

Hard Disc Packaging Product Life Cycle Analysis Summary

Product Description

The life cycle analysis (LCA) was performed on ten product packaging models configured to ship drives from three assembly plants in Asia to computer original equipment manufacturers' (OEM) assembly locations throughout the world. These containers hold as few as 20 drives and as many as 50 drives. The materials primarily include expanded polypropylene and corrugated fiberboard. The typical life cycle involves material sourcing from nearby container suppliers and distribution to three major geographies. This study was conducted on a "cradle-to-grave" basis and includes regionally specific estimates for end of life burdens.

The life cycle inventory analysis was conducted using GaBi LCA Software. The ReCiPe mid-point hierarchical method was used to determine life cycle impacts as shown below. Results are presented on a unit Hard Disc Drive (HDD) shipped basis. This Seagate commissioned study was prepared by WSP Environmental, and was 3rd party critically reviewed by EarthShift.



Life Cycle Analysis

Functional Unit, System Boundaries and Allocation Unit

The functional unit is defined as the amount of packaging protection and shipment required to deliver a hard disc drive from Seagate's assembly site to OEM computer manufacturing sites. Therefore the functional unit varies between different packs because each functional unit is designed to be used with specific hard disc drives, each having unique shipment protection requirements. Results are presented on a "per-pack" basis.

Results are presented for the four highest volume OEM shipping containers on a cradle-to-grave basis and include raw material extraction, pre-processing, transportation of materials to assembly, assembly, distribution to OEMs, and disposal and recycling at end-of-life. Environmental burdens from infrastructure production, e.g. the manufacturing of an auto-bagging machine, are not included within the study boundary and have not been targeted in primary and secondary data collection efforts.

Calculated Results

Impact	Unit Per HDD	Desktop 25 Pack	Desktop 20 Pack	Desktop 20 Pack w/ Clamshell	Notebook 50 Pack
Climate change	kg CO2 eq	2.00E-01	2.40E-01	5.70E-01	5.20E-02
Fossil depletion	kg oil eq	6.60E-02	8.00E-02	2.10E-01	1.60E-02
Freshwater ecotoxicity	kg 1,4-DB eq	7.20E-04	9.70E-04	2.10E-03	2.00E-04
Freshwater eutrophication	kg P eq	7.20E-07	9.20E-07	1.00E-06	2.30E-07
Human toxicity	kg 1,4-DB eq	6.50E-03	8.80E-03	1.70E-02	2.10E-03
Ionising radiation	kg U235 eq	3.00E-03	3.90E-03	7.60E-03	1.20E-03
Marine ecotoxicity	kg 1,4-DB eq	6.60E-04	8.90E-04	2.00E-03	1.80E-04
Marine eutrophication	kg N eq	3.10E-04	3.80E-04	8.80E-04	6.90E-05
Metal depletion	kg Fe eq	9.50E-05	1.20E-04	2.50E-04	3.20E-05
Ozone depletion	kg CFC-11 eq	2.80E-09	3.90E-09	4.50E-09	1.10E-09
Particulate matter formation	kg PM10 eq	7.00E-04	8.50E-04	2.20E-03	1.30E-04
Photochemical oxidant formation	kg NMVOC	7.30E-04	8.90E-04	2.20E-03	1.50E-04
Terrestrial acidification	kg SO2 eq	5.90E-04	7.20E-04	1.90E-03	1.50E-04
Terrestrial ecotoxicity	kg 1,4-DB eq	1.30E-06	1.70E-06	2.20E-06	4.20E-07
Water depletion	m3	4.90E-03	5.90E-03	2.40E-02	5.10E-03

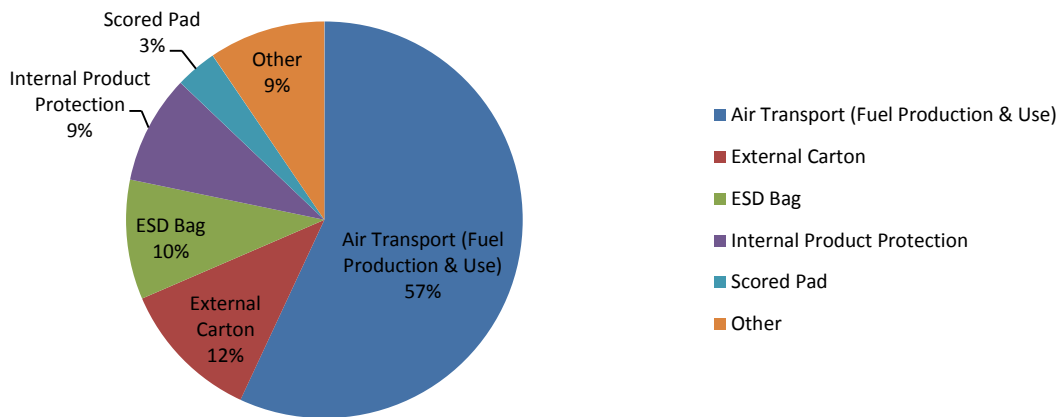
Climate Impacts

Climate change impacts are often a significant concern for our stakeholders and consequently the remainder of this document will focus on analysis of on carbon dioxide equivalent emissions (CO₂e) through the packaging product life cycle.

Summary of Results

The total life cycle greenhouse gas (GHG) emissions of 0.17kg CO₂e per average product are split between the various life cycle stages as presented below, with air freight accounting for over half of all packaging life cycle GHG emissions. When looking at GHG emissions per hard disc drive shipped for four common packaging designs, those packaging designs containing more drives had lower environmental impacts per drive. Energy use exhibited a similar trend. Packaging production and disposal accounts for roughly 1% of global warming impacts during a typical HDD's life cycle.

**Disc Drive Packaging
Relative Climate Change Impact Contributions**



The chart below compares the GHG emissions associated with each of four common OEM packaging configurations. It is important to note that that direct comparisons between packaging configurations is not possible due to differences in technical requirements met by each design.

**Relative Global Warming Packaging Impacts
Per Hard Drive Shipped**

