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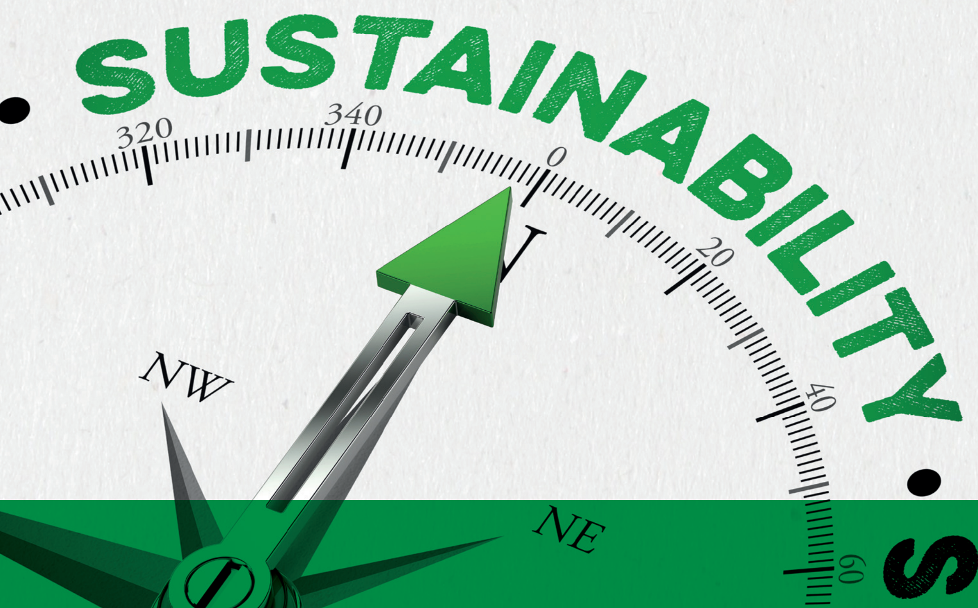
CESAER

CESAER Annual Meetings 2023

CARBON FOOTPRINT REPORT

February 2024



CESAER **Annual Meetings 2023**

CARBON FOOTPRINT REPORT

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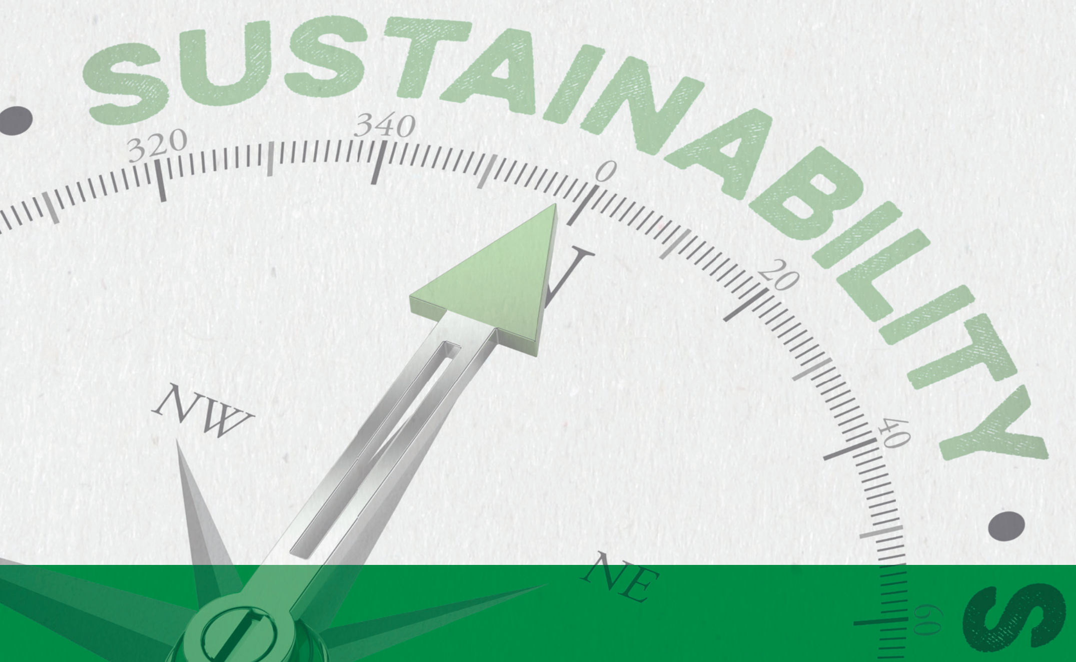
Executive summary

This report reveals the outcomes of the carbon footprint assessment conducted for the CESAER Annual Meetings held in Madrid from 18 to 20 October 2023. The analysis encompasses various aspects, including travel, commuting, accommodation, catering, restaurant, merchandising, energy, and streaming. Involving 136 participants from 27 European countries, the total carbon footprint (C footprint) reached 40.79 tonnes of CO_2 equivalent, with travel accounting for 83.4%, followed by catering at 7.95%, and accommodation in hotels at 7%. Travel and accommodation data were derived from a survey with a 39% response rate, enabling a direct calculation. For the remaining 61%, estimates were made based on participants' home cities. Catering and restaurant services provided ingredient quantities, facilitating the computation of the carbon footprint for meals and materials. Notably, the decision to serve exclusively vegetarian meals resulted in a reduction of approximately 3 tonnes of CO_2 equivalent compared to menus including meat products.



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List of abbreviations

Abbreviation	Definition
CAM	CESAER Annual Meetings
CESAER	Conference of European Schools for Advanced Engineering Education and Research
UPM	Universidad Politécnica de Madrid
ETSII	Escuela Técnica Superior de Ingenieros Industriales
GHG	Greenhouse gas
CO_2	Carbon dioxide
CO_2 eq	Carbon dioxide equivalent
CH_4	Methane
N_2O	Nitrous oxide
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride
S&T	Science & technology

1. Introduction and goal

CESAER is the association uniting 58 universities of Science & Technology (S&T) from Europe and beyond. The operations of the association are supported by several task forces, including Task Force Sustainability.

Every October, CESAER holds its annual meetings (CAM) where Members get to interact among themselves and advance and promote the work of the association both internally and externally. In 2023, the annual meetings were hosted by *Universidad Politécnica de Madrid* (UPM). The global theme of this CAM was 'Contributions of universities of science & technology to sustainability'.

In this context, UPM, in coordination with the CESAER Secretariat, decided to measure and analyse the carbon footprint of the event in order to know the possible improvement actions that could be implemented for future conferences.

This reports aims to present an analysis of the carbon footprint of the CAM held at *Escuela Técnica Superior de Ingenieros Industriales* (ETSII) in UPM (Madrid, Spain), and online, from 18 to 20 October 2023. The reports takes into account all the events during those days, including the welcome reception on 18 October and the high-level conference on 19 October. In total, 136 people attended the events.

About the carbon footprint calculation

Calculating the carbon footprint of the CAM is a first step in understanding its impact on the climate and initiating actions to reduce said impact.

The carbon footprint is an indicator that shows the total amount of greenhouse gases (GHG) emitted through direct or indirect effect. In this report, the carbon footprint is expressed in kilograms of CO_2 equivalent (kg CO_2 eq).

According to the Kyoto Protocol (1997), the main gases responsible for the greenhouse effect are:

- Carbon Dioxide (CO_2),
- Methane (CH_4),
- Nitrous oxide (N_2O),
- Hydrofluorocarbons (HFCs),
- Perfluorocarbons (PFCs),
- Sulphur hexafluoride (SF_6).

In this study, the different GHGs are measured in terms of CO_2 eq because this is a standard normalised impact measurement.

2. Boundaries of the study

General description of the event

Due to the long distances that most attendees had to travel (e.g. across the continent), the most important means of transport was by plane. Only a few came by train and the rest (mainly already based in Madrid) arrived by car or other means of local public transportation. The distribution of means of transportation is shown in figure 1 below:

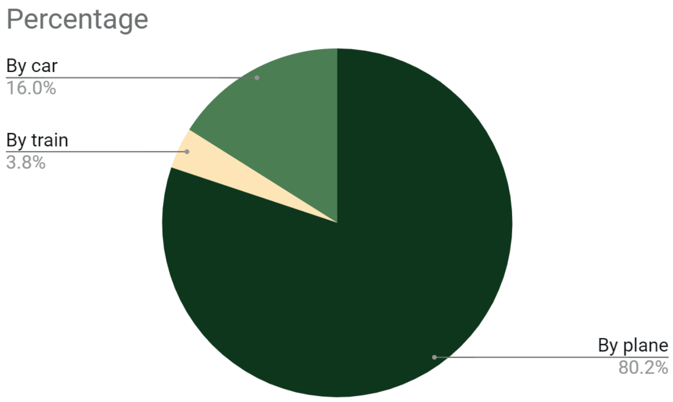

Fig. 1 Means of transportation distribution

Attendees stayed in different quality hotels as the following figure 2 shows:

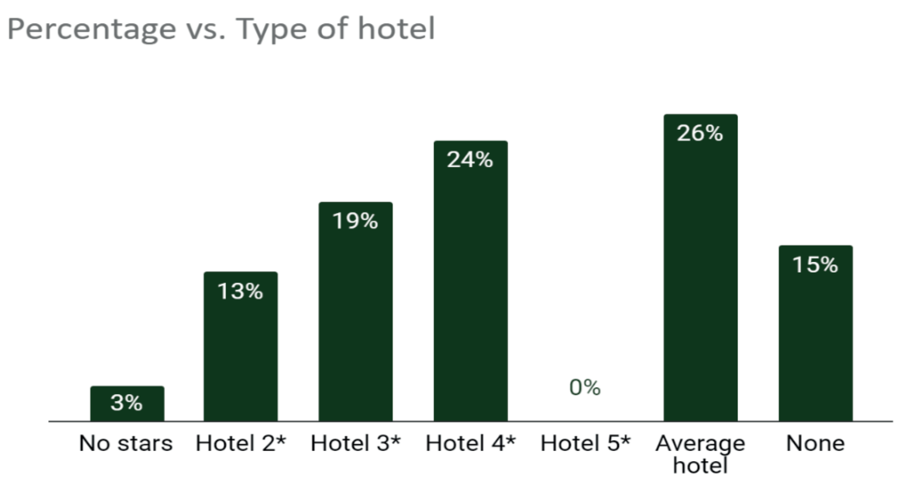

Fig. 2 Hotels contracted by the attendees by quality levels

(1) Average hotel: those that have no quality level assigned

The program included workshops, meetings of governing bodies including the general assembly, a high-level conference, and a social program. Online streaming of the general assembly and the high-level conference was also made available.

The whole event was designed following the recommendations of the Cercedilla manifesto (Sanz-Cobena et al., 2020) to be mindful of the environment including vegetarian menus for everyone, eco-friendly materials for merchandising and the use of public transport for the social program logistics.

In analysing the CAM carbon footprint, different emission sources have been identified. The following table 1 details those categories:

Table 1 GHG emitting activities

GHG emitting activities
Travel
Commuting
Accommodation
Catering
Restaurant
Merchandising
Energy
Streaming

The distribution of attendees by country was as presented in table 2:

Table 2. Attendees by country

Country	Attendees	%
Spain	28	21%
Belgium	14	10%
Netherlands	13	10%
Germany	11	8%
France	10	7%
Poland	6	4%
United Kingdom	6	4%
Norway	5	4%
Estonia	4	3%
Not Informed	4	3%
Austria	3	2%
Denmark	3	2%
Ireland	3	2%
Italy	3	2%
Germany	3	2%
Romanía	3	2%
Sweden	3	2%
Czech Republic	2	1%
Portugal	2	1%
Serbia	2	1%
Switzerland	2	1%
Australia	1	1%
Hungary	1	1%
Latvia	1	1%
Lithuania	1	1%
Turkey	1	1%
Ukraine	1	1%
TOTAL ATTENDEES	136	100%

3. Results

CAM 2023 total carbon footprint amounts to **40,979.34 kg CO_2 eq**, distributed in different categories as shown in the following table 3:

Table 3 CESAER Annual Meetings 2023 total carbon footprint distribution by category and source.

		Emissions (kg CO_2 eq)	Percentage (%)	Emissions (kg CO_2 eq)	Percentage (%)
Movement of participants	Travel	34,173.42	83.39%	37,284.07	90.98%
	Accommodation	2,871.67	7.01%		
	Commuting (including social programme)	238.98	0.58%		
Food supplies	Catering	3,258.87	7.95%	3,635.37	8.87%
	Dinner in Restaurant “InterContinental” (120 attendants)	233.12	0.57%		
	Dinner in Restaurant “La Favorita” (50 attendants)	140.35	0.34%		
	Waste	3.03	0.01%		
Materials, Energy and Communications	Merchandising	51.72	0.13%	59.90	0.15%
	Energy	8.06	0.02%		
	Streaming	0.11	0.00%		

The highest impact of the environment was created by attendees' travel, attendees' accommodation, and catering. This can be seen in the following table 4 and figure 3.

Table 4 CESAER Annual Meetings 2023 total carbon footprint distribution by category and source.

	Emmissions (kg CO2 eq)	Percentage (%)
Travel	34.173,42	83,39%
Catering	3.258,87	7,95%
Accommodation	2.871,67	7,01%
Commuting (including social programme)	238,98	0,58%
Restaurant InterContinental	233,12	0,57%
Restaurant La Favorita	140,35	0,34%
Merchandising	51,72	0,13%
Energy	8,06	0,02%
Waste	3,03	0,01%
Streaming	0,11	0,00%
Total	**40.979,34**	**100%**

98,35

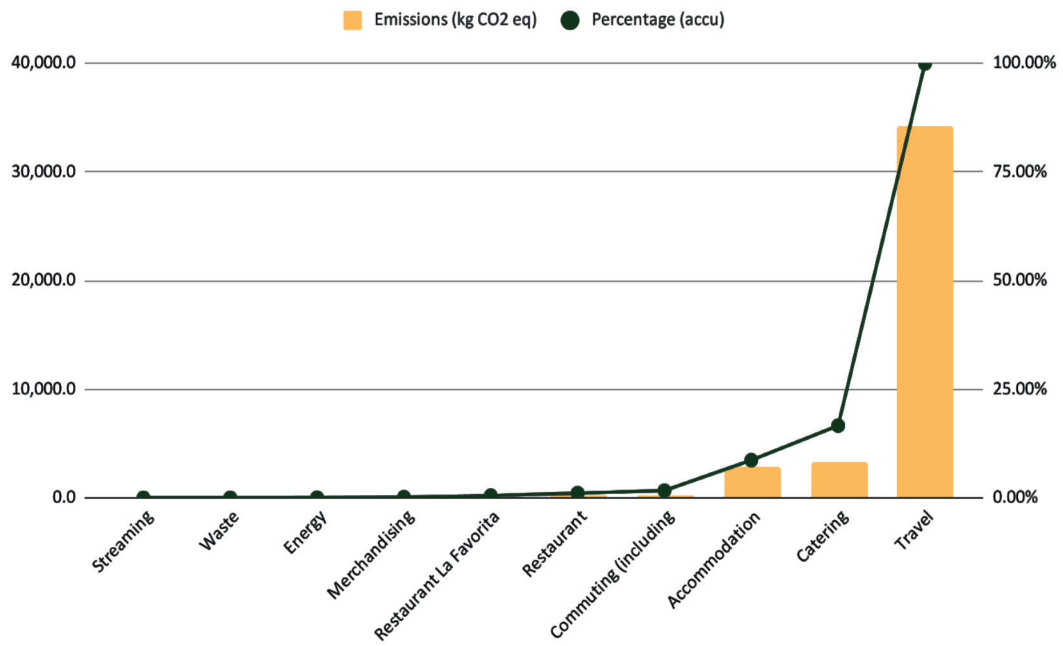

Fig. 3 Accumulated Carbon Footprint by source

On average, the event generated

- ~13,660 kg CO_2 eq per day
- ~300 kg CO_2 eq per participant
- ~100 kg CO_2 eq per participant perday

The typical carbon footprint for events is usually characterised by a range of 60 kg to 500 kg per person per day. Comparing this data with other events is not straightforward, as different estimates exist. For instance, some calculations suggest 175 kg of CO2 per person[1] for a three-day conference, while other research proposes a range of 500 to 1,500 kg of CO2 per person[2] for the same duration. Consequently, the CESAER event falls within the lower range, indicating a low environmental impact.

To make further comparisons it is also interesting to look at the annual carbon footprint per person per year in some European countries (see table 5) which were represented at CAM.

Table 5 t CO2 eq/person year. Source: The Global Carbon Project[3]

	France	Germany	Italy	Poland	Spain	Turkey
Annual impact by person (t CO_2 eq)	5.82	9.23	6.53	7.47	5.35	4.78
Impact by person and day (Kg CO_2 eq)	15.95	25.30	17.90	20.47	14.66	13.09

As more than 83% of the total CAM footprint is due to travel, a meaningful reduction would need a reduction of flights. In chapter 7 "Recommendations for future events" we propose tools to help CESAER choosing a location that would minimise flying needs. We also propose some actions to encourage participants to use more sustainable means of transport.

3.1. Detailed results

Data collection for this report was carried out through a form to be filled in by the CAM attendees, merchandising providers and by catering services and restaurants. The organising team (UPM and the CESAER Secretariat) also provided some data.

The response rate from the attendees was 39%. There were 53 responses from 136 attendees.

1 Link to the source. (Greenly, 2023)
2 Link to the source. (Jäckle, 2022)
3 Link to the source. (Global Carbon Project, 2020)

3.1.1. Travel, commuting and accommodation

The data for this category are derived from responses provided by participants who completed the form. For the remaining data, we made estimations based on the presumed behaviour of attendees from the same university and city. In cases where direct comparisons were not feasible, we devised plausible scenarios. For instance, this involved estimating travel by train to the nearest airport and subsequently by plane from that airport to Madrid.

- **Travel**

This includes travelling from the origin city to Madrid. It is the most emitting category as many participants had to travel long distances and used planes. The following map shows the cities of origin of the participants (see figure 4).

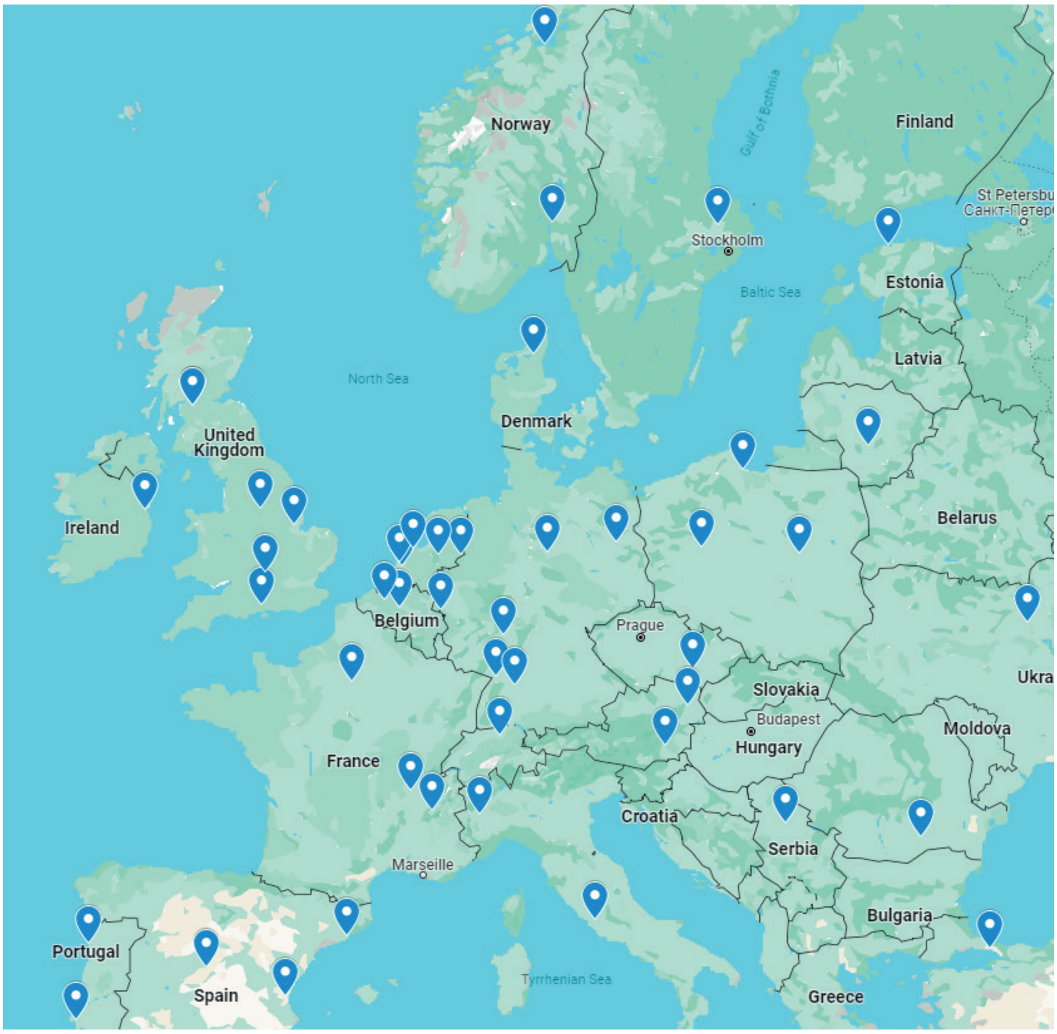

Fig. 4 Cities of departure for participants

More than 80% of the total carbon footprint (34 t CO_2 eq) was generated by travelling to the CAM venue.

- **Commuting**

Commuting calculations include journeys made in Madrid on the following routes:

- journeys to and from the airport
- journeys to and from the train station
- journeys to and from the restaurant and hotel
- journeys to and from the social programme

Organisers specifically booked restaurants close to the venue so attendees could walk to them.

This category had very low impact (<1%, 0.2 t CO_2 eq).

- **Accommodation**

Concerning the accommodation category, information on location and duration of stay was requested in the same form mentioned above (see Travel) to facilitate distance and commuting calculations. This is the third category with the greatest carbon footprint (7%, 2.8 t CO_2 eq).

3.1.2. Catering, restaurants and waste

The total carbon footprint related to food is 3,635 kg CO_2 eq. If the organisation had not offered vegetarian menus, the carbon footprint would have been about 6,600 kg CO_2 eq. We have estimated this difference by simulating the catering menu (90% of the carbon footprint of this category) and replacing vegetal proteins with meat.

The carbon footprint related to food is 9.4 kg CO_2 per person and day.

- **Catering**

The catering service provider *Subiendo Al Sur* was asked to fill out a table with menu items' quantities, weight of uneaten food (leftovers), tableware quantity and material, and the transportation used for delivery. The service was calculated for 110 attendees and the menu offered was fully vegetarian.

This category is also relevant because of the quantity of foods served (10) for 110 people and means about ~8% of the total (~3 t CO_2 eq). This means about 800 g of food per meal and participant (this average weight includes drinks).

Opting for a vegetarian menu helps mitigate the significant environmental effects associated with meat consumption, particularly beef and lamb, which have the highest carbon footprints among all protein sources. To assess the impact of choosing vegetarian options, a simulation by substituting some meat dishes with plant-based alternatives was conducted. For instance, beef burgers were replaced by quinoa burgers.

The resulting variance is approximately 3 tonnes of CO2 equivalent. If the current menu has a carbon footprint of 3 tonnes, a conventional menu with meat dishes would have contributed to an impact of 6 tonnes, doubling the environmental footprint. This signifies a noteworthy 7% reduction in the overall carbon footprint by embracing a vegetarian food choice.

- **Restaurants**

The conference dinner took place on 19 October at Hotel Intercontinental and gathered 120 people. The leadership track dinner was held on 20 October at the restaurant *La Favorita* with 50 people attending. The restaurants were asked to fill out a template with the menu offered, the ingredients used and their respective quantities. Once again, the menu offered were completely vegetarian.

When the data was not completely filled, we estimated the quantities of ingredients using recipes available on the Internet.

The restaurants services account for less than 1% of the total footprint.

- **Waste**

Two kind of waste were included in the calculations:

- Food waste: the amount of food waste was minimal, 4% of the food was wasted when, on average, 10% of food is wasted in Europe (European Commission, 2023).
- Organic waste: this accounts for paper napkins and cardboard plates used by. *Subiendo al Sur* catering. This waste weighted 2.8 kg. The carbon footprint here is hence not significant (<1 % or 0.003 t CO_2 eq).

3.1.3. Materials, energy, and communications

- **Merchandising**

This encompasses the carbon footprint arising from the manufacturing of the CAM merchandising. The items provided to the attendees consisted of a cotton bag, a smartphone stand and amplifier made from bamboo, and a bamboo pen. This category accounts for less than 1% of the overall total carbon footprint.

- **Energy**

The energy category includes electricity and natural gas consumption. It also has a very low impact, which is usually the case in most of events similar to CAM. In this case, the low impact can also been explained by the Guarantee of Origin of the electricity and the fact that, in October, in Madrid, the need to consume natural gas is not very high (i.e there is little need to heat rooms). Furthermore, UPM's electricity provider is certified carbon-free.

The energy carbon footprint is about 8 kg CO_2 eq.

- **Streaming**

Part of the meetings were broadcast.. Table 6 summarises how many people were connected online and for how long.

Table 2 Number of connections by day

Description	Attendees	Average duration per user (in hours)
19th October	38	1.29
20th October	15	1.78

The carbon footprint associated with the streaming was insignificant (< 1 kg CO_2 eq).

4. Conclusion

To conclude, the three most emitting categories of the CAM were travel, food and accommodation. The next part of this report will highlight some actions that can be considered to further lower the emissions in those specific categories.

5. Recommendations for future events

In this chapter, we explore key measures that could be incorporated in CESAER's upcoming events, focusing on the following pivotal categories:

- Travel
- Accommodation
- Food (catering and restaurants)
- Data collection

Travel

The best way to reduce the carbon footprint of an event like CAM is to reduce the need for travel.

We present a map (see Figure 5) illustrating each origin city, with lines connecting them to potential destinations in the Netherlands, Belgium, and Germany. These cities, located in close proximity, result in shorter travel distances for many participants as well as an increasing possibility for more participants to travel by train due to the closer geographical proximity compared to the city of departure for many participants. While considering the convenience that comes from increasing geographical proximity in relation to the city of departure for many participants, it is also important to acknowledge other important dimensions and considerations that have bearing on the location, this includes working towards a balanced geographical approach over a multi-year cycle for the location of events of an European association. There is much value for ensuring that participants from across Europe over time can experience different parts of the continent (centrally as well as north, east, south and west).

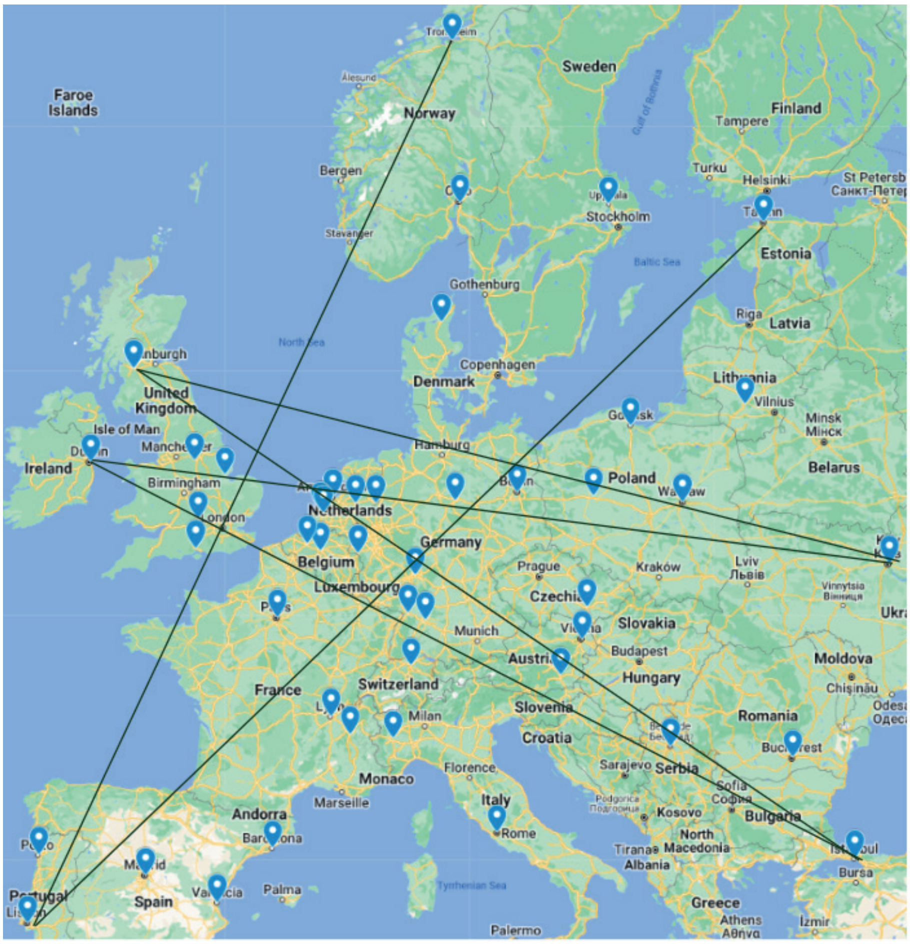

Fig. 5 Global optimised routes. Suggested locations for next events.

To facilitate for attendees to use trains, the organisers can offer the following information to the participants:

- possible train journeys and time needed (Eurail, 2023) (see figure 6).
- the virtuous impact of travelling by train instead of by plane (see table 7).

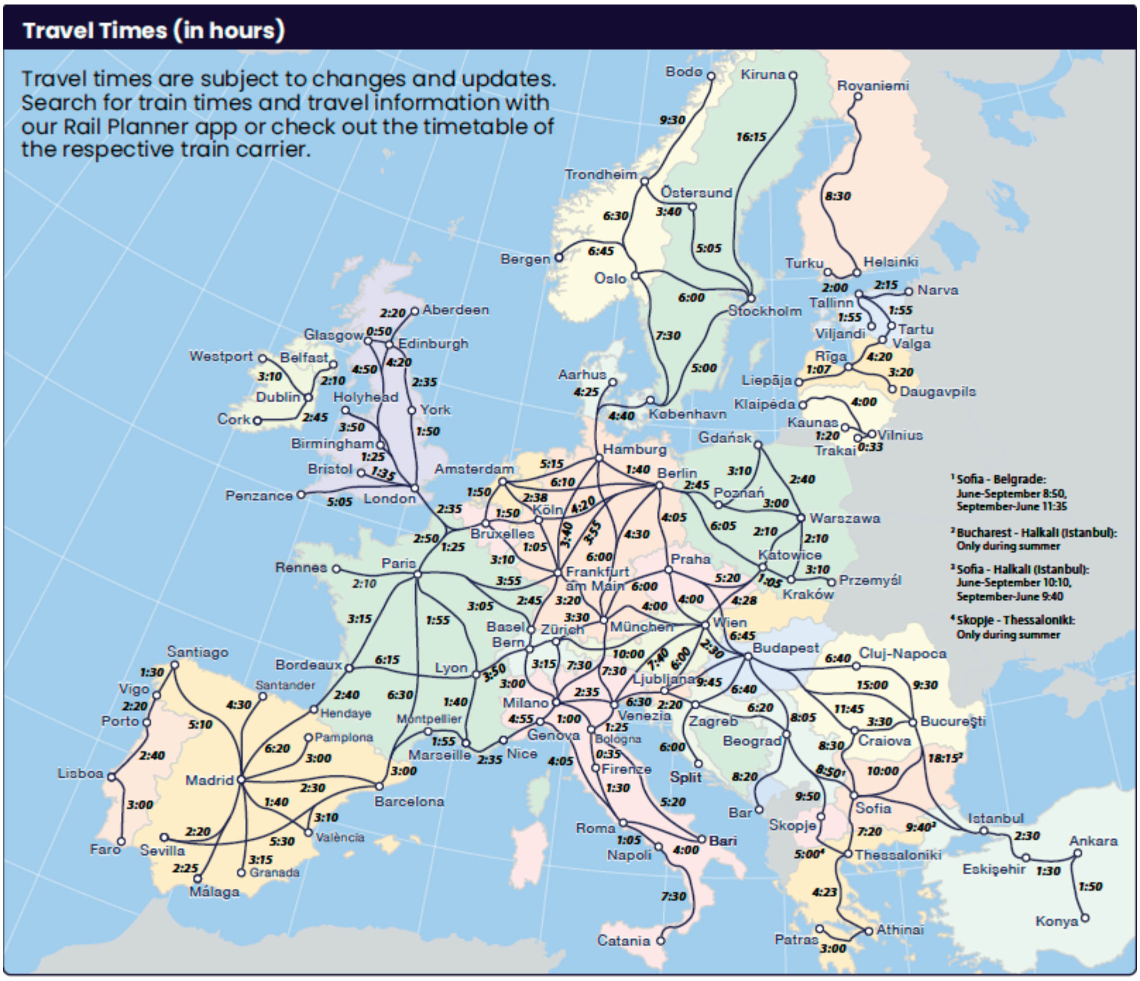

Fig. 6 Railway paths and length (Eurail, 2023).

Table 7 Estimated time and production of C02 eq for the different transport alternatives

Barcelona - Paris	Time	CO2
Train	6:15 (+ commuting to the train station (Eurail, 2023)	27.7 kg CO2 eq (OCCC)
Plane	2:00 (+ commuting to the airport) (Ryanair, 2023)	94.6 kg CO2 eq (ICAO)

It is important that CESAER Member universities lead by example whenever possible, and increasing use of train could be one such option.

Encouraging individuals from the same university to share the rental of an (electric) vehicle is another viable option. The organising university can then provide a map with electric charger points (Chargemap, 2023) (see figure 7).

While acknowledging that it would be welcome to boost options where the carbon footprint is reduced, it is also acknowledged that train (or electric vehicle) transportation will rarely be feasible for all participants. The intention is therefore to facilitate and encourage, and not to introduce challenges or restrictions.

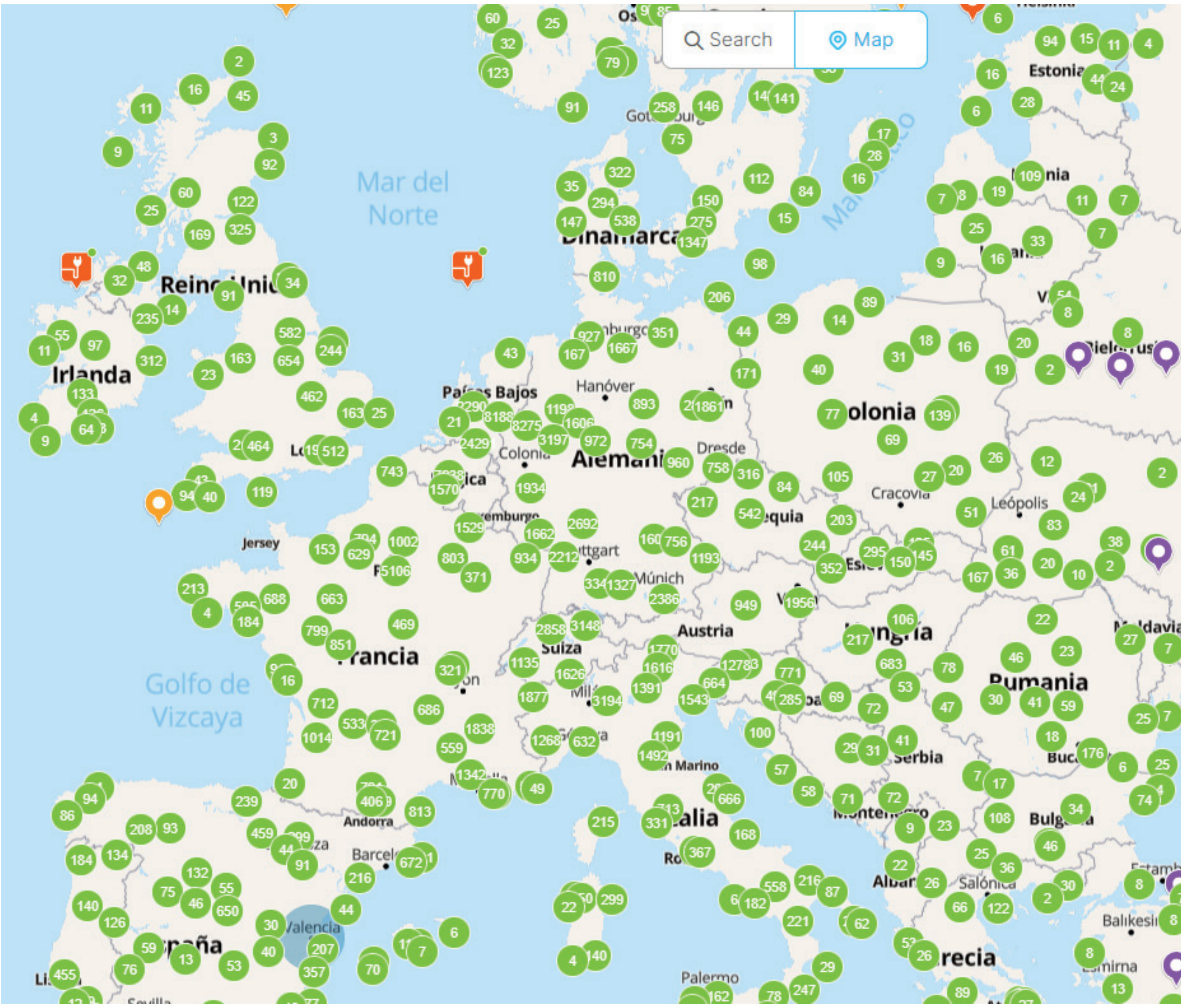

Fig. 7 Electric charger points.

Accommodation

The university that co-organises future CAM could invite attendees to stay at hotels that actively measure and diminish their carbon footprint. This would have two benefits:

1. Precision in carbon footprint calculation would increase, given the ability to gather primary data directly from the hotels.
2. The overall carbon footprint would decrease if attendees choose to stay in 'green' hotels.

The World Travel & Tourism Council (World Travel & Tourism Council, 2022) recommends the use of one free online tool for hotels developed Sustainable Hospitality Alliance.

This tool can be communicated to the hotels to help them calculate their footprint.

Catering and restaurants

The current environmental impact of catering is already minimal and may be challenging to further decrease. While opting for a vegan menu could be the next consideration, the reductions in the carbon footprint would be marginal, and there is a concern that it might negatively impact the experience for some attendees. It is further acknowledged that while much positive feedback was received for the catering at CAM 2023, some participants expressed a wish that some local meat dishes would have been made available. Exploring further communication around efforts and approaches chosen, and reasoning behind, can be considered for future CAM events.

Data collection

The survey achieved a response rate of 39%, necessitating certain assumptions to complete the study. To enhance data collection, various actions can be considered, each carrying its own set of advantages and disadvantages (table 8).

Table 8 Proposed data collection method: advantages and disadvantages.

Action	Pros	Cons
Data collection at the registration desk when attendees arrive	Precise information.	The duration spent at the desk per participant rises, potentially leading to queues and discomfort upon arrival.
Reduce the length of the survey	Likely (though uncertain) improved response rate	Less precise information
Insert small 'help' texts for some questions in the survey	Likely (though uncertain) improved response rate Precise information	Hard to implement while ensuring a positive user experience
Reaching out to attendees for any potentially missing information.	Precise information	Costly for the organisers. Possible discomfort among attendees

6. Annex

6.1. Methodology

The carbon footprint has been calculated using an activity factor multiplied by an emission factor of a well-recognised database or institution.

- **Travel**

The assessment involved determining the distance covered by attendees, using the *Escuela Técnica Superior de Ingenieros Industriales* of UPM as a reference point. Information collected included attendees' hometowns, mode of transportation (single or combined), travel distances, and specific details about various transportation methods (vehicle models, fuel types, etc.). Discrepancies between outbound and return journeys were taken into account.

In cases where attendees did not respond to the form but belonged to the same university as those who did, their data was inferred based on the available responses. For other non-responsive attendees, travel was estimated; for instance, assuming the use of a train to reach the nearest airport and then taking a plane to Madrid.

- **Commuting**

During the event, commuting trips around Madrid were analysed by means of transport and distance covered segmented in the following ranges (table 9):

Table 9 Distances option for commuting

I plan to make less than 20 km
Between 20 km and 50 km
Only commuting for the congress needs/program
Between 50 km and 100 km

For participants who did not complete the form, we inferred their information using the same methodology presented earlier (related to travel). In instances where attendees originated from cities with no provided responses, we assigned an average value based on the responses from other attendees. In the transportation category, we added a bus trip for the social programme at the Prado museum for 50 people. The return trip was made on public transportation.

- **Accommodation**

To calculate this, we collected information on the number of nights spent in the hotel and the star's rating of the hotels. Depending on the stars' rating a different emission factor was applied (see emission factor section below).

For participants who did not complete the form, we inferred their information using the same methodology presented earlier. In instances where attendees originated from cities with no provided responses, we assigned an emission factor of an 'average' hotel.

If a participant stayed in a hotel more than 4 nights, we only considered 4 nights because the rest of the nights were not related to the CAM.

- **Catering**

The emissions of catering were calculated thanks to the information given by the service provider *Subiendo al Sur.*

All quantities of the ingredients were written down and an emission factor was applied to each quantity (Poore, 2018).

When we lacked information on the weight of the ingredients, we have looked up a recipe on the Internet.

- **Restaurant**

We relied on the same methodology described under the 'Catering' subheading".

- **Merchandising**

The merchandising emissions were calculated based on the primary material and its weight, which typically constitutes the majority of the carbon footprint, especially when delivered by ship (which is often the case). As the obtained result is already relatively low, there was no necessity to enhance data collection for the calculation, as it would not significantly impact the overall carbon footprint of the event.

- **Energy**

The energy related emissions were calculated using the following criteria. We considered the total electricity and natural gas consumption of the venue in October. We allocated three days of consumption to the CAM considering the square metres of the areas used.

This means that we have multiplied the total emissions regarding electricity and natural gas by a factor of 3/31 and a factor of 1,498/36,989.

The electricity has an emission factor of zero because UPM has a Guarantee of Origin (renewable energy certificate).

- **Streaming**

Emissions were calculated considering how many attendees were streaming and how much time they spent watching the event. The emission factor used (table 10) come from an analysis of the International Energy Agency (IEA, 2020).

Table 10 Streaming connections by day

Description	Attendees	Average duration per user (h)
19th October	38	1.29
20th October	15	1.78

6.2. Emission Factors

The tables below detail the emission factors (EF) used for each category, as well as their units and the source of those EF.

Accommodation

Source: ADEME, France Environmental Agency (ADEME).

Table 1 Accommodation emission factors

Type of hotel	kg CO2 per night
No star	4.73
Hotel 2*	8.53
Hotel 3*	8.47
Hotel 4*	11.43
Hotel 5*	17.11
Average hotel	9.91

Commuting

Table 12 Commuting emission factors

Means of transport	Emmision tractor
By taxi	0,1392
By metro	0,0566
By bus	0,07392
By car	0,1392
Walking	0,0000
Electric taxi	0,02819248

Source: OCCC (Oficina Catalana del Canvi Climàtic, 2023)

Travel

This has been calculated with ICAO tool (ICAO, 2018)

Table 13 Travel emissions factors

Origin city	KG co2 (one way)	Notes
Tallinn	255.3	Stopover in Barcelona
Apeldoorn	130.9	Train until Amsterdam (75km) + plane
Lisbon	65.7	
Frankfurt	156.3	
Berlin	130.4	
Dublin	131.7	
Amsterdam	128.8	
Turin	165.7	
Paris	105.2	
Glasgow	229.1	Stopover in Barcelona
Delft	130.3	Train until Amsterdam (54km) + plane
Brussels	110.0	
Paris	105.2	
Aalborg	213.5	Stopover in Barcelona
Kaunas	201.7	
Ghent	111.4	Train until Brussels (49km) + plane
Switzerland	119.6	Train until Ginebra (51km) + plane
Roma, Italy	119.4	
Boston	297.4	
Oxford	118.5	Train until London (82km) + plane
Glasgow	229.1	Stopover in Barcelona
Sheffield	126.9	Train until Manchester (52km) + plane
Brno	221.8	Stopover in London
Lisbon	65.7	
Brussels	110.0	
Belgrade	201.6	

Origin city	KG co2 (one way)	Notes
Paris	105.2	
Karlsruhe	172.6	Stopover in Palma de Mallorca
Brussels	110.0	
Uppsala, Sweden	216.1	Train until Stockolm (63km) + plane
graz	208.6	Stopover in Munich
Braunschweig	256.3	Stopover in Napoles
Paris	105.2	
Istanbul	196.7	
Rotterdam	183.6	Stopover in Barcelona
Zurich	118.8	
Gdańsk	210.2	Stopover in Barcelona
Roma	119.4	
Lyon	99.6	
Grenoble	222.3	Stopover in London
Enschede	132.6	Train until Amsterdam (137km) + plane
Aachen, Germany	141.3	Train until Dusseldorf (69km) + plane
Kyiv	286.2	Car until Chisinau (Moldavia) + plane
Poznań	212.3	Stopover in Palma de Mallorca
Vienna	161.2	
Porto	63.1	
Southampton	120.06	Train until London + plane
Stuttgart	159.8	Train until Frankfurt + plane
Bucharest	166	
Warsaw	168.8	

Food

Source I: (Poore, 2018)

Source II: (Interbus, 2019)

Table 14 Food emission factors

Food	Emission factor	Source
Apples	0.43	Poore and Nemececk (2018) Available in OWID
Bananas	0.86	Poore and Nemececk (2018) Available in OWID
Barley	1.18	Poore and Nemececk (2018) Available in OWID
Beef/veal	99.48	Poore and Nemececk (2018) Available in OWID
Beef (for milk)	33.33	Poore and Nemececk (2018) Available in OWID
Beet sugar	1.81	Poore and Nemececk (2018) Available in OWID
Berries and grapes	1.53	Poore and Nemececk (2018) Available in OWID
Cane sugar	3.2	Poore and Nemececk (2018) Available in OWID
MANDIOCA/YUCA	1.32	Poore and Nemececk (2018) Available in OWID
Cheese	23.88	Poore and Nemececk (2018) Available in OWID
Citrus	0.39	Poore and Nemececk (2018) Available in OWID
Coffee	28.53	Poore and Nemececk (2018) Available in OWID
Dark chocolate	46.65	Poore and Nemececk (2018) Available in OWID
Eggs	4.67	Poore and Nemececk (2018) Available in OWID
Fish (fish farm)	13.63	Poore and Nemececk (2018) Available in OWID
Peanuts	3.23	Poore and Nemececk (2018) Available in OWID
Lamb and ram	39.72	Poore and Nemececk (2018) Available in OWID
Corn	1.7	Poore and Nemececk (2018) Available in OWID
Milk	3.15	Poore and Nemececk (2018) Available in OWID
Nuts	0.43	Poore and Nemececk (2018) Available in OWID
Oatmeal	2.48	Poore and Nemececk (2018) Available in OWID
Onions and leeks	0.5	Poore and Nemececk (2018) Available in OWID

Food	Emission factor	Source
Other fruits	1.05	Poore and Nemececk (2018) Available in OWID
Other legumes	1.79	Poore and Nemececk (2018) Available in OWID
Other vegetables	0.53	Poore and Nemececk (2018) Available in OWID
Peas	0.98	Poore and Nemececk (2018) Available in OWID
Pork Meat	12.31	Poore and Nemececk (2018) Available in OWID
Potatoes	0.46	Poore and Nemececk (2018) Available in OWID
Corral bird meat	9.87	Poore and Nemececk (2018) Available in OWID
Gambas (breeding)	26.87	Poore and Nemececk (2018) Available in OWID
Rice	4.45	Poore and Nemececk (2018) Available in OWID
Root vegetables	0.43	Poore and Nemececk (2018) Available in OWID
Soy milk	0.98	Poore and Nemececk (2018) Available in OWID
Tofu (soy)	3.16	Poore and Nemececk (2018) Available in OWID
Tomatoes	2.09	Poore and Nemececk (2018) Available in OWID
Wheat and rye	1.57	Poore and Nemececk (2018) Available in OWID
Came	1.79	Poore and Nemececk (2018) Available in OWID
Green leafy vegetables	0.51	Poore and Nemececk (2018) Available in OWID
Soy oil	6.32	Poore and Nemececk (2018) Available in OWID
Palm oil	7.32	Poore and Nemececk (2018) Available in OWID
Sunflower oil	3.6	Poore and Nemececk (2018) Available in OWID
Colza oil	3.77	Poore and Nemececk (2018) Available in OWID
Olive oil	5.42	Poore and Nemececk (2018) Available in OWID
Water	0.577	Inventario de Gases de Efecto Invernadero 2019 (interbus.es)

Merchandising

Source I: (Ecoinvent, 2022)

Source II: (Lenzing, 2019)

Table 15 Merchandising emission factors

Item	Emission factor	Source
Merchandasing bamboo	0.728	Modelled with openLCA and ecoinvent 3.9.1
Merchandasing cotton	3	http://www.ifatcc.org/wp-content/uploads/2018/01/A03-Taylor.pdf

Streaming

36 g CO2 per hour. (IEA, 2020)

Organic Waste

Source: OCCC (Oficina Catalana del Canvi Climàtic, 2023)

Table 3 Organic waste emisions

Item	Emission factor
Organic waste	0.07431

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