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Climate benefits of using Matsmart's services

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Elvira Molin, Sjoerd Herlaar



Author: Elvira Molin, Sjoerd Herlaar

Commissioned by: Matsmart AB

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IVL Swedish Environmental Research Institute Ltd.,

P.O Box 210 60, S-100 31 Stockholm, Sweden

Phone +46-(0)10-788 65 00 // www.ivl.se

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Summary

Food production and consumption have been identified as a sector with a major environmental impact. Emissions and mainly climate impact occur throughout the food's life cycle. Reducing the amount of food waste contributes to increased resource efficiency and thus also a reduced environmental impact from the food system. On behalf of the Government, the Swedish Environmental Protection Agency (2020) proposes a milestone of 20% weight loss of food waste per capita by 2025. Likewise, the proportion of recyclable food packaging will increase by 25% by 2030 (Swedish Environmental Protection Agency, 2020).

Matsmart contacted IVL Swedish Environmental Research Institute with a request to make climate calculations for their range of products. Matsmart sells products that would otherwise have been discarded. Groceries are bought in large quantities and sold online at a much lower price (20-90% lower). They are stored and sent with Postnord. Matsmart does not currently have any fresh products or inhouse production. The project aims to communicate to Matsmart's customers how much climate impact (CO₂-eq) that is "saved" by buying food from their service. The expected results are a better understanding of the environmental benefits of a service that redistribute food waste. In the project, simplified life cycle analyses (climate impact) of about 20 products have been performed.

A template of the climate footprint for the average shopping carts representing Matsmart's four largest markets, Sweden, Denmark, Finland and Germany, have been calculated. These standard values are rough estimates showing the order of magnitude and can be far from the product footprint calculated in environmental product declarations (EPD). Therefore, these templates should only be used in their context, i.e., calculate the potential for recycling and not be published/communicated externally as a climate impact per product.

The result is that the climate gain from Matsmart's service is 12.7 kg CO₂-eq for the Swedish shopping cart, 9.1 kg CO₂-eq for the Danish, 8.8 kg CO₂-eq for the Finish, and 7.88 kg CO₂-eq for the German cart. High emissions often correlate with a higher weight for the individual product. However, the products that have the most significant climate impact per kg of the product were consumed to a small extent in terms of weight. The calculations could be improved by inclusion of further aspects such as the number of satisfied calories per kg CO₂-eq or how consumption patterns are affected by or can be affected by Matsmart's service.

1 Calculation model

According to the model by Wranne (2020), for recycling and environmental benefits, the impact of recycling is calculated as the difference between a product being either recycled or purchased new. If a product is reused, the production of a new product is avoided, and transports and waste management that are connected to the produce. Reconditioning and delivery transport for reuse are however added to the impact.

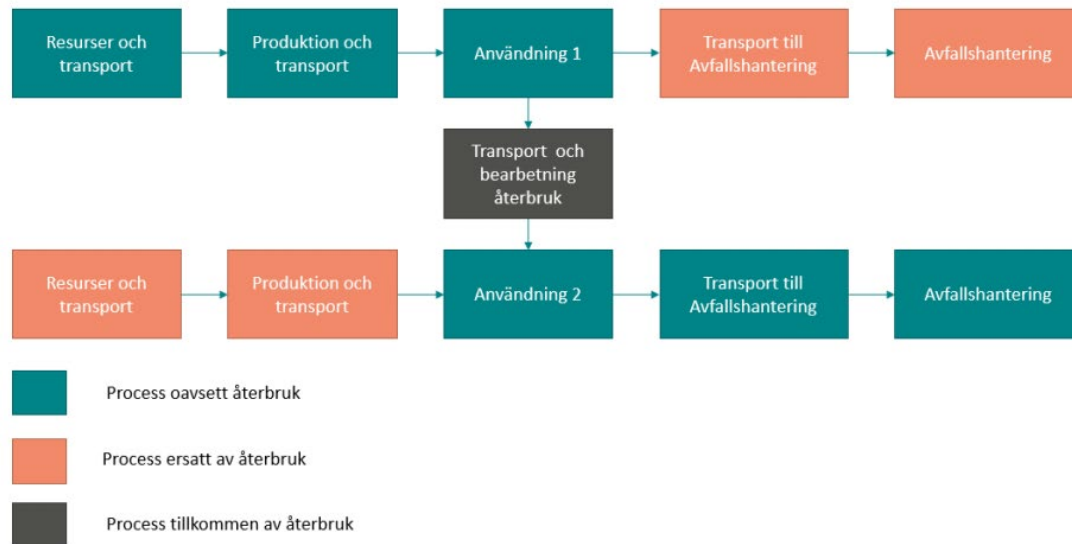


Figure 1 Calculation model for environmental benefits from recycling (Wranne, 2020).

Food is primarily a consumable item, and Matsmart's service sells waste from supermarkets and wholesale. This study calculated the climate impact from food waste as the climate impact from all upstream processes, from manufacturing to sales and consumption. If the food waste had not been reused or resold as food, it would have gone to digestion or incineration. Matsmart mainly sells food for which energy recovery should, as far as possible, be composting or digestion. The environmental benefit of Matsmart's service is thus calculated as net climate impact i.e., the difference between the climate impact from food production and the potential energy recovery during digestion.

$$\text{Production_Impact} - \text{Energy_Recovery} = \text{Net_Climate_Impact}$$

Where Production_Impact resembles the climate impact from the production stage, e.g., primary production, retail, packaging and transports etc. If a product doesn't come to use during its life span it will be sent to incineration or digestion. Energy_Recovery resembles the energy potentially recovery through digestion or incineration. The difference between climate impacts from production and the potential energy recovery are here calculated as Net_Impact resembles the final net climate impact of a product.

Recycling or treating waste and its environmental benefits have been estimated in reports such as "Climate impact from different waste fractions" (Miliute-Plepiene et al., 2019). Food waste for digestion is in the report estimated at -0.1 CO₂ eq per kg of waste.



Since products sold by Matsmart are already manufactured, the option would be to buy a new product, meaning that two units must be manufactured. Thus, in simple terms, the net climate impact of each product sold via Matsmart's service is saved.

1.1 Excluded in the model

This study is a simplified calculation of climate impact from a life cycle perspective. The study is limited in its scope and by the availability of data. Important concepts excluded from the study due to its scope are listed and explained below.

1.1.1 Transport

Shopping locally and reducing both the number and the length of transportation is a growing trend in the food sector (Caputo et al., 2017, Pullman and Wikoff, 2017, Reisch et al., 2013). However, several studies have shown how emissions from transport are a minor part of the total food emissions, see Cerutti et al. (2018). In Matsmart's operations, goods from the earlier stages of the food chain, before the grocery trade, are sent to a central warehouse in Örebro. Whether the number of transports is equivalent for the business compared with the traditional supply chains has not been studied within the framework of this project.

1.1.2 Rebound effects

This study does not include how the possibility of further sales of products that would otherwise have been discarded affects producers and other upstream activities. A rebound effect could be that production is not adapted to demand, thus stimulating a surplus. Food waste is amongst other causes generated due to low pricing and it is in the suppliers' interest to sell more (Gardfjell, 2019). Overproduction could, in the long run, have a greater negative environmental impact than taking advantage of food waste, but this has not been examined in this study.

The reduced-price impact on consumers, their purchasing power in relation to these, and correlating behaviour are excluded in this study. Low prices can stimulate additional purchases, overconsumption, and increased waste in the home, which should be dealt with in a more thorough investigation of the consequences of a service where one sells food waste at a reduced price. The consumer must think about buying resource-efficient foods and reduce wastage in the home (Naturskyddsöreningen, 2021).

1.1.3 Packaging

Packaging is a growing area of interest for both consumers and producers in the food industry. The task of a package is to protect the food, extend its shelf life, and preserve quality and function (Marsh and Bugusu, 2007). Packaging that fulfils the task can be environmentally beneficial and reduce food waste. Food packaging accounts for about 4% of emissions (Cerutti et al., 2018). In this study, we did not include packaging as data for material and weight were limited.

2 Results

Data for the calculations have been taken from existing EPD (Environmental Product Declarations) calculations, RISE available list for food, scientific literature, and the database Ecoinvent 3.5. The shopping carts primarily consist of composite products, and data have been chosen for equivalent products or the main ingredients. The result is an indication of the environmental benefit from Matsmart's service.

2.1 Shopping cart Sweden

The Swedish shopping cart consists of chocolate cakes, cookies, crispbread, crushed tomatoes, pasta, sweets, protein bars, seasonings, drinks, socks, chewing gum, and soap. The total weight is 9.7 kg, and the climate impact is calculated at 13.7 kg CO₂ eq, see Table 1. The gain from Matsmart's service will be 12.7 kg CO₂ eq. The products that account for the greatest climate impact in the Swedish shopping cart are pasta and crushed tomatoes. These products are also the heaviest. The only exception is the drink that weighed the most but contributed to the third-largest climate impact. Looking at the climate impact per kg of product, chewing gum had the greatest environmental impact due to the production of the sweetener xylitol, followed by socks and cotton production.

Table 1 calculations of climate gain from the Swedish cart at Matsmart

| | |
|-------------|---|
| Sweden | |
| 9.7 | Sum weight [kg] |
| 13.7 | Sum climate impact [kg CO₂-eq] |
| 1.1 | Climate benefits from digestion [kg CO₂-eq] |
| 12.7 | Net benefit with Matsmarts services [kg CO₂-eq] |

2.2 Shopping cart Denmark

The Danish shopping cart consists of chocolate cakes, drinks, beans, dishcloths, sweets, honey, crispbread, pastilles, panty liners, and chips. The total weight is 12.1 kg, and the climate impact is estimated at 10.3 kg CO₂eq, see Table 2. The gain from Matsmart's service will be 9.1 kg CO₂-eq. In the Danish shopping cart, it is the beverage that accounts for the largest climate impact and the one that has the greatest mass. The milkshake also had a higher weight than other goods, and the climate impact was second largest in the Danish shopping cart, followed by beans and honey. The panty protection has the greatest climate impact per kg of product, followed by packaged cooked beans and chocolate cakes.

Table 2 calculations of climate gain from the Danish cart at Matsmart

| | |
|-------------|---|
| Denmark | |
| 12.1 | Sum weight [kg] |
| 10.3 | Sum climate impact [kg CO₂-eq] |
| 1.2 | Climate benefits from digestion [kg CO₂-eq] |
| 9.1 | Net benefit with Matsmarts services [kg CO₂-eq] |

2.3 Shopping cart Finland

The Finnish shopping cart consists of chocolate cakes, seasonings, cotton swabs, dishcloths, cereals, juices, cakes, meal replacements, nut mix, pasta, panty liners, and flax chips. The total weight is 9.6 kg, and the climate impact is calculated at 9.8 kg CO₂-eq, see Table 3. The gain from Matsmart's service will be 8.8 kg CO₂-eq. In the Finnish shopping cart, pasta is responsible for the greatest climate impact, followed by meal replacements and cereals. Meal replacement had the single greatest weight, followed by juice and pasta. The largest climate impact per kg of the product was found in the cotton tops, panty liners, and the nut mix.

Table 3 calculations of climate gain from the Finish cart at Matsmart

| | |
|------------|---|
| Finland | |
| 9.6 | Sum weight [kg] |
| 9.8 | Sum climate impact [kg CO₂-eq] |
| 1.0 | Climate benefits from digestion [kg CO₂-eq] |
| 8.8 | Net benefit with Matsmarts services [kg CO₂-eq] |

2.4 Shopping cart Germany

The German shopping cart consists of wine gums, cheese-flavoured biscuits, and caramel-flavoured biscuits, hazelnut cream, pasta, noodles, salt, ketchup, cherry soda, vanilla protein drinks, and bamboo toothbrushes. The total weight is 12.57 kg, and the climate impact is estimated at 7.88 kg CO₂-eq, see Table 4. The gain from Matsmart's service will be 6.63 kg CO₂-eq. The soft drink is responsible for the greatest climate impact in the German shopping cart, followed by pasta and ketchup. The soft drink had the single largest weight, followed by pasta and vanilla protein drinks. The biggest climate impact per kg of the product was found in hazelnut cream, ketchup, and cheese biscuits.

Table 4 calculations of climate gain from the German cart at Matsmart

| | |
|--------------|---|
| Germany | |
| 12.57 | Sum weight [kg] |
| 7.88 | Sum climate impact [kg CO₂-eq] |
| 1.26 | Climate benefits from digestion [kg CO₂-eq] |
| 6.63 | Net benefit with Matsmarts services [kg CO₂-eq] |



3 Additional Thoughts

- The biggest benefit from Matsmarts service is created by buying a shopping cart containing products with a significant climate impact.
- There is often a connection between the highest weight and the greatest climate impact for individual products with similar properties.
- Some goods stood out more in terms of kg carbon dioxide equivalents per kg of product, such as chewing gum, socks, cotton tops, and panty liners. Here, there may be potential for the consumer to change habits to more resource-efficient products.
- Further studies could link calories and or nutritional content to climate impact.
- Continued studies on consumer behavior and rebound effects would provide increased transparency in the business.

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Appendix 1. Calculations for the representative shopping cart in Sweden

| Amount | Package | Net weight [g] | total volume [ml] | other [nr] | Product example | Country | kg CO ₂ -eq | kg | kg CO ₂ -eq |
|--------|-------------------------------|----------------|-------------------|------------|--|---------|------------------------|------|------------------------|
| 6 | Chokladbars | 35 | | | Marabour Dark Milk | Se | 1.37 | 0.21 | 0.29 |
| 10 | flaskor/burkar dryck | 330 | 330 | | Honest Hallon & Basilika | Se | 0.66 | 3.30 | 2.18 |
| 2 | förpackningar sås/smaksättare | 345 | | | Bullseye BBQ sås mokey bacon | Se | 1.20 | 0.69 | 0.83 |
| 2 | paket kakor | 190 | | | Ballerina Peanut | Se | 1.67 | 0.38 | 0.63 |
| 1 | paket knäckebröd | 225 | | | Pauluns superknäcke Chafrön, sesamfrön & Linfrön | Se | 1.18 | 0.23 | 0.27 |
| 4 | paket krossade tomater | 400 | | | Kung Markatta Krossade tomater | Se | 1.52 | 1.60 | 2.42 |
| 3 | paket pasta | 500 | | | Di Martino Linguini | Se | 2.17 | 1.50 | 3.25 |
| 1 | paket strumpor | 227 | | 6 | Pierre Robert Strumpor Svart | Se | 3.74 | 0.23 | 0.85 |
| 2 | paket tuggummi | 66 | | | Extra Mega Cubes Spearmint | Se | 8.68 | 0.13 | 1.15 |
| 3 | påsar snacks/godis | 100 | | | Choco Cheez | Se | 1.32 | 0.30 | 0.40 |
| 15 | styck proteinbars | 55 | | | Dalblads Swebar chokladboll | Se | 1.33 | 0.83 | 1.10 |
| 1 | tvål | 300 | 300 | | N.A.E Pump Delicatelyzza Parfymfri | Se | 1.08 | 0.30 | 0.32 |



Appendix 2. Calculations for the representative shopping cart in Denmark

| Amount | Package | Net weight [g] | total volume [ml] | other [nr] | Product example | Country | kg CO ₂ -eq | kg | kg CO ₂ -eq |
|--------|--------------------------|----------------|-------------------|------------|--|---------|------------------------|------|------------------------|
| 6 | chokladkakor | 35 | | | Marabou Dark milk 35g | DK | 1.67 | 0.21 | 0.35 |
| 10 | flaskor dryck | 500 | 500 | | Vitamin Well Forest Rush 500ml | DK | 0.66 | 5.00 | 3.31 |
| 12 | flaskor proteinmilkshake | 330 | 330 | | Nutra-Go Chocolate Milkshake 330ml | DK | 0.65 | 3.96 | 2.57 |
| 5 | paket bönor | 150 | | | Bonduelle økologiske sorte bønner 150g | DK | 2.18 | 0.75 | 1.64 |
| 1 | paket disktrasor | 78.5 | | 5 | 5-pak Mikroplastfri karklude | DK | 1.20 | 0.08 | 0.09 |
| 1 | paket godis | 80 | | | Kinder Suprise 80g | DK | 0.60 | 0.08 | 0.05 |
| 2 | paket honung | 400 | | | Økologisk & fairtrade honning 400g | DK | 1.01 | 0.80 | 0.81 |
| 2 | paket knäckebröd | 240 | | | Frukost Knækbrød | DK | 1.18 | 0.48 | 0.57 |
| 6 | paket pastiller | 25 | | | Dent Crush Solbær 25g | DK | 0.60 | 0.15 | 0.09 |
| 2 | paket trosskydd | 38 | | 20 | Always fresh & Protect 20pack | DK | 3.03 | 0.08 | 0.23 |
| 3 | påsar chips | 150 | | | Sörlands Havsalt & Peber Chips 150g | DK | 1.09 | 0.45 | 0.49 |
| 4 | påsar Fruktsnacks | 25 | | | Frugtfiduser Banan 25g | DK | 0.70 | 0.10 | 0.07 |

Appendix 3. Calculations for the representative shopping cart in Finland

| Amount | Package | Net weight [g] | total volume [ml] | other [nr] | Product example | Country | kg CO ₂ -eq | kg | kg CO ₂ -eq |
|--------|----------------------------------|----------------|-------------------|------------|---|---------|------------------------|------|------------------------|
| 4 | chokladkakor | 85 | | | Marabou Dark milk 85g | FI | 1.37 | 0.34 | 0.47 |
| 2 | förpackningar sås/smaksättare | 490 | | | Turun Senap 490 g | FI | 1.20 | 0.98 | 1.18 |
| 1 | paket bommulstops | 115 | | 200 | Topz 200 pack | FI | 3.74 | 0.12 | 0.43 |
| 4 | paket disktrasor | 30 | | 3 | Wettex Sieniliinat 3pack | FI | 1.20 | 0.12 | 0.14 |
| 1 | paket flingor | 750 | | | Start Musli Naturell 750g | FI | 1.79 | 0.75 | 1.34 |
| 6 | paket juice | 250 | 250 | | Marli Vital Hedelmänektari 250ml | FI | 0.60 | 1.50 | 0.90 |
| 2 | paket kakor | 60 | | | Fazer Praline Biscuit Lemon & Yoghurt 60g | FI | 1.67 | 0.12 | 0.20 |
| 4 | paket måltidsersättning | 990 | 990 | | Nutrilett Smoothie Nordic Berries 990ml | FI | 0.45 | 3.96 | 1.78 |
| 4 | paket nötmix | 60 | | | Anyday nuts mix 60g | FI | 2.60 | 0.24 | 0.62 |
| 4 | paket pasta | 280 | | | Ruiskaurapasta 280g | FI | 2.17 | 1.12 | 2.43 |
| 1 | paket trosskydd | 38 | | 20 | Always fresh & Protect 20pack | FI | 3.03 | 0.04 | 0.12 |
| 3 | påsar linschips | 90 | | | Lohilo Sourcream & Onion 90g | FI | 1.37 | 0.34 | 0.47 |



Appendix 4. Calculations for the representative shopping cart in Germany

| Amount | Package | Net weight [g] | total volume [ml] | other [nr] | Product example | Country | kg CO ₂ -eq | kg | kg CO ₂ -eq |
|--------|-----------------------------|----------------|-------------------|------------|--|---------|------------------------|------|------------------------|
| 2 | Vingum | 125 | | | XXL Volles Rohr Mix 125g | G | 0.60 | 0.25 | 0.15 |
| 1 | Vingum | 450 | | | Goldbärenbox 450g | G | 0.60 | 0.45 | 0.27 |
| 3 | Kex med ostsamk | 100 | | | MCV-TUC CHEESE 100G | G | 0.75 | 0.30 | 0.23 |
| 1 | Hasselnötskräm | 350 | | | ROW-MILKA HASELNUSSCREME GLAS 350G | G | 1.65 | 0.35 | 0.58 |
| 3 | Pasta | 500 | | | Macaroni 500g | G | 0.72 | 1.50 | 1.08 |
| 4 | Nudlar | 60 | | | KRE-INSTANTNUDELN GEMÜSE 60G | G | 0.50 | 0.24 | 0.12 |
| 1 | salt | 108 | | | SHG-POMMES SALZ DOSE 108G | G | 0.20 | 0.11 | 0.02 |
| 2 | Ketchup | 300 | | | HEL-GEWÜRZ-KETCHUP CURRY-TOMATE PIKANT 300ML | G | 1.08 | 0.60 | 0.65 |
| 2 | Kex med karamellsmaks | 140 | | 5 | 5-Pack PICK UP SALTED CARAMEL 28G | G | 0.20 | 1.40 | 0.28 |
| 1 | Läskedryck med körsbärssmak | | 6000 | | 12-Pack Rockstar Revolt Killer Cherry 0,5l | G | 0.66 | 6.00 | 3.97 |
| 5 | Tandborstar | 25 | | 5 | 5er Pack, Bamboo Toothbrush, ADULT - 5 COLORS - MEDIUM | G | 0.10 | 0.63 | 0.06 |
| 1 | Vaniljprotein dryck | | 750 | | SmartProtein Drink Vanilla 750g | G | 0.65 | 0.75 | 0.49 |



IVL Swedish Environmental Research Institute Ltd.
P.O. Box 210 60 // S-100 31 Stockholm // Sweden
Phone +46-(0)10-7886500 // www.ivl.se