CARBON TRUST

FARESHARE FOOTPRINT METHODOLOGY

Net impact of food waste redistribution

September 2021

ACKNOWLEDGMENTS

FareShare footprint methodology

This report is produced by the Carbon Trust based on impartial analysis of primary and secondary sources, including expert interviews.

The Carbon Trust would like to thank everyone that has contributed their time and expertise during the preparation and completion of this report.

For the avoidance of doubt, this report expresses independent views of the authors.

Who we are

The Carbon Trust's mission is to accelerate the move to a decarbonised future.

We are a trusted, expert guide to Net Zero, bringing purpose led, vital expertise from the climate change frontline. We have been pioneering decarbonisation for more than 20 years for businesses, governments and organisations around the world.

We draw on the experience of over 300 experts internationally, accelerating progress and providing solutions to this existential crisis. We have supported over 3,000 organisations in 50 countries with their climate action planning,

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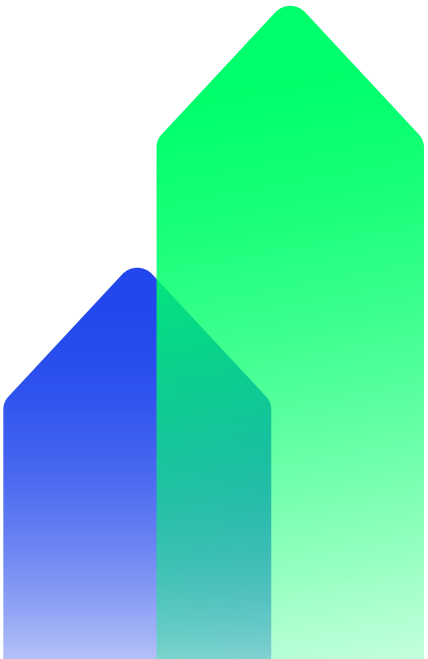

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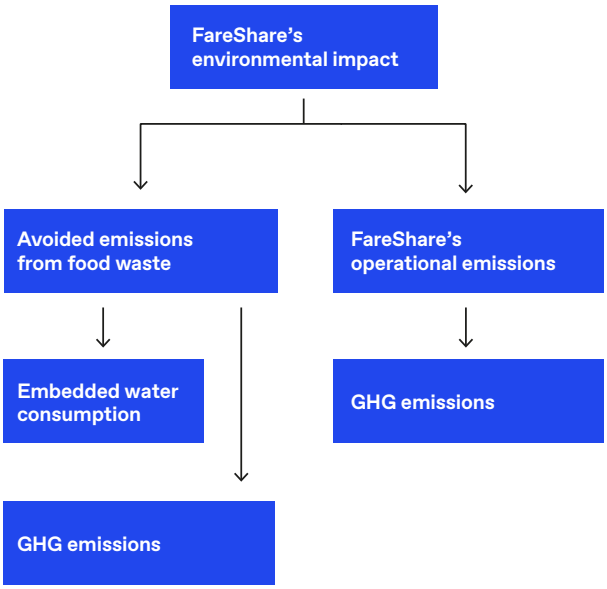
1. Introduction

FareShare encompasses a national network of charitable food redistributors within the UK, the organisation takes good quality surplus food from across the food industry and get it to more than 10,500 frontline charities and community groups. FareShare would like to understand and communicate the organisation's positive environmental impacts generated by redistributing surplus food that would otherwise be wasted. The Carbon Trust carried out an analysis quantifying these environmental impacts as greenhouse gas emissions and embedded water consumption. This report explains the methodological basis for the conducted analysis, and the result arrived.

FareShare's overall environmental impact is split into the organisation's operational emissions, and the impact of avoided food waste (as shown in Figure 1). These two categories were analysed separately, and hence two models were created. The water consumption of FareShare's own operations was not calculated as it fell outside the scope of this analysis.

FareShare's operational emission is analysed as Scope 1 and 2 emission, and outsourced distribution and transportation emissions following the Greenhouse Gas Protocol Organisational Footprinting Standard[1], which overlooks both direct and indirect emission generated through the organisation's own facilities and vehicles, as well as purchased electricity, cooling, and heating as demonstrated in Figure 2.

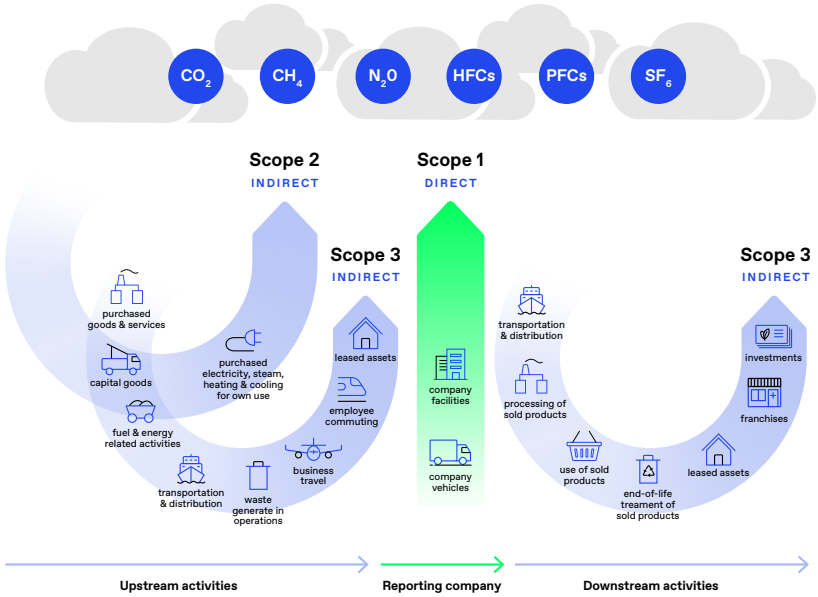
Figure 1: FareShare's environmental impact



This category will be referred to as "FareShare's Scope 1&2 Footprint and outsourced distribution and transportation emissions" within the remainder of the report.

The GHG emissions associated with the food waste avoided was analysed following Category 1 of the Greenhouse Gas Protocol on Corporate Value Chain (Scope 3) Accounting and Reporting Standard. The embodied water was analysed following the Water Footprint Assessment Manual. The impact of avoided food waste will be referred to as the "Embedded Environmental Impact of Redistributed Waste Food".

Figure 2: Greenhouse gas protocol Scopes. Source: WRI and WBCSD 2004



Note: Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), nitrogen trifluoride (NF_3).

1.1. Scope and boundary

Figure 3 below shows the simplified lifecycle of food enters and leaves FareShare's network.

The embodied environmental impact of FareShare's redistribution operations calculated each products cradle-to-gate lifecycle along the first three segments; the gate boundary is defined as the moment they enter FareShare's network. This boundary also includes any upstream transport that may occur in the food items' life cycle.

1.2. Data quality assurance

A data quality assessment consists of four data quality criteria were applied to ensure reliability of the analysis. Table 1 summarises the results from data quality assessment.

For both the Scope 1&2 and environmental impact footprints, all data was provided by FareShare and their direct suppliers. A sensitivity analysis was not carried out on the footprints due to the high-level nature of the Scope 1&2 analysis. Assigning the food waste to the emission factors was checked through to ensure the categorisation approach was correct for the study.

Figure 3 FareShare Food Lifecycle

Table 1: Data Quality Assessment

Exercise	Time specificity	Completeness of data	Data source	Auditability
Scope 1 and 2 footprint and outsourced paid distribution and transportation	2019/2020, reasonably recent	Majority of data correctly matched with factors	Primary and secondary data	All data sources documented
Food Waste Impact	2019/2020, majority of data matched reporting period	Majority of data correctly matched with factors	Primary data	All data sources documented

2. Scope 1 & 2 and outsourced distribution and transport emissions

2.1. Data sources

2.1.1 Activity data sources

The activity data supplied by FareShare was compiled from the following sources:

- **Fuel use:** invoices for vehicle fuel purchases, split by location.
- **Electricity usage:** invoices, split by location.
- **Gas consumption:** there was no gas consumption for FareShare.
- **F-gas:** no data on fugitive gas was provided by FareShare. Fareshare was unable to retrieve this data.
- **Outsourced distribution and transport:** summary of all invoices paid to transportation and distribution suppliers.

The breakdown of the emission categories per business unit is listed in Table 2. The table also includes the approach taken to calculate the emissions. The different approaches will be discussed in the relevant sections of this report.

Table 2: Data received relating to Scope 1&2 and outsourced transportation and distribution

FareShare Business Unit	Approach
Fuel use	
Total Fuel use (all locations)	Financial spend
Fuel use	Financial spend & litres used
Electricity	
East Anglia	Average units used
Evelyn Court (Office 1& 2)	Average units used
Merseyside	Average units used
Southern Central	Average units used and financial spend
West Midlands	Financial spend
Office Business	Financial spend
London	Financial spend
Outsourced transportation and distribution	
All costs associated to transport and distribution	Spend-based approach

2.2. Methodology for quantifying Scope 1, 2 & outsourced transportation and distribution emissions

Based on the data accessibility, availability, and quality, a mix of consumption and spend based approaches were applied to calculate the annual energy consumption, fuel use emission and emissions derived from transportation and distribution services that FareShare purchased.

2.2.1. Scope 1 emissions - emission derived from fuel usage for owned or leased vehicles

FareShare's Scope 1 emissions are direct greenhouse (GHG) emissions that occur from sources that are controlled or owned by FareShare. For FareShare this means combustion from their owned or leased vehicles. FareShare provided fuel cards and bills showing the total amount of fuel purchased and used, it also shows additional costs related to the vehicles.

Emissions derived from purchased fuel consumption were calculated using BEIS emission factors 2019/2020, as shown in equation 3 below:

Equation 1: Calculating the emissions related to fuel usage.

$$Fuel\ CO_2e\ emissions = Fuel\ litre\ usage * BEIS\ conversion\ factor$$

The information from the fuel cards provided the overall litres purchased. The fuel cards also show additional purchases that related to the vehicles E.g., Oil, window screen wash, Ad-Blue environmental chemical solution. These were included within in the boundary because they would fall under transportation related costs. For these cost types, EEIO factors were applied to reflect the associated emissions. These factors are detailed on the "EEIO – emission factors" tab within the model.

It was confirmed by FareShare that the invoices they provided show the total amount of fuel purchased and used. Subsequently, BEIS conversion factors for 2019/2020 have been used to calculate the upstream emissions of purchased fuel. These factors are detailed on the "BEIS – emission factors" tab within the model. By applying the appropriate emissions factor, the footprint reflects an estimate for the CO_2e emissions associated with the vehicles that are leased and/or owned by FareShare. By using full life cycle for fuels for Scope 1 and outsourced transportation and distribution, the footprint is compliant with a product carbon footprint methodology and therefore a fair comparison with the product footprint approach for the collected food.

2.2.2. Scope 2 emissions - emission derived from energy consumption

Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, heat or steam. FareShare's only has purchased electricity within their Scope 2. Electricity consumption is calculated and cross-verified using usage based and spend base approaches. The different approaches applied are differentiated in the model by colour.

FareShare provided a set of invoices and as MS Excel sheet showing the total spend on electricity purchased. For locations were kWh used were available an average kWh usage approached was used. For the remaining locations, were only the total financial spend was available, a spend based approach was used. Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, heat or steam. FareShare only has purchased electricity within their Scope 2. Electricity consumption is calculated and cross-verified using usage based and spend base approaches. FareShare provided a set of invoices and an Excel sheet showing the total spend on electricity purchased. Based on these types of data a mix method approach was used.

kWh usage approach

For a kWh usage approach, electricity invoices were available and included information on kWh used. Emissions were calculated based on kWh electricity consumed. Given that a full breakdown per month per site was not available, the annual electricity consumption was estimated based on average daily usage and subsequently extrapolated from available invoices to reflect a full year usage.

Subsequently, BEIS[2] conversion factors for 2019/2020 have been used to calculate upstream emissions of purchased electricity. These factors are detailed on the "BEIS – emission factors" tab within the model. Also, for electricity, a full life cycle emission factor was assessed for a fair comparison with the product carbon footprint approach for the collected food.

Equation 2: Calculating the emissions related to electricity.

$$Electricity\ CO_2e\ emissions = Electricity\ average\ kWh\ usage * BEIS\ conversion\ factor$$

Spend based approach

Based on the total spend to an electricity supplier, the spend was divided by the average p/kWh, to show the total kWh used. By applying this method, the model reflects an estimate which is less accurate than based on actual kWh. Subsequently, the result for this approach currently shows an estimate, based on this, BEIS full life cycle emission factors were applied. By applying the emission factors, it reflects the $kgCO_2e$ emitted for the electricity purchased by FareShare.

Equation 3: Calculating the emissions related to electricity (spend based).

$$\text{Electricity } CO_2e \text{ emissions} = \left(\frac{\text{Electricity spend}}{\text{Average p/kWh per supplier}}\right) * \text{BEIS conversion factor}$$

2.2.3. Emission derived from outsourced transportation and distribution

FareShare provided financial spend on all paid-for transportation and distribution activities; the expenses were broken down by supplier. Of the total costs spend on the transportation and distribution suppliers, Carbon Trust assumed that only a part of it was allocated for fuel use. To account for the associated emissions from fuel use, a proportion of the spend was used. Based on research from the Freight Transport Association[3], an average of 27.24% of total costs to transportation is allocated to fuel. This proportion of fuel costs was divided by the 2019 average fuel price per litre[4]. This gave an estimate for the total volume of fuel consumed by each supplier. Subsequently, BEIS full life cycle conversion factors for 2019 are used to calculated emission associated with the purchased fuels

2.3. Assumptions

Assume all the data is accurate and of reasonable quality and it is line with UK average. Moreover, it is assumed that FareShare has some level of operational or financial control over the FareShare business units (East Anglia, Depthford London Office, Merseyside, 'Office', 'Office Business', Southern Central and West Midlands) that fall under the discussed boundary. As mentioned, assumptions were made both for the average kWh approach as for the spend-based approach. Both reflect a location-based emission approach rather than specific to the energy grid supplier or specific distribution supplier.

3. Embedded environmental impact of redistributed waste food

For each food item that FareShare collects and prevents going to waste the embodied carbon and water used in the process of cultivating, manufacturing and transporting those food items are also prevented from going to waste. This is what constitutes the embedded environmental impact of FareShare as an organisation and will form the positive portion of the net impact of FareShare's operations.

The embedded environmental impact of redistributed waste food is measured in both a carbon and water footprint. The emission factors of food items were taken from Carbon Trust databases, developed with over 20 years of experience in carbon accounting. The water factors that convert the food waste mass into embedded water in m^3 is sourced from the Water Footprint Network. The methodological approach is explained in the following sections.

3.1. Data sources

3.1.1. Activity data sources

The data files provided by FareShare that have been included within the environmental impact model are related to food categorisation and the pallet weights of the individual categories that are distributed.

The food categorisation data included all the food items that FareShare have received and distributed within its system throughout the reporting year. This file also includes the outcome of the food categorisation that was undertaken by FareShare, assigning each food item to their own primary food categories and the emission factors that will be used in the impact model. The data includes the radials travelled by each food item within the FareShare network, these distances and their fuel usages were included within the calculation of the Scope 1&2 and outsourced transport model, which allowed for a net impact in terms of carbon emissions to be calculated.

The data within the file for average pallet weights assigned the average mass of each pallet for each of FareShare's primary categories, the overall tonnage of avoided food was calculated to be 6,700 tonnes within the reporting period. Of this mass 12% of the stock was not redistributed and accounted for as waste, as detailed within the logistics invoices.

3.1.2. Emissions data sources

Cradle-to-grave emission factors that incorporate upstream transport were used to calculate the avoided emission of food items. These emission factors were sourced from Carbon Trust databases compiled from a literature review[5] based on the UK industrial average data.

The embedded water consumption of the food waste was calculated using water factors from research undertaken by the Water Footprint Organisation and UNESCO-IHE[6,7].

3.2. Methodology

3.2.1. Carbon emissions

Firstly, FareShare matched the categories of FareShare's stock to the emission factors available in the database based on the similarity of the food items to the emission factors; 92% of total pallets of the stock within the reporting year were assigned to a food category with a suitable emission factor.

The data that was provided came in the form of product item, primary category, categorisation to the CT emission factor and the number of pallets of each item. FareShare has previously analysed the average pallet weight of each primary food category. The categorisation then resulted in food items being summed together by FareShare primary category and CT emission factor.

This allowed the resulting number of pallets to be converted into a final mass using the FareShare average pallet weights. This mass was then used in a simple formula to find the avoided emissions of food waste:

Equation 4: Emissions related to avoided food waste

$$CO_2e \text{ emissions of avoided food waste} = \text{activity data} * \text{emission factor}$$

The calculations followed the GHG Protocol Corporate Value Chain Standard Category 1 methodology.

The remaining 8% of the stock by number of pallets could not be specifically categorised to any emission factor because of the nature of the food items, i.e., 'Ambient Mixed Stock'. The proportion of each primary food category within the categorised stock was calculated, and the remaining uncategorised stock was assigned to each different food category. This 8% of stock was included in the overall emission calculations, using equation 2 above.

Densities of food items found within the FAO/INFOODS Database were used to in cases where food mass needed to be converted to volumetric measures, to match the unit of emission factors ($kgCO_2e/l$).

There is a 12% wastage of the overall tonnage of food that did not eventually become redistributed by FareShare. In the base scenario this food would have gone to waste regardless with the same embedded emissions, so this wastage was not modelled. However, there is an efficiency loss within FareShare's process because of the non-avoided food waste, from the transportation and storage of these items.

3.2.2. Embedded water

Due to the nature of water footprints and the research around water factors, the embedded water footprint was calculated to a higher level than the carbon footprint. By mass, 60% of FareShare's stock was categorised to match existing water factors, which mainly consisted of meat, fruit, vegetables, and other crops. Similarly, to the carbon footprint the number of each category's pallets was converted to mass which then was multiplied by a water factor to find the overall embedded water in m^3.

The proportion of each food category within the categorised stock was calculated, this allowed for a weighted average of the water factors used to be found. This water factor was then applied to the remaining 60% of the stock that could not be assigned to a specific water factor. Meat was categorised in a similar way with four water factors relating to meat but a significant number of pallets within the 'Meat' primary category that were ready meals and frozen food. The proportion of each meat category was found by number of pallets and the remaining pallets were assigned to the categories based on that proportion. Cured meat items were assigned to pork, and turkey was assigned to chicken.

Similar to the avoided carbon emissions the embedded water associated with the non-redistributed food waste would have gone through the usual end of life destinations in the base scenario.

3.2.3. Assumptions/expert opinions

The packaging End-of-Life (EoL) emissions did not require modelling as these emissions would be the same regardless if FareShare redistributed the food items or not, so these emission factors were not applied to the avoided carbon emission calculations.

For the food items data provided by FareShare, the following assumptions and decisions were made. Firstly, that the average pallet weights for each primary category were representative of the real pallet weights involved in FareShare's network. Following the categorisation exercise completed by FareShare, the mass of the remaining uncategorised stock was distributed amongst the categorised stock by proportion to the total weight.

For the meat category within the water footprint, firstly, the water factor for pig and chicken are considered to be the closed match for cure meat and turkey respectively. Secondly, the pallets that contained ready meals and frozen food within the 'Meat' primary food category were allocated to the other categorised water factors on a proportion basis.

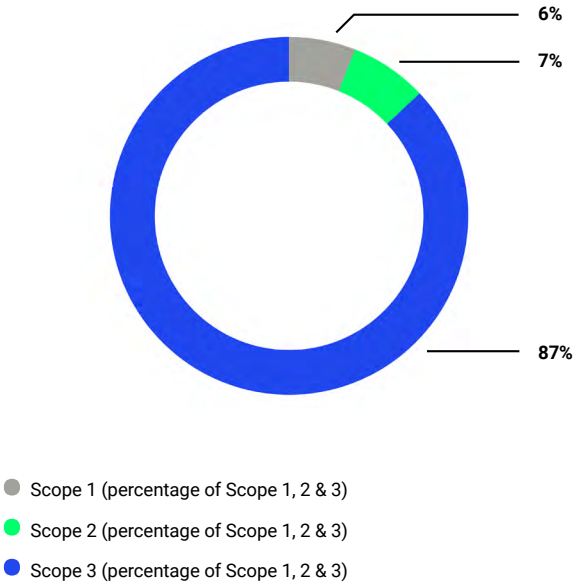
4. Results

This section provides the results of FareShare's environmental assessment for both the Scope1&2 and outsourced transportation and distribution footprint and the environmental impact of the avoided food waste.

Overall, FareShare's own footprint shows that their Scope 3 emissions associated with paid for transportation accounts for the vast majority of the CO_2 produced by their own activities. If FareShare wanted to reduce their own emissions to increase their net environmental impact further then their Scope 3 would be the most appropriate section to decrease.

The results of FareShare's overall Scope 1&2 and outsourced transportation and distribution footprint was 1,510.46 tCO_2e, with Scope 1 accounting for 5.91% and Scope 2 accounting for 7.39% and outsourced distribution and transportation for 86.69% of the total footprint. This can be put simply as the Scope 1 emissions are made up of the fuel consumption of FareShare's owned fleet and the Scope 2 emissions was the electricity consumption of FareShare's sites and the scope 3 category, outsourced transportation and distribution, as other distribution that FareShare paid for. Comparing FareShare's own operation against the outsourced transportation and distribution, this is considered minor.

Figure 4: Overall Scope 1&2 and outsourced transportation & distribution emissions (tCO_2e)

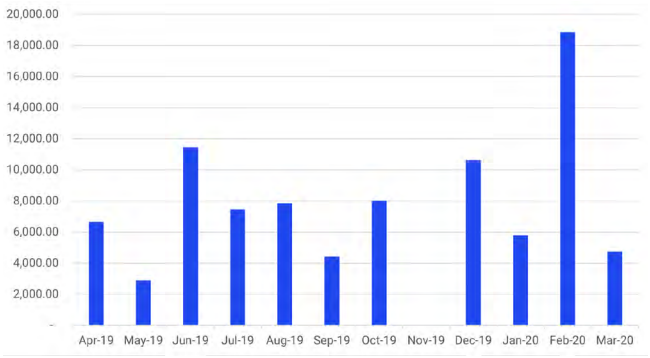


4.1. Scope 1: Fuel use

Scope 1 fuel use accounts for 5.91% of the total footprint, resulting in 89.30 tCO_2e. Figure 5 demonstrates the monthly breakdown of diesel fuel consumption.

However, it should be mentioned that this breakdown reflects an accounting breakdown rather than an fuel usage breakdown per month. Therefore, it does not represent fuel usage for that month, rather when accounting occurred It is however confirmed by FareShare that on an annual basis, fuel consumption does match fuel usage.

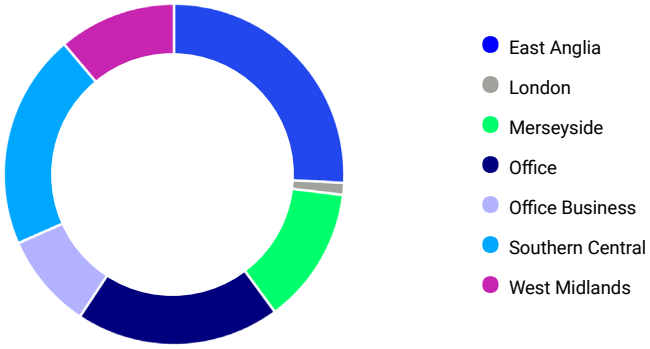
Figure 5: Fuel use emission by month - diesel (tCO_2e)



4.2. Scope 2: Purchased electricity

The pie chart below details the proportion each site location accounted for within the Scope 2 footprint. As can be seen, the site name 'East Anglia' and 'Southern Central' were the two locations with the highest emissions, combined totalling 51.63 tCO_2e, 46% of the Scope 2 footprint.

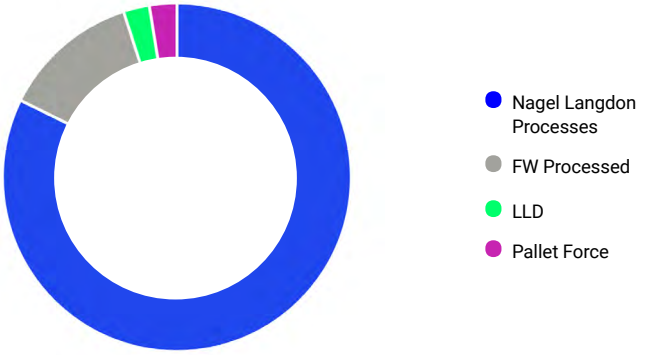
Figure 6: Electricity carbon emission (tCO_2e) breakdown by site location



4.3. Scope 3: Outsourced transport & distribution

The pie chart below portrays the carbon emission breakdown per supplier. The total carbon footprint of outsourced transport and distribution totalled 1,019.46 tCO_2e. The largest proportion of emissions is allocated to the supplier 'Nagel Langdon Processes', covering 82% of the total outsourced transportation and distribution emissions.

Figure 7: Carbon emissions (tCO_2e) breakdown by transportation and distribution supplier



4.4. Embedded environmental impact of redistributed waste food results

4.4.1. Carbon footprint

The overall carbon footprint of the food waste avoided by FareShare totalled 10,698 tCO_2e, which came from 6,699 tonnes of food waste in total. The two largest food categories by emissions were Dairy and Vegetables, accounting for 51.2% of the overall footprint. Alongside Dairy and Vegetables, only the Ready Meals, Fruit and Meat categories made up more than 5% of the overall emissions.

Figure 8: Carbon emissions (tCO_2e) breakdown by primary food category

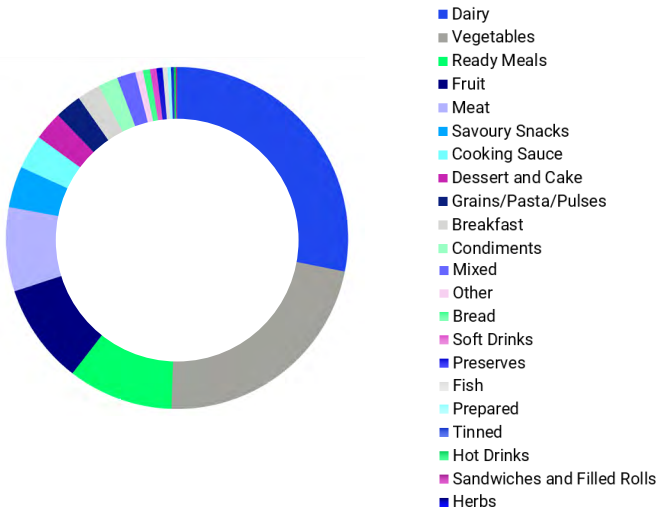
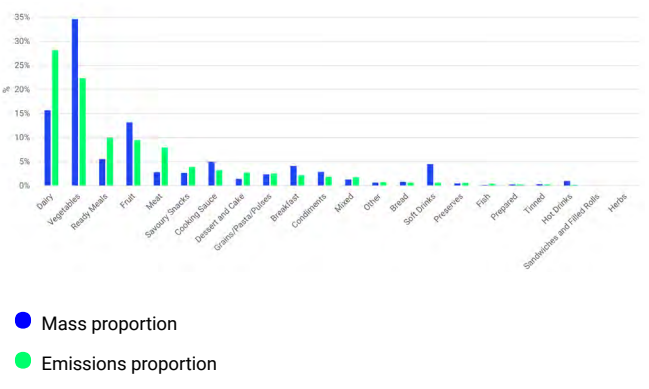


Figure 9 below details the differences in the overall mass of the different primary food categories and their associated emissions.

Figure 9: Proportion of total mass (tonne) and carbon emissions (tCO_2e) by primary food category



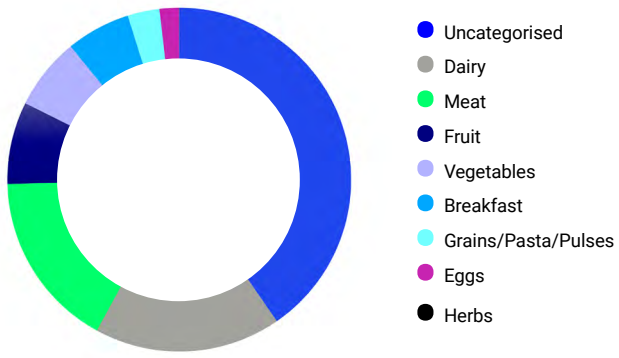
4.4.2. Water footprint

The total water footprint of the avoided food waste was 10,216,904 m³ of embedded water from the same mass of 6,699 tonne. The greatest category for the water footprint were food items within the uncategorised section, due to 40% of the stock by mass being uncategorised for the water footprint. As this category used the weighted average water factor of the remaining 60% categorised stock, its proportion of the water footprint was also 40%.

This 40% of uncategorised stock is due to the lack of available research into embedded water of food products. Water-based life cycle assessments focus on produce from farms rather than individual end products that are sold in supermarkets. This means that there is a large proportion of the stock that FareShare redistributes that is unassigned to a specific water factor.

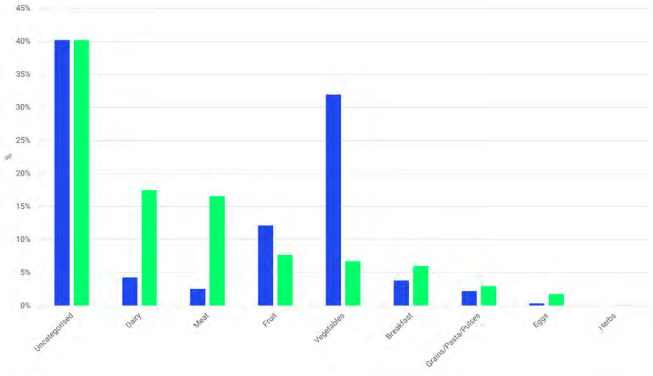
The largest categories that were assigned specific water factors were Dairy and Meat with water footprints of 1,786,245 m³ and 1,691,855 m³ respectively, with only Fruit, Vegetables and Breakfast having water footprints greater than 5% of the overall footprint.

Figure 10: Water footprint (m³) breakdown by primary food category



As can be seen in Figure 11, the differences in the proportion of overall mass and embedded water of the different primary food categories are great. The water intensity for dairy and meat outweighs the vegetables, even though vegetable products have the largest mass proportion, the embedded water footprint is less than half of the diary's footprint.

Figure 11: Proportion of total mass (tonne) and embedded water (m³) by primary food category



4.5. FareShare net impact 2019/2020

The two exercises that have been conducted by Carbon Trust effectively show the emissions associated with FareShare's operations and the avoided emissions of the food waste. The net impact of FareShare's operations subtracts their own footprint which includes their utility usage and transportation from the emissions associated with avoiding the food they redistribute.

The project found that FareShare had prevented approximately 6,699 tonnes of surplus food going to waste, which helped contribute to the mitigation of an estimated 10,698 tonnes of carbon emissions annually. Considering FareShare's operational emission of 1,246.87 tCO_2e in total, FareShare achieved net impact of 9,450.13 GHG abatement in total for reporting year 2019/2020.

This is shown in figure 12 and 13 below.

Figure 12: FareShare footprint (tCO_2e) proportion to Carbon footprint (tCO_2e) of food waste avoided

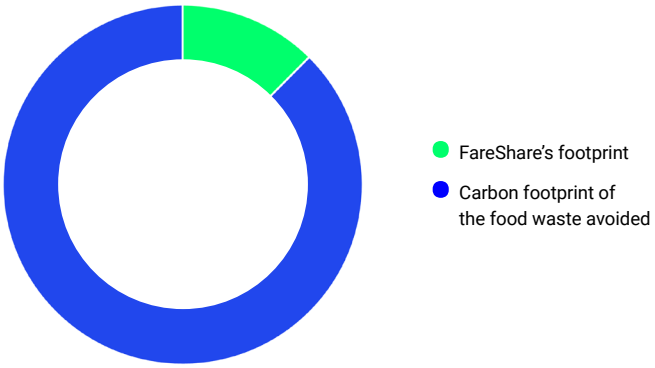
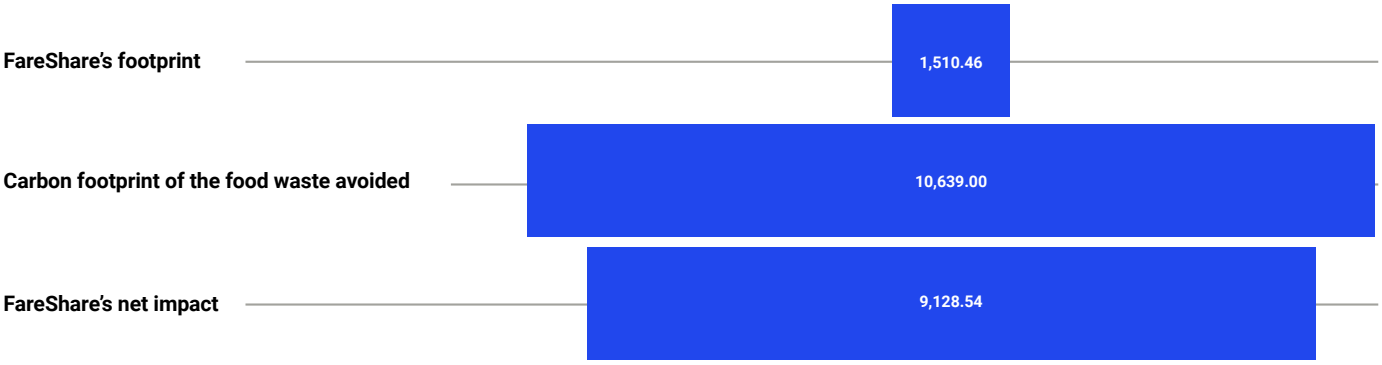


Figure 13: The net emissions (tCO_2e) of FareShare's operations, compared to their footprint and avoided emissions (tCO_2e) of the redistributed food waste



5. Summary and recommendations

This report has set out the methodology for assessing FareShare's impact both of their own operation emissions and avoided emissions and embedded water due to the re-distribution of food waste. It also provides the net environmental impact of avoiding food waste and an analysis of those results. It details the assumptions applied and decisions made by the Carbon Trust in the development of the two models.

Below set outs the process required to update the models and recommendations for future improvements.

5.1. Recommendations

FareShare's own operation emissions

Firstly, it is recommended to report on CO_2e emissions both on location-based and market-based approach as the best practice, to provide more reliable calculation for carbon emission derived from purchased electricity.

Secondly, fugitive gases (also known as F-gases) of FareShare's operation is not included in the analysis due to absence of data. These F-gases relate to refrigeration or air conditioning units and have a very high global warming potential. Due to the nature of FareShare's operations with regards to the refrigeration of certain food items, the emissions associated with F-gasses could be sizeable. Therefore, clear documentation of fugitive emissions would allow FareShare to gain clearer understanding of the Scope 1&2 emissions.

Thirdly, for outsourced transportation and distribution that FareShare paid for it is recommended to retrieve either distance data or fuel purchased data from the suppliers. This will provide more reliable calculation associated with the distribution and assess if and how these emissions can be tackled. This could potentially result into an overall reduction of FareShare's net impact.

Embedded environmental impacts of redistributed waste food

Firstly, it is recommended as part of FareShare's own data collection within their databases that they assign individual food items to the appropriate carbon emission factors to allow for a more automatic process of calculating the embedded carbon emissions.

Secondly, the water footprint that has been calculated is a high-level embedded water consumption of the food items that FareShare processes. Currently only the water that is used to grow or create a food item is calculated with no consideration for water origins and scarcity how water scarce the region is. This would allow for a more accurate result of the overall environmental impact of the avoided food waste. However, there is still minimal research into this area and may not merit the resources required to complete.

6. Endnotes

1 Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, WBCSD, WRI

2 BEIS emissions factors are used by UK and international organisations to report on 2019/2020 greenhouse gas emissions Source for the BEIS emission factors: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

3 Transport Engineer, Operator Costs survey 2019: http://www.transportengineer.org.uk/transport-engineer-features/operator-costs-survey-2019/199509

4 BEIS Monthly and annual prices of road fuels and petroleum products: https://www.gov.uk/government/statistical-data-sets/oil-and-petroleum-products-monthly-statistics

5 Sources included Ecoinvent 3.7.1, World Food Life Cycle Database, Agrifootprint database and academic journal publications.

6 Mekonnen, M & Hoekstra, A: The Green, Blue and Grey Water Footprint of Farm Animals and Animal Products, 2010

7 Mekonnen, M & Hoekstra, A: The Green, Blue and Grey Water Footprint of Crops and Derived Crop Products, 2011

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