Introduction

Various higher educational institutions as well as public and private agencies desire to reduce their impact on the environment, mainly their greenhouse gas emissions. Carrying out a greenhouse gas emissions inventory is the first step towards realizing the institutions environmental footprint. Most greenhouse gas inventories do not include supply chain-specific emissions or calculations. The intent of this paper is to provide public and private sector professionals with a guidebook as to how to track and report on their supply chain-specific greenhouse gas emissions.

The American Colleges and Universities Presidents Climate Commitment (ACUPCC), is a voluntary commitment that over 600 colleges and universities have dedicated themselves to. This commitment asks the institutions to draft an institutional climate action plan, complete a comprehensive inventory of all greenhouse gas emissions (GHG) and create institutional structures to guide the development and implementation of the plan (Presidents Climate Commitment, 2013). The recommended calculator by the ACUPCC is Clean Air-Cool Planet. While this is an excellent GHG calculator, it does not facilitate assessment of supply chain emissions. PCC utilized a carbon calculator developed by Good Company, a Eugene-based sustainability consultant team. The GHG calculator created by Good Company allows the client to assess their supply chain-specific emissions, through the Economic Input-Output Life Cycle Assessment (EIO-LCA), developed by Carnegie Mellon in 2002.

"The Economic Input-Output Life Cycle Assessment (EIO-LCA) method estimates the materials and energy resources required for, and the environmental emissions resulting from, activities in our economy. It is one technique for performing a life cycle assessment, an evaluation of the environmental impacts of a product or process over its entire life cycle" (www.eiolca.net). This methodology has been compared to a calculator developed specifically for the state of Oregon through the Oregon Department of Environmental Quality. Both methods included assessing embodied emissions related to manufacturing, purchasing and transportation of goods within the United States. While EIO-LCA was developed with a nation-wide approach to transporting and manufacturing goods, the Oregon-specific calculator, developed in part by the Oregon Department of Environmental Quality, was developed with Oregon-specific embodied emission factors in mind.

When the same sets of data were put into the tools, both tools yielded the same results. This further cements the accuracy of using the EIO-LCA tool, even though it is based on US averages of carbon emissions factors.

The EIO-LCA tool was developed with US averages of emissions factors for each of the 17 categories, listed below.

Methodology

The first step in assessing the carbon footprint of an institution's supply chain emissions, is to collect data. Depending on how far back in time the institution wants to go, the main contact in developing this inventory should first contact the college's purchasing department. The data that you want, is all purchases organized by fiscal year. This includes, but is not limited to, salary and benefits data, grants data as well as general purchasing transactions from all categories of the college. Once you have the spreadsheets, you need to pivot the data into workable ranges. For more info, see the link here that gives you a "how-to" regarding pivoting tables: www.dummies.com/how-to/content/how-to-create-a-pivot-table-in-excel-2010.seriesId-223716.html

Once the data is pivoted to reflect institutional-specific accounting codes, the non-applicable EIO-LCA assessment data must be deleted from the spreadsheet. This data will vary, depending on what type of institution is completing the assessment. In the cases of a higher education institution, categories that need to be omitted include, but are not limited to, the following:

- Salaries and benefits;
- Grants dollars;
- Transfers of monies; and
- Utilities.

Now that the non-applicable data has been deleted from the spreadsheet (i.e. salaries and benefits, grants dollars, etc.) the user is able to pivot the data again and organize it specific to the EIO-LCA categories. These categories are as follows:

- Chemicals (labs, grounds, custodial, etc);
- Classroom supplies;
- Computer and telephone software and licensing;
- Computers and electronics;
- Construction;
- Food services (food);
- 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 that the data has been organized into the institutional-specific accounting codes, and all inapplicable accounting codes have been omitted, the data is now able to be organized into the 17 aforementioned categories. Although there was a large amount of data initially received from the Accounts Payable department, the data has been pivoted to reflect all internal account codes, reducing the amount of data significantly in the spreadsheet. By organizing the data into 17 categories, the amount of data to analyze has been significantly reduced.

Now that the data is organized into17 lines of data, encompassing all EIO-LCA-specific categories, each dollar amount must be adjusted for inflation. The EIO-LCA tool was developed in 2002 by Carnegie Mellon. Depending on how the institution organizes its fiscal years, the data may need to be averaged between two separate fiscal years. This would be applicable if the institution in question had fiscal years that ran from July 1-June 30. The most effective place to get information regarding inflation rates is the U.S. Bureau of Labor Statistics, Consumer Price Index. See link to inflation rates here: http://www.bls.gov/cpi/

Now that the data is organized into 17 different lines per each fiscal year, and has been adjusted for inflation rates, now it is time to input the data into the EIO-LCA tool. At the link here: http://www.eiolca.net/cgi-bin/dft/use.pl the actual tool for use can be found, free of charge. While using the tool, keep in mind that the first step of the tool must be set to "U.S. 2002". Also make sure to select the correct industry, specific to the institution, and make sure that step 4 in the tool is set to convert economic activity to greenhouse gases.

Once all 17 categories have been through the tool, the greenhouse gas equivalent of all economic activity for that particular fiscal year will be accounted for. The data is now ready to be entered into the GHG calculator. The calculator must lend itself to being able to calculate supply chain-specific emissions. Although not all calculators are capable of calculating supply chain emissions, Good Company, a non-profit based in Eugene, Oregon, produces a calculator that allows for evaluation of supply chain emissions. A link to their website can be found here: http://www.goodcompany.com/

Case Study: Portland Community College

Portland Community College completed its most comprehensive GHG inventory to date in summer 2012, and the team anticipates completion of the second GHG inventory in late July 2013. These dates are in line with the beginning and ending dates of fiscal years at the college. The purpose of this document is to educate public and private agencies how to assess their supply chain emissions, and make recommendations for how to implement reductions in those emissions, both at the end of the life cycle of a product or service as well as at the beginning.

To assess an institution's supply chain-specific carbon footprint, requires some patience. PCC took on this daunting task in the summer of 2012. The GHG inventory team decided to dive into assessing procurement, with the assistance of PCC's Procurement department. The first GHG inventory PCC completed was in 2006, which is what the college's GHG inventory reduction goals are based upon. Naturally, it made sense to take the research and assessment back to this baseline year. Working with the Procurement department was crucial in this strategy.

First, the team needed to collect the data associated with procurement. Data spreadsheets the team received from the Procurement department were similar to the picture listed below. This was easy data to gather, but difficult to decipher at first, with no formal background or training in working in this level of detail in procurement data. See image below for a detailed snapshot of the raw data the team received.

Sum of amount	Fiscal Year								
Account	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	Grand Total
03010	2141189.21	2422894.36	2311976.35	2571937.04	2687171.08	2847640.95	2599714.64	2951781.19	20534304.82
03011	146.13	323.81	17529.76	11194.35	16516.77	15222.68	15800.82	7696.77	84431.09
03015	1165.51	22667.85	77970.36	31390.08	47467.13	55054.64	43606.23	40954.72	320276.52
03016		535.23	16362.05	19534.82	14065.76	6207.73	603.88	339.34	57648.81
03020	0								0
03023	935444.96	1008335.57	1074055.21	1057425.29	1067314.42	1200435.79	1384190.53	1441627.91	9168829.68
03024	83144.42	85499.87	83305.97	81781.37	84350.58	87907.24	101698.76	109653.48	717341.69
03025	613458.6	746268.84	659577.86	626340.91	688689.64	794298.32	782439.63	1003369.14	5914442.94
03026	42772.48	47152.75	52627.66	69536.5	48838.21	78827.85	47723.9	51832.5	439311.85
03030	533917.7	358742.27	417493.72	362231.35	315482.91	365729.44	475931.18	360416.49	3189945.06
03090	158854.6	147336.42	126815.18	18219.34	21526.55	35540.42	58200.77	63584.86	630078.14
03250		2388063.53	4247878.05	2821553.73	2487883.78	2727394.22	1809541.16	4321829.09	20804143.56
03270		456513.66	746234.77	849113.54	799037.33	779405.81	695720.34	577682.4	4903707.85
03340	106850	80812.12	83784.25	78745	79450	131400	86941.99	100690	748673.36
03353	22852.95	169776.07	164874.01	42336.46	856.82	216	3538.32		404450.63
03361	219251.65	199872.65	135849.85	118739.89	241814.69	168653.62	204310.46	379941.34	1668434.15
03371	394206.6	503821.09	399072.2	400881.29	748014.47	1179514.95	1993571.78	1396055.92	7015138.3
03372	300	39734.69	7470.9	3171.2			19.95	29807.24	80503.98
03410	179585.36	234881.75	246621.78	259510.98	187821.06	57459.5	74221.55	64281.15	1304383.13
03420	1107651.43	1759094.81	847838.37	645310.62	820289.16	741168.64	980832.66	650642.01	7552827.7
03430				173436.76	1077981.89	1368786.73	835078.73	1245425.21	4700709.32

Now that the team had acquired this data, from fiscal year 2006-fiscal year 2012, the team needed to be able to decipher and understand what the trends in data are. The team asked the Procurement staff, along with Accounts Payable, to assist with deciphering this data. The team needed assistance in interpreting the account codes supplied by Procurement and Accounts Payable. An example of this is the 3000 account code at PCC; the team was able to delete 1000 and 2000 funds from this process because both funds cover salaries and benefits for faculty and staff, and students, respectively. Once the team was able to delete these two funds, they were left with the 3000 fund. The 3000 fund encompasses categories ranging from supplies to consultants and fees to contracted maintenance. In order to get a detailed breakdown of this fund, along with the other non-deleted funds from Procurement and

Accounts Payable, the GHG planning team asked for training from the "internal experts" on purchasing.

Representatives from the Procurement and Accounts Payable teams made up the training team for this exercise. The GHG planning team had two different trainings; one training broke down the details of all account codes the team would be assessing while the second training taught the team tricks for navigating the purchasing database more efficiently and effectively. Below, an image detailing out PCC's 3000 fund account codes, and what each account code stands for. Note the pivoting function in the corners of the middle column. This will be detailed in further sections.

Sum of amount		Fiscal Year
Account	Desc	FY03
03010	Supplies	2141189.21
03011	LRC Materials	146.13
03015	AV Materials	1165.51
03016	Press Operation - Supplies	
03020	temp to remove py void lws	0
03023	Food Service Products	935444.96
03024	Supplies,Vending	83144.42
03025	Supplies,Lab Expense	613458.6
03026	Supplies, Grounds Maintenance	42772.48
03030	Postage	533917.7
03090	Miscellaneous	158854.6
03250	Minor Equipment	
03270	Operating Leases	
03340	Audit Services	106850
03353	Moving & Storage Fees	22852.95
03361	Legal Services	219251.65
03371	Consultants & Professional Services	394206.6
03372	Survey & Inspection Fees	300
03410	Publications & Periodicals	179585.36
03420	Dues and Fees	1107651.43
03430	#N/A	
03440	#N/A	
03501	Rental Expense	338037.71

Now that the team had the PCC-specific organizational method in an easy-to-understand format, thanks to the trainings given by the Procurement and Accounts Payable departments, the team was able to begin deleting account codes from the years of available data. Deleting account codes is crucial to the process, as the user does not want to double-count (in the case of electricity usage or hauling costs) or count simple transfers of money as contributing to the overall carbon footprint of the

institution. Below, please find a screen shot that is color-coded and shows account codes the team deleted and also kept within the calculation process:

REMOVE?	ACCOUNT	SUB CATEGORY (ACCOUNTING)	GRAND TOTAL $ FY 2003	REASONING BEHIND REMOVAL. E.Crum 1.5.12
	03910	Overnight Travel Expenses	706045.75	
	03915	Travel,Recruiting(Employment Exp)	100830.12	
	03920	Travel,Staff Mileage -In Distr	257478.7	
	03925	Non-Overnight Travel Expenses	411659.84	
	04001	Resale,Materials	7730997.36	
Yes	04901	Storeroom Purchases	0	no cost
	04902	Postage	7.27596E-11	
Yes	04905	Intn'l Student Insurance	0	no cost
Yes	04917	PACE Services		no cost
Yes	04919	PORTALS	19.9	too small - diminishing return
Yes	04999	Misc. Clearing		no cost
Yes	05001	Miscellaneous Expenses		no cost
Yes	05101	Grants		no cost
Yes	05230	Unused Funds Returned to the State		no cost
Yes	05304	4 Fund Intrafund Transfers		no cost
Yes	05873	Util,Gas,Heat for Buildings	480031.66	already accounted for in scope II
Yes	05874	Util,Electricity	3236418.48	already accounted for in scope II
	05875	Util,Water & Sewage	946123.88	
Yes	05876	Util,Garbage Removal	970733.88	already accounted for in scope III
	05878	Util,Telephone	1410294.04	
Yes	06010	Collection Cost	55.58	too small - diminishing return
	07050	Capital Leases & FFE, Minor Equip	2547214.87	
	07070	Capital Leases	1694641.05	
	07100	Furniture/Fixtures/Equipment	1891924.49	
	07200	Library Books	333700.62	
	07300	Construction - Buildings	3179194.44	
	07310	Capital Improvement - Buildings	16644377.95	
	07360	Capital,Contracted Services	3604	
	07371	Architect/Design/Enginerring	5816782.68	
Yes	07380	Purchase of Property		no cost
	07385	Purchase of Property - Buildings	6130.5	

Eliminating transfers of money and creating a "cut off" to the amount of a transaction the team would assess was a learning experience for the GHG planning team. When calculating supply chain emissions, dollars equal emissions to the user. However, in an institution as large as PCC, transfers of monies from account code to account code are quite common. To the untrained eye, this can be misleading and can make for much more calculations than are truly necessary. At first, the team was attempting to label every line of data in these fiscal year-specific spreadsheets, assuming that each dollar equaled a certain amount of greenhouse gas emissions per the category that the dollars were being spent on. This is not the case. Transfers of money were easy to spot, because of the training the team received from the Procurement and Accounts Payable staff.

At a certain point, when the team was getting "in the weeds" so to speak, regarding small transactions on purchasing cards for individualized departments, the Procurement and Accounts Payable folks gave the GHG planning team some much-needed advice: decide on a cut-off when the team would stop "counting" transactions. The team chose anything below $1000 was not worthy of being counted in this process. Clearly, the team was hesitant to proceed with this advice at first, because the integrity of this process may have been compromised by following this advice. However, as the team dove into purchases below $1000, it was found that most were purchasing card

purchases for supplies, and small purchases at that. The team sought out the advice of the Oregon Department of Environmental Quality on this topic. DEQ has experimented with different calculation methodologies for their supply chain emissions information, and recommended creating a "cut-off point" for transactions. DEQ's was below $100, but their scope has much fewer users than PCC's does.

Now that the GHG team had deleted all unnecessary account codes and transactions, as well as had a solid understanding of the college's accounting methodology, the team was able to begin organizing the data in accordance with the Economic Input-Output Life Cycle Assessment categories. This assessment system, developed by the Green Design Institute at Carnegie Mellon University, is adopted by many institutions as the methodology behind estimating the carbon dioxide equivalent (CO2e) for purchased goods and services. "The EIO-LCA method estimates the materials and energy resources required for, and the environmental emissions resulting from, activities in our economy. It is one technique for performing a life cycle assessment, an evaluation of the environmental impacts of a product or process over its entire life cycle" (www.eiolca.net/method).

The team now had to group all of the data, into the EIO-LCA-specific 17 different categories. These categories are as follows:

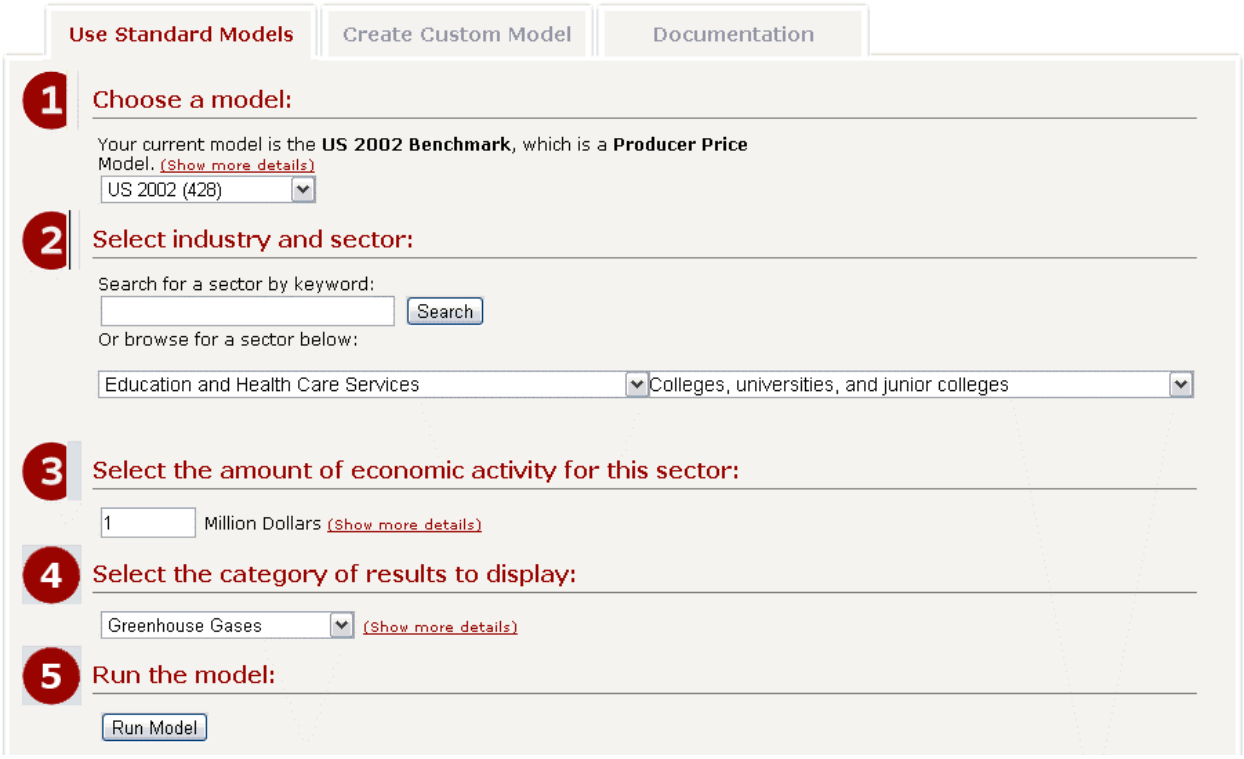
- Chemicals (labs, grounds, custodial, etc);
- Classroom supplies;
- Computer and telephone software and licensing;
- Computers and electronics;
- Construction;
- Food services (food);
- Furniture/fixtures/minor equipment;
- Grounds;
- Maintenance and repairs;
- Office supplies;
- Paper;
- Postage and shipping and receiving;
- Printing services;
- Professional services;
- Real estate;
- Travel; and
- Water.

Please see a screen shot of PCC's data grouped into these major categories, by fiscal year, below:

	PCC Subcategories - Analysis for Tool (summary)	FY 2006 Annual Expense $	Total Corrected Emissions MT CO2e
1	chemicals (labs, grounds, custodial, etc.)	$626,340.91	202.03
2	classroom supplies	$8,390,816.34	2,498.12
3	Computer and Telephone Software & Licencing	$2,173,526.70	413.48
4	computers & electronics	$122,357.18	48.42
5	construction	$7,561,889.64	4,295.78
6	Food Services (Food)	$1,139,206.66	615.96
7	Furniture / Fixtures / Minor Equipment	$4,149,444.34	1,558.12
8	grounds	$69,536.50	31.83
9	maintenance and repairs	$5,815,200.27	3,382.75
10	office supplies	$2,536,730.65	854.97
11	paper	$125,240.67	177.46
12	postage & shipping and receiving	$899,080.01	446.30
13	printing services	$1,196,306.02	604.74
14	professional services	$2,069,746.84	552.28
15	real estate	$1,041,874.18	278.20
16	travel	$1,754,676.31	1,804.36
17	Water	$1,109,240.44	1,840.63
	TOTAL MTCO2e	**$40,781,213.66**	**19,605.40**

It is recommended that this grouping happens with each fiscal year of data the institution is working with, so as to avoid confusion when calculating the CO2e-intensity for each category, and to avoid confusion when inputting this data into the selected GHG calculator. The EIO-LCA tool is free to use, and is available at www.eiolca.net. Please note: in the image above, the category of "total corrected emissions" is explained in the section below.

Once the data is organized by fiscal year and by categories, now the data can be entered into the EIO-LCA calculator. Below, please find a screenshot of the EIO-LCA calculator in action, along with a detailed explanation of each category that needs data entered:



Every time the EIO-LCA calculator is used for the purposes of calculating supply chain emissions, the user must use the US 2002 model. This is the most recent model, and is the most accurate. Under "select industry and sector", the 17 categories listed above that the user has organized are in correlation with the first drop down menu. Each of the 17 categories is represented in that drop down menu. Always select "colleges, universities and junior colleges" in the second drop down menu.

Under "select the amount of economic activity for this sector", the user should input the amount of dollars spent within that category in that specific fiscal year. Under "select the category of results to display", greenhouse gases should be selected. Once all data fields are entered, the user is ready to run the model! Please note, each individual category must be entered separately. It is recommended to have the spreadsheet that the user is working off of open while inputting data into the EIO-LCA calculator, so as to not lose any data. The GHG team created a small table within each fiscal year's worth of purchasing data that allowed the team to organize the data by category, enter the dollar amount spent within that category beside the category name and entered the total corrected emissions MTCO2e, as calculated with the EIO-LCA calculator.

Now that all 17 lines of data are encompassing all EIO-LCA-specific categories, each dollar amount must be adjusted for inflation. The EIO-LCA tool was developed in 2002 by Carnegie Mellon. Depending on how the institution organizes its fiscal years, two separate fiscal years may need to be averaged. This would be applicable if the

institution in question had fiscal years that ran from July 1-June 30. The most effective place to get information regarding inflation rates is the U.S. Bureau of Labor Statistics, Consumer Price Index. See link to inflation rates here: http://www.bls.gov/cpi/

Next Steps

Now that the data has been organized in the EIO-LCA methodology, and is an assessment of the true carbon footprint, the institution may now be wondering: what's next? How does the institution reduce the supply chain emissions, given this accurate GHG footprint? There are a few different ways to approach reducing supply chain emissions. Please note, these recommendations may be used together or individually.

Speak with vendors. Let them know what you are working on. The best method to this madness is to be as transparent as possible. Explain what the purpose to the vendors, and start asking about sustainability practices within their own company. The vendor can be asked if they have a publicly-available sustainability report and/or GHG footprint analysis. If they do, ask if this report has been verified by a third-party, outside of their company. It is highly likely the company does have a sustainability annual report, but does not have a GHG footprint assessed. As an example, PCC approached International Paper with this idea, assuming that they would have some sort of sustainability report or a carbon footprint assessment available publicly. At the time of this report, a carbon footprint assessment was not available for International Paper.

Assess what your college is spending their money on. In order to start reducing GHGs associated with supply chain, you should start focusing energy on the "heaviest hitters" within your supply chain assessment.

Work within: Start doing outreach to the departments and contacts that are largely attributing to the GHG footprint (think Administrative Assistants, Purchasers, etc.) regarding what supply chain emissions are and how to reduce them. This can be accomplished through developing a green purchasing guide, educating users on environmental impacts of purchasing and empowering the purchasers to make change within their purchasing habits.

Erin Stanforth is the Sustainability Manager for Portland Community College. She has been with the college for over five years, holds a bachelor's degree in Sustainable Development from Appalachian State University and an MBA in Sustainable Business from Marylhurst University. Erin can be reached at erin.stanforth@pcc.edu or 971-722-8581.