PRE-DESIGN		EARLY SD		50% SD		100% SD	EARLY DD		50% DD		100% DD	
Overall budget, program, and pro-forma set	*Draft of overall schedule set for project planning*	*OPR complete*	*Building siting (orientation + massing) set*	*Building type/ code set*	*Major systems set*	*Structural + envelope performance criteria set*	*Draft construction schedule set*	*Secondary structural systems set (curtain wall, etc.)*	*Outline specifications*	*Exterior elevations set*	*D-B: Manufacturer/ vendor chosen*	*Exterior assemblies set*

WHOLE BUILDING

SET GOALS
- Operational carbon: Set energy use intensity (EUI) goals + fuel source
- Embodied carbon: Set carbon intensity limits ($kgCO_2eq/sf$), % reduction targets, and/or limits
- Rating system metrics

LCA: MASSING COMPARISON
Study massing options

Establish relevant regulations and rating systems (Buy Clean CA, LEED, LBC, etc.)

Set baseline if tracking relative improvements (% reduction)

HOT SPOT ANALYSIS
- Perform whole building LCA
- Identify top material impacts
- Establish strategies for reducing or optimizing materials with the biggest impact

Identify optimization opportunities (see "Materials" section below)

Update LCA model + track change in life cycle impacts over DD

STRUCTURE

REVIEW GOALS
- Architect and engineer discuss carbon reduction + goals
- Discuss schedule + budget implications with contractor (D-B)
- Work with geotechnical engineer + structural to optimize foundations

LCA: STRUCTURAL COMPARISON
- Study structural concepts + alternatives
- Confirm most appropriate system (P.T. vs. mild, steel, wood, etc.)

STRUCTURE FIXED
- Structural performance criteria is fixed (loads, design strength, serviceability)
- Incorporate embodied carbon reduction targets

STRUCTURAL HOT SPOTS
- Push for cement reductions if using concrete (topping slab, mat foundations, and other low-hanging fruit at a minimum!)
- Consider schedule implications

Architect/engineers collaborate to reduce volume of structural materials as possible

Finalize reduction strategies in structure (e.g. cement reduction in concrete, sourcing goals for steel, etc.)

ENVELOPE

Envelope constraints set through code analysis, daylighting + energy modeling studies

LCA: ENVELOPE STUDIES
- Compare facade + assembly design options
- Test assemblies - insulation layers, etc.

ENVELOPE HOT SPOTS
- Identify target item reductions
- Push for low carbon insulation + other hot spots

Identify optimization opportunities (see "Materials" section below)

Establish reduction strategies for envelope (e.g. insulation preference, window type, etc.)

MATERIALS

Collaborate to create new product/ ingredients or use existing material?

NEW EXISTING

(EXISTING) LOW-IMPACT PRODUCT SELECTION

Architect/interior designers collaborate to reduce hot spots through reduction or materials selection

Review Existing EPDs and LCA Data and select low impact options

Collaborate with manufacturers to pursue 3rd party-verified mill- or manufacturer-specific data if possible

NEW PRODUCT DESIGN

New product research and testing

Finalize chemical composition of new product

New product R+D complete

ROAD MAP TO REDUCING BUILDING LIFE CYCLE IMPACTS

A TIMELINE OF KEY MILESTONES + ACTIONS

BY THE CARBON LEADERSHIP FORUM

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Reducing embodied carbon and other life cycle impacts in construction requires collaboration between designers, builders, and manufacturers across the building sector. This timeline suggests milestones for ensuring teams can take action before 'the last responsible moment.' Every project is different, but this is a complex process requiring early interaction and engagement for success.

For additional introduction and definitions, please see the online version of this timeline on the Carbon Leadership Forum website (http://www.carbonleadershipforum.org)

In the interest of minimizing embodied carbon, the first questions that owners and designers should ask themselves before embarking on a project are:
- Is a building required?
- Can you re-use an existing building?
- Can you build a smaller building?

EARLY CD	50% CD	100% CD	BIDDING	CONSTRUCTION	BUILT

Specifications set — *Rating system design credits submitted* — *Buy-outs complete*

LCA: CONFIRM REDUCTION STRATEGIES
- Confidence can achieve reduction goals
- LCA calcs on design complete

SPECS/DESIGN CALCS
- Confirm reduction strategies are specified
- Research best in class GWP and identify 3+ materials to specify

Update LCA Model, track changes in CDs

+ Submit calculations if applying for rating system credits

Design team + builder collaborate to ensure % reductions included in bid requirements

SUBMITTALS
- Confirm optimizations maintained through buy-out

FINAL ASSESSMENT
- Update LCA model per submittals
- Calculate project GHG emissions
- Calculate % below or above LCI targets
- Reflect on differences between design and as-built LCA and identify future strategies

SHARE
- Document results in firm database
- Share your results + lessons learned!

SPECS/DESIGN CALCS
- Confirm reduction strategies are specified
- Research best in class GWP and identify 3+ materials to specify

Design team + builder collaborate to ensure % reductions included in bid requirements

SUBMITTALS
- Collaborate to set final concrete mixes if using
- Update LCA to reflect final design

SPECS/DESIGN CALCS
- Confirm reduction strategies are specified
- Research best in class GWP and identify 3+ materials to specify

Design team + builder collaborate to ensure % reductions included in bid requirements

SUBMITTALS
- Confirm optimizations maintained through buy-out

Design-Build: Work with Builder to select products with lowest (verified) impact

D-B-B: Discuss Spec Feasibility: How To Incorporate, Select Product type with lower industry average as well as product specific choices

REVIEW SPECS FOR IMPACT REDUCTION
- Identify 3+ materials to specify that meet reduction goals based on research
- Incorporate new product if applicable

Design Team + Builder Collaborate To Ensure % Reductions Included In Bid Requirements

BUY-OUT + SUBMITTALS
- Track optimizations through submittal process
- Work with builder to ensure % reductions maintained throughout buy-out

OPTIMIZE: NEW PRODUCT VERIFICATION

Assemble Manufacturing Data For Lca

LCA Of New Product (By Manufacturer)

EPD Certification

Publish New EPD For Product