034.81	7,556.96	4,253.24
Total	56,369.53	64,768.28	87,280.66

Table 76 – Estimated monthly emission reduction of Hydroelectric Power Plants for generation of renewable energy (tCO2e)

Months	UHSO	UHSS	UHPP
January	277,511.16	194,229.37	33,602.65
February	275,384.92	178,453.29	32,513.56
March	276,310.82	228,665.97	36,178.44
April	191,490.02	172,923.98	31,508.20
May	119,695.28	121,736.61	39,733.56
June	114,568.05	121,172.27	43,844.75
July	204,812.03	189,915.94	35,683.38
August	265,709.70	246,137.60	34,631.40
September	240,711.29	224,594.97	33,157.73
October	223,913.61	201,794.36	34,645.12
November	272,953.56	197,820.83	35,731.88
December	272,652.53	263,215.18	34,928.41
Total	2,735,712.97	2,340,660.38	426,159.08

Tabela 1 – Estimativa de redução de emissão mensal das hidrelétricas dos Consórcios por geração de energia renovável (em tCO_2e)

Months	HYDROPOWER PLANTS	
	UHIT	UHMA
January	315,244.98	67,107.25
February	281,184.31	58,636.98
March	208,130.91	41,511.32
April	134,068.50	28,403.96
May	98,795.96	19,763.17
June	174,802.86	25,757.00
July	264,769.82	55,572.70
August	262,637.59	55,552.91
September	229,048.81	47,498.54
October	265,487.90	62,021.69
November	248,781.13	55,928.17
December	263,843.68	53,724.29
Total	***2,746,796.44***	***571,477.98***

Emission reduction estimates consolidated by type of approach-Operational Control and Ownership – are presented below.

Table 77 – Reduction of GHG emissions renewable electricity generation of Tractebel Energia - Operational Control

Power Plants	Net electricity generation DEL-REC (MWh)	Emission reduction (tCO2e)
CTJL	4,458,497.68	-
UTWA	1,078,301.58	-
UTCH	282,702.18	-
UTFE	205,569.66	87,280.66
UCLA	131,753.87	56,369.53
UHSO[1]	6,405,402.72	2,735,712.97
UTIB	152,545.82	64,768.28
UHSS[1]	6,964,219.91	2,340,660.38
UHPF[1]	1,076,932.93	-
UEBB	87,137.23	42,756.87
UETR	115,445.05	56,661.70
UHSA	1,194,518.10	-
UHPP	997,534.73	426,159.08
UHCB[1]	4,329,774.24	-
UTAL	-	-
PHAB	26,821.27	11,483.67
PHJG	73,653.30	31,548.14
LIFO	66,961.72	32,826.07
PHRO	85,309.03	36,552.82
UEGU	142,498.62	69,911.76
UETB	2,452.87	1,199.42
UEFL	126,604.40	62,105.29
UFCA	3,373.42	1,664.32
UEMU	105,603.33	51,793.82
Total	***28,113,613.66***	***6,109,454.77***

[1]Power plants acting as synchronous compensators and, therefore, the net generation considered is “DEL”.

Table 78 -GHG emission reduction of generation of renewable electricity of Tractebel Energia-Corporate Participation

Plants/Offices	Net electricity generation DEL-REC (MWh)	Emission reduction (tCO2e)
CTJL	4,458,497.68	-
UTWA	1,078,301.58	-
UTCH	282,702.18	-
UTFE	205,569.66	87,280.66
UCLA	131,753.87	56,369.53
UHSO[1]	6,405,402.72	2,735,712.97
UTIB[2]	105,653.24	44,858.51
UHSS[1]	6,964,219.91	2,340,660.38
UHPF[1]	1,076,932.93	-
UHMA[2]	1,337,652.91	571,477.98
UHET[2]	1,734,940.54	-
UEBB	87,127.90	42,756.87
UETR	115,445.05	56,661.70
UHSA	1,194,518.10	-
UHIT[2]	6,425,174.94	2,746,796.44
UHPP	997,534.73	426,159.08
UHCB[1]	4,329,774.24	-
UTAL	-	-
PHAB	26,821.27	11,483.67
PHJG	73,653.30	31,548.14
UEPS	66,961.72	32,826.07
PHRO	85,309.03	36,552.82
UEGU	142,498.62	69,911.76
UETB	2,452.87	1,199.42
UEFL	126,530.13	62,105.29
UFCA	3,373.42	1,664.32
UEMU	105,603.33	51,793.82
Total	***37,564,405.86***	***9,407,819.42***

[1]Power plants acting as synchronous compensators and, therefore, the net generation considered is "DEL".
[2]Plants in which Tractebel Energia does not have 100% equity interest

It is important to mention that the methodology for calculation of GHG emission reduction considered above was used only to enable the accounting of emission reductions. However, the calculations do not indicate and/or demonstrate compliance of eligibility criteria and additionality for obtaining carbon credits under the CDM, with exception of UETR, UEGU, UEFL and UEMU, who already are registered CDM projects.

b) **Sinkholes by Forest Planting**

Removals of CO_2 by sinkholes, or CO_2 sequestration, are estimated in General from the formulas below[1].

$$\Delta C_G = \sum_{i,j} \left(A_{i,j} \cdot G_{TOTALi,j} \cdot CF_{i,j} \right)$$

$$G_{TOTAL} = \sum \left\{ G_W \cdot (1 + R) \right\}$$

Where:

ΔCG =	Stock biomass, tC
$A_{I,j}$ =	Area, ha
$G_{TOTALi,j}$ =	Average increment, $t_{dry\ matter}$/ha/year
$CF_{I,j}$ =	Carbon fraction in dry matter, tC/$t_{dry\ matter}$ (default value[2]= 0,47)
G_W =	Average increment on above-ground biomass $t_{dry\ matter}$/ha
R =	Shoot/root ratio, dry tmatéria on biomass below ground/dry t-matter on above-ground biomass.

For simplification and conservatism, R is assumed to be equal to zero (only the aboveground biomass carbon fixing). For the determination of carbon stocks in the areas of planted forests it is necessary to know which type of forest cover is being parsed (native forest, planted forest, pasture, field, etc), in addition to the knowledge of the time of planting of each area. Whereas planting activities conducted by Tractebel Energia are performed with native trees (forestry and fruit) and creeping vegetation cover, the calculations of CO_2 sequestration was calculated based on the IPCC default data (2006)[3] of 150 tonnes of dry matter/ha and 0.47 tonnes of carbon/dry matter. Like this:

ΔCG = A × 150 × 0.47 × 44/12 = A × 258.5 tCO_2

Considering the acreage data, provided by Tractebel Energia plants, it was possible to calculate GHG emission reductions according to the following tables. It is important to mention that only voluntary planting (which does not require legal obligation) were considered in the analysis.

[1]IPCC (2006). Guidelines for National Greenhouse Gas Inventories-Volume 4 – Agriculture, Forestry and Other Land Use.
[2] IPCC (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry.
[3] IPCC (2006). Guidelines for National Greenhouse Gas Inventories-Volume 4 – Agriculture, Forestry and Other Land Use. Chapter 4, page 4.63.

Table 79 -GHG emission reduction of planting of Tractebel Energia – Operational Control

Plants/Offices	Planted area (ha)	Emission reduction (tCO2e)
CTJL	13.24	3,422.54
UTWA	-	-
UTCH	-	-
UTFE	-	-
UCLA	-	-
UHSO	2.14	552.67
UTIB	-	-
UHSS	5.29	1,366.43
UHPF	19.55	-
HEADQUARTERS	-	-
UEBB	0.24	63.28
UETR	0.72	187.36
UHSA	16.20	4,187.29
UHPP	-	-
UHCB	7.84	2,025.89
UTAL	-	-
PHAB	-	-
PHJG	-	-
LIFO	-	-
PHRO	-	-
UEGU	-	-
UETB	-	-
UEFL	-	-
UFCA	-	-
UEMU	-	-
ESP	-	-
Total	65.22	11,805.46

Table 80 -GHG emission reduction of planting of Tractebel Energia Corporate Participation

Plants/Offices	Planted area (ha)	Emission reduction (tCO2e)
CTJL	13.24	3,422.54
UTWA	-	-
UTCH	-	-
UTFE	-	-
UCLA	-	-
UHSO	2.14	552.67
UTIB *	-	-
UHSS	5.29	1,366.43
UHPF	19.55	-
HEADQUARTERS	-	-
UHMA *	-	-
UHET *	7.34	0,00
UEBB	0.24	63.28
UETR	0.72	187.36
UHSA	16.20	4,187.29
UHIT *	7.32	0,00
UHPP	-	-
UHCB	7.84	2,025.89
UTAL	-	-
PHAB	-	-
PHJG	-	-
LIFO	-	-
PHRO	-	-
UEGU	-	-
UETB	-	-
UEFL	-	-
UFCA	-	-
UEMU	-	-
ESP	-	-
CTJL	79.88	11,805.46

* Plants that Tractebel Energia does not have 100% equity interest

Annex VII. Total emissions of UHET, UHIT and UHMA

In the case of hydroelectric plants (UHET) Estreito, Machadinho (UHMA) and Itá (UHIT), Tractebel Energia has no Operational Control and that this report only reported emissions of these plants in proportion to equity participation of Tractebel Energia, and below we present these GHG emissions power plants.

→ **Estreito (UHET)**

During 2015, issued a total of 492.51 UHET tCO_2e distributed in 1, 2 and 3 Scopes as shown in the figure below.

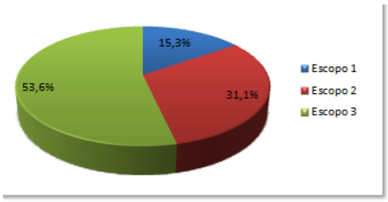

Figure 147 – Representation of GHG emissions of UHET by scope (100%)

Emissions by source type of scope 1 and 2 are presented in the figure below.

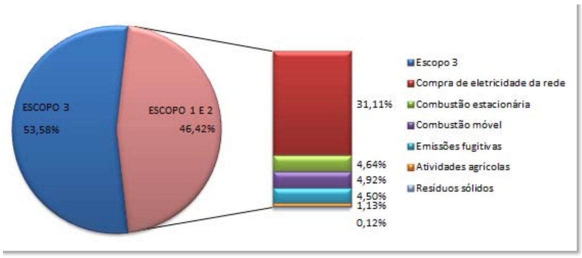

Figure 148 – Representation of GHG emissions from source UHET (100%)

In 2015, emissions of CO_2 from the combustion of biomass resulted in 42.64 tCO2 and 0.05 t R-22 non-Kyoto gas.

The greenhouse gas emissions are detailed in the table below.

Table 81 – GHG emissions of 100% of emissions – UHET (in tonnes)

Emission sources	CO2	CH4	N2O	SF6	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1							
Stationary combustion	24.18	0.001	0.0002		24.26	1.62	
Mobile combustion	24.95	0.01	0.002		25.73	12.81	
Processes							
Fugitive emissions	0.70	0.00	0.00	0.001	23.50		0.05
Agricultural activities	0.00	0.00	0.02		5.92	0.00	
Solid wastes	0.00	0.02	0.00		0.60	0.00	
Total Scope 1	49.83	0.03	0.02	0.00	80.01	14.43	0.05
Scope 2							
Purchased electricity from the grid	132.50				132.50		
Scope 3							
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	142.85	0.04	0.01		147.79	25.84	
Waste generated in operations	0.00	0.06	0.00		1.62	0.00	
Business travels	121.71	0.003	0.004		123.08	1.85	
Employees transportation (home-work)	7.38	0.0005	0.0004		7.51	0.52	
Transport and distribution (downstream)	0.00	0.00	0.00		0.00	0.00	
Total Scope 3	271.94	0.11	0.02	0.00	280.00	28.21	0.00
Total emissions	454.27	0.14	0.04	0.00	592.51	42.64	0.05

→ **Itá (UHIT)**

During 2015, the UHIT issued a total of 160.84 tCO_2e distributed in 1, 2 and 3 Scopes, as shown in the figure below.

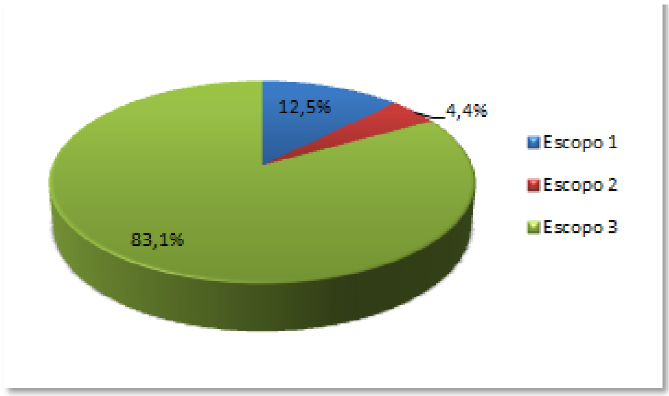

Figure 149 - Representation of GHG emissions the UHIT by scope (100%)

Emissions by source type of scope 1 and 2 are presented in the figure below.

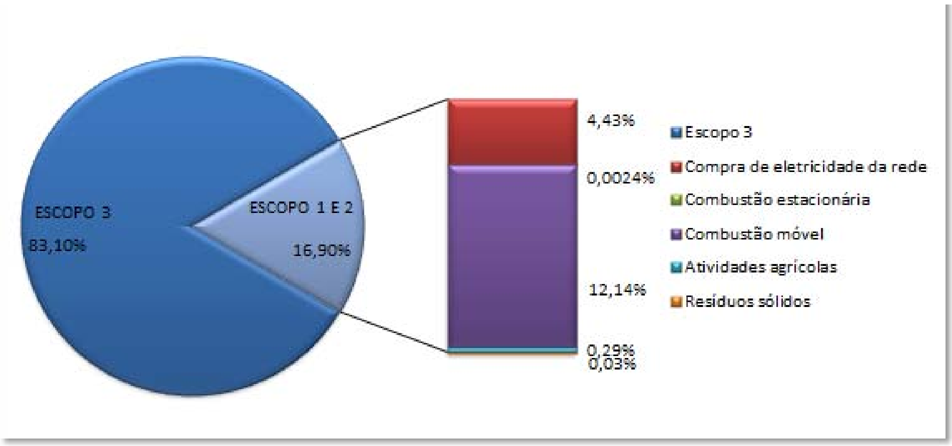

Figure 150 -Representation of GHG emissions the UHIT by source (100%)

CO_2 emissions from combustion of biomass resulted in 27.90 tCO_2 and the non-Kyoto gases emissions resulted in 0.02 t R-22.

The greenhouse gas emissions are detailed in the table below.

Table 82-GHG emissions the UHIT 100% of emissions – (in tonnes)

Emission sources	CO2	CH4	N2O	CO2e	CO2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0.004	0.00	0.00	0.004	0.0003	
Mobile combustion	19.13	0.01	0.001	19.69	12.25	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.02
Agricultural activities	0.00	0.00	0.002	0.47	0.00	
Solid wastes	0.00	0.001	0.00008	0.05	0.00	
Total Scope 1	19.14	0.006	0.003	20.21	12.25	0.02
Scope 2						
Purchased electricity from the grid	5.89			5.89		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	57.49	0.02	0.01	59.64	11.61	
Waste generated in operations	0.00	0.40	0.00	10.09	0.00	
Business travels	23.22	0.002	0.001	23.61	1.19	
Employees transportation (home-work)	40.67	0.003	0.002	41.39	2.86	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	121.38	0.43	0.01	134.73	15.66	0.00
Total emissions	146.41	0.43	0.01	160.84	27.90	0.02

→ **Machadinho (UHMA)**

During 2014, UHMA issued a total of 4,927.89 tCO_2e distributed in Scopes 1, 2 and 3 as shown in the figure below.

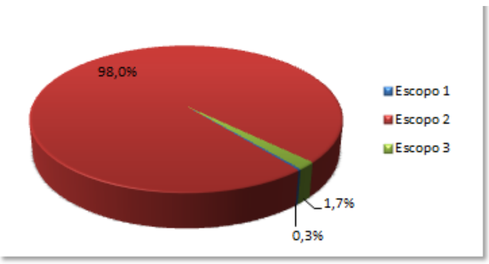

Figure 151 – Representation of GHG emissions of per-scope UHMA (100%)

Emissions by source type of scope 1 and 2 are presented in the figure below.

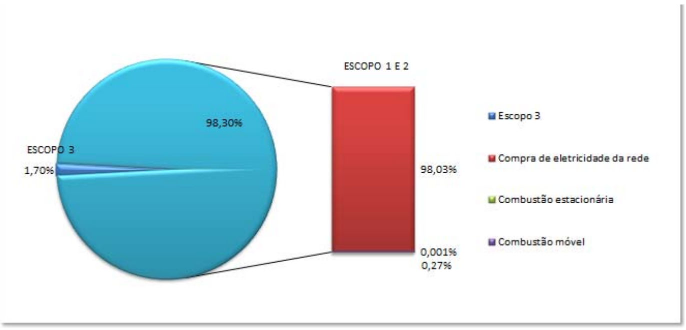

Figure 152 – Representation of GHG emissions from source UHMA (100%)

CO_2 emissions from combustion of biomass resulted in 14.86 tCO_2 and the non-Kyoto gases on UHMA resulted in 0.01 t R-22.

The greenhouse gas emissions are detailed in the table below.

Table 83 -GHG emissions of UHMA-100% of the emissions (in tonnes)

Emission sources	CO_2	CH_4	N_2O	CO_2e	CO_2 from biomass	Non-Kyoto gases
Scope 1						
Stationary combustion	0.03	0.00	0.00	0.034	0.00	
Mobile combustion	12.94	0.003	0.001	13.26	6.24	
Processes						
Fugitive emissions	0.00	0.00	0.00	0.00		0.01
Agricultural activities	0.00	0.00	0.00	0.00	0.00	
Solid wastes	0.00	0.00	0.00	0.00	0.00	
Total Scope 1	12.98	0.003	0.00	13.29	6.24	0.01
Scope 2						
Purchased electricity from the grid	4,831.03			4,831.03		
Scope 3						
Fuel and energy-related activities not included in Scope 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	27.82	0.01	0.003	28.85	5.48	
Waste generated in operations	0.00	0.36	0.00	8.89	0.00	
Business travels	1.09	0.0001	0.0001	1.11	0.05	
Employees transportation (home-work)	43.94	0.003	0.002	44.72	3.09	
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	
Total Scope 3	72.85	0.367	0.005	83.56	8.62	0.00
Total emissions	4,916.86	0.37	0.01	4,927.89	14.86	0.01

Annex VIII. Global warming potential of greenhouse gases and non-Kyoto gases

The Global warming potential (GWP) is presented in the table below.

Table 84 – Global warming Power of greenhouse gases

Gas	Family/Type	GWP
Carbon dioxide (CO2)	-	1
Methane (CH4)	-	25
Nitrous oxide (N2O)	-	298
HFC-23	HFC	14,800
HFC-32	HFC	675
HFC-41	HFC	92
HFC-125	HFC	3,500
HFC-134	HFC	1,100
HFC-134a	HFC	1,430
HFC-143	HFC	353
HFC-143a	HFC	4,470
HFC-152	HFC	53
HFC-152a	HFC	124
HFC-161	HFC	12
HFC-227ea	HFC	3,220
HFC-236cb	HFC	1,340
HFC-236ea	HFC	1,370
HFC-236fa	HFC	9,810
HFC-245ca	HFC	693
HFC-245fa	HFC	1,030
HFC-365mfc	HFC	794
HFC-43-10mee	HFC	1,640
Sulphur hexafluoride (SF6)	-	22,800
Nitrogen trifluoride (NF3)	-	17,200
PFC-14	PFC	7,390
PFC-116	PFC	12,200
PFC-218	PFC	8,830
PFC-318	PFC	10,300
PFC-3-1-10	PFC	8,860

Gas	Family/Type	GWP
PFC-4-1-12	PFC	9,160
PFC-5-1-14	PFC	9,300
PFC-9-1-18	PFC	7,500
TRIFLUOROMETHYL SULFUR PENTAFLUORIDE	PFC	17,700
PERFLUOROPROPANE	PFC	17,340
R-400	Compound	0
R-401A	Compound	16
R-401B	Compound	14
R-401C	Compound	19
R-402A	Compound	2,100
R-402B	Compound	1,330
R-403A	Compound	1,766
R-403B	Compound	3,444
R-404A	Compound	3,922
R-406A	Compound	0
R-407A	Compound	2,107
R-407B	Compound	2,804
R-407 C	Compound	1,774
R-407D	Compound	1,627
R-407E	Compound	1,552
R-407F	Compound	1,825
R-408A	Compound	2,301
R-409A	Compound	0
R-409B	Compound	0
R-410A	Compound	2,088
R-410B	Compound	2,229
R-411A	Compound	14
R-HORN	Compound	4
R-412A	Compound	442
R-413A	Compound	2,053
R-414A	Compound	0
R-414B	Compound	0
R-WITH A 415 A	Compound	22
R-415 BAKER	Compound	93

Gas	Family/Type	GWP
R-416A	Compound	844
R-417A	Compound	2,346
R-417B	Compound	3,027
R-417C	Compound	1,809
R-418A	Compound	3
R-419A	Compound	2,967
R-419B	Compound	2,384
R-420A	Compound	1,258
R-421A	Compound	2,631
R-421B	Compound	3,190
R-422A	Compound	3,143
R-422B	Compound	2,526
R-422C	Compound	3,085
R-422D	Compound	2,725
R-422E	Compound	2,592
R-000 P	Compound	2,280
R-424A	Compound	2,440
R-425Â	Compound	1,505
R-426A	Compound	1,508
R-427A	Compound	2,138
R-428A	Compound	3,607
R-429A	Compound	12
R-430A	Compound	94
R-431A	Compound	36
R-432A	Compound	0
R-433A	Compound	0
R-434A	Compound	3,245
R-435A	Compound	25
R-436A	Compound	0
R-436B	Compound	0
R-437A	Compound	1,805
R-438A	Compound	2,264
R-439A	Compound	1,983
R-440A	Compound	144

Gas	Family/Type	GWP
R-441A	Compound	0
R-442A	Compound	1,888
R-443A	Compound	0
R-444A	Compound	87
R-...	Compound	129
R-500	Compound	32
R-501	Compound	0
R-502	Compound	0
R-503	Compound	5,935
R-504	Compound	325
R-505	Compound	0
R-506	Compound	0
R-507 or R-507A	Compound	3,985
R-508A	Compound	13,214
R-508B	Compound	13,396
R-or R-509A 509	Compound	4,945
R-510A	Compound	0
R-511A	Compound	0
R-512A	Compound	189
R-12 (CFC -12)	CFC	10,900
R-124 (HCFC 124)	HCFC	609
R-22 (HCFC -22)	HCFC	1,810