



Methodology for the calculation of GHG Inventory. Red Eléctrica Group.in Spain

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1. Scope of the inventory

Organizational boundaries:

The inventory applies to the activities that take place in Spain: Red Eléctrica Corporación, S.A.; Red Eléctrica de España, S.A.U.; Red Eléctrica Infraestructuras en Canarias, S.A.U. (REINCAN); Red Eléctrica Sistemas de Telecomunicaciones, S.A.U. (REINTEL); Red Eléctrica Internacional, S.A.U.(REI) and Red Eléctrica y de Telecomunicaciones, Innovación y Tecnología, S.A. (RETIT) Hereinafter we will refer to them as Red Eléctrica. The emission calculation is performed under operational control criteria.

Operational scope

Emissions associated to Company's activities and facilities are quantified, taking into consideration the following scopes:

Scope 1: Direct GHG emissions

Emissions resulting from the Company's controlled or owned sources:

- Fugitive Emissions: SF₆ gas leaks in electricity substations and refrigerant gases leaks from air conditioning systems.
- Mobile Combustion: emissions derived from fuel consumption of the fleet.
- Stationary combustion: derived from the combustion of fuels used in diesel generating sets. No other stationary combustion source exists in the Company.

Scope 2: GHG indirect emissions from electricity consumption.

- Electricity consumption
- Electricity losses in the transmission grid.

Scope 3: Other indirect GHG emissions

- Supply chain: Purchase of goods and services.
- Capital goods.
- Life cycle of fuel and energy consumed: emissions due to energy production (not included in scope 1 and 2).
- Upstream transportation and distribution.
- Waste management.
- Business travel by plane, train and car (taxi, private and rented vehicles).
- Employees commuting to the work place.
- Leased assets.



2. Methodology and data to be used to calculate emissions

2.1 Direct emissions: SCOPE 1

2.1.1 Fugitive emissions of SF₆ at electricity substations

SF₆ gas is a dielectric gas that is used in electrical substations. It is mainly found in the switchgears and Gas Insulated Substations (GIS).

Method of calculation

SF₆ gas emissions are calculated using the following formula

Total SF₆ leaks = Leaks from equipment in service + Leaks associated with the end of life of equipment

- Leaks from equipment in service: the amount of gas leaking from operational equipment is regarded as equivalent to the amount used to fill the equipment in question minus the gas recovered. This information is recorded in accordance with the instructions set out in Red Eléctrica's internal procedures. (The amount of gas recorded includes leaks inherent to the equipment itself, leaks resulting from the breakdown or ageing of this equipment and leaks associated with accidents: emissions during operation and maintenance emissions, as defined in the Voluntary Agreement between MAGRAMA, AFBEL, UNESA, REE and the waste and SF₆ gas managers signed in 2015).
- Leaks associated with the end of the SF₆ equipment's operational life are calculated by applying the figure shown in the voluntary agreement for the equipment in question: this is calculated by applying the emission rate shown in the Voluntary Agreement (0.4%) mentioned in the previous paragraph.

CO₂ emissions: in order to convert SF₆ emissions to CO₂, the GWP for 100 years is used, as published in the fourth IPCC report (2007) of 22800.

2.1.2 Fugitive emissions of refrigerant gas from air conditioning systems

Air conditioning equipment is fitted at both buildings, substations and telecommunication booths. (Telecommunication booths data are not included in the inventory yet)

Method of calculation

- Equipment in service leaks: calculations are based on the amount of gas used to refill each equipment each year (refilled gas = leaked gas).
- Retired equipment leaks: considering the difference between the rated load of the equipment and the gas recovered from this one at the end of its useful life.

The GWP figures for 100 years are used, as published in the fourth IPCC report (2007) (Regulation 517/2014), as indicated in the document issued by the Spanish Climate Change Office (OECC).

2.1.3 Emissions resulting from fuel consumption of the fleet

When calculating these emissions, the following vehicles are considered:

- Fleet vehicles: those that are owned by Red Eléctrica. These vehicles are used by technicians in different areas to perform their work.
- Shared leasing vehicles used by technicians in different areas to perform their work.



- Manager's vehicles: emissions derived from fuel consumption by vehicles, owned by Red Eléctrica or leasing cars, used by managers to perform their work (excluding private use).

Method of calculation

Emissions are calculated using the following formula:

$$\text{Emissions (tCO}_2\text{ eq)} = \text{total liters of fuel consumed (by type)} * \text{emission factor}$$

(according to the type of fuel used).

Emission factors: as published by the Spanish Climate Change Office OECC. Annex 1 includes emission factor used for the emissions calculation from the consumption of fuel by fleet vehicles, according to each type of fuel.

2.1.4 Emissions resulting from the consumption of fuel in diesel generating sets

Diesel Generating sets are in most of Red Eléctrica substations and some buildings in order to ensure the supply in the event of electricity failure. In general (with some exceptions), the number of operating hours registered, corresponds to the time where they have been on in order to perform maintenance checks to ensure that they are in working conditions.

Method of calculation.

Calculations are based on the number of hours they have been in operation and the power of each generator (apparent power).

$$\text{Apparent power (KVA)} * \text{power factor (0.8)} = \text{active power (kw)}$$

$$\text{Active power (kw)} * \text{hours of operation (h)} = \text{energy generated (kwh)}$$

Assumptions made: We assume a power factor of $\cos\varphi=0.8$. We assume that the generating sets are operating at maximum power (which means that we are taking account of the worst possible scenario as regards emissions, since generators normally operate well below maximum power

Emission factor used: 0.28 kgCO₂/kwh (Source: DEFRA)

2.2 Indirect emissions: SCOPE 2

2.2.1 Electricity consumption

These are the emissions associated with the consumption of electricity at the different facilities.

Method of calculation

These emissions are calculated by multiplying the consumption of electricity by the emission factor applicable to each case (market-based methodology).

Emission factors:

- Energy mix factor that corresponds to each specific electricity distribution company: contract information is used if available (It will be always the case of the green energy). On the contrary, when contract information is not available, the relevant emission factors must be those determined by the Spanish Climate Change Office OECC attached in Annex 1.
- Emission factor (peninsular, Balearic or Canary electric mix): calculated by Red Eléctrica in accordance with the methodology defined by Red Eléctrica.



2.2.2 Electricity losses in the transmission grid

The transmission of electricity involves some loss of electricity in the grid, which means that in order to satisfy customer final demand it is necessary to increase the amount of electricity generated. There are several reasons and factors that contribute to these losses, being the Joule Effect the most significant. (*The Joule Effect refers to the phenomenon by which, when a conductor carries electrical current, some of the kinetic energy from the electrons is transformed into heat due to their collision with the atoms of the conductor material along which they are travelling, thus raising the temperature of this material*).

The amount lost is directly related to the location of generation points and its associated consumption points, the amount of energy required, the energy mix, international exchanges and the shape of the demand curve.

Method of calculation

*Emissions = Losses in the transmission grid * average emission factor for electricity in the year in which the inventory is calculated.*

Losses from the transmission network: Based on the figures published in the daily electricity balance sheet for 31st December of the year for which the calculation is to be made (Losses are considered also for Balearic and Canary Islands systems).

<http://www.ree.es/es/actividades/balance-diario>

Emission factor: the figure calculated by Red Eléctrica is used, as in section 2.2.1 (specific factor for each system).

2.3 Indirect emissions: SCOPE 3.

2.3.1 Supply chain: purchase of goods and services

These include emissions that are associated with the life cycle of goods and services acquired by Red Eléctrica.

Method of calculation

- The annual expenditure is broken down for each group of items purchased by Red Eléctrica - groups already included in scopes 1 and 2 or in other categories of scope 3, are excluded from this calculation to avoid double counting-

The emissions are obtained by multiplying the expenditure of each group of items by the emission factor that best fits their denomination.

Emission factors: those from the Comprehensive Environmental Data Archive (CEDA) 4.0 database that provides emissions per dollar of production for more than 400 sectors of the US economy are used. The CEDA database is used by the US Environmental Protection Agency (U.S. EPA), the Department of Commerce (DOC) and the European Commission for policy support.

- For the most relevant suppliers, Red Eléctrica carries out specific data collection work to improve the calculation described above. In case that suppliers provide quality information regarding the life cycle of the products purchased or emissions information verified by a third party, it will be used instead of applying the CEDA emission factors on the annual expenditure.



2.3.2 Capital goods

These include emissions that are associated with the capital goods acquired by REE. Capital goods are final products that have a prolonged useful life and are treated as fixed assets, as property or an equipment.

Method of calculation

The emissions of the assets acquired in the year are estimated by multiplying the area of the facilities acquired by the base values, or relevant benchmarks. The emissions of the goods acquired are only considered in the year of acquisition, without apportioning over time.

Some groups of items (mentioned in category 1) are included in this category because they correspond to the concept of capital good. In this case, the emissions are calculated using the corresponding CEDA factors or using the direct information available from suppliers, which is incorporated following the same criteria as in the case of emissions of products and service, as explained in the previous section

Emission factors: USEPA (1995) Heavy Construction Operations Benchmark and Comprehensive Environmental Data Archive (CEDA) 4.0

2.3.3 Life cycle of fuel and energy consumed

These include emissions due to energy and fuel production, consumed by Red Eléctrica and that have not been included in scope 1 and scope 2:

- Emissions associated with the extraction, production and transport of fuels consumed by Red Eléctrica
- Emissions associated with the extraction, production and transport of fuel consumed in the generation of electricity, steam, heat or refrigeration used by Red Eléctrica

Method of calculation

- Fuels consumed: To obtain associated emissions, fuel consumption is multiplied by an emission factor that results from combining the emission factors of DEFRA and the factors of emission proposed by OECC
- Fuels consumed in the generation of electricity: only emissions associated with non-renewable energy consumption are considered. Emission factor: Well-to-tank (WTT) for Spain, DEFRA (upstream).

Emission factors: OECC y DEFRA.

2.3.4 Upstream transportation and distribution

This category includes emissions associated with the transport and distribution of products acquired by REE in vehicles not owned by REE. Two types of transport are considered:

- External transport of products and materials between the supplier and Red Eléctrica facilities;
- Internal transport of materials between Red Eléctrica facilities

Method of calculation

- External transport: The annual expenditure is broken down for the groups of items that refer to this type of service. The **emission factor** CEDA 4.0 for this type of articles is applied. (KgCO₂/Euro) Same methodology as 2.3.1.



- Internal transport: Emissions are calculated from the litres of diesel consumed by the company that carried out the logistics service for Red Eléctrica. The logistics company monitors the kilometres travelled and litres of fuel used by each individual vehicle. Emissions are calculated using the same methodology used for scope 1 emissions (REE vehicles. **Emission factors** from OECC).

2.3.5 Waste management

This category includes emissions associated with the treatment of waste generated by REE's operations considering their final treatment: landfill disposal, recycling, incineration, composting, etc.

Method of calculation

Detailed information on the amount of waste (kg) is collected by type of waste and treatment method.

Emission factors: DEFRA (for each type of waste and final treatment method).

2.3.6 Business travel

These include emissions associated with business travel by plane, train (high-speed and long-distance) and car (private vehicles, shared leasing, rented vehicles, manager's vehicles and taxis).

Method of calculation

2.3.6.1. Trips by plane

The travel agency provides the trip data, ticket type and number of routes.

The emissions of each route are calculated by multiplying the total distance (distance of the route x number of routes) x emission factor of the ICAO (International Civil Aviation Organization).

2.3.6.2. Trips by train

The travel agency provides the trip data: type of train (high speed or long distance), distance of the route and number of routes ticket type and number of routes.

The emissions of each route are calculated by multiplying the total distance (distance of the route x number of routes) x emission factor.

Emission factor: Published by RENFE. AVE: RENFE Sustainability (2011); Long distance: RENFE, Environmental Report (2007).

2.3.6.3. Trips by car

- a) Private vehicle: calculations are based on the number of kilometres travelled.
- b) Rental vehicle: calculations are based on the number of kilometres travelled, provided by car rental suppliers.

Emission factors: DEFRA 2017

- c) Taxis: Emissions are calculated by the company hired to carry out this service, with its own methodology.

2.3.7 Employees commuting to the workplace

Necessary data (kilometres travelled by employees according to each transport method employed) are obtained from a survey to all employees. Once the calculation is made for the employees responding to the survey, the results are extrapolated for the entire workforce.

Emission factors:

Train: SACE tool (from Andalusian Autonomous Community) and RENFE



Motorbike: SACE

Bus: SACE

Car: DEFRA.

2.3.8 Leased assets (downstream)

This category includes the emissions associated with the operation of assets owned by REE and leased to third parties, whose impact has not already been considered in the scope 1 and 2 inventory.

Method of calculation

Electricity consumption primary data is considered, if they are available. If not, electricity consumption is estimated from leased area data (using benchmark information: CIBSE (2000)).

Emission factors: the same as in scope 2. (If thermal energy is consumed: OECC)

3. Calculation procedure

The Sustainability Department receives information from the different units, compiles it and makes the relevant calculations for the GHG inventory.

Once these calculations have been completed, an internal validation session is carried out, during which the figures are reviewed, and the inventory is closed prior to its validation by an external independent body.

4. Uncertainty

All the processes relating to the different sources of emissions fall within the scope of REE's quality and environmental systems. These systems are respectively certified under standards ISO 9001:2000 and ISO 14001:2004.

Implementation of these quality systems minimises any uncertainty in the information used to calculate the GHG inventory.

To minimise any uncertainty associated with emission factors, official sources are used whenever it is possible.

Of all the sources considered in the inventory, only scope 3 emissions are considered to lie higher levels of uncertainty due to the fact that primary data are not always used for the calculation.

5. Recalculation of the historical series

In the case of significant variations that are important to consider in the historical series, the emissions will be recalculated, mainly those of the base year (2015).

These variations can be caused by the increase in the scope of the inventory, incorporation of assets or modification in the calculation methodology.

It is considered there is a significant variation if there is a value higher than 2% in the total amount of emissions and/or an increase of 10% in the affected category.

Nevertheless, even there are not changes which may affect significantly, it is possible to recalculate the emissions in the historical series if it is necessary to its evolution analysis to check its accomplishment or the redefinition of the reduction objectives



Annex 1. Emission factors

- a. Emission factors used, proposed by the Spanish Climate Change Office (OECC). Version published in April 2019

https://www.miteco.gob.es/es/cambio-climatico/temas/mitigacion-politicas-y-medidas/factores_emision_tcm30-479095.pdf

Emission factors according to the type of fuel used (2018):

Gasoline (kg CO ₂ /l)	2,157
Diesel (kg CO ₂ /l)	2,493

Energy mix factors that corresponds to each specific distribution Company (2018):

Endesa Energía, S.A: 0,38

Gas Natural Comercializadora, S.A.: 0,25 (Naturgy)

Iberdrola Clientes, S.A.U.: 0,27

EDP Comercializadora, S.A.U: 0,23

Fennie Energía, S.A.: 0

Viesgo Energía, S.L.: 0.21

- b. Emission factor for diesel generating sets:

DEFRA 2019: 0,273 kg CO₂/kWh