Activating Circular Services in the Electric and Electronic Sector

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776714

Circular Economy in practice in the Electric and Electronic sector

Wednesday 14 September | 10:30 - 12:00 CEST

FREE to join please register

Please mute your microphone

Please use the chat box to formulate any questions you may have

Thank you!

Activating Circular Services in the Electric and Electronic Sector

Circular Economy in practice in the Electric and Electronic sector

Introduction to Circular Economy
Business Models in C-SERVEES

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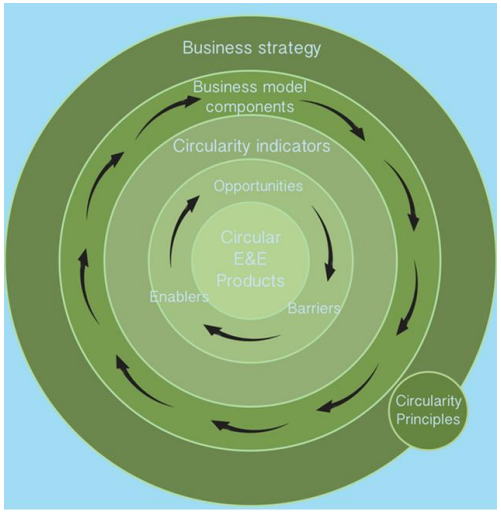
Loughborough University, UK

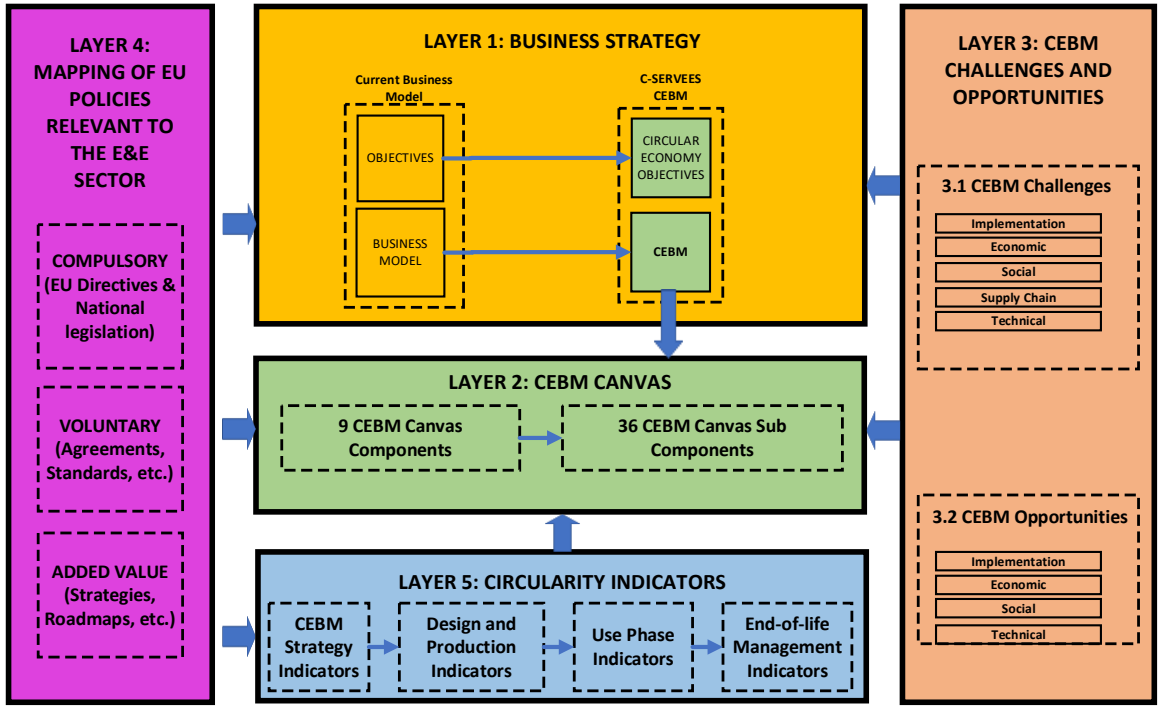
14 September 2022

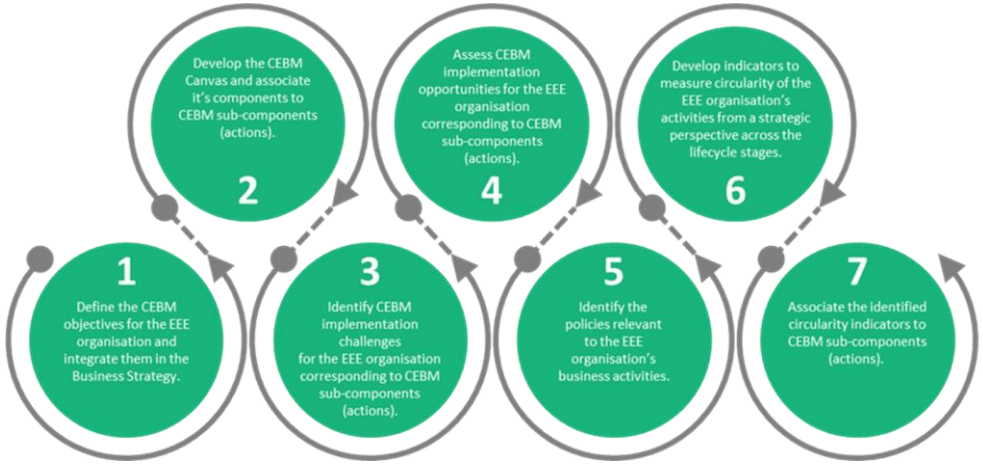
C-SERVEES Circular Economy Business Models (CEBM) Tasks

1. Development of a **reference circular economic economy business model <u>for the E&E sector</u>** (**REF-CIRCMODE**).
2. Development of a product-specific **CEBM for each of the <u>four target products in C-SERVEES</u>**:
   - Washing machines' circular economic business model (**WASH- CIRCMODE**)
   - Printers' circular economic business model (**PRINT- CIRCMODE**)
   - Telecom ALM products' circular economic business model (**ALM-CIRCMODE**)
   - TV sets and displays' circular economic business model (**TV- CIRCMODE**)

From conceptual organigram to REF-CIRCMODE Framework





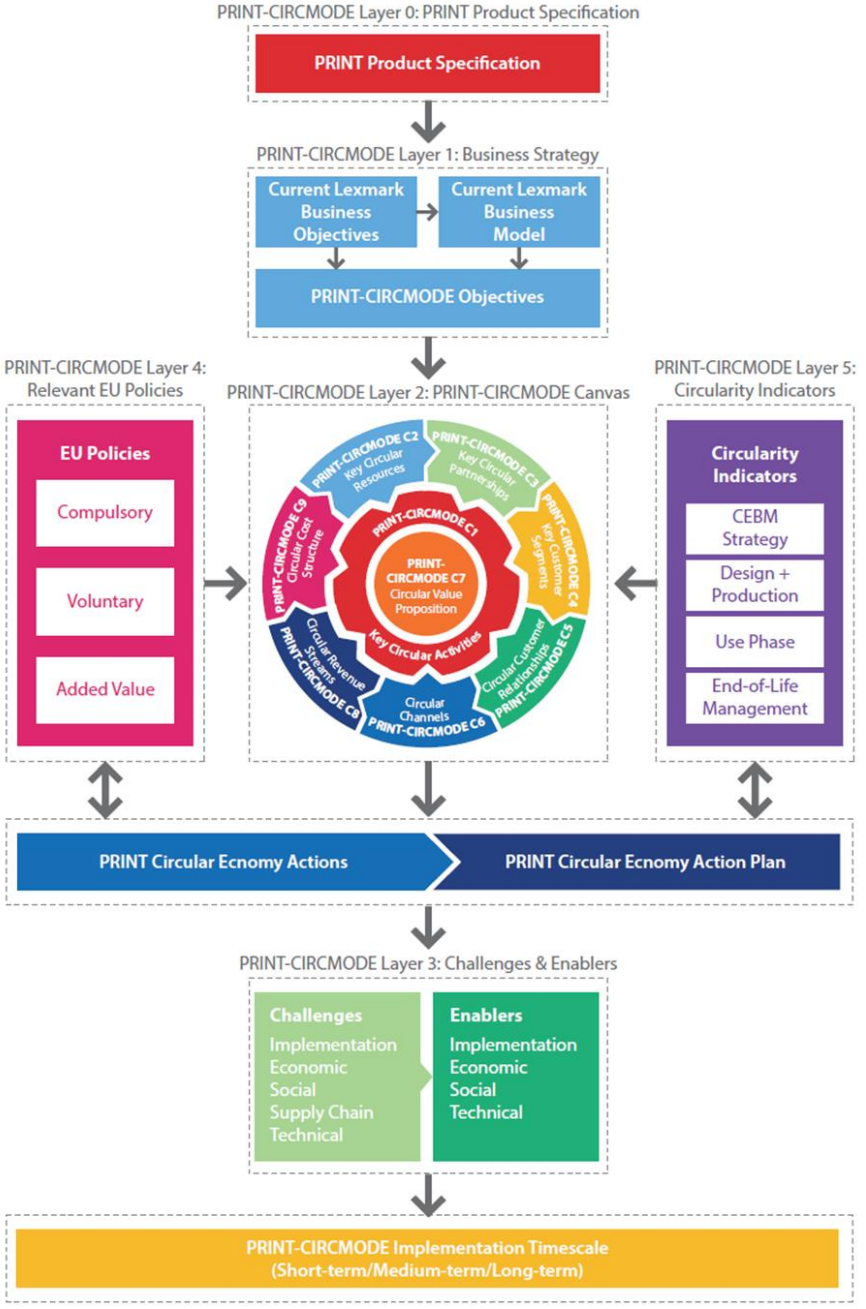


Publication (2021): "**A circular economy business model innovation process for the electrical and electronic equipment sector**". *Journal of Cleaner Production*
DOI: 10.1016/j.jclepro.2021.127211 (https://www.sciencedirect.com/science/article/pii/S095965262101430X?via%3Dihub)

Product specific CEBM (CIRCMODE)

Product specific CEBMs methodological steps

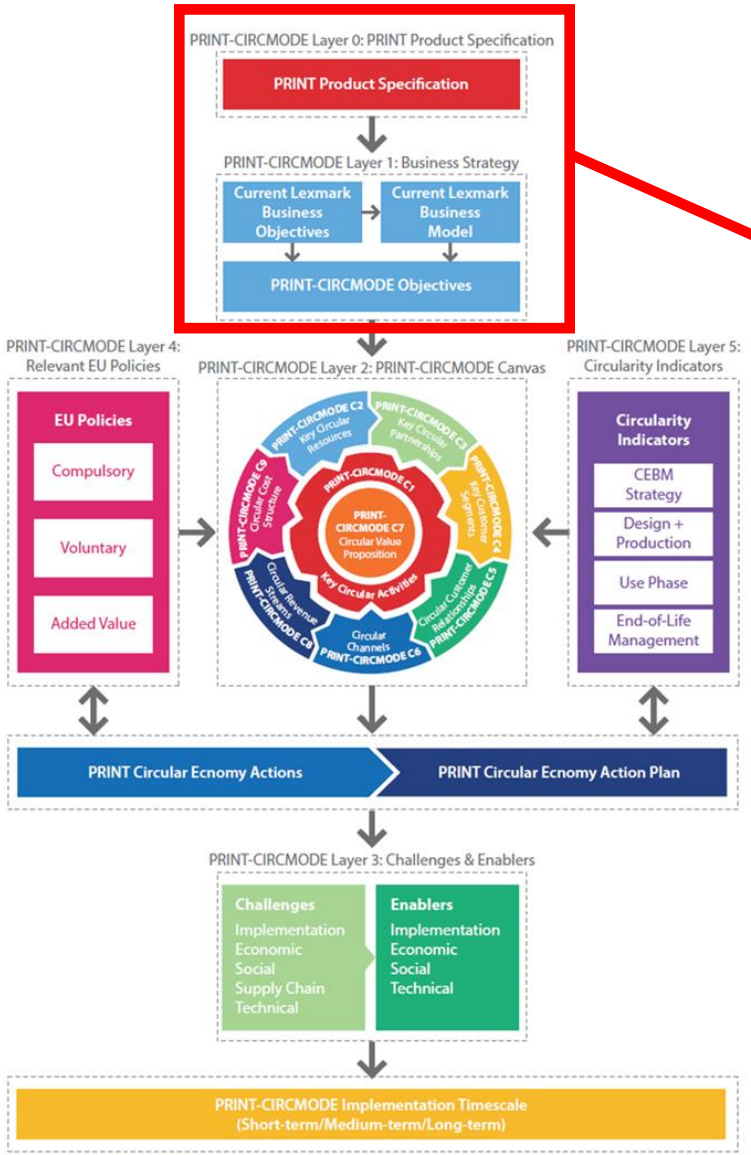
1. REF-CIRCMODE mapping for the 4 C-SERVEES product specific CEBMs
2. Product specific CEBM data capture and analysis
3. WP2, WP3 (ICT tools) and WP4 (demonstrations) integration
4. Product specific CEBM validation visits to ENVA, Lexmark & Arcelik
5. Validated product specific CE actions to be demonstrated in WP4



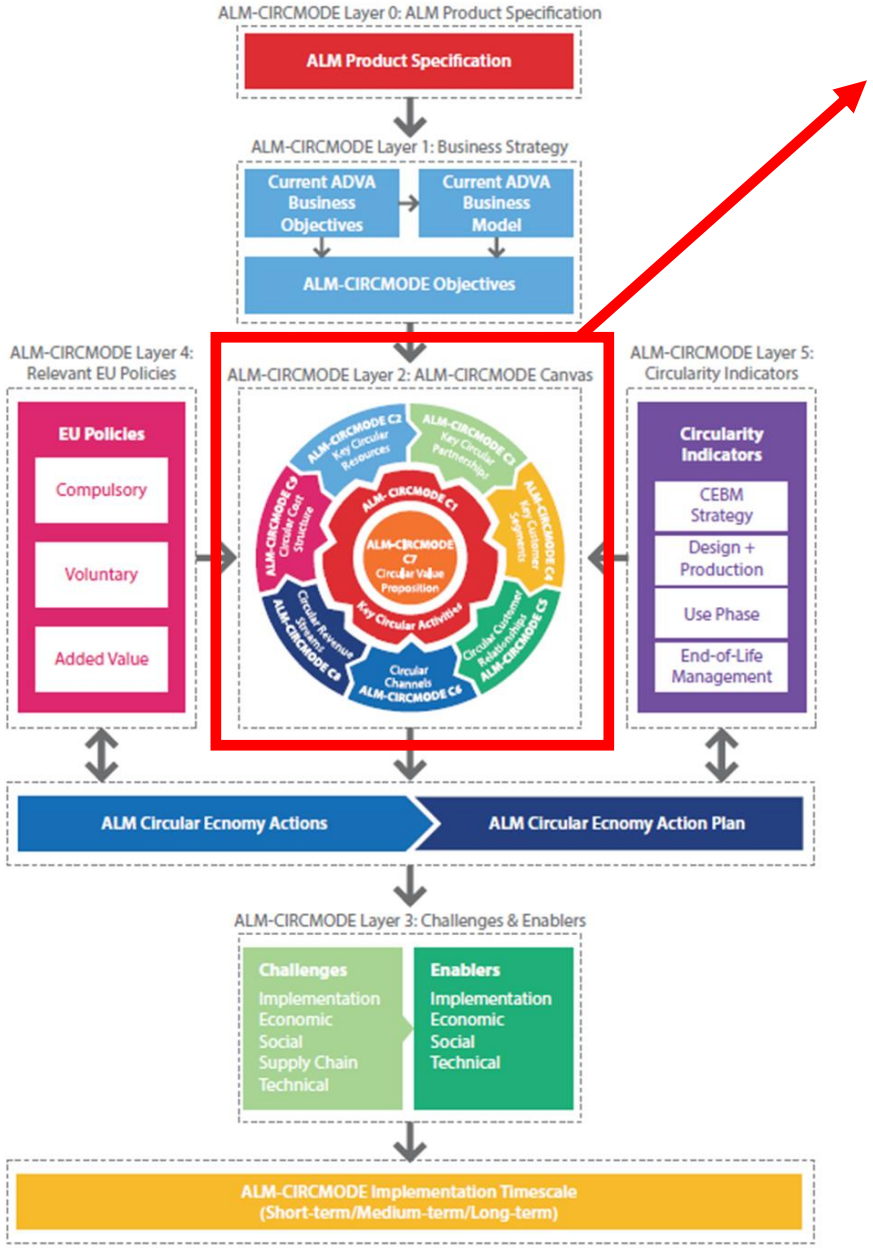
Product specific CEBM Layer 0 (Product Specification)

PRINTER REQUIRED INFO	LEXMARK PRINTER SPECIFICATION
• Product name	Lexmark MX721ade
• Brand	Lexmark
• Product reference/code	25B0000
• General description	*Put output at up to 65 ppm* in more places with the Lexmark MX721ade, the multifunction product with features and performance to satisfy even large workgroups.*
• Technical information o (including life span)	Imaging Unit Estimated Yield Up to: 150000 pages, based on 3 average letter/A4-size pages per print job and ~ 5% coverage5
• Dimensions o height o depth o width	Size (in. - H x W x D) 29.1 x 22.0 x 22.8 in.
• Voltage	Average Power 0.2 watts (Hibernate Mode) 1.8 watts (Sleep Mode) 41.5 watts (Ready Mode) 800 watts (Printing) 830 watts (Copying) 75 watts (Scanning)
• Energy class	ENERGY STAR, ICES-003 Class A, BSMI Class A, VCCI Class A, US FDA/CDRH, UL 60950-1, FCC Class A, cUL CAN/CSA-C22.2 60950-1, NOM, MET-I, IEC 60825-1, CB EN/IEC 60950-1, CB EN/IEC 60825-1, CCD-035, CE DoC (EN 62301 Class A, EN 62311, CE EN/IEC 60950-1, CE EN/IEC 60825-1, EN 61000-3, EN 55022 Class A, EuP, EN 55024, UL), EFTA (CE), CISPR 22 Class A, KCC, CCC, CECP, CEL, A-tick DoC, C-tick CoC, UL-AR, KC mark, UL GS mark, ISO 532B, ECMA-370, TED, GOST-R, SII, TER, Bel GISS
• Colour (s)	Monochrome Laser
• Weight	Weight (lb.): 97.2 lb.
• Parts and associated suppliers	100-Sheet Multipurpose Feeder, Integrated Duplex, 550-Sheet Output Bin, 550-Sheet Input Gigabit Ethernet (10/100/1000), Front USB 2.0 Specification Hi-Speed Certified port (Type A), Rear USB 2.0 Specification Hi-Speed Certified Port (Type A), USB 2.0 Specification Hi-Speed Certified (Type B), One Internal Card Slot
• Packaging	40.2 x 27.6 x 28.9 in. Packaged Weight (lb.)
o type of packaging o dimensions of packaging (h,d,w)	129 lb. Corrugated paper, Styrofoam, composites
• Production location(s)	China (PRC)
• Sale location(s)	Worldwide
• Target user(s)	Enterprises (This is an FCC Class A device. Not intended for use in residential or domestic environments.)
• New product, or product under development	no
• Product photo(s).	
Other information relevant to this product and circularity	

Product specific CEBM Layer 1

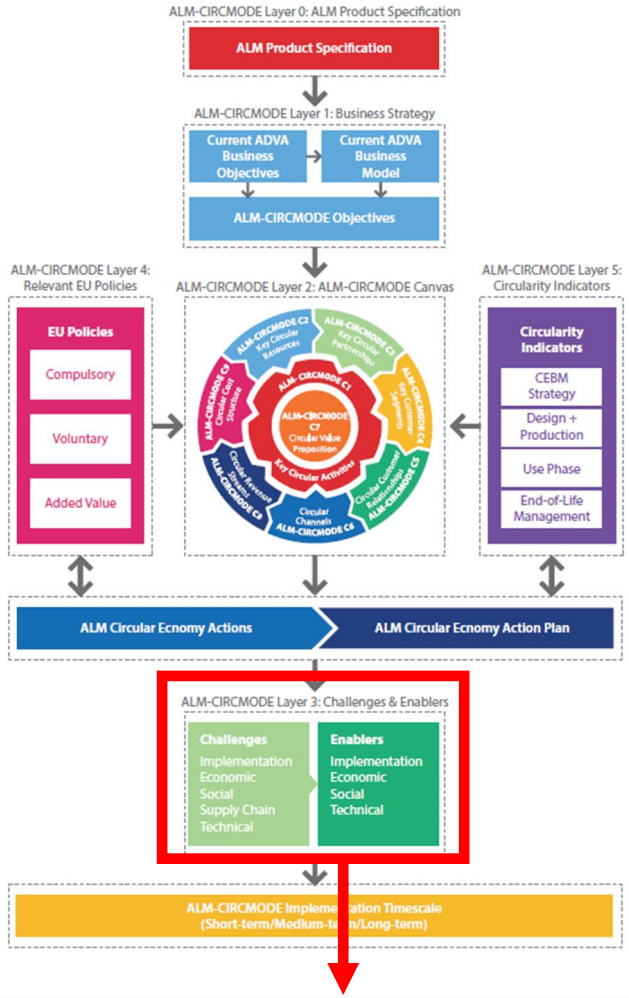


Current Business Objectives	PRINT-CIRCMODE Objectives
1. To be responsive and flexible in meeting specific business customer needs. 2. To provide one of the best values in enterprise network printer-based products. 3. To offer targeted printing and document workflow solutions. 4. To provide leading edge MPS and content and process management solutions.	*To increase the circularity of Lexmark printers by **enhancing the buyback and takeback** operations through:* 1. *Improving return **logistics**.* 2. *Increasing **volumes** of printers returned.* 3. *Improving **information** on the condition of returning printers.* 4. ***Reuse** of suitable salvaged parts in the refurbishment process.* 5. *Raising **awareness** of the scheme amongst stakeholders.* 6. ***Selling** refurbished printers (requires a buyer & user behaviour change?).* 7. *Reaching a point of **scalability**.*



Layer 2 Components	Layer 2 Sub-Components	Example Circular Economy Actions
Key Circular Activities	1.1 Diversify circular activities	A1.1 Expand product and component recovery and refurbishment programme
	1.2 Embrace eco-design	A1.2 Design to improve the durability of products and components
	1.3 Circular production strategies	A1.3 Continuously audit production and suppliers production against circularity indicators
	1.4 Circular logistics and distribution	A1.4 Improve reverse logistics for greater product take-back
	1.5 Repair and maintenance services	A1.5 Explore competitiveness of 3D printing for smaller plastic parts for repair
	1.6 End-of-life circularity	A1.6 Provide recyclers with material declaration to aid recycling
	1.7 Track materials and components	A1.7 Material labels or tags (RFID, QR) for recycling
Key Circular Resources	2.1 Competitive financing models	A2.1 Conduct cost analysis on secondary/virgin materials
	2.2 Skills and training programmes	A2.2 Improve promotion and training of circular economy for sub-contractors
	2.3 Use of ICT	A2.3 Use ICT to improve information sharing across the supply chain
Key Circular Partnerships	3.1 New alliances/existing partnerships	A3.1 Improve partnerships with component suppliers
	3.2 Private/public procurement	A3.2 Form partnerships to expand the customer base
	3.3 Partnerships' cultural issues	A3.3 Active media/PR campaign on refurbished products
Key Customer Segments	4.1 B2B/B2C customer segments	A4.1 Ensure refurbished products are desirable to environmental conscious customers
	4.2 Cultural patterns	A4.2 Target 'green conscious' B2B customers
	4.3 Social class/demographic segments	A4.3 Study networks of resellers to take advantage of a long-term B2C market
Circular Customer Relationships	5.1 Customer relationships initiatives	A5.1 Offer/discuss circular solutions with dedicated customers
	5.2 Social media platforms	A5.2 Enable customer circular economy requirements' feedback via company platforms
	5.3 Change traditional relationships	A5.3 Existing/new contracts modified to provide extra support for takeback/buyback
	5.4 After-sales services	A5.4 Provide enhanced after sales services and /warranty for circular offerings
Circular Channels	6.1 Customer communications	A6.1 Use ICT platforms to disseminate and communicate circular economy offerings
	6.2 Brand and organisation's image	A6.2 Inclusion of circular activities when participating in events/symposia
	6.3 Eco-labelling and certificates	A6.3 Participate in eco-labelling certification and/or standards for circular economy
	6.4 Data security	A6.4 Address data security issues for returned/refurbished equipment
	6.5 Marketing strategies	A6.5 Include circular economy messages in bilateral communication
Circular Value Proposition	7.1 Products as a service/bundles	A7.1 Introduce a Product Service System offering to complement current portfolio
	7.2 Leased, rented or shared product	A7.2 Explore the potential for shared products through simulation and calculation
	7.3 Sustainable consumption patterns	A7.3 Leverage the use of blockchain based ICT tools to improve printers' circularity
	7.4 Circular end-of-life options	A7.4 Learn from best practice to improve the product collection/return programme
Circular Revenue Streams	8.1 Recurring revenues	A8.1 Incentivize customer returns of end-of-use product for high-end product lines
	8.2 Financial administration	A8.2 Explore renting or leasing options for medium size B2B customers
	8.3 Value from waste	A8.3 Reuse end-of-life parts in refurbished products
Circular Cost Structure	9.1 Mitigate additional costs	A9.1 Reduce legislative compliance fees for WEEE management via collection programme
	9.2 Manufacturing and sales processes	A9.2 Reduce the costs of design for recycling measures
	9.3 Cost of take-back and return	A9.3 Improve tracking and reverse logistics system to mitigate costs with returned products
	9.4 Lower lifetime costs over initial cost	A9.4 Expose the real, hidden cost of waste management to consumers

Product specific Layer 3 (Challenges & Enablers)



ALM-CIRCMODE Canvas Category	ALM-CIRCMODE Sub-Component	CE Actions	Challenges	Enablers
ALM-C1: Key Circular Activities	ALM_C1.1 Diversify circular activities	ALM_A1.1.1 Design for longevity ALM_A1.1.2 Design for recycling (See A4.2.1 and ALM_A9.2.1)	• Risks cannibalising existing markets • Cost pressure • Low customer/market acceptance • Technical obsolescence and improvements in energy efficiency mean that design for longevity is not always desirable. 15 years is the upper limit	• Legislation • Influence of lead customers as early adopters • End-customers' pressure on B2B customers (not seen yet, but predicted) • Existing facilities to test products with "artificial aging"

Product specific Layer 3 (Challenges & Enablers)

Product specific CEBM Layer 4 (EU Policy Mapping)

EU Policies

CBEM Component	CEBM Sub-component	CE Actions	Compulsory (Directives etc.)				Voluntary Agreements					Other relevant documents	
			REACH Regulation	The Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) (Directive 2011/65/EU) - incorporates	WEEE Directive	Dodd-Frank Act	National voluntary schemes e.g. Electrical and Electronic Equipment Sustainability Action Plan 2025 (UK)	**Standards:** The Commission financially supports the work of the 3 European standardisation			**Other:** SBTi (Science Based Targets initiative) Now a binding agreement	Roadmap for a Resource Efficient Europe	EU Raw Materials Initiative
								ETSI (the European Telecommunications Standards Institute	**CEN** (the European Committee for Standardization)	**CENELEC** (the European Committee for Electrotechnical Standardization)			
C1 - Key Circular Activities	ALM_C1.1 Diversify circular activities	ALM_A1.1.1 Design for longevity	X	X							X		
		ALM_A1.1.2 Design for recycling			X						X		
	ALM_C1.2 Eco-design	ALM_A1.2.2 Eco-design approach in production and Design for Recycling			X						X		
	ALM_C1.3 Production process	ALM_A1.3.1 Consider supply chain				X							
		ALM_A1.3.2 Improvements to own											
	ALM_C1.4 logistics and distribution	ALM_A1.4.1 Improve ADVAnced (reverse) logistics											
	ALM_C1.5 Repair and maintenance	ALM_A1.5.1 Remote monitoring and preventive maintenance											
	ALM_C1.6 End-of-life circularity	ALM_A1.6.1 Assign components to most efficient recycling pathways			X								
		ALM_A1.6.2 Provide recyclers with bill of materials to aid recycli...			X								

Product specific CEBM Layer 5 (Circularity Indicators)

WASH-CIRCMODE Sub-component		CE Action	Circularity Indicators: CT1 CEBM Strategy Indicators – CI1: Percentage of goods produced that	CT1 CEBM Strategy Indicators – CI2: Percentage of product that follow eco-	CT2 Design and Production Indicators – CI3: Percentage of recycled/recyclable content in a product	CT3 Use Phase Indicators – CI4: Percentage of goods repaired through after-sales services compared	CT3 Use Phase Indicators – CI5: Percentage of product offering product service systems compared	CT3 Use Phase Indicators – CI6: Percentage of products operating in sharing networks	CT4 End-of-life Management – CI7: Percentage of reused, recycled and recovered parts and materials that	CT4 End-of-life Management – CI8: Quality of materials recovered through	CT4 End-of-life Management – CI9: Percentage of collected or taken back end-of-life products prepared for reuse, refurbished, remanufactured and
WASH_C1 - Key Circular	WASH_C1.1 Diversify circular activities	WASH_A1.1.1 Increase recycled plastic content in WM parts	x	x	x						
		WASH_A1.1.2 Decrease factory waste and turn it to a product part	x		x						

Publication (2022): "**Developing and applying circularity indicators for the electrical and electronic sector: A product lifecycle approach,** *Sustainability*, 14(3). DOI: 10.3390/su14031154 (https://www.mdpi.com/2071-1050/14/3/1154)

CIRCMODE CE Actions that are currently being implemented in TV-CIRCMODE demonstrations

Publication (under review): "**Implementing a Circular Economy Business Model Canvas in the Electrical and Electronic Manufacturing Sector: A Case Study Approach",** *Sustainable Production and Consumption.*

TV-CIRCMODE Circular Economy Action to be implemented in WP4	Life cycle stage
TV_A1.1.1 Increase recycled plastic content in TV components	Design and Production
TV_A1.1.4 Develop a renting model for B2B and B2C customers	Distribution and Use
TV_A1.1.5 Collecting and remanufacturing end of use TV sets	End-of-Life
TV_A.1.2.1: Increase the durability of LED panel and mainboard	Design and Production
TV_A1.4.1: Enable collection of TVs back from customers with a partner in Europe	End-of-Life
TV_A1.5.1 Use 3D printing for TV components	Distribution and Use
TV_A1.6.2 Increase circularity of TV waste plastics	End-of-Life
TV_A1.7.1 Enable traceability of remanufactured TV parts	End-of-Life
TV_A2.2.1 Develop dismantling and repair training programmes	End-of-Life
TV_A2.3.1 Use QR codes to provide information about materials and company's circularity to all the value chain	Design and Production; End-of-Life
TV_A.3.3.1: Create awareness among TV B2B consumers via the help of QR codes inserted in products	End-of-Life
TV_A3.3.2: Obtain feedback from TV B2B customers via questionnaires and living labs	Distribution and Use; End-of-Life
TV_A4.1.1 Expand partnerships with ARÇELIK TV dealers and retailers to sell remanufactured B2C TVs	End-of-Life
TV_A4.1.2 Develop new corporate B2B sales channels in Europe for renting TVs	Distribution and Use
TV_A4.3.1 Target low-income customers for the sale or rent of refurbished TVs (students, pensioners, house shares, etc.)	End-of-Life
TV_A.5.3.1: Initiate a take back collection system in Europe with a partner.	End-of-Life
TV_A7.2.1 Develop a TV rent business model for Smart Boards and Digital Signage products	Distribution and Use
TV_A7.4.1 Develop circular end-of-life recovery strategies for end of use TVs outside Turkey	End-of-Life
TV_A8.2.1 Assess the feasibility of TV renting options	Distribution and Use

Thank you!

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Activating Circular Services in the Electric and Electronic Sector

Circular Economy in practice in the Electric and Electronic sector

Implementation of the C-SERVEES Circular Economy Business Models in the demonstrations

Partner: Gaiker

Date & Place: 14 September 2022 | Online

Large-scale demonstrations

Validation of the new CEBMs and ICT services through **4 demonstrations involving specific EEE products and their value chains**

Large household appliances:

ARCELIK washing machines

Demo: 100 units

IT equipment:

LEXMARK printers & toner cartridges

Demo: 200 + 1K units

Consumer equipment:

ARCELIK TV sets/displays

Demo: 100 units

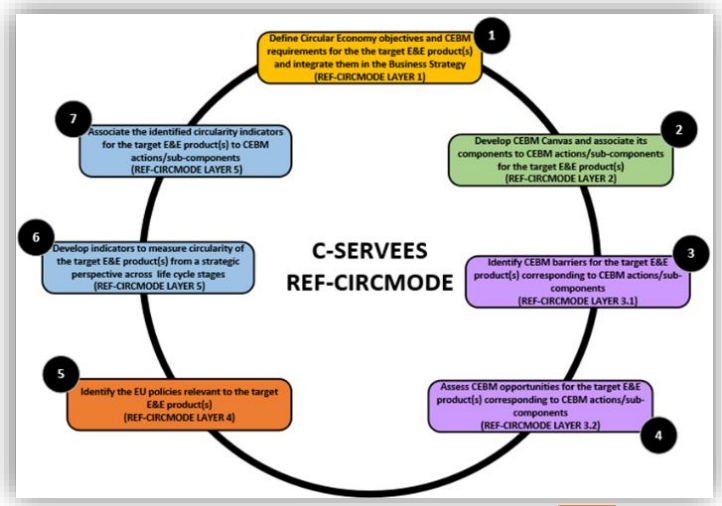
Telecom equipment:

ADVA ALM product line

Demo: 200 units

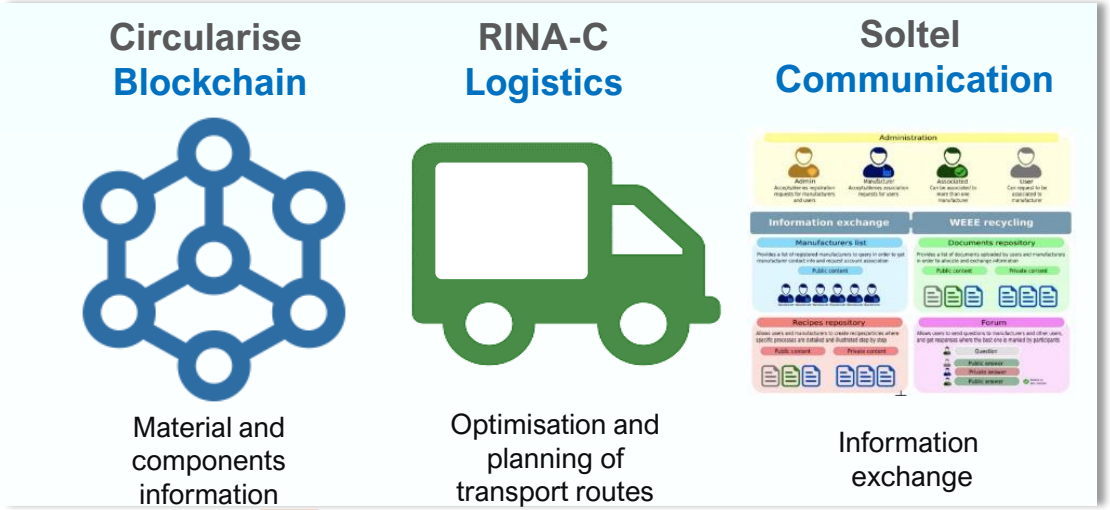
Demonstration background

WP2: CEBMs

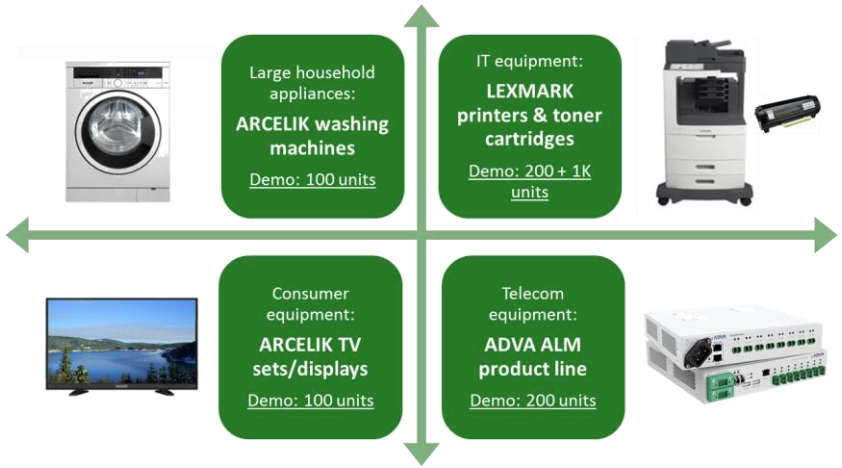


WM-CIRCMODE
PRINT-CIRCMODE
ALM-CIRCMODE
TV-CIRCMODE

WP3: ICT tools



WP4: demos



Testing ground for our newly developed CEBMs and ICT functionalities

CEBM implementation

Washing machine demonstration List of CE actions		
Design phase	Use phase	EoL phase
WASH_A1.1.1 Increase recycled plastic content in washing machines' components	WASH_A1.1.4 Develop a washing machine renting model for B2B customers	WASH_A1.1.5 Develop a strategy to collect and remanufacture end of use washing machines
WASH_A1.2.1 Use novel formula to increase recycled PET content in the washing machines' tub to make it more durable	WASH_A3.3.2 Obtain feedback from washing machines' B2B customers via questionnaires	WASH_A1.5.1 Use 3D printing for washing machines' components
WASH_A2.3.2 Use QR codes to provide information about washing machine's materials and company's circularity	WASH_A4.1.2 Develop new corporate B2B sales channels in Europe for renting refurbished washing machines	WASH_A2.2.1 Develop washing machines' dismantling and repair training programmes
	WASH_A8.2.1 Assess the feasibility of washing machines' leasing/renting options	WASH_A2.3.2 Use QR codes to provide information about washing machines' materials and company's circularity
		WASH_A4.1.1 Expand partnerships with Arçelik dealers and retailers to sell remanufactured B2C washing machines'
		WASH_A.5.3.1 Initiate a take back collection system for end of use washing machines in Europe with a partner

Large-scale demonstrations

DEMONSTRATION GOALS			
	Design phase	Use phase	End-of-life phase
 	Implement eco-design (increase recycled content)	Explore eco-leasing opportunities, collect customers' feedback	Improve repair and refurbishment operations
 	Explore eco-design potential (design for dismantling)	Improve logistics and collect customers' feedback	Promote refurbishment operations and increase material circularity
	Implement eco-design (design for energy efficiency and design for recycling)	Analyse and implement PSS for ALM products	Lifetime optimisation model for ICT products (LCA based)

ICT TOOLS enablers

- Certification by ICT
- Logistics Platform
- Smart Questioning
- Information exchange

Activating Circular Services in the Electric and Electronic Sector

Thank you for your attention!

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Activating Circular Services in the Electric and Electronic Sector

Circular Economy in practice in the Electric and Electronic sector

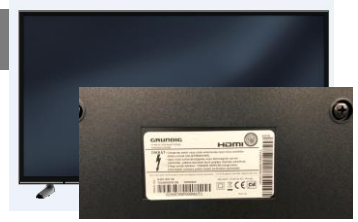
Lessons learnt from the ARÇELİK (WM & TV) demonstration

Partner: ARÇELİK

Date & Place: 14 September 2022 | Online

WM & TV Demonstration by Arçelik

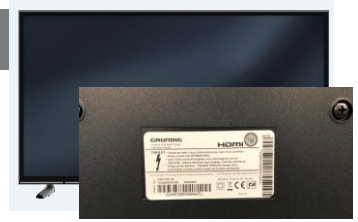
	WM	TV
Design and Production	**Increased recycled content** 10% recycled PET in tub *(for the first time in a 1200 rpm WM tub's raw material)* & 63,5% recycled PP in detergent box group (except drawer) and inner cover *(for the first time for Grundig brand)*	**Increased recycled content** 30% PC_ABS_v0 in TV back cover- ***first time***
Distribution and Use	**Rent model tried in B2B channel for the first time & feasibility study & surveys** • 25 WM's - Fundation Matia, Spain • 40 WM's – Samsun University Dorms, Turkey • 35 WM's – Bolu University Dorms, Turkey	• 53 TV's - Fundation Matia, Spain • 22 TV's – Samsun University Dorms, Turkey • 25 TV's – Bolu University Dorms, Turkey
End of Life	**Giving end of life products a new life- refurbished products- initiating a take back and collection system with Partner Emaus** **Customer experience at living labs** **Trial of 3D printed spare parts** **Trial of recovery of materials from end of life products- recyclability options**	



Outcomes from the Project – Design and Production

WM

TV



Recycled Content

Use of PC_ABS_V0 material from Covestro for the first time in TV back cover- first with 30% recycled material for demo project

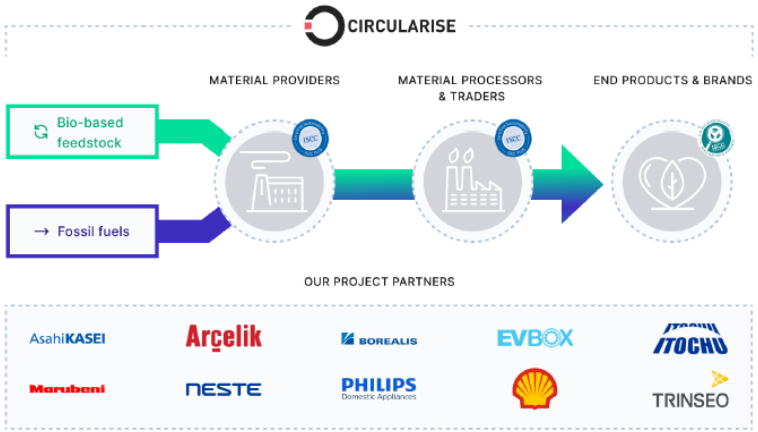
Increased to 40% recycled material for extension to Grundig TV's produced for Germany – more than 24 tons of recycled material used in c.4000 TV's

Turkey cannot import recycled raw material- so Arçelik tries to create the same infrastructure with a Turkish supplier all the while trying to talk with the government on how to get over this issue

Use of ICT Tools

CES Fair 2019 Joint Showcase – Arçelik & Circularise

QR code integration with partner Circularise - *partnership extension outside CSERVEES- mass balance certification via blockchain



First time 10 companies from chemicals and appliance industry come together to try the public blockchain on certification of biobased materials via mass balance approach

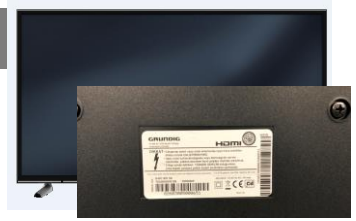
Outcomes from the Project – Distribution and Use

WM

- 25 WM's - Fundation Matia, Spain
- 40 WM's – Samsun University Dorms, Turkey
- 35 WM's – Bolu University Dorms, Turkey

TV

- 53 TV's - Fundation Matia, Spain
- 22 TV's – Samsun University Dorms, Turkey
- 25 TV's – Bolu University Dorms, Turkey



Feasibility Study

- **Carried out first time in the company related to refurbished product sales (previously done for pay as you wash service)**
- **Positive NPV for a 10 year period for both Turkey and Spain but with better results in Turkey- mainly cheaper labor cost**
- Most important factor is successful increase in customer numbers
- Sensible to the factors below:
- +/- change in price, number of first contract, successful attrition, installation, warranty, logistics, labor, WACC

Pre-Demo Survey by Arçelik

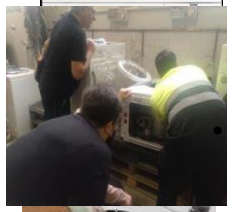
- Carried out among global Arçelik employees internally: 39% would rent instead of buying a new one if same quality and warranty terms apply.
- Second hand refurbished product acceptance is highly correlated to price. 78% would only buy a refurbished item with a discount.

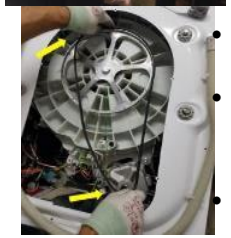
Eligibility

- WM's are more suitable for B2B segments such as dormitories, elderly care homes
- TV's are suitable for hotels, elderly care homes, dormitories

Outcomes from the Project – Refurbishment

WM





- Refurbishment process has been developed by EMAUS.
- Trainings for EMAUS workers carried out through Sareteknika. Trainings contributed to improving worker skills: increasing WEEE recovery rate from 3% to 3,5%.
- Gasket placement is labor intensive and requires manual performance.
- Arçelik products have been rated as easily reparable by EMAUS technicians.
- WM repair process deployment is easier compared to TV repair process.

TV

- Refurbishment process has been developed by EMAUS.
- Trainings for EMAUS workers carried out through a collaboration with Telenis. Trainings contributed to improving worker skills: increasing WEEE recovery rate from 3% to 3,5%.
- TV recovery requires special skills and expertise and special equipment should be used to prevent static electricity.
- PCB, plastic covers, led bars, cables are easy to refurbish
- LCD panels have the highest damage rate and they are not easy to be repaired.
- Connectors connecting LCD board to the panel and the wild cables attached to the LCD panel are extremely important.

- **Repair technicians are better equipped to repair WM's instead of TV's whereas results of both Arçelik survey and living labs survey show that consumers are more willing to buy a refurbished TV rather than a WM. This shows the need to invest in infrastracture and labor capabilities to equip the technicians for TV repairs so customer demand can be met.**
- Emaus currently does not recover components from refurbished products so there is potential to use recovered WEEE items rather than buying new spare parts.
- Arçelik can cooperate with EMAUS outside of the project on training of technicians, preparation of reference manuals for all technicians, facilitate agreements with distributors, logistics operators, on extraction and sale of WEE components as spare parts or to be used in refurbished products.
- ICT Platforms such as Soltel can be used to collect, document and transfer knowledge in a safe and secure manner between manufacturers and repairers.
- Risk of electric shocks during dismantling, risk of harming LED panel makes it very difficult, labor and investment intensive for TV's.

Living Lab Activites and Results- End of Life

"It is based on the principle that you cannot value something that you do not understand".

OBJECTIVES:

- Define de user profiles
- Analyze the sales potential
- Pedagogical demonstration

METHODOLOGY:

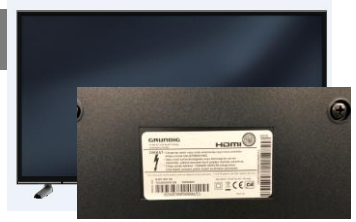
- A demonstration space is designed at the Emaus facilities (Ekocenters) explaining the project.
- User profiles that can match with the offered products are created and defined. Once defined, they are recruited.
- 17 tests are carried out to measure the interest in the refurbished washing machine product and 17 tests to measure interest in the refurbished television product.
- Subsequently, the data are collected and the test results are analyzed.
- The challenge lies in transferring this innovation to people in the street, citizens who do not work in innovation.

Outcomes from the Project – End of Life, Living Lab Results

WM

- 88% of participants would prefer to buy a refurbished WM.
- 47% of participants estimate the lifetime of a washing machine to be between 10-15 years.
- 47% of participants would buy a refurbished WM for a price of EUR 241.
- 76% of respondents indicated they would buy a refurbsihed WM from EMAUS.
- 59% of the respondents prefer EMAUS and GRUNDIG to be jointly responsible for the warranty of the WM.
- 59% of the respondents think the warranty term should be 2 years.
- 87% of the participants trust that the product would have been better treated with rent model at a center for elderly people for 3 years.
- Participants find it interesting to know the hours of use of the product, 53% of people believe that it is a piece of information to take into account when making the decision to buy a washing machine.

TV



- All participants would prefer to buy a refurbished TV.
- 53% of participants estimate the lifetime of a TV to be between 5-10 years.
- 41% of participants would buy a refurbished WM for a price of EUR 250.
- 82% of respondents indicated they would buy a refurbished TV from EMAUS.
- 65% of the respondents prefer EMAUS and GRUNDIG to be jointly responsible for the warranty of the WM.
- 59% of the respondents think the warranty term should be 2 years.
- 80% of the participants trust that the product would have been better treated with rent model at a center for elderly people for 3 years.
- Participants find it interesting to know the hours of use of the product, 47% of people believe that it is a piece of information to take into account when making the decision to buy a washing machine.

Outcomes from the Project – End of Life, 3D Printing Results

Partnership with Particula

WM

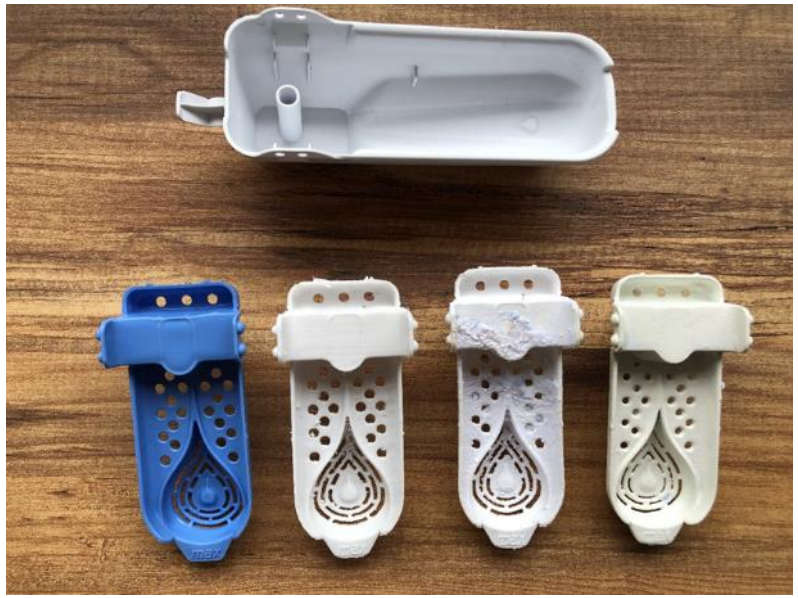
- WM's have several components including plastics, metals, rubbers, concrete wieghts, etc.
- Plastics were selected to be 3D printed- (**Liquid detergent container**)
- ***WM 3D printing tests failed.***
  - WM works under dynamic loads which require mechanical strength. Parts in contact with water are expected to be resistant to chemicals and high temperatures.
  - There is a perceptual quality expectation for visible parts of the washing machine like front panel, front door.
  - Detergent box was considered as a first option but they could not be printed in the 3D printer.
  - Therefore, same tests were concluded with liquid detergent container group but printed version's surface was not smooth, clogged with detergent. The polished versions also failed and got deformed.

TV

- rPET and PETG filamet are the most suitable materials for 3D printing.
- **TV stands** have been selected as the parts to be tested.
- ***TV 3D printing tests failed.***
  - The formulation developed was too rigid and could not pass the safety tests.
  - TV stands are critical components because they carry the TV.
  - The 3D printed TV stands could not pass the safety tests.
    - Products with weight >7kg could not pass the tests.
    - The demo products are 9kg.

3D Printing Activities for WM and TV

WM demo



Left to right: *original, 3D printed & unpolished, after testing 3D printed & unpolised, after testing 3D printed & polished*

after testing 3D printed & polished

after testing 3D printed &unpolished

- 3D printing part selection is critical due to the dimension&geometry
- Perceptual quailty is failed
- The tests have failed.

3D Printing Activities for WM and TV

- The tests have failed.
- The material formulation is too rigid to be used.
- rPET and PETG filament are the most suitable for TV sets and display spare plastic parts production
- Products with weight >7kg could not pass the tests.
- The demo products are 9kg.

FACILAN C8 material, 30 % infill density

FACILAN C8 material, rPETG 30 % infill density

PET G material - 20 % infill density and 0.2 layer

PETG material - with the infill density of 30 %, 15% and 20%.

TV demo

PETG 30% infill 0.2r PETG

FACILIAN C8 30% 0.2

PETG 30% infill 0.2r, PETG 50% infill 8 perim 0.2 refol

PETG 50% infill 8 perim 0.2r

The first LVD -Low Voltage Directive (product safety test standard made under IEC 62368-1) test failed to pass the safety test at the LVD station, therefore the planned 4 samples left are not completed.

Second party, after testing 3D printed

Outcomes from the Project – End of Life, Dismantling

WM

GRUNDIG Washing Machine
DISMANTLING PROCEDURE

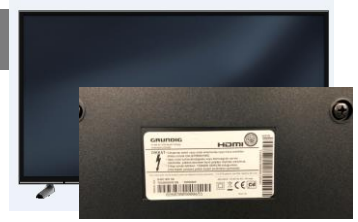
- Partners: Greentronics
- Greentronics prepared a dismantling procedure for demo products.

	Recycler
Time to dismantle/check parts (mins)*	22
Time to pack parts ready for shipment (mins)*	14
Cost to pack the parts (€)*	50
Cost to ship the parts (€)*	180/730
Hourly rate (€)	3,8

**Average time per WM part*

- Costs of the dismantling, packaging, labor and shipping provided by dismantlers is considerably high compared to the cost of obtaining such components as new ones.
- The recovery of the components by a refurbishment company rather than a recycler can add more value considering the complexity of the recycling process and the low chances of recover at the site of the recyclers coupled with high costs.

TV



- Partners: Greentronics and Indumetal
- Dismantling procedures have been produced.

TV Component Recovery Costs	Greentronics	Indumetal
Time to dismantle/check parts (mins)	10,5	13
Time to pack parts ready for shipment (mins)	5	21
Cost to pack the parts (€)	10	4
Cost to ship the parts (€)	480	200
Hourly rate (€)	3,8	30

- Two different costs show the sensitivity of the feasibility based on logistics, labor, packaging costs.
- Recyclers do not receive WEEE in good conditions. This reduces the potential to recover spare parts. Therefore, from a circularity and recovery of components perspective, it makes more sense for repair companies to have special operations to work on the recovery of components before the product becomes waste.

Outcomes from the Project – End of Life, Dismantling

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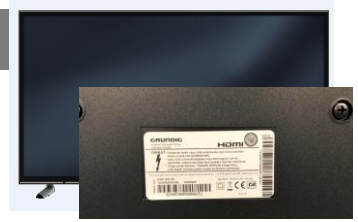

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Outcomes from the Project – End of Life, Validation of Recycled Plastic Materials

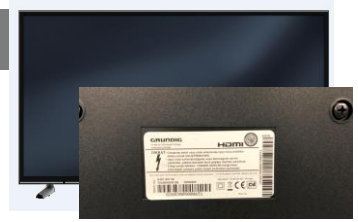
Partnership with Gaiker & Aimplas

WM

Detergent box gr from end-of-life Beko/Grundig washing machines were collected by Emaus at their facilities. (PP material from detergent box)

- The tests proved to provide positive results and are compliant with Arçelik specs except for physical properties such as MFI and mechanical properties such as Izod and tensile strength.
- These properties can be improved to meet Arçelik standards by including virgin materials and reformulating.

TV



Material provided by INDUMETAL
(PC-ABS parts from EoL TV panels)

- Tests are compliant with Arçelik specs except for mechanical properties such as tensile strength and elongation at yield.
- Properties can be improved to meet Arçelik standards by including virgin materials and reformulating.
- Recycled parts need to be checked for halogens according to TV ecodesign criteria.
-

Activating Circular Services in the Electric and Electronic Sector

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776714

Activating Circular Services in the Electric and Electronic Sector

Circular Economy in practice in the Electric and Electronic sector

Lessons learnt from the ALM (ICT equipment) demonstration

Partner: ADVA

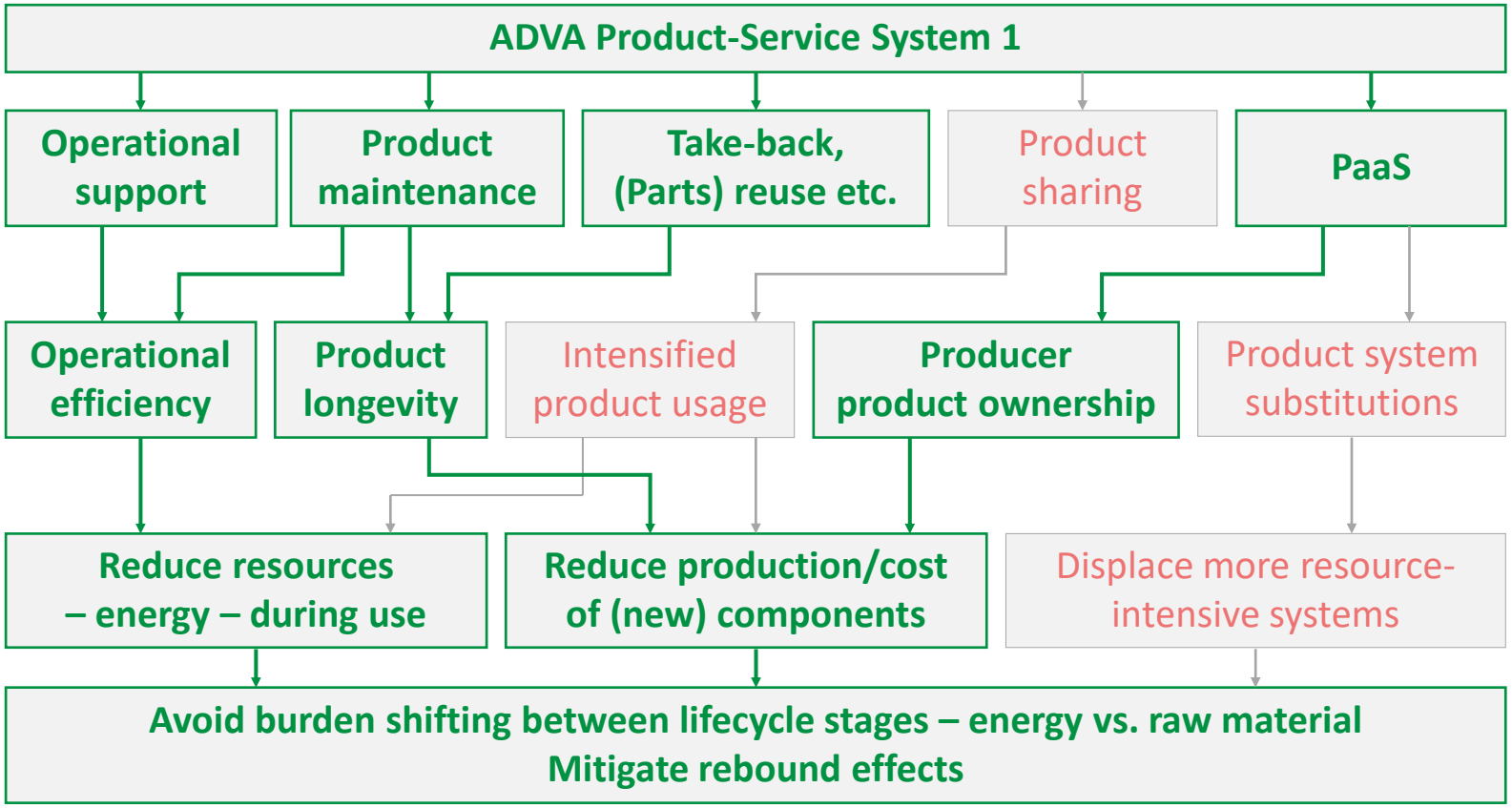
Date & Place: 14 September 2022 | Online

CEBM canvas – ADVA focus

1. Key circular activities	**1.2** Embrace ecodesign to ensure circularity across all lifecycle stages **1.4** Develop circular logistics and distribution **1.5** Provide repair and maintenance services **1.6** Optimize EoL circularity
5. Circular customer relationships	**5.4** Provide/enhance after-sales services, including improved guarantees or warranties
6. Key circular channels	**6.4** Adopt commitment to ensure highest possible level of data security
7. Circular value proposition	**7.1** Adopt options for providing products as a service or bundles of products and services **7.2** Enhance offerings for leased, rented or shared product options **7.4** Enhance circular EoL options, including take-back
8. Circular revenue streams	**8.1** Enhance offerings that attract recurring revenues such as bundles of sales and services, leasing, remanufacturing **8.2** Adopt financial administration to enable CE business models such as leasing options **8.3** Enhance activities that obtain value from WEEE, e.g., parts reuse, preparation for reuse or resale, and/or recycling
9. Circular cost structure	**9.3** Enhance strategies and practices to address cost associated with take-back and return of EoL products

*All other canvas aspects not regarded productive **for ICT network equipment** after initial assessment*

PSS overview



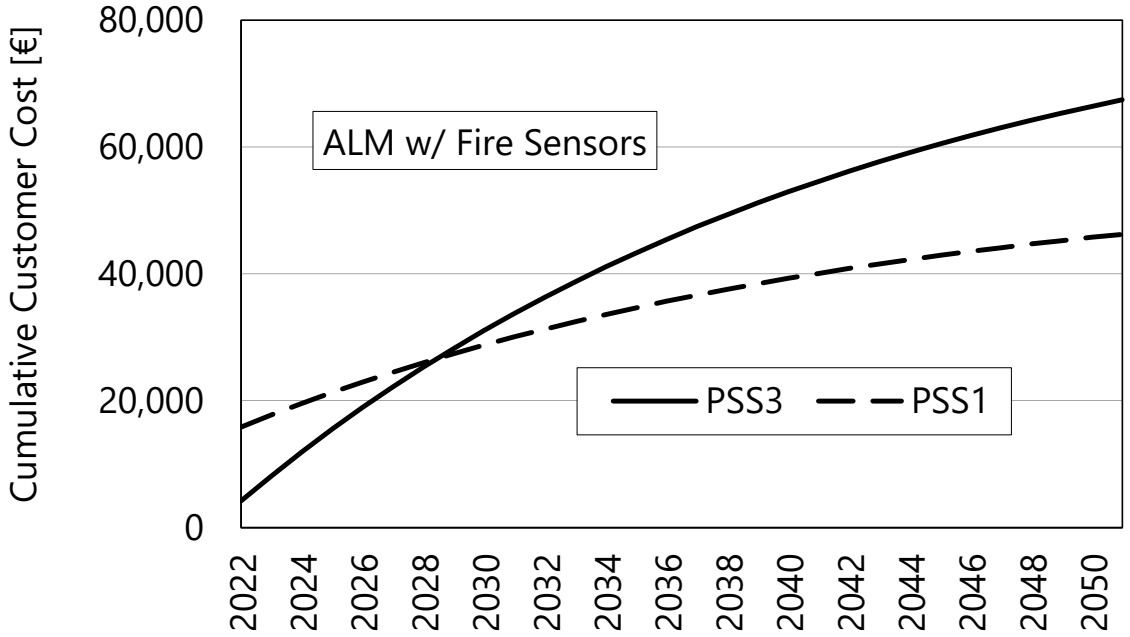
Certain PSS not feasible for infrastructure ICT equipment because of its specific capabilities and characteristics

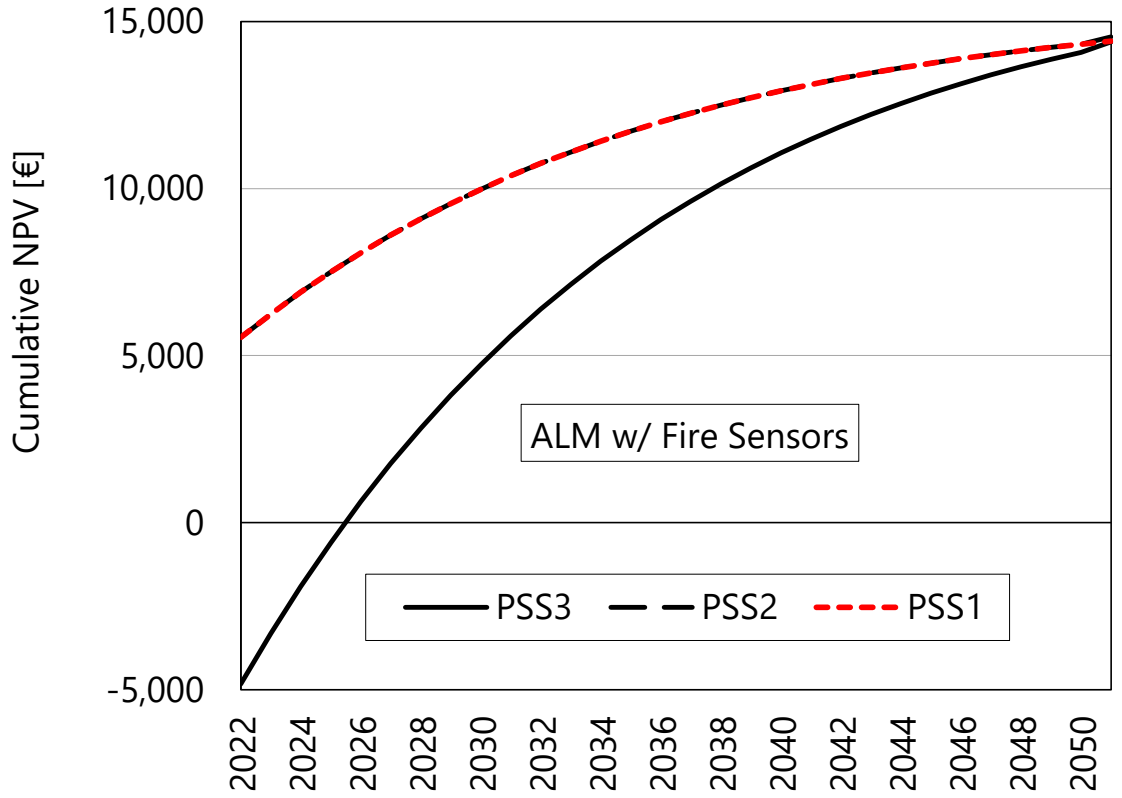
- Product sharing / utilization
- Product substitution
- Intensified usage

Interesting fact : practically all old leasing-project attempts (last 8 years) failed

PSS analysis

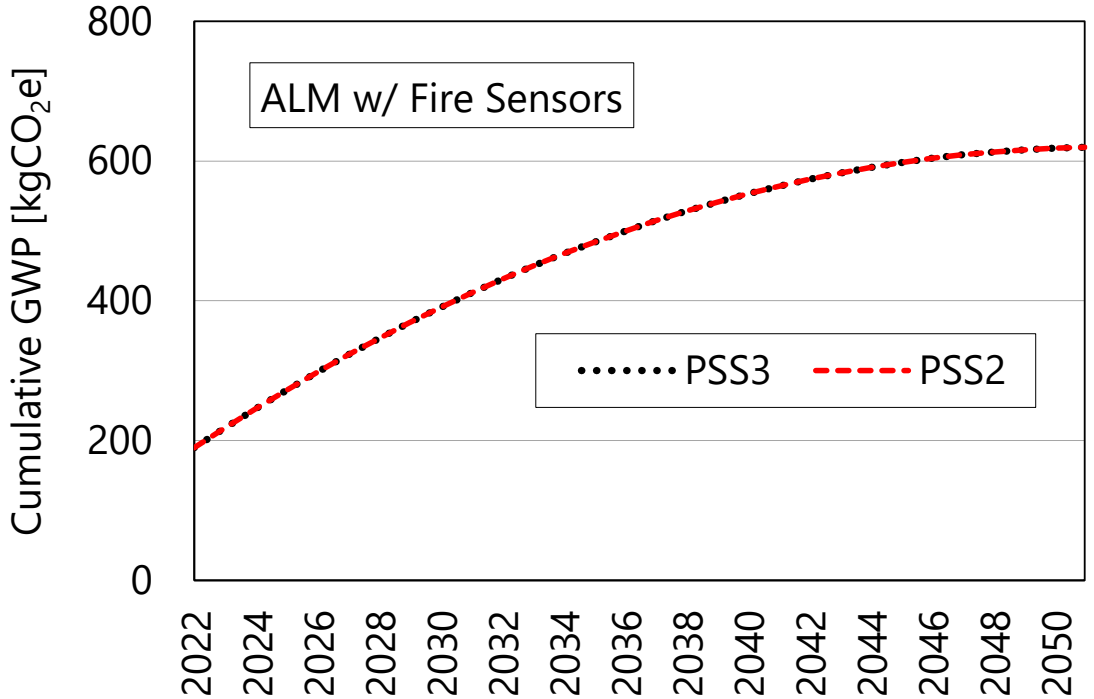
- Different products (not just ALM)
- All relevant monetary and environmental parameters considered
- ADVA view plus customer view
- **Several PSS are viable and will be implemented**





Lifetime emissions…

- The PSS were also assessed regarding lifetime emissions, including EoL effects
- **PSS with take-back at EoL perform similarly good regarding these emissions**
  - Sales + maintenance + take-back at EoL
  - Leasing, including maintenance and take-back at EoL – both, leasing products and leasing services



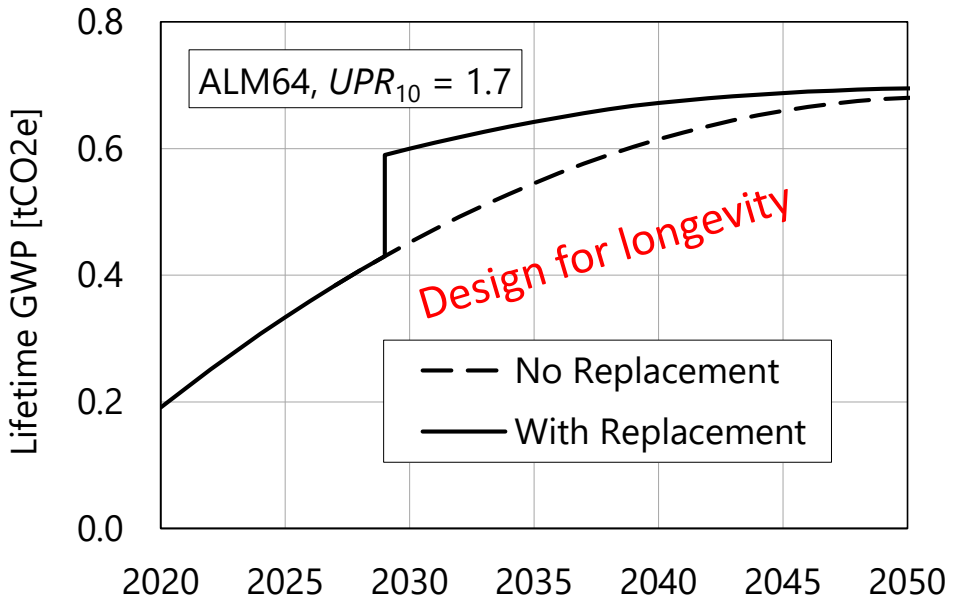
Lifetime analysis

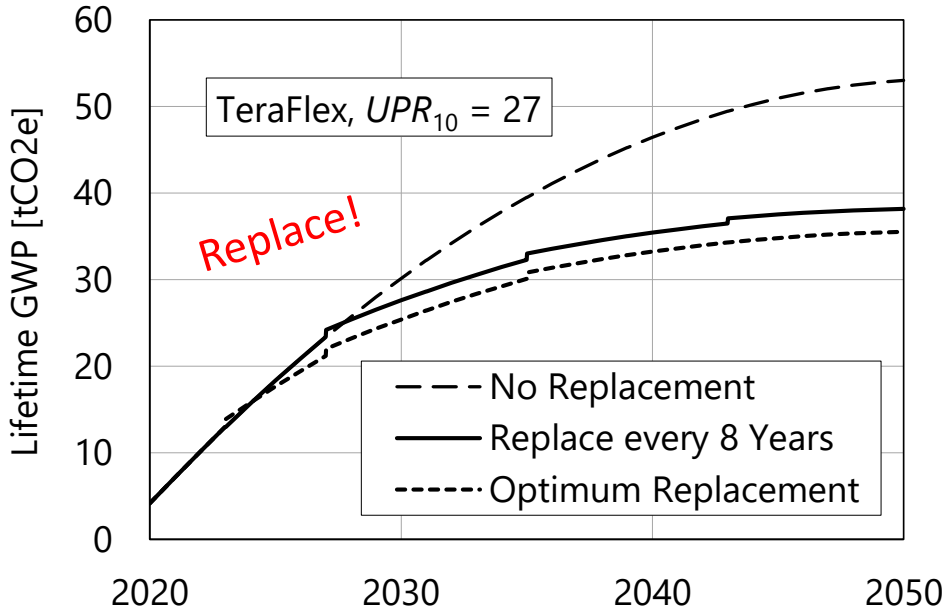
- Product lifetime and associated energy consumption may have an influence on PSS selection
- Conducted extensive lifetime-optimization analysis based on total-lifetime emissions minimization

$$UPR_{10} := \frac{\text{GWP of the first 10 years in the use phase}}{\text{GWP of the production phase}}$$

- UPR_{10} < 4* – longest-possible product lifetime
- UPR_{10} > 4* – replace by more efficient successor

UPR_{10} can identify if products should be replaced due to energy consumption in order to optimize lifetime GWP

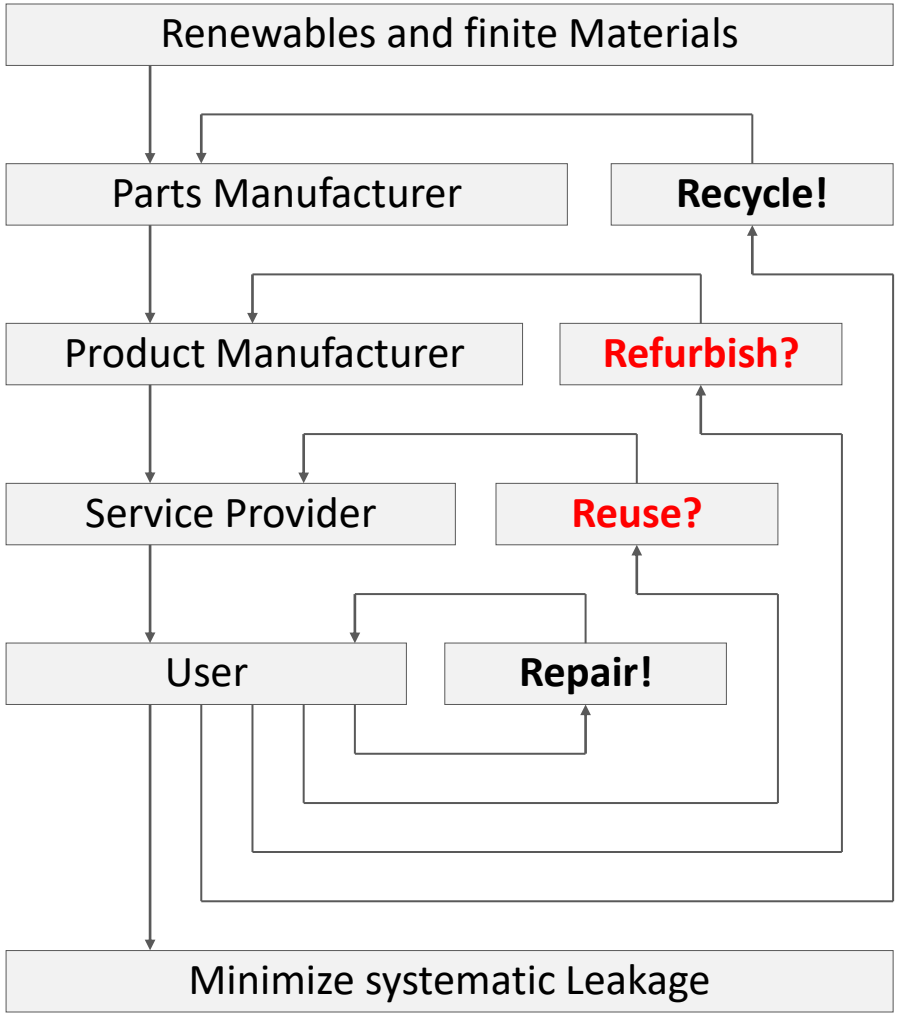




*) For EU grid-mix electricity

Conclusions (ICT network equipment!)

- For certain product classes, we *must* look at energy consumption to avoid adverse effects
- For fast-paced markets like infrastructure ICT, functional obsolescence also is a challenge
- Some CE loops are feasible for our products
- Likewise, some PSS are promising
  - Will extent service / maintenance business
  - Will go into first leasing PSS
- *We will extend our CE business*



Activating Circular Services in the Electric and Electronic Sector

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776714

Activating Circular Services in the Electric and Electronic Sector

Circular Economy in practice in the Electric and Electronic sector

“What are customers' expectations toward refurbished printers ? How to build an attractive business case for refurbished printers? ”

Partner: Lexmark (Patrick Carminati)

Date & Place: 14 September 2022 | Online

Agenda

- ❑ Customers' expectations
- ❑ Current state and associated challenges
- ❑ C-SERVEES demo aiming at addressing the challenges
- ❑ Conclusions

Customer expectations

Several surveys: mass mailing, face to face and product testing

- Willingness to buy refurbished products is high and cross the board
- A refurbished product is expected to **cost up to 50% less** than a brand new one
- Users don’t mind too much about cosmetic defect and can accept light ones, key focus is on **performance:** print quality, reliability, noise, speed
- Purchasers have a different view: **price price and price**
- Minority wants/needs the **latest technology** in their products

Current state and associated challenges

Printers

- Lexmark printers are designed to last long (+7 years)
- Maintenance parts that need to be change to ensure proper performance during their lifetime
- Considered by OEM as an investment, sold at cost or lower than cost
- **Refurbishing comes at cost: major drivers: reverse logistic, material, labor**

Cartridges

- Lexmark remanufacture about 40% of the sold cartridges in Europe
- Designed to be remanufactured
- Can be remanufactured up to 10 times, with same performance than new
- Already contain 37% of recycle resin

Market

- **Demand for sustainable products is rising but is still low**

Reverse Logistic

- Make customer life easy and reduce cost: automatize the take back/buy back processes
- Competitor interview: what about sharing reverse logistic cost ?
- Consolidate product pick up and optimize associated cost as well as CO2 impact. Use of ICT platform to help
- Need to sort printers at customer door to determine how to handle: refurbish, harvest, recycle to minimize cost. ICT tool may help
- Make sure that “EoL” product are not considered as waste and get refurbished instead of recycled

Addressing the challenges

Material

- Demo with recyclers to recover parts @ recycler's location
  - ✓ The business case close & ICT tool can support
  - ✓ Low volume, bad shape: require to identify EoL products upstream
  - ✓ Interview with a resource recovery company
- Reuse resin
  - ✓ Need to get proper resin identification and appropriate sorting to reuse resin from same products/brand to ensure performance. Reusing resin from other sources require chemical treatments
- 3D printing: very limited opportunities
- Cosmetic defect
  - ✓ Is a lever to reduce cost, customer acceptance evolve positively. Lexmark revisited the cosmetic spec : new sales dynamic
- Yield study
  - ✓ Cost trade off

Labor

- One time qualification cost is not neglectable (several k€)
- Efficiency can be easily increased with very limited investments (not specific to a given product family)
  - ✓ Requires demand/volume: starting 2000 units of the same model per year
  - ✓ 15 to 20% reduction

Demand Generation

- Need to incent sales teams to sell refurbished products and therefore inform customers about such program and its interest (competitor interview abound in this direction). Lexmark sales will now promote LECP (Lexmark Equipment Collection Program)

- PSS (Product Service System) seen as an enabler: OEM keeping ownership of their products brings various benefits: fleet management, decision to extend lifetime, refurbish, harvest parts, recycle, optimize associated cost and environmental impact. Lexmark launches a subscription program

- Customer educations on program availability, environmental benefits. Lexmark is developing a marketing campaign in this direction

- Other enablers: regulations, financial incentives (e.g. reduced VAT)

Conclusion

- Need Product to be design such a way their Lifetime can be easily extended, and they can be easily refurbished
- Design should also allow for software & firmware upgrade
- Sales force to be incented
- Customer to be educated
- Legislation to support
- Challenge: to sell refurbished printers, EoL printers are needed.
- PSS seems to bring the most efficient solution

Activating Circular Services in the Electric and Electronic Sector

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776714

Activating Circular Services in the Electric and Electronic Sector

Circular Economy in practice in the Electric and Electronic sector

Results of the optimization and validation (technical, economic, environmental performance) of the demonstrations

Partner: AIMPLAS

Date & Place: 14 September 2022 | Online

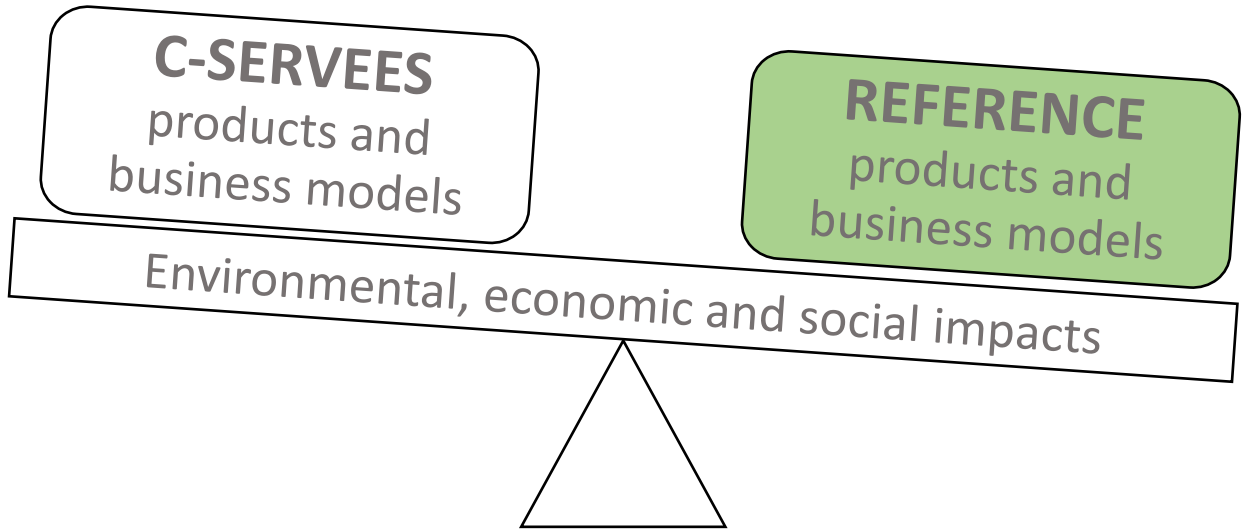
Activating Circular Services in the Electric and Electronic Sector

Life cycle sustainability assessment

Work Package 5: **Optimization and validation of the circular economic business models and eco-services**

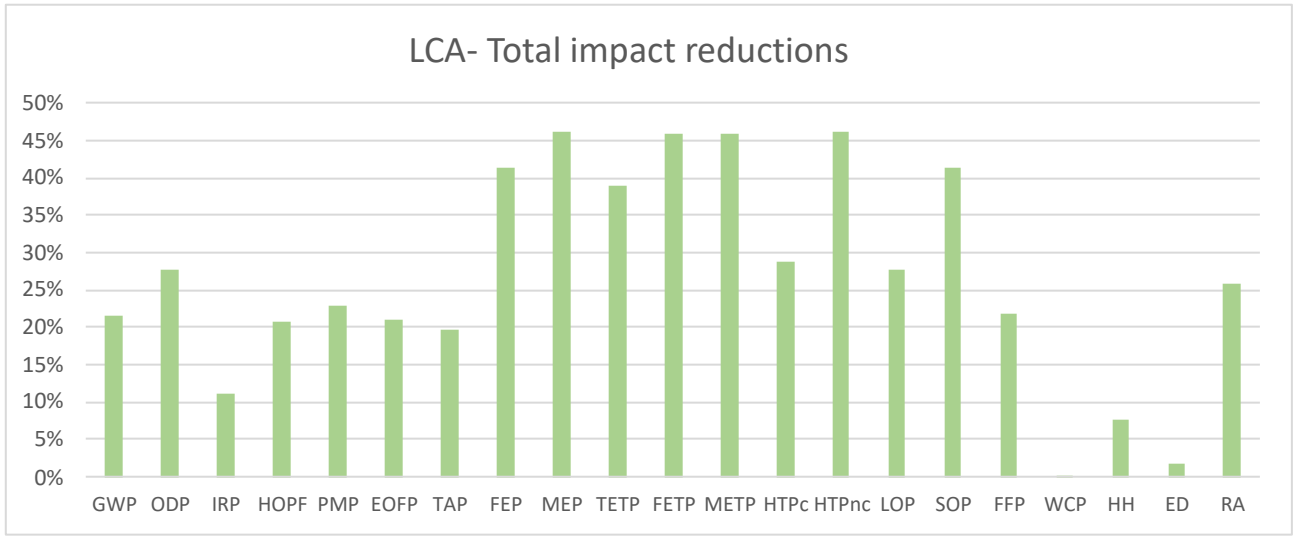
Main Objective

To validate the new business models by verifying their techno-economic, environmental and social feasibility in demonstrations of the four specific products across their value chains



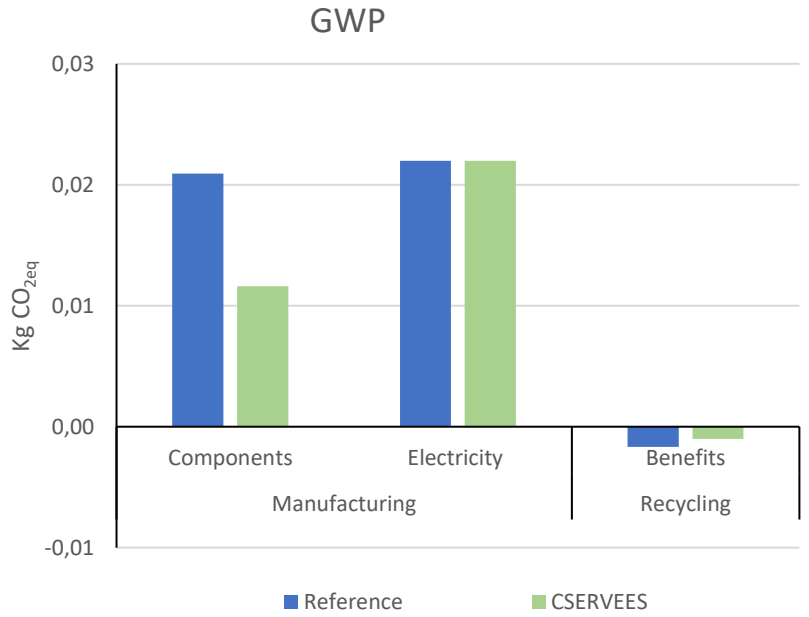
Activating Circular Services in the Electric and Electronic Sector

TV- Environmental Analysis: LCA



More reduction
- MEP FETP
- METP

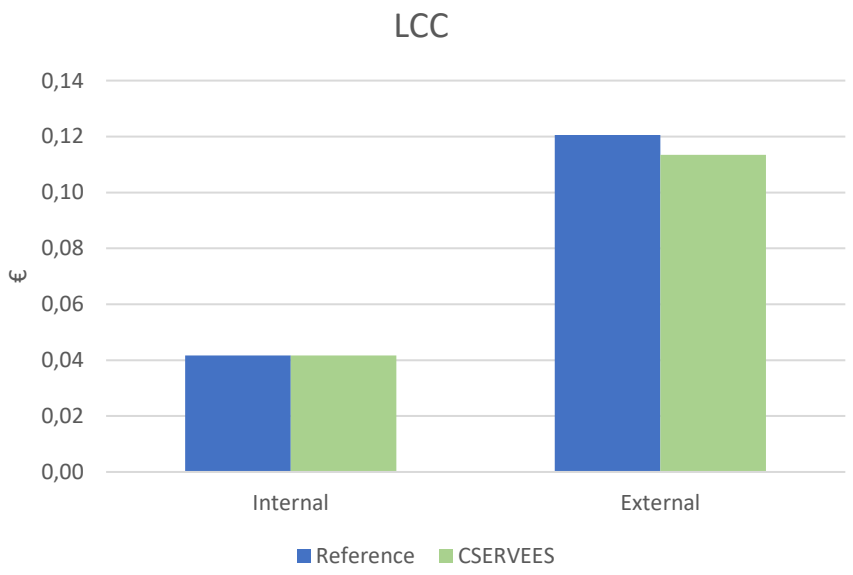
Lower reduction
- WCP
- ED
- HH

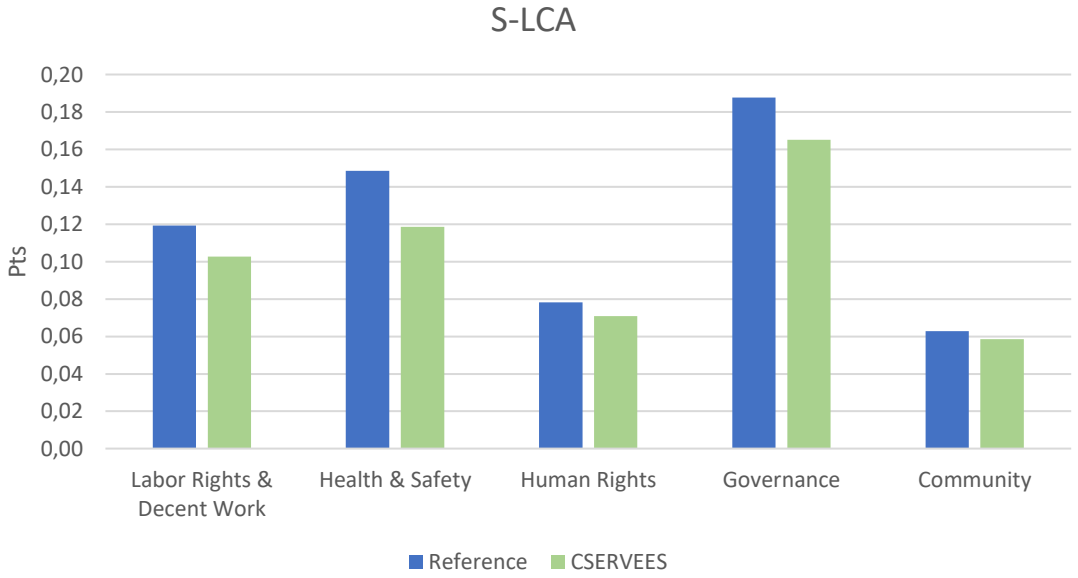


- Manufacturing reduction: 44%
- Total reduction: 21,6%

Activating Circular Services in the Electric and Electronic Sector

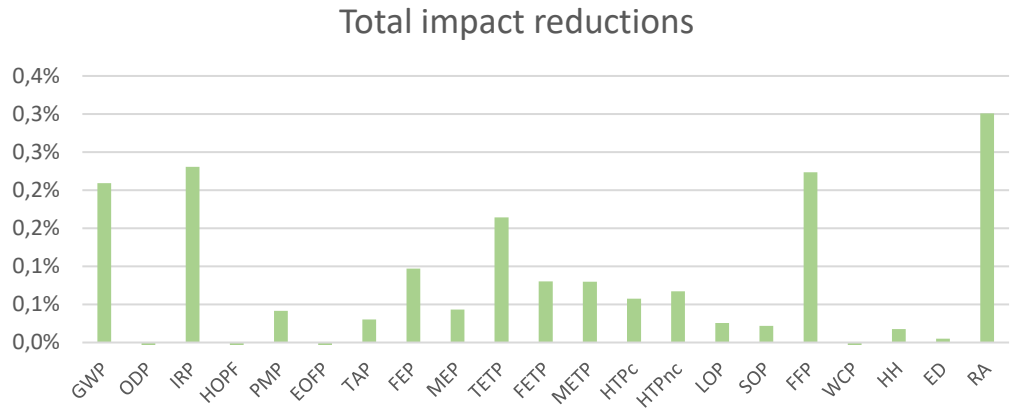
TV-
Economic and Social Analysis: LCC - SLCA

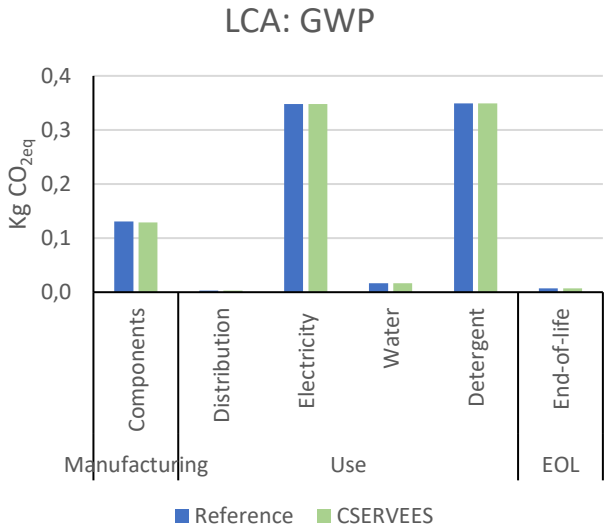




Activating Circular Services in the Electric and Electronic Sector

Washing Machine- Environmental Analysis: LCA





More reduction

- RA
- IRP
- FFP
- GWP

Lower reduction

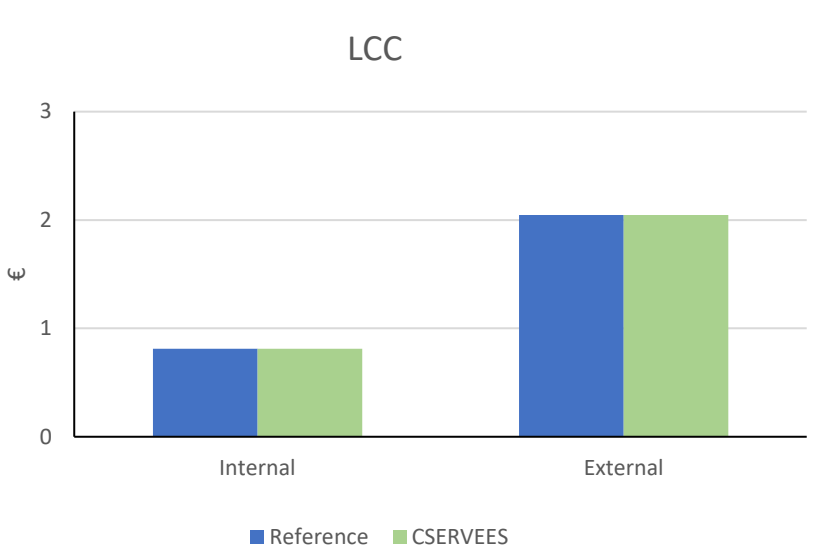
- ODP
- HOPF
- EOFP
- WCP

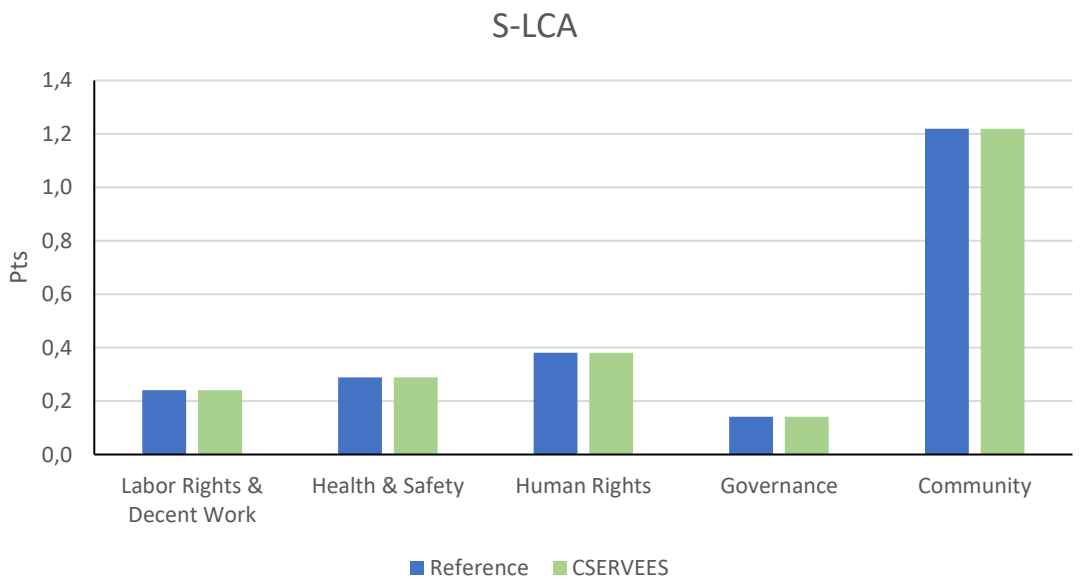
- Manufacturing reduction: 1,3%
- EOL reduction: 0,9%

- Total reduction: 0,2%

Activating Circular Services in the Electric and Electronic Sector

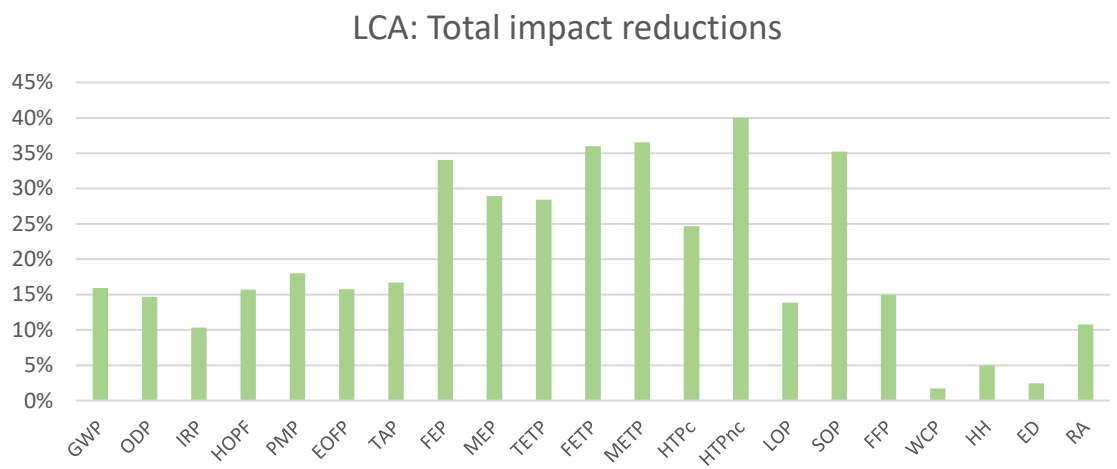
Washing Machine- Economic and Social Analysis: LCC - SLCA

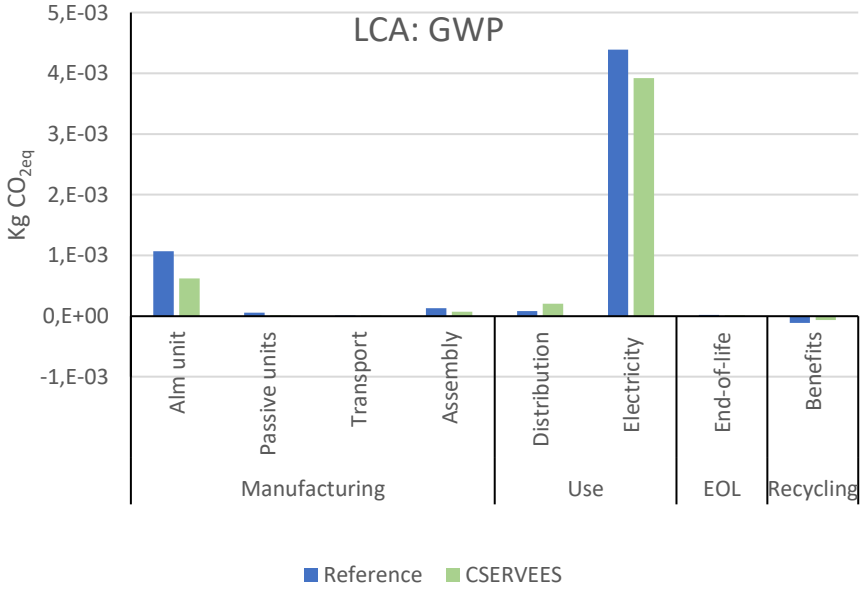




Activating Circular Services in the Electric and Electronic Sector

ALM-
Environmental Analysis: LCA





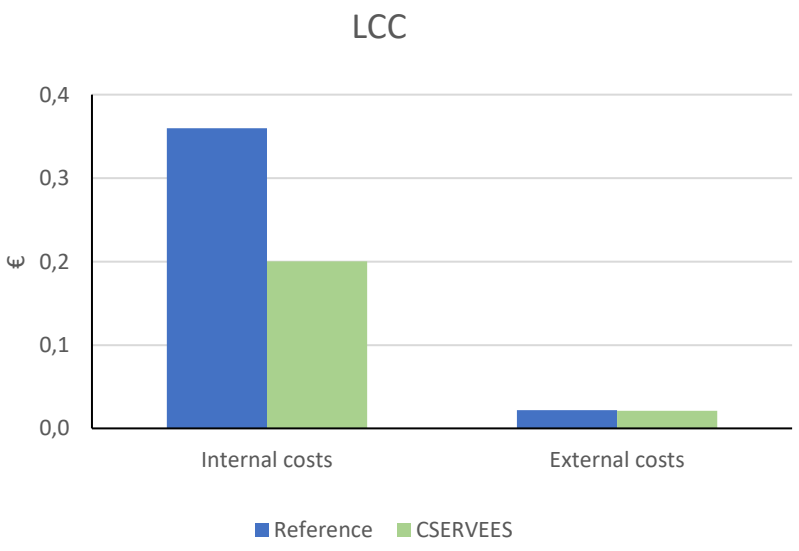
More reduction
- HTPnc
- METP
- FETP

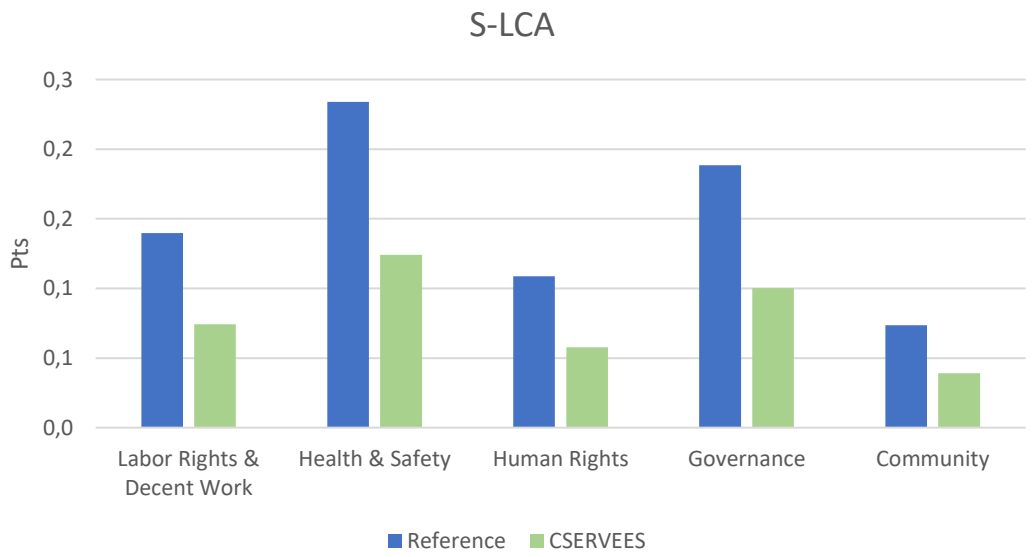
Lower reduction
- WCP
- ED
- HH

- EOL reduction: 41,8%
- Total reduction: 15,9%

Activating Circular Services in the Electric and Electronic Sector

ALM-
Economic and Social Analysis: LCC - SLCA

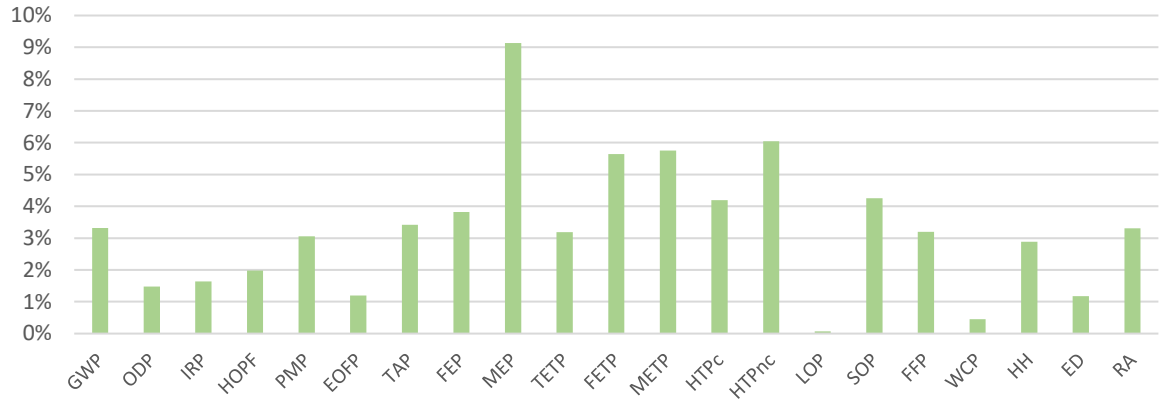




Activating Circular Services in the Electric and Electronic Sector

PRINTER
Environmental Analysis: LCA

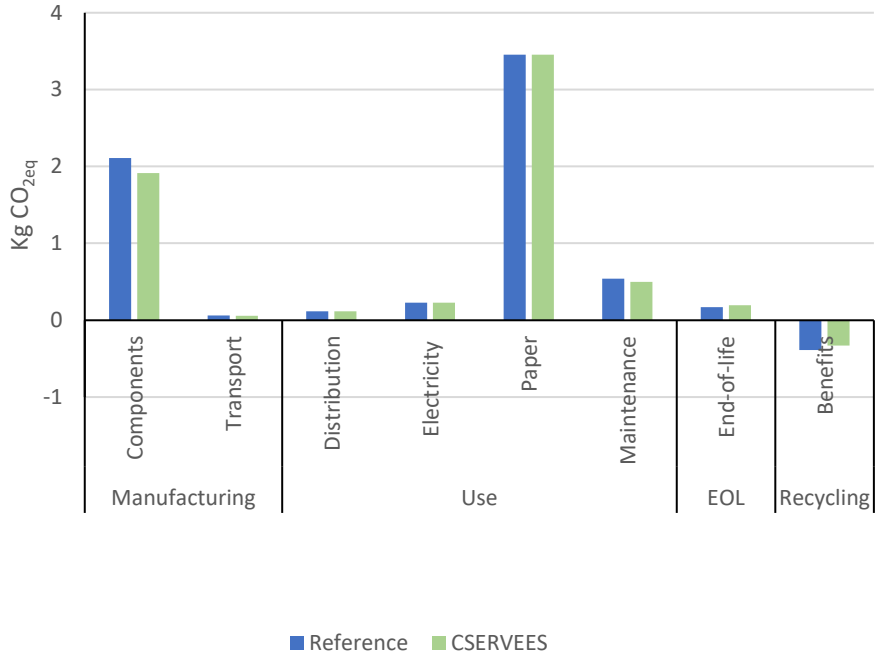
LCA: Total impact reductions



More reduction
- MEP
- HTPnc

Lower reduction
- LOP
- WCP
- EOFP

LCA: GWP



- Manufacturing reduction: 9,3%
- Total reduction: 3,3%

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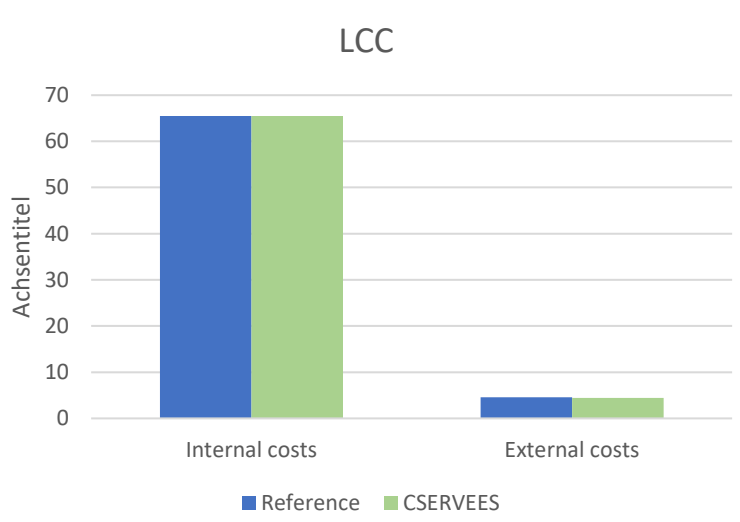
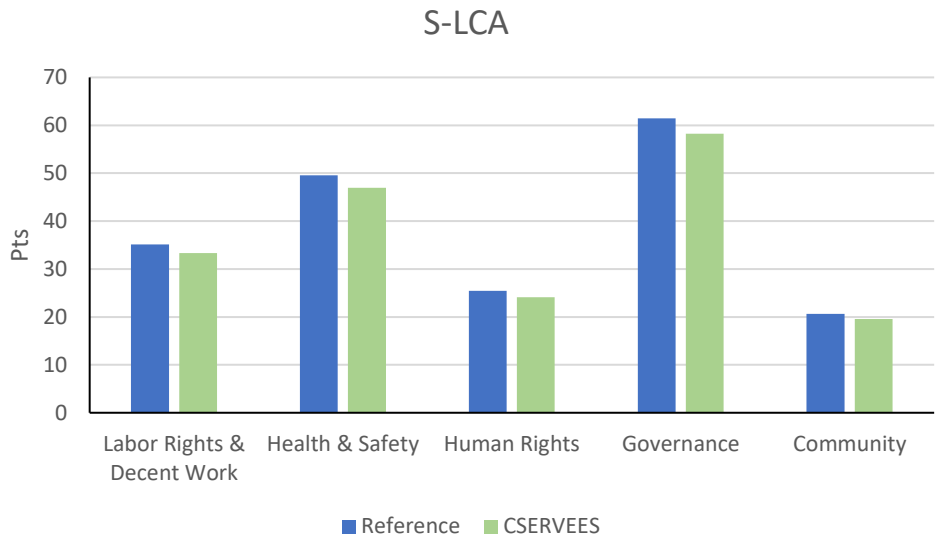
PRINTER
Economic and Social Analysis: LCC - SLCA





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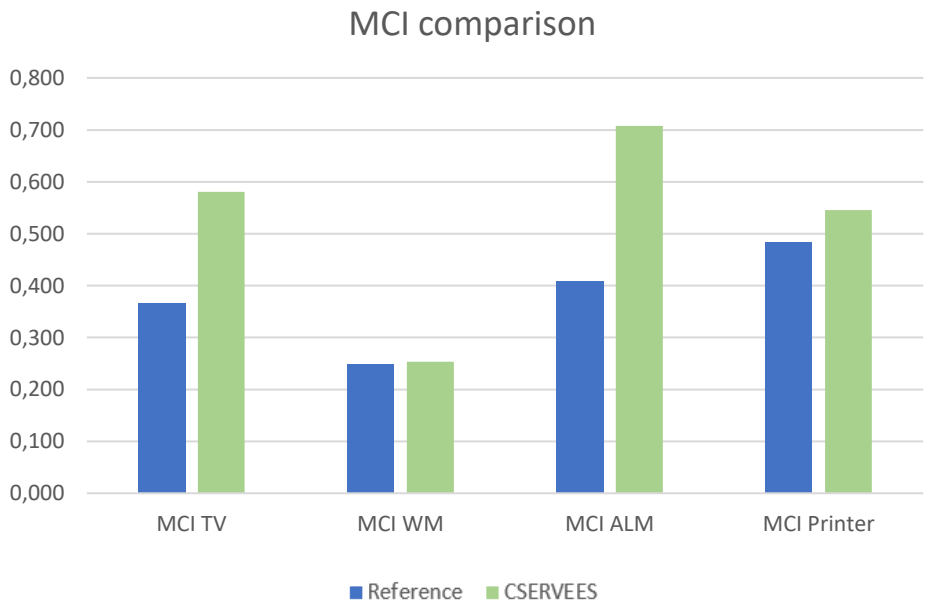
MCI comparison scenarios



MCI	Variation
Tv	58,6%
Washing machine	1,7%
ALM	73,1%
Printer	12,8%

Activating Circular Services in the Electric and Electronic Sector

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https://c-serveesproject.eu/

https://www.youtube.com/channel/UCP1eODyIc5cMWtK8UywFnBw

https://www.linkedin.com/in/cservees-project/

https://twitter.com/cservees

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Save the date!

Final event on October 19 in Brussels. More details to come.

Stay tuned!

Visit our website: https://c-serveesproject.eu/

Learn more!

Check out our YouTube channel for insightful visuals:

C-SERVEES Project

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C-SERVEES Horizon 2020 project

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