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Policy Brief No. 2

Regulation of Common Chargers for Smartphones and other Compatible Devices: Screening Life Cycle Assessment

Project sustainablySMART

1 Introduction: Harmonisation of Mobile Phone Chargers

The European Commission launched an initiative to regulate mobile phone chargers and those of compatible devices in December 2018 outlining a plan to adopt a regulation in late 2019 [1]. Interoperability of chargers between mobile phones is supposed to reduce the e-waste problem as chargers can be reused when a user upgrades to a new phone.
The European Commission will consider at least the technical scenarios listed in Figure 1.

1. Plug charger with detachable cable.
   a. USB Type A socket on plug charger and:
      i. Cable from USB Type A to USB 2.0 Micro B;
      ii. Cable from USB Type A to USB Type C;
      iii. Cable from USB Type A to proprietary socket (e.g. Apple Lightning);
      iv. Cable of the previously defined types plus external adaptor.
2. Plug charger with detachable cable.
   b. USB Type C socket on plug charger and:
      i. Cable from USB Type C to USB 2.0 Micro B;
      ii. Cable from USB Type C to USB Type C;
      iii. Cable from USB Type C to proprietary socket (e.g. Apple Lightning);
      iv. Cable of the previously defined types plus external adaptor.
3. Plug charger with no detachable cable:
   i. Cable terminating with USB 2.0 Micro B;
   ii. Cable terminating with USB Type C;
   iii. Cable terminating with proprietary socket (e.g. Apple Lightning);
   iv. Cable of the previously defined types plus external adaptor.

Figure 1 – Plug charger and cable combinations [1]

In the course of the Horizon 2020 project sustainablySMART substantial life cycle data has been generated to assess various aspects of modularity of smartphones [2] and of upcoming technology trends, such as wireless charging [3]. Selected LCA results can serve as input to the current discussion about harmonization of chargers.

2 Life Cycle Analysis of a Smartphone and Charging System

2.1 Goal and scope

2.1.1 Goal

By using life cycle assessment tools, this report aims to give some insights into distinct life cycle relevancy of smartphones, chargers and charging cables. An overview of the related impacts of three sub-devices is provided: a smartphone, a charging cable and an AC adapter. With this focus the environmental relevancy of the charge and the cable can be quantified, compared to the smartphone. The technological scenarios reflected by this analysis are (see [1]):

1. Plug charger with detachable cable.
   a. USB Type A socket on plug charger and:
      i. Cable from USB Type A to USB 2.0 Micro B;
      ii. Cable from USB Type A to USB Type C

The scenarios with USB Type C sockets on the plug charger and with proprietary sockets (e.g. Apple Lightning) on the smartphone side are assumed to yield very similar results.

2.1.2 Scope

For the study only the production and end of life phases are considered. Use phase is neglected and considered not relevant for this study, although energy efficiency of the charger is relevant when discussing lifetime extension versus upgrading to a new charger. Transport is also excluded.
For the impact assessment the CML methodology is chosen, in its 2016 updated version [4]. Five impact categories have been considered, taking into account their relevance in electronic products: abiotic depletion of elements, abiotic depletion of fossil fuels, global warming potential, human toxicity potential and terrestrial eco-toxicity potential.

2.2 Approach

2.2.1 Product models

Three devices are under study: a smartphone, an AC adapter and a cable to connect both.
The smartphone model is based on a pre-existing model of a Fairphone 2 [2] assessed by Fraunhofer. Since the Fairphone 2 is a modular smartphone and implies therefore some extra impacts in the production phase, the version used for this report includes some modifications to make it more similar to a conventional smartphone.
The AC adapter has been modelled following an actual device disassembled in order to identify the different parts and components and their dimensions and weights. The model information can be found in Table 1. It has been modelled in two main parts: the printed circuit board with the electronics components for energy conversion and management and the plastic body that contains it.
The cable has been modelled as two parts: the cable itself and the USB plug, type A [5]. For that, different sources have been used. Standards documentation has been consulted for the dimensions [6], while material information has been extracted from manufacturer information [7]. The weight of some parts was estimated using an actual cable.

Table 1 - Device list

Device	Specs [8] [9]
AC adapter	EP-TA20EWE model (Samsung) Fast charging (1,67 A and 9 V output)
Cable	EP-TA20EWE model (Samsung) Micro USB cable 113 cm long
Smartphone	Modified version of a Fairphone 2 smartphone Display size: 5 inch Battery 2420 mAh at 3,8 V Memory 32 GB Weight 148 g

2.2.2 Assumptions

Following assumptions and limitations have to be considered when interpreting the results:

- The micro USB port of the cable (the end that is connected to the smartphone) has been modelled as a C type micro USB plug. There are however, various standards for different phones, so this part is not broadly representative.
- Following our reference [2] for the smartphone modelling, the EoL phase has been built for the metals recovery only, as the most representative approach for WEEE treatment. The modelled recycling process is a state-of-the-art metals smelter [10]. Recovery of other materials, additional treatments that might be needed or existing different pathways for the waste have been left out.
- Allocation of the recovered materials has been done by avoided burden approach.
- The production phases have been mainly (but not exclusively) modelled using generic datasets of the GaBi software. EoL phases, on the contrary, have been modelled using Ecoinvent and other external datasets.

2.2 Results

Figure 2 shows the relative impacts of each of the devices. Not surprisingly, the smartphone represents most of the impacts share (always 90% or higher except from ADP elements). The second is always the AC adapter and the least impactful of the group is the cable with an impact share of around 1 %.

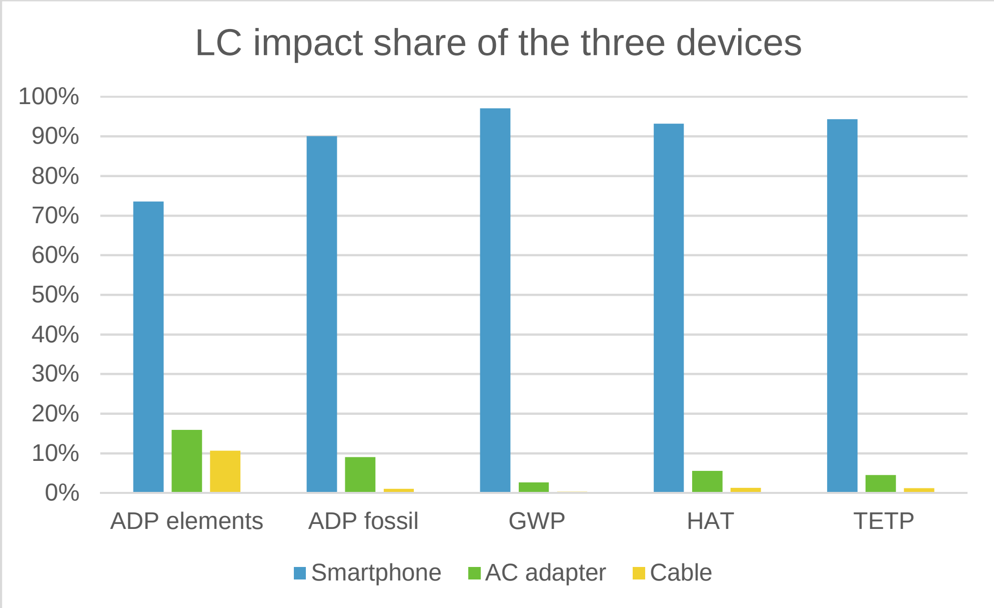

Figure 2 - Share of environmental impacts per device

Whereas the smartphone impacts are depicted only for comparison purposes to get the overall correlations right, it is evident, that among the adapter-cable-assembly the adapter is the critical part. Impacts of the cable connecting the adapter with the smartphone are much lower than those of the adapter, except for the impact category abiotic depletion
Relative impact values for the life cycle phases of the cable only are shown in Figure 3: In all impact categories production is the main driver taking up more than 90 % of the environmental impacts. In some of the impact categories the end of life phase shows environmental benefits, in particular for abiotic resource depletion. For the fossil abiotic depletion and the global warming potential, however, the impact of the end of life phase is environmentally detrimental.

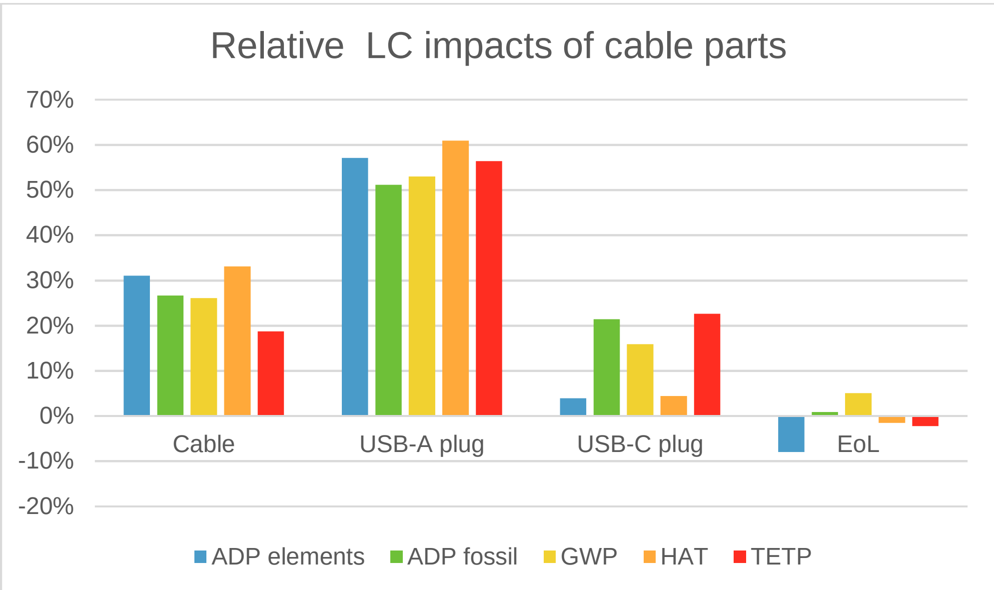

Figure 3 - Impact share (cable)

Performing the same analysis for the adapter and smartphone, a trend can be seen. In the case of the adapter (Figure 4), the end of life phase shows a greater relevance in some of the impacts and more benefits compared to the cable.
Table 2 shows the absolute values for the five impact categories for the three devices under study.

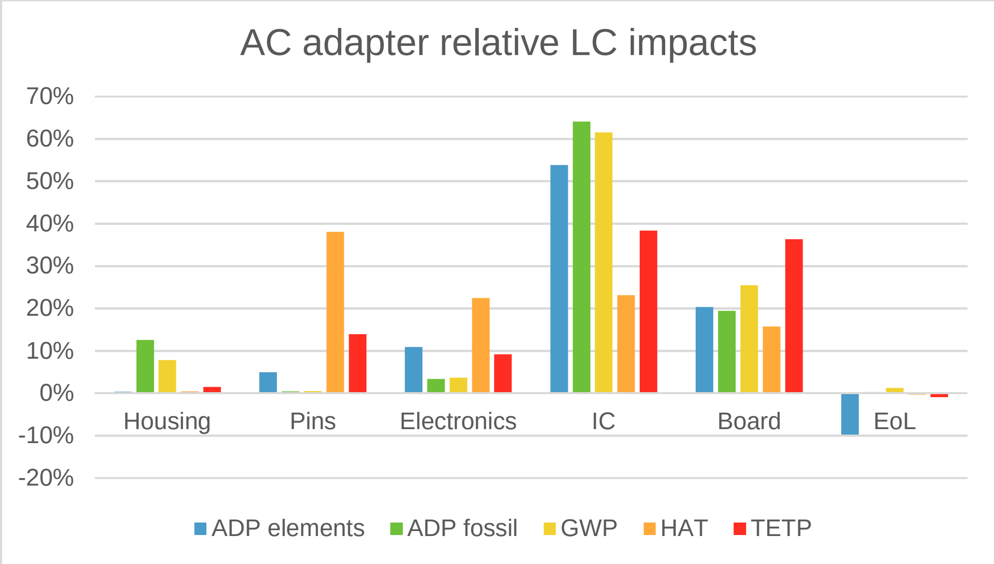

Figure 4 - Impact share (AC adapter)

Table 2 - Absolute values of impact categories under study

Impact categories		**Smartphone**		**AC adapter**		**Cable**	
	Unit	Production	EoL	Production	EoL	Production	EoL
ADP elements	kg Sb eq.	6,29E-04	-3,34E-04	7,15E-05	-7,74E-06	4,66E-05	-4,404E-06
ADP fossil	MJ	123	-4,9	11,8	2,94E-02	1,3	1,10E-02
GWP	kg CO_2 eq.	33,6	-0,407	0,898	1,11E-02	9,58E-02	5,08E-03
HAT	kg DCB eq.	8,44	-0,296	0,485	-1,67E-03	1,14E-01	-1,77E-03
TETP	Kg DCB eq.	0,097	-2,69E-03	4,56E-03	-4,43E-05	1,21E-03	-2,77E-05

2.3 Interpretation

Cables are the least impactful part of the system.
The considerable difference in terms of environmental impacts between the AC adapter and the cable suggests that it is much more important to keep in use the adapter and not necessarily the cable. However, also keeping the cable in use and avoiding the production of a new cable yields environmental benefits according to this screening study.
The life cycle impacts of complex electronics products are dominated by the manufacturing phase and proper end-of-life treatment results only in minor credits, if at all. Thus, the environmental argument for harmonizing chargers is rather with avoiding production of not necessarily needed chargers and the effect of avoided e-waste is only the “tip of the iceberg”.

3 Consequences for harmonising “common chargers” by regulation

The trend of modularity in chargers (the AC adapter and the cable being separated pieces connected via a USB Type A or C plug) seems to be beneficial since the failure of one element does not necessarily lead to the replacement of both.
The environmental impacts of chargers is much more related to the AC adapter than to the power and data cable. It is therefore of much higher importance to **standardize the interface on the secondary side of the adapter** than to standardize also the interface between the power / data cable and the end device.
This approach requires logically a **detachable cable**.
Proprietary interfaces between power / data cable and smartphone provide some other benefits, such as reliability and robustness aspects, which are better fulfilled by some proprietary designs. Investigating these benefits is not part of this study.

The **environmental benefit** of harmonized common chargers however **materializes only**, if smartphones thereafter are sold **without AC adapters** (or without AC adapters and power / data cable), which is done only by very few small players in the market, such as Fairphone and SHIFT. Given that the interface of the adapters is already broadly harmonised by USB Types A and C the main policy challenge is to **require** or **incentivize not to sell new adapters with every new smartphone**.

4 References

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