Reducing the Carbon Footprint of Every Building.
Understanding Carbon

Embodied Carbon

Operational Carbon
Understanding Carbon

Total Carbon Emissions of **Single Building**

*Global Average Building Carbon Footprint: Business as Usual*

Embodied Carbon

\( +/\!/-50\% \)

Operational Carbon

\( +/\!/-50\% \)
Understanding Carbon

Whole life carbon*

Embodied carbon*

A1-3
PRODUCT Stage
- A1 Raw material supply
- A2 Transport
- A3 Manufacturing

A4-5
CONSTRUCTION PROCESS stage
- A4 Transport
- A5 Construction-installation process

Use stage embodied carbon*

B1-7 USE stage
- B1 Use
- B2 Maintenance
- B3 Repair
- B4 Refurbishment
- B5 Replacement

C1-4 END OF LIFE stage
- C1 De-construction demolition
- C2 Transport
- C3 Waste processing
- C4 Disposal

Beyond the lifecycle*
- D1 Benefits and loads beyond the building life cycle
  - Reuse
  - Recovery
  - Recycle

Upfront carbon*

Operational carbon*

B6 Operational energy use

End of life carbon*

B7 Operational water use

Out of scope
Understanding Carbon

Whole life carbon

Embodied carbon

A1-3 PRODUCT Stage
A2 A3
A1 Raw material supply
Transport
Manufacturing
A4 A5
A4 A5 Transport
Construction-installation process

Use stage embodied carbon

B1-7 USE Stage
B1 B2 B3 B4 B5
Use
Maintenance
Repair
Refurbishment
Replacement

Operational carbon

B6 Operational energy use

End of life carbon

C1-4 END OF LIFE Stage
C1 C2 C3 C4
De-construction demolition
Transport
Waste processing
Disposal

Beyond the lifecycle

D Benefits and loads beyond the building life cycle

Reuse
Recovery
Recycle

Beyond the lifecycle

Operational water use

Out of scope
Reducing Embodied Carbon

What to do, when.

LCA Tools (Tally, OneClick, Athena)

<table>
<thead>
<tr>
<th>WHOLE BUILDING LCA</th>
<th>TALLY WORKFLOW</th>
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<tbody>
<tr>
<td>Schematic Design</td>
<td>Analysis of Building Components</td>
</tr>
<tr>
<td>Design Development</td>
<td>Design Option Comparison</td>
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</table>

New vs Retrofit?
Right size the building.

X vs Y system?
Systems CO2 reductions.

*Start Supplier Outreach

We did it!
Current GAP in EC accounting!

LCA Tools (Tally, OneClick, Athena)
Reducing Embodied Carbon

What to do, when.

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WHOLE BUILDING LCA

TALLY WORKFLOW

Schematic Design

Design Development

Construction Documentation

Project Procurement

Analysis of Building Components

Design Option Comparison

Whole Building Life Cycle Analysis Report

Embodied Carbon Assessment

Product Comparison and Procurement

New vs Retrofit?

X vs Y system?

X vs Y Mnfr/Product?

Carbon smart procurement.

Right size the building.

Systems CO2 reductions.

Mfr/Product CO2 reductions.

CO2 reductions realized.

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WHOLE BUILDING LCA

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Design Option Comparison

Whole Building Life Cycle Analysis Report

Tally Bill of Materials Import

Embodied Carbon Assessment

Product Comparison and Procurement

Embodied Carbon Calculation

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We did it!
Supply chain emissions reduction.
Reducing Embodied Carbon

Supply chain emissions reduction.

- **Wish List**
  - Available to Everyone
  - Easy to Use
  - Free to Use
  - Open & Transparent Data Source
  - Open API (willing/able to share data with other tools)
  - Focused on Supply Chain Accountability

**Embodied Carbon Reduction Tool (Supply Chain Specific)**

CARBON LEADERSHIP FORUM
UNIVERSITY OF WASHINGTON

Microsoft

Wish List

- Available to Everyone
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Reducing Embodied Carbon

Supply chain emissions reduction.

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Embodied Carbon Reduction Tool (Supply Chain Specific)

Embodied Carbon in Construction Calculator

Embodied Carbon in Construction Calculator

Wish List

- Available to Everyone
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- Open API (willing/able to share data with other tools)
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Embodied Carbon in Construction Calculator
Embodied Carbon Benchmarking Study

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>QUANTITY</th>
<th>ESTIMATE</th>
<th>EMBODIED CARBON PER MATERIAL EPDs</th>
<th>BUILDING EMBODIED CARBON (EC) ESTIMATE</th>
</tr>
</thead>
</table>

**OPERATIONAL IMPACTS**
- Plant Operating Energy (MJ): 38.6
- On-Site Plant Fuel Consumption (MJ): 11.1
- Concrete Batch Water (m³): 1.68E-01
- Concrete Wash Water (m³): 1.91E-02
- On-Site Waste Disposal (kg): 0.0

**ENVIRONMENTAL IMPACTS**
- Total Primary-Energy (MJ): 3,017
- Climate Change (kg CO₂ eq): 445
- Ozone Depletion (kg CFC 11 eq): 1.31E-08
- Acidification Air (kg SO₂ eq): 2.96
- Eutrophication (kg N eq): 0.09
- Photochemical Ozone Creation (kg O₃ eq): 0.61

Declared Unit: 1 m³ of 10,000 psi concrete at 28 days
Building Material Quantities from Construction Estimates, BIM models and Tally

Into EC3
Building Material Quantities
from Construction Estimates, BIM models and Tally
Building Material Quantities

from Construction Estimates, BIM models and Tally

Into EC3
Kg CO2e from Environmental Product Declarations

*current database holds over 22,000 epds
The EC3 tool version v-17.1.2_b-1161 is in Public Beta, and continues to be developed with a broad range of stakeholders. To learn about, discuss, help define, and improve the EC3 tool, visit our EC3 Community Forum.

The Carbon Query Database is Online and contains:

- 22,289 Product Specific EPDs
- 432 Industry EPDs
- 317 Concrete
- 196 Steel
- 163 Ceiling Panels
- 83 Openings
- 81 Gypsum Board
- 40 Wood
- 39 Aluminium
Search for 5000 psi ready mix concretes in a region

- Search by known performance characteristics
- Apply Policy or Certification Compliance
- Filter by location
- Number of EPDs that meet search parameters

**Conservative 80% Benchmark**

**Achievable 20% Target**

**2019 CLF Baseline**

**SEARCH BY PROPERTIES: 03 30 00 CAST-IN-PLACE CONCRETE**

- **DESIGN INTENT**
  - Compressive Strength
  - @ Curing Time
  - Compressive Strength Other @ Curing Time
  - W/C Ratio
  - SCM

- **Compliance**
  - Buy Clean California 2020

**SEARCH RESULTS AND STATISTICS**

- Samples: 4744
- Achievable: 273 kgCO2e
- Average: 325 kgCO2e ± 0.0533
- Conservative: 386 kgCO2e

**Declared Unit: 1 yd³**

**Report Bugs & Feedback**
Comparison of 5000 psi ready mix concretes in a region

Ability to compare manufacturers and assess baselines and targets

30-50% REDUCTION (possible in regional supply chain)

2019 CLF BASELINE

5000 psi mix CONSERVATIVE BENCHMARK

5000 psi mix ACHIEVABLE TARGET
### Find & Compare Materials

**View details from the Search page**

**View the digitized EPD data for a specific product/mix**

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>Manufact.</th>
<th>Plant</th>
<th>Product</th>
<th>Description</th>
<th>Compress.</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shotcrete</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>ReadyMix</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5000 psi</td>
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</table>

**Organization Name:** Stoneway Concrete

- **Plant Name:** Black River
- **Product Name:** 458374C
- **Description:** F0, #8 CA, Control Flow
- **GWP:** 285 kgCO2e
- **Declared Unit:** 1 yd³

- **Concrete Compressive Strength 28D:** 5000 psi
- **Aggregate Size Max:** 0.374 in
- **Min Pipeline Size:** 1.5 in

**Original EPD File:** [DOWNLOAD EPD](#)

**Report Bugs & Feedback**
Every EPD is digitized

View the digitized EPD and download the PDF

ENVIRONMENTAL PRODUCT DECLARATION

Product Name *

458374C

DOWNLOAD

Date of Issue *
2019-05-27

Valid Until *
2024-05-27

EMBODIED ENVIRONMENTAL IMPACT

Declared Unit *
1 m³

Mass per 1 m³ *
2.4 Mg

Embodied GWP per 1 m³ *
303 kgCO₂e

Estimated Uncertainty
25%

PRODUCT SPECIFICATIONS for "458374C"

Product Description *
FD, #8 CA, Control Flow

FD, #8 CA, Control Flow

Compressible Strength 28D
34.5 MPa

Aggregate Size Max
0.374 in

Compressible Strength Other

Min Slump

Max Slump

Min Pipeline Size
1.5 in

W/C Ratio

SCM Min

SCM Max
Sankey Diagram for Building Project, Structural System

Simple visualization of available reductions based on current supply chain

Locally produced rebar

30% reduction possible in concretes

Large variance in emissions of rebar based on manufacturing location

2019 CLF Baseline

Achievable Embodied Carbon Target

Zero Embodied Carbon
Comparison of carpet tiles globally

Ability to compare manufacturers and assess baselines and targets

2019 CLF BASELINE
Carpet Tile CONSERVATIVE 80% BENCHMARK
Carpet Tile ACHIEVABLE 20% TARGET

50-75% REDUCTION
Sankey Diagram for Building Project, Tenant Improvement

Simple visualization of available reductions based on current supply chain

50% reduction possible for Carpet

2019 CLF Baseline

Achievable Embodied Carbon Target

Zero Embodied Carbon
Available Reduction (30% on average)
Realized Embodied Carbon for Project X

- Overall Building: 80 Kg CO2e/sf
- Concrete: 45 + 20 Kg CO2e/sf
- Steel: 20 + 15 Kg CO2e/sf
- Timber: 5 + 5 + 5 Kg CO2e/sf
- Aluminum: 15 + 10 Kg CO2e/sf
- Glazing: 5 + 5 Kg CO2e/sf
- Insulation: 5 + 1 Kg CO2e/sf
- Gypsum Board: 3 Kg CO2e/sf
- Ceiling Tiles: 1 Kg CO2e/sf
- Carpet: 2 Kg CO2e/sf

Legend:
- Blue: Baseline
- Orange: Achievable
- Gray: Realized
30% reduction in CO2 emissions
JUST BY having data and ASKING.
Market Transformation is Happening
Market Transformation is Happening

EC3 Users

Users by Stated Profession

- Architecture
- Landscape Architecture
- Structural Engineering
- Civil Engineering
- Life Cycle Assessment
- Research/Academia
- Construction
- Manufacturing
- Building Owner
- Sustainability Consulting
- Media
- Other

Active Users
Waitlist
Pilot Users

Nov 2018 to Nov 2019 (1 year)
Nov 2019 to Feb 2020 (12 weeks)

Nov 2019 to Feb 2020 (12 weeks)
Operational

Embodied

….and more!
The Embodied Carbon Network

- First free, industry network focused on embodied carbon
- Over 15 local network chapters and growing
- Over 2,000 network participants currently engaging

Chapters active/forming in:
ECN Austin
ECN Australia
ECN Atlanta
ECN Bay Area
ECN Boston
ECN Calgary
ECN Chicago
ECN Hong Kong
ECN NYC
ECN Pittsburgh
ECN Portland
ECN Rocky Mountain (Denver/Boulder)
ECN Seattle
ECN Toronto
ECN UK
ECN Vancouver
ECN Yellowstone

Join the ECN at: https://carbonleadershipforum.org
Operational

Policy

Embodied
Buy Clean California Act

State agencies, University of California and California State University System, construction materials industries, other interested parties can learn more about the embedded carbon emissions of construction materials used in public works projects.
Bay Area Low-Carbon Concrete Code

- First open access model policy language for low embodied-carbon concrete
- First local specifications for low embodied-carbon concrete
- Supported by 4 jurisdictions and over 30 industry partners

Access the code at:
Tools & Certifications
Operational

....and more!

Embodied

....and more!
Use EC3 database to assess market for EPD adoption.

Use EC3 project planner to set stage A1-A3 embodied carbon reduction targets

Use EC3 database to inform procurement and selection.

- First free, open-access tool for upfront embodied carbon
- First free, open-access database of EPDs
- Over 50 industry partners supported its development
- Over 5,000 registered users since its launch in Nov 2019
- New non-profit established to continue its development

Register for tool at: www.buildingtransparency.org
Thank you!

stacy.smedley@buildingtransparency.org