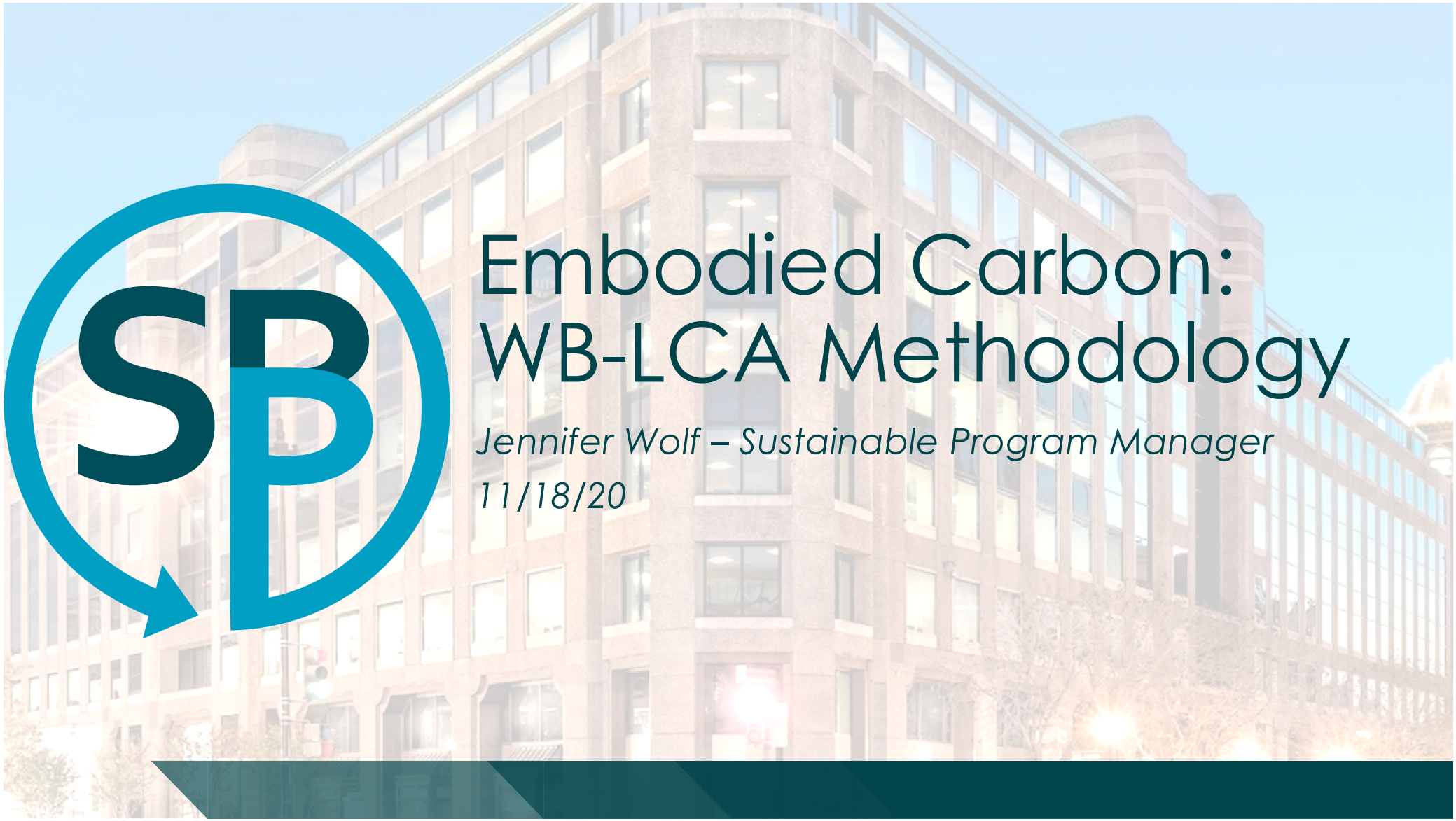


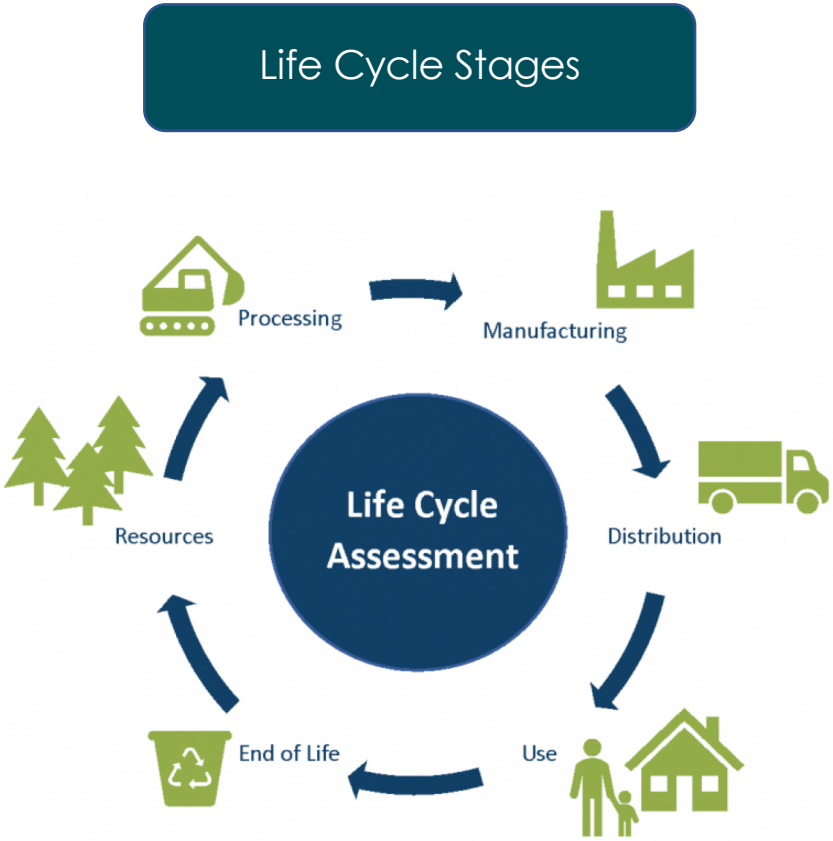
Embodied Carbon: WB-LCA Methodology

Jennifer Wolf – Sustainable Program Manager

11/18/20

Overview

Life Cycle Assessment (LCA) is used as a tool to assess the environmental impacts of a product, process or activity throughout its life cycle; from the extraction of raw materials through to manufacturing, transport, use, and disposal.



Types of LCAs

EPDs
Life cycle assessment of a product (cradle to gate).

Whole Building LCA
Assessment that uses EPDs for all products included in a building (focus on structure and enclosure) to quantify impact (cradle to grave).

Product EPDs are the building blocks of a whole building LCA.

SUSTAINABLE BUILDING PARTNERS

Goals

LEED v4.1 Whole-Building LCA Requirements

Path	Point(s)	Criteria
Path 1	1	Conduct an LCA of the project's structure and enclosure.
Path 2	2	**Path 1**
		+ at least 5% reduction in three (3) impact categories
Path 3	3	**Path 1**
		+ at least 10% reduction in three (3) impact categories
Path 4	4	**Path 3**
		+ 20% reduction for global warming potential
		+ incorporate building reuse and/or salvage materials
All projects achieving Paths 2, 3, or 4		GHG must be one of the three impact categories met
		No impact category assessed as part of the life-cycle assessment may increase by more than 5% compared with the baseline building.

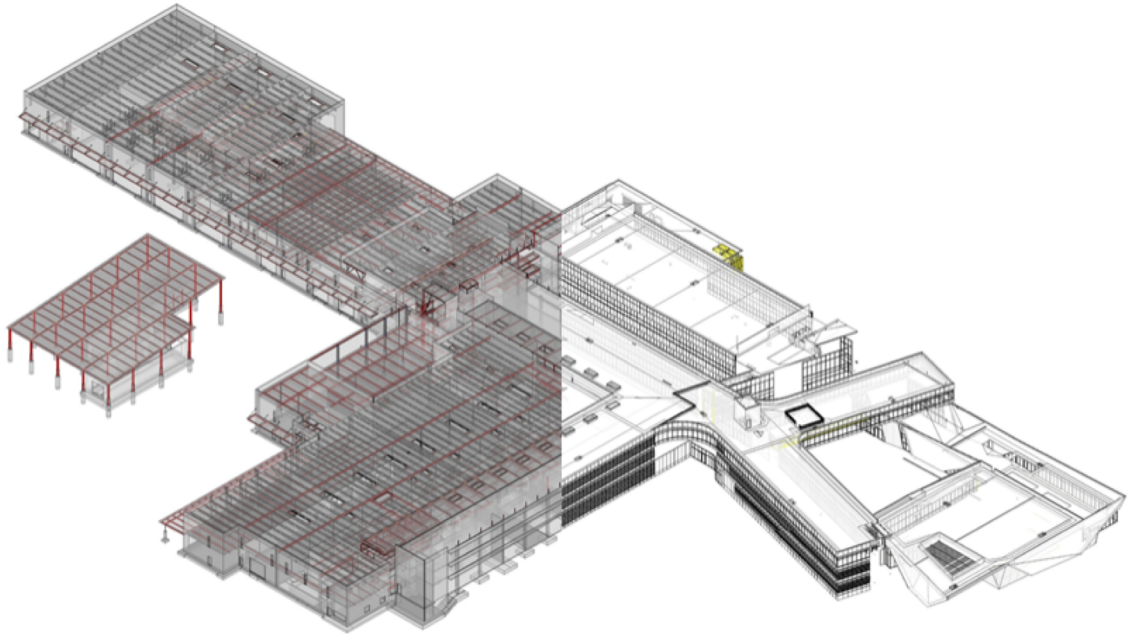
Impact Categories

- Global Warming Potential (GHG)
- Depletion of Stratospheric Ozone (SOL)
- Acidification (ALW)
- Eutrophication (EUT)
- Formation of Tropospheric Ozone (FTO)
- Depletion of Nonrenewable Energy Sources (DNR)

LCA Scope

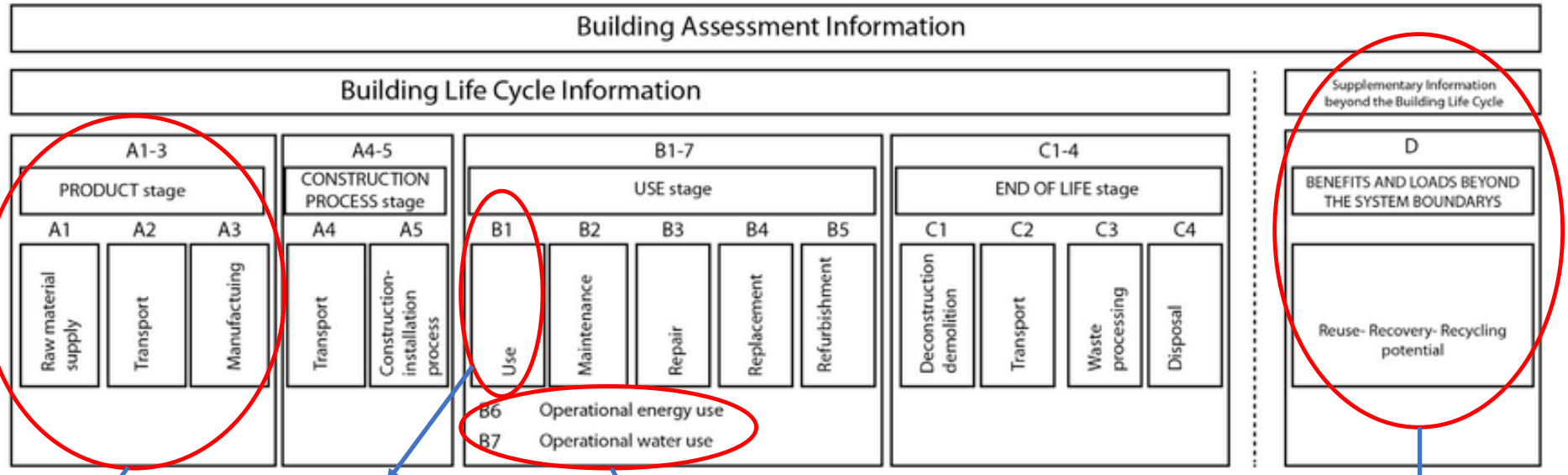
Structure
Foundations
Columns
Beams
Slabs

Enclosure
Façade Finish
Sheathing
Insulation
Framing
Drywall
Windows
Roof



SUSTAINABLE BUILDING PARTNERS

Modules



EPDs

Not required in LEED Boundary

Not included in LEED Boundary

Not required in LEED Boundary, sometimes in C

SUSTAINABLE BUILDING PARTNERS

Software

Athena
Sustainable Materials
Institute

Assessment

- TRACI, version 2.1 or newer
- CML, version 2001–November 2012 or newer
- ReCiPe, version 1.07 (midpoints) or newer

Methodology

Baseline

Options
1. Archetype (industry standard)
2. Early Design
3. Existing Building

Criteria
- Thermally similar
- Functionally equivalent
- Same Gross Area

Reduce Material Quantity

Use Product Specific EPDs

Reduce Distance to Manufacturer

Decrease Replacement Frequency

Design

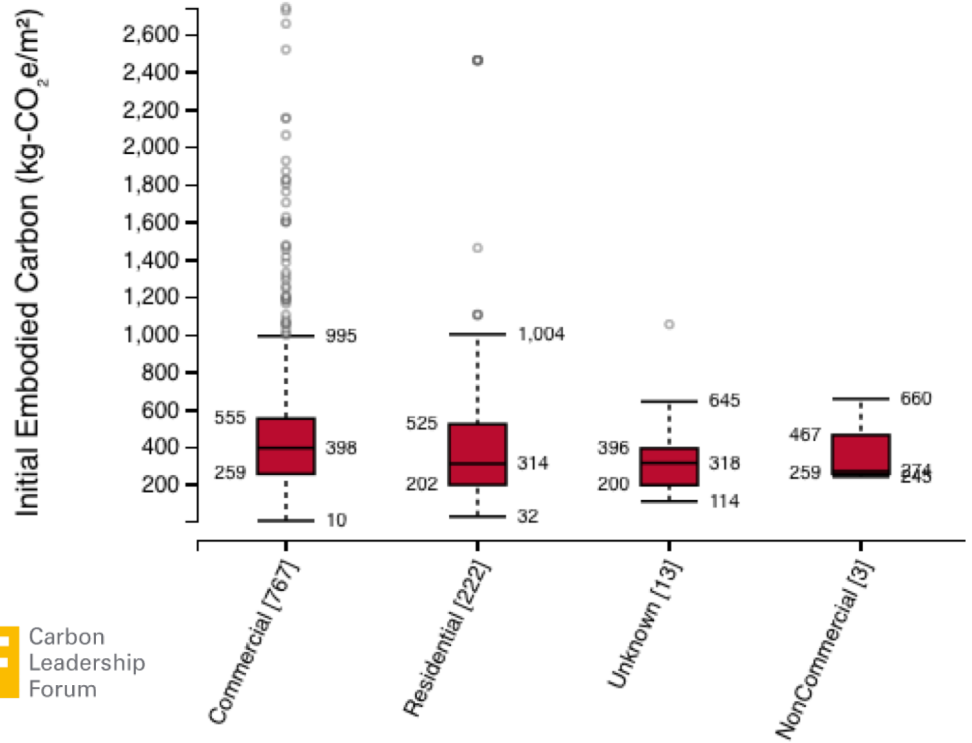
- Final documents
  - REVIT Model
  - Energy Model
  - Specifications
- Installed materials
  - Submittals

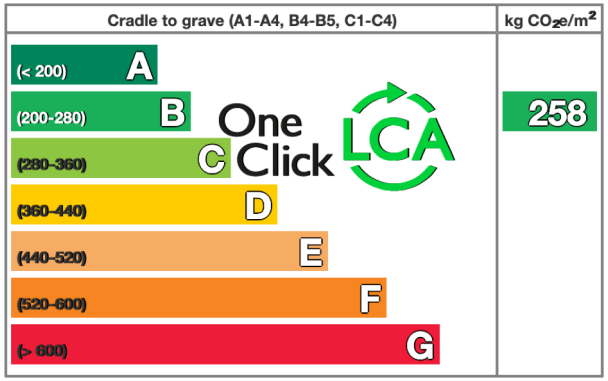
SUSTAINABLE BUILDING PARTNERS

Timing

SD – Schematic Design	• Massing Comparison • Evaluate structure + envelope concepts
DD - Design Development	• Hot Spot Analysis • Quantify materials and their impacts
CD – Construction Documents	• Impact Reducing Specification Language • Identify key materials
CA – Construction Admin	• Impact Reducing Materials • Confirm incorporation of key materials

Benchmark - Buildings





Carbon Leadership Forum

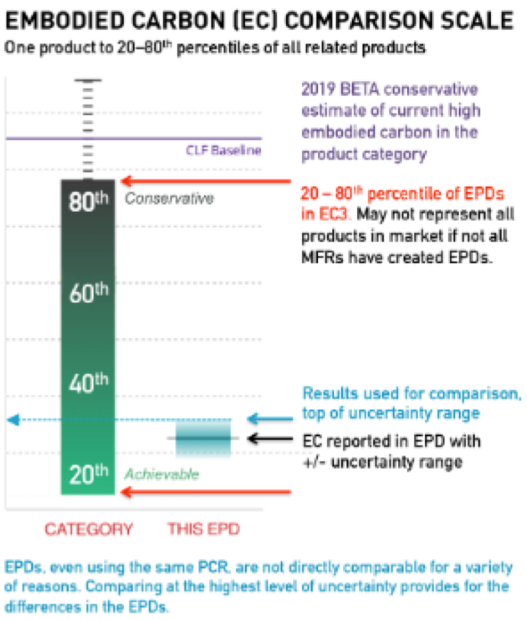
Limitations: Better data that is needed to enable benchmarking

https://carbonleadershipforum.org/embodied-carbon-benchmark-study-1/

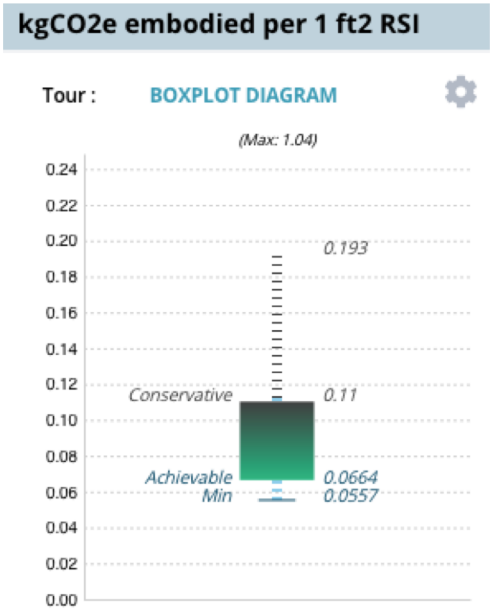
SUSTAINABLE BUILDING PARTNERS

Benchmark - Materials

Methodology



Specification



Selection

EcoTouch® PINK® FIBERGLAS™ Batt & Roll Insulation - Kraft Faced	EPD | UL	C2Grave, N. America
	CO2e | EC3	20th percentile

https://buildingtransparency.org

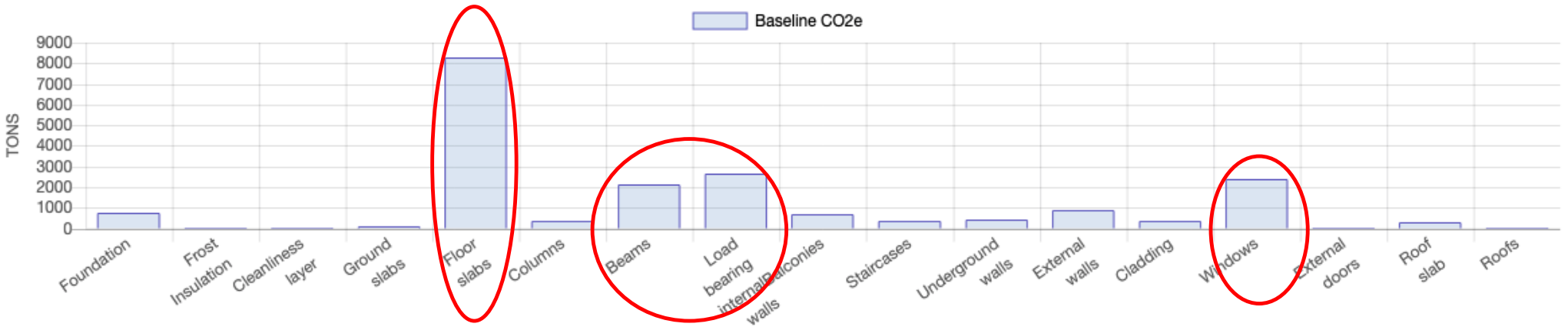
SUSTAINABLE BUILDING PARTNERS

Challenges

- Increase the use of LCA in early-design decision making
- Guidelines to improve quality, consistency, comparability of results
- Standardized definition or process of “defining a baseline”
- Standardized process for characterizing bill of material information
- Data is limited
- Pace of data evolution

SUSTAINABLE BUILDING PARTNERS

Element Impact Opportunities

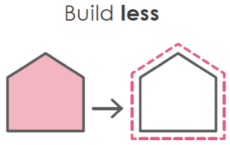


Reference Project – 750,000 sf Multifamily Project – OneClick Results

SUSTAINABLE BUILDING PARTNERS

Strategies - Elements

Build Less
- Re-use existing buildings and components.
- Share spaces; make them multi-functional.
- Simplify the design.
- Consider structure as a finish.



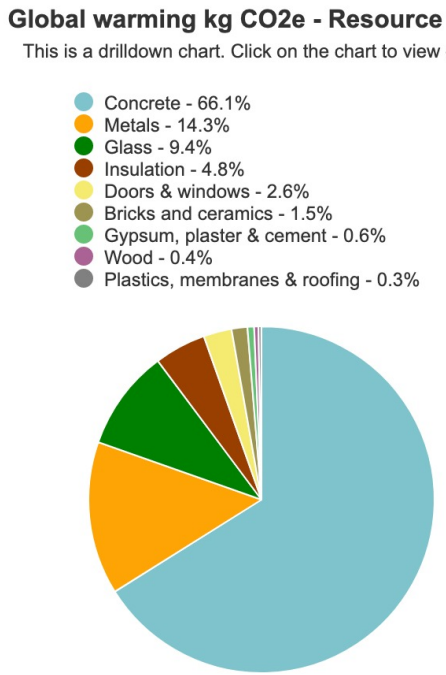
Build Wise
- Ensure longevity and durability.
- Identify material efficiencies, like a repeating module.
- Design for 100% utilization rate where possible.
- Reduce transport distance.

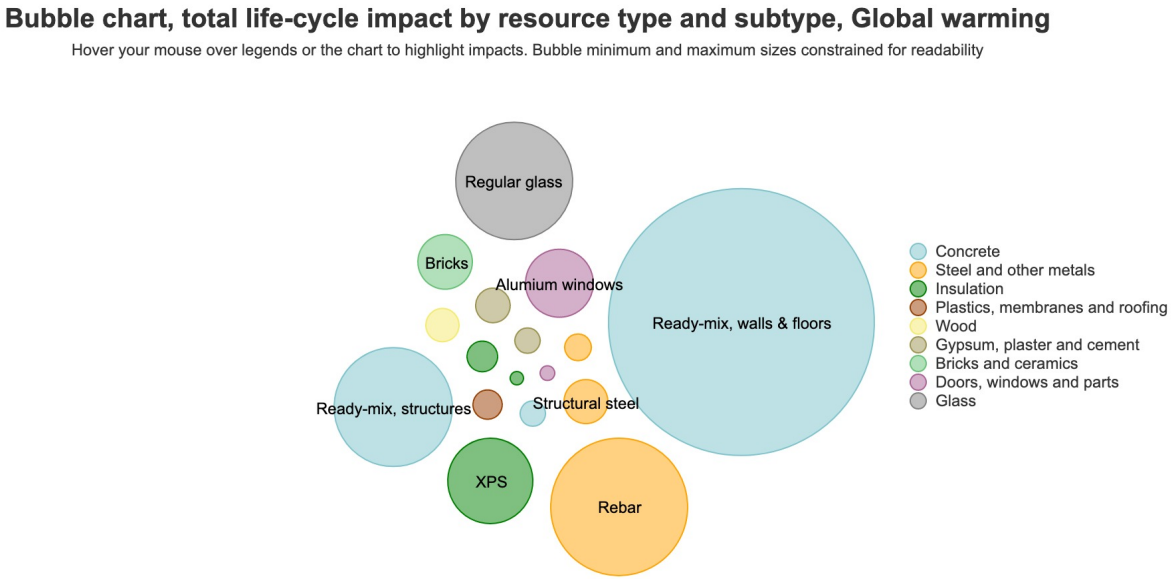
Build Light
- Re-visit structural strength requirements.
- Reduce dead load.
- Limit oversized structural members.

Build Low Carbon
- Identify 'big ticket items', focus on 'big wins' first
- Consider natural and renewable materials.

SUSTAINABLE BUILDING PARTNERS

Material Impact Opportunities



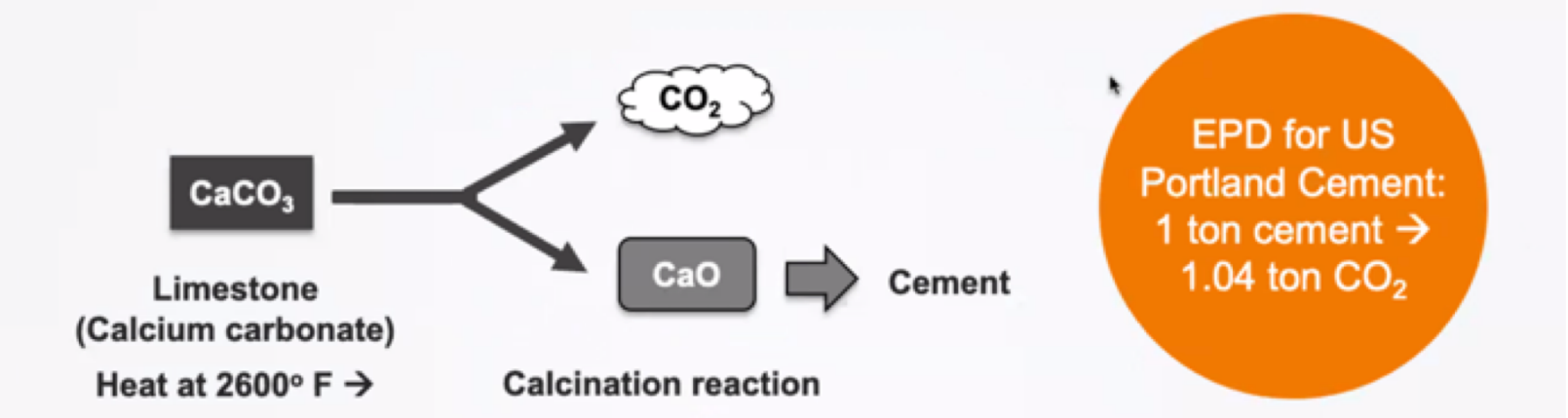


Reference Project – 750,000 sf Multifamily Project – OneClick Results

SUSTAINABLE BUILDING PARTNERS

Concrete Overview

Cement → 12% of weight / 95% of CO2



Not-So-Fun Fact: Cement is responsible for 8% of global CO2 emissions.

Concrete Strategies

Goal: Cement Management for Low Carbon Concrete

Strategy	Impact
Increase recycled content (slag, other SCMs) **beyond 20%, which is considered baseline*	Increases strength Increases durability Decreases early strength gain, may impact schedule Limited quantity for long-term/global strategy
Use alternative cementitious matls and aggregates (portland-limestone cements, etc)	Regional variability in availability Performance considerations
Use carbon sequestration (CarbonCure)	Increases strength by ~10% (hydrates better) Decreases cement quantity, GWP (2.5%) Increases cure time, may impact schedule Decreases durability and service life
Limit early strength requirements (>28 days when possible)	Increases slag and carbon sequestration content Increases project schedule
Decrease transportation distance **30 mi used in baseline*	Decreases GWP

Specifications

- Prescriptive (current)
  - Min cementitious rqmt
  - Max SCM content
  - Max water/cement ratio
- Performance (consider)
  - Design strength (>28 days)
  - Early-age strength
  - Thermal limits
  - Shrinkage (if applicable)
  - Permeability
  - Exposure class
  - Test Data
  - GWP

SUSTAINABLE BUILDING PARTNERS

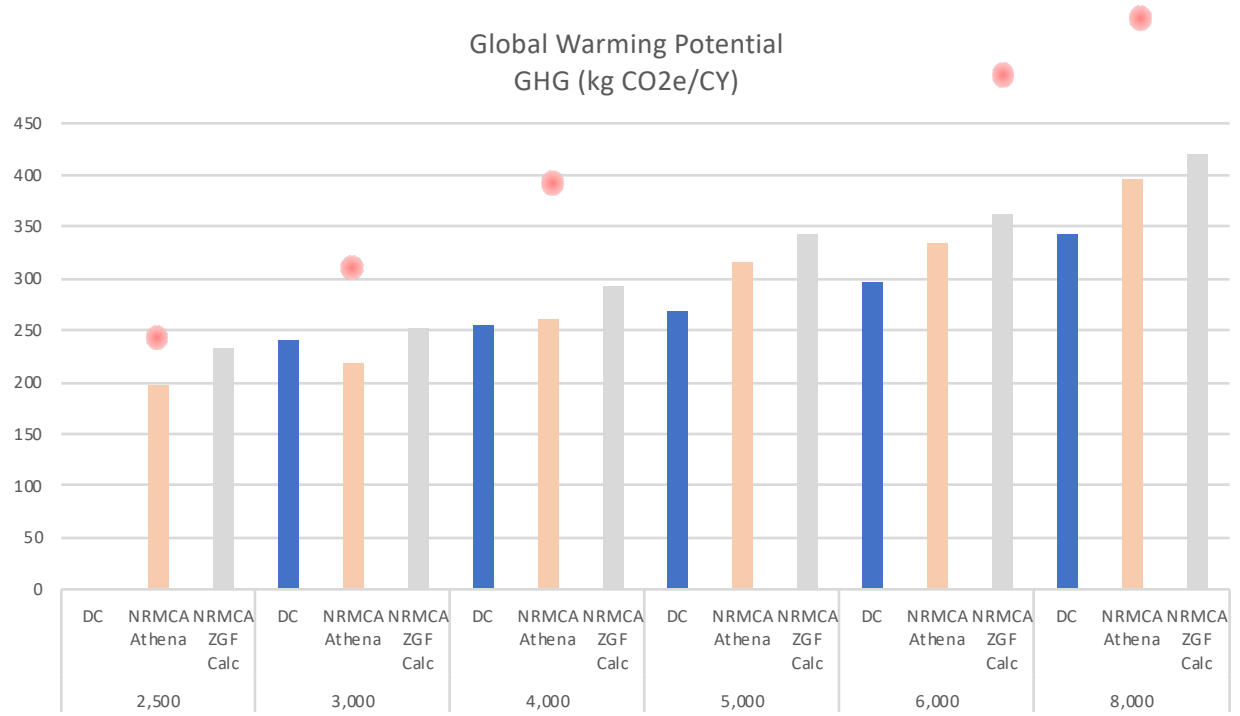
Concrete - Carbon Benchmark

- Level of uncertainty in data

  (wide variation in benchmarks)

- Full GWP reductions not realized in mixes without EPDs

  (SCMs & CarbonCure absent)



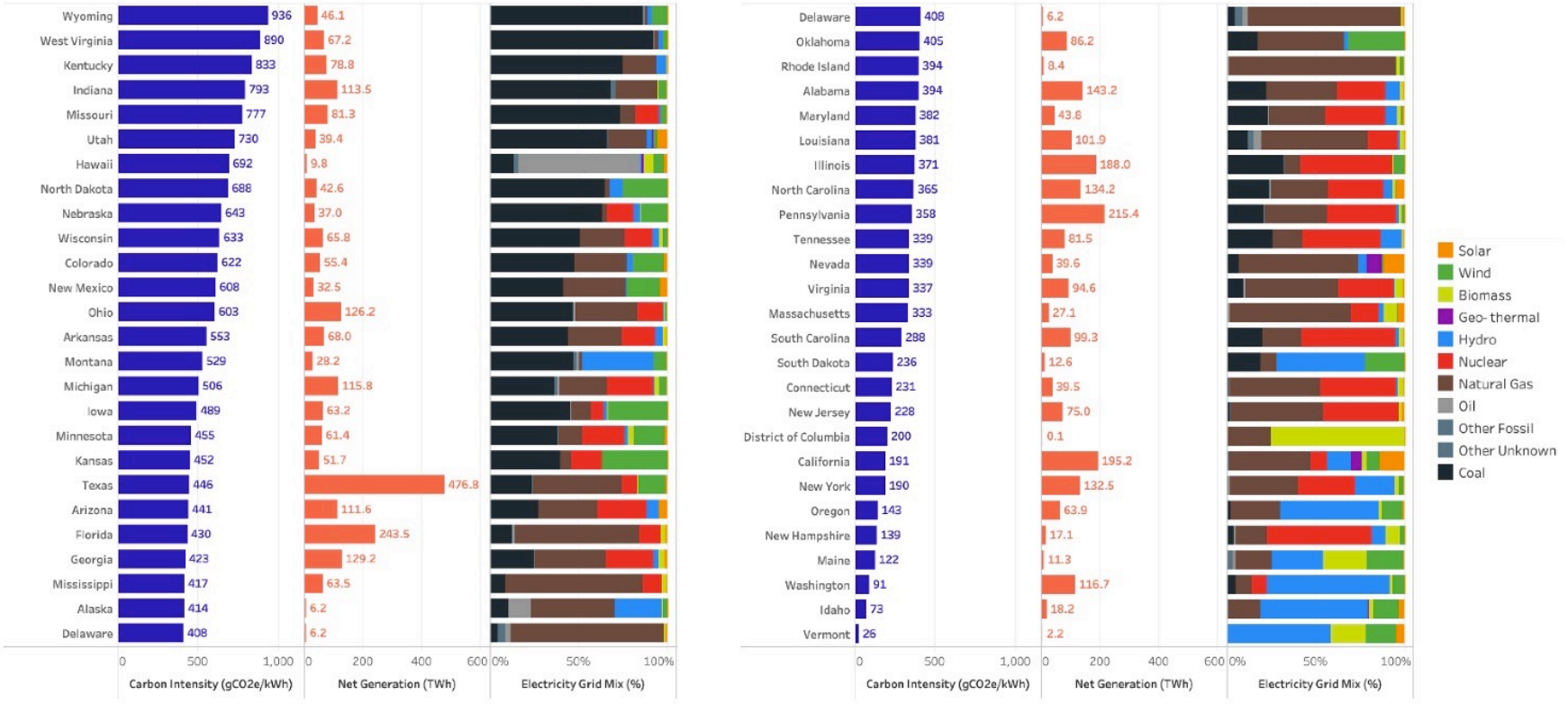
SUSTAINABLE BUILDING PARTNERS

Steel Strategies

- Steel Production
  - Basic Oxygen Furnace (coal/natural gas)
  - Electric Arc Furnace (local-electric grid)
- EAF
  - 68% of US Steel
  - Uses recycled scrap
  - Hot-rolled shapes and rebar
- Industry-average recycled content (baseline)
  - 75% (rebar) – 98% (HSS) recycled content
- Consider EAF and transport distance

United States - Electricity Grid Carbon Intensity

(gCO2e / kWh)



(Data Source: EPA eGrid 2018, Visualization by Priopta)

SUSTAINABLE BUILDING PARTNERS

Aluminum Strategies

- Manufacturing – 10x electricity of steel
- Local electric grid matters
- Recycled aluminum uses 95% less energy
- Recycled aluminum can meet 30% demand

Reduce quantity
(but balance energy performance impacts)

Insulation Strategies

- XPS and spray foam high embodied carbon
- .. due to HFC blowing agents (1000x of CO2)

Consider natural sequestration materials

(but balance thermal performance & moisture requirements)

SUSTAINABLE BUILDING PARTNERS

Thank You!


sustainbldgs.com
SUSTAINABLE
BUILDING PARTNERS
JENNIFER WOLF, LEED AP BD+C,Homes
Sustainable Program Manager
o: 703-970-2890 x215
e: jennifer.wolf@sustainbldgs.com
2701 Prosperity Avenue, Suite 100
Fairfax, Virginia 22031
sustainbldgs.com