Momentus HDD Product Life Cycle Analysis Summary

Product Description

The Momentus 5400.6 500GB is a hard disc drive designed for standard form factor high-performance and mainstream laptops, entry-level laptops and external backup storage enclosures. This product is known for its innovative features and technology including laptop power management to reduce power consumption and ramp load features that remove the head from the disc during idle periods, reducing idle power consumption and adding to the durability of the drive.

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 life cycle. This study, commissioned by Seagate Technology, was prepared by WSP Environmental, and 3rd party critically reviewed by EarthShift.

Life Cycle Analysis

Functional Unit, System Boundaries and Allocation Unit:

The functional unit for this study is a single 500GB notebook HDD in operation for 3 years. The base case of this study assumed product distribution and use in the United States. The drive has a spindle speed of 5400 RPM and has 8 MB of cache, and is configured with 512 Bytes per sector.

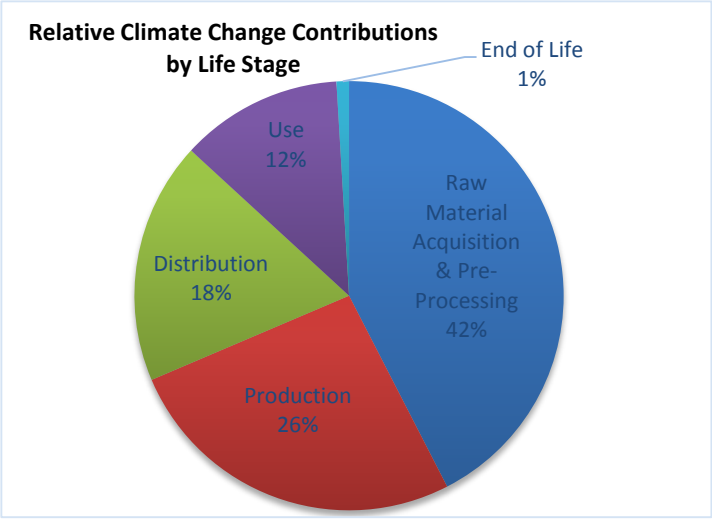
The system boundaries include raw material extraction, material manufacturing, supplier transportation, product assembly and distribution, packaging, consumer use and assumed end of life (EOL). Burdens from the recycling of product components at EOL are included in the system boundary, but avoided burdens 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 for the period FY2010. Burdens at Seagate's assembly were allocated on a production unit volume basis using FY2010 data.

Calculated Results:

Mid-point Impact	Unit	Total
Climate change	kg CO2 eq	7.3E+00
Ozone depletion	kg CFC-11 eq	1.5E-06
Human toxicity	kg 1,4-DB eq	9.3E+00
Photochemical oxidant formation	kg NMVOC	2.8E-02
Particulate matter formation	kg PM10 eq	1.6E-02
Ionizing radiation	kg U235 eq	1.1E+00
Terrestrial acidification	kg SO2 eq	5.0E-02
Freshwater eutrophication	kg P eq	6.2E-03
Marine eutrophication	kg N eq	9.2E-03
Terrestrial ecotoxicity	kg 1,4-DB eq	6.8E-04
Freshwater ecotoxicity	kg 1,4-DB eq	1.5E-01
Marine ecotoxicity	kg 1,4-DB eq	1.4E-01
Water depletion	m3	3.5E-02
Metal depletion	kg Fe eq	2.6E+00
Fossil depletion	kg oil eq	1.9E+00

Climate Impacts

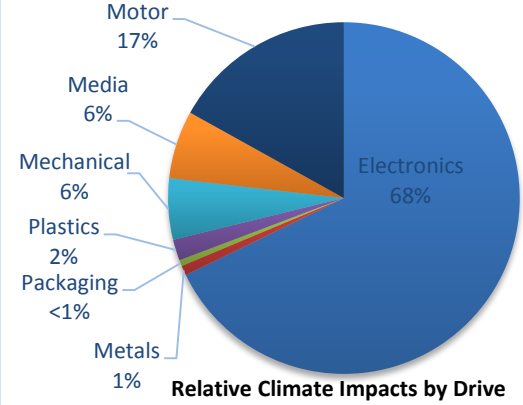
As climate impacts are often the foremost concern for our stakeholders, the remainder of this document will focus on analysis of on carbon dioxide equivalent emissions (CO_2 eq) through the lifecycle of the product. The total life cycle greenhouse gas (GHG) emissions of 7.34 kg CO2e per product are split between the various life cycle stages as presented in the graph 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 42% of the total product footprint, component manufacturing is largely determined by the materials used in each component and the energy intensity of component production.

Although electronic components make-up a little more than ten percent of the product weight, they account for close to 70% of the climate impacts in this phase of the product life cycle as shown in the chart on the next page.



Relative Climate Impacts by Drive Components

Production

The environmental impacts resulting from product assembly by Seagate for each Momentus 500GB hard 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. Since the Momentus hard drive is physically smaller than the typical drive assembled at this plant, the allocation procedure is likely to produce a conservative estimate for the assembly burdens. This estimate will be updated as better data are available.

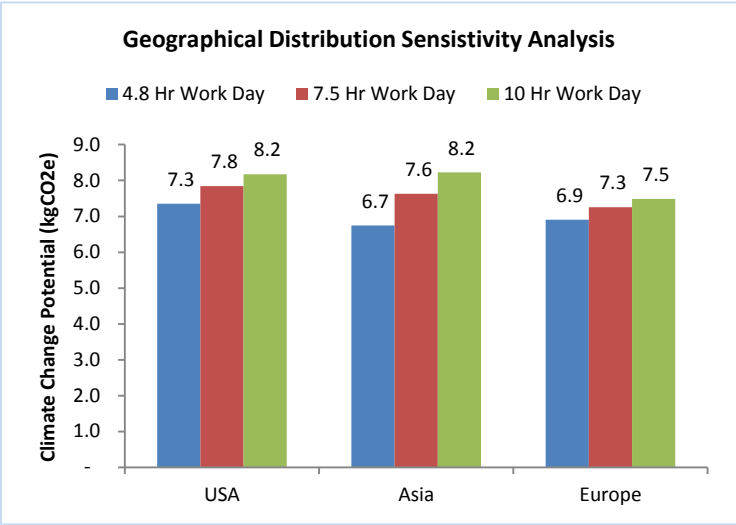
Distribution

The product life cycle assumes distribution to the United States, and shipments to customers from the Seagate assembly site follow the distribution model below right. The total GHG emissions from product distribution amount to 18% of the total life cycle impact.

Use Phase

Seagate's laptop power management technology optimizes product performance to minimize the costs and impacts associated with drive power draw. This study assumes that laptop OEMs leave Seagate power management scenarios enabled. To estimate lifetime product energy use, this study combines the drive's typical power draw in each mode of operation with annual hourly estimates for laptop operating modes from the literature. Additionally, it is assumed that during a typical year, the laptop is active 13% of the time and in sleep/standby model for the remaining amount of time. The estimated lifetime electricity consumption for the drive is 1.09 kWh, equivalent to the amount of energy needed to power a 60 Watt light bulb for 18 hours.

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. The product use phase and end of life phase will vary slightly by geography. 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 different product usage intensity scenarios which represent different lengths of the workday. The sensitivity results presented above show how the total product climate impacts vary by geography and use intensity.

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 Momentus 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.

Momentus 5400.6 HDD Bill of Substances

The table to the left and chart below illustrate the 39 greatest mass substances in the Momentus 5400.6 disc drive comprising a cumulative concentration of nearly 99%. Each remaining chemical substance comprises less than 0.1% by weight of the product. Seagate Momentus 5400.6 disc drives contain no bromine or chlorine above 900 parts per million (ppm) or listed phthalates at the homogeneous material level. In addition, there are no JIG/IEC 62474 restricted chemicals over allowed limits, no ozone depleting chemicals, and no REACH substances of very high concern (SVHC) over 1000 ppm at the article level, as of the date of this writing. Subsequent periodic additions to regulated and restricted chemicals may not be accounted for here.

Substance	CAS Number	Cumulative Concentration of Substances (%)
FE	7439-89-6	30.7014
AL	7429-90-5	59.0153
COPPER (METALLIC)	7440-50-8	70.4175
FIBROUS-GLASS-WOOL	65997-17-3	74.9029
CRYSTALLINE SILICA	14808-60-7	78.3608
NICKEL	7440-02-0	81.4267
SI	7440-21-3	84.1246
"DOPO" HALOGEN FREE FLAME RETARDANT	35948-25-5	86.0617
CHROMIUM	7440-47-3	87.5379
SILICA	7631-86-9	88.867
LCP POLYMER	147310-94-9	90.149
PHENOL, POLYMER WITH FORMALDEHYDE, GLYCIDYL ETHER	28064-14-4	91.3146
FUSED SILICA	60676-86-0	92.1721
PROPRIETARY		92.9727
NEODYMIUM	7440-00-8	93.6111
POLYESTER MATERIAL	25038-59-9	94.0334
POM	24969-26-4	94.4228
MANGANESE	7439-96-5	94.7626
AG	7440-22-4	95.0878
P	7723-14-0	95.385
AL2O3	1344-28-1	95.6605
BARIUM TITANATE(IV)	12047-27-7	95.9314
ACRYLATE URETHANE OLIGOMER	73324-00-2	96.1905
POLYACRYLATE	600-07-7	96.4485
BENZENEDICARBOXYLIC ACID POLYMER	60088-52-0	96.7029
ARALDITE GY 250	25068-38-6	96.9112
SN	7440-31-5	97.1065
ACRYLIC POLYMER	37325-11-4	97.294
POLY(BISPHENOL A CARBONATE)	111211-39-3	97.4679
BARITE	7727-43-7	97.625
ZINC	7440-66-6	97.7794
GLASS- FIBRE	65997-17-3	97.9225
C	7440-44-0	98.0612
EPOXY RESIN	129915-35-1	98.1883
DIIRON-TRIOXIDE	1309-37-1	98.2855