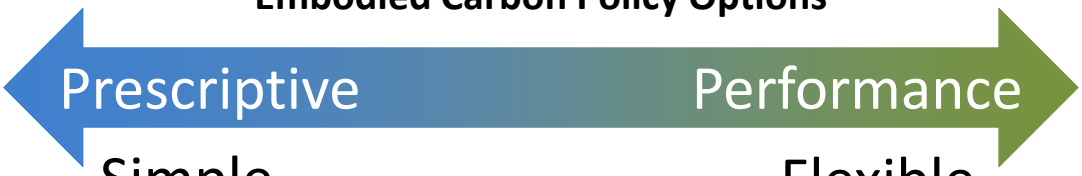
Policies on Embodied Carbon

Moderator: Prodipto Roy, Energy Innovation
Bruce King, Ecological Building Network
Kathryn Phillips, Sierra Club
Eden Brukman, City of San Francisco

GETTING TO zero FORUM

October 10, 2019

Embodied Carbon Policy Options



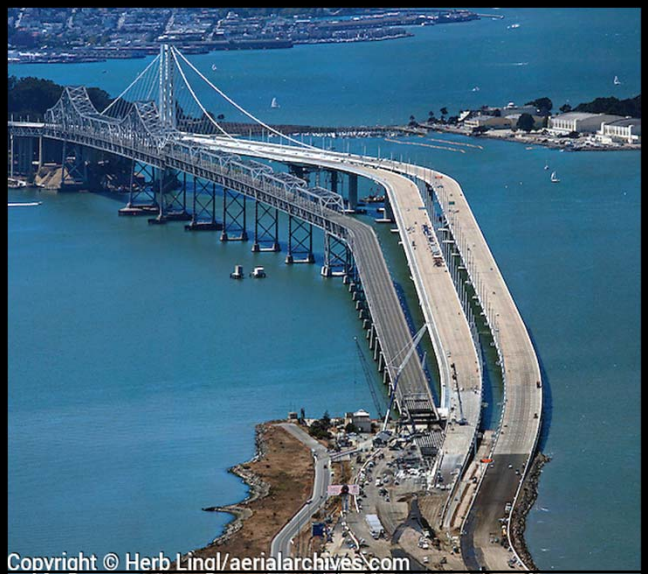
Simple — Flexible

Attribute-based — Complex

Embodied Carbon Policy Options

	Prescriptive	Performance
Material	Material Palette	Buy Clean Acts
WB	Design Guidelines	WB LCA

a concrete suggestion

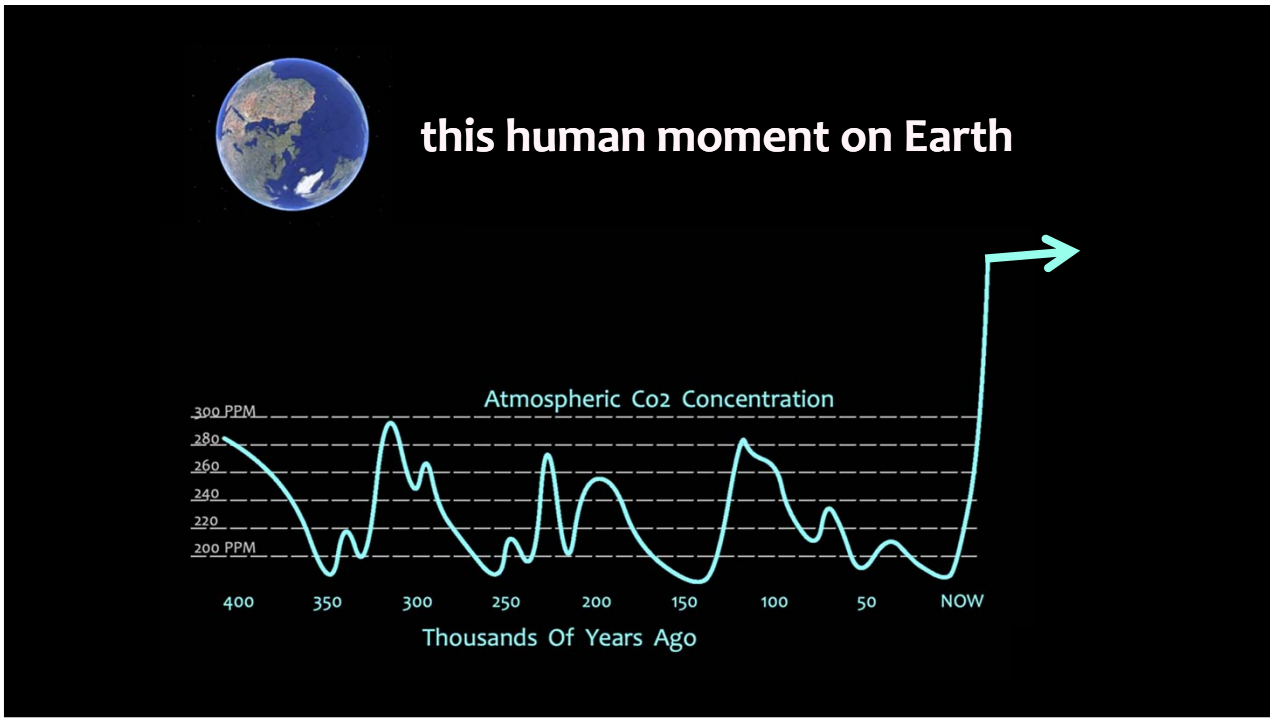


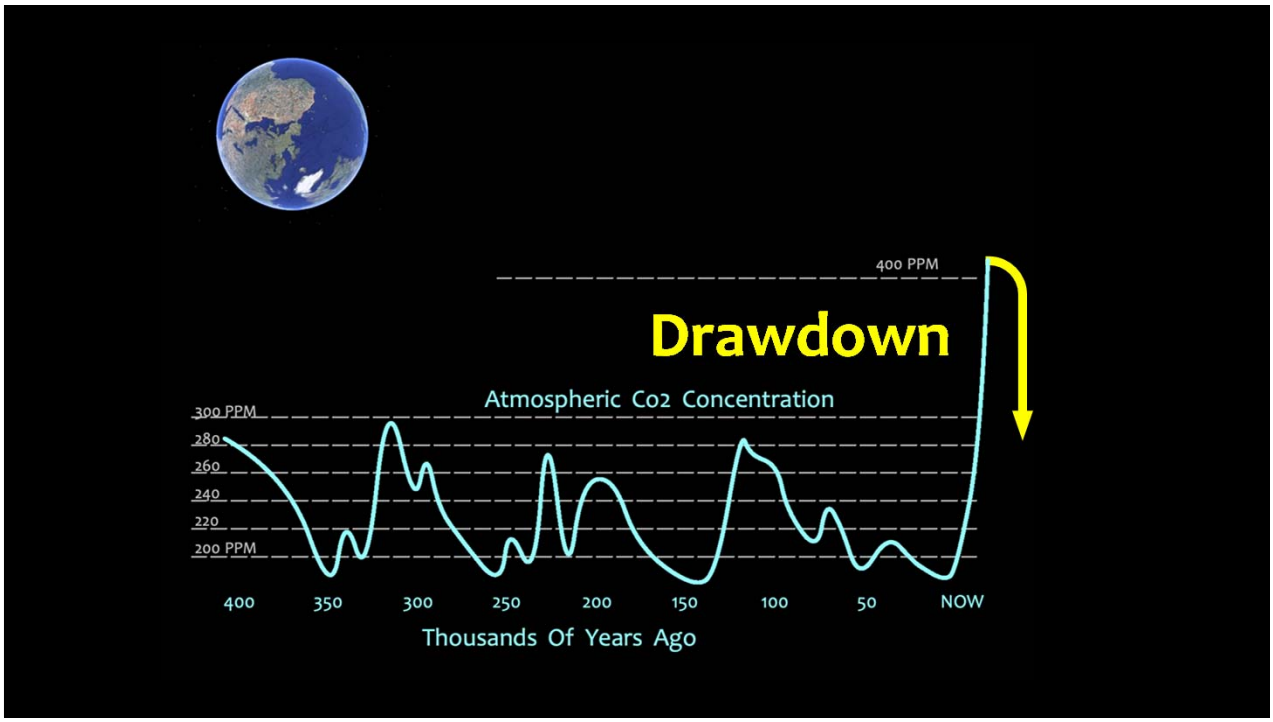
Bruce King

Getting to Zero

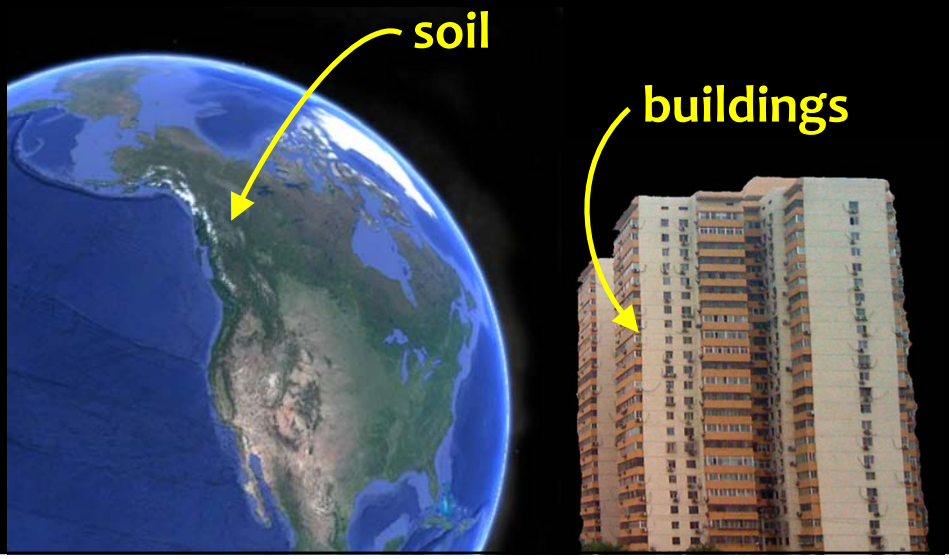
Oakland, California

October, 2019


this human moment on Earth
Atmospheric Co2 Concentration
300 PPM
280
260
240
220
200 PPM
400
350
300
250
200
150
100
50
NOW
Thousands Of Years Ago


400 PPM
Drawdown
Atmospheric Co2 Concentration
300 PPM
280
260
240
220
200 PPM
400
350
300
250
200
150
100
50
NOW
Thousands Of Years Ago

Where can we put the carbon?

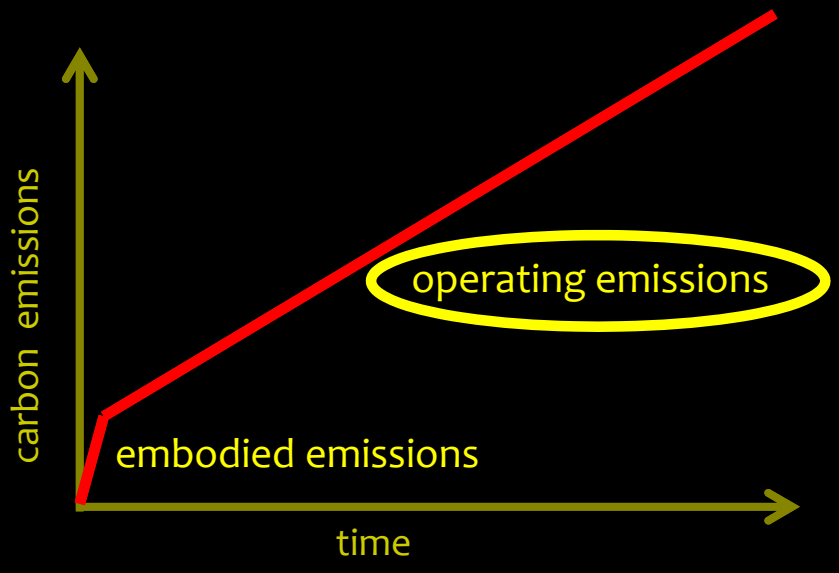


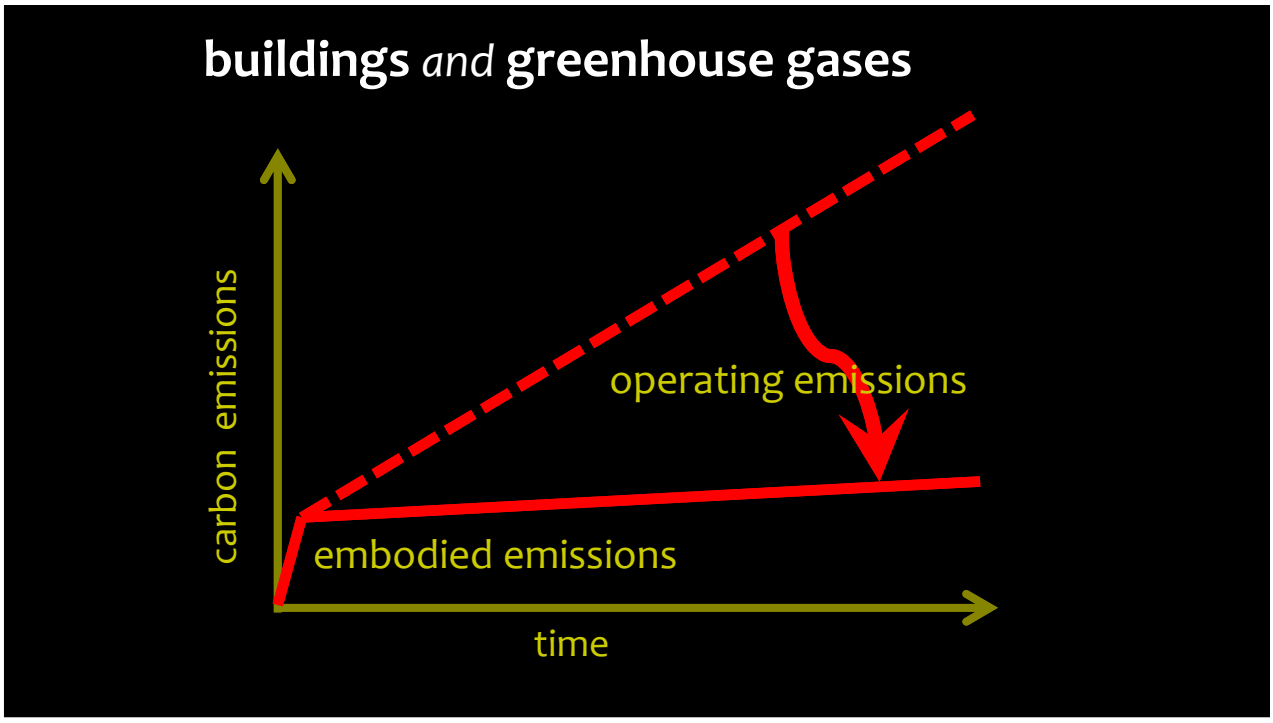
another New York City every 35 days

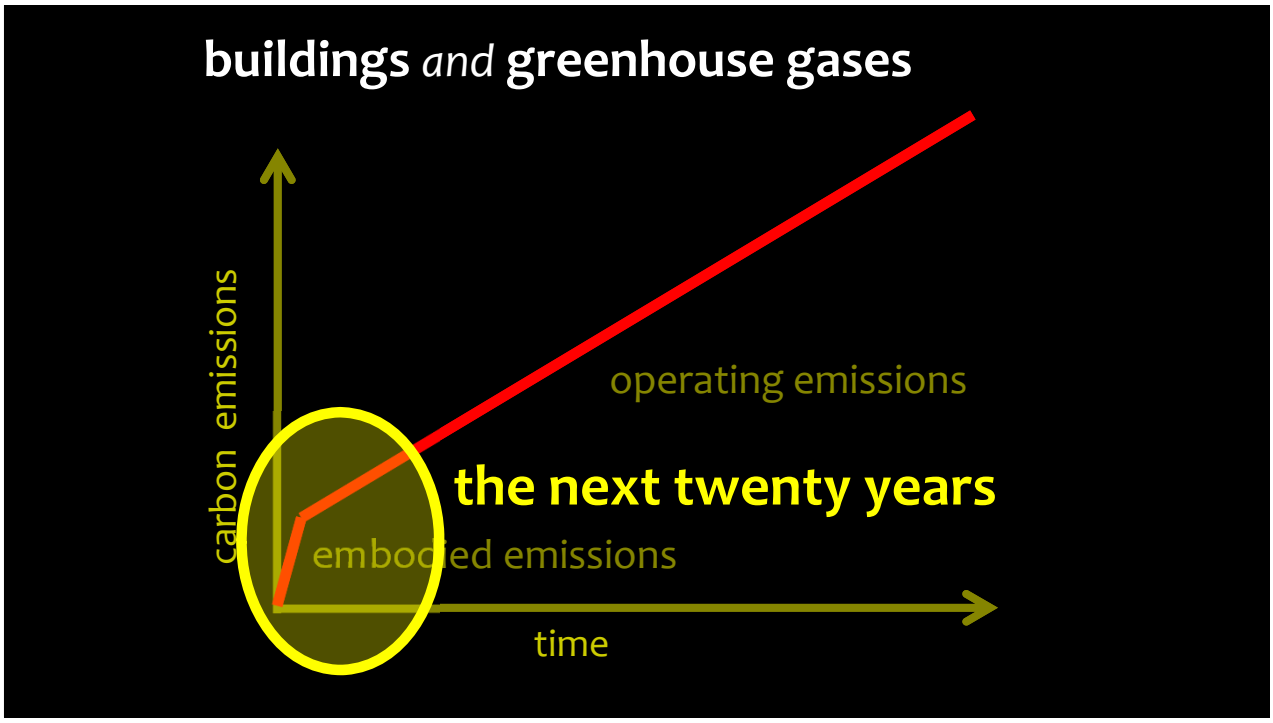
buildings *and* greenhouse gases

40%

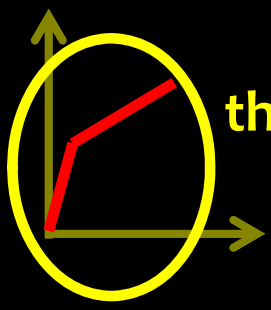
buildings *and* greenhouse gases




buildings *and* greenhouse gases
carbon emissions
operating emissions
embodied emissions
time


buildings *and* greenhouse gases
carbon emissions
operating emissions
the next twenty years
embodied emissions
time

buildings *and* greenhouse gases



the next twenty years

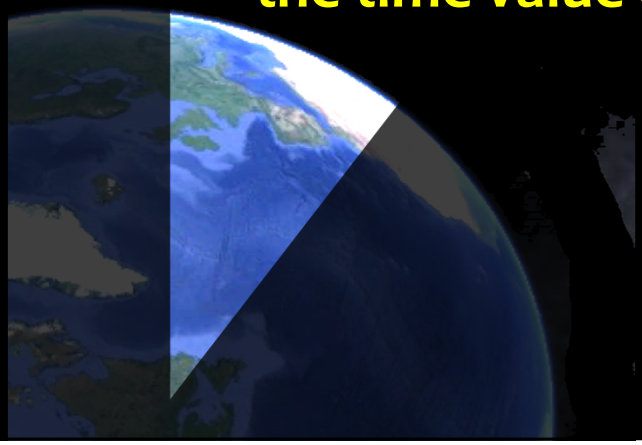
embodied emissions:
the materials we use

10%

building materials

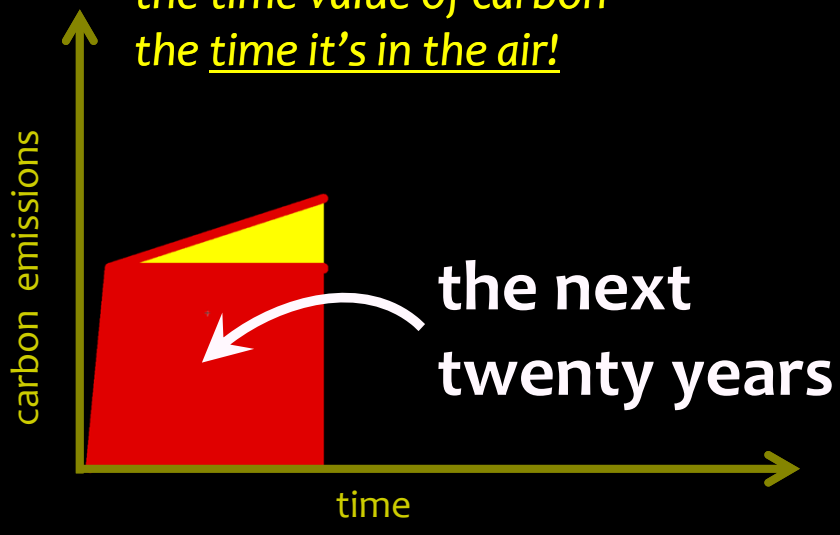
effectively much more than 10% –

the time value of carbon

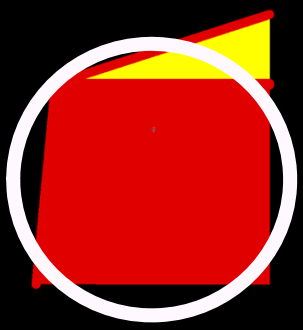


Climate Impact

the time value of carbon –
the time it's in the air!



3/4



of a building project's climate impact over the next twenty years is from <u>embodied carbon</u>

Where is the embodied carbon?

Global Ecology Embodied Greenhouse Gas Emissions

Material	Quantity of Material	Unit of Material	Tons of CO2 per Unit of Material*	Tons of CO2 Emissions	Percent
Concrete	620	CY	0.3	186	62%
Structural Steel	81	tons	1.05	85	28%
Reinforcing Steel	11	tons	1.05	12	4%
Carpet	3	tons	3.10	9	3%
Steel Studs	4	tons	1.05	4	1%
Glass	2	tons	1.30	2	1%
Gypsum Board	6	tons	0.20	1	0.4%
Polystyrene	0.4	tons	2.10	1	0.3%
Ceramic Tile	0.3	tons	1.40	0	0.1%
Batt Insulation	0.4	tons	1.50	1	0.2%
Acoustic Ceiling Tile	1	tons	0.20	0	0.1%
Totals				302	100%

94% of Co_2 footprint from structural materials

Source: Scott Shell, AIA, EHDD Architects, San Francisco, California

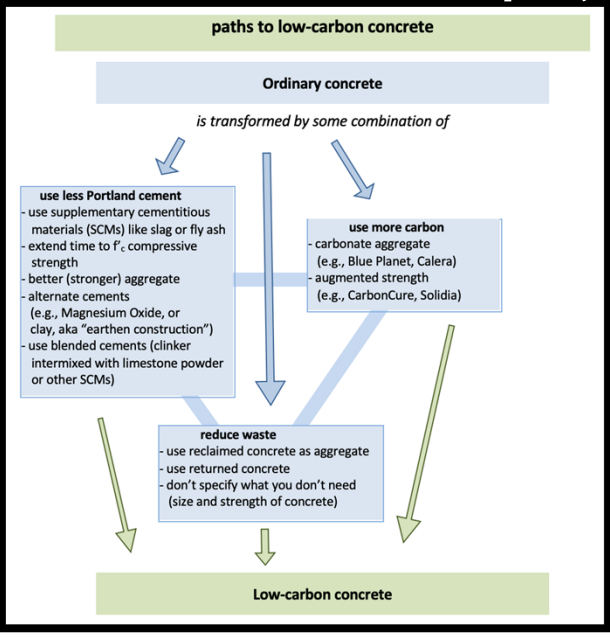
Concrete

8% of global emissions

a great place to start

the low-carbon concrete project

the low-carbon concrete project



the low-carbon concrete project

	Cement limits for use with any compliance method 19.07.050.1 thru 19.07.050.4	GWP limits for use with any compliance method 19.07.050.1 thru 19.07.050.4
Minimum specified compressive strength f'c, psi (5, 7)	Maximum ordinary Portland cement content, lbs/yd³ (1, 2, 4)	Maximum Global Warming Potential, GWP, kg CO_2e /m³
up to 2500 (3,4)	362	260
3000	410	289
4000	456	313
5000	503	338
6000	531	356
7000	594	394
7001 and higher	657	433
up to 3000 light weight	512	578
4000 light weight	571	626
5000 light weight	629	675

Table 19.07.050.1 – Cement and GWP limitations

the low-carbon concrete project

Notes

(1) Portland cement of any type per ASTM C150. The maximum cement content may be increased proportionately above the tabulated value when using an approved cement, or blended cement, demonstrated by approved EPD to have a plant-specific global warming potential (GWP_{PS}) lower than 1040 kg CO_2e/metric ton. The increase in allowable cement content would be (1040 / GWP_{PS}) %.

(2) Cement or GWP limits shown can be increased by 30% for concretes demonstrated to the Building Official as requiring high early strength. Such concretes could include:
   a. Precast, prestressed concrete
   b. Beams and slabs above grade
   c. Shotcrete

(3) Concrete with designated strength less than 2500 psi is not subject to minimum strength and reinforcing limitations of ACI 318.

(4) Concrete using clay, or both clay and cement, as binder shall be designed and constructed consistent with successful historical precedent or existing standards, or substantiated by test data, and is subject to approval by the Building Official. Clay-based concrete systems, historically known as earthen construction, include adobe (unfired earth) blocks, compressed earth blocks, cob (or *puddled earth*), and rammed earth. Concrete using both clay and cement, historically known as soil-cement, include roller-compacted concrete or road base, stabilized rammed earth, and stabilized earth block.

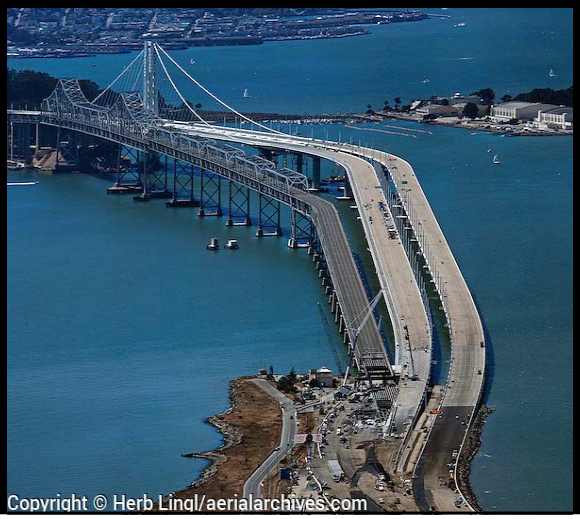
(5) The permit applicant must designate the time allotted for a concrete mix to reach its minimum specified compressive strength, be it 28, 56, 84 days or more.

(6) For concrete strengths between the stated values, use linear interpolation to determine cement and/or GWP limits.

the low-carbon concrete project

When deviations from compliance with this section occur the chief building official is authorized to require evidence of equivalent carbon reductions from the portions of remaining construction of the project to demonstrate alternative compliance with the intent of this chapter.

a price on carbon



the
low-carbon
concrete
building code

the low-carbon concrete project

- because concrete is everywhere

the low-carbon concrete project

- because concrete is everywhere
- Has to start somewhere
  and Bay Area is perfect

the low-carbon concrete project

- because concrete is everywhere
- Has to start somewhere
  and Bay Area is perfect
- Let's get viral
  a sneaky guerilla building code

the low-carbon concrete project

Building codes *vs.* Public Procurement

Outreach: concrete producers

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Building codes *vs.* Public Procurement

Outreach: concrete producers
engineers

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Building codes *vs.* Public Procurement

Outreach: concrete producers
engineers
other jurisdictions

the low-carbon concrete project

Building codes *vs.* Public Procurement

Outreach: concrete producers
engineers
other jurisdictions
other countries

Buy Clean CA and Beyond

Kathryn Phillips
Director
Sierra Club California
Kathryn.Phillips@sierraclub.org

Buy Clean CA Act Basics

- Who did it
- Why we did it
- What it is
- When it happens

The Who

An unexpected campaign coalition

Union of Concerned Scientists

SIERRA CLUB CALIFORNIA

BLUEGREEN ALLIANCE

State Building & Construction Trades Council of California

NRDC

UNITED STEELWORKERS USW UNITY AND STRENGTH FOR WORKERS

APEN ASIAN PACIFIC ENVIRONMENTAL NETWORK

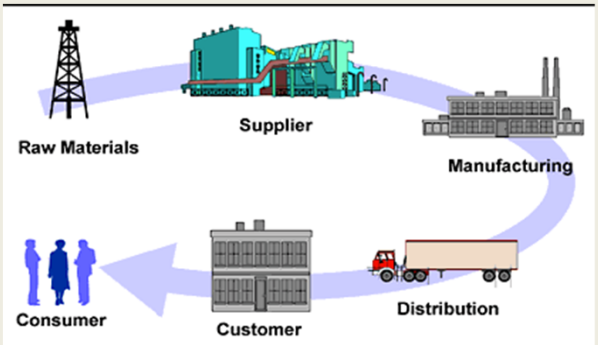
AMERICAN LUNG ASSOCIATION IN CALIFORNIA

ENVIRONMENT CALIFORNIA

CALIFORNIA ENVIRONMENTAL JUSTICE ALLIANCE

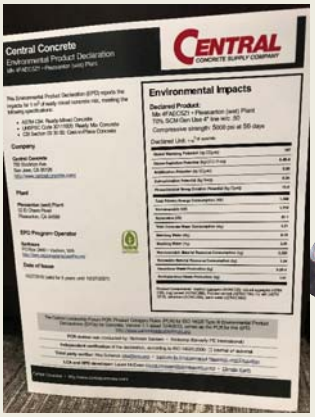
Rule #1: Who you hang out with matters.

The Why



Rule #2: How you spend your money matters.

The What



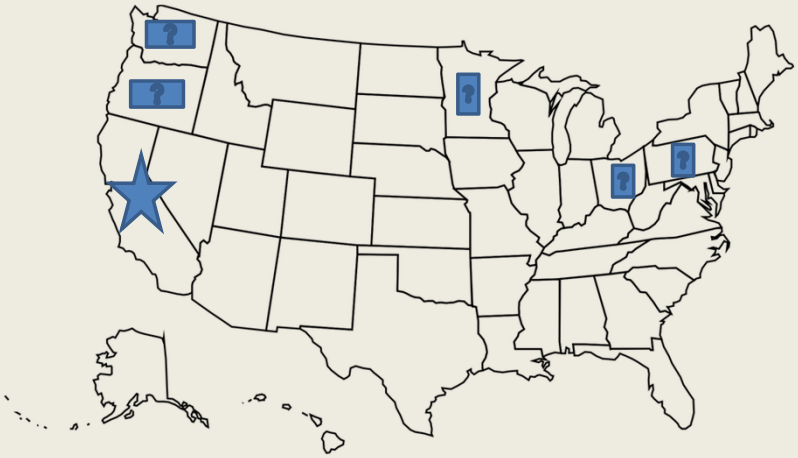
The When

- Department of General Services (DGS) responsible for implementation
  - AB 262 Implementation Website
- Phase-in timeline
  - Jan.1, 2019: request contractors to submit EPDs for project materials
  - Jan.1, 2020: require contractors to submit EPDs for project materials
  - Jan.1, 2021: DGS to establish global warming pollution (GWP) limit
  - July 1, 2021: require EPDs that meet GWP limit

Rule #3: All good things are worth waiting for, but not too long.

Other Buy Cleans

Popularizing the concept



Thank You

SIERRA CLUB CALIFORNIA

Material Impacts

Bringing Cities Together to Advance Climate Action

CNCA
CARBON NEUTRAL CITIES ALLIANCE

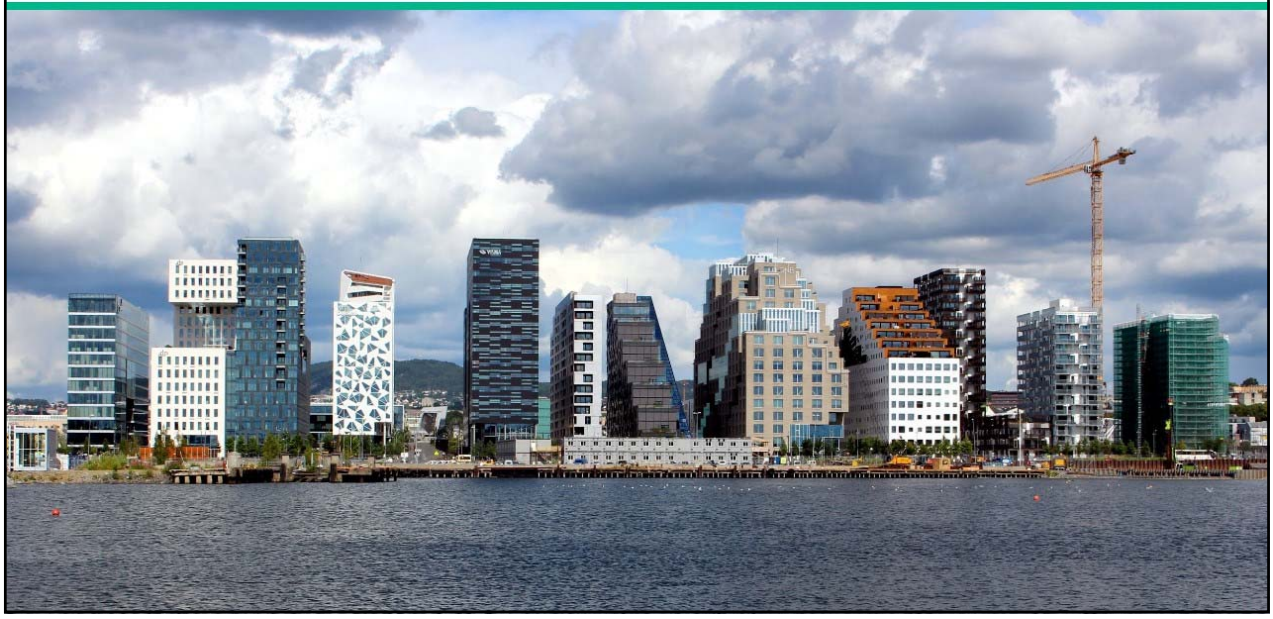
Embodied Carbon Workgroup
Forum: 23-25 April 2019, New York

C40 CITIES
CLIMATE LEADERSHIP GROUP

Clean Construction Workgroup
Forum: 20-23 May 2019, Norway

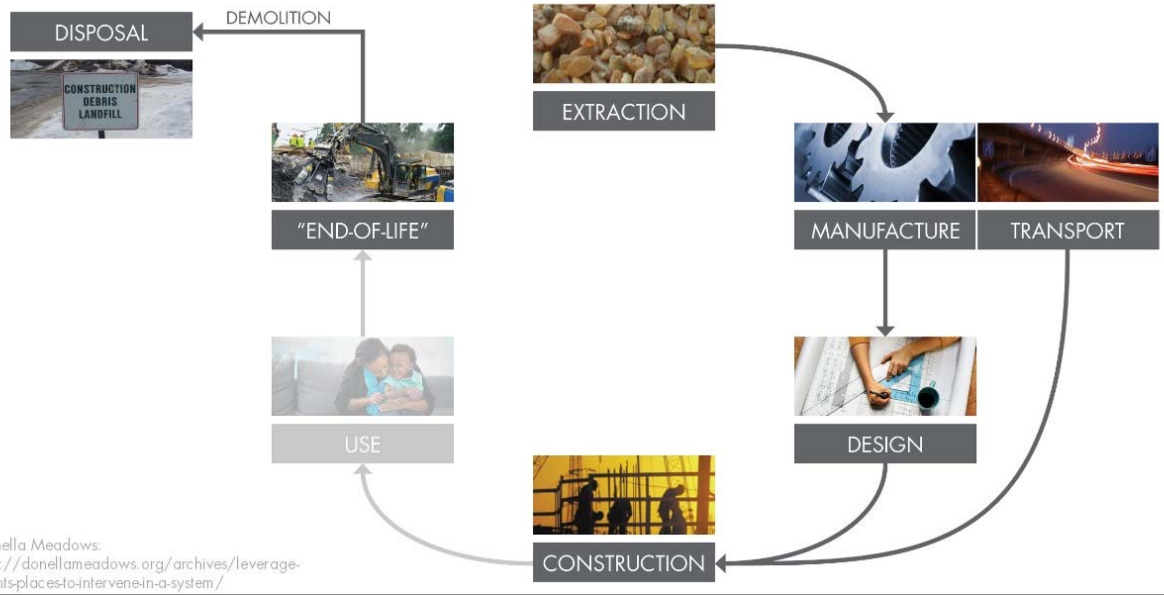
Zürich: Harmonized, Public, Free LCA Data bit.ly/2k20KZE

Oslo: Clean Construction bit.ly/2luSotW



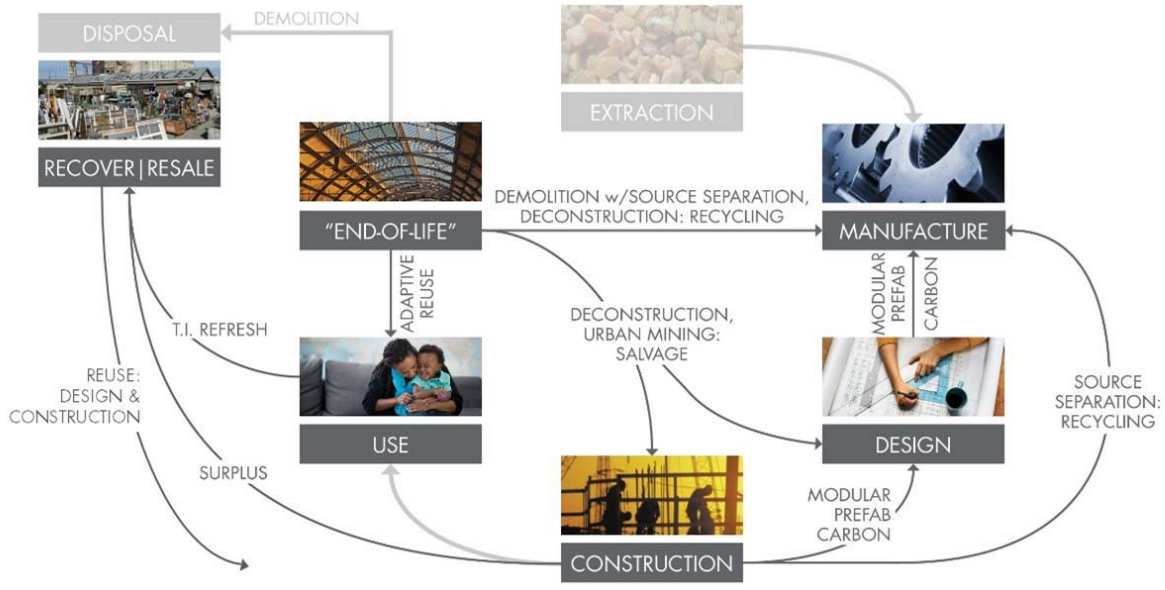
Vancouver: Low Carbon Materials & Designs bit.ly/2k0pOQL

Embodied Carbon: Places to Intervene in a System*

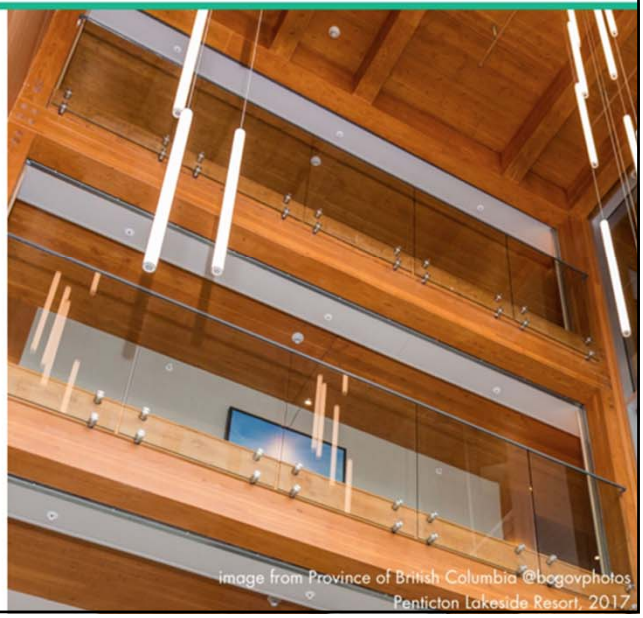


* Donella Meadows: http://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

Embodied Carbon: Opportunities for Intervention



Balancing Single Actions and Systems Change



End of Presentation

Current (Design,)C&D Practices Still Lead to Landfill

25%

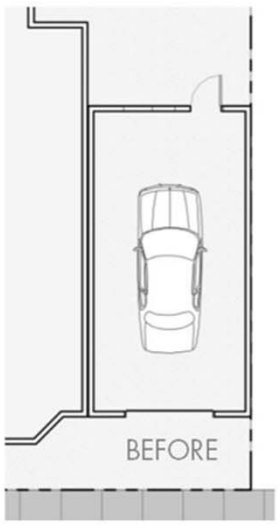
(*excludes "Alternative Daily Cover")

Finding Solutions for Urban Wood Waste

Upstream: Adaptive Reuse

photo © Drew Kelly, DPR San Francisco

Upstream: Optimize Density



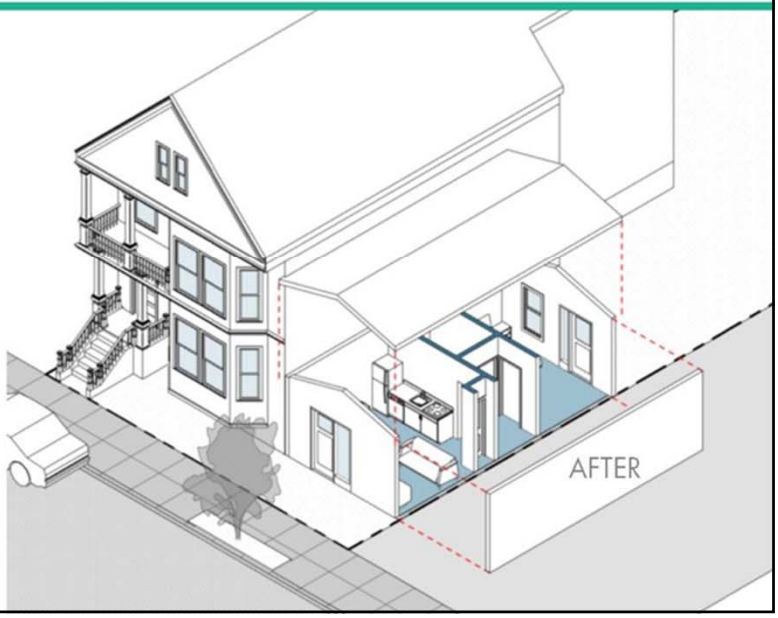


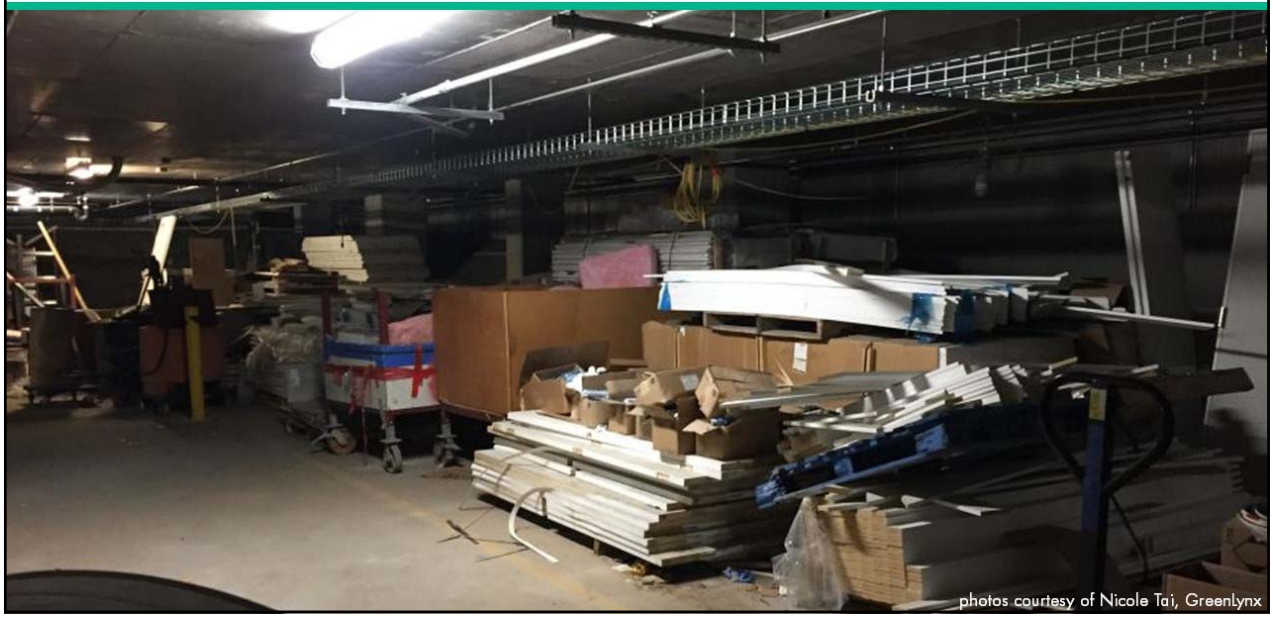
image from "Accessory Dwelling Units in San Francisco" 2018
https://sf-planning.org/about-accessory-dwelling-units

Upstream: Design for Disassembly

Upstream/Downstream: Material Reuse

photos courtesy of Nicole Tai, Greenlynx

Downstream: Construction Surplus and Interiors Refresh



photos courtesy of Nicole Tai, GreenLynx

Downstream: Deconstruction and Source Separation