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Life Cycle Assessments Do Have Limitations

A candid look at the limitations of life cycle assessments for improving efficiency and sustainability operations

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As companies plan to reduce the environmental impact of their operations, they are increasingly relying on tools such as life cycle assessments (LCAs) to understand the environmental impact of their products, processes, facilities, and technologies. A number of firms offer these services and generally will perform them according to recognized standards such as ISO 14044. However, companies may not be aware of the limitations, uncertainties, or assumptions underlying an LCA even when performed to an ISO standard. Even an LCA completed to the ISO standard may not be sufficient for use in marketing materials or disclosures unless further evaluated by a review board to meet the requirements of an Environmental Product Declaration (EPD).

LCAs May Rely on Generalized Data Sets

When assessing the emissions resulting from a given feedstock, an LCA may rely on databases that provide typical emissions factors for the production of chemicals, carbon intensity of electricity, and other factors. But these values may not be accurate for a given supplier or even the specific chemical being considered. The production of certain chemicals can occur by multiple processes with varying emissions treatment systems that lead to large variations in emissions factors. Certain chemicals may not have any specific data available and may be approximated using data for other chemicals.

Energy Metrics May Not Be Relevant to Your Process or Product

A number of energy metrics, such as cumulative energy demand (CED), cumulative energy use (CEU), and others, may or may not be included when reporting the energy intensity of a product or process. CED and CEU are both measurements of energy intensity, but CED includes the energy of materials, heat, and electricity sources, whereas CEU only considers the heat and electricity but does not consider the energy stored within the materials.

As a result of the various metrics used, the energy intensity reported by an LCA may not actually correlate to the required energy input of a product or process because other factors, such as the combustion energy of the fabrication materials (that are not combusted), are being included in the overall energy footprint. When using an LCA for decision-making, marketing, or disclosures, companies may want to consider the meaning of the energy metrics used in a supporting LCA to determine whether they are appropriate.

Comparative LCAs May Not Provide Good Comparisons

A comparative LCA, by definition, compares two processes or products. Oftentimes, comparative LCAs are used by companies developing new or novel processes and products that may have environmental benefits over existing technologies that often rely on fossil fuels and petrochemical feedstocks. While these companies often have reliable data for their own systems, the data for the conventional technology may not be as detailed and could lead to an unreliable comparison. The carbon footprint for any product or process (conventional or not) depends on how, where, and when it was produced. Consequently, comparative LCAs relying on outdated conventional process data or data generated in different regions may not provide a

reliable baseline for comparison. Recently, significant disputes have arisen around the carbon footprint of blue hydrogen, highlighting the sensitivity of LCAs to the assumptions of the investigators.

Companies interested in improving the sustainability of their operations have numerous choices for reducing their environmental impact that may not be well represented in a comparative LCA produced by a technology developer. For example, instead of replacing a petroleum feedstock with a bio-based feedstock, the company could replace a hydrogen feedstock derived from natural gas with green hydrogen generated from renewable energy, electrify previously fossil fuel powered equipment, or install a carbon capture system. Companies should not feel limited by the specific scenarios provided in a comparative LCA but rather may want to consider other options that provide similar environmental benefits and, potentially, other relevant benefits for the company. LCA studies also often consider water use, acidification potential, smog potential, ecotoxicity, and many other impacts that may present important tradeoffs or co-benefits that may be considered in addition to a reduced carbon footprint.

How Exponent Can Help

Exponent is assisting clients in reviewing LCAs for new and existing products, processes, facilities, and technologies and providing additional insights into the reliability, underlying assumptions, and relevance of these analyses to their business objectives. Exponent can also assist clients in performing specific and targeted assessments of emissions and compare the impact of processes and products on public health and local environments. These analyses can help companies identify optimal technologies to meet their specific environmental, social, and governance (ESG) and sustainable development goals and targets.

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