Ecodesign for smartphones

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Introduction

Around 1.56 Billion new smartphones per year : How could we reduce their impact ?

Not really realistic but we can still make steps towards it :

Carbon neutrality

What are we aiming at?

Recommendations to walk in the right direction

To do this we use

THIS PRESENTATION

Life cycle analysis and literature

Published LCA data

Fairphone 3

2020

- Already includes reparability possibility and sustainably sourced raw materials
- 39.5 kgCO2 eq
- Impact of modularity is calculated

Fairphone 2

2016

- First improvement of Fairphone
- 43.9 kgCO2 eq
- Recommendation section is pretty useful
- End of life scenarios are interesting

Sony Z5

2016

- Concludes, as the Fairphone, that IC and PCB are the major contributors
- 57 kgCO2 eq
- The emissions from IC production reflect the chip area difference between 2 nodes

Sony XperiaT

2013

- 45 kgCO2 eq
- Main contributions to the total GWP impact include IC production, phone shell raw material acquisition, production and assembly

Strategies

- Replacement cycle of smartphones was about 21 months in 2016.
- Median lifespan of a (pre-smartphone era) mobile phone decreased from 4.8 to 4.6 years between 2000 and 2005.
- Frequency of failures in smartphones can be relatively high compared to other products - 47% of failures in the first 2 years of use; 39% of failures between second and third year.

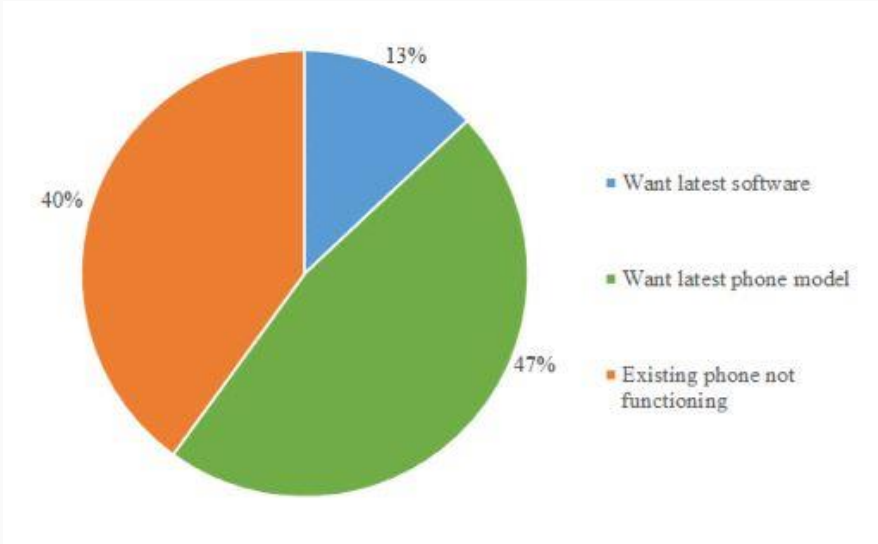


Fig 1. Reasons for purchasing a new smartphone [5]

Design for repair

- The main impact is caused by the product manufacturing (core module) => prolonging the use time has a high potential to reduce the overall environmental impact.
- The scenario presented in fig 2 shows a reduction of 28% in GWP and between 20 and 35 % depending on the impact category for the remaining criteria.
- The modular design – although increasing the initial production impact slightly – has the potential to reduce the overall environmental impact through enabled repairs.

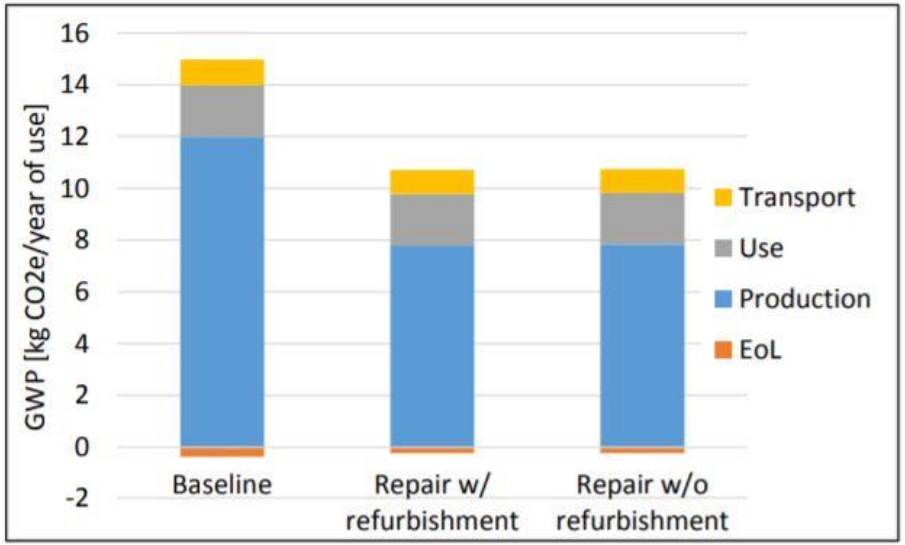


Fig 2. Results per year of use - baseline and repair scenario

Design for reliability

- Two design strategies for the functional lifetime of smartphones:
  - Improving the device reliability;
  - Improving the device repairability.
- Increasing the durability of smartphones is an option to reduce the environmental impacts of these devices
- This can be pursued by improving the reliability of the device.
- More reliability decreases chance of repair or replacements
- Reliability offers longer lifetime and less environmental impacts



Design for reliability

- Main failures of smartphones:
  - Display, Back cover, Battery, Operating System, Electronics
- Failure/limiting states of smartphones could be avoided or postponed through:
  - design of more robust devices, the use of high-quality parts
  - Future-proofing devices offering sufficient memory capacity and performance
  - as well as the availability of software/ firmware and security updates over time

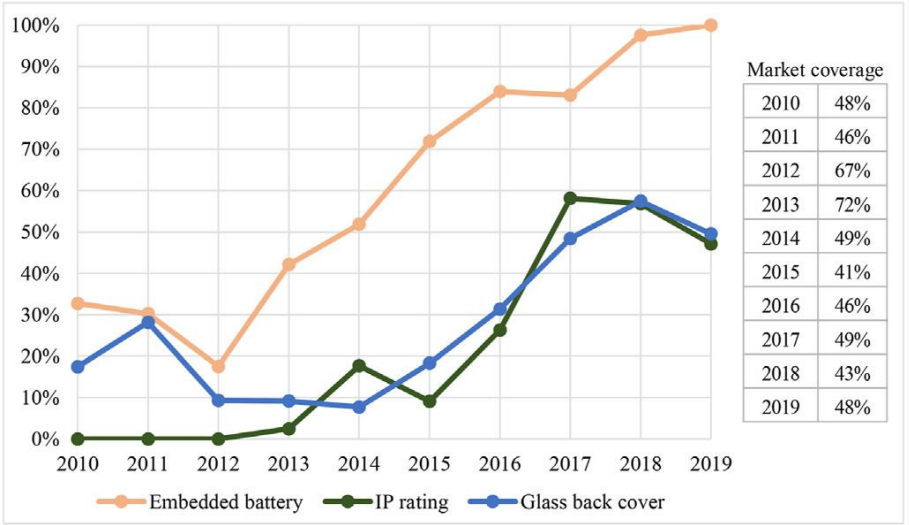


Fig 3. Evolution of design aspects with implications on reliability for best-selling smartphones in Europe (Berwald et al., 2020).

Design for upgradability

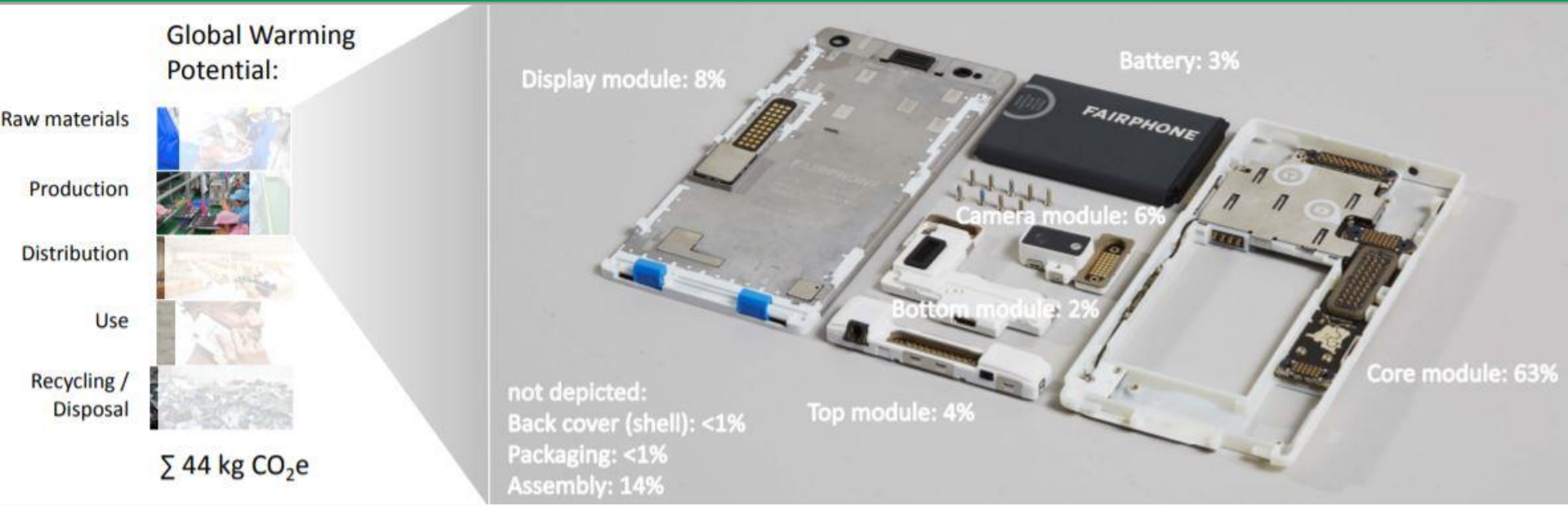


Fig 4. Fairphone 2 Life Cycle Assessment results (GWP) over full life cycle and per module

Design for Multi-functionality

Many devices got replaced by the rise of smartphones. For example:

Radio



Flashlight



GPS



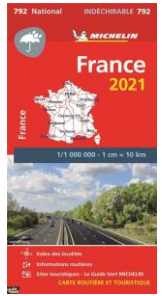
MP3 Player



Audio Recorder



Road Maps



Design for Multi-functionality 

Example of future device integration: **TV Remote**

GWP of a TV Remote Control for a 3 year use period = **13.45 kg CO2 eq**.

Increased smartphone energy consumption = 42.9 Wh => (**0.017 kg CO2 eq.**)

The reduction for one TV remote is equivalent to **34%** of the Fairphone 3 with 3 year usage.

Difficult to quantify the real impact without an adoption rate study.

Effect of Software on Energy Consumption 

The use phase of the Fairphone 2 is **13.6%**.

Comparing three video players (VLC Player, Youtube Video, Samsung Video) we get a **decrease** in energy consumption of **54%** between the worse (VLC Player) and the best (Samsung Video).

Methods to decrease energy consumption:

- from single thread to multithread => **36% decrease**
- from indetermined to determined progress bar => **12% decrease**

Design for Disassembly

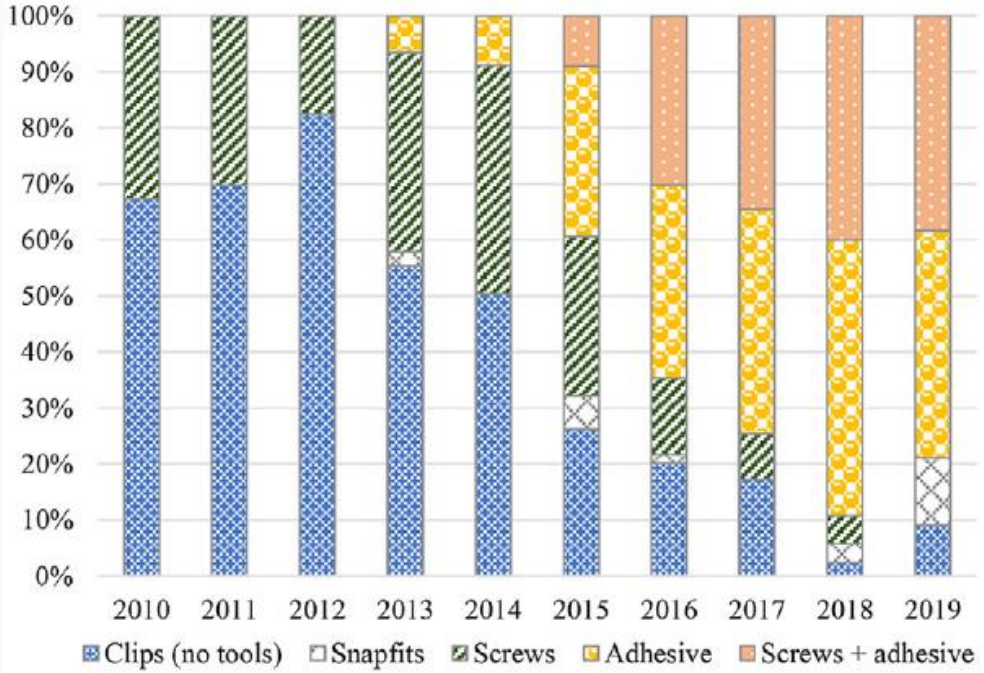
Disassembly

- A very crucial step in the remanufacturing process in terms of acquiring materials for production.

Significance

- Order and Level of Disassembly determines the efficiency of entire remanufacturing process
- Advantageous to remanufacture through disassembly than other EoL strategies
- Avails faster technology replacement than wear-out cycle

Design for Disassembly



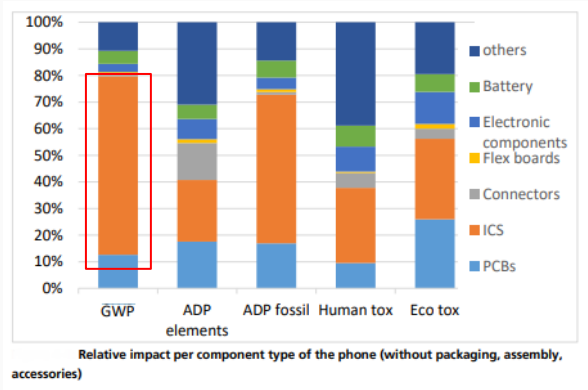
Market coverage	
2010	48%
2011	46%
2012	67%
2013	72%
2014	49%
2015	41%
2016	46%
2017	49%
2018	43%
2019	48%

Manufacturing Optimizations

- **R**enewable **E**nergy consideration by industries during mfg.
- Roles played by industries for green mfg.
- For e.g Apple Inc. claims 100% RE source for all facilities but not transparent of energy type used in mfg. 71% carbon footprint from product mfg.
- Roadmap for reducing the carbon emission and more Green Manufacturing.
- Impact of the GHG emission esp. on IC production must be considered.



Scope 1	
Direct emissions	<1%
Scope 2	
Emissions from electricity	0%
Scope 3	
Business travel and employee commute	1%
Product manufacturing	71%
Product transport	8%
Product use	19%
Material recovery	<1%
Emissions offset	-<1%



Relative impact per component type of the phone (without packaging, assembly, accessories)

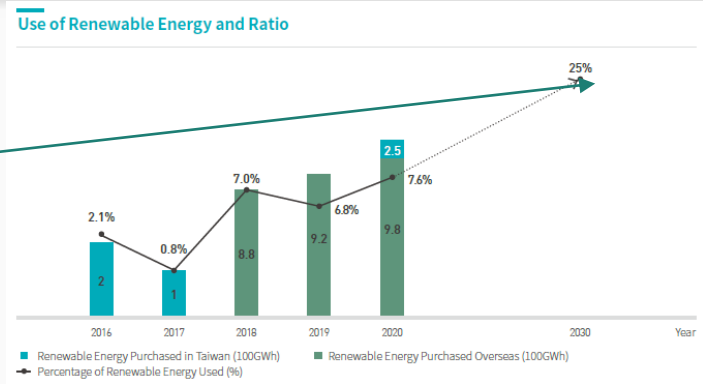
Manufacturing Optimizations (Case Study)

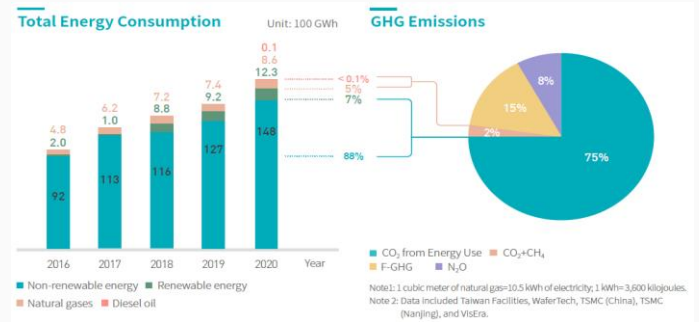
In 2020, **TSMC** carried out

- 460 energy-saving measures, 8 different categories
- 1230 GWh Renewable Energy Use
- 7.6% in 2020, aims for 25% in 2030
- 500 GWh Energy conserved (Actual output)
- Eq. of 250,000 metric tons of carbon emissions

➢ **21.6 million** eqv. of annual carbon absorption

- NT$1.25 billion of actual financial savings
- First semiconductor company in world to join RE100*
- Exemplary for other industry to use renewable energy in manufacturing





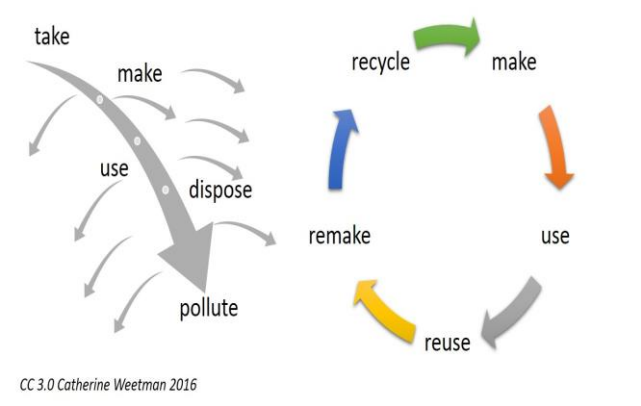
*Global initiative where members must commit to 100% renewable by 2050. Source: TSMC 2020 Report

Results and discussions



- Design for repair, reliability and upgradability - same purpose: longer lifetime cycles for devices => less environmental impact
- Design for Multi-functionality - communication between different industries to increase adoption rate
- Effect of software on energy consumption - creating a energy label for apps
- Design for Disassembly - simplify the process => ease to remanufacture/recycle (e.g. use screws instead of adhesive)
- Manufacturing optimisation - switching to green energy => most impactful

Conclusion



- Manufacturing (up to 80%+ of emissions) - hardest to implement but with the highest environmental impact;
- Design for repair - smaller impact (reduction of 20-30% in emissions) but already being adopted by companies;
- Low energy software - low impact (less than 10% reduction), depends on user adoption - easy to implement

Thank you!

