Zurich University of Applied Sciences

Life Sciences and Facility Management

Institute of Natural Resource Sciences

Repair services and their rebound effects

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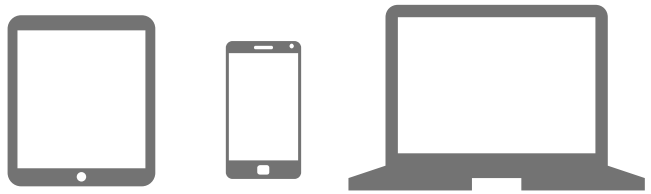
Lifetime Extension of MIEDs: Motivation

Mobile Internet-Enabled Devices (MIEDs)



Contribution of ICT sector to global greenhouse gas emissions

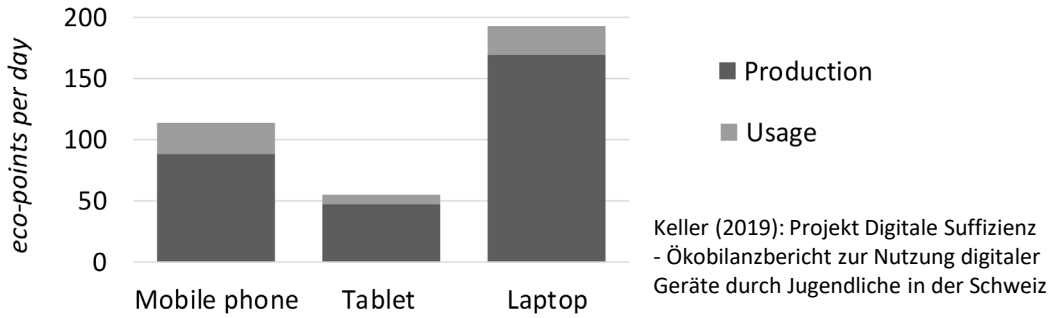
1%
2007

14%
2040

Belkhir (2018): Assessing ICT global emissions footprint: Trends to 2040 & recommendations

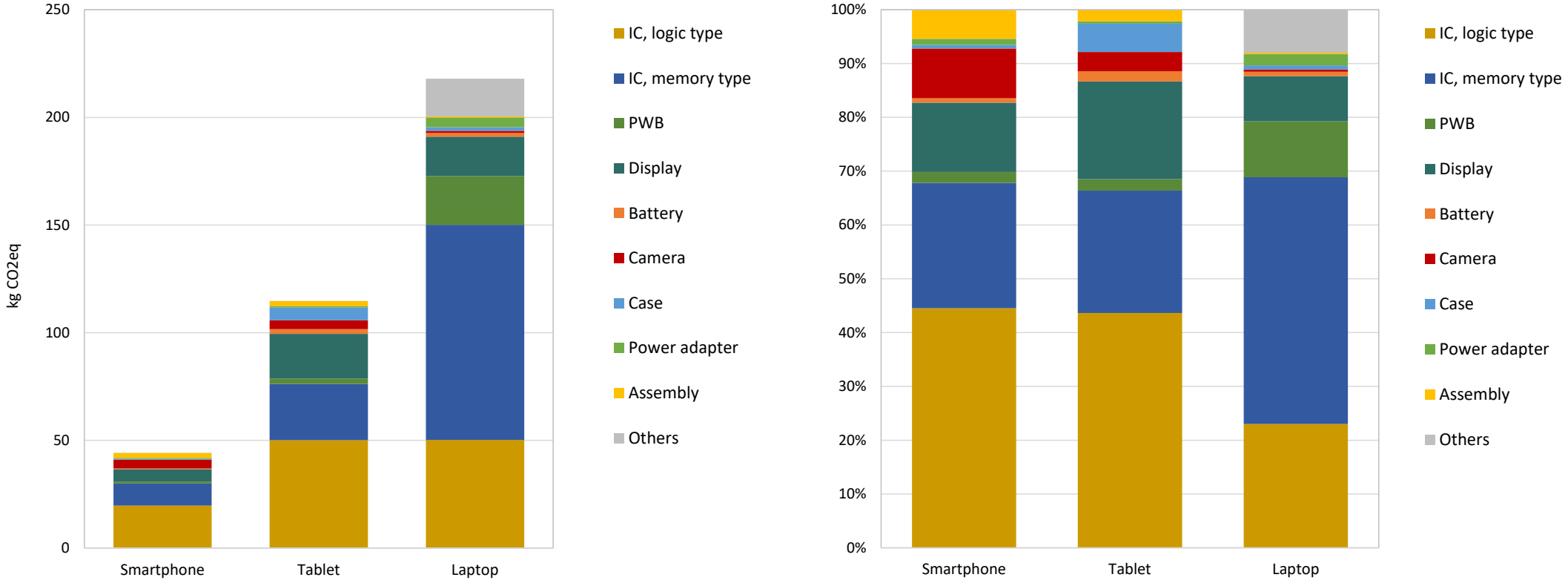
Result of our project “Digital sufficiency”

- Production phase has greatest impact
- Lifetime extension has great potential to reduce the ecological footprint



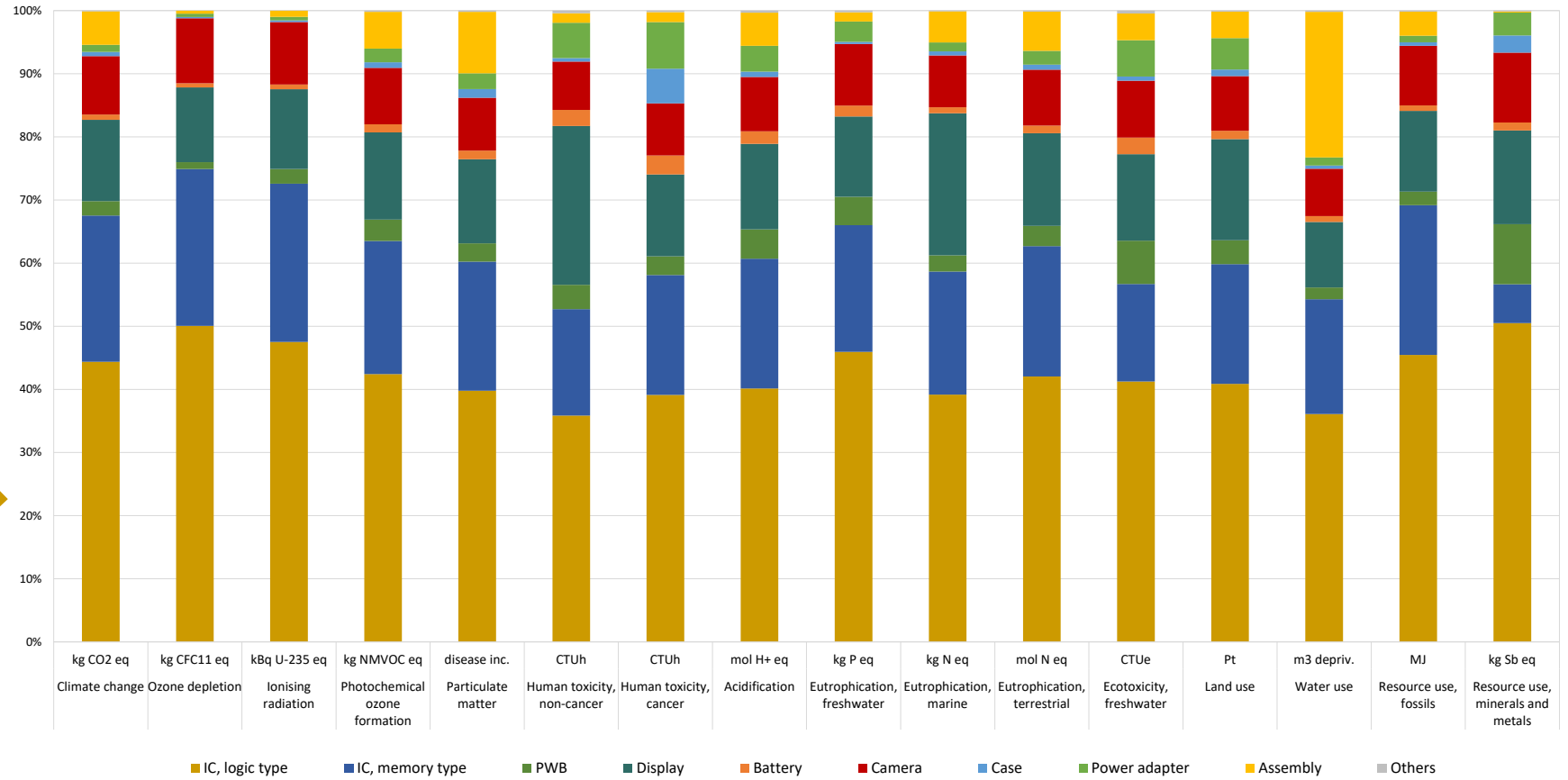
Keller (2019): Projekt Digitale Suffizienz - Ökobilanzbericht zur Nutzung digitaler Geräte durch Jugendliche in der Schweiz

GHG Emissions during MIED Production per Component



The production of integrated circuits (such as memory chips, CPUs and graphics chips) accounts for the majority of the carbon footprint in production phase.

Production of a Smartphone: Environmental Footprint (EF) Method



Production of ICs dominates in all categories, a lifetime extension therefore has a positive effect on all environmental dimensions

Indirect Environmental Impacts of Interventions for Service Lifetime Extension: Repair Services

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In order to holistically assess the environmental impact of measures for service lifetime extension, rebound mechanisms must be taken into account:

1. **Induction effects**
   Occur when the implementation of interventions for service lifetime extension induces activities that are associated with environmental impacts (e.g. production of replacement components or transport for repair).
2. **Imperfect substitution**
   Occurs if the service lifetime extension of a device does not reduce the production of a new device 1:1.
3. **Re-spending effect**
   Occur when used devices are more affordable than new ones, leading to an increase in the effective income of consumers, who increase their consumption of (other) goods or services that are themselves associated with environmental impacts.

Methodology for rebound effects

Environmental impact assessment of rebound effects of selected interventions

Rebound levels:
- Induction
- Substitution
- Re-spending

Environmental impacts:
- GHG emissions
- Mineral resource depletion
- Particulate matter
- Total environmental impact

Devices:
- Smartphone
- Tablet
- Laptop

Intervention:
- Repair display
- Replace battery
- others

Re-spending profile

Consumption sectors	Share
Motor vehicles and parts	5%
Furnishings and durable household equipment	3%
Recreational goods and vehicles	3%
Other durable goods	2%
Food purchased for off-premises consumption	6%
Alcoholic beverages purchased for off-premises consumption	1%
Clothing and footwear	4%
Gasoline and other energy goods	3%
Other nondurable goods	8%
Housing	16%
Household utilities	3%
Health care	16%
Transportation services	3%
Recreation services	4%
Food services and accommodations	6%
Financial services	4%
Insurance	4%
Other services	9%

Estimated savings:

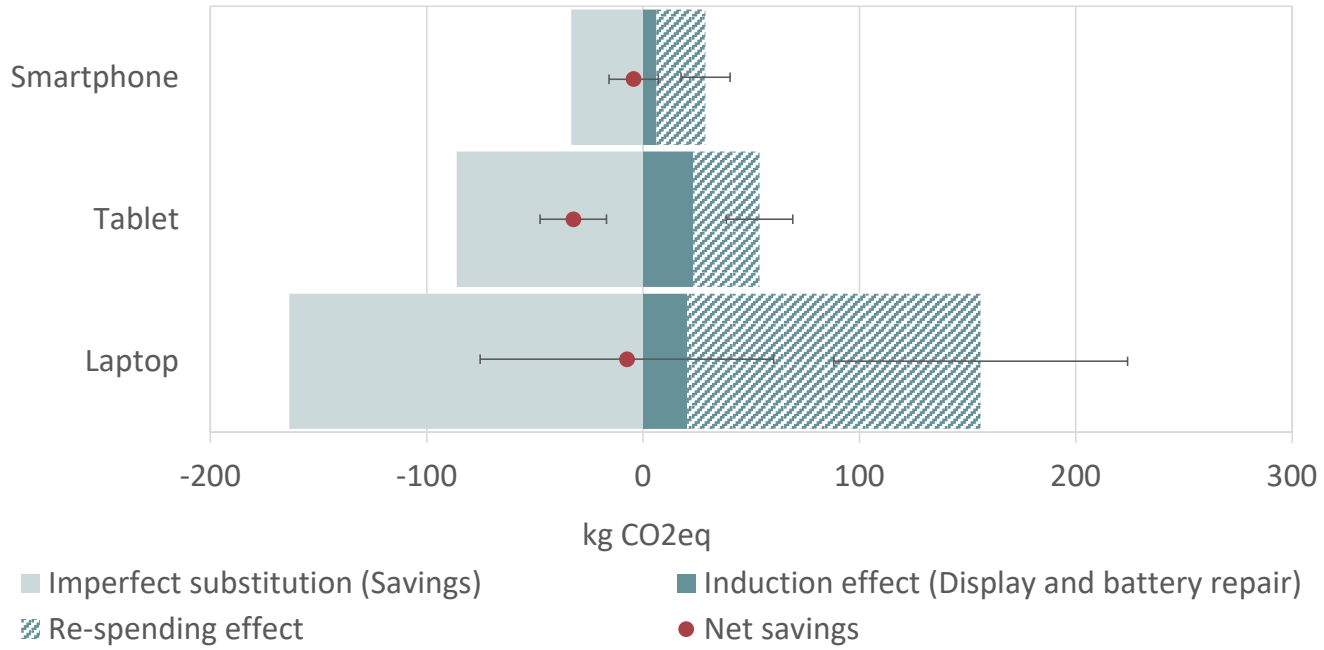
	Smartphone	Tablet	Laptop
Economic Saving CHF	105	142	627
Economic Saving CHF 2005	100	134	594

- Calculated based on current prices for apple products
- New products from apple vs used products from Revendo
- Economic savings are calculated based on the average of 4 models
- Corrected for inflation between 2005 and 2020 (5.2%)

Makov, T., & Font Vivanco, D. (2018). Does the Circular Economy Grow the Pie? The Case of Rebound Effects From Smartphone Reuse. *Frontiers in Energy Research*, *6*.

Environmental Impact of Rebound Effects: Greenhouse gas emissions

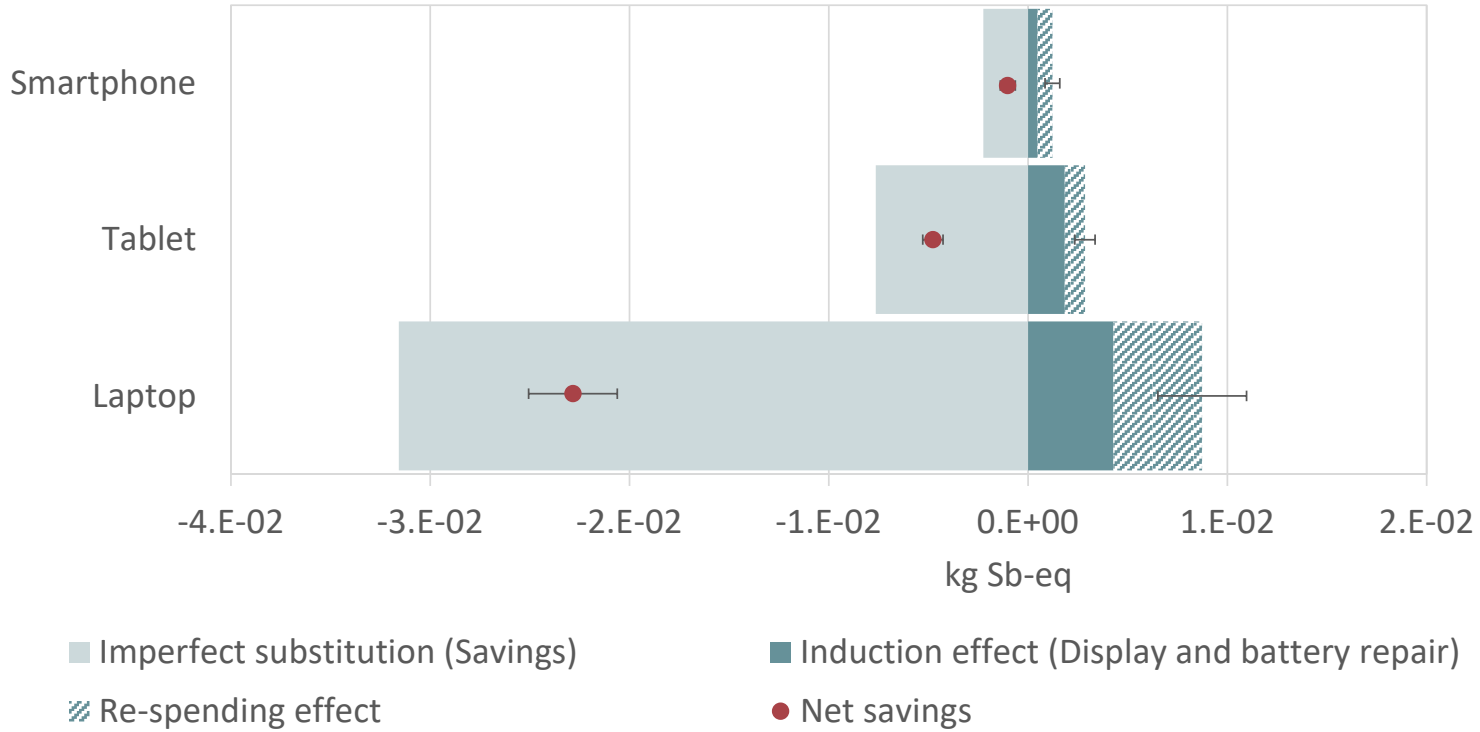
Intervention: Repair of the display and battery



- Intervention repair results in net savings for GHG emissions for all device types
- Net savings for GHG emissions are the highest for tablets

Environmental Impact of Rebound Effects: Mineral Resources

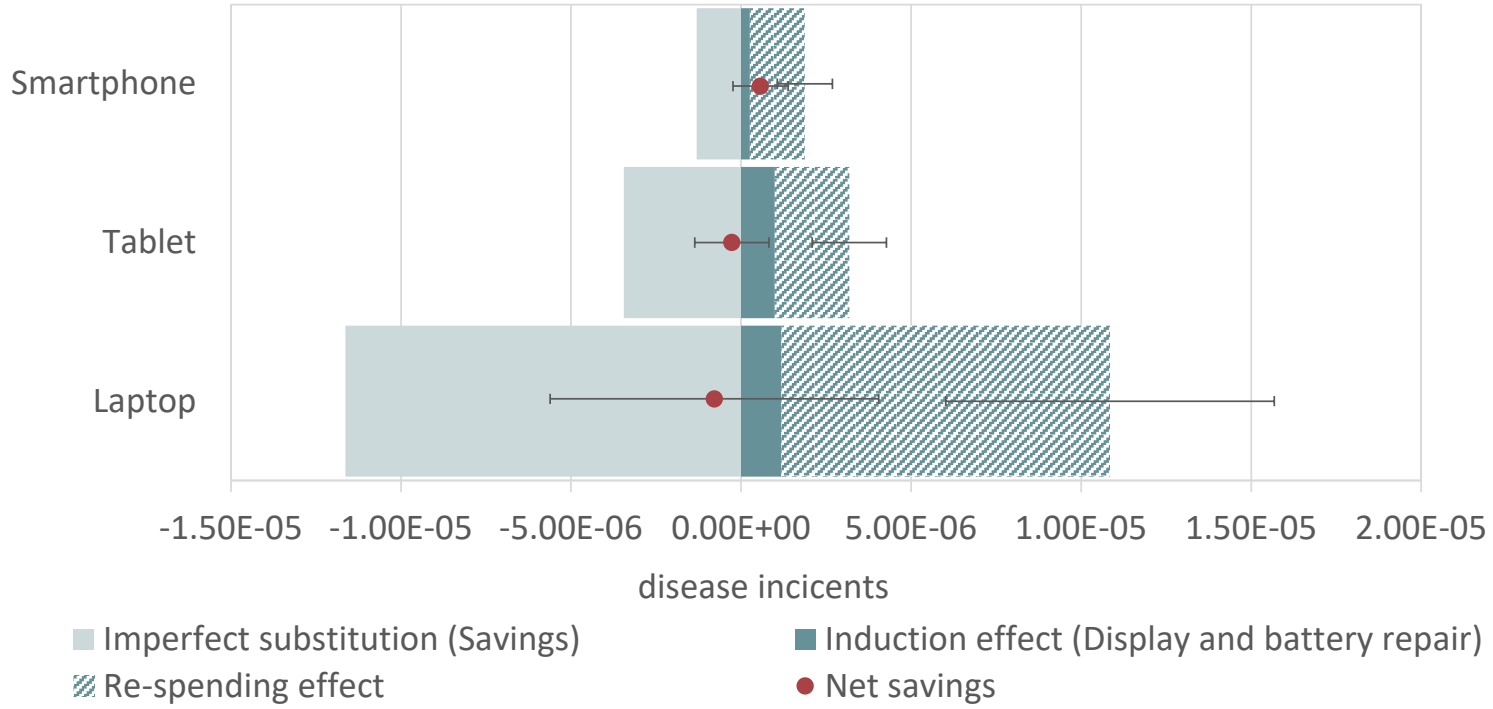
Intervention: Repair of the display and battery



- Intervention repair results in net savings for mineral resources for all device types
- Net savings for mineral resources are the highest for laptops

Environmental Impact of Rebound Effects: Particulate matter

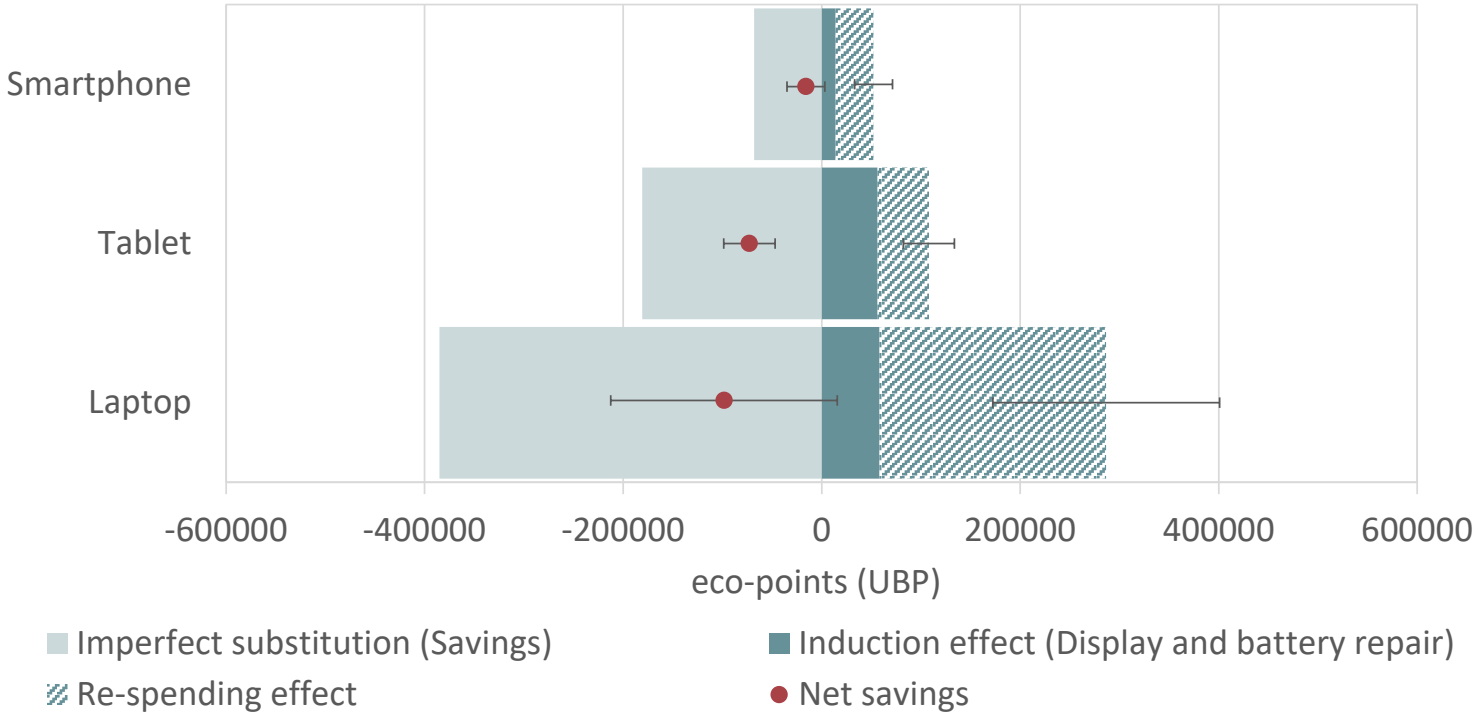
Intervention: Repair of the display and battery



- Intervention repair results in net savings for particulate matter for laptops
- Tablets show low savings
- No savings for smartphones

Environmental Impact of Rebound Effects: Ecological scarcity

Intervention: Repair of the display and battery



- Intervention repair results in net savings for total environmental impacts for all device types
- Net savings for total environmental impacts are the highest for laptops

Environmental Impact of Rebound Effects: Limitations

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- No sensitivity and uncertainty analysis for (im)perfect substitution
- Significant uncertainties at the rebound level re-spending (re-spending profile as well as savings)

→ Scenarios and uncertainty analysis are necessary

- Adapt re-spending profile from the US to better reflect European or Swiss re-spending profile
- Improve data on monetary savings for the intervention “repair”
- Expand the set of analysed interventions

Conclusion

1. **Intervention repair services leads to net savings in environmental impacts**
   For all devices and environmental impacts except for smartphones and particulate matter the intervention repair leads to net savings in environmental impacts, even if re-spending is considered.

2. **Highest net savings for mineral resources**
   For all device type the net savings are the highest for mineral resources and less pronounced for particulate matter and GHG emissions.
   Total environmental impacts show significant net savings for all device types.

3. **Re-spending and imperfect substitution are difficult to quantify**
   Rebound effects caused by re-spending and imperfect substitution have high inherent uncertainty due to the underlying assumptions and will have to be further analysed with sensitivity and uncertainty analysis.

Thanks for your attention

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