

ECO-CALCULATOR

METHODOLOGY

The objective of Copy-Care Scandinavia's (CCS's) Eco-Calculator is to provide an analytical tool for the easy and clear comparison of the environmental impact of a CCS intelligently remanufactured cartridge versus an OEM cartridge through the primary use of a Life Cycle Assessment (LCA). LCA is a cradle to cradle analysis technique to assess the lifetime environmental impact of a product - from the extraction of raw materials to material processing, manufacture, distribution, use and end of life disposal or recycling.

The most critical phase in an LCA study is the Life Cycle Impact Assessment (LCIA) where the magnitude and significance of the potential environmental impacts of a product system is evaluated.

This LCA has been performed in accordance with ISO 14040:2006(E) and ISO 14044:2006(E).

The LCIA was calculated using the Eco-indicator 99 life cycle impact assessment methodology. The Eco-indicator 99 methodology links a combination of midpoint impact categories to three damage-oriented endpoints ie. human health, ecosystem quality and resources.

1) Human health (DALY) – Disability Adjusted Life Years: the overall number of life years lost due to disease caused by environmental impacts. Midpoints include carcinogens, respiratory organics, respiratory inorganics, climate change, radiation and ozone layer.

2) Ecosystem Quality (PDF) – potentially disappeared fraction of species: the change in biodiversity. Midpoints include ecotoxicity, acidification/eutrophication and land use.

3) Resources (MJ) – Mega joules of surplus energy: the amount of surplus energy required in the future to extract the resources in question. Midpoints include minerals and fossil fuels.

ECO-CALCULATOR CRITERIA

New Materials in Production

The mass of new components required to produce an OEM cartridge is compared to the mass of new parts required to produce a remanufactured cartridge. The difference between the two numbers is the mass of materials reused and therefore deflected from the corporate waste stream when a remanufactured cartridge is used instead of a new cartridge. Upon disassembly of the OEM cartridge, each part is weighed. The average mass of a remanufactured cartridge is calculated based on the combined weight of the replacement parts and replacement ratio. This average mass differential is approximately 1.027kg per remanufactured toner cartridge. This LCA is not intended to be representative of an open loop system where the empty cartridge quality and recovery yields may not be controlled and adequately modelled. It is also not intended to be representative of the entire toner cartridge remanufacturing industry in which cartridge quality may not be as tightly controlled.

Plastic and Metal to Landfill

Reusing a single cartridge saves an average of 0.91kg of metal and plastic waste from being deposited in landfills.

Oil

Remanufacturing uses 50% less oil to produce a remanufactured cartage than the equivalent OEM. An OEM cartridge uses 3.785 litres of oil to manufacture a single unit.

Energy – Cumulative Energy Demand (CED)

CED measured in megajoules is the total lifetime energy, both renewable (kinetic, solar, potential, biomass, water) and non-renewable (fossil, nuclear, metals, minerals) invested in the manufacture, transportation, use, and disposal of a product. Transportation distances and manufacturing are the primary

impacts of energy use. The measurement of CED is important as it can be a proxy for greenhouse gas emissions and other environmental impacts caused by energy use.

For the purposes of this calculation, the CED for cartridge life cycle has been standardised to 10,000 cartridges as a modest representation of a remanufacturing number per month. The results show therefore that over 400,000 megajoules of energy demand was saved by using 10,000 CCS remanufactured cartridges instead of 10,000 OEM cartridges which is enough energy to power almost nine single family homes for an entire year.

The cumulative calculation showed that the CCS reman cartridge used 48% less energy than its OEM equivalent.

Global Warming

The Global Warming Potential classification model used for this analysis was developed by the Intergovernmental Panel on Climate Change (IPCC) and expresses Global Warming Potential for time horizon 100 years (GWP100), in kg carbon dioxide equivalents (kg CO₂ eq). The selected LCIA method used was IPCC 2007 GWP 100a V1.01. The kg CO₂ eq for an OEM cartridge is 4.249 compared to 2.526 for a CCS remanufactured cartridge, meaning the CCS cartridge represents a kg CO₂ eq saving of 1.723 or 41%. The CCS cartridge reduced footprint is due to the amount of impact that is avoided through the reuse of components, with 79% of the OEM cartridge mass reused in a CCS cartridge.

Human Health Damage

Human Health Indicator is based on the premise that all human beings should not suffer any illnesses, disabilities or premature death resulting from environmental impacts. The human health indicator links the mass of any emission to exposure and dose, and an number of health effects. The damaging effect of the human health indicator is quantified as the overall number of life years lost due to disease caused by environmental impacts (DALY). Such impacts include:

Carcinogens

Carcinogenic effects due to emissions of carcinogenic substances to air, water and soil. Damage is expressed in Disability adjusted Life Years (DALY)/kg emission.

Respiratory organics

Respiratory effects resulting from summer smog, due to emissions of organic substances to air, causing respiratory effects. Damage is expressed in Disability adjusted Life Years (DALY)/kg emission.

Respiratory – inorganics

Respiratory effects resulting from winter smog caused by emissions of dust, sulphur and nitrogen oxides to air. Damage is expressed in Disability adjusted Life Years (DALY)/kg emission.

Climate change

Damage, expressed in DALY/kg emission, resulting from an increase of diseases and death caused by climate change.

Radiation

Damage, expressed in DALY/kg emission, resulting from radioactive radiation.

Ozon layer

Damage, expressed in DALY/kg emission, due to increased UV radiation a result of emission of ozone depleting substances to air.

The cumulative result showed that the CCS intelligently remanufactured cartridge is 34.2% less harmful to human health than its equivalent OEM. Further information are requested by contacting Copy-Care Scandinavia Ltd..