Methods Paper for the Lifestyle Test – Greece

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Methodology in general

The Lifestyle test quantifies the individual's climate impact across four key domains: housing, transport, food, and other consumption. The carbon footprint includes the impact of daily activities determined by lifestyle choices, excluding greenhouse gas (GHG) emissions resulting for example from public services and financial activities. Thus, the lifestyle carbon footprint does not consider GHG emissions for example public health care or education services, business travels or investments.

In essence, to calculate the carbon footprint of a consumption category, the quantity of consumption (measured in kg, euros, kWh, km, etc.) is multiplied by the corresponding emission factor (kgCO2e * kg, euros, kWh, km, etc.).

The test calculates the carbon footprint using consumption-based accounting instead of production-based accounting. Production-based accounting focuses solely on direct emissions from domestic production activities within specified geographical boundaries. In contrast, consumption-based accounting covers both direct emissions in a country and embodied emissions of imported goods while excluding emissions associated with exported goods. The test employs the bottom-up Life Cycle Assessment (LCA) method and physical units, except for the other consumption domain for purchases. The carbon footprint of purchases and pets is calculated using the top-down environmentally extended input-output EEIO method and monetary units.

For a more in-depth understanding of the methodology behind consumption-based accounting, refer to the report "1.5-Degree Lifestyles: Towards a Fair Consumption Space for All" by Akenji et al. (2021), specifically pages 32 to 35. The consumption and emission intensity data are mainly the same as those used in the upcoming report by the Hot or Cool Institute (Hot or Cool, forthcoming).

The LifeStyle test is based on average consumption levels and carbon footprints, which are then adjusted according to users' answers. For example, in the housing category, heating emissions are estimated from average heating demand and adjusted based on the user's home type, building age, and renovation status. The final consumption is then multiplied by the emission intensity of the chosen heating method. While most calculations start from average values, in some cases it's more practical to ask users directly about their consumption levels. In the transport category, for instance, users enter their own driving distances rather than relying on average national car usage km/person/year as a baseline.

This method is chosen to ensure that the test remains user-friendly and that participants can answer the questions without needing to look up additional information. For example, in the case of heating, asking users to provide their heating consumption in kilowatt-hours (kWh) would be impractical, as most people may not know this information offhand.

Living

The climate impacts of living consider the construction and maintenance of buildings, the heating of dwellings and water, electricity, and water consumption. The following section describes how each question affects the calculations.

Household members

The energy consumption and construction of the user's home are evenly distributed among all household members.

Building type

Building type affects the heating and construction emissions. Specifically, the building type impacts the insulation, thereby affecting heating demand. The extent of heating reduction varies based on the thermal insulation actions employed. The correlation between the insulation and heating demand is estimated using information from the following sources: BPIE (2023), GJETC (2020) and Mastrucci et al (2021). Users can choose between the following housing types: (1) an old house with poor insulation and a conventional boiler, (2) poor insulation with a modern heating system, and (3) good insulation with a modern heating system. The energy consumption of a well-insulated house with a modern heating system is assumed to be 25% lower than that of an old house with poor insulation and a conventional boiler

The construction and maintenance of buildings include GHG emissions from manufacturing of the building materials, land-use change of the building area, and construction, maintenance, and demolition of the buildings. The climate impact of construction is affected by the building type. Detached houses and terraced houses have a construction and maintenance footprint of 9.87 kgCO2e/y/m2 and flats have a construction and maintenance footprint of 8.62 kgCO2e/y/m2 (Joint Research Centre, 2018).

Electricity

Electricity consumption includes all household electrical uses, excluding space and water heating, as these are included under heating emissions when electricity is used for those purposes. The Lifestyle test lacks specific questions regarding the user's electricity consumption. Consequently, all users are assumed to have the same electricity consumption, 1 341 kWh/person/year (excluding electricity used for heating) (IEA, 2023).

The emission intensity of grid electricity is modeled using data IEA (2023) and CO2e data from ecoinvent 3.9. Grid electricity includes both domestically produced and imported electricity. Emission intensity accounts for direct and indirect emissions. Indirect emissions include production chain emissions from fuels, land-use emissions, and embedded emissions from renewable energy equipment like solar panels and wind turbines. The average grid electricity for 2023 is 0.396 kgCO2e/kWh. All users are assumed to use grid electricity.

Primary heating method

The question about the primary heating method includes the common heating methods used in Greece. The Lifestyle test estimates user's space heating consumption (kWh/person/year) by using the average space heating consumption in Greece. The adjustment is made based on the user's responses regarding the insulation type and the room temperature when space heating is in use. The average space heating consumption is 2690 kWh/person/year (EuroStat, 2022).

Emission intensities for space heating options are mostly based on ecoinvent 3.9. For ground and air-source heat pumps, data comes from Lyons et al. (2022), using an average efficiency (COP) of 4.

Room temperature

Higher room temperatures require more heating than lower temperatures. An estimation of "a 2-degree rise in temperature equals a 10% increase in heat energy" (Motiva, 2019).

Showering

Showering forms the majority, over 70%, of the total residential water use (EEA, 2020). The water consumption during showers is estimated based on the user's shower duration, where 1 minute of showering is equivalent to 12 litres of water of which 40% is hot water (Motiva, 2020). The climate impact of water consumption considers tap water production, wastewater treatment and the energy required for water heating and emission intensities for these are sourced from ecoinvent 3.9.

Mobility

Driving

The carbon footprint of driving is calculated using the annual kilometres driven and the type of fuel used in the user's car. GHG emissions are evenly distributed among the typical number of occupants in the user's car. Emissions include the production and maintenance of vehicles, the use of road infrastructure, and direct and indirect emissions from fuel consumption. Direct emissions occur during fuel use, while indirect emissions come from producing and supplying the fuel. The production and maintenance of vehicles, as well as the use of road infrastructure, are modelled using ecoinvent 3.9. Emission intensities for vehicle production and maintenance vary depending on the fuel type, for example electric cars include emissions from battery production and maintenance.

Emission intensities of fuel consumption for petrol, diesel, and gas vehicles are sourced from ecoinvent 3.9 (Wernet et al., 2016). For electric vehicles, emissions are modelled based on average electricity consumption kWh/v-km (EV Database, 2024). It is assumed that vehicles are charged using the national grid, and therefore the emission intensity considers the national electricity mix. Emissions from hybrid vehicles are modelled using data from Transport & Environment (2024) for conventional hybrids (HEVs) and plug-in hybrids (PHEVs).

Public transport

Public transport includes travel by bus, train, tram, and metro. The emission intensities of these modes are from ecoinvent 3.9 (kgCO2e/p-km) (Wernet et al., 2016). The test includes one question about public transport without differentiating between modes. To calculate GHG emissions, a weighted average emission intensity is calculated based on the average Greek shares between different modes (Eurostat, 2021).

Emissions include the production and maintenance of vehicles, the use of road and rail infrastructure, and direct and indirect emissions from fuel consumption.

Air travel

Emissions from air travel are estimated based on the number of hours a user spends flying in a year, considering the average airspeed of commercial planes of 800 km/h (GoFlex Air, 2024; The Aviation Factory, 2023; Thrust Flight, 2024).

The fuel consumption per passenger during a flight is influenced by various factors, including the air fleet, aircraft occupancy rate, and the allocation of emissions between passengers and cargo. In the Lifestyle test, the carbon footprint of flying includes not only direct and indirect emissions from fuel use but also embedded emissions from aircraft and airports, as well as the impact of increased atmospheric radiative forcing.

Air traffic contributes to atmospheric radiative forcing through the release of fine particles at high altitudes and alterations in cloud cover. While there is considerable uncertainty in these estimates, recent research, published in 2021 by Lee et al., suggests that 66% of the total climate impact of aviation comes from sources other than the direct impact of the carbon dioxide in fuel. Consequently, to account for these additional causes of radiative forcing based on current knowledge, it is justifiable to multiply the carbon footprint calculated from fuel consumption by a factor of three (Lee et al., 2021).

Travel by ferry

The test asks the number of times that the user had ferry trips. The distance of one trip is based on the typical ferries operating in the most popular ferry routes from Piraeus (Athens) to Santorini, Mykonos, Paros, Naxos, Crete (Heraklion), Rhodes, Aegina, Hydra, and Spetses.

Emissions from ferry transport can vary significantly depending on the allocation method used to distribute emissions between passengers and freight. The calculations consider foot passengers only and do not include emissions from vehicles transported on board.

The emission intensity for ferry trips is based on the following sources: TNMT (2021), KTH Royal Institute of Technology and UBA (2021). The value includes direct CO_2 emissions from fuel consumption and indirect emissions from fuel production, as well as emissions from ship building, maintenance, and scrapping. The emission intensity is 0.131 kgCO2e/p-km and distance of one trip is 190 km.

Walking or biking

Walking and biking are considered to be carbon-free alternative means of transport and not part of footprint calculation. This question is asked to be able to offer more precise actions after taking the test in the action plan phase.

Food

Eating habits

The carbon footprint of food considers the diet composition, the quantities consumed and food waste. Energy required for cooking and cooling of food ingredients at home is included in the living section and grocery shopping trips are part of the transport section.

The amount of food eaten is evaluated by asking if user eats less, average, or more compared to other people. The assumption in the test is that the user consumes 15% more or less than the average person in Greece.

To define the diet composition, the test asks how much user eat the food groups which affect the most to the carbon footprint, such as meat, fish, dairy and beverage consumption. For food groups not explicitly addressed, the test assumes adherence to the average Greek diet. The main source of consumption data for the average diet is primarily from the Food and Agriculture Organization of the United Nations FAOSTAT (2022). FAOSTAT does not differentiate dairy products, such as cheese, liquid milk and fermented milk products from each other and thus the data from dairy products are sourced from Info Milk (2013). The data from FAOSTAT's food balance sheets (2022) provide information on the foods available in the stores (kg/capita/year) and this data is then compatible with the emission intensities used in the calculations.

Emission intensities primarily come from the ecoinvent 3.9 database (Wernet et al., 2016). In instances where specific intensities are unavailable in ecoinvent, AGRIBALYSE 3.1 (2022) is used. The methods for calculating emission intensities in both databases are similar, ensuring comparability. The system boundary for carbon intensities is cradle-to-store.

If the user eats less or no meat, fish, and dairy, these are substituted by plant-based alternatives. The substitution scenario is based on Eat Lancet report (Willet et al., 2019), where animal-based products are substituted by legumes, nuts, seeds, vegetables and grains.

Questions ask food consumption in a number of portions and average portion sizes are based on EatForHealth numbers (National Health and Medical Research Council, 2021). Some questions combine multiple food groups, considering the share of average Greek consumption between these groups.

Food categories

Beef

Beef was classified under its own category due to having higher emission intensity than other meats. The emission intensity for beef is derived from ecoinvent 3.9. Since the consumption amount of meat is not live weight that is available in stores, the emission intensity from ecoinvent is converted using factors for live weight to bone free weight (Clune et al., 2017; Wernet et al., 2016).

Pork, chicken, or eggs

The emission intensity of pork is slightly higher than other foods in the category but significantly lower than that of beef. The proportions of different foods are determined based on their average consumption in Greece (FAOSTAT 2022). Emission intensities for pork and poultry are from ecoinvent 3.9, while the emission

intensity for eggs is from AGRIBALYSE 3.1 (2022). The emission intensities for pork, chicken, and fish are converted from live weight to carcass weight, using factors from Clune et al. (2017).

Fish and other seafood

The emission intensities are from ecoinvent 3.9 and the intensities are converted from catch weight to raw weight (Clune et al., 2017; Wernet et al., 2016).

Dairy products

The intensity of milk, cream, and butter is from ecoinvent 3.9, while concentrated milk's intensity is from AGRIBALYSE 3.1 (2022). The cheese category includes soft and hard cheese products made from cow's milk and intensities are from AGRIBALYSE 3.1 (2022).

Beverages

The emission intensities for all beverage products are from AGRIBALYSE 3.1 (2022) or ecoinvent 3.9. The average Greek share of coffee, tea, fruit and vegetable juices, soft drinks and alcoholic beverages was considered in the beverage consumption question (FAOSTAT 2022).

Food waste

The food waste calculations include GHG emissions from biowaste treatment and the additional food production needed for the wasted food. The emission intensity of biowaste treatment is sourced from ecoinvent 3.9. The majority of the climate impact of food waste is from food production rather than biowaste management.

Eating outside and food delivery

As concerns meals eaten outside the home, the energy consumption used for providing the service, or preparing the food (1 kWh/time eating out), was taken into account. A carbon footprint of a food delivery or a restaurant visit takes into consideration the average transport to or from the restaurant and the average energy consumption of restaurant service per customer. The question also takes into consideration the average carbon footprint of waste in take-away meals. Data is from the following sources: Crawford (2021), Shopfood (2020), Statista (2015) and United Nations Environment Programme (2021).

Consumption

Living, mobility and food are the most significant contributors to the carbon footprint of an average Greek. It would require a number of questions to make a comprehensive estimate and analysis of the climate emissions of other sectors of personal consumption. In such a case, the effort it would require for a respondent to complete this section would no longer be in proportion to the significance of this sub-sector. Therefore, the Lifestyle test focuses on key aspects within this section, including GHG emissions from purchases and pets.

Shopping habits

The test has a question on users' shopping habits and purchases, allowing them to specify whether they buy more, the same amount, or less than the average Greek. Consumption is adjusted by 30% accordingly. Purchases include furnishings, home care products, clothing, footwear, goods related to leisure activities and hobbies, audiovisual devices, and printed materials. On average, a Greek spent 1348 euros in 2022 on these products (Eurostat, 2022). The climate impact of purchases is calculated using emission intensities from exiobase 3.8.2 (Stadler et al., 2021). To align consumption amounts with exiobase intensities, conversion from current prices to basic prices is necessary.

Second-hand

Choosing second-hand items, such as clothing or electronics, contributes to a reduced climate impact by prolonging the use time of items. The Lifestyle test has question on secondhand clothing and electronics which contributes to 40 % of all consumption of household goods in Greece (Eurostat, 2022). Users can indicate the frequency with which they purchase second-hand items (never, seldom, 50 %, or always). The climate impact of clothes and electronics is reduced by 0 %, 10 %, 50 %, or 80 % accordingly.

Pets

While pets bring joy and are often regarded as family members, it's essential to recognize that they also contribute to environmental impact through the consumption of natural resources, including food and various services and products. Given the diverse sizes of pets, ranging from tiny hamsters to horses, the Lifestyle Test asks about pet-related expenditures to calculate their associated GHG emissions.

EXIOBASE does not include all pet-related services in a single product category. Therefore, emission intensity was modeled using multiple EXIOBASE categories.

Pet food is not listed as a distinct product in EXIOBASE but is spread across broader food categories. For this study, it was mapped to “Food products nec”, “Meat products nec”, and “Products of vegetable oils and fats”, reflecting the typical composition of pet food. Pet medication does not appear as a separate product either. It was included under the broader product group “Chemicals nec”, which covers various chemical products including pharmaceuticals. Veterinary services fall under the broader “Health and social work” category in EXIOBASE. The data on the shares of spending on pet food, products, services, and medication are from AnimalhealthEurope.

Action Plans

After completing the Lifestyle Test, users receive personalized recommendations for actions to reduce their carbon footprint. These are tailored to their responses—for example, if someone follows a fully plant-based diet, they won’t receive suggestions related to reducing meat or dairy consumption. Each recommended action is grouped under a relevant consumption domain, indicating where the emissions reduction primarily occurs.

For most actions, the reduction impact is calculated based on the user’s answers. For instance, in the transport category, users answer to their driving or flying habits enable personalized mitigation estimates for

actions that reduce driving and flying. However, for actions where the test does not collect specific information about individual habits (like waste sorting or washing clothes at lower temperatures), the mitigation impact is assumed to be the same for all users and is based on the average reduction potential in that country.

Some actions, such as “Take your family or friends on a nature hike” or “Give the gift of time”, do not have calculated reduction impact because they’re impossible to reliably quantify. In addition to footprint-reducing actions, the test includes handprint actions such as “Crowdfund and invest in sustainable solutions” or “Vote for politicians who think sustainably”. A handprint action refers to a positive action user can take that helps others or society reduce their environmental impact but does not directly reduce their own climate impact and thus these actions also do not have calculated reduction number. Actions, which do not have calculated reduction impact, are labeled with a light bulb icon instead of a specific reduction number.

Average carbon footprint in Greece

On the carbon footprint results page, users can compare their individual results with the national average carbon footprint. The national average is calculated using the same data sources and methodology as those used in the Lifestyle Test. The national average footprints cover the same categories as the test: living, personal transport, food and other consumption (purchases and pets) (Table 1).

Additional data sources

Some additional data sources are used to calculate the average Greek carbon footprint. These are not used in the Lifestyle test because the test directly asks the consumption amounts, for example driven kilometers or portions of meat and beverages.

Transport

For private car and motorcycle use and bus and train travel, passenger-kilometres (p-km) are from Eurostat (2021) for the year 2018. Air travel data is based on figures from the International Civil Aviation Organization ARC 2022 Report (ICAO, 2024). Whenever possible, the reported figures exclude business travel to better reflect personal lifestyle emissions.

Food

Food consumption amounts are based on FAO (2022) data. Household food waste amount is from the Food Waste Index Report 2024 (UNEP 2024).

Table 1. The average Greek carbon footprint (kgCO2e/person/year).

TOTAL	**5900**
Living	2010
Transportation	1190
Food	2260
Other consumption	440

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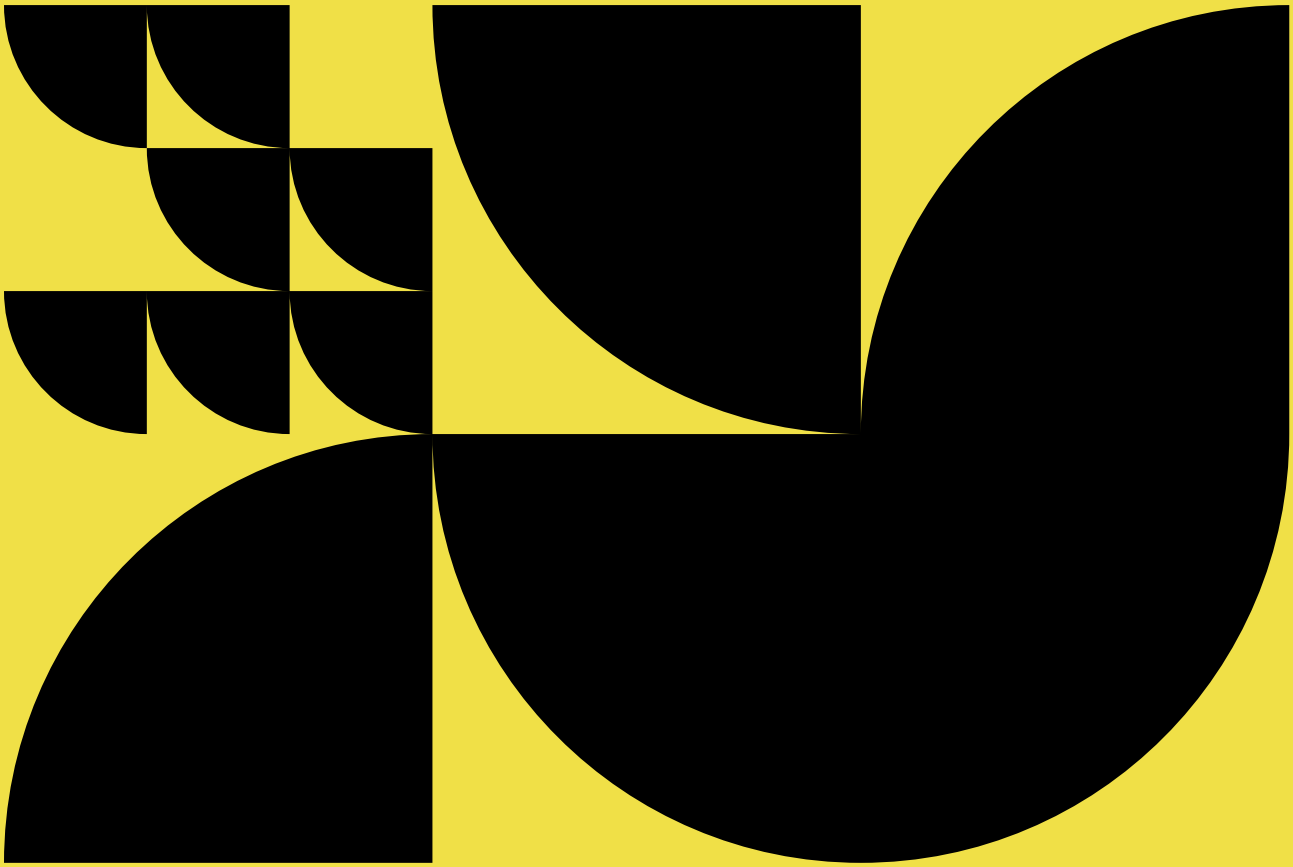

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