Life cycle assessment at Eastman

Life cycle assessment (LCA) is a holistic approach used to quantify the potential environmental impacts of a product or activity throughout its life cycle — from raw material and resource extraction to manufacture, consumer use, and end of life. Results from LCA studies can be used to inform decisions at many levels, including material selection, design considerations, corporate strategy, and policy. Eastman developed an in-house LCA team in 2009 and continues to invest in capability development. A majority of Eastman's top-selling products have been characterized using LCA.

Mission

The Eastman LCA team creates long-term value for Eastman, our partners, and stakeholders by leveraging our expertise in LCA to drive sustainable choices. LCA helps Eastman steer a sustainable product portfolio and drive resource productivity.

Goals

The Eastman LCA team provides insight into life cycle impacts to:

- Engage value chain partners in conversations about sustainability, enabling collaboration to reduce cradle-to-grave impacts and maximize brand value
- Guide Eastman's product and technology portfolio management and strategy, driving responsible innovation throughout product and process development
- Create a culture within Eastman that promotes life cycle thinking

Team organization

Eastman LCA efforts are coordinated through Corporate Innovation in partnership with Corporate Sustainability. The LCA practitioners reside in Eastman's Corporate Innovation division in North America. The LCA team collaborates with each of Eastman's businesses as well as functional partners in Manufacturing, Utilities, Process Engineering, and Health, Safety and Environment.

Tools

Eastman LCAs are primarily calculated using the GaBi LCA software package by thinkstep. As part of the GaBi platform, Eastman has access to many of the most widely used and accepted LCA databases.

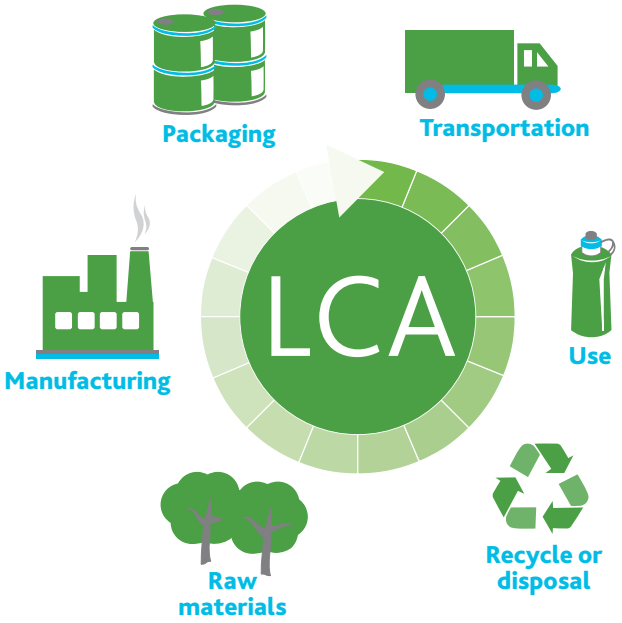
Standards

Eastman makes its best effort to conduct LCAs according to ISO standards 14040 and 14044. In addition, Eastman uses the "Life Cycle Metrics for Chemical Products" guidelines published by the World Business Council for Sustainable Development (WBCSD) for more detailed guidance. The WBCSD guidelines were developed in collaboration with 10 global chemical companies, including Eastman, with an objective of supporting the consistent and credible communication of the environmental footprints of chemical products. These guidelines go beyond the ISO standards by providing additional guidance specific to the chemical industry.

Eastman operates complex and highly integrated chemical processes which require careful consideration of LCA scope, allocation methods, recycling, cut-off criteria, and other details.

Use of external consultants

While most LCAs are conducted internally, Eastman uses external contractors to alleviate resource limitations. LCAs that require third-party validation or specific expertise may be reviewed or conducted externally.



Life cycle assessment process

The Eastman LCA process consists of the following steps:

1. LCA goal and scope definition

The LCA goals and scope are defined and agreed on at the start of each study project. Goal and scope determine the level of detail required as well as the functional unit or basis of the study and the system boundary.

2. Data collection

Eastman uses its own primary data as much as possible. For processes within Eastman boundaries, data on material and energy usage are collected from manufacturing accounting systems. Data are reviewed with manufacturing engineers and cost analysts to ensure accuracy and completeness. In some instances, engineering expertise and process data are used to adjust distributions of utilities to the individual

product level. Care is taken to accurately represent all significant material and utility flows into and out of the process. Air emissions are typically based on regulatory permit limits or actual process estimates if available. Data for external flows such as purchased materials are typically collected from published databases if not provided by suppliers. Eastman is careful to select the appropriate database model. In the absence of a published data set for a specific flow, Eastman chooses a proxy or develops a model from literature or engineering calculations.

3. Inventory analysis and impact assessment

A Life Cycle Inventory (LCI) is compiled for the studied product or process using GaBi LCA software. Life Cycle Impact Assessment (LCIA) methods, such as those specified by the WBCSD or our customers, are then used to calculate life cycle impact assessment indicators such as global warming potential, photochemical ozone creation potential, eutrophication potential, and many others.

4. Documentation of results

Completed LCA studies are documented in internal Eastman technical reports, typically with a Confidential security classification. Internal reports include full disclosure of all relevant assumptions, exclusions, allocation methods, sensitivity analyses, data sources, and other supporting information. The full LCA report is peer reviewed by the LCA team, manufacturing process experts, and other stakeholders prior to finalization.

5. Communication with stakeholders

The LCA team works with business, technology, and sustainability managers to develop appropriate interpretation and communications of LCA results to both internal and external stakeholders.

6. LCA model retention, maintenance, and updates

The LCA team maintains a cumulative master database of all Eastman LCA models. Previously modeled Eastman processes are used to generate models for downstream processes, which enable Eastman to model the connectivity of our complex stream. Models are updated as needed to reflect current operating conditions.

LCA modeling of onsite power generation

Energy consumption is typically a major contributor to the cradle-to-gate greenhouse gas footprint of chemical products. Eastman's Kingsport site is heavily integrated and produces its own energy from multiple cogeneration powerhouses on-site. Due to integration, the steam and electricity from on-site powerhouses are intermingled. Our product LCAs are based on our own primary data for energy sources.

In 2017–2018, Eastman completed conversion of its largest powerhouse from coal to natural gas at its Kingsport, Tenn., site. This retrofit was the most significant air pollution control project in Eastman's history and enhances Eastman's emission reduction efforts.

Eastman developed an accounting framework to assign some of the retrofitted natural gas energy to a select group of manufacturing areas in Kingsport. The businesses that sell the products from the select manufacturing areas pay an internal fee associated with the cost of the powerhouse retrofit project. The LCAs for all other products manufactured in Kingsport reflect a blended energy mix that excludes the assigned natural gas energy. The methodology is applied consistently across all products at the site.

Under this accounting system, the products which receive select assignment of natural gas energy reflect the LCA benefits resulting from the business investment. If averaged across the entire site, the benefits of the investment would otherwise be significantly diluted. This new framework is designed to help incentivize further investment in cleaner energy at integrated sites. A methodology paper is in the process of submission to a peer-reviewed journal. We hope that other companies facing similar challenges with integrated asset transformation can benefit from this approach.

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The results of **insight**™

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