

## Free Agent GoFlex Ultra-Portable Drive Kit Product Life Cycle Analysis Summary

### Product Description

The Free Agent Go Flex Ultra-Portable Drive Kit is a portable hard disc drive sold by Seagate and its JDM partners at retail stores and is intended for the general consumer products market. The device uses a USB 2.0 or 3.0 interface to transfer data and supply power to the device from a connected personal computer.



### Life Cycle Analysis

#### Functional Unit, System Boundaries and Allocation Unit:

The functional unit for this study is a single GoFlex drive kit in intermittent 3 year customer use as a backup device. The drive kit includes the hard disc, hard disc enclosure, USB cables, packaging, and installation booklets contained in the box. The base case of this study assumed product distribution and use in the United States, Europe, and Asia. LCA results are specific to each of the eight drives in the family as each model number has different technical and performance specifications defining its functionality.

The system boundaries are inclusive of raw material extraction, material manufacturing, supplier transportation, product assembly and distribution, packaging, consumer use and assumed end of life (EOL). Burdens from the recycling of product components at EOL are included in the system boundary but avoided burdens from displaced virgin raw materials are subject to a cut-off and are not included. Systems infrastructure such as the manufacture of machinery or buildings used in product production and assembly have been excluded. All product components were considered in this study with the Bill of Materials provided by Seagate. Burdens at Seagate's assembly were allocated on a production unit volume basis.

SimaPro v7.2 software and the Ecoinvent v2.2 database were used during preparation of the LCA. The ReCiPe mid-point hierarchical method was used to determine life cycle impacts for the product. This study, commissioned by Seagate Technology, was prepared by WSP Environmental, and 3<sup>rd</sup> party critically reviewed by EarthShift.

### Calculated Impacts:

Mid-point Impact	Unit	Total
Climate change	kg CO2 eq	1.36E+01
Ozone depletion	kg CFC-11 eq	1.29E-06
Human toxicity	kg 1,4-DB eq	1.49E+01
Photochemical oxidant formation	kg NMVOC	4.25E-02
Particulate matter formation	kg PM10 eq	2.25E-02
Ionizing radiation	kg U235 eq	2.49E+00
Terrestrial acidification	kg SO2 eq	6.46E-02
Freshwater eutrophication	kg P eq	1.03E-02
Marine eutrophication	kg N eq	4.36E-03
Terrestrial ecotoxicity	kg 1,4-DB eq	2.45E-03
Freshwater ecotoxicity	kg 1,4-DB eq	2.45E-01
Marine ecotoxicity	kg 1,4-DB eq	2.36E-01
Water depletion	m3	1.19E-01
Metal depletion	kg Fe eq	7.88E+00
Fossil depletion	kg oil eq	3.29E+00

### Climate Impacts

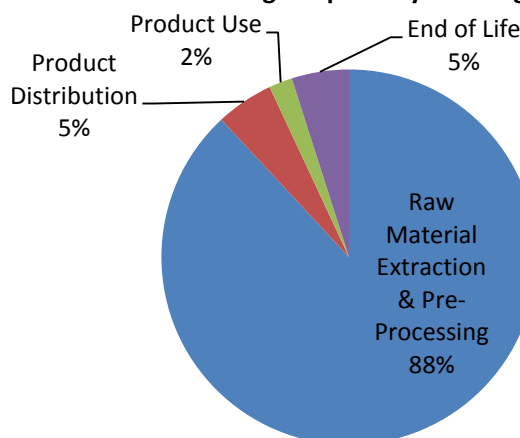
Climate Change Impacts are often a significant concern for our stakeholders and consequently the remainder of this document will focus on analysis of carbon dioxide equivalent emissions (CO2e) through the product lifecycle. The total life cycle greenhouse gas (GHG) emissions of 13.6 kg CO2e per product are split between the various life cycle stages as presented to the right.

#### Raw Material Acquisition and Pre-processing

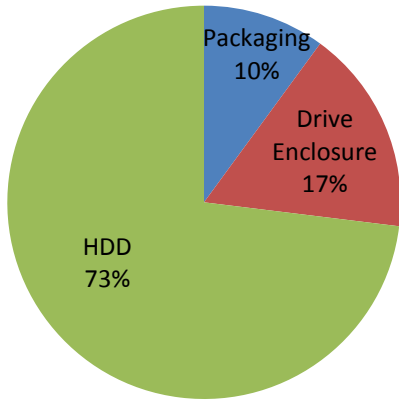
This phase captures the impacts associated with raw material extraction to finished goods delivered to Seagate's point of assembly.

Composing 88% of the total product footprint, component manufacturing is largely determined by the materials used in each component and the energy intensity of component production.

### Climate Change Impacts by Life Stage



**Relative Climate Impacts by Drive Component Type**



As seen in the figure to the left, the hard disc drive accounts for three quarters of raw material climate impacts, with the drive enclosure and packaging accounting for 17% and 10% of climate impacts respectively.

**Production**

The environmental impacts resulting from product assembly by Seagate for each GoFlex drive were estimated using activity data from Seagate’s GHG emission inventory. Activity data from the inventory were allocated to the product on a unit volume manufactured basis. Thus, all direct and indirect emissions from both production and facility operation, including heating and cooling, vehicle fleets, and fugitive emissions, have been captured in this estimate.

**Distribution**

The product life cycle assumes distribution to the United States, Europe, Asia, and shipments to customers from the Seagate assembly site. The total GHG emissions from product distribution amount to only 5% of the total life cycle impact.

**Use Phase**

Seagate engineers estimate that retail external drives like the GoFlex are plugged into a PC and used for 2 hours per day (14 hours per week) for a 3 year period. This is thought to be a conservative assumption in that most users would use the drives far less than this amount. This means that the HDD is actively being used about 8% of the time on average.

Sensitivity analysis was conducted to evaluate how the product’s climate impacts would change for distribution and use in different geographies. The product is also distributed and used within Europe and Asia, and representative distribution models for each are available from Seagate. For each geographic region, the product use phase and end of life phase will also be slightly different. The use phase sensitivity was modeled by changing the source of grid electricity from US average to Europe average and to China average for Asia.

The sensitivity analysis also evaluates GoFlex models with different storage capacities. A 750 GB and 1500 GB model were selected to represent the low and high level of impact for a GoFlex Drive Kit.

**End of Life (EOL) & Recycling**

Although the LCA data for electronic products’ EOL/recycling phase has not been well established, and primary data are not available for this product, reasonable estimates of industry practices were made in this analysis based primarily on Ecoinvent unit processes. These processes represent the manual dismantling and depollution, and the mechanical treatment (shredding) of devices subject to the European Community Waste Electrical and Electronic Equipment Directive (WEEE) in various fractions based on common transfer coefficients for this type of treatment in Switzerland. These processes have been considered as representative for the global situation, and applied to the GoFlex drive, although it is recognized that this will produce an optimistic result for EOL impacts. Recycling of packaging waste was derived from Environmental Protection Agency (EPA) data on Municipal Solid Waste Generation, Recycling, and Disposal in the United States.

**Geographical Distribution Sensitivity Analysis**

