Imaging equipment and its consumables: preparatory study for Ecodesign

3rd Technical Working Group Meeting

11th October 2023

Joint Research Centre

European Commission

Meeting agenda	**Start time** (approx.)
Dial-in / Connection	09:30
Key learnings from Tasks 1-4	09:40
Environmental and economic assessment of Base cases (Task 5)	10:10
Environmental and economic assessment of Design Options (Task 6)	10:30
Coffee break	10 min
Ecodesign measures for devices (Task 7) - Description of all measures - Detailed analysis of selected measures	11:00
Ecodesign measures for cartridges (Task 7) - Description of all measures - Detailed analysis of selected measures	12:10
Next steps	13:20
End meeting	13:30

Purpose of 3rd Technical Working Group meeting

- JRC to present Tasks 1-7
  - Summarize key learnings from Tasks 1-4
  - Describe environmental and economic assessment of base cases and design options (Tasks 5-6)
  - Explain proposals of ecodesign measures for devices and cartridges (Task 7)
- Stakeholders to provide feedback/data and ask questions

How to interact during the TWG meeting?

- Type your comments in the chat box, indicating also your name and organisation
- After each section, the JRC will give you the floor, according to the comments received in the chat, to further elaborate comments
- Please remember to mute your microphone and close your camera at the end of your intervention
- TWG Meeting slides will be published in project website

Policy context and timing

DG ENV

European Commission

Process for adoption of measures

Ecodesign Directive

Regulatory procedure with scrutiny

- Preparatory study planned to be finalized at the end of this year
- Draft measures are planned to be discussed in the Consultation Forum early next year, based on final version of the preparatory study (date tbc)
- Commission works on impact assessment started in parallel with preceding steps
- Adoption of measures is foreseen in early 2025

European Commission

Preparatory Study for ecodesign

Research questions

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Research questions

Which are the main issues in the imaging equipment sector?	Which are the environmental hotspots?	What is the improvement potential?	Which specific measures should an ecodesign regulation include?
Which should be the main objectives of an ecodesign regulation?	Which are the economic hotspots?	Which areas should ecodesign regulation be focused on?	What is the improvement potential at EU level?
Tasks 1 – 4 Analysis of Market, Users and Technologies	**Task 5** Environmental and economic assessment of base cases	**Task 6** Environmental and economic assessment of design options	**Task 7** Policy options and scenario analysis

Key learnings - Devices

Tasks 1 - 4

Which are the main issues in the imaging equipment sector?

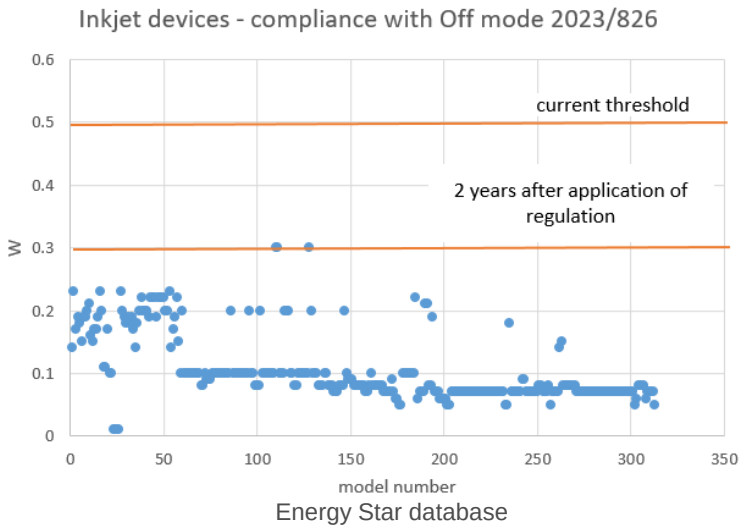
Which should be the main objectives of an ecodesign regulation?

European Commission

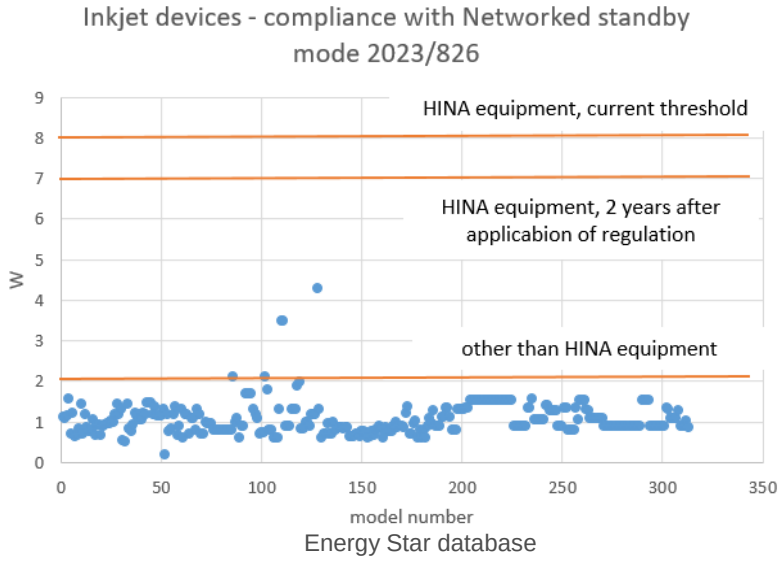
Energy

Energy

- Non-active modes (sleep, off) are more relevant than Active modes, particularly in inkjet devices.
- Most of inkjet devices are compliant with current thresholds of Regulation 2023/826 (1) for **Off mode** and **Networked Standby** mode.



Energy Star database



Energy Star database

(1) Regulation 2023/826 laying down ecodesign requirements for off mode, standby mode and networked standby energy consumption

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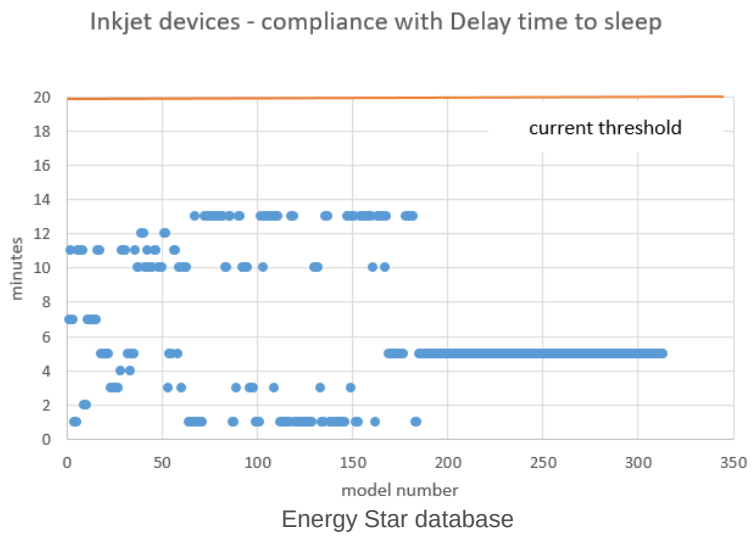
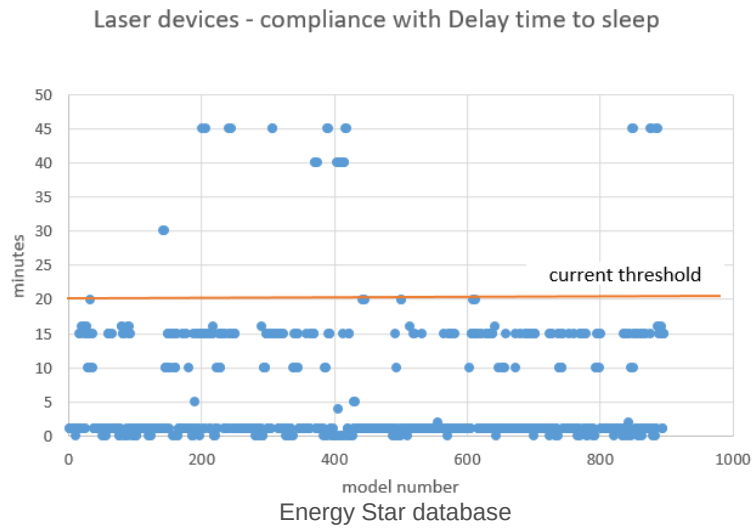
Energy

- Regulation 2023/826: **automatic transition between Active and Non-active modes** < 20 minutes
- Most of inkjet and laser devices are already compliant with this threshold



Energy Star database

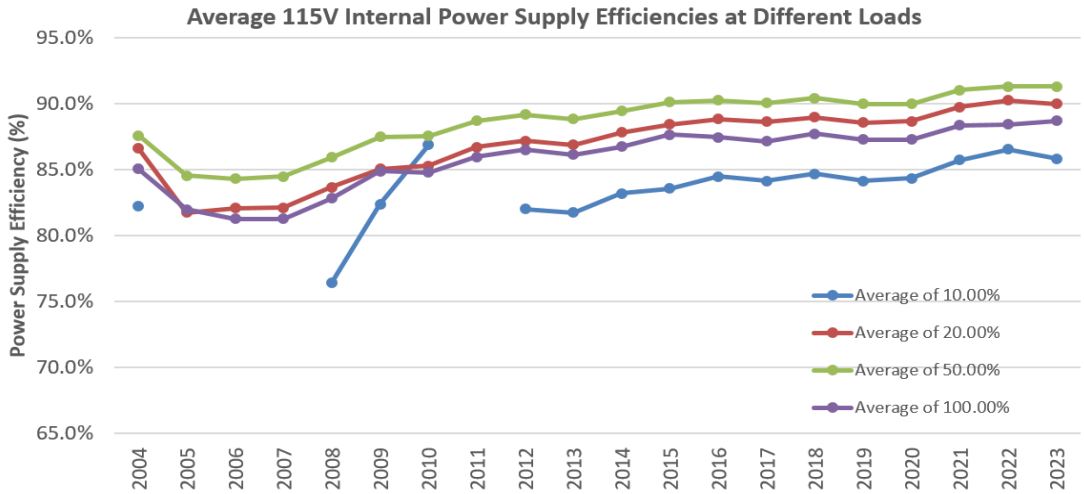


Energy Star database

European Commission

Energy

- The efficiency of **internal power supplies** (IPS) has been improving over the past 20 years (1).
- Efficiency of IPS is lower when they operate at low capacity. Printers tend to spend most of the time at low capacity.
- Using more energy efficient IPS can contribute to improve overall efficiency of the device.



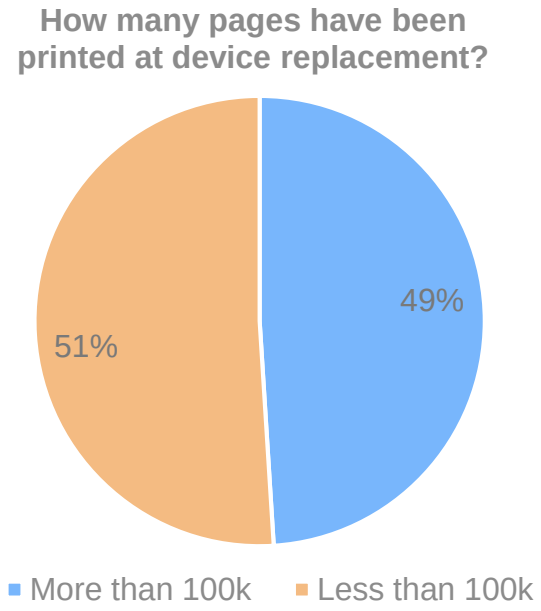
(1) Data provided by non-governmental organisation

Repair, Refurbish and Lifetime

Repair, Refurbish and Lifetime

Office sector – Pages printed at replacement

- Printers in offices are mostly purchased through Managed Print Service (MPS) contracts.
- Under MPS contracts, when devices are replaced, often they have not fulfilled their duty cycle (1)
- 51% of devices in MPS contracts are replaced with less than 100.000 pages printed (2)
- Fusers, transfer units or drums often have 70% remaining lifetime when they are discarded (3)



(1) Feedback provided by Keypoint Intelligence (2023)
(2) Data provided by supplier of software for Managed Print Service contracts
(3) Feedback from device refurbishers

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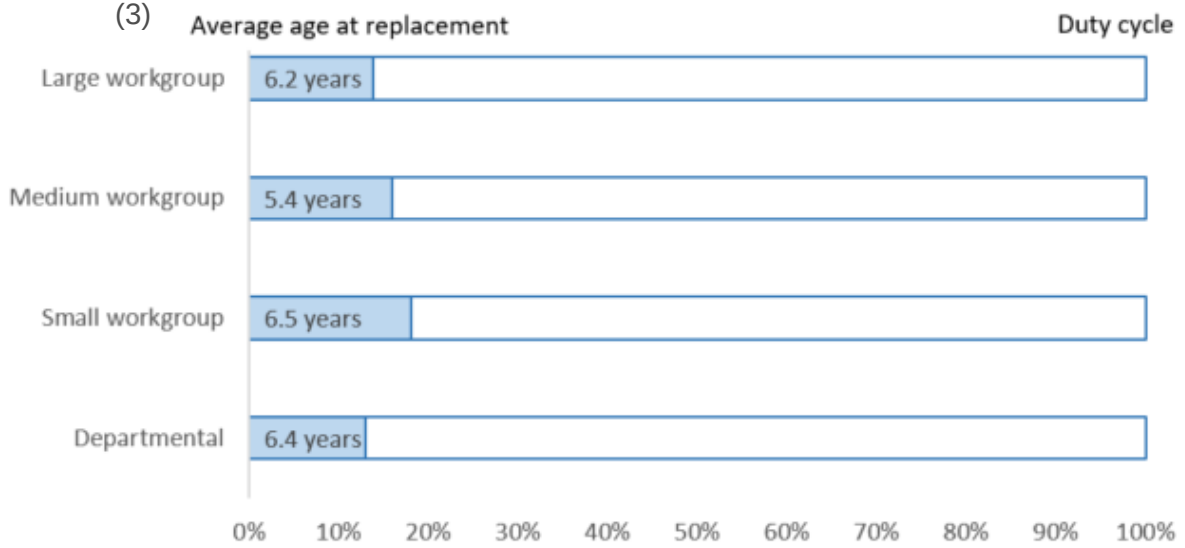
Repair, Refurbish and Lifetime

Office sector – Age of printers at replacement

- Technical lifetime of devices is around 12-14 years (1)
- Average age of printers at replacement is around 6 years. At that age, printers have used between 15-22% of their duty cycle (2)

(3)



(1) Feedback from device refurbishers
(2) Data provided by device OEM
(3) Based on Table 28 of Preparatory Study

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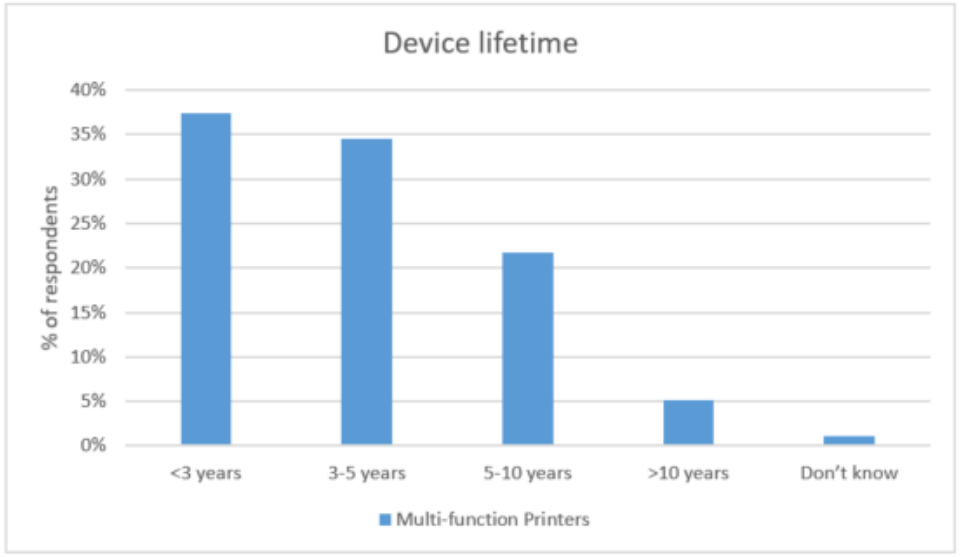
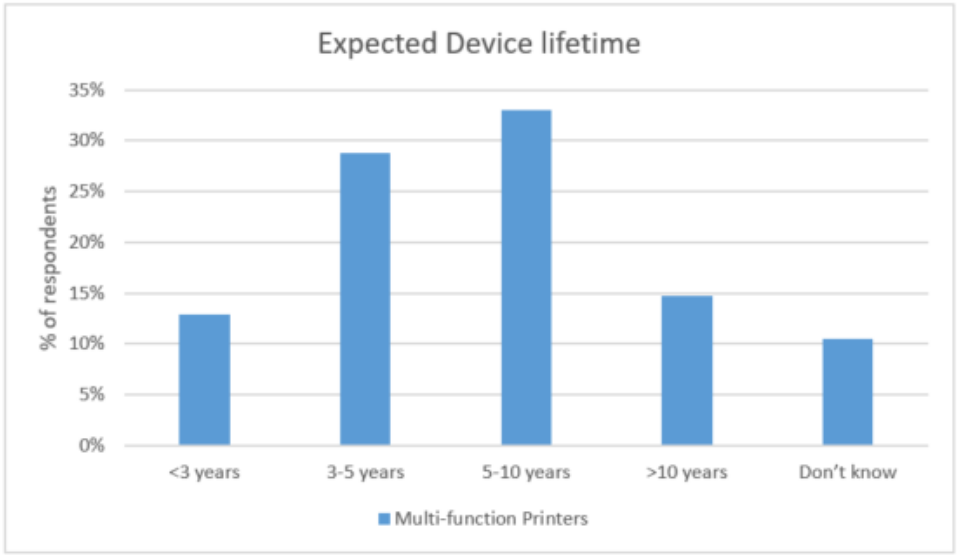
Repair, Refurbish and Lifetime

Domestic sector

- Most of the devices in stock today have been used for 5 years or less.
- Most of consumers have the intention of using their devices for 5-10 years (1)



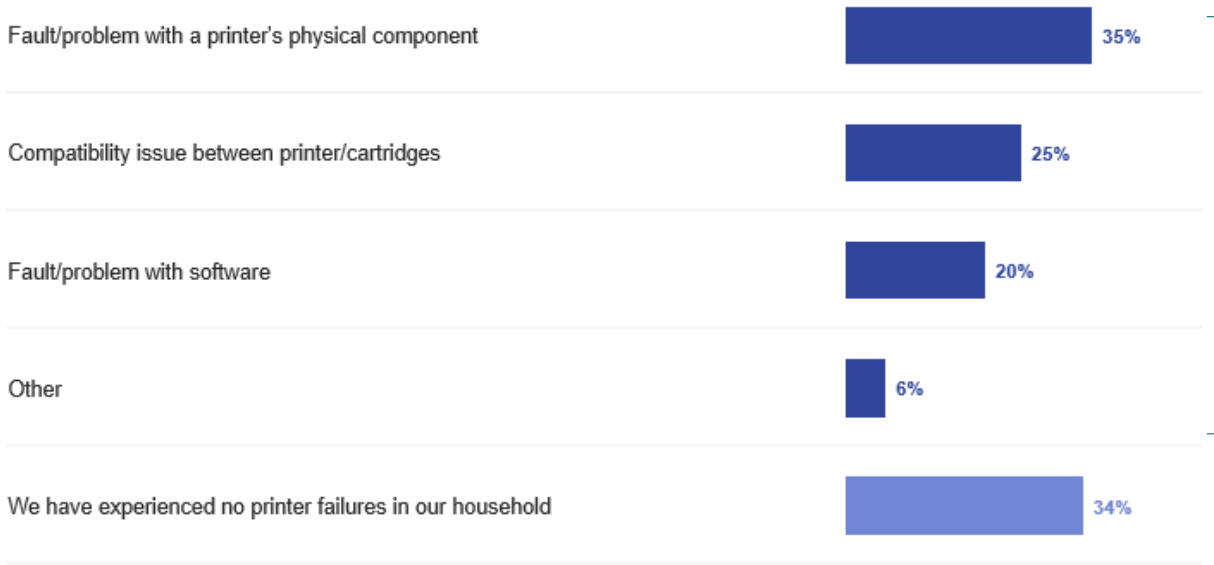


(1) User behaviour survey Task 3

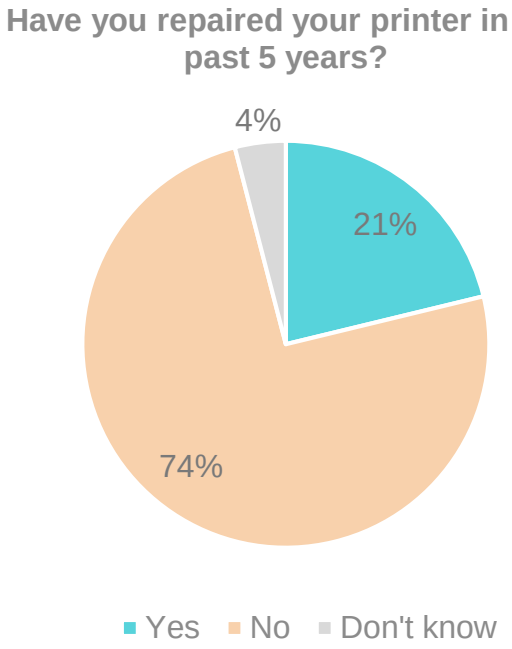
Repair, Refurbish and Lifetime

Domestic sector

- Nearly 70% of consumers have had an issue with their printer. However, only 21% repaired it (1)



68% of consumers experienced an issue with the printer



(1) User behaviour survey Task 3

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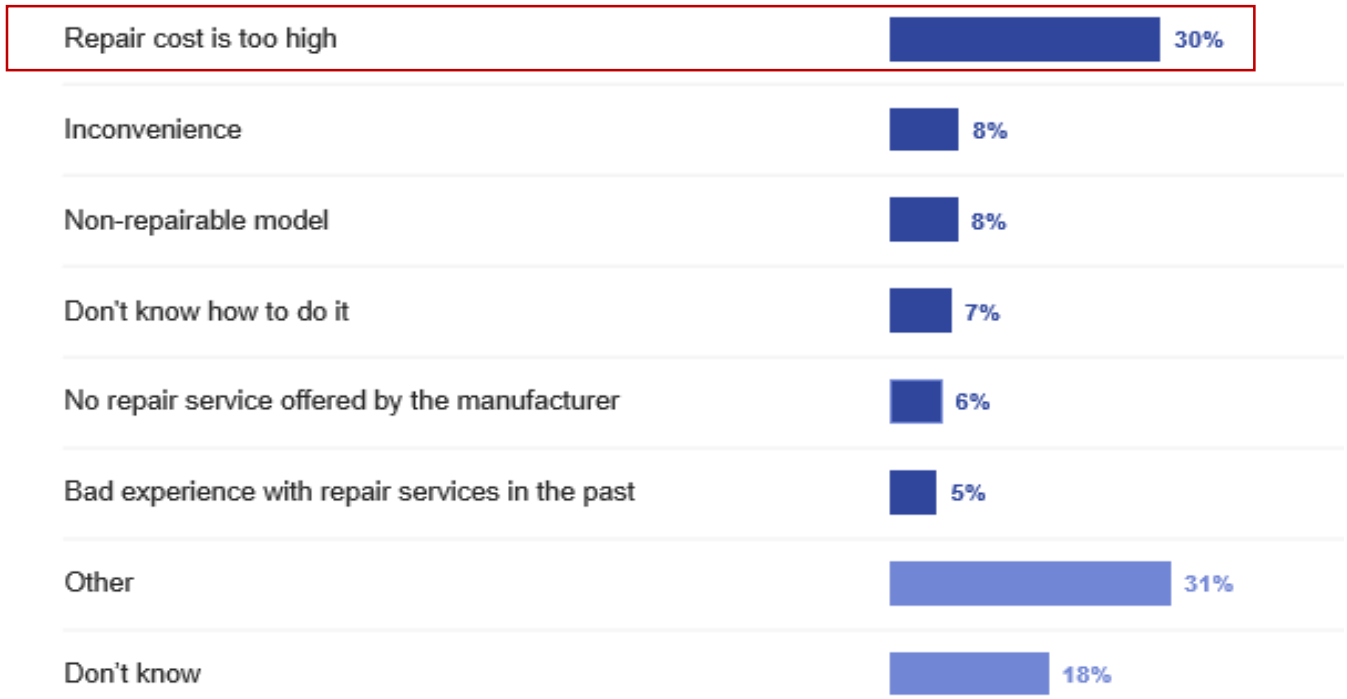
Repair, Refurbish and Lifetime

Domestic sector

- The main reason for users not repairing their printer is because it is too expensive (1)



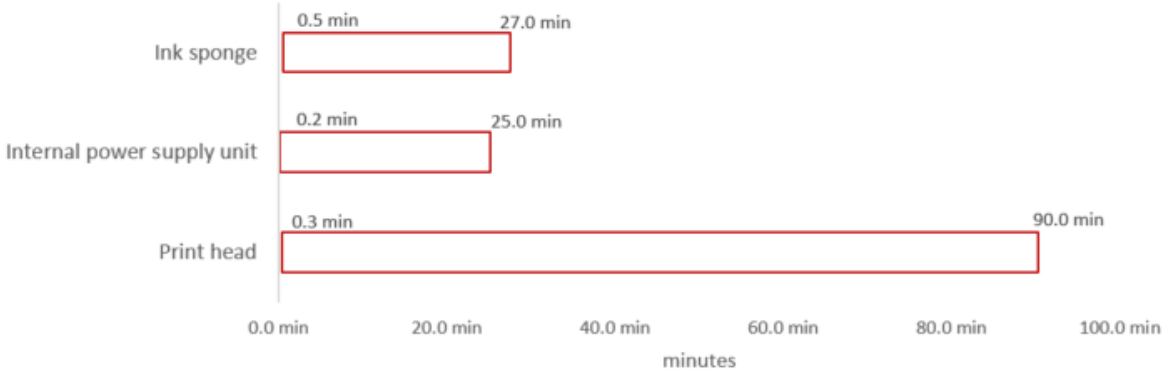
(1) User behaviour survey Task 3

Repair, Refurbish and Lifetime

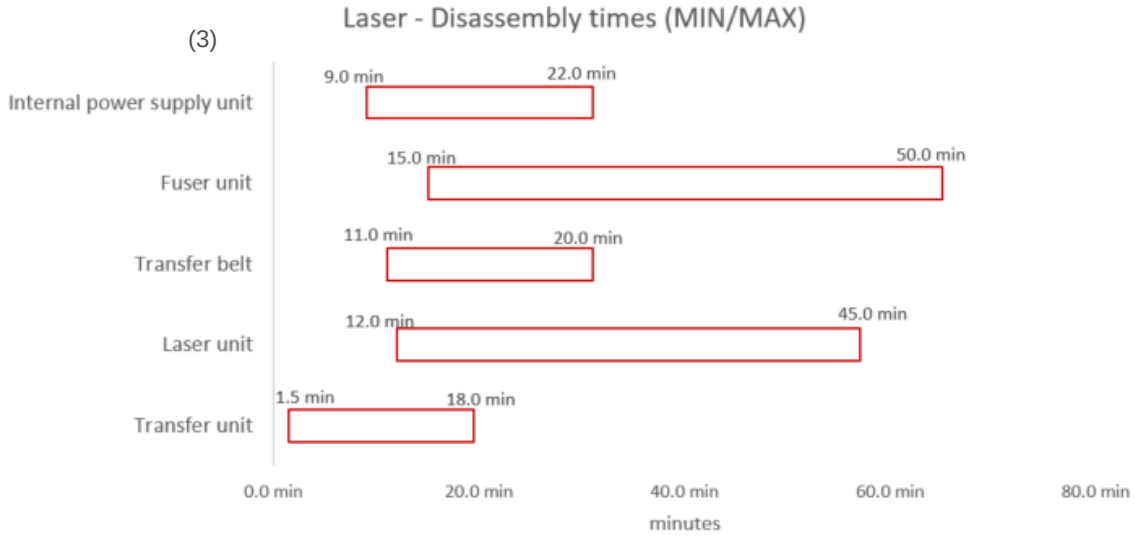
Domestic sector

- Priority parts in some printers have long disassembly times (1)

(2) Inkjet - Disassembly times (MIN/MAX)



(3) Laser - Disassembly times (MIN/MAX)



- Spare part provision and software/firmware updates are currently not guaranteed (1)

(1) Ritthoff et al (2023). Methods and standards for assessing the reparability of electrical and electronic devices
(2) Based on Table 35 of Preparatory Study
(3) Based on Table 36 of Preparatory Study

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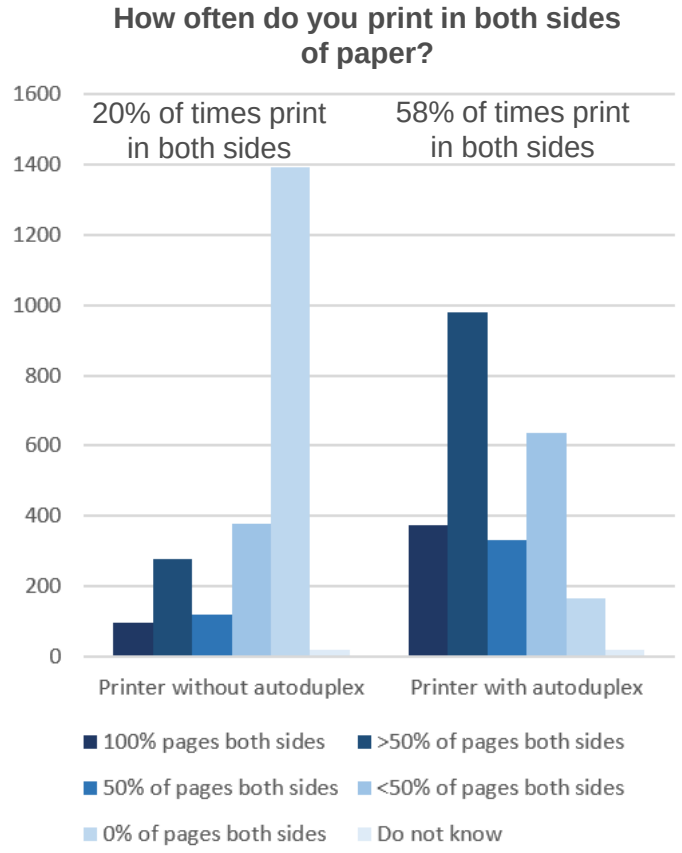
Paper use

Paper use

- Autoduplex function: the printer can automatically print on both sides of paper
- The percentage of users printing in both sides of paper increases when the printer has Autoduplex function (1)



(1) Data provided by consumer organisation in NL

Post-consumer recycled plastic

Post-consumer recycled plastic

- Studies highlight that PCR content plastic in devices has environmental benefits over the use of virgin materials, due to reductions in **raw materials** and **product manufacturing** (1) (2)

(1) Meyer et al (2016). Analysing the environmental impacts of laptop enclosures using screening-level life cycle assessment to support sustainable consumer electronics
(2) Karvinen (2015). Life cycle assessment and technical performance of recycled and bio-based plastics.

Key learnings - Cartridges

Tasks 1 - 4

Which are the main issues in the imaging equipment sector?

Which should be the main objectives of an ecodesign regulation?

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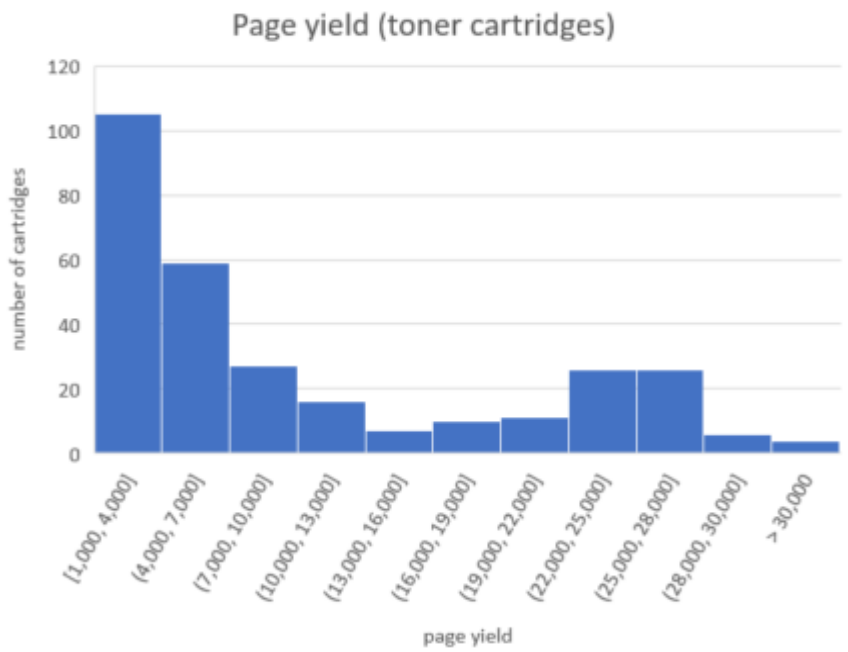
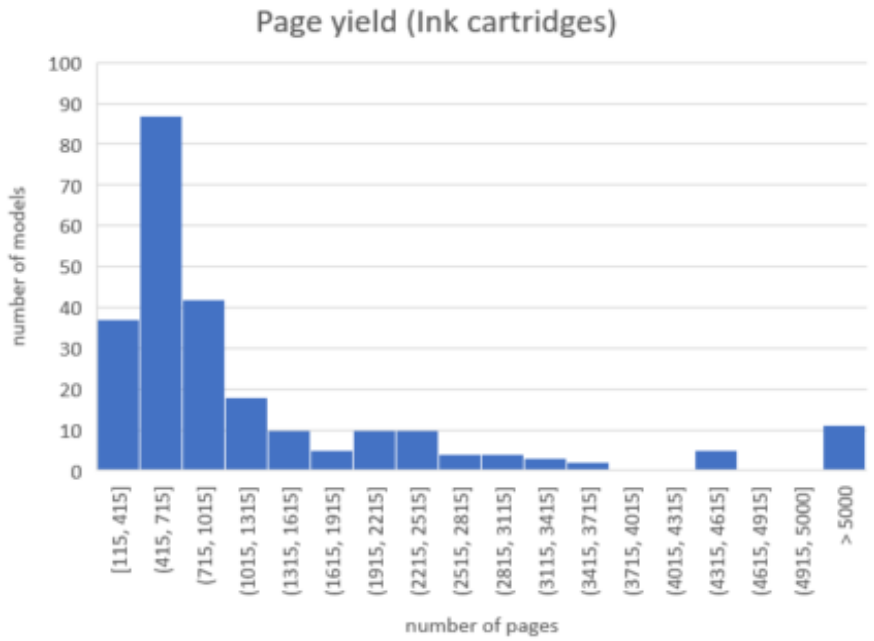
Page yield

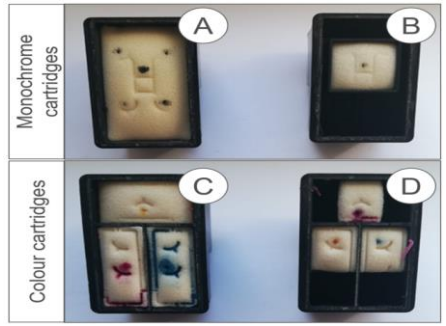
Cartridge page yield

- Ink and toner cartridges in the market are biased towards low page yield (1)





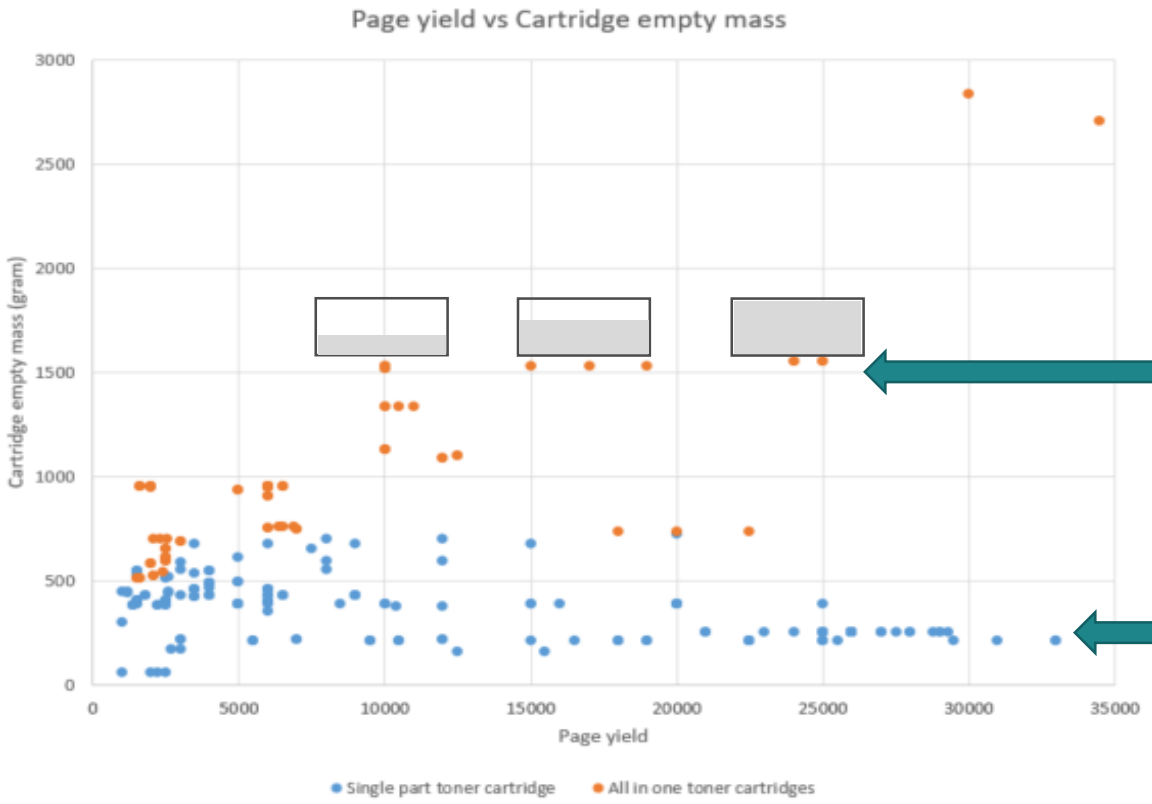
- Examples of cartridges with low page yield: Starter cartridges and cartridges with internal compartments



(1) Data provided by ETIRA

Cartridge page yield

- Cartridges are often not filled up to their optimal capacity (1)



Same mass, different yield

Same mass, different yield

(1) Data provided by ETIRA

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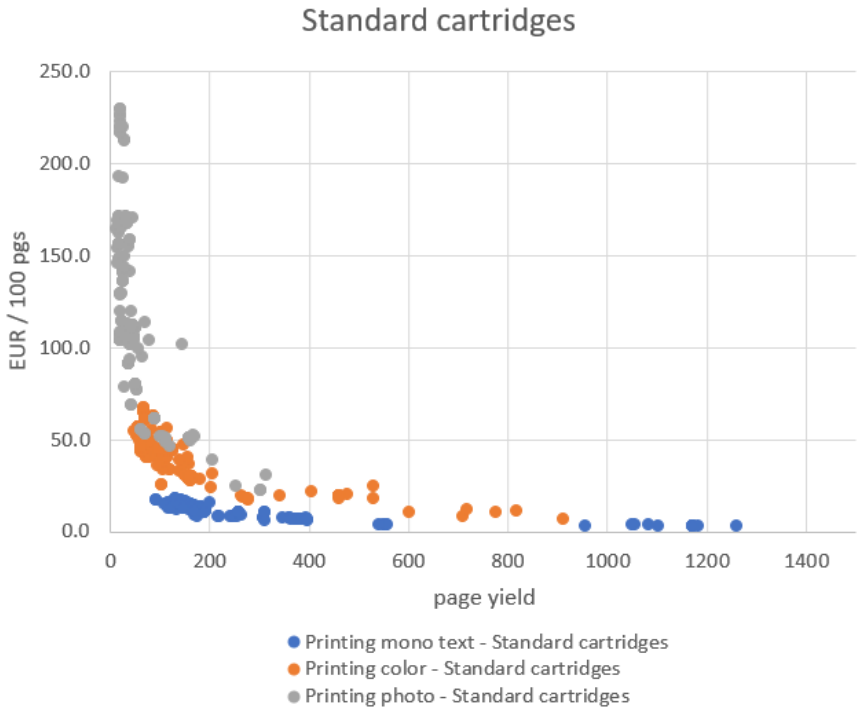
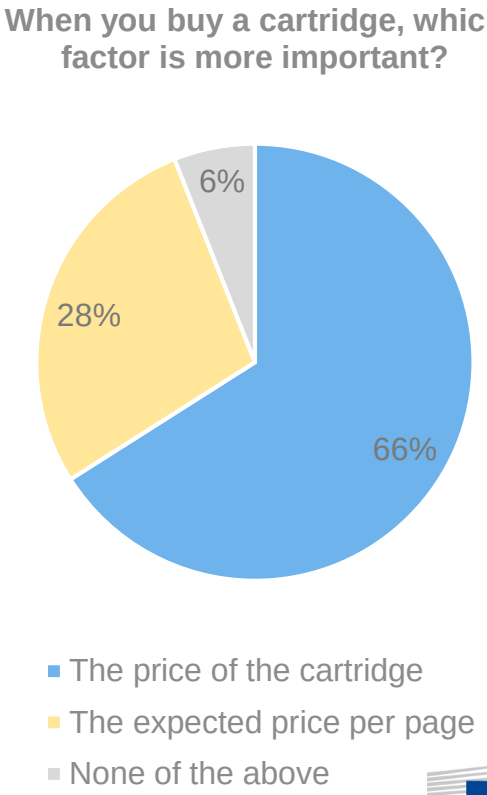
Cartridge page yield and cost

- It is more expensive to print with low yield cartridges, in cost per page (1)



- Consumers give more importance to the price of the cartridge, rather than the cost per page (2)



(1) Data provided by consumer organisation in NL
(2) User behaviour survey Task 3

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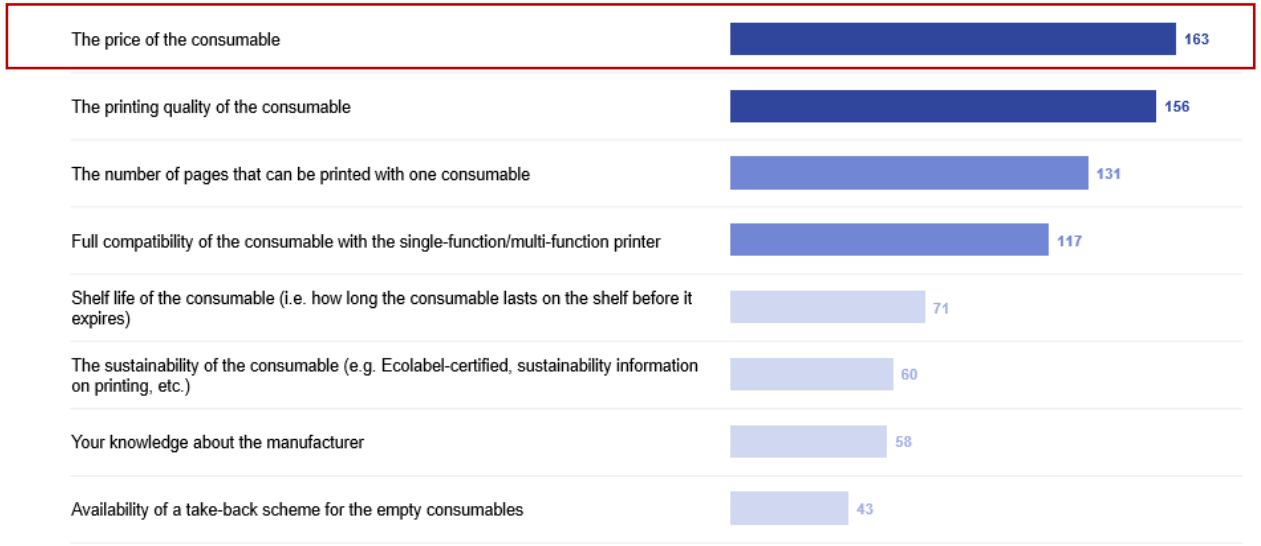
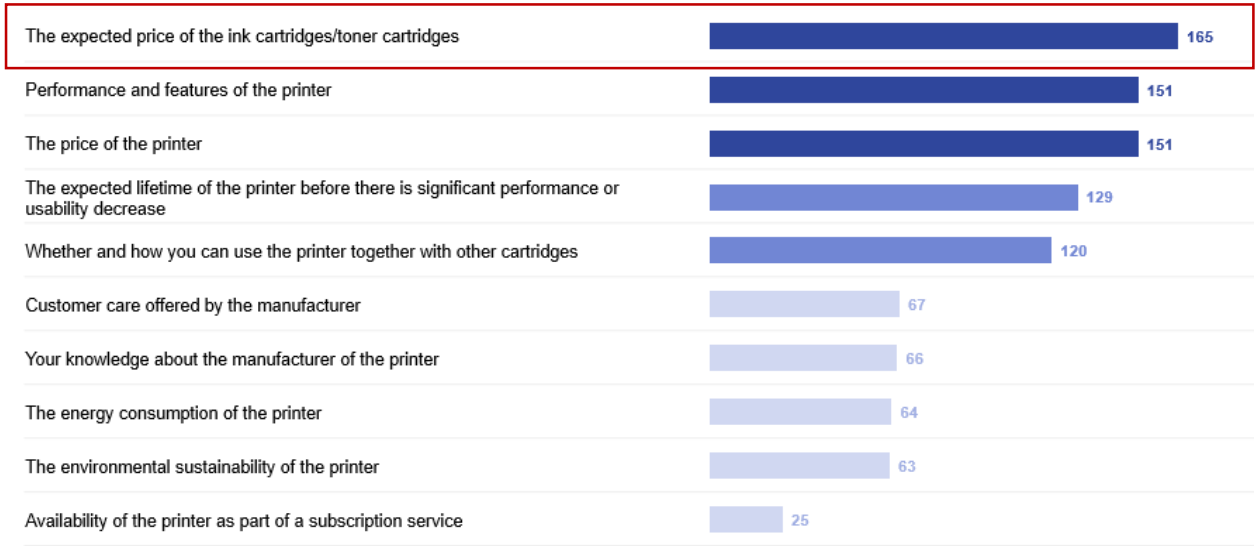
Cartridge page yield and cost

- Cost of consumables is the most relevant factor when buying a **cartridge** and a **printer** (1)

Importance of factors when buying a cartridge



Importance of factors when buying a printer



(1) User behaviour survey Task 3

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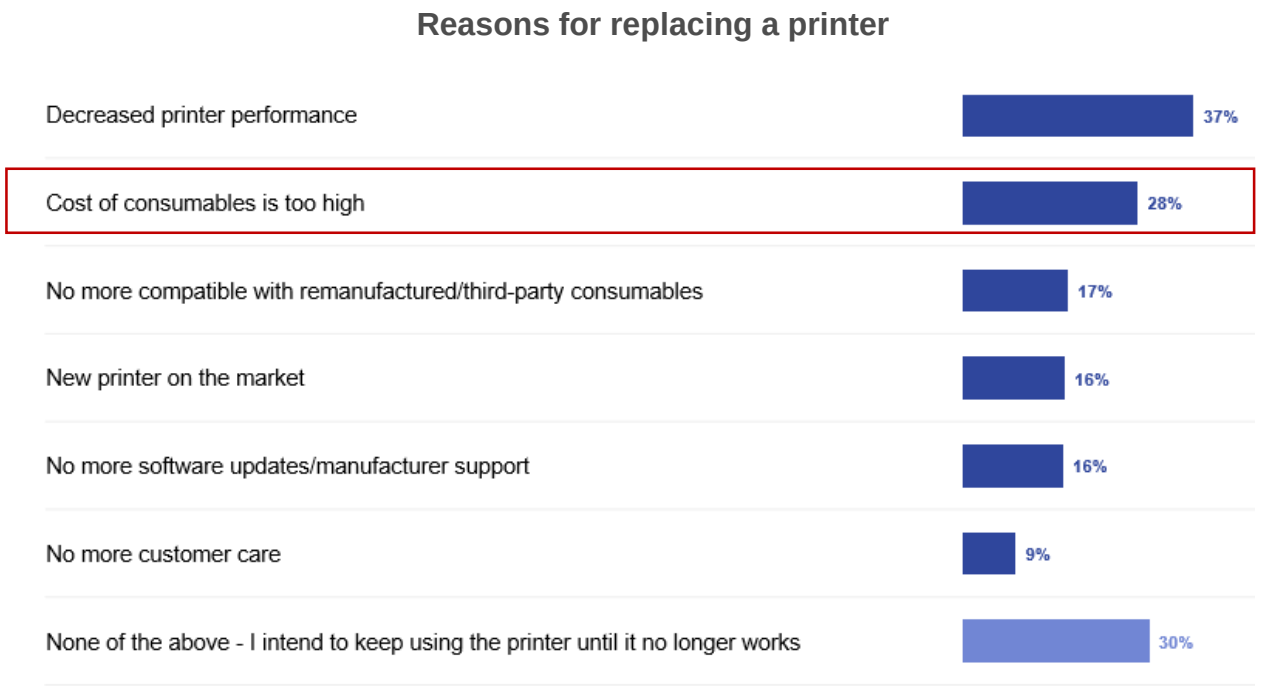
Cartridge page yield and cost

- Cost of the cartridge is the 2nd most relevant factor to replace a printer (1)

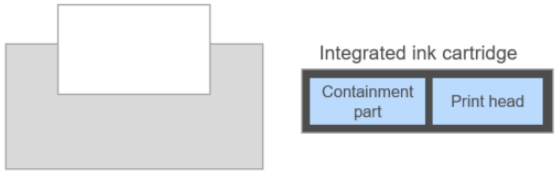
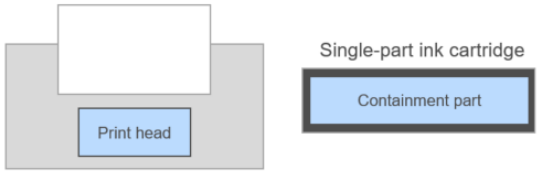


(1) User behaviour survey Task 3

Material efficiency

Cartridge material efficiency

$$Material\ efficiency = \frac{Page\ yield}{Mass\ of\ cartridge\ (empty)}$$

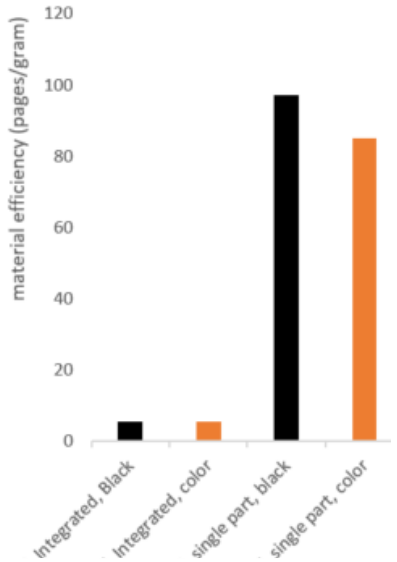
Cartridge configurations	Ink	Toner
Integrated All-in-one		
Single-part		

Cartridge material efficiency

- Single-part toner cartridges are more material efficient than all-in-one

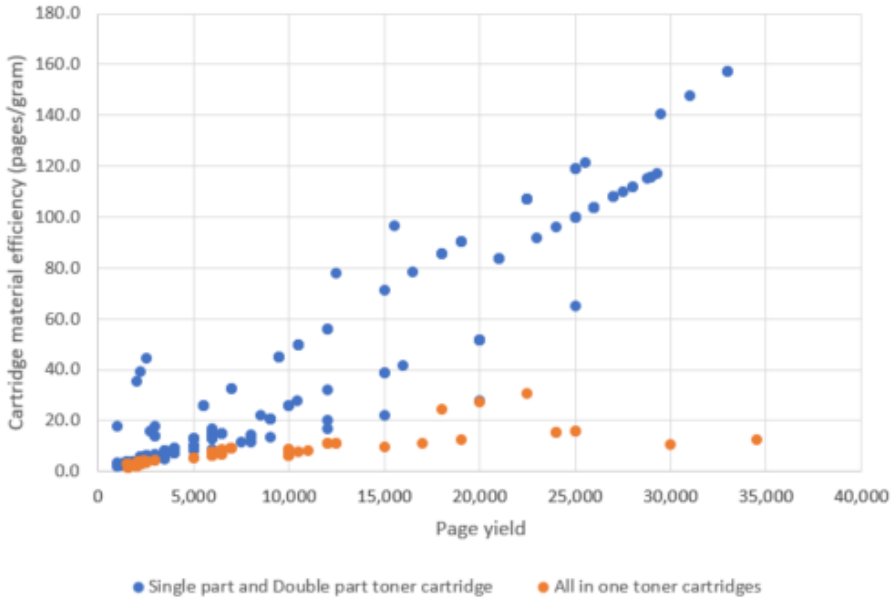
Keypoint Intelligence laboratory analysis (2023)

(1)



ETIRA database

(2)



(1) Feedback from Keypoint Intelligence
(2) Data provided by ETIRA

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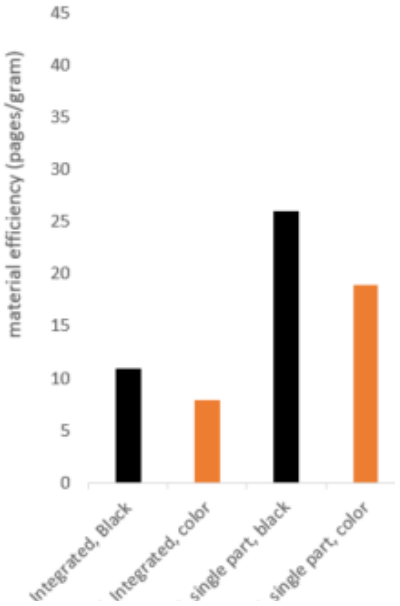
Cartridge material efficiency

- Single-part ink cartridges are more material efficient than integrated

Keypoint Intelligence laboratory analysis (2023)

(1)



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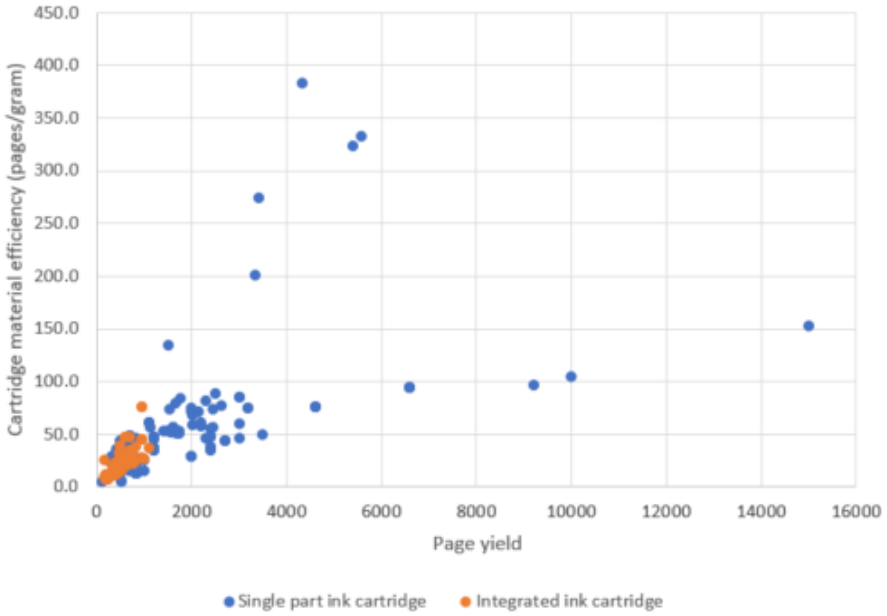

(1) Feedback from Keypoint Intelligence
(2) Data provided by ETIRA

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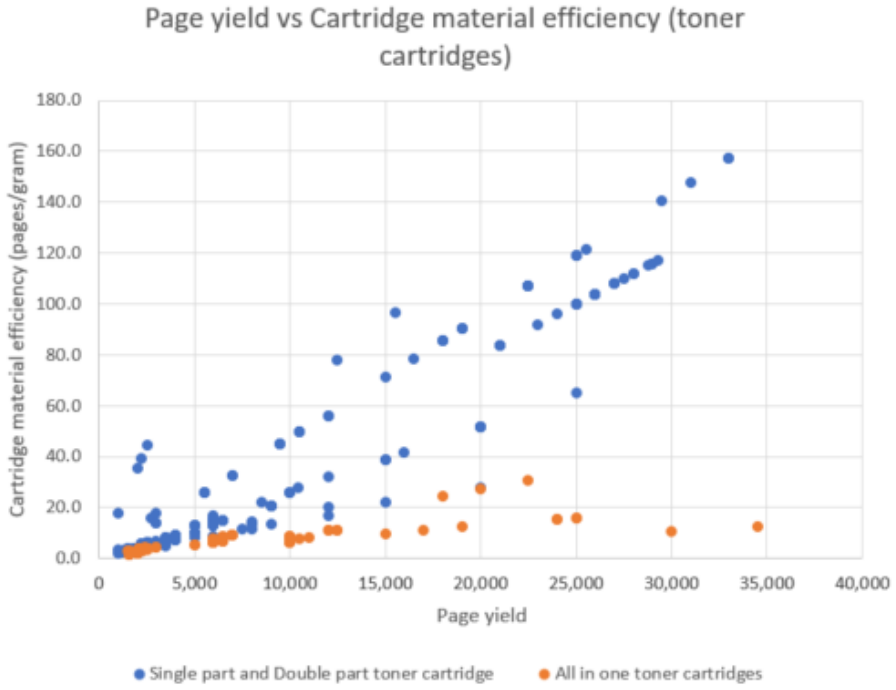
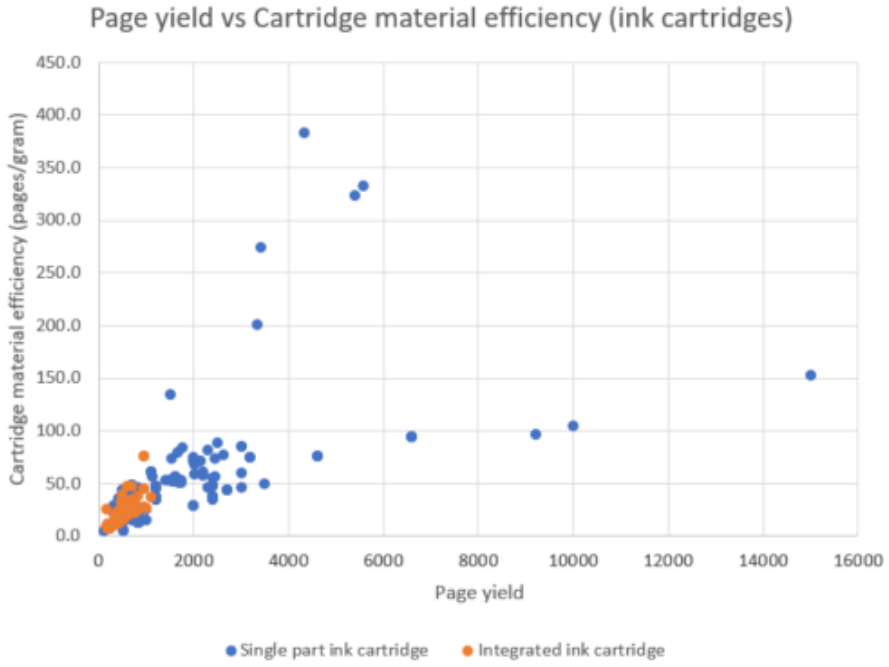
Cartridge material efficiency

- Material efficiency is correlated with page yield: higher yield cartridges tend to be more material efficient (1)





(1) Data provided by ETIRA

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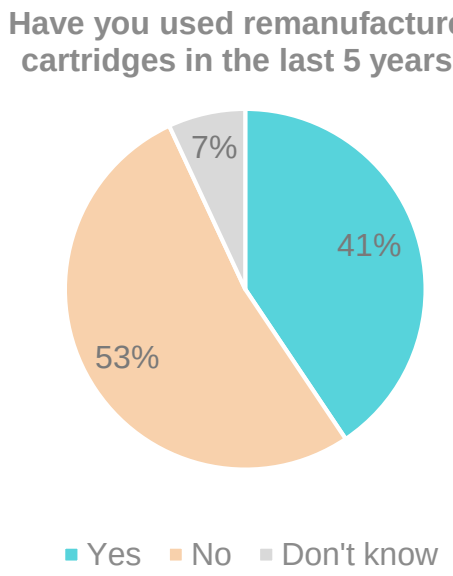
Cartridge reuse

Cartridge reuse

- 41% of consumers have used remanufactured cartridges (1)



- It is cheaper to print with remanufactured cartridges (2)

(1) User behaviour study Task 3
(2) Based on data from Huang et al (2019); Waugh et al (2018), ETIRA

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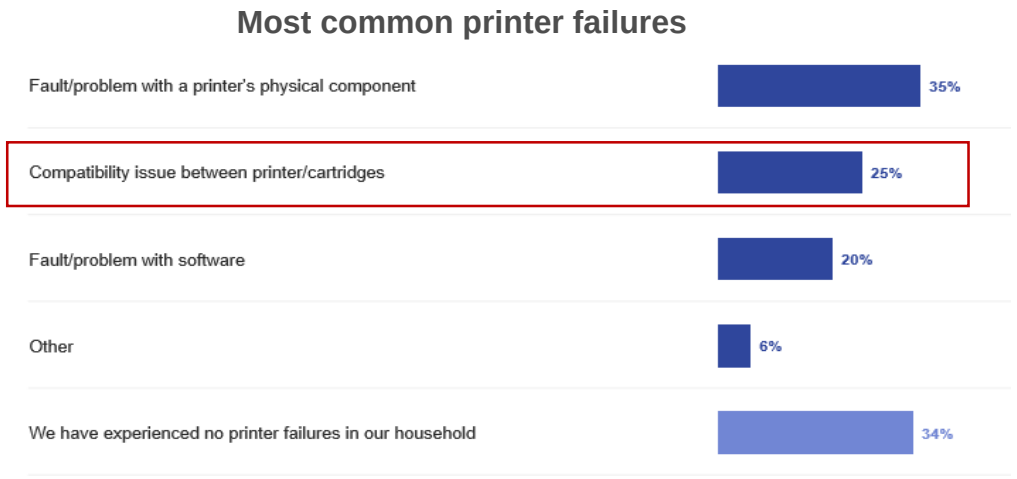
Cartridge reuse

- Low cartridge reuse rates around 10-25% (1) in contrast with high technical potential for reuse of 85-90% (2)
- Multiple design-related barriers prevent higher reuse rates (3)
  - a) Chips that cannot be reset by third party operators
  - b) Software and firmware updates blocking third party cartridges
  - c) Irreversible joining practices
  - d) Key components in areas not easily accessible
  - e) Superfluous design features
  - f) Fragile components in exposed areas
  - g) Fragile materials and non-durable design
  - h) OEM logos and badges
  - i) Low capacity cartridges
  - j) Lack of information on cartridge life condition
  - k) Lack of information on how to remanufacture

(1) Based on data from Huang et al, (2019); Waugh et al, (2018); ECOS (2022); Eurovaprint (2021)
(2) Waugh et al (2018)
(3) Feedback from cartridge remanufacturers and bibliography

Cartridge reuse

- Multiple design-related barriers prevent higher reuse rates
  - a) Chips that cannot be reset by third party operators
  - b) Software and firmware updates blocking third party cartridges



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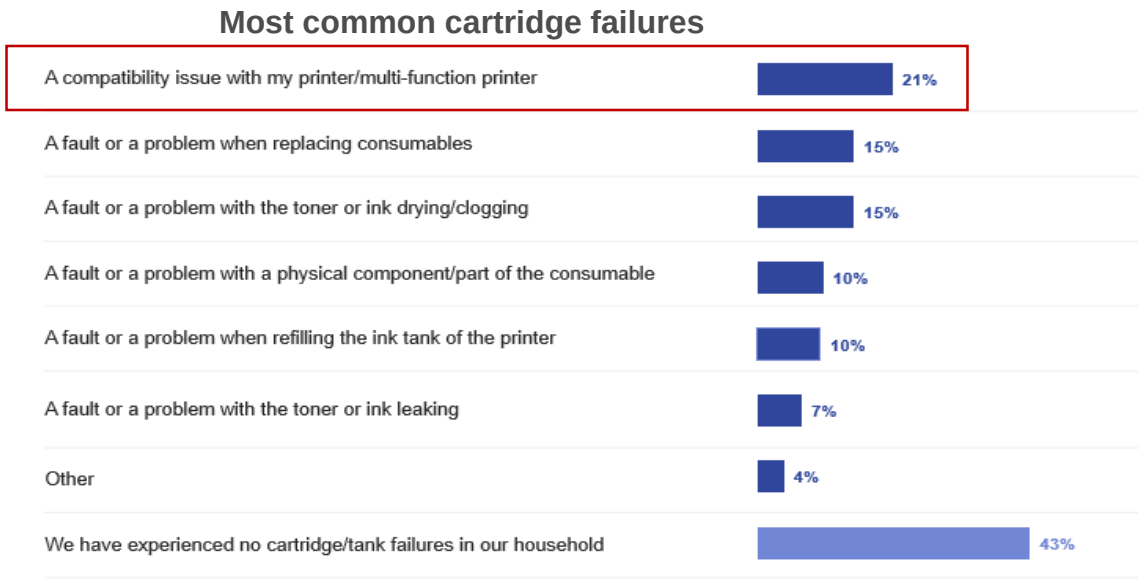

(1) User behaviour survey Task 3

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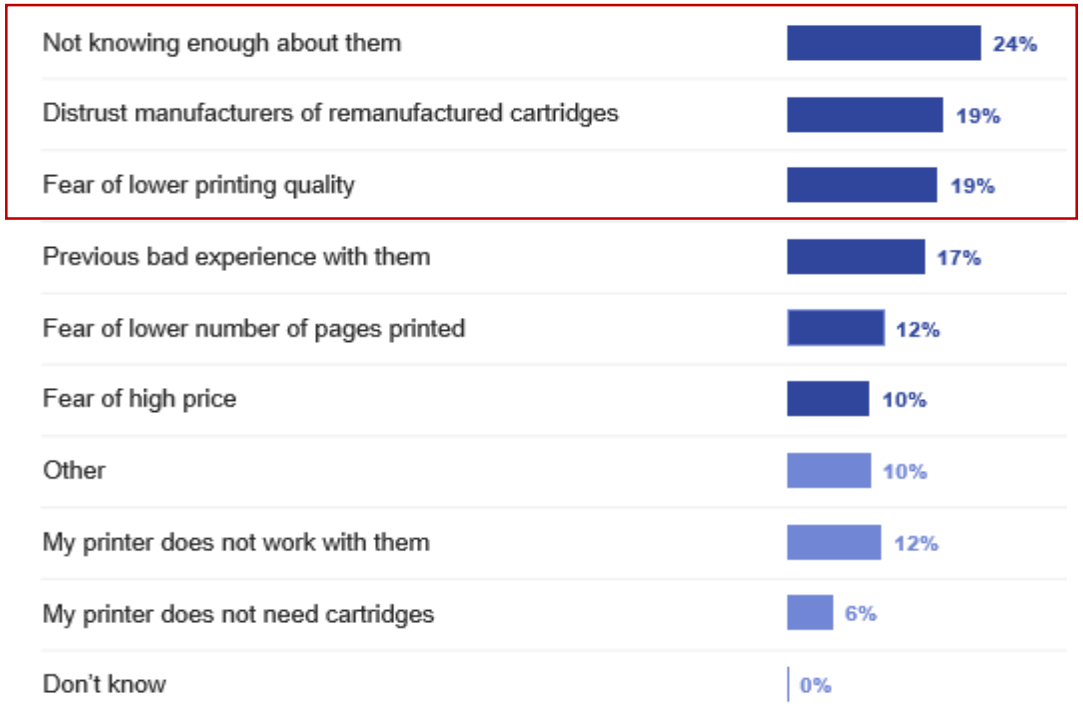
Cartridge print quality and paper waste

Cartridge print quality and paper waste

- 53% of consumers have not used remanufactured cartridges (1)
- Reasons for not using remanufactured cartridges are: lack of knowledge, distrust, fear of low performance

Reasons for not using remanufactured cartridges (1)



(1) User behaviour survey Task 3

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Cartridge print quality and paper waste

- Studies point out that some non-OEM cartridges have higher failure rates than OEM cartridges, contributing to the generation of paper waste (1) (2) (3) (4)

- DIN 33870-1 and DIN 33870-2 define the quality requirements for the remanufacturing process of toner cartridges and appropriate test methods

(1) Spencerlab (2016). Monochrome cartridge reliability comparison study.
(2) Keypoint Intelligence (2017). Original HP inkjet print cartridges vs Third party.
(3) Du et al (2023). Competition of consumables' original brand manufacturers and remanufacturers considering the entry of compatible manufacturers.
(4) Huang et al (2019). Revision of Voluntary Agreement of Imaging equipment.

Objectives of ecodesign measures

Which should be the main objectives of an ecodesign regulation?

Objectives of ecodesign measures for devices

Which should be the main objectives of an ecodesign regulation?

Objectives in Devices
1. Ensure that devices last longer and are easier to repair, refurbish and recycle
2. Explore untapped potential for improved energy savings in devices
3. Optimize the consumption of paper
4. Increase the amount of post-consumer recycled plastic in devices

Objectives in Cartridges
5. Improve capacity utilisation in cartridges
6. Encourage the use of material efficient cartridge configurations
7. Increase the possibilities to remanufacture a cartridge
8. Reduce the amount of paper wasted due to performance of cartridges

Key learnings

Feedback & Discussion

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Environmental and economic assessment

Tasks 5 - 6

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Environmental and economic assessment of Base Cases

Which are the environmental hotspots?

Which are the economic hotspots?

Life Cycle Assessment

Stages of a Life Cycle Assessment

Stage	Content
Goal and Scope	Definition of objective, scope, functional unit, system boundaries, impact categories
Inventory	Data collection
Life Cycle Impact Assessment	Translate inventory data to impacts on environment
Interpretation	Assessment of results

Scope

- Scope, devices: representative products in the imaging equipment market, for use in office and household

	Device Base Cases	Use	Description	Speed (ipm)
Small office A4	Device1	Small office	Laser A4 color	26
	Device2	Small office	Laser A4 mono	42
Large office A4	Device3	Large office	Laser A4 color	52
	Device4	Large office	Laser A4 mono	70
Large office A3	Device5	Large office	Laser A3 color	80
	Device6	Large office	Laser A3 mono	90
Household	Device7	Household	Inkjet A4 color	15

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Scope

- Scope, cartridges: representative products in the imaging equipment market, for use in office and household devices

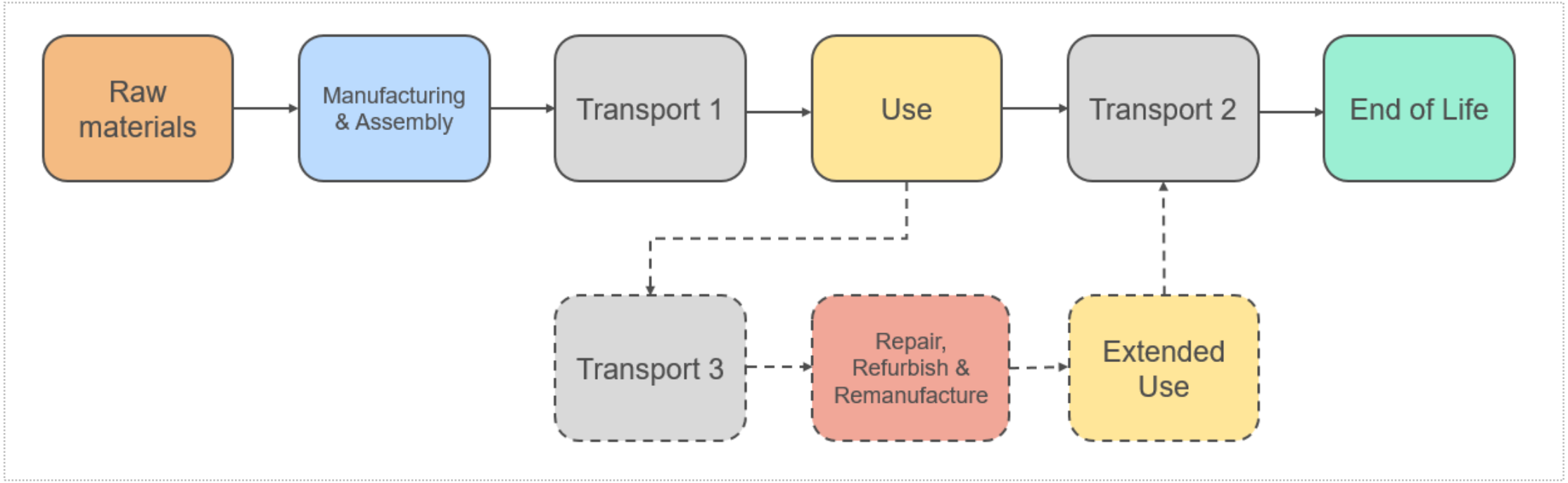
	Base Case	Description
Toner	Cartridge1	Toner cartridge for A4 device (all-in-one)
	Cartridge2	Toner cartridge for A3 device (all-in-one)
Ink	Cartridge3	Ink cartridge for A4 device (integrated)

Functional unit

- Functional Unit (FU): description of the performance of the product system, for use as a reference unit
- The FU is the baseline for comparing products with different characteristics
- It should allow comparing products with different performance for various aspects (mass, materials, energy, lifetime, etc.)

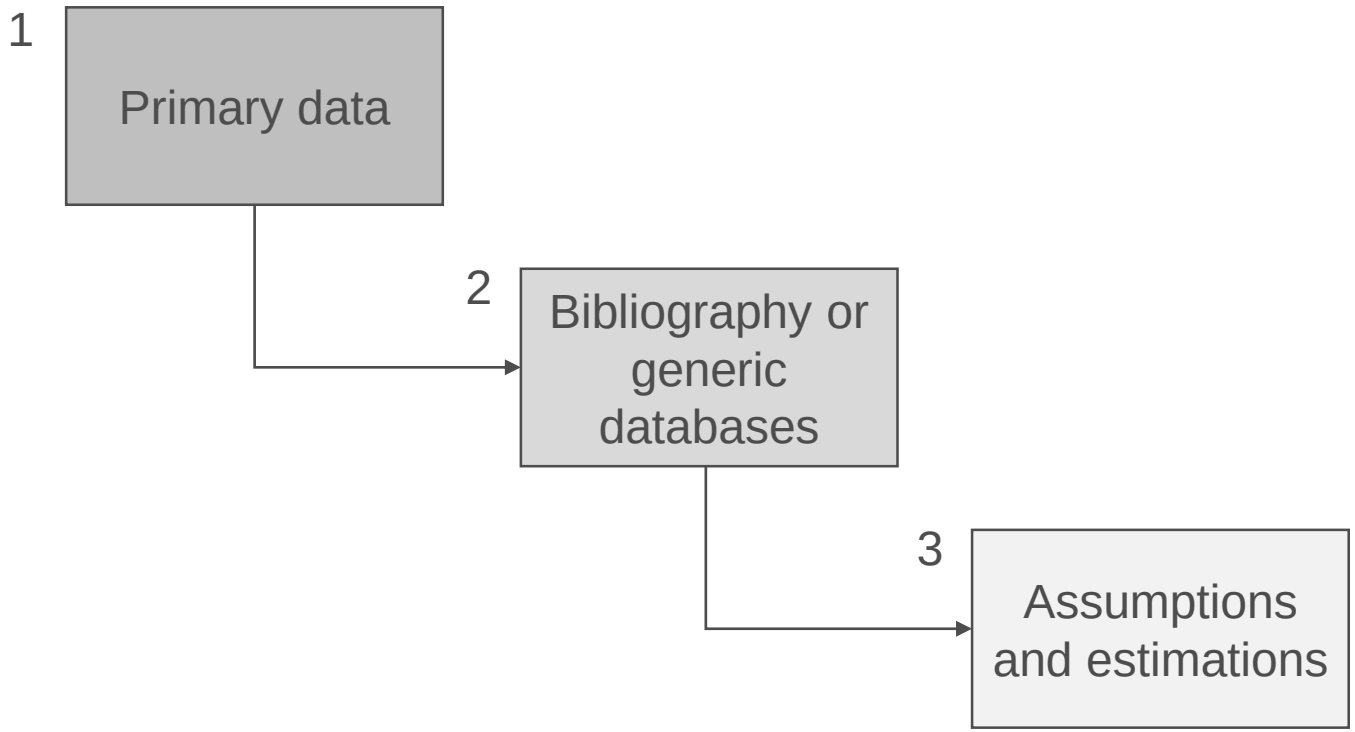
***FU**: The production of 1 printed page*

System boundaries



Inventory

- Collect data necessary to characterize the base cases, allowing the evaluation of improvement potential of different aspects



Inventory example: Device 7

	Material composition			Energy	Paper	Lifetime		Manufacturing and Refurbishing		Reparability		
	Mass (kg)	Bill of materials (%)	PCR plastic content (%)	TEC (kWh/year)	Frequency of printing both sides	Longevity (years)	Printed pages (number)	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Refurbish events (n)	Repair time (h)	Spare parts (%)
Device7	8.6	…	0%	1.76	20%	4.0	4,224	296	n/a	0	n/a	0%

	Transport (km)					End of Life		Cost				
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to repair centre	Place of use to EoL	Recycling (%)	Landfill (%)	Purchase price (EUR)	Transport cost (EUR/km)	Repair cost (EUR/h)	Energy cost (EUR/kWh)	Paper cost (EUR/pg)
Device7	300	12,000	300	100	20	50%	50%	160	0.10	30	0.25	0.01

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Inventory example: Cartridge 1

	Material composition		Capacity		Reuse		Manufacturing and Remanufacturing			Paper
	Mass (kg)	Bill of materials (%)	Page yield (pages)	Material efficiency (pages/gr)	Low / Medium /High	Reuse cycles	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Substituted components (%)	Failure rate (%)
Cartridge1	1.19	…	7500	6.3	Low	0	10.7	n/a	0%	2%

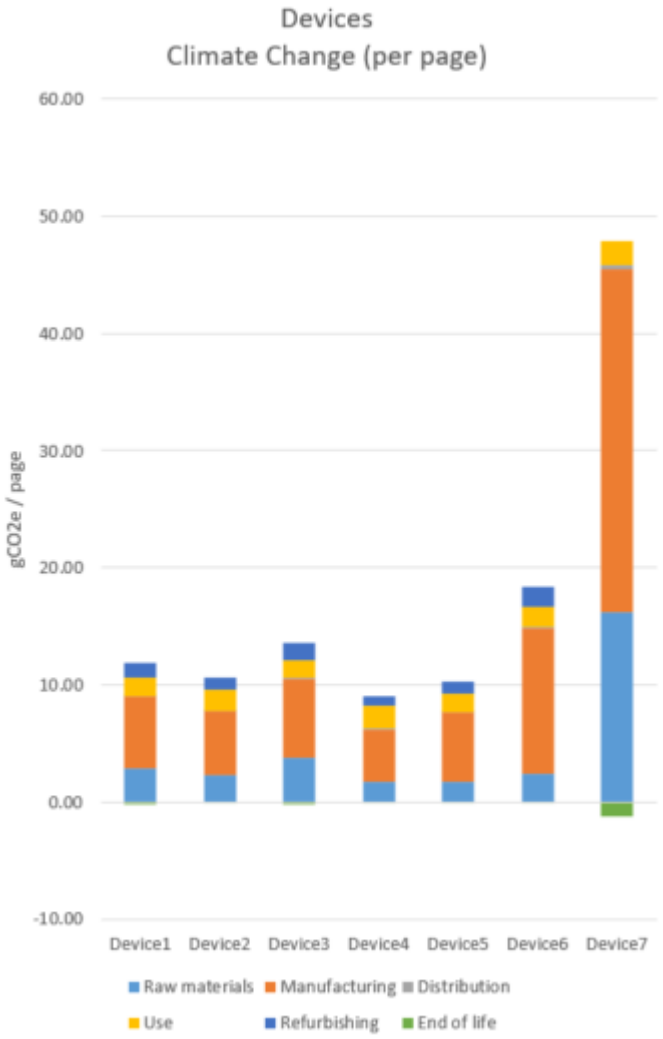
	Transport (km)					End of Life		Cost		
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to reman centre	Place of use to EoL	Recycling (%)	Landfill (%)	Cost per page original (EUR)	Cost per page reman (EUR/pg)	Paper cost (EUR/pg)
Cartridge1	300	12,000	300	n/a	20	50%	50%	0.014	n/a	0.01

Impact categories and indicators

Impact categories	Unit of measure
Climate change, total	kg CO_2 eq
Ozone depletion	kg CFC-11 eq
Human toxicity, cancer	CTUh
Human toxicity, non-cancer	CTUh
Particulate matter	disease incidence
Ionising radiation, human health	kBq U_{235} eq
Photochemical ozone formation, human health	kg NMVOC eq
Acidification	mol H+ eq
Eutrophication, terrestrial	mol N eq
Eutrophication, freshwater	kg P eq
Eutrophication, marine	kg N eq
Ecotoxicity, freshwater	CTUe
Land use	pt
Water use	m^3 water eq. of deprived water
Resource use, minerals and metals	kg Sb eq
Resource use, fossils	MJ
Primary energy consumption	MJ

Life cycle impact assessment - Devices

Which are the environmental hotspots?



- Raw materials and product manufacturing are the environmental hotspots for devices
- Use and Refurbishing have a smaller contribution to the total impact
- Distribution and End of life have a negligible contribution to the impact
- Household inkjet A4 color is the BC with the highest impact.
- Large office laser A4 monochrome is the BC with the lowest impact.

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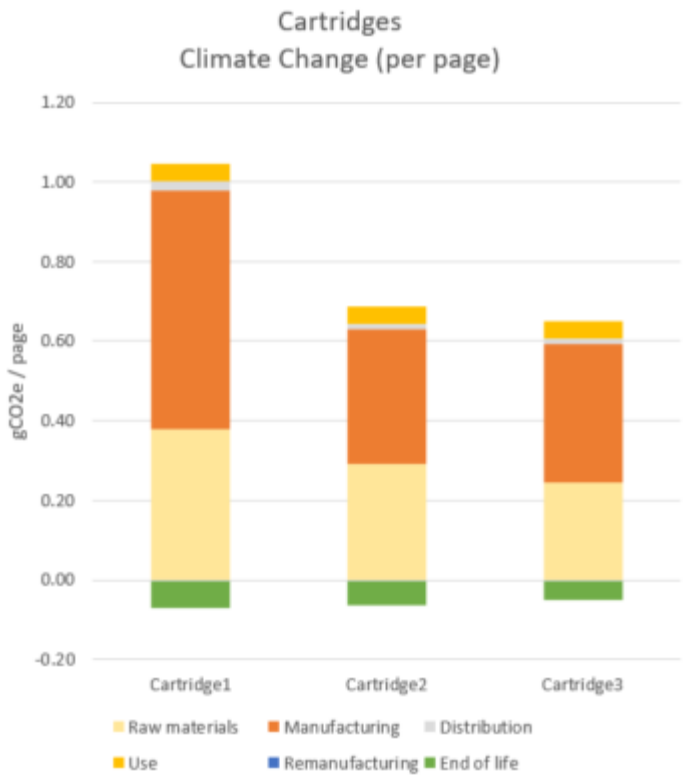
Life cycle impact assessment - Cartridges

Which are the environmental hotspots?



- Raw materials and product manufacturing are the environmental hotspots for cartridges
- Use and End of life have a smaller contribution to the total impact
- Distribution has a negligible contribution to the impact
- Toner cartridge A4 is the BC with the highest impact.
- Ink cartridge A4 is the BC with the lowest impact.

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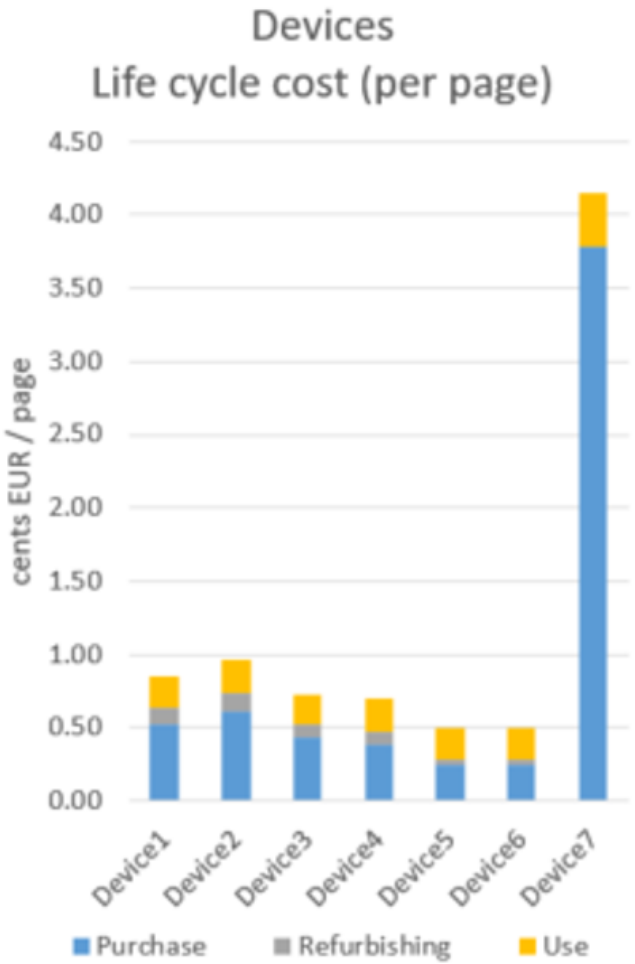
Life cycle costing - Devices

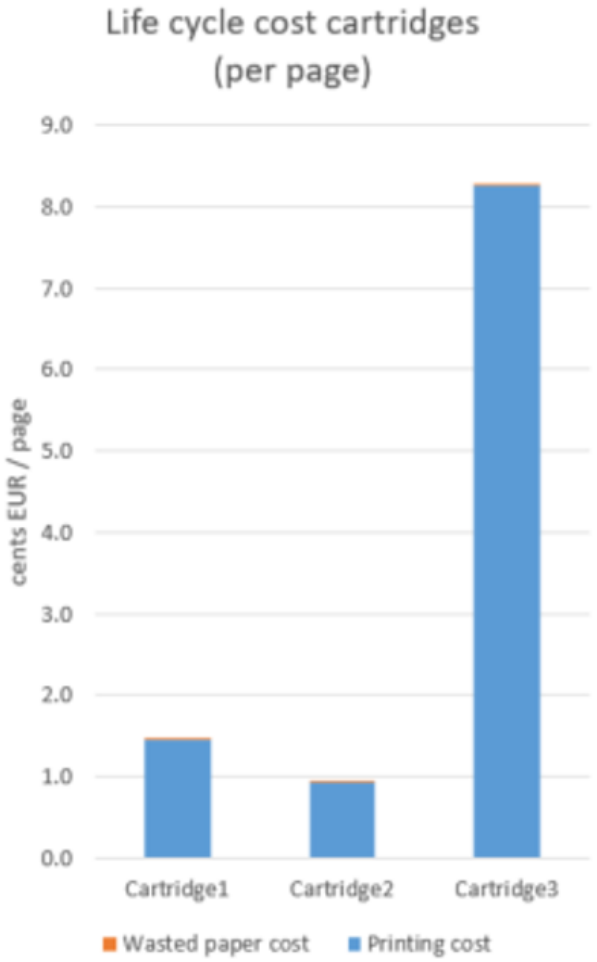
Which are the economic hotspots?



- In Devices printing less pages in lifetime, Purchase price is the most relevant factor in the life cycle costing of devices.
- In Devices printing a higher number of pages, Purchase price has a similar relevance with Use
- Household inkjet A4 color is the BC with the highest cost.
- Large office laser A3 color is the BC with the lowest cost.

Life cycle costing - Cartridges

Which are the economic hotspots?



- Printing cost has the highest contribution to the overall cost of cartridges
- Ink cartridge, A4 integrated is the BC with the highest cost.
- Large office laser A3 color is the BC with the lowest cost.

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Environmental and economic assessment of Design Options

What is the improvement potential?

Which areas should ecodesign regulation be focused on?

Design Options for Devices

What is the improvement potential?

Objectives	Design Options
1. Ensure that devices last longer and are easier to repair, refurbish and recycle	**Device 1.1 to Device 7.1** Device with extended lifetime
2. Explore untapped potential for improved energy savings in devices	**Device 1.2 to Device 7.2** Device with reduced energy consumption
3. Optimize the consumption of paper	**Device 7.3** Device with reduced paper consumption
4. Increase the amount of post-consumer recycled plastic in devices	**Device 1.4 to Device 7.4** Device with increased use of post-consumer recycled plastic

= to Base cases, with changes in specific parameters

Device with extended lifetime

	Material composition			Energy	Paper	Lifetime		Manufacturing and Refurbishing		Reparability		
	Mass (kg)	Bill of materials (%)	PCR plastic content (%)	TEC (kWh/year)	Frequency of printing both sides	Longevity (years)	Printed pages (number)	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Refurbish events (n)	Repair time (h)	Spare parts (%)
Device7	8.6	…	0%	1.76	20%	4.0	4,224	296	n/a	0	n/a	0%
Device7.1	9.4	=	=	=	=	6.0	6,336	326	33	1	2	20%

	Transport (km)					End of Life		Cost				
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to repair centre	Place of use to EoL	Recycling (%)	Landfill (%)	Purchase price (EUR)	Transport cost (EUR/km)	Repair cost (EUR/h)	Energy cost (EUR/kWh)	Paper cost (EUR/pg)
Device7	300	12,000	300	50	20	50%	50%	160	0.10	30	0.25	0.01
Device7.1	=	=	=	25	20	75%	25%	176	=	24	=	=

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Device with reduced energy consumption

	Material composition			Energy	Paper	Lifetime		Manufacturing and Refurbishing		Reparability		
	Mass (kg)	Bill of materials (%)	PCR plastic content (%)	TEC (kWh/year)	Frequency of printing both sides	Longevity (years)	Printed pages (number)	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Refurbish events (n)	Repair time (h)	Spare parts (%)
Device7	8.6	…	0%	1.76	20%	4.0	4,224	296	n/a	0	n/a	0%
Device7.2	=	=	=	1.41	=	=	=	=	=	=	=	=

	Transport (km)					End of Life		Cost				
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to repair centre	Place of use to EoL	Recycling (%)	Landfill (%)	Purchase price (EUR)	Transport cost (EUR/km)	Repair cost (EUR/h)	Energy cost (EUR/kWh)	Paper cost (EUR/pg)
Device7	300	12,000	300	50	20	50%	50%	160	0.10	30	0.25	0.01
Device7.2	=	=	=	=	=	=	=	=	=	=	=	=

Device with reduced paper consumption

	Material composition			Energy	Paper	Lifetime		Manufacturing and Refurbishing		Reparability		
	Mass (kg)	Bill of materials (%)	PCR plastic content (%)	TEC (kWh/year)	Frequency of printing both sides	Longevity (years)	Printed pages (number)	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Refurbish events (n)	Repair time (h)	Spare parts (%)
Device7	8.6	…	0%	1.76	20%	4.0	4,224	296	n/a	0	n/a	0%
Device7.3	=	=	=	=	58%	=	=	=	=	=	=	=

	Transport (km)					End of Life		Cost				
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to repair centre	Place of use to EoL	Recycling (%)	Landfill (%)	Purchase price (EUR)	Transport cost (EUR/km)	Repair cost (EUR/h)	Energy cost (EUR/kWh)	Paper cost (EUR/pg)
Device7	300	12,000	300	50	20	50%	50%	160	0.10	30	0.25	0.01
Device7.3	=	=	=	=	=	=	=	=	=	=	=	=

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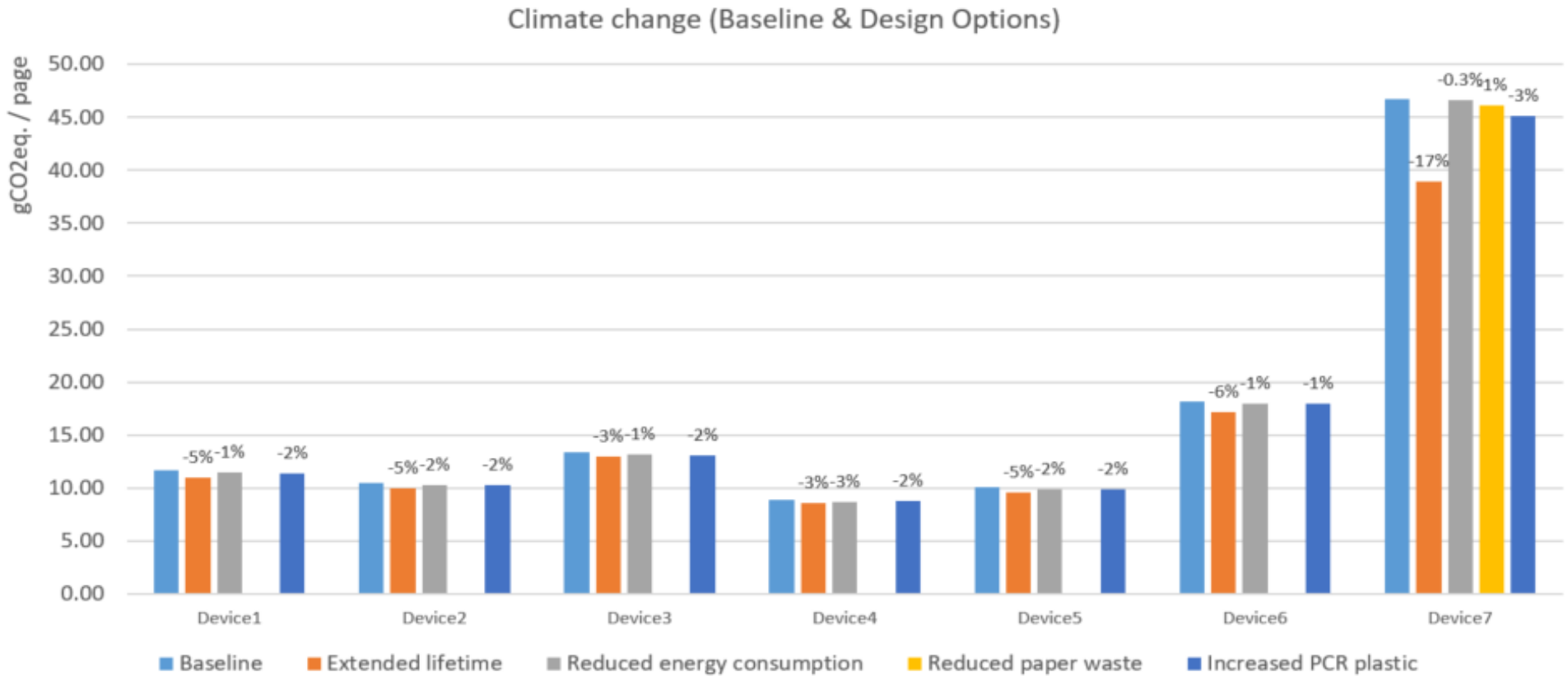
Device with increased PCR plastic content

	Material composition			Energy	Paper	Lifetime		Manufacturing and Refurbishing		Reparability		
	Mass (kg)	Bill of materials (%)	PCR plastic content (%)	TEC (kWh/year)	Frequency of printing both sides	Longevity (years)	Printed pages (number)	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Refurbish events (n)	Repair time (h)	Spare parts (%)
Device7	8.6	…	0%	1.76	20%	4.0	4,224	296	n/a	0	n/a	0%
Device7.4	=	=	75%	=	=	=	=	=	=	=	=	=

	Transport (km)					End of Life		Cost				
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to repair centre	Place of use to EoL	Recycling (%)	Landfill (%)	Purchase price (EUR)	Transport cost (EUR/km)	Repair cost (EUR/h)	Energy cost (EUR/kWh)	Paper cost (EUR/pg)
Device7	300	12,000	300	50	20	50%	50%	160	0.10	30	0.25	0.01
Device7.4	=	=	=	=	=	=	=	=	=	=	=	=

LCA of design options - Devices

What is the improvement potential?



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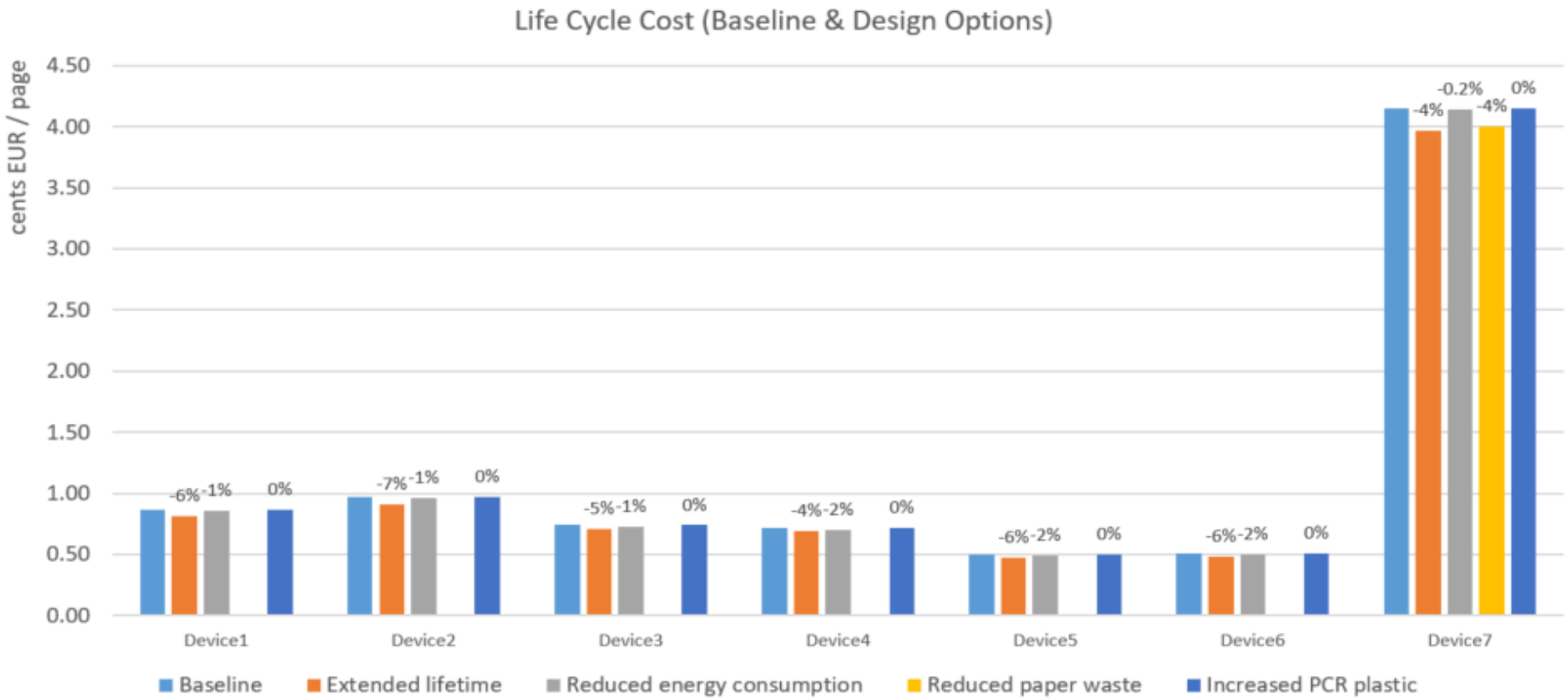
LCC of design options - Devices

What is the improvement potential?



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Design Options for Cartridges

What is the improvement potential?

Objectives	Design Options
5. Improve capacity utilisation in cartridges	**Cartridge 1.1 to Cartridge 3.1** Cartridge with improved capacity utilisation
6. Encourage the use of material efficient cartridge configurations	**Cartridge 1.2 to Cartridge 3.2** Cartridge with improved material efficiency configuration
7. Increase the possibilities to remanufacture a cartridge	**Cartridge 1.3 to Cartridge 3.3** Cartridge with enhanced remanufacturability
8. Reduce the amount of paper wasted due to performance of cartridges	**Cartridge 1.4 to Cartridge 3.4** Cartridge with reduced failure rate

= to Base cases, with changes in specific parameters

European Commission

Cartridge with improved capacity utilisation

	Material composition		Capacity		Reuse		Manufacturing and Remanufacturing			Paper
	Mass (kg)	Bill of materials (%)	Page yield (pages)	Material efficiency (pages/gr)	Low / Medium /High	Reuse cycles	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Substituted componetns (%)	Failure rate (%)
Cartridge1	1.19	…	7500	6.3	Low	0	10.7	n/a	0%	2%
Cartridge1.1	=	=	9375	=	=	=	=	=	=	=

	Transport (km)					End of Life		Cost		
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to reman centre	Place of use to EoL	Recycling (%)	Landfill (%)	Cost per page original (EUR)	Cost per page reman (EUR/km)	Paper cost (EUR/pg)
Cartridge1	300	12,000	300	500	20	50%	50%	0.014	n/a	0.01
Cartridge1.1	=	=	=	=	=	=	=	0.013	=	=

Cartridge with enhanced remanufacturability

	Material composition		Capacity		Reuse		Manufacturing and Remanufacturing			Paper
	Mass (kg)	Bill of materials (%)	Page yield (pages)	Material efficiency (pages/gr)	Low / Medium /High	Reuse cycles	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Substituted components (%)	Failure rate (%)
Cartridge1	1.19	…	7500	6.3	Low	0	10.7	n/a	0%	2%
Cartridge1.2	1.25	=	15000	=	Medium	1	11.3	1.65	7%	=

	Transport (km)					End of Life		Cost		
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to reman centre	Place of use to EoL	Recycling (%)	Landfill (%)	Cost per page original (EUR)	Cost per page reman (EUR/pg)	Paper cost (EUR/pg)
Cartridge1	300	12,000	300	n/a	20	50%	50%	0.014	n/a	0.01
Cartridge1.2	=	=	=	300	=	75%	25%	0.014	0.009	=

Cartridge with improved material efficient configuration

	Material composition		Capacity		Reuse		Manufacturing and Remanufacturing			Paper
	Mass (kg)	Bill of materials (%)	Page yield (pages)	Material efficiency (pages/gr)	Low / Medium /High	Reuse cycles	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Substituted componetns (%)	Failure rate (%)
Cartridge1	1.19	…	7500	6.3	Low	0	10.7	n/a	0%	2%
Cartridge1.4	0.18	=	=	41.6	=	=	1.6	=	=	=

	Transport (km)					End of Life		Cost		
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to reman centre	Place of use to EoL	Recycling (%)	Landfill (%)	Cost per page original (EUR)	Cost per page reman (EUR/km)	Paper cost (EUR/pg)
Cartridge1	300	12,000	300	500	20	50%	50%	0.014	n/a	0.01
Cartridge1.4	=	=	=	=	=	=	=	=	=	=

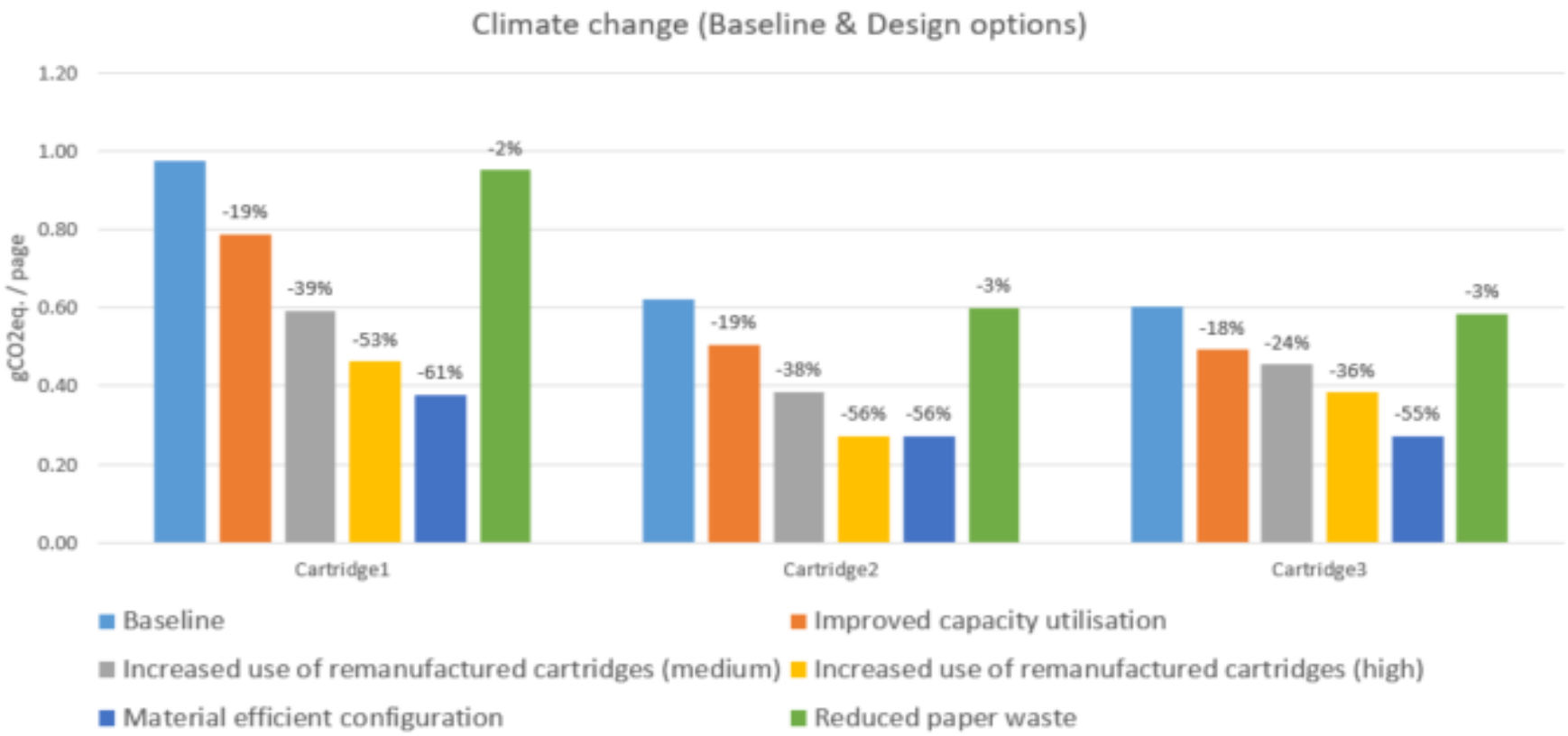
Cartridge with reduced paper waste

	Material composition		Capacity		Reuse		Manufacturing and Remanufacturing			Paper
	Mass (kg)	Bill of materials (%)	Page yield (pages)	Material efficiency (pages/gr)	Low / Medium /High	Reuse cycles	Manufacturing Energy (kWh/unit)	Refurbishing Energy (kWh/unit)	Substituted componetns (%)	Failure rate (%)
Cartridge1	1.19	…	7500	6.3	Low	0	10.7	n/a	0%	2%
Cartridge1.1	=	=	=	=	=	=	=	=	=	1%

	Transport (km)					End of Life		Cost		
	Manufacturing to shipping	Shipping to EU	EU to point of sale	Place of use to reman centre	Place of use to EoL	Recycling (%)	Landfill (%)	Cost per page original (EUR)	Cost per page reman (EUR/km)	Paper cost (EUR/pg)
Cartridge1	300	12,000	300	500	20	50%	50%	0.014	n/a	0.01
Cartridge1.1	=	=	=	=	=	=	=	=	=	=

LCA of design options - Cartridges

What is the improvement potential?



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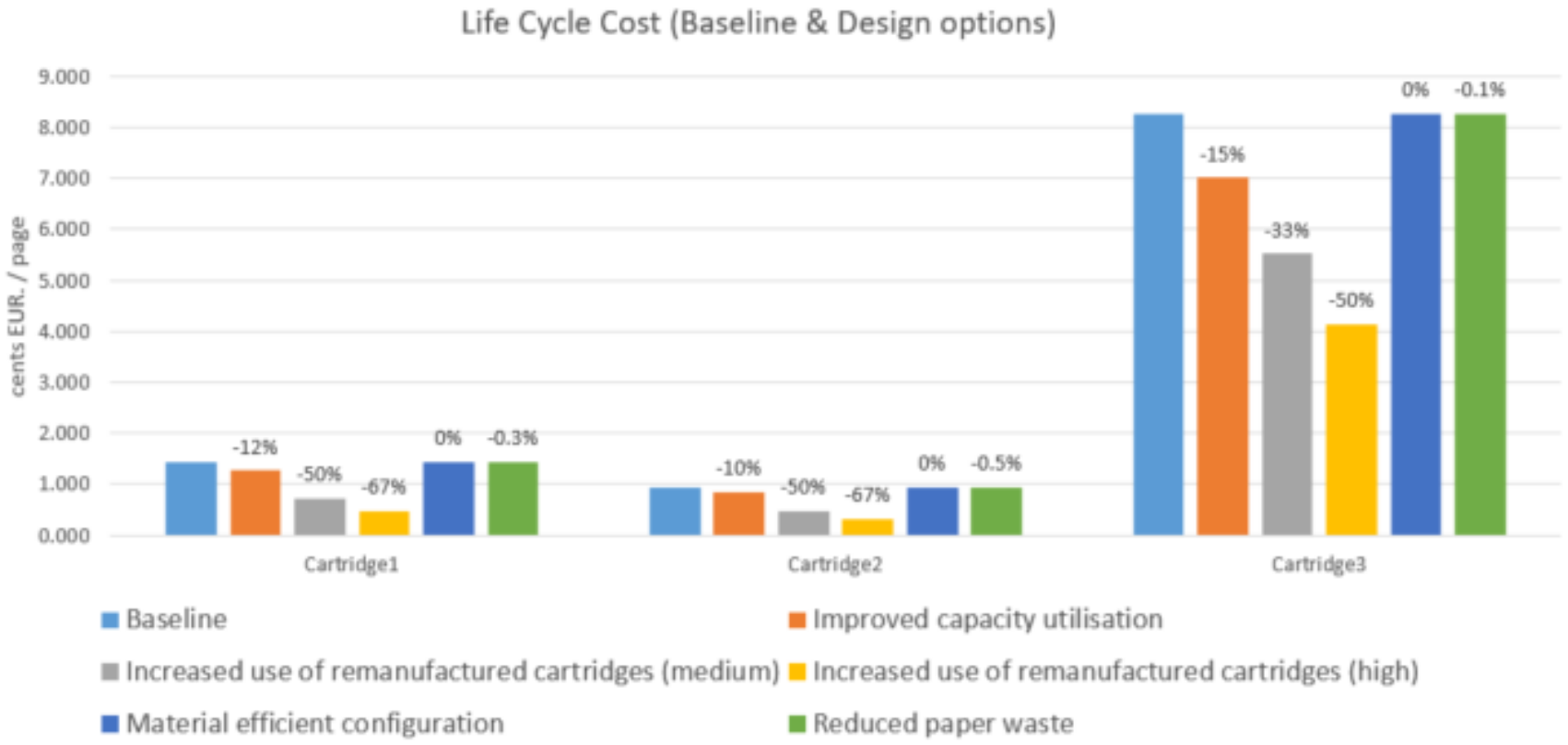
LCC of design options - Cartridges

What is the improvement potential?



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Devices

What is the improvement potential?

Which areas should ecodesign regulation be focused on?

Objectives	Design Options	Climate change improvement potential (gCO2eq./page)	Consumer expenditure improvement potential (cEUR/page)	Areas for measures
1. Ensure that devices last longer and are easier to repair, refurbish and recycle	Device with extended lifetime	0.3 – 7.8 **(3-17%)**	0.03 – 0.18 **(4-7%)**	Reparability
				Durability
				Recyclability
2. Explore untapped potential for improved energy savings in devices	Device with reduced energy consumption	0.14 - 0.25 (0-3%)	0.01 (0-2%)	Energy efficiency
3. Optimize the consumption of paper	Device with reduced paper consumption	0.65 (1%)	0.15 **(4%)**	Paper use
4. Increase the amount of post-consumer recycled plastic in devices	Device with increased use of post-consumer recycled plastic	0.15 - 1.6 (1-3%)	0 (0%)	PCR plastic

Cartridges

What is the improvement potential?

Which areas should ecodesign regulation be focused on?

Objectives	Design Options	Climate change improvement potential (gCO2eq./page)	Consumer expenditure improvement potential (cEUR/page)	Areas for measures
5. Improve capacity utilisation in cartridges	Cartridge with improved capacity utilisation	0.11 – 0.19 **(18-19%)**	0.09 – 1.26 **(10-15%)**	Capacity utilisation
6. Encourage the use of material efficient cartridge configurations	Cartridge with improved material efficiency configuration	0.33 – 0.60 **(55-61%)**	0 (0%)	Material efficiency
7. Increase the possibilities to remanufacture a cartridge	Cartridge with enhanced remanufacturability	0.15 – 0.51 **(24-56%)**	0.47 – 4.13 **(33-67%)**	Remanufacturability
8. Reduce the amount of paper wasted due to performance of cartridges	Cartridge with reduced failure rate	0.02 (2-3%)	0.005 (0.1-0.5%)	Paper use

Environmental & Economic assessment

Feedback & Discussion

European Commission

Policy options

Task 7

Which specific measures should an ecodesign regulation include?

What is the improvement potential at EU level?

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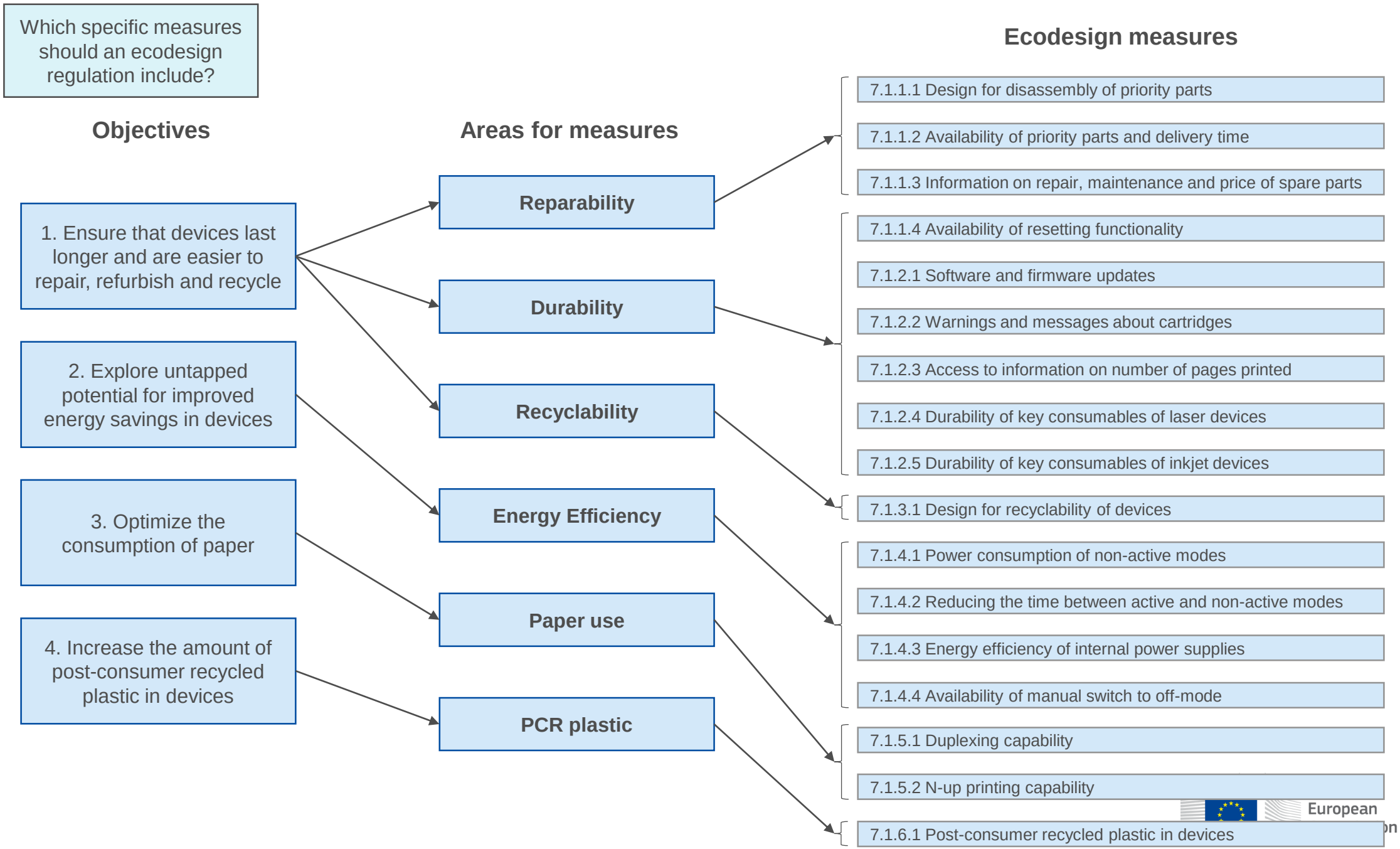
Ecodesign measures for devices

Which specific measures should an ecodesign regulation include?



Reparability

Area for measure	Measure	Purpose
Reparability	7.1.1.1 Design for disassembly of priority parts	Reducing disassembly times and cost of repair, ensuring that fasteners are removable and repair is carried out with commonly available tools, etc.
	7.1.1.2 Availability of priority parts and delivery time	Provide certainty that priority parts will be delivered within a reasonable timeframe, and that they will be available for a considerable amount of time of the printer lifetime.
	7.1.1.3 Availability of information on repair, maintenance and price of spare parts	Guarantee that relevant information on repair is provided to consumers/repairers, and that price of spare parts is reasonable.
	7.1.1.4 Availability of resetting functionality	Ensure that devices are not discarded because resetting functionality was not available.

Durability

Area for measure	Measure	Purpose
Durability	7.1.2.1 Software and firmware updates	Provide certainty that software and firmware updates will be available for consumers, and that they will be available for the for a considerable amount of time of the printer lifetime. Ensure that these updates will not change the device performance or prevent the use of 3rd party cartridges (barrier b)
	7.1.2.2 Warnings and messages about cartridges	Ensure that inflammatory messages about remanufactured cartridges are not delivered to consumers (barrier m)
	7.1.2.3 Access to information on number of pages printed	Ensure that any user can have access to the current lifetime status of the printer and compare it with its technical lifetime.
	7.1.2.4 Durability of key consumables of laser devices	Guarantee a minimum durability of key components of laser devices
	7.1.2.5 Durability of key consumables of inkjet devices	Guarantee a minimum durability of key components of inkjet devices

Recyclability

Area for measure	Measure	Purpose
Recyclability	7.1.3.1 Design for recyclability	Ensure that materials can be identified at end of life and that products will be designed to be easily dismantled, avoiding contamination of materials.

Energy

Area for measure	Measure	Purpose
Energy	7.1.4.1 Power consumption of non-active modes	Ensure that devices comply with ambitious thresholds for their non-active modes.
	7.1.4.2 Reducing time between active and non-active modes	Reduce the amount of time that devices spend in active modes.
	7.1.4.3 Efficiency of internal power supply units	Increase energy efficiency of devices by tackling a key component.
	7.1.4.4 Availability of manual switch to off-mode	Guarantee that devices can be manually switched off by the user.

Paper

Area for measure	Measure	Purpose
Paper	7.1.5.1 Availability of duplexing capability	Ensure that all devices in the market can print in both sides of paper.
	7.1.5.2 Availability of n-up printing capability	Ensure that all devices in the market can print more than one page in each sheet of paper.

Post-consumer recycled plastic

Area for measure	Measure	Purpose
Post-consumer recycled plastic	7.1.6.1 Post-consumer recycled plastic in devices	Gradually increase the amount of post-consumer recycled plastic used in devices.

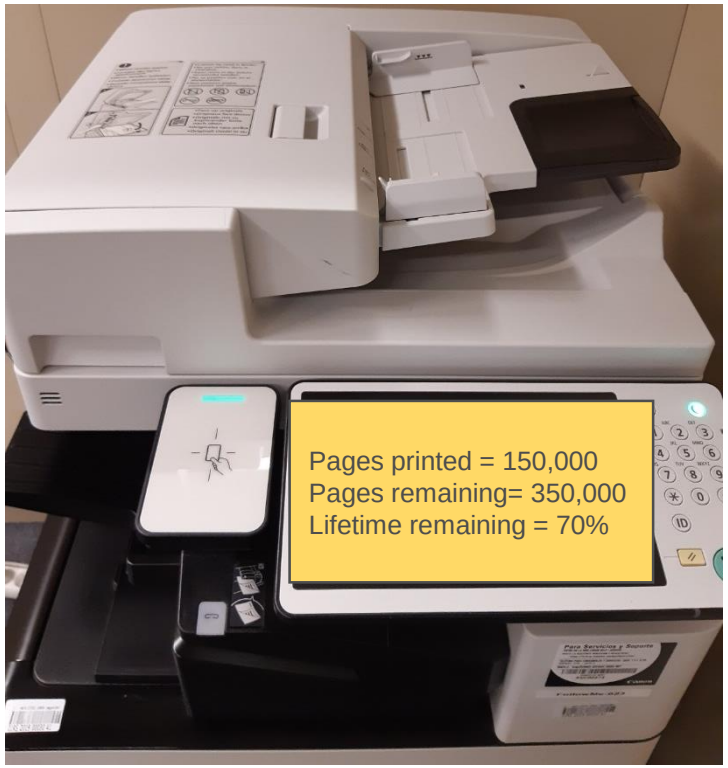
Ecodesign measures for devices (in detail)

7.1.2.1 Availability of software and firmware updates

Content of measure	*Updated software and firmware shall be provided for a minimum period of 10 years after the placing on the market of the last unit of a product model.* (…) *Software and firmware updates shall not prevent the refilling and remanufacturing of cartridges or the use of third party cartridges.*
Feedback from stakeholders	Should this measure be applicable to remanufactured cartridges and third party cartridges? Only to remanufactured cartridges?

7.1.2.3 Access to information on number of pages printed

Content of measure	*Devices shall have a function that provides information to the user to compare the number of pages printed versus the device duty cycle.*
Feedback from stakeholders	Can this measure help to reduce quick replacement rates of printers? How feasible is it from technical point of view?



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7.1.2.4 Durability of key consumables of laser devices

Table 108. Minimum durability of key consumables of laser devices

	Minimum number of pages			
	Fuser unit	Transfer unit	Waste toner unit	Drum unit
24 months after entry into force of this regulation	50,000	50,000	20,000	10,000
36 months after entry into force of this regulation	57,500	57,500	23,000	11,500
48 months after entry into force of this regulation	62,500	62,500	25,000	12,500

Feedback from stakeholders	Are thresholds well balanced? Are any key components missing?

7.1.2.5 Durability of key consumables of inkjet devices

Table 109. Minimum durability of key consumables of inkjet devices

	Minimum number of pages	
	Ink collection unit	Print head unit
24 months after entry into force of this regulation	10,000	10,000
36 months after entry into force of this regulation	11,500	11,500
48 months after entry into force of this regulation	12,500	12,500

Feedback from stakeholders	Are thresholds well balanced? Are any key components missing?

7.1.4.1 Power consumption of non-active modes

Operational mode	Conditions	Minimum requirement of Regulation 2023/826	Minimum requirements proposed (ecodesign for imaging equipment)
Standby mode	In any condition providing only a reactivation function, or providing only a reactivation function and an indication of reactivation function	<0.5W	**<0.3W**
	In any condition providing only information or status display, or providing only a combination of reactivation function and information or status display, or providing only a reactivation function and an indication of enabled reactivation and information or status display	<0.8W	**<0.4W**
Networked standby	HiNA equipment or equipment with HiNA functionality	<8W	**<4W**
	HiNA equipment or equipment with HiNA functionality, 2 years after application of Regulation	<7W	**<4W**
	Networked equipment other than HiNA equipment or equipment with HiNA functionality Not applicable to large format printing equipment	<2W	**<1W**
Off mode	Off mode	<0.5W	**<0.3W**
	Off mode, 2 years after application of Regulation	<0.3W	**<0.2W**

No equivalence in Energy Star

Sleep mode in Energy Star

Off mode in Energy Star

Feedback from stakeholders	Are thresholds well balanced? How feasible is it from technical point of view?

European Commission

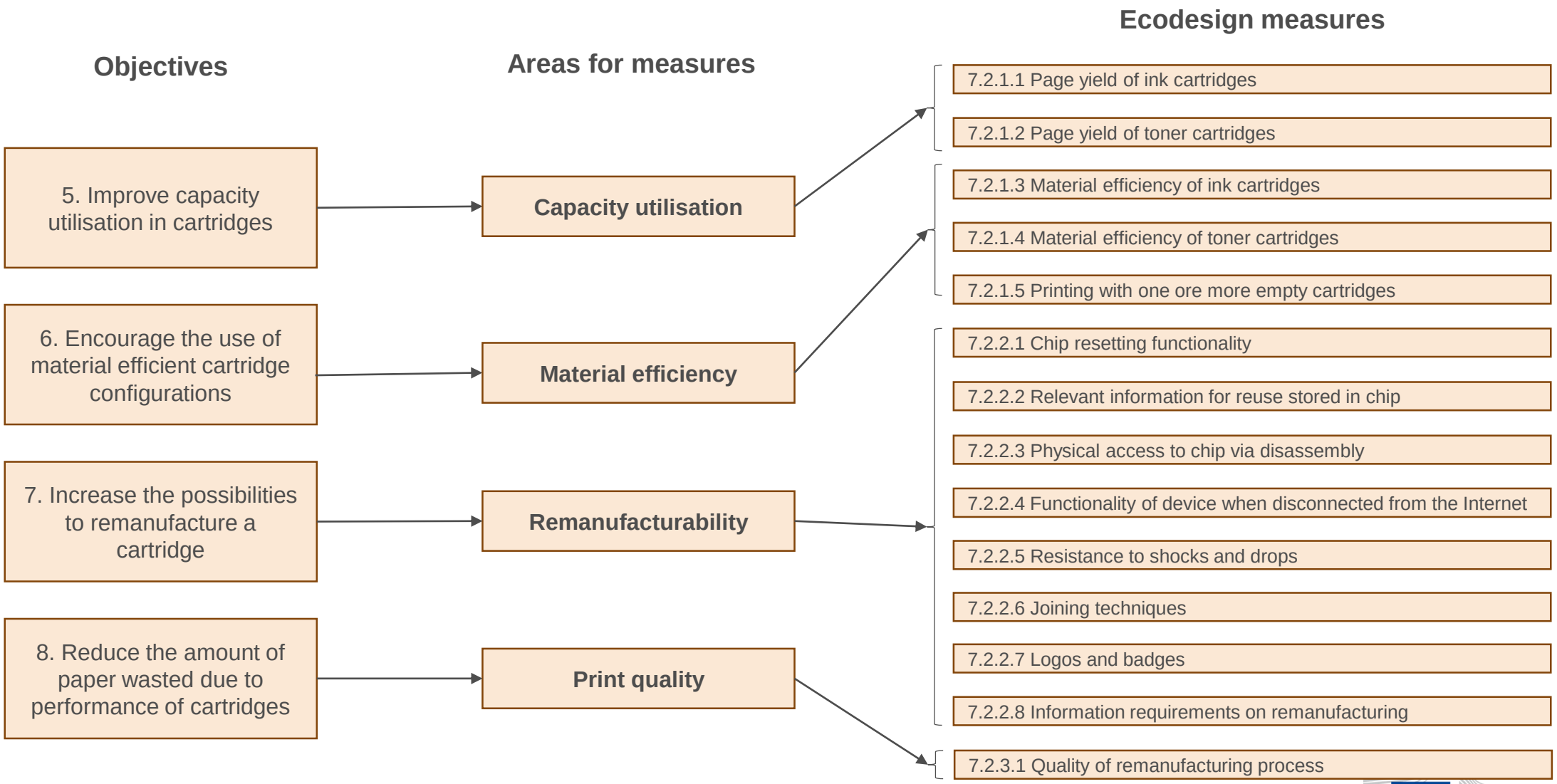
Ecodesign measures for devices

Feedback & Discussion

European Commission

Ecodesign measures for cartridges

Which specific measures should an ecodesign regulation include?



Capacity utilisation

Area for measure	Measure	Purpose
Capacity utilisation	7.2.1.1 Page yield of ink cartridges	Encourage the design of ink cartridges with optimised capacity and lower cost per page
	7.2.1.2 Page yield of toner cartridges	Encourage the design of toner cartridges with optimised capacity and lower cost per page

Material efficiency

Area for measure	Measure	Purpose
Material efficiency	7.2.2.1 Material efficiency of ink cartridges	Encourage the design of cartridges with material efficient configurations.
	7.2.2.2 Material efficiency of toner cartridges	Encourage the design of cartridges with material efficient configurations.
	7.2.2.3 Printing with one or more empty cartridges	Guarantee that cartridges containing more than one colour can still print in monochrome when one of the other colours is depleted.

Remanufacturability

Area for measure	Measure	Purpose
Remanufacturability	7.2.3.1 Chip resetting functionality	Guarantee that empty cartridges with chip can be reused by registered operators, ensuring minimum key functionality in the cartridge (barrier a)
	7.2.3.2 Relevant information stored in chip	Ensure that empty cartridges with chip will contain relevant information that facilitates reuse processes (barrier j)
	7.2.3.3 Physical access to chip via disassembly	Ensure that the chip will be easily accessible to facilitate the resetting process (barrier d)
	7.2.3.4 Functionality of devices when disconnected from Internet	Guarantee that consumers can disconnect devices from the Internet and still use them

Remanufacturability

Area for measure	Measure	Purpose
Remanufacturability	7.2.3.5 Resistance to shocks and drops	Guarantee a minimum durability in cartridges so that they will not get critically damaged during collection and storage (barriers f, g)
	7.2.3.6 Joining techniques	Ensure that cartridges can be easily disassembled without permanent damage (barrier c)
	7.2.3.7 Logos and badges	Ensure that logos and badges in cartridges can be easily removed without permanent damage (barrier h)
	7.2.3.8 Information requirements on remanufacturing	Provide certainty to consumers on how and where to dispose their empty cartridges Guarantee that consumers of remanufactured cartridges have relevant information about the remanufacturing process and the operator.

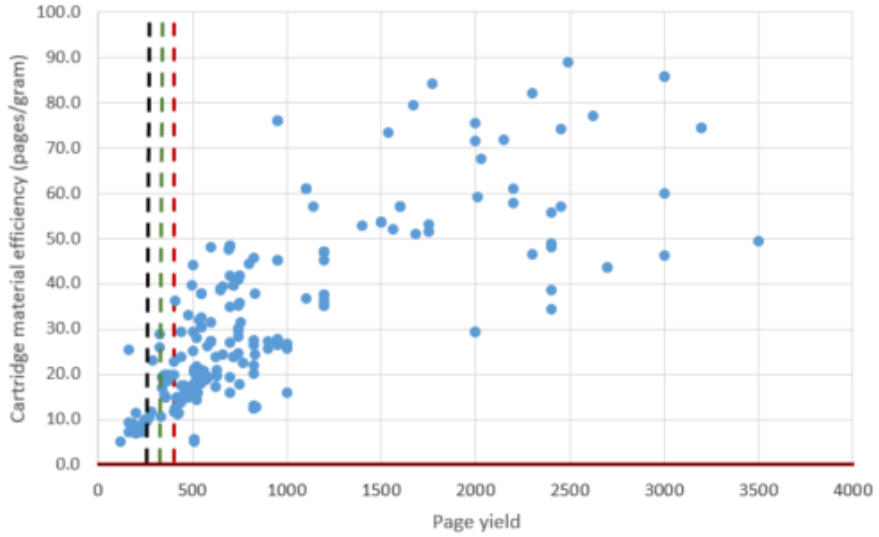
Paper

Area for measure	Measure	Purpose
Paper	7.2.4.1 Quality of remanufacturing process	Guarantee that remanufactured cartridges have a minimum quality for printing.

Ecodesign measures for cartridges (in detail)

7.2.1.1 Page yield of ink cartridges

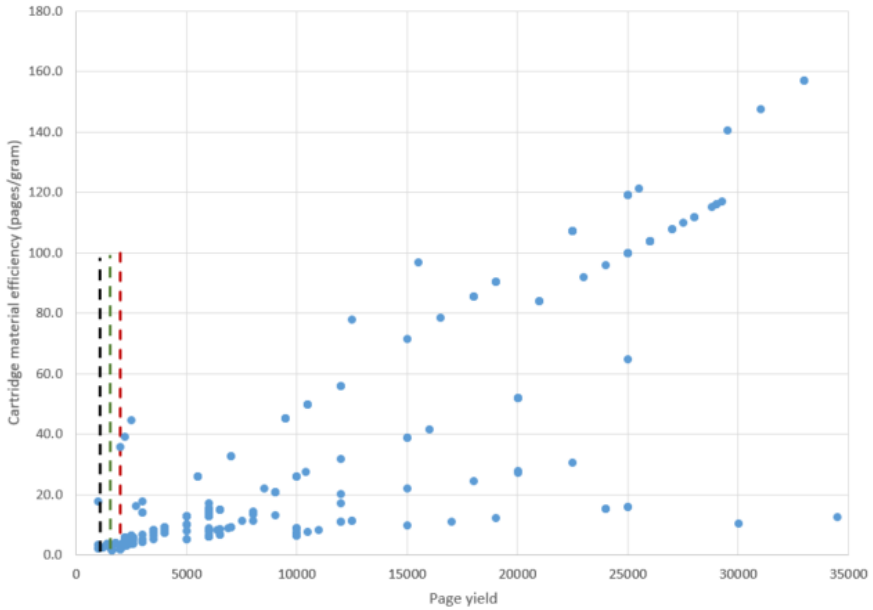
	Minimum page yield
Tier 1 (24 months after entry into force)	300 pages
Tier 2 (36 months after entry into force)	350 pages
Tier 3 (48 months after entry into force)	400 pages



Feedback from stakeholders	Are thresholds well balanced? Are there any trade-offs to consider?

7.2.1.2 Page yield of toner cartridges

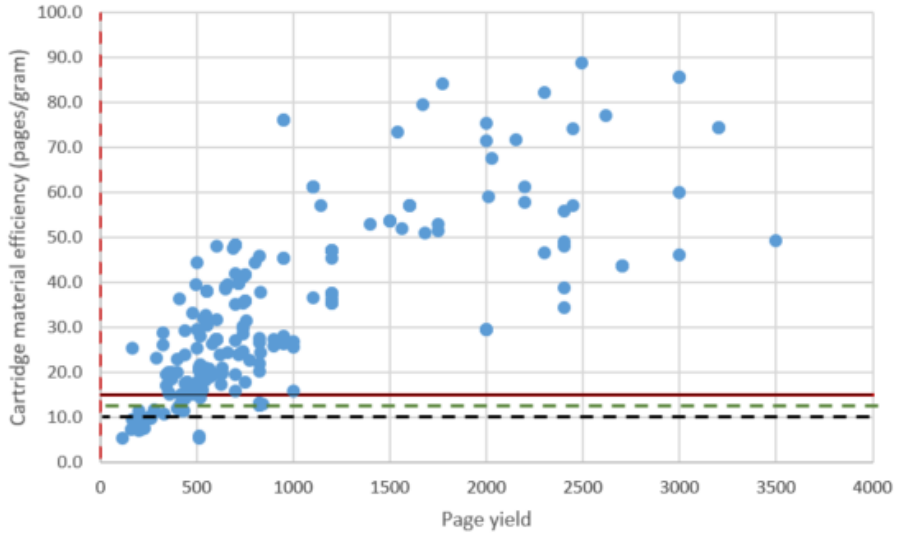
	Minimum page yield
Tier 1 (24 months after entry into force)	1500 pages
Tier 2 (36 months after entry into force)	1750 pages
Tier 3 (48 months after entry into force)	2000 pages



Feedback from stakeholders	Are thresholds well balanced? Are there any trade-offs to consider?

7.2.2.1 Material efficiency of ink cartridges

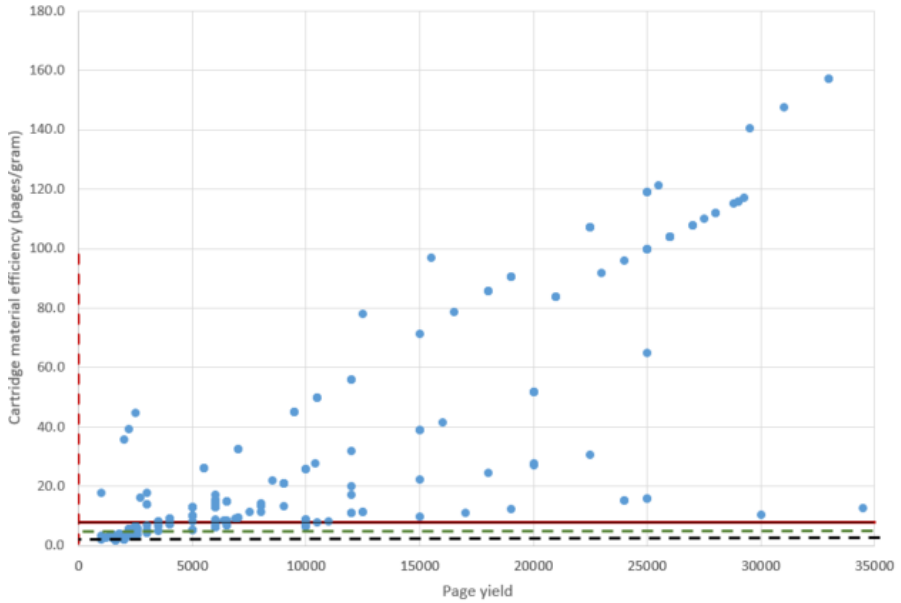
	Minimum material efficiency
Tier 1 (24 months after entry into force)	10 pages/gram
Tier 2 (36 months after entry into force)	12.5 pages/gram
Tier 3 (48 months after entry into force)	15 pages/gram



Feedback from stakeholders	Are thresholds well balanced? Are there any trade-offs to consider?

7.2.2.2 Material efficiency of toner cartridges

	Minimum material efficiency
Tier 1 (24 months after entry into force)	5 pages/gram
Tier 2 (36 months after entry into force)	6.5 pages/gram
Tier 3 (48 months after entry into force)	8 pages/gram



Feedback from stakeholders	Are thresholds well balanced? Are there any trade-offs to consider?

7.2.3.1 Chip resetting functionality

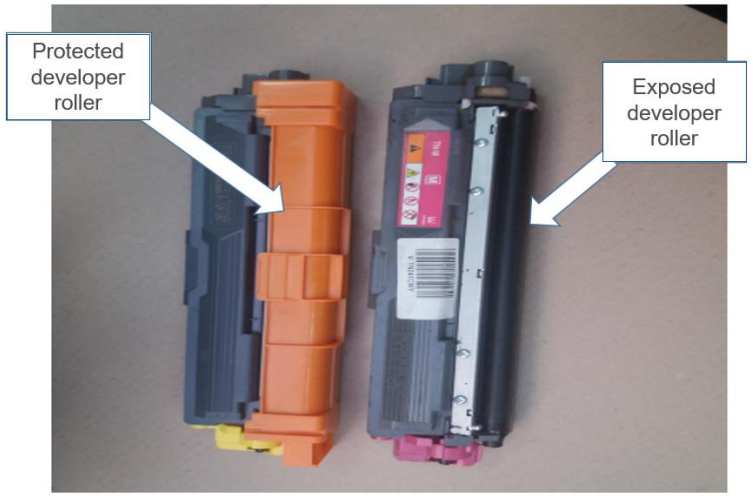
Content of measure	*Cartridges shall be designed in a way that the chip can be reset by registered professional remanufacturers so that they will print with key functionality.* *Key functionality refers to:* *-Cartridge acceptance* *-Calibration* *-Clean and align print heads* *-No blocking data collection agents* *-Single installation message without use of inflammatory terminology* *-Functioning ink or toner level gauge and/or approximate page count remaining, if provided with the original cartridge* *Chip resetting may be provided either by resetting and reusing the original chip present in the cartridge, or by supplying a replacement chip.* *Chip resetting functionality may be provided to any registered professional remanufacturer (with technical competence, with insurance) who requests it, at a reasonable and proportional cost.* *Chip resetting functionality may be provided in less than 5 working days.* *<u>Exemption to consider</u>* *The requirement to provide a solution for remanufacturing with key functionality would not apply to subscription and service models cartridges as long as the manufacturer of those cartridges provides a convenient, free-of-charge collection or return solution to independent remanufacturers that collect those cartridges and the manufacturer collects the cartridges with a view to reuse/recycling in accordance with lifecycle thinking*
Feedback from stakeholders	Is key functionality defined appropriately? What are the pros and cons on the exemption on subscription and service models?

7.2.3.2 Relevant information stored in chip

Content of measure	*Cartridges containing chips shall be designed in a way that the chip can store at least the following information:* *-Serial number* *-ID of original manufacturer* *-ID of operator(s) that have remanufactured the cartridge* *-Dates of remanufacturing operations* *-Compliance with regulation 2019/1020 on product market surveillance*
Feedback from stakeholders	How feasible is it from technical point of view?

7.2.3.5 Resistance to shocks and drops

Content of measure	*Cartridges shall be designed in a way that they comply with specifications of a standard drop test. The cartridges should retain full functionality after 20 drops.*
Feedback from stakeholders	How feasible is it from technical point of view?



7.2.3.8 Information requirements on remanufacturing

Content of measure	*Information shall be provided to consumers regarding the possibilities to remanufacture or refill cartridges. If the cartridge cannot be remanufactured or refilled, this should be clearly indicated in the product packaging or instructions.* *Information shall be provided to consumers on how to facilitate the remanufacturing or refilling of cartridges, indicating where and how to return it or dispose it.* *Cartridges commercialized as remanufactured shall provide information on the latest date and place of remanufacturing, as well as contact data of the operator which carried out the remanufacturing.*
Feedback from stakeholders	Can this measure contribute to increase cartridge collection rates? Can it help to increase confidence in remanufactured cartridges?

Ecodesign measures for cartridges

Feedback & Discussion

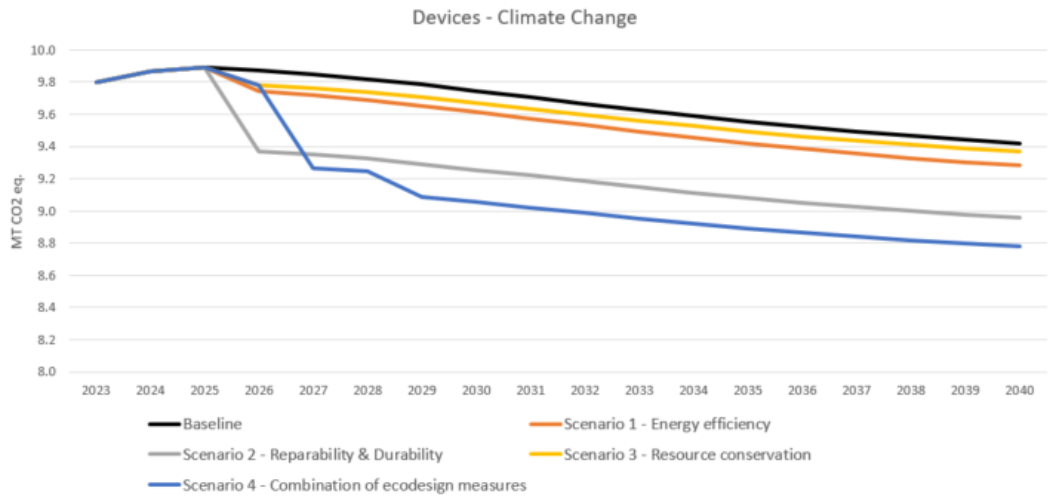
European Commission

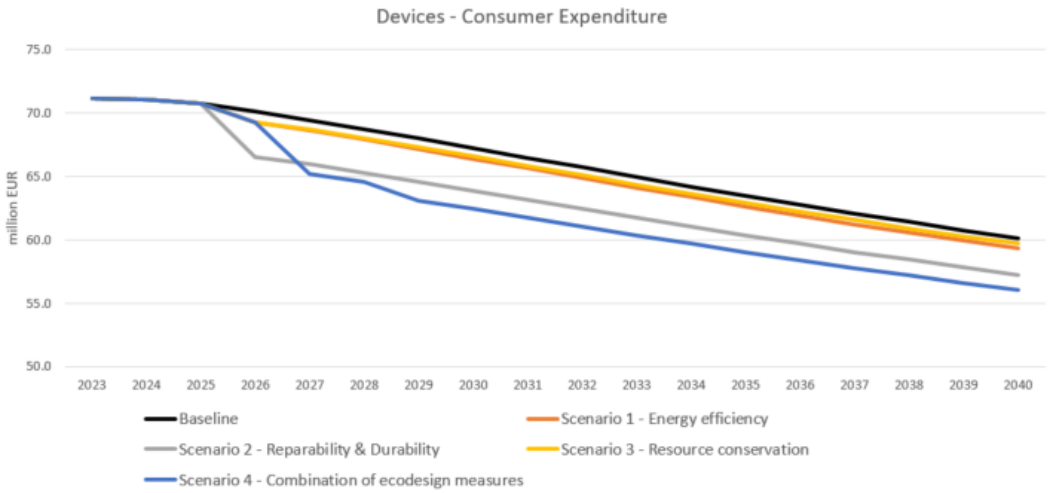
Scenario analysis

What is the improvement potential at EU level?

Scenario analysis Devices

What is the improvement potential at EU level?





European Commission

Scenario analysis Devices

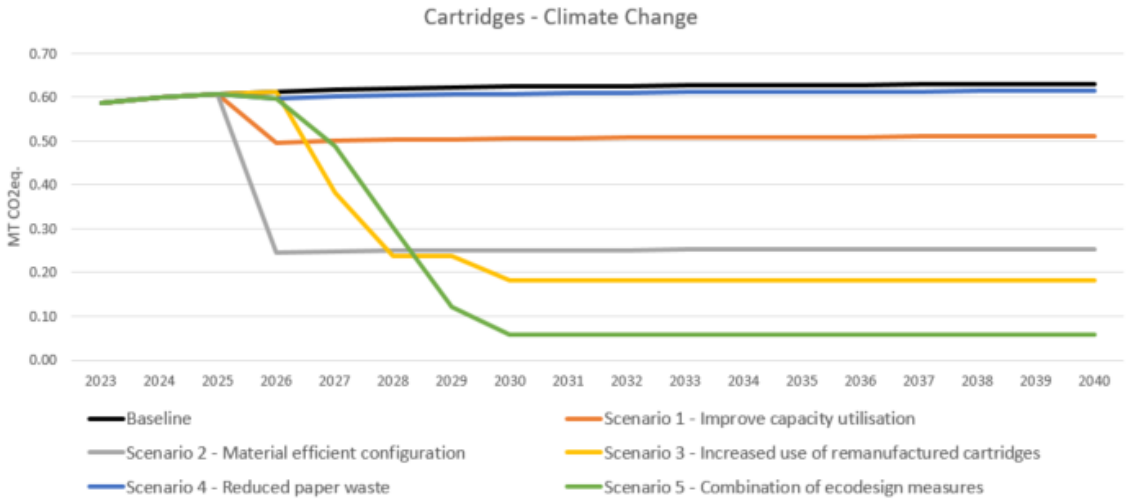
What is the improvement potential at EU level?

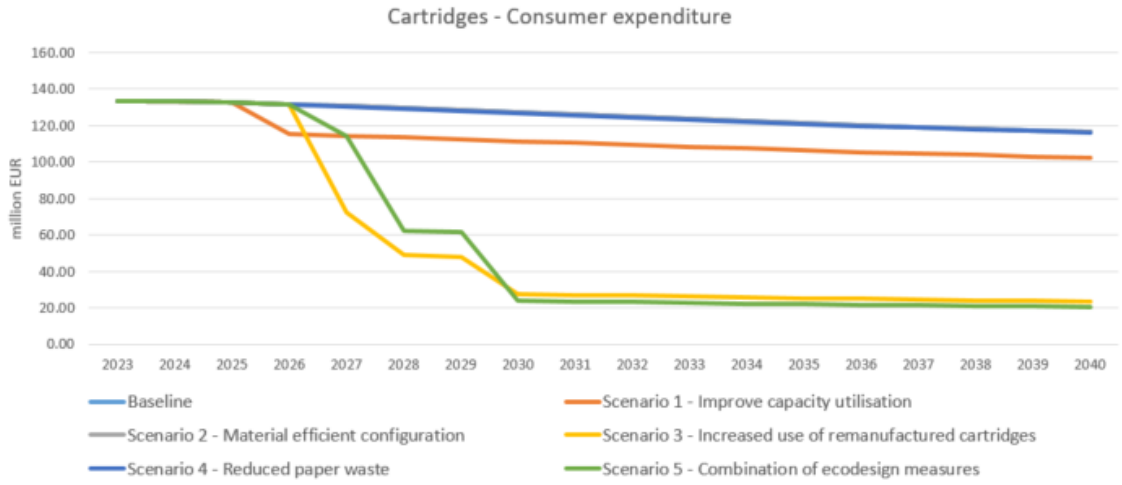
Table 119. Improvement potential of scenarios for devices

Scenario	Description	Improvement potential Climate change (MTCO2eq.)	Improvement potential Consumer expenditure (million EUR)
Scenario BAU	Business as Usual	0	0
Scenario 1	Energy efficiency	2.0	12.5
Scenario 2	Reparability and durability	7.2	48.2
Scenario 3	Resource conservation	1.0	9.1
Scenario 4	Combination of different ecodesign measures[159]	9.2	63.0

Scenario analysis Cartridges

What is the improvement potential at EU level?





European Commission

Scenario analysis Cartridges

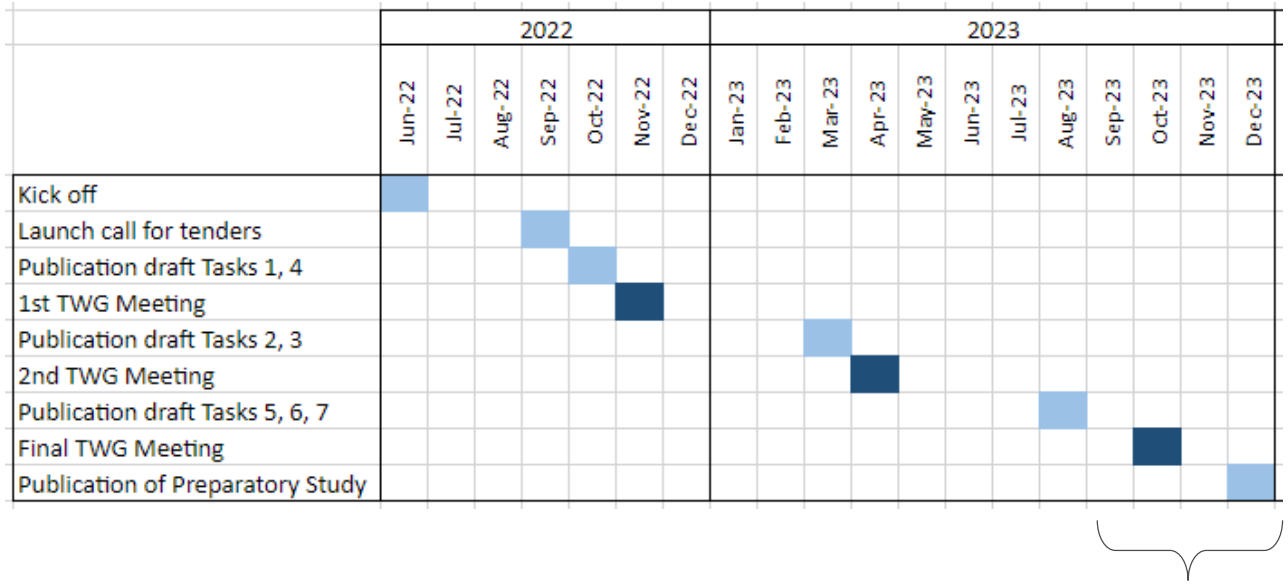
What is the improvement potential at EU level?

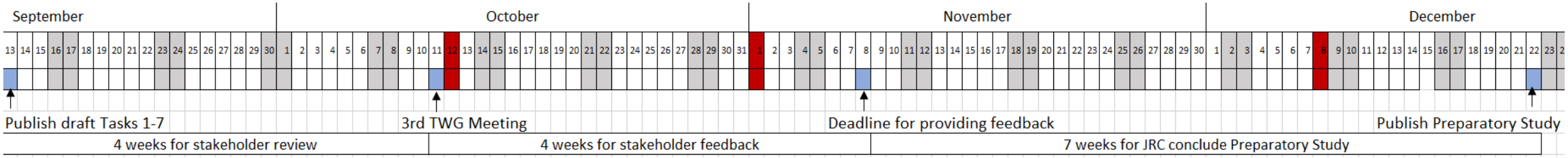
Table 121. Improvement potential of scenarios for cartridges

Scenario	Description	Improvement potential Climate change (MTCO2eq.)	Improvement potential Consumer expenditure (million EUR)
Scenario BAU	Business as Usual	0	0
Scenario 1	Capacity utilisation	1.8	229.8
Scenario 2	Material efficient configuration	5.6	0.0
Scenario 3	Remanufacturing	5.9	1275.6
Scenario 4	Reduced paper waste	0.2	5.5
Scenario 5[160]	Combination of different ecodesign measures	7.3	1110.0

Next steps

Timeline for Preparatory Study





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Next steps

- Gather and process comments from 3rd TWG Meeting
- Deadline for sending written comments: 8th November 2023 (please use template)
- Publication of final version of Preparatory Study: before 22nd December 2023

Thank you

European Commission