OneStor SP2584 Extensible Storage Platform (ESP) Product Life Cycle Assessment (LCA)

Product Description

The OneStor SP2584 is a five rack unit (5U)-size data storage unit ideally suited for enterprise-class applications including big data analytics, high performance computing, digital media, compliance retention, and data archival.

Life Cycle Assessment

Functional Unit, System Boundaries, and Allocation Unit

The functional unit for the study is defined as a single Seagate Systems OneStor SP2584 unit, providing all of the capabilities to which it was designed, operating at a Tier 4 data center for a period of 10 years. Each OneStor unit contains 84 Seagate Constellation hard disc drives (HDDs). The base case of this study assumes product distribution and use in the United States, Europe, and Asia.

The system boundaries are inclusive of raw material extraction, material manufacturing, supplier transportation, product assembly and distribution, packaging, consumer use, and 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. Infrastructure processes such as the manufacture of machinery and buildings used in support of the OneStor are excluded from all life cycle phases. All product components associated with Constellation HDDs are incorporated in the study, based on the bill of materials provided by Seagate. All product components associated with the OneStor unit are also incorporated in the study, based on the bill of materials provided by Seagate Systems. Manufacturing burdens at Seagate component manufacturing and assembly sites are allocated on a production unit volume basis.

SimaPro v8 software and the Ecoinvent v3 database were used during preparation of the LCA. Modeling of printed circuit board assemblies (PCBA) relied on the LCA software GaBi v6.

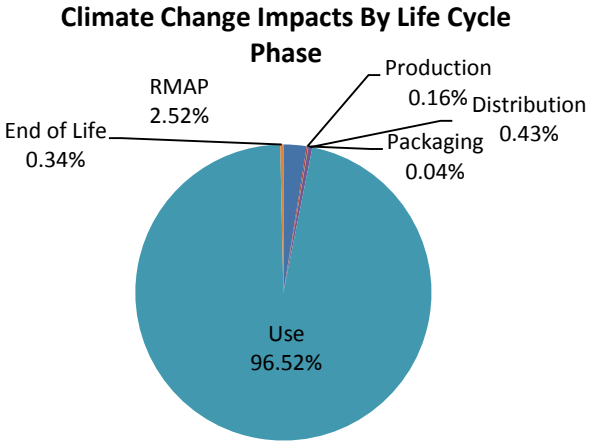
Overall Results

The ReCiPe v1.08 mid-point hierarchical method was used to determine life cycle impacts for the product life cycle as shown below.

Mid-point Impact	Unit	Total
Climate change	kg CO_2 eq	1.9E+05
Ozone depletion	kg CFC-11 eq	2.4E-03
Terrestrial acidification	kg SO_2 eq	1.5E+03
Freshwater eutrophication	kg P eq	4.3E+01
Marine eutrophication	kg N eq	3.0E+01
Human toxicity	kg 1,4-DB eq	6.5E+03
Photochemical oxidant formation	kg NMVOC	6.4E+02
Particulate matter formation	kg PM10 eq	4.4E+02
Terrestrial ecotoxicity	kg 1,4-DB eq	5.9E+00
Freshwater ecotoxicity	kg 1,4-DB eq	1.9E+01
Marine ecotoxicity	kg 1,4-DB eq	4.1E+01
Ionising radiation	kBq U235 eq	1.9E+04
Water depletion	m^3	3.7E+05
Metal depletion	kg Fe eq	2.1E+03
Fossil depletion	kg oil eq	4.0E+04

Climate Impacts

Focusing on Climate Change and Greenhouse Gas (GHG) emissions, we calculate the total life cycle cradle-to-grave GHG emissions for this product of 185 metric tons CO_2 eq per unit product, allocated across the various life cycle stages as shown at right.



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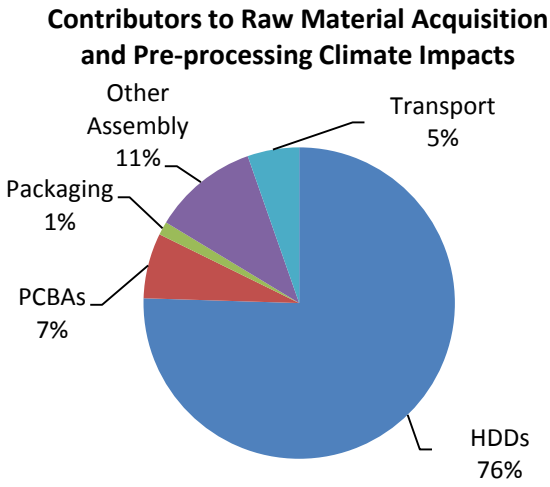
Raw Material Acquisition and Pre-processing (RMAP)
This phase captures the impacts associated with raw material extraction through production of finished goods delivered to Seagate's point of assembly. RMAP comprises approximately 2.5% of the total product footprint. Component manufacturing is largely determined by the materials used in each component and the energy intensity of component production.

As shown at right, the majority (76%) of raw material climate impacts arise from production of the 89 Constellation HDDs that provide storage capacity for the product, with the remaining amount divided across electronic components, the chassis and other components, and air transport of HDDs to assembly facilities. HDDs comprise 40% of the product by mass but are responsible for ~70% of the cradle-to-gate environmental impacts (including non-climate change impacts).



Production
The environmental impacts resulting from product assembly and testing by Seagate Systems takes place in Malaysia, Mexico, and the United Kingdom. Impacts from product assembly arise from use of electricity, fuels, and direct air emissions. Activity data are allocated to individual devices on a unit volume manufactured basis.

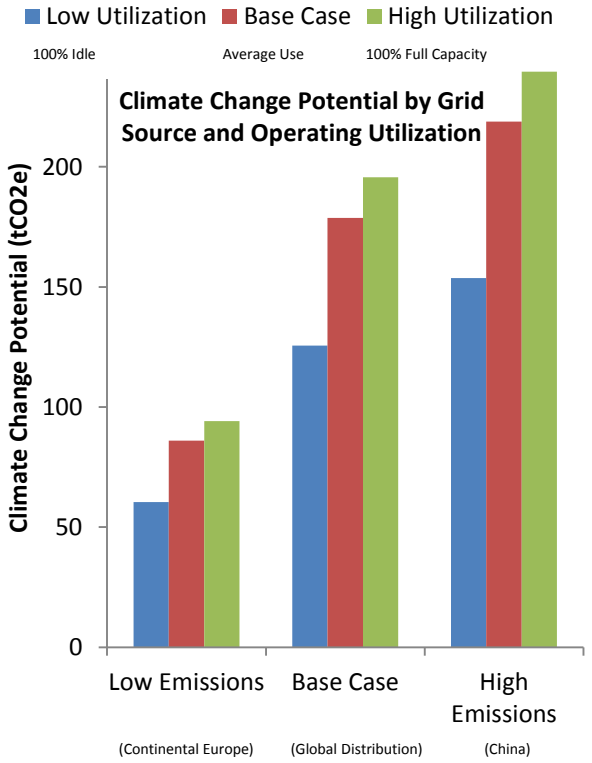
Distribution
The product life cycle assumes distribution to customers in the United States, Europe, and Asia from Seagate Systems assembly sites in Malaysia, Mexico, and the United Kingdom. Despite the majority of product being shipped to customers via air freight, total GHG emissions from product distribution amount to less than 1% of total life cycle impact.

Use Phase
The OneStor product is intended for use in enterprise-class data centers that provide online data storage and access capabilities on a continuous basis. However, data centers are equipped with redundant storage and computation capacity and consequently data center utilization rates can range from 25% to 45%. It is estimated that 148 MWh of electricity is required over the 10 year period to operate the product, which includes energy used by fans, HDDs, LEDs and energy lost in power conversion. Secondary electricity requirements for data center cooling are not included in the study.

Sensitivity analysis was conducted to evaluate how the product's climate impacts change based on variations in distribution and use across different geographies. This use phase sensitivity was modeled by changing the source of grid electricity from an electricity mix in accordance with the product's global distribution (base case) to the averages for continental Europe (low emission case) and China (high emission case).

The sensitivity analysis also evaluated different server operating scenarios to determine the impact of utilization on drive lifetime energy use. These scenarios represent average use (base case), 100% idling (low-use case), and 100% full capacity (high-use case) of an ESP.

Results show that the use phase dominates life cycle impact for the product, accounting for over 95% of all impact. Sensitivity analysis of the use phase reveals that the geography of use, and therefore electricity emission factor, has a greater impact on the overall results than does the intensity of product utilization. Even when idle, the OneStor product consumes relatively large amounts of electricity. The difference in lifetime electricity use across use intensity scenarios is not as great as that resulting from electricity emission factors across regions.



End of Life (EOL) and Recycling
Although secondary LCI data for the EOL and recycling phase of electronic products is not well established, and primary data are not available, reasonable estimates of industry practices were made in this assessment, based primarily on Ecoinvent unit processes. These processes represent manual dismantling and depollution, and mechanical treatment (shredding) of WEEE 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 OneStor product, although it is recognized that this will produce an optimistic result for EOL/recycling impacts. Total life cycle impact is less than 1% for this phase.

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