The European Commission's science and knowledge service

Joint Research Centre

Material efficiency aspects of personal computers product group

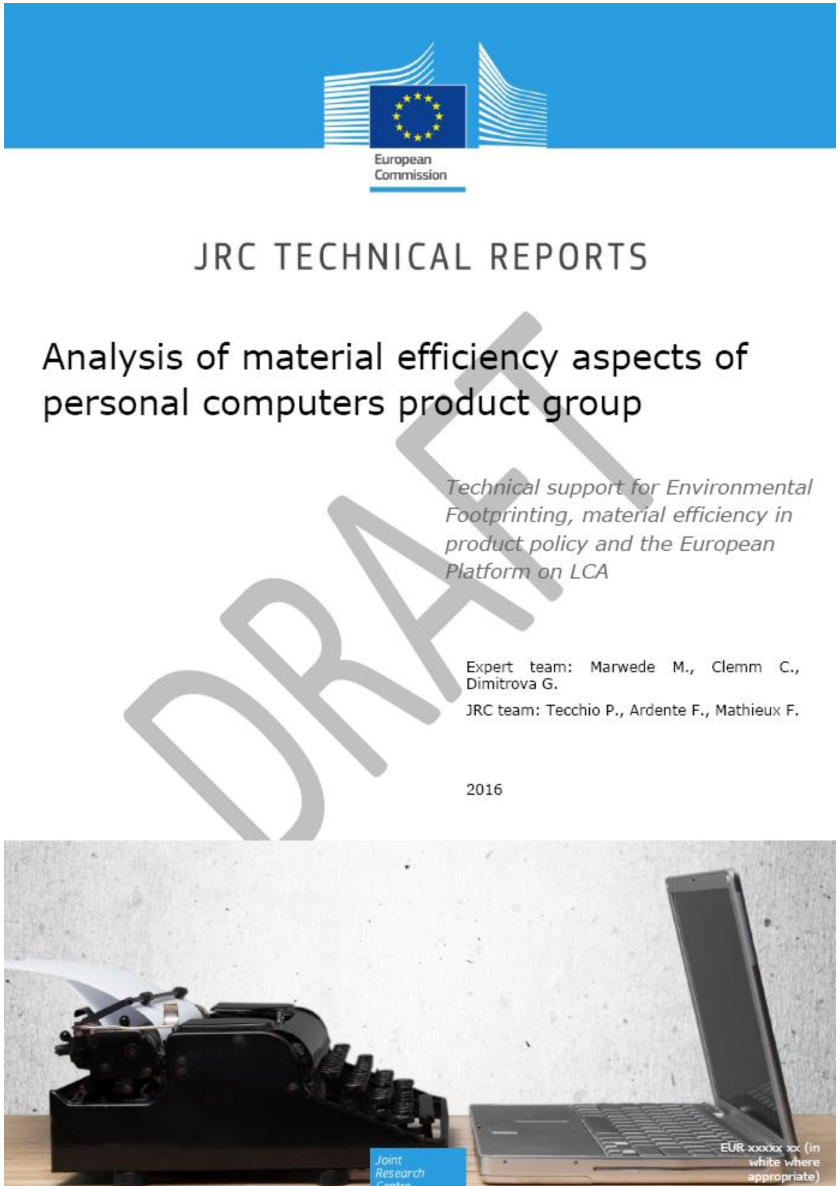
Paolo Tecchio

European Commission

Outline

- Background
- Analysis of resource savings and repair practices
- Analysis of recycling of computers
- Discussion

Background


European Commission

JRC TECHNICAL REPORTS

Analysis of material efficiency aspects of personal computers product group

DRAFT

Technical support for Environmental Footprinting, material efficiency in product policy and the European Platform on LCA

Expert team: Marwede M., Clemm C., Dimitrova G.

JRC team: Tecchio P., Ardente F., Mathieux F.

2016

Joint Research Centre

EUR xxxxx xx (in white where appropriate)

Cooperation with DG ENER and Viegand Maagøe and VITO since June 2016

Team

JRC: Tecchio P., Ardente F., Mathieux F.

Experts: Marwede M., Clemm C., Dimitrova G.

Draft report cited in the review study

Task 3.4 (EoL computers)

Task 4.2 (use of materials)

Task 7.3 (material efficiency)

European Commission

Background and methodology

- Estimated annual **sales** in 2030: desktop computers 13.6 million units; notebook computers 41.7 million units; tablets 38.5 million units

- Typical **lifetime** of 6 years for desktop computers, 5 years for notebooks and 3 years for tablets

✓ **Analysis of current practices**
✓ **Identification of hot-spots**
✓ **Identification of workable actions**
❑ **Quantification of potential results**

- Material efficiency aspects
  - ✓ to enhance **resource savings**
  - ✓ to enhance **reuse/repair**
  - ✓ to enhance **recyclability**

Resource savings and repair

Notebooks: what is the situation?

- Main **reasons** for buying a new notebook: "it was defect" (46%), "it didn't have enough functions" (25%) (Prakash et al 2016)
- **31%** of notebook owners reported a failure in the first three years (SquareTrade 2009)

- Frequent failures and malfunction
- **Exterior parts**: keyboards, displays (IDC, 2010)
- **Internal parts**: batteries, mass storage systems (IDC, 2010; Prakash et al 2016), main boards

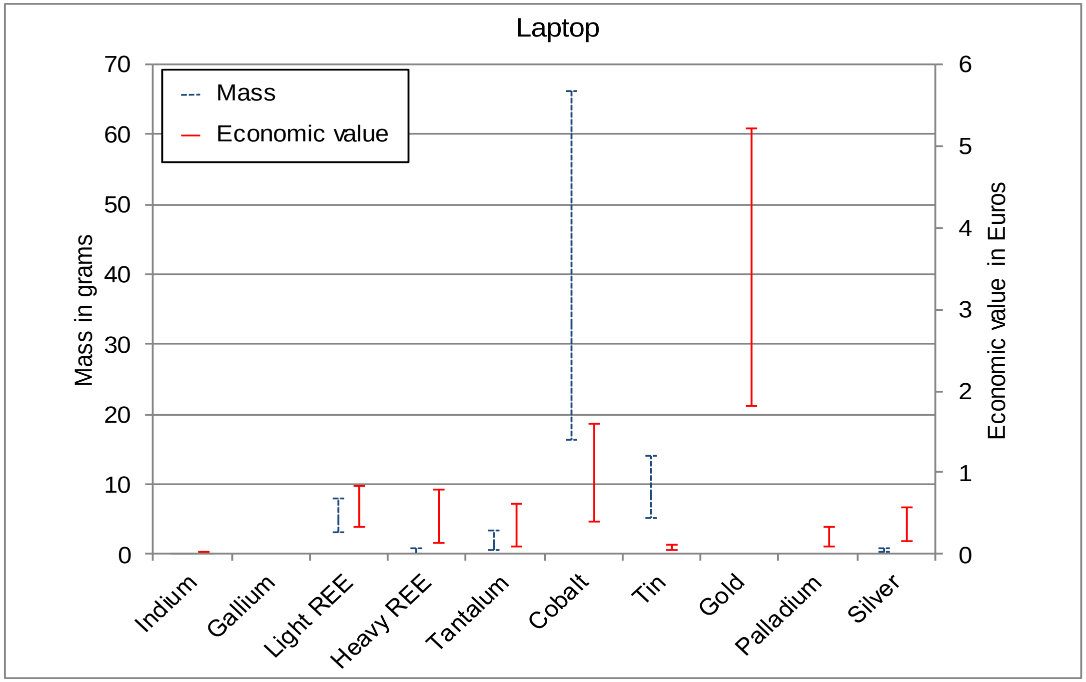
- **Possible limits to repair**: built-in and soldered components (Bölling 2016, Prakash et al 2016)
- Survey participants would not send a device to a repair service to **exchange the battery** (Forsa, 2013)

European Commission

Resource savings and repair

Critical raw materials

Raw materials are crucial to Europe's economy (DG GROWTH, 2016). The European Commission has created a list of **Critical Raw Materials** (CRMs).



CRMs and other relevant materials in notebooks (Chancerel et al., 2015)

European Commission

Resource savings and repair

Resource savings

Batteries

- **1.5** batteries/mobile computer (Prakash et al 2016)
- The durability of batteries potentially **limits the lifetime** of the device it is powering if replacement is economically not feasible
- **Lithium-ion batteries** contain a high amount of **critical raw materials** such as cobalt

External power supplies (EPS)

- **EPS design is optimized** for the device to be powered but is often not usable with other devices (IEEE Std 1823, 2015)
- The concept of a **common EPS** aims at potential reuse and share
- USB Type-C may reduce EPS need (e.g. by plugging into a display integrating Type-C)

Resource savings and repair

Hot-spots

- Durability and resource savings
  - **Battery lifetime**
  - ✓ Need of information about battery cycle life
  - ✓ Need of tools to help users preserving batteries cycle life

  - **External power supply**
  - ✓ Need to reduce unnecessary external power supplies

- Repair and reuse
  - **Key components**
  - ✓ Need of information on disassemblability of key components

  - **Privacy**
  - ✓ Need of tools to protect users' privacy

Recycling

What is the situation?

- Recycling of computers is usually based on the combination of **manual dismantling** of components containing hazardous substances and valuable materials (e.g. batteries, printed circuit boards, displays) and **mechanical processing**

- The recycling of **desktop computers** is generally perceived as non-problematic by recyclers

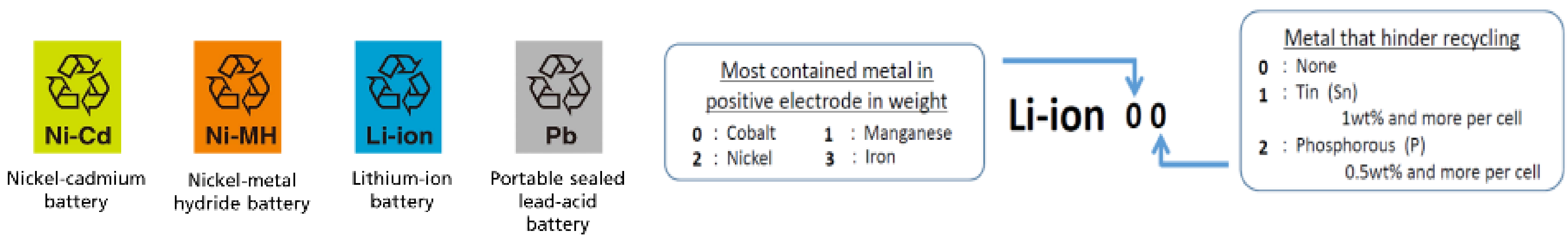
- The design of **notebooks** and **tablets** can originate some difficulties for the dismantling of components, especially for compact computers with glued parts

- **Tablets**: the number of discarded products is still very limited, but it is expected to grow largely in the next years

Recycling

Specific issues

- **Manual dismantling**: for batteries and display units. Necessary for efficient recovery of main boards, PCBs, HDDs and ODDs
- **Plastics**: recyclability is generally very low due to large variety of plastics and FR combined in the same product (EN TS 16524)
- **Batteries**: sorting is mostly done manually, but no mark is mandatory to comprehensively identify the chemistry (in Europe)



Battery Recycle Mark, mandatory in Japan (Battery Association of Japan)

Recycling

Hot-spots

- Ease of dismantling
  - ✓ Need of information on dismantling of key components
- Recyclability of plastics
  - ✓ Need of information on the type of plastic using standardised symbols
  - ✓ Need of information on the use of flame retardants in plastics
- Recyclability of batteries
  - ✓ Need of a better identification of type and composition of batteries, to be applied at the battery pack level and at the battery cell level

From the identification of hot-spots to the identification of workable actions to enhance material efficiency

Material efficiency

Battery durability: facts & rationale

- The capacity of some batteries fades quicker than others
- Current legislation (**Regulation 617/2013**) requires manufacturers to provide data on expected cycle life, but **relevant information is missing**:
    1. Definition of loading cycles
    2. Capacity threshold at which the battery is considered wasted
    3. Measurement methodology (standard)

✓ Informing users about the **state of health of the battery** after a pre-defined number of charging cycles

✓ Establishing minimum levels of **battery durability**

European Commission

Material efficiency

Battery durability: points of discussion

- Standard **EN 61960** is available (2011). Does it need revision to be used for a policy requirement?

- Number of charging cycles (500)?

- Testing level to be used?
  - **battery cells** or
  - **battery packs**

- Procedure to be used?
  - **accelerated procedures** (125 days) or
  - **non-accelerated procedures** (188 days)

Material efficiency

Battery durability: facts & rationale

- One factor determining both the cycle life and calendar life of batteries is the **state of charge (SoC)**

- A common use pattern for notebooks is **stationary use** (in grid operation, i.e. directly plugged into a power outlet or using a docking station)
- High levels of **SoC** (e.g. 100%) are known to accelerate the aging of batteries

✓ In case of grid operation (i.e. without cycling), users could benefit improved durability thanks to lower SoC (**50-70%**)
✓ An **optimisation tool** can be developed to manage the SoC during grid operation and thus prolonging battery lifetime

Material efficiency

Battery durability: **points of discussion**

- How the battery optimisation software will be **integrated** and **pre-configured**?
- Is the **limit to the SoC** of the battery of **70%** a possible target?

Material efficiency

External power supplies: **facts & rationale**

- As dedicated recycling processes for EPS are **economically not viable**, the rationale for this measure is to reduce the amount of electronic waste

✓ Products sold without EPS (**decoupling**) can enhance resource saving, but shall be recognizable by users

✓ **Labelling** on the packaging to promote decoupling? And to address the problem of **incompatibility of devices/EPS** (inability to reuse an EPS when changing notebook computer or tablet)

Material efficiency

External power supplies: points of discussion

- **Decoupling** of products and EPS: reduction of costs for manufacturers? What is the decoupling rate today?
- **Standard** IEEE Std 1823 (common power supplies for mobile devices) is available (2015): can it be used to start standardization activities (e.g. definition of power supply **specifications**)?

European Commission

Material efficiency

Disassemblability of key components: **rationale**

- Reversible disassembly of key components would enhance:
  - **Reparability** (defects and failures are main reasons for buying a new device)
  - **Upgradability** (recognized to be a key feature for users)
  - Swift separation at EoL

✓ Comprehensive **instructions** provided to **repairers** can enhance reparability and reusability of computers

- Furthermore, **battery performance** is a key feature for users

✓ An additional information (**logo?**) regarding also the ease of disassembly of batteries can be provided **to users**

Material efficiency

Disassemblability: **points of discussion**

- **Standardisation activities** are needed (especially for definition of logos, tools, etc.)

- **Where** should the logo be? What should communicate?
  1. Batteries can be manually disassembled (no need of tools)
  2. Batteries can be disassembled with the use of tools
  3. Battery replacement need assistance

- **Specifications** (definition) of battery types are needed
- **Information:** detail of information to be provided to targeted audience (professional repairers and users)

Material efficiency

Data sanitisation: facts & rationale

- One major barrier to the reuse, repair and recycling of computers is **data privacy issues**

- Major operating systems usually include an option to "**factory reset**" the device, but this does not necessarily guarantee that all personal data are deleted permanently
- Availability of SW/FW needed to recover data from an erased mass storage systems

✓ **Reliable and comprehensive data deletion** functions available to the user would help the reuse market (care to theft)

European Commission

Material efficiency

Data sanitisation: **points of discussion**

- Definition of reasonably-safe *data sanitisation* is needed
- **Standardisation activities** are needed
- **Available national standards:**
  - US Department of Defense 5220.22-M
  - HMG IS Standard 5 (UK)
  - DIN 66399 (DE)
  - NIST 800-88r1 (US)
- Mentioned in **prEN 50614** - Draft document - Requirements for the preparation for re-use of WEEE

Material efficiency

Recycling: **facts & rationale**

- **Miniaturization** makes recycling increasingly challenging → certain components (e.g. batteries, panels, etc.) **risk to be disposed of** in other waste

✓ Possible actions could be developed to facilitate the **identification** of EEE components and materials:
  - ✓ Key (valuable) components
  - ✓ Plastic parts (> 50 g)
  - ✓ Plastic parts containing flame retardants (> 25 g)
  - ✓ Battery packs and battery cells
  - ✓ Critical raw materials (?)

Material efficiency

Recycling: **points of discussion**

- Specification on the use of **adhesive tapes** (for batteries)?
- Detail on **content of CRMs**?
  Relevant information on the content of cobalt in batteries, or the content and location of components containing rare earths

Material efficiency

Recycling: points of discussion

- Use of **QR code** for Li-ion batteries (and or others)?
  The following information can be accessible via the QR code
  (i) main battery chemistry systems
  (ii) sub-chemistry system
  (iii) link to material safety data sheet

- Use of **RFIDs** for automatic sorting?

- More appropriate as horizontal requirement in the Battery Directive (under review, but could take time…)

European Commission

Discussion

Do you see other additional hot-spots to take into consideration to enhance

- **Resource saving**
- **Repair and reuse**
- **Recycling**

Comments and feedback are welcome

- paolo.tecchio@ec.europa.eu

European Commission

The European Commission's science and knowledge service

Joint Research Centre

Material efficiency aspects of personal computers product group

Paolo Tecchio, Fulvio Ardente, Fabrice Mathieux, Max Marwede, Christian Clemm, Gergana Dimitrova

European Commission