Koho Enterprise Solid-State Drive Product Life Cycle Assessment Summary

Product Description

The Koho solid state drive (SSD) family includes the next-generation of high-capacity, high-performance Serial Attached SCSI (SAS) SSDs designed with multiple endurance offerings optimized for demanding enterprise applications and maximum total cost of ownership savings. The Koho family delivers ultra-fast, consistent and easily scalable performance that exceeds 12Gb/s SAS single port bandwidth.

Life Cycle Assessment

Functional Unit, System Boundaries and Allocation Unit:

The functional unit for this study is a single Koho SSD in operation for 5 years. The base case of this study focuses on the 1920 GB Koho model (ST1920FM0003) and assumes product distribution and use in the United States and Europe. The Koho family includes drives ranging in capacity from 400 to 3840 GB. Five drive models in addition to the base case were included in the study.

The system boundaries are inclusive of raw material extraction, material manufacturing, supplier transportation, final product assembly and distribution, packaging, consumer use, and assumed end-of- life (EOL). Systems infrastructure such as the manufacture of machinery or buildings used in product production and final product assembly have been excluded. All product components were considered in this study with the Bill of Materials provided by Seagate.

GaBi ts v.6.110, SimaPro v8.0.3.1, and the ecoinvent v3.0 database were used during preparation of the life cycle assessment (LCA).

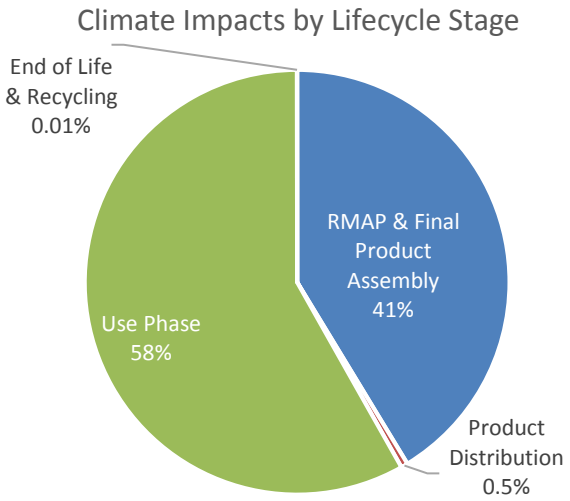
Overall Results

The ReCiPe mid-point hierarchical method was used to determine life cycle impacts for the Koho 1920 GB model (base case) product life cycle as shown below.

Mid-point Impact	Unit	Total
Climate change	kg CO2 eq	4.3E+02
Ozone depletion	kg CFC-11 eq	7.6E-06
Terrestrial acidification	kg SO2 eq	2.8E+00
Freshwater eutrophication	kg P eq	1.3E-01
Marine eutrophication	kg N eq	8.0E-02
Human toxicity	kg 1,4-DB eq	2.8E+01
Photochemical oxidant formation	kg NMVOC	1.4E+00
Particulate matter formation	kg PM10 eq	7.7E-01
Terrestrial ecotoxicity	kg 1,4-DB eq	4.2E-02
Freshwater ecotoxicity	kg 1,4-DB eq	1.6E+00
Marine ecotoxicity	kg 1,4-DB eq	1.7E+00
Ionising radiation	kBq U235 eq	1.4E+02
Water depletion	m3	1.1E+03
Metal depletion	kg Fe eq	1.3E+02
Fossil depletion	kg oil eq	1.5E+02

Climate Change Impacts

As Climate Change impacts are often the foremost concern to our stakeholders, the remainder of this document will focus on analysis of carbon dioxide equivalent emissions (CO_2eq) through the life cycle of the product. The total life cycle greenhouse gas (GHG) emissions of 425 kg CO_2eq per drive are shown by life cycle stage in the figure at right.



Use Phase

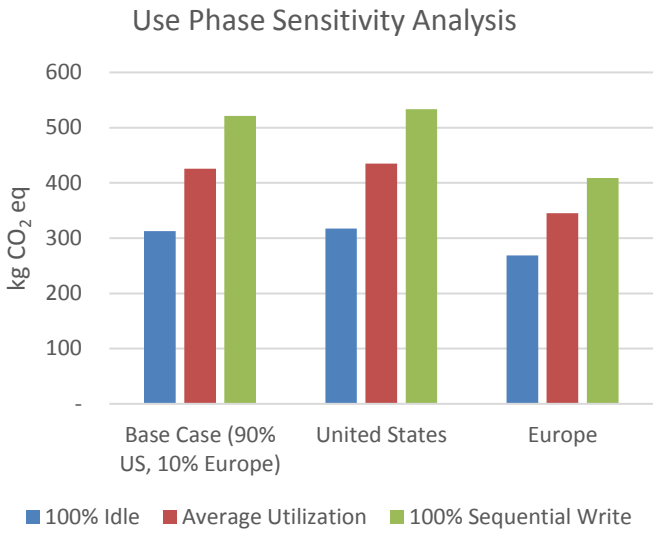
The Koho drives are intended for use in servers and data centers that operate continuously and provide online data storage and access capabilities throughout the day and year. Seagate engineers specify that under typical use, a Koho drive will remain active during its 5 year lifetime, operating equally across random read, random write, sequential read, and sequential write modes. The estimated 5 year electricity consumption for the drive is 337 kWh, which is less than the energy used to power a 7-Watt light emitting diode (LED) lamp over its useful life.[1]

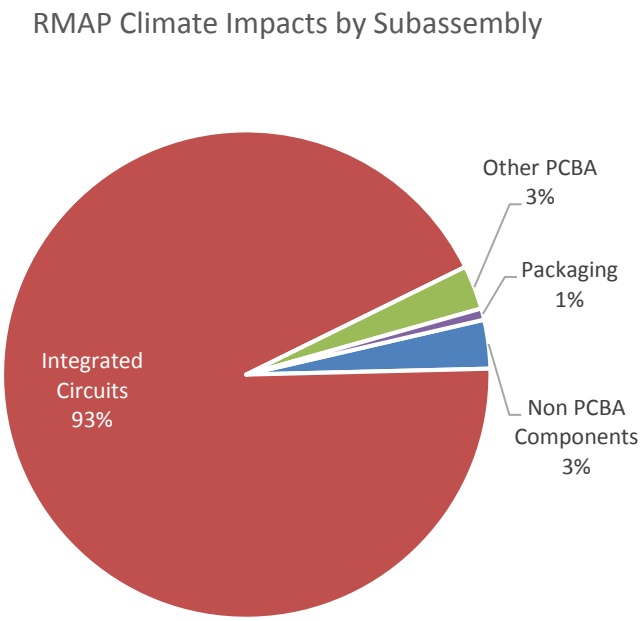
[1] Based on an assumed LED lamp life of 50,000 use hours.

Sensitivity analyses were conducted to evaluate how the product's impacts would change for distribution and use in different geographies. The product is distributed and used in countries around the world, with primary use in the United States and Europe. For each geographic region, the use phase impacts will vary as a function of the local grid fuel composition and subsequent emission factors. The use phase sensitivity was modeled by changing the source of grid electricity from a base-case weighted average by country of use (based on Seagate sales forecasts) to either Europe or the United States, to better illustrate use phase emissions specific to users in each country.

The sensitivity analysis also evaluates different drive operating scenarios to determine the impact of use phase on the drive lifecycle. These scenarios represent the base case average, minimum, and maximum use energy intensity of the base model drive. Results of the sensitivity are shown in the figure at right.

- 100% Idle – Servers and drives are always powered on, but remain in idle mode.
- Average Use – Servers and drives are powered on and active, with operating mode distribution representative of typical Koho use.
- 100% Sequential Write – Servers and drives are never idle and are always operating in their highest power demand operating mode, sequential write.





Raw Material Acquisition and Pre-Processing (RMAP)
This phase captures the impacts associated with raw material extraction to finished goods delivered to the point of final product assembly. Composing 41% of the total product footprint, component manufacturing impacts are largely determined by the materials used in each component and the energy intensity of component production.

As seen in the figure at left, 96% of RMAP climate impacts are attributed to the printed circuit board subassembly, with 93% of impacts driven by the embodied energy in the installed integrated circuits. The drive chassis subassembly (i.e., drive cover, labels, screws) accounts for only 3% of climate impacts, with packaging and other printed circuit board subassembly (PCBA) components accounting for 1% and 3% of impacts, respectively.

Final Product Assembly
The Koho PCBA and subassemblies are assembled, packaged, and shipped to customers by a contract manufacturing facility. Final product assembly energy and associated impacts were estimated using industry average data.

Distribution
The product life cycle assumes distribution to customers in the United States and Europe from the contract manufacturing facility in Ayuthaya, Thailand. The total GHG emissions from product distribution amount to less than 1% of the total life cycle impact.

End of Life & Recycling
Although LCA data for the EOL/recycling phase of electronics has not been well established, and primary data are not available for this product, reasonable estimates of industry practices were made in this assessment based primarily on ecoinvent unit processes. These processes represent the manual dismantling and depollution, and the mechanical treatment (shredding) of Waste Electrical and Electronic Equipment directive devices 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 Koho drive, although it is recognized that this will produce an optimistic result for EOL impacts. Recycling of packaging waste was derived from US Environmental Protection Agency data on Municipal Solid Waste Generation, Recycling, and Disposal in the United States.