Report

Greenhouse Gas Emissions Associated with Purchasing of Goods and Services by the City of Eugene, Oregon

Development of an Oregon-specific Estimation Method and Comparison to EIO-LCA.net

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Executive Summary

Many public agencies want to reduce greenhouse gas emissions associated with agency operations. A common first step involves developing a greenhouse gas inventory, which identifies emissions associated with various activities. Until recently, inventories have typically not quantified emissions associated with purchased goods and services. Recent research – including groundbreaking work by the City of Eugene – suggest that these emissions may in fact well exceed emissions associated with municipal use of energy and power, the historic focus of most municipal operations inventories. Methods for estimating purchasing-related emissions for non-energy goods and services are relatively novel, and this paper explores the results of two separate methods for estimating the emissions associated with producing the goods and services purchased by Eugene in 2010: EIO-LCA.net, a widely-used online tool developed by Carnegie Mellon University's Green Design Institute, and CBEI-GPP, a model associated with Oregon's statewide consumption-based greenhouse gas emissions inventory. The two models generate results that are remarkably consistent with regard to all important details. Although this study is limited to purchasing by one municipality in one year, the similarity of results between the two models improves confidence in both approaches and suggests that, despite some potentially significant differences between them, Oregon users can use just one – and either one – with a higher level of confidence.

Acknowledgements

Oregon DEQ wishes to acknowledge Heather Nelson, Babe O'Sullivan, and Matt McRae at the City of Eugene for their participation in this project. The EIO-LCA.net model is produced by Carnegie Mellon University's Green Design Institute. The CBEI model was produced by the Stockholm Environment Institute, U.S Center. A Eugene-based consultancy, Good Company, staffs Operation Climate Collaborative, which supports municipal governments, including Eugene, involving greenhouse gas inventories. David Allaway of the Oregon Department of Environmental Quality developed the government purchasing prices version of CBEI (CBEI-GPP) and served as the primary author of this report.

Introduction and Purpose

Historically, public agencies interested in reducing the "carbon footprint" of their agency operations have focused primarily on emissions associated with energy use in the built environment and agency travel, with some focus on smaller emissions sources such as solid waste. At the same time, there is growing awareness of the greenhouse gas impacts that occur "upstream" of agencies, associated with producing the goods and services (other than electricity and fuels) that public agencies purchase.

In Oregon, Good Company performed one of the first efforts to estimate the magnitude of these emissions for the Oregon University System. In producing a greenhouse gas inventory, Good Company used EIO-LCA.net, a widely available and free tool, to estimate the emissions associated with the production of non-energy goods and services purchased by the state's universities. This effort demonstrated that the emissions associated with the university system's supply chain were almost as large as all scope 1 and 2 emissions combined (scope 1 emissions being those from on-campus sources, such as natural gas use and refrigerant leakage, and scope 2 being combustion emissions at the point of generation for electricity and district steam used by the university system).

Since that time, a number of other public agencies in Oregon (and elsewhere) have conducted similar analyses, typically with similar results. Operation Climate Collaborative has helped numerous public agencies conduct greenhouse gas inventories, typically focusing on government operations. Several members have included supply chain emissions in their inventories. These communities often find results comparable to that of the Oregon University System: upstream emissions associated with purchased goods and services can be very significant. For example, the City of Eugene's 2010 greenhouse gas inventory for internal operations estimates that while the emissions associated with fuel, power and refrigerant use in vehicles and buildings were approximately 18,100 metric tons of carbon dioxide equivalent, the emissions embedded in purchased goods and services (estimated using EIO-LCA.net) were even higher: approximately 26,000 metric tons of CO2e.

Separately, in 2011 the Oregon Department of Environmental Quality published a consumption-based greenhouse gas emissions inventory for all Oregon (not just Oregon state government operations). Unlike conventional greenhouse gas inventories, which at the community-scale have historically tended to focus on emissions that occur from sources inside the community's (state's) geopolitical boundaries, a consumption-based inventory estimates the globally-distributed emissions associated with the act of consumption, defined consistent with the concept of "final demand" used by economists and in national economic accounting. Oregon's consumption-based inventory includes estimates of emissions associated with the full life cycle (production, use, disposal) of goods and services (including but not limited to energy) purchased by Oregon households and governments, as well as one category of purchases by Oregon businesses – those classified as capital investment (as well as net increases in inventory).

Because government purchasing is included in the economic definition of consumption, all emissions associated with purchasing by all public agencies in Oregon are included in

Oregon's consumption-based emissions inventory. These include upstream emissions associated with the purchase of non-energy goods and services by municipalities such as Eugene. However, there are some differences in the methods and emissions factors used by Oregon and Eugene. In addition, Oregon's statewide consumption-based inventory does not call out the emissions of any one public agency or municipality, but rather aggregates all state and local purchasing together. However, the model behind Oregon's consumption-based emissions inventory (called the "CBEI model") can be applied to estimate emissions associated with any unique combination of commodities – including the same purchasing data used by the City of Eugene. This led Oregon DEQ and the City of Eugene to ask the following question: given the same purchasing data for Eugene's municipal operations, do the EIO-LCA.net and Oregon CBEI models generate similar estimates of purchasing-related emissions?

Answering this question is important as more communities (and organizations) express interest in using these types of models to estimate greenhouse gas emissions associated with purchased goods and services. It is important to understand that because both models use economic input-output methods (as opposed to traditional process life cycle analysis), they offer limited granularity, providing detail at the level of individual commodity categories, which can be very broad (for example, "fresh fruits and vegetables"). The models cannot be used to compare the "carbon footprints" of competing products, brands, or production methods within the same commodity (e.g., apples vs. tomatoes, or field crops vs. hothouse crops). However, their primary benefit in the context of institutional purchasing is as a screening tool – to identify which types of goods and services likely contribute the most to greenhouse gas emissions. Knowing this is a valuable first step as it allows governments (and other organizations) to prioritize limited resources and focus on those types of goods and services that contribute the most to emissions and, by extension, may offer larger opportunities for emissions reductions. Similarly, it can help organizations avoid "sweating the small stuff" and spending significant resources working to reduce greenhouse gas emissions associated with products or services which contribute relatively little in total. Because the two models (EIO-LCA.net and Oregon CBEI-GPP) were developed independently of each other, if they generate similar results, then users can have greater confidence in both. If however the models generate results that are significantly different, then users might have lower confidence in one or both models.

Fortunately, this report demonstrates that both models, when applied to Eugene's municipal purchasing data (for calendar year 2010), generate results that are highly consistent when used as a screening tool, for the purpose of identifying those categories of goods and services which contribute the most to the city's purchasing-related carbon footprint.

Organization of this report

Subsequent sections of this report begin with a comparison of the EIO-LCA.net and Oregon CBEI models. One of several important distinctions (explained in greater detail below) is that while Eugene used the EIO-LCA.net model in a "producer prices" mode (also explained below), and the Oregon CBEI model is also a producer price model, the purchasing expenditures used as inputs in both models were expressed in purchaser prices. For this reason, and for the purpose of this analysis, DEQ created a customized model, called here "CBEI-GPP" (for "consumption-based emissions inventory - government purchaser prices.") The report describes the method used to develop CBEI-GPP. Results of both models (EIO-LCA.net and CBEI-GPP) are then presented separately. The final section of this report compares the results of both models as applied to the City of Eugene's municipal purchases for calendar year 2010. Additional technical details are available from Oregon DEQ by contacting this report's author, David Allaway.

Comparison of the EIO-LCA.net and Oregon CBEI models

Both EIO-LCA.net and CBEI are environmental input-output models and use similar methods and algorithms to estimate emissions. They're both designed to estimate the emissions "upstream" of the consumer; that is, the emissions associated with producing a good or service, as well as all of the supply chain (including supply chain transportation) emissions. They're not designed to estimate emissions associated with the direct use of goods (such as emissions from burning gasoline in a car).

As input-output models, both estimate emissions based on users' input of purchases expressed in monetary terms (U.S. dollars). The models begin with the user-input of dollar expenditures for one or more commodities. The models use economic census and other data to estimate how these consumer expenditures flow through various sectors of the economy. For example, a government's $800 purchase of a computer might flow first to the computer manufacturer, and upwards from there to manufacturers of semiconductors, electrical components, plastics and packaging, and from those suppliers to manufacturers of primary materials (e.g., copper), basic chemicals, fuels, and so forth. This generates an estimate of all of the production (in dollars) in all of multiple commodity sectors required to satisfy the act of final consumption. Separately, for each commodity sector, sector-specific emissions factors (emissions per dollar of production) are developed. Emissions factors are typically derived from national-level greenhouse gas inventories. However, since these national inventories rarely disaggregate emissions into each of the hundreds of different commodity sectors used in the economic input-output models, various allocation techniques are used to allocate emissions to each sector. Finally, production activity in each sector (required to satisfy a given level of consumption) is multiplied by the emissions factor for each sector to estimate the emissions resulting from each producing sector. The resulting emissions per producing commodity sector are then added together to generate the estimate of "upstream" emissions required to satisfy the defined quantity and type of consumption. All of these calculations occur "behind the scenes"; users simply enter a consumption value and the model generates results. (EIO-LCA.net requires users to enter one value at a time, while the CBEI model allows users to entire their entire suite of purchasing data across all commodity categories.)

While both models share this much in common, they also have some potentially significant differences:

- EIO-LCA.net is well established and widely-used, including a user-friendly online interface, whereas Oregon's CBEI model is very new and has not yet been made available in a similar manner.
- EIO-LCA.net has undergone some degree of peer review, while the Oregon CBEI model has only been reviewed internally, by its developer (Stockholm Environment Institute) and the Oregon DEQ.

- EIO-LCA.net allows for estimations of multiple "upstream" impacts (such as energy use and releases of select toxic chemicals), while Oregon CBEI is limited to greenhouse gas emissions. (For the purpose of Eugene's climate-related work, this distinction is not important.)
- The two models draw on different economic input-output models. EIO-LCA.net is derived from inter-industry transaction data compiled by the federal Bureau of Economic Analysis, and divides all possible forms of consumption between 428 different commodity sectors (goods and services). Oregon CBEI (in its current form) is derived from the IMPLAN economic modeling system, version 2. This divides all possible forms of consumption into 509 different commodity sectors. Generally speaking, CBEI offers greater speciation than EIO-LCA.net. For example, the commodity sector "fertilizer manufacturing" in EIO-LCA.net is represented by three separate commodity sectors in Oregon CBEI. Occasionally, however, CBEI offers less speciation, where multiple commodity sectors in EIO-LCA.net are aggregated into a single sector in Oregon CBEI.
- The publicly-available and free version of EIO-LCA.net used by the City of Eugene follows an economic and emissions model from calendar year 2002. (A 2007 update is expected soon). The Oregon CBEI model uses calendar year 2005 (a 2010 update is scheduled to be released in early 2013). The analysis using Eugene data was conducted for calendar year 2010, so for both models, 2010 purchasing data was scaled back to 2002/2005 using consistent methods (for most commodities, consumer price index data).
- The free, publicly-available version of EIO-LCA.net is a single-region model that relies exclusively on U.S. economic and emissions data. That is, while recognizing that many supply chains extend well outside of the United States, U.S. input-output tables are used to estimate all inter-industry relationships and U.S. national emissions data are used to estimate all emissions intensities. In contrast, Oregon CBEI is a multi-region model, which divides economic activity and emissions into three different regions: Oregon, the remainder of the U.S. and the rest of the world. In theory, Oregon CBEI should yield more accurate results for this reason (all other things being equal).
- EIO-LCA.net allows the user to run the model in either a "producer price" mode or a "purchaser price" mode. Oregon CBEI, as originally designed, operates purely as a producer price model. Eugene's use of EIO-LCA.net also used the producer price mode. The distinction between the two modes is best illustrated with an example. Consider the purchase of a $1 cookie. In a purchaser price model, this is treated as a single expenditure: a $1 purchase of a cookie. The cookie manufacturer does not receive the full $1, however, due to retail, wholesale, and transportation margins that add to the price of the cookie (the producer's price) as the cookie makes its way from the producer to the customer. A producer price model actually treats the $1 purchase as a series of separate purchases, such as the purchase of a cookie and the purchase of retail services.

Creation of a purchaser price model for CBEI is discussed in the next section. However, before leaving this section, in summary, it's worth noting that three of the other differences above – level of review, differences in economic models and commodity sectors, and single-vs.-multi region modeling – were deemed sufficient to question whether the two models would generate comparable results or not.

Creating a government purchaser price model for Oregon CBEI

This section further explains the motivation behind creating CBEI-GPP (the government purchasing price version of Oregon CBEI) and then summarizes the method for doing so.

Eugene's own analysis, using EIO-LCA.net, was conducted in that model's producer price mode. However, the actual model inputs were purchaser prices. Purchasers, including municipal governments, typically only know purchaser prices; producer prices are often now known to purchasers. Ideally, if purchasing data is only available in purchaser prices, then a purchaser price model should be used.

One can translate from a producer price model to a purchaser price model by taking retail and wholesale margins, and some fraction of transportation activities (to account for freight transit but not movement of people) and reallocating them (and their supply chains) to other producing sectors. This is typically performed at the level of the entire economy. Yet government purchasing is often quite different from economy-wide purchasing, which is dominated by household consumption. Governments often purchase goods directly from wholesalers, bypassing retail channels (and associated transportation) altogether.

For this reason, and anticipating that other governments in Oregon might want to conduct similar analyses, Oregon DEQ developed a customized version of CBEI that operates using "government purchasing prices" – that is, a purchaser price model that reflects the transportation, wholesale and retail margins that are unique to government purchases.

Readers not interested in the method of developing CBEI-GPP may skip to the next section; lack of familiarity with these details in no way alters the ability to understand the modeling results.

The steps involved in this process include the following:

First, state and local expenditures (in 2005 dollars) and associated "three-phase" (upstream) emissions (in kT CO2e) are isolated from the main (producer price) CBEI model, for each of the 509 commodity sectors in that model. These are both expressed in producer prices.

Next, a series of adjustments are made to expenditures and emissions values (for each commodity), as follows:

- State/local government expenditures on wholesale trade (IMPLAN sector 390) are reallocated from wholesale trade to 344 manufacturing (product)-related commodities (IMPLAN sectors 46 - 389), in proportion to the state/local

(Oregon) government expenditures on each of those commodities. The same is done for the associated upstream emissions.

- Next, state/local government expenditures on retail trade (IMPLAN sectors 401 - 412) are reallocated from these commodities to the same 344 manufacturing (product) related commodities as above, again in proportion to the state/local government expenditures on each of those commodities. The same is done for the associated upstream emissions.
- The same is performed for expenditures and emissions associated with IMPLAN sectors 399 (water transportation) and 400 (truck transportation), using the simplifying assumption that all government expenditures on these commodities are associated with the movement of purchased freight.
- 98 percent of state/local government expenditures on rail transportation (IMPLAN sector 392) are allocated to the same 344 manufacturing (product) related commodities using the same method. The 98 percent factor is an estimate of percentage of rail-related expenditures (and emissions) associated with freight (as opposed to movement of people). The 98 percent value is derived from a 2009 U.S. Department of Transportation study of fuel sales (use) by freight vs. passenger rail providers. The same is done for associated upstream emissions. The remaining 2 percent remain associated with the rail transportation sector, as an estimate of state/local government expenditures on passenger rail services.
- A similar approach was used for air transportation expenditures and emissions (IMPLAN sector 391), but a scaling factor of 20 percent (freight) was used instead. No information on the relative emissions of passenger air vs. freight air were easily identified (either for the economy as a whole, or for state/local government purchases), so this report uses 20 percent as a rough estimate. A sensitivity analysis (using both 0 percent and 100 percent re-allocation) was conducted and results did not change significantly.
- State/local government expenditures on pipeline transportation (IMPLAN sector 402) are allocated entirely to IMPLAN sector 31 (natural gas distribution). The same is done for associated upstream emissions.

The preceding steps converted state/local government purchase and emissions data from producer prices to purchaser prices. The resulting emissions were divided by the resulting purchases to generate an estimate of emissions intensities (emissions per dollar) for each commodity sector, specific to Oregon state/local government purchasing, using purchaser prices.

As the original CBEI model used 2005 emissions and statewide purchasing data, but Eugene's analysis was for 2010, emissions intensities were scaled downward using inflation factors (under the simplifying assumption that commodity prices have increased, but other than that, emissions intensities have not changed). Three different inflation factors are used:

- For food-related commodities (IMPLAN sectors 1 - 5, 9 - 13, 16, and 46 - 88) the Consumer Price Index for "All Urban Consumers, Food" was used.
- For construction-related commodities (IMPLAN sectors 33 - 45) the Turner Building Cost Index was used.

- For all other commodities, the Consumer Price Index for "All Urban Consumers, Less Food and Energy" was used.

The resulting emissions intensities (for 2010) were then compared against City of Eugene purchasing data for 2010, allocated into various IMPLAN commodity sectors by the city's staff. Unfortunately, in a few cases, Eugene reported purchases of commodities in 2010 for which IMPLAN estimated no state/local purchasing in 2005. In these cases, state/local emissions intensities (in purchaser prices) were not available (due to the use of economic allocation in converting from producer prices and emissions to purchaser prices and emissions). To fill this need, all of the preceding steps were repeated at the level of all Oregon consumption (household, federal/state/local government and business capital/inventory formation), and economy-wide emissions intensities (expressed in 2010 purchaser prices) were used where state/local government emissions intensities were not available.

Results of the two models: City of Eugene 2010 purchases

Eugene's estimate of upstream emissions associated with the purchase of non-energy goods and services for 2010, using the EIO-LCA.net model, is 27,536 metric tons of carbon dioxide equivalent..DEQ's estimate, using the CBEI-GPP model, is slightly lower: 25,184 metric tons of CO2e.

Full model results using EIO-LCA.net are in Table 1. Full model results using CBEI-GPP are in Table 2.

Table 1.
GHG emissions (upstream) associated with goods and services purchased by City of Eugene, 2010 – EIO-LCA.net Producer Price Model

Sector	MTCO2e	Percent of Total
Sector #230103: Other nonresidential structures	12261.26	45%
Sector #327310: Cement manufacturing	4305.98	16%
Sector #5419A0: All other miscellaneous professional and technical services	1785.12	6%
Sector #332500: Hardware manufacturing	1047.56	4%
Sector #325188: All other basic inorganic chemical manufacturing	969.97	4%
Sector #339940: Office supplies (except paper) manufacturing	881.83	3%
Sector #561700: Services to buildings and dwellings	602.84	2%
Sector #230101: Nonresidential commercial and health care structures	579.33	2%
Sector #336111: Automobile manufacturing	546.63	2%
Sector #7211A0: Hotels and motels, including casino hotels	385.25	1%
Sector #811200: Electronic equipment repair and maintenance	308.93	1%
Sector #334220: Broadcast and wireless communications equipment	305.35	1%
Sector #311990: All other food manufacturing	272.29	1%
Sector #334111: Electronic computer manufacturing	261.72	1%
Sector #230301: Nonresidential maintenance and repair	257.75	1%
Sector #325510: Paint and coating manufacturing	230.44	1%
Sector #8111A0: Automotive repair and maintenance,	211.53	1%

Sector	MTCO2e	Percent of Total
except car washes		
Sector #541100: Legal services	191.17	1%
Sector #51912: Libraries and archives	157.05	1%
Sector #513300: Telecommunications	113.12	0%
Sector #325120: Industrial gas manufacturing	103.88	0%
Sector #315210: Cut and sew apparel contractors	96.28	0%
Sector #541610: Management consulting services	93.47	0%
Sector #541800: Advertising and related services	93.04	0%
Sector #541300: Architectural and engineering services	92.57	0%
Sector #333112: Lawn and garden equipment manufacturing	91.54	0%
Sector #323110: Printing	90.66	0%
Sector #491000: Postal service	87.44	0%
Sector #561300: Employment services	86.61	0%
Sector #524200: Insurance agencies, brokerages, and related related services	84.64	0%
Sector #322291: Sanitary paper product manufacturing	76.15	0%
Sector #322230: Stationery product manufacturing	65.09	0%
Sector #33299C: Other fabricated metal manufacturing	65.07	0%
Sector #333920: Material handling equipment manufacturing	59.42	0%
Sector #511200: Software publishers	58.99	0%
Sector #33291A: Valve and fittings other than plumbing	56.44	0%
Sector #339113: Surgical appliance and supplies manufacturing	52.88	0%
Sector #324191: Petroleum lubricating oil and grease manufacturing	48.87	0%
Sector #532400: Commercial and industrial machinery and equipment rental and leasing	47.44	0%
Sector #3259A0: All other chemical product and preparation manufacturing	44.22	0%
Sector #339950: Sign manufacturing	42.17	0%
Sector #333911: Pump and pumping equipment manufacturing	41.75	0%
Sector #325610: Soap and cleaning compound manufacturing	34.14	0%
Sector #33299A: Ammunition manufacturing	33.51	0%
Sector #336112: Light truck and utility vehicle manufacturing	33.33	0%
Sector #334516: Analytical laboratory instrument manufacturing	29.01	0%
Sector #33999A: All other miscellaneous manufacturing	22.62	0%

Sector	MTCO2e	Percent of Total
Sector #812300: Dry cleaning and laundry services	21.84	0%
Sector #212320: Sand, gravel, clay and refractory mining	16.39	0%
Sector #713940: Fitness and recreational sports centers	14.62	0%
Sector #339111: Laboratory apparatus and furniture manufacturing	12.09	0%
Sector #621A00: Offices of physicians, dentists and other health practitioners	12.03	0%
Sector #337127: Institutional furniture manufacturing	11.15	0%
Sector #561600: Investigation and security services	7.55	0%
Sector #325310: Fertilizer manufacturing	7.29	0%
Sector #334419: Other electronic component manufacturing	5.52	0%
Sector #711500: Independent artists, writers and performers	5.28	0%
Sector #333415: Air conditioning, refrigeration and warm-air heating equipment manufacturing	5.00	0%
Sector #611B00: Other educational services	4.59	0%
Sector #541400: Specialized design services	2.40	0%
Sector #32619A: Other plastics product manufacturing	1.94	0%
Sector #335312: Motor and generator manufacturing	1.65	0%
Sector #511120: Periodical publishers	0.16	0%
Total	**27535.85**	**100%**

Table 2.
GHG emissions (upstream) associated with goods and services purchased by the City of Eugene, 2010 – CBEI-GPP Purchaser Price Model

Sector	MTCO2e	Percent of Total
Maintenance and repair of highways, streets, bridges and tunnels	7,924.59	31%
Cement manufacturing	4,169.19	17%
All other miscellaneous professional and technical services	3,471.43	14%
Hardware manufacturing	1,431.64	6%
Office supplies (except paper) manufacturing	1,074.03	4%
Other basic inorganic chemical manufacturing	655.60	3%
Broadcast and wireless communications equipment	546.00	2%
Automobile and light truck manufacturing	515.98	2%
Electronic computer manufacturing	466.92	2%
Water, sewer and pipeline construction	452.98	2%

Sector	MTCO2e	Percent of Total
Electronic equipment repair and maintenance	363.33	1%
Commercial and institutional buildings	358.03	1%
Services to buildings and dwellings	348.42	1%
Legal services	267.98	1%
Cut and sew apparel manufacturing	215.10	1%
All other food manufacturing	212.99	1%
Maintenance and repair of nonresidential buildings	190.85	1%
Hotels and motels, including casino hotels	173.45	1%
Information services	163.72	1%
Automotive repair and maintenance, except car	157.00	1%
Paint and coating manufacturing	146.08	1%
Management consulting services	144.34	1%
Other new construction	118.71	0%
Insurance agencies, brokerages and related services	108.51	0%
Telecommunications	103.27	0%
Software publishers	92.57	0%
Lawn and garden equipment manufacturing	92.41	0%
Miscellaneous fabricated metal product manufacturing	86.48	0%
Architectural and engineering services	84.90	0%
Metal valve manufacturing	80.64	0%
Employment services	79.51	0%
Advertising and related services	79.25	0%
Postal service	68.61	0%
Surgical appliance and supplies manufacturing	64.18	0%
Industrial truck, trailer and stacker manufacturing	58.94	0%
Sanitary paper product manufacturing	53.55	0%
Stationery and related product manufacturing	50.89	0%
Pump and pumping equipment manufacturing	46.60	0%
Commercial printing	46.55	0%
Analytical laboratory instrument manufacturing	45.67	0%
Machinery and equipment rental and leasing	43.37	0%
Petroleum lubricating oil and grease manufacturing	35.35	0%
Ammunition manufacturing	35.24	0%
Industrial gas manufacturing	33.37	0%
Buttons- pins- and all other miscellaneous manufacturing	30.06	0%
Other miscellaneous chemical product manufacturing	28.99	0%
Sign manufacturing	23.74	0%
Soap and other detergent manufacturing	22.37	0%
Dry cleaning and laundry services	21.56	0%
Institutional furniture manufacturing	13.31	0%
Envelope manufacturing	13.11	0%

Sector	MTCO2e	Percent of Total
Laboratory apparatus and furniture manufacturing	11.09	0%
Offices of physicians, dentists and other health practitioners	9.91	0%
Independent artists, writers and performers	7.98	0%
All other electronic component manufacturing	7.02	0%
Fitness and recreational sports centers	6.80	0%
Investigation and security services	6.46	0%
Sand, gravel, clay and refractory mining	5.56	0%
Air conditioning, refrigeration- and forced air heating	5.20	0%
Other educational services	4.16	0%
Specialized design services	3.23	0%
Nitrogenous fertilizer manufacturing	1.91	0%
Resilient floor covering manufacturing	1.73	0%
Motor and generator manufacturing	1.62	0%
Periodical publishers	0.15	0%
Total	**25,184.16**	**100%**

Discussion

The two separate modeling efforts generated estimates within 10 percent of each other, which is quite good given the uncertainties associated with these types of models.

Even more importantly, both models generated highly consistent results when used as a screening tool to identify highest-impact purchases. Drawing from purchases in more than 60 different commodity categories, the two models show that purchases in only six or seven sectors are responsible for more than 75 percent of supply chain emissions. Better yet, the two models name essentially the same sectors, and almost in the same rank order:

- EIO-LCA.net identifies “other (than buildings) nonresidential structures” as the top contributor (45 percent of the total), while CBEI-GPP identifies “maintenance and repair of highways/streets” as the top contributor (31 percent of the total).[1]
- Both models identify cement manufacturing as the second contributor (16 to 17 percent of purchase-related emissions).
- Both models identify professional and technical services as the third most important contributor (6 to 14 percent of purchase-related emissions).
- Hardware manufacturing comes in fourth in both models (4 to 6 percent of purchase-related emissions).
- “Other basic inorganic chemicals” are ranked fifth (4 percent) by EIO-LCA.net and sixth (3 percent) by CBEI-GPP.

[1] The EIO-LCA and CBEI-GPP models sometimes use different naming conventions to describe the same commodities. In this particular case, staff may have classified the purchases inconsistently between the models, but the result is specific to road/street maintenance and repair.

- Similarly, "office supplies except paper" is ranked fifth (4 percent) by CBEI-GPP and sixth (3 percent) by EIO-LCA.net.
- Rounding out the top 75 percent in CBEI-GPP is the category "broadcast and wireless communications equipment (2 percent), which shows up slightly further down the rank-order list in EIO-LCA.net.

Extending this analysis even further, to the top 90 percent, the two models still generate fairly consistent results, with the following commodities added in both models:

- Automobile and light truck manufacturing
- Non-residential construction (including water/sewer construction)
- Non-residential maintenance and repair
- Services to buildings and dwellings
- Electronic equipment repair and maintenance
- Electronic computer manufacturing
- Food

In addition, only one commodity ("hotels and motels") was identified in the top 90 percent of commodities contributing to purchase-related emissions in the EIO-LCA.net model but not the CBEI-GPP model. And only two commodities ("legal services" and "cut and sew apparel") were identified in the top 90 percent of commodities for CBEI-GPP but not EIO-LCA.net.

This research effort set out to answer the question: *"Given the same purchasing data for Eugene's municipal operations, do the EIO-LCA.net and Oregon CBEI models generate similar estimates of purchasing-related emissions?"* The answer is a resounding "yes," although this should be qualified, as the analysis only compared one set of purchasing data for one community and one year. Regardless, similarity of results between the two models improves confidence in both approaches and suggests that, despite some potentially significant differences between them, users can use just one – and either one – with a higher level of confidence.