

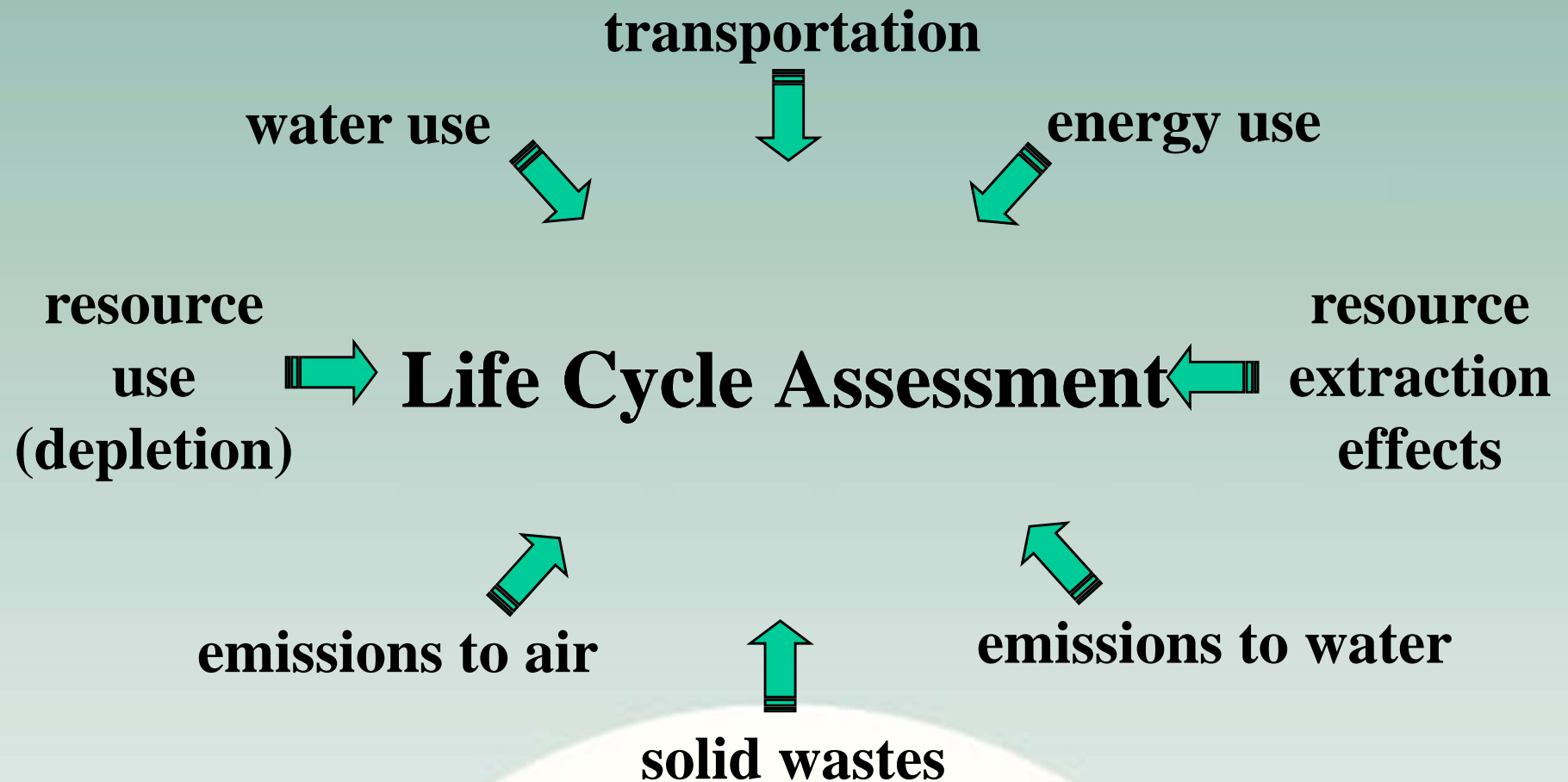
Window Life Cycle Assessment Project

Center for Sustainable Building Research, University of Minnesota

Athena Institute

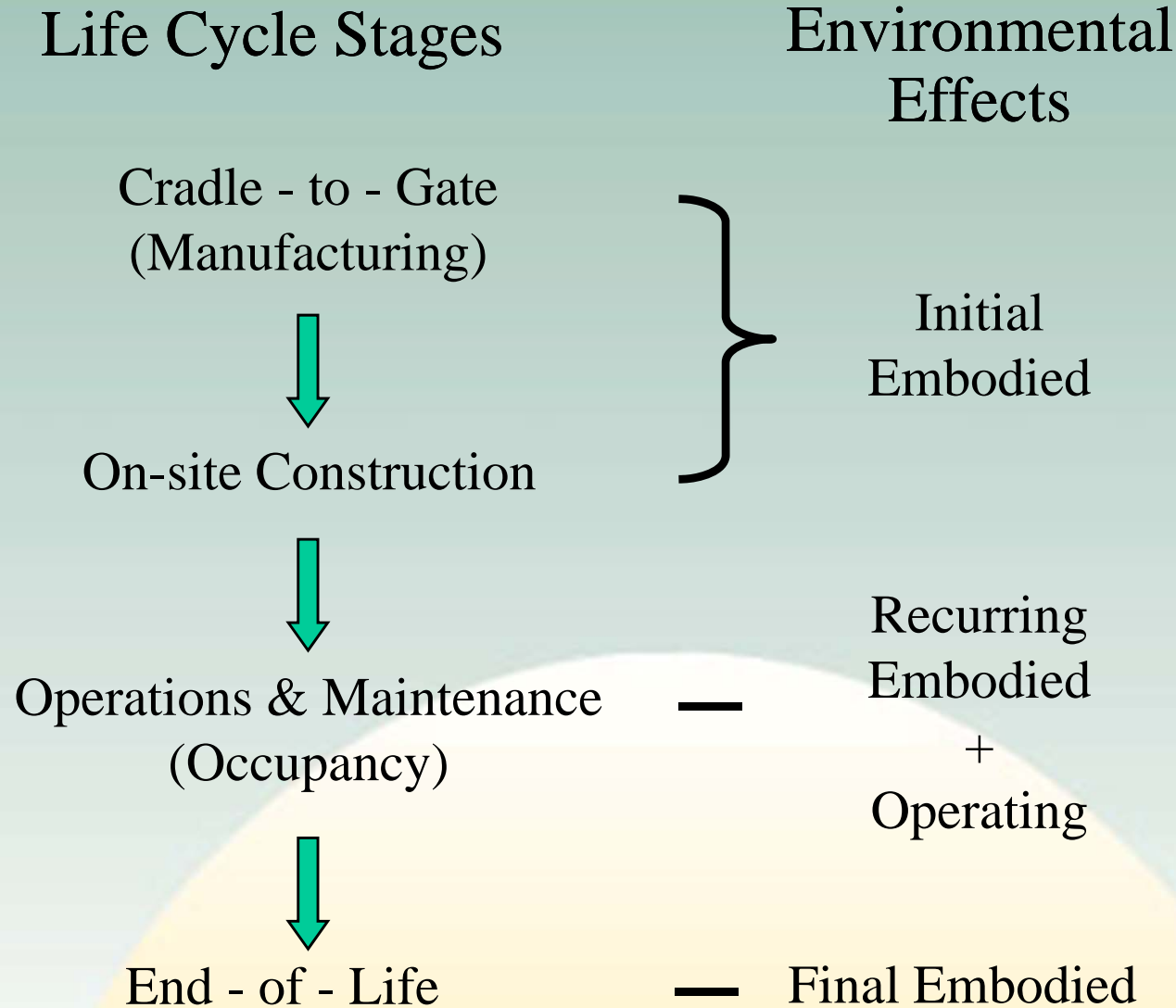
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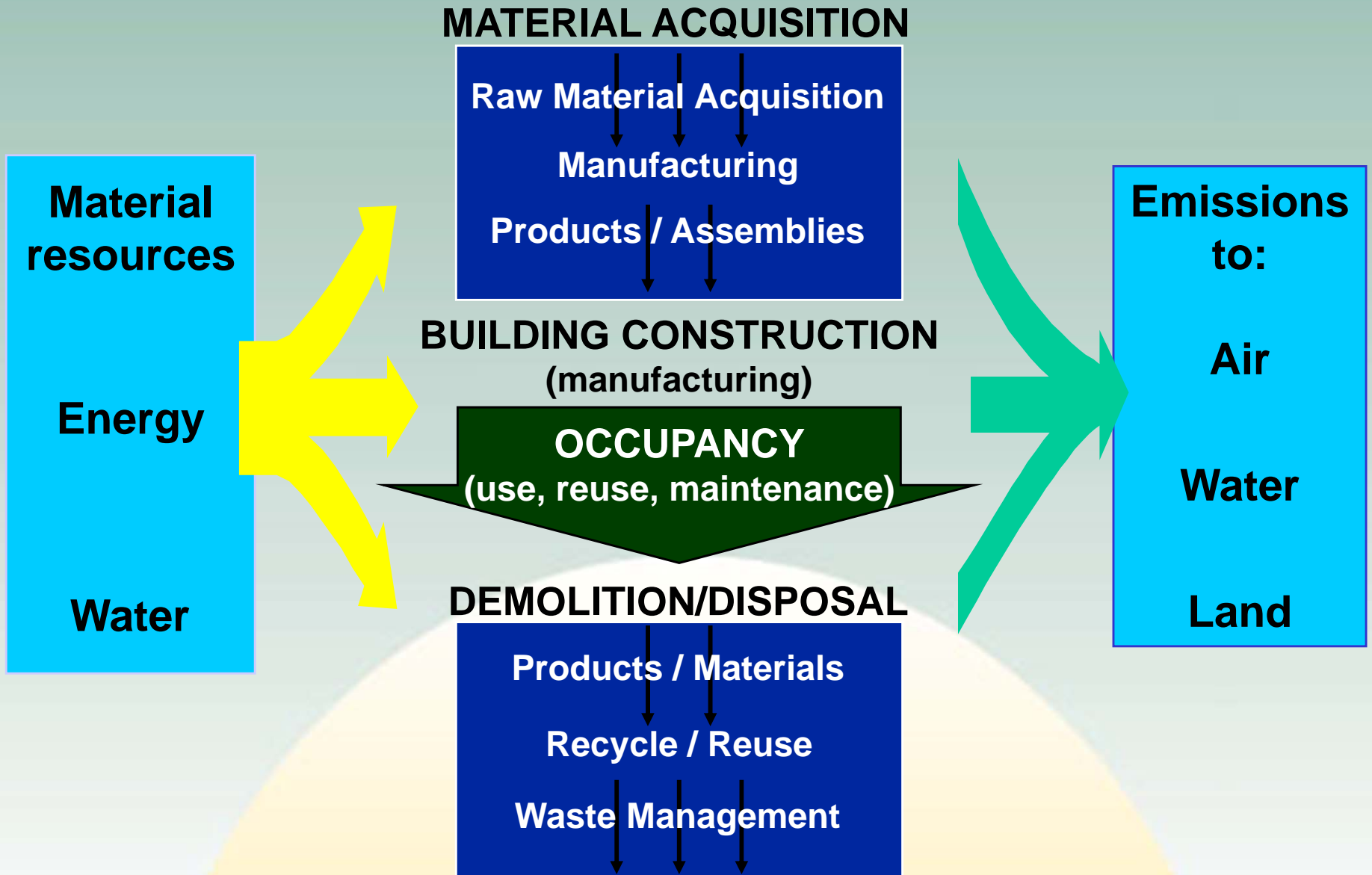


a methodology for assessing the life cycle environmental performance of products and processes

Life Cycle Stages and Effects



Building Life Cycle Inventory



LCA for Windows: Scope & Goals

Document completed in March 2010 with help from stakeholders representing US government departments and industry associations. Commissioned by the US Department of Energy (DOE).

There are **two fundamental goals** for undertaking this LCA that reflect the different needs of the potential users of the results.

Primary Goal: to provide accurate LCA profiles of representative window types to quantify differences between the most common applications and for use in prescriptive rating systems (ENERGY STAR program, USGBC's LEED program and GBI's Green Globes program) based on these results.

Secondary Goal: to generate modular process data for manufacturing window components and window units for use by LCA practitioners in case studies and to generate calculation tools for a wider audience, and for use in rating systems based on calculated LCA results for individual applications.

LCA for Windows: Scope & Goals

Residential Functional Unit:

Application (12): 914mm x 1524mm (double hung, 3' x 5') and 1200mm x 1200mm (fixed) windows installed in single family house for 85 years—modeled in six different climates

Operability (2): fixed and double hung (casement published in database)

Glazing Type (4): double and triple glazed, produced with sputter coat and hard coat low-E glass—all with argon fill, spacer (develop weighted average reflective of the majority of the current market: aluminum, stainless steel, nickel-plated tin).

Frame Type (4): vinyl, fiberglass, aluminum clad wood, and vinyl clad wood (unclad wood included in database)

Commercial Functional Unit:

Application (18): 1500mm x 2500mm (fixed), 900mm x 1500mm (casement) and 1500mm x 2500mm (curtain wall) windows installed in a high-rise office building for 73 years—modeled in six different climates

Operability (3): fixed, casement, and curtain wall

Glazing Type (4): double and triple glazed, produced with sputter coat and hard coat low-E glass—all with air fill, and aluminum spacers

Frame Type (2): fiberglass and aluminum

LCA for Windows: Work Plan & Budget

Document completed in August 2010 with help from stakeholders representing US government departments and industry associations. Commissioned by the US Department of Energy (DOE).

PHASE I (Cradle-to-Gate): Work Plan Elements and Tasks

Primary Gate-to-Gate Data Collection

Primary manufacturing processes are those specific to windows and require firsthand data collection as to waste generation and resource use. Window manufacturing can take several forms.

Frame Manufacturer, IGU Manufacturer, Hardware manufacturer, Assembler (Job Shop), Integrated Manufacturer

Upstream Secondary Data Collection

The upstream resource, intermediate product and energy LCI data for each of the processes (e.g., cradle-to-gate softwood lumber manufacture, PVC resin, primary and secondary aluminum billets, etc.) will be based on the most up to date secondary data sources (e.g., US LCI database, American Chemistry Council, World Steel Organization, the International Aluminum Institute and other LCI databases).

LCA for Windows: Work Plan & Budget

Process and Product	Min. No. of surveys	Max. No. of surveys	Notes
Frame Manufacturer			
Wood lineal	3	10	Milled wood lineal to assembler
Vinyl Lineal	3	10	Extruder to assembler
Fiberglass lineal	3	10	Protruder to assembler
Aluminum lineal and/or mullion	3	10	Extruder to assembler
IGU Manufacturer	3	10	May need up to 10 to cover the breadth of glazing and coating type configuration and float glass production
Hardware manufacturer			
Steel components	3	10	Smaller number of manufacturers, some of which may produce steel and plastic components—they also represent a small proportion of the total window assembly
Plastic components	3	10	
Assembler (Job Shop)	3	10	Large number of these facilities—do we need a representative sample for each lineal type? May increase survey size exponentially
Integrated Manufacturer	3	10	Smaller number of these large facilities, but each may specialize in a certain frame type (e.g. wood, vinyl, etc.)
Grand total	27	90	Upwards of 100 surveys
Likely total (bold values above summed)	9	60	Upwards of 70 surveys

LCA for Windows: Work Plan & Budget

At the end of Phase I complete **cradle-to-gate** LCI data modules and results will be available for the various residential and commercial window units/systems. The LCI data modules will be scalable to facilitate analysis of other window dimensions or components.

LCA for Windows: Work Plan & Budget

PHASE II (Gate-to-Grave): Work Plan Elements and Tasks

Primary Installation, Maintenance and Replacement

Thermal Performance

End-of-Life

Completion of Phase II will culminate in the development of complete cradle-to-grave LCA of the various window systems.

LCA for Windows: Deliverables

Phase I deliverables will summarize the cradle-to-gate research (supply chain profiles that span from resource extraction to manufactured window unit or components at the plant):

- Interim report summarizing the cradle-to-gate data development. This report will document the various functional unit permutations and quantity take-offs, building archetypes and component make-up, gate-to-gate LCI based on questionnaires, and cradle-to-gate LCI model developed by integrating manufacturing data with upstream secondary datasets.

Phase II deliverables will summarize the cradle-to-grave research (cradle-to-gate results plus installation, use, maintenance, replacement and end-of-life treatment):

- Final report that incorporates the interim report with a summary of the gate-to-grave data development. This report will document the Phase I findings and the assumptions regarding installation, maintenance/replacement, and the results of the end-of life survey.
- Confidential LCA reports to participating manufactures/suppliers.
- Modular database whereby additional window permutations and combinations may be assessed. This database will be made publicly available via the US LCI Database.

LCA for Windows: Budget

PHASE I Tasks	Estimated Budget
Develop functional unit permutations and combinations quantity take-offs	\$17,500
Finalize building archetypes and component make-up	\$8,550
Primary gate-to-gate data questionnaire development, collection and modeling in LCA software	\$99,000 \$137,500
Upstream secondary data collection and integration with survey data	\$20,000
Reporting interim and final Phase I results report	\$18,000
CSBR personnel and expenses including project administration	\$40,515
Total Phase I Budget Estimate	\$203,565 \$242,065
PHASE II Tasks	Estimated Budget
Installation, Maintenance/Replacement and End-of-life disposition survey and related literature review	\$35,000 \$45,000
Thermal performance (use phase) modeling	\$45,000
End-of life modeling	\$7,000
Reporting - interim and final Phase II results report	\$18,500
Cradle-to-Grave Database Development + upload to US LCI database	\$15,000
CSBR personnel and expenses including project administration	\$23,070
Total Phase II Budget Estimate	\$143,570 \$153,570
Total Phase I & II Project Estimate	\$347,135 \$395,635
Less commitment from DOE (\$35,000) and EPA (\$25,000)	\$287,135 \$335,635

LCA for Windows: Next Steps

Secure funding for completions of Phase I (\$203,565–\$242,065)

- 50K commitment from US DOE (15K already spent on document development/coordination)
- 25K commitment from US EPA
- Request for funding submitted to NFRC (\$7,500)
- Request for funding submitted to industry associations

Secure funding for completion of Phase II (\$143,570–\$153,570)

- Commitment from US DOE (amount unknown at this time)
- Commitment from US EPA (amount unknown at this time)
- Request for funding will be submitted to NFRC
- Request for funding will submitted to industry associations

Questions or Comments

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