Methods Paper for the Lifestyle Test – Estonia

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101037342.

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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 like eating, commuting, dressing etc. Lifestyle test is not tracking our activities, it is based on an algorithmic calculation tool, utilizing large, aggregated databases generally describing our consumption and the correlating greenhouse gas (GHG) emissions. This information is collected and analyzed by the project partners and integrated into the calculation tool where it will be used for calculating a personal carbon footprint, based on the individual answers of 32 questions of the Lifestyle test. Answering these questions does not require an expert level knowledge but it would help to be aware of our daily consumption - how much do we eat, travel, buy clothing etc. After completion, test will provide detailed overview of the results and suggest actions to reduce the carbon footprint.

The test calculates the carbon footprint using a unique methodology, combining different methods of environmental accounting. This hybrid methodology is building on an earlier work of Sitra developing personal carbon footprint test in Finland and these practical experiences are now integrated into the Lifestyle test also for other countries. Where possible, the test calculates the carbon footprint using consumption-based accounting instead of production-based accounting that focuses solely on direct emissions from domestic production activities within specified geographical boundaries. Where possible, the test employs the bottom-up Life Cycle Assessment method and physical units. Elsewhere (for example the carbon footprint of purchases and pets) the top-down Environmentally Extended Input-Output method and (sometimes) monetary units are used. In essence, to calculate the carbon footprint of a consumption category, the quantity of consumption (measured in kilograms, euros, kilowatt hours, kilometers, etc.) is multiplied by the corresponding carbon emission factor (kgCO2e per kilogram, euro, kilowatt hour, kilometre, etc.).

When possible, the lifestyle carbon footprint does not consider GHG emissions from public services and financial activities, for example public health care or education services, business travels or investments. However, due to the usage of aggregated data, this distinction is not always possible to make. For example, the national transport model used for calculating private car usage does not make that distinction between private and public, nor does the food supply database, used for calculating food consumption.

The test relies on Estonian specific aggregated consumption data collected from local reliable data sources, most notably national data brokers like Estonian Statistics and National Institute for Health Development. In case no national data is available, international data sources like Eurostat and Eurobarometer are used. Private car transport footprint is calculated using the data in national transport model provided by National Road Administration. Footprint of specific services is collected (or consulted) from the national service providers like Elron and Estonian Business and Innovation Agency. Topic-specific studies are consulted and referred where possible from Estonian Institute of Economic Research, Estonian University of Life Sciences, Stockholm Environment Institute Tallinn Centre (SEI Tallinn). SEI Tallinn developed and validated Estonian dataset in cooperation with Rohetiiger SA.

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 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. Calculated from national 2021 census data there were 2.4 persons per dwelling (Statistics Estonia datasets RL21205 and RL21801). Average area of dwellings per inhabitant was 30.1 m² (Statistics Estonia RL21205).

Building type

Building type affects the heating and construction emissions. Specifically, the building type impacts the insulation, thereby affecting heating demand. Lifestyle test estimates the insulation type of a user's home based on the construction year of the building. Older buildings are assumed to have inferior insulation, ventilation and heating/cooling system compared to newer ones. The correlation between the insulation and heating demand is estimated based on the analysis using information from National Registry of Buildings Ehitisregister and National Building Refurbishment Grant reports maintained by Estonian Business and Innovation Agency (formerly KredEx SA). According to the internal analysis of energy performance of the buildings, the estimated values for the energy performance of buildings according to the building period are:

Energy performance class of buildings with building period until 1990 is F (261...330 kWh/(m^2y) for private house and 221...280 kWh/(m^2y) for apartment buildings).

Energy performance class of buildings with building period between 1991...2000 is E (211...260 kWh/(m^2y) for private house and 181...220 kWh/(m^2y) for apartment buildings).

Energy performance class of buildings with building period between 2001...2010 is D (161...210 kWh/(m^2y) for private house and 151...180 kWh/(m^2y) for apartment buildings).

Energy performance class of buildings with building period between 2011...2020 is C (121...160 kWh/(m^2y) for private house and 121...150 kWh/(m^2y) for apartment buildings).

Energy performance class of buildings with building period after 2020 is B (51...120 kWh/(m^2y) for private house and 101...120 kWh/(m^2y) for apartment buildings).

About 68% of Estonians are living in apartment buildings, 29% in private houses and 3% in other types of dwellings, according to calculations using Statistics Estonia dataset RL21801.

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. Specifically, detached houses and terraced houses have a construction and maintenance footprint of 6.9 $kgCO_2e/(m^2y)$ and flats have a construction and maintenance footprint of 8 $kgCO_2e/(m^2y)$ (Saari, 2001; Salo et al., 2016).

Electricity

Lifestyle test lacks specific questions regarding the user's electricity consumption. Consequently, all users are assumed to have the same estimated national average electricity consumption of 831 kWh/person/year excluding the estimated energy consumption for the heating (calculated using Statistics Estonia 2022 dataset KE0230 in comparison with the Odyssee-Mure 2019 database).

Despite the absence of personalized consumption data, the test includes a question allowing users to specify the type of electricity they use: "green", "ordinary", or "I don't know". Green electricity considers renewable electricity sources used in Estonia (hydro, biofuels, wind and solar panels) while ordinary electricity represents the average grid electricity. Grid electricity is also used for users who indicate they don't know their electricity type.

The emission intensity of grid electricity is modelled using data KE0230 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 0.279 kgCO2e/kWh.

Primary heating method

The question about the primary heating method includes the common heating methods used in Estonia. According to calculations based on Statistics Estonia 2022 dataset KE0230 in comparison with Odyssee-Mure, 2019, Lifestyle test estimates the average of 196 $kWh/(m^2y)$ heating consumed by Estonian households in 2022. The adjustment is made based on the user's responses regarding their home construction year and the room temperature when space heating is in use.

The emission intensities of the heating options are from ecoinvent 3.9. except for ground and air heat pumps where the data are from (Scandinavian Lämpöpumppu, 2024). If the user has an electric or air/ground heating pump for heating, the calculations integrate the emission intensity specific to the user's response to the electricity type question (ordinary or green electricity). Emission intensity for biomass in heating, residential use and electricity production was calculated 0.0003 $kgCO_2e/kWh$ as in 2021 (SEI Tallinn 2022). Average emission factor for district heating in Estonia was calculated 0.154 $kgCO_2e/kWh$ (SEI Tallinn 2022).

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" is used in the test (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 kilometers 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), representing an average of 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). Emissions include the production and maintenance of vehicles, the use of road and rail infrastructure, and direct and indirect emissions from fuel consumption.

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 Estonian shares between different modes (Calculated using Statistics Estonia TS101 and RV069U datasets, 2023). According to Statistics Estonia datasets the shares are: Bus 63%, Ferry 26%, Rail 8%, Tram and Trolley 3%.

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 incorporates 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 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 (Tallin to Helsinki and Stockholm).

Emissions from ferry transport can vary significantly depending on the allocation method used to distribute emissions between passengers and freight. Common allocation methods include area-based, weight-based, and economic value-based approaches. In the Lifestyle test, the emission intensity for ferry trips is based on reported values from ferry operator Tallink Silja (Tallink Group, 2024), which applies weight-based allocation. These figures account only for direct CO_2 emissions from fuel consumption. Indirect emissions from fuel production, as well as emissions from shipbuilding, maintenance, and scrapping, are based on data from TNMT (2021). The calculations consider foot passengers only and do not include emissions from vehicles transported on board.

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 the 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 Estonian.

To define the diet composition, the test asks how much the user eats from different food groups that have the highest impact on carbon footprint, such as meat, fish, dairy, and beverage consumption. For food groups not explicitly addressed, the test assumes adherence to the average Estonian diet. The main sources of consumption data for the average Estonian diet are the food supply balance sheets PM20, PM31, PM33, PM34, PM37, PM42, PM45, PM47 provided by Statistics Estonia and the National Dietary Survey 2014 datasets RTU011 and RTU021 by National Institute for Health Development. Consumption of alcohol beverages data has been sourced from a 2021 study by Estonian Institute of Economic Research. Fish and fish products consumption data has been sourced from a 2022 study of Estonian Institute of Economic Research. Due their nature food supply balance sheets provide somewhat different outcome (food provided vs the food consumed) and these differences are factored in into the emission analysis. If not provided, food consumption is calculated per capita using the population data in Statistics Estonia dataset RV069U.

Carbon 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 carbon intensities in both databases are similar, ensuring comparability. Emission of the cereals production is based on the study provided by the Ministry of Environment (Astover et al., 2015). 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 the National Dietary Survey 2014 data RTU011 and RTU021 by National Institute for Health Development in comparison with EatForHealth numbers (National Health and Medical Research Council, 2021).

Food categories

Beef

Beef is classified under its own category due to having a higher emission factor than other meats. The emission intensity for domestically produced beef is derived from Hietala (2023) and imported beef from ecoinvent 3.9 (Wernet et al., 2016). Emission intensity from ecoinvent is converted from live weight to carcass weight using factors from Clune et al., (2017).

Pork, Chicken, fish and seafood, or eggs

The emission intensity of pork is slightly higher than other foods in the category but significantly lower than beef. The proportions of different foods are determined based on their average consumption in Finland. Emission intensities for domestically produced pork and poultry are sourced from Hietala (2023) and imported ones from ecoinvent 3.9 (Wernet et al., 2016). The emission intensity for fish is from ecoinvent 3.9. and for eggs from AGRIBALYSE 3.1 (2022). Emission intensities for pork, poultry, and fish from ecoinvent are converted from live weight to carcass/catch weight using factors from Clune et al. (2017).

Dairy products

The emission intensities are obtained from ecoinvent 3.9. The cheese category includes soft and hard cheese products made from cow's milk and emission intensities are sourced from AGRIBALYSE 3.1 (2022).

Beverages

The emission intensities for all beverage products are sourced from AGRIBALYSE 3.1 (2022) or ecoinvent 3.9 (Wernet et al., 2016). The average share of coffee, tea, fruit and vegetable juices, soft drinks and alcoholic beverages was considered in the beverage consumption (National Institute for Health Development RTU021, 2014; National Institute for Health Development, 2021).

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 from ecoinvent 3.9 (Wernet et al., 2016). The majority of the climate impact of food waste is from food production rather than biowaste management.

Consumption

Living, mobility and food are the most significant sub-sectors in the carbon footprint of an average Estonian. It would require a number of questions to make a comprehensive estimate of the climate emissions of other sectors of personal consumption. In such a case, the effort it would require for the user 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, summer cottages, and pets.

Shopping habits

On average, the combined spendings to furnishings and home care products, clothes and footwear, goods related to spare time activities and hobbies, audiovisual devices, as well as books, magazines, newspapers, and paper products amount to approximately 2125 € per person per year (Eurostat, 2022). The carbon intensities used to calculate the climate impact of purchases are sourced from exiobase 3.8.2 (Stadler et al., 2021). To align consumption amounts with carbon intensities, conversion from consumer 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. Lifestyle test has question on second-hand clothing and electronics which contributes to 41% of all consumption of household goods in Estonia (Eurostat, 2022). Respondents 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%, depending on the response.

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 3.8 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.

Cottages

The summer cottages are assumed to be modestly equipped, and basic heating is maintained year-round even when the cottage is not in active use. For cottages used throughout the year, it is assumed to be better equipped with proper insulation and an indoor toilet.

The earlier answer of the type of electricity used by the user was considered when calculating the GHG emissions from electricity. The climate impact of the cottage is divided between people using the cottage.

The carbon footprint of cottages includes construction and maintenance of the buildings, land use emissions and heating and electricity use. The emission intensities used are based on the calculation made by Koivula et al., (2019).

Action Plans

Upon completion of the Lifestyle Test, specific actions are recommended based on the user's responses. The mitigation potentials of these recommended actions are calculated according to the user's answers. However, for certain actions, such as washing laundry less often or recycling waste, where the test does not gather specific information about the user's habits, the mitigation impact is assumed to be the same for all users and is calculated based on an average Estonian. This approach allows for a more tailored set of actions and their mitigation potential while ensuring a realistic estimation of the impact of actions that lack personalized input.

Action recommendations have been developed to be applicable in a large variety of situations and (because of the limited number of questions) not all these situations can be foreseen by the test. Because of that, some of the actions can be more suitable for the specific user compared to the others. It's useful to think of the actions as opportunities rather than obligations. It's up to the user to make the final selection. Despite their different nature and their different challenges, all of the actions will have an impact reducing the carbon footprint of our daily activities.

Action recommendations have been developed in a way that provides opportunities for different types of interventions from simple consumption avoiding (*not doing* something) to changing our habits (*doing* something differently) to the large investments (changing the infrastructure). This allows every user to select an action they can manage with the resources currently available. It's clear that not everybody can buy a new car or build a new house. Even changing our daily habits like our diet or commuting may not be feasible for some. All of this is considered in these recommendations, allowing users to improve their lifestyle step-by-step, taking on the tasks they know they can do. Needless to say, it's possible to gradually move towards more challenging actions after completing the simpler ones.

Some of the actions require more effort than others and there can be situations where reducing our carbon footprint does not depend on mere individual choices but rather on the choices of other people around us. For example, some actions may be unavailable (or unreasonable) for us due to how the services are developed in our specific community. Although actions are developed in a way that should fit into the Estonian national and municipal legislative framework, there still can be local differences on availability and accessibility of options for low-carbon lifestyle. We are interested to hear about these differences and the challenges people are facing in reducing their carbon footprint. Please contact us if you are interested in sharing your efforts

Average carbon footprint in Estonia

On the carbon footprint results page, users can compare their individual footprint with the national average for Estonia. This average is calculated using the same data sources and methodology as the Lifestyle Test. It covers the same categories: living, personal transport, food, and other consumption (purchases, cottages and pets) (Table 1).

Additional data sources and assumptions

Some additional data sources are used to calculate the Estonia's average 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

- Private Car Use: According to the National Road Administration (Maanteeamet) 2020 report, Estonians traveled 8417.87 million kilometers by private car in 2019, equating to 6353.97 kilometers per capita. With an EU average car occupancy of 1.7, this results in 10801.75 passenger-kilometers per capita.
- Motorcycle Use: In 2019, motorcycle use totaled 58.3 million kilometers, or 44.01 kilometers per capita.
- Passenger Ferry Transport: Based on Statistics Estonia (TS101), ferry transport amounted to 1299.2 million passenger-kilometers by sea and 573.5 thousand by inland waterways, totaling 981.07 passenger-kilometers per capita.
- Electric Vehicles:
  As of 2019, 0.17% of Estonia's car fleet were electric vehicles (Eurostat 2019). This proportion is used to estimate the share of electric vehicle kilometers.
- Air Transport: International: Estimated at 956.99 passenger-kilometers per capita in 2019.
  Domestic: Estimated at 0.00015 passenger-kilometers per capita in 2019 (Statistics Estonia TS101)

Food

- Meat and Fish Consumption (per person/year): Beef: 8.6 kg, Pork: 39.9 kg, Poultry: 29.3 kg, Fish and seafood: 8.6 kg, Eggs: 15 kg (Statistics Estonia 2022 PM42, PM45; Estonian Institute of Economic Research 2022)
- Dairy Products: Cheese: 29.9 kg, other dairy (excluding cheese): 143.7 kg (Statistics Estonia 2017–2022 PM47)
- Beverage Consumption: Fruit and vegetable juices: 27.61 kg, soft drinks: 14.72 kg, Water/mineral water (as drinks): 213.36 kg, Coffee: 21.94 kg, Tea: 72.96 kg, Alcoholic beverages (age 15+): 119.81 liters (2020; National Institute for Health Development RTU021, 2021)
- Food Waste: Estonians waste 61.2 kg of food per capita annually, of which approximately 42% is edible, contributing significantly to the carbon footprint (Piirsalu et al., 2021).
- Daily Food Intake: Average daily food consumption is 3022 g per person (2109 g excluding water and alcohol), contributing to an annual food-related carbon footprint of 1960 kgCO_2e per person.

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

TOTAL	**7560**
Living	1480
Transportation	3180
Food	1960
Other consumption	940

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101037342.

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