

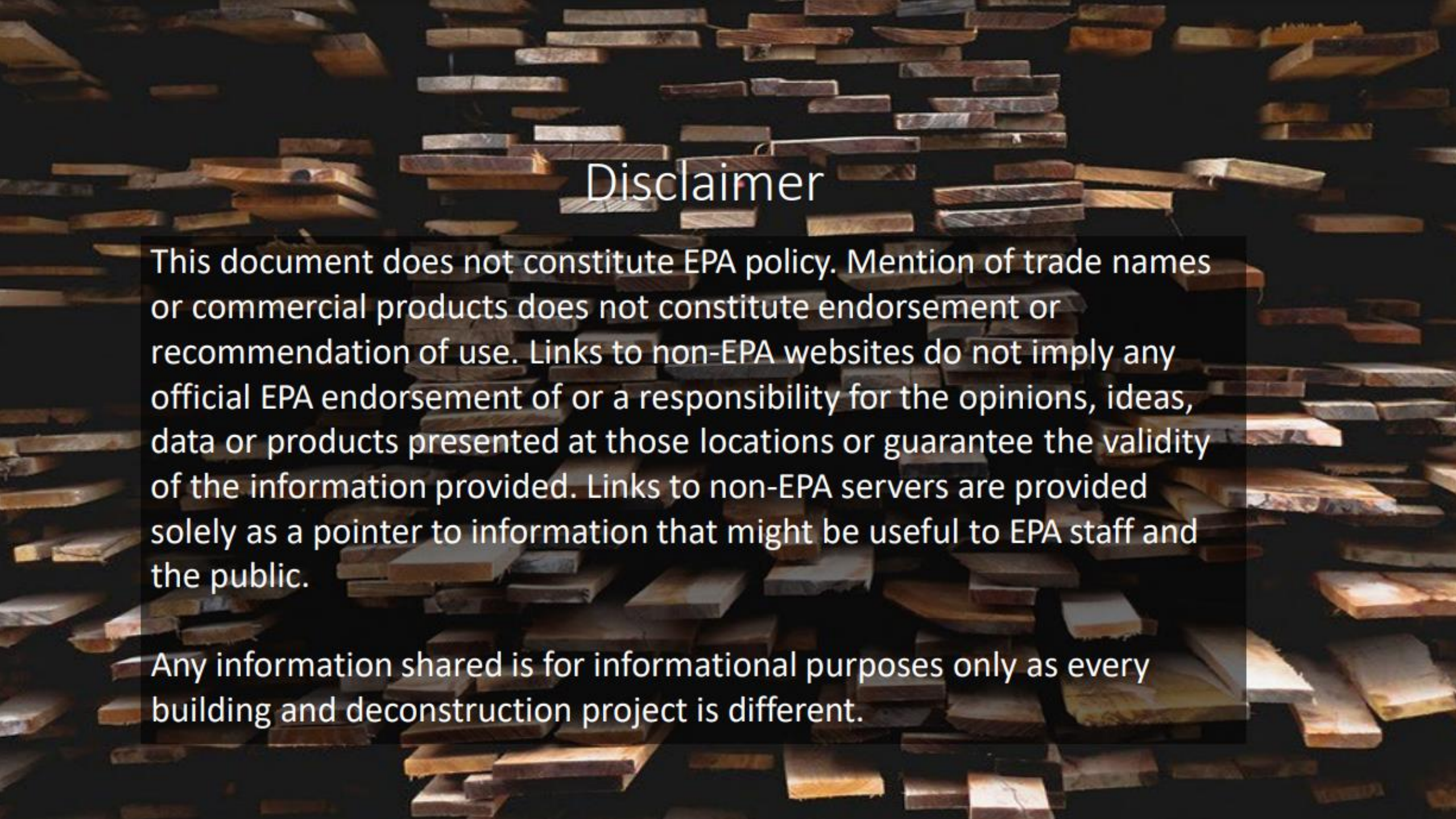


Embodied Carbon:

The next BIG sustainability opportunity

Reduce and Reuse:
Deconstruction Workgroup
September 28, 2022

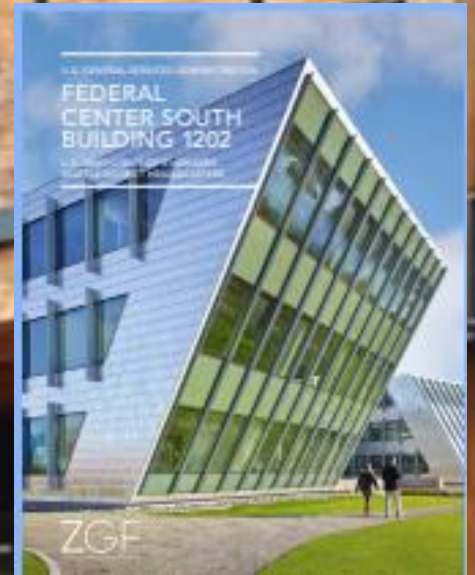
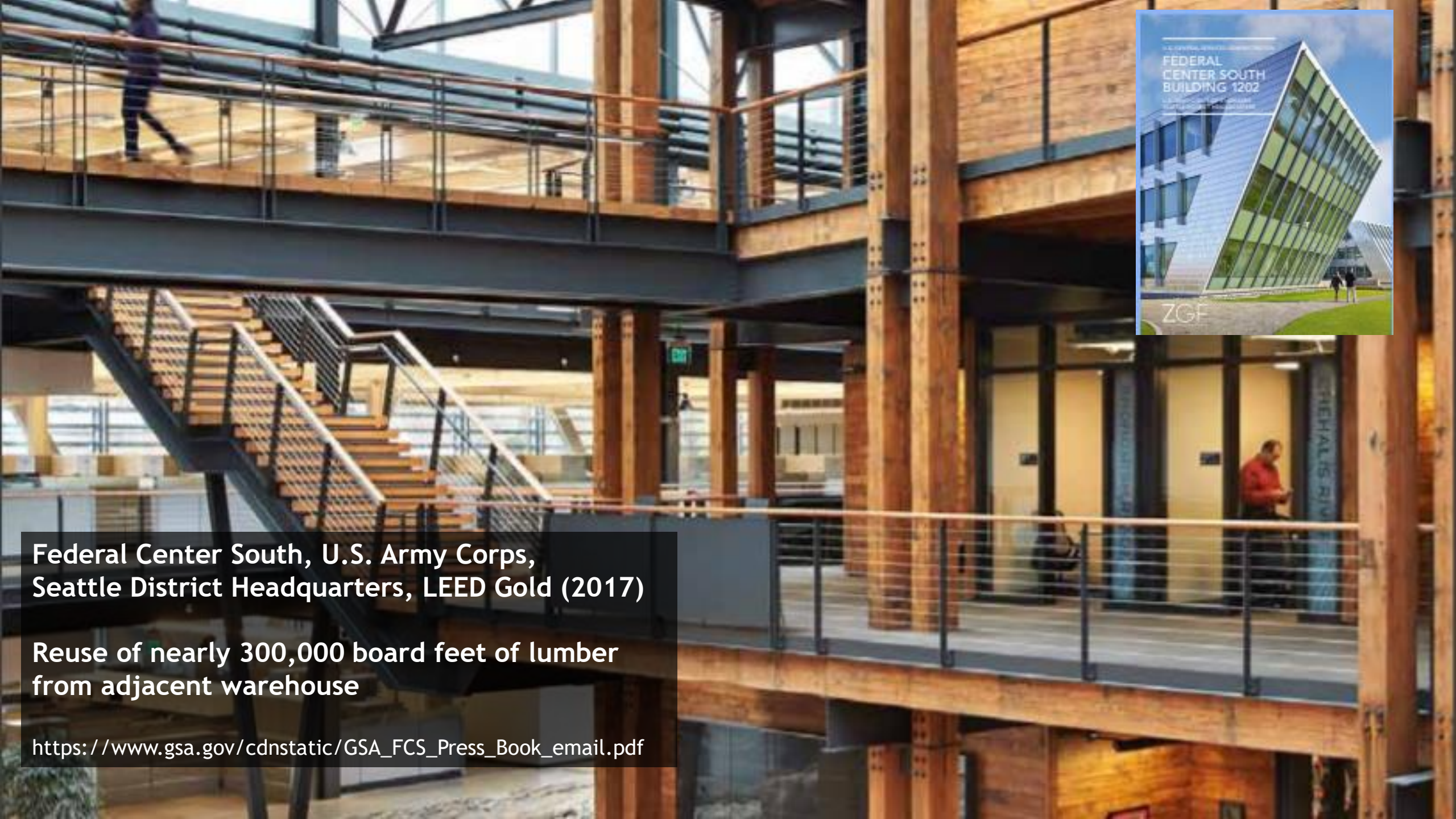
Timonie Hood, LEED AP
Zero Waste & Green Building Coordinator
U.S. EPA Region 9

The background of the slide is a close-up, artistic photograph of numerous wooden planks or boards stacked haphazardly. The planks are of various lengths and widths, with some showing natural wood grain and others appearing more weathered or stained. They are arranged in a way that creates a textured, three-dimensional effect, with some planks protruding more than others. The lighting is somewhat dramatic, with highlights on the edges of the wood and shadows in the gaps between them.

Disclaimer

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Any information shared is for informational purposes only as every building and deconstruction project is different.



**Federal Center South, U.S. Army Corps,
Seattle District Headquarters, LEED Gold (2017)**

**Reuse of nearly 300,000 board feet of lumber
from adjacent warehouse**

https://www.gsa.gov/cdnstatic/GSA_FCS_Press_Book_email.pdf



New HUD Section 8 Home Built from Reclaimed Lumber

- Florida floodplain buyout - undamaged 1970's home
- Efficient, mechanized deconstruction
- **Current building code allows reuse** -- alternative materials and methods
- OR & WA codes explicitly allow use of undamaged reclaimed lumber for structural purposes

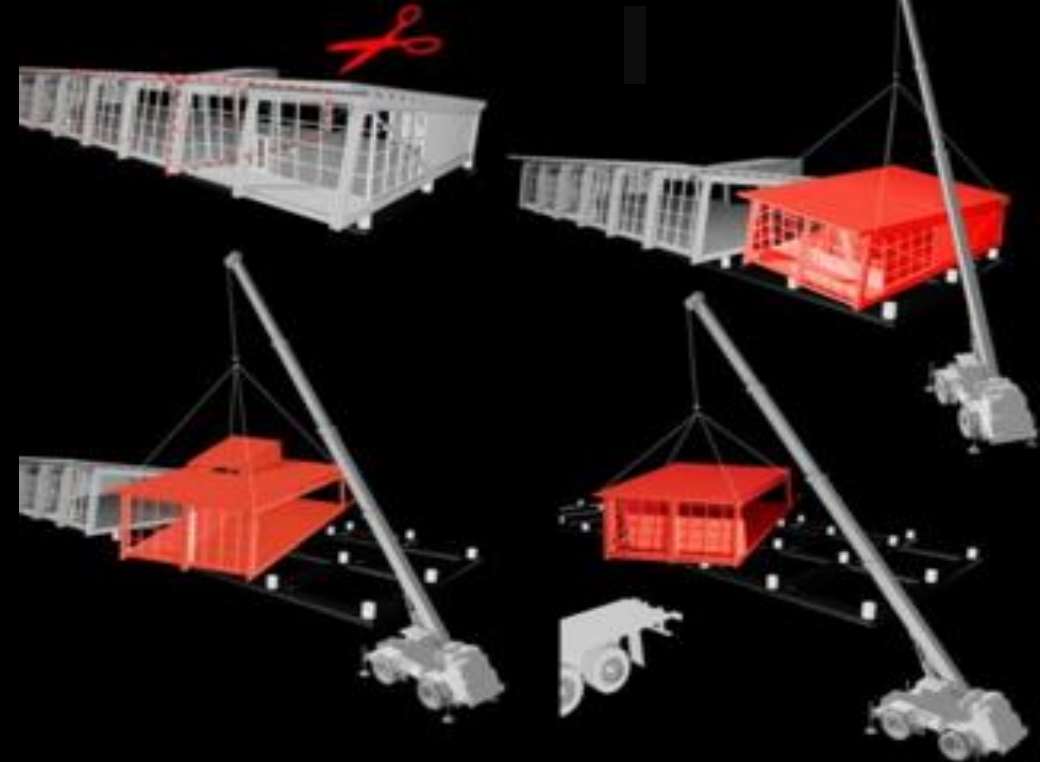
Lifecycle Building Challenge

EPA / American Institute of Architects / Building Materials Reuse Association online competition (2007-2009)

Designing buildings for adaptation/deconstruction, reuse, and low embodied carbon



<http://www.lifecyclebuilding.org>



A construction worker wearing a green safety vest with orange reflective stripes, an orange shirt, and a green cap is working on a wooden structure. He is holding a yellow power tool and looking upwards. The background shows wooden planks and a green geometric pattern on the right side of the slide.

Mandatory Deconstruction

- ▶ **Portland, OR** - Requires residential projects to be deconstructed (2016, expanded 2019)
 - ▶ Average wood recovery 5 tons/home
- ▶ **Palo Alto, CA** - Mandatory commercial & residential deconstruction (2020)
- ▶ **San Antonio, TX** - Phased-in residential ordinance focused on historic preservation (2022)
- ▶ **Cities across the nation adding deconstruction policy to Climate Action and Zero Waste Plans**

Portland: <https://www.portland.gov/bps/climate-action/decon>

Palo Alto: <https://www.cityofpaloalto.org/Departments/Public-Works/Zero-Waste/Zero-Waste-Requirements-Guidelines/Deconstruction-Construction-Materials-Management>

San Antonio: <https://sareuse.com>

New Lumberjacks

Growth Rings...

Map Developed by Shawn Wood,
City of Portland



Atlanta, GA
Baltimore, MD
Boise, ID
Chicago/Cook County
Connecticut (State of)
Denver, CO
Hennepin Co, MN
Ithaca/Cornell, NY
Milwaukee, WI
Nantucket, MA
Nashville, TN
Oakland, CA
Palo Alto, CA
Phoenix, AZ
Pittsburgh, PA
Portland, OR
Puerto Rico
San Antonio, TX
San Mateo County, CA
San Francisco, CA
Seattle/King County, WA
Somerville, MA
Vancouver, BC
Victoria, BC

Deconstruction executive orders, ordinances, incentives,
plans, or Deconstruction Advisory Groups

Annual U.S Materials Generation

U.S. EPA, 2018

Municipal Solid Waste:
292.4 million tons/
year



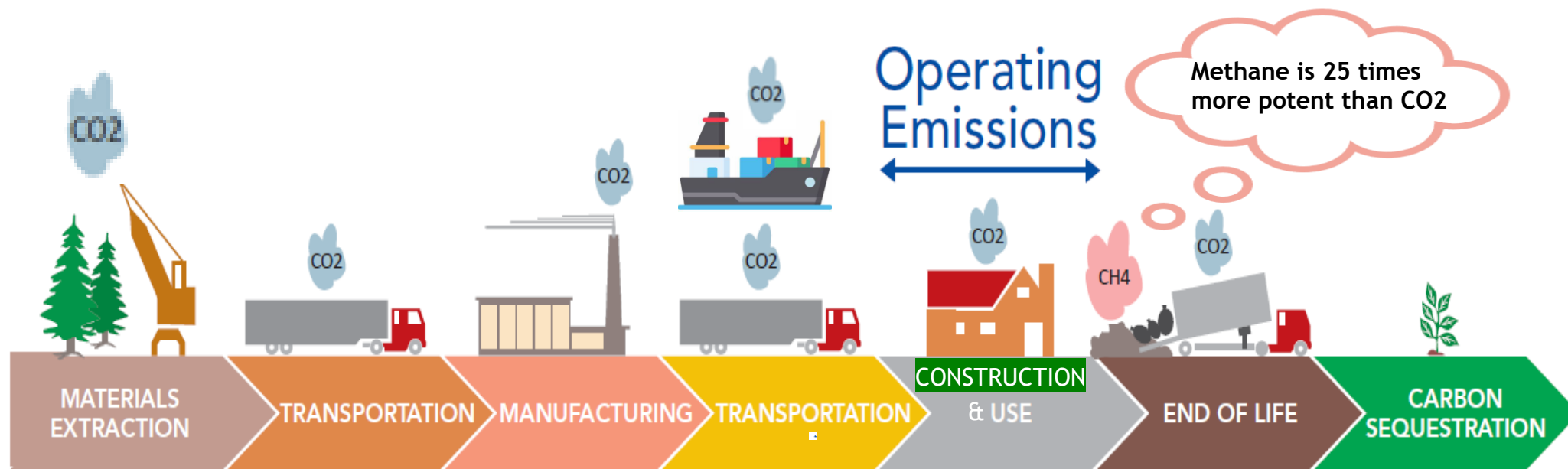
Construction &
Demolition Debris:
600 million tons/
year

- 90% from Demolition
- Less than 10% from Construction



Embodied Carbon vs. Operational Carbon

Operational Carbon: All of the energy used to keep buildings, warm, cool, ventilated, lighted and powered



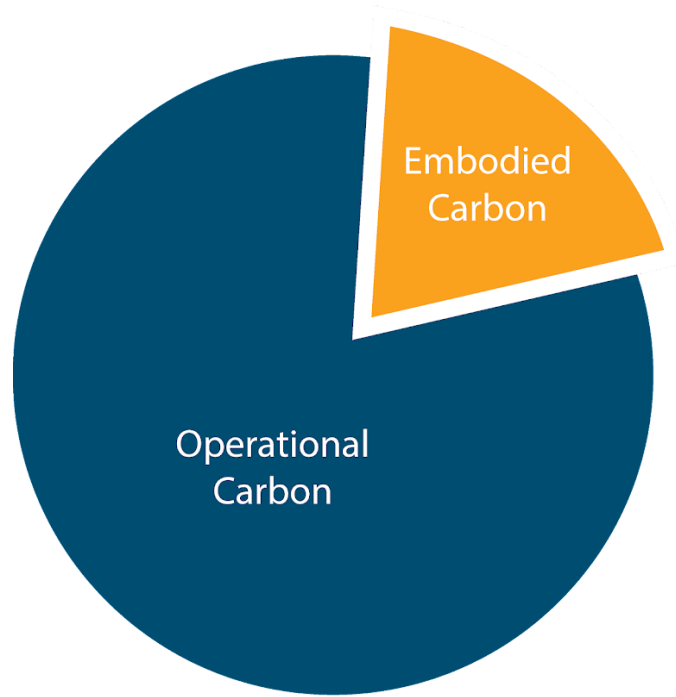
Embodied Carbon: GHG emissions from extraction, manufacturing, transportation, installation, maintenance, and disposal of materials

RECYCLE

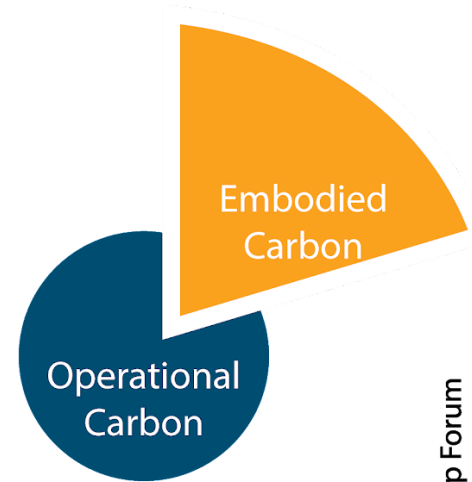
REUSE

COMPOST

Operating vs Embodied Carbon



Building as Usual



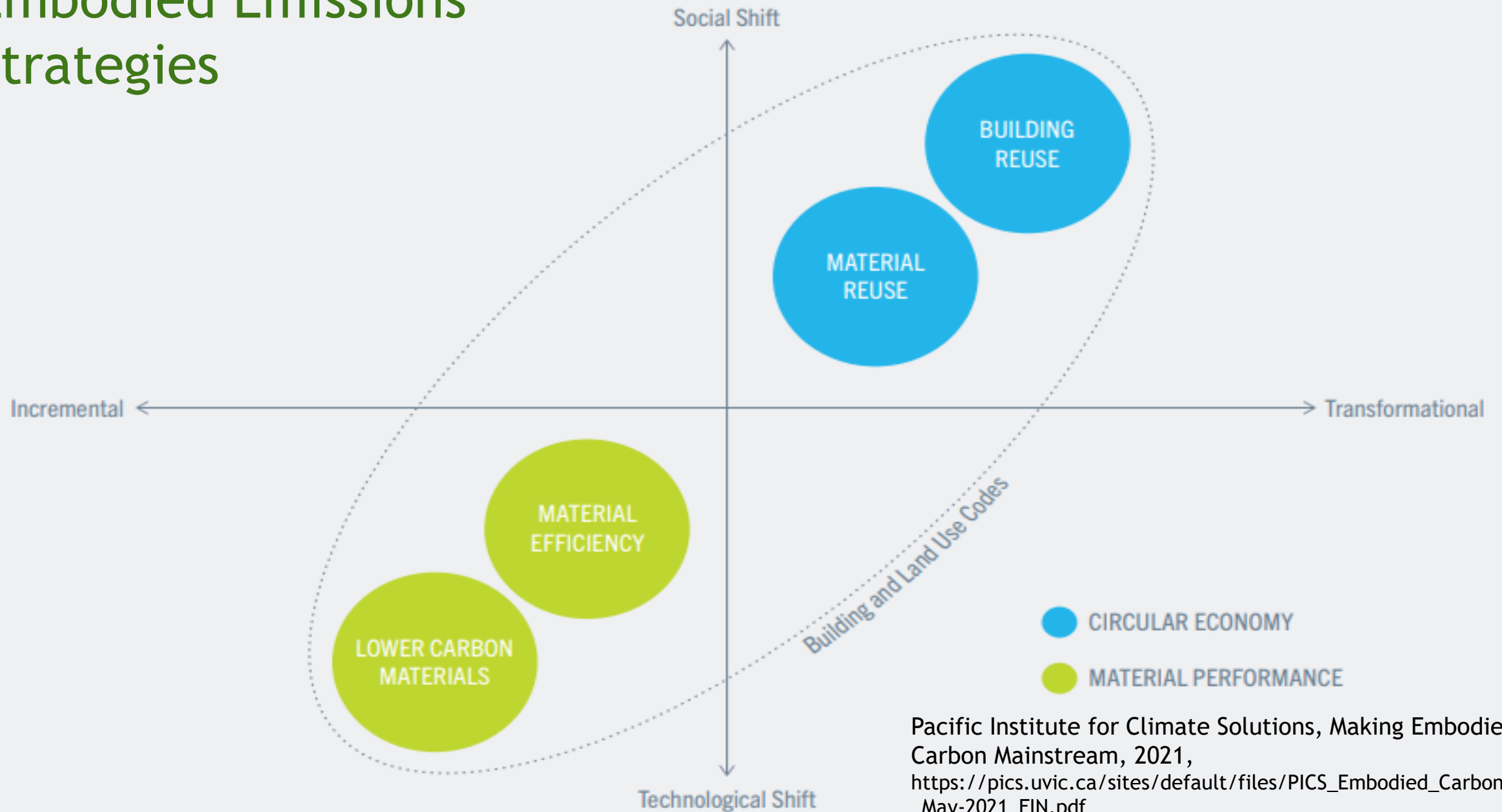
High Performance Building

credit: Carbon Leadership Forum

As buildings become **more energy efficient, embodied carbon becomes a greater proportion of total carbon emissions**

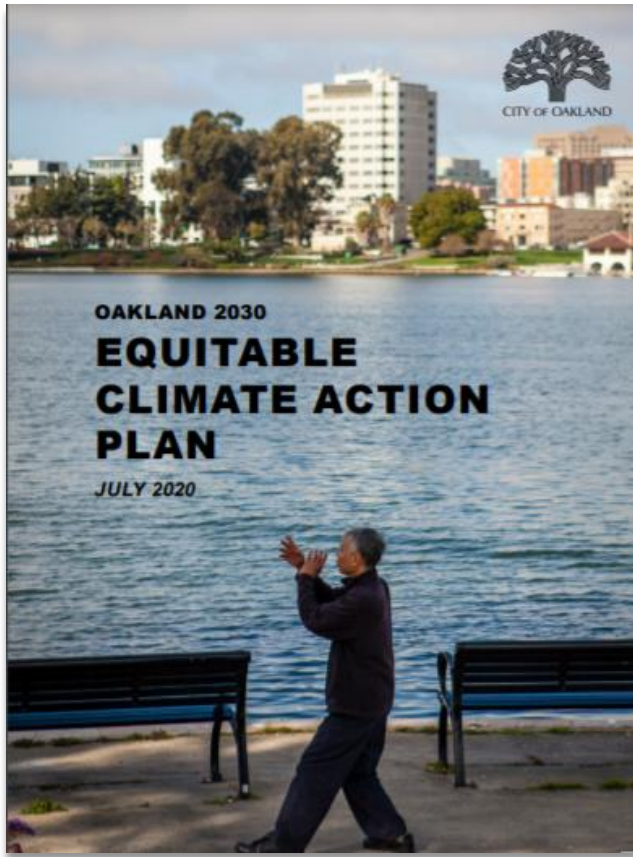
An estimated **49% of GHG emissions from buildings built between 2020-2050 will be from embodied carbon** as operational emissions fall - business as usual (Architecture 2030)

Embodied Emissions Strategies



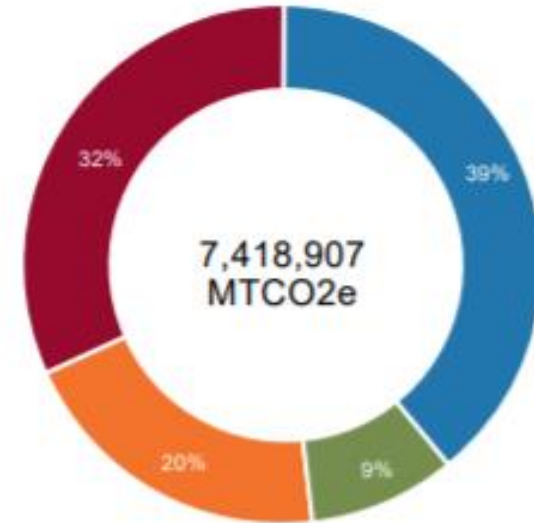
Pacific Institute for Climate Solutions, Making Embodied Carbon Mainstream, 2021,
https://pics.uvic.ca/sites/default/files/PICS_Embodied_Carbon_Report_May-2021_FIN.pdf

Major Shift in Climate Action Plans & Inventories to include Materials/Waste



Oakland 2030 Equitable Climate Action Plan, 2020, <http://www.oakland2030.com/>

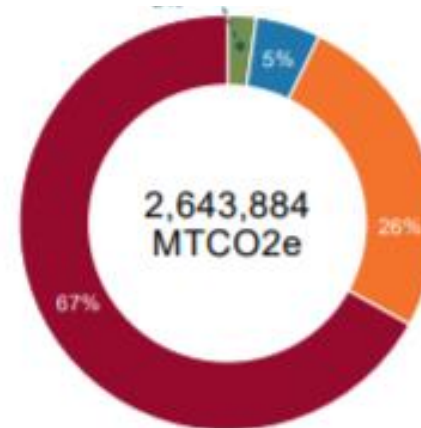
Lifecycle Emissions



39%
Waste

Transportation Buildings Waste Port

Local Emissions



5%
Waste

Oakland Equitable Climate Action Plan: Materials & Waste Action

Establish a Deconstruction Requirement

Lead Agency	Climate Benefit	Cost	Benefits
PBD		\$\$\$\$	
Establish a deconstruction requirement to reduce demolition waste from construction and renovation and facilitate material reuse. Regulate hauling and processing of construction and demolition debris to ensure that salvageable materials are identified and removed for reuse instead of being recycled or disposed to landfill.			



WARM Construction Materials Covered

Material
Asphalt Shingles
Carpet
Clay Bricks
Concrete
Dimensional Lumber
Drywall
Fiberglass Insulation
Fly Ash
Medium-density Fiberboard
Structural Steel
Vinyl Flooring
Wood Flooring

WARM: <https://www.epa.gov/WARM>
USEEIO: <https://www.epa.gov/land-research/us-environmentally-extended-input-output-useeio-technical-content>

EPA Embodied Carbon Tools

- ▶ **EPA WARM Model - OLEM Online Calculator**
 - ▶ Lifecycle GHG emissions reductions and energy savings of different waste management practices
 - ▶ 61 Materials & Types of Food, including **16 Construction Materials**
 - ▶ First version released 1998 / Now Version 15
- ▶ **US Environmentally-Extended Input-Output (USEEIO) Models - OLEM and ORD**
- ▶ **Many private sector tools**



Calculator Tool (Search “Reuse Grant Program” and enter information under “Inputs” Tab)

<http://www.arb.ca.gov/cci-resources>

Methodology:

https://ww2.arb.ca.gov/sites/default/files/classic/cc/capandtrade/auctionproceeds/calrecycle_reuse_finalqm_5-29-20.pdf

California Air Resources Board Wood Reuse/Embodied Carbon Calculator

► Based on EPA WARM emissions factors, covers:

- Softwood Lumber
- Hardwood Flooring
- Chairs
- Doors
- Cabinets, Shelving Units, Dressers, Bathroom Vanity
- Desks and Tables
- Bed Bases

► Developed to support \$2M CA Climate Investments Reuse Grant Program

<https://www.calrecycle.ca.gov/climate/grantsloans/reuse>

Environmental Product Declarations (EPDs)

Life Cycle Assessment Information

Nutrition Facts

Serving Size 2/3 cup (55g)	
Servings Per Container About 8	
Amount Per Serving	
Calories 230	Calories from Fat 40
% Daily Value*	
Total Fat 8g	12%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 37g	12%
Dietary Fiber 4g	16%
Sugars 1g	
Protein 3g	



Life Cycle Impact Results (per m³)

Declared Unit: 1 m³ of 10,000 psi concrete at 28 days

OPERATIONAL IMPACTS		PerformX™ PECC10K
Plant Operating Energy (MJ)		38.6
On-Site Plant Fuel Consumption (MJ)		11.1
Concrete Batch Water (m ³)		1.68E-01
Concrete Wash Water (m ³)		1.91E-02
On-Site Waste Disposal (kg)		0.0
ENVIRONMENTAL IMPACTS		
Total Primary Energy (MJ)		3,017
Climate Change (kg CO ₂ eq)		445
Ozone Depletion (kg CFC 11 eq)		1.31E-08
Acidification Air (kg SO ₂ eq)		2.96
Eutrophication (kg N eq)		0.09
Photochemical Ozone Creation (kg O ₃ eq)		0.61

- ▶ Environmental label for products that's like a nutritional label for food
- ▶ Goal: Make environmental data more reliable
- ▶ No single EPD database that covers building products around the world
- ▶ Industry-Wide EPDs
- ▶ Product Specific Type III EPD (Third-Party Reviewed)

The Embodied Carbon Imperative: GSA's Next Big Sustainability Opportunity

Advice Letter Key Policy Recommendations:

- ▶ Material approach for all projects
- ▶ Whole building life cycle assessment approach for larger projects (over \$3.095 million)
- ▶ **Deconstruction/Reuse - *recommended Net Zero Carbon Emissions***
- ▶ Environmental Product Declaration recommendations

<https://www.gsa.gov/blog/2021/04/05/the-embodied-carbon-imperative-gsas-next-big-sustainability-opportunity>

Advice Letter: <https://www.gsa.gov/governmentwide-initiatives/federal-highperformance-green-buildings/policy/green-building-advisory-committee/advice-letters-and-resolutions>



Inflation Reduction Act

EPA, GSA and Federal Highway Administration
Embodied Carbon Funding

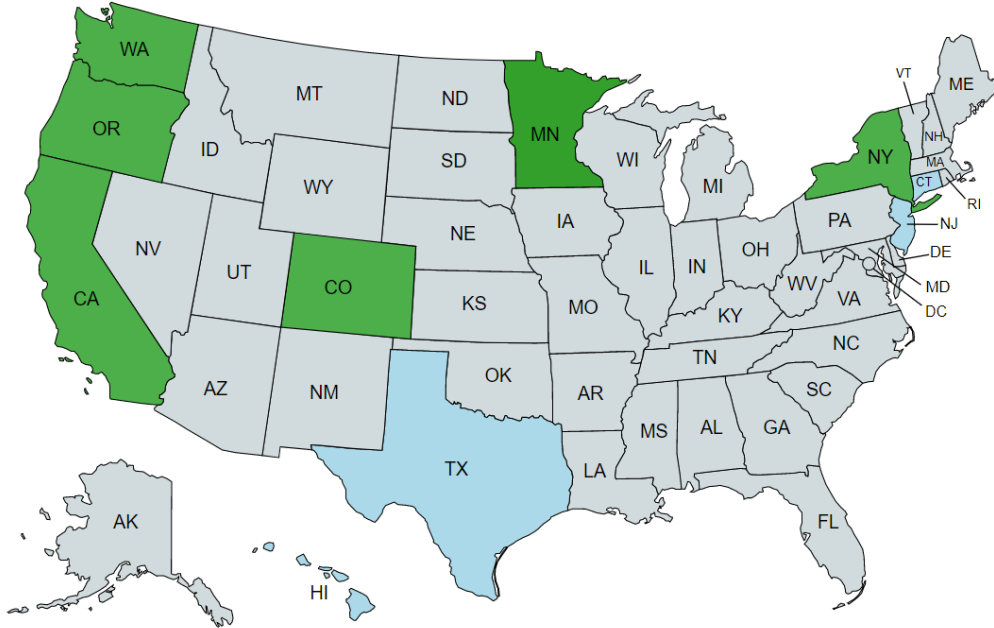


- ▶ **\$250 million** - Environmental Product Declaration support and technical assistance including measurements of lifecycle embodied greenhouse gas emissions (EPA)
- ▶ **\$100 million** - Low Embodied Carbon Labeling for construction materials (EPA)
- ▶ **\$2.15 BILLION** - acquire and install substantially low carbon materials by GSA in federal buildings (with EPA)
- ▶ **\$2 BILLION** - Federal Highway Administration procurement of low-carbon construction materials and products (with EPA)

Inflation Reduction Act, 2022

https://www.democrats.senate.gov/imo/media/doc/inflation_reduction_act_of_2022.pdf

Buy Clean Policies



Adopted Buy Clean Law
Introduced Buy Clean Legislation

- ▶ **Procure lower-embodied carbon materials for construction projects**
- ▶ **White House Buy Clean Task Force established in 2022**
- ▶ **California** adopted first U.S. Buy Clean law in 2017, followed by WA, OR, MN, NY and CO

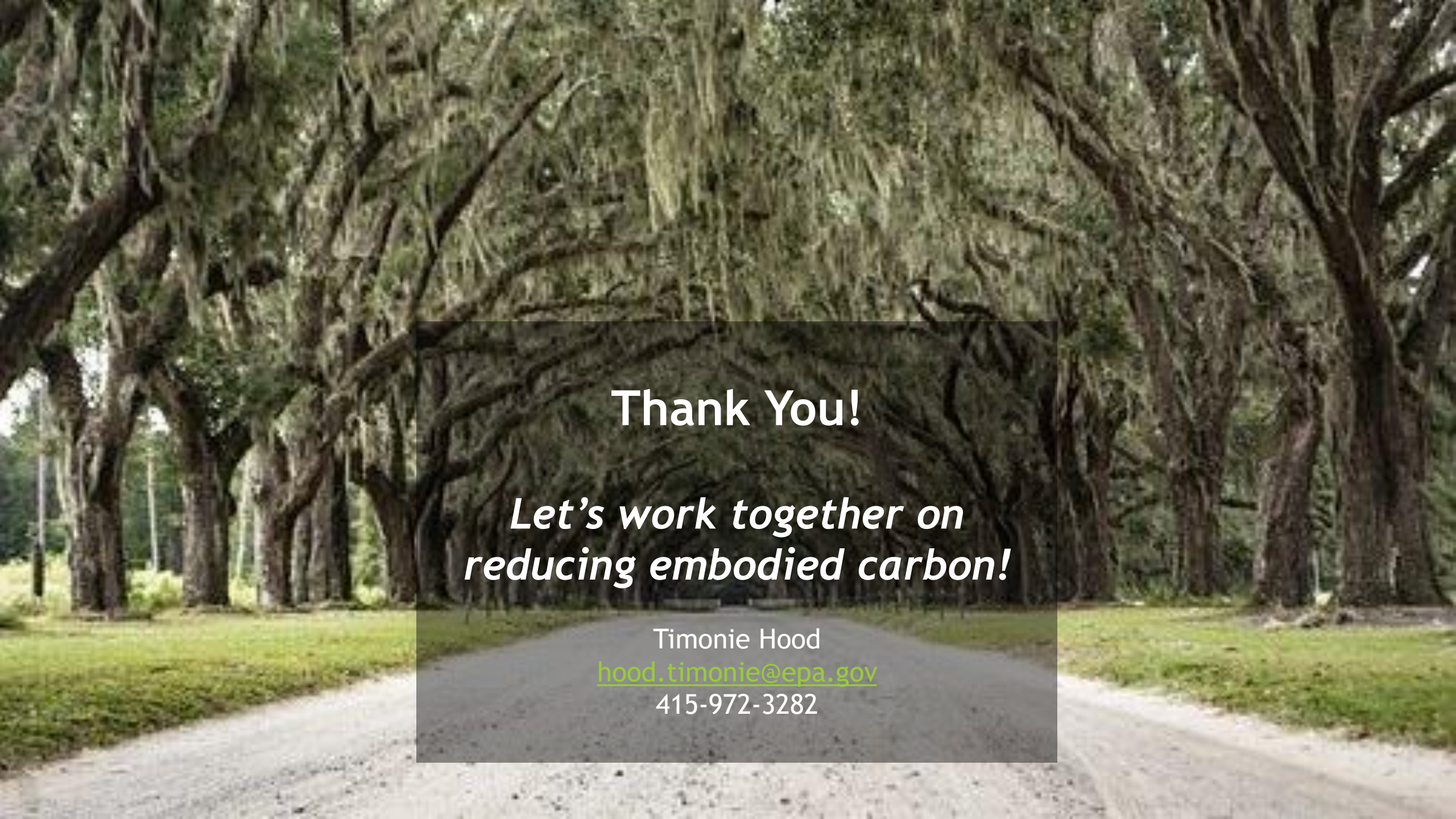
White House Buy Clean Task Force & Fact Sheet

<https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/15/fact-sheet-biden-harris-administration-advances-cleaner-industrial-sector-to-reduce-emissions-and-reinvigorate-american-manufacturing/> & <https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-buy-clean-actions-to-ensure-american-manufacturing-leads-in-the-21st-century/>



Embodied Carbon Opportunities

- ▶ Develop and implement decarbonization policies advancing deconstruction and safe reuse
- ▶ Require reclaimed materials in construction projects
- ▶ Add additional embodied carbon information, graphics, and resources - research and funding opportunities, programs, websites
- ▶ Support building code updates (low-carbon materials, reuse, recycled content, etc.)
- ▶ Host challenges to raise awareness and advance adoption
- ▶ Develop Climate Action Plans, case studies, and procurement documents focusing on embodied carbon
- ▶ Incorporate into Disaster Resilience Policies and Infrastructure



Thank You!

***Let's work together on
reducing embodied carbon!***

Timonie Hood

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415-972-3282

Resources

- **EPA Region 9 - Bay Area Deconstruction Workgroup** (email hood.timonie to join - all are welcome) <https://www.stopwaste.org/DeconstructionWorkgroup>
- **C40 (Climate Action Leaders) Resource Guide for Cities**
<https://www.c40knowledgehub.org/s/article/How-to-start-deconstructing-and-stop-demolishing-your-citys-buildings>
- **Carbon Leadership Forum** - <https://carbonleadershipforum.org/>
- **Worthen Foundation Building Decarbonization Practice Guide, Vol. 6**
<https://worthenfoundation.org/get-the-guide-bdpg>
- **San Antonio, Treasure in the Wall Report** - <https://www.sareuse.com/reports>
- **European Union Research** - Buildings as Material Banks / Circular Economy
<https://www.bamb2020.eu/>
- **EPA, Resiliency and Natural Disaster Debris Report**
<https://www.epa.gov/homeland-security-waste/resiliency-and-natural-disaster-debris-workshops>

Inspiring Deconstruction & Reuse Videos

U.S. EPA, The Benefits of Deconstruction (3:39)

<https://www.youtube.com/watch?v=otxKUlrX4mw>

City of Baltimore Deconstruction (15:05)

<https://www.youtube.com/watch?v=Drmgd33IRrs>

City of San Antonio, Story of 2 Homes (2:44)

<https://youtu.be/0R2sbpsUKPU>

City of San Antonio, Deconstruction Spotlight: Reuse Warehouse

<https://youtu.be/qT2Mz8kuwVg>

County of San Mateo Deconstruction Training (3:39)

<https://youtu.be/z-4tpNQLlcQ>

Metro Vancouver, Wood Waste Upcycling (4:45)

<https://vimeo.com/489603545>

StopWaste.org, Deconstruction of Building 802 (12:19)

<https://www.youtube.com/watch?v=v6F0JRUH8WI>

Exploring Alternatives, How Deconstructing Buildings Diverts a MASSIVE Amount of Waste - Sustainable Demolition Alternative (12:28)

<https://youtu.be/SLvYRKw4HHw>

Mercy Corps Deconstruction Video - Hurricane Katrina (2:07)

<https://youtu.be/zRIEV5dF8ns>

