Embodied Carbon in the Built Environment: Change Through Policy
February 16, 2018
Webinar Series Disclaimer

This session is provided as part of the Embodied Carbon Network 2018 Webinar Series. The Network is a collaboration of building sector practitioners, researchers, advocates, and government professionals. We invite guest speakers to share their knowledge and insight on carbon emission topics to get participants thinking and talking about new strategies to achieve climate change goals. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. Please note the opinions, ideas, or data presented by speakers in this series do not represent Embodied Carbon Network members policy or constitute endorsement by the Network.
Series Overview

Knowledge/strategies for reducing carbon emissions caused by building materials

Eight online sessions throughout 2018
Subject matter experts From ECN Taskforces
AIA Continuing Education Credits
Embodied Carbon Network

- Resource sharing, discussion, quick action
- Launched in 2017
- Initiative of the UW Carbon Leadership Forum
- Nine subject-specific Taskforces
Embodied Carbon Network

- 215 members from 76 global cities and 22 US states
- Professionals from manufacturing, construction, engineering, architecture & sustainability consulting firms, government agencies, academic institutions, & nonprofits
Webinar Overview

Today We Will Explore:

1. The role of local policy to mitigate climate change
   Amy Hattan
   Thornton Tomasetti

2. Current embodied carbon policies and opportunities
   Jordan Palmeri
   Oregon DEQ

3. The embodied carbon of tall buildings
   Ann Edminster
   Design AVEsues LLC

   Tina Dilegge
   Carbon Leadership Forum
Taskforce Goals

- Exchange resources and ideas
- Learn about, follow, and advocate for embodied carbon policies
- Educate policy makers: create fact sheet and framework
- Sharing lessons learned from Buy Clean Act
- Push LEED v.4 further
Forestry Innovation Investment’s International Policy Review: *Embodied Carbon of Buildings and Infrastructure*

- Buy Clean California, Buy Clean Washington
- Presentations by members: Greenbuild & West Coast Climate Forum
- New! LEEDing on Climate Change appeal to the USGBC
Indicators of Early Action by Local Governments to Mitigate Climate Change

Lessons from Theory and Practice

Harvard Belfer Center Discussion Paper 2008
A “Predictable Surprise”

Bazerman and Watkins (2004): Why do institutions fail to respond?

• A “Predictable Surprise”
  1. Decision makers are aware of the approaching problem
  2. They know that action is required to stop it from getting worse

• Why do they fail to respond in a timely manner while the problem gets worse?
  1. Response involves high short-term costs but long-term benefits
  2. Meanwhile, economic systems are operating effectively
  3. And powerful minorities benefit from the status quo
“What motivates municipalities to undertake mitigation efforts in the first place...has implications for the development of climate policy at multiple levels of scale.”

- Kousky and Schneider (2003)
Why do local governments take climate action?

• Decision makers perceive co-benefits from emissions reductions AND

• An entrepreneurial issue champion takes advantage of an open window for policy change
Why do local governments take climate action?

- A shock such as a natural disaster makes the impacts of climate change more salient to local decision-makers.
Why do local governments take climate action?

• Decision makers perceive co-benefits from emissions reductions AND

• An entrepreneurial issue champion takes advantage of an open window for policy change

• A shock such as a natural disaster makes the impacts of climate change more salient to local decision-makers

• Political support for environmental policies exists among constituents
Policy-oriented learning – the introduction of new scientific or technical information – does not indicate early policy action.

- Sabatier and Wieble (2007); Michele Betsill (2000)
Recommendations

1. Help decision makers to see where there are co-benefits from policies to reduce emissions

2. Frame actions to mitigate climate change in terminology that city leaders recognize as within their field of shorter term responsibility

3. Familiar, time-tested solutions may have more resonance with leaders than new solutions

4. Focus less on building awareness with the public; focus more on identifying potential policy entrepreneurs within the government who can be change agents
Embodied Carbon Policies and Opportunities

Embodied Carbon Network Webinar
February 15th, 2018

Jordan Palmeri
Materials Management Program
Overview

1. Existing Policies

2. Policy Opportunities
ENVIRONMENTAL PRODUCT DECLARATIONS (EPD) USED IN POLICY
Environmental Product Declarations (EPDs)

1. Concrete
2. Gypsum wallboard
3. Wood Products
4. Roofing
5. Steel products
6. Aluminum
7. Flooring
8. Insulation
9. Stone
10. Sanitary ceramics
11. Sealants
12. Building Hardware
13. Cladding systems
14. Doors
15. Etc......
Government Procurement

California AB 262

Buy Clean California - Spend taxpayer dollars consistent with California's climate change goals

Washington HB 2412
House Bill 3161

Sponsored by Representative RAYFIELD

SUMMARY

The following summary is not prepared by the sponsors of the measure and is not a part of the body thereof subject to consideration by the Legislative Assembly. It is an editor’s brief statement of the essential features of the measure as introduced.

Requires Department of Transportation to establish pilot program to assess how products that department or contractor for department procures affect emissions of carbon dioxide. Provides that pilot program must require prospective contractors to declare environmental product cost of certain products that department or contractor intends to bid for public improvement contract. Requires department to determine lowest responsible bidder after adding environmental product cost to product. Provides that local contracting agency may adopt practices of department. Requires all state contracting agencies to adopt practices of department beginning January 1, 2021. Requires Department of Environmental Quality to adopt and keep updated rules for calculating environmental product cost of certain products. Becomes operative January 1, 2018. Declares emergency, effective on passage.

A BILL FOR AN ACT

Relating to public contracting preferences in procuring certain materials; and declaring an emergency.

Be It Enacted by the People of the State of Oregon:

SECTION 1. (1) As used in this section:
(a) “Environmental product cost” means the cost, denominated in dollars, of a product’s life cycle environmental impact, calculated in accordance with rules the Department of Environmental Quality adopts under subsection (5) of this section.
(b) “Environmental product declaration” means a product-specific measurement of the life cycle environmental impact of a product, from the point of raw material extraction to the point of manufacture, that is certified by a third party and in accordance with international standards.

(2) The Department of Transportation shall establish a pilot program for assessing how products that the department or a contractor for the department procures in connection with a public improvement contract affect levels of carbon dioxide in the atmosphere. The pilot program must:
(a) Require a prospective contractor to respond to an invitation to bid for a public improvement contract with a disclosure of the environmental product cost of all concrete the prospective contractor expects to manufacture or purchase in the course of constructing, reconstructing or renovating the public improvement.
(b) Require the department to determine the lowest responsible bidder for a public improvement contract after adding the environmental product cost of concrete to each prospective contractor’s bid, if the public improvement will use concrete.

House Bill 3162

Sponsored by Representative RAYFIELD

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A BILL FOR AN ACT

Relating to procurements of certain materials at lowest carbon dioxide cost; and declaring an emergency.

Be It Enacted by the People of the State of Oregon:

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(a) “Environmental product cost” means the cost, denominated in dollars, of a product’s life cycle environmental impact, calculated in accordance with rules the Department of Environmental Quality adopts under subsection (5) of this section.
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Oregon Concrete EPD Program

http://www.ocapa.net/oregon-concrete-epds
Challenges - EPDs for purchasing

- Transport to site (A4)
- Costs to small businesses
- Data uncertainty - meaningful thresholds?
- Supply chain dominates – not manufacturing
- Foreign products w/o EPDs or conducted to different PCR
- How will EPDs be used?
LEED v4 as policy
1063 Block replacement, Olympia, WA
Multnomah County Courthouse, Portland, OR
MATERIAL REUSE
City of Portland Deconstruction Requirements

https://www.portlandoregon.gov/bps/68520
Oregon Building Code – reuse of structural lumber approved
WHOLE BUILDING POLICIES
Oregon Executive Order 17-20

- Signed in November 2017

- Titled – *Accelerating Efficiency in Oregon’s Built Environment to Reduce Greenhouse Gas Emissions and Address Climate Change*

- By 2022 and beyond establish carbon neutral operations of state buildings that does consider the embodied carbon of the building materials
Minneapolis – Buildings, Benchmarks and Beyond!

- Went into effect in July 2017
- Requires whole building LCA for state funded new buildings and major renovations
- 3 paths to compliance: whole building; assembly; material substitution

http://www.b3mn.org/guidelines/3-0/m_1/
May 1, 2017 update to policy for rezonings

• Requires reporting of embodied emissions for all rezoned buildings
• Requires LCA process consistent with LEED v.4
• LCA must include all envelope and structural elements, footings and foundations, complete structural wall assemblies, structural floors and ceilings, roof assemblies, and stair construction
• Equivalent annual embodied emissions values must be reported alongside operational emissions in kgCO2e/m2/year
• Data collected by city to understand scale of embodied emissions

Netherlands

• New residential and office buildings greater than 100 m² seeking permit must submit estimate of embodied GHG emissions
• As of 2018, a building’s total environmental profile will have an upper limit
• National EPD database
• Standardized method for whole building LCA and several tools available

Germany

• Whole building LCA required for new federal buildings. Buildings compared to benchmarks and points awarded accordingly
• Private sector green building program with a benchmark approach too
• National LCA/EPD database
• Free whole building LCA tool

France

- Manufacturer making environmental claim about construction product must submit an EPD to national EPD database (January 2014)
- National EPD database
- Offers building labels and incentives for voluntarily meeting both embodied carbon and net-zero energy consumption targets – mandatory in 2020

[Link](https://www.naturallywood.com/resources/embodied-carbon-buildings-and-infrastructure)
POLICY OPPORTUNITIES
Climate Action Plans
Public Institution GHGs

GHG Emissions from Public Institutions

PURCHASING 55%  OPERATIONS 45%

https://westcoastclimateforum.com/cfpt
Construction and Maintenance – large contribution

https://westcoastclimateforum.com/sites/westcoastclimateforum/files/related_documents/TA%20Final.pdf#page=4
Embodied complements operational carbon

Commercial energy reporting

Residential Energy/Carbon Score

CITY OF PORTLAND
ENERGY REPORTING
HOW-TO GUIDE
JANUARY 2017

UNDERSTANDING THE REPORTING REQUIREMENTS OF THE ENERGY PERFORMANCE POLICY FOR COMMERCIAL BUILDINGS

www.portlandoregon.gov/bps/energyreporting

Residential Energy/Carbon Score

This home's Energy Score: 3 out of 10
This home's estimated energy costs: $1,233 per year

Home Profile
Address: 123 Main St
City: Portland, OR 97201
Energy Score: 3

Assessment
Assessment Date: 12/23/2016
Exterior Date: 12/22/2016
Assessor Name: Maria Gomez
Gomez Energy Partners
Phone: 503-353-1211
Email: maria@gomezenergy.com
CCE License #: 1254567890

Energy Score Options
A 1 2 3 4 5 6 7 8 9 10

How much energy is this home likely to use?
Electric: 10,000 kWh/year (5600)
Natural Gas: 700 Therms/year (5633)
Other: Gas, Fire, Security, etc. (50)
Total energy costs per year: $1,233

This home's carbon footprint:

35

Extended energy year budget for under $1,000 for gas, electricity, and water energy

1.6

The tree

0

No credit

Energy savings and carbon reductions are dependent on user effort and water usage.

- Reduced energy use was calculated based on a home's building plan and energy-efficiency standards.
- Carbon footprint is based on energy consumption and water usage.
- Carbon emissions were calculated based on a home's building plan and energy-efficiency standards.
- This home's Oregon's Energy Performance Score standard compliant with Portland City Code Chapter 155.
MEASURE TO SHOW THAT MATERIALS MATTER
Oregon's consumption-based GHG emissions by economic category

- **Services**
- **Materials**
- **Fuels**
- **Electricity**

Percent of 2014 greenhouse gas emissions
2015 Oregon GHGs emissions by category + lifecycle stage

- Water and wastewater: 8%
- Wholesale: 5%
- Clothing: 2%
- Lighting and fixtures: 5%
- Other: 1%
- Furnishings and supplies: 3%
- Retailers: 4%
- Electronics: 4%
- Transportation services: 5%
- Other manufactured goods: 5%
- Healthcare: 7%
- Construction: 8%
- Services: 8%
- Appliances: 12%
- Food and beverages: 13%
- Vehicles and parts: 20%
- Wholesale: 1%
- Clothing: 1%
- Water and wastewater: 1%
- Other: 2%
- Vehicles and parts: 20%

Total: 88.7 MMT CO2e

* "Pre-purchase" are all emissions that occur prior to final purchase, including production, supply chain, transport, retail and wholesale. "Use" refers to emissions resulting from the use of vehicles, appliances, electronics and lighting. Other categories (e.g., food and clothing) have use phase emissions that are accounted for elsewhere. For example, emissions from cooking and laundering are both assigned to the category of "appliances", which include ranges and clothes dryers.
Building Code – internal conversions to multi-unit

This four-plex still looks like a single-unit home from the street. (Photo courtesy of Michael Anderson, Bike Portland.)
Building Reuse + Historic Preservation

The Total Carbon Study
Case Study of DPR Construction
San Francisco Office Building – Net Positive Existing Building Reuse
A Focus on Manufacturing Stage
Embodied Carbon via Tally – LCA Revit Plug In

November 13, 2015

Prepared by
Ecological Building Network
11 Mark Dr #4
San Rafael, CA 94903

Integral Group
427 13th Street
Oakland, CA 94612

Siegel & Strain Architects
1295 59th St
Emeryville, CA 94608

The Greenest Building:
Quantifying the Environmental Value of Building Reuse

Zoning Code

City of Portland Residential Infill Project: https://www.portlandoregon.gov/bps/article/657675
Thank You!

Jordan Palmeri
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CAN BUILDINGS BE TOO TALL?

Is THIS really helping from a CO$_{2\text{e}}$ perspective?
CAN BUILDINGS BE TOO TALL?

HYPOTHESIS: **YES.** The embodied carbon of tall buildings may not be offset by other carbon benefits.
CAN BUILDINGS BE TOO TALL?

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**IMPACTS WE NEED TO EVALUATE:**
- Transportation
- Operating energy
- Resiliency
- Livability
FOR STARTERS: embodied carbon vs. height

Least material/sq.ft. and most feasible for wood (low EE) structures
“WE NEED DENSITY BECAUSE TO SUPPORT GOOD MASS TRANSIT, AND WE NEED MASS TRANSIT TO REDUCE VEHICLE MILES TRAVELED ...” but ...

- What about where we already have good mass transit? (SF has 2\textsuperscript{nd} best job access to transit riders in the US)
- Does adding density reduce congestion?
- Will more mass transit ever catch up?
- Meanwhile, vehicle emissions grow as buildings go up and bring in more residents and workers
New energy-efficient, medium-density housing with photovoltaics can achieve energy use intensities as low as or lower than high-density housing when transportation is factored in.

From *The relationship between net energy use and the urban density of solar buildings*, O’Brien, et al., 2010
Among prototypes ranging from detached, single-family suburban homes to a single 215-story building, the 4-story courtyard building was the most energy-efficient and had the lowest life-cycle carbon intensity.

From *The Environmental Impact of Tall vs Small: A Comparative Study*, Drew et al., 2015
Where would you rather be in a power outage?
LIVABILITY IMPACTS

Where is the street life better?

sun, wind, shade, scale
Cities have climate action plans;
Their climate action plans are motivating them to look at the building sector;
Development economics favor taller buildings in urban centers;
Combating those economic forces will require policy action;
Getting public officials to change policy on height will require persuasive research.

WE HAVE LOTS OF QUESTIONS TO ANSWER!
Let’s get some research done!

Thank you!
What Can We Do?
The Story of Buy Clean Washington
“State agencies should take climate change into account ... and employ full environmental life-cycle accounting to evaluate and compare infrastructure investments and alternatives” – HB 2412

“ Significant quantities of emissions are released during the manufacture and transport of products used in public infrastructure projects.”
The Feedback Loop

Support for bill goal but not necessarily support for its original draft language

Concern about eligible materials – what to include, how to categorize, market readiness

Research needed to assess bill’s environmental impact and feasibility of implementation

Pilot projects and phased implementation encouraged
What Next?

• There is appetite for embodied carbon policies

• Analysis of policies and options needed

• ECN an effective platform to share emerging policy news, communicate. How to grow this role?

• Resources needed to better position ourselves to inform evidence-based decision making
• Stick around for Q & A

• Next webinar: Renewable Materials | March 16 – Register today @ https://attendee.gotowebinar.com/register/1424284661671244803

• Learn more about the Embodied Carbon Network at www.embodiedcarbонnetwork.org

• Join one or more ECN Taskforces

• To receive AIA continuing education credit send your AIA member number to info@embodiedcarbонnetwork.org
Thank you!

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