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Policy Brief No. 1

Eco-design of Mobile Devices

Project sustainablySMART

1 Introduction

The EU funded Horizon2020 project sustainablySMART will change the lifecycle of mobile information and communication technology devices by developing new product design approaches. This includes enhanced end-of-life performance, re-use and remanufacturing aspects implemented on the product and printed circuit board level, as well as new re-/de-manufacturing processes with improved resource efficiency.
Some research results require a favorable policy environment to lead to intended positive effects. This policy brief is meant to contribute to ongoing policy discussions based on research findings resulting from sustainablySMART.

2 Findings

Modularity of Smartphones

The Lifecycle Assessment of the Fairphone 2 indicated that modularity initially comes at an additional environmental impact of roughly 10% compared to conventional, non-modular designs. This added environmental burden is mainly due to connectors, module housings and additional printed circuit board area, but is easily compensated, if modularity leads to better reparability and thus longer product lifetimes. On the example of the Fairphone 2 an overall carbon footprint reduction through extending product lifetimes from 3 to 5 years has been demonstrated. The calculated effect is a reduction of approximately 30% of greenhouse gas emissions per year of product use. Similarly high savings are not achievable with any other single eco-design strategy.
In a recyclability analysis [1] the positive effect of modularity on material recovery rates has been demonstrated: A separation of plastics (shell), display (to light metal recycling for magnesium recovery from the display back plate), battery and electronics (modules to smelter) allows to channel these four fractions to distinct recycling processes.

Critical Resources

Further separation of individual target components from either modular or conventional smartphones to recover indium, rare earth elements, tungsten, gallium, or tantalum seems not to be economically viable unless these materials are separated in processes targeting at reusable components of higher value. Among the aforementioned elements neodymium-iron-boron magnets in loudspeakers, microphones and motors of vibration alarms are those with the highest material value in smartphones and tablet devices and thus are from an economic perspective candidates with the highest potential, that separate extraction and recycling might become economically viable. For separated tantalum capacitors there are also economically viable recycling processes in place, but the extraction of individual capacitors from used devices is the economic challenge.

Battery Ageing

Research on smartphone battery ageing by the sustainablySMART project confirms some essential factors for obsolescence of batteries and devices with embedded batteries:

- Charging and discharging batteries under significantly elevated temperatures contributes to a rapid ageing of batteries
- Similarly charging batteries at below 0°C damages the battery
- Storing batteries at low temperatures (but above 0° C) and with a moderate state of charge minimizes the effect of calendaric ageing
- Keeping the state-of-charge in a mid-range between 20 and 80% or even narrower to 50% increases battery lifespans (number of full charging cycle equivalents) drastically

3 Policy Conclusions

Modularity is favorable as long as the modular concept clearly targets at better **reparability**, hardware **upgradeability** and / or better **material separation at end-of-life**. In particular the lifetime extension effect of modularity will yield a better environmental life cycle performance. The approach to measure such a performance in EU policy are **Product Environmental Footprints** (PEFs) [2]. It is not yet defined, how PEFs will be implemented in any legislation, but to set the right incentives for modularization it is important, that the PEF methodology, including related product category rules (PCRs), allows for a differentiation of product lifetimes depending on design features such as modularity. Under the **Ecodesign Directive** [3] the modular approach needs to be addressed through some new criteria, such as

- a declarable **reparability score**[1],
- a **requirement for removable batteries** (as long as the manufacturer does not provide evidence that battery lifetime is not a limiting factor for an acceptable product lifetime),
- a **disassembly time threshold for some key components** (such as the display unit) with standard tools.

Modularity as such cannot be translated into an unambiguous eco-design criterion as the level of modularity and the way the modularity concept supports a sustainable product use has to be considered. Modular product designs however can serve as a Best-Available-Technology (BAT) benchmark being referenced in the product specific regulation.

As recovery of some **critical raw materials** from waste devices is currently not economically viable due to very low concentrations and a complex material matrix, stimulating substitution or recycling requires policy incentives. The EU **Conflict Minerals Regulation** [4] could contribute to a politically motivated tantalum or tungsten recycling to secure these potential conflict minerals from recycling as a non-conflict source. Apart from the EU conflict minerals policy the ongoing developments under the **Ecodesign Directive** might have an effect on reducing the use of certain, not yet readily recoverable materials: Some draft product regulations propose a declaration of the content of some of the aforementioned elements in a product. This kind of transparency might lead to additional substitution efforts to reduce the amount of these declarable elements.

Policy measures on battery ageing actually are of two flavors: Requirements regarding the **internal battery management** to charge the battery under conditions, which are favorable for a long battery lifespan and **information requirements** targeting at the consumer to inform him about the most appropriate charging patterns. The latter could be a mandatory feature to charge only up to a certain SoC limit at 80 or 90% unless this feature is intentionally disabled by the user. Alternatively there could be a technical requirement to foster innovation towards lower electrolyte degradation at high SoC (exact requirement still to be defined). An

[1] research on a robust and verifiable reparability assessment is work in progress a spart oft he project sustainablySMART

information requirement about the battery lifespan under a defined set of charging regimes (fast charging, normal charging between 0 and 100% SoC, and between 20 and 80% SoC) would increase transparency for the consumer regarding the effect of charging patterns. Such requirements can be implemented through the **Ecodesign Directive** but appropriate test standards still need to be defined.

4 References

[1] Fairphone's Report on Recyclability: Does modularity contribute to better recovery of materials? February 2017

[2] Simone Manfredi, Karen Allacker, Kirana Chomkhamsri, Nathan Pelletier, Danielle Maia de Souza: Product Environmental Footprint Guide, European Commission Joint Research Centre, Ispra, 2012, Ref. Ares(2012)873782 - 17/07/2012

[3] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related product

[4] Regulation (EU) 2017/821 of the European Parliament and of the Council of 17 May 2017 laying down supply chain due diligence obligations for Union importers of tin, tantalum and tungsten, their ores, and gold originating from conflict-affected and high-risk areas

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