Life cycle impacts of Electrolux domestic washing machines and proposal for their impact reduction

Stefano Zuin, Rustem Saitov, Monica Celotto, Michele Nori, Giovanni Colombera, Elisa Stabon.

THE 10TH INTERNATIONAL CONFERENCE
ON LIFE CYCLE MANAGEMENT

05-08 SEPTEMBER 2021
STUTTGART. GERMANY

LCM 2021

Agenda

- Introduction: For The Better 2030
- Objective
- Case study
- Results
- Final remarks
- Reference

Introduction: For the Better 2030

- towards carbon neutrality & circularity

- Lead in energy- and resource-efficient solutions
- Offer circular solutions and business models
- Eliminate harmful materials

- Be climate neutral and drive clean, resource-efficient operations
- Act ethically, lead in diversity and respect human rights
- Drive supply chain sustainability

- Make sustainable eating the preferred choice
- Make clothes last twice as long with half of the environmental impact
- Make homes healthier and more sustainable through smart solutions for air, water and floors

Supporting the UN Sustainable Development Goals and Climate targets

Objective

The adoption of a science-based approach and more specifically, of Life Cycle Assessment (LCA) is a key tool within the Electrolux "For The Better 2030" sustainability framework.

The objective of this study is to evaluate the potential environmental impacts of an Electrolux appliance, by using the Life Cycle Assessment (LCA) methodology, through a case study of a domestic washing machine (WM). Secondly, this study will discuss some proposal for a potential impact reduction, by focusing on use pattern of WM.

Talking sustainability with our laundry consumers

Electrolux is using its voice to inspire and educate consumers that want to be at the forefront of sustainable living.

"Sustainability is a strong driver for our brands, affecting all parts of the experience from innovation to communication, how products perform and how consumers can improve the outcome," explains Annika Priou, VP Global Brand Development. "We want to help consumers get better results and we show what we stand for and what we believe in, which leaves a lasting impression of our brand."

Make it Last campaign

In 2020, Electrolux launched the Make it Last campaign – a global message platform that embodies our promise to make clothes last twice as long with half the environmental impact. It taps into a deep consumer need to elevate the importance of more environmentally friendly laundry care.

"With the Make it Last campaign, our aim is to increase awareness of more sustainable laundry and promote better behavior while connecting seamlessly to product benefits and features," concludes Priou. "We know from consumer research that this connection is very important."

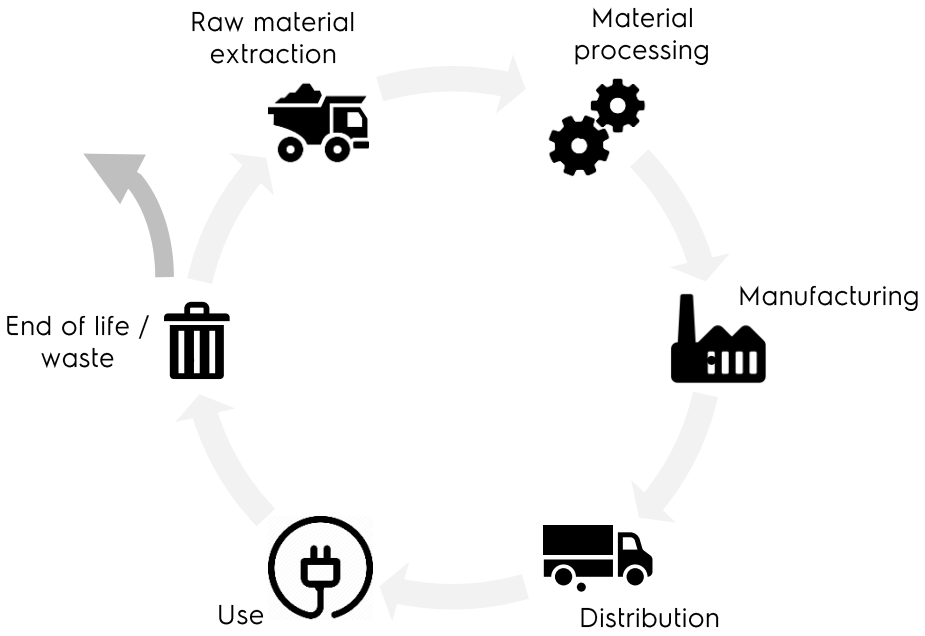
ELECTROLUX SUSTAINABILITY 2020 11

https://www.electroluxgroup.com/en/category/sustainability/sustainability-reports/

Case study
- Goal and scope

- The goal of this study is to provide an overview of potential impacts relating to a WM.

- The system boundaries include all life cycle stages, from cradle to grave.



- The scope is the current AEG L7FEE842 model
  - 8 kg loads
  - "C" energy label

- The functional unit (FU) is expressed as «one unit of the product over its life cycle", such as a WM with an expected life span of 10 years and a defined use pattern
  - 220 washing cycles/year
  - Cotton ECO 40°C washing cycle
  - Powder detergent

Case study

- Inventory data

- Primary data (i.e., foreground data) come from Bill Of Materials (BOM) of selected model, direct measures in laboratories (e.g., energy consumption) and factory (Italy).
- Secondary data come from literature and from the EuP studies report - Lot 14.
- Information related to generic materials and processes come from commercial Life Cycle Inventory Ecoinvent 3.5 database (i.e.. background data), specifically the unit model "Allocation, recycled content / cut-off".

LC phases	Parameters	Data	Source
Raw materials and their processing	WM modules (Body, Door, Hydraulic, Packaging, Washing G., EEC)	AEG L7FEE842 BOM	Electrolux
Transport	Truck/road Container ship /sea	150 km 6000 miles (EEC)	Assumption
Manufacturing	Electricity Natural gas Water	23.6 kWh/unit 19.3 kWh/unit 73.18 liter/unit	Electrolux
Distribution	Truck/Road	200 km	Assumption
Use phase (ECO 40°C cycle, 8 kg load, WM used in EU-28)	Electricty Water Detergent Lifespan Cycles/yr WM connected to sewage s. Water drained	0.615 kWh/cycle 41 liter/cycle 91 g/cycle (powder) 10 years 220 cycle/year 80% (EU average) COD, nitrogen and phosphorous	Electrolux Electrolux IEC A EN/IEC 60456. EuP studies EuP studies Eurostat 2016 Morel and Diener (2006)
End of life	Collection rate of WEEE (*) Recycling rate of materials from collected WEEE	100% EU average	Assumption Eurostat 2016

Table 1 - The main modeling choices, assumptions and data used. Note: * WEEE=waste electrical and electronic equipment.

LCM 2021

Case study

- Impact assessment

The impact assessment methods for the case study were selected to cover:

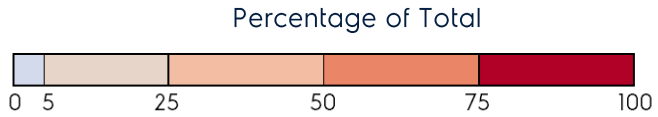
- impacts on:
- Global Warming Potential (GWP; kg CO_2-eq) (IPCC, 2013)
- Potential of water deprivation (Available Water Remaining/AWARE; m^3)
- Depletion of mineral resources (Mineral Resource Scarcity/MRS; kg Cu-eq) (ReCiPe method)

- damage to
- Ecosystem Quality (ED), counted as the local species loss integrated over time (species x year; ReCiPe method)

Results

- Impact assessment results, EU-28 scenario

	Overall	Raw materials	Manufact.	Transports & Distribution	Use phase	End of life
GWP [kg CO_2-eq]	1431.9	16%	<1%	<1%	82%	1.4%
AWARE [m^3]	808	11%	<1%	<1%	92%	<1%
MRS [kg Cu-eq]	15.8	40%	<1%	<1%	60%	<1%
ED [species · year]	9.25E-05	1%	<1%	<1%	98%	<1%

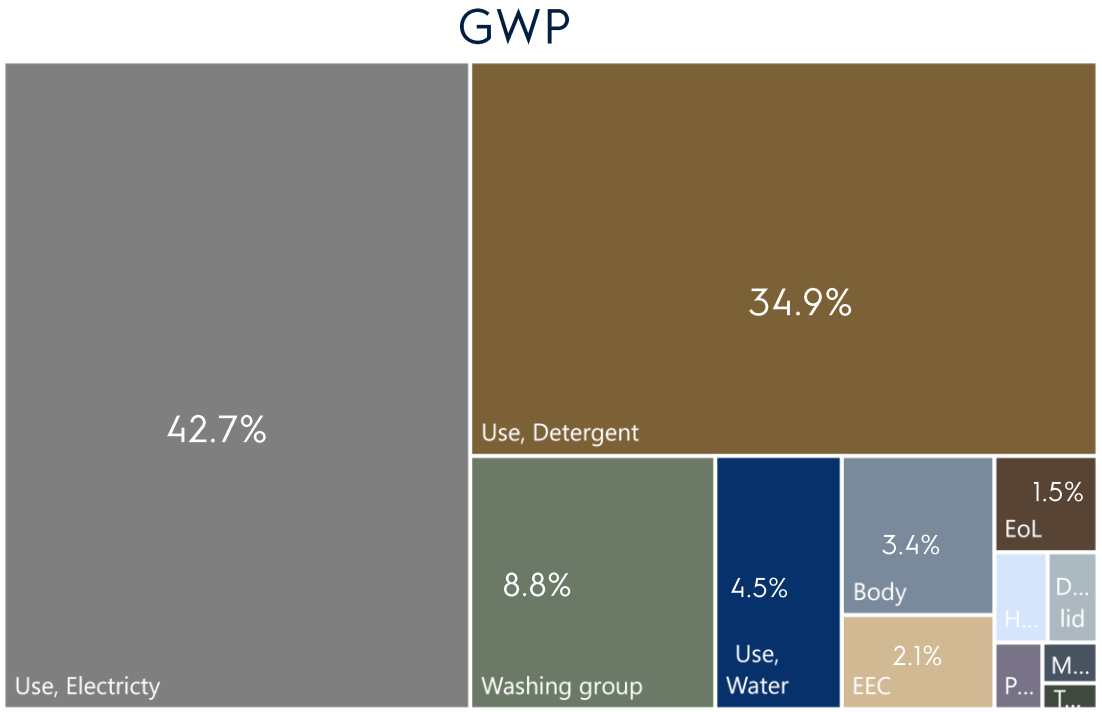


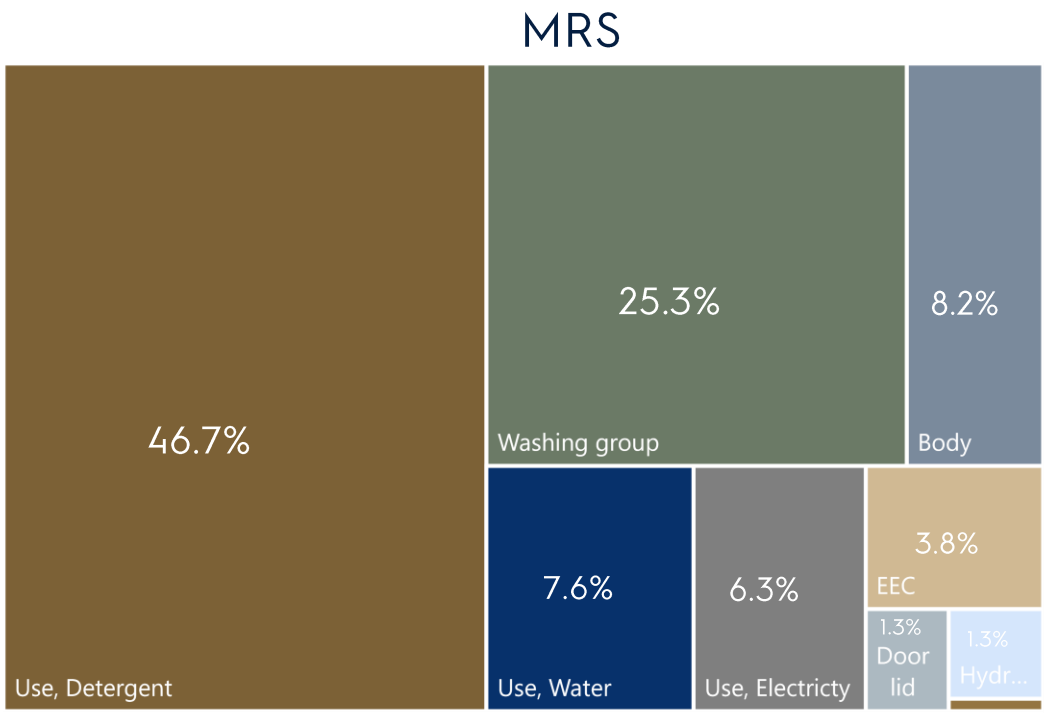
The **use phase is the most relevant life cycle** stage of WM, as it accounts for 60% impacts for MRS, more than 80% in climate change and water use categories, and solely responsible for all damage to ecosystem quality.

LCM 2021

Results

- Contribution (%) of life cycle stages, with disaggregation into functional groups of WM

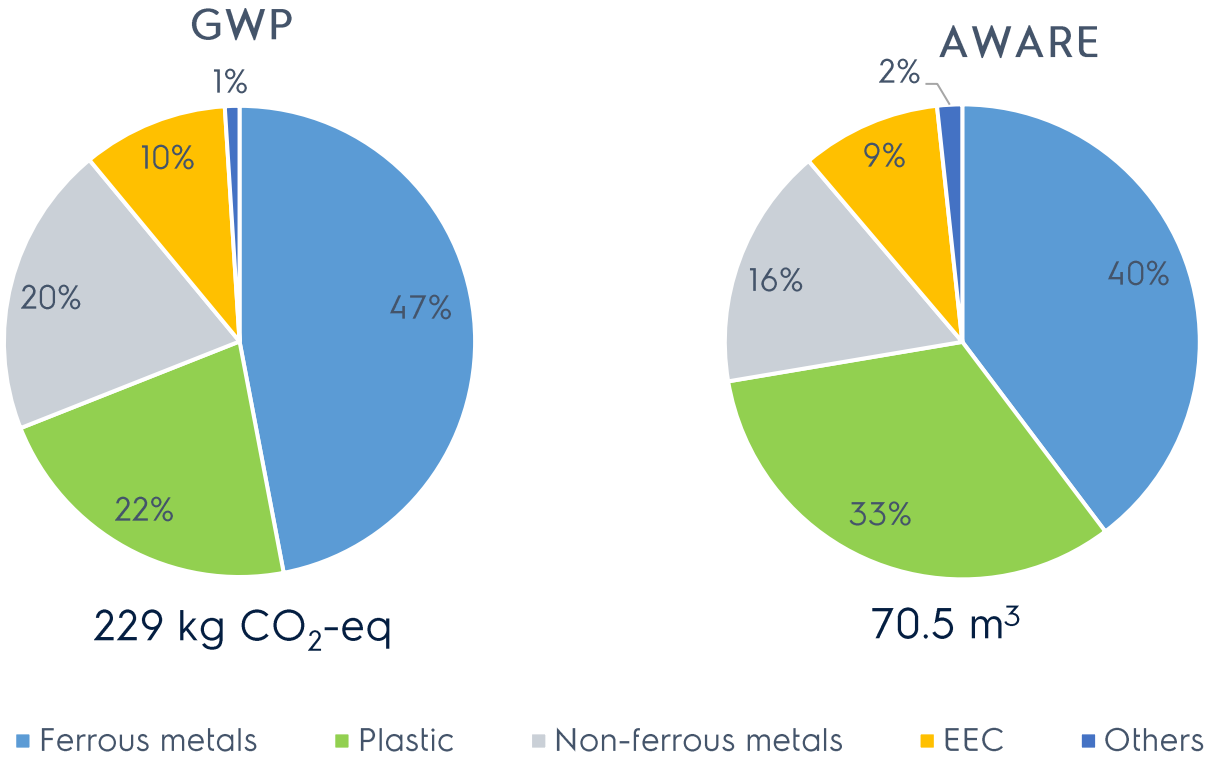




For the GWP, the largest contribution is posed by **electricity and detergents consumed during the WM use** (around 43% and 35% of the total GWP, respectively); while for the MRS, the contribution is mainly due to detergent (46.7%) followed by **washing group** (25.3%) of the WM.

Results

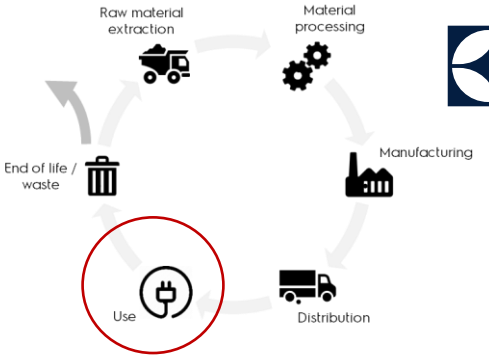
- Contribution (%) of the main raw materials of WM



Ferrous metals (i.e., cast iron and chromium, carbon, low-alloyed and unalloyed steels) count for 47% of the GWP and 75% of MRS. Among other materials, plastics (including its processing) hold a share of 22% of GWP and 33% of AWARE impacts.

Results

- Insight on use phase: ECO 40°C vs COTTON 30°C & 40°C



The use phase strongly affects the total environmental footprint; therefore, we evaluated washing cycles at different temperature and with different detergent type and dose.

Cycle	Load [Kg]	Water cons. [Liters]	Energy cons. [kWh]	Detergent type & dose [g]	N. rinses
ECO 40°C	4.8	40	0.543	Powder, 91 g	2
Cotton 40°C	4.0	45	0.690	Liquid, 57.12	2
Cotton 30°C	4.0	45	0.400	Liquid, 57.12	2

Powder detergent composition IEC A (EN/IEC 60456)

Substance	% (w/w)
Zeolite	28.3
Sodium perborate tetrahydrate	20
Sodium carbonate	11.6
Alkylbenze sulfonate linear (LAS)	8.8
Sodiu sulfate	6.5
Ethoxylated fatty acid C12-18	4.7
Anti foam	3.9
Sodium soap	3.2
Sodium silicate	3
TAED	3
Phosphonic acid	2.8
Sodium salt	2.4
Others	1.8

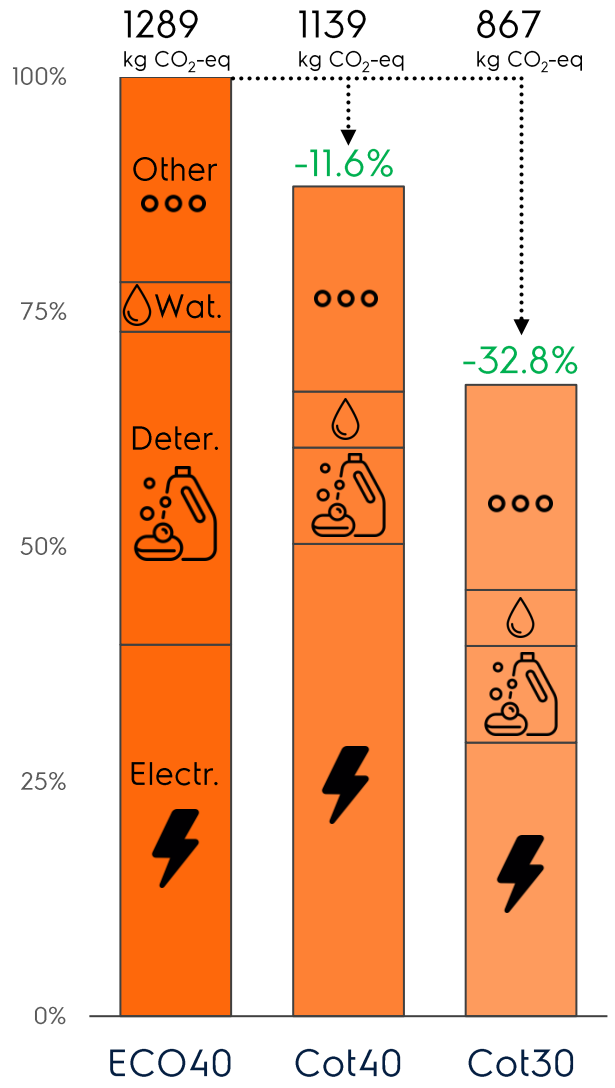
Liquid detergent composition (PEF Category Rules for household heavy-duty liquid laundry detergents)

Substance	% (w/w)
Water	70
Alkylbenze sulfonate linear (LAS)	6.8
Non-ionic surfactants	5.9
Sodium alkyl ether sulfates (SLES)	3.5
Oleochemicals fatty acid. soap	2.4
Glycols	2.3
Citric acid. and salts of	2.3
sodium hydroxide	2.7
Fragrances	0.7
Polymers	0.7
triethanolamine	0.6
Glycerine	0.6
Enzymes	0.6
sodium phosphonate	0.4
Others	0.5

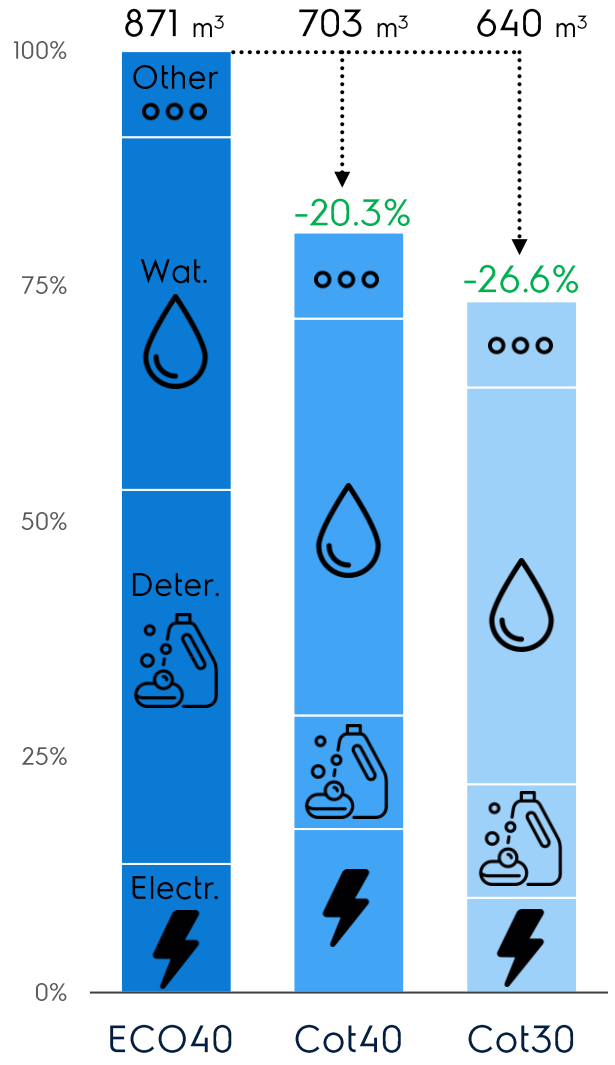
Results

- GWP and AWARE impacts change from ECO40 to Cotton 40°C & 30°C, 220 cycles/yr in 10 years, EU-28

GWP

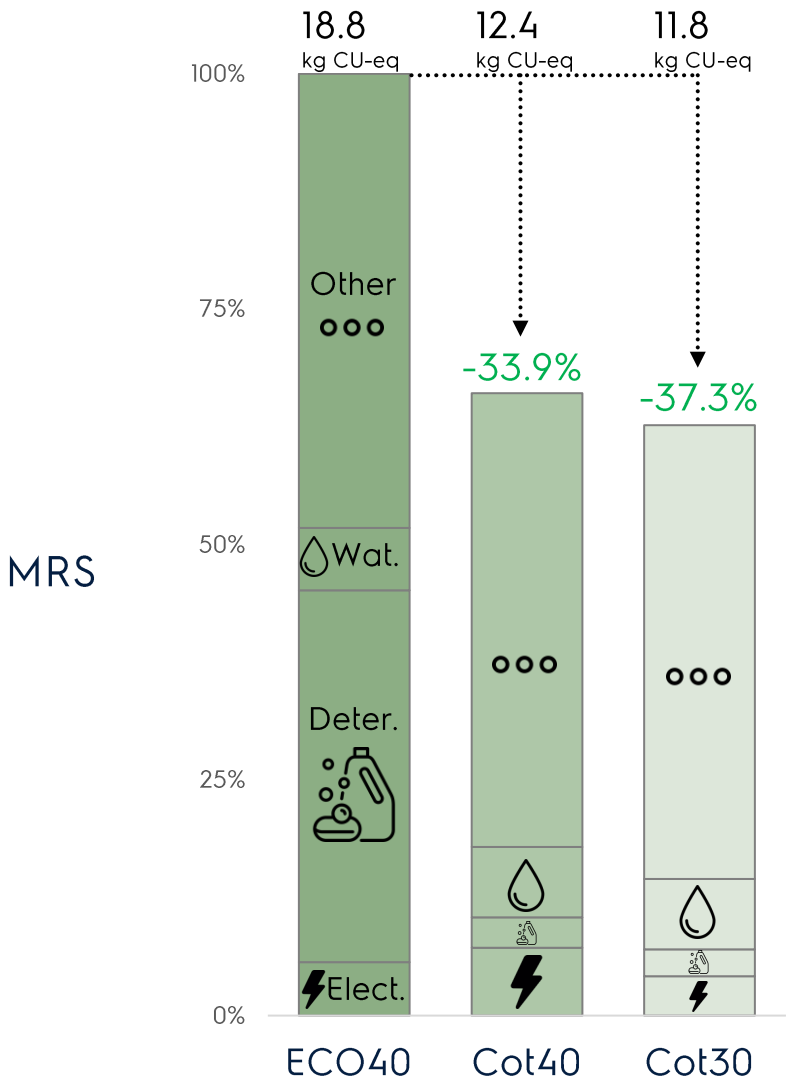


AWARE



Results

- MRS impacts change from ECO40 to Cotton 40°C & 30°, 220 cycles/yr in 10 years, EU-28



Cotton cycles with liquid detergent have **LESS** impacts in terms of GWP, AWARE and MRS.

Final remarks

1. LCA was applied to current domestic WM to create environmental footprint profiles based on current information, and relevant hotspot information can be obtained.

2. Further work is still required to improve the confidence in the results, especially:
    1. the inventory data of detergent (data gaps in the production of some chemicals), and
    2. consumer habits and use pattern.

3. Use phase largely dominates the overall environmental footprint, and we could levarage on this topic to stimulate better user behavior and reduce the environmental impact, for instance to make citizens effectively aware of the benefits of washing al lower temperature.

https://www.electroluxgroup.com/en/electrolux-study-reveals-current-laundry-practices-out-of-step-with-climate-concerns-32373/

LCM 2021

Reference

- Morel A, Diener S, (2006). Greywater Management in Low and Middle-Income Countries, Review of different treatment systems for households or neighbourhoods. Swiss Federal Institute of Aquatic Science and Technology (Eawag). Dübendorf, Switzerland.
- Preparatory Studies for Eco-design Requirements of EuPs. LOT 14: Domestic Washing Machines & Dishwashers. Tasks 3 -5. December 2007.
- IEC 60456:2010. Clothes washing machines for household use - Methods for measuring the performance.
- https://www.aise.eu/our-activities/sustainable-cleaning-78/product-environmental-footprint.aspx
- https://www.ipcc.ch/assessment-report/ar5/
- http://www.wulca-waterlca.org/aware.html
- https://www.rivm.nl/bibliotheek/rapporten/2016-0104.pdf
- https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products/washing-machines_en
- https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_electrical_and_electronic_equipment


Electrolux