Greenhouse Gas (GHG) Scope 3 Inventory and Corporate Climate Strategy for Ocean Spray Cranberries Inc

by Averi Cumings, Seoyeon Jang, Krystal Krygowski, Isabel Nakisher, Melissa Warshauer

A project submitted
in partial fulfillment of the requirements
for the degree of
Master of Science
(Environment and Sustainability)
at the University of Michigan
April 2022

Faculty Advisor: Mike Mazor, School for Environment and Sustainability, University of Michigan

Abstract

According to the Greenhouse Gas Protocol, the Corporate Value Chain (Scope 3) Accounting and Reporting standard, Scope 3 greenhouse gas (GHG) emissions constitute emissions that result from indirect activities or assets not owned by an organization. Of all the GHG emissions generated by the food and beverage industry, as much as 90% are Scope 3, often stemming from complex agricultural, manufacturing, and distribution supply chains out of the direct control of large brands (Greenhouse Gas Protocol, 2015). In an effort to address and mitigate climate change for their farmer-owned cooperative, Ocean Spray Cranberries (OSC) sought help to conduct a GHG inventory of Scope 3 emissions and identify Scope 3 reduction targets.

The University of Michigan Master's Project team was tasked with conducting a GHG inventory of Scope 3 emissions to assess the baseline of OSC indirect emissions. A value chain map was created in conjunction with OSC's sustainability team. A specialized Scope 3 calculator relevant to OSC'S Scope 3 categories and updated emissions factors was developed as a tool to assess indirect emissions. In addition, the team helped calculate upstream transportation and distribution emissions reductions associated with shifts to regional production in Canada and Australia.

This project provided tools to help inform OSC's corporate climate strategy to mitigate the effects of and adapt to climate change. Students received better insight into the challenges associated with accounting for and reducing indirect Scope 3 emissions.

Acknowledgements

We wish to thank the many people who aided us in the completion of this project: our faculty advisor Michael Mazor, for providing counsel, expertise and championing our team; Ocean Spray Cranberries, Inc., Jennifer Bowe (Former Associate Manager, Global Impact & Sustainability), Emily O'Halloran (Assistant Manager, Sustainable Agriculture & ESG); and our families and friends for their support in our pursuit of the MS degree.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

DJSI: Dow Jones Sustainability Index
EF: Emission Factor
EFDB: Emission Factor Database
EIO-LCA: Economic Input-Output Life Cycle Assessment
EPA: Environmental Protection Agency
GHG: Greenhouse Gas
GHG Protocol: Greenhouse Gas Protocol
GRI: Global Reporting Initiative
GWP: Global Warming Potential
IPCC: International Panel on Climate Change
LCA: Life Cycle Assessment
LCI: Life Cycle Inventory
OSC: Ocean Spray Cranberries
SBTi: Science-Based Targets initiative
SBT: Science-Based Targets
SDC: Sweetened Dried Cranberries
USEEIO: US EPA Environmentally-Extended Input-Output

1. Introduction and Background

1.1 Project Objective and Scope

Founded in 1930, Ocean Spray Cranberries, Inc. (OSC) is a farmer-owned cranberry cooperative that operates throughout the United States, Canada, and Chile. The cooperative consists of 700 family-owned farms. OSC is the majority market shareholder of the world's cranberries and is headquartered in Lakeville, Massachusetts. Today, OSC's product portfolio is divided into four categories: beverages, Craisins® or sweetened dried cranberries, sauce, and fresh fruit.

Outlined in OSC's mission is to improve the health of both people and the planet, putting sustainability at the core of making the cooperative regenerative and resilient for future generations. Sustainable agriculture is fundamental to protecting the world's cranberry supply, as agriculture is both a contributor to the changing climate and vulnerable to the effects of climate change. OSC has started developing a comprehensive strategy to address climate change within the cooperative. Previous projects have included a Scope 1 and 2 greenhouse gas inventory, target setting for greenhouse gas (GHG) emission reduction, mitigation as well as communication planning.

The risk climate change poses to the food and agriculture industry can have major impacts on company performance and its long term social and environmental value. Corporate climate strategies are an essential component in addressing global climate change and keeping to a global temperature rise scenario well below 2-degrees Celsius; this challenge cannot be addressed by individuals and governments alone. Many companies are working to estimate and report GHG emissions stemming from company vehicles and purchased electricity, which comprise Scope 1 and 2. There is an increasing recognition and need to also measure and disclose these companies' Scope 3 emissions, or indirect emissions associated with operations not owned or controlled by the reporting company (Greenhouse Gas Protocol, 2015).

Therefore, it is important that OSC addresses and works to mitigate climate change for their farmer-owned cooperative through conducting a GHG inventory. In order to further help in determining the company's environmental impact and to build on previous efforts in calculating Scope 1 and 2 emissions, we began the process of calculating Scope 3 emissions as well as providing the company resources to enable them to set targets on their Scope 3 emissions.

1.2 Ocean Spray History and Background

Ocean Spray Cranberries began in 1930 when three cranberry farmers - Marcus Urann, John Makepeace, and Elizabeth Lee - banded together to create a single cranberry-growing family. After sending their jellied cranberry sauce to market, growers from all across the country began joining the cooperative (Ocean Spray, n.d.). Today, OSC is owned by 700 cranberry growers and currently employs 2,000 people in the United States, Canada and Chile.

OSC's cooperative structure is unique in that their farmers are shareholders. This structure allows smallholder farmers to benefit, as 100% of the profits are returned to the growers. Per contractual agreement, farmers agree to produce a set amount of cranberries in exchange for the benefit of stock ownership, cooperative marketing benefits, voting rights, and technical support. Having a management team dedicated to bringing products to the market allows farmers to focus on managing and growing their farms and cranberry production.

1.3 Climate Change and Risk to Cranberry Production

1.3.1 Climate change and agriculture

Climate plays an important role in agricultural productivity. However, as GHG emissions dramatically increase, agricultural production is facing various consequences such as geographical shift, yield changes in agriculture, and reduction in water availability for irrigation (Aydinalp & Cresser, 2008). Moreover, climate change is expected to result in worsening soil conditions, drought and desertification, disease and pest outbreaks on crops and livestock, and sea-level rise (Kurukulasuriya & Rosenthal, 2003). The Environmental Protection Agency (EPA) states that, "temperature changes can cause habitat ranges and crop planting dates to shift and droughts and floods due to climate change may hinder farming practices".

1.3.2 Climate Impacts on Different Regions

1.3.2.1 Northeastern United States

The Northeastern United States is best known for its diverse climate where the temperature is much colder near the north and at higher elevations ("Climate Impacts in the Northeast", n.d). As climate change worsens, the temperature in the region will increase between 2.5 and 5.5 degrees Celsius (4.5 and 10 degrees Fahrenheit) by the 2080s ("Climate Impacts in the Northeast", n.d). According to the U.S. Global Climate Change Research Program, the Northeastern region has experienced a greater increase in extreme precipitation than any other region in the United States, and is predicted to experience sea level rise of up to 4 feet by 2100 (Horton et al., 2014). These changes can result in an increase in pests and invasive species posing difficulty for farmers to continue to grow crops and fruits (Horten et al., 2014). It is expected that farmers will have to adapt to different agricultural practices, which can be challenging due to the variability and uncertainty of weather and natural disasters, such as hurricanes and flooding (Horten et al., 2014).

1.3.2.2 Midwestern United States

The Midwestern United States is surrounded by the Great Lakes and has extremely cold winters and humid summers ("Climate Impacts in the Midwest", n.d). The Midwest has already undergone various climate change stresses including shifts in population, socioeconomic changes, and air and water pollution (Pryor et al., 2014). As temperature increases, precipitation is becoming more intense, leading to sediment runoff and erosion ("Climate Impacts in the Midwest", n.d). These can negatively impact agriculture by increasing growing seasons, decreasing yields of some crops or fruits, and thus decreasing agricultural productivity (Pryor et al., 2014).

1.3.2.3 Northwestern United States

The Northwestern United States experiences rainy weather where winters are colder and summers are much hotter and drier (“Climate Impacts in the Northwest”, n.d). Since the region is located along the Pacific coastline, warmer winters cause more rainfall than snow, leading to rising sea levels and an increase in the risk of coastal flooding (“Climate Impacts in the Northwest”, n.d). Changes in streamflow and a significant decrease in the snowpack will also alter the availability and timing of the water in streams and rivers, which will cause more difficulty for farmers to adapt to climate change with inadequate soil conditions (Mote et al., 2014). The annual temperature in the region has already risen by about 0.7 Celsius (1.3-degrees Fahrenheit), and extreme weather events such as wildfires, droughts, and floods, will become increasingly more common if the trend continues (“Climate Impacts in the Northwest”, n.d & Blair et al., 2021).

1.3.3 Climate change and Cranberries

Cranberries (Vaccinium macrocarpon) are perennial fruits, native to North America and are very sensitive to heat stress. This sensitivity can decrease the yields and quality of the fruit and increase disease (Blair et al., 2021 & USDA Research Seeks to Strengthen Cranberry Resiliency as Climate Change Affects Production : USDA ARS, 2021). With that said, cranberries are particularly tolerant of flooding and are grown in wetland systems known as cranberry bogs (The Cranberry, n.d.). Unfortunately, the impacts of climate change pose many different challenges and risks to cranberry farming.

As temperature increases, earlier spring and milder and shorter winters can be expected (Ocean Spray, n.d.). While pollinators, such as bees, play a crucial role in the growth of cranberries, these pollinators will no longer be able to pollinate due to earlier spring and therefore, the opening of the cranberry flowers will not coincide with their pollinating seasons (Blair et al., 2021). Milder and shorter winters will increase growing seasons, potentially generating pest insects (Ocean Spray, n.d.). This presents big challenges in crop protection as well as increases farmer investment in pesticides. In addition, extreme weather patterns such as excessive rain, humidity, and extreme droughts during summer will promote more pathogenic fungi growth resulting in frequent fruit rot infection ("Fruit rot - cooperative extension: Cranberries”, n.d). Considering these negative consequences that many farmers are currently facing in different regions, it is essential for Ocean Spray to measure not only the direct greenhouse gas emissions but also the indirect corporate level greenhouse gas emissions in order to manage its carbon footprint.

2. Methods

2.1 Emissions Scope

According to the GHG Protocol's Corporate Standard, Scope 1 emissions are direct GHG emissions that occur from sources that are owned or controlled by the company. These emissions can be generated from the combustion of fuels (natural gas, coal, diesel, etc.) typically within furnaces, boilers, and vehicles owned and operated by the company. Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Scope 2 emissions typically occur at the facility where electricity is generated.

Scope 3 greenhouse gas (GHG) emissions constitute emissions that result from indirect activities or assets not owned by the organization. A Scope 3 GHG emission inventory covers 15 different activities such as purchased goods and services, business travel, waste disposal, transportation, and distribution, etc. (**Figure 1).** Upstream Scope 3 emissions include those generated from material acquisition and pre-processing. Downstream Scope 3 emissions involve the emissions generated after the production process, during distribution and storage, product use, and the product's end-of-life (Greenhouse Gas Protocol, 2015). Transportation and distribution occur both upstream with the movement of materials and downstream with the distribution of final products.

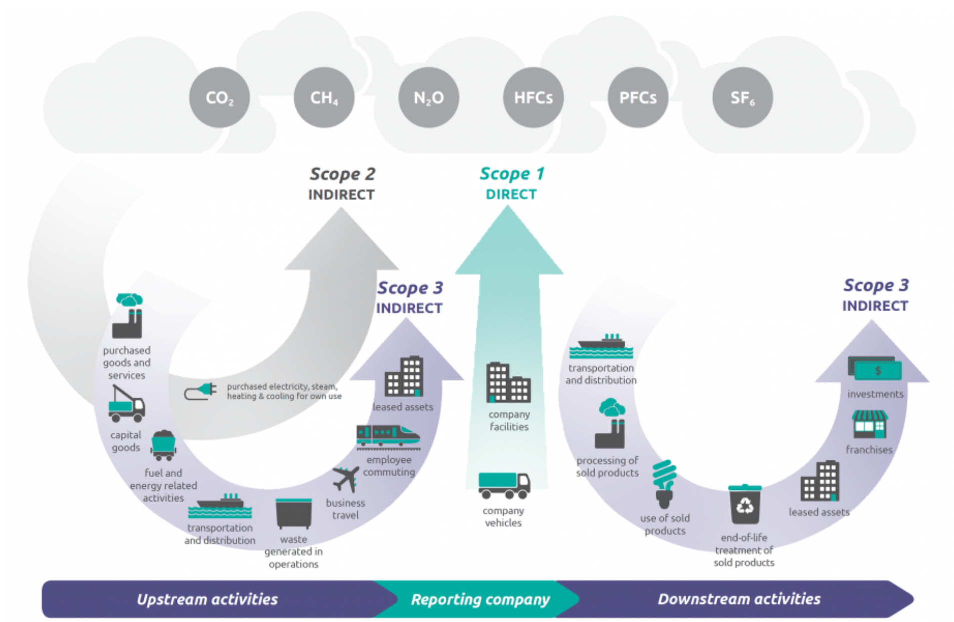


Figure 1. The Greenhouse Gas Protocol (WRI and WBCSD, 2001).

Of all the GHG emissions generated by the food and beverage industry, as much as 90% are Scope 3, often stemming from complex agricultural, manufacturing, and distribution supply chains out of the direct control of large brands. In some cases, often with industries that rely heavily on their supply chain as opposed to internal operations, this can represent the majority of an organization's GHG emissions.

In measuring Scope 3 emission, organizations can better understand opportunities for emissions and cost reductions that exist outside their direct operations. This allows companies to understand risks and opportunities associated with product chain emissions. Calculating and understanding these emissions can help companies identify GHG reduction targets and track performance. Public reporting of Scope 3 emissions can enhance company reputation and transparency with their consumers and stakeholders (Greenhouse Gas Protocol, 2015).

2.2 Setting Organizational Boundaries

According to a previous project conducting a Scope 1 and 2 inventory, emissions from OSC's cooperative farmers fall into Scope 3 (Blair et al., 2021). The farmers represent an upstream supplier even though they have an ownership stake in the corporate activities of the cooperative. Based on this notion, all on-farm activities are considered indirect emissions to OSC and therefore need to be included in a Scope 3 inventory.

An important step in conducting a full Scope GHG inventory is to select an approach for consolidating GHG emissions that can be consistently applied throughout the process of accounting and reporting GHG emissions (Greenhouse Gas Protocol, 2015). There are three types of organizational approaches outlined in the GHG Protocol's Corporate Standard: equity share, financial control, and operational control. Equity share approach refers to when companies account for emissions based on their share of equity in the operations. Under the financial control approach, a company will account for 100% of the operations for which they bear the majority risk and benefit from the operations financial performance (Ford, n.d.). Under the operational approach, a company will report 100% of emissions from operations where the company or one of its subsidiaries has complete authority to create and apply operating policies (Greenhouse Gas Protocol, 2015).

In performing their Scope 1 and 2 inventory, OSC determined that the operational control approach would be the most appropriate method of GHG accounting (Blair et al., 2021). This method also supported the classification of grower-members as Scope 3, since farm activities lie outside of the operational control of OSC corporate. Along the lines of this distinction, emissions from activities at OSC's corporate headquarters also fell within Scope 3 as their office buildings are under operational lease. **Figure 2** from the Greenhouse Gas Inventory and Corporate Climate Strategy for Ocean Spray Cranberries, Inc outlines the visual breakdown of Scope delineations.

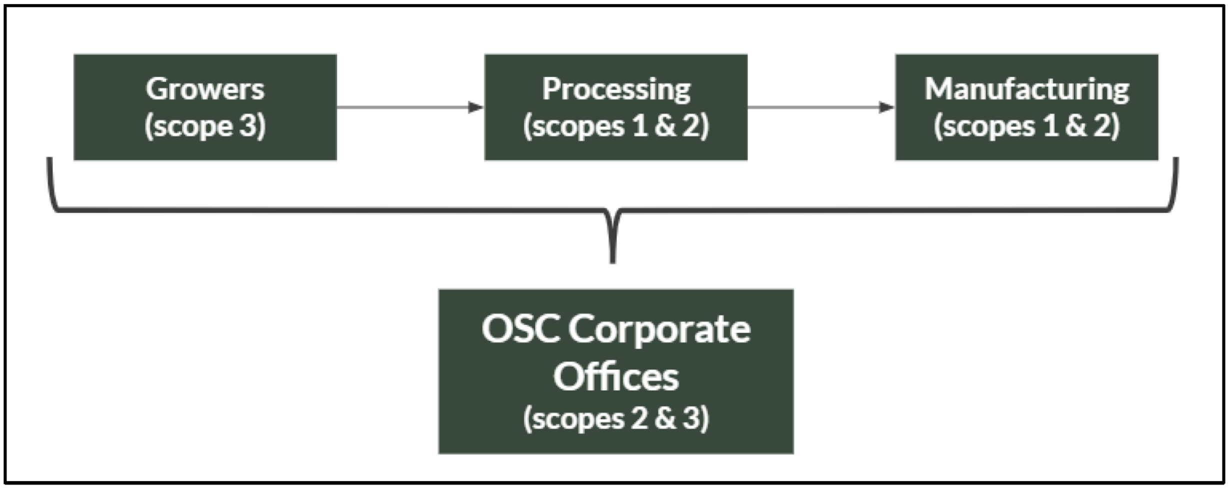


Figure 2. Scope boundary destinations for organizational activities within OSC. Boundary delineations were determined using the operational control approach from the GHG Protocol. (Blair et al., 2021)

2.3 Mapping Value Chain

As stated in the GHG Protocol's Corporate Standard, mapping the value chain can be a useful first step toward identifying relevant Scope 3 activities. The updated version of the 2008 value chain map can be found in Appendix A. This map shows structural and operational changes to OSC's productions since 2008. Supply chains are inherently dynamic, and therefore, the map only represents the processes on one specific day, where this day is assumed typical. Continuing off the Scope 1 and 2 inventory performed for OSC, 2019 was used as a baseline year to map the value chain.

Status of ownership was denoted by the shape and color of the numbered box, as seen in **Figure 3**. Because an operational control approach was chosen, the ownership status (i.e. company-owned, leased by company, third party) was important in distinguishing whether the activities were Scope 1 and 2 or Scope 3.

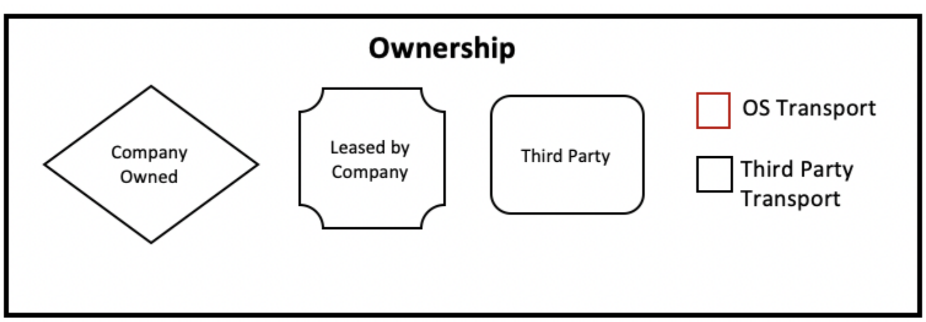


Figure 3. Ownership status identification table for OSC 2019 Value Chain Map

OSC owns ten manufacturing facilities and eight receiving facilities across North America and Chile, thus, the majority of these facilities activities fall into Scope 1 and 2 emissions. Manufacturing facilities produce the products that OSC sells. The food manufacturing facilities produce sweetened dried cranberries (SDC) and cranberry concentrate, while the beverage manufacturing facilities produce various juices and other drinks. (Blair et al., 2021) While some fruit is received by local grower-screeners, the majority of it is received via company-owned receiving facilities.

The box denoting fruit farming, as seen in **Figure 4**, represents the over 700 farms in the farmer cooperative. Control and operations of these farms lie outside of the purview of OSC, thus their emissions-generating activities fall into Scope 3 emissions (colored blue for upstream Scope 3 emissions).

Figure 4. Fruit farming identifier in OSC 2019 Value Chain Map.

The distinction of the movement of intermediate products and sold final products was denoted by the shape of the box describing the type of product (**Figure 5**). **Figure 6** demonstrates this: cranberries transported from Receiving Facilities (2,3) to the Food Plant (7) are intermediate products. After being transported to a Co-packer (10) or Distribution Center (6,9,12,13), the ingredients will become OSC's sold final products, such as sauce, Craisins®, beverages, trail mix, powder mix, bar-pac, etc.

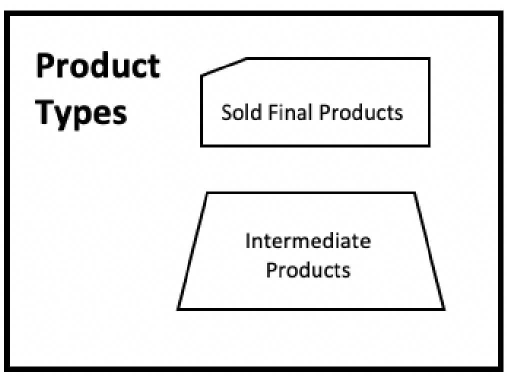


Figure 5. Product type identification table in OSC 2019 Value Chain Map.

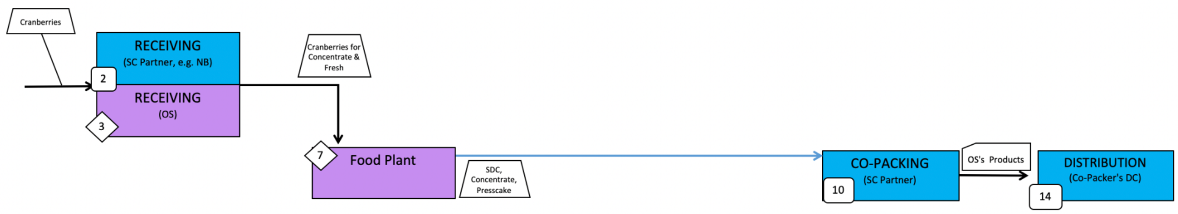


Figure 6. Product transition from intermediate products to sold final products.

Between the time of the first Scope inventory in 2008 and the current inventory of 2019, Ocean Spray modified their value chain to improve their processes. While Ocean Spray farmers used to produce cranberries, citrus and blueberries, today the co-op's farmers specialize in cranberries and licensing and/or purchasing agreements have been made to acquire blueberries and citrus (as denoted in **Figure 7**).

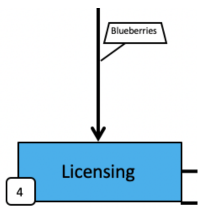


Figure 7. Licensing agreement to acquire blueberries and other citrus in OSC's 2019 Value Chain Map

As shown in **Figure 8**, movement from box 11 'Processing (Customer's Plant)' to box 15 'Distribution (Customer's Distribution Center)' demonstrates the process of selling SDC, concentrates and other intermediate products to customers to be used to make customer's sold final products. These activities are captured in the "processing of sold goods" category. In addition, Ocean Spray will account for the emissions in *Category 9: Downstream Transportation and Distribution* from transport to the customer's plant and from the customer's distribution..

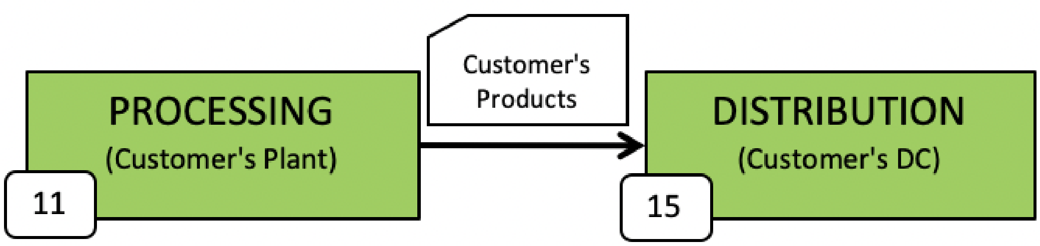


Figure 8. Selling intermediate products for customer's use in making sold final products.

New to Ocean Spray since 2008 is their e-commerce platform. As denoted from the yellow arrow from box 16 to box 18 (**Figure 9**), some OS and customer's final products are bought via online processes and transported directly from the retailer's distribution center to the end consumer.

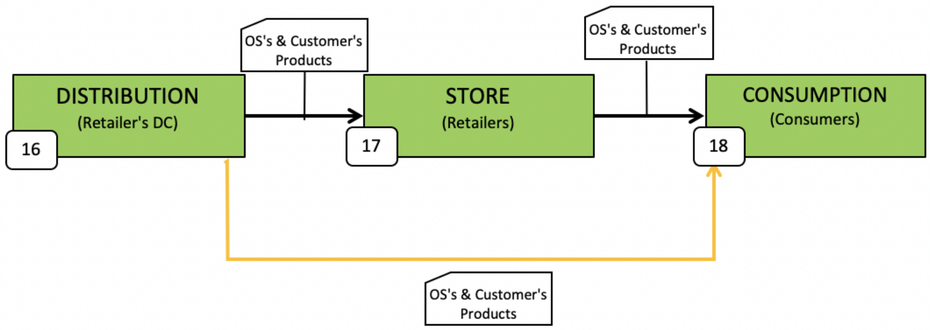


Figure 9. E-commerce platform allowing products to bypass retailers and be received directly by consumers.

Finally, not yet depicted in the diagram, are the emissions associated with marketing and other service providers. As these companies are not owned by Ocean Spray, their services would be accounted for in the current Scope 3 inventory. All of the movements and plants/processes are described in further detail in the Step Descriptions table in Appendix B.

2.4 Emissions Factors

According to the GHG protocol, an emission factor is a factor that converts activity data into GHG emissions data. For example, in order to calculate the emissions for the purchase of raw materials, the spend data pulled from invoices is used as the activity data. Then the emissions factor converts the dollar value into tons or kg of each greenhouse gas. Finally, the global warming potential (GWP) is a value provided by the IPCC that converts the tons of emissions, for example tons CH_4, into tons of CO_2 equivalent (CO_2e). This value is based on the gas' ability to store heat in the atmosphere (***Equation 1***).

Equation 1: *GHG Calculation* (CO_2 *equivalent) = Activity Data x Emission Factor x GWP*

Thus, it is important to take emission factors from reputable sources such as EPA USEEIO, EIOS-LCA, Ecoinvent, or Intergovernmental Panel on Climate Change (IPCC). We considered 5 different emission factors data sets for OSC and determined, of those, the US EPA EEIO models and reports, and EPA Emission Factors Hub would be the best to incorporate in OSC's Scope 3 GHG calculations.

The US EPA Environmentally-Extended Input-Output (USEEIO) is a life cycle assessment model that combines economic-environmental models to capture traditional economic calculations, sustainability, and environmental decision-making (US EPA, n.d). Using this model, the EPA has developed reports which include different supply chain emission factors covering numerous categories of goods and services in the US economy (US EPA, n.d). A specific report that can be used in our Scope 3 calculations is the "EEIO Supply Chain Greenhouse Gas

Emission Factors for US Industries and Commodities” because OSC’s categories encompass a large portion of goods and services.

GHG Emission Hub is another dataset provided by the EPA. This dataset was collected by both EPA's Greenhouse Gas Reporting Program and the Center's technical guidance (US EPA, n.d). It is frequently updated, currently in the 2021 version, and contains emission factors for upstream and downstream transportation, business travel, product transport, employee commuting, waste, and purchased electricity. Since OSC’s Scope 3 categories include these, this tool can be utilized in the Scope 3 calculation.

Another well-known dataset we considered was the Economic Input-Output Life Cycle Assessment (EIO-LCA) from Carnegie Mellon. This method estimates the materials and energy resources and the environmental emissions activities from products in our economy (Eiolca. Net - Free Life Cycle Assessment on the Internet, n.d.). It provides guidance on the relative impacts of resource use and GHG emissions in different types of products and materials in the supply chain (CMU, n.d.). Though the tool performs the necessary calculations in real-time, it pulls from the EPA USEEIO and Emissions Factors Hub of 1992 to 2007. Thus, this was not the ideal tool for our project.

The Ecoinvent database is a more detailed Life Cycle Inventory (LCI) database that supports many different types of sustainability assessments (“Ecoinvent Database”, n.d.). This database includes over 18,000 datasets based on geographies but would require life cycle assessments (LCA) to access environmental emissions factor data (“Ecoinvent Database”, n.d.). Also, it does not contain some specific datasets required for Ocean Spray such as fruit concentration unless the process to make concentrate for each component is known. This is not a feasible option for the Scope of our project or the ability and data availability of Ocean Spray.

Finally, the Intergovernmental Panel on Climate Change (IPCC) has an Emissions Factor Database (EFDB) that acts as a library of emissions factors and other parameters used to estimate greenhouse gas emissions (EFDB - Main Page, n.d.). The emissions factor options provided by the IPCC are limited and are based on land use. The data is pulled from 1999 and 2006, which is outdated to be used. While there is data for agricultural products, they are focused on methane emissions from animal husbandry or dairy farming. There is no data available for packaging plastics and cardboard or crop production which are specifically needed for the project.

2.5 Software Comparisons

2.5.1 Accuvio

OSC had previously used Accuvio, an Ireland-based software company, to track and analyze their greenhouse gas emissions. Accuvio can track data for GHG emissions, waste, energy, water, and water treatment. Accuvio can also help aggregate data for reporting frameworks, such as CDP, Global Reporting Initiative (GRI), and the Dow Jones Sustainability Index (DJSI).

Since the summer of 2019, OSC has used Accuvio to help aggregate GHG emissions data by assigning nodes to each facility (manufacturing, receiving, farm). Accuvio users can then classify each node by region and type of facility (i.e., OSC owned or leased) to appropriately assign emissions activities and their corresponding emissions factors.

For various reasons, including a contract renewal and the acquisition of Accuvio by a company called Diligent, Accuvio was inaccessible for this project's purposes. Therefore, our team began conducting initial research on alternative GHG inventory software companies. The first step in this process was sending initial emails and inquiries to a series of software companies and setting up a time to meet and learn more about their software offerings and capabilities. The purpose of these meetings was to conduct a preliminary evaluation of the software and bring feedback back to OSC in order to aid in the decision making process. Questions asked during each meeting and subsequent notes taken from the information shared were guided by the initial software company meetings conducted by OSC which were to find a software company that improved efficiency of data collection and use, created value for the cooperative, and supported target and goal development (**Appendix C**). For privacy purposes, the candidate companies names are held in confidence and only revealed to OSC.

2.5.2 Summary of Meeting with Company A

Company A could support the Scope 3 inventory for 13 of the 15 categories included in Scope 3, with the option to have a personal library of categories based on company needs. They make quarterly updates to the information included in the software database. In regard to price, there was a range of options, each including different features depending on the Scope of the companies intended use of the software. Company A makes constant improvements to the specific levels of reporting and is working on building a more user friendly interface for their software. Training for use of the software is a one time fee that includes a five to six part training, these sessions are provided through recordings and if more training is needed professional service hours are available. More detailed notes from the meeting with Company A can be found in a diagram in **Appendix D**.

2.5.3 Summary of Meeting with Company B

Company B could support the Scope 3 inventory for all 15 categories included in Scope 3, although it was mentioned that as of current, the software has not worked with category 10 or 15, as their clients have not needed these categories. Analysts on their team have a schedule they follow for making updates to information in the database, this schedule is refreshed annually. Base cost for Company B includes most of the features to use the software for a Scope 3 inventory, it was noted that there would be an extra cost if the company wants a client success manager to meet monthly to aid with screening and data needs. A feature that stood out during the meeting was Company B’s use of PowerReport BI to automate responses to questions in CDP reports and have it easily transferred to a PDF or Powerpoint in order to better visualize breakdowns of emissions by supplier. More detailed notes from the meeting with Company B can be found in a diagram in **Appendix E**.

2.5.4 Analysis and Discussion

The meetings with Company A and B proved to be informative when inquiring about GHG Scope 1, 2, and particularly 3, inventory software. Company A could track thirteen of the fifteen categories, this was due to the fact that they have not had a need to track the remaining two categories yet. Company B could track all fifteen categories, however, similar to Company A, it had not been asked to track two of the fifteen categories. It is important to note that Company B does have the capability to track all fifteen. Both softwares were customizable and could be created to be more user friendly in their own ways. In addition, as GHG inventory software became more popular and helpful in allowing companies to assess their emissions, both companies did quarterly to yearly reviews of information in the database as well as continuing to seek improvements and new features for their respective software.

After meeting with both companies and reporting back to OSC it became clear that although both companies seemed viable options in terms of their offerings, sticking with Accuvio or to not use 3rd party software at all was the direction OSC wanted to go. Specifically, Company B had mentioned that if we were to go with their software, it would be most helpful to have all three Scopes in the system and that information would take time, effort, and money to transfer due to it already being established in the Accuvio software.

While recontracting negotiations with Accuvio were taking place and our team was needing to move forward with the Scope 3 inventory, the best option was to begin working on and editing a calculator for OSC to help with the Scope 3 inventory. While all of the software companies would be viable options for OSC and likely make GHG inventory calculations much easier, the calculator we built, and the conversations we had with each of these companies will serve as a base and a tool for OSC as they continue their journey in reaching target emission reductions.

2.6 Calculator Description

Due to the proprietary nature of the information, the team faced real challenges acquiring company data to perform a Scope 3 inventory. Because a goal for the calculator was for our team to get a more in-depth understanding of how to calculate each Scope 3 category, we will use model or approximate activity data. The 2008 spreadsheet from OSC was used as a starting point and specific values were replaced with an order-of-magnitude value (i.e., $38,834.23 became $10,000 as a placeholder that does not reveal confidential information). The calculator was created for each of the Scope 3 Categories that were determined to be relevant to OSC, which will be discussed in the next section. The calculator was based on the 2008 GHG Emissions Inventory and discussions with the client contact.

The spreadsheet (**Appendix F**) was created as a tool for OSC to conduct a preliminary calculation of the emissions in each of the Scope 3 Categories and easily see the inputs and factors for each of the categories. The first step in the GHG calculation process was to determine the emissions-based screening method to estimate the emissions. This gave a summary of how and why each method was determined and provided reasoning as to how to approach the calculation. For most of the categories, this was dependent on the data provided and the client provided business operations. The second step is to determine which of the Scope 3 emissions will be calculated. Currently there is no requirement to calculate all categories as all may not be applicable to the operations. For example, OSC does not have investments (Category 15) for which they need to calculate emissions. In addition to removing categories that are not applicable, companies also rank Scope 3 activities from largest to smallest according to their estimated GHG emissions to determine which activities have the most significant impact (Greenhouse Gas Protocol, 2015). Some of the categories may have a negligible impact on the overall emissions and therefore may not be calculated. Currently there is no required standard for what should and should not be calculated.

The main goal for our team was to document what categories were relevant and needed to be calculated and provide reasoning for the categories that were not relevant to OSC. The main goal for OSC was to have a spreadsheet that could be easily used to calculate a rough estimate of their GHG emissions to help identify which categories deserved more attention. It was also used for them to see what data was required for each of the categories. OSC will utilize Accuvio to run their official inventory. As explained in Section 3.4, the calculator contains an overall summary tab that shows the GHG emissions for each of the categories in each applicable emissions type as well as an overall total, where the factors were pulled from. For example, the summary table clearly shows that Categories 1 and 2 utilize factors from EPA US EEIO "Supply Chain Greenhouse Gas Emission Factors for US Industries and Commodities" while Categories 4, 5, 6, 7, 8, and 12 utilize factors from US EPA "GHG Emissions Factors Hub" (Categories 3, 10, 11, 13, and 14 were not calculated and emissions factors will be determined if needed based on activity data provided).

3. Scope 3 Greenhouse Gas (GHG) Inventory

3.1 Description of Scope 3 Categories

As stated previously, Scope 3 emissions account for emissions associated with a company's value chain that were not included in Scope 1 or 2. There are fifteen distinct reporting categories identified by the GHG Protocol to account for Scope 3. It should be noted that not each category will be relevant to every company, so thorough evaluation of a company's value chain is needed when conducting a Scope 3 GHG inventory. A description of what is included in each of the 15 categories is described below.

Per the *GHG Protocol* (Greenhouse Gas Protocol, 2015), upstream categories include:

- Category 1, Purchased goods and services: all upstream emissions from production of products purchased or acquired by the company, such as materials and components.
- Category 2, Capital goods: fixed assets or a final product that is used by the company, which include equipment, machinery, buildings, facilities, and vehicles.
- Category 3, Fuel and energy related activities: emissions related to the production of fuels and energy purchased and consumed by the industry such as mining of coal, refining of gasoline, extraction of natural gas, and generation of electricity, steam, heating, and cooling.
- Category 4, Upstream transportation and distribution: emissions from the transportation and distribution of products purchased by the industry in vehicles and facilities owned or operated by third parties. These include different modes of transportation such as air, rail, road, and marine transport as well as storage of purchased products in warehouses, distribution centers, and retail facilities.
- Category 5, Waste generated from operations: emissions from disposal of both solid waste and wastewater and waste treatment by third parties. These include disposal in a landfill, disposal in a landfill with landfill-gas-to-energy, recovery for recycling, incineration, and composting.
- Category 6, Business travel: emission from employees' transportations from business travels in vehicles operated by third parties. These include different modes of travel such as air, rail, bus, and automobile travel.
- Category 7, Employee and commuting: emission from employees' transportations from home to work places. These include different modes of travel such as air, rail, bus, and automobile travel.
- Category 8, Upstream leases assets: emission from leased assets that are not included in either Scope 1 or 2. These include emissions from running an office or other company's lease assets.

Downstream categories include:

- Category 9, Downstream transportation and distribution: emissions from the transportation and distribution of products sold by the industry in vehicles and facilities owned or operated by third parties. These include storage of sold products in warehouses and distribution centers, storage of sold products in retail facilities, and different modes of transportation (air, rail, road, and marine).
- Category 10, Processing of sold products: emissions from processing of sold intermediate products by third parties.
- Category 11, Use of sold products: emissions from used sold products produced by the industry. These include direct use-phase emissions which are products such as petroleum, automobiles, aircraft, refrigeration and air-conditioning equipment and indirect-use emissions which are products that require washing, drying, cooking, refrigeration, heating, and heated water in order to use the product.
- Category 12, End-of-life treatment of sold products: emission of the product during the waste disposal and treatment process. These include any waste materials such as recycled, landfill, and incinerated, that are produced after the use of the product.

- Category 13, Downstream leased assets: emissions of assets that are leased to third parties and are owned by the industry. These include equipment, machinery, buildings, facilities, and vehicles.
- Category 14, Franchises: all emissions from operating franchises, which are not included in Scope 1 and 2.
- Category 15, Investments: emission from the company's investments such as equity investments, debt investments, project finance, managed investments and client services.

3.2 Determining Company Relevant Scope 3 Categories

Relevant Scope 3 categories can be determined by a preliminary screening process. The GHG Scope 3 Guidance provides detailed information about each category and what might be considered relevant to a company. The first step in the screening process is to lay out a company's supply chain and business operations. For example, OSC does not own any franchisees and therefore Category 14 was deemed not relevant. The size of the category can determine its relevance as categories that significantly contribute to a company's GHG profile are important to calculate. Categories can also be deemed relevant if they are identified as critical by key stakeholders (i.e., customers, suppliers, board members, etc.), if there are potential emissions reduction opportunities that can be influenced by the company, or if they pose a significant risk to the company or its operations (Greenhouse Gas Protocol, 2015). Finally, relevance can be determined by sector-specific guidance or by additional criteria developed by the company or industry sector (Greenhouse Gas Protocol, 2015).

In reviewing the previous OSC Scope 1 and 2 assessment, it was believed that purchased goods and services (category 1) and up-and-downstream transportation and distribution (categories 4, 9) were their largest sources of emissions. Purchased goods and services was identified as the largest category because it includes emissions generated from all on-farm activities and are sources of high spend. As identified in the value chain map, most of OSC's transportation services are third-party contracted, and therefore their activities should be included in Scope 3 emissions. Category 1 was also deemed critical by key OSC stakeholders as emissions associated with agriculture and production may have the largest potential for emissions reduction that could be influenced by the company. These emissions also significantly contribute to the company's risk exposure to climate change. In addition, Categories 4 and 9 would be a large contributor because OSC must transport the products throughout the production and distribution chain.

The following categories were deemed relevant to OSC and have completed sections in the excel calculator, formatted for OSC to input activity data and pull from relevant emission factors:
Purchased Goods and Services (category 1) is material for OSC because farm activities were classified as Scope 3, which includes all on-farm emissions resulting from the planting, growing, irrigating, and harvesting of cranberries and other ingredients. In addition, these emissions would include the purchase of intermediate ingredients not produced by cooperative farmers, such as sugar, additives/colorants, packaging, processing aid, and sunflower oil among others.

Capital Goods (category 2) is material for OSC because the company owns assets such as buildings, equipment and land used to operate and manufacture cranberry products. OSC owns 10 manufacturing facilities and 8 receiving facilities across North America and Chile. These upstream activities fall under capital goods. More specifically, for OSC these can include farmlands, sidetracks for railroads, buildings, and land improvement for paving parking lots or landscaping. Along with these types of capital goods, any fixed assets from other companies that OSC uses, such as co-packing assets, are all part of this category.

Upstream Transportation and Distribution (category 4) is material to OSC because OSC leverages third-party logistics companies to transport and distribute cranberries and other OSC products. As shown in the value chain map, transportation and distribution covers the major component of the emission since it is needed in order to move the product to different facilities within OSC.

Waste Generated from Operations (category 5) is material to OSC because of the upstream waste that is generated from the production and packaging of their many cranberry based products. This could include waste generated while processing and juicing cranberries, as well as excess materials from packaging processes. Because OSC does not currently track their waste, assumptions would need to be made about the amount of each material that is disposed.

Business Travel (category 6) is material to OSC because the farmer co-operative has grown to an international level industry, which means that there are opportunities for OSC employees to travel for collaboration efforts. Any company-reported and sourced distances traveled on account of OSC business trips would be included in this category. For example, traveling by plane to attend a business conference in Australia and any travel that took place while there.

Employee Commuting (category 7) is material to OSC because they rely on employees at multiple levels of operations. These employees commute daily, resulting in emissions from transportation between home and work. Examples of transportation types include: car travel, bus travel, rail travel, etc. Any emissions from teleworking are also included in this category.

Downstream Transportation and Distribution (category 9) is material to OSC because it encompasses the emissions resulting from transporting products to retailers to be distributed. Examples of this for OSC could include shipping products from one country to another, then transporting to retail stores.

End-of-Life Treatment of Sold Products (category 12) is material to OSC because it includes the emissions that result from their products upon reaching end-of-life. An example of this would be the packaging used to contain cranberry juice. While the juice is a consumable product, the plastic packaging will be waste treated in some way. This category requires OSC to use industry assumptions about how much product reaches different end of life stages.

The following categories were deemed relevant to OSC, but need further information. These categories were given a section in the excel calculator for when the necessary data and emission factors are gathered:

Fuel and Energy Related activities not included in Scope 1 or 2 (category 3) is material for OSC because there are additional fuel and energy related activities such as electricity used in OSC facilities. These facilities include beverage, receiving and conversion.

Upstream Leased Assets (categories 8), is material because OSC leases some of their facilities. OSC would account for energy related emissions from Scope 1 and 2 upstream assets that they lease from other parties. This would involve estimates about emissions that result from each asset, and could be measured by emissions per asset type OSC leased.

Processing of Sold Products (category 10) is material to OSC because the company sells products such as dried cranberries to customers who then process the intermediate cranberries in a final product.

Use of Sold Products (category 11) includes indirect use phases such as energy used to refrigerate OSC products once they have been opened. OSC was interested in taking this into consideration, however it should be noted that the GHG protocol states "... companies are required to include direct use-phase emissions of sold products. Companies may also account for indirect use-phase emissions of sold products, and should do so when indirect use-phase emissions are expected to be significant" (GHG Protocol, "Technical Guidance for Calculating Scope 3 Emissions"). Research such as an LCA should be conducted to determine if there are significant emissions that result from downstream refrigeration.

Downstream Leased Assets (category 13) is material to OSC because of the leased assets the company owns and leases out. OSC would account for energy related emissions from Scope 1 and 2 downstream assets that are already not included in their Scope 1 and 2 calculations. This would involve estimates about emissions that result from each asset, and could be measured by emissions per asset type OSC leased.

The following categories were deemed irrelevant to OSC's emissions profile and not included within the excel calculator:

Franchises (category 14) are not material to OSC as the company does not own franchises.
Investments (category 15) are not material to OSC as the company does not own investments.

3.3 Selecting Calculation Method

For most categories, there are multiple methods of calculating GHG emissions, with varying levels of data recommendations. It is for the company to determine which method would be most representative of the data for which they have access. As laid out in the GHG protocol, companies should select calculation methods for each category based on the following criteria:

- The relative size of the emissions from the Scope 3 activity
- The company's business goals (see chapter 2 of the Scope 3 Standard)
- Data availability
- Data quality
- The cost and effort required to apply each method
- Other criteria identified by the company.

A corporation such as OSC can use the GHG Protocol Technical Guidance for Calculating Scope 3 Emissions to determine which calculation method is most representative of the company's GHG emissions. Each category in this Guidance section has a decision making tree one can follow to determine the most accurate method for which data exists. For example, Category 1 Purchased Goods and Services decision making tree is shown in **Figure 10**. This tree shows that in this category a company can choose from four potential calculation methods: supplier-specific method, hybrid method, average-data method and spend-based method. Once a company determines which method is most applicable to them, they can follow the Technical Guidance to complete the calculation. They would repeat this process in each relevant category and sum the total to determine the companies complete GHG emissions. The calculation methods determined most representative in each category for OSC to use at this time are shown in Appendix G.

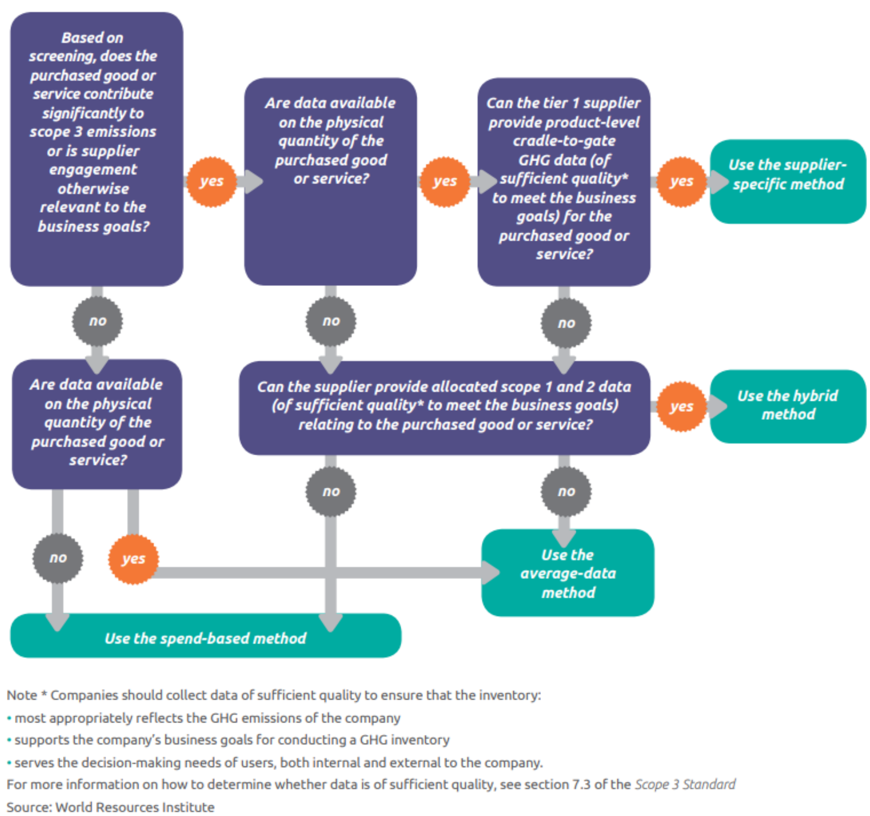


Figure 10. Decision tree for selecting a calculation method for emissions from purchased goods and services: Sourced from: Technical Guidance for Calculating Scope 3 Emissions.

3.4 OSC Scope 3 Categories Calculations

3.4.1 Purchased Goods and Services (Category 1)

OSC followed the GHG Protocol's decision tree to determine the accessibility and accuracy of data. Suppliers and cooperative farmers were unable to provide product-level cradle-to-gate information or Scope 1 and 2 relating to purchased goods. Therefore, OSC pulled spend based data from internal spend sheets to calculate the emissions impact of purchased goods and services. The value of purchased goods or services, functions as the activity data and will be provided by OSC for each product. The emission factors for this category were industry goods and services CO_2, CH_4 and N_2O emissions, measured in kgCO_2 eq./2018 USD. See Appendix G for the spend based method equation and emission factor source.

3.4.2 Capital Goods (Category 2)

Category 2 was calculated utilizing the average spend data method. These are the average dollar value of goods purchased, and relevant industry average emission factors. Similar to category 1, suppliers were unable to provide product-level cradle-to-gate information or Scope 1 and 2 relating to capital goods. The US EEIO tool provides emissions factors based on the emissions' upstream production and consumption impact. Therefore, to complete the average spend based calculation, OSC pulled spend based data from internal spend sheets to calculate the emissions impact of capital goods. The value of capital goods functions as the activity data and will be provided for each capital goods purchased by OSC. The emission factors for this category were average industry capital goods CO_2, CH_4 and N_2O emissions, measured in kg CO_2 eq./2018 USD. See Appendix G for the average spend based method equation and emission factor source.

3.4.3 Fuel and Energy Related activities not included in Scope 1 or 2 (Category 3)

The best calculation method for OSC to incorporate this category would be the supplier specific method. This would provide specific emissions associated with fuel usages that are not already included in Scope 1 and 2 inventories. At this time, this category does not have a completed tab in the excel calculator. However, once farmers are able to provide the necessary data this will be the most optimal calculation method for OSC. The data needed for this category would be fuel purchases in units of weight. The emission factors would need to be pulled from Scope 1 and 2. At the time of creating this calculator our team did not have this information. Currently there is a placeholder tab to be used once the activity data and emission factors are able to be entered into the excel spreadsheet. With that information, calculations for category 3 can be included in the total emissions for Scope 3.

3.4.4 Upstream Transportation and Distribution (Category 4)

The optimal calculation method for OSC in this category would be the distance-based method since distance data required for this method is the most accessible to OSC. For this calculation, the activity data needed from OSC would include the mode of transport, mass of the freight being transported and the distance traveled. The emission factors for this category were pulled from EPA Emissions Hub, Table 8. This provided CO_2, CH_4 and N_2O emission factors for multiple vehicle types. OSC will also need to provide the specific vehicle type used in order to identify the exact emission factors necessary. See Appendix G for the distance based method equation and emission factor source.

3.4.5 Waste Generated in Operations (Category 5)

The best method of calculation for OSC to use in this category was the average data method. This is because OSC should be able to determine the average amount of waste being disposed of in different ways due to their upstream production. For this calculation, the activity data needed from OSC would include the type of waste disposal method used, such as landfill or recycling. It also requires the mass and type of material being disposed of, thus providing the proportion of each material going to each type of waste disposal. The emission factors for this category were pulled from EPA Emissions Hub, Table 9. This provided CO_2, CH_4 and N_2O emissions factors associated with different types of waste treatments. See Appendix G for the distance based method equation and emission factor source.

3.4.6 Business Travel (Category 6)

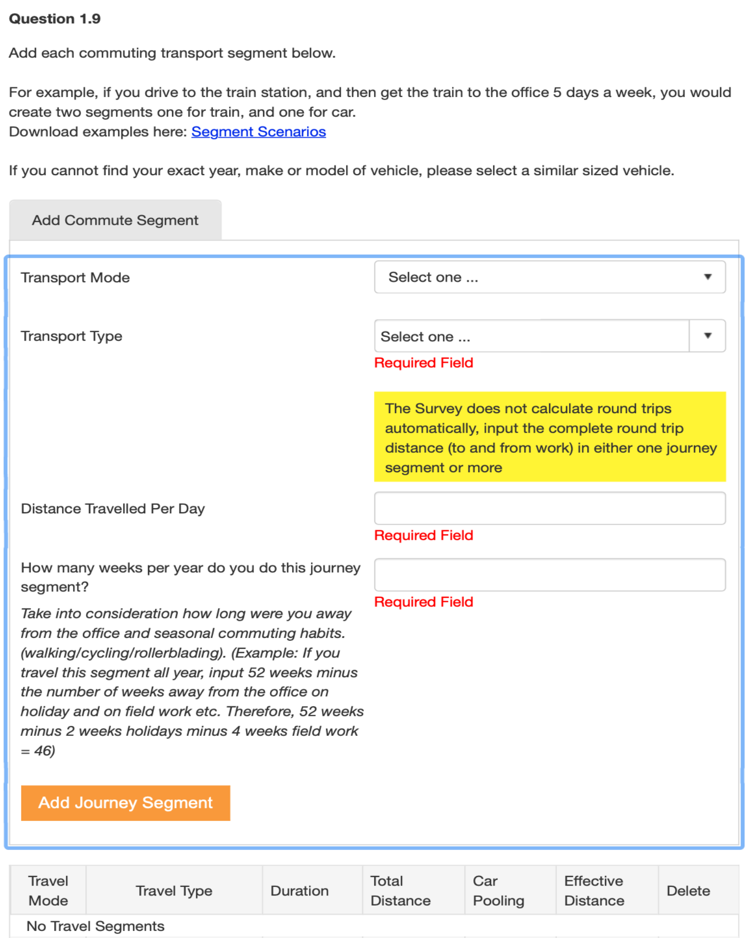
The best method of calculation for OSC to use in this category is the distance based method. This is because the activity data required for this method is the most accessible to OSC, since there is an assumption that business travel information is maintained within the company. For this calculation, the activity data needed from OSC would include the mode of transportation, such as plane, car or train. Also necessary is the distance traveled while using that form of transportation. The emission factors for this category were pulled from EPA Emissions Hub, Table 10. This provided CO_2, CH_4 and N_2O emissions factors associated with business travel based on different modes of travel. See Appendix G for the distance based method equation and emission factor source.

3.4.7 Employee Commuting (Category 7)

Using a survey to directly gather primary data from employees, OSC used the distance based method to begin to calculate the category 7 emissions. In order to calculate emissions from employee commuting Ocean Spray intends to collect data from their employees on the following:

1. Total distance traveled by employees over the reporting period (e.g., passenger-miles traveled)
2. Mode of transportation used for commuting (e.g., train car, bus, bike)

To make the survey more user friendly to employees, commuting segments were used to calculate total distance traveled by employees in the given reporting period. Mode of transportation was included in the segment calculations. The question is displayed in **Figure 11**.



Question 1.9

Add each commuting transport segment below.

For example, if you drive to the train station, and then get the train to the office 5 days a week, you would create two segments one for train, and one for car.
Download examples here: Segment Scenarios

If you cannot find your exact year, make or model of vehicle, please select a similar sized vehicle.

Add Commute Segment

Transport Mode — Select one ...

Transport Type — Select one ...
Required Field

The Survey does not calculate round trips automatically, input the complete round trip distance (to and from work) in either one journey segment or more

Distance Travelled Per Day
Required Field

How many weeks per year do you do this journey segment?
Take into consideration how long were you away from the office and seasonal commuting habits. (walking/cycling/rollerblading). (Example: If you travel this segment all year, input 52 weeks minus the number of weeks away from the office on holiday and on field work etc. Therefore, 52 weeks minus 2 weeks holidays minus 4 weeks field work = 46)
Required Field

Add Journey Segment

Travel Mode	Travel Type	Duration	Total Distance	Car Pooling	Effective Distance	Delete
No Travel Segments						

Figure 11: Question from the Ocean Spray Commuter Survey, created through Accuvio to gather data on commuting segments from employees.

The data collection through the survey was created based on guidelines provided by Greenhouse Gas Protocol and include (Greenhouse Gas Protocol, 2015):

- Distance traveled by employees per day, or location of residence and office
- The number of days per week that employees use different vehicle types
- Number of commuting days per week and number of weeks worked per year
- Employees' region of residence/work
- Whether there is a significant car-pooling scheme in operation, the proportion of employees using the scheme and the average occupancy per vehicle

A template was given from Accuvio to work off of in creating a commuter survey that met OSC's needs. The survey included a series of ten questions including details about transportation mode, type, and distance traveled. The survey was intended to be sent to Ocean Spray employees to gather data on their commuting in order to use the information in a GHG Scope 3 Inventory. The following steps were taken in order to prepare the survey to be sent to employees: a review of the template email and survey, based on the template provided a draft of an introduction email to Ocean Spray employees was written, creation of an introduction to be at the top of the survey, suggestions for edits to the survey questions and content. Feedback given for the survey was minimal, as the template proved to be useful for Ocean Spray's needs. A completed email and survey introduction were sent to Ocean Spray's sustainability lead and the company proceeded from there.

The emission factors for category 7 were pulled from EPA Emissions Hub, one of the sources for industry standards recommended by the GHG Protocol. This provided CO_2, CH_4 and N_2O emissions factors associated with commuter travel. See Appendix G for the distance based method equation and emission factor source.

3.4.8 Upstream Leased Assets (Category 8)

This category is applicable to companies that operate leased assets (i.e., lessees). The recommended method of calculation for OSC to use with this category is the average data method. The data needed for this calculation method could include total floor space of leased buildings, number of leased buildings, and the amount and type of any other assets that OSC leases (i.e., company car). At the time of creating this calculator our team did not have this information. Currently there is a placeholder tab to be used once the activity data and emission factors are able to be entered into the excel spreadsheet. With that information, calculations for category 8 can be included in the total emissions for Scope 3.

3.4.9 Downstream Transportation and Distribution (Category 9)

The best method of calculation for OSC to use in this category is the distance based method. This is because the activity data required for this method is the most accessible to OSC, with the assumption that the transportation of products downstream is filed within the company. For this calculation, the data required from OSC for this calculation includes mass of freight transported, transportation mode and distance traveled. The emission factors for this category were pulled from EPA Emissions Hub, Table 8. This provided CO_2, CH_4 and N_2O emissions factors associated with downstream transportation. See Appendix G for the distance based method equation and emission factor source.

3.4.10 Processing of Sold Products (Category 10)

The method of calculation recommended for OSC with this category would be the average data method. The assumption is that OSC would be able to determine what percentage of a secondary product would have emissions because of their cranberries. The activity data needed includes the mass of the intermediate product, and information for allocation. The emission factors for this category would need to be pulled from the emission generating facilities Scope 1 and Scope 2 emission factors. In other words the energy needed to transform the sold OSC product into a final product. At the time of creating this calculator the team did not have this information. Currently there is a placeholder tab to be used once the activity data and emission factors are able to be entered into the excel spreadsheet. With that information, calculations for category 10 can be included in the total emissions for Scope 3.

3.4.11 Use of Sold Products (Category 11)

While this category can be included for OSC, it was determined that further research will be required before this section can be completed in the calculator. If OSC does plan to include these indirect emissions from end customer refrigeration, it is recommended that OSC conduct an LCA on downstream refrigerators and allocate the emissions that result from refrigerating OSC products. If these indirect emissions result in a significant percentage then they should be included in the OSC inventory. As there are still uncertainties into which direction OSC may take with this category, a recommendation on calculation method and emission factors was not made at this time.

3.4.12 End-of-Life Treatment of Sold Products (Category 12)

The best method of calculation for OSC in this category would be the average data method. This is because this category is reliant upon assumptions on customer behavior to determine the percentage of each disposal method. Because the cranberries do not contribute to fossil carbon dioxide emissions, the end-of-life of packaging is the main source of Category 12 Scope 3 emissions. For this calculation, the data OSC would need to make assumptions on include the type of waste disposal method used by consumers, such as landfill or recycling. It also requires the mass and type of material being disposed of, thus providing the proportion of each material going to each type of waste disposal. The emission factors for this category were pulled from EPA Emissions Hub, Table 9. This provided CO_2, CH_4 and N_2O emissions factors associated with different types of waste treatments. See Appendix G for the distance based method equation and emission factor source.

3.4.13 Downstream Leased Assets (Category 13)

The method of calculation recommended for OSC to use with this category is the average data method. This is because OSC is the owner of the leased assets and would have information regarding those assets, such as buildings that OSC leases to tenants. The data needed for this calculation method could include total floor space of leased buildings, number of leased buildings, and the amount and type of any other assets that OSC leases. At the time of creating this calculator our team did not have this information. Currently there is a placeholder tab to be used once the activity data and emission factors are able to be entered into the excel spreadsheet. With that information, calculations for category 13 can be included in the total emissions for Scope 3.

3.4.13 Franchises (Category 14)

From discussions with our client, it was determined that OSC did not have any downstream franchises. For this reason, we did not include this category as part of our calculator. If franchises are ever added in the future, considerations should be taken when deciding which calculation method would best quantify the category.

3.4.13 Investments (Category 15)

From discussions with our client, it was determined that OSC did not have any downstream investments. For this reason, we did not include this category as part of our calculator. If investments are ever added in the future, considerations should be taken when deciding which calculation method would best quantify the category.

4. Case Study

Reflecting on all this work, we saw that there was potential for emissions reductions if Ocean Spray made strategic changes to company operations. In PY18,[1] they did make a few operational adjustments to regionalize their co-packing facilities to be closer to final destinations and we had the opportunity to roughly calculate the reduction in emissions associated with these changes. The following case studies show the impact that such operational changes can have.

4.1 Regionalizing Canadian production of Beverages

OSC had traditionally produced their 1.77L (60 oz) and 1.89L (64oz) beverages at Facility A in Kenosha, Wisconsin. This product was then transported 914 kilometers to Facility B, a distribution center in Ontario, Canada. In PY18, OSC regionalized their production of this product to a co-packing plant (Facility C) in Scarborough, Ontario. Facility C is 45 kilometers from Facility B. Today, 1.8 million cases of beverage are now locally produced and distributed in the Ontario region, which equates to 1,630 trucks reducing their transportation distance by 869 kilometers.

Using this information, we sought to calculate the emissions now saved by reducing the distance traveled by 869 kilometers. We assumed that there were still 1,630 trucks worth of product traveling between the co-packer and distribution center, but now only traveling a distance of 45 kilometers rather than 914 kilometers. Because all of OSC's transportation is third-party owned and operated, we did not include the return logistics of empty trucks in the calculation. We used average data for an 18-wheeler including fuel economy from the 2015 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles from the EPA (EPA, 2011). This fuel economy standard states that the average fuel economy of an 18-wheeler truck is 3.0 kilometers per liter (EPA, 2011).

The greenhouse gasses carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are primarily emitted during mobile combustion (cars, trucks, buses) and should all be accounted for when calculating emissions associated with transportation and distribution (EPA, 2020). Each

[1] OSC's Processing Year 18 refers to July 2019 to June 2020

greenhouse gas has an assigned GWP. The GWP is 1 for CO_2, 28–36 for CH_4, and 265–298 for N_2O.

To calculate CO_2 emissions associated with truck travel, we used Equation 1 (Equation 2) from the EPA's Direct Emissions from Mobile Combustion guidance document (EPA, 2020). Equation 1 is used for when fuel consumption is known only in mass or volume units and there is no information on the heat content or carbon content. Equation 1 is shown below:

$$Emissions = Fuel \times EF_1 \qquad \text{(Equation 2)}$$

Where, $Emissions = Mass\ of\ CO_2 emitted$,

$Fuel = Mass\ or\ volume\ of\ fuel\ combusted$, and

$EF_1 = CO_2 emissions\ factor\ per\ mass\ or\ volume\ unit$

For this calculation, emissions factors were taken from the EPA's Mobile Combustion guidance document (EPA, 2011) The emissions factor for CO_2 associated with diesel fuel came from Appendix A, Table A-1 in the EPA's Guidance for Mobile Combustion (EPA, 2011).

To calculate the CH_4 and N_2O emissions associated with this reduction, we used Equation 4 (Equation 3) from the EPA's Direct Emissions from Mobile Combustion guidance document. Equation 4 is used to calculate the emissions from fuel combusted for on road vehicles such as cars, trucks, and buses. Equation 4 is shown below:

$$Emissions = Distance \times EF_1 \qquad \text{(Equation 3)}$$

Where, $Emissions = Mass\ of\ CH_4\ or\ N_2O\ emitted$,

$Distance = Vehicle\ distance\ traveled$, and

$EF_1 = CH_4\ or\ N_2O\ emission\ factor\ per\ distance\ unit$

The emissions factors for CH_4 and N_2O associated with Moderate Diesel Medium-and Heavy-Duty Trucks and Buses in Appendix B, Table B-1 in the EPA's Guidance for Mobile Combustion (EPA, 2011). The GWP for CH_4 for mobile combustion is 25 and the GWP for N_2O for mobile combustion is 298 (Solomon, S. et al., 2007)

The volume of diesel was calculated based on the fuel economy of the truck (3 km/liter) and the total distance traveled, shown as Equation 5 below.

$$Volume\ of\ Diesel\ Combusted\ (liters) = \frac{3\ km}{liter} \times distance\ traveled\ (km) \qquad \text{(Equation 5)}$$

The baseline scenario is laid out in **Table 1**. Before PY18, OSC was transporting 1,630 trucks 914 kilometers, a total of 1,490,000 kilometers a year. After applying the emissions factors as stated in Equation 1, the total metric ton CO_2-equivalent GHG emissions for transportation of product from Kenosha to Ontario was 1,350 $mtCO_2e$.

Baseline Scenario		
Number of fully loaded trucks	**1630**	**trucks**
Average distance traveled per truck (miles)	**914**	**km**
Total distance traveled (miles)	1490000	km
Total amount of fuel consumed (diesel)	501000	liters
Total GHG emission	**1350**	**Tonne CO2-eq**

Table 1. Baseline scenario calculation for truck travel GHG emissions (mtCO_2e) associated with transportation from Facility A to Facility B.

In the new scenario, displayed in **Table 2,** the number of trucks remained the same (1,630) while the distance traveled decreased to 45 kilometers. After the regional change in PY18, OSC reduced their distance traveled to 74,500 kilometers. After applying the emissions factors as stated in Equation 1, the total metric ton CO_2-equivalent GHG emissions for transportation of product from Facility A in Kenosha to Facility C in Ontario was 67 mtCO_2e.

New Scenario		
Number of fully loaded trucks	1630	trucks
Average distance traveled per truck (km)	45	kilometers
Total distance traveled (km)	73500	kilometers
Total amount of fuel consumed (diesel)	24700	liters
Total GHG emission	**67**	**Tonne CO2-eq**

Table 2. New scenario calculation for truck travel GHG emissions (mtCO_2e) associated with transportation from Facility A to Facility C.

Comparing the baseline and new scenario, we can see that by localizing the production or juice concentrate to Canada, OSC was able to reduce distance traveled by 140,000 kilometers. This distance equated to an annual GHG emission reduction of approximately 1,280 metric tons CO_2-equivalent.

According to the EPA's Greenhouse Gas Equivalencies Calculator, the 1,280 metric tons CO_2-equivalent emissions reduction is equivalent to 162 home's annual energy use or the average annual distance traveled by 278 passenger vehicles ("Greenhouse Gas Equivalencies Calculator", n.d.).

4.2 Regionalizing Australian production of Beverages

In PY18, OSC produced 1,062,000 cases of their 1.5 liter beverages at Facility D in Nevada and transported it with flavoring and other intermediate products to their co-packers in Australia (multiple locations). After PY18, OSC began producing their juice concentrate at Facility E in Australia. While their flavoring and other intermediate products are still transported from Nevada to Australia, the cases of juice concentrate now regionally produced equates to 830 ocean containers no longer shipping internationally.

To determine the emissions reduction from regionalizing procurement of cranberry concentrate, we limited the Scope of the calculation to the 830 containers no longer shipping internationally. Under this Scope, our baseline scenario was 830 containers traveling the distance from the Los Angeles Port in the United States to the Melbourne Port in Australia. Using the Shipping Distances and Time Calculator from SeaRates, we determined the mileage of an average cargo ship from L.A. to Melbourne to be 11,300 kilometers (SeaRates, n.d.). Because Ocean Spray was still transporting ingredients internationally but wanted to determine the reduction of emissions associated only with the 830 ocean container, the baseline was compared to a zero emissions scenario.

We used the GHG Protocol's Mobile Combustion Calculator to calculate the emissions of the baseline scenario using a Weight Distance activity methodology. As we didn't have third-party data on the vehicle-type, we assumed the scenario cargo ship was selected as the "Watercraft - Shipping - Large Bulk Carrier (14201 tonnes deadweight)". This was chosen as an average size over the "Small Bulk Carrier (1720 tonnes deadweight)" and the "Very Large Bulk Carrier (70000 tonnes deadweight)".

The weight distance equation as defined by the GHG Protocol Category 4: Upstream Transportation and Distribution guidance document is shown below:

$$Emissions = Mass\ of\ goods \times distance\ traveled \times EF \qquad \text{(Eq 4)}$$

Where $Emissions = Mass\ of\ CO_2e\ emitted,$

$Mass\ of\ goods = Sum\ of\ mass\ of\ goods\ purchased\ (tonnes\ or\ volume),$

$Distance\ traveled = distance\ traveled\ in\ transport\ leg\ (km)$, and

$EF = emission\ factor\ of\ transport\ mode\ or\ vehicle\ type\ (kgCO_2e/tonne\ or\ volume/km)$

The emissions factors for this GHG Protocol's calculator are sourced from the US EPA Climate Leaders Program. For this case study, we selected U.S. based emissions factors. The GWP values were taken from the 2014 IPCC Fifth Assessment Report (Solomon, S. et al., 2007).

For this calculation, we used the standard weight of a 40-ft shipping container, which is 3,640 kg. The data above was input into the GHG Protocol's Calculator for Mobile Combustion which generated an GHG emissions total of 1,430 metric ton CO_2-equivalent (World Resource Institute, 2015).

According to the EPA's Greenhouse Gas Equivalencies Calculator, the 1,430 metric tons CO_2-equivalent emissions reduction is equivalent to 172 home's annual energy use or the average annual distance traveled by 311 passenger vehicles ("Greenhouse Gas Equivalencies Calculator", n.d.).

5. Observed Challenges

Throughout the project the team was able to experience the real challenges and opportunities associated with performing a Scope 3 GHG inventory for a private company. We learned that one of the main challenges in a Scope 3 inventory is acquiring data. After conversations with the OSC team we learned that this is normal, in part because it requires requesting or calculating data that is not owned or controlled by the reporting company. While purchasing companies may have influence over their supply chain, the data may not exist, as many suppliers likely have never performed their own inventory. On rare occasions, there is data readily available and the company is able to make accurate estimates, but often average or spend data must be used. As we experienced with OSC, spend data was confidential information that they were unable to share with a third party. The benefit and driver of completing a Scope 3 inventory is so that companies can better engage with their supply chain, upstream and downstream. Performing a Scope 3 inventory first may result in over- or under-estimations of emissions, but it does work to mobilize companies to track emissions interconnectedness in industries and ties between industries across the globe.

Even though we were unable to calculate and report Scope 3 emissions, there is still a benefit of looking into the aspects of the supply chain and where the emissions are generated. Throughout the project, we were able to get a deeper understanding about the information required and project difficulties that could be expected in GHG Scope 3 projects. The output for a GHG Scope 3 inventory does not always include all possible categories, but focuses on the categories that the company decides is applicable, significant, and has emissions reduction potential.

As outlined in the calculation method section, there are multiple methods to calculating a company's Scope 3 emissions. Starting the project, we were under the impression that OSC would be using Accuvio to do their Scope 3 emissions inventory. Accuvio has some aspects that make it a great tool to do those calculations, and other aspects that make it difficult to understand the implications of the values for each emissions category. For OSC to see exactly where their largest emissions are coming from (as an estimate) the team generated Scope 3 calculator tool was used. This way OSC can see a summary of their different categories, percent impact, etc.. A company should determine which software is best for their specific inventory. For companies that have a simple supply chain, they may be able to utilize the spreadsheet calculator. However, for companies with a more complex supply chain, they may find that using software would be much easier. A consultant can bring experience and can offer recommendations on best emissions mitigation practices within a company's industry. In addition, through contractual obligation and a long-term relationship, it is easier to trust a consulting firm to remain confidential on data than it is a university group. In this sense, a consulting firm would likely not face the same challenge we did in obtaining spend data.

Given that in our instance the data was too sensitive for OSC to share, our team had to make a shift and focus on understanding what goes into each category and providing a very rough estimate of some calculations. In the future, OSC may need to prioritize and consider who they want to manage this project, ideally someone who can be granted access to their data.

Through the use of the calculator it was apparent that we were missing a lot of the required data to complete the calculations specifically for OSC. As an alternative, we still created the calculator as a thought exercise and to consider the implications and inputs to the emission calculations. We learned that there are a lot of assumptions that must be taken and recorded in order to ensure that the calculations are accurate to the best of our ability. We learned from this that there are regional and industry specific values to choose from. When we had the data available for industry/company specific emissions factors we would use those values. However, in reality this is not usually the case. The values that are more commonly used are ones that convert the dollars spent to GHG emissions. This gives a very rough estimate of the Scope 3 emissions from that specific category. Once the spend is converted to emissions for each line item, the five greenhouse gasses are converted to CO_2 equivalents. This gives an overall estimation of the total greenhouse gas effect. One of the most important aspects of these calculations is to ensure that they are repeatable. For this, we carefully noted all our decisions and sources for all calculations. That way when OSC does have their data together they may be able to use this calculator as a guide to understand what is involved in the calculations even though they will be using a software program to do the physical calculations.

OSC has now completed two student Master's projects with the University of Michigan and have made some steps towards their GHG Emissions Scope 1, 2, and 3, but they are not done yet. An opportunity for the future of OSC might be to hire internal personnel to manage this project or hire a third party consultant. If they do decide to pursue a third party consultant, they must ensure they will have the legal department's support to share the data. This project was a great learning experience, we were able to see some critical roadblocks and how large businesses operate. If there was no actionable data available (as the team experienced) then we must do individual research on the topic. There was also some difficulty with sharing of operational processes. While it was a good experience to go out and do research on our own, in hindsight, it would have been more valuable to be provided with more base information about their supply chain and operational processes.

6. Conclusion

6.1 Key Insights

The following are key insights that were observed and reflected upon throughout the duration of this project. These insights are derived from the processes and decision making behind calculating GHG Scope 3 emissions for a cranberry manufacturer supply chain.

(1) *Greenhouse gas emissions encompass many different aspects of the cranberry supply chain.* While creating the calculator we learned which specific business activities go into each Scope 3 Category. Data can both be general and very detailed. For example, the spend data for very small items might have a small GHG footprint, however, when added together it has a significant GHG footprint. In conclusion, supply chains are dynamic, mapping the value chain only captures a company's operations at one moment in time.

(2) *Aspects of Scope 3 emissions have differing significance, as it relates to agricultural manufacturing.* Different supply chains will have very different Scope 3 emissions. For OSC, we learned that Category 1 - Purchased Goods and Services and Category 2 - Capital Goods have a higher general impact than Category 7 - Employee Commuting. This is because there are so many different items and services that go into creating OSC's products, most of which come from the grower-owners farms.

(3) *Cranberries have a long shelf-life, this leads to less waste and therefore the resulting emissions are low.* Some foods and beverages require that items be stored and/or transported at a certain temperature. Cranberries do not need cold storage or transportation and have a long shelf life. Given this, Category 4 - Upstream Transportation and Distribution and Category 9 - Downstream Transportation and Distribution are not the highest GHG emitters. The long shelf life of cranberries leads to less spoilage and therefore cranberries can be stored for a long time with little energy input. This reduces the GHG emissions over the lifetime of each cranberry.

(4) *Decisions around where a specific business activity should be categorized is important as to not double count emissions.* For some of the business travel there was fuel purchased. However, the business travel calculation only includes fuel that is burned during travel. We had multiple discussions to figure out which category was the best place to put fuel usage. It was determined that it would be included under business travel.

6.2 Future Work: Full Scope 3 Inventory

OSC is committed to working towards setting Science-Based Targets (SBTs) in order to reduce emissions connected to the company in line with a 1.5 degree celsius climate trajectory. OSC is a large organization (>500 employees) and as anticipated, OSC's Scope 3 emissions make up more than 40% of their emissions profile. According to the Science-Based Targets initiative, companies whose Scope 3 emissions makeup more than 40% of their emissions profile must set targets on their Scope 3 emissions. Achieving a full Scope 3 GHG inventory is necessary to set SBTs, and with its completion, OSC can conduct assessment on where the largest reductions can be made. With this knowledge, OSC can begin implementing strategies to reduce their total corporate GHG emissions. Some of the Scope 3 categories may be best to account for using Accuvio, since it does hold Scope 1 and 2 emissions data from growers. Alternatively, OSC can input gathered data into the excel calculator, completing the sections that were not able to be accounted for at this time. The future work that OSC's needs to take in completing the Scope 3 inventory are as follows:

For upstream Scope 3 emissions, OSC will need to engage with growers to identify upstream fuel-and-energy related activities not included in Scope 1 and 2. For Category 7 - Employee Commuting, we suggest that OSC sends out the commuter survey to gather data on employee commuting habits. This should be done sooner rather than later as the survey intends to capture the habits of commuting in 2019, before the pandemic and the mass migration to a hybrid work environment. For Category 8 - Upstream Leased Assets, the company must identify their leased facilities for the reporting year and include their emissions in a Scope 3 inventory.

For downstream Scope 3 emissions, OSC could consider collaborating on emissions inventories with their customers who use OSC's ingredients to produce their own product. With Scope 1 and 2 emissions data from their customer, along with the percentage of sale to the customer, OSC could calculate their emissions from processing of their sold goods. To accurately calculate the use of sold products, we recommend that OSC perform a cradle-to-grave Life Cycle Assessment (LCA) on their worst case product, such as one that requires refrigeration. A cradle-to-grave assessment could also determine the average waste of product by OSC's consumers, which could help cover Category 12 - End of Life Treatment of Sold Products. Finally, for Category 13 - Downstream Leased Assets, OSC should determine their owned assets that they lease out and account for the emissions generated from those facilities that are not included in a Scope 1 and 2 inventory.

References

Aydinalp, C., & Cresser, M. S. (2008). The effects of global climate change on agriculture. American-Eurasian Journal of Agricultural & Environmental Sciences, 3(5), 672-676.

Blair, S., Chen, R., Hefelfinger, S., Heeseung, K., Mullin, C., Seguin, E., Greenhouse Gas Inventory and Corporate Climate Strategy for Ocean Spray Cranberries, Inc. April 30, 2021. University of Michigan.

CMU, S. M. (n.d.). Cmu—Economic input-output life cycle assessment—Carnegie Mellon University. Retrieved 16 April 2022, from http://www.eiolca.net/index.html

Ecoinvent database. (n.d.). Ecoinvent. Retrieved 16 April 2022, from https://ecoinvent.org/the-ecoinvent-database/

EFDB—Main page. (n.d.). Retrieved 16 April 2022, from https://www.ipcc-nggip.iges.or.jp/EFDB/main.php

Eiolca. Net—Free life cycle assessment on the internet. (n.d.). Retrieved 16 April 2022, from http://www.eiolca.net/cgi-bin/dft/use.pl

"Final Rule for Phase 1 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles." *EPA*, Environmental Protection Agency, 15 Sept. 2011, https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-phase-1-greenhouse-gas-emissions-standards-and.

Ford, Kylie (n.d.). "How to Define Boundaries for GHG Reporting." *GRESB*, Global Real Estate Sustainability Benchmark (GRESB), https://gresb.com/nl-en/2021/08/19/how-to-define-boundaries-for-ghg-reporting/.

Fruit rot - cooperative extension: Cranberries - university of maine cooperative extension. (n.d.). *Cooperative Extension: Cranberries*. Retrieved 16 April 2022, from https://extension.umaine.edu/cranberries/grower-services/diseases/fruit-rot/

"Greenhouse Gas Equivalencies Calculator" n.d., *EPA*, Environmental Protection Agency, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

"Greenhouse Gas Inventory Guidance Direct Emissions from Mobile Combustion Source." *EPA*, Environmental Protection Agency, Dec. 2020, https://www.epa.gov/sites/default/files/2020-12/documents/stationaryemissions.pdf.

Greenhouse Gas Protocol. "GHG Protocol Agricultural Guidance." April 25, 2020. https://ghgprotocol.org/agriculture-guidance.

Greenhouse Gas Protocol. “GHG Protocol Corporate Accounting and Reporting Standard.” 2015. https://ghgprotocol.org/corporate-standard.

Greenhouse Gas Protocol.“Corporate Value Chain (Scope 3) Standard”. https://ghgprotocol.org/standards/scope-3-standard

Greenhouse Gas Protocol. “Technical Guidance for Calculating Scope 3 Emissions (version 1.0).” 2013. https://ghgprotocol.org/scope-3-technical-calculation-guidance

Horton, R., G. Yohe, W. Easterling, R. Kates, M. Ruth, E. Sussman, A. Whelchel, D. Wolfe, and F. Lipschultz, 2014: Ch. 16: Northeast. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 371-395. doi:10.7930/J0SF2T3P

Kurukulasuriya, P., & Rosenthal, S. (2013). Climate change and agriculture: A review of impacts and adaptations.

Mote, P., A. K. Snover, S. Capalbo, S. D. Eigenbrode, P. Glick, J. Littell, R. Raymondi, and S. Reeder, 2014: Ch. 21: Northwest. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 487-513. doi:10.7930/J04Q7RWX

Ocean Spray Cranberries, Inc. “About the Cooperative.” Accessed April 2, 2022. https://www.oceanspray.com/en/Our-Story/Ownership.

Ocean Spray Cranberries, Inc. "Our Cranberry Harvest.” Accessed April 16, 2022. https://www.oceanspray.com/en/Our-Story/About-the-Harvest.

Pryor, S. C., D. Scavia, C. Downer, M. Gaden, L. Iverson, R. Nordstrom, J. Patz, and G. P. Robertson, 2014: Ch. 18: Midwest. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 418-440. doi:10.7930/J0J1012N.

SeaRates. (n.d.). *International Container Shipping: Online Freight Marketplace*. SeaRates. Retrieved April 19, 2022, from https://www.searates.com/

Solomon, Susan, et al. “IPCC’s Fourth Assessment Report (AR4) Technical Summary.” *IPCC*, Intergovernmental Panel on Climate Change, 2007, https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-ts-1.pdf.

The cranberry. (n.d.). Center for Agriculture, Food, and the Environment. Retrieved 16 April 2022, from https://ag.umass.edu/cranberry/about/cranberry

“Understanding Global Warming Potentials” n.d., *EPA*, Environmental Protection Agency, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

US EPA. (n.d.). *Climate Impacts in the Northeast*. Retrieved 16 April 2022, from https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-northeast

US EPA. (n.d.). *Climate Impacts in the Northwest*. Retrieved 16 April 2022, from https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-northeast

US EPA. (n.d.). *Climate Impacts in the Midwest*. Retrieved 16 April 2022, from https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-northeast

US EPA. (n.d.). GHG emission factors hub. Retrieved 16 April 2022, from https://www.epa.gov/climateleadership/ghg-emission-factors-hub

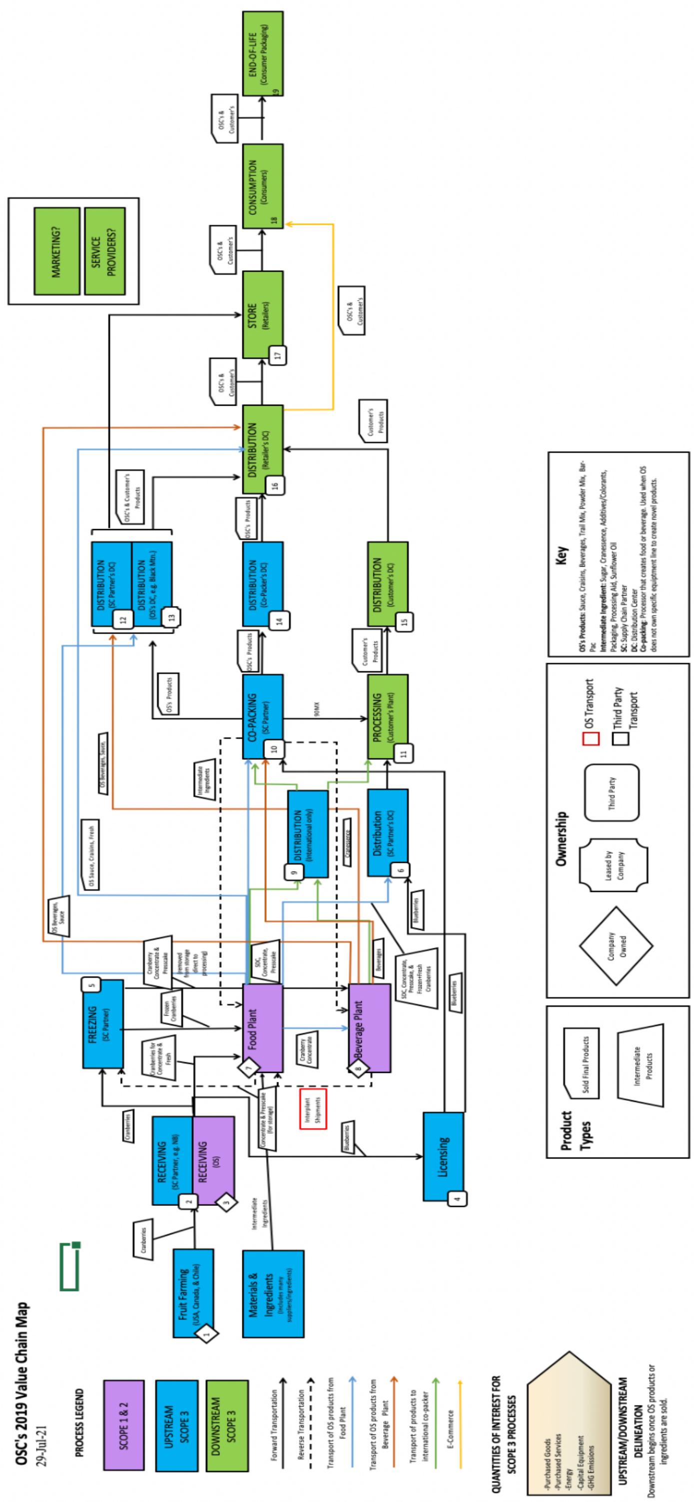
US EPA, O. (n.d.). US Environmentally-Extended Input-Output (USEEIO) models. Retrieved 16 April 2022, from https://www.epa.gov/land-research/us-environmentally-extended-input-output-useeio-models

USDA research seeks to strengthen cranberry resiliency as climate change affects production: USDA ARS. (2021, December 14). https://www.ars.usda.gov/news-events/news/research-news/2021/usda-research-seeks-to-strengthen-cranberry-resiliency-as-climate-change-affects-production/#:~:text=More%20extreme%20and%20hotter%20weather,and%20increases%20in%20disease%20pressure

World Resources Institute (2015). GHG Protocol tool for mobile combustion. Version 2.6.

Appendix

Appendix A: Map of Ocean Spray's 2019 Corporate Value Chain



Appendix B: Explanation of Movement through OSC Value Chain

Step	Name	Description	Transportation	To	Name	Description
1	Fruit Farming	Company owned farms located in the United States, Canada and Chile produce cranberries	→	2	Receiving (SC partner)	Cranberries produced by co-op farmers transported to supply chain partner receiving station
			→	3	Receiving (OS)	Cranberries produced by co-op farmers transported to OS receiving station
2	Receiving (SC partner)	Third party supply chain partner recieves cranberries from fruit farms	→	4	Licensing	Cranberries delivered from third party SC partner to licensing partner; lallowance for use of OS logo/licensing for blueberry products
			→	5	Freezing (SC Partner)	Cranberries delivered from third party SC partner to third party sC partner freezes cranberries for later use
			→	7	Food Plant	Company owned food plant recieves cranberries from third party facility for processing & distribution
3	Receiving (OS)	Company owned receiving center recieves cranberries from fruit farms	→	4	Licensing	Cranberries delivered from OS receiving center to licensing partner; lallowance for use of OS logo/licensing for blueberry products
			→	5	Freezing (SC Partner)	Cranberries delivered from OS receiving center to third party sC partner freezes cranberries for later use
			→	7	Food Plant	Company owned food plant recieves cranberries from OS facility for processing & distribution
4	Licensing	Third party allowance for use of Ocean Spray logo/licensing with blueberry products (Partners: Kraft Heinz, Pepsi Co, Lyons Magnus, Oppy)	→	6	Distribution (SC Partner DC)	Blueberries transported to supply chain partner's distribution center
			→	10	Co-Packing (SC Partner)	Blueberries transported to SC partner's co-packing facility to create final products (or novel products) using equiptment OS does not o
5	Freezing (SC Partner)	Third party supply chain partner freezes cranberries	→	7	Food Plant	Frozen cranberries are sent to food plant for processing
			→	8	Beverage Plant	Cranberry concentrate and presscake sent to beverage plant for further processing
6	Distribution (SC Partner DC)	Third party supply chain partner's distribution center recieves SDC, concentrate, presscake, fresh and frozen cranberries	→	11	Processing (Customer's Plant)	Customer purchases intermediate products for use in their final product
7	Food Plant	Company owned food plant recieves intermediate products and ingredients for processing & distribution	- - - →	5	Freezing (SC Partner)	Concentrate and Presscake return to freezer to be stored
			→	6	Distribution (SC Partner DC)	SDC, Concentrate, and Presscake sent to SC Partner's DC to be distributed to customer
			→	8	Beverage Plant	Cranberry concentrate sent to beverage plant
			→	9	Distribution (International Only	SDC, Concentrate, and Presscake sent to DC for international distribution
			→	10	Co-Packing (SC Partner)	SDC, Concentrate, and Presscake sent toCo-Packing partner to create novel final products
			→	12	Distribution (SC Partner DC)	SDC, Concentrate, and Presscake sent to SC Partner's DC to be distributed to retailers
			→	13	Distribution (OS's DC)	SDC, Concentrate, and Presscake sent to OS's DC to be distributed to retailers
			→	16	Distribution (Retailer's DC)	OS Sauce, Craisins and fresh cranberries sent to Retailer's DC
8	Beverage Plant	Company owned beverage plant recieves intermediate products and ingredients for processing & distribution	- - - →	7	Food Plant	Interplant shipments sent between food and beverage plant
			→	9	Distribution (International Only	Beverages sent to DC for international distribution
			→	10	Co-Packing (SC Partner)	Beverages sent to co-packing partner to make novel final product
			→	12	Distribution (SC Partner DC)	Cranessence sent to SC Partner's DC to be distributed to retailers
			→	13	Distribution (OS's DC)	Cranessence sent to OS's DC to be distributed to retailers
			→	16	Distribution (Retailer's DC)	OS Beverages and sauces sent to Retailer's DC
9	Distribution (International Only	Third party international partner's distribution center recieves SDC, concentrate and presscake	→	10	Co-Packing (SC Partner)	SDC, Concentrate, and Presscake sent to SC co-packing partner to create novel final product
			→	11	Processing (Customer's Plant)	SDC, Concentrate and Presscake bought as intermediate products to be processed at customer's plant
10	Co-Packing (SC Partner)	Third party supply chain partners creates novel products that OS cannot make	- - - →	7	Food Plant	Intermediate ingredients transported back to food plant
			- - - →	8	Beverage Plant	Intermediate ingredients transported back to beverage plant
			→	11	Processing (Customer's Plant)	Novel final products sent to customer's plant for processing
			→	13	Distribution (OS's DC)	Novel final products sent to customer's plant for processing
			→	14	Distribution (Co-Packer's DC)	Novel final products sent to co-packer's distribution center
11	Processing (Customer's Plant)	Third party customer's processing of products	→	15	Distribution (Customer's DC)	Customer sends their products to their distribution center
12	Distribution (SC Partner DC)	Third party supply chain partner's distribution center recieves from beverage and food plants	→	16	Distribution (Retailer's DC)	OS's final products sent to retailer's distribution centers
			→	17	Store (Retailers)	Os's final products sent directly to retailer's store
13	Distribution (OS's DC)	Center leased by Ocean Spray to help in distributing products recieved from food and beverage plants	→	16	Distribution (Retailer's DC)	OS's final products sent to retailer's distribution centers
			→	17	Store (Retailers)	Os's final products sent directly to retailer's store
14	Distribution (Co-Packer's DC)	Third party co-packing (multiple) distrubution center	→	16	Distribution (Retailer's DC)	OS's final products sent to retailer's distribution centers
15	Distribution (Customer's DC)	Third party customer distribution center (follows in chain of licensed out products)	→	16	Distribution (Retailer's DC)	Customer's final products sent to retailer's distribution centers
16	Distribution (Retailer's DC)	Third party distribution center for retailer, houses Ocean Spray products, customer's products, and products directly from beverage and food plants	→	17	Store (Retailers)	OS's and Customer's final products sent to retailer's stores
			→	18	Consumption	OS's and Customer's final products sent to customers via E-commerce
17	Store (Retailers)	Third party store sells Ocean Spray and Customer's products	→	18	Consumption	OS's and Customer's final products bought in stores by customers
18	Consumption	consumers buy and use Ocean Spray and Customer's products either from store or right from the distribution center	→	19	End-of-Life	End-of-Life treatment of OS's and Customer's final product waste and packaging
19	End of Life	packaging & waste left after product consumption				

Appendix C. Questions asked during software introduction meetings.

Questions asked during each meeting with the software companies are as follows:

1. Does the price include any consulting/advice/technical support?
2. What new features are coming out soon?
3. How many people can access/edit the information with the general subscription? What is the additional cost to add more?
4. How often is the information updated to keep up with the current regulations?
5. Will there be a section added in the future about the SEC disclosure?
6. What emissions factors are used for Scope 3? Is this customizable?
7. What are the audit features? How is data reviewed/submitted for third party review?
8. Are there training sessions for new employees or people that are new to the software?
9. How is data collected for scope 3? For example, employee travel information, is it an email survey? Can employees upload to a website individually? Does one person have to collect and upload?

Appendix D. Notes from meeting with Company A

Questions:	Scope 5
Does the price include any consulting/advice/tech support?	- Consultants can help with customizable calculations for unique emissions factors needed - Many options for price range – depending on scope - Have annual software model and monthly software model
What new features are coming out soon?	- Constant updates and improvements happening all the time - Working on new more user friendly interface - Constant improvements on specific levels of reporting - Market indicative reporting
How many people can access/edit the information with the general subscription? What is the additional cost to add more?	- No limit - Everyone can have specific trackers they are
How often is the information updated to keep up with current regulations?	- Minimum of quarterly updates - All updates are marked in an audit trail
Will there be a section added in the future about the SEC disclosure?	
What emissions factors are used for scope 3? is this customizable?	- 13/15 categories supported - Can also track franchise and investments but hasn't been a need for clients thus far - Can have a personal library for categories
What are the audit features? How is data reviewed/submitted to third party for review?	
Are there trainings/training videos for new employees or people that are new to the software?	- Part of onboarding (one time fee) includes 5-6 part training for members of the team - Recorded and provided to us - Professional service hours if need more training
How is data collected for scope 3? For example, employee travel information is it an email survey, can they upload to a website individually? Or does one person have to collect and upload?	- Highly configurable - the initial login page might look different for each user (can be customized for each individuals need) - Activity tracker health bar – can see where data stands - Top emissions factors in resource library - Have customizable library to calculate specifics for clients - Automatic data transfer – scope 5 connects to facility or tracker (monthly) - Cadence can be customized ,"tracker" - any specific metric (including social metrics) - Have ability to have special user interface – they can access any part of hierarchy

Appendix E. Notes from meeting with Company B

Questions:	Company B
Does the price include any consulting/advice/tech support?	- Extra cost: have premium support if you want a client success manager - Success managers would meet monthly with the team and help with screening/data needs. Serve as an outside resource that focuses on software
What new features are coming out soon?	- Launching a supplier portal, where suppliers can log in, and capture/enter data, track and assess their performance which then feeds into Envizi - Can award them and put on a scale based on performance
How many people can access/edit the information with the general subscription? What is the additional cost to add more?	
How often is the information updated to keep up with current regulations?	- Refresh schedule around every year depending on database - Analysts have a schedule they follow
Will there be a section added in the future about the SEC disclosure?	
What emissions factors are used for scope 3? is this customizable?	- All 15 categories, but have not worked with category 10 or 15 - Envizi would manage any public factor that Ocean Spray would want to apply - Can bring in spend data and connect with internal spend system - Can get activity data that comes from supplier system that gives volume of quantity purchased – either manually or automatically
What are the audit features? How is data reviewed/submitted to third party for review?	- Activity/Spend data can be automated so it keeps up with annual audits - Also supports manual and/or surveys - PowerReport BI – automates answers for all environmental questions in CDP report – just need to copy and paste into questionnaire - Can share link to dashboard – export to PDF or Powerpoint and can see breakdown of emissions by supplier – 30,000 ft view of scope 3 (what supplier or data types or which categories) - There are industry-specific frameworks
Are there trainings/training videos for new employees or people that are new to the software?	- Two levels of support - Load all the data, creates data factors, screesn all users – when you log in everything is ready - Has "knowledge base" where you log tickets or ask questions
How is data collected for scope 3? For example, employee travel information is it an email survey, can they upload to a website individually? Or does one person have to collect and upload?	- Reports from systems tracking category info –> sent to email address –> server –> Envizi - Can do APIs but usually do connectors with third -party system to email address or SFPP systems that push out data at a recurring frequency - Data can also be uploaded manually - Can attach file to support data (this is customizable)
Additional Presentation Notes:	- Envizi engages with clients to do all 15 scopes – not just 3. - 180 clients, 200,000 sites under management - On-site emissions reduction goals may be a good option for Ocean Spray because of their relationship with agriculture. - Once Ocean Spray sets targets, you can enter targets into Envizi and track progress - Home page can be customized to get to information quickly – based on location/reports/etc - Can structure business by setting up hierarchies – depends on how they want their data pushed out - Reporting at processing level (i.e., cranberry farm level), by business groups or location-based

Appendix F. Summary of OSC GHG Scope 3 Calculator

Excel Calculation Formulas

In order to calculate the emissions we needed to ensure that the proper emissions factors were being pulled. This meant that we had to write an excel formula that would pull the emission factor based on multiple inputs. One way to do this in excel is to use the "INDEX" and "MATCH" functions. The index function is used to look at a matrix, and see which column and row value you are looking for. As an example below, this formula will pull the emissions factor from the 2015 Industry Data worksheet based on matching the first and second lookup requirement. This Industry data is listed so that one column shows the industry and then the next column shows the emissions type. Therefore, the formula had to be written so that excel was matching both columns to pick the correct emissions factor from column F.

```
=INDEX('2016_Detail_Industry'!$F$2:$F$1581,MATCH($F16&J$15,'2016_Detail_Industry'!$B$2:$B$1581
&'2016_Detail_Industry'!$C$2:$C$1581,0))
```

For when you want to match only two columns.

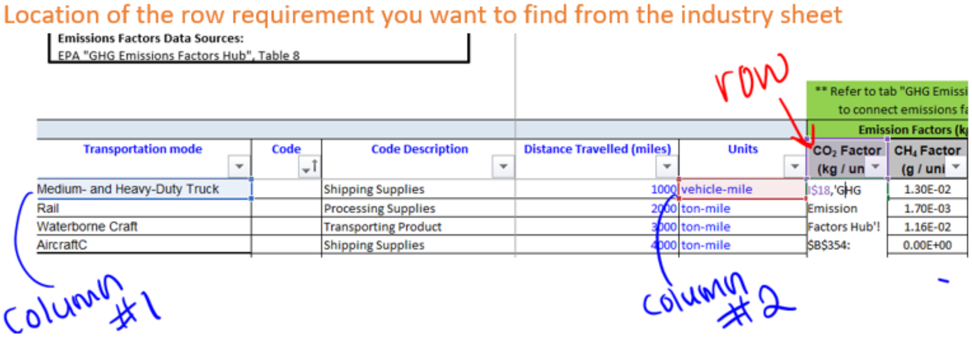
- Column with the value you want to find from industry sheet
- First lookup requirement in your current sheet (ex. Category 1 sheet)
- Location of the first requirement you want to find from the industry sheet
- second lookup requirement in your current sheet (ex. Category 1 sheet)
- Location of the second requirement you want to find from the industry sheet

Some of the other emissions calculations required picking an emissions factor based on two columns and one row. To do this, the formula needs to have the same start as matching only two columns but an added "MATCH" after listing the second column. This is due to the way that the spreadsheet was set up. Here the formula is pulling the GHG Emissions Factor based on three requirements (ex. Transportation method, units, and emissions type).

=INDEX('GHG Emission Factors Hub'!$B$355:$H$361,MATCH($B19&$H19,'GHG Emission Factors Hub'!$C$355:$C$361&'GHG Emission Factors Hub'!$I$355:$I$361,0),MATCH(I$18,'GHG Emission Factors Hub'!$B$354:$H$354,0))

For when you want to match two columns and one row

- Full Table with the value you want to find from industry sheet
- First column lookup requirement in your current sheet (ex. Category 1 sheet)
- Location of the first column requirement you want to find from the industry sheet
- second column lookup requirement in your current sheet (ex. Category 1 sheet)
- Location of the second column requirement you want to find from the industry sheet
- Row requirement lookup requirement in your current sheet (ex. Category 1 sheet)
- Location of the row requirement you want to find from the industry sheet



Below are a few more examples of other "INDEX" formulas that were used. They have the same color coding as above.

=INDEX('GHG Emission Factors Hub'!$B$355:$H$361,MATCH($B19,'GHG Emission Factors Hub'!$C$355:$C$361,0),MATCH(I$18,'GHG Emission Factors Hub'!$B$354:$H$354,0))

=INDEX('GHG Emission Factors Hub'!$B$355:$H$361,MATCH($B19, '2016_Detail_Industry'!$B$2:$B$1581,0),MATCH(J$15, '2016_Detail_Industry'!$C$2:$C$1581,0))

=INDEX('2016_Detail_Industry'!$F$2:$F$1581,MATCH($F16&J$15,'2016_Detail_Industry'!$B$2:$B$1581 &'2016_Detail_Industry'!$C$2:$C$1581,0))

Calculator Example - Category 1 - Purchased Goods and Services:

The user inputs for this category include the material description, group material description, total dollar value, and OS category. Based on these inputs the spreadsheet pulls the applicable item code from the 2008 -App.IO Emissions Factors and provides the commodity name that is equivalent in the 2016 details commodity information. The commodity name and code tells the spreadsheet which emissions factors to pull in units of kg CO_2e/2018 USD purchased. The far right side of the spreadsheet summarizes the emissions based on each of the OS categories. The blue text in the photo below are user input values.

Category 1: Purchased Goods and Services

Technical Guidance for Calculating Scope 3 Emissions

GHG Protocol Method:
Spend-Based Method requires: economic value of goods and services, and relevant industry average emission factors

OS Activity Data Source:

Emissions Factors Data Sources:
US EEIO "Supply Chain Greenhouse Gas Emission

Cells with blue text are inputs

Return to Summary Sheet

Category 1 GHG total: 1374784 kg CO2e

$7,813,369

** Use these columns to adjust for GDP and deflation factor

Purchase Information					NAICS Code			Purchase Information - 20...	
Material	Material Description	Group Material	Group Material Description	Total Value 2016 (Dollar)	OS Category	Code	Sector Name	Deflation Factor	Value (dollars)
24047000	TRIPOTASSIUM CITRATE	1500	Acidulants	$19,609	Oil	311225	Fats and oils	0.87	$17,059.855
24380000	6/128OZ. CRANAPPLE H-BLISS WRAP -2009	2090	Corrugated beverage	$21,714	Other Food	311990	All other food	0.87	$18,891.196
29175000	PINEAPPLE FLAVOR WONF, NATURAL	1400	Flavors	$3,226	Flavor	311940	Seasoning and	0.87	$2,806.968
	APPLE JUICE CONC ALL	1200	Flavors	$19,609	Flavor	311940	Seasoning and	0.87	$17,059.855
	JJ-PEAR CONC #1451	1200	Flavors	$21,714	Flavor	311940	Seasoning and	0.87	$18,891.196
	APPLE JUICE CONC ALL	1200	Flavors	$17,806	Flavor	311940	Seasoning and	0.87	$15,491.216
	JJ-PEAR CONC #1451	1200	Flavors	$18,016	Flavor	311940	Seasoning and	0.87	$15,674.350
	DEIONIZED APPLE JUIC	1200	Flavors	$18,227	Flavor	311940	Seasoning and	0.87	$15,857.485
	DC BEVBASE CRBY W/AC	1427	Flavors	$18,437	Flavor	311940	Seasoning and	0.87	$16,040.619

Once the user inputs those values, the excel sheet will pull the NAICS code and Sector Name from the appropriate table. See screenshots below of the formulas for these cells.

```
=INDEX('2008 -App.IO Emissions Factors'!$P$9:$R$58,MATCH($G16,MAT_ING,0),MATCH(H$15,'2008 -App.IO Emissions Factors'!$P$8:$R$8,0))
```

	D	E	F	G	H	I	J	K	L	M	N
							** Use these columns to adjust for GDP and deflation factor		** Refer to tab "2016 Industry" or "2016 emissions factor for you		
Purchase Information				NAICS Code			Purchase Information - 20...		Emission Factors (kg CO2		
	Group Material	Group Material Description	Total Value 2016 (Dollar)	OS Category	Code	Sector Name	Deflation Factor	Value (dollars)	carbon dioxid	methane	nitrous o
	1500	Acidulants	$19,609	Oil	311225	:s and oils	0.87	$17,059.855	0.276	0.100	0.2
009	2090	Corrugated beverage	$21,714	Other Food	311990	All other food	0.87	$18,891.196	0.614	0.050	0.
	1400	Flavors	$3,226	Flavor	311940	Seasoning and	0.87	$2,806.968	0.253	0.050	0.0

As you can see, the NAICS code is pulling from the 2008 IO Emissions Factors.

```
=INDEX(NAICS,MATCH($H16,NAICS_CODES,0),MATCH(I$15,'2008 -App.IO Emissions Factors'!$B$8:$M$8,0))
```

	D	E	F	G	H	I	J	K	L
							** Use these columns to adjust for GDP and deflation factor		** Refe
Purchase Information				NAICS Code			Purchase Information - 20...		
	Group Material	Group Material Description	Total Value 2016 (Dollar)	OS Category	Code	Sector Name	Deflation Factor	Value (dollars)	carbon dic
	1500	Acidulants	$19,609	Oil	311225	Fats and oils	0.87	$17,059.855	0.27
2009	2090	Corrugated beverage	$21,714	Other Food	311990	All other food	0.87	$18,891.196	0.61
	1400	Flavors	$3,226	Flavor	311940	Seasoning and	0.87	$2,806.968	0.25

While the Sector Name is based off of the NAICS code that was previously pulled from the table. This cell looks in the NAICS table for that specific code and then relays the sector name. Below shows how the emissions factor is pulled based on the user input values and the NAICS code.

=INDEX('2016_Detail_Commodity'!$A$1:$F$1577,MATCH($H16&L$15,'2016_Detail_Commodity'!$A$1:$A$1577&'2016_Detail_Commodity'!$C$1:$C$1577,0),MATCH($L$14,'2016_Detail_Commodity'!$A$1:$F$1,0))

	H	I	J	K	L	M	N	O
ıic value			** Use these columns to adjust for GDP and deflation factor		** Refer to tab "2016 Commodity" to connect emissions factor fo your materials			
try avera	NAICS Code		Purchase Information - 20...		Emission Factors (kg CO2 e/2018 USD)			
	Code	Commodity Name	Deflation Factor	Value (dollars)	carbon dioxide	methane	nitrous oxide	other GHGs
	326160	Plastic bottles	0.87	$17,059.855	0.302	0.025	0.000	0.007
	311990	All other foods	0.87	$18,891.196	0.149	0.050	0.000	0.006
; Emissio	311940	Seasonings and dressings	0.87	$2,806.968	0.159	0.050	0.000	0.007
	311930	Flavored drink concentrates	0.87	$17,059.855	0.085	0.025	0.000	0.007

The carbon dioxide cell pulls the emissions factor from the 2016 Detail Commodity table based on the NAICS code, emission factors title, and emissions type. The additional input for the formula of the emissions factor title is due to the organization of the table. The remainder of the emissions factors are pulled via the same method.

The emissions are then calculated as shown in the photo below.

=L16*K16

	K	L	M	N	O	P	Q	R	S	T
	mns to adjust for	** Refer to tab "2016 Commodity" to connect emissions factor for your materials				Totals				
nic value	lation factor					1227931.2	1517.8	0.1	252.4	
try avera	tion - 20...	Emission Factors (kg CO2 e/2018 USD)				Emissions (kg CO2e)				
	Value (dollars)	carbon dioxide	methane	nitrous oxide	other GHGs	carbon dioxide	methane	nitrous oxide	other GHGs	Total GHG Emissions (kg CO2e)
	$17,059.855	0.302	0.025	0.000	0.007	5152	426	0	119	5698
	$18,891.196	0.149	0.050	0.000	0.006	2815	945	0	113	3873

As you can see, it pulls the emissions factor in column L and the dollar value after it has been altered for deflation. Each of the emissions calculated are in units of kg CO_2e and therefore can be summed to get the total GHG Emissions for that activity. Once all the values are calculated, the final result is summed and the summary table on the first tab pulls this value, as well as the sum of all the different emissions types. See the next image, which shows the summary table.

Ocean Spray Greenhouse Gas Emissions Summary

For the period: Pool Year 20.....

*****This spreadsheet was made by UMich students and has not yet been verified. *****

Refer to GHG Protocol for Calculations:

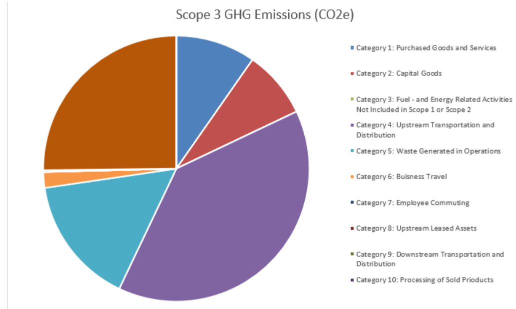
Tecnical Guidance for Calculating Scope 3 Emissions

Brief Summary

Scope	GHG Emissions (kg CO2e)	% of Total Footprint	
1: Direct Emissions from Owned/Controlled Operations	91,264	0.7%	*< added from first UM masters team Table 7*
2: Indirect Emissions from the Use of Purchased Electricity, Steam, Heating, and Cooling	77,197	0.6%	
3: Other Indirect Emissions from Upstream and Downstream Value Chain	12,668,642	98.7%	
Total	**12,837,103**	**100%**	

Unit conversion: metric tons of C02eq = 907.185 kg CO2 eq

Units: t CO2e = metric tons of carbon dioxide equivalent



Detailed Summary

Scope 3 Categories	Total GHG Emissions (kg CO2e)	% of Total Footprint	CO2 Emissions (kg CO2e)	CH4 Emissions (kg CO2e)	N20 Emissions (kg CO2e)	Other Emissions (kg CO2e)	Calculation Method	Data Source:	Data Source: Emissions Factors
Category 1: Purchased Goods and Services	**1,229,702**	**9.6%**	**1,227,931**	**1,518**	**0**	**252**	GHG Corporate Protocol		EPA US EEIO "Supply Chain Greenhouse Gas Emission Factors for US Industries and Commodities"

As you can see the summary data shows the total greenhouse gas emissions in kg CO_2e, CO_2 emissions, CH_4 emissions, N_2O emissions, and other emissions. It also calculates the percent of the total greenhouse gas Scope 3 footprint and lists the calculation method (GHG Corporate Protocol) and the emissions factors that were used (EPA US EEIO "Supply Chain Greenhouse Gas Emission Factors for US Industries and Commodities").

The remainder of the categories followed the same general calculation methods/formulas, pulling the information described in Section 3.4.

Appendix G. Table showing each OSC Scope 3 category and the calculation method determined, the equation necessary and source for emission factors.

OSC Scope 3 Category	Calculation Method	Equation	Emission Factor Sourced From
(1) Purchased Goods and Services	Spend-Based	CO_2e emissions = ∑(**value of purchased good or service** ($) * **EF** per unit of economic value (kgCO_2e/$)	US EPA EEIO "Supply Chain Greenhouse Gas Emission Factors for US Industries and Commodities" report
(2) Capital Goods	Average-Spend Based	CO_2e emissions = ∑(**value of purchased good or service** ($) * **EF** per unit of economic value (kgCO_2e/$)	US EPA EEIO "Supply Chain Greenhouse Gas Emission Factors for US Industries and Commodities" report
(3) Fuel and Energy Related activities	Supplier Specific	CO_2e emissions = ∑ (**quantities of good purchased** (e.g., kg) × **supplier-specific product emission factor** of purchased good or service (e.g., kg CO_2 e/kg))	Scope 1 and 2 emission factors
(4) Upstream Transportation and Distribution	Distance Based	CO_2e emissions = ∑ (**mass of goods purchased** (tonnes or volume) × **distance traveled in transport leg** (km) × **emission factor** of transport mode or vehicle type (kg CO_2e/tonne or volume/km))	EPA Emission Factors Hub - Table 8
(5) Waste Generated from Operations	Average Data	CO_2e emissions = ∑ (**total mass of waste** (tonnes) × **proportion of total waste** being treated by waste treatment method × **emission factor** of waste treatment method (kg CO_2e/tonne))	EPA Emission Factors Hub - Table 9
(6) Business Travel	Distance Based	CO_2e emissions = ∑ (**distance traveled by vehicle type** (vehicle-km or passenger-km) × **vehicle specific emission factor** (kg CO_2e/vehicle-km or kg CO_2e/passenger-km))	EPA Emission Factors Hub - Table 10
(7) Employee and commuting	Distance Based	CO_2e emissions = ∑ (**daily one-way distance** between home and work (km) × **2** × **number of commuting days per year**) + ∑ (**total distance traveled** by vehicle type (vehicle-km or passenger-km) × **vehicle specific emission factor** (kg CO_2e/vehicle-km or kg CO_2e/passenger-km))	EPA Emission Factors Hub - Table 10
(8) Upstream Leased Assets	Average Data	CO_2e emissions = ∑ (**average emission factor** for building type (kg CO_2e/m^2/year) × **total floor space of building type** (m^2))	*Not Determined Yet*

(9) Downstream transportation and distribution	Distance Based	CO_2e emissions = ∑ (**quantity of goods sold** (tonnes) × **distance traveled** in transport legs (km) × **emission factor** of transport mode or vehicle type (kg CO_2e/tonne-km))	EPA Emission Factors Hub - Table 8
(10) Processing of sold products	Average Data	CO_2e emissions = ∑ (**mass of sold intermediate product** (kg) × **emission factor** of processing of sold products (kg CO_2e/kg of final product))	Scope 1 and 2 emission factors
(11) Use of Sold Products	*Not Determined Yet*	*Not Determined Yet*	*Not Determined Yet*
(12) End-of-life treatment of sold products	Average Data	CO_2e emissions = ∑ (**total mass of sold products** at end of life after consumer use (kg) × **% of total waste** being treated by waste treatment method × **emission factor** of waste treatment method (kg CO_2e/kg))	EPA Emission Factors Hub - Table 9
(13) Downstream leased assets	Average Data	CO_2e emissions = ∑ (**average emission factor** for building type (kg CO_2e/m^2/year) × **total floor space of building type** (m^2))	*Not Determined Yet*