SGS

Statement BR14/8260

Greenhouse Gas Verification Statement

The inventory of Greenhouse Gas emissions in 2014 of

Tractebel Energia S.A

Rua Phascoal Apostolo Pítsica, nº5064
Florianópolis – SC – 88025-255 – BR

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

ISO 14064-1:2007 e Programa Brasileiro GHG Protocol

For the following activities:

"Electricity Generation"

Authorized by

Vanda Nunes
Director
Date: 4 April 2015

SGS ICS Certificadora Ltda.
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Inventário GEE - OVV
OVV 0007

This Statement is not valid without the full Greenhouse Gas Assertion and the verification scope, objectives, criteria and findings available on pages 1 to 9 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 in accordance with

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 2014.

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 2014.

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 2014. The verification was based on the verification scope, objectives and criteria as agreed between TRACTEBEL Energia S.A. and SGS on 23 to 27/03/2015.

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 2014 arising from Electricity Generation 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 hypothetical, projected and/or historical in nature.

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.

Inventário GEE - OVV

OVV 0007

This Statement is not valid without the full Greenhouse Gas Assertion and the verification scope, objectives, criteria and findings available on pages 2 to 9 of this Statement.

The organizational boundary was established following operational control approach.
Title or description activities: Electricity Generation.
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; e, NF_3.
Directed actions: N.A.
GHG information for the following period was verified: 2014.
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 of 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 2014 disclosing emissions of 6.413.949,50 metric tonnes of CO2 equivalent (operational control) and 6.415.233,72 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.

Inventário GEE - OVV
OVV 0007

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

Emissions Source							
Scope 1	CO_2	CH_4	N_2O	HFC	PFC	SF_6	CO_2e
Stationary combustion	6.311.343,55	355,18	128,66	-	-	-	6.358.562,58
Mobile combustion	655,11	0,13	0,04	-	-	-	671,54
Process	4.120,11	0,00	0,00	0,00	0,00	0,00	4.120,11
Fugitive emissions	5,26	0,00	0,00	0,01	0,00	0,00	26,14
Agricultural activities	0,00	0,00	0,02	-	-	-	4,63
Waste	0,00	0,01	0,00	-	-	-	0,37
Total Scope 1	**6.316.124,03**	**355,32**	**128,72**	**0,01**	**0,00**	**0,00**	**6.363.385,37**
Scope 2							
Grid electricity purchase	**18.711,25**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**18.711,25**
Scope 3							
Activities related with fuel and energy not included in Scopes 1 and 2	1.641,27	0,03	0,00	0,00	0,00	0,00	1.642,86
Transport and distribution (upstream)	18.350,53	1,24	1,00	-	-	-	18.679,86
Waste from operation	0,00	19,92	0,01	-	-	-	502,26
Business travel	652,96	0,04	0,03	-	-	-	662,60
Employees shift (house – work)	338,27	0,03	0,02	-	-	-	345,10
Transport and distribution (downstream)	9.847,70	0,60	0,53	-	-	-	10.020,20
Total Scope 3	**30.830,74**	**21,86**	**1,60**	**0,00**	**0,00**	**0,00**	**31.852,87**
Total emissions	***6.365.666,02***	***377,18***	***130,31***	***0,01***	***0,00***	***0,00***	***6.413.949,50***

(Source: GHG Inventory Report f 2014 Version 3, 31/03/2015 – table 78).

Inventário GEE - OVV

OVV 0007

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

Emissions Source	CO_2	CH_4	N_2O	HFC	PFC	SF_6	CO_2e
Scope 1							
Stationary combustion	6.311.349,07	337,10	126,24	-	-	-	6.357.397,51
Mobile combustion	676,87	0,13	0,05	-	-	-	693,97
Process	4.120,11	0,00	0,00	0,00	0,00	0,00	4.120,11
Fugitive emissions	5,31	0,00	0,00	0,01	0,00	0,05	1.170,04
Agricultural activities	0,00	0,00	0,04	-	-	-	11,21
Waste	0,00	0,01	0,00	-	-	-	0,37
Total Scope 1	**6.316.151,35**	**337,24**	**126,33**	**0,01**	**0,00**	**0,05**	**6.363.393,22**
Scope 2							
Grid electricity purchase	**19.670,31**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**19.670,31**
Scope 3							
Activities related with fuel and energy not included in Scopes 1 and 2	1.641,27	0,03	0,00	0,00	0,00	0,00	1.642,86
Transport and distribution (upstream)	18.467,88	1,26	1,01	-	-	-	18.800,61
Waste from operation	0,00	19,96	0,01	-	-	-	503,31
Business travel	707,98	0,04	0,03	-	-	-	718,35
Employees shift (house – work)	475,63	0,04	0,03	-	-	-	484,87
Transport and distribution (downstream)	9.847,70	0,60	0,53	-	-	-	10.020,20
Total Scope 3	**31.140,46**	**21,93**	**1,62**	**0,00**	**0,00**	**0,00**	**32.170,20**
Total emissions	***6.366.962,12***	***359,17***	***127,95***	***0,01***	***0,00***	***0,05***	***6.415.233,72***

(Source: GHG Inventory Report f 2014 Version 3, 31/03/2015 – table 79).

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 2014 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 2014 Versão 3, 31/03/2015) as a whole.

Note: This Statement is issued, on behalf of Client, by ***SGS ICS Certificadora Ltda*** ("SGS") under its General Conditions for Green Gas Verification Services available at http://www.sgs.com/terms_and_conditions.htm. The findings recorded hereon are based upon an audit performed by SGS. A full copy of this statement, the findings and the supporting GHG Assertion may be consulted at **TRACTEBEL Energia S.A.** This Statement does not relieve Client from compliance with any bylaws, federal, national or regional acts and regulations or with any guidelines issued pursuant to such regulations. Stipulations to the contrary are not binding on SGS and SGS shall have no responsibility vis-à-vis parties other than its Client.

ANNEX A – LIST OF UNITS INCLUDED IN THE SCOPE

OFFICE/UNIT	ADRESS
Sede da Tractebel Energia **SEDE**	**Rua Pascoal Apóstolo Pitsica,5064 Dib Mussi,366 Agronômica Cep: 88025-225 Florianópolis - SC**
Escritório da Tractebel Energia **Escritório SP**	**Alameda Santos, 905, 4º , Cerqueira Cesar CEP: 01.419-001 São Paulo – SP**
Complexo Termelétrico **CTJL**	**Av. Paulo Santos Mello s/nº, Jorge Lacerda, Centro, Cep:88745-000 Capivari de Baixo , SC**

Inventário GEE - OVV

OVV 0007

Usina Termelétrica Charqueadas UTCH	Rua Geólogo White,s/n Centro, Cep: 96745-000 Charqueadas - RS
Usina Termelétrica Alegrete UTAL	Rua João Galant, s/nº Ibirapuitã, CEP: 97.546-330 Alegrete – RS
Usina Termelétrica William Arjona UTWA	Rod.BR 060, s/nº Estr.Vicinal,Distrito Imbirissu, Cep:79115-540 Campo Grande - MS
Usina Termelétrica Ibitiúva Bioenergética UTIB	Fazenda Piratininga, s/n º Pitangueiras CEP: 14.750-000 Pitangueiras – SP
Usina Termelétrica Ferrari/Ferrari Termoelétrica S/A UTFE	Fazenda da Rocha, s/nº 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 Rua Geólogo White, s/nº 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 442,5 CEP: 85.568-000 Saudade do Iguaçu – PR

Usina Hidrelétrica Salto Osório UHSO	Rodovia PR 473, Km 33 CEP: 85.575-000 São Jorge D'Oeste – PR
Usina Hidrelétrica Passo Fundo UHPF	Usina Hidrelétrica Passo Fundo, s/nº, Cep: 99645-000 Entre Rios do Sul - RS
Usina Hidrelétrica Cana Brava UHCB	UHE – Cana Brava, Zona Rural Cana Brava, Cep: 73790-000 Cavalcante - GO
Usina Hidrelétrica São Salvador UHSA	Rod. TO 387 PRN São Salvador Km 40 à Esquerda + 20 Km Zona Rural, Cep: 77360-000 Paranã - TO
Usina Hidrelétrica Estreito UHET	Rodovia BR 230, Km 8, s/nº Zona Rural, Cep: 65975-000 Estreito - MA
Usina Hidrelétrica Ponte de Pedra UHCB	Estr UHE – Ponte de Pedra, s/nº Zona Rural, Cep: 78790-000 Itiquira - MT
PCH Areia Branca PHAB	Fazenda Cachoeira Bonita, s/nº Santo Antonio do Manhuaçu Zona Rural, Cep: 35321-000 Caratinga - MG
PCH José Gelásio PHJG	Rodovia BR 163 Km 102, s/nº Ribeirão de Ponte de Pedra Zona Rural, Cep:78740-275 Rondonópolis - MT
PCH Rondonópolis PHRO	Rodovia BR 163 Km 102, s/nº Ribeirão de Ponte de Pedra Zona Rural, Cep:78740-275 Rondonópolis - MT

Usina/Central Eólica Beberibe UEBB	Fazenda Uberaba, s/n, Praia das Fontes, CEP: 62.840-000 Beberibe – MT
Usina/Central Eólica Pedra do Sal UEPS	Praia Pedra do Sal, s/nº Zona Rural, Cep: 64200-000 Parnaíba - Piauí
Usina/Central Eólica Guajirú UEGU	Sítio Manguinhos, s/nº Manguinhos, cep: 62690-000 Trairi – CE
Usina/Central Eólica Mundaú UEMU	Fazenda Boca da Mata, s/nº Zacarias, Cep: 62690-000 Trairi – CE
Usina/Central Eólica Fleixeiras I UEFL	Sítio Canaã, s/nº Canaã, Cep: 62690-000 Trairi – CE
Usina/Central Eólica Trairi UETR	Sítio Estrela, s/nº Sítio Estrela, Cep: 62690-000 Trairi – CE
Usina Fotovoltaica Cidade Azul UFCA	BR 101, s/nº - Km 329 Revoredo, Cep: 88704-700 Tubarão – SC

Inventário GEE - OVV

OVV 0007

eQAO

REPORT

GREENHOUSE GAS EMISSIONS INVENTORY OF 2014 YEAR

Tractebel Energia S/A

Adelino Ricardo Jacintho Esparta
Technical Director

March 31st, 2015

Version 3

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Table of Contents

List of Figures

List of Tables

1. Abbreviations and Acronyms

AMA	Environment Unit of Tractebel Energia (from the Portuguese Unidade Organizacional de Meio Ambiente da Tractebel Energia)
AR4	IPCC Fourth Assessment Report (2007)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CEUT	Utilities Center of Tractebel Energia (from the Portuguese Central de Utilidades da Tractebel Energia)
CH_4	Methane
CO_2	Carbon dioxide
DEFRA	Department for Environment, Food and Rural Affairs
DJU	Legal Affairs Unit of Tractebel Energia (from the Portuguese Unidade Organizacional Assuntos Jurídicos)
DOC	Degradable Organic Carbon
DOP	Production Operating Unit of Tractebel Energia (from the Portuguese Unidade Organizacional de Operação da Produção da Tractebel Energia)
DPS	Document, Supply and General Services Unit of Tractebel Energia (from the Portuguese Unidade Organizacional de Documentação, Suprimentos e Serviços Gerais da Tractebel Energia)
GHG	Greenhouse Gas
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
MAPA	Brazilian Ministry of Agriculture, Livestock, and Supply ("MAPA" from the Portuguese Ministério da Agricultura, Pecuária e Abastecimento)
MCTI	Brazilian Ministry of Science, Technology and Inovation ("MCTI"

	from the Portuguese Ministério de Ciencia, Tecnologia e Inovacão)
N_2O	Nitrous oxide
NF_3	Nitrogen trifluoride
PFCs	Perfluorocarbons
RC	Tractebel Energia responsible person for data collection for the greenhouse gas inventory
SAR	IPCC Second Assessment Report (1995)
SEPRE	Energy Production Unit of Tractebel Energia (from the Portuguese Setor de Produção de Energia da Tractebel Energia)
SESMT	Security and Occupational Work Unit of Tractebel Energia (from the Portuguese Setor de Segurança e Medicina do Trabalho da Tractebel Energia)
SF_6	Sulphur hexafluoride
SIN	National Interconnected System (from the Portuguese Sistema Interligado Nacional)
TMSH	Hydropower Plant Maintenance Unit of Tractebel Energia (from the Portuguese Unidade Organizacional Central de Manutenção de Hidrelétricas da Tractebel Energia)
TMSS	Maintenance System Center Unit of Tractebel Energia (from the Portuguese Unidade Organizacional Central de Manutenção de Sistemas da Tractebel Energia)
TMST	Thermoelectric Power Plant Maintenance Unit of Tractebel Energia (from the Portuguese Unidade Organizacional Central de Manutenção de Termelétricas da Tractebel Energia)
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WMO	World Meteorological Organization
WRI	World Resources Institute

2. Summary of 2014 Results

Greenhouse Gas Emissions (in tCO_2e)

Emissions sources	Control approach 2014	Equity share approach 2014
Scope 1		
Stationary combustion	6,358,562.58	6,357,397.51
Mobile combustion	671.54	693.97
Process	4,120.11	4,120.11
Fugitive emissions	26.14	1,170.04
Farming activities	4.63	11.21
Solid waste	0.37	0.37
Total Scope 1	**6,363,385.37**	**6,363,393.22**
Scope 2		
Purchased electricity from the grid	**18,711.25**	**19,670.31**
Scope 3		
Fuel and energy activities not included in Scopes 1 and 2	1,642.86	1,642.86
Transport and distribution (upstream)	18,679.86	18,800.61
Solid waste from operations	502.26	503.31
Business travel	662.60	718.35
Employees transportation (home - work)	345.10	484.87
Transport and distribution (downstream)	10,020.20	10,020.20
Scope 3	**31,852.87**	**32,170.20**
Total emissions	**6,413,949.50**	**6,415,233.72**
Biomass emissions (tCO_2)	**941,304.07**	**882,667.28**
Non-Kyoto Gas (tCO_2e)	**279.39**	**325.59**

3. Introduction

Tractebel Energia, in accordance with its Climate Change Policy, in the same way that focuses and develops renewable energy projects (including the ones under the Clean Development Mechanism – CDM) and research and development (R&D), as well as other intrinsic actions, it is preparing, since 2010, its annual greenhouse gas (GHG) inventory.

It is an important strategic corporate tool in a context of climate change that allows the company knows better its processes, at the same time that assesses and improves its management system related to GHG.

The inventory incorporates all its 26 operational power plants during 2014 year, located in twelve Brazilian states, and its administrative headquarters and its Energy Commercialization office, located in Florianópolis (SC) and São Paulo capital, respectively, totaling 28 organizational units considered in this study.

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

In its constant search for the highest sustainability standards, and using the inventory as an important management tool, Tractebel Energia inserted its collecting GHG data in its Integrated Management System for application in all operational power plants and offices previously mentioned.

As in previous years, in 2015, Tractebel Energia contracted SGS, a renowned company in the country regarding GHG Inventory auditing in the Energy Sector – and accredited for it, by INMETRO–, in order to attest quality and credibility in its 2014 GHG inventory and its associated quality management system.

This report presents the Tractebel Energia GHG Inventory of the year of 2014, presenting the GHG emissions of the company and its organizational units – operational power plants (26) and its offices (2) –, distributed in Scopes 1, 2 and 3, as well as other related information.

[1] From the Portuguese “Programa Brasileiro GHG Protocol”.

4. Tractebel Energia S.A.

Corporate name: Tractebel Energia S.A.

CNPJ (Brazilian Tax Corporation Registration number): 02.474.103/0001-19

Economic Sector: Electricity and gas

Sub-sector: Electricity, gas and utilities

Scope: Operational power plants of electricity generation and commercialization.

Address: R. Paschoal Apóstolo Pítsica, nr. 5064, 88025-255, Florianópolis, SC

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

Institutional information:

Tractebel Energia operates electricity generating power plants, being also an active agent of electricity commercialization. The largest private power generator in Brazil, with headquarters in Florianópolis, Santa Catarina state, and power plants located in the five regions of Brazil, precisely 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 2014, Tractebel Energia's generating complex included 26 (twenty six) operational plants: 6 (six) wind, 9 (nine) hydroelectric, 3 (three) small hydro and 7 (seven) thermal power plants, which three of their thermoelectrics are operated with biomass (sugarcane bagasse and wood waste).

Tractebel Energia is controlled by GDF SUEZ Energy Latin America Participações Ltda. (a subsidiary of GDF-SUEZ, a world leader in energy), which holds 68.71% of its capital share.

Based on the vision of being, in a sustainable way, the best energy company in Brazil, Tractebel Energia, in line with its Climate Change Policy, held its first GHG emissions inventory in 2011 - referring to 2010 operations - following the principles of the GHG Protocol. The objectives of the company are to identify the GHG emission sources, quantify emissions and use the inventory as a management and decision making tool.

5. Responsible Company and Professionals in the Preparation of the Inventory

EQAO is the company responsible for preparing the 2014 GHG inventory of Tractebel Energia. The experience in advising carbon credit projects enabled EQAO to develop GHG inventories for companies interested in quantifying their GHG emissions. EQAO has experience in accounting emissions from industrial groups from small to large-sized companies such as cement, pulp and paper, glass manufacturing, chemical, power generation and distribution, mining and heavy civil construction.

Tractebel Energia has provided EQAO all necessary requested information for the preparation of the inventory.

Section 5.1 presents professionals involved from EQAO's side. Also, it presents professionals from Tractebel Energia, who provided information and centralized in Tractebel Energia as whole (AMA representatives), as well as in power plants and offices (RCs).

Besides of these professionals, representatives of Tractebel Energia from the DOP, DPS, DJU and power plants, from SEPRE, SESMT, CEUT and administrative sectors, as well as TMSH, TMST and TMSS, have an important contribution for the entire work.

5.1. Responsibility - EQAO

The responsible personnel for preparing the 2014 Tractebel Energia Inventory from EQAO's side are:

- Adelino Ricardo J. Esparta – EQAO director and founding partner – Coordinator of Tractebel Energia GHG Inventory;
- Karen Midori Nagai – EQAO Project Analyst;
- Renata de Oliveira Freitas – EQAO Project Analyst.

5.2. Responsibility - Tractebel Energia (AMA and RCs)

The following Tractebel Energia professionals from AMA, power plants and offices (as RCs), contributed for collecting data used in the GHG inventory for the year of 2014.

Table 1 – Tractebel Energia personnel responsible for data collection for the GHG inventory preparation of 2014 year

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	Clesio de Lima Silva	Civil Technician
UEGU	Liliana Dutra dos Santos	Chemical Engineer	Clesio de Lima Silva	Civil Technician
UEMU	Liliana Dutra dos Santos	Chemical Engineer	Clesio de Lima Silva	Civil Technician
UETR	Liliana Dutra dos Santos	Chemical Engineer	Clesio de Lima Silva	Civil Technician
UTFE	Liliana Dutra dos Santos	Chemical Engineer	Marcelo Delpizzo Caneschi	Environment and Utilities Coord.
UCLA	Liliana Dutra dos Santos	Chemical Engineer	Geovane Soares	Utilities Technician II
UTIB	Liliana Dutra dos Santos	Chemical Engineer	Marcelo Delpizzo Caneschi	Environment and Utilities Coord.
CTJL	Liliana Dutra dos Santos	Chemical Engineer	Marcelo Delpizzo Caneschi	Environment and Utilities Coord.
UTWA	Liliana Dutra dos Santos	Chemical Engineer	David Dilson Ferreira Paim	Shift Superviser
UTCH	Rita Tissot	Environmental Process Coord.	Simone Da Silva Guimarães	Utilities Technician
UTAL	Rita Tissot	Environmental Process Coord.	Simone Da Silva Guimarães	Utilities Technician
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.	Jonas Benedet	Environmental Technician
UHIT	Sérgio Luiz Souza	Environmental Process Coord.	Jonas Benedet	Environmental Technician
UHMA	Sérgio Luiz Souza	Environmental Process Coord.	Jonas Benedet	Environmental Technician
UFCA	Liliana Dutra dos Santos	Chemical Engineer	Marcelo Delpizzo Caneschi	Environment and Utilities Coord.

6. Methodology

6.1. Considered Gases

This report presents the results of the Greenhouse Gas Inventory of Tractebel Energia S/A regarding its operational activities in 2014. For this, the five gases and two gas families internationally recognized as greenhouse gases were considered in accordance with 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).

CH_4, N_2O, SF_6, NF_3, HFCs and PFCs emissions are expressed in CO_2e, considering the respective global warming potential (GWP) of each gas, according to the IPCC and ASHRAE reports. The GWP of each gas is presented in Annex III of this report.

In the case of Tractebel, the following gases were identified: **CO_2, CH_4, N_2O, SF_6 and HFC (R-410A)**. It is worth mentioning that **HCFCs (HCFC-22 or R-22)** emissions were also identified, although they are not considered by the Kyoto Protocol. Anyway, R-22 emissions were separately reported .

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 definition of the organization boundaries can be made by using 2 (two) approaches: the company's operational control or by its equity share of the emission source. The first approach includes, in the Inventory, all GHG emission sources from operations over which the company has control; the second considers emissions from operations proportionally to its equity share.

Table 2 - Summary of organizational boundaries

Approach	Criteria	Accounting for GHG emissions
Control	Authority over the emission source.	Emissions are considered if the company holds control over the emission source (100%), otherwise, emission source is disregarded (0%).
Equity share	Percentage of ownership.	GHG emissions are proportional to the percentage of ownership.

In the case of Tractebel Energia S/A, the inventory preparation was carried out considering the two approaches presented above. Thus, emissions of the following Tractebel Energia's operational units were considered.

Table 3 – Generation park of Tractebel Energia S.A.

Power plants / Offices	Acronym	Fuel / river	State	Instaled capacity (MW)	Institution that holds Operational Control	Tractebel's Equity Share
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%
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%
Passo Fundo Hydropower plant	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	PHJG	Ribeirão Ponte de	MT	24	Tractebel Energia	100%

Small Hydropower Plant		Pedra				
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%
Charqueadas Thermoelectric Power Plant	UTCH	Mineral Coal	RS	72	Tractebel Energia	100%
Ferrari Thermoelectric Power Plant	UTFE	Sugarcane Bagasse	SP	80.5	Tractebel Energia	100%
Ibitiúva Thermoelectric Power Plant	UTIB	Sugarcane Bagasse	SP	33	Tractebel Energia	69,26%
Jorge Lacerda Termoelectric Complex	CTJL	Mineral 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 Solar Power Plant	UFCA	Sun	SC	3	Tractebel Energia	100%
Tractebel Energia' office in São Paulo	ESP	-	SP	-	Tractebel Energia	100%
Tractebel Energia's headquarters (Florianópolis office)	Head Office	-	SC	-	Tractebel Energia	100%

6.2.2. Operational Boundaries

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

Table 4 - Scope of GHG emissions

Scope	Coverage
Scope 1: **Direct emissions**	Emissions source owned or controlled by the company.
Scope 2: **Indirect emissions**	Emissions from the generation of electric and/or thermal energy consumed by the company.
Scope 3: **Other indirect emissions**	Emission sources not owned or controlled by the company. The inclusion of these emissions is optional.
Biomass emissions	CO_2 emissions generated during the biomass combustion.

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

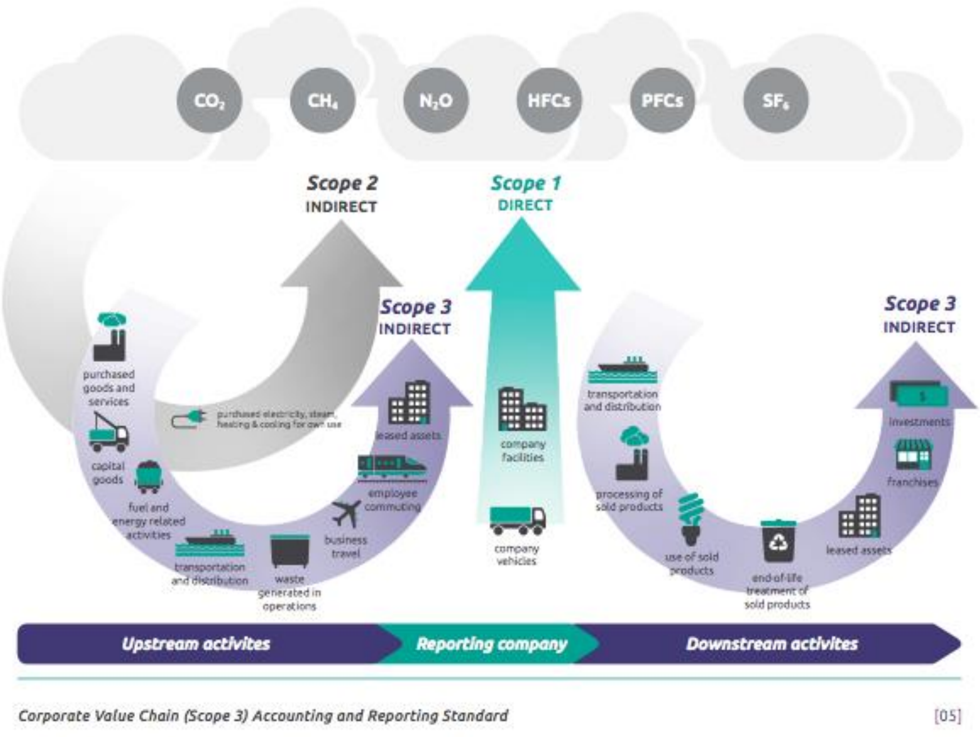


Figure 1 - Flow chart illustrating emission categories

Source: GHG Protocol (2011)

According to the GHG Protocol, Scope 3 emissions are not mandatory and shall not involve a complete GHG life cycle analysis of all operations of the company. Commonly, significant emissions under this scope are reported in the inventory only.

For reporting the greenhouse gas, the GHG Protocol establishes the following emission sources:

Table 5 - GHG emissions sources described in the GHG Protocol

Scope	Emission source	Definition
Scope 1	Stationary combustion	Stationary combustion for electricity, steam, heat or energy generation with the use of equipment in a fixed location.
	Mobile combustion	Mobile combustion for general transportation and vehicles out off road, as the ones used in construction, agriculture and forests.
	Fugitive emissions	Unintentional releases of substances as sulphur hexafluoride (SF_6) in electrical equipment, hydrofluorocarbons (HFCs) during the use of refrigerant equipment and air conditioning, and methane leak (CH_4) in the transportation/distribution of natural gas.
	Industrial process	Emissions other than combustion resulted from physical or chemical processes.
	Farming activities	Emissions from agricultural activities such as fertilizer use, vegetation burning and / or agricultural waste.
	Solid waste	Emissions from waste treatment in landfills, incineration or composting.
	Wastewater	Emissions from anaerobic wastewater treatment.
Scope 2	Electric energy purchase	Emissions from electric energy purchase.
	Thermal energy purchase	Emissions from thermal energy purchase.
Scope 3	Transport and distribution (*upstream*)	Emissions from transportation and distribution of products purchased or acquired through vehicles contracted by the organization.
	Solid waste from operations	Emissions from waste treatment in landfills, incineration or composting.

Scope	Emission source	Definition
	Wastewater generated in operations	Emissions from anaerobic wastewater treatment.
	Business travel	Emissions from the employees' transportation for activities related to the organization's business, such as aircraft, trains, buses, cars and boats.
	Transport and distribution (*downstream*)	Emissions from the transportation and distribution of products sold through vehicles not contracted by the organization.
	Fuel and energy activities not included in Scopes 1 and 2	Emissions related to fuels not included in the previous categories.
	Employees transportation (home - work)	Emissions from to employees' transportation from home to work.

In the case of Tractebel Energia, the following emission sources were identified:

Table 6 - GHG emission sources of the 2014 inventory

Scopes	Emission sources		Power plant / office
Scope 1	Stationary combustion	Boiler installed at thermoelectric power plants	UTAL, UTCH, CTJL, UTIB, UTWA, UCLA and UTFE
Scope 1	Stationary combustion	Chambers of combustion in power plant with turbine operated with gas	UTWA
Scope 1	Stationary combustion	Emergency diesel generator (emergency generators with diesel motor)	UHCB, UHET, UHPP, UHSO, UHSS, UHSA, PHAB, PHJG, PHRO, UTAL, UTCH UTIB, UCLA and Head Office
Scope 1	Stationary combustion	Instruments for boiler firing	UCLA
Scope 1	Stationary combustion	Forest Chipper	UCLA

Scopes	Emission sources		Power plant / office
Scope 1	Stationary combustion	Spillway diesel group	UHMA, UHIT and UHPF
Scope 1	Stationary combustion	Acetylene cylinders for equipment welding / maintenance	CTJL, UTCH, UHSA, UHMA, UTWA and UCLA
Scope 1	Mobile combustion	Rented vehicles permanently located at the company's facilities or under operational control of the company	UHCB, UHET, UHIT, UHMA, UHPF, UHPP, UHSO, UHSS, UHSA, UEBB, UEPS, UETR, PHAB, PHJG, PHRO, UTAL, UTCH, UTIB, CTJL, UCLA, UTWA and Head Office
Scope 1	Mobile combustion	Own vehicles (cars and boats)	UETR, UHCB, UHSO, UHSS, UHSA, CTJL and Head Office
Scope 1	Mobile combustion	Wheel loaders and forklifts owned by the company or leased under the company's control	CTJL, UCLA and UETR
Scope 1	Process	Desulfurization (desulphuriser)	UTCH
Scope 1	Fugitive	Air conditioning	Head Office
Scope 1	Fugitive	SF_6 equipment	UHET and UHIT
Scope 1	Fugitive	CO_2 fire extinguishers	UHET, UHSO, UHSS, UHSA, UEPS, UTAL, UTCH, CTJL, UTIB UCLA, UTWA and Head Office
Scope 1	Fugitive	Acetylene cylinders for equipment welding / maintenance	UCLA
Scope 1	Farming activities	Fertilizers use	UHCB, UHIT, UHET, UHMA, UHPF, UHPP, UHSO, UHSS, UTIB and CTJL
Scope 1	Solid waste	Aerobic composting	UHPP
Scope 2	Energy purchase	Electricity consumption from the grid	All
Scope 3	Fuel and energy activities not	Stationary combustion equipment that the company has no operating	UHSS

Scopes	Emission sources		Power plant / office
	included in Scopes 1 and 2	control (compressors)	
Scope 3	Fuel and energy activities not included in Scopes 1 and 2	Trimmers / chainsaws	UHSS and UHSO
Scope 3	Transport and distribution (*upstream*)	Rented vehicles used to transport people, raw materials and / or products / by-products contracted by the company	UHCB, UHET, UHIT, UHMA, UHPF, UHPP, UHSO, UHSS, UHSA, UEBB, UEPS, PHAB, PHJG, PHRO, UTAL, UTCH, CTJL, UTIB and UCLA
Scope 3	Business travel	Air travel	UEBB, UEPS, UETR, UHCB, UHET, UHIT, UHMA, UHPF, UHPP, UHSO, UHSS, UHSA, UTAL, UTCH, CTJL, UCLA, UTWA, Head Office and ESP
Scope 3	Business travel	Any employee travel on rented vehicles	UEBB, UEPS, UHCB, UHET, UHMA, UHIT, UHPF, UHPP, UHSO, UHSS, UHSA, UTAL, UTCH, CTJL, UCLA, UTWA, Head Office and ESP
Scope 3	Solid waste	Waste disposed in landfills	UHCB, UHET, UHIT, UHMA, UHPF, UHSO, UHSS, UHSA, UEBB, UEPS, UTAL, UTCH, UTIB, CTJL, UCLA, UTFE and UTWA
Scope 3	Solid waste	Aerobic composting	UHSS, PHAB, PHJG, CTJL and Head Office
Scope 3	Employees transportation (home – work)	Vehicles used for employees transportation (home – work)	PHJG, PHRO, UHCB, UHET, UHMA, UHIT, UHPF, UHPP, UHSO, UHSS, UHSA, CTJL, UCLA and UTWA

Scopes	Emission sources		Power plant / office
Scope 3	Transport and distribution (*downstream*)	Rented vehicles used to transport people, raw materials and / or products / by-products not contracted/paid by the company	UTCH and CTJL
Biomass emissions	CO_2 emissions generated from the biomass combustion	Biodiesel, ethanol, wood waste and sugarcane bagasse combustion	UTIB, UCLA, UTFE and other utilities with consumption of diesel oil, gasoline and ethanol (mobile and stationary combustion)

GHG emissions from hydropower plant reservoirs were not considered. According to ELETROBRÁS (2012), there is no "international scientific consensus regarding a methodology that allows the GHG emissions estimation in these reservoirs and calculates emission balance (or net emissions) of water bodies".

In the case of gases not listed in the Kyoto Protocol, but regulated by the Montreal Protocol, only one gas used in the Tractebel units was identified, R-22. This gas was used in 2014 year in the following units:PHJG, UHCB, UHET, UHIT, UHMA, UHPF, UHPP, UHSA, CTJL, UCLA, UTIB and UTWA.

While comparing the emission sources considered in 2013 year, it was possible to observe fugitive SF_6 emissions in 2014 year considered in Scope 1. Similarly to 2013, there were no GHG emissions due to incineration of waste in Scope 3.

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

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.

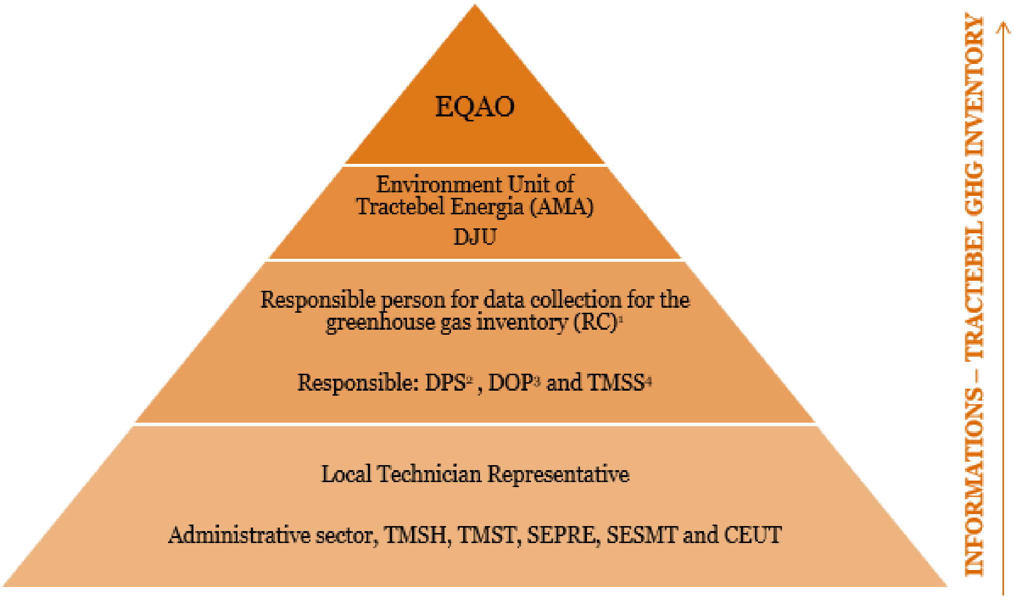
Ancillary services ensure the quality and safety of the energy generation, contributing to SIN reliability. They are provided according to the Ancillary Service Agreement ("CPSA" from the Portuguese Contrato de Prestação de Serviços Ancilares) established between the generation agent and the National 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 according to the emission sources identified in Table 5, and categorizes data collection by: air conditioning, electricity consumption, stationary combustion, mobile combustion, fire extinguisher, fertilizers, processes, waste, SF_6 and air travel as shown in Table 6 above.

Thus, data collection was carried out according to the flow of information below:



[1] Liliana, Claudiano, Sérgio Luiz, Andréia, Anderson, Rita, Letícia e Simone.

[2] Milena

[3] Maioral/Maira.

[4] Santos/Marcelo

Figure 2 – Information flow for the preparation of the GHG inventory of Tractebel Energia S/A

As presented in Figure 2, the Administrative Sector, TMSH, TMST, SEPRE, SESMT and CEUT provide information to the Local Technician, or directly to RC, in case the power plant/office has no Local Technician Representative.

The Local Technician collects data used in the GHG emission sources, identified according to "Instrução de Trabalho IT-MA-GE-006", fulfilling the form "FR-Coleta de Dados Inventário".

After filling out the form, the responsible for data collecting (RC), which also receives DPS data, DOP and TMSS, forwards the form to the Environment Unit of Tractebel Energia (AMA). This Organizational Unit, which also receives DJU information on the equity share of the company in the power plants and offices, after assessment, forwards the collection sheets of all plants and offices to EQAO (advisory company) for the arragements for the inventory preparation.

6.4. Bases and References

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

- "The Greenhouse Gas Protocol – a Corporate Accounting and Reporting Standard – Revised Edition" – WRI/WBCSD, 2011;
- "Especificações de Verificação do Programa Brasileiro GHG Protocol" – Second edition – WRI/FGV, 2011;
- "Contabilização, quantificação e publicação de Inventários Corporativos de Emissões de Gases de Efeito Estufa", First edition – WRI/FGV, 2012;
- "ISO 14.064:2007 - Sistema de Gestão de Gases do Efeito Estufa" – *International Organization Standartization*, 2007.

The accounting methodologies are mainly based 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 the emissions of each Tractebel Energia unit, the calculation tool "Ferramenta_GHG_Protocol_v2014.0.xlsx" made available by the GHG Protocol – Brazilian Program was used. Therefore, data monitored by Tractebel Energia business units for the calculation of emission factors were considered and, in cases which there was no monitored data from Tractebel's side, emission factors available in the calculation tool of the Program were used.

The following table details the main emission factors used in the 2014 inventory[2].

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[2] The emission factors shown in Tables 7 to 13 are generic factors and, therefore, their use does not reflect the emissions presented in the inventory. As mentioned in the report, the emission factors are defined based on the net calorific value of each fuel from stationary combustion, the percentages of ethanol and biodiesel considered in the mobile fossil fuels

Table 7 – 2014 emission factors for stationary combustion

Fuel	Unit	CO_2 (kg/un.)	CH_4 (kg/un.)	N_2O (kg/un.)	CO_2e Emission factor (kg/un.)
Acetylene	kg	3.385	0	0	3.385
Steam coal 3100 kcal / kg	Tonnes	1,168.4	0.01235	0.01853	1,174.2
Steam coal 4500 kcal / kg	Tonnes	1,683.3	0.01779	0.02669	1,691.7
Natural gas	m^3	2.1	0.00004	0.00000	2.1
Gasoline	Liters	2.2	0.00010	0.00002	2.2
Fuel oil	Liters	3.1	0.00012	0.00002	3.1
Diesel oil	Liters	2.6	0.00011	0.00002	2.6
Ethanol	Liters	1.5	0.00006	0.00001	1.5
Sugarcane Bagasse	Tonnes	866.5	0.26754	0.03567	883.8
Biodiesel	Liters	2.3	0.00010	0.00002	2.4
Wood waste for direct burning	Tonnes	1,916.6	0.54261	0.07235	1,951.7

Table 8 – 2014 emission factors for mobile combustion per type of fuel

Fuel	Unit	CO_2 (kg/un.)	CH_4 (kg/un.)	N_2O (kg/un.)	CO_2e emission factor (kg/un.)
Commercial gasoline	liters	2.0	0.00070	0.00020	2.100
Diesel oil	liters	2.6	0.00015	0.00013	2.636

varying monthly, nitrogen percentage of fertilizers used for each plant, in amount of waste destined from each category (paper, sewage sludge, food waste, etc.), among other factors. Therefore, the application of these factors in the activity data will not result in the emissions presented in this report.

(commercial)					
Natural gas vehicle (NGV)	m³	2.0	0.00339	0.00011	2.117
Liquefied petroleum gas (LPG)	kg	2.9	0.00288	0.00001	3.007
Ethanol	liters	1.5	0.00038	0.00001	1.470
Biodiesel	liters	2.4	0.00033	0.00002	2.445

Table 9 – 2014 emission factor for mobile combustion per type of fleet

<table>
<tr><th>Type of fleet</th><th>Average fleet consumption</th><th>Unit</th><th>CO_2e emission factor(kg or liter/km)</th></tr>
<tr><td>Car - gasoline</td><td>11.3</td><td rowspan="4">km / liter</td><td>0.186</td></tr>
<tr><td>Car – ethanol</td><td>6.9</td><td>0.213</td></tr>
<tr><td>Car -flex – gasoline</td><td>12.2</td><td>0.015</td></tr>
<tr><td>Car - flex – ethanol</td><td>8.5</td><td>0.025</td></tr>
<tr><td>Car - NGV</td><td>12</td><td>km / m³</td><td>0.176</td></tr>
<tr><td>Motorcycle – gasoline</td><td>37.19</td><td rowspan="11">km / liter</td><td>0.005</td></tr>
<tr><td>Motorcycle - flex - gasoline</td><td>43.2</td><td>0.000</td></tr>
<tr><td>Motorcycle – flex - ethanol</td><td>29.3</td><td>0.001</td></tr>
<tr><td>Microbus - diesel</td><td>3.8</td><td>0.694</td></tr>
<tr><td>Road bus – diesel</td><td>3</td><td>0.879</td></tr>
<tr><td>Urban bus – diesel</td><td>2.3</td><td>1.146</td></tr>
<tr><td>Semi light truck - diesel</td><td>9.1</td><td>0.290</td></tr>
<tr><td>Light truck - diesel</td><td>5.6</td><td>0.471</td></tr>
<tr><td>Medium truck - diesel</td><td>5.6</td><td>0.471</td></tr>
<tr><td>Semi heavy truck - diesel</td><td>3.4</td><td>0.775</td></tr>
<tr><td>Heavy truck - diesel</td><td>3.4</td><td>0.775</td></tr>
</table>

Table 10 – 2014 emission factor for air travel

Distance	kg CO_2/passenger x km	kg CH_4/passenger x km	kg N_2O/passenger x km	kg CO_2e/passenger x km
Long-distance (d ≥ 3,700 km)	0.1019	0.0000005	0.0000032	0.1029
Middle-distance (500 ≤ d <3,700 km)	0.0806	0.0000000	0.0000025	0.0814
Short-distance (d < 500 km)	0.1421	0.0000029	0.0000045	0.1435

Table 11 – 2014 emission factors for waste

Destination	Unit	CO_2 emission factor (kg/un.)	CH_4 emission factor (kg/un.)	N_2O emission factor (kg/un.)	CO_2e emission factor (kg/un.)
Sanitary landfill	kilogram	0	0.0820	0	2.050
Landfill (not sanitary)	kilogram	0	0.0547	0	1.367
Composting	kilogram	0	0.004	0.0003	0.189
Incineration	kilogram	0.88	0	0	0.880

Table 12 – 2014 emission factors for fertilizers use

Type of fertilizer	Unit	CO_2 emission factor (kg/um.)	CH_4 emission factor (kg/um.)	N_2O emission factor (kg/un.)	CO_2e emission factor (kg/un.)
Organic	kilogram	0.157	0	0	0.157
Synthetic	kilogram	7.071	0	0	7.071

Table 13 – 2014 emission factors of the National Interconnected System

Month	CO_2 emission factor (tCO_2/MWh)
January	0.0911
February	0.1169
March	0.1238

Month	CO_2 emission factor (tCO_2/MWh)
April	0.1310
May	0.1422
June	0.1440
July	0.1464
August	0.1578
September	0.1431
October	0.1413
November	0.1514
December	0.1368
Average	**0.1355**

According to the article from Kalkreuth (2005), the coal from Rio Grande do Sul State, used in Charqueadas power plant (UTCH), is classified as sub-bituminous. Thus, CO_2, CH_4 and N_2O emission factors of coal used for UTCH unit were revised as presented in Table 14. This revision was required since the GHG Protocol – Brazilian Program considers CO_2, CH_4 and N_2O emission factors for bituminous coal only.

Table 14 – CO_2, CH_4 e N_2O emission factors from the energy sector for bituminous and sub-bituminous coal (in kg/TJ)

Gas	Bituminous 2012 Inventory	Sub-bituminous 2013/2014 Inventory
CO_2	94,600	96,100
CH_4	1	1
N_2O	1.5	1.5

Source: IPCC (2006)[3]

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

In the following table, it can be observed methodologies and references of emission factors presented the tables above for each emission source founded.

Table 15 – Methodology and source of emission factors considered

Emission source	Methodology	Source of Emission Factors
Stationary combustion – direct and indirect	- IPCC 2006 – vol. 2 Energy – Cap. 2 Stationary combustion; - GHG Protocol – Brazilian Program tool 2014.	- 2012 National Energy Balance (BEN 2012); - IPCC 2006 – vol. 2 Energy – Cap. 2 Stationary combustion; - Ministry of Science and Technology. 2nd National Communication of Brazil to the United Nations Framework Convention on Climate Change. Brasília: MCT, 2010.
Mobile combustion – direct and indirect	- IPCC 2006 – vol. 2 Energy – Cap. 3 Mobile combustion; - Ferramenta GHG Protocol Brasil 2014	- 2014 National Energy Balance (BEN 2014); - IPCC 2006 – vol. 2 Energy – Cap. 3 Mobile combustion; - MAPA Ordinance nr. 105, of 28.2.2013 - DOU 1.3.2013 – Ministry of Agriculture, Livestock e Supply; - Lei nr. 13,033 dated September 24th, 2014.
Process	- Stoichiometric calculation	- Information Sheet and Safety for Chemical Material Products - dolomitic limestone; - GDF Suez Group - Local Instruction - GHG Emissions Reporting – 28/07/2014.
Fugitive	- IPCC 2006 – vol. 2 Energy – Cap. 4 Fugitive emissions; - GHG Protocol – Brazilian Program tool 2014	- 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.
Farming activities	- IPCC 2006 – vol. 4 AFOLU – Cap. 11 N2O emissions from managed soils, and CO2 emissions from lime and urea application;	- IPCC 2006 – vol. 4 AFOLU – Cap. 11 N2O emissions from managed soils, and CO2 emissions from lime and urea application;

Emission source	Methodology	Source of Emission Factors
		- Climate Change 2007: Working Group I: The Physical Science Basis (IPCC 2007), item 2.10.2 Direct Global Warming Potentials, tabela 2.14.
Energy purchase	- GHG Protocol – Brazilian Program tool 2014	- CO2 emission factors of SIN to corporate inventories – GHG Protocol – Brazilian Program tool 2014 (MCTI 2015).
Business travel	- IPCC 2006 – vol. 2 Energy – Cap. 3 Mobile combustion; - Ferramenta GHG Protocol Brasil 2014	- IPCC 2006 – vol. 2 Energy – Cap. 3 Mobile combustion; - GHG Protocol – Brazilian Program tool 2014; - 2014 Government GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors. FINAL. October 2014 (DEFRA 2014).
Solid waste	- IPCC 2006 – vol. 5 Waste – Cap. 3 Solid waste disposal / Cap. 4 – Biological treatment of solid waste; - GHG Protocol – Brazilian Program tool 2014	- IPCC 2006 – vol. 5 Waste – Cap. 3 Solid waste disposal / Cap. 4 – Biological treatment of solid waste.
CO_2 emissions from biomass combustion	- GHG Protocol - GHG Protocol – Brazilian Program tool 2014	- 2012 National Energy Balance (BEN 2012); - MAPA Ordinance nr. 105, of 28.2.2013 - DOU 1.3.2013 – Ministry of Agriculture, Livestock e Supply; - Lei nr. 13,033 dated September 24th, 2014; - Ministry of Science and Technology. 2nd National Communication of Brazil to the United Nations Framework Convention on Climate Change. Brasília: MCT, 2010.

The Net Calorific Value (NCV) and the percentage of nitrogen contained in fertilizers, both monitored by Tractebel Energia, were considered for the accounting of GHG emissions when this data is available. Thus, the specific NCV of fuels from stationary combustion fuel of thermoelectric power plants and the percentage of nitrogen contained in fertilizers used in the plants are described in the tables below.

Table 16 – Net calorific value (NCV) monitored by Tractebel Energia

Power Plants	Fuel	GJ/t
Charqueadas	Steam coal 3100 kcal / kg	13.0
	Diesel oil - commercial	42.3
Ferrari	Sugarcane bagasse	7.1
Ibitiúva	Diesel oil - commercial	35.5
	Sugarcane bagasse	5.4
Jorge Lacerda	Steam coal 4500 kcal / kg	18.2
	Fuel oil	39.8
	Diesel oil - commercial	42.3
Lages	Diesel oil - commercial	42.3
	Wood waste for direct burning	7.0
Willian Arjona	Natural gas - dry	35.4
	Diesel oil - commercial	42.3

Table 17 – Percentage of nitrogen in fertilizers used by Tractebel Energia

Power plant	Type of fertilizer	Percentage of nitrogen in fertilizers
UHIT	Organic	2.0%
	Synthetic	8.0%
UHMA	Organic	2.0%
UHPF	Organic	2.0%
	Synthetic	8.0%
UHSO	Organic	1.5%
UHSS	Organic	1.5%

In relation to the waste sent to landfills, which was registered in the collection data form as "sludge (water treatment station)", the degradable organic carbon (DOC)[4] of 0.05 was used, the specific DOC for sludge made available by the IPCC (2006), since the tool of the GHG Protocol – Brazilian Program does not consider this category of waste. The sludge sent to landfill was identified in UHCB, UHSO, UHSS, CTJL, UTAL, UTWA and UCLA units.

Furthermore, other GHG accounting methodologies were used for cases which accounting methods were not available by the GHG Protocol – Brazilian Program tool. Methodologies and assumptions adopted for the GHG accounting from emission sources not included by the program are described below.

(a) Fertilizers use

GHG emissions from the use of fertilizers are mainly related to the nitrous oxide (N_2O) generation. Nitrous oxide is produced during microbial denitrification, while anaerobic bacteria use nitrate (NO_3^-) as the final electron acceptor to replace the oxygen (O_2). This process occurs in anoxic conditions, being favored by the availability of carbon and the presence of NO_3^-, from the mineralization of soil organic matter and the application of mineral and organic fertilizers.

The methodology used for N_2O estimative emissions of agricultural soils follows the IPCC (2006). The direct N_2O emissions of agricultural soils, according to the most general method ("Tier 1"), are calculated by the following equation[5]:

$$N_2O_{Direct}\text{-}N = N_2O - N_{Ninputs} + N_2O\text{-}N_{OS} + N_2O\text{-}N_{PRP}$$

Where:

$N_2O_{Direct}\text{-}N$ = N-N_2O annual direct emissions in agricultural soils, in kg N-N_2O yr^{-1}

$N_2O\text{ -}N_{Ninputs}$ = N-N_2O of N annual direct emissions of fertilizer applied in soil, in kg N-N_2O yr^{-1}

$N_2O\text{-}N_{OS}$ = N-N_2O annual direct emissions of cultivated organic soils, in kg N-N_2O yr^{-1}

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

[5] N_2O = N-N_2O × 44 ÷ 28

$N_2O\text{-}N_{PRP}$ = N-N_2O annual direct emissions of animal manure intentionally applied to soils, in kg N-N_2O yr^{-1}

Assuming no application of animal manure and neither cultivated organic soils, only the portion of N applied as fertilizer to the soil will be considered.

$$N_2O - N_{Ninputs} = (F_{SN} + F_{ON} + F_{CR} + F_{SOM}) \times EF_1$$

Where:

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

F_{ON} = Annual quantity of N in animal manure, composed, sludge and other additions of organic N applied to soil, in kg N yr^{-1}

F_{CR} = Annual quantity of N in crop waste that annually return to soil, in kg N yr^{-1}

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

EF_1 = Direct N_2O emission factor applied to N quantities added to soils, in kg N yr^{-1}

The minimum quantity of nutrients and fertilizers specifications in Brazil follows the requirements of Normative Instruction of the Ministry of Agriculture, Livestock and Supply ("MAPA" from the Portuguese Ministério da Agricultura, Pecuária e Abastecimento) number 5 dated February 23rd, 2007 (revised by IN-MAP 21/2008), with significant variations depending on the type of fertilizer used. For example, autoclaved bone meal (1%), ammonium sulfate (20%), urea (45%), anhydrous ammonia (82%), etc.

For F_{SN} and F_{ON} calculation, the percentage of nitrogen presented in the fertilizer made available by Tractebel Energia was used. In the absence of information, it was considered the percentage used in the 2010 and 2011 inventories of the company, so, 1% for organic fertilizers, according to Normative Instruction from the Brazilian Ministry of Agriculture, Livestock and Supply nr. 25, dated July 2009, and 45% for synthetic fertilizers, considering the nitrogen concentration in urea, the synthetic fertilizer most used in Brazil.

Regarding the EF_1, according to IPCC (2006), in the absence of a local emission factor, it shall be used the default data of 0.01.

Considering that in the case of the Tractebel Energia is reasonable to assume F_{CR} = F_{SOM} = 0 and, therefore, direct emissions related to fertilizers use are directly proportionally to the quantity of N as fertilizer applied to soil, we have:

For conversion of N_2O-N emissions for N_2O emissions, the following equation shall be considered:

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

Thus, the final equation is:

$$N2O_{emissions}\ (kg_{N2O}) = (F_{SN} + F_{ON}) \times 0{,}01 \times 44/28$$

(b) Desulfurization process

The desulfurization process is used for Charqueadas thermoelectric power plant. For emissions accounting, 2 (two) calculation options were considered.

The first option considers the quantity of gypsum produced and the emission factor used by GDF Suez Group of 0.2558 tCO_2e/t gypsum produced (gypsum stoichiometric ratio, CASO4.2H2O, and CO2in the process).

Table 18 – Emissions from the desulfurization process in UTCH based on the quantity of gypsum produced in 2014

Month	Quantity of gypsum produced (t)	CO_2e emissions (t)
January	1,983.0	507.3
February	121.4	31.1
March	106.9	27.3
April	1,080.9	276.5
May	1,309.2	334.9
June	1,561.4	399.4
July	2,005.4	513.0
August	1,387.4	354.9
September	2,125.8	543.8
October	2,264.4	579.2
November	543.4	139.0
December	1,617.4	413.7
Total	**16,106.8**	**4,120.1**

For the second option, CO_2 emissions are accounted from stoichiometric calculations based on the quantity of lime used in the desulfurization process. Such methodology was considered in the audited GHG inventories of Tractebel Energia for the years of 2010, 2011, 2012 and 2013.

Since there is no reliable record of the lime type used, it was conservatively considered the type which presents the highest emission, *i.e.* the dolomitic limestone with levels of *CaO* and *MgO* of 27.27% and 25%, respectively. The following equations detailed the calculation, considering that, for 2014 year, the company used 8,185 tonnes of lime. Therefore, we have:

$$CaCO_{3(S)} \xrightarrow{\Delta} CaO_{(S)} + CO_{2(g)}$$

mCaO = 0.2727 *x* 8,185 = 2,232.3 *ton*

56.08 ton. *CaO* ------ 44.01 ton. CO_2

2,232.3 ton. *CaO* ----- X

X = 1,751.8 ton. CO_2 from $CaCO_3$ / year

$$MgCO_{3(S)} \xrightarrow{\Delta} MgO_{(S)} + CO_{2(g)}$$

mMgO = 0.25 *x* 8,185 = 2,046.5 *ton*

40.31 ton. *MgO* ------ 44.01 t CO_2

2,046. 5 ton. *MgO* ----- Y

Y = 2,234.3 ton. CO_2 from $MgCO_3$ / year

Thus, adding both results above, emissions from limestone use are 3,986.2 tCO_2e. The monthly accounting due to the amount of lime used is presented in the table below.

Table 19 – Emissions from the desulfurization process in UTCH based on the quantity of limestone used in 2014

Month	Quantity of limestone used (t)	CO_2e emissions (t)
January	1,047.0	509.8
February	63.0	30.7
March	37.3	18.2
April	834.5	406.4

Month	Quantity of limestone used (t)	CO_2e emissions (t)
May	703.0	342.3
June	533.2	259.6
July	923.0	449.5
August	694.0	337.9
September	983.0	478.7
October	1,127.0	548.8
November	233.2	113.6
December	1,007.7	490.7
Total	**8,185.9**	**3,986.2**

Considering the two methods presented above, the CO_2 emissions from the desulfurization process in Charqueadas thermoelectric power plant are greater in the first option, *i.e.* based on the amount of gypsum produced and the emission factor provided by GDF Suez Group. Thus, UTCH emissions, for this process, considered for the 2014 Inventory, are based on the first option in order to ensure a conservative approach.

(c) Acetylene use

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

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

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

Therefore, for the combustion of one (1) molecule of acetylene, two (2) molecules of CO_2 are emitted, then, for each 26 g of C_2H_2 burned, 88 g of CO_2 are emitted. Thus, the emission factor considered for the acetylene use is 88 gCO_2/ 26 gC_2H_2 = 3.385 gCO_2/ gC_2H_2.

6.5. Methodological Changes in Comparison to 2013 Year

Structural changes of an inventory organization and methodological accounting changes may significantly impact the accounting of greenhouse gas emissions, making it difficult their monitoring over time. Thus, this section aims to identify corporate, operational and methodological changes between 2013 and 2014 years.

In 2014, 6 (six) power plants were included when compared to previous year (2013):

Table 20 – Power plants included in the 2014 inventory

Power Plant	Acronym	Type
Flexeiras Wind Power Plant	UEFL	Wind
Guagiru Wind Power Plant	UEGU	Wind
Mundaú Wind Power Plant	UEMU	Wind
Trairi Wind Power Plant	UETR	Wind
Cidade Azul Solar Photovoltaic Power Plant	UFCA	Solar
Ferrari Thermoelectric Power Plant	UTFE	Thermoelectric operated with sugarcane bagasse

Tractebel Energia has 100% operational control and 100% equity share of units presented in Table 20. Regarding the other operational units, there were no changes on equity share of Tractebel Energia S/A in comparison to 2013 year. Significant changes regarding operations were not identified neither.

In 2014, there were no changes with respect to fuels used in stationary and mobile sources in the operations of Tractebel Energia, thus, fuels are the same as in 2014.

On the contrary, changes in GHG emissions calculation approach were identified in 2014 for the desulfurization process at Charqueadas thermoelectric power plant, as explained in section 6.4. Additionally, in 2014, emissions from acetylene combustion due to welding for the maintenance of equipment, as identified during the audit visit in CTJL occurred on March 26th, 2015, were considered. Another source of emission identified through the analysis of documented evidence provided during the audit is the CO_2 cylinder also used for the welding process (MIG/MAG process). Thus, emissions from the use of acetylene and CO_2, both for welding/maintenance, were included in the 2014 inventory.

According to the GHG Protocol – Brazilian Program, the emission factors, considered variables, are those that change on a monthly or annual basis, as is the case of the CO_2 emission factor of the National Interconnected System, the percentage of biodiesel contained in diesel and ethanol in gasoline. Thus, these parameters have influence in the annual result of the GHG emissions accounting.

Table 21 – Evolution of the annual average of emission factor of the SIN, percentage of biodiesel added to diesel oil and ethanol added to gasoline (2012 – 2014)

Parameter	2012	2013	2014
CO_2 emission factor of the SIN (tCO_2/MWh)	0.0653	0.0960	0.1355
% ethanol in gasoline	20%	23%	25%
% biodiesel in diesel oil	5%	5%	5.67%

Source: MCTI (2014), MAPA (2014) e ANP (2014)

7. Inventory Results

7.1. Control Approach

This section presents the GHG emissions based on the control approach of Tractebel Energia. Thus, GHG emissions from units were Tractebel Energia has 100% operational control are considered: CTJL, UTCH, UTWA, UHPF, UHSO, UTIB, UCLA, UTFE, UHSS, UHPP, UTAL, UHCB, UHSA, PHJG, PHAB, PHRO, UEBB, UEFL, UEGU, UEMU, UEPS, UETR, UFCA and the offices located in Florianópolis and São Paulo.

The following tables detail the representativeness of each emission source for each controlled power plant/unit by Tractebel Energia in its respective scope, as well as for Tractebel Energia as a whole.

Table 22 - Representativeness of emission sources in each scope for wind power plants – Control Approach

Emission source	UEBB	UEFL	UEGU	UEMU	UEPS	UETR
Scope 1						
Stationary combustion	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Mobile combustion	100.00%	0.00%	0.00%	0.00%	99.90%	100.00%
Process	-	-	-	-	-	-
Fugitive emissions	0.00%	0.00%	0.00%	0.00%	0.10%	0.00%
Farming activities	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Solid waste	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%
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Transport and distribution (upstream)	74.07%	0.00%	0.00%	0.00%	82.90%	0.00%
Solid waste from operations	9.71%	0.00%	0.00%	0.00%	12.32%	0.00%
Business travel	16.22%	0.00%	0.00%	0.00%	4.78%	100.00%

Emission source	UEBB	UEFL	UEGU	UEMU	UEPS	UETR
Employees transportation (home - work)	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%

Table 23 - Representativeness of emission sources in each scope for hydropower plants – Control Approach **Emission source**	UHCB	UHPF	UHPP	UHSO	UHSS	UHSA
Scope 1						
Stationary combustion	5.34%	4.22%	30.62%	22.23%	9.96%	1.71%
Mobile combustion	88.10%	95.78%	54.70%	77.57%	88.82%	97.90%
Process	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fugitive emissions	0.00%	0.00%	0.00%	0.13%	0.30%	0.39%
Farming activities	6.57%	0.00%	12.23%	0.07%	0.92%	0.00%
Solid waste	0.00%	0.00%	2.45%	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%
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%	2.12%	83.17%	0.00%
Transport and distribution (upstream)	46.14%	20.71%	89.04%	35.48%	7.55%	58.73%
Solid waste from operations	12.98%	0.00%	0.00%	11.25%	0.81%	3.28%
Business travel	22.26%	2.60%	10.96%	3.81%	1.07%	9.33%
Employees transportation (home - work)	18.61%	76.70%	0.00%	47.34%	7.40%	28.66%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 24 – Representativeness of emission sources in each scope for small hydro and solar photovoltaic power plants – Control Approach

Emission source	PHAB	PHRO	PHJG	UFCA
Scope 1				
Stationary combustion	30.23%	76.96%	99.85%	0.00%
Mobile combustion	69.77%	23.04%	0.15%	0.00%
Process	-	-	-	-
Fugitive emissions	0.00%	0.00%	0.00%	0.00%
Farming activities	0.00%	0.00%	0.00%	0.00%
Solid waste	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 activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%	0.00%
Transport and distribution (upstream)	99.63%	66.76%	66.75%	0.00%
Solid waste from operations	0.37%	0.00%	0.00%	0.00%
Business travel	0.00%	0.00%	0.00%	0.00%
Employees transportation (home - work)	0.00%	33.24%	33.25%	0.00%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	0.00%

Table 25 – Representativeness of emission sources in each scope for fossil fuel thermoelectric power plants – Control Approach

Emission source	UTAL	UTCH	CTJL	UTWA
Scope 1				
Stationary combustion	76.60%	99.27%	100.00%	100.00%
Mobile combustion	23.36%	0.01%	0.00%	0.00%
Process	0.00%	0.72%	0.00%	0.00%
Fugitive emissions	0.04%	0.00%	0.00%	0.00%
Farming activities	0.00%	0.00%	0.00%	0.00%
Solid waste	0.00%	0.00%	0.00%	0.00%

Emission source	UTAL	UTCH	CTJL	UTWA
Scope 2				
Purchased electricity from the grid	100.00%	100.00%	100.00%	100.00%
Scope 3				
Fuel and energy activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%	0.00%
Transport and distribution (upstream)	36.67%	79.40%	46.23%	0.00%
Solid waste from operations	49.88%	0.18%	2.80%	53.36%
Business travel	13.45%	0.09%	0.50%	2.73%
Employees transportation (home - work)	0.00%	0.00%	0.26%	43.91%
Transport and distribution (downstream)	0.00%	20.34%	50.20%	0.00%

Table 26 – Representativeness of emission sources in each scope for biomass thermoelectric power plants – Control Approach

Emission source	UTFE	UTIB	UCLA
Scope 1			
Stationary combustion	100.00%	99.50%	96.63%
Mobile combustion	0.00%	0.49%	3.36%
Process	-	-	-
Fugitive emissions	0.00%	0.00%	0.01%
Farming activities	0.00%	0.01%	0.00%
Solid waste	0.00%	0.00%	0.00%
Scope 2			
Purchased electricity from the grid	100.00%	100.00%	100.00%
Scope 3			
Fuel and energy activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%
Transport and distribution (upstream)	0.00%	100.00%	95.70%
Solid waste from operations	100.00%	0.00%	1.08%
Business travel	0.00%	0.00%	0.36%

Emission source	UTFE	UTIB	UCLA
Employees transportation (home - work)	0.00%	0.00%	2.86%
Transport and distribution (downstream)	0.00%	0.00%	0.00%

Table 27 – – Representativeness of emission sources in each scope for Tractebel Energia offices and the company as a whole – Control Approach

Emission source	ESP	SEDE	Tractebel
Scope 1			
Stationary combustion	0.00%	22.16%	99.92%
Mobile combustion	0.00%	48.53%	0.01%
Process	-	-	0.06%
Fugitive emissions	0.00%	29.32%	0.00%
Farming activities	-	-	0.00%
Solid waste	0.00%	0.00%	0.00%
Scope 2			
Purchased electricity from the grid	100.00%	100.00%	100.00%
Scope 3			
Fuel and energy activities not included in Scopes 1 and 2	0.00%	0.00%	5.16%
Transport and distribution (upstream)	0.00%	0.00%	58.64%
Solid waste from operations	0.82%	0.27%	1.58%
Business travel	99.18%	99.73%	2.08%
Employees transportation (home - work)	0.00%	0.00%	1.08%
Transport and distribution (downstream)	0.00%	0.00%	31.46%

Detailed results of GHG emissions are presented in the following sections.

7.1.1. Total Emissions

During the year of 2014, the operation units of Tractebel Energia emitted **6,413,949.50 tCO_2e**, considering Scopes 1, 2 and 3, as presented in the sections below.

The total GHG emissions of Tractebel Energia per type of gas and source under the Control Approach are presented in Annex I of this report.

7.1.1.1. Scope 1

Emissions of Scope 1 in 2014 represented 99.2% of total emissions, resulting in **6,363,385.37 tCO_2e**. Stationary combustion emissions represented 99.9% of total emissions from Scope 1.

Table 28 – Scope 1 GHG Emissions – Control Approach

Emission source	tCO_2e
Stationary combustion	6,358,562.58
Mobile combustion	671.54
Process	4,120.11
Fugitive emissions	26.14
Farming activities	4.63
Solid waste	0.37
Total of Scope 1	**6,363,385.37**

7.1.1.2. Scope 2

Regarding Scope 2, only emissions due to grid electricity purchase were identified. Considering the year of 2014, a total of **18,711.25 tCO_2e** were issued, representing 0.3% of total emissions of the operational units 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 was the case, in 2014, of

Cana Brava, Passo Fundo, Osorio and Salto Santiago hydropower plants[6]. This function makes it mandatory, on some cases, the energy consumption of the SIN by these power plants.

Some facilities also have an internal generator for emergency cases. However, the consumption of fuel for the generator related to this generator is from Scope 1. Thus, only the emissions due to energy consumption from the grid are considered as emissions from Scope 2.

7.1.1.3. Scope 3

Emissions from Scope 3, for the year of 2014, represented 0.5% of total emissions, resulting in **31,852.87 tCO_2e**, according to the emission sources presented in the table below.

Table 29 – Scope 3 GHG emissions – Control Approach

Emissions source	tCO_2e
Fuel and energy activities not included in Scopes 1 and 2	1,642.86
Transport and distribution (upstream)	18,679.86
Solid waste from operations	502.26
Business travel	662.60
Employees transportation (home - work)	345.10
Transport and distribution (downstream)	10,020.20
Total of Scope 3	**31,852.87**

It is worth mentioning that the category of transmission and distribution (upstream) are related to rented or contracted transport services by Tractebel Energia. The highest emission in this category is from the transportation of coal in UTCH. In the category of transportation and distribution (downstream), it is considered services contracted or third party services not paid/contracted by Tractebel Energia, which the

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

transportation of ash 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 the biomass combustion shall be reported separately since the CO_2 released during the biomass combustion is from the CO_2 removed from atmosphere as result of the photosynthesis and, therefore, it can be considered "neutral". It is important to mention that CH_4 and N_2O emissions cannot be considered neutral since these gases are not removed from the atmosphere during the biomass growth.

In the case of Tractebel Energia, CO_2 biomass emissions are from wood residues in boilers (Lages), sugarcane bagasse (Ibitiúva and Ferrari), ethanol combustion (also as percentage added to common gasoline) and the use of biodiesel (also as percentage added to diesel oil). Therefore, the CO_2 emissions from biomass combustion resulted in **941,304.07 tCO_2** distributed in Scope 1 and Scope 3 as presented in the table below.

Table 30 – Emissions of biomass combustion of Tractebel Energia distributed in Scopes 1 and 3

Scope	Emission source	tCO_2e
Scope 1	Stationary combustion	939,117.47
	Mobile combustion	134.11
Scope 2	Fuel and energy activities not included in Scopes 1 and 2	4,05
	Transport and distribution (upstream)	1,440.05
	Solid waste from operations	1.87
	Business travel	21.82
	Employees transportation (home - work)	35.14
	Transport and distribution (downstream)	549.57
Total		**941,304.07**

7.1.1.5. Emissions of non-Kyoto Gases

Just as CO_2 biomass combustion, gases non-listed in the Kyoto Protocol may be reported separately. In the case of Tractebel Energia, approximately 0.154 tonnes of HCFC (R-22) were emitted, which corresponds to **279.39 tCO_2e**. This gas is used in refrigerating equipment and air conditioning installed in the Tractebel Energia units.

7.1.2. Emissions per Unit

The GHG emissions of Tractebel Energia, per scope and power plant, are presented in the table below.

Table 31 – GHG Emissions of Tractebel Energia by scope and power plant – Control Approach (in tCO_2e)

Units	Scope 1	Scope 2	Scope 3	Total emissions	Biomass emissions	Percentage of GHG emissions participation
CTJL	5.141.350,52	9.781,26	14.681,80	5.165.813,58	1.260,48	80,5403%
UTWA	633.336,66	29,38	20,79	633.386,83	5,71	9,8751%
UTCH	569.818,23	78,71	13.026,79	582.923,72	895,52	9,0884%
UTFE	9.953,05	73,44	5,75	10.032,25	497.994,39	0,1564%
UCLA	4.750,27	144,11	1.240,06	6.134,44	250.043,54	0,0956%
UHSO	15,68	5.837,95	75,02	5.928,66	23,69	0,0924%
UTIB	3.830,13	91,08	2,03	3.923,23	190.889,24	0,0612%
UHSS	16,94	1.182,46	1.973,33	3.172,73	72,59	0,0495%
SEDE	71,78	262,04	518,90	852,73	19,11	0,0133%
UHPF	25,02	574,82	61,04	660,88	11,99	0,0103%
UHCB	34,09	487,51	28,99	550,58	15,74	0,0086%
UTAL	19,68	112,97	9,09	141,75	2,00	0,0022%
UHSA	45,48	0,04	52,30	97,83	23,98	0,0015%
UHPP	15,16	15,14	61,07	91,38	19,66	0,0014%
UETR	73,97	4,80	6,65	85,42	5,78	0,0013%
PHAB	11,54	4,16	28,28	43,98	2,77	0,0007%
PHRO	1,42	0,47	21,15	23,04	7,11	0,0004%
PHJG	0,60	1,12	21,16	22,87	6,87	0,0004%
UEPS	9,36	2,09	8,56	20,01	2,11	0,0003%
UEBB	5,76	1,32	8,88	15,97	1,79	0,0002%
UEMU	0,00	8,17	0,00	8,17	0,00	0,0001%
UEFL	0,00	6,58	0,00	6,58	0,00	0,0001%
UEGU	0,00	5,32	0,00	5,32	0,00	0,0001%
UFCA	0,00	4,74	0,00	4,74	0,00	0,0001%
ESP	0,00	1,60	1,21	2,80	0,00	0,0000%
Total emissions	***6.363.385,37***	***18.711,25***	***31.852,87***	***6.413.949,50***	***941.304,07***	***100,0%***

As can be observed in the table above, CTJL is responsible for 80.5% of total emissions from the operational units of Tractebel Energia.

In the sections below, GHG emissions from the operational units of Tractebel Energia are presented.

7.1.2.1. Wind Power Plants

The wind power plants emitted a total of 141.46 tCO_2e as described below.

→ **Beberibe (UEBB)**

UEBB emitted a total of 15.97 tCO_2e during 2014 year, distributed in the Scopes 1, 2 and 3, as presented below.

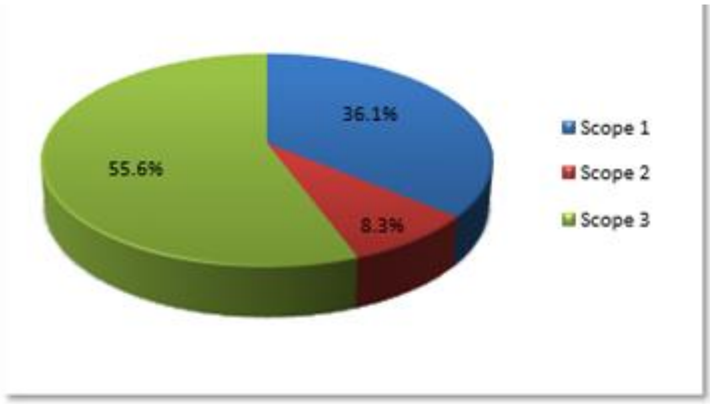

Figure 3 – Representativeness of UEBB GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

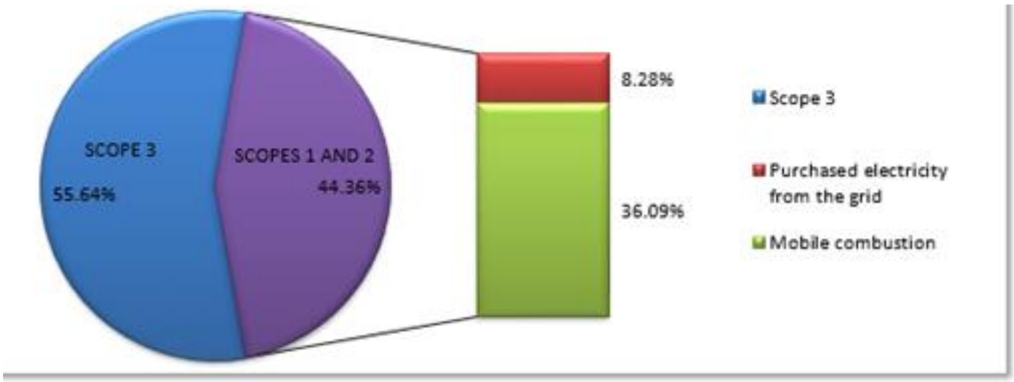

Figure 4 – Representativeness of UEBB GHG emissions by source

Emissions from biomass combustion resulted in 1.79 tCO_2. There were no emissions of non-Kyoto gases (R-22) in UEBB.

Emissions per greenhouse gas are presented in the table below.

Table 32 – UEBB GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	0.00	0.00	0.00	0.00	0.00
Mobile combustion	5.6626	0.0003	0.0003	5.76	0.32
Process	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**5.66**	**0.0003**	**0.0003**	**5.76**	**0.32**
Scope 2					
Purchased electricity from the grid	**1.32**	**-**	**-**	**1.32**	**0.00**
Scope 3					
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	6.29	0.003	0.001	6.58	1.45
Solid waste from operations	0.00	0.03	0.00	0.86	0.00
Business Travel	1.42	0.00004	0.0001	1.44	0.02
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	**7.72**	**0.04**	**0.001**	**8.88**	**1.47**
Total emissions	***14.70***	***0.04***	***0.001***	***15.97***	***1.79***

→ **Flexeiras (UEFL)**

UEFL emitted a total of 6.58 tCO_2e during the year of 2014 exclusively due to electricity purchased from the grid. There were no CO_2 emissions due to biomass combustion[7] or the use of non-Kyoto gases in the unit.

[7] It is important to mention that CO_2 emissions from biomass combustion include not only sugarcane bagasse or the wood waste combustion for electricity generation, but it also

→ **Guagiru (UEGU)**

UEGU emitted a total of 5.32 tCO_2e during the year of 2014 exclusively due to electricity purchased from the grid, similar to UEFL. There were no CO_2 emissions from the biomass combustion or the use of non-Kyoto gases in the unit.

→ **Mundau (UEMU)**

As UEFL and UEGU, UEMU emitted GHG due to electricity purchased from the grid only, resulting in 8.17 tCO_2e in 2014. There were no CO_2 emissions due to biomass combustion nor the use of non-Kyoto gases in the unit.

→ **Pedra do Sal (UEPS)**

UEPS emitted a total of 20.01 tCO_2e during the year of 2014.

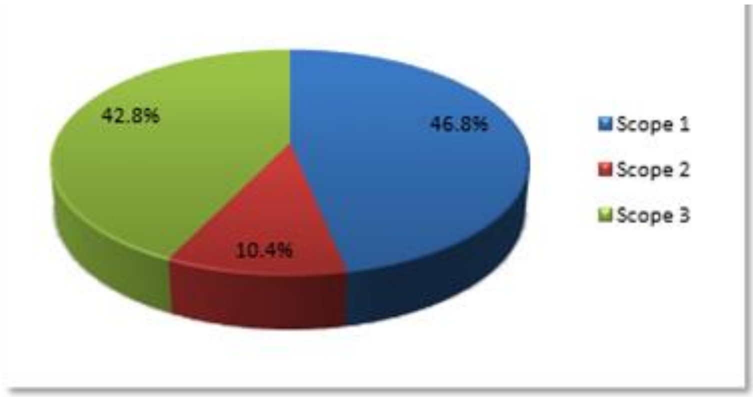

Figure 5 - Representativeness of UEPS GHG emissions by scope

Detailed emissions per type of source from Scope 1 and 2 are presented in the figure below.

include the percentage of ethanol added to gasoline and the biodiesel added to diesel oil.

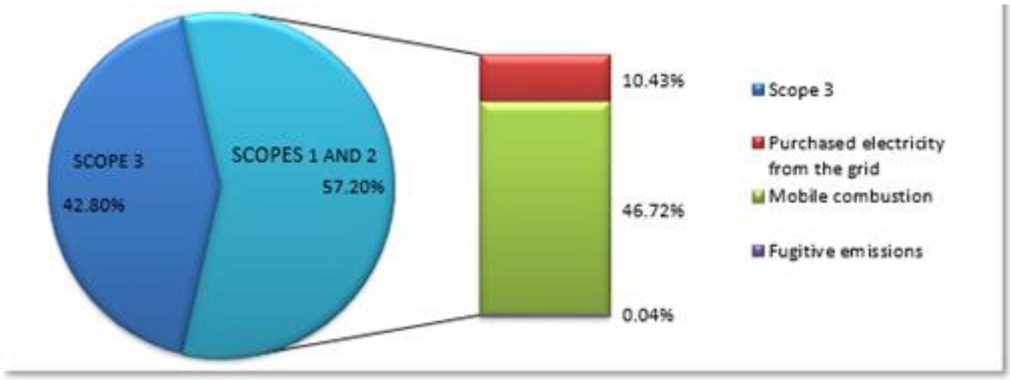

Figure 6 – Representativeness of UEPS GHG emissions by source

Emissions from biomass combustion resulted in 2.11 tCO_2. There were no emissions of non-Kyoto gases in UEPS.

Emissions per greenhouse gas are detailed in the table below.

Table 33 – UEPS GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	0.00	0.00	0.00	0.00	0.00
Mobile combustion	9.19	0.0006	0.0005	9.35	0.52
Process	-	-	-	-	-
Fugitive emissions	0.01	0.00	0.00	0.01	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**9.20**	**0.0006**	**0.0005**	**9.36**	**0.52**
Scope 2					
Purchased electricity from the grid	**2.09**	-	-	**2.09**	0.00
Scope 3					
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	6.79	0.003	0.001	7.10	1.56
Solid waste from operations	0.00	0.04	0.00	1.06	0.00
Business Travel	0.40	0.0001	0.00002	0.41	0.03
Employees transportation (home - work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution	0.00	0.00	0.00	0.00	0.00

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
(downstream)					
Total Scope 3	**7.19**	**0.04**	**0.001**	**8.56**	**1.59**
Total emissions	***18.47***	***0.05***	***0.001***	***20.01***	***2.11***

→ **Trairi (UETR)**

UETR emitted a total of 85.42 tCO_2e during the year of 2014.

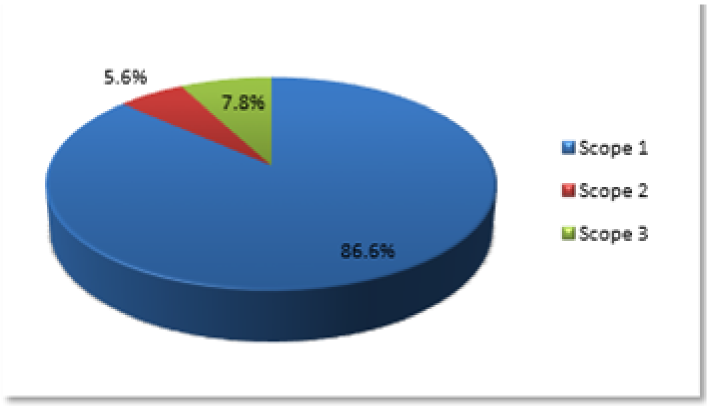

Figure 7 - Representativeness of UETR GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

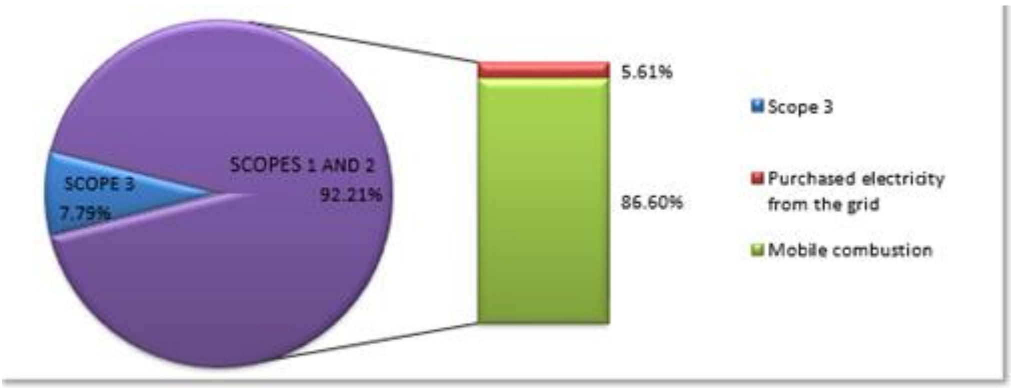

Figure 8 – Representativeness of UETR GHG emissions by source

Biomass combustion emissions resulted in 5.78 tCO_2. There were no emissions of non-Kyoto gases in UETR.

Emissions per greenhouse gas are detailed in the table below.

Table 34 – UETR GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	0.00	0.00	0.00	0.00	0.00
Mobile combustion	72.46	0.01	0.004	73.97	5.75
Process	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**72.46**	**0.01**	**0.004**	**73.97**	**5.75**
Scope 2					
Purchased electricity from the grid	**4.80**	-	-	**4.80**	-
Scope 3					
Fuel and energy activities not included in Scopes 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
Solid waste from operations	0.00	0.00	0.00	0.00	0.00
Business Travel	6.59	0.0001	0.0002	6.65	0.03
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	**6.59**	**0.0001**	**0.0002**	**6.65**	**0.03**
Total emissions	***83.84***	***0.01***	***0.005***	***85.42***	***5.78***

7.1.2.2. Solar Photovoltaic Power Plants

→ **Cidade Azul (UFCA)**

Tractebel Energia has 1 (one) solar photovoltaic power plant – Cidade Azul (UFCA) – which was responsible for emitting 4.74 tCO_2e in 2014, due to electricity purchased from the grid. There were neither CO2 biomass emissions nor non-Kyoto gases.

7.1.2.3. Small Hydropower Plants

The small hydropower plants from Tractebel Energia emitted a total of 89.89 tCO_2e during the year of 2014 as described below.

→ **Areia Branca (PHAB)**

PHAB emitted a total of 43.98 tCO_2e during the year of 2014.

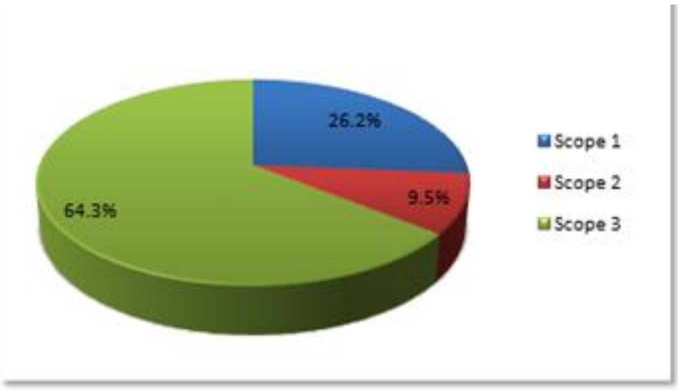

Figure 9 - Representativeness of PHAB GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

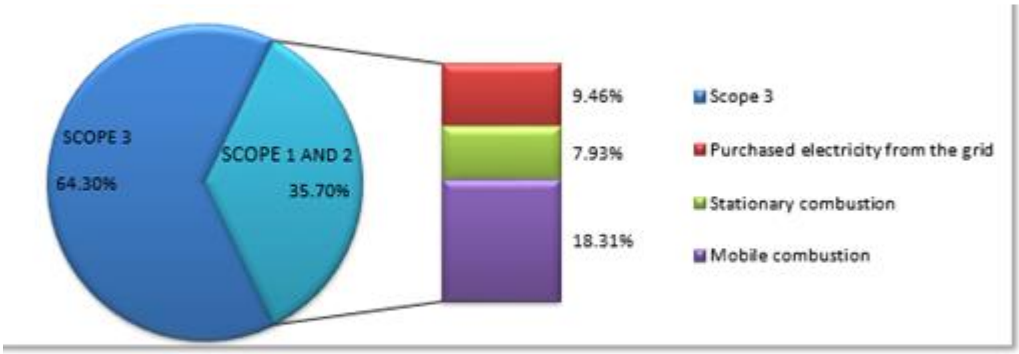

Figure 10 – Representativeness of PHAB GHG emissions by source

Emissions of biomass combustion resulted in 2.77 tCO_2. There were no emissions of non-Kyoto gases (R-22) in PHAB.

Emissions per greenhouse gas are detailed in the table below.

Table 35 – PHAB GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	3.48	0.00015	0.00003	3.49	0.19
Mobile combustion	7.90	0.001	0.0005	8.05	0.53
Process	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**11.38**	**0.001**	**0.0005**	**11.54**	**0.71**
Scope 2					
Purchased electricity from the grid	**4.16**	-	-	**4.16**	-
Scope 3					
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	27.61	0.003	0.002	28.17	2.05
Solid waste from operations	0.00	0.002	0.0002	0.10	0.00
Business Travel	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	**27.61**	**0.005**	**0.002**	**28.28**	**2.05**
Total emissions	***43.14***	***0.01***	***0.002***	***43.98***	***2.77***

→ **José Gelazio da Rocha (PHJG)**

PHJG emitted a total of 22.87 tCO_2e during the year of 2014.

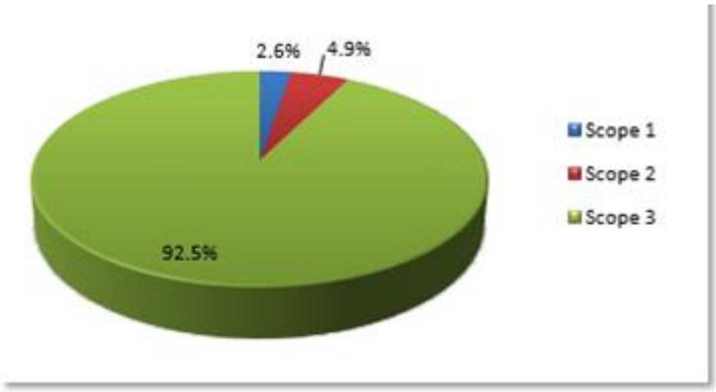

Figure 11 - Representativeness of PHJG GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

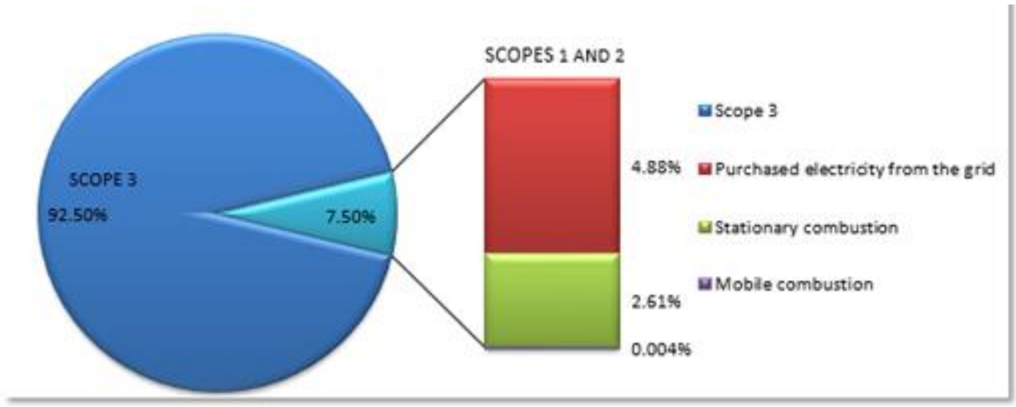

Figure 12 – Representativeness of PHJG GHG emissions by source

Emissions from the biomass combustion resulted in 6.87 tCO_2. Additionally, 3.62 tCO_2e was emitted due to the use of R-22 (non-Kyoto gas) in 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 36 – PHJG GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	0.60	0.00003	0.000005	0.60	0.03	-
Mobile combustion	0.00	0.00002	0.000001	0.00	0.09	-
Process	-	-	-	-	-	-

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Fugitive emissions	0.00	0.00	0.00	0.00	0.00	3.62
Farming activities	0.00	0.00	0.00	0.00	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**0.60**	**0.00005**	**0.00001**	**0.60**	**0.12**	**3.62**
Scope 2						
Purchased electricity from the grid	**1.12**	-	-	**1.12**	-	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	13.72	0.003	0.001	14.12	1.88	-
Solid waste from operations	0.00	0.0004	0.00003	0.00	0.02	-
Business Travel	0.00	0.00	0.00	0.00	0.00	-
Employees transportation (home - work)	6.87	0.00	0.00	7.04	4.84	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**20.59**	**0.005**	**0.002**	**21.16**	**6.74**	**0.00**
Total emissions	***22.30***	***0.005***	***0.002***	***22.87***	***6.87***	***3.62***

→ **Rondonópolis (PHRO)**

PHRO emitted a total of 23.04 tCO_2e during the year of 2014.

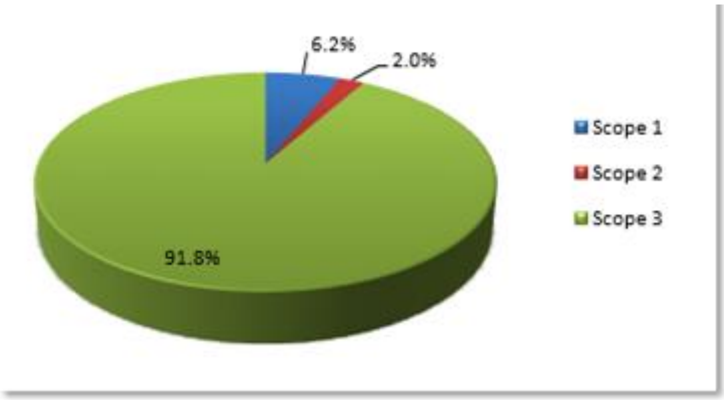

Figure 13 - Representativeness of PHRO GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

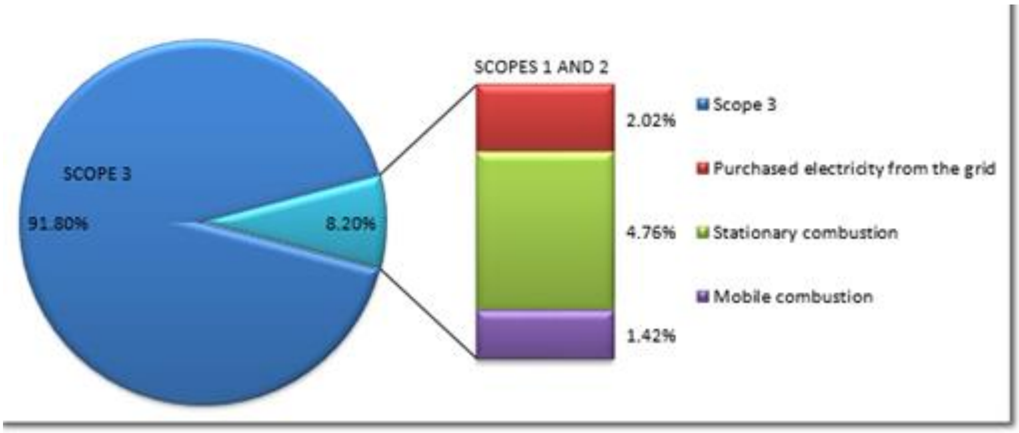

Figure 14 – Representativeness of PHRO GHG emissions by source

Emissions from biomass combustion resulted in 7.11 tCO_2. There were no emissions of non-Kyoto gases (R-22) in PHRO.

Emissions per greenhouse gas are detailed in the table below.

Table 37 – PHRO GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	1.09	0.00005	0.00001	1.10	0.06
Mobile combustion	0.32	0.0001	0.00002	0.33	0.32
Process	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**1.41**	**0.0001**	**0.00003**	**1.42**	**0.38**
Scope 2					
Purchased electricity from the grid	**0.47**	-	-	**0.47**	-
Scope 3					
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution	13.72	0.003	0.001	14.12	1.89

(upstream)					
Solid waste from operations	0.00	0.00	0.00	0.00	0.00
Business Travel	0.00	0.00	0.00	0.00	0.00
Employees transportation (home - work)	6.87	0.002	0.0004	7.03	4.84
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	**20.59**	**0.004**	**0.002**	**21.15**	**6.73**
Total emissions	***22.47***	***0.005***	***0.002***	***23.04***	***7.11***

7.1.2.4. Hydropower Plants

Tractebel Energia hydropower plants emitted a total of 10,502.07 tCO_2e during the year of 2014 as described below.

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

→ **Cana Brava (UHCB)**

UHCB emitted a total of 550.58 tCO_2e during 2014 year.

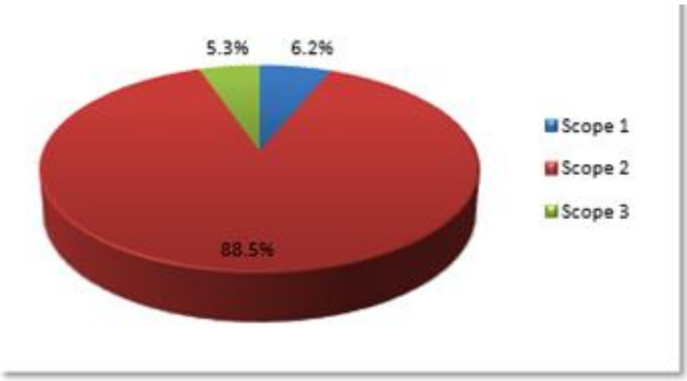

Figure 15 - Representativeness of UHCB GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

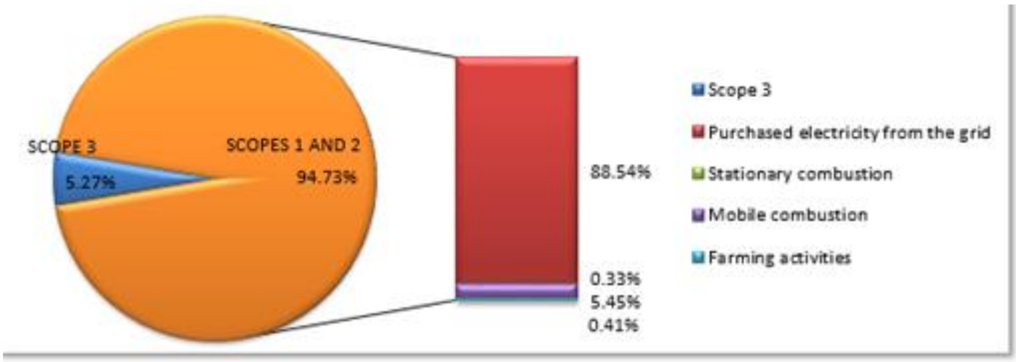

Figure 16 – Representativeness of UHCB GHG emissions by source

Emissions from biomas combustion resulted in 15.74 tCO_2. Regarding UHCB emissions from non-Kyoto gases, 30.35 tCO_2e was emitted due to R-22 use.

Emissions per greenhouse gas are detailed in the table below.

Table 38 – UHCB GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	1.81	0.0001	0.00002	1.82	0.10	-
Mobile combustion	29.27	0.01	0.002	30.03	11.63	-
Process	-	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00	30.35
Farming activities	0.00	0.00	0.01	2.24	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**31.08**	**0.01**	**0.01**	**34.09**	**11.72**	**30.35**
Scope 2						
Purchased electricity from the grid	**487.51**	**-**	**-**	**487.51**	**-**	**-**
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	13.01	0.003	0.001	13.38	3.48	-
Solid waste from operations	0.00	0.15	0.00	3.76	0.00	-
Business Travel	6.36	0.0004	0.0003	6.45	0.24	-

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Employees transportation (home - work)	5.30	0.0003	0.0003	5.40	0.30	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**24.67**	**0.15**	**0.002**	**28.99**	**4.02**	**0.00**
Total emissions	***543.26***	***0.16***	***0.01***	***550.58***	***15.74***	***30.35***

→ **Passo Fundo (UHPF)**

UHPF emitted a total of 660.88 tCO_2e during 2014 year.

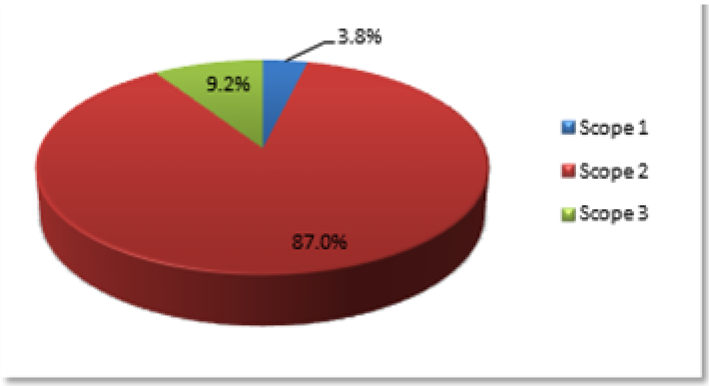

Figure 17 - Representativeness of UHPF GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

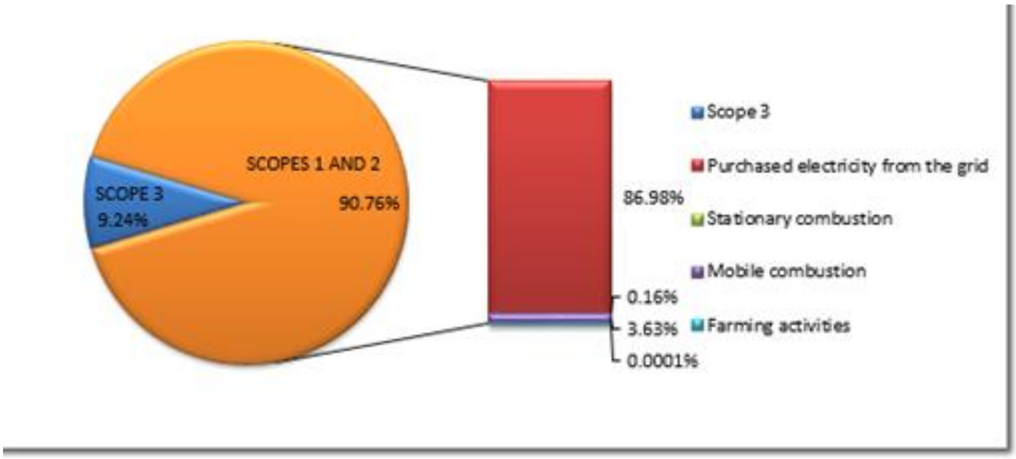

Figure 18 – Representativeness of UHPF GHG emissions by source

Emissions from biomass combustion resulted in 11.99 tCO_2. UHPF emissions from non-Kyoto gases resulted in 7.98 tCO_2e due to R-22 use.

Emissions per greenhouse gas are detailed in the table below.

Table 39 – UHPF GHG emissions (in tonnes)

Emissions sources	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**biomass emission**	**Non-Kyoto gases**
Scope 1						
Stationary combustion	1.05	0.00005	0.00001	1.06	0.06	-
Mobile combustion	23.44	0.004	0.001	23.97	6.57	-
Process	-	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00	7.98
Farming activities	0.00	0.00	0.000003	0.001	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**24.49**	**0.004**	**0.001**	**25.02**	**6.63**	**7.98**
Scope 2						
Purchased electricity from the grid	**574.82**	-	-	**574.82**	-	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	12.27	0.002	0.001	12.64	1.41	-
Solid waste from operations	0.00	0.00	0.00	0.00	1.22	-
Business Travel	1.55	0.0002	0.0001	1.58	0.13	-
Employees transportation (home - work)	46.01	0.003	0.002	46.82	2.60	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**59.83**	**0.01**	**0.004**	**61.04**	**5.36**	**0.00**
Total emissions	***659.14***	***0.01***	***0.01***	***660.88***	***11.99***	***7.98***

→ **Ponte de Pedra (UHPP)**

UHPP emitted a total of 91.38 tCO_2e during 2014 year.

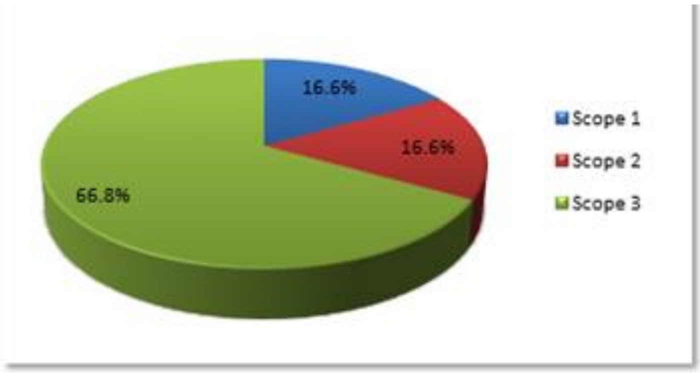

Figure 19 - Representativeness of UHPP GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

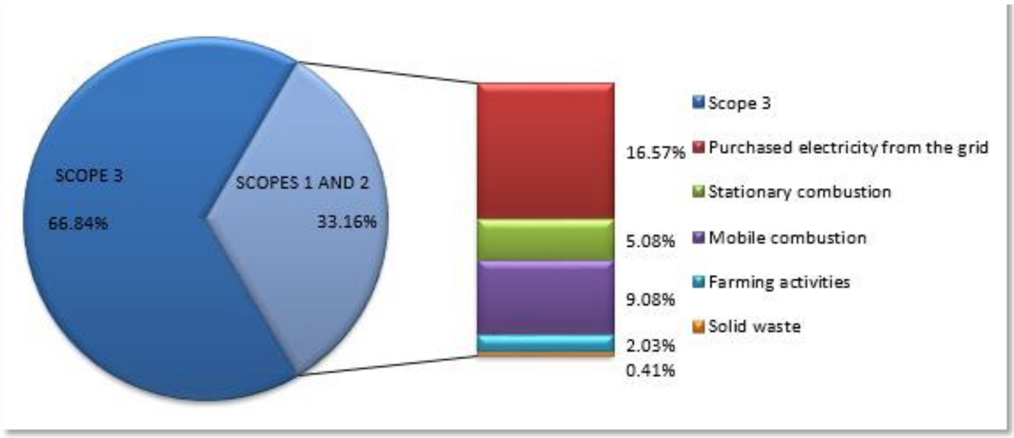

Figure 20 – Representativeness of UHPP GHG emissions by source

Emissions from biomass combustion resulted in 19.66 tCO_2. Emissions of non-Kyoto gases resulted in 63.89 tCO_2e from the use of R-22.

Emissions per greenhouse gas are detailed in the table below.

Table 40 – UHPP GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	4.63	0.0002	0.00004	4.64	0.25	-
Mobile combustion	8.04	0.003	0.001	8.29	9.27	-

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Process	-	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00	63.89
Farming activities	0.00	0.00	0.01	1.86	0.00	-
Solid waste	0.00	0.01	0.001	0.37	0.00	-
Total Scope 1	**12.67**	**0.01**	**0.01**	**15.16**	**9.52**	**63.89**
Scope 2						
Purchased electricity from the grid	**15.14**	-	-	**15.14**	-	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	52.89	0.01	0.004	54.38	10.14	-
Solid waste from operations	0.00	0.00	0.00	0.00	0.00	-
Business Travel	6.63	0.00003	0.0002	6.70	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	**59.52**	**0.01**	**0.004**	**61.07**	**10.14**	**0.00**
Total emissions	***87.33***	***0.02***	***0.01***	***91.38***	***19.66***	***63.89***

→ Salto Osório (UHSO)

UHSO emitted a total of 5,928.66 tCO_2e during 2014.

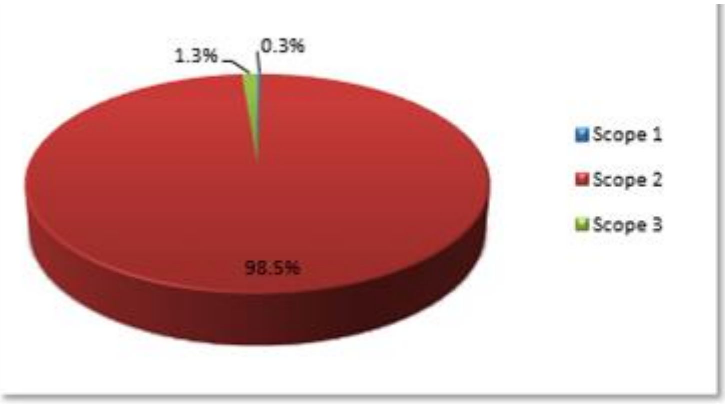

Figure 21 - Representativeness of UHSO GHG emissions by scope

Detailed emissions per source are presented in the figure below. Since Scope 2 emissions (electricity purchased from the grid) represented more than 98% of total emissions of this unit, Scope 2 emissions were disregarded to avoid distortions in the graph.

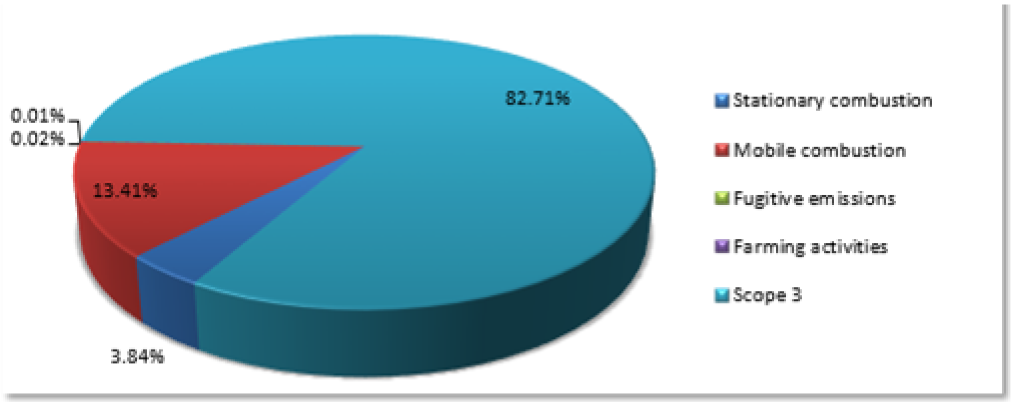

Figure 22 – Representativeness of UHSO GHG emissions by source (excluding scope 2)

Emissions from biomass combustion resulted in 23.69 tCO_2. There were no emissions of non-Kyoto gases (R-22).

Emissions per greenhouse gas are detailed in the table below.

Table 41 – UHSO GHG emissions (in tonnes)

Emissions sources	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**biomass emission**
Scope 1					
Stationary combustion	3.47	0.0001	0.00003	3.49	0.19
Mobile combustion	11.85	0.004	0.001	12.16	10.85
Process	-	-	-	-	-
Fugitive emissions	0.02	0.00	0.00	0.02	0.00
Farming activities	0.00	0.00	0.00004	0.01	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**15.35**	**0.004**	**0.001**	**15.68**	**11.03**
Scope 2					
Purchased electricity from the grid	**5,837.95**	**-**	**-**	**5,837.95**	**-**
Scope 3					

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Fuel and energy activities not included in Scopes 1 and 2	1.58	0.0001	0.00002	1.59	0.36
Transport and distribution (upstream)	25.76	0.01	0.002	26.62	6.87
Solid waste from operations	0.00	0.34	0.00	8.44	0.00
Business Travel	2.79	0.0004	0.0002	2.86	0.21
Employees transportation (home - work)	34.67	0.01	0.002	35.52	5.22
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	**64.81**	**0.35**	**0.005**	**75.02**	**12.66**
Total emissions	***5,918.11***	***0.35***	***0.01***	***5,928.66***	***23.69***

→ **Salto Santiago (UHSS)**

UHSS emitted a total of 3,172.73 tCO_2e during 2014 year.

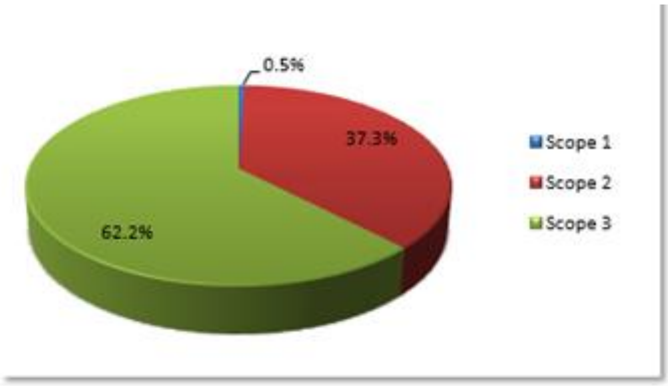

Figure 23 - Representativeness of UHSS GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

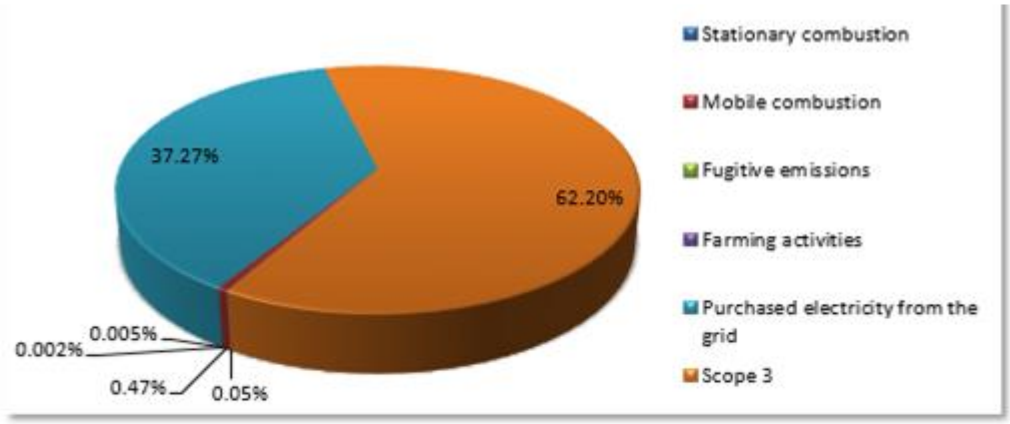

Figure 24 – Representativeness of UHSS GHG emissions by source

Emissions from biomass combustion resulted in 72.59 tCO_2. There were no emissions of non-Kyoto gases (R-22) in 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 42 – UHSS GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	1.68	0.0001	0.00001	1.69	0.09
Mobile combustion	14.60	0.01	0.001	15.05	22.16
Process	-	-	-	-	-
Fugitive emissions	0.05	0.00	0.00	0.05	0.00
Farming activities	0.00	0.00	0.0005	0.16	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**16.33**	**0.01**	**0.002**	**16.94**	**22.25**
Scope 2					
Purchased electricity from the grid	**1,182.46**	-	-	**1,182.46**	-
Scope 3					
Fuel and energy activities not included in Scopes 1 and 2	1,639.69	0.03	0.003	1,641.27	3.69
Transport and distribution (upstream)	144.27	0.04	0.01	148.93	36.68
Solid waste from operations	0.00	0.63	0.001	15.94	0.00
Business Travel	20.67	0.003	0.001	21.12	1.56

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Employees transportation (home - work)	143.56	0.01	0.01	146.08	8.40
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00
Total Scope 3	**1,948.19**	**0.70**	**0.03**	**1,973.33**	**50.34**
Total emissions	***3,146.98***	***0.71***	***0.03***	***3,172.73***	***72.59***

→ **São Salvador (UHSA)**

UHSA emitted a total of 97.83 tCO_2e during 2014 year.

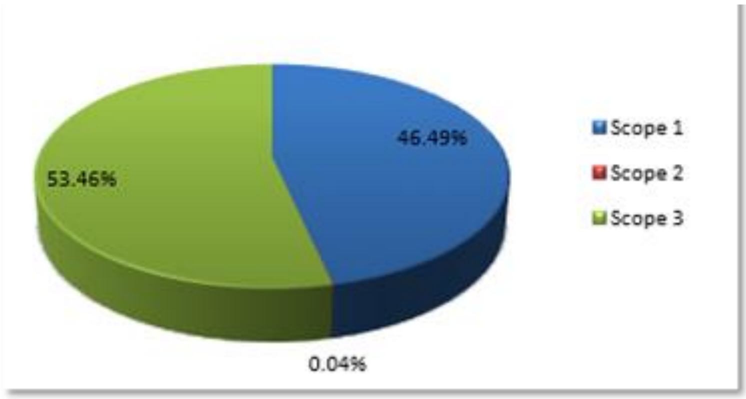

Figure 25 - Representativeness of UHSA GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

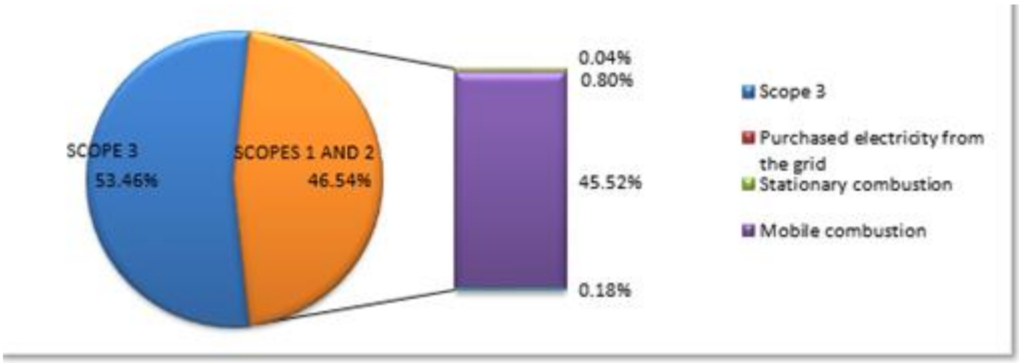

Figure 26 – Representativeness of UHSA GHG emissions by source

Emissions from biomass combustion resulted in 23.98 tCO_2. Non-Kyoto gas emissions of UHSA resulted in 12.13 tCO_2e from the R-22 use.

Emissions per greenhouse gas are detailed in the table below.

Table 43 – UHSA GHG emissions (in tonnes)

Emissions sources	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**biomass emission**	**Non-Kyoto gases**
Scope 1						
Stationary combustion	0.78	0.00003	0.00001	0.78	0.04	-
Mobile combustion	43.44	0.01	0.003	44.53	17.49	-
Process	-	-	-	-	-	-
Fugitive emissions	0.18	0.00	0.00	0.18	0.00	12.13
Farming activities	0.00	0.00	0.00	0.00	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	44.39	0.01	0.003	45.48	17.53	12.13
Scope 2						
Purchased electricity from the grid	**0.04**	**-**	**-**	**0.0439**	**-**	**-**
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	29.82	0.01	0.002	30.72	5.15	-
Solid waste from operations	0.00	0.07	0.00	1.71	0.00	-
Business Travel	4.76	0.001	0.0003	4.88	0.48	-
Employees transportation (home - work)	14.73	0.001	0.001	14.99	0.83	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**49.32**	**0.08**	**0.004**	**52.30**	**6.45**	**0.00**
Total emissions	***93.75***	***0.09***	***0.01***	***97.83***	***23.98***	***12.13***

7.1.2.5. Thermoelectric Power Plants

Tractebel Energia thermoelectric power plants emitted a total of 6,402,355.81 tCO_2e as described below.

→ **Alegrete (UTAL)**

UTAL emitted a total of 141.75 tCO_2e during 2014 year. This low emission, while compared to the previous years, occurred because this power plant practically did not operate during 2014 year.

Figure 27 - Representativeness of UTAL GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

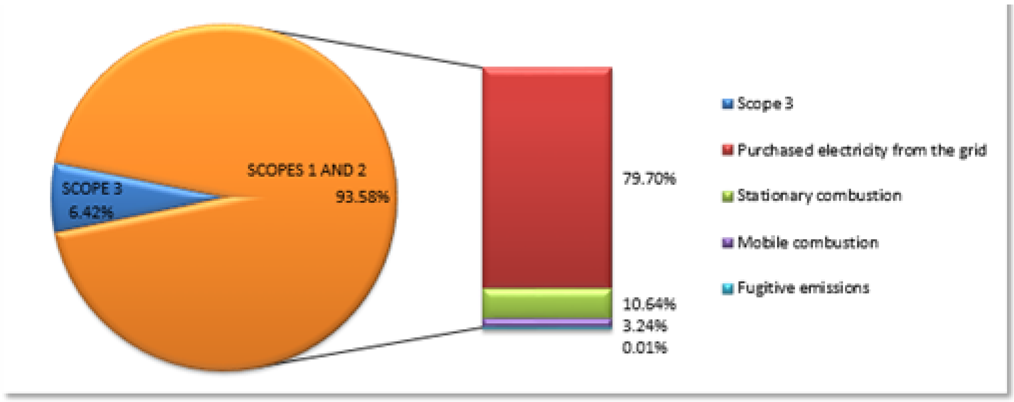

Figure 28 – Representativeness of UTAL GHG emissions by source

Emissions from the biomass combustion resulted in 2.00 tCO_2. There were no emissions of non-Kyoto gases (R-22) in 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 44 – UTAL GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	15.02	0.001	0.0001	15.08	0.80
Mobile combustion	4.44	0.001	0.0004	4.60	0.77
Process	-	-	-	-	-
Fugitive emissions	0.01	0.00	0.00	0.01	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**19.47**	**0.002**	**0.001**	**19.68**	**1.57**
Scope 2					
Purchased electricity from the grid	**112.97**	-	-	**112.97**	-

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 3					
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	3.26	0.0004	0.0002	3.33	0.19
Solid waste from operations	0.00	0.18	0.00	4.54	0.00
Business Travel	1.18	0.0004	0.0001	1.22	0.23
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	**4.43**	**0.18**	**0.0003**	**9.09**	**0.43**
Total emissions	***136.87***	***0.18***	***0.001***	***141.75***	***2.00***

→ **Charqueadas (UTCH)**

UTCH emitted a total of 582,923.72 tCO_2e during the year of 2014.

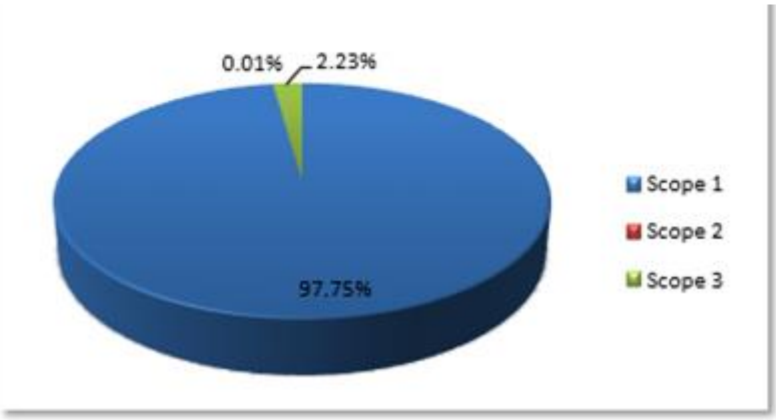

Figure 29 - Representativeness of UTCH GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in Figure 30. Considering the high representativeness of emissions from stationary combustion (97.75% of total UTCH emissions), this source was not considered in the figure below.

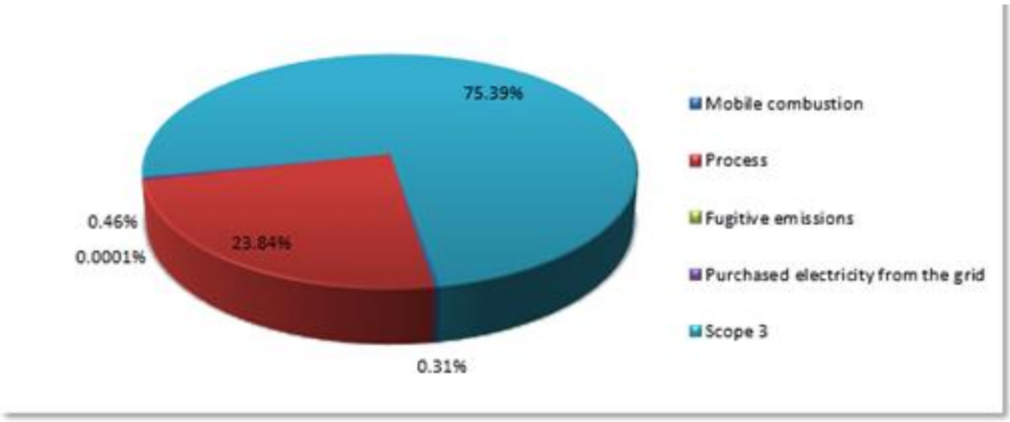

Figure 30 – Representativeness of UTCH GHG emissions by source (excluding stationary combustion)

UTCH emissions from Scope 1 represented 97.75% of total emissions. Considering stationary combustion only, it results in 565,644.42 tCO_2e emitted, *i.e.* 99.27% of total Scope 1 emissions and more than 97% of UTCH total emissions.

Emissions from biomass combustion resulted in 895.52 tCO_2. There were no emissions of non-Kyoto gases in 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 45 – UTCH GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	562,884.01	5.96	8.76	565,644.42	174.94
Mobile combustion	52.54	0.01	0.003	53.68	4.51
Process	4,120.11	0.00	0.00	4,120.11	0.00
Fugitive emissions	0.02	0.00	0.00	0.02	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	567,056.69	5.97	8.77	569,818.23	179.45
Scope 2					
Purchased electricity from the grid	**78.71**	**-**	**-**	**78.71**	**-**
Scope 3					

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	10,164.87	0.62	0.55	10,342.92	571.18
Solid waste from operations	0.00	0.93	0.00	23.17	0.00
Business Travel	11.24	0.002	0.001	11.48	0.89
Employees transportation (home - work)	0.00	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	2,603.62	0.16	0.14	2,649.22	144.00
Total Scope 3	**12,779.73**	**1.71**	**0.69**	**13,026.79**	**716.07**
Total emissions	***579,915.12***	***7.67***	***9.45***	***582,923.72***	***895.52***

UTCH relevant emissions from *upstream* transportation (transportation services contracted by Tractebel Energia) refer to diesel oil consumption used for coal transportation made by COPELMI, which represents more than 90% of the total diesel oil consumed for this category. In the case of *downstream* transportation (transportation services provided by third-party companies not contracted by Tractebel Energia), emissions due to diesel oil for ashes and gypsum transportation are considered. Dry ashes transportation represents approximately 70% of total diesel oil consumed under this category.

→ **Jorge Lacerda (CTJL)**

CTJL emitted a total of 5,165,813.58 tCO_2e during 2014 year.

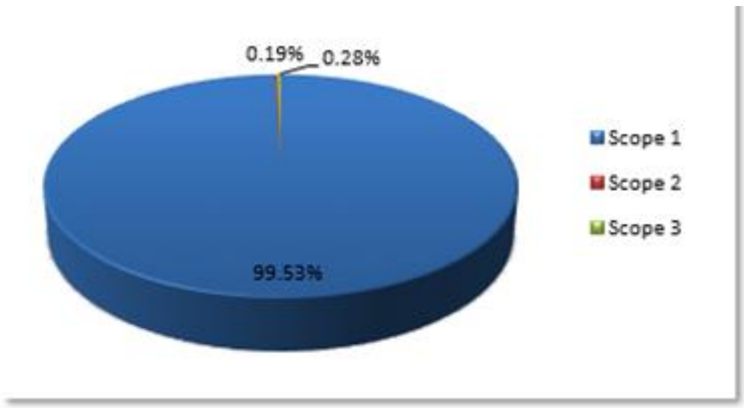

Figure 31 - Representativeness of CTJL GHG emissions by scope

Detailed emissions per source of Scope 1 and 2, excluding stationary combustion considering its high representativeness of this emission source, are presented in Figure 32.

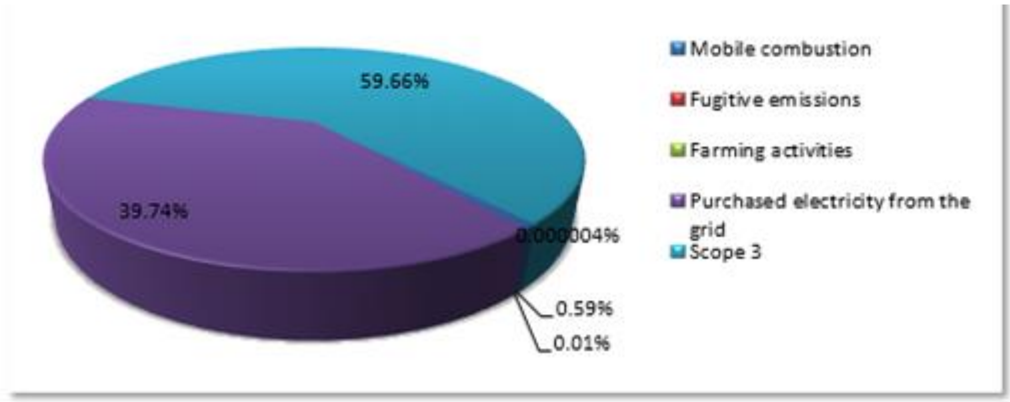

Figure 32 – Representativeness of CTJL GHG emissions by source (excluding stationary combustion)

Scope 1 emissions from stationary combustion only (5,141,203.45 tCO_2e) represented 99.5% of CTJL total emissions.

Emissions from biomass combustion resulted in 1,260.48 tCO_2. CTJL emissions from non-Kyoto gases resulted in 117.61 tCO_2e, due to small leaks of R-22 in air conditioning equipment of this unit.

Emissions per greenhouse gas are detailed in the table below.

Table 46 – CTJL GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	5,115,705.26	54.59	80.98	5,141,203.45	441.88	-
Mobile combustion	139.80	0.05	0.01	144.36	18.93	-
Process	-	-	-	-	-	-
Fugitive emissions	2.71	0.00	0.00	2.71	0.00	117.61
Farming activities	0.00	0.00	0.000003	0.001	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	5,115,847.77	54.64	81.00	5,141,350.52	460.81	117.61

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 2						
Purchased electricity from the grid	**9,781.26**	**-**	**-**	**9,781.26**	**-**	**-**
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	6,669.91	0.42	0.36	6,788.05	385.33	-
Solid waste from operations	0.00	16.31	0.01	410.97	0.00	-
Business Travel	72.41	0.01	0.005	74.13	6.65	-
Employees transportation (home - work)	37.02	0.002	0.002	37.67	2.11	-
Transport and distribution (downstream)	7,244.08	0.44	0.39	7,370.98	405.57	-
Total Scope 3	**14,023.42**	**17.19**	**0.77**	**14,681.80**	**799.66**	**0.00**
Total emissions	***5,139,652.44***	***71.82***	***81.76***	***5,165,813.58***	***1,260.48***	***117.61***

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

→ **Willian Arjona (UTWA)**

UTWA emitted a total of 633,386.83 tCO_2e during 2014 year.

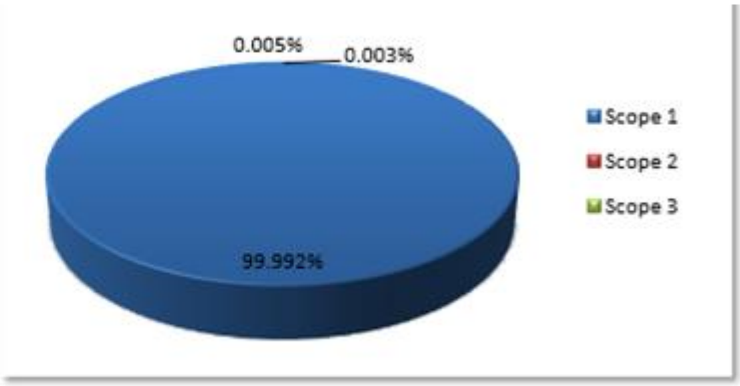

Figure 33 - Representativeness of UTWA GHG emissions by scope

Detailed emissions per source of Scope 1 and 2, except for stationary combustion given the high representativeness of this source, are presented in Figure 34.

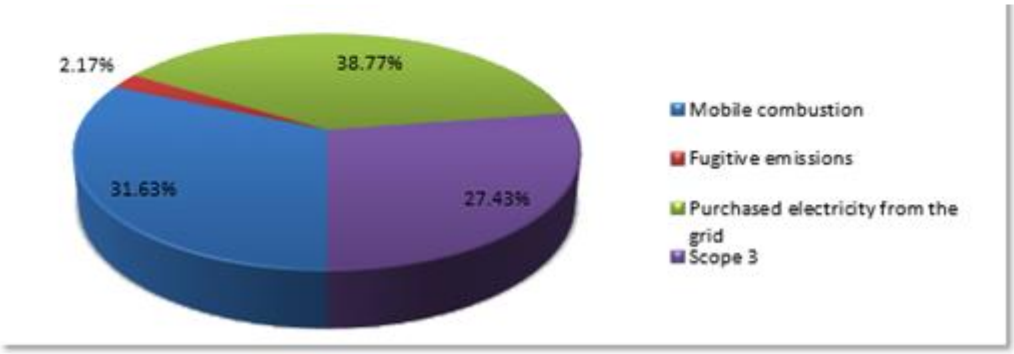

Figure 34 – Representativeness of UTWA GHG emissions by source (excluding stationary combustion)

Stationary combustion of Scope 1 only (633,311.03 tCO_2e) represented 99.98% of the total GHG emissions from UTWA.

Emissions from biomass combustion resulted in 5.71 tCO_2. The non-Kyoto gas emissions (R-22) resulted in 11.04 tCO_2e in 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 47 – UTWA GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	632,692.99	11.28	1.13	633,311.03	0.19	-
Mobile combustion	23.37	0.004	0.002	23.98	3.44	-
Process	-	-	-	-	-	-
Fugitive emissions	1.65	0.00	0.00	1.65	0.00	11.04
Farming activities	0.00	0.00	0.00	0.00	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	632,718.01	11.28	1.13	633,336.66	3.63	11.04
Scope 2						
Purchased electricity from the grid	**29.38**	**-**	**-**	**29.38**	**-**	**-**
Scope 3						
Fuel and energy activities not included in Scopes 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	-
Solid waste from operations	0.00	0.44	0.00	11.09	0.00	-
Business Travel	0.55	0.0001	0.0001	0.57	0.09	-
Employees transportation (home - work)	8.73	0.004	0.001	9.13	1.99	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**9.28**	**0.45**	**0.001**	**20.79**	**2.08**	**0.00**
Total emissions	***632,756.67***	***11.73***	***1.13***	***633,386.83***	***5.71***	***11.04***

Biomass Thermoelectric

→ **Lages (UCLA)**

UCLA emitted 6,134.44 tCO_2e during the year of 2014.

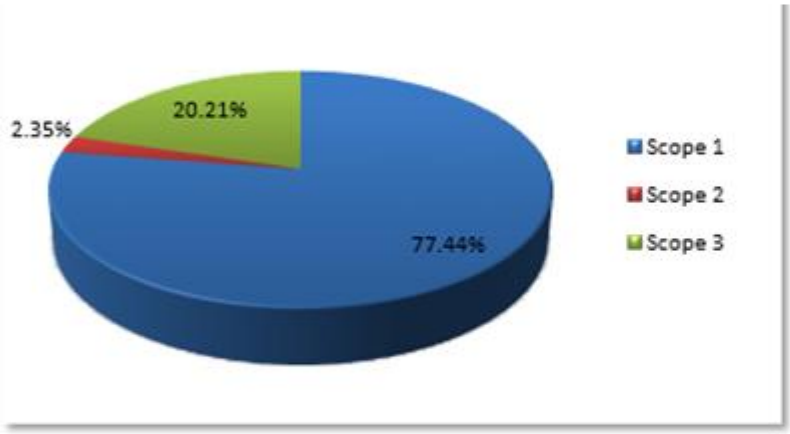

Figure 35 - Representativeness of UCLA GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below.

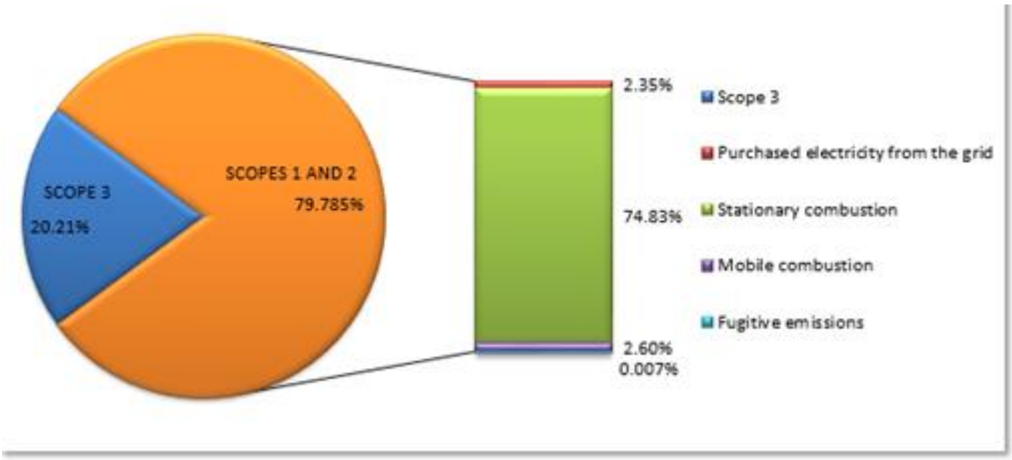

Figure 36 – Representativeness of UCLA GHG emissions by source

Emissions from biomass combustion resulted in 250,043.54 tCO_2. UCLA emissions of non-Kyoto gases resulted in 21.90 tCO_2e from R-22 use.

Emissions per greenhouse gas are detailed in the table below.

Table 48 – UCLA GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass	Non-Kyoto

					emission	gases
Scope 1						
Stationary combustion	9.10	70.77	9.44	4,590.13	249,966.10	-
Mobile combustion	156.91	0.01	0.01	159.73	9.87	-
Process	-	-	-	-	-	-
Fugitive emissions	0.40	0.00	0.00	0.40	0.00	21.90
Farming activities	0.00	0.00	0.00	0.00	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**166.42**	**70.78**	**9.44**	**4,750.27**	**249,975.97**	**21.90**
Scope 2						
Purchased electricity from the grid	**144.11**	**-**	**-**	**144.11**	**-**	**-**
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	1,166.35	0.07	0.06	1,186.77	63.28	-
Solid waste from operations	0.00	0.54	0.00	13.43	0.00	-
Business Travel	4.34	0.0005	0.00	4.42	0.28	-
Employees transportation (home - work)	34.50	0.01	0.003	35.44	4.00	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**1,205.18**	**0.61**	**0.07**	**1,240.06**	**67.57**	**0.00**
Total emissions	***1,515.71***	***71.39***	***9.51***	***6,134.44***	***250,043.54***	***21.90***

→ **Ferrari (UTFE)**

UTFE emitted a total of 10,032.25 tCO_2e during 2014 year.

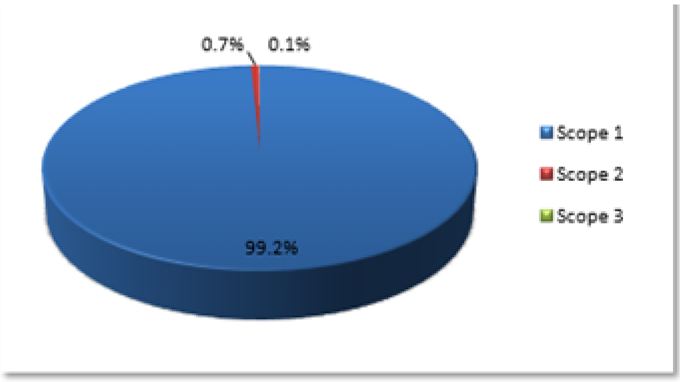

Figure 37 - Representativeness of UTFE GHG emissions by scope

UTFE has only one emission source for each scope and, therefore, its emission representativeness referred to stationary combustion (Scope 1), electricity purchase (Scope 2) and waste generated in operations (Scope 3).

Scope 1 emissions from stationary combustion (9,953.05 tCO_2e) represented 99.2% of total emissions of UTFE power plant.

Emissions from biomass combustion resulted in 497,994.39 tCO_2. There was no use of R-22 in 2014 and, therefore, emissions from non-Kyoto gases are zero.

Emissions per greenhouse gas are detailed in the table below.

Table 49 – UTFE GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Scope 1					
Stationary combustion	0.00	153.75	20.50	9,953.05	497,994.39
Mobile combustion	0.00	0.00	0.00	0.00	0.00
Process	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00
Farming activities	0.00	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00	0.00
Total Scope 1	**0.00**	**153.75**	**20.50**	**9,953.05**	**497,994.39**
Scope 2					
Purchased electricity from the grid	**73.44**	-	-	**73.44**	-
Scope 3					
Fuel and energy activities not included in Scopes 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
Solid waste from operations	0.00	0.23	0.00	5.75	0.00
Business Travel	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

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission
Total Scope 3	**0.00**	**0.23**	**0.00**	**5.75**	**0.00**
Total emissions	***73.44***	***153.98***	***20.50***	***10,032.25***	***497,994.39***

→ **Ibitiúva (UTIB)**

UTIB emitted a total of 3,923.23 tCO_2e during 2014 year.

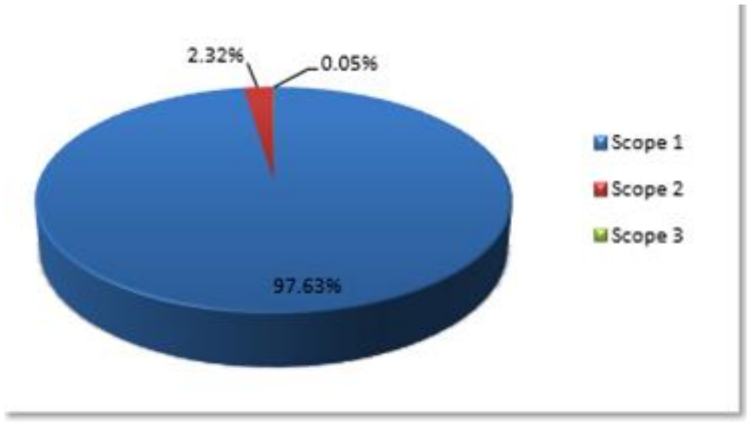

Figure 38 - Representativeness of UTIB GHG emissions by scope

Detailed emissions per source of Scope 1 and 2 are presented in the figure below, excluding stationary combustion due to the high representativeness from this emission source.

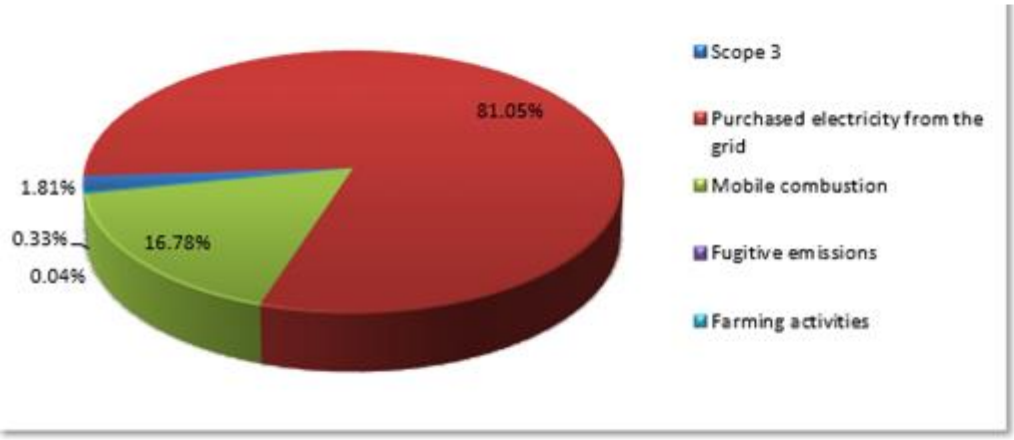

Figure 39 – Representativeness of UTIB GHG emissions by source (excluding stationary combustion)

Emissions from stationary combustion of Scope 1 (3,810.86 tCO_2e) represented 97.14% of UTIB total emissions.

Emissions from biomass combustion resulted in 190,889.24 tCO_2. Additionally, 10.86 tCO_2e were emitted due to R-22 use in 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 50 – UTIB GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	2.72	58.83	7.84	3,810.86	190,537.32	-
Mobile combustion	18.50	0.002	0.001	18.86	3.79	-
Process	-	-	-	-	-	-
Fugitive emissions	0.04	0.00	0.00	0.04	0.00	10.86
Farming activities	0.00	0.00	0.001	0.37	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**21.26**	**58.83**	**7.85**	**3,830.13**	**190,541.11**	**10.86**
Scope 2						
Purchased electricity from the grid	**91.08**	-	-	**91.08**	-	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	0.00	0.05	0.003	2.03	347.50	-
Solid waste from operations	0.00	0.00	0.00	0.00	0.63	-
Business Travel	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**	**0.05**	**0.003**	**2.03**	**348.13**	**0.00**
Total emissions	***112.34***	***58.88***	***7.85***	***3,923.23***	***190,889.24***	***10.86***

7.1.2.6. Offices

Tractebel Energia's offices emitted a total of 855.53 tCO_2e, as described below.

→ **Florianópolis (SC) – Head Office**

Tractebel Energia headquarters, located in Florianópolis, emitted a total of 852.73 tCO_2e during 2014 year.

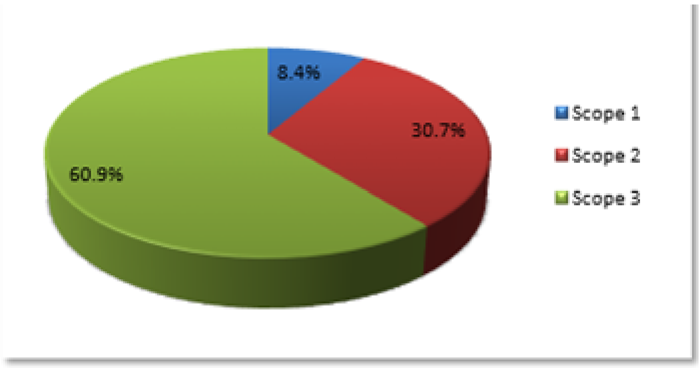

Figure 40 - Representativeness of GHG emissions headquarters in Florianópolis by scope

Detailed emissions per source are presented in the figure below.

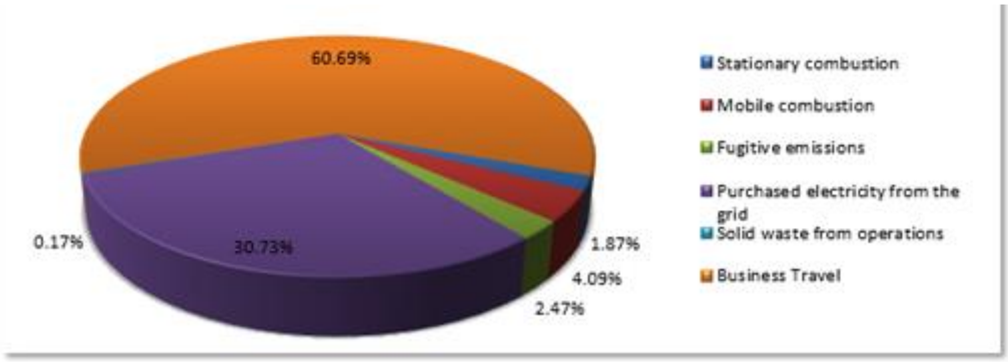

Figure 41 – Representativeness of GHG emissions of Tractebel Energia headquarters by source

Emissions from the biomass combustion resulted in 19.11 tCO_2. There were no emissions of non-Kyoto gases (R-22) in Tractebel Energia headquarters located in Florianópolis during 2014.

Emissions per greenhouse gas are detailed in the table below.

Table 51 – GHG emissions of Tractebel Energia headquarters (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	HFC	CO_2e	biomass emission
Scope 1						
Stationary combustion	15.85	0.001	0.0001	-	15.90	0.85
Mobile combustion	33.38	0.01	0.004	-	34.83	7.29
Process	-	-	-	-	-	-
Fugitive emissions	0.17	0.00	0.00	0.010	21.05	0.00
Farming activities	0.00	0.00	0.00	-	0.00	0.00
Solid waste	0.00	0.00	0.00	-	0.00	0.00
Total Scope 1	**49.40**	**0.01**	**0.004**	**0.01**	**71.78**	**8.14**
Scope 2						
Purchased electricity from the grid	**262.04**	-	-	-	**262.04**	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	0.00	0.00	0.00	-	0.00	0.00
Solid waste from operations	0.00	0.03	0.002	-	1.42	0.00
Business Travel	510.89	0.02	0.02	-	517.48	10.96
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	**510.89**	**0.05**	**0.02**	**0.00**	**518.90**	**10.96**
Total emissions	***822.33***	***0.06***	***0.03***	***0.01***	***852.73***	***19.11***

→ São Paulo (SP) Office

Tractebel Energia's office located in São Paulo emitted a total of 2.80 tCO_2e during 2014 year.

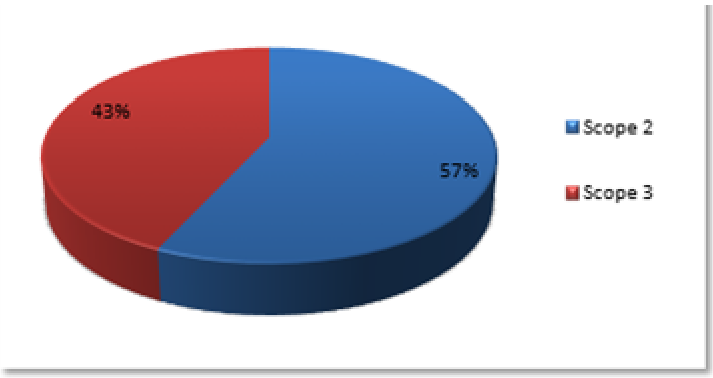

Figure 42 - Representativeness of GHG emissions in São Paulo's office by scope

Detailed emissions per source are presented in the figure below.

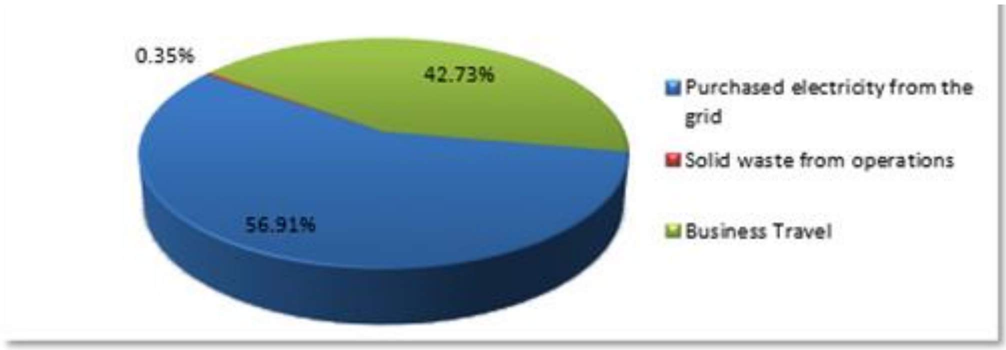

Figure 43 – Representativeness of GHG emissions of Tractebel Energia's office in Sao Paulo by source

As can be seen in the figure above, there were no Scope 1 emissions (direct emissions). Additionally, there were no emissions from biomass combustion nor use of non-Kyoto gases, as R-22.

Emissions per greenhouse gas are detailed in the table below.

Table 52 – GHG emissions in São Paulo's office (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e
Scope 1				
Stationary combustion	0.00	0.00	0.00	0.00
Mobile combustion	0.00	0.00	0.00	0.00

Emissions sources	CO_2	CH_4	N_2O	CO_2e
Process	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.00
Farming activities	0.00	0.00	0.00	0.00
Solid waste	0.00	0.00	0.00	0.00
Total Scope 1	**0.00**	**0.00**	**0.00**	**0.00**
Scope 2				
Purchased electricity from the grid	**1.60**	-	-	**1.60**
Scope 3				
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00
Transport and distribution (upstream)	0.00	0.00	0.00	0.00
Solid waste from operations	0.00	0.0004	0.00	0.01
Business Travel	1.19	0.00002	0.00004	1.20
Employees transportation (home - work)	0.00	0.00	0.00	0.00
Transport and distribution (downstream)	0.00	0.00	0.00	0.00
Total Scope 3	**1.19**	**0.0004**	**0.00004**	**1.21**
Total emissions	***2.78***	***0.0004***	***0.00004***	***2.80***

7.2. Equity Share Approach

This section presents emissions under the Equity Share Approach of Tractebel Energia. Results of the GHG calculation are detailed in the section below.

In the Equity Share Approach, UHET, UHMA and UHIT power plants are also considered, for which Tractebel Energia has equity share, but not the operational control.

The following tables detail the representativeness of each emission source for these power plants, as well as Tractebel Energia as a whole. Independently of the adopted approaches – Control or Equity Share –, it does not impact the representativeness of the emission sources. Therefore, the representativeness of the emission sources for the other power plants are presented in section 7.1 above.

Table 53 - Representativeness of emission sources in each scope for UHET, UHMA, UHIT units and Tractebel Energia – Equity Share Approach

Emissions sources	UHET	UHMA	UHIT	Tractebel
Scope 1				
Stationary combustion	14.70%	0.17%	0.00%	99.91%
Mobile combustion	27.02%	91.54%	1.13%	0.01%
Process	0.00%	0.00%	0.00%	0.06%
Fugitive emissions	44.36%	0.00%	98.84%	0.02%
Farming activities	13.92%	8.29%	0.03%	0.00%
Solid waste	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 activities not included in Scopes 1 and 2	0.00%	0.00%	0.00%	5.11%
Transport and distribution (upstream)	65.71%	14.26%	17.21%	58.44%
Solid waste from operations	0.76%	0.00%	0.00%	1.56%
Business Travel	31.54%	1.80%	7.09%	2.23%
Employees transportation (home - work)	1.99%	83.94%	75.70%	1.51%
Transport and distribution (downstream)	0.00%	0.00%	0.00%	36.62%

7.2.1. Total Emissions

During the year of 2014, Tractebel Energia emitted a total of **6,415,233.72 tCO_2e** distributed in scopes 1, 2 and 3 as presented in the sections below.

The total GHG emissions of Tractebel Energia per type of gas and source in the Equity Share approach are presented in Annex I of this report.

7.2.1.1. Scope 1

Scope 1 emissions for 2014 year represented 99.2%, resulting in **6,363,393.22 tCO_2e**. Emissions from stationary combustion only represented 99.9% of total emissions from Scope 1.

Table 54 – Scope 1 GHG emissions – Equity Share

Emissions sources	tCO_2e
Stationary combustion	6,357,397.51
Mobile combustion	693.97
Process	4,120.11
Fugitive emissions	1,170.04
Farming activities	11.21
Solid waste	0.37
Total Scope 1	**6,363,393.22**

7.2.1.2. Scope 2

Regarding Scope 2, only emissions due to electricity purchased from the grid were identified. Considering the year of 2014, **19,670.31 tCO_2e** were emitted, which represented 0.31% of Tractebel Energia total emissions.

The emissions contribution of this scope, due to the operation of the hydroelectric power plants of the company as a synchronous compensator of the National Interconnected System, can also be observed in the Equity Share approach, in which Itá and Machadinho hydroelectric power plants provide ancillary services, besides of Cana Brava, Passo Fundo, Salto Osório and Salto Santiago[8].

7.2.1.3. Scope 3

[8] List of power plants that provide ancillary services are available at: <http://www.ons.org.br/download/contratos_ancilares/Andamento%20dos%20CPSAs-27-09-13.pdf>.

Scope 3 emissions for the year of 2014 represented 0.50%, resulting in **32,170.20 tCO_2e**, according to emission sources presented below.

Table 55 – Scope 3 GHG emissions – Equity Share Approach

Emissions sources	tCO_2e
Fuel and energy activities not included in Scopes 1 and 2	1,642.86
Transport and distribution (upstream)	18,800.61
Solid waste from operations	503.31
Business Travel	718.35
Employees transportation (home - work)	484.87
Transport and distribution (downstream)	10,020.20
Total Scope 3	**32,170.20**

7.2.1.4. Biomass Emissions

CO_2 emissions from the biomass combustion of Tractebel Energia resulted in **882,667.28 tCO_2**.

7.2.1.5. Emissions of non-Kyoto gases

Emissions from gases not listed in Kyoto Protocol totaled **325,59 tCO_2e**.

7.2.2. Emissions per Unit

Tractebel Energia GHG emissions, per scope and power plant, are presented in the table below.

Table 56 – GHG Emissions of Tractebel Energia by scope and power plant – Equity Share (in tCO2e)

Units	Scope 1	Scope 2	Scope 3	Total emissions	Biomass emissions	Percentage of GHG emissions participation
CTJL	5,141,350.52	9,781.26	14,681.80	5,165,813.58	1,260.48	80.5242%
UTWA	633,336.66	29.38	20.79	633,386.83	5.71	9.8732%
UTCH	569,818.23	78.71	13,026.79	582,923.72	895.52	9.0866%
UTFE	9,953.05	73.44	5.75	10,032.25	497,994.39	0.1564%
UCLA	4,750.27	144.11	1,240.06	6,134.44	250,043.54	0.0956%
UHSO	15.68	5,837.95	75.02	5,928.66	23.69	0.0924%
UHSS	16.94	1,182.46	1,973.33	3,172.73	72.59	0.0495%
UTIB*	2,652.74	63.08	1.41	2,717.23	132,209.89	0.0424%
UHMA*	4.01	957.13	10.75	971.89	1.93	0.0151%
UHIT*	1,137.84	5.00	169.09	1,311.93	20.41	0.0205%
SEDE	71.78	262.04	518.90	852.73	19.11	0.0133%
UHPF	25.02	574.82	61.04	660.88	11.99	0.0103%
UHCB	34.09	487.51	28.99	550.58	15.74	0.0086%
UHET*	43.38	24.92	138.11	206.41	20.23	0.0032%
UTAL	19.68	112.97	9.09	141.75	2.00	0.0022%
UHSA	45.48	0.04	52.30	97.83	23.98	0.0015%
UHPP	15.16	15.14	61.07	91.38	19.66	0.0014%
UETR	73.97	4.80	6.65	85.42	5.78	0.0013%
PHAB	11.54	4.16	28.28	43.98	2.77	0.0007%
PHRO	1.42	0.47	21.15	23.04	7.11	0.0004%
PHJG	0.60	1.12	21.16	22.87	6.87	0.0004%
UEPS	9.36	2.09	8.56	20.01	2.11	0.0003%
UEBB	5.76	1.32	8.88	15.97	1.79	0.0002%
UEMU	0.00	8.17	0.00	8.17	0.00	0.0001%
UEFL	0.00	6.58	0.00	6.58	0.00	0.0001%
UEGU	0.00	5.32	0.00	5.32	0.00	0.0001%
UFCA	0.00	4.74	0.00	4.74	0.00	0.0001%
ESP	0.00	1.60	1.21	2.80	0.00	0.00004%
Total emissions	***6,363,393.22***	***19,670.31***	***32,170.20***	***6,415,233.72***	***882,667.28***	***100.0%***

* Power plants without Tractebel Energia's 100% ownership

In the following sections, GHG emissions of Tractebel Energia per operational unit are presented.

7.2.2.1. Wind Power Plants

Since Tractebel Energia has 100% equity share of Beberibe (UEBB), Flexeiras (UEFL), Guagiru (UEGU), Mundau (UEMU), Pedra do Sal (UEPS) and Trairi (UETR) wind power plants, GHG emissions from these units under the Equity Share approach are the same to the ones under the Control approach. Thus, results of GHG emissions from these units are described in section 7.1.2.1.

7.2.2.2. Solar Photovoltaic Power Plants

Since Tractebel Energia has 100% equity share of Cidade Azul (UFCA) solar photovoltaic power plant, GHG emissions from this unit under the Equity Share approach are the same to the ones under the Control approach. Thus, results of GHG emissions from these units are described in section 7.1.2.2.

7.2.2.3. Small Hydropower Plants

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

Therefore, GHG emissions from these units under the Equity Share approach are the same to the ones under the Control approach. Results of GHG emissions from these units are described in section 7.1.2.3.

7.2.2.4. Hydropower 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) hydropower plants. Therefore, emissions from these power plants are described in section 7.1.2.4 above.

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

→ **Estreito (UHET)**

Considering Tractebel Energia's equity share of 40.07% in UHET, this unit emitted 206.41 tCO_2e during the year of 2014. The distribution of emissions among scopes can be observed in the graphics below.

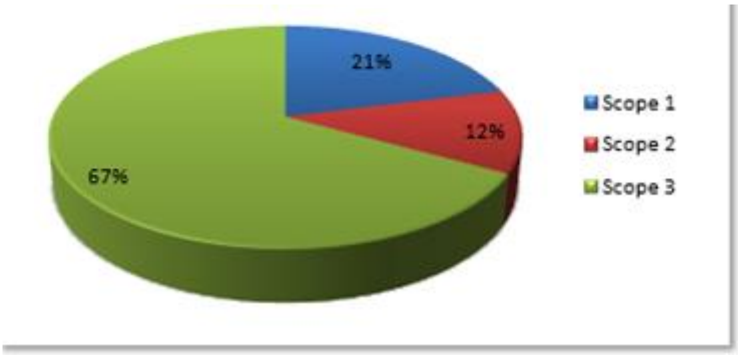

Figure 44 – Representativeness of UHET GHG emissions by scope

The representativeness of emissions per source of Scope 1 and 2 are presented in the figure below.

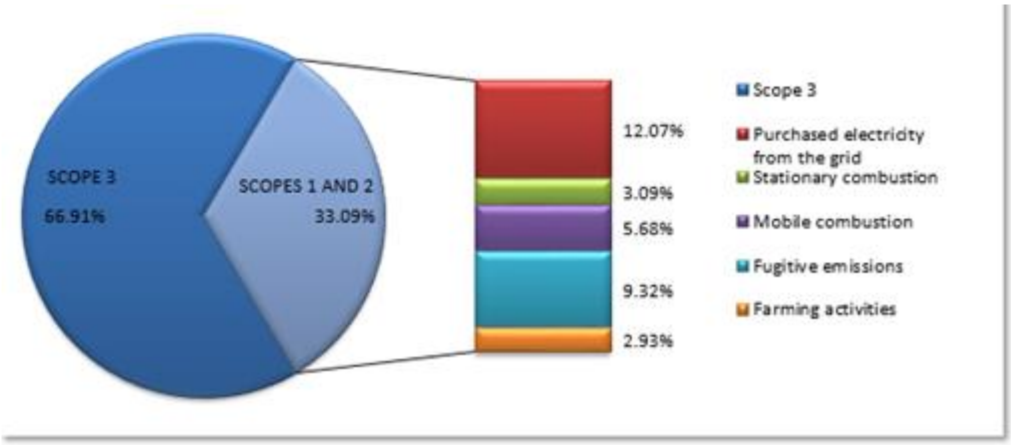

Figure 45 – Representativeness of UHET GHG emissions by source

Biomass emissions resulted in 20.23 tCO_2 and 37.71 tCO_2e of non-Kyoto gases in 2014. Emissions per greenhouse gas are detailed in the table below.

Table 57 - UHET GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	SF_6	CO_2e	biomass emission	Non-Kyoto gases
Scope 1							
Stationary combustion	6.35	0.0003	0.0001	-	6.38	0.34	-
Mobile combustion	11.39	0.003	0.001	-	11.72	5.08	-
Process	-	-	-	-	-	-	-
Fugitive emissions	0.06	0.00	0.00	0.001	19.24	0.00	37.71
Farming activities	0.00	0.00	0.02	-	6.04	0.00	-
Solid waste	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 1	**17.80**	**0.003**	**0.02**	**0.001**	**43.38**	**5.42**	**37.71**
Scope 2							
Purchased electricity from the grid	**24.92**	-	-	-	**24.92**	-	-
Scope 3							
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	87.84	0.02	0.01	-	90.75	13.45	-
Solid waste from operations	0.00	0.04	0.00	-	1.05	0.00	-
Business Travel	42.97	0.001	0.002	-	43.56	1.21	-
Employees transportation (home - work)	2.70	0.0002	0.0001	-	2.75	0.15	-
Transport and distribution (downstream)	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 3	**133.52**	**0.06**	**0.01**	**0.00**	**138.11**	**14.82**	-
Total emissions	***176.23***	***0.07***	***0.03***	***0.001***	***206.41***	***20.23***	***37.71***

UHET total emissions (100%) can be observed in Annex II of this report.

→ **Itá (UHIT)**

Considering the equity share of 68.99% of Tractebel Energia in UHIT, this unit emitted 1,311.93 tCO_2e during the year of 2014. The emissions ratio among scopes can be observed in the graphics below.

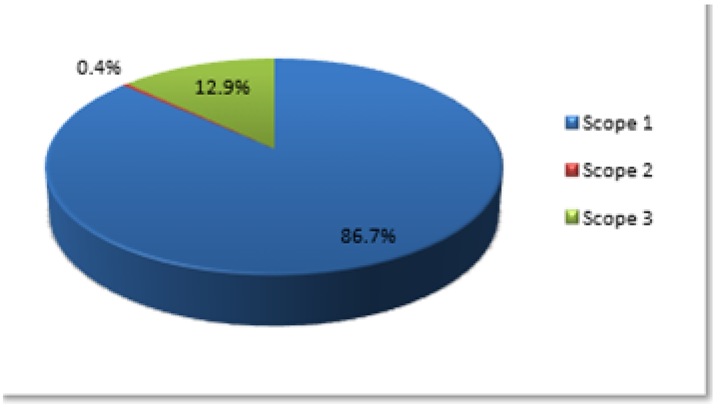

Figure 46 – Representativeness of UHIT GHG emissions by scope – Equity Share

Emissions representativeness per source of Scope 1 and 2 is presented in the figure below.

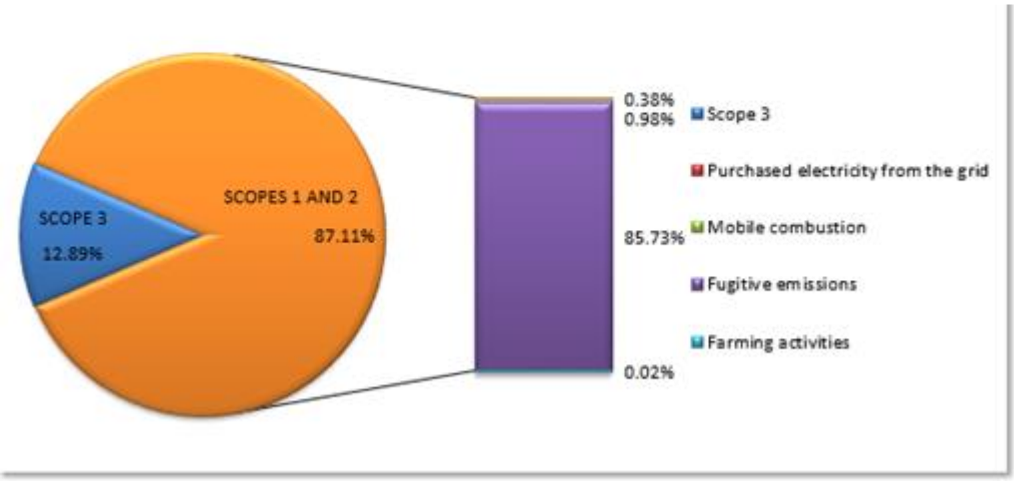

Figure 47 – Representativeness of UHIT GHG emissions by source

Biomass emissions resulted in 20.41 tCO_2 and emissions from non-Kyoto gases in 6.99 tCO_2e. Emissions per greenhouse gas are detailed in the table below.

Table 58 - UHIT GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	SF_6	CO_2e	biomass emission	Non-Kyoto gases
Scope 1							
Stationary combustion	0.00	0.00	0.00	-	0.00	0.00	-
Mobile combustion	12.49	0.003	0.001	-	12.84	6.93	-
Process	-	-	-	-	-	-	-
Fugitive emissions	0.00	0.00	0.00	0.05	1,124.67	0.00	6.99
Farming activities	0.00	0.00	0.00	-	0.32	0.00	-
Solid waste	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 1	**12.50**	**0.003**	**0.002**	**0.05**	**1,137.84**	**6.93**	**6.99**
Scope 2							
Purchased electricity from the grid	**5.00**	-	-	-	**5.00**	-	-
Scope 3							
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	28.00	0.01	0.003	-	29.10	5.40	-
Solid waste from operations	0.00	0.00	0.00	-	0.00	0.86	-
Business Travel	11.85	0.0003	0.0004	-	11.99	0.17	-
Employees transportation (home - work)	125.79	0.01	0.01	-	127.99	7.06	-
Transport and distribution (downstream)	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 3	**165.64**	**0.02**	**0.01**	**0.00**	**169.09**	**13.48**	**0.00**
Total emissions	***183.14***	***0.02***	***0.01***	***0.05***	***1,311.93***	***20.41***	***6.99***

UHIT total emissions (100%) can be assessed in Annex II of this report.

→ **Machadinho (UHMA)**

Considering Tractebel Energia's equity share of 19.28% in UHMA, this unit emitted 971.89 tCO_2e during 2014. The distribution of emissions in each scope can be seen below.

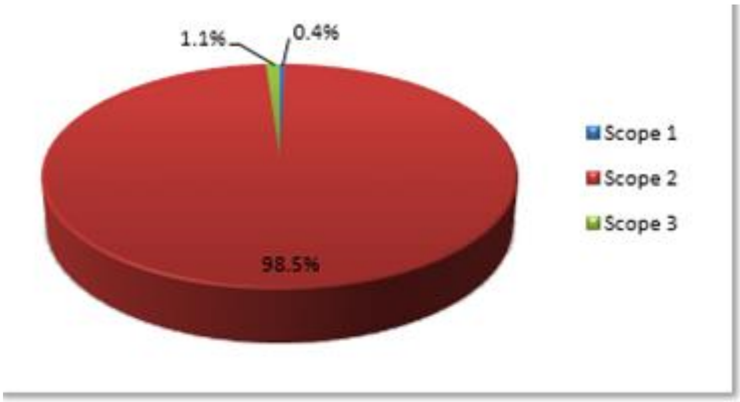

Figure 48 – Representativeness of UHMA GHG emissions by scope – Equity Share

Emissions representativeness per source of Scope 1 and 2 is presented in the figure below.

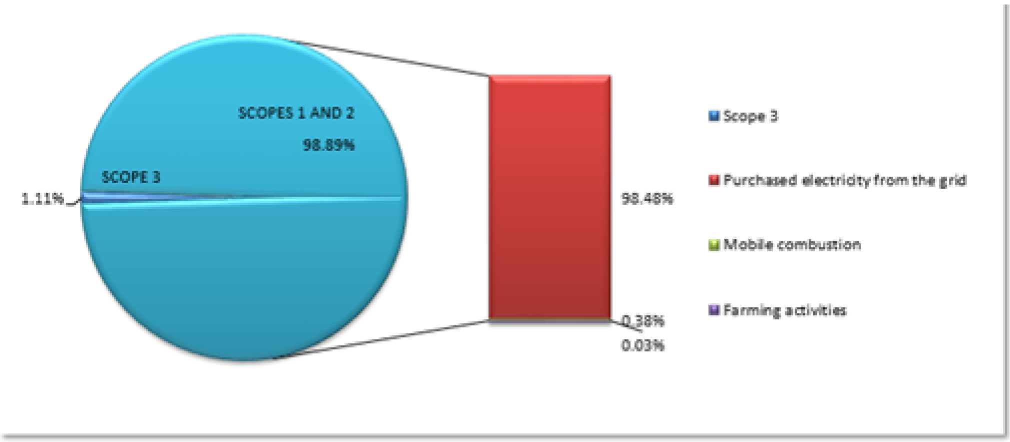

Figure 49 – Representativeness of UHMA GHG emissions by source

Biomass emissions resulted in 1.93 tCO_2 and non-Kyoto gases in 4.83 tCO_2e in 2014. Emissions per greenhouse gas are detailed in the table below.

Table 59 - UHMA GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	0.00	0.00	0.00	0.00	0.00	-
Mobile combustion	3.56	0.001	0.0003	3.67	1.16	-
Process	-	-	-	-	-	-

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Fugitive emissions	0.00	0.00	0.00	0.00	0.00	4.83
Farming activities	0.00	0.00	0.00	0.33	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**3.56**	**0.001**	**0.001**	**4.00**	**1.16**	**4.83**
Scope 2						
Purchased electricity from the grid	**957.13**	-	-	**957.13**	-	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	1.51	0.0001	0.0001	1.53	0.08	-
Solid waste from operations	0.00	0.00	0.00	0.00	0.17	-
Business Travel	0.19	0.00003	0.00001	0.19	0.02	-
Employees transportation (home - work)	8.87	0.001	0.0005	9.03	0.50	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**10.57**	**0.001**	**0.001**	**10.75**	**0.77**	**0.00**
Total emissions	***971.26***	***0.002***	***0.002***	***971.89***	***1.93***	***4.83***

UHMA total emissions (100%) can be observed in Annex II of this report.

7.2.2.5. Thermoelectric Power Plants

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

Ibitiúva (UTIB) emissions are described below.

→ **Ibitiúva (UTIB)**

Considering Tractebel Energia's equity share of 69.26% in UTIB, this unit emitted 2,717.23 tCO_2e during 2014. The emissions ratio among the scopes can be observed in the graphics below.

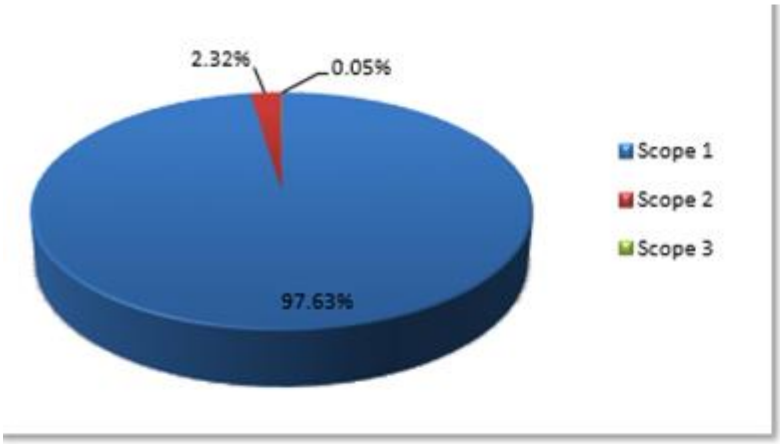

Figure 50 – Representativeness of UTIB GHG emissions by scope – Equity Share

The representativeness of emissions per source of Scope 1 and 2 is presented in the figure below, excluding stationary combustion due to its high emissions in relation to other sources.

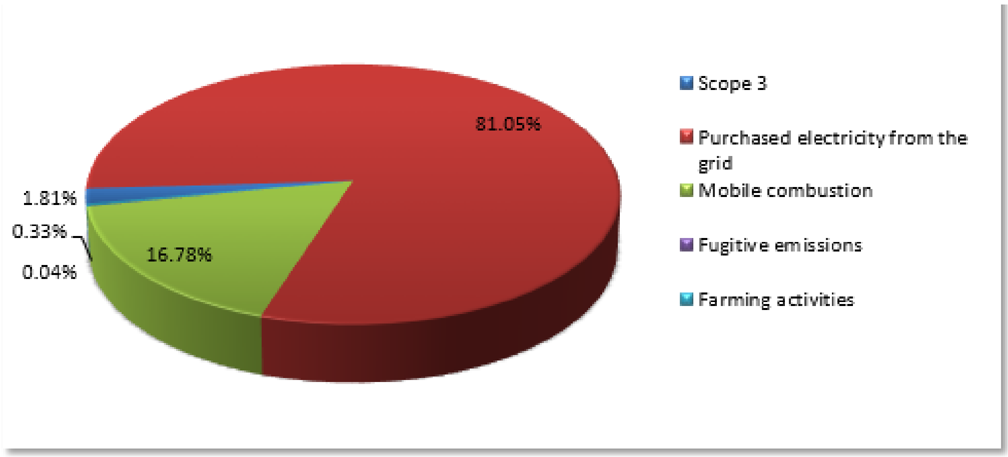

Figure 51 – Representativeness of UTIB GHG emissions by source (excluding stationary combustion)

Biomass emissions resulted in 132,209.89 tCO_2 and non-Kyoto gases resulted in 7.52 tCO_2e.

Emissions per greenhouse gas are detailed in the table below.

Table 60 – UTIB GHG emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	1.88	40.74	5.43	2,639.40	131,966.15	-
Mobile combustion	12.81	0.001	0.001	13.06	2.63	-
Process	-	-	-	-	-	-
Fugitive emissions	0.03	0.00	0.00	0.03	0.00	7.52
Farming activities	0.00	0.00	0.00	0.26	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**14.73**	**40.75**	**5.43**	**2,652.74**	**131,968.78**	**7.52**
Scope 2						
Purchased electricity from the grid	**63.08**	-	-	**63.08**	-	-
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	0.00	0.03	0.002	1.41	240.68	-
Solid waste from operations	0.00	0.00	0.00	0.00	0.44	-
Business Travel	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**	**0.03**	**0.002**	**1.41**	**241.11**	**0.00**
Total emissions	***77.81***	***40.78***	***5.44***	***2,717.23***	***132,209.89***	***7.52***

7.2.2.6. Offices

Since the headquarters of Tractebel Energia located in Florianópolis and the office located in São Paulo are 100% owned by Tractebel Energia, GHG emissions from these units are the same to those presented in section 7.1.2.6.

8. Analysis of Emissions

8.1. Control Vs. Equity Share

GHG emissions under the Control approach resulted in 6,413,949.50 tCO_2e and 6,415,233.72 tCO_2e considering the Equity Share approach, which results in **1,284.22 tCO_2e** difference between approaches.

In the table below, total results per power plant in each approach can be observed.

Table 61 - Comparison of emissions from each plant in the approaches of Control Approach and Equity Share

Power plants / Offices		Control Approach		Equity Share	
		tCO_2e	%	tCO_2e	%
Beberibe	100%	15.97	0.0002%	15.97	0.0002%
Fleixeiras I	100%	6.58	0.0001%	6.58	0.0001%
Guajirú	100%	5.32	0.0001%	5.32	0.0001%
Mundaú	100%	8.17	0.0001%	8.17	0.0001%
Pedra do Sal	100%	20.01	0.0003%	20.01	0.0003%
Trairi	100%	85.42	0.0013%	85.42	0.0013%
Cana Brava	100%	550.58	0.0086%	550.58	0.0086%
Estreito	40.07%	-	-	206.41	0.0032%
Itá	68.99%	-	-	1,311.93	0.0205%
Machadinho	19.29%	-	-	971.89	0.0151%
Passo Fundo	100%	660.88	0.0103%	660.88	0.0103%
Ponte de Pedra	100%	91.38	0.0014%	91.38	0.0014%
Salto Osório	100%	5,928.66	0.0924%	5,928.66	0.0924%
Salto Santiago	100%	3,172.73	0.0495%	3,172.73	0.0495%
São Salvador	100%	97.83	0.0015%	97.83	0.0015%
Areia Branca	100%	43.98	0.0007%	43.98	0.0007%
José Gelazio da Rocha	100%	22.87	0.0004%	22.87	0.0004%
Rondonópolis	100%	23.04	0.0004%	23.04	0.0004%
Alegrete	100%	141.75	0.0022%	141.75	0.0022%
Charqueadas	100%	582,923.72	9.0884%	582,923.72	9.0866%
Ferrari	100%	10,032.25	0.1564%	10,032.25	0.1564%
Ibitiúva	69.26%	3,923.23	0.0612%	2,717.23	0.0424%
Jorge Lacerda	100%	5,165,813.58	80.5403%	5,165,813.58	80.5242%
Lages	100%	6,134.44	0.0956%	6,134.42	0.0956%

Power plants / Offices		Control Approach		Equity Share	
		tCO_2e	%	tCO_2e	%
William Arjona	100%	633,386.83	9.8751%	633,386.83	9.8732%
Cidade Azul	100%	4.74	0.0001%	4.74	0.0001%
São Paulo	100%	2.80	0.00004%	2.80	0.0000%
Florianópolis	100%	852.73	0.0133%	852.73	0.0133%
Total		**6,413,949,50**	**100%**	**6,415,233.70**	**100.0%**

8.2. Uncertainty Analysis

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. The uncertainty assessment is presented as follows.

8.2.1. Qualitative Analysis

In spite of the efforts of Tractebel Energia in collect accurate data as possible, some parameters resulted uncertainty to GHG emissions calculation of Tractebel Energia's inventory. Such parameters as well as the actions taken to reduce this effect are detailed below.

(a) Mobile combustion:

For some units of Tractebel Energia, part of mobile combustion emissions was calculated from distance data traveled by vehicles multiplied by the average consumption by type of fleet, available from the GHG Protocol – Brazilian Program tool. This calculation provides greater uncertainty in inventory when compared to the calculation from the actual fuel consumption.

(b) Fertilizers use:

According to the Work Instruction "Meio Ambiente - IT-MA-GE-006" established by Tractebel Energia to collect GHG data, in the absence of information related to the percentage of nitrogen in fertilizers used, values of 45% for synthetic fertilizers and 1% for organic fertilizer shall be used. In spite of not using specific data from a fertilizer supplier, these values were adopted conservatively based on Normative Instruction of the Ministry of Agriculture, Livestock and Supply Nr. 25th, July 2009, which recommended the value of 1% for organic fertilizers, and, in the case of the synthetic fertilizers value for urea use was considered since it is the most widely type used in Brazil.

(c) Reservoir emissions from hydropower plants:

GHG emissions from reservoir of hydropower plants were not included in this inventory. As explained in section 6.2.2, there is no methodology internationally approved that allows GHG emissions estimative in reservoirs.

8.2.2. Quantitative Analysis

The uncertainty assessment of the 2014 GHG inventory of Tractebel Energia was performed for each of its units. For this, we used the tool provided by the GHG Protocol "ghg uncertainty.xls" (GHG Protocol, 2003) which considers the Gaussian method, which requires the distribution of measurement data converges to a normal distribution and the individual uncertainties are smaller than 60% of the expected mean.

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

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

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

Direct measurements identified to Tractebel Energia refer to fugitive emissions, *i.e.* CO_2 fire extinguishers or gases used in refrigeration and air conditioning equipment. The other issues were classified as indirect measurements, since there is no monitoring or direct verification of greenhouse gases.

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

Table 62 – Value and reference of the emission factor uncertainty

Emission source (indirect measurements)	Uncertainty level of the Emission factor (Confidence interval expressed in ± 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)
Process desulfurization	+/- 15.0%	GHG Protocol (2003)
Wastes (landfill / composting)	+/- 30.0%	GHG Protocol (2003)
Fertilizer use (organic/synthetic)	+/- 30.0%	IPCC (2006)

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

Table 63 – Uncertainty rating for measurements

Rating	Uncertainty level
High	≤ 5%
Good	≤ 15%
Fair	≤ 30%
Poor	> 30%

Source: GHG Protocol (2003)

According to the Work Instruction "Meio Ambiente – IT-MA-GE-006" established by Tractebel Energia for GHG data collection, the "nature of evidence" shall be considered. Based on the nature of the evidence of data provided by Tractebel Energia, the following classification was established.

Table 64 – Uncertainty rating of activity data

Nature of the evidence	Data uncertainty	Uncertainty Rating	Reference
Energy Measurement System	+/- 0.20%	High	ONS (2011). Submodule 12.2. ver. 2.0 / 2011. Accuracy class of energy meters.
Fuel System (bagasse)	+/- 0.50%	High	Bextra Operation Manual. UTIB weighing equipment deviation
Fuel System (coal)	+/- 1.00%	High	"IT-CA-UTCH-015. Calibration of Dynamic Balance Bextra. UTCH weighing Balance (1%).
Fuel System (fuel oil)	+/- 1.00	High	It was considered the greatest uncertainty among those reported to the Fuel System.
System fuel (diesel oil)	+/- 1.00	High	It was considered the greatest uncertainty among those reported to the Fuel System.
System fuels (natural gas)	+/- 0.50%	High	Calibration Certificate of UTWA Meter issued by IPT
System fuels (wood)	+/- 1.00%	High	Certificate of conformity issued by Toledo in Brazil for the UCLA weighing equipment
Other reports from the information system of Tractebel Energia	+/- 5.00%	High	GHG Protocol (2003)
Sales of Receipt	+/- 5.0%	High	GHG Protocol (2003)
Certificate of waste destination (with quantities) or weighing tickets	+/- 5.00%	High	GHG Protocol (2003)
Supplier report	+/- 15.0%	Good	GHG Protocol (2003)
Internal Control Sheet	+/- 30.0%	Fair	GHG Protocol (2003)
Internal estimative	+/- 40.0%	Poor	GHG Protocol (2003)
Other evidence*	+/- 40.0%	Poor	GHG Protocol (2003)

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

The values presented in the table above were not changed in 2013. Therefore, uncertainty variations in units between 2013 and 2014 are, exclusively, due to the nature of the evidence considered for data presented in the GHG Inventory and not to the uncertainty classification presented in Table 64.

The result of the uncertainty analysis for each unit from Tractebel Energia is presented in Table 65. It is important mentioning that uncertainty assessment was made considering 100% of emissions for those Tractebel Energia has 100% equity share.

Although Tractebel Energia has no 100% ownership of these units, total emissions of UHET, UHIT and UHMA units were also considered. This approach does not impact the final result, since total emissions are used to indicate the range of uncertainty in regard to total emissions only.

Table 65 – Uncertainty analysis for the units of Tractebel Energia

Units	Indirect measurements	Direct measurements	Aggregate uncertainty	Reliability rating
UHET	+/- 3.3%	+/- 5.0%	+/- 3.0%	High
UHPP	+/- 3.7%	+/- 0.0%	+/- 3.7%	High
CTJL	+/- 4.0%	+/- 15.0%	+/- 4.0%	High
UEBB	+/- 4.8%	+/- 0.0%	+/- 4.8%	High
UHIT	+/- 4.8%	+/- 5.0%	+/- 4.3%	High
UHSS	+/- 5.6%	+/- 30.0%	+/- 5.6%	Good
UETR	+/- 5.6%	+/- 0.0%	+/- 5.6%	Good
UTIB	+/- 5.6%	+/- 30.0%	+/- 5.6%	Good
PHJG	+/- 5.7%	+/- 0.0%	+/- 5.7%	Good
UHPF	+/- 5.7%	+/- 0.0%	+/- 5.7%	Good
PHRO	+/- 5.7%	+/- 0.0%	+/- 5.7%	Good
UHCB	+/- 6.2%	+/- 0.0%	+/- 6.2%	Good
UTAL	+/- 6.2%	+/- 5.0%	+/- 6.2%	Good
UHSA	+/- 6.6%	+/- 15.0%	+/- 6.6%	Good
UHMA	+/- 6.9%	+/- 0.0%	+/- 6.9%	Good
UHSO	+/- 6.9%	+/- 30.0%	+/- 6.9%	Good
UEPS	+/- 6.9%	+/- 5.0%	+/- 6.9%	Good
UEFL	+/- 7.0%	+/- 0.0%	+/- 7.0%	Good
UEGU	+/- 7.0%	+/- 0.0%	+/- 7.0%	Good
UEMU	+/- 7.0%	+/- 0.0%	+/- 7.0%	Good
UFCA	+/- 7.0%	+/- 0.0%	+/- 7.0%	Good
SEDE	+/- 7.1%	+/- 14.9%	+/- 6.9%	Good
ESP	+/- 8.3%	+/- 0.0%	+/- 8.3%	Good
PHAB	+/- 9.2%	+/- 0.0%	+/- 9.2%	Good
UTCH	+/- 10.4%	+/- 5.0%	+/- 10.4%	Good
UTFE	+/- 14.3%	+/- 0.0%	+/- 14.3%	Good
UTWA	+/- 15.8%	+/- 15.0%	+/- 15.8%	Fair
UCLA	+/- 28.2%	+/- 3.7%	+/- 28.2%	Fair
TOTAL	**+/- 13.9%**	**+/- 4.8%**	**+/- 3.7%**	**High**

Values indicated with "+/-0.0%" (zero) in direct emissions in the table above are due to refrigerant gases or CO_2 fire extinguishers, for example. Therefore, "+/-0.0%" does not mean absence of uncertainty, but absence of direct emissions involved in the unit.

Since the uncertainty range of the emission factor used for each type of source is the same for all units of Tractebel Energia, the difference between the final results of uncertainty for each unit is based on the evidence provided for each activity data.

The assessment of total aggregated uncertainty was performed considering the weighted average of emissions, resulting in +/- 3.7%, *i.e.* a high classification ("high"). This analysis was performed to give more emphasis to the data of units that have higher emissions, avoiding distortions of the final results.

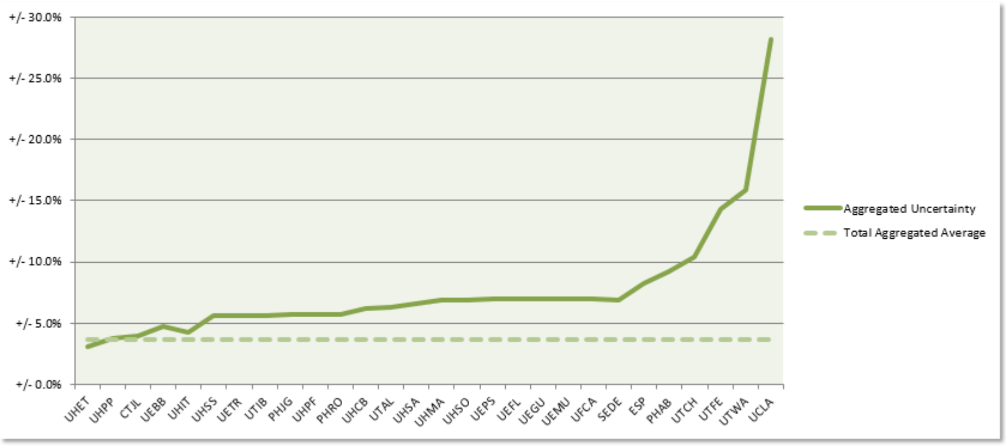

Figure 52 – Uncertainty chart for the Tractebel Energia units and the total aggregated average

As presented in table and figure above, UHET has the best rating (+/- 3.0%). This result demonstrates that this unit considered data that are more reliable and, thus, has low uncertainty of the data collected. On the other hand, UCLA has the highest data uncertainty (+/- 28.2%, rated "fair"), due mainly to estimative considered for transmission and distribution (upstream) and business travel - mobile combustion. This result also shows a greater dependence on data from subcontractors and suppliers.

Uncertainty analysis of GHG emissions is presented in the figures below.

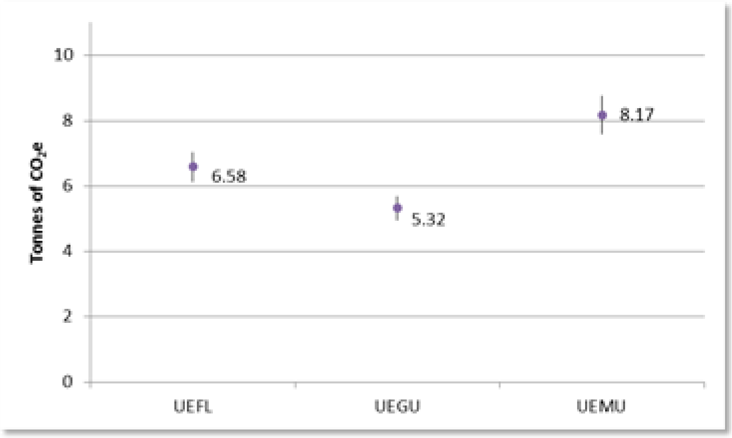

Figure 53 – Uncertainty analysis of GHG emissions from UEFL, UEGU and UEMU wind power plants

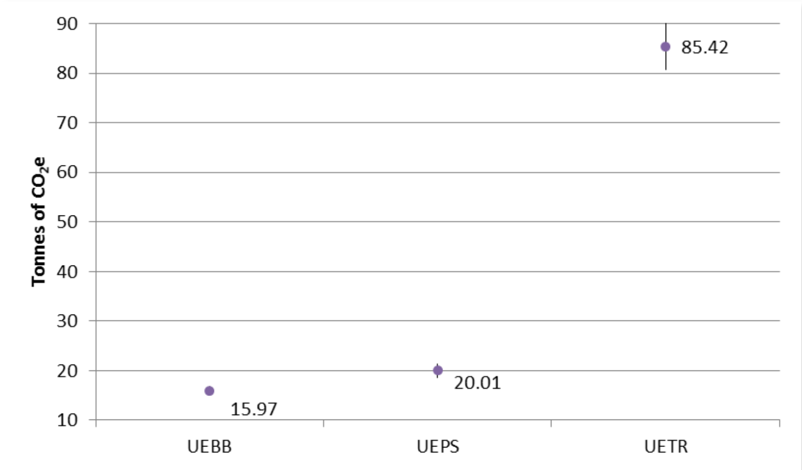

Figure 54 – Uncertainty analysis of GHG emissions from UEBB, UEPS and UETR wind power plants

In spite of UETR appears higher value uncertainty as shown in the figures above, the wind farms that have higher uncertainty is UEFL, UEGU and UEMU (+/- 7.0% uncertainty). By having higher emissions in relation to other units, emissions range up and down is greater. Thus, the graph gives the impression that the UETR has higher uncertainty, which is not correct.

Among the wind power plants, UEBB has the lowest uncertainty (+/- 4.8%), followed by UETR (+/-5.6%) e UEPS (+/-6.9%).

The small hydropower plants present an uncertainty range from +/- 5.7% to +/-9.2%, as can be seen in the figure below.

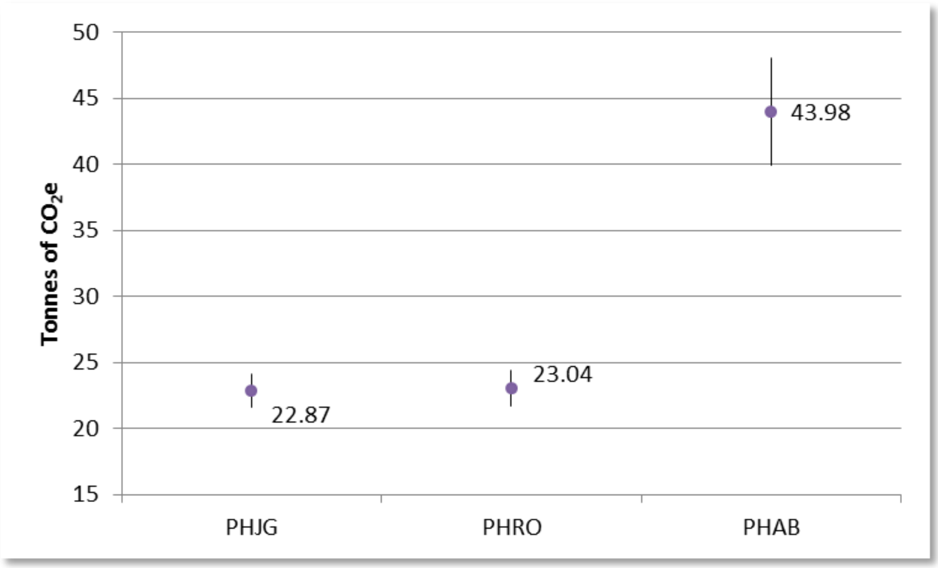

Figure 55 – Uncertainty analysis of GHG emissions from small hydropower plants

Regarding Tractebel Energia offices, the figure below can give the false impression that there is no uncertainty for GHG emissions from São Paulo office (ESP). However, this misunderstanding is because of GHG emissions of ESP are very small. In fact, uncertainty in emissions of the São Paulo office (+/- 8.3%) is higher than the Tractebel Energia headquarters in Florianópolis (+/- 6.9%).

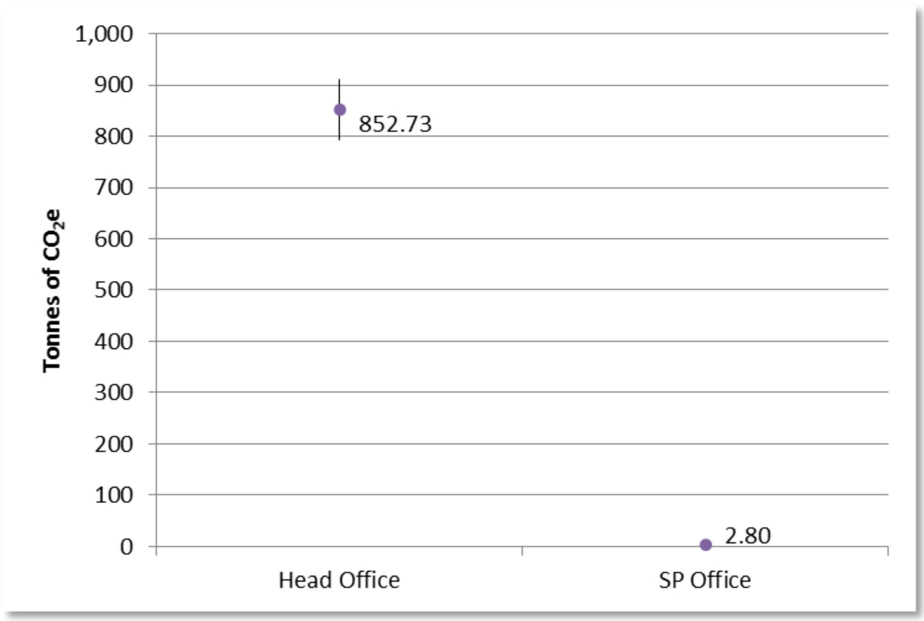

Figure 56 – Uncertainty analysis of GHG emissions from Tractebel Energia's offices

Considering the great difference between emissions from UHSS, UHSO and UHMA and other hydroelectric plants, the uncertainty analysis was performed separately for this group. Data uncertainty of these plants are also similar, which the UHMA and UHSO have a higher level of uncertainty +/- 6.9%, followed by UHSS (+/- 5.6%).

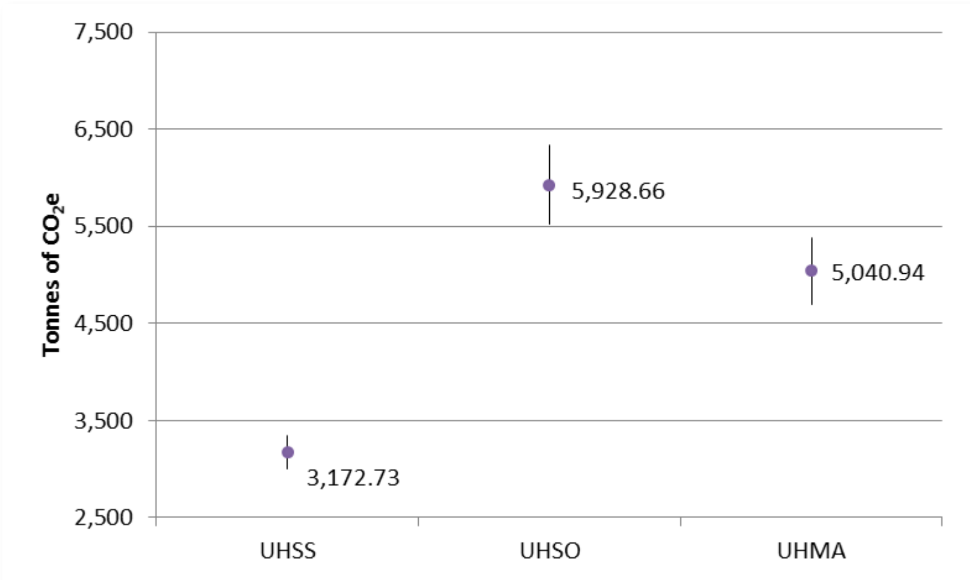

Figure 57 – Uncertainty analysis of GHG emissions from UHSS, UHSO and UHMA plants

Just as the uncertainty analysis of Tractebel Energia's offices, Figure 58 below appears that UHIT presents higher uncertainty than UHCB and UHPF, which is not correct. This effect is due to the highest emission of UHIT, resulting in a relatively greater emissions range. However, UHIT has an uncertainty of +/- 4.3%, followed by UHPF (+/- 5.7%) and UHCB (+/- 6.2%). UHET, as previously mentioned, has the lowest uncertainty among Tractebel Energia units (+/- 3.0%). UHPP and UHSA have uncertainty levels of +/- 3.7% and +/- 6.6%, respectively.

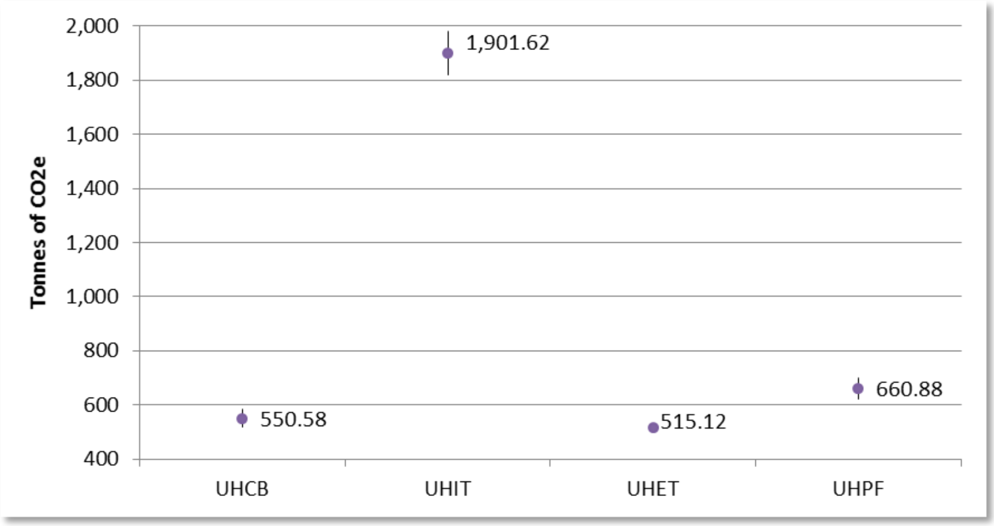

Figure 58 – Uncertainty analysis of GHG emissions from UHCB, UHIT, UHET and UHPF plants

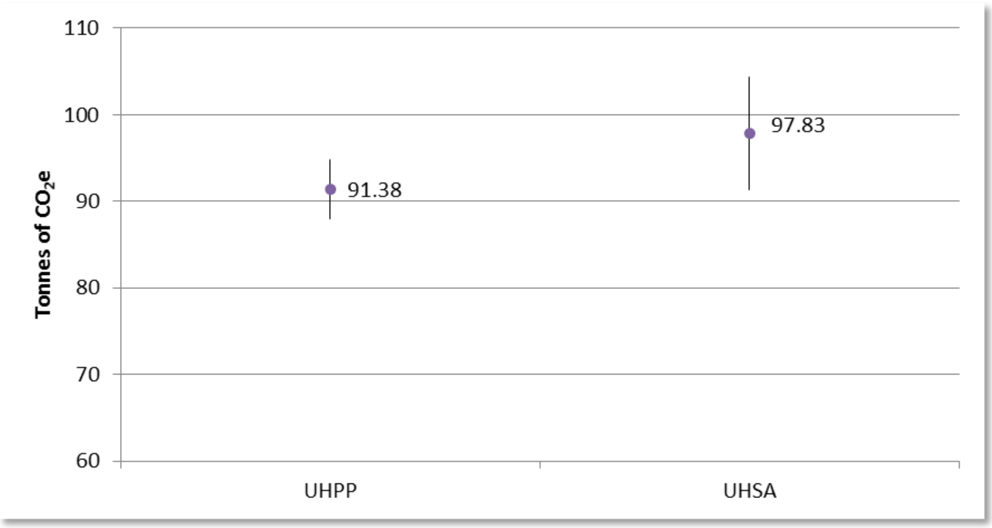

Figure 59 - Uncertainty analysis of GHG emissions from UHPP and UHSA plants

Because of their significant difference in regard to emissions, thermoelectric plants were also analyzed separately, as presented in the figures below.

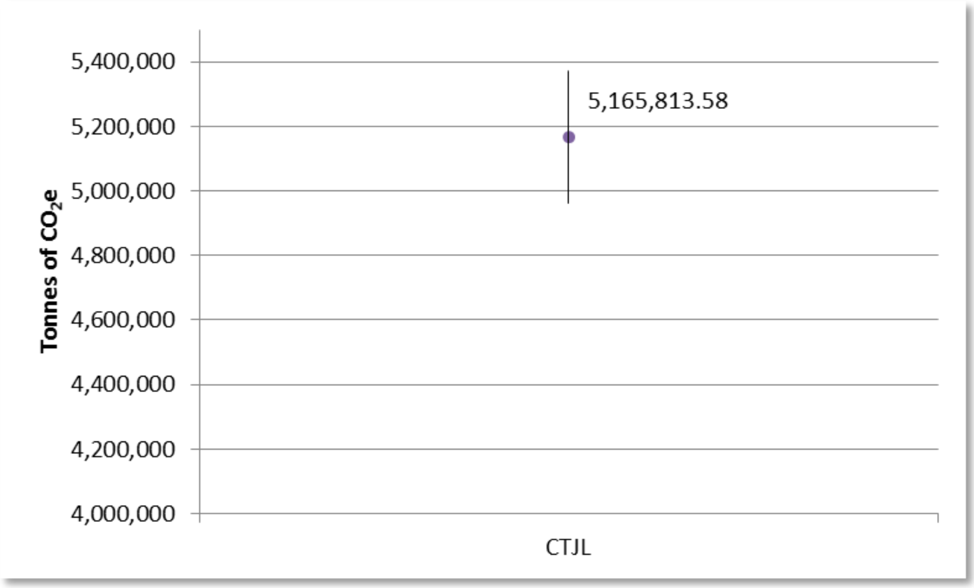

Figure 60 – Uncertainty analysis of GHG emissions from CTJL

CTJL is responsible for 80.5% of total GHG emissions of Tractebel Energia. Thus, the uncertainty of +/- 4.0% has significant impact on emissions, varying it from 4,961,415.19 to 5,370,211.97 tCO_2e. However, CTJL improved its level of uncertainty when comparing to 2013 year, since it passed from +/- 5.1% on 2013 to +/- 4.0% in 2014.

UTCH has also relatively high emissions that result in 9.1% of total emissions of Tractebel Energia. The aggregated uncertainty of +/- 10.4% results in an emissions range from 522,575.57 to 643,271.88 tCO_2e. Based on this result, UTCH worsened the level of uncertainty when compared to 2013 data, changing from +/- 4.9% in 2013 to +/- 10.4% in 2014.

UTWA emissions represent 9.9% of total emissions of Tractebel Energia. The aggregated uncertainty of +/- 15.8% results in an emissions range from 533,252.15 to 733,521.51 tCO_2e. As well as UTCH, UTWA worsened the level of uncertainty changing it from +/- 5.0% in 2013 to +/- 15.8% in 2014. In turn, UTAL presented a level of uncertainty of +/- 6.2% in 2014.

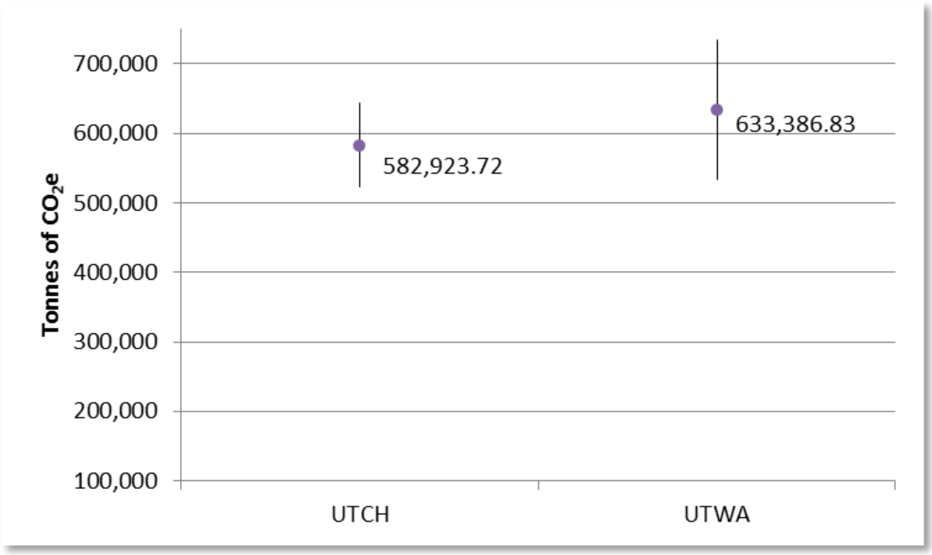

Figure 61 – Uncertainty analysis of GHG emissions from UTCH e UTWA plants

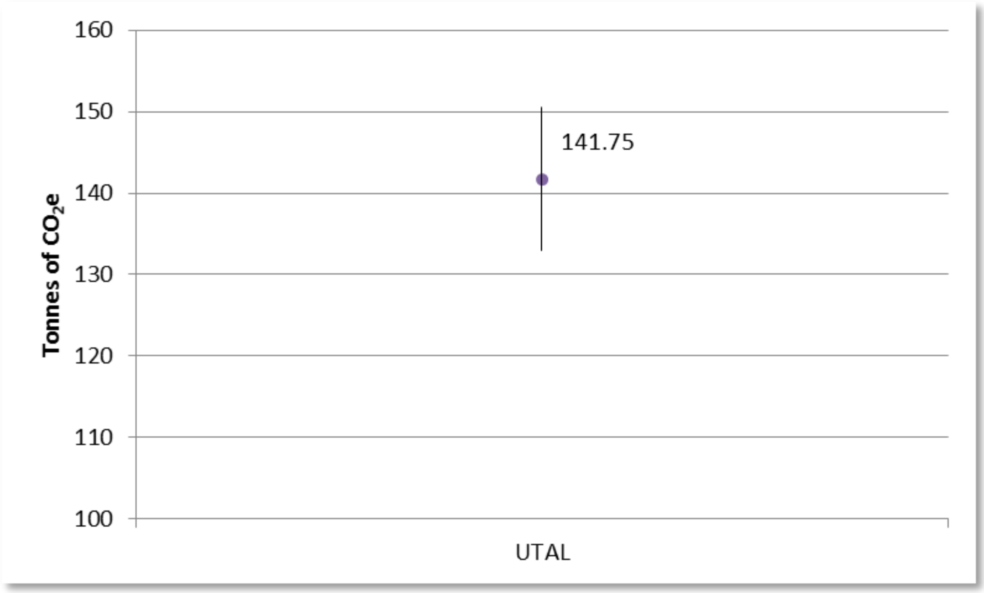

Figure 62 - Uncertainty analysis of GHG emissions from UTAL unit

Among the thermoelectric power plants operated with biomass, UCLA is the one with the higher level of uncertainty (+/- 28.2%), followed by UTFE (+/- 14.3%) and UTIB (+/- 5.6%).

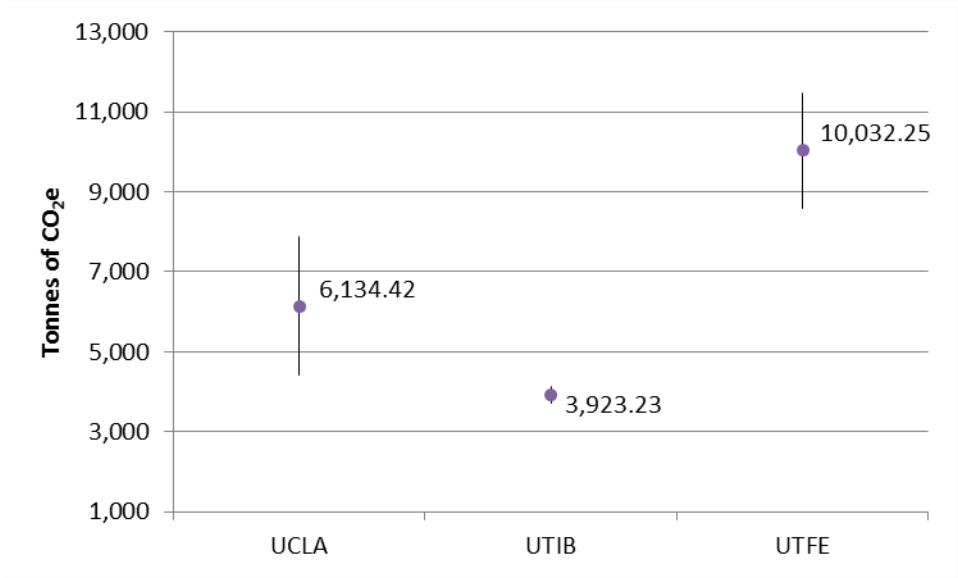

Figure 63 – Uncertainty analysis of GHG emissions from UCLA, UTIB and UTFE

UFCA presented emissions uncertainty of + -7.0% in 2014. Considering low emissions in relation to the other units of the group, UFCA's uncertainty presents little variation on emissions (from 4.4 to 5.1 tCO_2e).

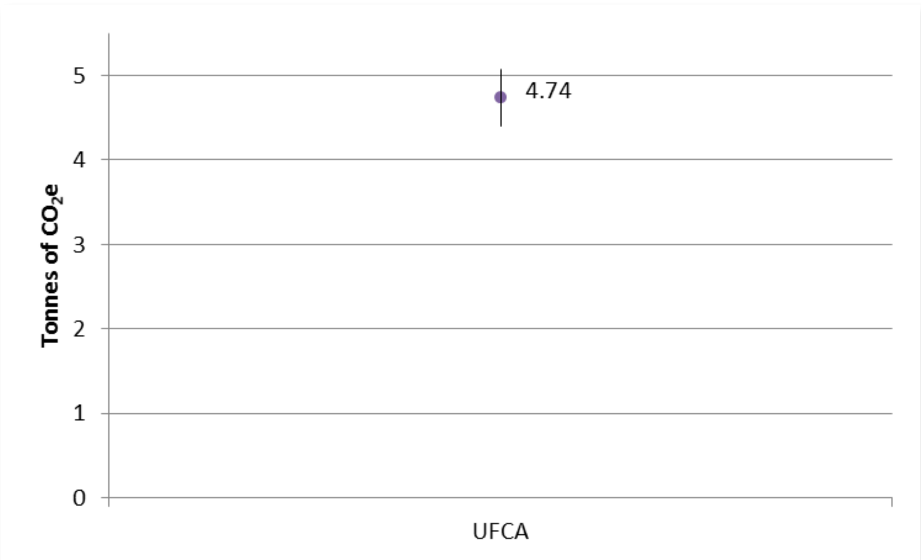

Figure 64 – Uncertainty analysis of GHG emissions from UFCA unit

8.3. Evolution of GHG Emissions

Base Year is the reference year used for the analysis / comparison of GHG emissions over time. Thus, 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.

Since the GHG inventories of Tractebel Energia were audited every year, including the year 2010, the results of the inventories presented in the reports provided by Tractebel Energy from 2010 to 2014 were considered in order to analyze the evolution of GHG emissions. Thus, the base year considered in this analysis is 2010.

The evolution of emissions of Tractebel Energia is presented in sections below.

8.3.1. Total Emissions

Total GHG emissions of Tractebel Energia in 2014, under the Control approach, resulted in a reduction of 1.31% over the previous year, from 6,499,134.27 tCO_2e in 2013 to 6,413,949.50 tCO_2e in 2014, in which there was a reduction of Scope 1 and 2 and increase of Scope 3 emissions.

Regarding the base year - 2010 - emissions in 2014 resulted in a reduction of 0.4%. In Table 66, emissions can be observed throughout the five years inventoried.

Regarding 2012, 2014 GHG emissions increased by 19.6% and, compared to 2011, increased 65.0%. Considering the period from 2010 to 2014, 2013 was the year with higher GHG emissions, followed by the 2010 year.

Table 66 – GHG emissions by scope Tractebel Energia in tCO_2e – Control Approach (2010-2014)

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

Whereas GHG emissions Scope 1 represent over 98% of Tractebel Energia emissions in the period 2010 to 2014, these emissions are responsible for significant variations of total emissions in the period.

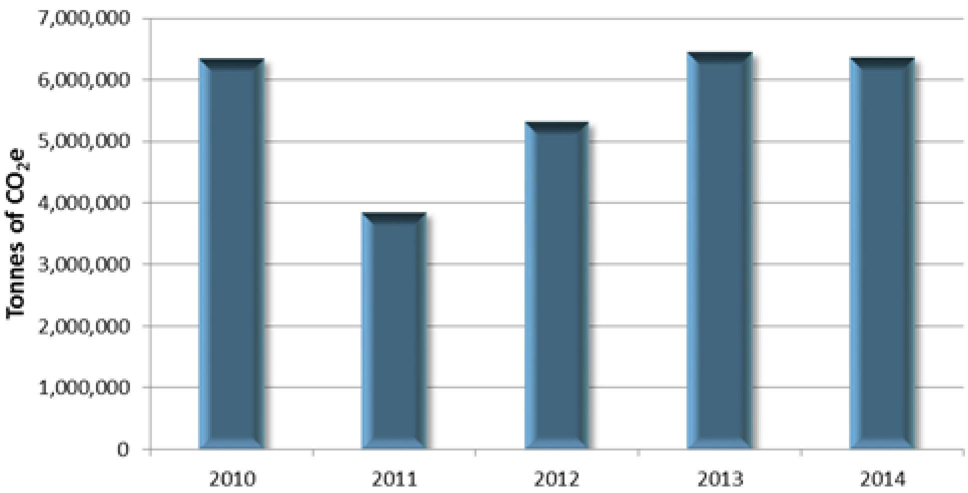

Figure 65 – Scope 1 historic emissions from Tractebel Energia - Control Approach (2010-2014)

As can be seen in the figure above, there was 1.3% reduction in Scope 1 emissions from 2013 to 2014. From the Scope 1 emission sources, 99.92% comes from stationary combustion.

Note that the electricity generation system in Brazil is based on large hydropower plants, which are subjected to seasonality, depending on the "raw material" availability (water), causing periodic variations on energy made available to the grid. Thermoelectric power plants in the country are responsible to meet this deficiency, since they are not affected by weather changes, which may impact other plants. In 2013, like the other years, the increase of thermal power demand resulted in an increased generation by thermal plants of Tractebel Energia, such as the fossil fuel, recording, greater CO_2e emissions of "stationary combustion" and, consequently, a higher value for the company as a whole.

For the same period, there was also a reduction of Scope 2 GHG emissions of 0.7% and 15.5% increase in Scope 3 emissions as presented in the figure below.

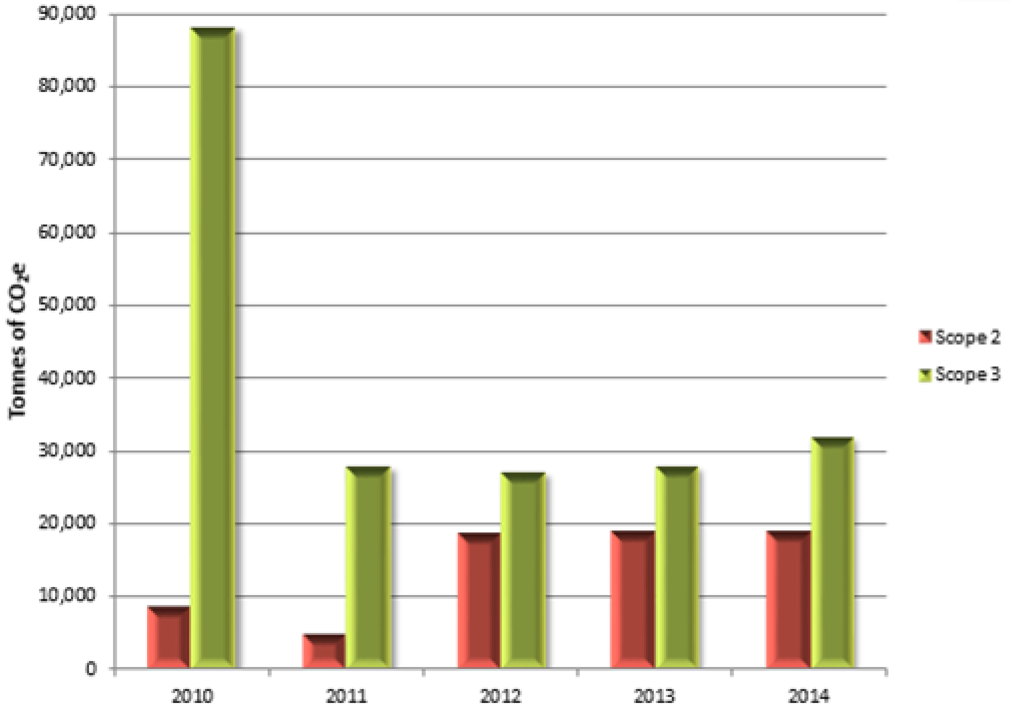

Figure 66 – Scopes 2 and 3 historic emissions from Tractebel Energia - Control Approach (2010-2014)

The variation of Scope 2 results is partly explained by the variation of grid electricity consumption and by the variation of the CO_2 emission factor of the SIN, as presented below.

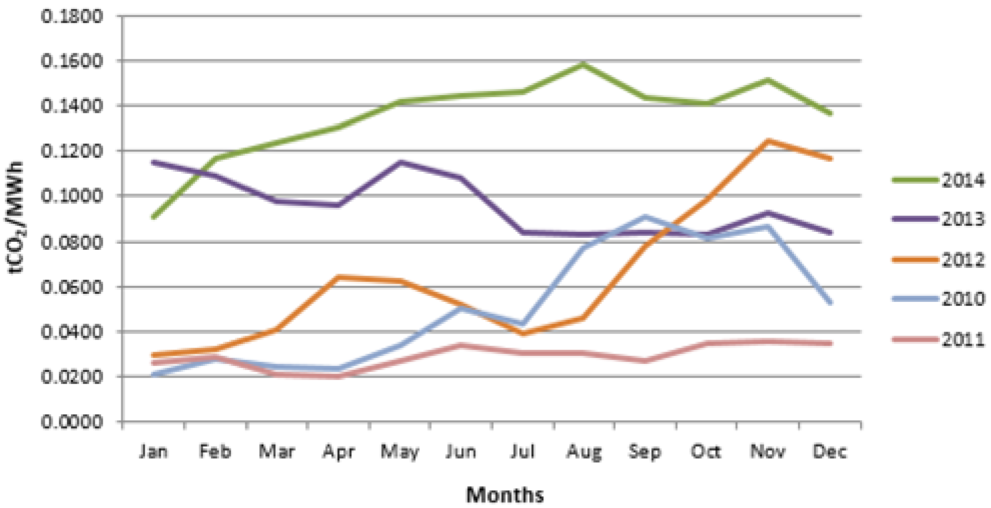

Figure 67 – Monthly CO_2 emission factor from SIN in tCO_2/MWh (2010 – 2014)

Source: MCTI (2015)

Since there was an increase of 41.1% on the emission factor from 2013 to 2014, the reduction of Tractebel Energia Scope 2 emissions is exclusively due to a reductions of electricity consumed / purchased from the grid, which great part of this consumption, is from some plants of the company which performs as synchronous compensator of the SIN.

Regarding CO_2 emissions from biomass combustion, an increase of 87.4% emissions can be observed when compared to 2013 year.

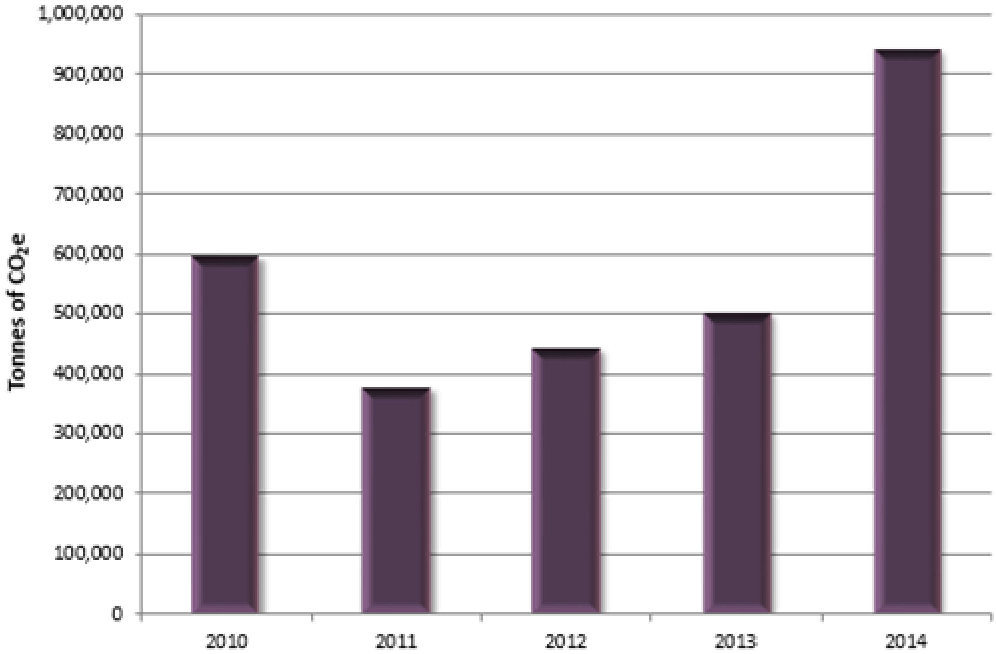

Figure 68 – Evolution of the emissions from the biomass combustion Tractebel Energia – Control Approach (2010 – 2014)

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

Parameters that could impact the emissions from the use of biomass are: (i) CO_2 emission factor of fuels, (ii) ethanol percentage added to gasoline and biodiesel added to diesel oil and (iii) quantity of fuel used, both mobile and stationary combustion.

During 2010 and 2014, there were no changes of the CO_2 emission factors of fuels used by Tractebel Energia. However, there was an increase in percentage of ethanol added to gasoline and biodiesel to diesel, as shown below.

Table 67 – Percentage of ethanol added to gasoline and biodiesel to diesel oil (2010 – 2014)

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

Source: ANP (2014), BRASIL (2014)

Despite the table above presents an increase in the percentage share of biomass in fuels, the variation of this rate from 2013 to 2014 is not considered significant to impact GHG emissions in 2014.

Therefore, the significant increase is due to increased combustion of biomass, mainly due to the acquisition of Ferrari thermoelectric power plant (UTFE) by Tractebel Energia in 2014. Biomass emissions resulted by UTFE operation were 497,994.39 tCO_2 in 2014 representing 52.9 % of total biomass emissions of Tractebel Energia.

Regarding emissions of non-Kyoto gases (R-22), a reduction of 56.4% of emissions can be observed from 640.81 in 2013 to 279.39 tCO_2e in 2014. On the contrary to what occurred in 2014, 87.92% emissions increased in 2014 over the previous year (from 341.01 to 640.81 tCO_2e). The emissions increase in 2013 compared to 2012 is also due to the R-22 GWP change, passing from 1,500 to 1,810.

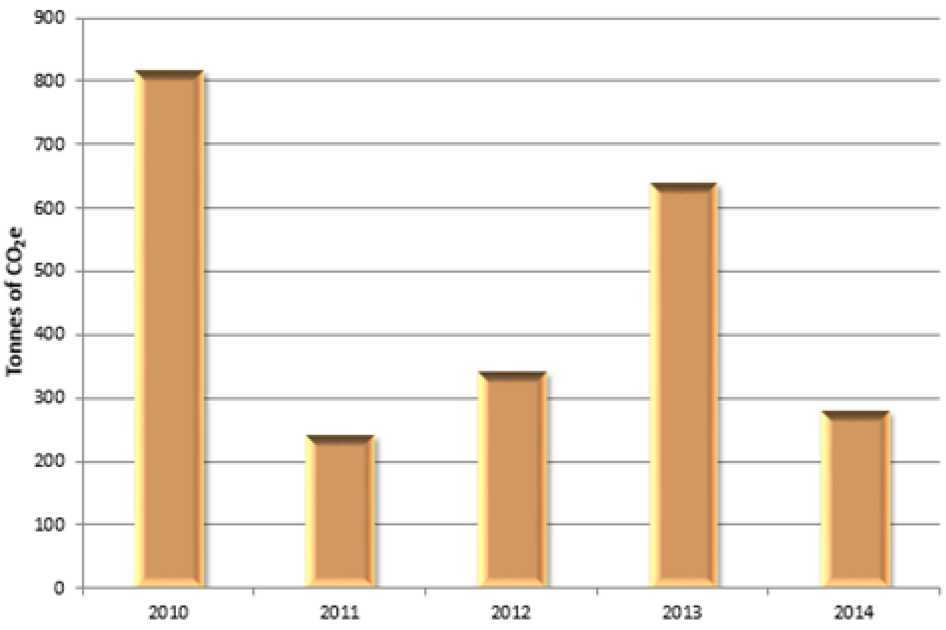

Figure 69 – Evolution of the emissions from non-Kyoto gases (R-22) Tractebel Energia – Control Approach (2010 – 2014)

The evolution of GHG emissions under the Equity Share approach is intrinsically related to Control approach, in which emissions vary proportionally to the shareholding of Tractebel Energia in the plants. Thus, in principle, it can be stated that there was an increase of total GHG emissions in the Equity Share approach.

Additionally, six (6) units - UEFL, UEGU, UEMU, UETR, UTFE and UFCA - were included in Tractebel Energia portfolio, which Tractebel Energia has 100% Operational Control and Equity Share. Thus, it is expected to occur a relatively increase GHG emissions compared to previous years.

Table 68 – Tractebel Energia's GHG emissions by scope in tCO_2e – Equity Share Approach (2010-2014)

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

Considering data presented above, there was a 1.29% reduction in Tractebel Energia emissions in 2014 when compared to the previous year, similar to the increase in the Control approach (1.31% reduction).

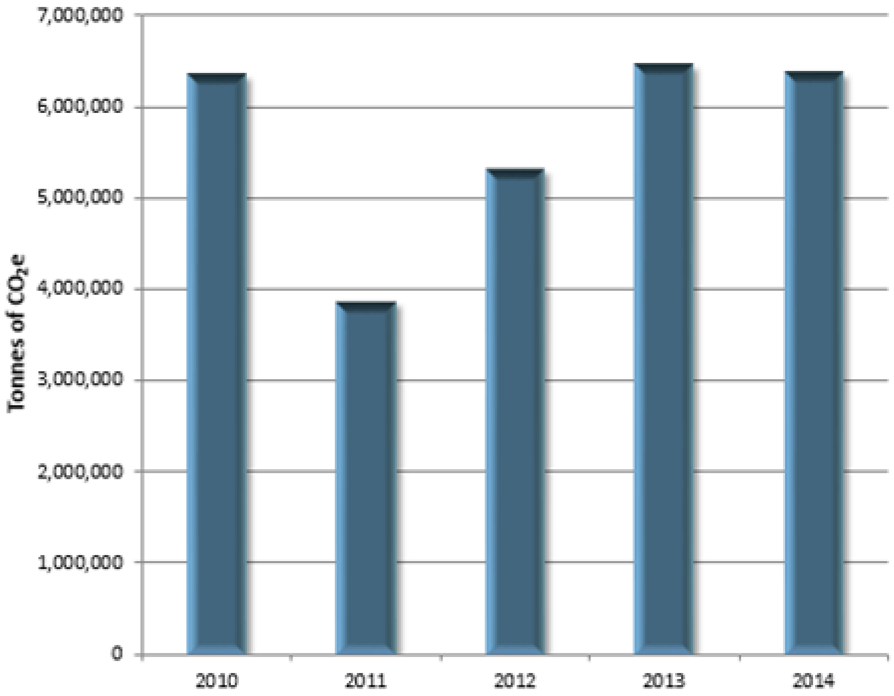

Figure 70 – Scope 1 historic emissions from Tractebel Energia – Equity Share

Regarding Scope 1, there was a reduction of 1.35%, similar to the increase for this scope in the Control approach (1.38%).

For Scope 2, there was a reduction of 2.47% in electricity consumption emissions, against 0.72% reduction in the Control approach.

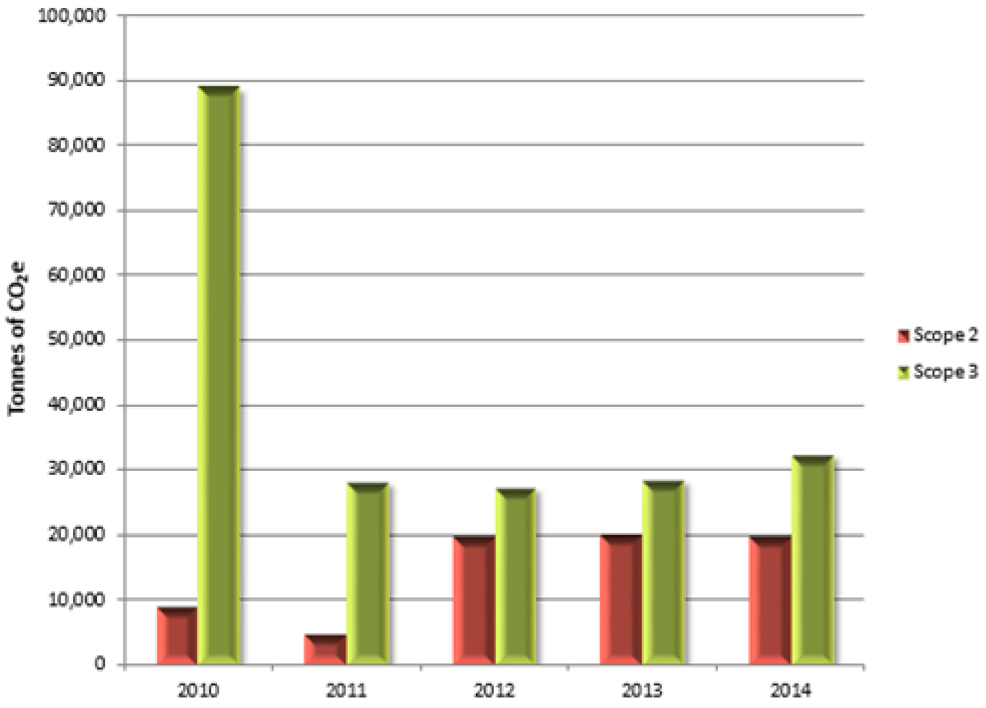

Figure 71 – Scopes 2 and 3 historic emissions from Tractebel Energia – Equity Share

Regarding the Scope 3, there was a 13.59% increase of emissions in 2014 over the previous year, similar to the increase in the Control approach (13.77%).

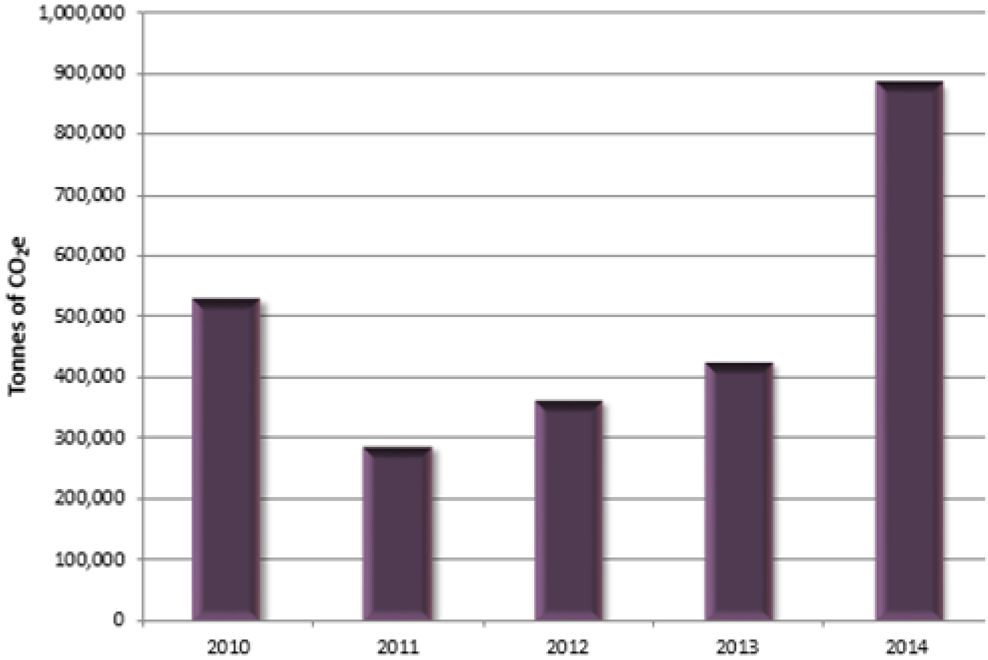

Figure 72 – Evolution of the emissions from the biomass combustion Tractebel Energia – Equity Share

CO_2 emissions from biomass combustion increased by 107.9% compared to 2013, from 424,635.09 tCO_2 to 882,667.28 tCO_2.

With respect to non-Kyoto gas, emissions increased from 656.65 to 325.59 tCO_2e in 2014, *i.e.*, reduced 50.42%.

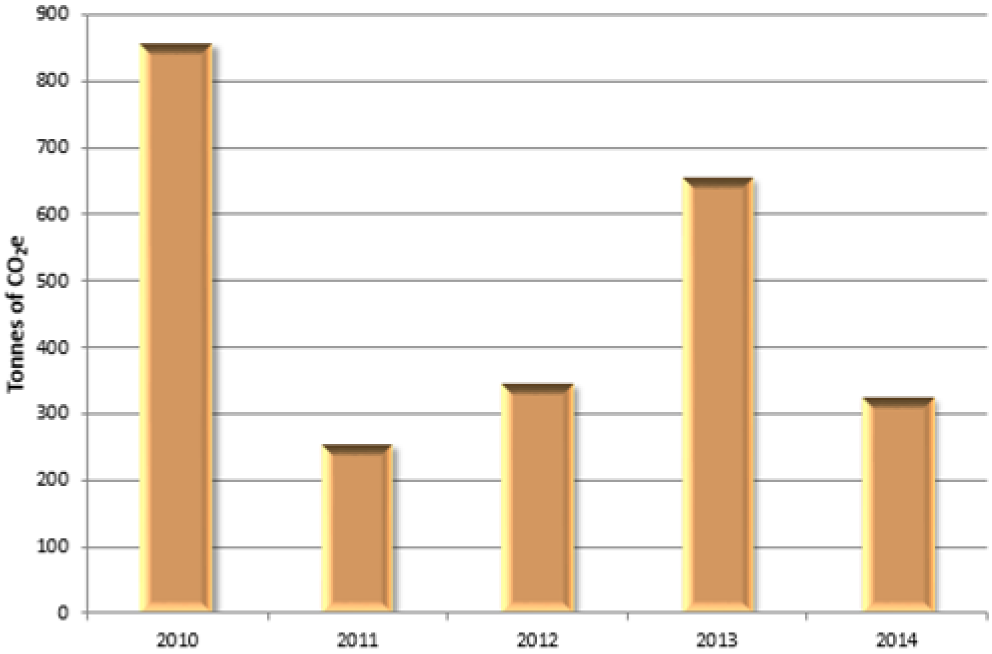

Figure 73 - Evolution of the emissions from non-Kyoto gases (R-22) Tractebel Energia – Equity Share

8.3.2. Emissions per Unit

The evolution of emissions for each unit of Tractebel Energia is presented below. It is worth mentioning that, for the years of 2010 and 2011, it was not possible to identify the CO_2 emissions from biomass combustion and non-Kyoto gases per unit (the summary accounting of 2010 and 2011 did not include these emissions per unit). Thus, it was not possible to analyze the evolution of these emissions in this period.

UEFL, UEGU, UEMU, UETR, UTFE and UFCA units were not included in this analysis, as they have been included in Tractebel Energia's generation park in 2014 and, thus, there are no historical emissions of these units.

8.3.2.1. Wind Power Plants

→ **Beberibe (UEBB)**

The total GHG emissions of UEBB in 2014 resulted in a reduction of 15.1% when compared to the previous year. This reduction is explained by the reduction of Scope 1 and 3 emissions of 34.7% and 5.8%, respectively. On the other hand, Scope 2 emissions increased by 139% compared to 2013, but it was not enough to increase the total emissions of UEBB, since Scope 1 and 3 emissions together represent 91.7% of the total unit.

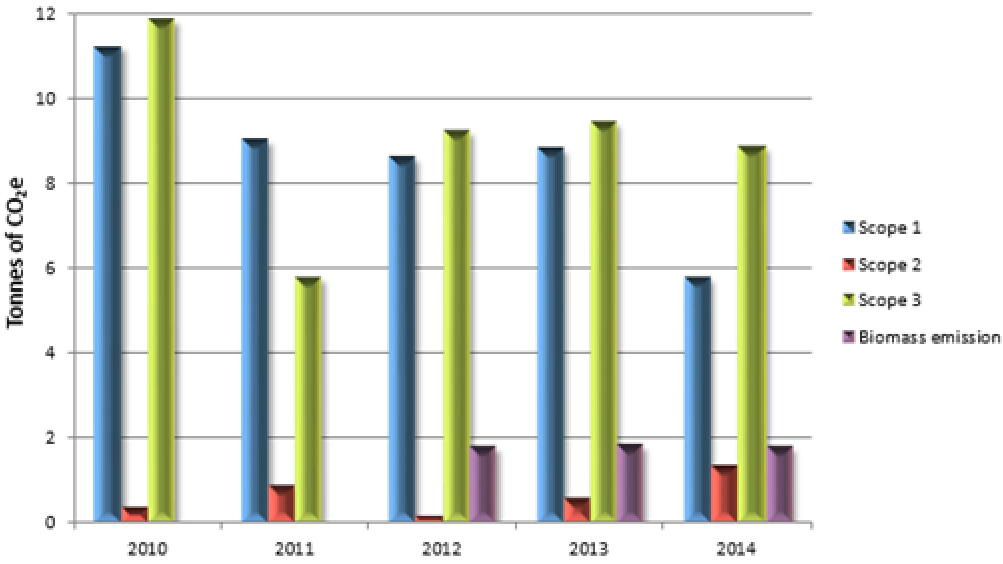

Figure 74 – GHG emissions evolution of UEBB in tCO_2e

Biomass emissions also reduced 0.8% when compared to 2013 year.

→ **Pedra do Sal (UEPS)**

The total GHG emissions of UEPS resulted in an increase of 91.4% in 2014 when compared to the previous year. This increase is explained by increase of emissions in all scopes. In this way, Scope 1 emissions increased by 12.9% compared to 2013, Scope 2 emissions increased by 61.0% and Scope 3 in 885.8%. The significant increase of Scope 3 emissions in UEPS is due to the inclusion of the transmission and distribution emissions (upstream) and travel to business sources, previously allocated in other plants.

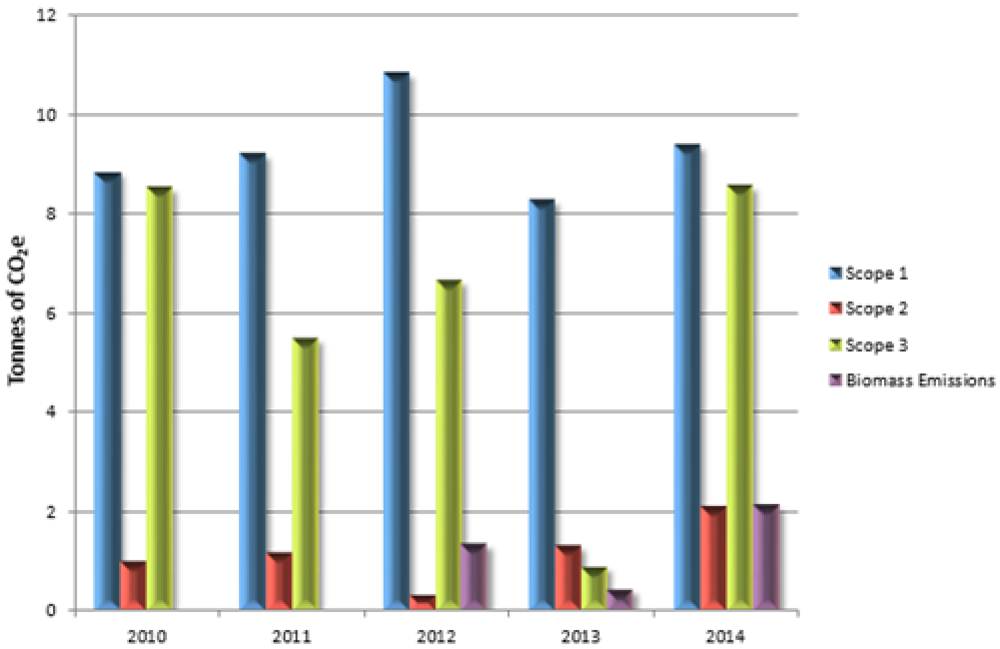

Figure 75 – GHG emissions evolution of UEPS in tCO_2e

Similarly, CO_2 emissions from the combustion of biomass increased by 425.7% in 2014, when compared to 2013 year.

8.3.2.2. Small Hydropower Plants

→ **Areia Branca (PHAB)**

The total GHG emissions of PHAB resulted in an increase of 20.9% in 2014 over the previous year, with an increase in all scopes: 4.5% in Scope 1, 278.2% in Scope 2 and 16.85% in Scope 3. Emissions from the biomass combustion reduced in 5.8%.

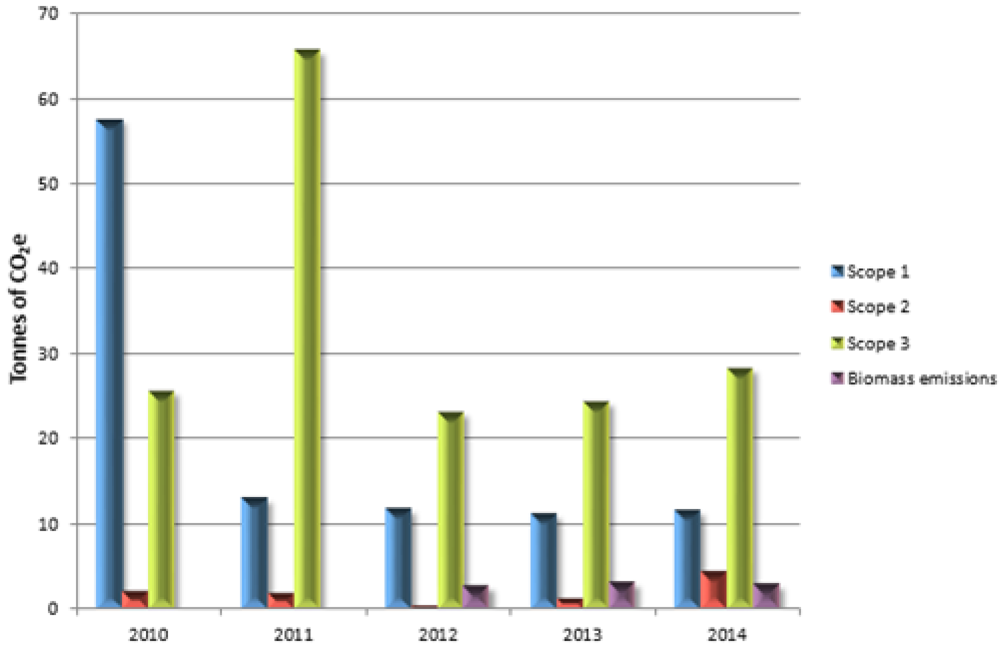

Figure 76 – GHG emissions evolution of PHAB in tCO_2e

→ **José Gelazio da Rocha (PHJG)**

The total GHG emissions of PHJG reduced by 20.3% in 2014 based on 2013 year. It is the third consecutive year that PHJG unit reduces their total emissions.

For the Scope 1, there was a 30.6% reduction and 21.7% in Scope 3. Similarly, the CO_2 emissions from biomass combustion have been reduced by 16.7% compared to 2013. On the other hand, Scope 2 emissions increased by 40.0% over the previous year.

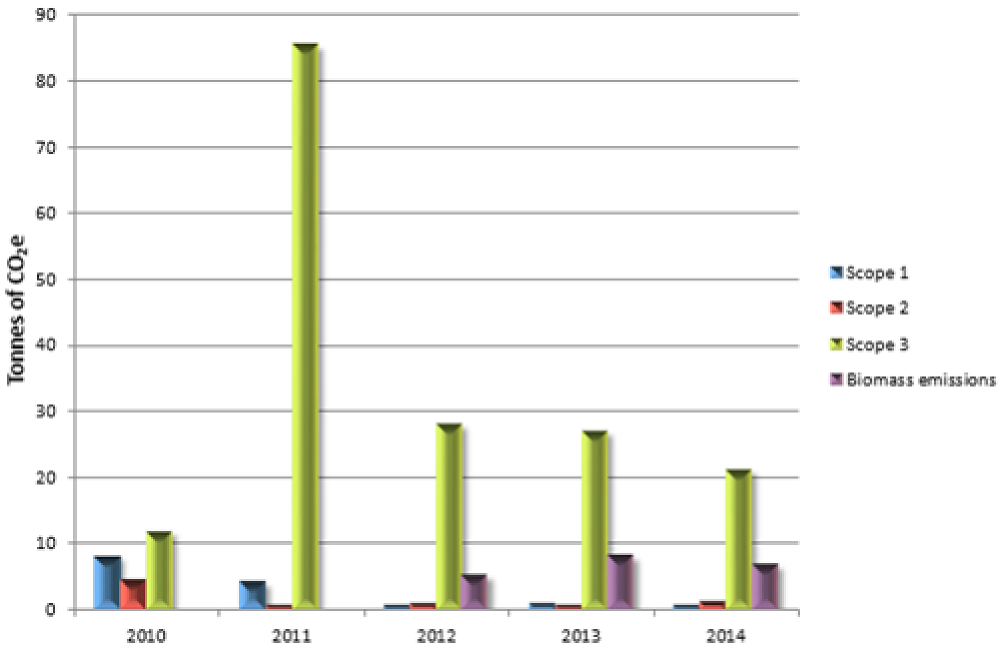

Figure 77 – GHG emissions evolution of PHJG in tCO_2e

→ **Rondonópolis (PHRO)**

The total GHG emissions of PHRO reduced by 20.8% in 2014 over the previous year, in which only the Scope 2 showed an increase. Scopes 1 and 3 decreased by 7.5% and 22.7%, respectively. Similarly, the emissions of biomass reduced by 16.7%, while emissions Scope 2 increased by 134.8%.

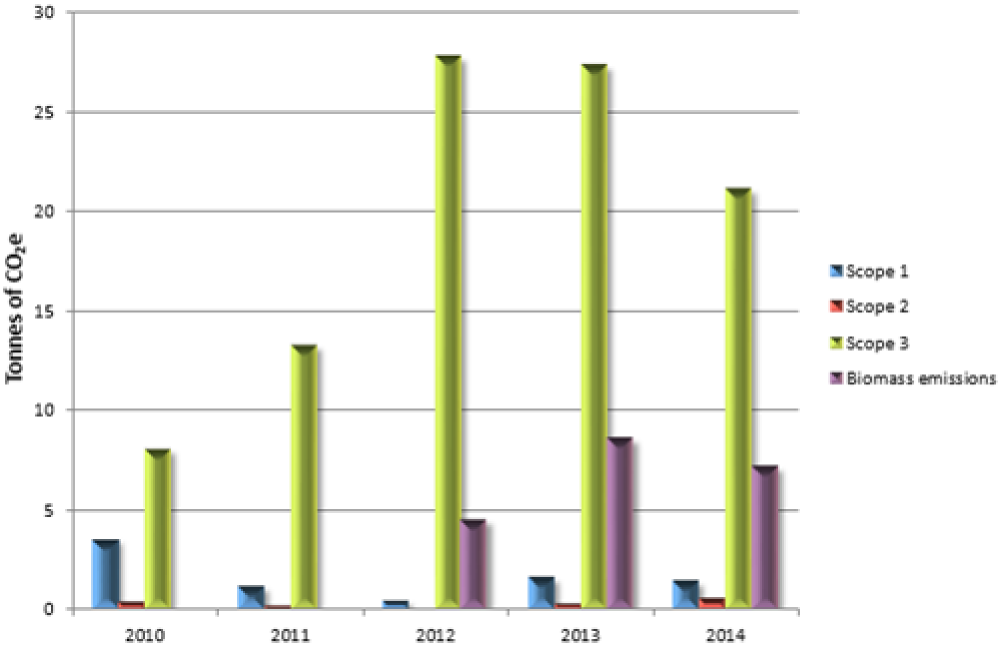

Figure 78 – GHG emissions evolution of PHRO in tCO_2e

8.3.2.3. Hydropower Plants

→ **Cana Brava (UHCB)**

UHCB emissions increased from 105.37 tCO_2e in 2013 to 550.58 tCO_2e in 2014, *i.e.* increased by 422.5% compared to 2013. This increase in emissions is due to the significant increase in Scope 2 emissions of 7,041.8%, from 6.83 tCO_2e to 487.51 tCO_2e. Furthermore, emissions from Scope 1 and biomass increased by 22.8% and 5.2%, respectively.

Despite of 59.0% reduction in Scope 3 emissions, it could not compensate for the increase Scope 2 of almost 7,042% in 2014, which resulted in significant increase in the total emissions of UHCB.

The increase in UHCB Scope 2 emissions is related to its performance as a synchronous compensator SIN.

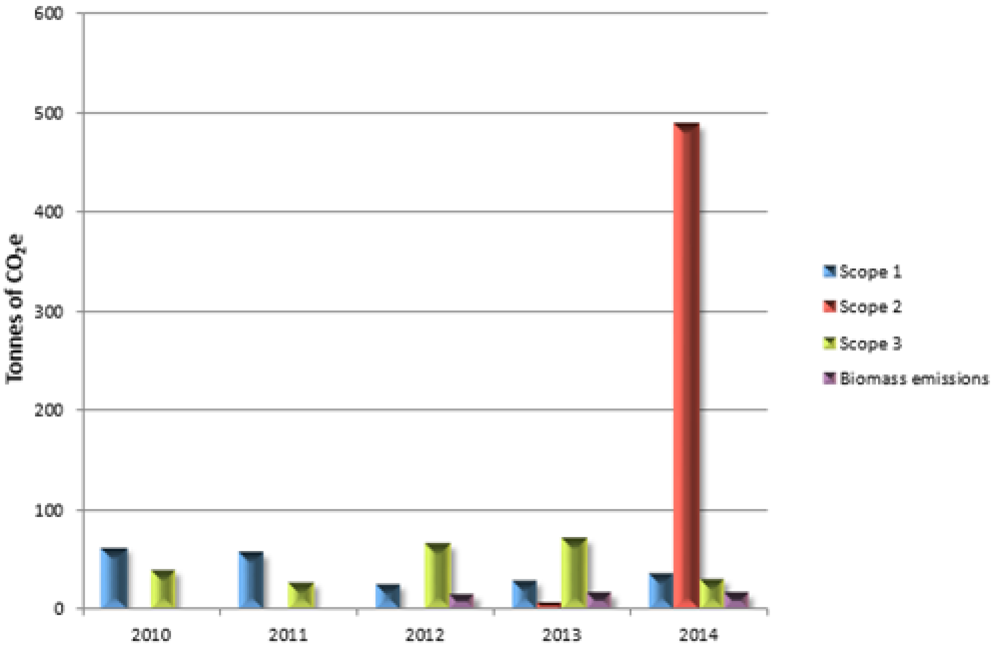

Figure 79 – GHG emissions evolution of UHCB in tCO2e

→ **Estreito (UHET)**

The evolution analysis of UHET GHG emissions was possible from 2011 onwards, since UHET was not operational in 2010.

Considering the Equity Share approach, GHG emissions from 2014 reduced by 9.0%. This variation is due to the reduction of Scope 2 and 3 emissions of 25.8% and 23.3% respectively, opposed to the situation in 2013. On the other hand, Scope 1 emissions increased by 226.2% from 13.30 tCO_2e in 2013 to 43.38 tCO_2e e in 2014.

In 2013, Scope 2 emissions increased 3,540.89% and 2,427.62% in Scope 3, which changed from 7.12 tCO_2e to 179.97 tCO_2e.

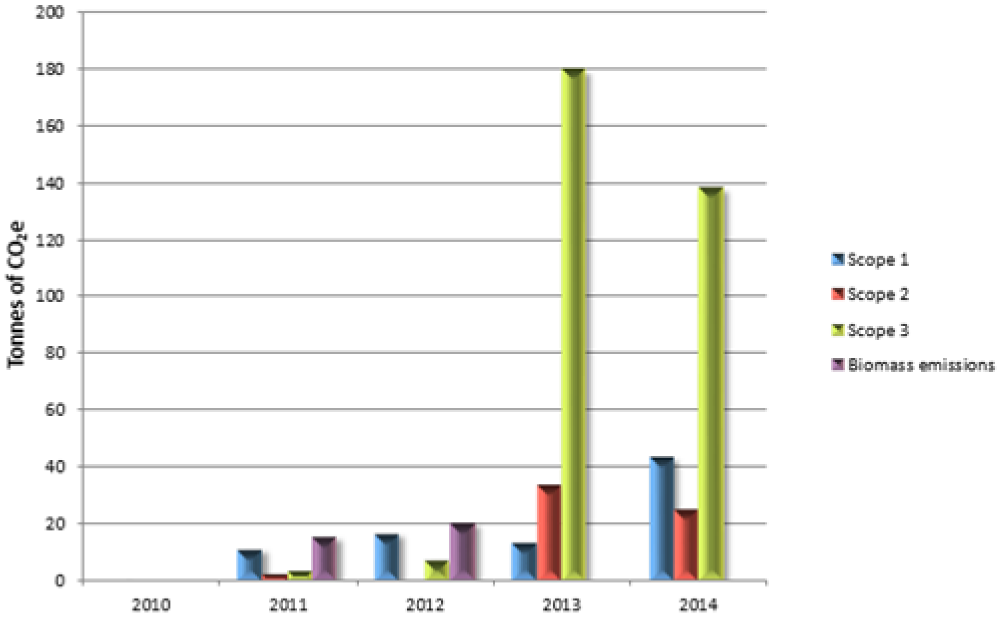

Figure 80 – GHG emissions evolution of UHET in tCO2e - Equity Share

→ Itá (UHIT)

Considering the Equity Share approach, UHIT emissions increased significantly in all scopes in 2014. The total emissions increased by 875.9% compared to 2013.

The Scope 1 emissions increased by 43,290% due SF6 emissions. Although the unit has used 71.5 kg of SF_6 only, these emissions represent 1,630 tCO_2e due to its high GWP of 22,800.

Scope 2 emissions increased by 207.9% and Scope 3 in 29.9%, respectively. Biomass emissions also increased by 47.0%.

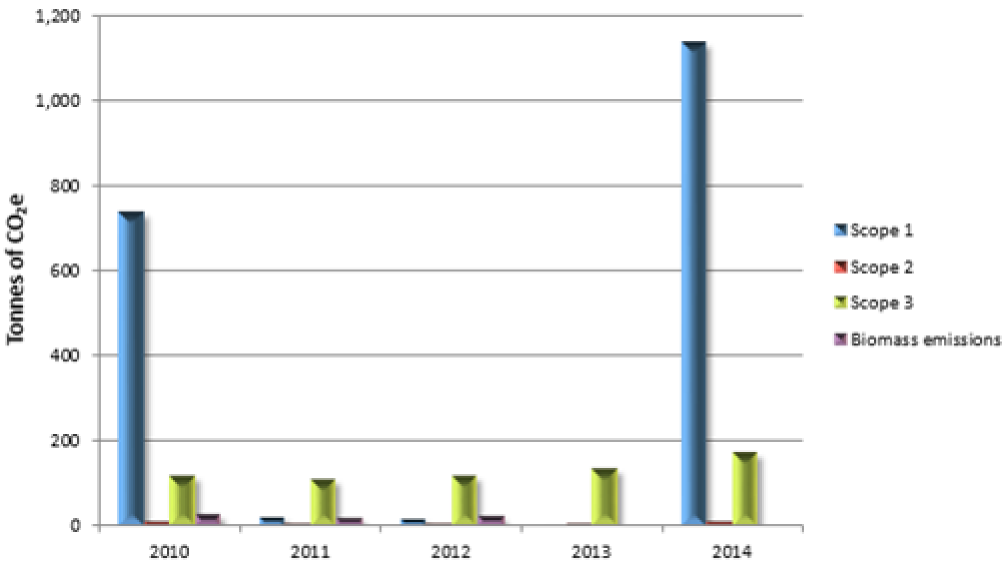

Figure 81 – GHG emissions evolution of UHIT in tCO_2e - Equity Share

Since the shareholding of Tractebel Energia did not change in the period from 2012 to 2014, there was no impact on the variation of emissions of that order.

→ **Machadinho (UHMA)**

Just as the UHET and UHIT units, the Equity Share of UHMA also did not change. Thus, there was no impact on the variation of emissions of that order.

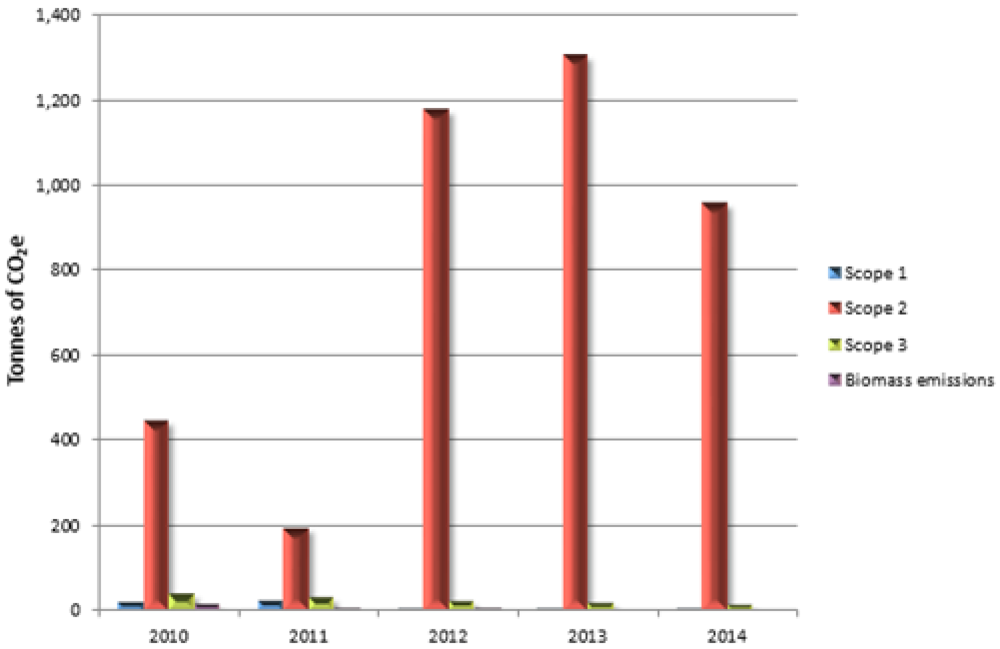

Figure 82 – GHG emissions evolution of UHMA in tCO2e - Equity Share

In 2014, total emissions of UHMA unit decreased by 26.35% compared to 2013, due to reduction of emissions in Scopes 2 and 3 in 26.5% and 32.3%, respectively. On the other hand, Scope 1 emissions increased by 308.5% in 2014.

The large consumption of electricity is associated with the great need of UHMA performance as synchronous compensator of the SIN.

→ **Passo Fundo (UHPF)**

UHPF GHG emissions reduced 80.2% over the previous year, mainly due to the reduction of 82.2% of emissions in Scope 2 - about 6 times less than the amount of emissions of 2013. Similarly, Scope 3 emissions were reduced by 33.8%.

Unlike Scopes 2 and 3, Scope 1 emissions increased by 60.9% in 2014, mainly due to emissions from mobile combustion. Likewise, the biomass emissions increased in 2014 (28.2% increase).

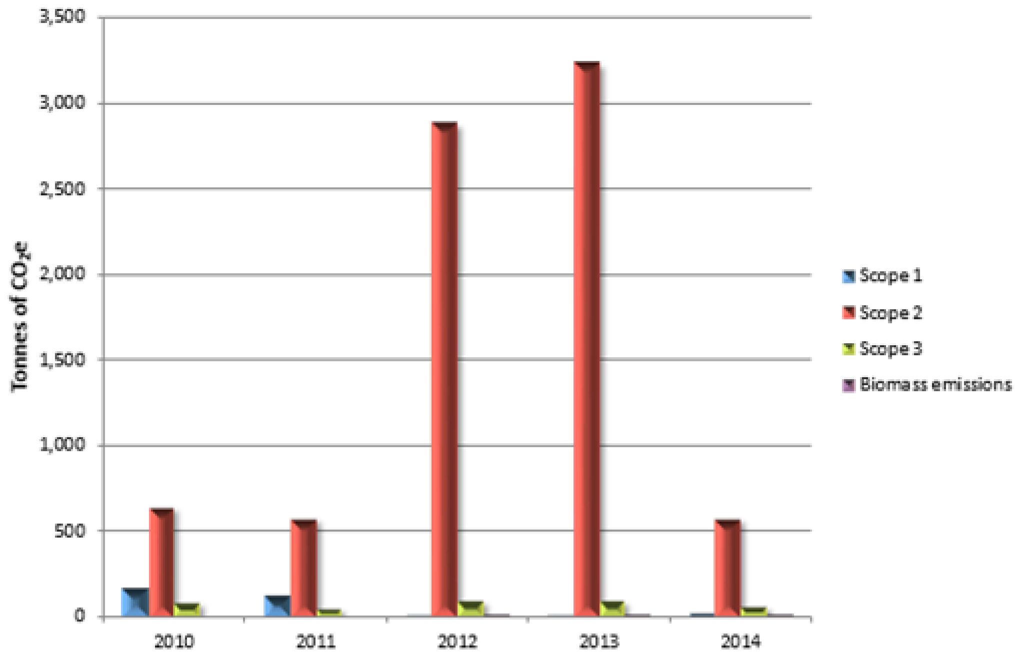

Figure 83 – GHG emissions evolution of UHPF in tCO2e

→ **Ponte de Pedra (UHPP)**

GHG emissions of UHPP unit decreased by 27.5% in 2014 over the previous year, as can be seen in the following figure.

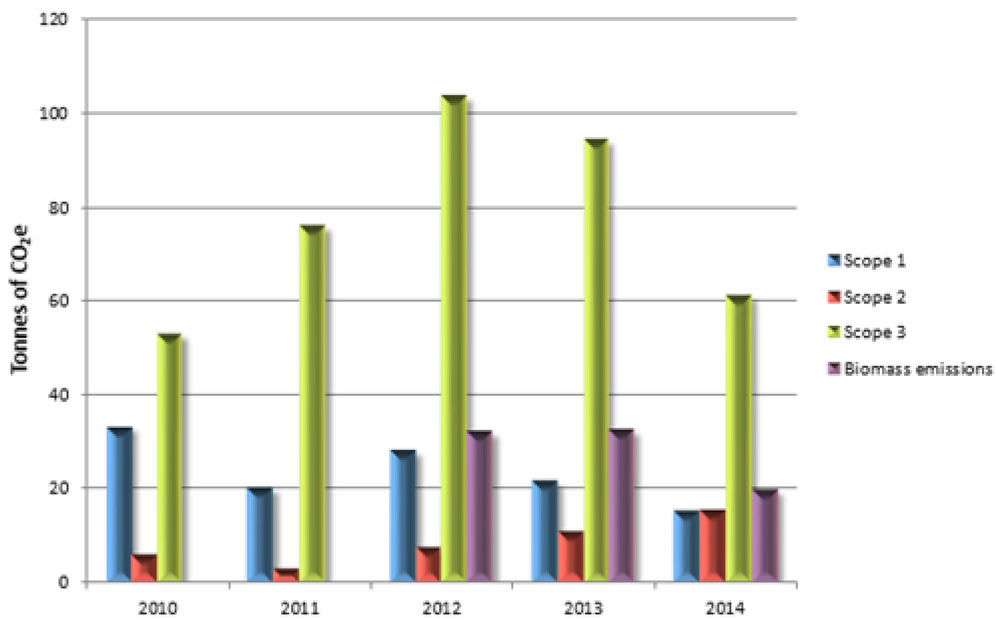

Figure 84 – GHG emissions evolution of UHPP in tCO2e

The figure above shows that there was a reduction of emissions in Scope 1 and 3, 29.3% and 35.1%, respectively. Biomass emissions were also reduced by 39.4% in 2014. Scope 2 emissions increased by 43.9%. In two consecutive years, emissions have the same trend: reduction of Scope 1 and 3 and increase Scope 2.

→ **Salto Osório (UHSO)**

In 2014, UHSO unit increased its emissions by 13.7% over the previous year, from 5,213.86 to 5,928.66 tCO_2e, as shown in the figure below.

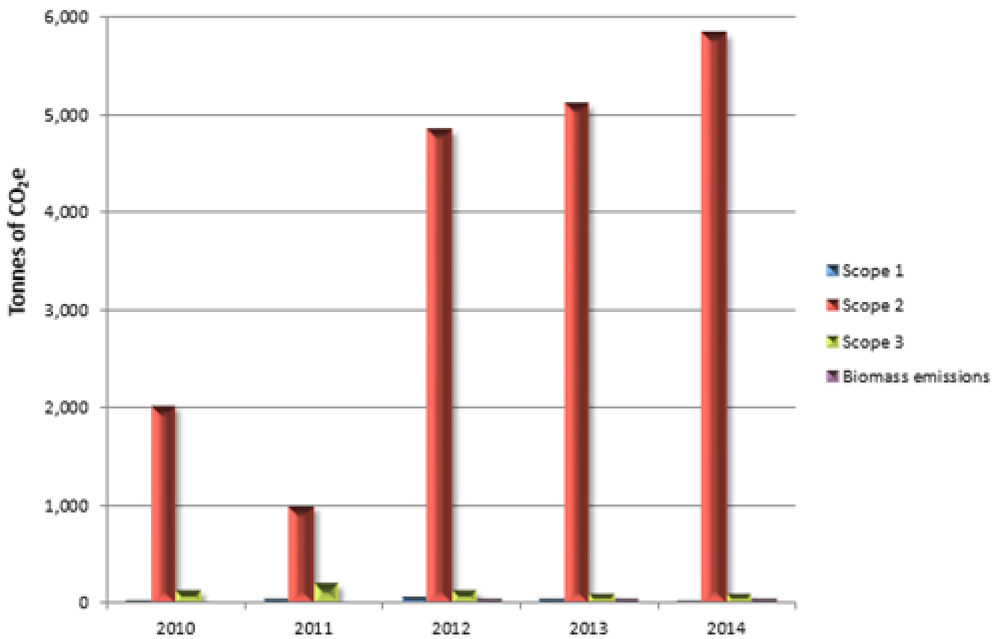

Figure 85 – GHG emissions evolution of UHSO in tCO2e

This variation is due to the increase in emissions in 2014 of Scope 2 by 14.4% compared to the year 2013. Biomass emissions also increased by 0.6%.

On the other hand, Scope 1 and 3 emissions reduced in 26.8% and 15.4%, respectively, leading to lower emissions of UHSO in the third consecutive year for these scopes.

→ **Salto Santiago (UHSS)**

The UHSS presented a 9.5% reduction in emissions in 2014, as seen in the figure below.

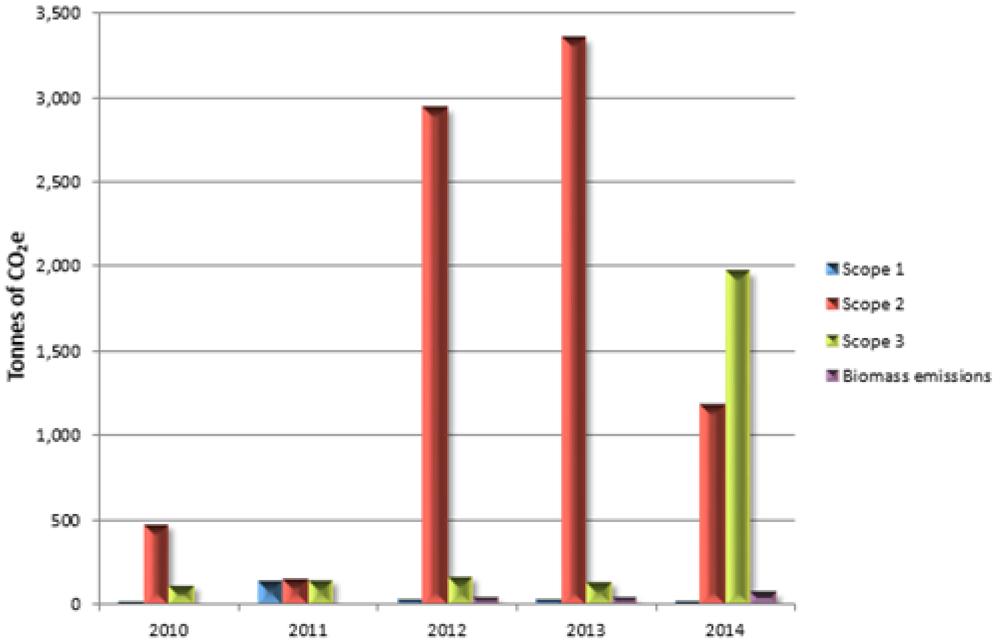

Figure 86 – GHG emissions evolution of UHSS in tCO2e

This reduction is mainly due to Scope 2 emission reductions (64.7% reduction over 2013) combined to the reduction of Scope 1 emissions in 33.7%, as shown in the figure above. The performance of UHSS as synchronous compensator of the SIN impacts significantly on emissions Scope 2 of the unit.

The Scope 3 emissions, however, increased by 1,432.3% in 2014, from 128.78 tCO_2e in 2013 to 1,973.33 tCO_2e in 2014. The increase in Scope 3 emissions is due mainly to the inclusion of fuel use in other equipment such as compressors and trimmers not considered in 2013. In addition, there was an increase of waste emissions (388.8%), transport and distribution upstream (445.9%) and fuels for employees' transportation in home – work route (156.9%).

Emissions from biomass combustion also increased by 97.7% in 2014.

→ **São Salvador (UHSA)**

UHSA emissions resulted in a reduction of 34.3%, from 148.97 to 97.83 tCO_2e, as shown below.

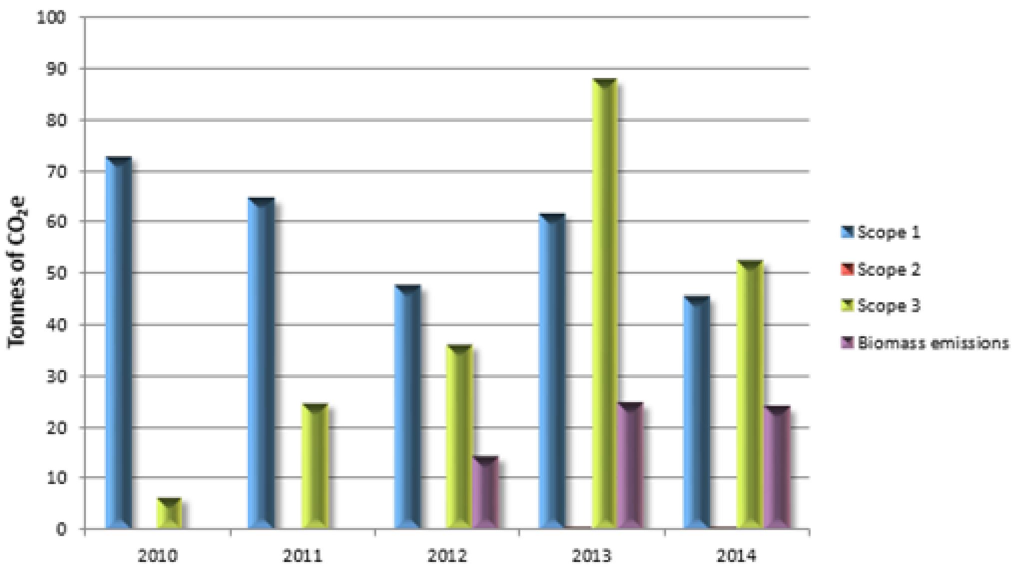

Figure 87 – GHG emissions evolution of UHSA in tCO2e

Scope 2 emissions increased 13,337% in 2014, however there was no significant impact on emissions since it changed from 0.0003 tCO_2e to 0.04. Scope 1 and 3 emissions decreased by 25.9% and 40.3%, respectively, and thus it contributed to the overall reduction in emissions of UHSA.

Emissions from biomass combustion were also reduced by 2.6%.

8.3.2.4. Thermoelectric Power Plants

Since the majority of thermoelectric power plants emissions is from the stationary combustion, Scope 1 GHG emissions were considered separately from other scopes for most of the cases presented below, in order to avoid distortion on graphics.

→ **Alegrete (UTAL)**

Emissions from UTAL unit reduced dramatically in 2014, from 28,844.79 tCO_2e in 2013 to 141.75 tCO_2e in 2014 (99.5% reduction). This variation is related to the significant reduction of emissions of stationary combustion in Scope 1, from 28,455.67 tCO_2e e in 2013 to 19.68 tCO_2e in 2014, since the UTAL practically did not generate energy in 2014.

Similarly, emissions from Scopes 2 and 3 were reduced by 14.5% and 96.5%, respectively. Biomass combustion emissions also reduced by 86.4% in 2014.

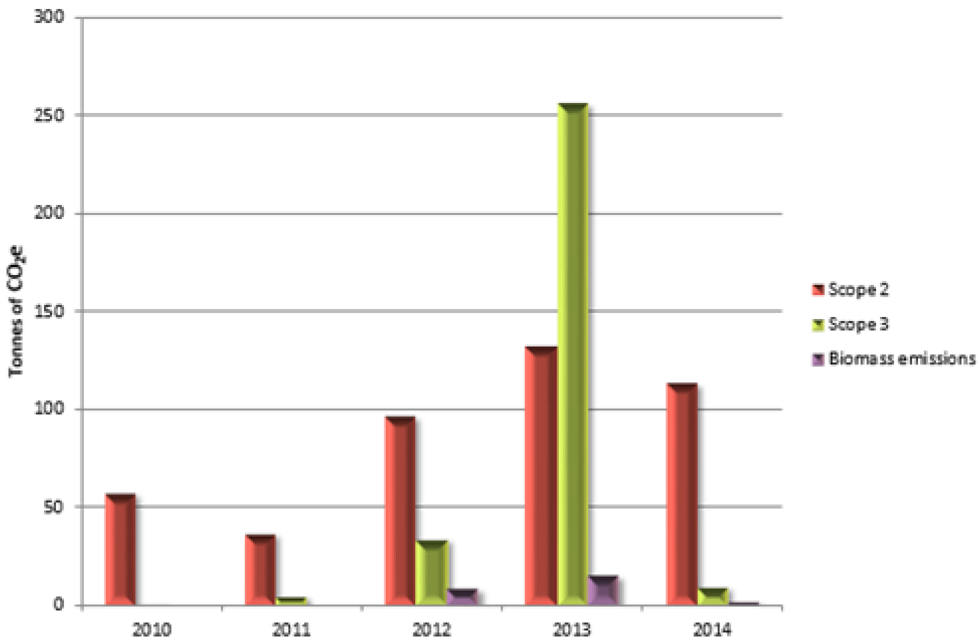

Figure 88 – GHG emissions evolution in scope 2 and 3 of UTAL in tCO_2e

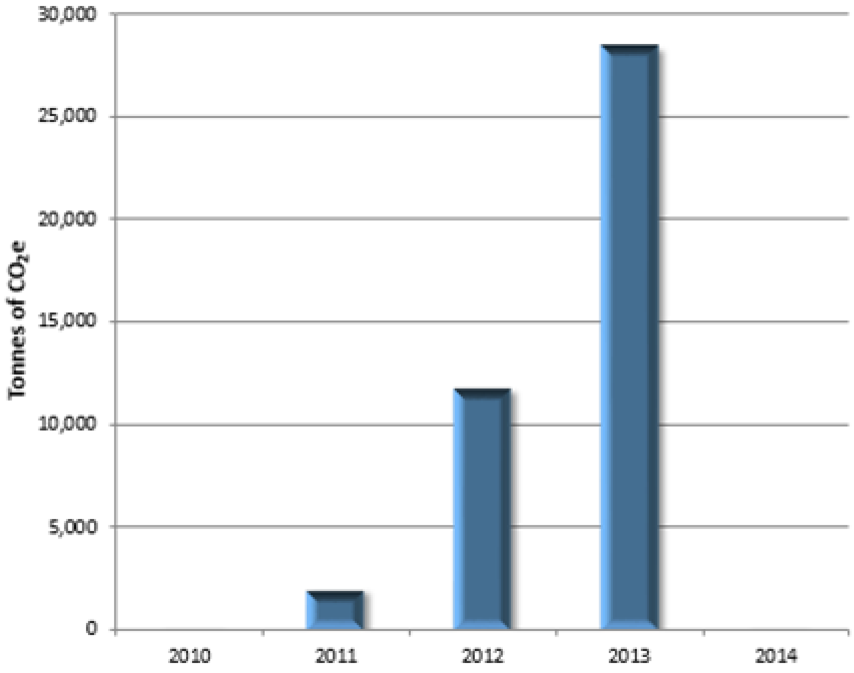

Figure 89 – GHG emissions evolution in scope 1 of UTAL in tCO_2e

→ **Charqueadas (UTCH)**

UTCH GHG emissions increased 68.8% compared to 2013. This increase can be seen in Scopes 1 and 3. Scope 1 emissions increased 70.2% and Scope 3 in 26.7%, while Scope 2 emissions decreased by 4.1%. The figures below illustrate the variation of emissions over the years.

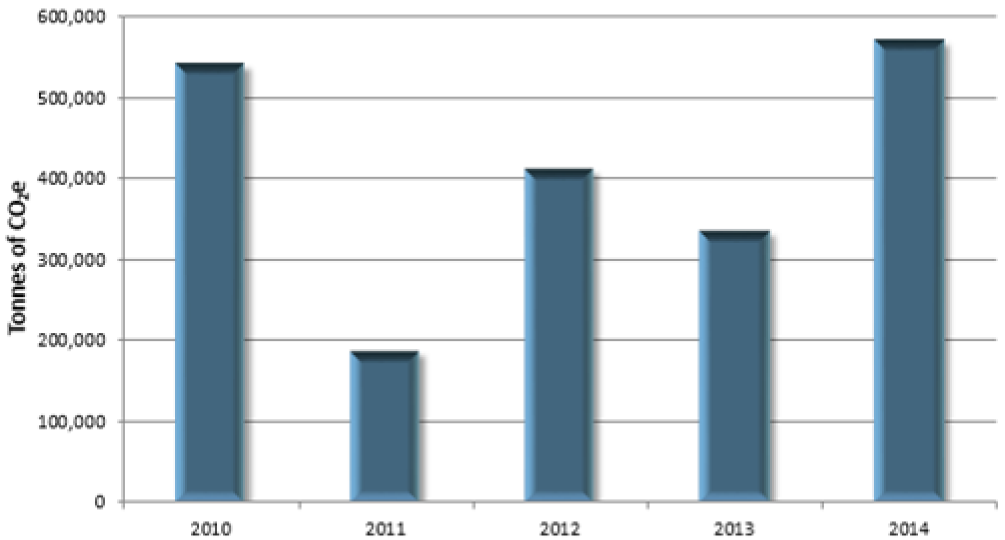

Figure 90 – GHG emissions evolution in scope 1 of UTCH in tCO_2e

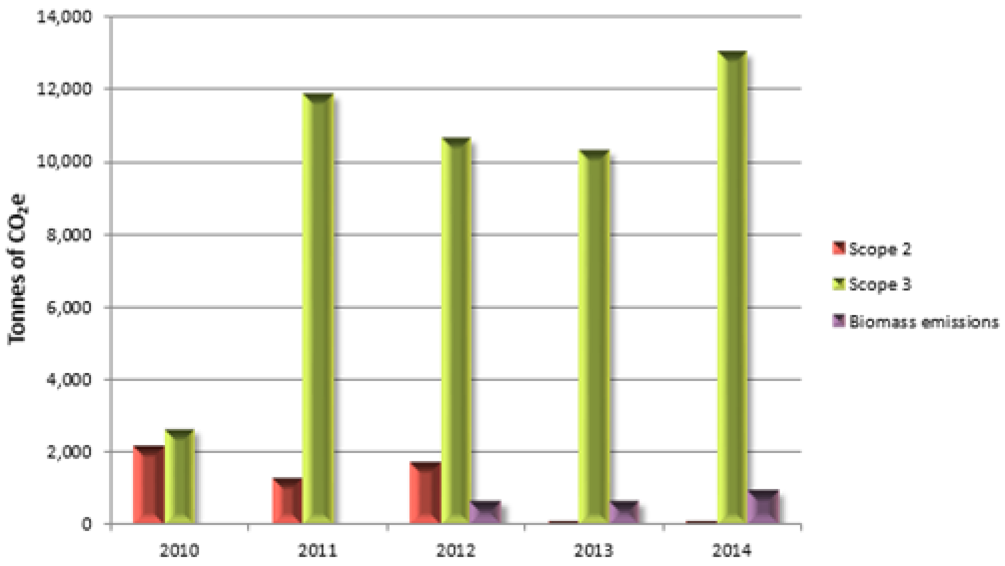

Figure 91 – GHG emissions evolution in scope 2 and 3 of UTCH in tCO_2e

→ **Jorge Lacerda (CTJL)**

CTJL GHG emissions reduced in 12.4% during 2014, changing from 5,896,660.61 to 5,165,813.58 tCO_2e.

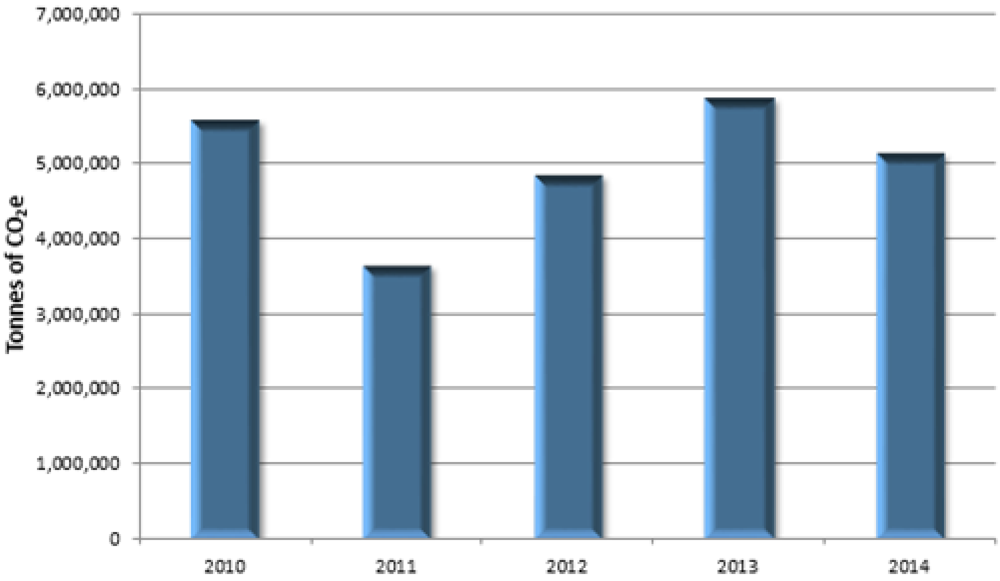

Figure 92 – GHG emissions evolution in scope 1 of CTJL in tCO_2e

Scope 1 emissions from stationary combustion were the main responsible for the reduction of total emissions of CTJL unit, which presented a decrease of 12.5% compared to 2013.

Scope 2 emissions increased by 50.1% and Scope 3 decreased 3.1%, respectively. Biomass emissions increased by 67.7%.

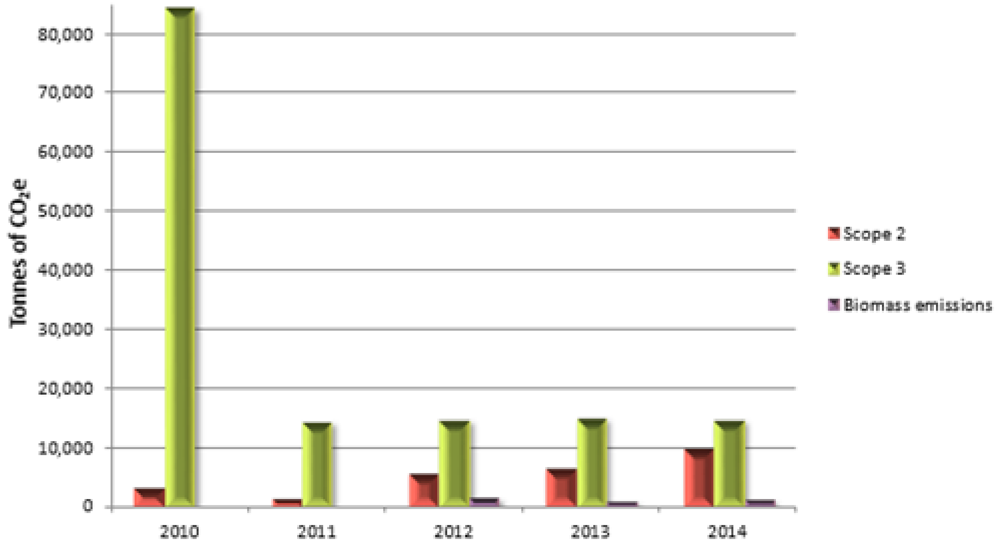

Figure 93 – GHG emissions evolution in scope 2 and 3 of CTJL in tCO_2e

→ **Willian Arjona (UTWA)**

In the case of UTWA unit, there was a significant increase of 210.6% emissions compared to 2013, *i.e.*, emissions increased from 203,891.92 tCO_2e in 2013 to 633,386.83 tCO_2e in 2014. 2014 is the year in which the UTWA emitted more GHG in the 2010-2014 period.

The Scope 1 emissions increased by 210.7% in 2014, from 203,818.47 tCO_2e in 2013 to 633,336.66 tCO_2e in 2014, as seen can be seen in the figure below.

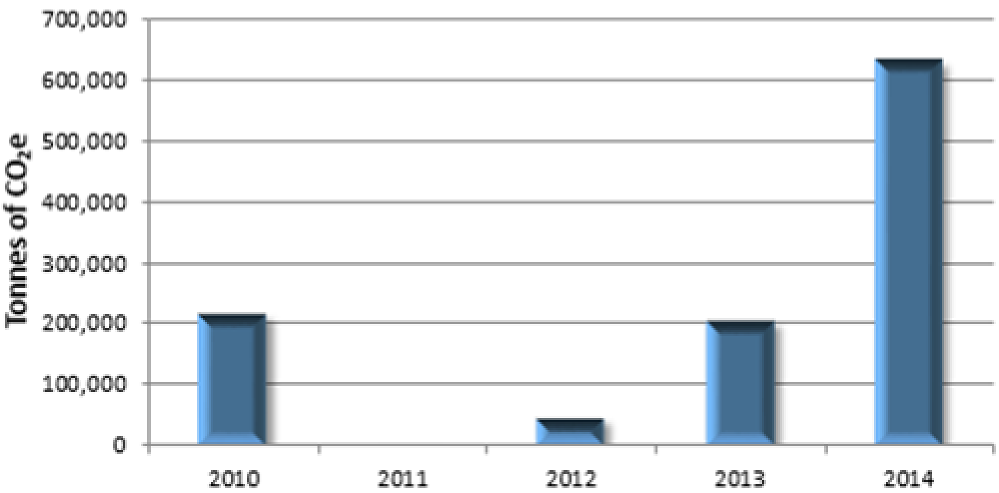

Figure 94 – GHG emissions evolution in scope 1 of UTWA in tCO_2e

In 2011, GHG emissions were significantly low (912.23 tCO_2e) and, therefore, such emissions are not reflected in the figure above.

Scope 2 emissions, in 2014, decreased 52.7% compared to the previous year. Scope 3 and biomass combustion emissions increased by 82.9% and 161.7% in 2014, as can be seen in the table below.

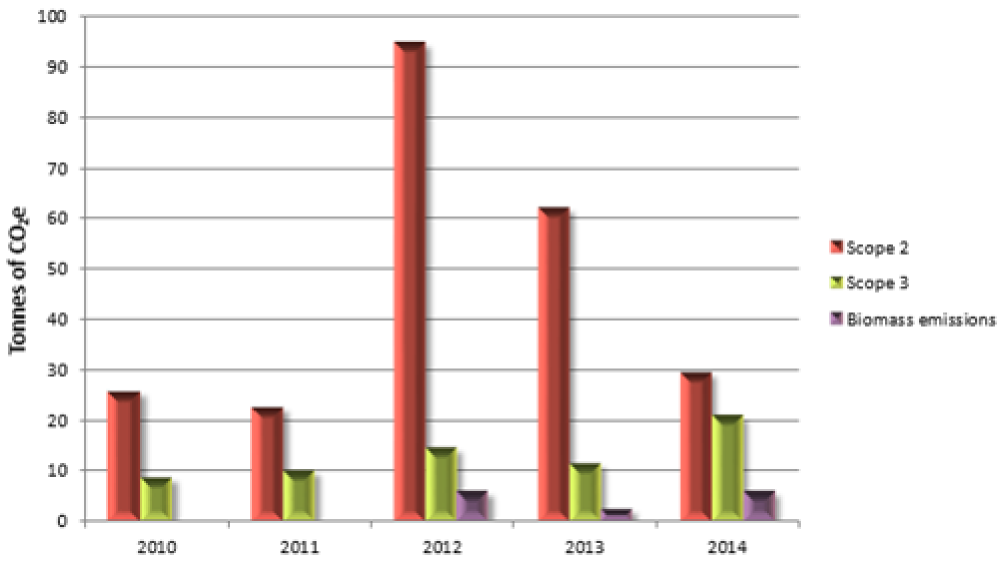

Figure 95 – GHG emissions evolution in scope 2 and 3 of UTWA in tCO_2e

Thermoelectric operated with biomass

→ **Ibitiúva (UTIB)**

Considering the total emissions of UTIB unit in 2014, there was a 23.7% reduction over the previous year. For Scope 1, there was a variation of -24.6%, 63.6% in Scope 2 and -51.6% in the Scope 3.

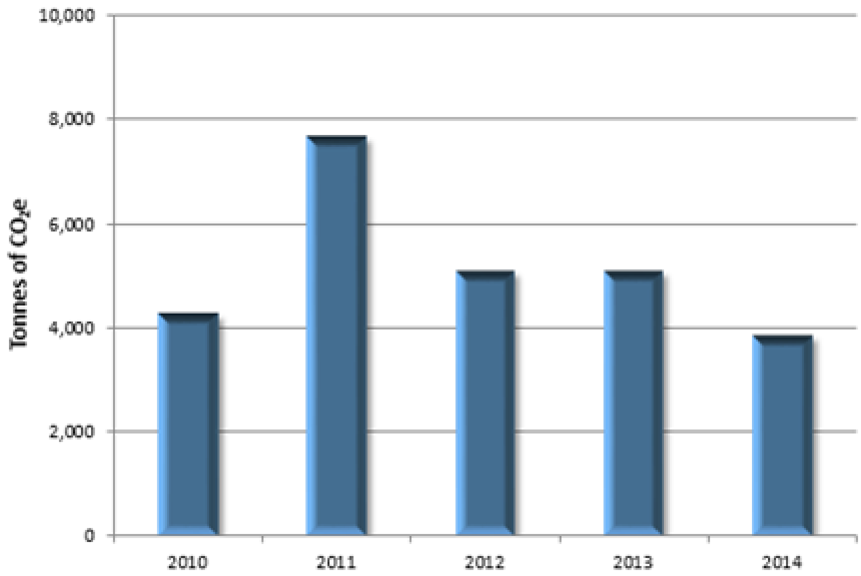

Figure 96 – GHG emissions evolution in scope 1 of UTIB in tCO_2e – Control Approach

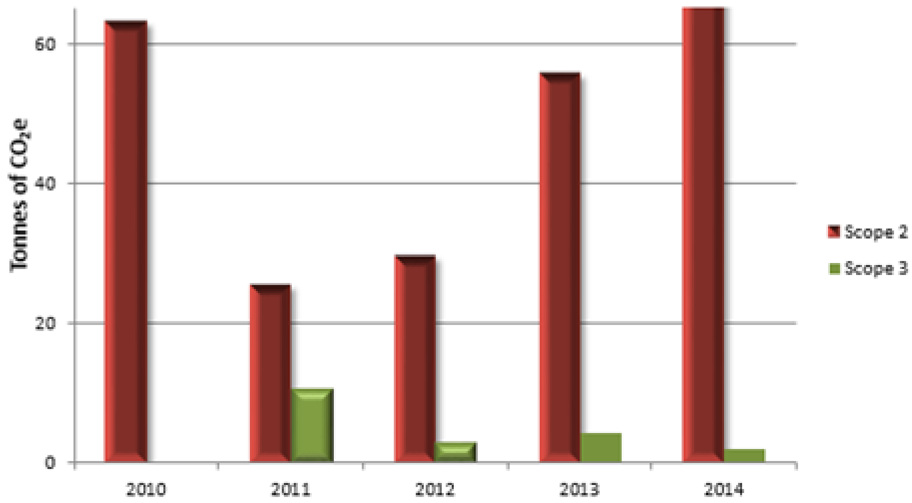

Figure 97 – GHG emissions evolution in scope 2 and 3 of UTIB in tCO_2e – Control Approach

In the case of biomass, CO_2 emissions decreased by 24.5% for the year 2014 compared to the year 2013.

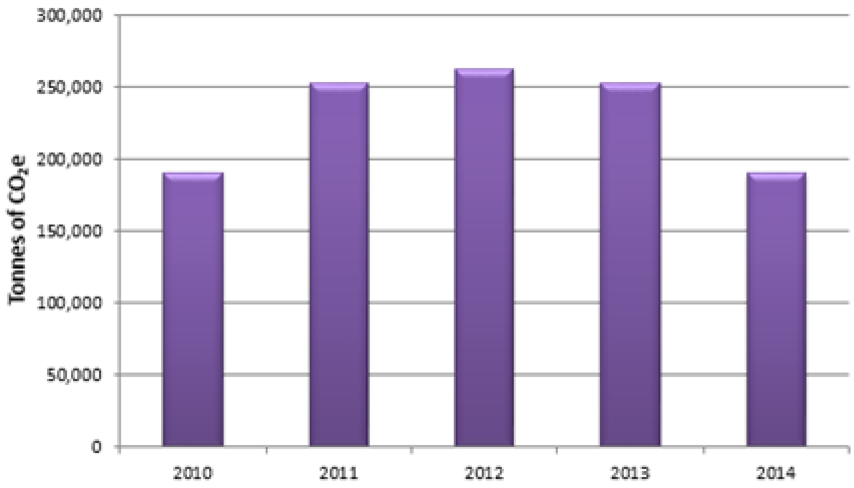

Figure 98 – Evolution of UTIB biomass emissions in tCO2e – Control Approach

As there was no change in the shareholding structure of Tractebel Energia between 2012 and 2013, the same emission variations are noted for the Equity Share approach. However, it is noteworthy that in 2011, Tractebel Energia increased from 64.14% to 69.26% its equity share on UTIB. The following images illustrate the emissions variation in Equity Share approach over the years.

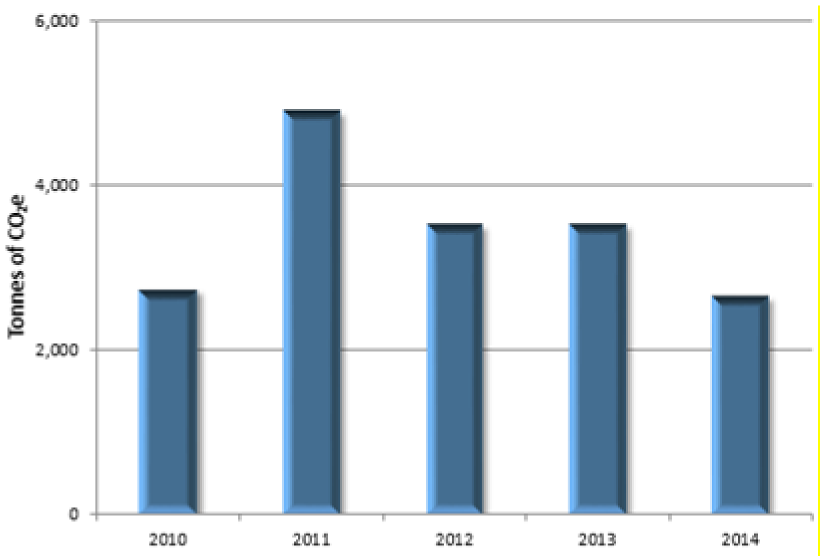

Figure 99 – GHG emissions evolution in scope 1 of UTIB in tCO_2e – Equity Share

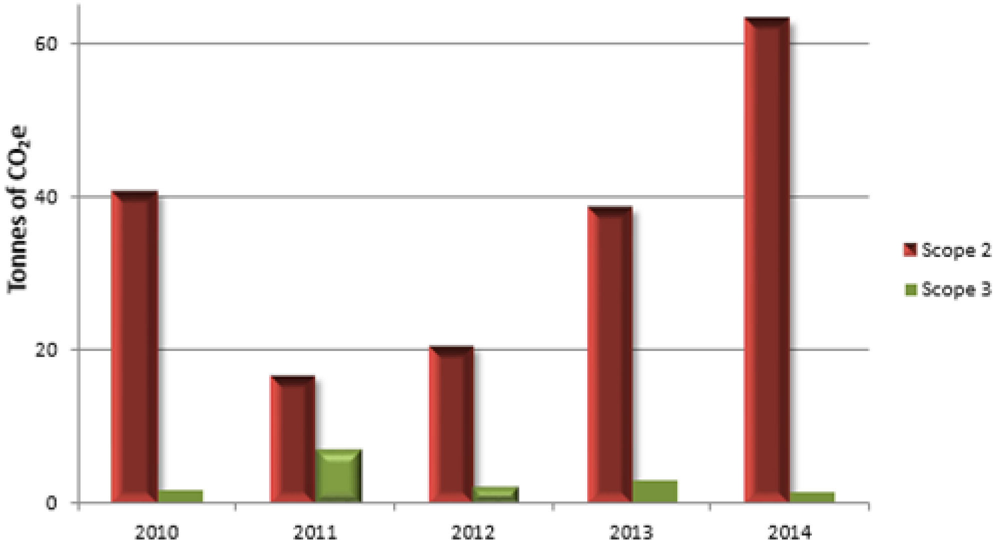

Figure 100 – GHG emissions evolution in scope 2 and 3 of UTIB in tCO_2e – Equity Share

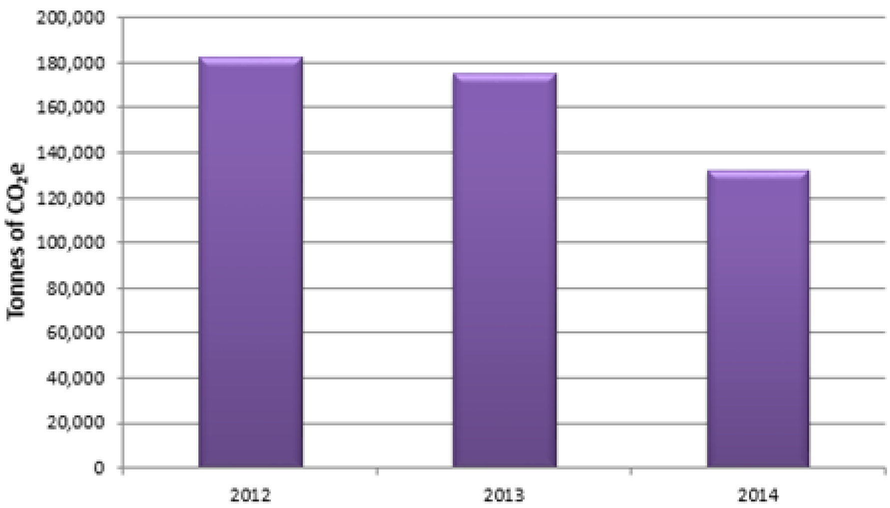

Figure 101 - Evolution of UTIB biomass emissions in tCO2e – Equity Share

→ **Lages (UCLA)**

In 2014, UCLA unit recorded an increase of 7.0% of GHG emissions over the previous year. Historically, this plant reduced the Scope 1 emissions over the years; however, in 2013 and 2014, the scope of emissions increased 43.11% compared to 2012 and 0.7% compared to 2013.

Scope 2 and 3 emissions varied in 44.2% and 35.5% in 2014, respectively, which indicates an increase in emissions in all scopes.

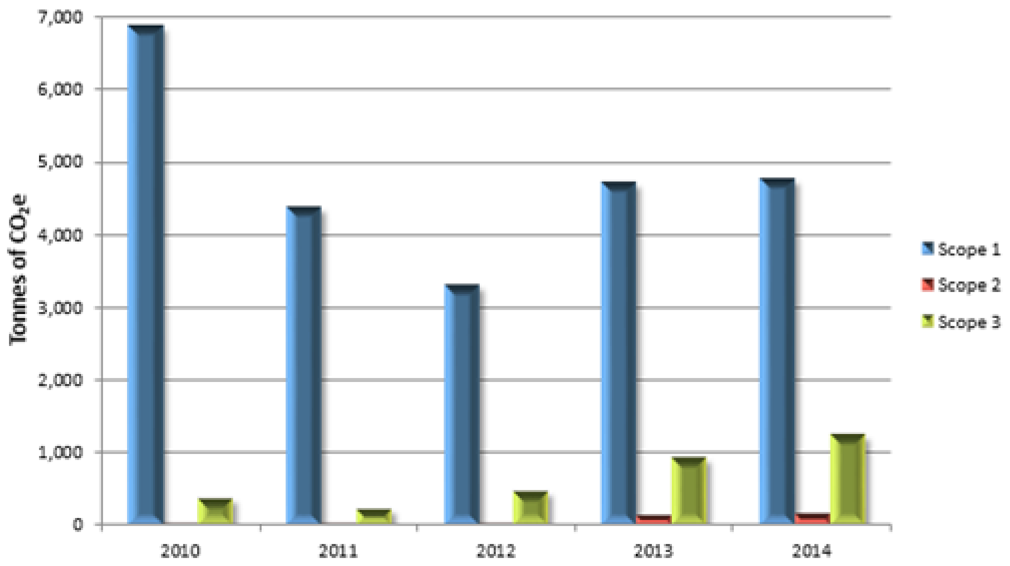

Figure 102 – GHG emissions evolution of UCLA in tCO_2e

For biomass emissions, it can be observed that there was 0.9% increase of emissions in 2014.

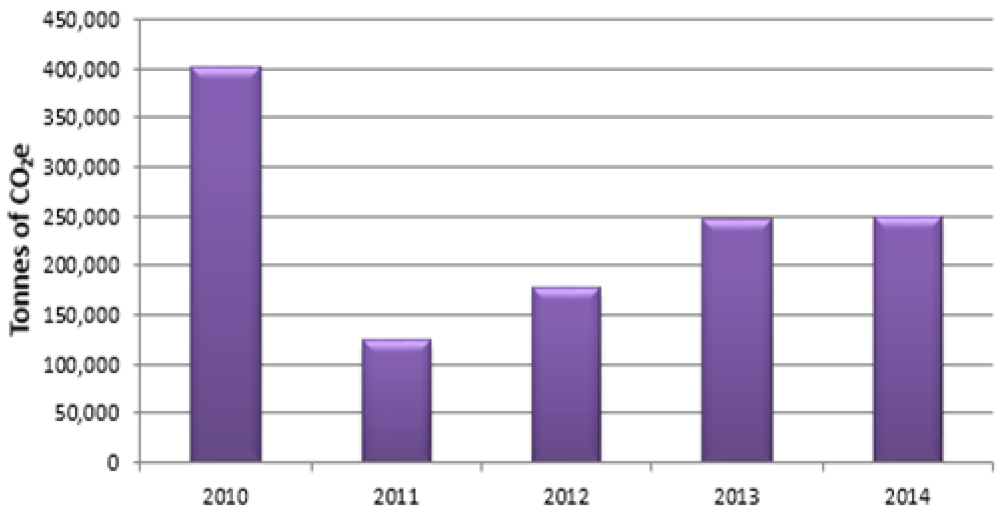

Figure 103 – Evolution of UCLA biomass emissions in tCO2e

8.3.2.5. Offices

→ **Florianópolis (SC)**

The headquarters of Tractebel Energia in Florianópolis emitted a total of 852.73 tCO_2e in 2014, which resulted in a reduction of 19.6% over the previous year.

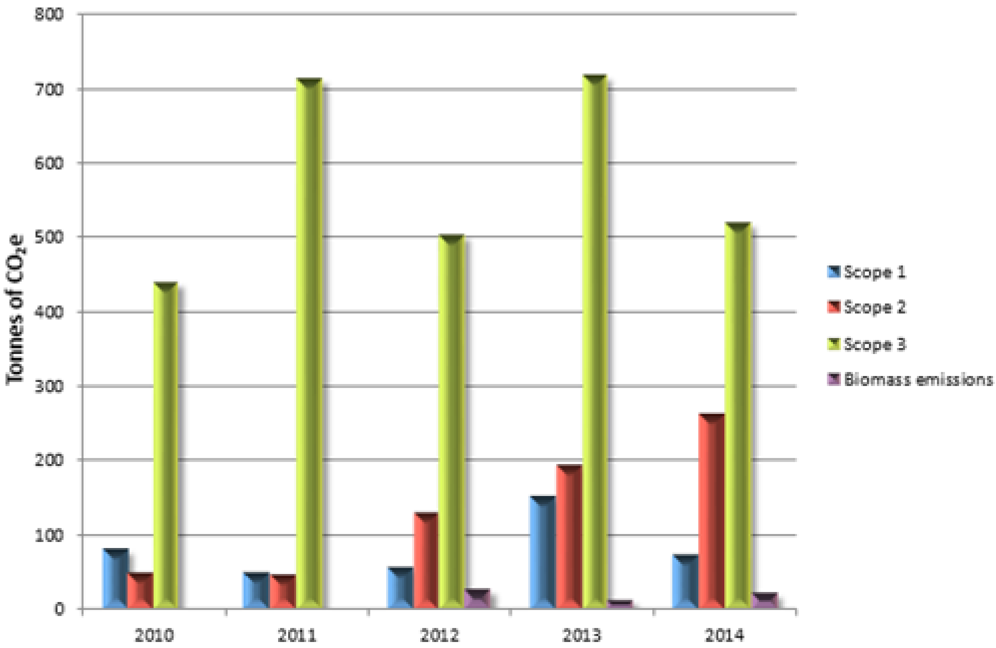

Figure 104 – GHG emissions evolution from headquarters in Florianópolis in tCO_2e

As expected, the higher GHG emissions of Tractebel Energia headquarters are concentrated in Scope 3, which represented between 60 and 88% of total emissions in the 2010-2014 period.

As can be seen in the figure above, there was a reduction in Scope 1 and 3 emissions of 52.1% and 27.6%, respectively, and an increase in Scope 2 of 35.7%.

→ **São Paulo (SP)**

The total GHG emissions of the São Paulo office demonstrate slight change in the 2010-2013 period. In 2014, there was a significant reduction of 49.8% in total emissions.

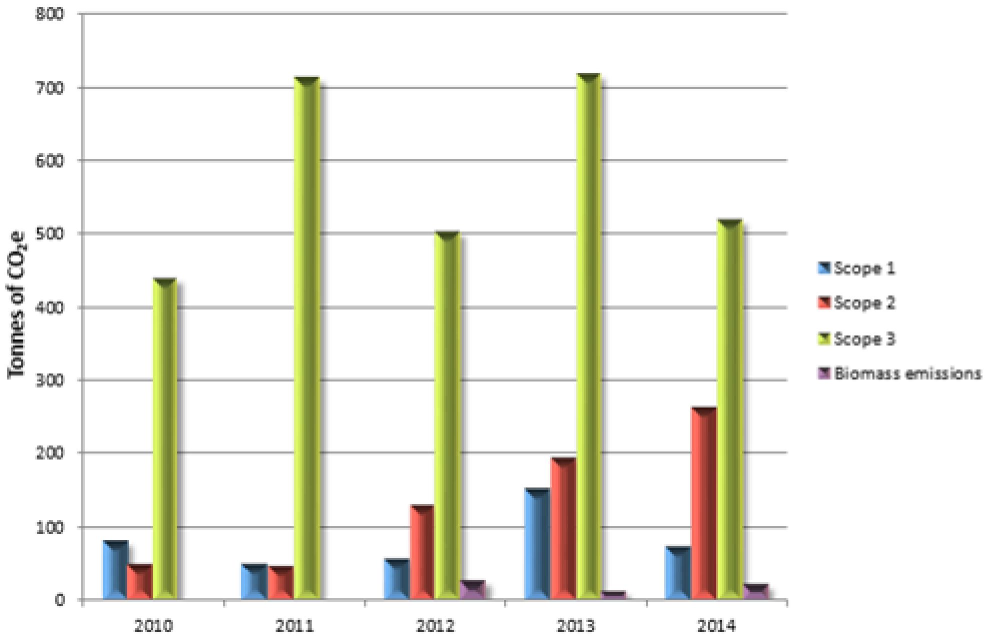

Figure 105 – GHG emissions evolution in São Paulo's office in tCO2e

In 2014, there were no emissions of Scope 1 and 1.21 tCO_2e were emitted in Scope 3, which resulted in a reduction of 67.1% of emissions in over 2013. There were no emissions of biomass or non-Kyoto gases for the period.

8.4. GHG Emissions Balance

For the calculation of GHG emissions balance of Tractebel Energia, the GHG emissions identified in section 7 of this report and the following actions promoted Tractebel Energia that reduce GHG emissions were considered.

The identified activities that reduce emissions of Tractebel Energia are: the generation of renewable energy and sinks of CO_2 due to forest planting. The GHG accounting methodologies and results to the operational units of Tractebel Energia are described below.

8.4.1. Electricity Generation to the Grid

Wind, hydro and biomass power plants, in operation, generate greenhouse gas emission reductions by providing clean and renewable energy to the National Interconnected System (SIN).

The methodology used for the calculation of GHG emission reductions for renewable electricity generation is based on the methodology ACM0002 "Grid-connected electricity generation from renewable sources" (UNFCCC, 2012). Thus, plants that meet the minimum criteria for the applicability of this methodology, based on renewable energy generation and reservoir area in the case of hydropower plants, were considered.

This methodology was provided by the Executive Board of the Clean Development Mechanism (CDM) of the Kyoto Protocol, in which projects emission reductions that generate renewable electricity and are connected to the grid can be accounted from the determination of a baseline. In general, the following summarized equation is used.

$$ER_y = BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$

Where:

ER_y = Emission reductions in a year y (tCO_2e/year)

BE_y = Baseline emissions in a year y (tCO_2e/year)

$EG_{PJ,y}$ = Net electricity generated to the grid in year y (MWh/year)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for renewable energy projects connected to the grid in year y (tCO_2e/year)

The $EF_{grid,CM,y}$ calculation is based on the equation below:

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

Where:

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2e/year)

w_{OM} = Weighting of operating margin emission factor (%)

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2e/year)

W_{BM} = Weighting of build margin emission factor (%)

The operating and build margin CO_2 emission factors of the National Interconnected System are published by the Brazilian Interministerial Commission on Global Climate Change ("CIMGC" from the Portuguese Comissão Interministerial de Mudança Global do Clima) and, therefore, data provided by this institution was used. For the operating margin, the average monthly factor for the year 2014 was considered. However, the build margin for the year 2014 was not published up to preparation of this report. Therefore, value of the build margin provided by MCTI for the year 2013 was considered.

For the weights of the emission factor, ACM0002 factors were considered, *i.e.* 50% for the operating and build margins for hydropower projects and, 75% for the operating margin and 25% for the build margin for wind projects. Thus, we considered the CO_2 emission factors as follows.

Wind power projects

0.2713 × 25% + 0.5837[9] × 75% = 0.5056 tCO_2/MWh

Hydropower and biomass projects

0.2713 × 50% + 0.5837[22] × 50% = 0.4275 tCO_2/MWh

Furthermore, the ACM0002 methodology provides methane emissions calculation, depending on the reservoir size of the hydropower projects. Thus, projects that have power density greater than $4W/m^2$ and less than or equal to $10W/m^2$, shall consider methane emissions from reservoirs as follows:

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

Where:

$PE_{HP,y}$ = Project emissions from water reservoirs of hydropower plants in year y (tCO_2e);

[9] Annual average of the operating margin CO_2 emission factor of the SIN available by MCTI. Data was inserted for exemplification only. Calculation of emission reductions considered the monthly average of this emission factor.

EF_{Res} = Default emission factor for emissions from reservoirs of hydro power plants – according to the methodology the default value is 90 Kg CO_2e/MWh;

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

Considering data of net electricity generation supplied by Tractebel Energia and the CO_2 emission factor of the SIN provided by MCTI, as well as from the plants that meet the minimum criteria of power density established in the methodology[10], it was possible to calculate the GHG emission reductions as presented in the tables below.

[10] Hydropower plants are considered elegible considering a power density (installed power divided by the reservoir area) greater than 4 W/m^2. Hydroelectric power plants that have power density greater than 4W/m^2 and less or equal to 10W/m^2, shall discount the methane emissions from reservoir in the total emission reductions from the renewable electricity generation.

Table 69 – GHG emission reduction renewable electricity generation from Tractebel Energia - Control Approach

Units	Net electricity generation (MWh)	Emission reductions (tCO_2e)
CTJL	4,578,635.80	-
UTWA	1,211,895.05	-
UTCH	281,582.39	-
UTFE	155,219.26	66,010.93
UCLA	132,339.61	56,495.19
UHSO	6,315,490.69	2,703,202.82
UTIB	154,860.37	65,944.33
UHSS	8,001,119.07	2,704,617.46
SEDE	-	-
UHPF	931,241.92	-
UHCB	2,067,737.56	-
UTAL	0.00	-
UHSA	1,234,059.51	-
UHPP	989,741.59	423,762.99
UETR	119,144.91	60,465.13
PHAB	55,486.66	23,790.31
PHRO	93,570.34	40,036.63
PHJG	86,588.61	37,016.47
UEPS	62,171.34	27,389.77
UEBB	83,874.30	42,613.60
UEMU	87,938.65	44,454.47
UEFL	126,840.68	64,375.33
UEGU	126,518.23	64,217.21
UFCA	1,833.27	927.67
ESP	-	-
Total	***26,897,889.81***	***6,425,320.29***

Table 70 – GHG emission reduction renewable electricity generation from Tractebel Energia – Equity Share Approach

Units	Net electricity generation (MWh)	Emission reductions (tCO_2e)
CTJL	4,578,635.80	-
UTWA	1,211,895.05	-
UTCH	281,582.39	-
UTFE	155,219.26	66,010.93
UCLA	132,339.61	56,495.19
UHSO	6,315,490.69	2,703,202.82
UHSS	8,001,119.07	2,704,617.46
UTIB*	107,256.29	45,673.04
UHMA*	1,303,893.47	556,817.83
UHIT*	6,154,464.89	2,629,000.93
SEDE	-	-
UHPF	931,241.92	-
UHCB	2,067,737.56	-
UHET*	2,109,909.11	-
UTAL	0.00	-
UHSA	1,234,059.51	-
UHPP	989,741.59	423,762.99
UETR	119,144.91	60,465.13
PHAB	55,486.66	23,790.31
PHRO	93,570.34	40,036.63
PHJG	86,588.61	37,016.47
UEPS	62,171.34	27,389.77
UEBB	83,874.30	42,613.60
UEMU	87,938.65	44,454.47
UEFL	126,840.68	64,375.33
UEGU	126,518.23	64,217.21
UFCA	1,833.27	927.67
ESP	-	-
Total	***36,418,553.20***	***9,590,867.78***

* Power plants without Tractebel Energia's 100% ownership

It is important to mention that the methodology for the GHG emission reduction calculation considered above was used only to enable the calculation of emission reductions. However, the calculation does not indicate and/or demonstrate compliance with the eligibility criteria and additionality to obtain carbon credits under the CDM.

8.4.2. Sinks by forest

CO_2 removal by sinks, or CO_2 sequestration, are estimated generally by the following equation[11].

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

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

Where:

ΔC_G = Biomass stock, t_C

$A_{i,j}$ = Area, ha

$G_{TOTALi,j}$ = Mean net annual increment, $t_{dry\ matter}$/ha/year

$CF_{i,j}$ = Carbon fraction of dry matter, t_C/ $t_{dry\ matter}$ (default value[12]= 0.47)

G_w = Mean biomass increment above ground, $t_{dry\ matter}$ /ha

R = Below-ground biomass to above-ground biomass ratio, $t_{dry\ matter}$ below-ground biomass / $t_{dry\ matter}$ above-ground biomass.

For simplicity and conservatism, R will be considered equal to zero (only above-ground biomass fixing carbon). For determining the carbon stock in the areas of planted forests is necessary to know what type of forest cover is being analyzed (native forest, planted forest, grassland, field, pasture, etc.), and knowledge at the time of planting each area. Since the planting activities carried out by Tractebel Energia are performed with native trees (forest and fruit) and native undergrowth vegetation, the CO_2 sequestration calculations were calculated based on IPCC default data (2006)[13] of 150 tonnes of dry matter / ha and 0.47 tons of carbon / dry matter. Then:

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[11] IPCC (2006). Guidelines for National Greenhouse Gas Inventories - Volume 4 – Agriculture, Forestry and Other Land Use.

[12] IPCC (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry.

[13] IPCC (2006). Guidelines for National Greenhouse Gas Inventories - Volume 4 – Agriculture, Forestry and Other Land Use. Chapter 4, page 4.63.

$$\Delta C_G = A \times 150 \times 0{,}47 \times 44/12 = A \times 258{,}5\ tCO_2$$

Considering data of planted forest provided by Tractebel Energia's power plants, it was possible to calculate the GHG emission reductions as presented in the tables below.

Table 71 - GHG emission reduction of Tractebel Energia planting – Control Approach

Units	Planted area (ha)	Reducing Emissions (tCO_2e)
CTJL	5.17	1,335.93
UTWA	-	-
UTCH	-	-
UTFE	-	-
UCLA	-	-
UHSO	1.26	325.71
UTIB	-	-
UHSS	8.06	2,083.51
SEDE	-	-
UHPF	-	-
UHCB	-	-
UTAL	-	-
UHSA	2.80	723.80
UHPP	0.39	101.33
UETR		
PHAB	-	-
PHRO	-	-
PHJG	-	-
UEPS	-	-
UEBB	1.45	374.31
UEMU	-	-
UEFL	-	-
UEGU	-	-
UFCA	-	-
ESP	-	-
Total	***19.13***	***4,944.59***

Table 72 - GHG emission reductions from Tractebel Energia's planting activities – Equity Share Approach

Units	Planted area (ha)	Emission reductions (tCO_2e)
CTJL	5.17	1,335.93
UTWA	-	-
UTCH	-	-
UTFE	-	-
UCLA	-	-
UHSO	1.26	325.71
UHSS	8.06	2,083.51
UTIB*	-	-
UHMA*	-	-
UHIT*	3.73	964.81
SEDE	-	-
UHPF	-	-
UHCB	-	-
UHET*	-	-
UTAL	-	-
UHSA	2.80	723.80
UHPP	0.39	101.33
UETR	-	-
PHAB	-	-
PHRO	-	-
PHJG	-	-
UEPS	-	-
UEBB	1.45	374.31
UEMU	-	-
UEFL	-	-
UEGU	-	-
UFCA	-	-
ESP	-	-
Total	***22.86***	***5,909.40***

* Power plants without Tractebel Energia's 100% ownership

8.4.3. Conclusion

Through the methodologies and calculations presented above, it was possible to calculate the emissions balance of Tractebel Energia as follows.

Table 73 – GHG emissions balance of Tractebel Energia – Control Approach

Units	CO_2 emissions (in tCO_2e)	Emission reductions (tCO_2e)		Total balance (tCO_2e)
		Plantation	Net power generation	
CTJL	5,165,813.58	1,335.93	-	5,164,477.65
UTWA	633,386.83	-	-	633,386.83
UTCH	582,923.72	-	-	582,923.72
UTFE	10,032.25	-	66,010.93	-55,978.68
UCLA	6,134.44	-	56,495.19	-50,360.75
UHSO	5,928.66	325.71	2,703,202.82	-2,697,599.87
UTIB	3,923.23	-	65,944.33	-62,021.10
UHSS	3,172.73	2,083.51	2,704,617.46	-2,703,528.24
SEDE	852.73	-	-	852.73
UHPF	660.88	-	-	660.88
UHCB	550.58	-	-	550.58
UTAL	141.75	-	-	141.75
UHSA	97.83	723.80	-	-625.97
UHPP	91.38	101.33	423,762.99	-423,772.94
UETR	85.42	-	60,465.13	-60,379.71
PHAB	43.98	-	23,790.31	-23,746.33
PHRO	23.04	-	40,036.63	-40,013.59
PHJG	22.87	-	37,016.47	-36,993.60
UEPS	20.01	-	27,389.77	-27,369.76
UEBB	15.97	374.31	42,613.60	-42,971.95
UEMU	8.17	-	44,454.47	-44,446.30
UEFL	6.58	-	64,375.33	-64,368.74
UEGU	5.32	-	64,217.21	-64,211.89
UFCA	4.74	-	927.67	-922.93
ESP	2.80	-	-	2.80
Total	***6,413,949.50***	***4.944.59***	***6,425,320.29***	***-16,315.39***

Table 74 – GHG emissions balance of Tractebel Energia – Equity Share Approach

Units	CO_2 emissions (in tCO_2e)	Emission reductions (tCO_2e)		Total balance (tCO_2e)
		Plantation	Net power generation	
CTJL	5,165,813.58	1,335.93	-	5,164,477.65
UTWA	633,386.83	-	-	633,386.83
UTCH	582,923.72	-	-	582,923.72
UTFE	10,032.25	-	66,010.93	-55,978.68
UTAL	141.75	-	-	141.75
UCLA	6,134.44	-	56,495.19	-50,360.75
UHSO	5,928.66	325.71	2,703,202.82	-2,697,599.87
UTIB	2,717.23	-	45,673.04	-42,955.81
UHPF	660.88	-	-	660.88
UHIT	1,311.93	964.81	2,629,000.93	-2,628,653.82
UHMA	971.89	-	556,817.83	-555,845.93
UHSS	3,172.73	2,083.51	2,704,617.46	-2,703,528.24
UHCB	550.58	-	-	550.58
UHET	206.41	-	-	206.41
SEDE	852.73	-	-	852.73
UHSA	97.83	723.80	-	-625.97
UHPP	91.38	101.33	423,762.99	-423,772.94
UETR	85.42	-	60,465.13	-60,379.71
PHAB	43.98	-	23,790.31	-23,746.33
PHRO	23.04	-	40,036.63	-40,013.59
PHJG	22.87	-	37,016.47	-36,993.60
UEPS	20.01	-	27,389.77	-27,369.76
UEBB	15.97	374.31	42,613.60	-42,971.95
UEMU	8.17	-	44,454.47	-44,446.30
UEFL	6.58	-	64,375.33	-64,368.74
UEGU	5.32	-	64,217.21	-64,211.89
UFCA	4.74	-	927.67	-922.93
ESP	2.80	-	-	2.80
Total	***6,415,233.72***	***5,909.40***	***9,590,867.78***	***-3,181,543.46***

As can be seen in the tables above, all power plants that generate renewable energy to the grid reduce more emissions than emit. Such reductions, although not certified, reflect, according to the methodology applied, the contribution of these plants to reduce emissions of greenhouse gases.

In addition to the initiatives presented above, it is noteworthy that Tractebel Energia also develops other actions to reduce CO_2e emitted to the atmosphere, as described below.

The company is developing a research and development project (R&D) that will allow the reduction its CO_2e emissions related to the use of coal through a co-firing technology (dual fuel) with the use of rice straw as a supplementary fuel to coal in thermoelectric power plants. If feasibility is proved, it will result in a project that will generate GHG emission reductions in the main emission source. The company also invests in research and development on technologies for the development of solar and tidal power generation. Through this initiative, it was possible the implementation of Cidade Azul solar photovoltaic power plant in 2014.

Another action that reduces GHG emissions developed by Tractebel Energia is the use of teleconferencing technologies. The company encourages this practice that saves GHG emissions, time and financial resources, although currently there is no control of GHG emissions reductions provided by this measure.

The company also promotes reduction of CO_2 emissions due to the large use of its ashes in the cement industry. Furthermore, Tractebel Energia also promotes actions to improve the energy efficiency in its plants, reducing their GHG emissions per MWh generated.

8.5. Key Indicators

From the result of Tractebel Energia emissions, it is possible to develop indicators to identify whether GHG emissions changes over the years are associated with an increase in productivity or loss in efficiency. Thus, the analysis of indicators, as shown below, considers 100% of emissions from units included in this report, independently of the approach.

Table 75 - 2014 GHG emission indicators of Tractebel Energia – Control Approach

Units	tCO_2e/net MWh (DEL)	tCO_2e/net MWh (DEL - REC)	tCO_2e/gross MWh
CTJL	1.12824	1.14623	1.02931
UTWA	0.52264	0.52265	0.51628
UTCH	2.07017	2.07403	1.65342
UTFE	0.06463	0.06486	0.04226
UCLA	0.04635	0.04649	0.04115
UHSO	0.00094	0.00094	0.00093
UTIB	0.02533	0.02545	0.02348
UHSS	0.00040	0.00040	0.00039
SEDE	-	-	-
UHPF	0.00071	0.00071	0.00070
UHCB	0.00027	0.00027	0.00026
UTAL	47,249.11233	-0.16952	70,873.66850
UHSA	0.00008	0.00008	0.00008
UHPP	0.00009	0.00009	0.00009
UETR	0.00072	0.00072	0.00069
PHAB	0.00079	0.00079	0.00077
PHRO	0.00025	0.00025	0.00024
PHJG	0.00026	0.00026	0.00026
UEPS	0.00032	0.00032	0.00031
UEBB	0.00019	0.00019	0.00018
UEMU	0.00009	0.00009	0.00009
UEFL	0.00005	0.00005	0.00005
UEGU	0.00004	0.00004	0.00004
UFCA	0.00258	0.00263	0.00258
ESP	-	-	-
Total	***0.23846***	***0.23912***	***0.23083***

Table 76 - 2014 GHG emission indicators of Tractebel Energia – Equity Share Approach

Units	tCO_2e/net MWh (DEL)	tCO_2e/net MWh (DEL - REC)	tCO_2e/gross MWh
CTJL	1.12824	1.14623	1.02931
UTWA	0.52264	0.52265	0.51628
UTCH	2.07017	2.07403	1.65342
UTFE	0.06463	0.06486	0.04226
UCLA	0.04635	0.04649	0.04115
UHSO	0.00094	0.00094	0.00093
UHSS	0.00040	0.00040	0.00039
UTIB*	0.02533	0.02544	0.02348
UHMA*	0.00075	0.00075	0.00074
UHIT*	0.00021	0.00021	0.00021
SEDE	-	-	-
UHPF	0.00071	0.00071	0.00070
UHCB	0.00000	0.00000	0.00000
UHET*	0.00010	0.00010	0.00010
UTAL	47,249.11233	-0.16952	70,873.66850
UHSA	0.00008	0.00008	0.00008
UHPP	0.00009	0.00009	0.00009
UETR	0.00072	0.00072	0.00069
PHAB	0.00079	0.00079	0.00077
PHRO	0.00025	0.00025	0.00024
PHJG	0.00026	0.00026	0.00026
UEPS	0.00032	0.00032	0.00031
UEBB	0.00019	0.00000	0.00000
UEMU	0.00009	0.00009	0.00009
UEFL	0.00005	0.00005	0.00005
UEGU	0.00004	0.00004	0.00004
UFCA	0.00258	0.00263	0.00263
ESP	-	-	-
Total	***0.17615***	***0.23959***	***0.23130***

* Power plants without Tractebel Energia's 100% ownership

As can be seen in the tables above, UTAL presented the greatest difference in indicators since this unit generated 0.003 MWh energy in 2014 and, therefore, its indicator (tCO_2e per MWh) was significantly different while compared to other units of the group.

Furthermore, the tCO_2e/gross MWh indicator from UFCA was conservatively calculated from the net energy generation (del), since there is no gross energy generation measurement at the plant and the energy consumption of the power plant is from the grid only. For the other plants, the corresponding measurements of gross generation were considered.

The table below presents the evolution of the indicator tCO_2e/MWh of Tractebel Energia from 2010 to 2014 in the Control and Equity Share approach. The energy used to calculate the indicator is the gross energy generated.

Table 77 – Evolution of emissions per generated energy of Tractebel Energia in tCO_2e /MWh (2010-2014)

Approach	Unit	2010	2011	2012	2013	2014
Control Approach	tCO2e	6,438,560.68	3,887,768.12	5,362,746.78	6,499,134.27	6,417,020.72
	tCO2e/MWh	0.23541	0.15027	0.21866	0.23559	0.23083
Equity Share Approach	tCO2e	6,438,365.99	3,885,394.48	5,362,530.66	6,499,234.56	6,418,304.93
	tCO2e/MWh	0.18680	0.11290	0.17962	0.18206	0.23130

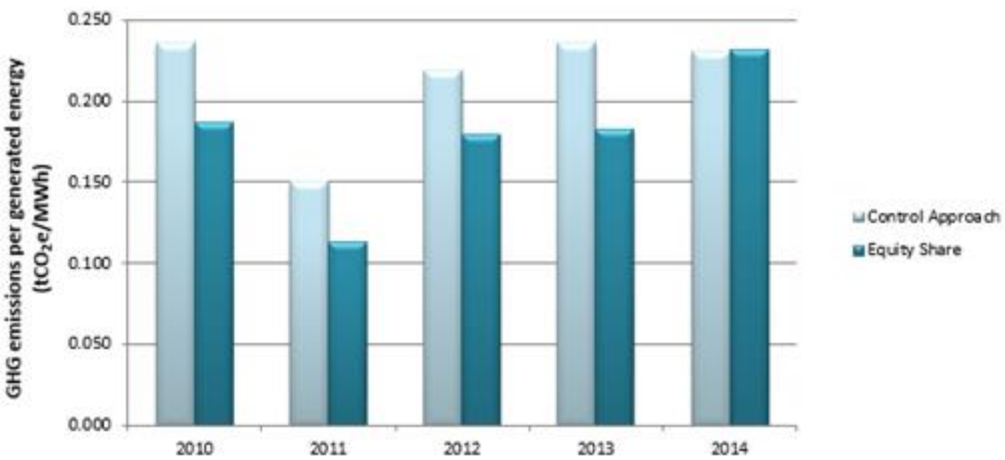

Figure 106 - Evolution of emissions per generated energy from Tractebel Energia in tCO_2e/MWh (2010-2014)

9. Opportunities on Emission Reductions

The largest emission source of greenhouse gases detected in this inventory is the stationary combustion, responsible for over 99% of emissions. Therefore, the efforts for the emission reductions shall be focused on this source. In order to achieve such goal, investment in research and development projects (R&D) for the substitution of fossil fuel used in biomass thermoelectric power plants is suggested. Moreover, investment in improvements on boilers efficiency in order to reduce the fuel consumption can be an alternative environmentally and economically attractive.

Furthermore, it is observed that the total installed capacity, 86% of plants in operation and 100% of plants under construction are from renewable sources. Prioritizing investment in renewable energy projects, such as hydroelectric, wind and biomass is important to be maintained, in order to enable the generation of renewable energy certificates and/or carbon credits.

Considering other sources of emission with minor representativeness, some initiatives can be considered aiming GHG emission reductions. In the case of transportation of employees, raw materials and waste, an alternative would be the use of biofuels such as ethanol and biodiesel, instead of using gasoline and diesel oil. In the case of transport of employees and directors, the teleconferencing system should be maintained to reduce the number of air travel, which also involves a possibility of reducing costs and improving management and efficiency.

Another important issue is the awareness and sensitization of employees for emission reduction initiatives. For this, we propose the development of courses and workshops, as well as the dissemination of posters presenting incentives for sustainable attitudes. In the same line, the contractors/suppliers who provide goods and services to Tractebel Energia should also be engaged in this initiative. Thus, it is suggested that, as far as possible, Tractebel Energia requires the reporting of their greenhouse gas emissions, as well as a GHG mitigation plan.

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

10. Improvement Suggestions

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

- Consideration of more data and information on documents which have low level of uncertainty, for example, invoices / sales of receipts, ensuring the accuracy of data and aiming future audits;
- Preparation of procedures and automated / systematic internal controls aiming to obtain consistent data and information faster;
- Promotion of detailed sources of emissions in the collection data form, mostly from stationary and mobile combustion, for the identification of emission sources associated with each unit of Tractebel Energia.

We propose that these procedures and controls should consider:

- Monitoring data and information regarding mobile combustion, such as routes, distances, fuel consumption, fuel type, etc, reducing the dependence on third-party data and control;
- Monitoring data related to wastewater treated by third-parties.

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Annex I

Total emissions of Tractebel Energia by gas type and source in the Control and Equity Share approach are presented below.

Table 78 – Tractebel Energia's GHG emissions per type of gas and source - Control Approach

Scope 1	CO_2	CH_4	N_2O	HFC	PFC	SF_6	CO_2e	CO_2 biomass
Stationary combustion	6,311,343.55	355.18	128.66	-	-	-	6,358,562.58	939,117.47
Mobile combustion	655.11	0.13	0.04	-	-	-	671.54	134.11
Process	4,120.11	0.00	0.00	0.00	0.00	0.00	4,120.11	0.00
Fugitive emissions	5.26	0.00	0.00	0.01	0.00	0.00	26.14	0.00
Farming activities	0.00	0.00	0.02	-	-	-	4.63	0.00
Solid waste	0.00	0.01	0.00	-	-	-	0.37	0.00
Total Scope 1	**6,316,124.03**	**355.32**	**128.72**	**0.01**	**0.00**	**0.00**	**6,363,385.37**	**939,251.57**
Scope 2								
Purchased electricity from the grid	**18,711.25**	0.00	0.00	0.00	0.00	0.00	**18,711.25**	**0.00**
Scope 3								
Fuel and energy activities not included in Scopes 1 and 2	1,641.27	0.03	0.00	0.00	0.00	0.00	1,642.86	4.05
Transport and distribution (upstream)	18,350.53	1.24	1.00	-	-	-	18,679.86	1,440.05
Solid waste from operations	0.00	19.92	0.01	-	-	-	502.26	1.87
Business travel	652.96	0.04	0.03	-	-	-	662.60	21.82
Employees transportation (home - work)	338.27	0.03	0.02	-	-	-	345.10	35.14
Transport and distribution (downstream)	9,847.70	0.60	0.53	-	-	-	10,020.20	549.57
Total Scope 3	**30,830.74**	**21.86**	**1.60**	**0.00**	**0.00**	**0.00**	**31,852.87**	**2,052.49**
Total emissions	***6,365,666.02***	***377.18***	***130.31***	***0.01***	***0.00***	***0.00***	***6,413,949.50***	***941.304.07***

Table 79 – Tractebel Energia's GHG emissions per type of gas and source – Equity Share Approach

Scope 1	CO_2	CH_4	N_2O	HFC	PFC	SF_6	CO_2e	CO_2 biomass
Stationary combustion	6,311,349.07	337.10	126.24	-	-	-	6,357,397.51	880,546.63
Mobile combustion	676.87	0.13	0.05	-	-	-	693.97	146.11
Process	4,120.11	0.00	0.00	0.00	0.00	0.00	4,120.11	0.00
Fugitive emissions	5.31	0.00	0.00	0.01	0.00	0.05	1,170.04	0.00
Farming activities	0.00	0.00	0.04	-	-	-	11.21	0.00
Solid waste	0.00	0.01	0.00	-	-	-	0.37	0.00
Total Scope 1	**6,316,151.35**	**337.24**	**126.33**	**0.01**	**0.00**	**0.05**	**6,363,393.22**	**880,692.74**
Scope 2								
Purchased electricity from the grid	**19,670.31**	0.00	0.00	0.00	0.00	0.00	**19,670.31**	**0.00**
Scope 3								
Fuel and energy activities not included in Scopes 1 and 2	1,641.27	0.03	0.00	0.00	0.00	0.00	1,642.86	4.05
Transport and distribution (upstream)	18,467.88	1.26	1.01	-	-	-	18,800.61	1,352.16
Solid waste from operations	0.00	19.96	0.01	-	-	-	503.31	2.70
Business travel	707.98	0.04	0.03	-	-	-	718.35	23.21
Employees transportation (home - work)	475.63	0.04	0.03	-	-	-	484.87	42.85
Transport and distribution (downstream)	9,847.70	0.60	0.53	-	-	-	10,020.20	549.57
Total Scope 3	**31,140.46**	**21.93**	**1.62**	**0.00**	**0.00**	**0.00**	**32,170.20**	**1,974.54**
Total emissions	***6,366,962.12***	***359.17***	***127.95***	***0.01***	***0.00***	***0.05***	***6,415,233.72***	***882,667.28***

Annex II

Since, in the case of Estreito (UHET), Machadinho (UHMA) and Ita (UHIT) hydropower plants, Tractebel Energia has no operational control and this report considers emissions from these plants proportionally to Tractebel Energia's ownership only, total GHG emissions of these plants are presented below.

→ **Estreito (UHET)**

During 2014 year, UHET emitted a total of 515.12 tCO_2e distributed in Scopes 1, 2 and 3 as presented in the figure below.

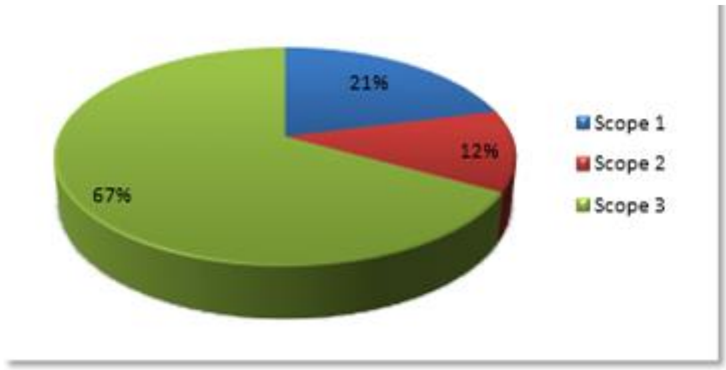

Figure 107 – Representativeness of UHET GHG emissions by scope (100% of emissions)

Emissions by type and source from Scope 1 and 2 are presented in the figure below.

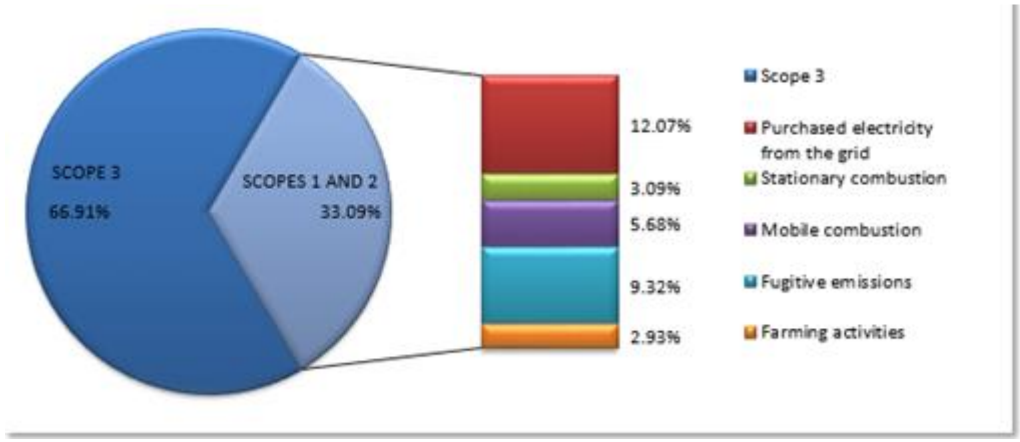

Figure 108 – Representativeness of UHET GHG emissions by source (100% of emissions)

In 2014, CO_2 emission from biomass combustion resulted in 50.49 tCO_2 and 94.12 tCO_2e of non-Kyoto gas.

Emissions per greenhouse gas are detailed in the table below.

Table 80 – UHET GHG emissions – 100% of emissions (in tonnes)

Emissions sources	**CO_2**	**CH_4**	**N_2O**	**SF_6**	**CO_2e**	**biomass emission**	**Non-Kyoto gases**
Scope 1							
Stationary combustion	15.86	0.0007	0.00014	-	15.91	0.85	-
Mobile combustion	28.41	0.01	0.002	-	29.26	12.67	-
Process	0.00	0.00	0.00	0.00	0.00	0.00	-
Fugitive emissions	0.14	0.00	0.00	0.002	48.02	0.00	94.12
Farming activities	0.00	0.00	0.05	-	15.07	0.00	-
Solid waste	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 1	**44.41**	**0.01**	**0.05**	**0.00**	**108.26**	**13.52**	**94.12**
Scope 2							
Purchased electricity from the grid	**62.18**	-	-	-	**62.18**	-	-
Scope 3							
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution (upstream)	219.22	0.05	0.02	-	226.47	33.57	-

Emissions sources	CO_2	CH_4	N_2O	SF_6	CO_2e	biomass emission	Non-Kyoto gases
Solid waste from operations	0.00	0.11	0.00	-	2.63	0.00	-
Business Travel	107.25	0.002	0.005	-	108.72	3.02	-
Employees transportation (home - work)	6.73	0.0004	0.0004	-	6.85	0.39	-
Transport and distribution (downstream)	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 3	**333.20**	**0.16**	**0.02**	**0.00**	**344.67**	**36.98**	**0.00**
Total emissions	***439.80***	***0.17***	***0.08***	***0.00***	***515.12***	***50.49***	***94.12***

→ **Itá (UHIT)**

During 2014 year, UHIT emitted a total of 1,901.62 tCO_2e distributed in Scopes 1, 2 and 3 as presented in the figure below.

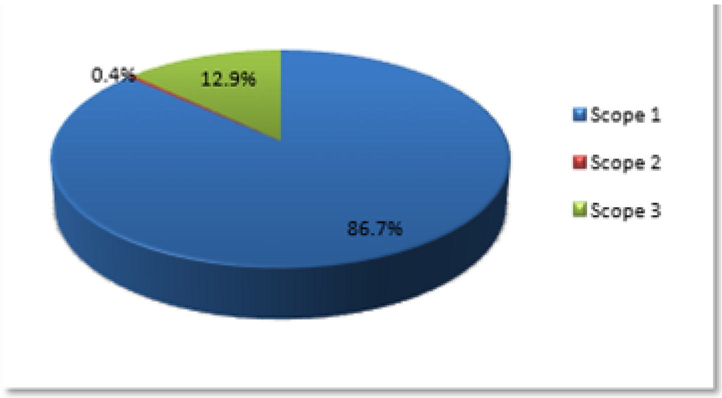

Figure 109 – Representativeness of UHIT GHG emissions by scope (100% of emissions)

Emissions by type and source from Scope 1 and 2 are presented in the figure below.

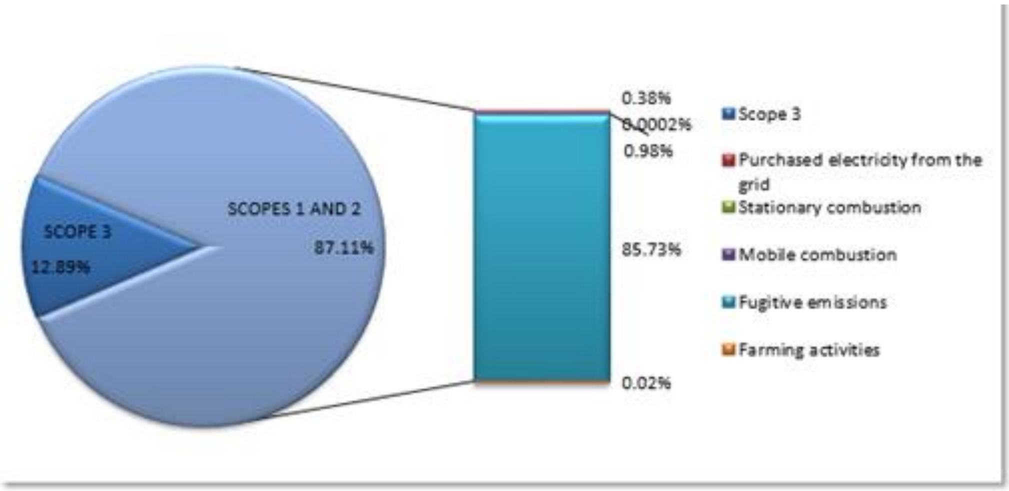

Figure 110 – Representativeness of UHIT GHG emissions by source (100% of emissions)

CO_2 emissions from biomass combustion resulted in 29.58 tCO_2 and emissions of non-Kyoto gases resulted in 10.14 tCO_2e.

Emissions per greenhouse gas are detailed in the table below.

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

Emissions sources	CO_2	CH_4	N_2O	SF_6	CO_2e	biomass emission	Non-Kyoto gases
Scope 1							
Stationary combustion	0.004	0.00	0.00	-	0.004	0.0002	-
Mobile combustion	18.11	0.005	0.0013	-	18.61	10.05	-
Process	0.00	0.00	0.00	0.00	0.00	0.00	-
Fugitive emissions	0.00	0.00	0.00	0.07	1.630.20	0.00	10.14
Farming activities	0.00	0.00	0.002	-	0.47	0.00	-
Solid waste	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 1	**18.11**	**0.005**	**0.003**	**0.07**	**1,649.28**	**10.05**	**10.14**
Scope 2							
Purchased electricity from the grid	**7.25**	-	-	-	**7.25**	-	-
Scope 3							
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	0.00	-

Emissions sources	CO_2	CH_4	N_2O	SF_6	CO_2e	biomass emission	Non-Kyoto gases
Transport and distribution (upstream)	40.58	0.01	0.004	-	42.18	7.83	-
Solid waste from operations	0.00	0.00	0.00	-	0.00	1.24	-
Business Travel	17.18	0.0005	0.001	-	17.38	0.24	-
Employees transportation (home - work)	182.33	0.01	0.010	-	185.53	10.23	-
Transport and distribution (downstream)	0.00	0.00	0.00	-	0.00	0.00	-
Total Scope 3	**240.09**	**0.02**	**0.01**	**0.00**	**245.09**	**19.53**	**0.00**
Total emissions	***265.46***	***0.03***	***0.02***	***0.07***	***1,901.62***	***29.58***	***10.14***

→ **Machadinho (UHMA)**

During 2014 year, UHMA emitted a total of 5,040.94 tCO_2e distributed in Scopes 1, 2 and 3 as presented in the figure below.

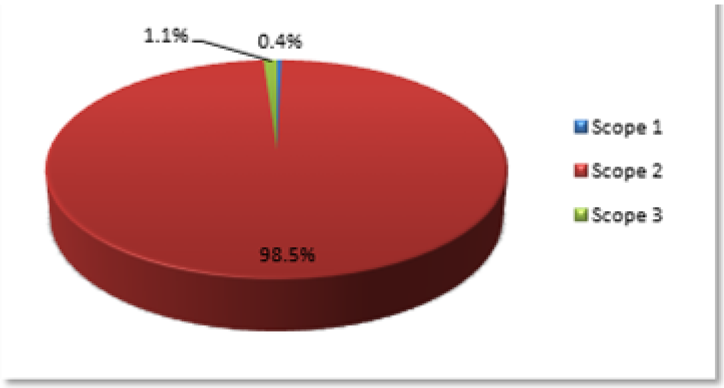

Figure 111 – Representativeness of UHMA GHG emissions by scope (100% of emissions)

Emissions by type and source from Scope 1 and 2 are presented in the figure below.

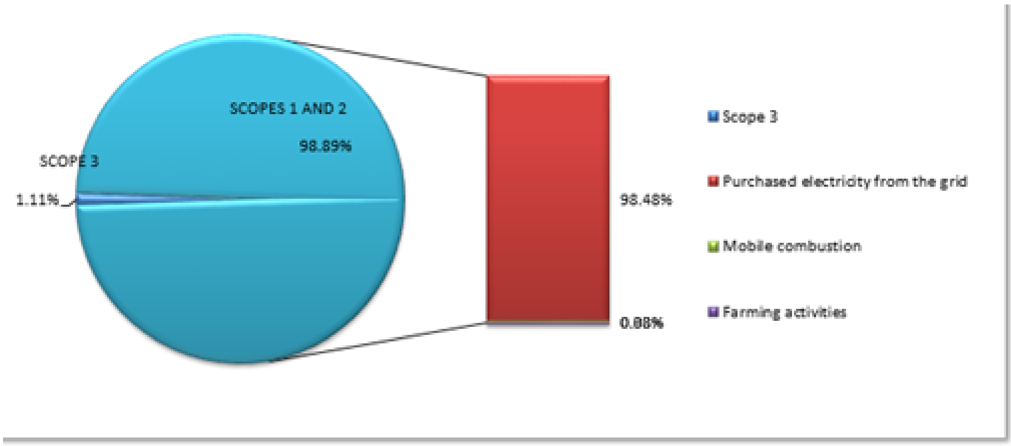

Figure 112 – Representativeness of UHMA GHG emissions by source (100% of emissions)

CO_2 emissions from biomass combustion resulted in 10.00 tCO_2 and non-Kyoto gases emissions resulted in 25.03 tCO_2e.

Emissions per greenhouse gas are detailed in the table below.

Table 82 – UHMA GHG emissions – 100% of emissions (in tonnes)

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
Scope 1						
Stationary combustion	0.03	0.00	0.00	0.035	0.00	-
Mobile combustion	18.48	0.005	0.0015	19.04	6.00	-
Process	0.00	0.00	0.00	0.00	0.00	-
Fugitive emissions	0.00	0.00	0.00	0.00	0.00	25.03
Farming activities	0.00	0.00	0.006	1.72	0.00	-
Solid waste	0.00	0.00	0.00	0.00	0.00	-
Total Scope 1	**18.52**	**0.005**	**0.01**	**20.80**	**6.00**	**25.03**
Scope 2						
Purchased electricity from the grid	**4.964.37**	-	-	**4,964.37**	-	0.000
Scope 3						
Fuel and energy activities not included in Scopes 1 and 2	0.00	0.00	0.00	0.00	0.00	-
Transport and distribution	7.82	0.0005	0.0004	7.95	0.44	-

Emissions sources	CO_2	CH_4	N_2O	CO_2e	biomass emission	Non-Kyoto gases
(upstream)						
Solid waste from operations	0.00	0.00	0.00	0.00	0.87	-
Business Travel	0.98	0.0002	0.0001	1.01	0.09	-
Employees transportation (home - work)	46.01	0.003	0.002	46.82	2.60	-
Transport and distribution (downstream)	0.00	0.00	0.00	0.00	0.00	-
Total Scope 3	**54.81**	**0.003**	**0.003**	**55.78**	**4.00**	**0.00**
Total emissions	***5,037.69***	***0.01***	***0.01***	***5,040.94***	***10.00***	***25.03***

Annex III

The Global Warming Potential (GWP) is presented in the table below.

Table 83 – Global Warming Potential of greenhouse gases

Gas	Family / Type	GWP
Carbon dioxide (CO_2)	-	1
Methane (CH_4)	-	25
Nitrous oxide (N_2O)	-	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
Sulfur hexafluoride (SF_6)	-	22,800
Nitrogen trifluoride (NF_3)	-	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
PFC-4-1-12	PFC	9,160
PFC-5-1-14	PFC	9,300
PFC-9-1-18	PFC	7,500

Gas	Family / Type	GWP
Trifluoromethyl sulfur pentafluoride	PFC	17,700
Perfluorocyclopropane	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-407C	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-411B	Compound	4
R-412A	Compound	442
R-413A	Compound	2,053
R-414A	Compound	0
R-414B	Compound	0
R-415A	Compound	22
R-415B	Compound	93
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

Gas	Family / Type	GWP
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-423A	Compound	2,280
R-424A	Compound	2,440
R-425A	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
R-441A	Compound	0
R-442A	Compound	1,888
R-443A	Compound	0
R-444A	Compound	87
R-445A	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

Gas	Family / Type	GWP
R-507 or R-507A	Compound	3,985
R-508A	Compound	13,214
R-508B	Compound	13,396
R-509 or R-509A	Compound	4,945
R-510A	Compound	0
R-511A	Compound	0
R-512A	Compound	189