UNIVERSITY OF RICHMOND

Chapter 9: Assessing Scope 3 Emissions Within a University Department

Using a Life Cycle Assessment and Supply Chain Case Studies

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Introduction

Every day, an individual comes into contact with innumerous products and systems. These products, such as a cup of coffee or a cell phone, have associated costs that individuals accept as the complete cost of that item; however, that cost is incomplete. The costs and emissions associated with materials extraction, transportation, disposal, and more are frequently overlooked in considering the cost of a good. To understand the full range of environmental impacts of consumer behavior, one must take into account the costs of the product's life cycle, which includes the impacts of the processes from creation to disposal. Life cycle assessments and life cycle costing are essential to understanding the true costs and emissions from a product or industry.

For this report, we conducted a small-scale life cycle assessment for the Department of Geography and the Environment. To supplement the scope of our results, we integrated case studies into our project that analyzed two commonly utilized products frequently purchased by our University: Coca-Cola *PlantBottles* and Hammermill Paper. The purpose of this project is to identify opportunities to reduce Scope 3 emissions associated with University purchasing habits. While the scope of this report is limited, analysis of the department and the two case studies suggest the University should conduct a larger, more comprehensive supply chain assessment in the future to identify opportunities to increase efficiency and decrease overall greenhouse gas (GHG) emissions from campus. We hope to encourage the University to pursue a strategy to reduce the Scope 3 emissions.

Methods

In order to perform the life cycle assessment, we selected a verified tool to calculate the life cycle emissions associated with the University's procurement habits. We chose the

Economic Input-Output Life Cycle Assessment (EIO-LCA) tool based on two factors. First, the tool has proven successful in a study at Portland Community College in Oregon examining supply chain emissions at institutions of higher education. Portland Community College completed a full institutional GHG emissions inventory using the EIO-LCA tool (Stanforth 2013). Second, the tool is the most comprehensive, free tool available for life cycle assessments, and is frequently used for student projects and by researchers (Green Design Institute 2008). A process-based life cycle assessment was beyond our capacity in terms of resources, such as time and data. While the EIO-LCA tool was the best option for the purpose of our research, the method is not without limitations, which will be addressed separately and thoroughly in a unique section, EIO-LCA background & limitations.

The EIO-LCA tool makes two major assumptions. First, it assumes proportionality in the inputs per output. Second, the tool aggregates the US production facilities into 500 sectors (Hendrickson, Lave and Matthews 2006, 3-6). The Green Design Institute at Carnegie Mellon University made these assumptions based on publicly available national industry and purchasing data (2008). Using the EIO-LCA tool requires extensive purchasing data. The tool accounts for the emissions from 17 categories, including: chemicals, classroom supplies, computer and telephone software and licensing, computers and electronics, construction, food services, furniture/ fixtures/ minor equipment, grounds, maintenance and repairs, office supplies, paper, postage and shipping and receiving, printing services, professional services, real estate, travel and water.

Given the allotted time and other resources for our project, we chose to analyze the purchasing data for one department from the three most recent years, 2011-2013. We selected the Department of Geography and the Environment because it is the home department of our major and a small enough department (seven faculty and staff) that we could manage the volume of data. Once we received the purchasing data, we developed a legend of relevant account codes that corresponds with the 17 categories evaluated in the EIO-LCA tool, shown in Table 1. The data was arranged by fiscal years, so we had to average it into calendar years to fit the tool. With the help of the Nancy Propst, Administrative Coordinator, we identified 17 relevant codes (not direct matches with the tool categories). Some of the categories in the tool are not part of the department's budget and were therefore excluded from the assessment. These categories are: real estate, grounds, computer software and licensing, computers and electronics, furniture/fixtures, construction, maintenance and repairs, and professional services.

We entered the data in Excel, arranged by month, year, and account code. Once we sorted the purchasing data, all prices were adjusted for inflation using the US Inflation Calculator, found at www.usinflationcalculator.com. The inflation rates for 2011, 2012, and 2013, were 4.44%, 2.3%, and 0.8%, respectively. The EIO-LCA tool is available online at www.eiolca.net. Figure 3 shows a screenshot of the inputs for the tool. For this study, we used the US 2002 Purchaser Price Model, which has the boundaries of "cradle to consumer." Given the role of a university, the Purchaser Price Model (versus a Producer Price Model) is representative of the way a campus consumes. We then selected "Education & Health Care Services" as the broad sector group and "colleges, universities, and junior colleges" as the detailed sector. Then the financial information is input as the economic activity for the sector. The category of results to display is greenhouse gases, given that we are interested in the CO_2 emissions associated with the department's spending. Once those four steps are completed, the model runs and generates total tons of carbon dioxide (CO_2) emissions, as well as a more comprehensive breakdown of the emissions. For the purpose of this report, we are only concerned with total CO_2 emissions. Using the results of the tool, we developed the charts and graphics discussed in our results section.

EIO-LCA Background & Limitations

The EIO-LCA offers a free and user-friendly means of conducting a life cycle assessment for purchasing data based on a specified sector, here, colleges & universities. The Carnegie Mellon University Green Design Institute developed the EIO-LCA model in 1995, based on Wassily Leontief's economic theory of the EIO-LCA model. Since its beginnings, the tool has been used widely by researchers, LCA practitioners, business users, students and others. The tool generates the relative impacts of emissions associated with a range of industries through looking at the supply chain.

While the tool successfully generates the sector's emissions contributions based on financials, there are assumptions and limitations in the EIO-LCA method. The assumptions are addressed in the above methods section, but mainly: the method is a linear model and the impact vectors for environmental effects are allocated values based on weighted averages from industry sectors.

The main limitation of the instrument for our project has been that the results from the tool suggest that decreasing spending is the only means to reduce emissions associated with the life cycle of products. The model cannot take into account reduced emissions from items purchased locally or products made from recycled materials, for example. For this reason, the emissions results from the tool are more representative of a baseline for understanding and decision-making. While selecting a more sustainable product option might not quantitatively bring down emissions levels based on the EIO-LCA, the results offer insight into the purchasing habits of the entity, namely the Department of Geography and the Environment here. The results make it easy to recognize areas where spending is significantly higher than the average sector, which offers a meaningful starting point for recommendations in changing purchasing habits. At the university scale, departments with high spending could be flagged and observed more comprehensively to see how investing in sustainable products could bring down costs as well as emissions. At the department scale, account codes associated with high spending can be evaluated for purchasing habits.

Results

Using the data from Tables 1-3, we generated charts and graphs based on the emissions information calculated in the EIO-LCA tool. Table 1 shows details on each account code used for the analysis. Figure 1a-c shows a detailed breakdown of spending per year, displaying the percentage of the total for each category within the given year. Table 2 shows the total spend and total emissions for each calendar year. 2013 had the highest spending, with $10,279, and consequently, the highest emissions, with 3,153 pounds of CO_2 for the year. In total, the department's spending for 2011-2013 was responsible for 7,106 pounds of CO_2 emissions. The results (Fig. 2) showed that the ten largest spending categories over the course of 2011-2013 were Program Support, Entertainment, General Materials/Supplies, Student Travel, Lab/Class/Studio/Club, Vendacard, Honoraria, Special Projects, Food, and Printing. Telephone Base was omitted from Figure 2 because the department does not have control over those finances. The University controls the licensing fee, but it is important for future planning to note the significance of the fee with respect to the department's budget. The top ten categories signify opportunities for change and emissions reduction (Table 3). The emissions associated with each of the top ten spending categories are displayed in Table 3. Telephone Base, with 2,513 pounds of CO_2 over three years, is the largest category by a significant amount. The next category, Program Support, generated 1, 323 pounds of CO_2. The results should be used as a signal for the magnitude of emissions produced on a campus scale.

Why Conduct a University-Wide Assessment?

The University of Richmond's Climate Action Plan (CAP) outlines a strategy to reach the goal of carbon neutrality by 2050. The CAP includes the University's greenhouse gas (GHG) inventory, which shows the breakdown of emissions by activity. The GHG inventory includes Scope 1 and Scope 2 emissions, but not Scope 3 emissions. Scope 1 emissions are those that University are directly responsible for, such as the University fleet and buildings. Scope 2 emissions are those that the University indirectly creates through purchased electricity. Scope 3 emissions, which are not included in the inventory, are the indirect emissions caused from the production and disposal of goods, travel, and investments of the University (EPA 2012).

The scope of our research gives a visual of what a University-wide assessment would reveal. Our project should be used as the foundation for a larger study. For the Department of Geography and the Environment, seven faculty and staff members were responsible for 2,245 pounds of waste sent to a landfill over just three years (EPA 2014). Given that there are over 300 full-time faculty members and over 60 undergraduate majors at UR, there is tremendous opportunity to better understand the University's carbon footprint (Richmond.edu 2014). A more comprehensive assessment would allow the University to identify departments with the most Scope 3 emissions. Through recognizing these major emitters, the University could take proactive steps towards reducing the overall GHG profile.

How to Create the University's Scope 3 Emissions Profile

For a University-wide life cycle assessment, the University should take advantage of the school's resources to hire the necessary personnel. A project team could include staff members, interns, or a third party resource (such as a consulting firm). The team would look at all departments and offices. The University could use the EIO-LCA method again, but it would be more beneficial to pursue a higher caliber tool. There are many software tools available for purchase that take a more detailed look at product life cycles, such as GaBi by PE International. Other resources include non-profit organizations, such as GHG Protocol and the Carbon Disclosure Project. The project would likely take about one year to complete, depending on how many hours per week are dedicated to the project. This project took place over 10 weeks as course research and looked at a department with seven faculty and staff. Given that the University has over 300 faculty members, there will be a large amount of time and data associated with generating meaningful results (Richmond.edu 2014). The University should utilize its resources to become a leader among its competitors through conducting one of the first comprehensive Scope 3 GHG emissions inventory assessments.

Geographic Dimensions of Supply Chains

Given the limitations of the tool, we chose to analyze the supply chains of two specific products to supplement the results of our life cycle assessment. The physical geography of supply chains draws connections between all components of a product's production, distribution and consumption. The University purchases many name brand products. Our project analyzes the supply chains of Coca-Cola's *PlantBottle* and Hammermill Paper, a brand of the International Paper Company. The objective for this portion was to inform the University and consumers about each product's global connections and help the consumer connect his or her purchasing habits to the global dimensions of the products. These supply chain analyses allow an individual to actively engage in reducing GHG emissions through altering their purchasing habits. In this example, the individual could limit bottled water consumption and opt out of unnecessary printing. The case studies are based on a literature review of information pertaining to each product, as well as specific information related to the business practices of companies that the University purchases from.

Case Study 1: Coca-Cola

All around the University of Richmond campus, there are multiple vendors that sell Coca-Cola's Dasani *PlantBottles*. Whether you are a student picking up quick water at ETC or you are a visiting student reaching into the mini fridge for a refreshing drink at the admissions office, these bottles are everywhere on campus. You may have even seen the green *PlantBottle* logo on the side of the drink and wondered what having a 30% plant-based bottle means. Coca-Cola has committed to enhancing their sustainability. They decided to move away from their previous 100% petroleum based plastic bottles to a bottle that is made from 30% sugar-based MEG (monoethylene glycol) and 70% PTA (purified terephthalic acid) by weight. Through the creation of these mix composition bottles, Coca-Cola has eliminated a little more than 170,000 metric tons of CO2 emissions (Coca-Cola Company, 2013). While these bottles may provide a reduction in GHG emissions, emissions are still being produced through the various modes of transportation these partially plant-based products use as they are shipped around the world to ensure the customers can buy them at a low price.

The infographic for *PlantBottles* enables the user to better understand the amount of emissions associated with the production, transportation and recycling process of these plastic bottles (Figure 4). The supply chain begins in Southeast Brazil, where sugar cane is grown in

Araraquara, Sao Paulo. (Coca-Cola Company, 2013) The ethanol is transported to India Glycols Ltd., India. Here the sugar cane is converted into Bio-MEG (illustrated in Fig. 4). This chemical is transferred to Indonesia, where it is combined with petroleum-based PTA to create plastic water bottles (Guzman, 2012). Indorama Ventures, located in India (figure 4), is a popular PET bottle producer, which Coca-Cola supports (Coca-Cola Company, 2013). These bottles are then shipped over to Norfolk, Virginia and filled with filtered tap water. After the bottles are filled, Coca-Cola Bottling Company sends the Dasani bottles to Sandston, VA and then a truck delivers the bottles to the University of Richmond. (Pete 2014) Lastly, they are then transported over to the Virginia Waste Services located in Chester, VA.

Coca-Cola recognizes that their company is just getting started. They note in their commercials and on their site that just because the bottles come from plants, they are not necessarily better for the environment. Coca-Cola is working with leading academic, government and NGO partners, to evaluate a large range of agricultural sources without compromising food sources (Coca-Cola Company, 2013). Their future plans are to create a 100% plant-based plastic bottle. They are currently working to rebuild their supply chain to move away from a dependence on fossil fuels. It is their goal to inspire other companies to become more committed to “doing the right thing” (Coca-Cola Company, 2013). Lastly, they strongly support recycling of their bottles as an “opportunity to take simple everyday actions to create change” (Coca-Cola Company, 2013). One way Coca-Cola could enhance their supply chain would be through supporting local sugar cane ethanol for their plant-based bottles.

Case Study 2: Hammermill Paper

The Pulp & Paper Mill industry is responsible for more than 210 million metric tons of CO_2 emissions each year. These emissions are generated in two major ways: the combustion of on-site fuels and non-energy related emissions (such as by-products) (EPA 2010, 6-7). Understanding where these emissions are created gives spatial orientation to our consumption practices. Also, paper makes up 27% of municipal solid waste; more than any other material Americans throw away (EPA 2014), meaning that there is significant opportunity for consumption reduction. The paper production process is resource intensive, requiring large amounts of forests for harvest, water for pulp mills, and other resources. Given the magnitude of the industry, about $200 billion in products annually, sustainable management of the industry at large and small scales is essential to ensuring low environmental impacts (American Forest & Paper Association 2014).

Every day, the University community uses hundreds of pages of Hammermill brand paper. In just four weeks, Boatwright Memorial Library collected 4,600 feet of paper (Richmond 2014). To a student, the only cost associated with printing is “print credits,” which do not serve as a disincentive for printing. Rarely does a student think about where the paper came from: from which forest, paper mill, or warehouse. The supply chain of commercial printing paper represents an important aspect of understanding the emissions associated with production as well as the product’s global connections. International Paper Company’s website provides a map of the global operations for its brands. Using information from the website, we created a map that demonstrates the operations associated with commercial printing and imaging (Figure 5).

Before consumer use, paper products begin as timber forest products and are harvested as virgin fiber. For any percentage of the paper made from recycled material, those recycled fibers are brought in to supplement the presence of virgin fibers. Once the fibers are harvested, the product is manufactured in a mill. The manufacturing process is largely responsible for the emissions associated with the chemical processes associated with creating the grade of paper necessary for commercial printing. Once the product is developed for consumption, the finished materials are packaged and transported to a warehouse or distribution center (Paper Task Force 1995, 30-35).

The paper supply chain case study is useful for understanding the spatial dimensions of a product's life cycle and how each stage is associated with unique emissions not traditionally accounted for. For the University, it is important to emphasize habits that reduce printing. The University should seek to purchase 50-100% recycled content paper whenever possible, rather than the current 30% baseline. Higher recycled content paper combined with reduced printing efforts would minimize the University's carbon footprint from paper consumption.

Conclusion

As the effects of climate change become increasingly severe, there are numerous risks for humans, animals, and the environment. The disruption of natural systems is likely to produce changes in precipitation, weather patterns, and resource availability (Water Impacts of Climate Change 2013). There are multiple ways to cope with the impacts of climate change, but two primary methods are adaptation and mitigation. These two strategies provide opportunities to reduce the level of vulnerability that society and nature will experience. Adaptation addresses the near term issues, such as building higher floodwalls to cope with increased flooding events. The method seeks to reduce impacts through projects that protect humans and threatened resources or lands. Adaptation does not directly target the actual cause of anthropogenic climate change, but often takes place in response to climate stimuli with the purpose of alleviating current stresses to protect against future stress (Füssel 2007, 265). Mitigation, in contrast, targets the root of climate change directly. This process allows the magnitude of vulnerabilities experienced by all climate-sensitive systems to decrease significantly. When considering which action is better, measuring the effectiveness of mitigation techniques is easier than measuring the effectiveness of adaptation because of the difficulty in quantifying the future impacts avoided through adaptation strategies. (Füssel 2007, 265). Through comprehensive supply chain management, the University would be able to reduce their emissions and mitigate contributions to climate change

The University of Richmond signed the Climate Action Plan in December 2010, which committed them to reaching carbon neutrality by 2050. The Climate Action Plan is updated biennially to evaluate progress and outline strategies for reaching carbon neutrality through specific sections. Each section targets a different part of University operations, including energy use, administration, conservation, education, and materials management. While the CAP has developed concrete goals, it overlooks a component of our GHG emissions inventory associated with the University's purchasing practices. Scope 3 emissions are not included in our current CAP.

This project is the building block of a larger process to profile the University's carbon footprint. We suggest that the University conduct an all-inclusive University-wide (all departments and offices) assessment of GHG inventory including Scope 3 emissions. This assessment would reveal opportunities to increase purchasing efficiencies. With this information the University would be able to take a few different approaches in reducing supply chain emissions. The University should recognize offices and departments with the highest spending and implement a sustainable purchasing plan that outlines the low-impact products. Educating purchasers about supply chain emissions is an easy way to begin changing purchasing habits and raising awareness on the topic. Through taking proactive steps towards evaluating and reducing the University's Scope 3 emissions profile, the University could effectively mitigate climate change and become a leader among other institutions of higher education.

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Dr. David Salisbury, UR Associate Professor of Geography

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Appendix

Table 1: Relevant account codes chosen for the report. These were selected based on the categories included in the EIO-LCA tool.

Code	Category	Details
7022	Program Support	Lab supplies, GIS Day, partial field trips
7028	Office Supplies	Materials for faculty and staff
7029	General materials/supplies	Other materials for the department
7071	Vendacard	For copies made on RICOH machine
7072	Printing	General printing
7081	Postage	Mail services
7082	Stamps	Mail services
7093	Fed-Ex & UPS	Mail services
7152	Non-Employee travel	Conferences, field trips, other travel
7153	Student Travel	Conferences, trips, class travel
7191	Telephone Base	Department phone lines - University controlled
7311	Books	Purchased for department
7959	Lab/Class/Studio/Club	Lab materials - no longer used
7903	Entertainment	Food, experiential learning
7902	Food	Food purchased outside events
7102	Honoraria	Guest dinners, dining services charges
7054	Special Projects	Gifts, events, other discretionary spending

Table 2: Breakdown of spending per year and associated emissions. Emissions are shown in pounds of CO_2.

Year	Total Spend	Pounds of CO_2
2011	$5,634	1,727
2012	$7,278	2,226
2013	$10,279	3,153
Total Emissions		7,106

Table 3: Top ten categories by CO_2 emissions and spending. Used to generate figures 1a-c.

Account Code	Category	2011	2012	2013	Total Spend	Pounds of CO_2
7191	Telephone Base	$1,200.00	$4,000.00	$3,000.00	$8,200	2,513

7029	General materials/supplies	$1,552.87	$1,935.85	$830.71	$4,319	1,323
7022	Program Support	$320.12	$902.44	$780.73	$2,003	613
7903	Entertainment	$270.11	$963.85	$735.98	$1,970	604
7153	Student Travel	$224.61	$65.66	$958.56	$1,249	384
7959	Lab/Class/Studio/Club	$0.00	$869.53	$0.00	$870	267
7071	Vendacard	$463.80	$164.35	$167.50	$796	245
7102	Honoraria	$898.87	-$137.49	$0.00	$761	234
7054	Special Projects	$0.00	$473.62	$82.10	$556	170
7902	Food	$224.61	$223.90	$22.10	$471	143
7072	Printing	$45.16	$271.95	$124.35	$441	134

Figures 1a,b, and c: These figures show the breakdown of spending per category for each individual calendar year, 2011-2013.

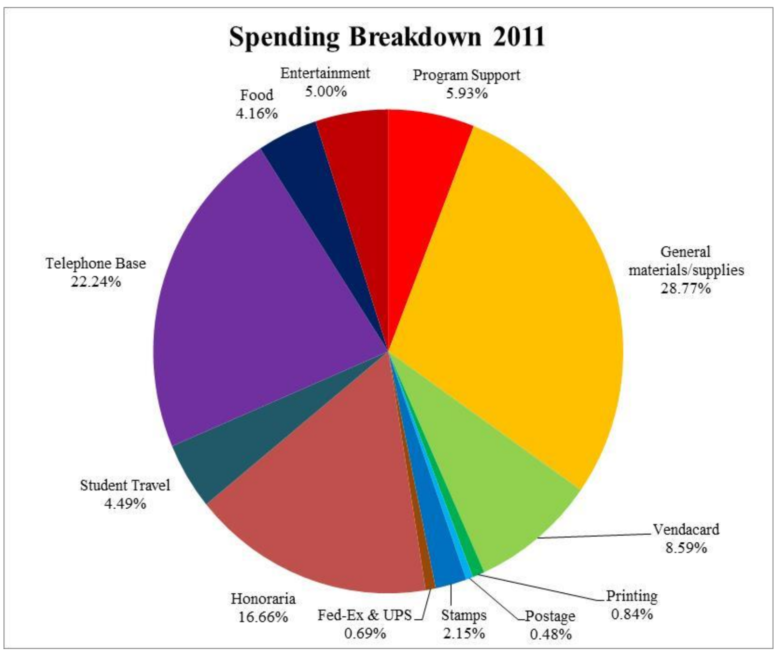

Figure 1a.

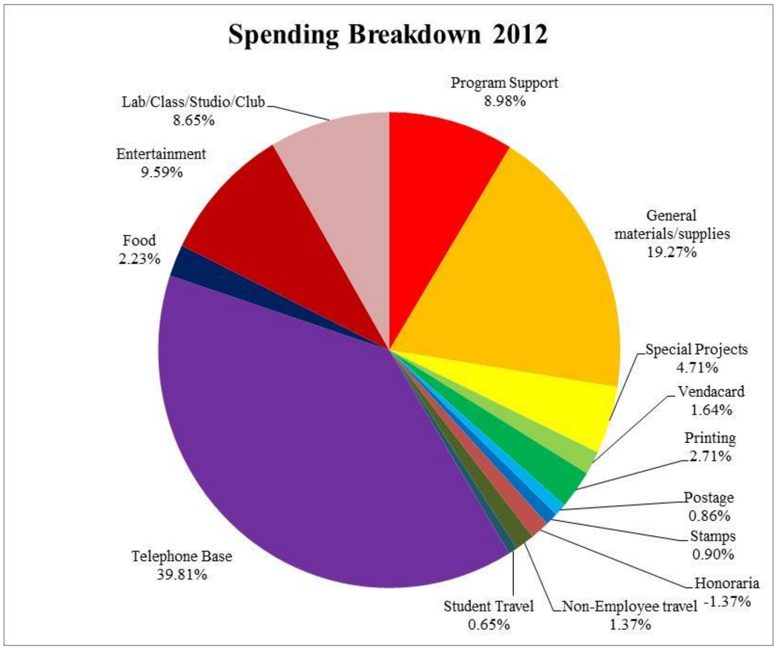

Figure 1b.

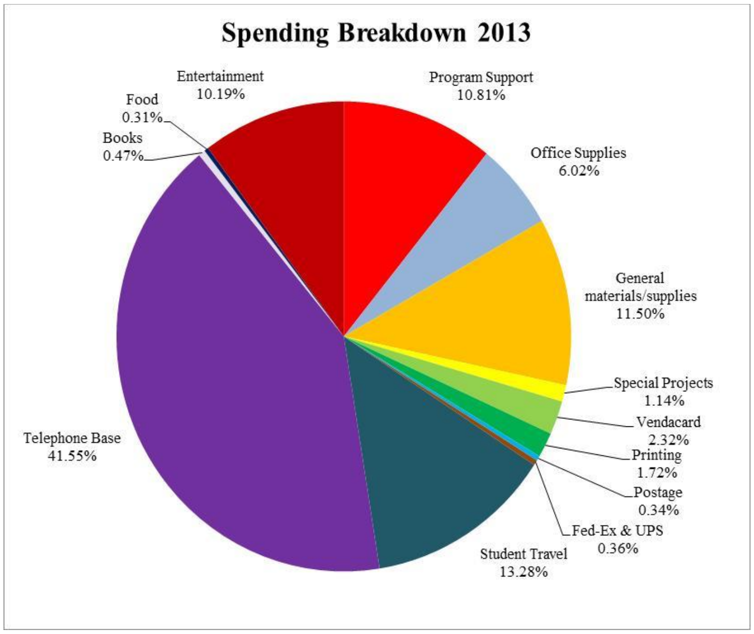

Figure 1c.

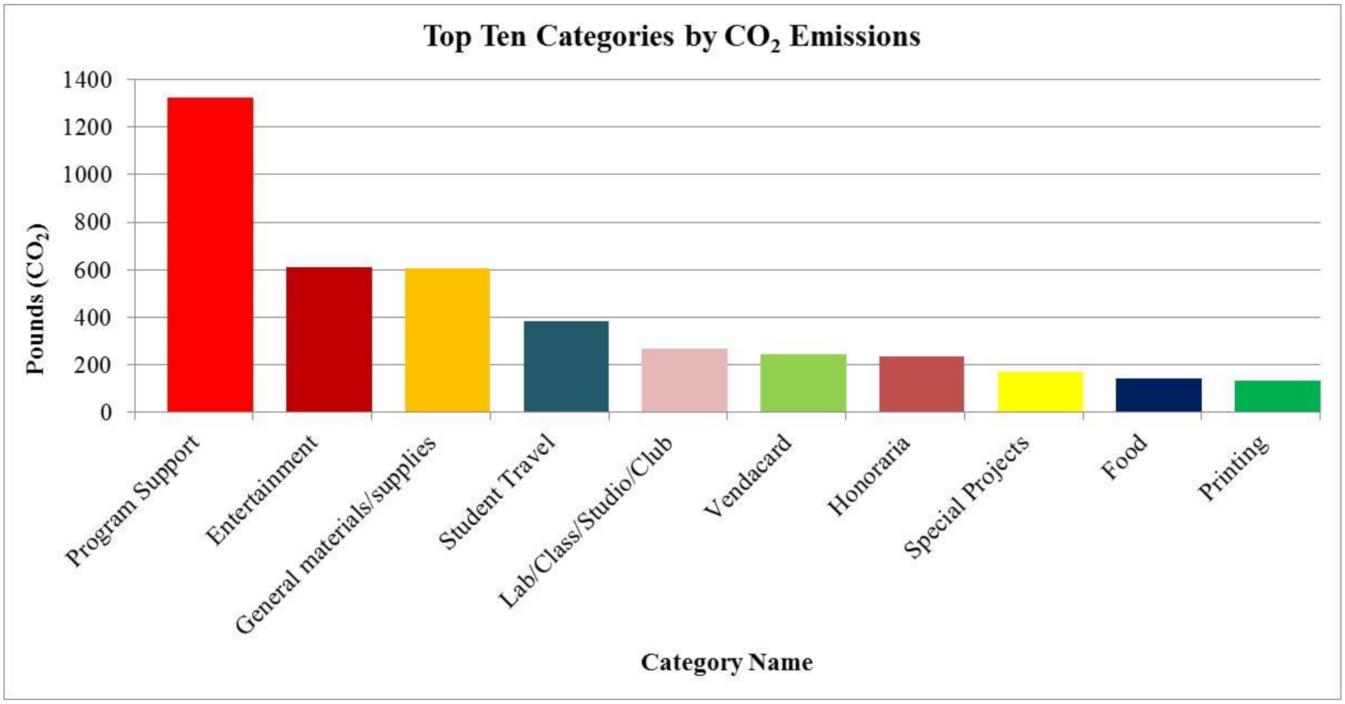

Figure 2: The top ten categories associated with the highest CO_2 emissions. Telephone base is eliminated from this graph based on that the department does not have control over this category.

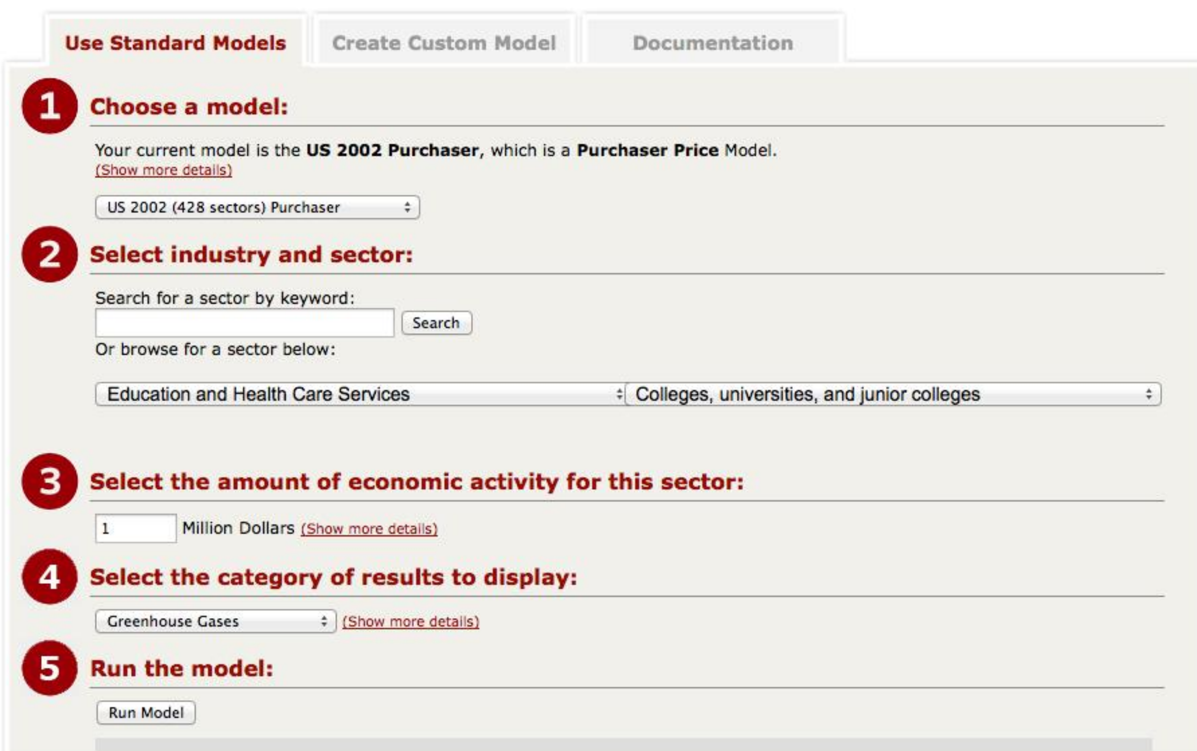

Figure 3: A screenshot of the EIO-LCA tool used to generate the emissions data.

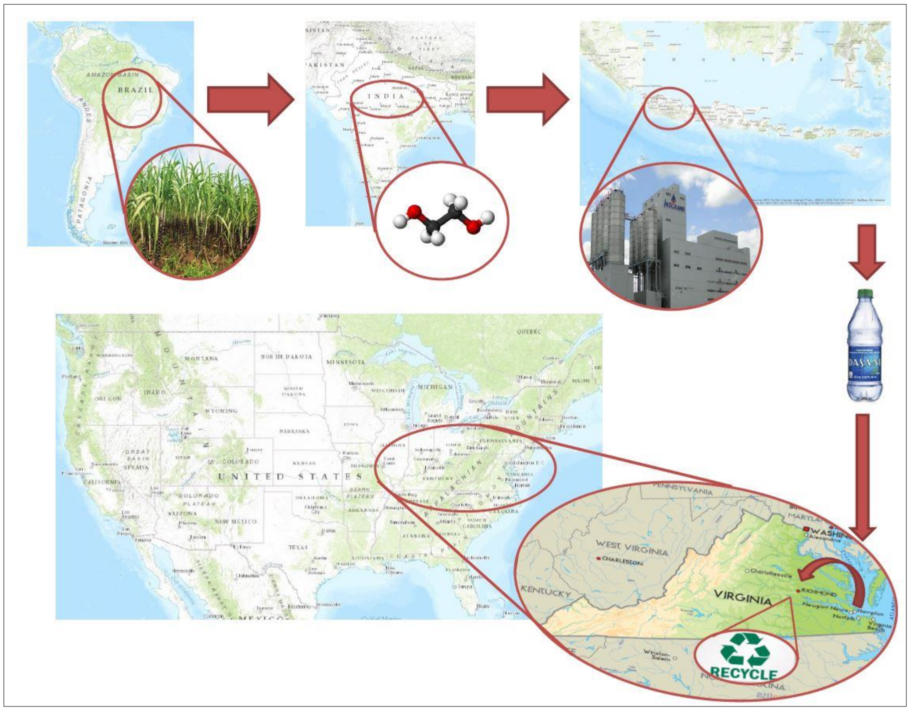

Figure 4: Infographic of supply chain for Coca-Cola's *PlantBottle* water bottle. The *PlantBottle* is currently made from 30% sugar-based MEG (monoethylene glycol) and 70% PTA (purified terephthalic acid) by weight. Images found using Google search.

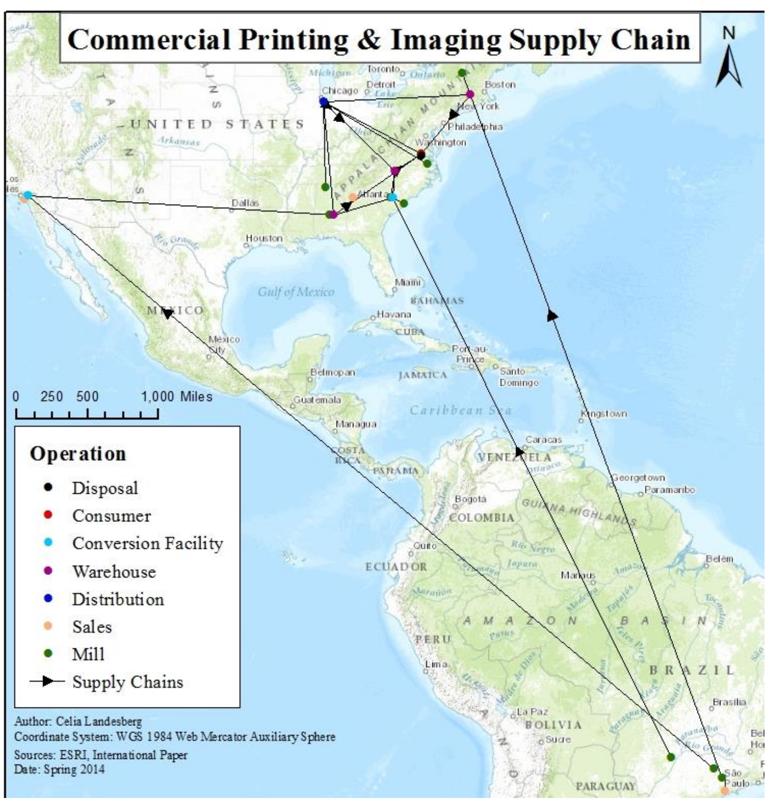

Figure 5: Map of operations and supply chain route for International Paper's Commercial Printing & Imaging business.