

**INVENTORY OF GREENHOUSE GASES - SUMMARY
2014**

**CELSIA S.A. E.S.P.
Colombia**

Summary of Results



3.1.3 Period covered by the report

The report is calculated based on information provided from January 1 to December 31, 2014.

4. QUANTIFICATION OF GHG EMISSIONS

According to the ISO 14064-1 standard for the quantification of an Organization's greenhouse gas emissions, the system limits, which are comprised of the organizational and operating limits, must be determined by the company. The limits defined for Celsia S.A E.S.P., as per the provisions of the standard, are set out below.

Definition of limit: organizational or operational

4.1.1 Definition of limit: organizational or operational

The organizational limits for conducting the Organization's GHG Inventory are determined based on the operating control approach, which includes the facilities, processes, and operations controlled by the Organization in Colombia.

4.1.2 Operating limits

The operating limits defined for CELSIA S.A. E.S.P. encompasses Scope 1, direct emissions: and Scope 2, indirect emissions based on consumption of energy from the national energy mix for the calculated year.

Scope 3 (voluntary) includes indirect emissions relevant to the operations or to topics of interest around a culture of cooperation for the Organization.

4.2.1 Identification of facilities and sources of emission

The Figure 1 shows the facilities included in this calculation, corresponding to thermal and hydroelectric power plants and administrative offices located in Colombia.

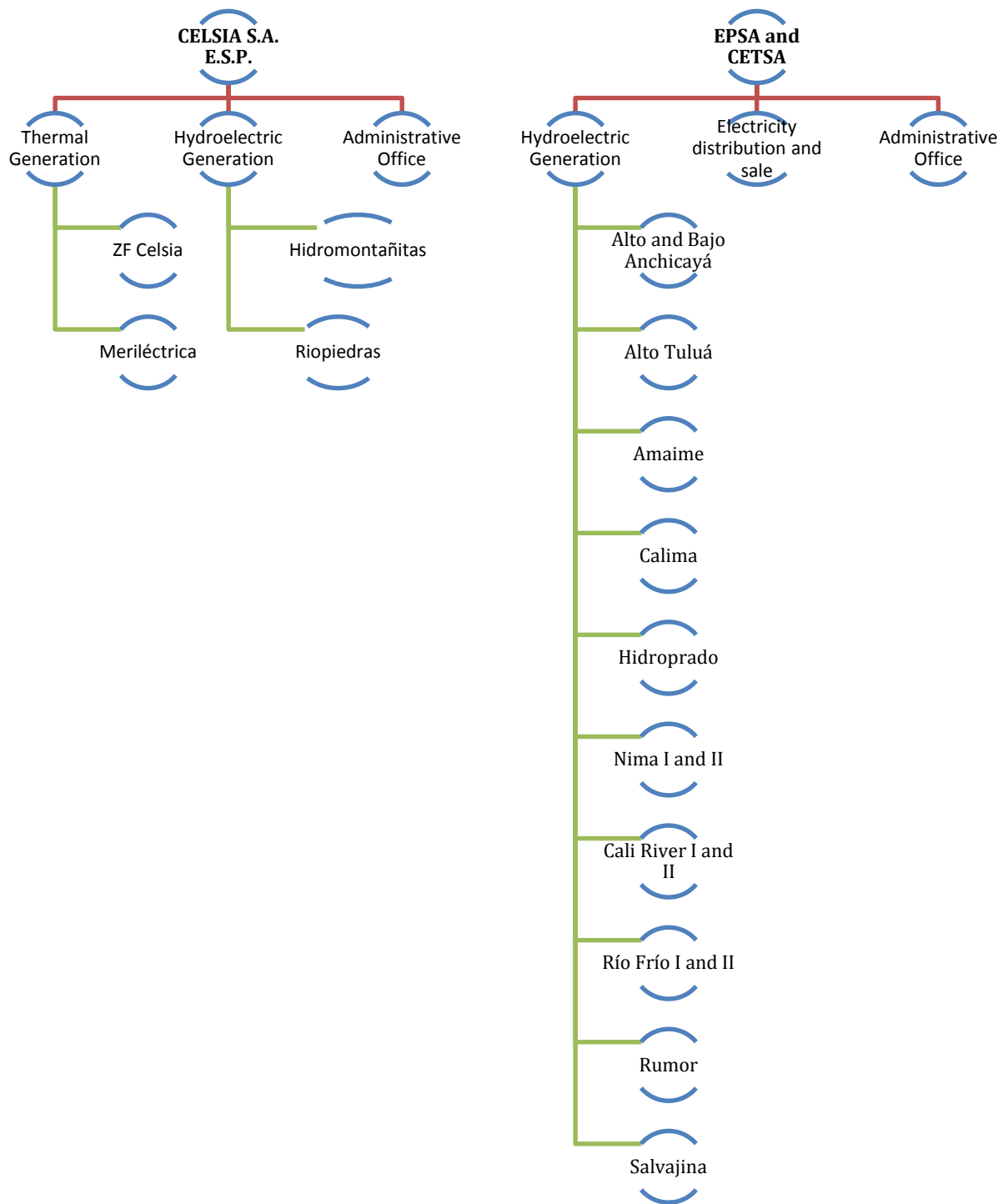


Figure 1. Facilities controlled by CELSIA S.A. E.S.P. in Colombia

4.2.4 Description of changes to the quantification methodology

For 2014, the calculations were made using the new global warming potentials published in 2013 by the Intergovernmental Panel on Climate Change (IPCC 1), which were reassessed and updated in the Fifth Assessment Report.

The data utilized up to last year corresponds to that published in 2007 in the Fourth Assessment Report, and an account of the modified values is provided in this chapter.

4.2.5.5 Description of the emission sources excluded from this inventory

EPSA makes a donation of fuel to the army. The Company accounts for this fuel as a purchase, but, because it is donated to and used by the army, it is not used for Company operations and is included as an indirect emission (Scope 3).

Emissions from power plants that have not yet come into operation, recent acquisitions, and facilities outside Colombia are excluded.

4.3.8 CELSIA S.A. E.S.P. - Summary

The Table 1 sets out a summary of the Organization's inventory for 2014, which shows the total emissions, broken down by each firm (Celsia and EPSA).

Table 1. Summary of the Organization emissions in 2014

Company	2014 Emissions (tons CO ₂ e/year)			
	Scope 1	Scope 2	Total	Contribution A1+A2
Celsia	1,421,741.88	4,134.82	1,425,876.70	96.44%
EPSA	2,901.86	49,763.27	52,665.13	3.56%
Total	1,424,644	53,898	1,478,542	

The Table 2 shows the emissions of Celsia's assets for 2014, and the Table 3 sets out the emissions for EPSA's assets separately. This is because the reduction strategies are conducted for each business unit.

Table 2. 2014 Celsia Asset Emissions - Summary

Facility	2014 Emissions (tons CO ₂ e/year)			
	Scope 1	Scope 2	Total	Contribution A1+A2
Celsia Administrative	746.9	133.3	880.2	0.062%
Zona Franca Celsia	1,240,774.1	3,697.6	1,244,471.8	87.278%
Meriléctrica	180,211.5	296.1	180,507.6	12.659%
Riopiedras	3.40	6.55	9.95	0.001%

¹ IPCC. Intergovernmental Panel on Climate Change 2013, Fifth Assessment Report . (IPCC 2013)

Facility	2014 Emissions (tons CO2e/year)			
	Scope 1	Scope 2	Total	Contribution A1+A2
Hidromontañas	5.95	1.27	7.21	0.001%
Total	1,421,742	4,135	1,425,877	

Table 3. 2014 EPSA Asset Emissions - Summary

Facility	2014 Emissions (tons CO2e/year)			
	Scope 1	Scope 2	Total	Contribution
EPSA and CETSA Administrative	385	662	1,046.9	1.99%
EPSA and CETSA Distribution	1,499	47,719	49,217.9	93.45%
Alto and Bajo Anchicayá	306	1,013	1,318.9	2.50%
Alto Tuluá	1.23	2.92	4.2	0.01%
Amaime + Nima I and II + Río Cali I and II	46.20	9.53	55.7	0.11%
Calima	35.65	175.36	211.0	0.40%
Hidroprado	16.33	166.71	183.0	0.35%
Río Frío I and II	1.88	0.02	1.9	0.00%
Rumor	3.07	0.35	3.4	0.01%
Salvajina	608.32	13.92	622.2	1.18%
Total	2,902	49,763.3	52,665	

4.3.9 Specific Emissions

The specific emissions are calculated from total emissions and the generation of each of the power plants.

The Table 4 shows the specific thermal generation emissions for 2014.

Table 4. Specific emissions from thermal generation, 2014

Facility	2014 Generation (kWh)	Scope 1 Emissions (tons CO2e)	Scope 2 Emissions (tons CO2e)	A1 Indicator (gr CO2/kWh)	A1+A2 Indicator (gr CO2e/kWh)
Zona Franca Celsia	2,548,152,446.00	1,240,774.14	3,697.63	486.93	488.38
Meriléctrica	267,377,280.00	180,211.53	296.07	674.00	675.10

The Table 5 shows the specific hydroelectric generation emissions for 2014

Table 5. Specific hydroelectric generation emissions, 2014

Facility	2014 Generation (kWh)	Scope 1 Emissions (tons CO2e)	Scope 2 Emissions (tons CO2e)	A1 Indicator (gr CO2/kWh)	A1+A2 Indicator (gr CO2e/kWh)	
Celsia	Riopiedras	131,851,561.38	3.40	6.55	0.03	0.08
	Hidromontañas	157,646,816.32	5.95	1.27	0.04	0.05
EPSA	Alto and Bajo Anchicayá	1,573,934,516.00	305.73	1,013.16	0.19	0.84
	Alto Tuluá	76,005,597.00	1.23	2.92	0.02	0.05
	Amaime + Nima I and II + Río Cali I and II	97,784,094.13	46.20	9.53	0.47	0.57
	Calima	123,617,694.00	35.65	175.36	0.29	1.71
	Hidroprado	206,284,590.00	16.33	166.71	0.08	0.89
	Río Frío I and II	57,085,642.60	1.88	0.02	0.03	0.03
	Rumor	17,048,167.61	3.07	0.35	0.18	0.20
Salvajina	1,171,558,225.36	608.32	13.92	0.52	0.53	

The Table 6 shows the specific emissions for the Transmission and Distribution business, 2014.

Table 6. Specific Transmission and Distribution Emissions, 2014

Business	2014 Distribution (kWh)	Scope 1 Emissions (tons CO2e)	Scope 2 Emissions (tons CO2e)	A1 Indicator (gr CO2/kWh)	A1+A2 Indicator (gr CO2e/kWh)
EPSA - CETSA Distribution	2,043,357,238.00	1,498.61	47,719.26	0.73	24.09

5. EVOLUTION OF EMISSIONS OF CELSIA S.A. E.S.P.

From the base year 2012, the Organization's emissions have evolved due to several factors, such as new acquisitions, increased generation by thermal power plants, among others. The Table 7 show the total emissions quantified by facility for each year.

Table 7. Evolution of total emissions - Celsia S.A. E.S.P. 2012-2014

Facility	Tons CO2e/year		
	2012	2013	2014
ZFC	750.539	1.130.549	1.244.472
Meril�trica	80.987	132.905	180.508
EPSA	35.430	37.347	52.665
SHPPs: Riopiedras and Hidromonta�itas	4,66	20,66	17,2
Celsia Administrative	191	263	880
Total	867.151	1.301.085	1.478.542

As can be seen, emissions have progressively increased across all facilities, with the exception of small hydroelectric power plants.

For 2014, the total quantified emissions for the Organization increased by 14 % over 2013, and by 71% over 2012 (base year).

Tabla 8. Evolution of scope emissions Celsia S.A. E.S.P 2012-2014

Facility	2012		2013		2014	
	Scope 1	Scope 2	Scope 1	Scope 2	Scope 1	Scope 2
ZFC	747.075	3.464	1.126.904	3.645	1.240.774	3.698
Meril�trica	80.771	216	132.583	322	180.212	296
EPSA	4.188	31.242	2.713	34.635	2.902	49.763
PCHs	1,70	2,96	16,01	4,64	9,35	7,81
Celsia Administrative	103	88	104	159	747	133
Total	832.138	35.013	1.262.320	38.765	1.424.644	53.898
	867.151		1.301.085		1.478.542	

In general, in 2014 Scope 1 emissions have increased 71.2% over the base year 2012 and 12.9% compared to 2013. For the scope 2, the increase in 2014 is 54% for 2012 and about 39% 2013.

The specific causes of increase per facility are set out in Table 9.

Table 9. Factors that caused changes in emissions from the base year

Facility	Causes of changes in emissions
Zona Franca Celsia	<ul style="list-style-type: none"> Despite there being considerable reductions in diesel consumption for

Facility	Causes of changes in emissions
	<p>generation, Natural Gas consumption increased by 15% over 2013.</p> <ul style="list-style-type: none"> • There was a large increase in quantified SF₆ leaks compared with 2012 and 2013. • Electricity consumption is the lowest since the base year. • Natural gas leaks through air vents are the lowest for the three years quantified.
Meriléctrica	<ul style="list-style-type: none"> • Natural gas consumption increased by 19% over 2013. • For the first time since the base year, leaks through air vents were reported. • Lower consumption of electricity purchased from networks associated with higher self-consumption rates at the power plant.
EPSA	<ul style="list-style-type: none"> • Total imported electricity consumption fell by around 20% from 2013, and by 22% from 2012. • The consumption of diesel and diesel fuel for emergency plants and own vehicles increased by 8.7% over 2013, and by 22.5% from the base year. • The total quantity of gasoline consumed in Company vehicles fell by 0.4% and 12.3% from 2013 and 2012, respectively. • Replenishment of CO₂ extinguishers was six times greater than the quantity reported in 2013. • Losses from energy distribution reported in 2014 were 66.65% greater than in 2013, but just 1% more than the base year. • SF₆ leaks in 2014 increased by 5.5% over 2013, but were still 61% lower than those reported in the base year of 2012. • The energy emission factor for the Colombian mix calculated for 2014 is 4.1% greater than in 2013, and 61.2% over 2012. (this factor is outside the Organization's control).
SHPPs: Riopiedras and Hidromontañas	<ul style="list-style-type: none"> • The emissions in Scope 1 fell because of lower diesel fuel consumption in emergency electric power plants. • Imported energy consumption was greater than in previous years. • There was no replenishment of extinguishers for the year of the report, 2014.
Celsia Administrative	<ul style="list-style-type: none"> • Increase in gasoline in Company vehicles by 2,000% over that reported for 2013. • Fuel consumption from flights in own airplanes increased by 62% over the previous year. • The electricity used in the offices for 2014 was 20% less than that reported in 2013.

In general, the increase in generation is one of the main factors that determines an increase in the annual emissions for each facility, as the greater the energy generation, the more that resource consumption at operating level is associated with greater emissions as a consequence.

For distribution, the greater the quantity of energy distributed, the greater the losses generated, and an increase in the emissions quantified in Scope 2 is normally associated.

The Table 10 sets out the total generation per facility for 2012, 2013 y 2014.

Table 10. Generation per facility 2012-2014

Facility	Generation
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	kWh /year		
	2012	2013	2014
ZFC	1,543,706,157	2,473,815,883	2,548,152,446
Meril�trica	118,004,380	201,592,040	267,377,280
SHPPs	206,559,164	304,191,305	289,498,378
EPSA and CETSA (14 power plants)	3,170,260,604	3,190,438,617	3,323,318,527

The specific emission indicators determine the Organization's true progress in terms of the efficiency of each of the facilities assessed.

The specific emissions quantify the grams of CO₂ equivalent issued, per kilowatt per hour, generated in the reporting year.

The Table 11 shows the evolution of the specific emissions by facility from the base year.

Table 11. Evolution of specific emissions by facility 2012-2014

Facility	Indicator (gr CO ₂ e/kWh)					
	2012		2013		2014	
	A1	A1+A2	A1	A1+A2	A1	A1+A2
ZFC	483.95	486.20	455.5	457.0	486.93	488.4
Meril�trica	684.47	686.30	657.7	659.30	674.00	675.1
SHPPs	0.010	0.020	0.050	0.100	0.064	0.121
EPSA and CETSA	1.32	11.18	0.9	11.71	0.87	15.85

*2014 is the first year in which EPSA's emissions are calculated with a breakdown for each facility. Thus, for the purposes of comparing the evolution, this is done over the total generated.

According to the above, the specific emissions of the thermal power plants remain relatively stable compared with the base year, regardless of the increase in the total inventory quantified for 2014. This is because the increases in the inventory are associated with greater generation, and this is shown in the indicator.

The indicators for small hydroelectric power plants increased compared with the previous year and the base year, but this was primarily due to greater consumption of electricity associated with the increase in personnel and operating levels.

For EPSA, while the indicator with respect to Scope 1 decreased, which implies lower overall fuel consumption, but the total indicator that factors in emissions increased in Scope 2. This means that specific emissions are associated with distributions and transmission losses, but they are also significantly affected by the emission factor of the national energy mix, which applies to the quantities reported. This is an area that is beyond the Organization's control.

8.2.2 Own power plants: Small Hydroelectric Power Plants

In 2015, Celsia conducted a study with the objective of quantifying the reduction of emissions and removals of greenhouse gases from Celsia S.A. by way of small run-of-river hydroelectric power plants in 2014.

The reduction of emissions is accounted for using a power plant quantification method, which includes the selection of a base scenario and the identification and quantification of relevant secondary effects.

The ACM002 methodology, "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" was used to this end, while information on installed and effective plant capacity, net generation quantity, self-consumption, quantity of net energy supplied to the National Electrical Grid, and reservoir area was collected.

The accounting was applied to the following small hydroelectric power plants:

- Río Cali 1 and 2: Cali 1: hydroelectric power plant, located on the Cordillera Occidental, 2 km west of Cali, operates as a run-of-river plant, on a waterfall. It has an installed capacity of 1.8 MW.
- Nima 1 and 2: hydroelectric power plant, located on the Cordillera Central in the department of Valle del Cauca, approximately 13 km from Palmira city center. It has a capacity of 6.7 MW.
- El Rumor: the El Rumor power plant is located 5 km from the municipality of Tuluá, on the Cordillera Central. It exploits water from the Tuluá river for its generation. A run-of-river plant with an installed capacity of 2.5 MW
- Río Frío 1 and 2: hydroelectric power plant, located 3 km from the municipality of Riofrío, in the low-lying part of the Cordillera Occidental on the road that leads to the Salónica Township and 16 km to the west, separated by the municipality of Tuluá. A run-of-river plant with an installed capacity of 11.7 MW.
- Río Piedras: located in the department of Antioquia, some 90 km southeast of Medellín, in the jurisdiction of the municipality of Jericó. A run-of-river plant with an installed capacity of 19.9 MW, and an annual average generation of 150 GWh.

The removals calculated for the different power plants included are set out below:

Table 12. Removals of CO₂ calculated for SHPPs, 2014

SHPP, 2014	Emissions or removals from the power plant (tons of CO ₂ e)	Baseline or removals (tons of CO ₂ e)	Emissions due to leaks (tons of CO ₂ e)	Reduced or removed net GHG emissions (tons of CO ₂ e)
Río Cali 1	0	3,230	0	3,230
Río Cali 2				
Nima 1	0	10,051	0	10,051
Nima 2				
Río Frío 1	0	15,704	0	15,704
Río Frío 2				

Rumor	0	4,701	0	4,701
Río Piedras	0	36,268	0	36,268
Total	0	69,954	0	69,954

The emissions for 2014 that Celsia S.A. E.S.P. has the opportunity to discount from its inventory of greenhouse gases are **69,954 tons of CO₂e**, due to the generation of hydroelectric energy by small power plants (less than 20 MW).

Annex 1 sets out the calculations and results in accordance with the ISO 14064-2 standard.

9. TOTAL EMISSIONS - CELSIA S.A. E.S.P. 2014

Taking into account the emissions quantified in both the inventory of all Company facilities in 2014 and the estimates from removals due to the operation of small hydroelectric power plants (Annex 1), the totaled value is shown below in the Table 13.

Table 13. Total emissions and removals - Celsia S.A. E.S.P., 2014

Item	Emissions (tons of CO ₂ e year)
Celsia S.A. E.S.P. GHG Inventory, 2014	1,478,542
SHPP Removals, 2014	69,954
Total Emissions	1,408,588

Thus, the Company's balance of emissions in 2014 totaled **1,408,588 tons of CO₂ equivalent**.

10. CONCLUSIONS AND RECOMMENDATIONS

Direct emissions associated with thermal generation still constitute CELSIA's greatest contribution in 2014, as in previous years.

Overall, the Organization's total inventory for the year increased by 14% over 2013, and by 71% from the base year.

Greenhouse gas emissions associated with losses from the transmission and distribution of electricity are significant for EPSA. These losses reflect the efficiency of energy transport, which is affected by external variables such as the conductivity and the length of the wire. For 2014, transmission losses were 0.81%, and those due to distribution comprised 8.85% of the total distributed.

Though the Organization has worked to reduce fuel consumption in operations and control SF₆ leaks in substations and power plants, the main cause of increase in total emissions quantified for 2014 is greater consumption of natural gas as a consequence of the greater demand in the Colombian energy market placed upon thermal power plants over the last year, due to weather-related factors in the country.

Another cause of the significant inventory increase at Celsia S.A. E.S.P. is the electricity emission factor of the Colombian energy mix for the reporting year, which applies to imported energy consumption and to transmission and distribution losses. This factor is 61% greater than in 2012 (base year), and is not under the direct control of the Organization, but does have a direct bearing on the emissions results.

Through the quantification of the reduction in emissions associated with the operation of small hydroelectric power plants, Celsia had succeeded in reducing its 2014 inventory by a total of 69,954 tons of CO₂e.

The Organization's balance of emissions in 2014 is declared to be **1,408,588 tons of CO₂ equivalent** in total, taking into account the inventory of greenhouse gas emissions and the reduction in emissions from verified Organization power plants.