Carbon Footprint of the municipality of Fuentespalda (Spain) for the year 2021

Fuentespalda is a municipality in the Autonomous Community of Aragón, in Spain, with a population of 293 inhabitants, and an area of 38 km2, It's Carbon Footprint was carried out in November of 2022 to quantify the GHG emissions resulting from the activities of the town's services, as well as to set a series of reduction recommendations in the largest GHG emitting sources.

Goal and scope

The analysis consists in scope 1 and 2 emissions, namely the emissions caused by fuel combustion in boilers, furnaces, vehicles, as well as the emissions associated with the purchase of electricity, steam, heating, or cooling. Specific to Fuentespalda, the selected categories due to the significance of their consumptions were the following:

- Direct emissions of Scope 1, specifically subcategories 1.1 and 1.2, consisting in the fuel combustion in boilers, furnaces and vehicles owned by the town. The results explained below show the inventory considered in the analysis.
- Indirect emissions of Scope 2, specifically subcategory 2.1, which consists in the purchasing of energy exclusively from electricity.

Regarding the Greenhouse Gases, the scope of this study addresses carbon dioxide (CO_2,) methane (CH_4) and nitrous oxide (N_2O), since the other gases established by the Kyoto Protocol are not applicable to the activities in the municipality.

Methodology

The report was developed following the methodology from the ISO 14064-1:2019[1], as this is the standard for the management of GHG inventories, as well as for the quantification of their emissions and removals. This methodology consists in multiplying the activity of an emission source with its corresponding Emission Factor, and afterwards, relating each gas to its Global Warming Potential to normalize them to CO_2 equivalents, with the aim of simple and straightforward comparison.

The steps which were followed consisted in the definition of the scope of study, from which the emission sources were selected, the collection of the data on consumption of both fuel and electricity in each emission source, and the calculation of the carbon footprint following the ISO 14064-1:2019 recommendations.

The emission factors and Global Warming Potentials were extracted from official data sources such as the MITECO (Ministry for the Ecological Transition and the Demographic Challenge)[2]. The ISO 14064-1:2019 also states the need to define the uncertainty of each value, which ranged from 2% to 7% depending on the primary or secondary nature of the data. Thus, the uncertainty for the Fuentespalda results was set to 3,31%, which was classified as low to medium[3].

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[1] ISO 14064-1:2019 – International Standard for Greenhouse Gas Emissions and Removals. Quantification and Reporting at Organizational Level.

[2] MITECO (2020). Emission Factors, Register of the Carbon Footprint, Compensation and Carbon Dioxide Absorption Proyects. Spanish Office for Climate Change.

[3] The methodology was based on: IPCC (2001) Guide on Good Practices for the Management of Uncertainty.

Results

Table 1 presents the total emissions per emission source of the municipality of Fuentespalda in 2021, along with the emission factors used and the combined uncertainty. The carbon footprint amounts to 30,772 t CO_2 eq, being the citizen carbon footprint 0,105 t CO_2 eq.

Table 1. Total emissions per emission source

Category	Subcategory	Emissions	Emission Source	t CO_2 eq/year				
				Non biogenic $CO_{2\ eq}$	CO_2	CH_4	N_2O	Uncertainty (%)
1	1.1	Direct	Stationary combustión in fixed equipment	13,581	11,733	1,630	0,218	1,520%
	1.2	Direct	Mobile combustion in vehicles	2,507	2,486	0,000	0,021	0,439%
2	2.1	Indirect	Imported electricity	14,684	14,680			1,350%
Total				30,772	28,903	1,630	0,239	3,309%
Total CO_2eq tons/year			30,772					
Total CO_2eq tons/citizen			0,105					

Approximately half of the emissions originate from the combustion of fuel in fixed equipment, which is caused by the diesel boiler in the Town Hall, the camp site and the doctor's office. As seen in Table 2, the use of diesel boilers are large contributors, whilst the use of biomass as a fuel, such as in the public school, reduces the impacts at a CO_2 equivalent level.

Table 2: Category 1.1 emissions originating from the combustion of fuel in fixed equipment

Source of emission	Fuel	Consumption	Unit	Emission Factor			Emissions (t CO_2 eq)
				kgCO_2/unit	kgCH_4/unit	kgN_2O/unit	
Public school	Biomass pellets	10.675,000	kg	0,000	0,005	0,000	1,825
Town Hall	Diesel B	1867,200	l	2,721	0,000	0,000	5,091
Doctor's Office	Diesel B	933,600	l	2,721	0,000	0,000	2,545
Pensioners home	Diesel B	311,200	l	2,721	0,000	0,000	0,848
Camp site	Diesel B	1200,000	l	2,721	0,000	0,0001	3,272
Total emissions (t CO_2eq)							**13,581**

Regarding the emissions from the vehicles owned by the town, the totality of them originate from the diesel van, although in comparison with other emission sources, such as the fuels for fixed equipment, the impacts are low, as seen in table 1.

Table 3 shows how the other half of the Carbon Footprint of Fuentespalda comes from the purchasing of electricity.

Table 3: Category 2.1 emissions originating from the consumption of purchased electricity

Emission Source	Consumption (kWh)	Emission Factor	Emissions (t CO_2 eq)
		kgCO_2/kWh	
Council scale	46,730	0,144	0,007
Multi-purpose building	2443,000	0,144	0,352
Town Hall	1580,130	0,144	0,228
Public School	3111,820	0,144	0,448
Town court wall	637,960	0,144	0,092

Ayuntamiento de Fuentespalda

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Emission Source	Consumption (kWh)	Emission Factor (kgCO$_2$/kWh)	Emissions (t CO$_2$ eq)
Water distribution system	59.027,610	0,144	8,500
Public lighting	31.626,000	0,144	4,554
Cave lighting	185,580	0,144	0,028
Doctor's office and pensioner's home	1911,940	0,144	0,275
House	1000,230	0,144	0,144
Tower	398,640	0,144	0,057
Total kWh consumed	101.969,640	Total emissions	**14,680**

Overall, the largest contributors to the impacts from the purchasing of electricity are the water distribution facilities and the public lighting service.

Improvement measures

The improvement measures that have been recommended for Fuentespalda address the main emission sources which in summary, consist of the diesel burners and the electricity consumption in the water distribution system and public lighting services. Although the town has already carried out several improvement measures such as the installation of photovoltaic panels for reduced electricity consumption, as well as changing the burner in the school to biomass-sourced, it is encouraged to follow with the increase in solar power installations, as well as the substitution of the burners in the town hall and the camping for biomass burners. Other measures include good practices for the efficient use of energy, as well as envelope measures for more energy efficient buildings.