

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 ₂ eq/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 + alternatives 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.)

ROAD MAP TO REDUCING BUILDING LIFE CYCLE IMPACTS

A TIMELINE OF KEY MILESTONES + ACTIONS

BY THE CARBON LEADERSHIP FORUM

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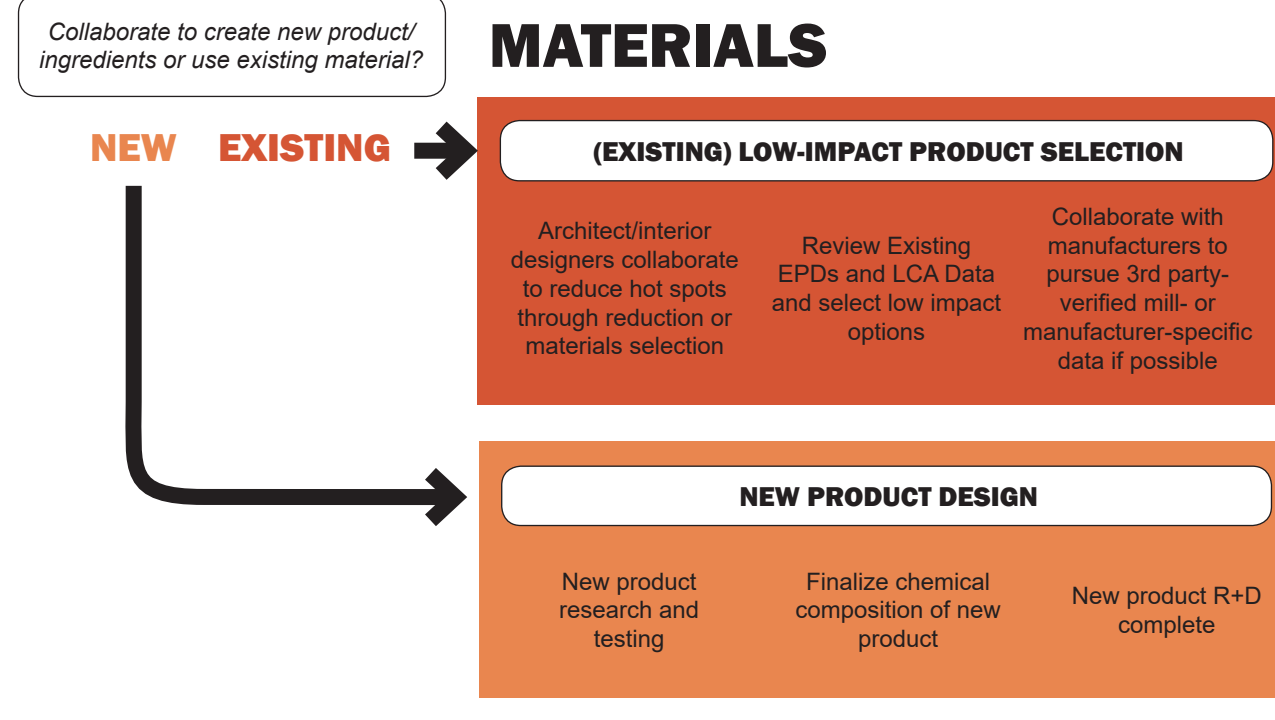
Additional thanks to the Seattle LCA Roundtable for providing early input.

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.

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?

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



EARLY CD	50% CD	100% CD	BIDDING	CONSTRUCTION	BUILT	
	Specifications set	Rating system 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		
Assemble Manufacturing Data For Lca	LCA Of New Product (By Manufacturer)	EPD Certification	Publish New EPD For Product			