Life Cycle Assessment

Samsung is conducting various activities to review and improve the environmental Impact of products. This document is a summary of the results of LCA conducted as part of these activities, which evaluates the potential environmental impact throughout the product's life cycle.

☐ Scope Definition

Introduction

The LCA was performed for the life cycle of the below model in reference to ISO standards, relevant standards and PCRs. (Reference flow: 1EA)

Target Model	SM-S938	Lifespan (yr)	3.0
Plant Country	Vietnam	Sales Country	Wordwide
Standards referred	ISO 14040/44, ISO14067, ISO14064, PAS2050, GHG Protocol, Korean EPD Guide and PCRs(Product Category Rules)		
LCIA methodology	CML v4.8 (Climate Change:IPCC)		
Database used	Ecoinvent 3.10		

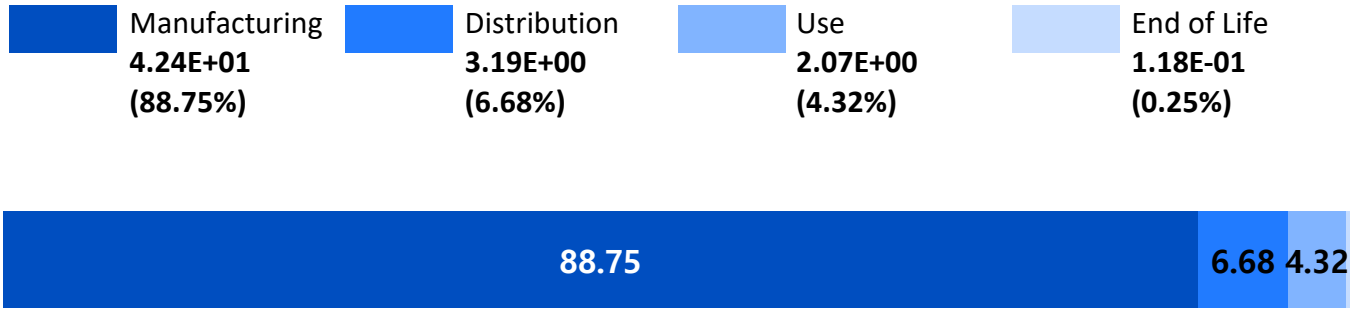
System Boundary

The system boundary includes all stages of the life cycle from Manufacturing, Distribution, Use and End of Life Stages.

☐ LCA result

Product Carbon Footprint (United Kingdom) 47.782067 kg CO2-eq

* Contribution results of climate change by life cycle stage in the UK, the main sales country



☐ LCA result

Value results for all impact categories by life cycle stage across all sales countries

United Kindom

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.78E+01	4.24E+01	3.19E+00	2.07E+00	1.18E-01
Acidification	kg SO2-eq	2.06E-01	1.90E-01	1.01E-02	6.07E-03	8.07E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.55E+01	6.69E+01	2.52E-01	2.71E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.82E+05	1.77E+05	8.14E+02	3.30E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.70E-01	9.17E-01	1.61E-02	3.50E-02	2.02E-03
Energy resources: non-renewable	MJ	5.32E+02	4.60E+02	4.21E+01	2.98E+01	2.55E-01
Eutrophication	kg PO4-eq	2.51E-01	2.46E-01	2.19E-03	2.27E-03	3.53E-04
Human toxicity	kg 1,4-DCB-eq	1.45E+02	1.35E+02	2.06E+00	6.92E+00	7.47E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	5.87E-07	3.47E-05	6.64E-08
Ozone depletion	kg CFC-11-eq	9.10E-06	8.98E-06	3.89E-08	8.56E-08	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.24E-02	1.12E-02	7.33E-04	4.21E-04	1.15E-05

Germany

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.86E+01	4.24E+01	3.01E+00	3.11E+00	1.18E-01
Acidification	kg SO2-eq	2.07E-01	1.90E-01	9.50E-03	7.38E-03	8.01E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.77E+01	6.69E+01	2.38E-01	4.88E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.87E+05	1.77E+05	7.69E+02	8.30E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.73E-01	9.17E-01	1.52E-02	3.90E-02	1.99E-03
Energy resources: non-renewable	MJ	5.34E+02	4.60E+02	3.97E+01	3.41E+01	2.52E-01
Eutrophication	kg PO4-eq	2.63E-01	2.46E-01	2.07E-03	1.42E-02	3.44E-04
Human toxicity	kg 1,4-DCB-eq	1.46E+02	1.35E+02	1.95E+00	8.70E+00	7.44E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	5.55E-07	3.92E-05	6.58E-08
Ozone depletion	kg CFC-11-eq	9.05E-06	8.98E-06	3.67E-08	3.40E-08	3.83E-10
Photochemical oxidant formation	kg ethylene-eq	1.25E-02	1.12E-02	6.91E-04	5.30E-04	1.13E-05

Spain

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.76E+01	4.24E+01	3.45E+00	1.65E+00	1.19E-01
Acidification	kg SO2-eq	2.08E-01	1.90E-01	1.09E-02	7.44E-03	8.06E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.56E+01	6.69E+01	2.75E-01	2.79E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.83E+05	1.77E+05	8.87E+02	3.61E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.73E-01	9.17E-01	1.75E-02	3.64E-02	2.06E-03
Energy resources: non-renewable	MJ	5.27E+02	4.60E+02	4.55E+01	2.13E+01	2.55E-01
Eutrophication	kg PO4-eq	2.51E-01	2.46E-01	2.37E-03	2.23E-03	3.65E-04
Human toxicity	kg 1,4-DCB-eq	1.45E+02	1.35E+02	2.25E+00	7.21E+00	7.51E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	6.52E-07	3.51E-05	6.63E-08
Ozone depletion	kg CFC-11-eq	9.05E-06	8.98E-06	4.21E-08	2.76E-08	3.85E-10
Photochemical oxidant formation	kg ethylene-eq	1.25E-02	1.12E-02	7.93E-04	4.43E-04	1.18E-05

France

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.64E+01	4.24E+01	3.16E+00	6.95E-01	1.18E-01
Acidification	kg SO2-eq	2.04E-01	1.90E-01	9.98E-03	4.07E-03	8.07E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.53E+01	6.69E+01	2.50E-01	2.47E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.82E+05	1.77E+05	8.08E+02	2.64E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.61E-01	9.17E-01	1.60E-02	2.58E-02	2.02E-03
Energy resources: non-renewable	MJ	5.11E+02	4.60E+02	4.17E+01	9.12E+00	2.55E-01
Eutrophication	kg PO4-eq	2.50E-01	2.46E-01	2.18E-03	1.48E-03	3.54E-04
Human toxicity	kg 1,4-DCB-eq	1.44E+02	1.35E+02	2.04E+00	5.70E+00	7.47E-01
Material resources: metals/minerals	kg Sb-eq	3.51E-03	3.48E-03	5.83E-07	3.33E-05	6.64E-08
Ozone depletion	kg CFC-11-eq	9.04E-06	8.98E-06	3.85E-08	2.00E-08	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.22E-02	1.12E-02	7.26E-04	2.36E-04	1.15E-05

Italy

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.84E+01	4.24E+01	3.07E+00	2.81E+00	1.18E-01
Acidification	kg SO2-eq	2.09E-01	1.90E-01	9.67E-03	9.94E-03	8.06E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.57E+01	6.69E+01	2.43E-01	2.89E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.83E+05	1.77E+05	7.86E+02	4.22E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.75E-01	9.17E-01	1.55E-02	4.09E-02	2.04E-03
Energy resources: non-renewable	MJ	5.39E+02	4.60E+02	4.04E+01	3.88E+01	2.55E-01
Eutrophication	kg PO4-eq	2.51E-01	2.46E-01	2.11E-03	2.97E-03	3.59E-04
Human toxicity	kg 1,4-DCB-eq	1.46E+02	1.35E+02	1.99E+00	8.04E+00	7.49E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	5.73E-07	3.51E-05	6.63E-08
Ozone depletion	kg CFC-11-eq	9.07E-06	8.98E-06	3.74E-08	5.38E-08	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.27E-02	1.12E-02	7.04E-04	6.95E-04	1.16E-05

Australia

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	5.19E+01	4.24E+01	2.70E+00	6.69E+00	1.22E-01
Acidification	kg SO2-eq	2.26E-01	1.90E-01	8.51E-03	2.75E-02	9.52E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	8.14E+01	6.69E+01	2.13E-01	8.57E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.98E+05	1.77E+05	6.89E+02	1.94E+04	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.69E-01	9.17E-01	1.36E-02	3.53E-02	3.02E-03
Energy resources: non-renewable	MJ	5.68E+02	4.60E+02	3.56E+01	7.20E+01	2.79E-01
Eutrophication	kg PO4-eq	2.86E-01	2.46E-01	1.85E-03	3.78E-02	3.68E-04
Human toxicity	kg 1,4-DCB-eq	1.48E+02	1.35E+02	1.74E+00	9.98E+00	8.40E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	4.99E-07	3.50E-05	6.87E-08
Ozone depletion	kg CFC-11-eq	9.06E-06	8.98E-06	3.28E-08	4.22E-08	6.26E-10
Photochemical oxidant formation	kg ethylene-eq	1.32E-02	1.12E-02	6.19E-04	1.33E-03	1.37E-05

Switzerland

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.57E+01	4.24E+01	2.90E+00	2.64E-01	1.16E-01
Acidification	kg SO2-eq	2.01E-01	1.90E-01	9.06E-03	2.70E-03	7.21E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.52E+01	6.69E+01	2.51E-01	2.41E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.81E+05	1.77E+05	8.06E+02	2.26E+03	1.35E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.54E-01	9.17E-01	1.57E-02	2.00E-02	1.93E-03
Energy resources: non-renewable	MJ	5.01E+02	4.60E+02	3.83E+01	2.71E+00	2.27E-01
Eutrophication	kg PO4-eq	2.49E-01	2.46E-01	1.99E-03	1.02E-03	3.26E-04
Human toxicity	kg 1,4-DCB-eq	1.43E+02	1.35E+02	2.06E+00	4.93E+00	6.00E-01
Material resources: metals/minerals	kg Sb-eq	3.51E-03	3.48E-03	7.11E-07	3.31E-05	6.23E-08
Ozone depletion	kg CFC-11-eq	9.02E-06	8.98E-06	3.55E-08	8.55E-09	3.73E-10
Photochemical oxidant formation	kg ethylene-eq	1.21E-02	1.12E-02	6.62E-04	1.48E-04	1.10E-05

Denmark

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.65E+01	4.24E+01	2.77E+00	1.24E+00	1.18E-01
Acidification	kg SO2-eq	2.04E-01	1.90E-01	8.68E-03	5.92E-03	8.06E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.60E+01	6.69E+01	2.40E-01	3.16E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.83E+05	1.77E+05	7.70E+02	4.32E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.71E-01	9.17E-01	1.50E-02	3.73E-02	1.99E-03
Energy resources: non-renewable	MJ	5.10E+02	4.60E+02	3.66E+01	1.34E+01	2.55E-01
Eutrophication	kg PO4-eq	2.52E-01	2.46E-01	1.91E-03	3.67E-03	3.45E-04
Human toxicity	kg 1,4-DCB-eq	1.45E+02	1.35E+02	1.96E+00	7.19E+00	7.45E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	6.75E-07	3.85E-05	6.64E-08
Ozone depletion	kg CFC-11-eq	9.04E-06	8.98E-06	3.40E-08	2.41E-08	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.23E-02	1.12E-02	6.34E-04	3.82E-04	1.13E-05

Netherlands

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.87E+01	4.24E+01	3.06E+00	3.07E+00	1.18E-01
Acidification	kg SO2-eq	2.05E-01	1.90E-01	9.67E-03	6.09E-03	8.07E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.61E+01	6.69E+01	2.42E-01	3.25E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.84E+05	1.77E+05	7.81E+02	4.55E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.76E-01	9.17E-01	1.54E-02	4.14E-02	1.99E-03
Energy resources: non-renewable	MJ	5.40E+02	4.60E+02	4.04E+01	3.97E+01	2.55E-01
Eutrophication	kg PO4-eq	2.52E-01	2.46E-01	2.11E-03	3.95E-03	3.45E-04
Human toxicity	kg 1,4-DCB-eq	1.46E+02	1.35E+02	1.98E+00	8.45E+00	7.45E-01
Material resources: metals/minerals	kg Sb-eq	3.52E-03	3.48E-03	5.60E-07	3.89E-05	6.64E-08
Ozone depletion	kg CFC-11-eq	9.11E-06	8.98E-06	3.73E-08	8.79E-08	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.24E-02	1.12E-02	7.04E-04	4.70E-04	1.14E-05

Sweden

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.56E+01	4.24E+01	2.74E+00	2.97E-01	1.18E-01
Acidification	kg SO2-eq	2.01E-01	1.90E-01	8.61E-03	2.69E-03	8.07E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.51E+01	6.69E+01	2.22E-01	2.33E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.81E+05	1.77E+05	7.14E+02	2.32E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.56E-01	9.17E-01	1.41E-02	2.34E-02	1.99E-03
Energy resources: non-renewable	MJ	4.98E+02	4.60E+02	3.61E+01	1.86E+00	2.55E-01
Eutrophication	kg PO4-eq	2.49E-01	2.46E-01	1.88E-03	1.08E-03	3.45E-04
Human toxicity	kg 1,4-DCB-eq	1.43E+02	1.35E+02	1.81E+00	5.22E+00	7.45E-01
Material resources: metals/minerals	kg Sb-eq	3.51E-03	3.48E-03	5.47E-07	3.15E-05	6.64E-08
Ozone depletion	kg CFC-11-eq	9.02E-06	8.98E-06	3.34E-08	6.79E-09	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.20E-02	1.12E-02	6.27E-04	1.45E-04	1.13E-05

USA

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	5.09E+01	4.24E+01	4.61E+00	3.80E+00	1.22E-01
Acidification	kg SO2-eq	2.15E-01	1.90E-01	1.44E-02	1.05E-02	9.52E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.67E+01	6.69E+01	4.03E-01	3.77E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.87E+05	1.77E+05	1.30E+03	7.53E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.87E-01	9.17E-01	2.52E-02	4.17E-02	3.02E-03
Energy resources: non-renewable	MJ	5.68E+02	4.60E+02	6.09E+01	4.72E+01	2.79E-01
Eutrophication	kg PO4-eq	2.58E-01	2.46E-01	3.18E-03	8.96E-03	3.68E-04
Human toxicity	kg 1,4-DCB-eq	1.48E+02	1.35E+02	3.32E+00	8.59E+00	8.40E-01
Material resources: metals/minerals	kg Sb-eq	3.51E-03	3.48E-03	1.17E-06	3.17E-05	6.87E-08
Ozone depletion	kg CFC-11-eq	9.06E-06	8.98E-06	5.61E-08	2.24E-08	6.26E-10
Photochemical oxidant formation	kg ethylene-eq	1.29E-02	1.12E-02	1.05E-03	6.08E-04	1.37E-05

Canada

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.84E+01	4.24E+01	4.29E+00	1.59E+00	1.21E-01
Acidification	kg SO2-eq	2.09E-01	1.90E-01	1.36E-02	5.52E-03	9.43E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.53E+01	6.69E+01	3.39E-01	2.35E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.83E+05	1.77E+05	1.10E+03	3.63E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.64E-01	9.17E-01	2.16E-02	2.36E-02	2.02E-03
Energy resources: non-renewable	MJ	5.36E+02	4.60E+02	5.66E+01	1.91E+01	2.80E-01
Eutrophication	kg PO4-eq	2.54E-01	2.46E-01	2.95E-03	4.90E-03	3.59E-04
Human toxicity	kg 1,4-DCB-eq	1.43E+02	1.35E+02	2.77E+00	4.80E+00	7.49E-01
Material resources: metals/minerals	kg Sb-eq	3.50E-03	3.48E-03	7.88E-07	2.11E-05	6.88E-08
Ozone depletion	kg CFC-11-eq	9.04E-06	8.98E-06	5.23E-08	8.09E-09	6.27E-10
Photochemical oxidant formation	kg ethylene-eq	1.26E-02	1.12E-02	9.86E-04	3.12E-04	1.22E-05

Austria

Environmental Imapact Category	Unit	Total	Manufacturing	Distribution	Use	EoL
Climate change	kg CO2-eq	4.72E+01	4.24E+01	2.84E+00	1.79E+00	1.18E-01
Acidification	kg SO2-eq	2.04E-01	1.90E-01	8.96E-03	5.76E-03	8.07E-05
Ecotoxicity: freshwater	kg 1,4-DCB-eq	7.61E+01	6.69E+01	2.25E-01	3.33E+00	5.64E+00
Ecotoxicity: marine	kg 1,4-DCB-eq	1.84E+05	1.77E+05	7.26E+02	4.90E+03	1.36E+03
Ecotoxicity: terrestrial	kg 1,4-DCB-eq	9.64E-01	9.17E-01	1.43E-02	3.08E-02	1.99E-03
Energy resources: non-renewable	MJ	5.18E+02	4.60E+02	3.75E+01	2.04E+01	2.55E-01
Eutrophication	kg PO4-eq	2.55E-01	2.46E-01	1.95E-03	6.47E-03	3.46E-04
Human toxicity	kg 1,4-DCB-eq	1.44E+02	1.35E+02	1.84E+00	6.83E+00	7.45E-01
Material resources: metals/minerals	kg Sb-eq	3.51E-03	3.48E-03	5.24E-07	3.33E-05	6.64E-08
Ozone depletion	kg CFC-11-eq	9.05E-06	8.98E-06	3.46E-08	3.71E-08	3.86E-10
Photochemical oxidant formation	kg ethylene-eq	1.23E-02	1.12E-02	6.52E-04	3.77E-04	1.14E-05

< Endnotes >

- LCA(or PCF) conducted by Samsung Electronics 'SDP-LCA Module' is verified for conformity by LRQA (Lloyd's Register Quality Assurance) according to the following international standards:

  - ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework
  - ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
  - ISO 14067:2018 Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification

  This verification of conformity includes implementation methods, related procedures and requirements for LCA(or PCF), but does not ensure the reliability of the data used for the product model or the resulting outcomes.

- LCA : Life Cycle Assessment / PCF : Product Carbon Footprint

- Samsung Electronics conducts LCA/PCF in accordance with the guidelines and requirements outlined in ISO 14040, ISO 14044, and ISO 14067. Some detailed requirements not defined in the standard refer to scenarios and conditions in documents and EPD programs issued by the Korean government.

  The scope of LCA in this report includes all life cycle stages, and both primary data and secondary data, including databases, were used for data collection. The PCF calculation was based on the GWP 100 index presented in the IPCC Sixth Assessment Report (AR6).

  - Manufacturing : This stage includes raw material extraction, processing, and parts manufacturing for the components that constitute the product, including its packaging materials.
    The composition of the product is based on the Bill of Materials (BOM), and the scope of inclusion in the parts manufacturing may vary from product to product.
    Also, It includes the assembly of parts, inspection, and packaging processes at the manufacturing site. It considers inputs and outputs directly used in product manufacturing.

  - Distribution : This stage involves transporting products from the manufacturing site to the country of sale, including delivery to the logistics warehouse in that country.

- Use : It is calculated by considering the product's lifespan in terms of annual power consumption during use. If water or consumables are required based on product characteristics, they are also considered.
  The Lifespan is referred to in the PCR (Product Category Rules) of the EPD by the Korean government.
  If PCR is not available, the product warranty period or internal standards are applied.
- End of Life : This stage considers collection rates and treatment methods (recycling, incineration, and landfill) for a product, package, and consumables. Collection rates and treatment method rates are based on data released by the Korean government/institute.

The results in this report are calculated based on the impact assessment methodology and conditions defined at the time of evaluation, and may be updated if conditions change.

In addition, this LCA/PCF result should not be compared with others if the functional unit, system boundary, data quality level, and LCIA methodology are not consistent. Comparing simple figures without the same conditions can be misleading, and we are not responsible for such comparisons.