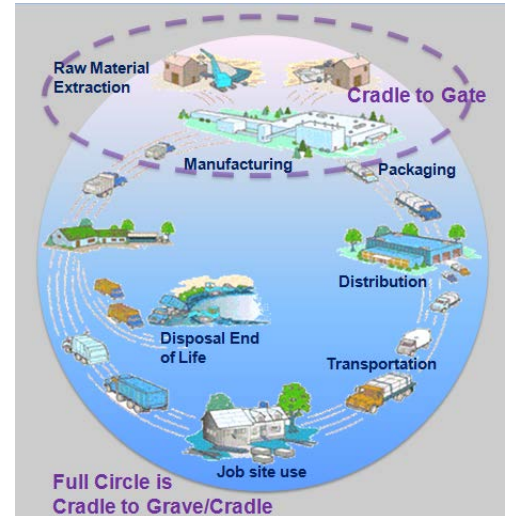


Life Cycle Assessment (LCA)

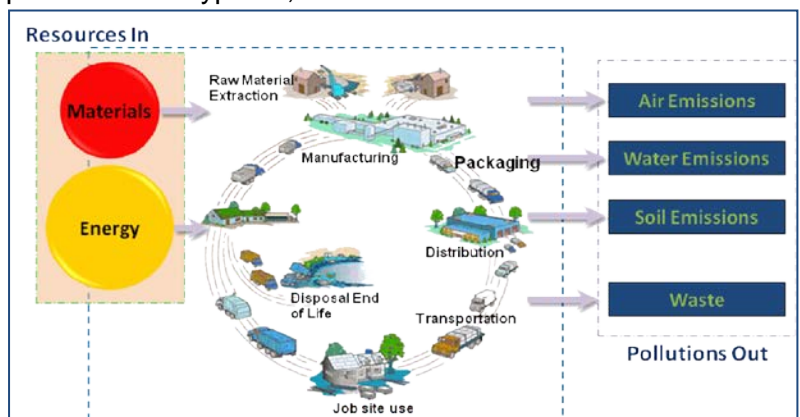
All products have positive and negative impacts on the environment and future generations. The scientific review of these impacts is referred to as the Life Cycle Assessment (LCA) of that product. LCI (Life Cycle Inventory) is the inventory of all inputs and outputs across all stages of a product. The product can be as simple as a building product, system or whole building. This review must be analyzed throughout all stages of the product's life (shown to the right) from first creation or extraction of all raw materials, raw material transportation, manufacturing, packaging, distribution, service life and maintenance, end-of-life removal, disposal or recycling or reuse of this product.



A simpler way to say this is that LCA is the scientific method to review everything going into the production, use and disposal of a product, all its impact on the environment along the way, and what is left over and their impacts.

The impacts that are evaluated are selected from the list of LCA Impacts based on the product type and can change from one product type to another. For example with most building materials **Primary Energy** (Embodied Energy), **Wastes**, **Global Warming** (Carbon Footprint), **Ground Level Ozone** (Smog), **Acidification** (increased acid to air, water or soil,) **and Eutrophication** (increased fertilizers and detergents into our water supplies) are usually the key reviewed Impacts and are a must for all construction material, systems, service, of whole building LCA.

Other impacts may be selected based on how much effect the product will have on the value or not. For example a drywall LCA may not select Mineral Depletion since Gypsum, the main raw material used in the production of drywall, is defined as a "**Perpetual Resource**" per ASTM E2114. A **Perpetual Resource** is a resource that is virtually inexhaustible on a human time scale or at a minimum will last over 700 years of consumption. Examples include: solar energy, tidal energy, and wind energy. Mineral examples include: gypsum, salt, and lime.



The review of a product through the raw material and manufacturing stages is referred to as **Cradle to Gate**, as illustrated in the Product Life Cycle above. This type of partial LCA is very useful for comparison by manufacturers to evaluate impacts or raw materials or components used within the production of and individual products or assemblies. The review across the complete (all) stages of product's life is referred to Cradle to Grave or Cradle to Cradle. This study is outlined in ISO 14040 *Life Cycle*

Assessment - Principles and Guidelines and is very useful by many parties having interest in that product, from the manufacturer, end users, architects and Specifiers, occupants, installers, many others.

Scopes of LCAs

In most cases, the impacts contributed from each stage of the LCA are uneven, i.e. one or two of the stages may dominate the assessment. For example, in the manufacture of aluminum products it is acquisition of materials (mining), purification of the ore, and chemical reduction of the aluminum into metal that create environmental impacts. Subsequent usage of aluminum products by consumers contributes very few impacts, although the facilitation of recycling of aluminum is an important step in avoiding the consumption of primary materials and energy. In contrast, for internal combustion-powered automobiles, usage by consumers creates 70-80% of the life cycle impacts. Thus, it is not always necessary that the LCA include all stages of analysis; in many cases it is only a portion of the product/service chain that is of interest, and often there is not enough information to include all stages anyway. For this reason there are certain characteristic terminologies for various “scopes” of LCAs that have emerged:

Cradle-to-grave: includes the entire material/energy cycle of the product/material, but excludes recycling/reuse.

Cradle-to-cradle: includes the entire material cycle, including recycling/reuse.

Cradle-to-gate: includes material acquisition, manufacturing/refining/fabrication (factory gate), but excludes product uses and end-of-life.

Gate-to-gate: a partial LCA looking at a single added process or material in the product chain.