



UR Family

Product Environmental Profile

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This document outlines the environmental impact of a GE Universal Relay (UR) product.

Introduction

A Life Cycle Assessment (LCA) quantifies the environmental impact of a product through its life cycle. This includes raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and recycling or disposal. This document provides the LCA results of the UR family of products. While the LCA was done on the C60 product, the other products in the UR family have similar structure, with modules, terminals, and front panels depending on order code.

The order code of the product used for this report is C60-UG3-AEH-F8L-H6W-M6W-P6X-U6X-W6S. It includes power supply, CPU, digital signal processor (DSP), and five contact input/output modules, for a total of eight modules inside the chassis.

The LCA is based on ISO standards 14040 and 14044.

LCA results depend on assumptions taken on each life cycle stage, database, calculation methods, and other factors. As such, the results presented in this report are unique to the assumptions and practices of GE Grid Solutions. The results cannot be compared with other companies and/or products without ensuring that all the factors considered are the same.

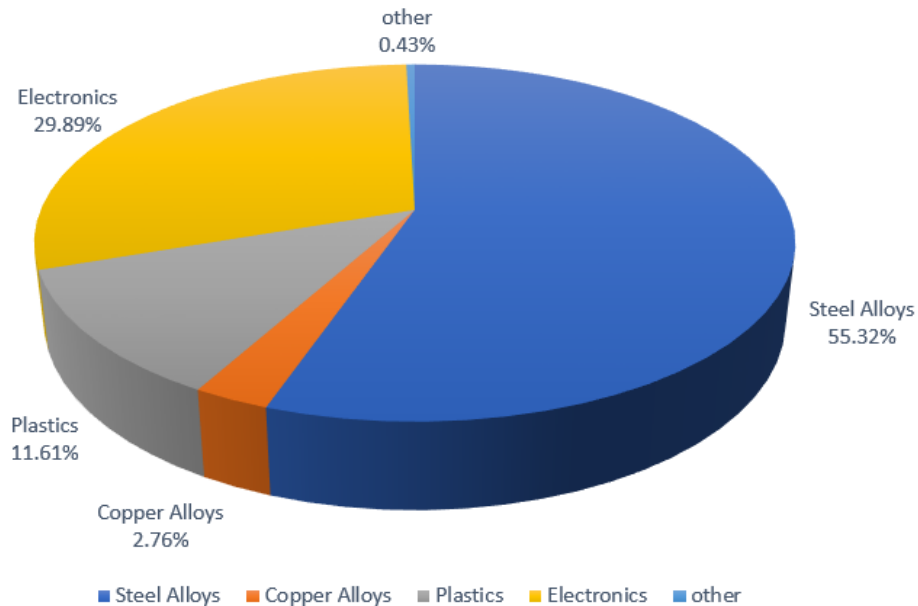
Materials

The total mass of a UR product is 12 kg to 16 kg, depending on options.

The figure shows the material composition of the C60. Packaging is excluded.



Figure 1: UR materials



Method

Analysis was done using SimaPro software version 9.0 and calculation method ILCD2011 Midpoint. The database used is EcolInvent version 3.

Environmental impact evaluation is carried out on the life cycle of the product for 16 environmental indicators. The appendix explains each indicator.

Phases

Manufacturing

Materials

For the materials phase, the following have been taken into account:

- The bill of materials for the C60
- Material transformation processes, such as sheet rolling, injection molding, and extrusion, made by subcontractors
- Processes for assembly of printed circuit boards
- Processes for surface treatments (zinc coating, tin plating, nickel coating)
- Transport of the raw materials to the production of sub-parts



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Factory

Here factory manufacturing refers to final product assembly. For this phase, the environmental impact of the GE factory in Añasco, Puerto Rico, includes energy consumption, water consumption, and waste production.

Distribution

Packaging

UR products generally are shipped loose without secondary packaging. Therefore, only primary packaging of the product has been considered.

The primary packaging includes a double-walled cardboard box, foam caps to retain and support the product within the package, an electrostatic discharge (ESD) bag to form a Faraday cage around the product, a documentation pack, and an accessory pack.

For a large order, the products are placed on a pallet and also stretch-wrapped. One pallet holds 20 units (four layers of five units) with approximate dimensions of 48 x 40 x 55 inches and an approximate gross weight of 700 lb.

Transport

It is assumed that 10% of the products are shipped by heavy truck (2,000 km) and 90% by air (10,000 km). This assumption is representative of the average transport process of such equipment.

Transport of semi-finished products from subcontractors to assembly unit is not taken into account.

Use

Service life

Expected service life is 20 years for UR devices manufactured June 2014 or later when applied in a controlled indoor environment and with electrical conditions within specification.

Energy consumption

The maximum power consumed is estimated to be 34 Watts, while average power consumption is about 25 Watts.

The typical power consumption calculated for the life cycle is:

$$25 \text{ Watts} \times 24 \text{ hours} \times 365 \text{ days} \times 20 \text{ years} = 4,380 \text{ kWh}$$

The energy used is based on the US electricity mix.

End of life

At the end of life, a UR product is assumed to be dismantled, recycled, and disposed of at a waste treatment center closest to a customer's installation. Hence the transport of the return of the product is not taken into account.



GE, as a producer of electrical and electronic equipment, complies with the Waste Electrical and Electronic Equipment European (WEEE) directive. A UR product must not be disposed of in a landfill once it reaches end of life.

The recyclability and recoverability rate of each material is assigned as per the International Electrotechnical Commission (IEC) technical report (TR) 62635: 2012.

Recycling and disposal are outlined in the UR Family Recycling and Disposal Instructions (GET-20096).

Results

For each environmental indicator, the results are presented by following the life cycle stage: manufacturing (including materials impact and factory impact), distribution, use, and end of life.

The table and figure provide the LCA results for the C60 product.

Table 1: C60 life cycle assessment

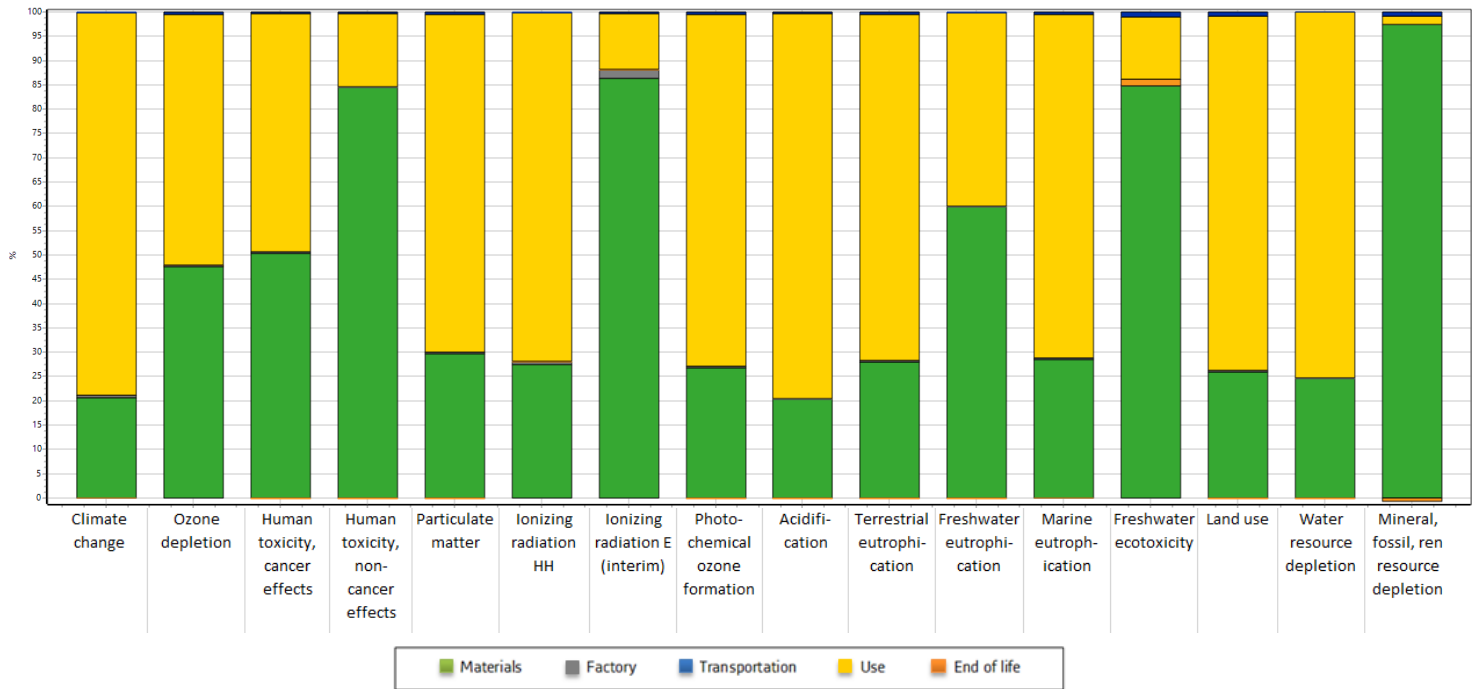
Impact category	Unit	Total	Materials	Factory	Distribution	Use	End of life
Climate change	kg CO2 eq	5.62E+03	1.16E+03	2.79E+01	1.37E+01	4.42E+03	-1.06E+00
Ozone depletion	kg CFC-11 eq	2.37E-04	1.13E-04	9.03E-07	1.16E-06	1.22E-04	7.19E-08
Human toxicity, cancer effects	CTUh	4.92E-04	2.48E-04	1.27E-06	1.60E-06	2.42E-04	-8.90E-07
Human toxicity, non-cancer effects	CTUh	5.56E-03	4.71E-03	5.62E-06	1.69E-05	8.38E-04	-1.27E-05
Particulate matter	kg PM2.5 eq	2.61E+00	7.76E-01	8.90E-03	1.17E-02	1.82E+00	-4.06E-03
Ionizing radiation HH	kBq U235 eq	1.80E+03	4.93E+02	1.06E+01	1.78E+00	1.29E+03	2.23E+00
Ionizing radiation E (interim)	CTUe	1.78E-03	1.53E-03	3.16E-05	5.87E-06	2.05E-04	1.20E-06
Photochemical ozone formation	kg NMVOC eq	1.53E+01	4.09E+00	5.46E-02	8.10E-02	1.11E+01	-1.60E-02
Acidification	molc H+ eq	4.66E+01	9.43E+00	1.11E-01	1.29E-01	3.70E+01	-5.69E-02
Terrestrial eutrophication	molc N eq	5.34E+01	1.49E+01	2.04E-01	2.74E-01	3.80E+01	-4.82E-02
Freshwater eutrophication	kg P eq	5.50E+00	3.30E+00	8.64E-03	1.16E-02	2.18E+00	-7.40E-03
Marine eutrophication	kg N eq	5.31E+00	1.52E+00	1.96E-02	2.55E-02	3.75E+00	-3.48E-03
Freshwater ecotoxicity	CTUe	1.64E+05	1.39E+05	1.23E+02	1.65E+03	2.10E+04	2.24E+03
Land use	kg C deficit	3.10E+03	8.03E+02	1.10E+01	2.60E+01	2.26E+03	-4.11E+00
Water resource depletion	m3 water eq	3.46E+03	8.51E+02	5.61E+00	1.27E+00	2.61E+03	-4.52E+00
Mineral, fossil, renewable resource depletion	kg Sb eq	5.93E-01	5.82E-01	1.29E-04	4.86E-03	1.00E-02	-4.08E-03



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The figure provides a graphical representation. The manufacturing phase includes materials in green and the factory in grey. The distribution/transportation phase is blue. The use phase is yellow, and end-of-life is orange.

Figure 2: C60 life cycle results



Analysis

As shown in the preceding figure, materials and use consume almost all resources.

Manufacturing

Materials

The impact is mainly from the chassis and energy consumption used during production of printed circuit board assembly (PCBA). It is the most significant reason for 6 of the 16 indicators.

Factory

The GE factory impact is not significant when compared to other phases. Impacts are mainly due to the energy consumption on-site.



Distribution

The impact of the distribution phase is relatively small. The impact is mainly due to the secondary packaging.

Use

The use phase is the most significant phase of a UR product on 10 of the 16 indicators. This is due to energy consumption over the 20 years of product operation.

End of life

Positive impacts are due to the recycling of steel alloys and copper alloys due to their high recyclability rate.

References

- ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 14040: 2006, Environmental management – Life cycle assessment – Principles and framework
- ISO 14020: 2000, Environmental labels and declarations – General principles
- ISO 14025: 2006, Environmental labels and declarations – Type III environmental declarations
- ISO 14001: 2015, Environmental management systems – Requirements with guidance for use
- IEC 62430: 2009, Environmentally conscious design for electrical and electronic products
- IEC TR 62635: 2012, Technical Report – Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment

Appendix – 16 categories

The SimaPro software implementation corresponds to the International Life Cycle Data (ILCD) system, version 1.0.9, May 2016, which is available at http://eplca.jrc.ec.europa.eu/?page_id=140

The ILCD 2011 Midpoint method was released by the European Commission, Joint Research Centre in 2012. It supports the correct use of the characterization factors for impact assessment as recommended in the ILCD guidance document "Recommendations for Life Cycle Impact Assessment in the European context - based on existing environmental impact assessment models and factors? (EC-JRC, 2011)".

Reference:

European Commission, Joint Research Centre, Institute for Environment and Sustainability. Characterisation factors of the ILCD Recommended Life Cycle Impact Assessment methods. Database and Supporting Information. First edition. February 2012. Luxembourg. Publications Office of the European Union; 2012.

The method used includes the following 16 midpoint impact categories, as output by the software.



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Climate change

Global Warming Potential calculating the radiative forcing over a time horizon of 100 years. IPCC 2007.

Ozone depletion

Ozone Depletion Potential (ODP) calculating the destructive effects on the stratospheric ozone layer over a time horizon of 100 years. World Meteorological Organization (WMO) 1999.

Human toxicity, cancer effects

Comparative Toxic Unit for humans (CTUh) expressing the estimated increase in morbidity in the total human population per unit mass of a chemical emitted (cases per kilogram). Specific groups of chemicals require further works. USEtox (recommended + interim).

Human toxicity, non-cancer effects

Comparative Toxic Unit for humans (CTUh) expressing the estimated increase in morbidity in the total human population per unit mass of a chemical emitted (cases per kilogram). Specific groups of chemicals require further works. USEtox (recommended + interim).

Particulate matter

Quantification of the impact of premature death or disability that particulates/respiratory inorganics have on the population, in comparison to PM2.5. It includes the assessment of primary (PM10 and PM2.5) and secondary PM (incl. creation of secondary PM due to SOx, NOx and NH3 emissions) and CO. Rabl and Spadaro 2004.

Ionizing radiation HH (human health)

Quantification of the impact of ionizing radiation on the population, in comparison to uranium 235. Frischknecht et al. 2000.

Ionizing radiation E (ecosystems)

Note: This method is classified as interim; see reference for explanation.

Comparative Toxic Unit for ecosystems (CTUe) expressing an estimate of the potentially affected fraction of species (PAF) integrated over time and volume per unit mass of a radionuclide emitted (PAF m3 year/kg). Fate of radionuclide based on USEtox consensus model (multimedia model). Relevant for freshwater ecosystems. Garnier-Laplace et al. 2008.

Photochemical ozone formation

Expression of the potential contribution to photochemical ozone formation. Only for Europe. It includes spatial differentiation van Zelm et al. 2008.

Acidification

Accumulated Exceedance (AE) characterizing the change in critical load exceedance of the sensitive area in terrestrial and main freshwater ecosystems, to which acidifying substances deposit. European-country dependent. Seppälä et al. 2006 and Posch et al. 2008.



Terrestrial eutrophication

Accumulated Exceedance (AE) characterizing the change in critical load exceedance of the sensitive area, to which eutrophying substances deposit. European-country dependent. Seppälä et al. 2006 and Posch et al. 2008.

Freshwater eutrophication

Expression of the degree to which the emitted nutrients reach the freshwater end compartment (phosphorus considered as limiting factor in freshwater). European validity. Averaged characterization factors from country dependent characterization factors. ReCiPe version 1.05.

Marine eutrophication

Expression of the degree to which the emitted nutrients reach the marine end compartment (nitrogen considered as limiting factor in marine water). European validity. Averaged characterization factors from country dependent characterization factors. ReCiPe version 1.05.

Freshwater ecotoxicity

Comparative Toxic Unit for ecosystems (CTUe) expressing an estimate of the potentially affected fraction of species (PAF) integrated over time and volume per unit mass of a chemical emitted (PAF m³ year/kg). Specific groups of chemicals require further works. USEtox (recommended + interim).

Land use

Soil Organic Matter (SOM) based on changes in SOM, measured in (kg C/m²/a). Biodiversity impacts not covered by the data set. Mila i Canals et al. 2007.

Water resource depletion

Freshwater scarcity: Scarcity-adjusted amount of water used. Swiss Ecoscarcity 2006.

Mineral, fossil, renewable resource depletion

Scarcity of mineral resource with the scarcity calculated as 'Reserve base.' It refers to identified resources that meet specified minimum physical and chemical criteria related to current mining practice. The reserve base may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. van Oers et al. 2002

For further assistance

For product support, contact the information and call center as follows:

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