

# 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 <sub>2</sub> -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 95% 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 (Wheel Loader, HL960A) 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

<b>Product Model</b>	HL960A			
<b>General Information</b>	(Wheel Loader) Heavy construction equipment used in large construction projects and on various work sites, including mining and agriculture, equipped with a wheel movement mechanism that allows quick and flexible movement, performing various functions ranging from simple tasks to loading and transporting heavy materials.			
<b>Product Spec.</b>	Model	Category	Operating Weight (ton)	Bucket Capacity (m <sup>3</sup> )
	HL960A	Wheel Loader	19.1	3.2~3.3
<b>Weight Information (Reference flow)</b>	HL960A (Curb Weight: 19,125kg per unit)			

### 2. LCA Implementation Information

<b>Functional Unit</b>	Emissions per operating hour			
<b>System Boundary</b>	<b>Stage of Analysis</b>	<b>Detailed Scope</b>		<b>Included in Analysis</b>
		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		●
<b>Data Quality</b>	<ul style="list-style-type: none"> <li>Upstream: Secondary data (LCI database)</li> <li>Core: Primary data and LCI DB <ul style="list-style-type: none"> <li>Time-Related Scope: January 2023 – December 2023</li> <li>Region Scope: Ulsan Plant, HD CONSTRUCTION EQUIPMENT, Republic of Korea</li> </ul> </li> <li>Downstream: Primary data and LCI DB <ul style="list-style-type: none"> <li>(Use Stage) User-based TMS information and secondary data (LCI DB)</li> <li>(Disposal Stage) Statistics-based scenario and secondary data (LCI DB)</li> </ul> </li> </ul>			
<b>LCA Software</b>	OpenLCA 2.3 (with EcolInvent v.3.10 LCI DB)			
<b>LCIA Method</b>	<b>Impact category</b>	<b>Indicator</b>	<b>Unit</b>	<b>Recommended default LCIA method</b>
	Global Warming Potential (GWP100)	Radiative forcing as Global Warming Potential (GWP100)	kg CO <sub>2</sub> -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 <sub>2</sub> -eq/hr	44.4	8.2	0.2	0.8	34.9	0.3
			18.5%	0.5%	1.7%	78.5%	0.7%