

West Coast Climate & Materials Management Forum

02 October 2018

Consumption Based Emissions – Part 1: Inventories

West Coast Climate and Materials Management Forum

The West Coast Climate and Materials Management Forum is a collaboration of state, local, and tribal government

- Develop ways to institutionalize sustainable materials management practices.
- Develop tools to help jurisdictions reduce the GHGs associated with materials



Check out the Forum's Resources

- Original Report Connecting Materials/Climate
- <u>Research Summaries</u>
- <u>Turn-key Materials Management Presentation</u>
- <u>Climate Action Toolkit</u>
- Food: Too Good to Waste Toolkit
- <u>Climate Friendly Purchasing Toolkit</u>
- <u>Reducing GHGs Through Composting and Recycling</u>

www.westcoastclimateforum.com



West Coast Climate Forum Webinar Series Disclaimer

This webinar is being provided as part of the West Coast Climate and Materials Management Forum Webinar Series. The Forum is a collaboration of state, local, and tribal governments. We invite guest speakers to share their views on climate change topics to get participants thinking and talking about new strategies for achieving our environmental goals. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Consumption-Based Emissions Inventories attribute all global emissions to the ultimate end user, so that, in addition to transportation and housing, the supply chain emissions that occur throughout the lifecycle of goods, food, and services consumed in a jurisdiction are included. When these upstream emissions are made visible, communities can consider policies to reduce these emissions, such as reuse and repair or low-carbon building materials, or educate their residents about steps they can take to reduce their personal carbon footprint. Climate leaders are increasingly considering consumption-based emissions in addition to production or activity-based emissions that have typically formed the basis of climate action planning.

Tuesday 02 October 2018



Today's Speakers



David Allaway is a Senior Policy Analyst at the Oregon Department of Environmental Quality's Materials Management Program. He leads projects related to sustainable consumption and production, materials (including waste) management, and greenhouse gases. He led efforts to develop and update Oregon's consumption-based greenhouse gas emissions inventory and contributed to the ICLEI US greenhouse gas accounting protocols for communities and recycling.



David Burch is a Principal Environmental Planner in the Climate Protection Section of the Planning Division at the Bay Area Air Quality Management District. Dave worked with researchers at the UC Berkeley Cool Climate Network to develop a consumption-based greenhouse gas emissions inventory for the San Francisco Bay Area which analyzes the variation in the GHG footprint among communities in the region.



rials Management Forum

Today's Speakers



Moderator: Miya Kitahara is a program manager at StopWaste, working on material and energy efficiency. She support Alameda County local government with climate action planning, including helping them incorporate consumption-based emissions.







Subscribe & Q MENU *

Boxes of fruits and veggies sit at the Hunts Point Terminal Produce Market in New York City, the largest distribution center of its kind in the world. New analysis suggests that cities need to do a better job counting the embodied carbon of the products they import.

PHOTOGRAPH BY JOHN TAGGART, BLOOMBERG VIA GETTY IMAGES

Cities Emit 60% More Carbon Than Thought

A new analysis finds that city planners have been undercounting greenhouse gas emissions from a key contributor.

The emissions we **count** may be going down, but are we just sending them elsewhere? The only boundary that counts in climate change is planetary.

Consumption-Based Emissions Inventory For San Francisco

Estimates of the Greenhouse Gases Released to Produce, Transport, Sell, Use, and Dispose of Goods and Services Consumed in San Francisco



King County Greenhouse Gas Emissions Inventory

A 2015 Update

December 2017

Prepared for King County, Washington

Stockholm Environment Institute - U.S. Center for City of San Francisco, California

Technical Report - May 2011



Examples of consumption-based emissions in local climate action: San Francisco, 2011 King County, 2015 Portland, 2015





Cities in Europe, North America and Oceana, and other cities that have high consumption-based GHG emissions, are **recommended to use consumption-based GHG inventories alongside their sector-based GHG inventories**, or incorporate key supply chains into the latter.

This would encourage more holistic GHG emissions assessments; enable decision-makers to consider a wider range of opportunities to reduce global GHG emissions; and provide an additional perspective with which to engage other stakeholders in climate action.

c40.org/researches/consumption-based-emissions

What does it mean for my work?

Materials management sector: Elevates the importance of "reduce/reuse" in the material hierarchy

Climate action sector: Broadens scope of potential local actions to reduce GHG emissions on a global scale





Links for more information:

- oregon.gov/DEQ/mm/Pages/Consumption-based-GHG.aspx
- baaqmd.gov/plans-and-climate/climate-protection
- <u>coolclimate.berkeley.edu/inventory</u>
- stopwaste.org/cbei





Next Up:



Oregon DEQ's Evaluation of Popular Packaging Attributes Wednesday, November 28th 10:00-11:30 (PST)

More to come in the Webinar series in 2019:

January 2019: Consumption-based emissions – Part 2: Actions March 2019: Oregon DEQ's Sustainability Frameworks White Paper April 2019: Food and Environment Product Footprint Research May 2019: Preventing the Wasting of Food



THANK YOU!

Please fill out the survey you receive after the webinar.

For more information, visit <u>www.westcoastclimateforum.com</u>



Oregon's Consumption-Based Greenhouse Gas Emissions Inventory

West Coast Forum on Climate and Materials Management

2 October 2018



David Allaway | Oregon Department of Environmental Quality

Common uses of community-scale greenhouse gas (GHG) inventories

- Establish a baseline and measure progress towards climate change goals
- Identify sources of emissions that the community can influence, identify trends in those emissions, and inform related efforts
 - Inform development of emissions reduction policy and targets
 - Support climate related projects, programs, planning efforts
 - Provide data and tools to community partners (e.g. cities, community groups, businesses, individuals)
- Communicate all of the above to policy-makers and the public





Limitations of conventional "in-boundary" or "sectorbased" inventories

- Provide an incomplete perspective of how communities contribute to emissions . . .
 - ... and by extension, opportunities to reduce emissions
 - Particularly acute for materials!
- Appear to penalize local production, reward outsourcing ("leakage")
- Alone, may lead to bad decisions (that increase global emissions)
- Alone, may provide misleading signals of change over time









Direction to DEQ from Oregon's Environmental Quality Commission (2007)

- Ask sister agencies to acknowledge that the sector-based ("inboundary") inventory is incomplete
- 2. Develop an accounting system that tells a more complete story
- 3. Encourage other governments to do the same





Oregon consumption-based GHG inventories

- CY 2005 (original) (published 2011)
- CY 2010 (full model update)
- CY 2012 (interim "light update")
- CY 2014 (interim "light update")
- CY 2015 (full model update)

Includes revision to CY 2005 and CY 2010 estimates
 Also includes first-order estimate of CY 1990 emissions





Consumption-based emissions inventories

- GHG emissions resulting from *consumption*
 - "Consumption" is defined in economic terms (<u>purchases</u> by "<u>consumers</u>" = households, government, business capital formation)
 - Consumption = a "root driver" of emissions
 - Emissions are life-cycle emissions and globally distributed
 - "Life-cycle" = Supply chain/Production + Use + Disposal
 - Includes, but not limited to, materials
 - Includes all fuels, energy, materials and services "consumed" by the community



Local consumption, global production (and emissions)

Division of labor "Sonicare Elite 7000" production and supply locations

China (Shenzhen), copper coils
 Japan (Tokyo), nickel cadmium cells
 France (Rambouillet), charging components
 China (Zhuhai), etching of circuit boards
 Taiwan (near Taipei), nickel cadmium cells, circuit board components
 Malaysia (Kuala Lumpur), circuit board components
 Philippines (Manila), soldering of circuit board components, tests

- 8 Sweden (Sandviken), 6 production of special steel
- 9 Austria (Klagenfurt), pre-cutting of special steel, plastic parts
- 10 United States (Snoqualmie), assembly of plastic parts

11 United States (Seattle), packaging

DEQ

David Allaway | Oregon Department of Environmental Quality

Der Spiegel, The Global Toothbrush, 01/31/2006

http://www.spiegel.de/international/spiegel/0,1518,398229,00.html 21

Oregon's method: Hybrid life cycle analysis



DEQ

David Allaway | Oregon Department of Environmental Quality

Based on presentation by: Jeffrey Morris, Sound Resource Management H. Scott Matthews, Carnegie Mellon University Michelle Morris, Sound Resource Management²² Frank Ackerman, Tufts University

Economic input-output analysis





David Allaway | Oregon Department of Environmental Quality

Economic input-output life cycle analysis

- Economic input-output analysis estimates financial flows through the supply chain
- Input-output LCA estimates *emissions intensities* (direct emissions/dollar) for different industries
- Upstream emissions = (dollars) x (emissions/dollar)
- Oregon's model uses 440 536 commodities and 3 geographic regions
 ➢Oregon and US economic data (consumption, trade, inter-industry multipliers, imports) from IMPLAN
 - Oregon and US emissions data from in-boundary inventories
 Foreign emissions intensities from CICERO (with adjustments)



Oregon's method: Hybrid life cycle analysis





David Allaway | Oregon Department of Environmental Quality

Based on presentation by: Jeffrey Morris, Sound Resource Management H. Scott Matthews, Carnegie Mellon University Michelle Morris, Sound Resource Management Frank Ackerman, Tufts University Some challenges of the consumption-based inventory

- Complex modeling requirements
- Much of the consumption data is estimated, not actual

➢Oregon demographics (# of households in 9 income strata) x average US/regional per-household consumption baskets for each income strata

- Lack of granularity (536 commodity types)
- Price-quality problem



Oregon 2015 consumption-based GHG emissions, by category of consumption and life cycle stage





David Allaway | Oregon Department of Environmental Quality

Oregon 2015 consumption-based GHG emissions, by consumer type





David Allaway | Oregon Department of Environmental Quality

Average per-household 2015 consumption-based GHG emissions, by income group





David Allaway | Oregon Department of Environmental Quality

■ In Oregon ■ Other US ■ Foreign

2015 Oregon consumption-based GHG emissions, by location of emission





2015 emission intensities

| Final Demand | Average LCA Emissions Intensities (kg CO2e/2015\$) |
|--------------------------------|--|
| Materials | 0.45 |
| Electricity (direct purchases) | 4.37 |
| Fuel (direct purchases) | 6.07 |
| Services | 0.16 |



David Allaway | Oregon Department of Environmental Quality

More 2015 emission intensities

| Categories | LCA Pre-purchase Emissions Intensities (kg CO2e/2015\$) |
|--------------------------|--|
| Transportation services | 1.1 |
| Clothing | 0.8 |
| Food and beverages | 0.7 |
| Appliances | 0.5 |
| Construction | 0.4 |
| Furnishings and supplies | 0.4 |
| Electronics | 0.2 |
| Services | 0.2 |



2005-2015 Oregon consumption-based GHG emissions

■ 2005 ■ 2010 ■ 2015





2005-2015 Oregon consumption-based GHG emissions, by meta-category





Sums of categories may not exactly equal totals due to rounding

David Allaway | Oregon Department of Environmental Quality

2005 – 2015 Oregon consumption-based GHG emissions, by meta-category





Comparison of Oregon's 2015 sector-based and consumption-based GHG emissions




Are emissions trending upward? Or downward?





David Allaway | Oregon Department of Environmental Quality

Oregon sector-based and consumption-based GHG emissions, 1990 - 2016





Drivers of change in Oregon consumption-based GHG emissions, 2005-2015





Summary uses of Oregon's consumption-based inventory

- ID "hot spots" (high emissions, high intensities)
 - ➢Hot spots → potential focus areas (e.g., food, concrete, built environment)
- Communication to consumers

DEQ's on-line carbon footprint calculator (but not from Oregon CBEI)

- Inform design of plans and programs
 - e.g., waste prevention focus on clothing and food (higher emissions intensities)
- Empower and justify "whole life cycle" approaches (→ Sustainable Materials Management, Oregon's 2050 Vision)

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Summary uses of Oregon's consumption-based inventory (continued)

- Oregon Sustainable Consumption Strategy (in process)
- Evaluating specific materials
 - ➢e.g., "nutrition density" of beverages
- Local government CBEIs (derived from Oregon's)
- Government purchasing tool (Scope 3 emissions)



- Materials Management in Oregon: 2050 Vision and Framework for Action
 - Full life-cycle approach
 - Includes but not limited to waste and recovery
 Major program reorientation for DEQ
- Increasing supply and demand of "space efficient housing"
 - ➢Green building standards
 - Support for local policy changes
 - ➤State code (green code)
 - ➢ Foundational research (e.g., appraisals, survey)
 - >Promotion (tours, conferences)







- Preventing the wasting of food
 - Strategy finalized last year
 - Measurement
 - ➤ Messaging
 - ➢Industry engagement
 - ≻Outreach, pilot projects

• Product Environmental Footprinting

Phase One: Foundational research

Phase Two: Concrete EPDs, food research, business case studies

• Low-carbon purchasing

➢Government purchasing toolkit (West Coast Forum)

≻New purchasing initiative



>Attributes research (November 28 Forum webinar)

David Allaway | Oregon Department of Environmental Quality



- Carbon Leadership Forum
- Strategic Plan for Reuse, Repair and Product Lifespan Extension
 - Workforce development
 - >Building material reuse; whole building reuse
 - ➢ Remanufacturing
 - ➤Textiles
- Sustainable Consumption Strategy

Under development







• Grants

- Deconstruction and building material reuse
- ≻Repair cafes
- ≻Hot air dryers in schools
- ➢ Reusable food service ware
- Furniture salvage and reuseWasted food prevention

≻Etc.

• Senate Bill 263: waste prevention and reuse requirements for cities, counties





- "Outcome based recovery rates" or "life cycle assessment of materials in waste generated"
 - Necessitates quantifying energy savings (+GHG reductions) from waste recovery
 Put in context: energy (+GHG) impacts of
 - waste generation
 - ≻Goals:
 - Prioritize recovery efforts
 - Refocus action upstream, where appropriate (e.g., prevention and reuse)





materials management

conserving resources · protecting the environment · living well

david allaway | allaway.david@state.or.us



David Allaway | Oregon Department of Environmental Quality



BAY AREA AIR QUALITY Management DISTRICT

Bay Area Consumption-Based Greenhouse Gas Emissions Inventory

West Coast Climate & Materials Mgmt Forum October 2, 2018

> David Burch Principal Environmental Planner Bay Area Air Quality Mgmt District



Bay Area AQMD

San Francisco Bay Area

- 9 counties, 100 + cities
- ~ 8 million residents

Our Mission

- Improve air quality
- Protect public health
- Protect the climate

What we do

- Monitor air pollution levels
- Regulate emissions from factories & refineries
- Support State & local GHG reduction efforts
- Provide grants & incentives
- Collaborate with partners
- Public education





Why We Developed a CBEI

Why would an air quality regulatory agency develop a CBEI?

- Demonstrate leadership on climate
- Acknowledge responsibility for our full GHG contribution
- Identify emissions not shown in production-based GHG inventory
- Inform our 2017 Clean Air Plan

 identify measures to strengthen our regional climate strategy
- Understand what drives the size & composition of GHG footprint
- Educate Bay Area cities and their residents about actions they can take to reduce consumption-based emissions



Bay Area CBEI

Methodology developed by UC Berkeley *Cool Climate Network*

- Year 2013 emissions of the "Kyoto 6" greenhouse gases
- Full life cycle analysis using best available data for Bay Area
- Attributes all emissions to the final consumer
 regardless of location where emissions actually occurred
- Business sector is treated as an intermediary, not a final user
- Does <u>not</u> include emissions from government activities
- Highly granular: estimates avg GHG footprint for each of 4,700 Census block groups in Bay Area (~ 500-600 households)
- Provides a CBEI for each Bay Area city and county



Bay Area GHG Inventories by Major Category



Consumption-based inventory ~ 34% larger

US Average Household GHG Footprint



SF Bay Area Average Household GHG Footprint



GHG Emissions from Food Sector

- Food is GHG-intensive
 - accounts for ~ 10% of total expenditures
 - but 19% of Bay Area GHG emissions







BAY AREA Air Quality Management

DISTRICT

GHG Intensity per Kilo of Food



Clune et al. Journal of Cleaner Production. 2016



Reducing GHG Emissions from Food

Food Production

- Reduce waste
- Improve efficiency
- New technologies
- "Carbon farming"



Food Consumption

- Plant-based diet
- Less processed food
- Reduce waste
- Eat with the season
- Buy local



Tactful messaging on diet is key



Key Factors in GHG Footprint

GHG footprint varies in size & composition

Cool Climate Network model includes 30+ factors

But 6 factors account for 93% of variation in GHG footprint

- household size (# people)
- household income
- size of home (square footage of dwelling unit)
- population density of neighborhood
- carbon intensity of electricity
- vehicle ownership rate

GHG Emissions and Household Income

- Household income has strong influence on both size & composition of GHG footprint
- Especially in relation to transportation, goods, services - income & air travel are highly correlated
- Lower income households spend larger portion of income on basic food & shelter
- As income increases, people spend more on discretionary goods & services
- Quality vs quantity





Local Variation in GHG Footprint

- Large variation in <u>size</u> and <u>composition</u> of GHG footprint
- GHG footprint is generally lower in urban core areas - smaller homes, lower vehicle ownership rate, better transit
- Variation between Census block groups: ratio of 7 to 1
- Variation within (large cities): ratio of 4 or 5 to 1
- Variation between cities: ratio of 3 to 1
- Should we consider this variation in crafting emissions reduction efforts?



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Click on the map data. Use the ssions within the od, goods and p box showing a h block group.

Block Group Detail

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Emissions by Key Sector

111

The pie chart below shows a breakdown of the key sectors contributing to the total CO2e emissions. Hover over the pie chart for additional information.

X

►

GHG Emissions from Transportation by Block Group







Opportunities

Reduce GHG emissions from both production & consumption sides

Embrace circular economy

- Improve efficiency
- Promote re-use
- Reduce waste

Use market signals

- Carbon tax
- Labeling of GHG emissions (disclosure & transparency)

Consumer education

- Promote low-carbon diet: Plant-based foods / less processed food
- Avoid high-GHG goods; consume low-GHG services



Procurement Policies

Establish embodied GHG emission standards for key products

California's "Buy Clean Act" (AB 262, 2017):

- Requires State to establish "global warming potential standards by 1/1/2019: steel, glass
- Contractors for State-funded projects must submit an Environment Product Declaration to demonstrate compliance



How Bay Area AQMD is Using CBEI

- Included a section on "conscientious consumption" as part of long-range vision in our 2017 Clean Air Plan
- Encouraging climate planners in Bay Area cities to consider local variation in emissions footprint
- Working to educate Bay Area residents about most effective ways to reduce their GHG footprint
- Reducing emissions from food:
 - Building partnerships w food service providers
 - Climate-Friendly Cuisine conference on Sept 11
 - Webinar for local climate planners on Oct 22



Key Insights

- Consumption-based emissions exceed production-based emissions in developed economies
- Need to consider this "carbon loophole" or "leakage"
- Large variation in size & composition within Bay Area cities
- Food is major GHG source should not be ignored
- Government agencies cannot do it alone
- CBEI provides valuable info for public education

For Additional Information

www.baaqmd.gov/plans-and-climate/climate-protection

http://coolclimate.berkeley.edu/inventory

- Final Report for Bay Area CBEI
- Tables & graphs showing data for each city and county
- Interactive maps re: GHG footprint by Census block group
- Dave Burch: Dburch@BAAQMD.gov
- Dr. Chris Jones: <u>cmjones@berkeley.edu</u>
- The Carbon Loophole (Aug 2018) https://buyclean.org/media/2016/12/The-Carbon-Loophole-in-Climate-Policy-Final.pdf



Basic Approach



Estimate GHG footprint of average household:

- Transportation, Housing, Food, Goods, Services

Highly granular: each of 4,700 Census block groups in Bay Area

- **Step 1:** Develop a consumption profile for each Census block group
- **Step 2:** Multiply consumption inputs x life-cycle emissions factors
- **Step 3:** Add emissions for each product or service to calculate total GHG footprint





Data Sources

- Household demographics: household size, income, etc.
 US Census, American Community Survey & other sources
- Transportation: vehicle travel, air travel, etc.
 National Household Travel Survey
- Housing: home size, energy & water consumption, recycling rate electric, natural gas & water use data from utilities
- Food: Diet info from USDA & BLS Consumer Expenditures Survey
- Goods & Services:
 - Bureau of Labor Statistics Consumer Expenditures Survey
 - Input-Output Life Cycle Assessment Model

Life Cycle Emissions for Automobile

Upstream In-Use Downstream **Individual Parts Fuel Consumption** Landfill Production, including • Fuel economy upstream emissions for •Fuel type each part Driving conditions **Recycling / re-use** (credit) Vehicle Assembly Upstream emissions from refining gasoline **Shipping to Dealer** Vehicle Maintenance