Calculating Supply Chain Greenhouse Gas Emissions for Institutional Purchasing
A How-To Guide

Table of Contents

GLOSSARY 25

INTRODUCTION 2

STEPS TO COMPLETE A SUPPLY CHAIN GHG INVENTORY 4

I. LEADERSHIP SUPPORT AND ASSEMBLING THE RIGHT TEAM 4

II. SELECT AN INVENTORY APPROACH AND GHG ESTIMATION TOOL 5

III. PREPARE A SPREADSHEET 8

IV. COLLECT AND REFINE PURCHASING DATA 9

V. EXCLUDE CERTAIN PURCHASES 12

VI. ADJUST EXPENDITURES FOR INFLATION 13

VII. SORT AND GROUP DATA 14

VIII. ASSIGN GHG INTENSITIES TO PURCHASES 15

IX. CALCULATE GREENHOUSE GAS EMISSIONS 17

X. SUMMARIZE THE RESULTS 19

DEVELOP AN ACTION PLAN 23

Introduction

Many governments at the local, regional, state, and national level, as well as institutions of higher education, have adopted emissions reductions targets in an effort to avert the most dangerous effects of climate change. The West Coast Climate and Materials Management Forum is developing a Climate Friendly Purchasing Toolkit to focuses on an aspect of these efforts that is sometimes overlooked - reducing the climate impacts of purchasing. This "How-To" guide addresses the first steps toward managing upstream purchasing-related emissions – measurement of this emissions source.

This "How-To" document was created to guide local governments and other institutions through estimating and reporting supply chain GHG emissions – creating a supply chain greenhouse gas emissions inventory, also called simply a supply chain emissions inventory. Other sections of the Climate Friendly Purchasing Toolkit (http://westcoastclimateforum.com/) provide suggestions for incorporating the results into a plan for climate-friendly government purchasing.

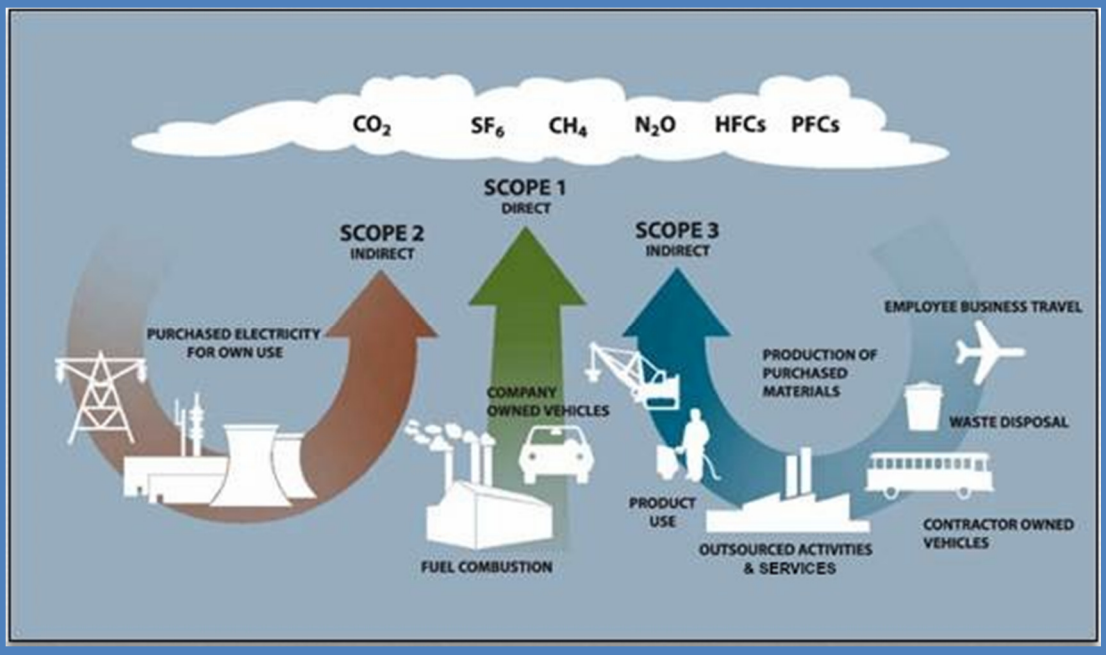
Before you begin, it is necessary to conduct a bit of background research. You're going to need to learn a little bit about supply chain emissions and related web-based tools, and a lot about how purchasing works at your institution. It is also important to understand your specific objectives, depending on context and opportunities available in your organization. Reducing the climate impact of purchasing will be an overarching aim of any project to estimate supply chain emissions. However a small municipal government might plan to present supply chain emissions results to specific vendors to underscore the importance of reducing their operational emissions and sourcing low-carbon materials, while a large university's sustainability department might want to analyze the emissions associated with purchasing to design and target a training for staff involved in procurement of high-impact products.

Think about how your institution will benefit from a supply chain emissions inventory and how the results will advance climate-friendly purchasing. Establish some preliminary objectives for the project. What questions are you trying to answer? What will the final products look like? Who will be the audience for these products? What stakeholders should be involved from the start? These early goals might change over the course of the project.

The result of a supply chain emissions inventory may identify high-impact purchasing categories that are not traditionally targeted in most green purchasing program. The potential for surprising answers and original insights into the climate impact of purchasing practices is the best reason to conduct a supply chain emissions inventory.

In addition, understanding high-impact purchasing categories of supply chain emissions can be helpful in suggesting possible priorities for action. While the purchases with highest emissions aren't always the ones with the best opportunities for emissions reduction, they're always the best place to start looking at options.

Not all organizations can – or should – do a complete supply chain emissions inventory. These inventories can be time and resource intensive to complete. This toolkit includes the result of a study completed on behalf of the West Coast Climate Forum that is intended to inform organizations unable to compete their own inventory of their *likely* supply chain impacts, in order to help them prioritize their efforts. See the Toolkit section highlighting this report for more information.



Box 1: Learn about Greenhouse Gas Inventories and Supply Chain Analyses

An operations emissions inventory includes direct emission sources that are "owned" (often referred to as Scope 1 emissions), such as gasoline combustion in owned vehicles, and natural gas use for space and water heating in owned buildings and fugitive refrigerants. These emissions are released from owned operations under the direct control the institution. Scope 1 emissions are considered "required" reporting in all GHG inventory protocols.

Operations inventories also contain calculations and estimates of several types of indirect emissions that are "shared," meaning that multiple entities can claim some responsibility for releasing these emissions. One source of shared emissions is purchased electricity (often called Scope 2 emissions); these emissions are shared because they are released off-site by an electricity generator, yet they are caused by electricity use at a facility operated by the institution. All institutions' operations emissions inventories include emissions released in generating the electric power used by that institution. Scope 2 emissions are considered "required" reporting in all GHG inventory protocols.

Some operations emissions inventories include other sources of shared emissions, such as transportation and landfill emissions from waste disposal services, or the emissions caused by employees commuting to work. These shared emissions are called Scope 3 emissions by many GHG inventory protocols, and are often included in most organization's operational emissions inventory, though they are not always considered "required."

Emissions released as a result of producing the goods and services purchased by an institution – another source of shared emissions included in Scope 3 – are frequently overlooked in operations emissions inventories. And yet, these emissions are just like the emissions associated with electricity use. Whether the local government purchases electricity, concrete, paper or shoes, the emissions do not occur directly from the government's facilities, but rather occur at facilities owned by other companies.

Together, Scope 2 and 3 emissions make up the carbon footprint of an institution's supply chain. It may be useful to familiarize yourself with the Scopes model for classifying emissions sources, since this terminology is common in the world of GHG accounting. However, this "How-To guide" will describe emissions sources in words, not numbers.

Steps To Complete a Supply Chain GHG Inventory

This "How-To" guide offers a general method for estimating the climate impact of government purchasing in a step-by-step format. This resource is a guide, not a one-size-fits-all instruction manual. Performing a supply chain emissions inventory will be slightly different for every organization. In addition, the steps described in this Guide are not linear. Some of the steps may happen in parallel; some may be iterative; some may need to be repeated; some may not be necessary for all organizations. This Guide is primarily based on the experience of and written by Alameda County, California as they completed their inaugural supply chain emissions inventory. Their work was revised by the West Coast Materials and Climate Management Forum to also capture the experience of other organizations who have completed similar work in an attempt to make this guidance document applicable and accessible to various types and sized organizations.

This Guide breaks the supply chain GHG inventory process into 10 steps:

I. **Gain leadership support and assemble the right team** for effectively conducting a supply chain analysis.
II. **Select an inventory approach and tool** for estimating supply chain greenhouse gas emissions.
III. **Prepare an inventory spreadsheet.** Preparing the spreadsheet will clarify the inventory process and the data required to calculate supply chain emissions.
IV. **Collect and refine purchasing data** (i.e. annual expenditures) in a spreadsheet that includes all your institution's expenditures in one year, refine it with your institution's purchasing expert
V. **Exclude certain purchases** that may lead to under an over estimation or double counting of emissions.
VI. **Adjust expenditures for inflation** to account for the effect of inflation on the price of goods and services between the year(s) you're analyzing.
VII. **Sort and group data.** Depending on the data set, sorting and grouping can reduce the time required to complete the inventory.
VIII. **Assign GHG emission factors** (MT CO_2e / $1,000,000) by matching purchasing data with sectors in EIOLCA.net.
IX. **Calculate greenhouse gas emissions**
X. **Summarize and present the results** to stakeholders, decision makers, and potential collaborators to engage others in the effort to protect the climate through mindful purchasing.

I. GAIN LEADERSHIP SUPPORT AND ASSEMBLE THE RIGHT TEAM

Support from the leadership team is critical to provide the necessary budget, staff time and direction to effectively complete any action within an organization. Typically a supply chain analysis will be part of a completing a GHG inventory. One of the first steps to run an effective inventory process is the leadership team introducing the project to affected staff and setting an expectation of timely support for data collection effort.

In addition to leadership support, assembling the right group of staff to complete a supply chain analysis is a second critical element for success. Two general categories of staff will be required; 1) A coordinator that is detail oriented, interested in technical research, understands departments and roles within your organization, and is highly proficient in a spreadsheet tool like Microsoft Excel; 2) Accounting staff (or a related department) that understands the organization's purchasing data and is skilled at producing customized spend reports. Like data collection for other GHG inventory sources, it is possible and likely that the report required for the supply chain analysis is not already being created and it will take some trial and error to arrive at a useful data set. See the section IV. Collect and Refine Purchasing Data for more detailed information on this point.

II. SELECT AN INVENTORY APPROACH AND GHG ESTIMATION TOOL

There are two distinct approaches to completing a supply chain GHG analysis, as well as various hybrids approaches:

1) Survey your vendors and suppliers for their production GHG intensities
2) Use a tool to estimate the GHG intensities for various product and service types

The first approach will provide the most useful and accurate information, but it involves systematically surveying all of your organization's vendors and suppliers to determine the GHG intensity of their product or service per unit of expenditure (MT CO_2e / $1,000,000). For most public organizations, this approach is time and cost intensive and ultimately may not produce usable information. This approach is most useful to organizations that purchase large quantities of specific goods or services from a relatively small number of vendors or have the financial leverage or relationship to make such a request of their vendors. Even for those types of organizations – this approach may prove difficult if the supplier doesn't have the information readily available and is unwilling to complete their own GHG inventory (which is the basis for providing a GHG intensity of their product or service).

The second approach is to use a third party database or tool to estimate the upstream emissions generated from the production of the goods and services purchased by an organization. This approach is recommended for the vast majority of public organizations. A number of these tools are currently available from private software firms. Most require the user pay a one time or annual license fee. The exception is a free, publicly available resource for public and EIOLCA.net developed by Carnegie Mellon University Green Design Institute. This tool is currently the best, and only free resource available for this type of analysis and is recommended for most organizations. This tool may not be the best choice for a large, multinational manufacturing company with a complex supply chain, but it's a good fit for institutional purchasers and therefore is the focus of this Guide.

Here is a list of other available tools:

- **Greenhouse Gas Protocol – Scope 3 Evaluator** is a free, web-based tool that provides users with a simple interface to quickly approximate their indirect emissions that occur in the value chain, regardless of the size or sector of the organization. Companies can use this information to start identifying areas to pursue a more accurate inventory and focus their reduction efforts. The release of this tool coincides with the writing of this guidebook (https://quantis-suite.com/Scope-3-Evaluator/)
- **Comprehensive Environmental Data Archive (CEDA)** is a suite of environmentally extended input-output databases that are designed to assist various environmental systems analyses including life cycle assessments, carbon footprinting, water footprinting and embodied energy analysis, using the EIO-LCA method. The academic version of the database is available free of charge to qualified academic and non-profit research organizations through licensing agreements. (http://iersweb.com/services/ceda/)
- **Climate Earth** is a software and data provider focused on measuring, managing, and reporting environmental impacts from supply chains using EIO-LCA methodology. The company serves large organizations where calculating a supply chain footprint manually is not feasible, offering online applications via secure, web-based dashboards. (http://www.climateearth.com/)
- **Industrial Ecology Research Services (IERS)** is a sustainability measurement and advisory company that integrates best science and data with cutting-edge information technology. Their web-based solution, VitalMetrics®, helps organizations measure and manage key sustainability metrics throughout the supply chain. (http://iersweb.com/)
- **TruCost** is provides data and insight to help its clients understand the economic consequences of natural capital dependency. (http://www.trucost.com/)

Consumption-Based Emissions Inventory (CBEI) is a model originally created by the Stockholm Environmental Institute for the State of Oregon, King County, and other clients. It was originally designed to evaluate consumption-based emissions at the level of a whole community, but the model can be adjusted to evaluate just supply chain emissions associated with government purchasing.

Description of EIOLCA.net and Limitations

The tool recommended in this How-To guide was developed and is supported by Carnegie Mellon University – Green Design Institute's *Economic Input-Output Life Cycle Assessment* (EIO-LCA). Researchers at the Green Design Institute have developed this free online tool (available online at www.eiolca.net) to estimate life-cycle greenhouse gas emissions (up to the point of purchase) for 428 sectors of the U.S. economy. In other words, EIOLCA.net will estimate the emissions associated with production of a computer or a building, but NOT the emissions associated with operation and energy usage.

The model is valuable for simple, cost-effective emissions *estimates*. The strength of the model is its ability to provide comprehensive estimates by using aggregate values for all goods and services in the 428 sectors. Its weakness is that it cannot provide a detailed estimate for specific processes. In order to accurately estimate embodied emissions for a specific purchase, that product's specific supply chain must be assessed. This alternative is typically extremely time-consuming and often relies on data from many private sources.

EIOLCA.net can be used to look at all sorts of environmental emissions—particulate matter, smog-creating ozone, toxic chemicals, and many others. In this supply chain GHG emissions inventory, the focus is on greenhouse gases. Once you have mastered using EIOLCA.net for greenhouse gases, you can use it the same way to assess other environmental impacts.

The EIOLCA.net model has several noteworthy sources of uncertainty.

- It is based on United States industry averages and assumes all goods and services are manufactured in the United States. These averages do not include the influence of major U.S. trading partners, such as China, on emissions factors, nor does the model have the ability to account for specific sourcing practices such as a higher than average percentage of post-consumer recycled content in paper products.
- The model relies on a relatively old data set from 2002, which will not capture recent efficiency improvements or best practices that result in lower emissions for specific industrial sectors.
- The data set also requires adjustments to be made to account for inflation (see section VI of this guide).
- Organizational accounting codes don't always directly map to the economic sectors included in the model.

(BOX 2) Learn about EIO-LCA

Most (and likely all) available supply chain GHG estimation tools use an EIO-LCA model and approach. EIO-LCA stands for Economic Input-Output Life Cycle Assessment. The name may sound intimidating, but the concept is simple when broken down.

Economic input-output is a technique for modeling the interactions between different industries in the economy. This mathematical model creates a picture of the industries, or sectors, that contribute to producing a particular good or service. It shows the average inputs needed to make any dollar value of output—the finished product for sale—from any economic sector. For example, a $20,000 purchase of a car may result in (or require) $500 of production by the rubber industry, $3,000 of production from the steel industry, $1,000 of production from the advertising industry, and so forth. Economic input-output models help us understand how much production (in many different economic sectors) is required to produce a given amount of final product. This basic concept is now central to economic analysis and decision-making, and the economist who developed this approach, Wassily Leontief, was awarded the Nobel Prize in economics for his work.

Life cycle assessment means estimating the total environmental impact of a product from extracting raw materials to disposing of it at the end of its life. EIO-LCA combines the results from the economic input-output model with information about each sector's emissions to the environment, including GHG emissions. The average input from all other sectors needed to create a particular dollar value of output from a particular sector is used in tandem with the emissions data for all those supply chain sectors to create an *emissions factor*—the average supply chain GHG emissions per dollar spent on the output of that particular sector.

In broad terms, the EIO-LCA method consists of utilizing the following equation to estimate total CO_2-equivalent emissions for various areas of expenditure:

$$\frac{CO_2e}{\$} \cdot \$ = CO_2e$$

In other words, the estimate stems from multiplying the carbon intensity of a given economic sector per dollar of output (the first term) by the quantity of purchases (the second term). This product is summed across purchasing categories, which differ in both carbon intensity and total dollars spent.

III. PREPARE AN INVENTORY SPREADSHEET

The reality of conducting a supply chain GHG inventory will likely involve organizing and analyzing a large amount of data in spreadsheet. The basic layout for the spreadsheet isn't complicated. An example is provided in Figure 1, below. The green cells will be filled with organizational purchasing data, or information provided by EIOLCA.net. The blue cells contain formulas, which are calculated and summarized in the bottom row of Figure 1. The primary difference between this example spreadsheet and the actual spreadsheet used for an inventory are the number of rows. Two example rows are used in this figure, but organizational purchasing data can be expected to include 10s to 100s of rows. Additionally, your spreadsheet workbook may include multiple versions of this worksheet that are created during sorts and summary of the information. We recommend you create a copy of the worksheet on which you can do any sorting, to prevent any unintentional loss of work.

Figure 1: Example spreadsheet layout for a supply chain GHG inventory.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1					Emissions Factors from EIOLCA.net							Calculated GHG Emissions					
2	Purchasing Category Description	Annual Expenditure	Inflation Correction Factor	Annual Expenditure (inflation corrected)	EIOLCA Sector # and Description	Total CO_2e	CO_2 Fossil	CO_2 Process	CH_4	N_2O	HFC / PFCs	Total CO_2e	CO_2 Fossil	CO_2 Process	CH_4	N_2O	HFC / PFCs
3		$ / year	unitless	$ / year		$MTCO_2e$ / $1 Million	$MTCO_2e$ / $1 M	$MTCO_2e$ / $1 M	$MTCO_2e$ / $1 M	$MTCO_2e$ / $1 M	$MTCO_2e$ / $1 M	MT CO_2e	MT CO_2e	MT CO_2e	MT CO_2e	$MTCO_2e$	$MTCO_2e$
4	Building Construction	$1,000,000	0.81	$810,000	230101: Nonresidential commercial and health care structures	589	484	61.4	29.3	9.51	4.36	477	392	50	24	8	4
5	Paper	$50,000	0.81	$40,500	322120: Paper mills	1520	1360	33.5	85.2	32	11.7	1231	1102	27	69	26	9
6	Source: Data from purchasing department		ICF = (2002 CPI / Inventory year CPI)	$ / year = C4*D4	Source: Data from EIOLCA.net							MT CO_2e = (E4/1000000)*G4	MT CO_2e = (E4/1000000)*H4	MT CO_2e = (E4/1000000)*I4	MT CO_2e = (E4/1000000)*J4	MT CO_2e = (E4/1000000)*K4	MT CO_2e = (E4/1000000)*L4
7																	
8		=	User input cell														
9		=	Calculated with a Formula														

IV. COLLECT AND REFINE PURCHASING DATA

It is critical to collect data on your organization's purchasing to complete the inventory. Data collection for an organizations first inventory can be time consuming. Your request may be new to your organization's accounting / purchasing staff. The following steps will guide you through this process, but as was mentioned previously, this guidance is not "one-size-fits-all".

1) Select an appropriate inventory year
2) Develop your data request and provide examples
3) Submit data request and meet with appropriate staff
4) Review and refine the data

The guidance will provide you with tips to make the process more efficient, but be prepared to describe your request multiple times to multiple people. There may be a number of data report iterations before you arrive at a useful data set.

1) Select an appropriate inventory year

If your institution is performing a greenhouse gas emissions inventory for direct and indirect emissions associated with operations, then create a supply chain inventory for that same year. That way, the two inventories complement each other. Emissions from your organization's procurement can be shown side-by-side with emissions from its operations to provide a more complete picture of climate impacts. Purchasing data is typically tracked on a fiscal year basis. More often than not, it is easier to collect the rest of your GHG inventory data (electricity, fuel, etc.) based on fiscal year as opposed to trying to collect purchasing data based on calendar year.

If there is no way to align the time period for supply chain and the rest of your emissions source than align them as closely as possible and state the difference in the methodology section of your report. This is often the case for organizations that have been conducting a GHG inventory for years on a calendar year basis and would like to add supply chain, but purchasing data is only available for fiscal years. Attempting to adjust existing fiscal year data sets to match calendar years is not recommended, as it is a laborious process that may need to be repeated year after year, and there is not a clear emissions measurement or management benefit. If your institution does want to understand the climate impacts of spending, but does not plan to do a full greenhouse gas inventory, then pick the most recent year's data that is available and consider requesting data for a number of prior years as well.

Collecting data and conducting a supply chain analysis for multiple years at one time provides a couple advantages. First, it requires only marginally more time. Requesting the data for multiple years; setting up the spreadsheet; and performing the associated calculations only requires slightly more time than doing the same for a single year. Second, performing the analysis for multiple years will provide a more robust picture of an organization's purchasing habits and avoid the possibility of inadvertently selecting an inventory year for which purchasing is at the low end or high end of the range. The most common type of purchase that will skew a given year's data set is construction. This is because the amount spent on construction can vary significantly from year to year and can have a major influence on the estimated supply chain emissions.

2) Develop the data request

Before approaching the purchasing department, accounting specialists, auditor, etc. (referred to here as the data provider) to request purchasing data, it is useful to develop a specific request including the following elements:

- **Time Period.** Be specific about the time period you would like to analyze. If you ask for multiple years' worth of data, be sure to ask the date provider if there have been any significant changes to the accounting system or purchasing classifications during that time period. To most efficiently complete an analysis for multiple years, the annual data sets should be comparable and not need any adjustments or modifications.
- **Data Boundaries.** Purchasing data should include all purchases made by your institution, its departments, agencies, and employees. Data from purchase orders is often the most accurate for determining which solicitations "belong" in a given year. Data that reflects actual payments may end up in the wrong year, since bills can go unpaid from the end of one year to the beginning of the next.
- **Critical Data Attributes.** There are two data fields that are absolutely necessary for performing a supply chain inventory:
    - **Purchase Type/Category/Code.** This field or column describes the type of good or service. The description should be intuitive to someone outside of purchasing. Also consider asking for a purchasing code legend. Purchasing departments generally have a written manual that describes the various purchasing codes in greater detail that will be available in a purchasing summary report.
    - **Total Annual Dollars Spent, by Category.** The data should include all purchases made by an organization including purchase cards (p-cards).
- **Secondary Data Attributes.** These data sets may be quite helpful in estimating supply chain emissions and interpreting results, but are not critical.
    - **Agency/Department.** As you decide what procurement categories to focus on and how to implement green purchasing practices, it will be helpful to know what agency or department within your institution is responsible for expenditures in certain categories.
    - **Vendor.** When considering results, it will be helpful to know from which vendors the institution makes purchases. For example, strategies for addressing supply chain emissions from office supplies purchases might look different for an organization that has one large office supplies contract versus one that purchases office supplies from a variety of vendors.
    - **North American Industry Classification System (NAICS) Codes**. These codes are used to organize enterprises and establishments into industry sectors—each vendor can be identified by their code or codes. This information can further assist you in assigning expenditures to economic sectors (EIO-LCA.net lists NAICS codes included in each of the model's sectors). Beware, though, these classifications can sometimes be wildly inaccurate, as business self-select their codes.
    - **Other Attributes.** For example, in some cases it may be possible to sort data based on the type of contract. This information can be useful when organizing results, since it makes sense to group purchases based on the type of solicitation. Purchase types with similar procedures might be more easily addressed in the same way. Once the purchasing department understands the data request considering asking for their recommendations about other available attributes that may be useful for the GHG analysis.
- **Data Format.** Data that is sortable by different fields or attributes (listed below) will be important. In a spreadsheet, this information will likely be organized into columns, with data on individual line items or accounts in each row. The spreadsheet format is required for completing a supply chain analysis, so beginning with the purchasing data in this form is ideal. Data providers may be used to providing reports as PDFs, so be clear that you prefer the data in a spreadsheet.
- **Data Examples.** See Figure 2 for a general example of the critical data required for the analysis. Each organization's accounting system and report format and style will be different, but this example provides a general idea of the type of critical information being sought for this inventory.

Figure 2: Example of critical purchasing data required for supply chain GHG inventory.

SUBCATEGORY Descr	Grand Total
Advertising/Marketing/Sales - Other	$ 4,114,846.10
Commercial Printing - Adv,Mrktg,Sales	$ 1,253,244.55
Creative Agencies	$ 7,693,673.05
Direct Mail	$ 11,642,764.84
Donations	$ 141,635.78
Gift Certificates	$ 786,509.86
Images, Photography	$ 599,357.85
Market Research	$ 7,904,826.52
Marketing Events	$ 285,560.63
Media Buying	$ 7,819,746.95
Media Production	$ 262,527.75
Misc Exp Non Mktg	$ 693,094.49
Newspaper, Magazines	$ 337,163.54
Promotional Materials	$ 2,223,474.22
Public Relations	$ 1,649,830.52
Signage	$ 392,678.28
Tickets Resale	$ 13,531,979.82
Via Magazine	$ 6,221,965.82
Yellow Pages	$ 1,775,725.26
Automotive Equipment	$ 1,770,219.94
Automotive Parts	$ 1,003.08
Automotive Services - Other	$ 1,806,652.06
Fuel	$ 1,893,454.29
Benefits - Other	$ 1,216,337.79
Business Insurance	$ 5,004,118.75
Insurance	$ 21,985,114.45

3) Submit data request and meet with the involved staff

Ideally all involved staff will have been identified and granted the necessary time to support the supply chain analysis by the leadership team. If this is not the case than seek that support from your manager or the manager of the purchasing department. Schedule a meeting with key representatives from the procurement department, finance office, or others who will assist you with obtaining and interpreting the organizational-wide purchasing data. Describe the project and timeline; the data being requested; and how you will use it (i.e. to estimate the climate impact of producing the goods and services the institution purchases, in order to inform strategies for climate-friendly purchasing). Consider preparing a short presentation about your supply chain emissions inventory project – the more your colleagues understand the project, the better they will be able to provide support.

4) Review and refine the data set

Once you receive the requested data, review it to make sure it contains the critical information – purchasing categories and the annual dollars spent in each. If possible, compare the data received to a secondary source, such as an annual budget report, to insure the two values are similar. Ideally the number of categories (i.e. line items) in the data will be less than 200 (this is an arbitrary threshold – the actual number of lines in a quality data set may be more or less). If the data set provided contains thousands of line items, ask for a new report that is further summarized or ask the data provider if there is a data attribute within the data set that can be used for summary purposes.

The purchasing data set is the foundation of the inventory and revising the base data becomes more difficult as the spreadsheet is built up in the following steps. Take the time necessary to work with the data provider to insure that the data is representative of the desired time period, organizational boundaries, and attributes as much as possible at this point in the process.

V. EXCLUDE CERTAIN PURCHASES

Once the primary purchasing data set has been reviewed, refined, and is considered complete, the next step is to exclude certain line items that will result in double counting emissions from other sources in a GHG inventory or otherwise should be excluded.

Double Counting

Certain line items in purchasing data represent emissions sources that will be accounted for more accurately using GHG inventory protocol methodology and other best practices in an operations GHG inventory. If your supply chain inventory is part of an operations inventory, then these emissions must be excluded from the supply chain emissions accounting to avoid double counting. The following types / categories of expenditures should be excluded from the purchasing data.

- **Utility payments** would double count electricity's power-plant emissions. These emissions are related to building energy use, so they can be addressed through purchasing energy-efficient products, changing processes, and retrofitting buildings. However, emissions associated with the supply chain of the electric industry (e.g., mining and transporting coal) are typically not included in operations inventories. By contrast, because the emissions associated with burning natural gas in a boiler or furnace are "direct" and occur at the point of energy use, these emissions are included in operations inventories and are not included in EIO-LCA.net models (although the supply chain emissions associated with sourcing, producing, refining, and transporting those fuels are).
- **Solid waste contracts** would double count landfill and waste-hauling emissions, assuming these categories are included in an operations emissions inventory. These emissions are best addressed through reducing, reusing, recycling, and composting. Purchasing can play a role by considering product attributes such as durability, reparability, and recyclability.
- **Rent payments** would double count the emissions from operating buildings, provided they are measured elsewhere in the GHG inventory.
- **Salaries and wages** manifest as emissions when the employees spend their personal money, which is outside the scope of both operational and supply chain inventories.

Other Exclusions

In addition to excluding purchases that may result in double counting emissions, there are also other purchases that should be excluded.

- **Inter- or Intra Departmental money transfers** between government agencies or to employees. Many institutions transfer funds between departments or accounts. Ask for training from your "internal experts" on how to identify intra-institutional payments in the expenditure data. This does not include grants or contracts to outside organizations to provide specific services. Those should be included in the supply chain inventory.
- **Health insurance and workers' compensation.** Health insurance is recommended for exclusions because it is very difficult to manage for emissions reductions. For many organizations, options for health care insurance companies are limited. At some point in the future, more health care insurance and provider options may be available. At that point vendors could be compared based on their efforts to limit emissions, but that is not the current reality. If included – health care insurance will likely be a significant emissions source, but it's one that cannot be managed effectively and is therefore excluded.
- **Land purchases**. It is the use and alteration of land that results in GHG emissions, not the purchase.
- **Donations** to non-profits or scholarships.

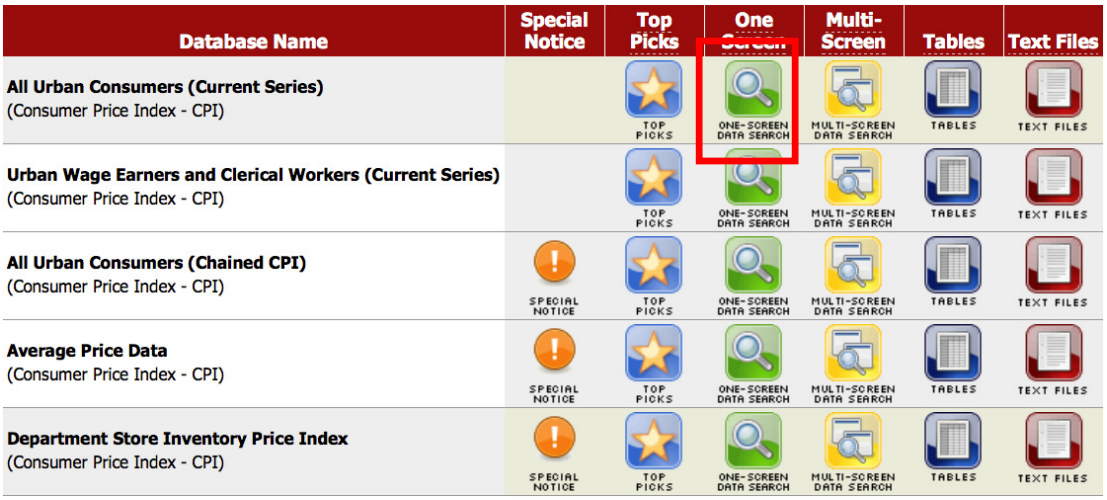
Be sure to document all of the line item purchases excluded from the raw data set. This can be done by copying and pasting the lines to a separate worksheet within the Excel workbook being used for the analysis or by assigning them an emissions factor of zero – in both cases be sure to note the reason and logic for the exclusion.

VI. ADJUST EXPENDITURES FOR INFLATION

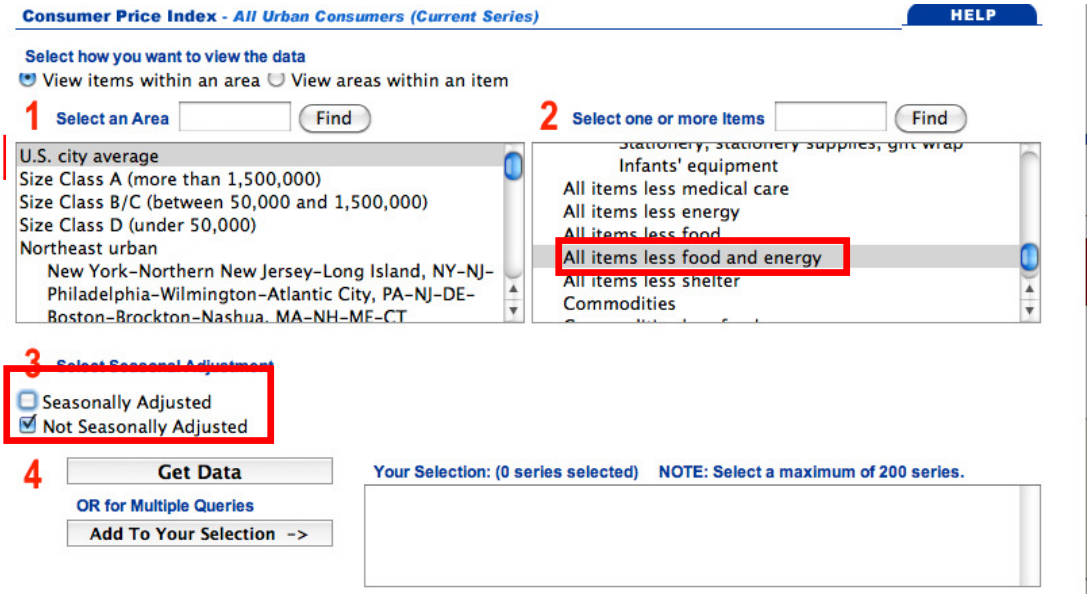
The EIO-LCA model was last updated in 2002 so some simple refinements need to be made in the method to account for inflation. Inflation does not pose a significant problem over a short period (a year or two), but the years between the most recent version of the EIO-LCA database (2002) and more recent periods of interest for most organizations becomes an issue. The following method is recommended to adjust raw purchasing data ($) for inflation. Inflation is important because it results in prices increase over time for similar items. If there is no adjustment for inflation, supply chain GHG emissions estimates will be inflated because over time the purchasing power of a dollar decreases.

To adjust purchasing data for inflation, follow these steps:

1) Go to the Bureau of Labor Statistics, Consumer Price Index Databases (http://www.bls.gov/cpi/data.htm). Select the button highlighted with the red box in Figure 1, *All Urban Consumers – One Screen Data Search*.



2) Select "*U.S. city average*"; Select "*All items less food and energy*"; Deselect check box for "Seasonally Adjusted" and click the "Get Data" button.



3) Calculate the Inflation Correction Value. Find and use the values in the table below for 2002 and the inventory year of interest (in the following example its 2013) and calculate the Inflation Correction Value with the formula shown below the table.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	HALF1	HALF2
2002	188.2	189.2	189.8	190.3	190.2	190.1	190.3	191.0	191.3	191.8	191.8	191.4	190.5	189.6	191.3
2003	191.8	192.5	193.0	193.1	193.2	193.0	193.2	193.5	193.6	194.3	193.9	193.6	193.2	192.8	193.7
2004	194.0	194.9	196.1	196.5	196.5	196.6	196.6	196.8	197.4	198.2	198.1	197.8	196.6	195.8	197.5
2005	198.4	199.5	200.7	200.9	200.8	200.6	200.8	201.0	201.3	202.3	202.3	202.1	200.9	200.2	201.6
2006	202.6	203.6	204.9	205.5	205.7	205.9	206.2	206.7	207.2	207.8	207.6	207.3	205.9	204.7	207.1
2007	208.009	209.112	209.923	210.311	210.316	210.474	210.756	211.111	211.628	212.318	212.435	212.356	210.729	209.691	211.767
2008	213.138	213.866	214.866	215.059	215.180	215.553	216.045	216.476	216.862	217.023	216.690	216.100	215.572	214.610	216.533
2009	216.719	217.685	218.639	219.143	219.128	219.283	219.350	219.596	220.137	220.731	220.384	220.025	219.235	218.433	220.037
2010	220.086	220.602	221.059	221.166	221.193	221.265	221.258	221.551	221.907	222.079	222.077	221.795	221.337	220.895	221.778
2011	222.177	223.011	223.690	224.118	224.534	224.891	225.164	225.874	226.289	226.743	226.859	226.740	225.008	223.737	226.278
2012	227.237	227.865	228.735	229.303	229.602	229.879	229.893	230.196	230.780	231.276	231.263	231.033	229.755	228.770	230.740
2013	231.612	232.432	233.052	233.236	233.462	233.640	233.792	234.258	234.782	235.162	235.243	235.000	233.806	232.906	234.706
2014	235.367	236.075	236.913	237.509	238.029	238.157	238.138	238.296	238.841	239.413				237.008	

$$\text{Inflation Correction Value} = \frac{2002\ Annual\ CPI\ (190.5)}{2013\ Annual\ CPI\ (233.8)} = 0.81$$

4) Multiply the Inflation Correction Value by each line item in the raw purchasing data to adjust for inflation.

VII. SORT AND GROUP DATA

1. Sort the Data

Different organizations group and organize purchasing data in different ways depending on accounting and management needs. Additional sorting and grouping may be useful and make the process of assigning emissions factors in the next step more efficient. Grouping and sorting data now begins the process of summarizing the results, so begin with the end in mind. Take a moment to review some of the tables and graphics presented in the "Summarize the Results" section of this Guide to inform how you approach sorting and grouping the purchasing data.

There are two general approaches to sorting the data:

- **Sort by Expenses:** In general, a supply chain GHG inventory should be focused on high-spend—and thus high-impact—purchasing categories. Making sure every single purchase ends up in the correct economic sector is not important. Concentrate on the types of goods and services on which your institution spends the most money, and make sure those purchases are considered in the inventory. This approach is useful for detailed purchasing data (i.e. thousands of line items). Or work with your data provider to further summarize the raw purchasing data into higher-level categories to reduce the number of line items. Sorting by expenses may be used in conjunction with sorting by purchasing descriptions.
- **Sort by Purchasing Descriptions:** If the purchasing data is already highly summarized (i.e. approximately 200 rows), begin by sorting by purchasing descriptions. Sorting by purchasing descriptions will allow grouping of like purchases into categories and allow for a more efficient process of assigning emissions factors.

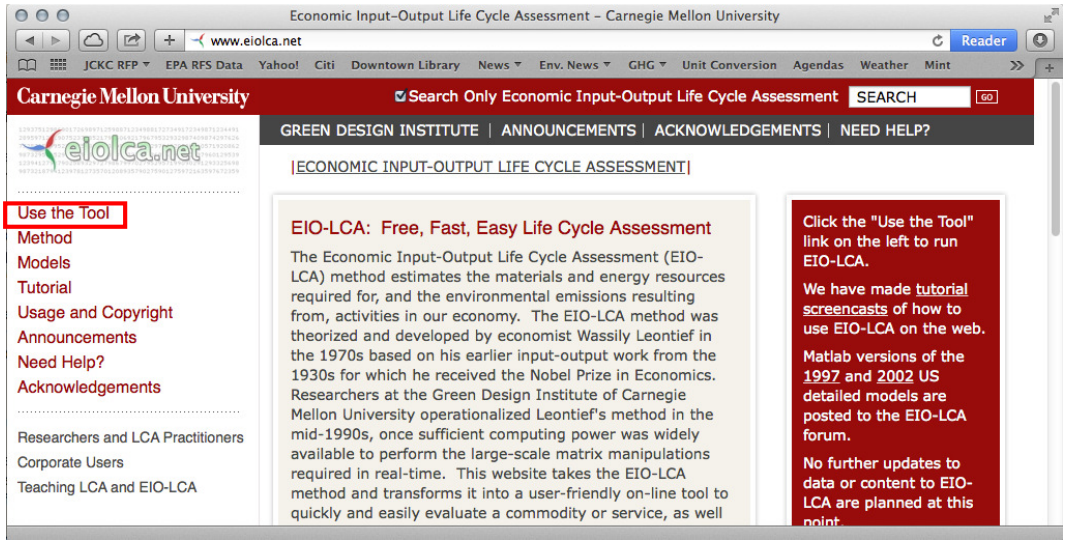
There may very well be other sorts that could be performed to reduce the time necessary to perform this analysis. As was stated previously, this is not a one-size fits all guide, so experiment and use what works based on available data.

VIII. ASSIGN GHG EMISSIONS FACTORS TO PURCHASES

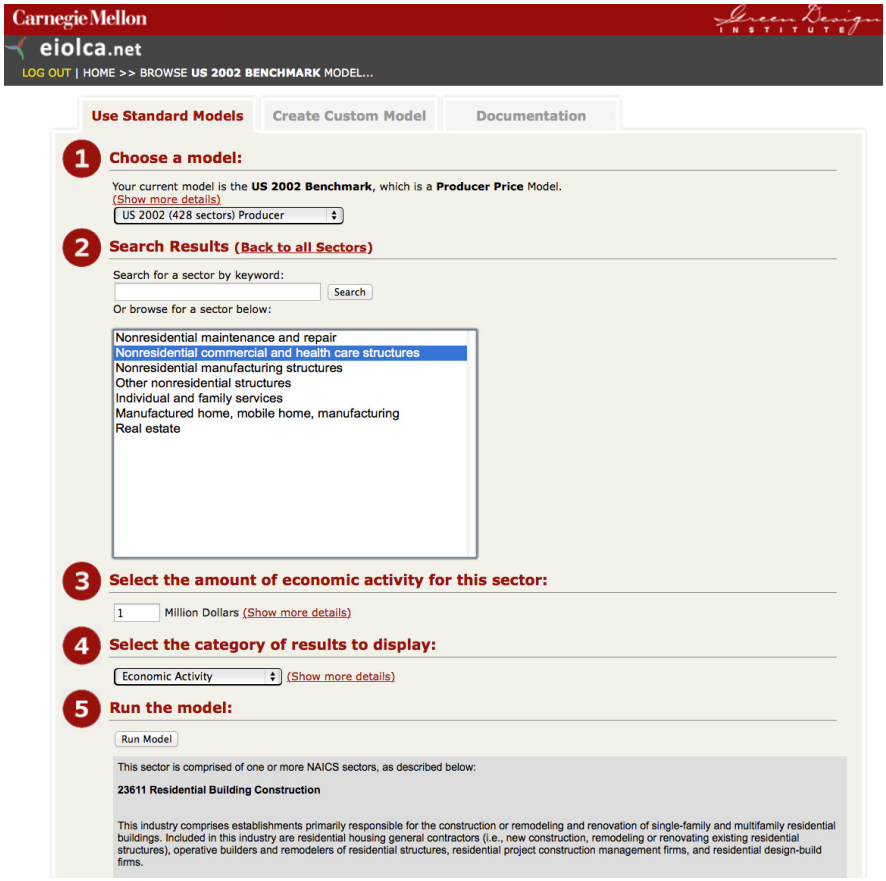
EIOLCA.net has been described previously as a tool, but for the purpose of this guidance, it can also be thought of as database of emissions factors for various goods and services (MT CO_2e / $1,000,000). It represents 492 sectors in the US economy. The emissions factors taken from EIOLCA will be multiplied by the inflation-adjusted purchase values to estimate GHG emissions for a purchase or group of purchases.

This section will describe how to map each line item of purchase data to one, or multiple, sectors in EIOLCA.net. This process is broken into the following steps.

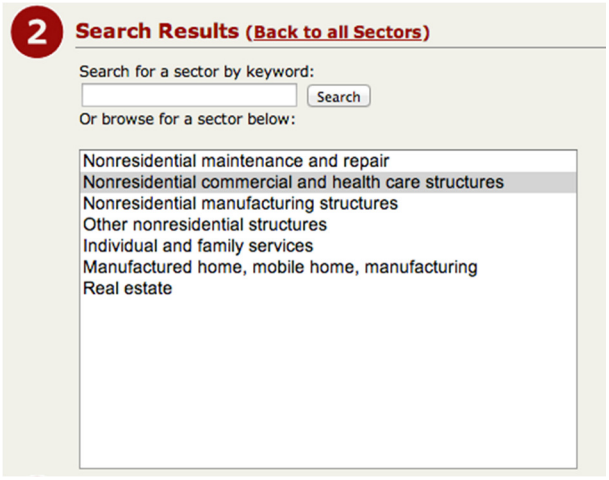
a. **Go to** EIOLCA.net **and select "Use the Tool"** from the menu on the left hand side of the screen. From this page you can also select other links like "Method" and "Tutorials" if you want to learn more about EIOLCA.



b. **Choose a model:** Use the U.S. 2002 (428 sectors) Producer model – it should be the default. This model is appropriate for institutional purchasers who buy the majority of their goods wholesale. For organizations that purchase the majority of goods from retail locations select US 2002 (428 sectors) Purchaser model. **Note**: The Purchaser model does not provide sector descriptions (grey box below the "Run the Model" button). Descriptions are very useful is choosing which economic sector to assign to a purchase or group of purchases. Because the descriptions do not function in the Purchaser model neither does the keyword search function described in step c.



c. **Select a Sector** in EIOLCA.net that matches the description of a purchase. There are two ways to search the sectors to find the best match: 1) Search for a sector by keyword (recommended method), or 2) Browsing the sectors using the drop-down menus. Searching by keyword is typically the most efficient way to find the EIOLCA.net sectors that match your institution's purchases. Type a key word(s) from the purchasing category description into the search field and click the "Search" button. EIOLCA.net searches the economic sector descriptions and returns all of the sectors in which the key word(s) appear. Select the sectors one at a time and read through the descriptions to determine which is the most relevant for a purchase. The descriptions will appear below the "Run Model" button once a sector is highlighted. Most purchasing categories can be represented by a single economic sector from EIOLCA. There may however be certain categories that require the emissions factor from multiple economic sectors be averaged together to represent a purchasing category.



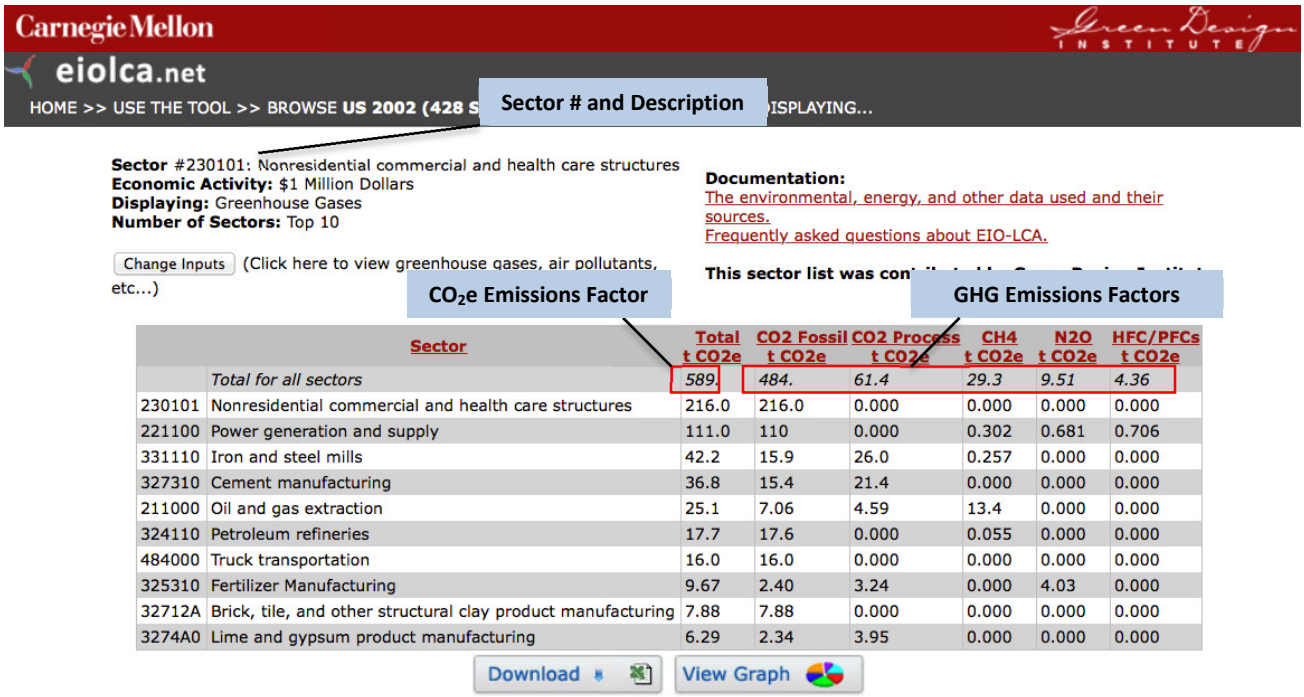
d. Select the Economic Activity: Leave this field set to the default value - $1,000,000. Doing so for each economic sector you choose in your analysis will provide you with a comparable emissions factor values (MT CO_2e / $1,000,000). This emissions factor can then be entered into your spreadsheet to convert dollars spent into greenhouse gas emissions. Remember to divide each line item purchase by $1,000,000 prior to multiplying by the emissions factor in the analysis spreadsheet.

e. Select the Category of Results: Choose Greenhouse Gases from the drop-down menu. In examining high-impact categories and designing green purchasing strategies, it is of course important to take into account a variety of

environmental impacts. Thus it may be useful to use the tool later on to look at other "categories of results" such as Toxic Releases or Conventional Air Pollutants while forming recommendations or collecting more data to inform future green purchasing efforts.

f. **Click the "Run the Model" button.**

g. **Copy and Paste the Results into Inventory Spreadsheet.** An example of the results screen is shown on Figure 3. The red boxes indicate the elements to copy and paste into your spreadsheet. The primary value(s) of interest are in the top line in the results table, specifically the box labeled CO_2e Emissions Factor. The CO_2e emissions factor is most important to complete the supply chain inventory emissions estimates, but it is also recommended to capture the individual GHG emissions factors, as they give more detail on the actual kinds of emissions associated with the sector (e.g. CO2 from fossil fuels vs. methane emissions vs. other GHG chemicals). Capturing these values is as easy as highlighting, copying, and pasting them into your spreadsheet. Consider documenting the sector number and sector description for transparency in order to answer questions about the inventory and to aid in replication of the analysis in the future. If you're wondering where to put the EIOLCA results, go back to the "Prepare Your Spreadsheet" section of this Guide.



Sector		Total t CO2e	CO2 Fossil t CO2e	CO2 Process t CO2e	CH4 t CO2e	N2O t CO2e	HFC/PFCs t CO2e
	Total for all sectors	*589.*	*484.*	*61.4*	*29.3*	*9.51*	*4.36*
230101	Nonresidential commercial and health care structures	216.0	216.0	0.000	0.000	0.000	0.000
221100	Power generation and supply	111.0	110	0.000	0.302	0.681	0.706
331110	Iron and steel mills	42.2	15.9	26.0	0.257	0.000	0.000
327310	Cement manufacturing	36.8	15.4	21.4	0.000	0.000	0.000
211000	Oil and gas extraction	25.1	7.06	4.59	13.4	0.000	0.000
324110	Petroleum refineries	17.7	17.6	0.000	0.055	0.000	0.000
484000	Truck transportation	16.0	16.0	0.000	0.000	0.000	0.000
325310	Fertilizer Manufacturing	9.67	2.40	3.24	0.000	4.03	0.000
32712A	Brick, tile, and other structural clay product manufacturing	7.88	7.88	0.000	0.000	0.000	0.000
3274A0	Lime and gypsum product manufacturing	6.29	2.34	3.95	0.000	0.000	0.000

NOTE: all the Sectors listed under the top line represent the products and processes that go into the good or service you are estimating. EXPLAIN why the first one is the same as the top-line sector you are calculating.

IX. CALCULATE GREENHOUSE GAS EMISSIONS

Convert dollars spent to greenhouse gases emitted (in carbon dioxide-equivalent).

Your spreadsheet now contains data for total expenditure for a product category for the inventory year (in 2002-equivalent dollars) and a supply chain emission factor which corresponds to a certain EIO-LCA.net economic sector. To get an estimate of the total supply chain emissions represented by that row, simply multiply dollars spent by the emission factor and divide the product by one million.

A	B	C	D	E	F
Code	**Description**	**Adjusted Spend***	**EIO-LCA.net Economic Sector**	**EF#**	**Total MT CO2e**
BOAT1	Boats & Marine Equip & Supply	$ 524,130.82	Boat building	532	**279**
BOAT2	Boats & Marine Svcs	$ 17,626.31	Water transportation	2780	**49**
BOOKS	Books & Maps	$ 54,973.66	Book publishers	213	**12**
CABLE	Cabling Svcs: Data & Voice	$ 293,893.61	Services to buildings and dwellings	491	**171**
CHEM2	Chemicals: Water Treat, Boiler	$ 1,614,422.86	All other basic inorganic chemical manufacturing	2180	**3,519**
CLCT	Collection Svcs & Transactions	$ 814.35	Business support services	186	**0**
CLOTH	Clothing: Except Uniforms	$ 500,424.08	Other cut and sew apparel manufacturing	509	**255**

*PPI adjusted total spend

Emissions factor

>Calculating supply chain emissions in Excel. *In this example, adjusted spend in 2002 dollars is in column C and the emission factor for that category's EIO-LCA.net sector is in column E (your spreadsheet may be different, of course). The Excel formula for your "Total Emissions" column might look like:*

*=C5/1000000*E5*

You only have to enter this formula into one cell. Microsoft Excel allows you to "'drag" the formula down the column to complete the calculation. For more tips using Microsoft Excel, search online tutorials.

Total up all supply chain emissions.

Add up the emissions from all classifications or categories to yield the total supply chain greenhouse gas emissions, in CO_2e, from your institution's entire procurement in your study year. Remember, it's just an estimate.

Later on, when you present the results from your supply chain inventory project, remember to make the distinction between operations emissions and supply chain emissions very clear. Institutions do not directly control the activities that cause supply chain emissions, unlike emissions from everyday operations and services.

Group results into a few big categories plus "other."

For comparing the supply chain emissions of different types of purchasing, related sectors can be grouped into a few general categories of procurement, such as "Construction & Maintenance," "Service Contracts," and "Food." This allows you to see the scale of impact similar purchase types have in order to help you prioritize where to take action to mitigate these impacts. Similar goods and services with similar methods of procurement will be easier to address jointly, and thus

X. SUMMARIZE THE RESULTS

The objective of estimating the supply chain emissions of government purchasing is to prioritize "sustainable procurement" efforts toward areas where the biggest positive impact can be made with your limited resources. Categorizing similar types of procurement together into a few general categories of procurement, such as "Construction & Maintenance," "Service Contracts," and "Food," will allow you to recognize this opportunity for efficient climate action through improving purchasing practices.

Group results into a few big categories plus "other."

Consider the goals of your study, and your purchasing profile to select five to ten categories to group your purchases into for the purposes of reporting your results. The purchasing categories shown in the table below are taken directly from the meta-analysis study presented by the West Coast Climate Forum in the Climate Friendly Toolkit. They represent the most commonly used categorizations by organizations included in that study.

Purchasing Category	Category Description
Construction and Maintenance (Facilities, Grounds and Infrastructure)	All new construction, renovation and maintenance on buildings, other facilities, infrastructure and grounds.
Vehicles and Equipment	Vehicles, furniture and equipment and associated maintenance. Equipment could include items such as appliances, off-road vehicles and other medical and scientific equipment.
Computers and Phones	Hardware and software for computers and phones and related services.
Chemicals	Cleaning supplies, water treatment chemicals, lab supplies, paint, etc.
Other Operating Supplies	Consumable materials including parts, tools, and various other items.
Professional Services and Community Programs	A variety of professions including medical, financial, law, engineering, etc. Community and support programs and grants including libraries, medical services, etc.
Office Supplies and Printing	Miscellaneous office supplies, printing services and paper.
Food, Lodging and Transportation	Food service, food purchased for retail sale, lodging in hotels, conferences, transit and freight.
Other	All other miscellaneous goods and services.

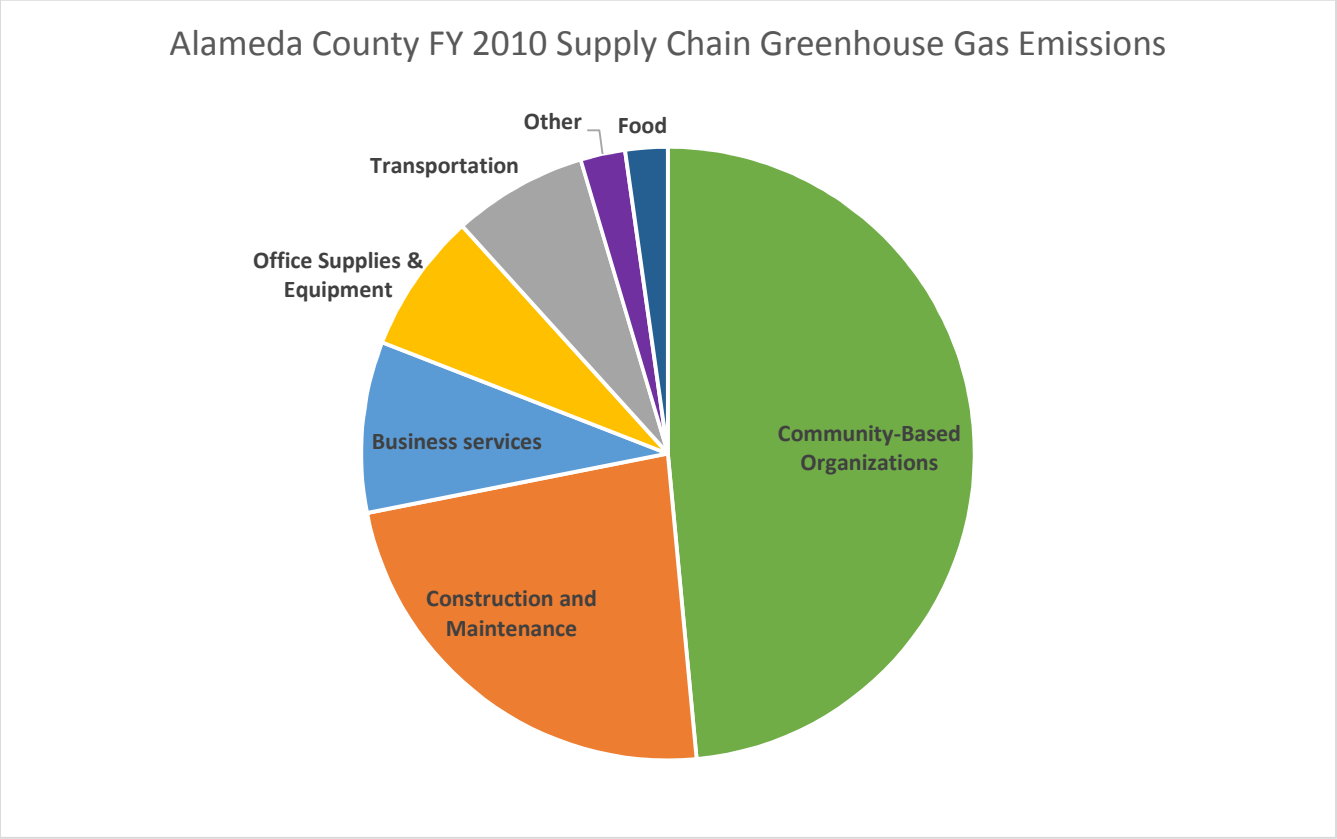
For each line in your spreadsheet, assign one of the categories (or other). These categories can be rolled up in order to present the scale of impact for certain purchasing categories in your supply chain.

Code	Description	EIO-LCA.net Economic Sector	Total MT CO2e	CATEGORY
BOAT1	Boats & Marine Equip & Supply	Boat building	279	**Transportation**
BOAT2	Boats & Marine Svcs	Water transportation	49	**Transportation**
BOOKS	Books & Maps	Book publishers	12	**Office Supplies & Equipment**
CABLE	Cabling Svcs: Data & Voice	Services to buildings and dwellings	171	**Business services**
CHEM2	Chemicals: Water Treat, Boiler	All other basic inorganic chemical manufacturing	3,519	**Construction and Maintenance**
CLCT	Collection Svcs & Transactions	Business support services	0	**Business services**
CLOTH	Clothing: Except Uniforms	Other cut and sew apparel manufacturing	255	**Other**

> Example categorization. *In this example, each purchasing code is assigned to one of six categories, or "Other," in order to group like goods and services for reporting and analyzing results.*

Present the results

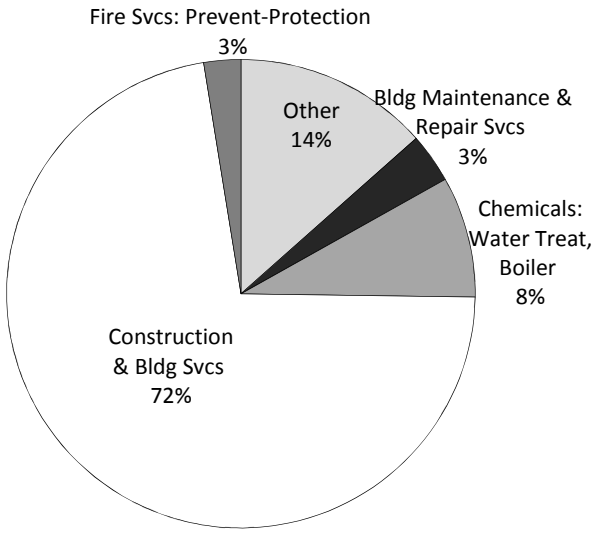
A simple way to represent the results of your supply chain emissions is to produce a pie chart that divides total supply chain emissions into the large purchasing categories you selected in the previous step. Pie charts are best for presenting this data because the relative climate impacts are more important than the numbers. See figure bewlow for an example.



> Alameda County category pie chart. *This chart shows the share of the total supply chain carbon footprint associated with each purchasing category.*

Create more figures and charts for presentations and reporting

From there, you can make a variety of graphs and tables that can help identify strategies for addressing high-impact categories of purchases. You may wish to analyze which government agency spent the most money in your high-impact category, or which specific spending type where the largest contributors of GHG emissions to a purchasing category as in figure 5. Box 3 describes one other graphic that may be useful in deciding which strategies to use when identifying strategies for addressing the climate impacts of certain purchasing categories.



Construction and maintenance category supply chain emissions, by purchasing code. *This chart assigns the GHG emissions associated with purchases in Construction & Maintenance to the specific Alameda County purchasing codes that make up that category. Construction and building services make up nearly three-fourths of the total climate impact of this category, suggesting that those service contracts might be a good target for climate-friendly purchasing initiatives.*

Box 3: Developing procurement strategies based on GHG emissions driver

Supply chain GHG emissions can be broken into two 'drivers': economic demand (money spent on finished products) and the emission intensity of the economic activities that satisfy that final demand (the supply chain emission factor). These two numbers multiplied together yield total emissions ($ x GHG/$ = GHG). Simply put, we can separate environmental impacts caused by human economic production into those two variables: scale and intensity.

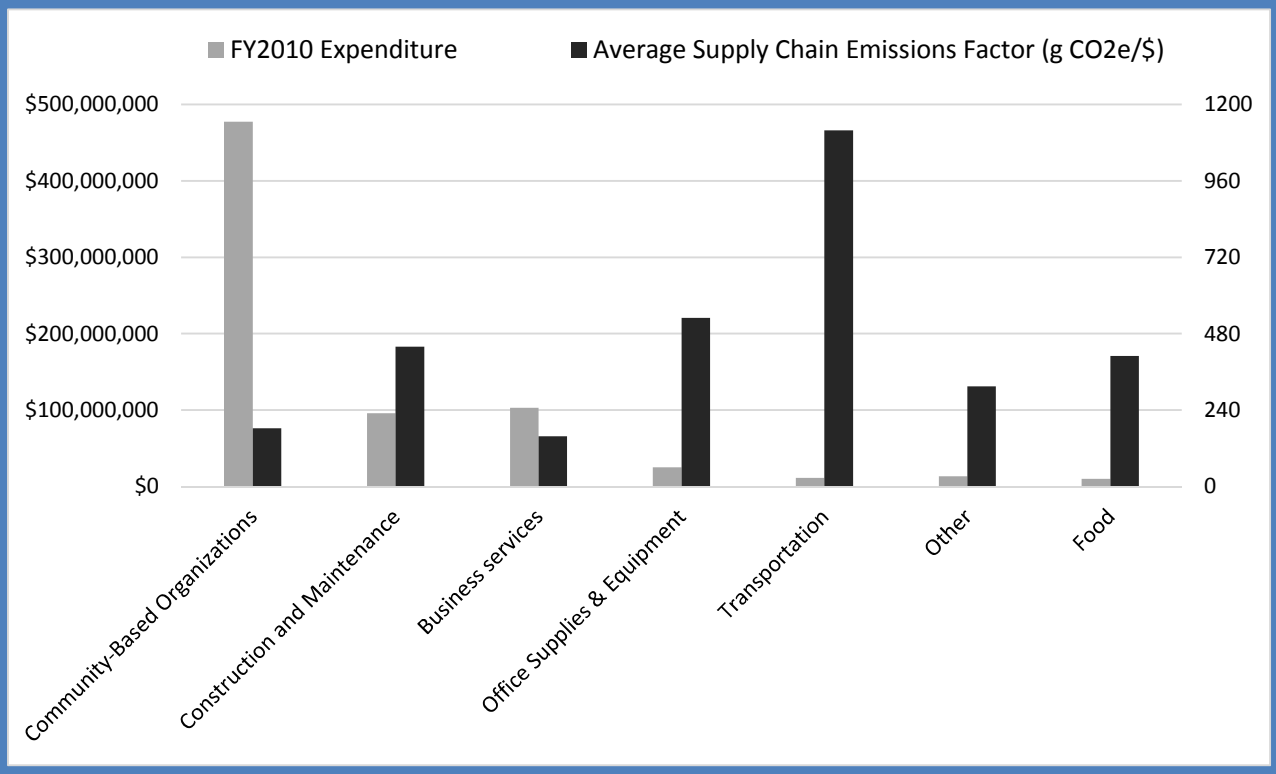
For example, categories with massive expenditures driving supply chain emissions, but low emissions per dollar spent, require measures that address large quantities of expenditures all at once to achieve significant emissions reductions. On the other hand, for purchasing categories with emissions-intensive supply chains but small total expenditure, any strategies to reduce consumption—buy less—or purchase lower-carbon alternatives—buy green—can make a big difference in term of purchasing's climate impact.

This breakdown points to the two methods for reducing the climate impact of purchasing: (1) buy fewer goods and services, or (2) buy goods and services with smaller carbon footprints.

First, buying less can decrease *scale*. Purchasing less should not mean doing without; the effects that purchasing less may have on a community must be considered. Buying less in such a way that diminishes government services may not protect the climate at all, since private business or charity might step in to fill these gaps and provide services in a way that results in higher GHG emissions, or worse, communities might be underserved. To reduce supply chain emissions, institutions must use the resources they have more efficiently, in a way that allows them to purchase less, such as

duplexing documents and using electronic means to communicate reduce the amount of paper that must be purchased without reducing the effectiveness of their service delivery.

Second, buying products with smaller supply chain carbon footprints can lessen the *intensity* of government purchasing. To continue the illustration from the previous paragraph, where paper records cannot easily be moved to digital files, purchasing paper whose production is less emissions-intensive is another way to reduce supply chain climate impact. Paper made from post-consumer recycled content rather than virgin pulp entails fewer supply chain emissions, and also provides many other environmental benefits. For more tips on the best strategies for reducing the climate impact of purchased goods and services, visit the Climate Friendly Purchasing Toolkit at http://westcoastclimateforum.com/.



Total expenditure and average emissions factor for each Alameda County purchase category. *This chart shows the two drivers that determine total supply chain emissions from a given group of purchases: scale (dollars spent) and intensity (upstream emissions per dollar spent). Note that grams per dollar is exactly equivalent to metric tons per million dollars – g CO_2e/$ = MT CO_2e/$1 million.*

Identify the hot spots *within* the supply chains of high-impact categories.

You can use the results from the EIO-LCA.net or any other EIO-LCA tool to see what other sectors contribute most to the supply chain emissions associated with the categories of government purchasing. For example, the image bellow shows the top ten sub-sectors that contribute to the emissions factor for "Nonresidential commercial and health care structures". Note that the single largest contributor is direct emissions from the sector. This means that the operational emissions of vendors providing that good or service produces a higher portion of emissions than other parts of their supply chain, such as the power they use (#2) or the materials they buy and use (iron and steel #3, cement #4).

Interpreting results: Construction services as an example. *EIO-LCA.net results for "Nonresidential commercial and healthcare structures."*

We can assume in the case of construction services that some portion of the electricity in the construction services supply chain is used on site by electric-powered construction equipment. With this information, we know that we can address a significant portion of the supply chain emissions associated with construction service contracts by working with our contractors (also called vendors or first-tier suppliers). In this case, that may mean specifying certain low-emission practices in the service contract, such as requiring that the contractor to power off machinery not in use instead of idling.

For sectors whose supply chain greenhouse gas emissions occur predominantly further "upstream," the best way to reduce supply chain emissions (other than buying less, of course) may be through purchasing or soliciting products with attributes related to lower-carbon production processes, such as goods made from recycled content. Not only can an institution commit to buying recycled-content paper, but they can also specify that printing services contractors produce deliverables on recycled-content paper.

DEVELOP AN ACTION PLAN

You now have the tools to talk about your work. If you get the chance to present preliminary results to a small group of stakeholders—perhaps the purchasing contacts that provided you with data and helped you understand it—then take advantage of the opportunity with a short presentation on what you found out.

Assess opportunities for addressing high-impact categories.

High-impact purchasing categories may or may not be a good candidate for green purchasing effort—suitability for emissions-reducing action among competing opportunities depends on a lot of factors besides scale, intensity, and total emissions from a category.

One thing to consider when assessing priorities is to evaluate the potential to tackle the whole category at once, such as adding environmental language to a contract that covers a substantial portion of it. A high-emitting category whose

main driver of climate impact is the emissions intensity of the supply chain will be suitable for green purchasing effort if there's a way to systematically use that product or group of products more efficiently, so that your government can buy less.

These are just examples, of course. Use the Climate Friendly Toolkit (http://westcoastclimateforum.com/) for ideas and inspiration in your quest to reduce supply chain greenhouse gas emissions. The strategies and approaches that will work best for your institution will of course depend upon hundreds of factors, most of which are specific to the institutions and procedures in place. Performing a supply chain emissions inventory is just one step in the direction of putting together the right plan for your organization.

Make it collaborative.

As you're exploring possibilities and evaluating options to reduce supply chain emissions, you'll need to do some internal investigation into purchasing practices and opportunities to insert "green language" into solicitations and contracts and work with large vendors to green their practices and supply chains (which are, by extension, also your supply chains). Presenting your work to small audiences is an opportunity to ask questions and bounce early ideas off of potential stakeholders.

Hold off on a big presentation.

If you can afford delay, consider waiting to put the supply chain emissions inventory in front of more and bigger audiences until a plan has been made to address some of the supply chain emissions. Your audience will want to know what the project means for them, and people love solutions when they are told about problems.

Focus on co-benefits.

Reducing supply chain greenhouse gas emissions does not sound sexy because it isn't. But the best way to achieve that goal is to buy less, which is easily phrased as "save money," "increase efficiency," or "make public dollars go further." If your objective is to reduce jobsite emissions of construction contractors, go ahead and focus on cleaner air; you can even translate that into healthier children (near a school) fewer cases of asthma, fewer sick days among employees or whatever seems appropriate. Greenhouse gas reductions can be the softly mentioned co-benefit. Just make sure to be clear that you're protecting the climate!

(BOX 4) Operations emissions versus Supply Chain emissions

Keep in mind that comparing direct and indirect emissions from government operations with your supply chain's climate impact is not comparing apples to apples. Institutions have a lot of control over their day-to-day operations, but have less control over the actions of their suppliers or the design, material choice and production of the products they buy. Even if the supply chain carbon footprint dwarfs that of government operations, as it does for most public agencies, it doesn't mean that climate action efforts should be focused entirely on green purchasing. Other factors to consider include: influence over the source of emissions ("owned" versus "shared" emissions); opportunities to change practices; and time, effort, and money investment necessary to achieve emissions reductions.

Glossary

A **greenhouse gas emissions inventory** is the accounting of an institution's climate impact by calculating or estimating emissions from a number of different sources, using internationally agreed upon protocol. An organization's first accounting of greenhouse gas (GHG) emissions provides a baseline to develop a plan and goals for emissions reductions and to evaluate future progress toward climate goals. The focus of this How-To Guide is supply chain emissions, which is only one of many emissions sources typically included in a GHG inventory.

As a first step in conducting a GHG inventory, an institution must define an **organizational boundary** to determine what emissions sources to include in an emissions inventory. Often public institutions like governments use "operational control" to delineate an organizational boundary, which means measuring GHG emissions from all operations over which the institution has direct control. Therefore, governments and other institutions that aim to reduce their emissions often start with an **operations emissions inventory**, which includes multiple emissions sources, categorized by "Scope", under an institution's operational control. Box 1 provides a brief description of the Scope categories and emissions sources included in each.

The **supply chain** is all the resource extraction, material refinement, product manufacturing, other industrial processes, distribution, warehousing and wholesaling, as well as transportation between these steps and processes, involved in creating and delivering commodities purchased by an institution. Simply put, supply chain represents material extraction for all material and energy inputs to the point of retail sale for goods and food. Supply chain also includes the purchase of services (e.g., law, accounting, etc.), which again includes all the material inputs required to bring a service to market (building energy, paper, electronics, travel, etc.).

Supply chain emissions are the GHGs emitted between extracting raw materials from nature and selling finished goods and services to an institution; they represent the climate impact of institutional purchasing. Because operations inventories have historically included emissions associated with purchased electricity, this document (and common practice) uses the term "supply chain emissions" to refer only to shared emissions associated with purchases of goods and services not counted elsewhere. In most cases, this category will comprise all supply chain emissions except combustion of fuels to generate energy consumed by the institution.

A **supply chain greenhouse gas emissions inventory** is an *estimate* of the greenhouse gases emitted in creating and delivering the goods and services purchased by an organization. This type of inventory uses simple, model-based tools to approximate total supply chain emissions and identify high-emitting purchase categories. It can be extended to determine supply chain "hot spots"—the production processes that cause the most emissions. This information can help organizations prioritize their climate friendly purchasing efforts, and inform the strategies they employ to address these impacts.