Estimating 2013 Consumption-Based Greenhouse Gas Emissions for the City of Eugene – Overview of Methodology

Prepared by David Allaway, Oregon Department of Environmental Quality
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This document summarizes the methods used to estimate the City of Eugene's consumption-based greenhouse gas emissions for 2013.

The estimate of consumption-based emissions is derived from a model that was first developed by Stockholm Environment Institute's US Center, under contract to the Oregon Department of Environmental Quality (DEQ), as part of estimating Oregon's 2005 consumption-based greenhouse gas emissions. This model then underwent a series of revisions as DEQ updated it to calendar year 2010. It was this 2010 Oregon model that was modified in order to estimate Eugene's 2013 consumption-based emissions.

This document only summarizes the revisions that were made to convert the Oregon 2010 model to a City of Eugene 2013 model. The original 2005 model is described in detail in a technical report that can be downloaded at http://www.deq.state.or.us/lq/pubs/docs/ConsumptionBasedGHGEmissionsInventoryORTechnicalReport.pdf. Revisions to the 2005 model (to create the Oregon 2010 model) are described in Appendix B of the report *Oregon's Greenhouse Gas Emissions through 2010: In-Boundary, Consumption-Based and Expanded Transportation Sector Inventories* (Oregon Departments of Environmental Quality, Energy, and Transportation, 2013).

Changes made to convert the Oregon 2010 model to a Eugene 2013 model are as follows:

Final Demand

Final (institutional) demand was provided to DEQ by the City of Eugene from the IMPLAN 2013 dataset (Lane County + Zip Code file). Two adjustments were made to this data:

- First, Zip Code-level final demand data was pro-rated to the City of Eugene based on the percentage of individuals living in each Zip Code located within the City's boundaries. This was done for all six Zip Codes included within the City's municipal borders. Results were summed together for a city-wide total.
- Second, because IMPLAN transitioned from a 440 commodity/sector model in 2010 to a 536 commodity/sector model starting in 2013, demand by commodity was converted from the 536 commodities to 440 commodities using a bridge provided by IMPLAN. This allowed Eugene's 2013 final demand data to align with the underlying 2010 model, without having to reconfigure the entire model and calculate new emissions intensities for all sectors.

DEQ maintained the original model's structure of estimating gross demand for three regions of the world. However, because Eugene was interested in comparing emissions in its in-boundary inventory with those in the consumption-based inventory (to observe areas of overlap and difference), the three regions were changed from Oregon/rest of the US/other countries to Eugene/rest of US/other countries.

This required a number of adjustments and assumptions, since trade flow data was not available within the IMPLAN model at the municipal (or Zip Code) level.

To approximate gross demand satisfied within Eugene's borders, DEQ made the following assumptions and adjustments to the model:

- DEQ estimated what percentage of Eugene's final demand is satisfied by final production in Eugene using industry import ratios drawn from the 2012 Lane County model. These import ratios were adjusted upwards to account for the fact that Eugene businesses likely import more of their component parts from outside Eugene than Lane County businesses import from outside of Lane County (given the larger size and supplier pool to draw from). The 2012 Lane County model was used rather than 2013 because of the need to maintain the 440-category sectoring scheme. In a few cases, the Eugene 2013 model contained final demand for a commodity (in the 440 category sectoring scheme) for which the Lane County 2012 model showed no final demand (and thereby, no local production ratio); in these cases, DEQ used a simple average drawn across all 440 categories.
- Gross demand inside Eugene's borders is the product of two matrices: Eugene's 2013 final demand (expressed in 440 categories) and the Lane County 440x440 type 1 input-output matrix. This is an estimate of how much Lane County businesses draw supplies from other Lane County businesses. The use of a County-wide input-output matrix likely overestimates the amount of in-boundary gross demand for the City of Eugene. In addition, there were many rows and columns in the Lane County 2012 matrix that were blank, but for which the Eugene 2013 data suggested that final demand was being satisfied by in-boundary production. In these cases, DEQ copied inter-industry factors from the Oregon 2010 matrix (which was much more complete), then adjusted them downward to account for the smaller inter-industry ratios within the smaller geographic and business community of Eugene.

These adjustments are very crude and provide only a first-order approximation of gross demand inside Eugene's borders.

DEQ maintained the use of 2010 U.S. inter-industry matrices from IMPLAN (for domestic production outside of the City's boundaries). While this reflects the supply chains of different producing industries for 2010 vs. 2013, the 2010 values are assumed to be a fairly reasonable proxy for 2013.

Greenhouse Gas Coefficients

Because the Eugene model operates using 2013 purchases, greenhouse gas coefficients should also be expressed in 2013 dollars. DEQ did not calculate new greenhouse gas coefficients for 2013, as the data required to do so for Oregon is not currently available. Rather, emissions factors for 2010 were converted to 2013 dollars using the CPI-U.

In addition, a decision was made to estimate Eugene's 2013 GHG emissions using updated global warming potentials contained in the Intergovernmental Panel on Climate Change's AR-5 report. For Oregon (Eugene) and US emission factors, this update involved simply scaling the

emissions (from the Oregon and US 2010 GHG inventories) for non-CO2 gases in proportion to the change in global warming potentials. Because GHG coefficients for imports (both final products and component parts for domestic final production, calculated separately) are derived from the US emissions factors, the inclusion of AR-5 emissions factors in the calculation of US emissions factors is carried over into emissions factors for imports.

Finally, real (inflation-adjusted) emissions factors for all three regions of the world were adjusted based on region-wide changes in emissions intensities. For the US and global emissions factors, these were drawn from comparisons of 2010 to 2013 emissions intensities; for Oregon (where 2013 emissions have not yet been published), 2012 is used as a proxy for 2013. In all three regions, real (inflation-adjusted) emissions intensities (emissions per dollar of economic output) fell from 2010 levels, resulting in a reduction in all emissions factors.

Greenhouse Gas Emissions
No substantive changes were made in this element of the model. For purposes of modeling, (adjusted) Oregon greenhouse gas coefficients are used as a proxy for in-Eugene production.

LCA Processing
No substantive changes were made in this element of the model.

Use
Direct emissions associated with residential and commercial (non-transportation) petroleum and natural gas use were provided by the City of Eugene. Government's share of commercial emissions was derived as a ratio, consistent with the 2010 Oregon model. Indirect emissions were also estimated by Eugene, but for all fuel uses; ratios of indirect-to-direct emissions were taken from Eugene's estimates and applied to consumption-based direct estimates.

Similar adjustments were made to model the emissions associated with use of (non-transportation) electricity.

Emissions estimates provided by the City of Eugene included combustion byproducts, so no separate estimate was made of those emissions.

Emissions associated with vehicle fuel use were estimated using a multi-step process:

- Eugene's estimates of direct emissions from vehicle gasoline and diesel use were pro-rated to the residential and government sectors in proportion to results of a detailed transportation emissions allocation module contained in the 2010 Oregon consumption-based emissions inventory model.
- Estimates of direct emissions from Lane Transit District vehicles were added to the government vehicle use emissions.
- Indirect ("well to pump") emissions for transportation fuels were estimated and allocated using ratios drawn from the City's estimates of all indirect emissions relative to all direct emissions (including emissions not carried over to the consumption-based model, such as inter-city passenger rail and airport vehicles).

Emissions associated with household and government use of vehicle lubricants were estimated by pro-rating Oregon's 2010 emissions estimate based on the ratio of Eugene's 2013 population to the statewide 2013 total population.

Direct emissions associated with residential use of vehicle refrigerants, household refrigerants, and vehicle lubricants were estimated by taking the City's estimates of Eugene's refrigerant-related emissions, and allocating them based on 2010 statewide estimates.

Disposal

For emissions from household and government post-consumer waste sent to disposal facilities, DEQ started with a 2013 disposal estimate (in tons) provided by the City of Eugene. It is assumed that all waste disposal from Eugene goes either to the Short Mountain Landfill or the Coffin Butte Landfill; both are modeled as having lifetime average gas collection efficiencies of 80 percent.

Waste composition data from a Eugene 2010 study was used to estimate the tons of waste by waste type.

Emissions from all waste sent to landfill were allocated to households and governments (and the remainder allocated out of the consumption-based results) using estimates of these sectors' contribution to overall waste disposal. Waste disposal for households was estimated by the City of Eugene. Waste disposal from government sources was derived by multiplying city-wide disposal tonnage by an allocation factor derived previously (for the 2010 statewide model).

Separate calculations estimated the emissions resulting from on-site combustion of wastes in fireplaces and backyards. For the sake of simplicity, DEQ estimated tonnages of on-site combustion of mixed garbage and yard debris using estimates derived previously for the City of Portland, and pro-rating them to Eugene based on populations.

Model Reconciliation

No substantive changes were made to this element of the model.

LCA Demand Modeler

No substantive changes were made to this element of the model.