D-mat

Calculation basis used in the Sitra lifestyle test

D-mat oy, Viivi Toivio and Michael Lettenmeier

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Living

The environmental impacts of living taken into account in the lifestyle test are generated by construction, the heating of dwellings and the use of electricity at home. The lifestyle test begins with a question on how many people live in the respondent's household, because the environmental impacts of housing are divided between all family members.

The environmental impacts of a building are taken into account by using an emission factor calculated per living area and the number of years the building has been in use (Saari et al. 2001: a block of flats equals 8.0 and a single-family house or semi-detached house equals 6.9 kg $CO_2e/y/htm^2$). The factor takes account of the land-use change, the manufacturing of materials and the construction, maintenance and demolition of the building. The assumed total lifespan is 50 years.

The default value for electricity consumption (excluding electricity used for heating) is based on a survey on households' electricity consumption conducted in 2011 (Adato Energia 2013). The default values are calculated as follows, when X = (number of people in the family – 1): Block of flats = 1400 + X x 500 / Semi-detached house = 2600 + X * 700 / Single-family house = 4600 + X * 900.

The greenhouse gas emissions of electricity production take into account the direct emissions of electricity production, or the emissions caused by burning of fuels and the fuel production chain. The emission factor of electricity production is 281 g CO_2e/kWh (Salo et al. 2017). The emission factor for green electricity is close to zero (Wernet et al. 2016). The coefficient takes account of the land-use changes related to electricity production. Green electricity has also been taken into account in rail transport (see the transport section).

The classification of the house types from different eras is based on the Ministry of the Environment's (Ministry of the Environment 2013) updated energy efficiency classification system and the estimates on the placement of buildings in different energy classes. Houses built after 2010 are considered "new building stock", whose typical energy class is C (energy consumption 130 kWh/m^2). The energy class A requires a house to produce some or all of its own energy and class B buildings are classified as low-energy houses. House types built between 1990 and 2010 typically represent the energy class D (energy consumption 160 kWh/m^2). The energy class of houses built before the 1990s may vary significantly, but by default older houses are expected to have higher energy consumption (energy class F, energy consumption 240 kWh/m^2).

The question concerning the primary heating method of the respondent's home takes into account the most commonly used heating methods. Because of almost equal emission factors, district heating and light fuel oil were classified under the same alternative response. The emission factor for district heating is 267 g CO_2e/kWh (Salo et al. 2015) and for light fuel oil 265 g CO_2e/kWh

(Official Statistics of Finland 2016). The response to the earlier question on the kind of electricity the respondent uses is taken into account in the calculations concerning the electricity consumption of electric heating, a ground-source heat pump or an air-source heat pump. The efficiency rate of ground-source heating and an air-source heat pump is based on the values specified by Motiva (2017c). An air-source heat pump is usually used as a complementary heating system, but when used us a primary heating method, there are probably more air-source heat pumps in use than one, and the efficiency of an air-source heat pump can be assumed to roughly correspond to the efficiency of ground heating. The emission factor for natural gas is 199 g CO_2e/kWh (Official Statistics of Finland 2016) and that for wood or pellets is 14 g CO_2e/kWh (Salo et al. 2017).

If the respondent is unable to define the primary heating method of his or her home, an average heating method defined separately for each house type – based on the Statistics Finland material (Official Statistics of Finland 2015) on energy consumption of housing by source of energy – is used. For example, in blocks of flats, the primary heating method is district heating, but a small share of blocks of flats are heated with light fuel oil. In single-family houses, on the other hand, the primary heating method is wood/pellets or electricity, but the use of ground-source heating, light fuel oil and district heating is also taken into account. Based on the relative shares of various heating methods, a weighted average was calculated as the emission factor used for the heating method of various house types.

In addition to the house type and time of construction, the respondents are asked in which part of Finland they live. This defines how much less/more heating energy they need in comparison to the average consumption of heating energy (+/– 10%) (Motiva 2017a). The effect of room temperature was also taken into account in the need for heating energy. A two-degree drop/rise in the room temperature may increase/reduce the need for heating energy by 10% (Motiva 2017b).

The time spent in a shower affects water consumption and therefore also the amount of heating energy used for heating the water. Heating one litre of water to the temperature of 40 degrees requires 0.04 kWh of energy.

Transport and tourism

The average estimates on the use of different means of transport are based on the National Travel Survey (2010-2011) statistics.

The carbon footprint of driving is calculated based on the annual number of kilometres driven and the average number of people driving a car. For driving, the climate emissions consist of the fuel consumption, the manufacturing of the car and the emissions from building the road infrastructure. The generated emissions are divided between the number of people typically driving a car. The emission factors for fuel are based on the emission factors (petrol and diesel) or consumption (natural gas-powered, electric or hybrid cars) per passenger kilometre reported by the LIPASTO database. Ten per cent of the emissions of natural gas-powered cars are assumed to derive from the use of petrol, since the gas-driven cars sold in Finland also have a petrol fuel option. The consumption ratio of biogas and natural gas is based on the shares of such gases produced as fuels reported by GASUM (2017). Biogas does not produce any calculated CO2 emissions, since the burning of gas releases the same amount of carbon dioxide as was captured in the "biogasified" material earlier in time (GASUM 2017). The emissions generated by the manufacturing of different car types are based on global average rates (Wilson 2013). Approximately 10 % (20 g CO_2/vehicle km) of the overall emissions from driving are allocated to road infrastructure (Hill et al. 2012).

Public transport includes travel by bus, train, tram and metro. The relative shares of the different means of public transport are based on the National Travel Survey (Henkilöliikennetutkimus 2010-2011) statistics. The shares were used as a basis for calculating a weighted average emission factor for public transport. The emission factors of different means of transport are based on the emission factors reported by the LIPASTO database. As regards rail transport, the use of green electricity by VR and Helsinki City Transport were taken into account. With reference to buses, the different shares and emission factors for city and long-distance transport have been considered.

The average lengths of routes for air travel and passenger shipping are based on the Statistics Finland material (Official Statistics of Finland 2016 and 2017) on the travel habits of Finns. Based on the statistics, an average value for the duration of a return trip by plane (approximately five hours) was calculated. The emission factor per hour for air travel is based on the average climate emissions per kilometre reported by the LIPASTO database. The kilometre- and hour-based lengths of different air routes were estimated with the help of flight time and distance calculators. The trip-specific average emission factor for maritime passenger transport was calculated on the basis of unit emission factors of different ship types and routes reported by the LIPASTO database and the relative shares of maritime transport destinations reported by Statistics Finland.

Food

The carbon footprint of the person taking the lifestyle test is affected by the amount of food he or she eats and the amount of waste this generates, as well as the relative amounts of different ingredients used. It is assumed that a respondent who eats less/more compared to other people at mealtimes eats on average 15 % smaller/larger portions.

In the lifestyle test, the respondent's diet is further calculated on the basis of the ingredients he or she consumes at mealtimes. The consumption of various products either reduces or increases the footprint, depending on whether the respondent eats less or more of such products compared to the average consumption habits in Finland. The reducing/increasing effect of the choices is deducted from/added to the carbon footprint of an average Finn, which is approximately 1.6 tons a year (Seppälä et al. 2009).

The ingredients with significant environmental impact have been classified into various categories: red meat and cheese; chicken, fish and eggs; milk and dairy products; and drinks. An average portion size was calculated for each category, and a portion-specific emission factor was calculated based on the percentage of the various ingredients of the portion. The portion sizes of the various ingredients are based on the reported annual consumption of food commodities per capita (Natural Resource Institute of Finland: Balance sheet for food commodities 2016) and the food measures defined by the National Public Health Institute (Sääksjärvi & Reinivuo 2004). The sources used for emission factors included the environmental effects of products defined in Kausiruoka (Seasonal food) by Kaskinen et al. 2011 and the Ecoinvent database (Wernet et al. 2016). For example, the Climate Guide.fi gives several estimates of the greenhouse gas emissions of foods.

Red meat and cheese were classified under the same category because of their high emission factors (Kaskinen et al. 2011: beef from Europe 19 kg CO_2e/kg and cheese 13 kg CO_2e/kg). Regardless of the fact that the emission factor for pork is lower than that for beef and cheese (Kaskinen et al. 2011: domestic pork 5.6 kg CO_2e/kg), it was included under the same category to make the use of the calculator clearer. The emission factors for chicken, fish and eggs are close to each other and clearly below the factor for pork, which is why they were classified under the same category. The emission factors used are: 3.6 kg CO_2e/kg for chicken, 3.0 kg CO_2e/kg for fish and 2.7 kg CO_2e/kg for eggs (Kaskinen et al. 2011).

Milk and dairy products were highlighted as a third category since their high consumption has an effect on the carbon footprint. Finns consume annually approximately 120 kg of milk and approximately 40 kg of other dairy products (excluding cheese) per person. In the lifestyle test, the emission factor used for milk is 1.4 kg CO_2e/kg (Kaskinen et al. 2011: low-fat milk from Finland). For drinks a portion-specific environmental impact was calculated, being approximately 0.3 kg CO_2e/portion (range 150-400 g/portion). The emission factors for different drinks are based on the sources Kaskinen et al. (2011), Wernet et al. (2016) and Berners-Lee (2010).

As concerns meals eaten outside the home, the energy consumption used for providing the service – preparing the food, for example (2 kWh/time eating out) – was taken into account. Finnish people throw away approximately 23 kg of edible food a year (Saarinen et al. 2011), which increases the carbon footprint. The emission factor for food waste was calculated based on the biowaste of an average Finnish person eating a mixed diet (2.55 kg CO_2e/kg biowaste).

Goods and purchases

Living, mobility and food are the most significant sub-sectors in the carbon footprint of an average consumer. 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. However, in the lifestyle test we wanted to highlight a few important matters, acknowledging that other choices (such as services and interests) have an impact as well. In this calculator, the sub-sectors included contain pets, summer cottages and consumption of goods.

The question concerning shopping habits includes goods, household articles, clothes and footwear. The question does not cover environmental impacts related to services, only tangible products. On average, the combined climate emissions of furnishings and home-care products, clothes and footwear amount to approximately 600 kg/person/year (Seppälä et al. 2009). The estimates of minimum and maximum values of goods consumed, on the other hand, are based on a survey by Kotakorpi et al. (2008): “KotiMIPS – Kotitalouksien luonnonvarojen kulutus ja sen pienentäminen” (Household Material Input Per Service unit – Natural resource consumption of

Finnish households and its reduction). The carbon footprint of a person buying recycled goods is estimated to be 50 % smaller than that of an average consumer, because buying recycled products does not generate the climate emissions caused by the manufacturing of new goods and clothes.

Pets bring joy to people's lives and are often treated as members of the family. However, pets also consume natural resources in the form of food and different services and products. Still, the question concerning pets is difficult, because pets can be of very different sizes. The estimate about the average monetary value of the products and services Finnish people use for their pets is based on the PetNets survey (2015). On the other hand, the estimates of the quantitative content of products and services are based on the price comparisons of various service providers and companies. The estimates produced by Hirvilammi et al. (2014) on the air consumption of different services were used as the source for the climate emissions of services. Air consumption describes the amount of air changed chemically or physically or used for combustion, or in practice the amount of oxygen used for producing a service. The air consumption is often directly proportional to CO_2 emissions, because burnt oxygen generates CO_2. The climate emissions of food consumed by pets were estimated by comparing the nutritional values of dog and cat foods, and using the emission factors of the Ecoinvent database.

There are almost 500,000 summer cottages in Finland. The average living area of a summer cottage is approximately 50 m^2, but there is a lot of variation in how the cottages are equipped (Mökkibarometri 2016). In the question about summer cottages, the assumption is that the summer cottage is modestly equipped. The average electricity consumption during summer season and/or winter season was also taken into account (Piiroinen 2009). It is assumed that basic heating is maintained in a cottage used year-round even when it is not in active use. The earlier answer given by the respondent on whether he or she uses ordinary or ecological electricity was taken into account when calculating electricity consumption. In addition to electricity consumption, the lifestyle test accounts for the climate impacts of the consumption of raw materials needed for building the cottage, land use and maintenance of the cottage. The emission factor used is based on the calculation made by Salo et al. (2008) on the day-specific air consumption caused by the use of a cottage (modest free-time residence 27 kg/day). The estimates of the average usage of cottages in summer and winter (days/year) are based on the statistics of the Free-Time Residence Barometer (Mökkibarometri 2016). The climate emissions generated by the use of a cottage are divided between people using a cottage on a regular basis.

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