# HD CONSTRUCTION EQUIPMENT Product LCA Implementation Overview

## 1. Glossary

| Term | Definition |
|---|---|
| Impact Category | Class specifying environmental issues of concern, including global warming, eutrophication, or acidification, to which assessed product or system results may be assigned |
| Life Cycle | Consecutive and interlinked stages of a product system, from raw materials acquisition or generation from natural resources to final disposal |
| Cradle to Grave | The stages from the time natural resources are extracted from the ground to the disposal |
| Life Cycle Impact Assessment | Phase of Life Cycle Assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of a product system throughout the life cycle of the product |
| Life Cycle Assessment | A technique for compiling and comprehensively evaluating the inputs, outputs, and potential environmental impacts of a product system throughout its life cycle |
| Product System | A collection of materially and energetically connected unit processes, which perform one or more defined functions |
| Unit Process | Smallest element considered in the life cycle inventory analysis for which input and output data are quantified |
| System boundary | Set of criteria specifying which unit processes are part of a product system |
| Energy using Products | Consumer goods such as refrigerators, washing machines, and cars that consume energy during the use phase |
| Non-energy Using Products | Consumer goods such as clothing and furniture that do not consume energy during the use phase |
| Functional Unit | Quantified performance of a product system for use as a reference unit |
| Primary Data | Data determined by direct measurement, estimation or calculation from the business sites |
| Secondary Data | Data excluding primary data, including nationally-certified life cycle inventory (LCI) data, industry-average LCI data, and other LCI data |
| Allocation (Partitioning) | The process of partitioning the input or output flows of a process or a product system between the product system being studied and one or more other product systems |
| Cut-off Rules | Criteria for excluding specific material or energy flows related to the product system from an assessment |

## 2. Key Implementation Methods Based on ISO 14040/44

| Category | Application Details |
|---|---|
| Functional Unit | kg $CO_2$-eq per unit of product operating time |
| System Boundary | Entire life cycle (Cradle to Grave) |
| Life Cycle Impact Assessment Methodology | The IPCC 2021 (GWP100) methodology is applied to evaluate potential impacts in the global warming impact category. |
| Cut-off Rules | A cumulative weight threshold of 99% is applied when selecting product components. |
| Allocation | Allocation is based on the product's weight. |

# Summary

The Life Cycle Assessment (LCA) of the construction equipment (Excavator, HX235ALCR) was performed in accordance with the general procedures and requirements of ISO 14040 and ISO 14044. The scope of the impact assessment spans from cradle to grave, as defined by ISO 14025 and ISO/TS 14067, including stages such as raw materials acquisition, processing, manufacturing, transportation, use, and disposal. Emissions per operating hour of a single standard model unit were defined as the functional unit for the assessment. The LCA was conducted in alignment with ISO guidelines by developing an LCA implementation model for construction equipment based on the process data of company. The impact assessment results for the product's carbon emissions (Global Warming Potential) were derived using the developed performance model.

## 1. Product Information

| | | | | |
|---|---|---|---|---|
| **Product Model** | HX235ALCR | | | |
| **General Information** | **(Excavator)** Heavy construction equipment used across various worksites, including large-scale construction projects, mining, and agriculture. Equipped with a powerful digging arm and bucket, it performs tasks such as excavating soil and lifting materials. | | | |
| **Product Spec.** | Model | Category | Operating Weight (ton) | Bucket Capacity ($m^3$) |
| | HX235ALCR | Excavator | 25.7 | 0.80~1.34 |
| **Weight Information (Reference flow)** | HX235ALCR (Curb Weight: 25,685kg per unit) | | | |

## 2. LCA Implementation Information

| | | | |
|---|---|---|---|
| **Functional Unit** | Emissions per operating hour | | |
| **System Boundary** | **Stage of Analysis** | **Detailed Scope** | **Included in Analysis** |
| | Pre-Manufacturing Stage | Extraction and processing of raw materials | ● |
| | | Manufacturing of products by Tier 1 suppliers | X |
| | | Transporting (suppliers → manufacturing site) | X |
| | Manufacturing Stage | Product manufacturing process | ● |
| | | Product distribution | ● |
| | Use Stage | Product use | ● |
| | Disposal Stage | Product disposal | ● |
| **Data Quality** | • Upstream: Secondary data (LCI database)<br>• Core: Primary data and LCI DB<br>- Time-Related Scope: January 2022 – December 2024<br>- Region Scope: Gyeongsan Plant, SE-AN precision machinery, Republic of Korea<br>• Downstream: Primary data and LCI DB<br>- (Use Stage) User-based TMS information and secondary data (LCI DB)<br>- (Disposal Stage) Statistics-based scenario and secondary data (LCI DB) | | |
| **LCA Software** | OpenLCA 2.3 (with Ecolnvent v.3.12 LCI DB) | | |
| **LCIA Method** | **Impact category** | **Indicator** | **Unit** | **Recommended default LCIA method** |
| | Global Warming Potential (GWP100) | Radiative forcing as Global Warming Potential (GWP100) | kg $CO_2$ –eq | from openLCIA methods ✓ IPCC 2021, AR6 |

## 3. Results of the Impact Assessment

| Impact category | Unit | Total | Pre-Manufacturing | Manufacturing | | Use | Disposal |
|---|---|---|---|---|---|---|---|
| | | | | Production | Distribution | | |
| Global Warming Potential (GWP100) | kg $CO_2$–eq/hr | 35.4 | 5.0 | 0.1 | 0.5 | 29.5 | 0.2 |
| | | | 14.1% | 0.4% | 1.4% | 83.4% | 0.7% |