Greenhouse Gas Analysis of Arrowtown Drinks

Analysis of the greenhouse gas emissions associated with Arrowtown Drinks by Zevero LTD

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Contents

Abstract

An environmental assessment was undertaken for the greenhouse gas (GHG) emissions of Arrowtown Drinks in line with GHG Protocol product standards. Arrowtown's scope 1, 2 and 3 emissions were analysed and the emissions for Arrowtown's two alcoholic sparkling water drinks. The assessment found that 10.22% of total emissions fell into Scope 1, 1.17% within Scope 2 and 88.61% within Scope 3. Scope 3 emissions are split into upstream and downstream activities of which 92.50% relate to upstream emissions and 7.50% in downstream emissions. For the two Arrowtown products analysed, Red Berries (RB) and Lime and Elderflower (LE) the Global Warming Potential (GWP) was equal to 0.279kgCO_2e and 0.278kgCO_2e respectively. Arrowtown's Corporate footprint is 9.77t CO_2e during the reporting period.

1 Introduction

An environmental assessment was undertaken to calculate the greenhouse gas (GHG) emissions for Arrowtown Drinks and their products Red Berries (RB) and Lime and Elderflower (LE). This report aims to provide complete transparency in outlining how the results were collated to inform readers of the GHG emission hotspots in the supply chain. This report has been conducted with reference to the GHG Protocol Corporate and Product Standards [1, 2, 3].

All aspects of direct and indirect emissions have been considered and are explained within the main body of this report. In completing this analysis Arrowtown Drinks seeks to identify GHG emission hotspots for reductions and offset. Arrowtown Drinks understands the importance of reducing its carbon footprint and will continue to operate in conjunction with being environmentally conscious.

1.1 Aims and Objectives

The overall aim is to complete a full GHG assessment of Arrowtown Drinks and their two products, RB and LE through direct and indirect processes to allow the company to understand their carbon footprint and decide on emission reduction strategies in future business practices.

Best practices in reduction techniques will be highlighted in the main body of this report after the full GHG assessment results have been completed. This systematic approach to the analysis is critical in choosing the right mitigation strategies in GHG reduction.

2 Methodology

2.1 Standard Compliance

This report is based on compliance conditions with the GHG Protocol Corporate Standard and GHG Protocol Product Standard. Full transparency is provided about the sourcing of results that should be used for customer and business education. Any source which has been used in the main body of the report or appendices are referenced.

In line with the GHG Protocol Corporate Standard, Scope 1 emissions focus on direct emissions to the environment from company operations while Scope 2 focuses on the indirect emissions drawn for energy generation involved in the company's operations. Finally, Scope 3 emissions are intended to hold companies accountable for their wider impact on the environment, not just direct emissions from operations. Scope 3 emissions are split into upstream and downstream emissions. Upstream emissions relate to factors that are attributed to material acquisition and pre-processing whereas downstream emissions relate to distribution and end of life. Table 1 shows an overview of the scopes and their respective activities. It was intended that all possible activities, contributing to Scope 3 emissions were accounted for, to provide the most accurate representation of Arrowtown's total emissions.

Table 1: The activities contributing to Arrowtown Drinks Corporate Standard footprint.

Scope	Related Activities
1	Company Vehicles
2	Generation of purchased electricity
3 (Upstream)	Agricultural Transport Arrowtown packaging Fuel WTT Product Processing Product Transport Raw Ingredients Water Supply Water Treatment
3 (Downstream)	Delivery of Goods End of Life Material Disposal

The GHG Protocol Product Standard factors are outlined in Table 2. Two of Arrowtown Drinks were analysed; Red Berries (RB) and Lime and Elderflower (LE). All agricultural subsections were included in the Product Standard calculation. The calculations were then used as the basis of the Corporate Standard for agricultural inputs. Sections omitted from the Product Standard were done so due to not having reasonable emission attribution to the final products being sold and therefore would be unreasonable to aggregated into the final product emissions. During the results section, the differences between Corporate and Product Standards are made apparent.

Table 2: The activities contributing to Arrowtown Drinks Product Standard footprint.

Product Standard	Included Activities	Omitted Activities
Agricultural	Agricultural Transport Raw Materials	Agricultural Packaging
Processing	Electricity Gas Refrigerant Leakage Water Use Water Treatment	Capital Goods
Packaging	Aluminium Cans Packaging Labels Cardboard Packaging Pallets and Pallet Wrap	
Transportation	Transport to Distributor Delivery Transport	Employee Commute

2.2 System boundaries

The main system boundaries for the assessment are shown in Figure 1. This assessment focuses on a "cradle-to-grave" approach, with the main categories being: agricultural inputs, transport, processing, packaging, waste and delivery transport. The system thus covers all of Arrowtown Drinks' decisions that contribute to their overall GHG emissions. By using this boundary, Arrowtown Drinks can extrapolate key areas in their supply chain and have the opportunity to adapt operations to further lower their total emissions.

Excluded from the analysis were office related equipment e.g. pens, paper and marketing collateral due to the minimal impact they would have on Arrowtown Drinks carbon emissions and the lack of data available.

2.3 Data Collection and Uncertainty

Arrowtown Drinks provided records of all data necessary for the completion of the analysis. Data inventories were reviewed by Zevero LTD to determine quantities and sourcing locations relating to agricultural inputs, transport, processing, waste, delivery and consumer activities. Where data had not already been collected or further detail was required, further research was carried out with suppliers contacted directly for information.

Corresponding emission data in this paper was collected from various published sources and leading life cycle assessment (LCA) databases for specific products. LCAs are seen as one of the most accurate ways of analysing the environmental burden of specific products. LCA sources are conducted in the vast number of cases on guidance outlined in the ISO 14044/14040. However, input data can vary affecting the transferability and comparability of certain sources. To account for this, each source has been reviewed to determine the quality and applicability of input methods. Where necessary, sources have been modified to account for updated figures. To obtain accurate data, the most up to date papers from reliable sources were used for each aspect. When there was no exact data existing on a certain topic, estimates have been assumed and recorded. Any uncertainties that were qualitatively thought to be significant were then subjected to the sensitivity analysis in this report.

2.4 Impact Factors

Many sources referenced in this paper include multiple impact categories to try to evaluate the whole environmental burden of a specific item. In line with the GHG Protocol standards, the scope of this assessment is limited to global warming potential (GWP) which is measured as a function of carbon dioxide equivalent (CO_2e). This impact category uses the global warming potential of CO_2 as a reference value and analyses gases environmental impact over a 100 year period. The GHG gases considered included: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, where all GWP were related to the IPCC Fifth assessment report. Table 3, highlights the different conversion factors for the three main GHG as recorded in the IPCC Fifth assessment report [4].

Table 3: An overview of the most common greenhouse gases and their global warming potentials.

Greenhouse Gas	Notation	Global Warming Potential
Methane	CH_4	28
Nitrous Oxide	N_2O	265
Carbon Dioxide	CO_2	1

2.5 Functional Unit

The assessment was conducted with number of sold products as the functional unit. The density of Arrowtown Drinks was 0.9kg/l based on an ingredient breakdown provided by a supplier. This functional unit was used to normalise different papers to achieve an overall $kgCO_2e$/330ml can for each product to enable ease of comparison. For total cumulative emissions (Scope 1, 2 & 3) the unit of analysis has been shown as $kgCO_2e$.

2.6 Transport

The origin of specific products was source and estimated freighting methods from major origin ports to the UK. Four major methods analysed were an average HGV with an average laden, an average cargo ship, an average van and an electric car. None of the products have been assumed air-freighted due to the shelf life and the type of product.

Delivery methods for Arrowtown Drinks have been calculated by analysing all customer orders and running a postcode-to-postcode Google Maps API calculation to find the average customer distance. As Arrowtown distribute products themselves and through an external logistics provider, a percentage breakdown was calculated to improve the accuracy of emission data for each delivery method. The average distance for Arrowtown Drinks' customer orders delivered by a logistics provider was 131.38km. The average

distance for drinks distributed by Arrowtown Drinks was assumed to be 20km per trip as all orders completed by Arrowtown Drinks are done locally.

2.7 Agricultural Inputs

Ingredients lists were gathered for Arrowtown Drinks two core products RB and LE. Across the two products, 100% of the products by weight were analysed.

Papers collected in this study assess a number of sources of emissions from farming. These can be broken down into:

- **Synthetic Fertilizers and Lime**
  Greenhouse gas emissions associated with fertilizer production vary according to different processing technologies and energy sources. Most analysis includes emissions from three primary nutrients (N, P and K). CO_2 emissions during the production of these inputs result from the energy required for production and transport.

- **Production of pesticides**
  In order to control weeds, pests and diseases, farmers apply chemicals such as herbicides, fungicides, and insecticides to crops. GHG emissions are released during the manufacture of pesticides, which includes formulation, packaging and transportation.

- **Production and maintenance of farm machinery and equipment**
  Greenhouse gas emissions from the use of machinery and equipment for crop production can be categorised into direct and indirect emissions. The direct emissions related to feed crops are caused by the burning of fossil fuel during field operations and the indirect emissions arise from the manufacture of farm machinery, amortisation and maintenance of the machines.

- **Land use change**
  Soils are an important part of the carbon cycle and changes in soil carbon can influence GHG emissions. GHG emissions can result from soil carbon losses caused by land-use changes (LUC).

- **On-farm machinery use for field operations**
  Agricultural machinery can be employed in a number of field activities such as soil management, fertilization, harvesting, irrigation, etc. On-farm emissions associated with the use of fossil fuel use for field operations will vary by cropping practice, the scale of production, level of mechanisation and type of machinery used.

- **Abstraction of groundwater for irrigation**
  The direct energy inputs are primarily used to operate farm machinery and pumps, while indirect energy inputs refer to energy used to produce equipment and other goods and services used on-farm. Where groundwater is used, more energy is required for pumping. The energy required for pumping depends on the crop water requirement, total head, flow rate and system efficiency.

- **Application of agricultural lime**
  Agricultural lime is commonly used in the management of croplands and grasslands to decrease soil acidity. Lime is often applied in the form of crushed limestone ($CaCO_3$) or crushed dolomite ($CaMg(CO_3)2$). Adding carbonates to soils in the form of lime or dolomite leads to CO_2 emissions as the carbonate limes dissolve and release bicarbonate ($2HCO_3$), which breaks down into CO_2 and water

- **Nitrous oxide emissions from soils**
  In most soils, an increase in available nitrogen enhances nitrification and denitrification rates, which then increases the production of N_2O, along with indirect emissions from leaching and volatilization. The main sources of N_2O included in the methodology for estimating N_2O emissions from soils include synthetic nitrogen fertilizers, organic nitrogen applied as fertilizers e.g. animal manure, nitrogen in crop residues. Many fertilizers contain nitrogen, part of which is released into the atmosphere as nitrous oxide.

The above inputs in the agricultural phase are often specific to the study of the individual farm. There can be different values between different farms due to the differing production conditions and methods. The uncertainty for this therefore must be considered when analysing results. Reasonable assumptions were made with respect to productions climates and the agricultural processes for each product.

Depending on the product, one or more of the above emission sources can be not applicable, therefore omitted from specific LCAs. Notably, land-use change is not included in a number of papers referenced in this assessment. The effects of land-use change are very product/country of origin-specific and therefore it is hard to generalise. For example, the land-use change of the majority of apple production in the UK would be negligible as apple trees have been established for a number of years, whereas the effects of land-use change are significant for beef produced in Brazil due to the large amount of deforestation required to produce grazing land.

2.8 Processing

Analysis of the environmental burden linked to processing takes into account the GHG emissions from the energy consumption to turn the raw product into the final item that is sold. The majority of the energy consumption in the processing phase is the electrical and gas use of capital machinery not owned by Arrowtown Drinks.

The processing of turning raw ingredients into Arrowtown Drinks' products is outsourced to a facility outside the company's operational control, therefore, making data collection harder. Instead, an LCA for sparkling beverages was used to

estimate the emissions of four key processing stages: ingredient Mixing, canning, refrigeration and pasteurisation [5].

2.9 Packaging

The main source of Arrowtown Drinks emissions is 330ml aluminium cans. Data on CO_2e emission from aluminium cans include the average EU recycling rate of 72.9% which was consistent with suppliers' information [6]. Other product packaging emissions included the product label.

The packaging Arrowtown used for distribution was also analysed. This included wooden pallets , pallet wrap and cardboard boxes. Boxes were weighed and calculated against their respective emission factors.

2.10 Waste

End of Life (EOL) analysis was conducted for all of Arrowtown Drinks upstream and downstream products with all items assumed to be recycled or reused.

3 Grouped Results

The results are separated into grouped results, GHG Protocol Corporate Standard results and GHG Protocol Product Standards results. Please see Tables 1 and 2 in the methodology section of this report to understand the inputs for both the protocol and product standards.

The following section outlines GHG emissions for agricultural inputs, processing, transport and packaging. Each section of results has been weighted to best display the relative emission burden. For a full breakdown of results please see the supplementary data. Transport of agricultural products was deemed part of "agricultural input" results and has been omitted from the transport section.

3.1 Processes

The highest emission contributor during the processing phase is the refrigeration and cooling of the drink after it has been canned, making up 96% of total processing emissions. Wasted products are excluded from the boundaries of this report due to a lack of data.

3.2 Transport and Delivery

Transport emissions for Arrowtown Drinks were based on production to distribution and distribution to customers. Production to distribution was a 70/30 split between two locations. The average distance travelled between distribution and customer location was 380.45km. The emissions from the distribution to the customer were split between two methods each using different transport types. Third party logistics were assumed to be using an average laden van with Arrowtown distributing orders locally through an electric vehicle.

3.3 Waste and Packaging

Figure 1 demonstrates the total GHG emissions (production and End of Life) for all packaging types during the reporting period. The aluminium can and cardboard box take up a significant majority of the emissions from product packaging. Aluminium cans however are infinitely recyclable and are more likely to be recycled at the kerbside than glass or plastic. Cardboard is also required for the delivery of the product. In figure 1, other packaging includes pallets, pallet wrap and tape rolls.

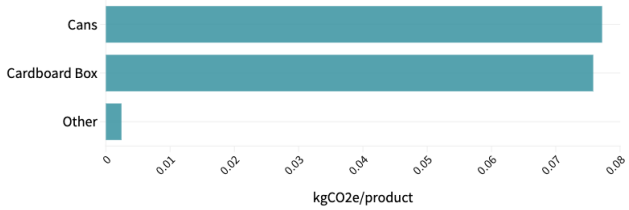


Figure 1: The packaging emissions associated with Arrowtown Drinks

4 Corporate Standard

The relative scope emissions shown in Figure 2, shows that 10.18% of the total emission burden for the reporting period is associated with Scope 1, 1.58% with Scope 2, 81.63% with Upstream Scope 3 and 6.61% with Downstream Scope 3.
All specific scope emission breakdowns are shown in the following section.

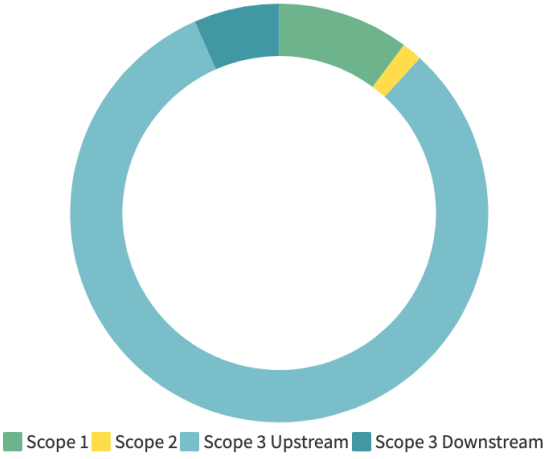


Figure 2: The full scope 1, 2 and 3 emissions of Arrowtown Drinks

4.1 Scope 1

Scope 1 emissions for Arrowtown Drinks is solely from the emissions of company vehicles. This totals 998.85 $kgCO_2e$ for the reporting year. For fuel use, well-to-tank emissions are accounted for in Scope 3 emissions.

4.2 Scope 2

Arrowtown Drinks only had a small amount of Scope 2 emissions based on working from home and the subsequent generation of purchased electricity, this totalled 114.15 kgCO_2e for the reporting period [7]. The well-to-tank emissions of purchased electricity were accounted for in Scope 3 emissions.

4.3 Scope 3

88.61% of Arrowtown Drinks emissions fall into Scope 3. The majority of these emissions are in the packaging, raw materials and transport of Arrowtown's products. The other in the graph below is the well-to-tank emissions from Scope 1 and 2.

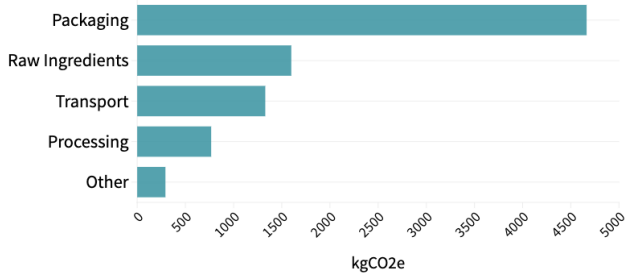
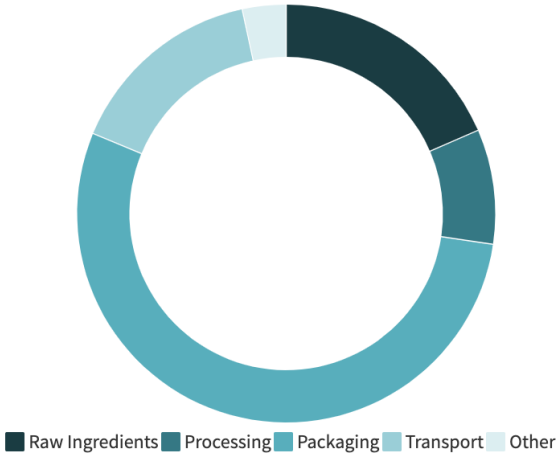


Figure 3: The Scope 3 emissions of Arrowtown Drinks.

5 Product Standard

Both Arrowtown products have nearly exact GWPs. There is a marginal difference of 0.39% between the two drinks. This is due to the Agricultural Inputs of Arrowtown's products.

Each can of Lime and Elderflower drink has a carbon footprint of 0.278kgCO_2e. The Red Berries drink has the higher of the two footprints with a carbon footprint of 0.279kgCO_2e.



5.1 Sensitivity Analysis

Parameter choices used when modelling includes a certain degree of uncertainty. To analyse the effect of different uncertainties, a sensitivity analysis was conducted for various aspects. For each sensitivity analysis, the effect was recorded on the Product and Corporate Standard.

• Agricultural input: the effect of increasing the emissions of the spirit base by 50% was conducted.
• Product packaging: other packaging emissions (labels, pallets and pallet wrap) were increased by 100%.
• Processing: the energy required in the product processing stage was increased by 100%.

The results of the sensitivity analysis are shown in Table 4 and 5.

Table 4: Sensitivity analysis results, showing percentage change (increase) in the Corporate emissions for each Scenario 1, 2 & 3

	Scenario 1 (%)	Scenario 2 (%)	Scenario 3 (%)
Corporate	5.57%	0.73%	7.82%

Table 5: Sensitivity analysis results, showing percentage change (increase) in products for each Scenario 1, 2 & 3

Product	Scenario 1 (%)	Scenario 2 (%)	Scenario 3 (%)
RB	6.98%	0.86%	9.17%
LE	7.00%	0.86%	9.20%

Increasing the emission factor for the base spirit by 50% had a moderate impact on both the Corporate and Product footprint. The impact was greater on the Product footprint.

The doubling of emissions associated with other packaging (label, pallet and pallet wrap) had minimal impact at only 0.86% for the Product footprint and 0.73% for the Corporate footprint.

The greatest change was from doubling the emissions associated with the processing of each Arrowtown Drink. This figure was used as the data was not collected from source, instead an LCA on the processing of canned sparkling drinks. Doubling the emissions associated with processing had a 7.82% on the Corporate footprint and up to a 9.2% impact on the product footprint. This was an extreme case variance but still falls within a 10% increase in emissions.

6 Discussion

Analysis of Arrowtown Drinks highlighted the main carbon hotspots to be the packaging of their products, transport and the use of a company car.

Although packaging is a major contributor to Arrowtown Drinks' total emissions, current data shows that cans have a lower environmental burden than glass bottles. Furthermore, cans have a high packaging efficiency when placed into cardboard boxes, therefore reducing the GHG emissions from delivery. While Arrowtown Drinks have shown good practice in their choices, such as the use of an electric car for their local deliveries, their packaging materials and their local sourcing, like all companies, there are opportunities to further reduce their carbon emissions before offsetting any emissions.

6.1 Scope 1 Reductions

Decreasing Scope 1 emissions is vital in the prevention of global warming. If every company were diligent in reducing their direct emissions, indirect emissions will subsequently reduce throughout the world.

Company vehicles, which relates to 100% of Arrowtown Drinks' Scope 1 emissions can be reduced through the use of an electric vehicle (EV) or by reducing vehicle movements. Arrowtown has now taken steps to use an electric vehicle for company travel. While there are associated carbon emissions with the charging of EVs, the UK grid is decarbonising, thus reducing the operational emissions relating to transport.

6.2 Scope 2 Reduction

Arrowtown Drinks' Scope 2 emissions come from the purchase of electricity. Currently, best practices for reducing the emissions associated with electricity is through investment in photovoltaic (PV) arrays to allow for the conversion of solar energy into electricity.

6.3 Scope 3 Reduction

Due to Scope 3 emissions being indirect, it can be difficult to reduce emissions. For example, Arrowtown Drinks do not have control over their production process and therefore rely on their manufacturer to reduce their emissions. Despite this, below a number of options are presented.

- **Ingredient Reduction**
  Agricultural inputs equal 1,597.74kgCO_2e of Arrowtown Drinks emissions. The largest individual contributor to this by emissions is the spirit base, making up 72% of total agricultural emissions. To reduce emissions Arrowtown Drinks may look to ensure their spirit base comes from the UK is organic where possible.
- **Processing** Arrowtown Drinks can look to engage with their contracted partner for canning their drinks to implement carbon reductions such as using solar energy. This will result in them having fewer emissions associated with the production of the drink.

7 Conclusion

An environmental assessment was undertaken for the GHG emissions at Arrowtown Drinks in line with the GHG Protocol Corporate and Product standards. Scope 1, Scope 2 & Scope 3 emissions were all analysed and emissions for their two products. Across the three scopes, 10.22% of the total emission burden for the year is associated with Scope 1, 1.17% with Scope 2 and 88.61% for Scope 3. Scope 3 emissions are split into upstream and downstream activities of which 92.50% of Scope 3 emissions relate to upstream and 7.50% to downstream.

For the reporting period, Arrowtown Drinks' total Corporate footprint totalled 9.77tCO_2e.

8 Supplementary Data

To be made available on request. Any references not provided here will be included in the supplementary data.

9 Assurance

Zevero LTD has undertaken a first-party limited assurance review of the 2021 Greenhouse Gas Analysis of Arrowtown Drinks, with the conducting participants not responsible for the GHG inventory process. Conflict of interest was avoided by best academic integrity practices and mutually exclusive reviewed data by participants with necessary academic GHG inventory competencies. Procedures of assurance were performed by counter calculation and were dictated by inspection of documents, assessment of the appropriateness of methods and cross-referenced verification of obtained data. Based on the review performed and the data gathered, nothing has come to Zevero's attention that the inventory process and subsequent GHG emission findings are not in accordance with the GHG Protocol Corporate and Product Standards.

London, 01/09/2021

Zevero LTD

10 References

[1] P. Bhatia, C. Cummis, L. Draucker, D. Rich, H. Lahd, and A. Brown, "Greenhouse gas protocol product life cycle accounting and reporting standard," 2011.

[2] P. Bhatia, C. Cummis, D. Rich, L. Draucker, H. Lahd, and A. Brown, "A corporate accounting and reporting standard," 2011.

[3] P. Bhatia, C. Cummis, D. Rich, L. Draucker, H. Lahd, and A. Brown, "Greenhouse gas protocol corporate value chain (scope 3) accounting and reporting standard," 2011.

[4] G. G. Protocol, "Global warming potential values, adapted from ipcc fifth assessment report (ar5). 2014."

[5] D. Amienyo, H. Gujba, H. Stichnothe, and A. Azapagic, "Life cycle environmental impacts of carbonated soft drinks," *The International Journal of Life Cycle Assessment*, vol. 18, no. 1, pp. 77–92, 2013.

[6] MPE, "Life cycle assessment of aluminium beverage cans in europe. excecutive summary," 2019.

[7] Ecoact, *Homeworking emissions Whitepaper*. 2020.