

Article

Determining the 2019 Carbon Footprint of a School of Design, Innovation and Technology

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Abstract: As a contribution to the fight against climate change, ESNE's 2018/19 carbon footprint has been evaluated using the CarbonFeel methodology, based on ISO 14069 standards. In the scenario studied, greenhouse gas (GHG) emissions produced by direct and indirect emissions have been included. For comparative purposes, a second scenario has been analyzed in which fossil fuels used for heating are replaced by electrical energy from renewable sources. A decrease of 28% in GHG emissions has been verified, which could even reach 40% if the energy for thermal conditioning was replaced by renewables.

Keywords: climate change; global warming; carbon footprint; GHG emissions; climate emergency



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1. Introduction

The consumption of resources in the last century has experienced an exponential growth in all fields, as indicated in the Special Report on Climate Change and Land of the Intergovernmental Panel on Climate Change (IPCC) [1], boosted in a synergetic cycle by the exponential increase in population, growing up from 1 billion at the beginning of the 20th century to the current 7.7 billion, with perspectives of reaching between 9.5 (the most optimistic scenario), to 12.5 million in 2100 (the most pessimistic) [2]. The IPCC report clearly outlines that the increase in Greenhouse Gas (GHG) emissions (mainly CO₂, N₂O, CH₄, O₃, CFC, H₂O) produced by human activity are responsible for the acceleration of the current climate change. The IPCC have estimated an average increase of 1.5 °C as a safe limit to avoid catastrophic and irreversible global changes for the planet. Above 2 °C, the consequences can have unpredictable effects on life on Earth [3]. Primary energy consumption continues expanding (1.3% last year) [4]. This process has also intensified the generation of solid, gaseous, liquid and radioactive wastes [5]. This path has brought us to the record level of GHG in the history of the planet, raising from the 300 CO₂ ppm maximum historical level to more than 415 ppm nowadays [6].

The European Union (EU), signatory of the Paris Agreement, assumed a leadership role in promoting measures to restrict it to 1.5 °C [7]. European policies have been establishing frameworks for action, first until 2020 and then for 2030 [8]. The European Green Deal presents an action plan to make the EU's economy sustainable [9], and a proposal for the first European Climate Law (EUR-Lex, 2020) establishing the framework to achieve climate neutrality and amend Regulation (EU) 2018/1999 [10]. The Draft Law 121/000019 on Climate Change and Energy Transition submitted in May 2020 in Spain, aims to achieve, by 2050, climate neutrality and an electricity system based exclusively on generation of renewable sources [11].

1.1. Approaches to Environmental Assessment of Buildings

With the building and construction sector being one of the major sources of emissions, since the first initiatives to fight against climate change, several approaches have been proposed for its assessment. The Life Cycle Assessment (LCA) is a methodology for assessing environmental impacts associated with every stage of the life cycles of products, including the final disposition, which is also used for construction [12]. Beyond the contribution of this methodology to the understanding of the polluting effects of a product or construction throughout all stages, it is often difficult to put into practice and too complex to be analyzed by designers in order to make decisions about the improvement of the selection of designs and materials. Ecological Footprint (EF) is another commonly used approach to measure the ecological assets of natural resources of a given activity or population in terms of “Global hectares”, tracking six categories of productive surface areas: cropland, grazing land, fishing grounds, built-up land, forest area, and carbon demand on land [13,14]. Both methodologies could be complementary, since the LCA is more detailed in terms of coverage of impact categories and EF takes into account the carrying capacity of the territory [15].

Without leaving aside the validity of these approaches, the climate urgency in terms of global warming makes it appropriate to emphasize the Carbon Footprint (CF) approach for design optimization. The CF derives its name from the EF, but does not share the sense of pressure in terms of use of territory; it expresses the impact on global warming in units of tons of CO₂, taking into consideration not only carbon dioxide emissions, but also other gases with greenhouse potential effects in relation to CO₂ (GHG). Several definitions of CF can be found in the literature. The Global Footprint Network interprets CF as “the fossil fuel footprint part of the EF or the demand on CO₂ land” [16]. A more comprehensive definition it is provided by Wiedmann and Minx: “The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product” [17]. Although there is no standard methodology for evaluation, a variety of literature supporting the use of CF in construction impact evaluations across the world can be found [18] for new buildings and rehabilitation [19]. CF can therefore be assessed by different methods and different functional units if they meet the requirements of the definition [20]. Schools, universities, or any building with educational purposes are also potential GHG emitters [21,22]. Determining their CFs can contribute to the elaboration of a plan for to reduce their emissions [23], as well as to improve the design of new infrastructures, as some research shows [24].

1.2. Contribution of Construction to GHGs

In Spain, about 9% of GHG emissions in 2018/2019 was associated with construction, as described in the 2020 Report on Greenhouse Gas Emissions Series 1990–2018 of the Ministry for Ecological Transition and the Demographic Challenge [25] (p. 105). From a global perspective, the UN Global Status Report 2017 establishes that buildings and construction together account for 36% of global final energy use and 39% of energy-related carbon dioxide emissions when upstream power generation is included [26]. For this reason, ESNE aims to shape policies for the reduction in GHG emissions, energy saving and reduction, and optimized waste management. In order to face this challenge, it is essential to identify the initial GHG emissions. Subsequently, it is proposed to register the contribution to its emissions in the Spanish Inventory System (SEI). This is described in the cited report [13].

In this project, to calculate ESNE’s 2018/19 CF, the methodology developed by CarbonFeel has been used. It is framed in the SchoolFeel program of CarbonFeel to support the fight against climate change at the level of schools and universities [27]. In an effort to sensitize students, the idea is to promote the understanding of the phenomenon and of individual influence, the motivation to act collaboratively, and finally, to provide them with the necessary knowledge to incorporate carbon accounting in their daily activities. In this way, these future professionals and managers of design and industrial activities

will be able to be proactive by promoting measures to reduce, compensate and mitigate their effects.

2. Materials and Methods

2.1. Methodology

The aforementioned tools allowed us to carry out and analyze the carbon footprint inventory of products, processes and organizations, based on different standards: ISO 14067 for products, ISO 14069 for corporate footprint or Global Protocol for Greenhouse Gas Emissions (GPC) at scale community for cities. It also enables ecological footprint—Global Footprint Network—and hydric footprint—Water Footprint Network—analyses. The CarbonFeel Initiative has been promoted by the NGO Funciona Foundation for International Collaboration, which facilitates its free use by students of educational institutions that are members of the ResearchFeel alliance for research and teaching. It is a set of solutions that provides a calculation tool called BookFeel, a methodological guide (ProjectFeel) that provides a series of deliverables that ensure total transparency of the calculation [28]. It is structured using the semantic language Footprint Electronic Exchange Language (FEEL) based on the standard XML Schema (XSD) of the World Wide Web Consortium (W3C) and proposes the use of primary data in order to avoid controversial questions about the use of secondary data in the calculation of carbon footprint.

The results are expressed in kilograms of CO₂ equivalent [kgCO₂-e]. This equivalence is calculated according to the greenhouse effect potential of the main GHGs: carbon dioxide (CO₂), methane (CH₄), nitrogen oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆) and nitrogen trifluoride (NF₃), all referring to the CO₂ effect. The methodology and calculation algorithm of emissions follows the guidelines given by the “Guide for the calculation of the carbon footprint” of the Spanish Office of Climate Change [29]:

$$\text{Emissions [gCO}_2\text{-e]} = \text{Activity Data} \times \text{Emission Factor}$$

The activity data may be the mass of material, consumptions or other methods to evaluate each item. Data have to be configured according to the use conditions, such as the chapter it affects, type of impact, units or year of calculation. It takes into account not only the GHGs emitted, but also the GHG sink effect—e.g., gas absorption due to own, promoted or managed forested areas by the university—when present.

However, the CF of a facility (building, school, hotel, etc.), service or product provides necessary but not sufficient information to determine the efficiency against GHG emissions. In an increasingly demanding society in terms of knowledge about the carbon footprint produced by services or products consumed and the impact this has on global warming, the education sector can be a driving force in responding to this demand. One of the objectives of this methodology is to define parameters of comparability, not only for an installation or product over time, but on a comparative level between similar ones in such a way that it facilitates decision-making on the choice of study centers as well as contributing to the reduction in these effects. The following activity rates are proposed for weighting CF, depending on the number of users, hours of use and surface area in order to facilitate the comprehension of the client’s or user’s contribution to GHG emissions: kgCO₂-e/m², kgCO₂-e/student or kgCO₂-e/student-hour [30–33]. The use of the kgCO₂-e per student assessment is justified as it is an objective measure for comparison and will serve as a verification ratio of the improvements adopted.

BookFeel is structured on different levels for the scenario configuration:

- SCOPE STRUCTURE—this describes a hierarchical set of chapters that groups the different emission sources, according to each protocol, structured in three levels [28,34,35]:
Scope 1, combustion direct emissions—changes in land use . . . ;
Scope 2, indirect energy emissions—main electric power purchased;

Scope 3, other indirect emissions—footprint acquired with purchased products, services or waste generated by the activity.

Each chapter is associated with an algorithm that must be configured according to its scope of application.

- Analytic structure—in a corporate footprint, this could be constituted by the production centers, and these by sections or departments.

Table 1 give an example of BookFeel calculation factors, algorithms, conversion factors and sources. All data, factors and algorithms sources and URLs are explicitly referenced.

Table 1. Examples of algorithms and emission factors.

Factor	Algorithms
	CO ₂ -e Emissions = E000 × F186 × 0.000001
	Total emissions in tCO ₂ -e
	E000 = consumption of material/service/object of study (UF, Functional unit)
	0.000001 = Conversion factor gCO ₂ to tCO ₂
	F186. Scale factor per general functional unit
	Value = 8.1000 (gCO ₂ /UF)
P986	Source: Winnipeg Sewage Treatment Program South End Plant https://www.winnipeg.ca/finance/findata/matmgmt/documents//2012/682-2012//682-2012_Appendix_H-WSTP_South_End_Plant_Process_Selection_Report/PSR_rev%20final.pdf Comments: Appendix 7 Material Plastic Fiber GRP. Functional unit: gr Year: 2012

2.2. GHG Scenario of ESNE

The study was conducted during the 2018/19 academic year. The starting situation will be called Scenario 1. ESNE's facilities include two buildings for educational and research purposes, equipped with classrooms, offices, workshops and laboratories, cafeteria and garage. It takes up 4000 m², and is located in a residential area in the north of the city of Madrid, in Chamartin District, Alfonso XIII avenue. It is used daily by approximately 1500 students, using 900,000 student-hours, calculated as follows:

$$\text{student-hour} = \text{students enrolled} \times \text{total number of hours per day} \times \text{number of days}$$

As regards the modern part of the facilities, the air conditioning is based on cold-heat equipment with heat pump, which coexists with heating by hot water radiators from a diesel boiler in the former area. For lighting, different types of LED lamps or panels and energy-saving lamps are combined. The exterior is a ventilated façade with brick walls with projected insulation. The enclosures and windows are double glazed with an insulating chamber.

To elaborate the inventory of the carbon emissions of ESNE, the followings scope structures have been taken into account: Scope 1, fuels burned, and fugitive emissions (refrigerant gas); Scope 2, electricity consumed; Scope 3, materials for teaching, paper, business and field trips and workers commuting. The analytic structure includes the following items: a single campus, GHG emissions caused by person for their daily commute to work, business and field trips, and materials acquired for academic, teaching and research purposes.

Some inputs have been neglected because they are not directly under control of ESNE. Student transportation is a highly variable component that does not depend on ESNE decisions. The university campus is located in the center of Madrid. There is not a parking area available for students, therefore, 95% of them use public transport to access the campus. The university promotes the use of collective transport, walking or cycling. The consulted literature does not indicate that there is much potential for improvement in this regard [36]. This is not the case for teachers and staff, since the working hours and the availability of a parking area strongly influences the choice of the mode of transport.

Cafeteria services, provided by an external company, have not been included either, but may be included in future specific studies; as an aged building, the materials used in its construction have not been included either. The tables below describe the emission sources that have been included.

2.3. Calculations Criteria

For emissions due to air travel, the calculation methodology and factors given by the UN agency International Civil Aviation Organization (ICAO) have been used [37]. In substance, this methodology applies the best publicly available industry data for aircraft types, route specific data, passenger load factors and cargo carried. The CO₂ emissions per passenger was assessed taking into a total of 565,000 km per year of business and field trips flights, by means of these four basic steps:

1. Estimation of the aircraft fuel burn.
2. Calculation of the passengers' fuel burn based on a passenger/freight factor.
3. Seat occupied = total seats $\times$ load factor
4. CO₂ emissions/passenger = (passengers' fuel burn $\times$ 3.16)/seat occupied

It is interesting to note that for flights over 3000 km, the CO₂ emissions per passenger in the premium cabin are twice as high as the corresponding emissions per passenger in the economy cabin, as seen in other studies [38].

As regards car, bus and train travel, calculation was based on these criteria:

- 2018 Guidelines Defra Conversion Factors [39].
By car: average diesel car 0.178 kg CO₂ person/km, one seat occupied;
 average petrol car 0.184 kgCO₂ person/km, one seat occupied.
By bus: regular diesel bus, 0.023 kg CO₂ person/km.
- For train and metro, a Renfe/SNCF methodology based on the Ecopassenger calculator was considered [40]:
By train/Metro: 0.025 kg CO₂ person/km (regular Spanish electric mix).

It should be noted that by using the railroad electric mix with green certificates instead of the regular Spanish electric mix, GHG emission drops by half [41].

For daily employees' commutes, the values shown in Table 2, obtained from an internal survey, express the number of kilometers traveled by employees to work per year. Results are presented in rounded numbers.

Table 2. Employee travel to work (Scenario 1).

Mode of Transport	Km/Year
—Without consumption	44,040
Walking	43,320
Bicycle	720
—Railway transport	304,920
Metro	99,960
RENFE suburban trains	204,760
Tramway	200
—Road transport	314,440
Citybus	31,960
Private electric vehicle. (car/bicycle/motorbike)	35,880
Private car diesel	127,040
Private car gasoline	61,080
Private motorbike	58,480
Total	663,400

In Table 3, business and field trips values are shown. It describes annual travel for educational and business reasons of students, lecturers and managers, by road, air and railway modes of transport:

Table 3. Business and field trips (Scenario 1).

Mode of Transport	km/Year
—Road	57,060
Bus	47,480
Diesel car ¹	9580
—Train	37,400
—Air	565,000
Total	695,460

¹ Average occupation 3 passengers per car.

Table 4 summarizes the main emission sources, including trips and employees commuting, organized in the corresponding three scopes.

Table 4. Main emission sources inventory (Scenario 1).

Scope	Chapter	Data	Units
1	Fossil fuels (Diesel C)	11,000	L
	Leakage Refrigerant gas (R-410A)	4.3 ¹	kg
2	Electricity	241,572 ¹	kWh
3	Materials		
	Textiles	1439	kg
	Wood	100	kg
	Cardboard + paper + books	11,850	kg
	IT equipment	524	kg
	Water	1628 ¹	m ³
	HPDE 3D printer	4.2 ²	kg
	Furniture	452	kg
	Business and field trips	695,000	km/year
	Land	94,460	km/year
	Employee commuting	663,400	km/year
	Waste		
	Cardboard + paper	6500	kg
	Light packaging	2100	kg
	Remaining fraction	4200	kg

¹ Invoices supplier company. ² High density polyethylene. ³ Calculated results.

3. Results

The results of the calculations obtained are presented in Table 5. The total gives a figure of about 255,548 kgCO₂-e.

Electrical energy consumption, producing 72,471 kg CO₂-e (Scope 2), stands out as the main source of emissions. The 31,548 kg produced by Diesel C stationary combustion for heating (Scope 1) represents the second most significant emission. The WTT transmission and distribution losses (18,802 kg CO₂-e) also represents an important source (Scope 3). This source is not manageable as it depends on the electrical system. For purchased products, from 34,645 kg CO₂-e of materials, 10,075 kg are related to paper consumption (included photocopying) and 11,388 kg to textiles used for fashion practices. As regards commuting, road private combustion modes correspond to 28,290 kg CO₂-e, significantly higher compared to urban bus (2564 kg CO₂-e) and rail transport (14,626 kg CO₂-e). Concerning business and field trips, flights represent a significant part of GHG emissions: 21% of Scenario 3 and 12% of total ESNE emissions were international flights (28,992 kg

CO₂-e), representing the main part of the total of 29,855 kg CO₂-e. Private car road transport (6382 kg CO₂-e) is also significant compared to buses (991 kg CO₂-e), even more taking in account the km·person relation. AVE transportation means the less affecting mode (1153 kg CO₂-e).

Table 5. ESNE carbon footprint 2018/19 (Scenario 1).

Scope	CF (kg CO ₂ -e)
1. Direct emissions and absorptions	40,526
Stationary combustion	31,548
Refrigerant leakage (R-410A)	8978
2. Indirect energy emissions (Electricity consumed)	72,471
3. Other indirect emissions	142,549
Energy not included in direct and indirect	
WTT transmission and distribution losses ¹	18,802
Products purchased	34,645
Water (natural)	643
Wood/cork/basketry/rubber/plastic products	158
Furniture	2501
Paper, books and cardboard	11,254
Computer, electronic and optical products	8699
Textile products	11,387
Employee commuting	47,391
Train/Metro/Tram	14,626
Road transport	32,765
Urban bus	2564
Private car	
Diesel	16,755
Petrol	11,523
Electric (incl. bike and skateboard)	1923
Business and field trips	38,382
International and national flights	29,855
Road transport	7374
By bus	991
Private car	6382
Train (AVE)	1153
Waste	3328
Cardboard + paper	366
Light packaging	252
Remaining fraction	2710
Total	255,548

¹ WTT (Well to tank): additional emissions (related to electricity).

4. Discussion

Based on the obtained results, some clues can be found to outline alternatives for reducing greenhouse emissions. The contribution of electricity to emissions is noteworthy, being the highest negative contributor and coinciding with other results of other reviewed studies [23]. This source represents a difficult optimization; today, education is strongly linked to technological progress and the use of tools that require considerable electrical expenditure, and electrical devices (PCs, lighting, air conditioning) are already of maximum efficiency. As regards air conditioning, the insulation of the enclosure has recently been improved; a ventilated façade covers the entire surface and enclosures have double-glass windows with air chambers. The replacement of the aluminum carpentry by a more efficient one with thermal break could be assumed, but this option would represent an important investment. However, a better solution is within reach: the availability of certified renewable energy in Spain means that the best option is to replace the supplier with one with certified green energy. Taking into account this option, the purchased electricity will have no GHG emissions, reducing the total to 183,078 kg CO₂-e (Scenario 2).

In this case, the GHG emissions of Scenario 2, compared with the initial situation (Scenario 1), represents a saving of 28% (Figure 1). This is the easiest and most immediate way to reduce the CF of ESNE, and can be reached with noninvestments, probably even with discounts from suppliers, since electricity from renewable sources in Spain usually has a lower annual cost than the regular mix.

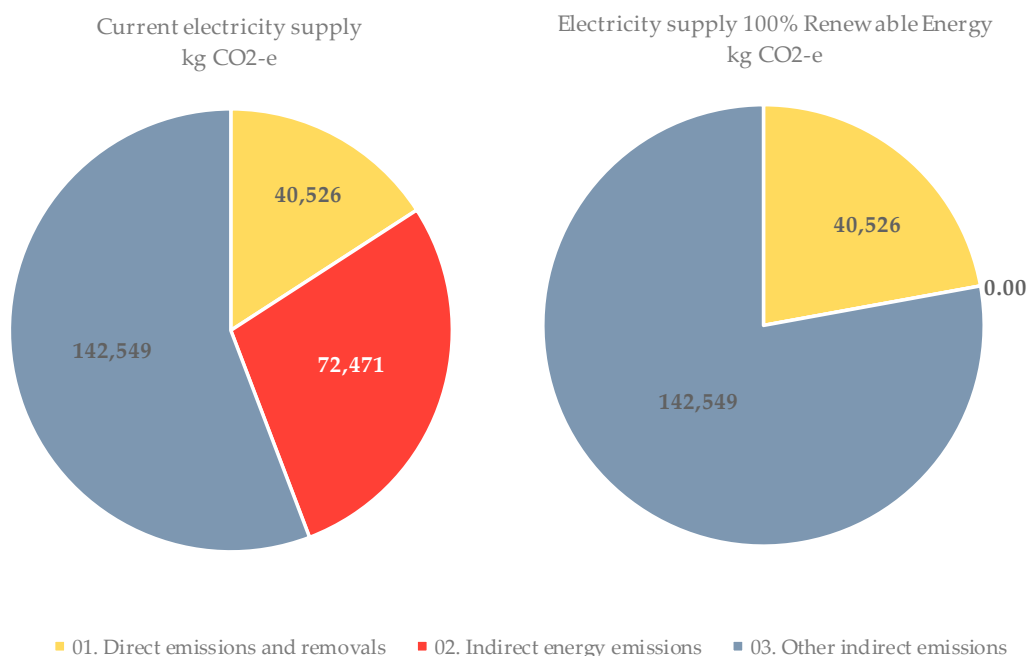


Figure 1. Electricity supply carbon footprint distribution scopes (kg CO₂-e).

The change between scenarios can be reflected by means of the indexes described in Section 2.1. Table 6 shows the activity rates in both scenarios (255,548 kg CO₂-e for Scenario 1, and 183,078 for Scenario 2), considering 1500 students enrolled and a total of 900,000 h/year, as indicated in Section 2.2:

Table 6. Activity rates of Scenarios 1 and 2.

Ratios	Kg CO ₂ -e/m ²	Kg CO ₂ -e/Student	Kg CO ₂ -e/Student·h
Built-up area: 4000 m ² Students: 1500			
Scenario 1	64	170	0.28
Scenario 2	46	122	0.20
Reduction		−28%	

The emission ratio per person decreases from 0.28 to 0.20 kg CO₂-e/student-hour, and the hourly emission is 420 to 300 kg CO₂-e/hour for the total number of students. Each student enrolled in a full academic year of 600 teaching hours per year, meaning a total emission of 170 kg CO₂-e in the present situation, and 120 kg CO₂-e for Scenario 2. This figure should be updated annually, taking into account the improvements made to correct the resulting carbon footprint. Educational centers could inform students and future students of these data in an exercise of transparency or even promotion.

The next option in importance to decrease GHG emissions may be found in the 31,548 kg CO₂-e from the combustion of heating oil. To maintain the current water radiator system, this fuel could be replaced by natural gas, but this solution is expensive, since it requires the replacement of the current low efficiency boiler, unfeasible to adapt for use with natural gas. However, replacing direct combustion heating with heat pump air conditioners powered by green electricity would be a better solution. By means of a quick

calculation, the additional electricity consumption needed can be estimated considering: a boiler combustion efficiency of 80%, a lower calorific value of 1028 kWh/L for Diesel C [42] and an efficiency of 60% for Split heating equipment [43]. This would result in an approximate electricity consumption of 90,000 kWh. This would increase annual electricity consumption to 331,000 kWh, 37% higher, but would eliminate the consumption of 11,000 L of a fossil fuel, its GHG emissions and highly polluting smoke. The result would be a decrease in CF to 155,500 kg CO₂-e, 60% of the initial amount.

In order to further CF improve, the next option should be to decrease GHG emissions from transportation. Employees produce 28,290 kg CO₂-e a year to go to work every with private fuel vehicles. According to the results obtained in the survey conducted using 116 employees, 37 use this mode of transport. This represents about 0.79 kg CO₂-e/km·person (or 764 kg CO₂-e/year per person). In comparison, about 80 people using public transport produce 17,190 kg CO₂-e, a ratio of about 0.05 kg CO₂-e/km·person (183 kg CO₂-e/year per person), only 6% in terms of km·person (24% in a year·person basis). It should be noted that several electric (six in the present day) and hybrid cars are continuously being incorporated into the workforce. Measures such as time optimization, including the reduction in attendance days, could significantly improve this balance.

Business and field trips give another perspective. While there are significant improvements to be made, long-distance air travel has few solutions. In this account, there are 73 person flights in Europe and long trips, 18 person traveling to Beijing and 10 to Miami (USA). It should be noted that international flights cause a significant amount of 409 kg CO₂-e/year, but, taking in account the distance (kg CO₂-e/km·person), the emission ratio is as low as intercity bus transportation. Once again, the lower emissions are due to high-speed railway transportation, less than 5% of private diesel cars (Table 7).

Table 7. Carbon Footprint (CF) ratios per year of business and field trips (Scenario 1).

Ratios	kg CO ₂ -e/km	kg CO ₂ -e/Person
—Travel to work		
Private combustion vehicles	0.788	764
Public transport	0.051	183
—Study and business trips		
Private diesel cars	0.667	236
Bus	0.054	16
Flights	0.053	409
Train AVE	0.031	29

5. Conclusions

The results obtained and literature review make it possible to draw conclusions based on a proposal for reducing carbon footprints.

If the calculation of the student-hour activity rate is applied, accompanied by calculation rules agreed by the sector, a register could be developed to allow comparability and to help mitigate global warming caused by educational activities and infrastructure.

The impact of Scope 2 is the highest of the factors studied, referring to the University's electricity expenditure. This incidence could be eliminated if the production of electrical energy was supplied by a company with a 100% renewable energy source, where the contribution of kg CO₂-e emissions disappears, in addition to replacing old and inefficient installations with systems that use less energy.

Another action to be taken is the rehabilitation of old buildings in order to improve energy efficiency. In this study, the emission of greenhouse gases due to heating is 31,548 kg CO₂-e. The insulation of the building envelope is an action to be taken into account to reduce the thermal transmittance and the heating energy consumption by around 90% if it is combined with adequate ventilation and a more efficient heating system, reaching values of 3155 kg CO₂-e [44].

On the other hand, the carbon footprint produced by ESNE could be mitigated with the contribution of green spaces responsible for absorbing carbon, with an annual action of extending the trees in an institution, as was considered by Diponegoro University on its university campus [22] or Trisakti University in Jakarta [45], and studied at Suranaree University of Technology in Thailand, where the green area captured 40% of the total emissions produced by the university [46]. In the event that no land is available on campus, one option to consider would be the creation of green façades or vertical gardens, which also contribute to the insulation of the building's façade envelope [47].

University education should include sustainability and sustainable development in training actions [48], instructing students in sustainable development in all areas, as well as informing them of the impact that their way of life has on the planet, efficiency in the use of electricity and water, reduction in the use of paper (10), and contribute to raising awareness of the three Rs method “reduce, reuse and recycle”, in addition to the alternatives presented, in order to improve the impact of kg CO₂-e [49].

Another point to be dealt with would be the study of the optimization of working time in attendance, trying to reduce attendance as much as possible, to avoid trips that are not essential, even considering the possibility of limiting working days to four.

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