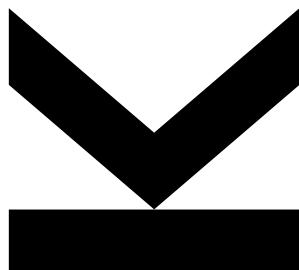


# INNOVATION POTENTIALS FOR MOBILE DEVICES IN THE CIRCULAR ECONOMY

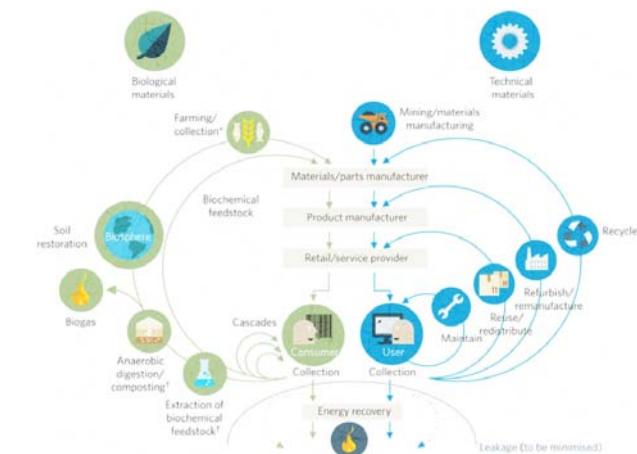
(INNOVATIONSPOTENZIALE MOBILER ENDGERÄTE IN DER CIRCULAR ECONOMY)



Innovationsverbund Nachhaltige Smartphones (INAS),  
Centre for Sustainability Management, Leuphana Universität Lüneburg, 23.6.2016

**Prof. Dr. Erik G. Hansen**

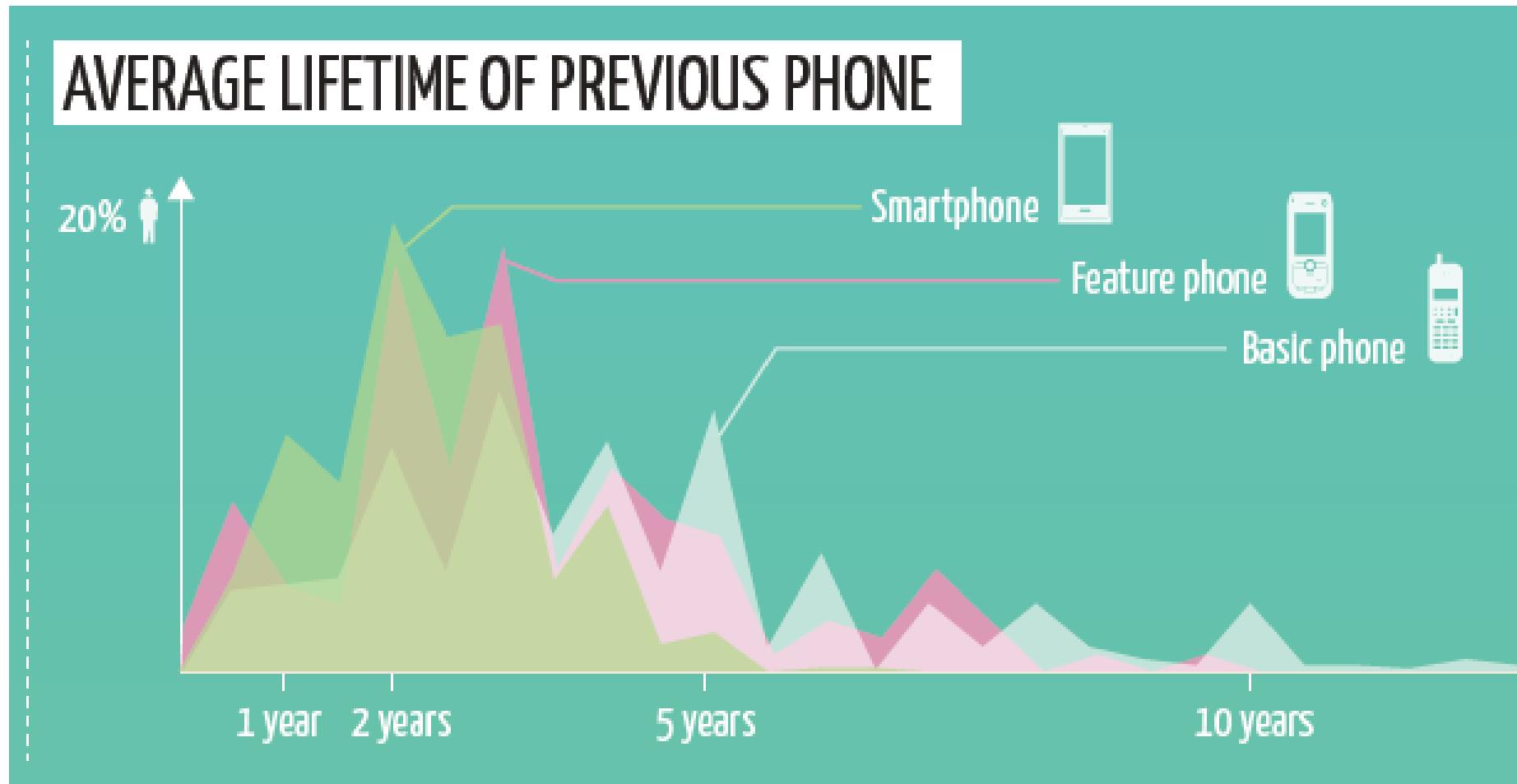
Institute for Integrated Quality Design (IQD)



# AGENDA

1. Introduction with some Smartphone challenges
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4. Conclusion

## DECREASING PRODUCT LIFETIME



Infographic by Youge Xiao.

Taken from <http://www.fairphone.com/2014/06/20/next-step-in-life-cycle-assessment-inventory-analysis/>

## FAST FASHION CONSUMPTION STYLES



TEXTE

11/2016

# Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz“

Für Mensch & Umwelt

Umwelt  
Bundesamt

TEXTE 11/2016

Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz, Bau und Reaktorsicherheit

Forschungskennzahl 3713 32 315  
UBA-FB 002290

**Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz“**

von

Siddharth Prakash, Günther Dehoust, Martin Gsell, Tobias Schleicher  
Öko-Institut e.V. – Institut für Angewandte Ökologie, Freiburg

Prof. Dr. Rainer Stamminger  
Universität Bonn, Institut für Landtechnik, Bonn

## PRODUCT OBSOLESCENCE

- Electronic goods are intentionally designed for a specified technical lifespan (though dependent on user groups)
- Various reasons for premature product replacement
- In the case of mobile phones:
  - Design/fashion trends
  - Incentives of telco operators for premature replacement
  - Bad product design (e.g. non replaceable batteries)
- Product price also depends on offered services, availability of replacement parts, design, reparability etc.

Source: Prakash (2014); Prakash et al. 2016

# Digging for rare earths: The mines where iPhones are born

How are these unusual minerals extracted from the ground and why is that process an environmental risk? CNET's Jay Greene explains.

Tech Industry

September 26, 2012

12:00 AM PDT



by **Jay Greene**  
@iamjaygreenie

MOUNTAIN PASS, Calif. -- About 60 miles southwest of Las Vegas, in a mine some 500 feet deep, the beginnings of an iPhone come to life.

But the sleek, shiny iPhone is far, far removed from the rocks pulled out of this giant hole, which looks like a deep crater on the moon. A very deep crater. The ground is covered with rust-colored boulders, rocks, and pebbles. The walls



The rare-earth mineral mine in Mountain Pass, Calif., run by Molycorp.

Source: <http://www.cnet.com/news/digging-for-rare-earths-the-mines-where-ip> (1.10.2015)



Source: <http://eitrawmaterials.eu/> (11.4.2016)

## RARE EARTHS (SAMPLES)

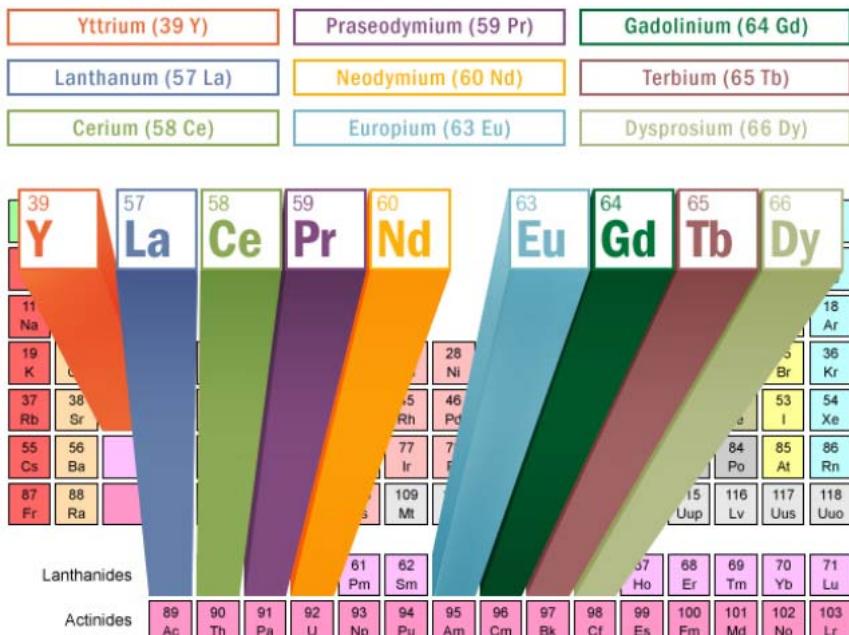


Image source: [www.seltenerdmetalle24.de](http://www.seltenerdmetalle24.de)

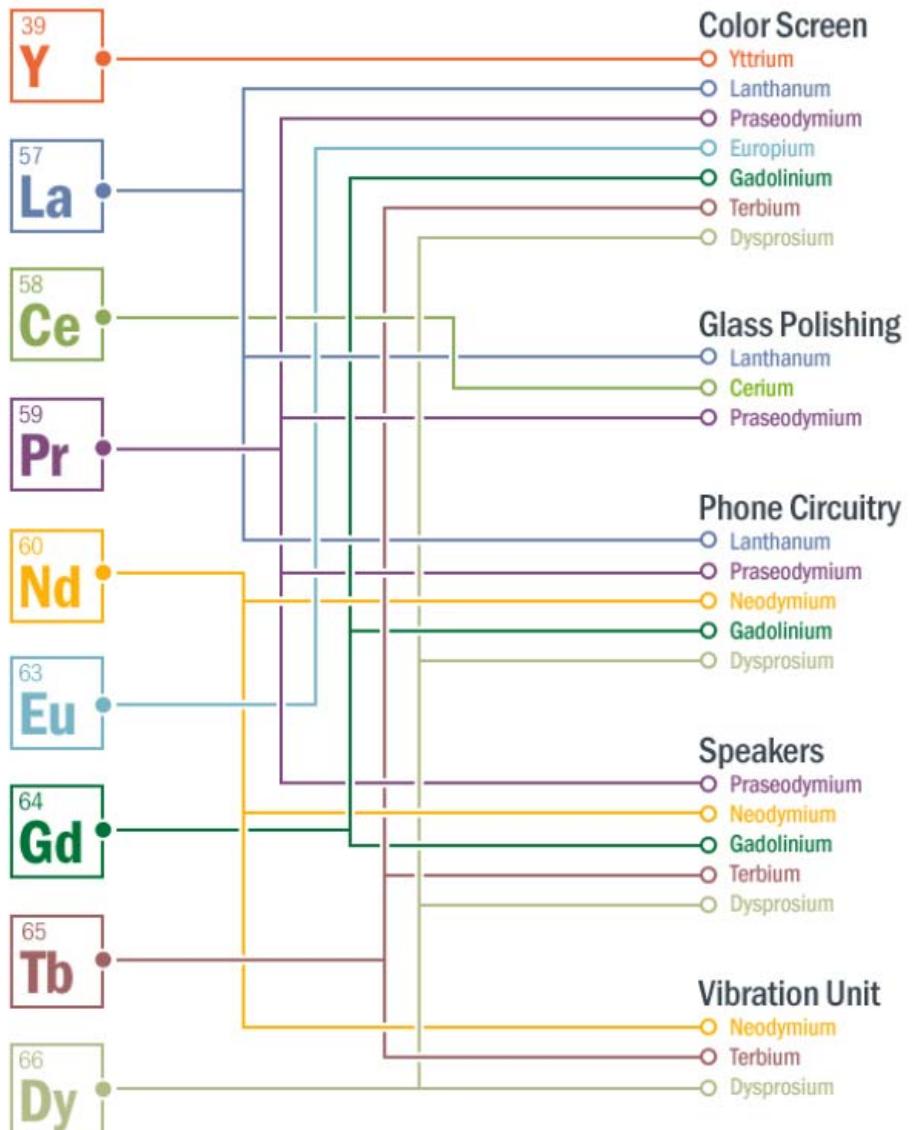
# RARE EARTHS AND SMARTPHONES

## THE PERIODIC TABLE OF iPHONES

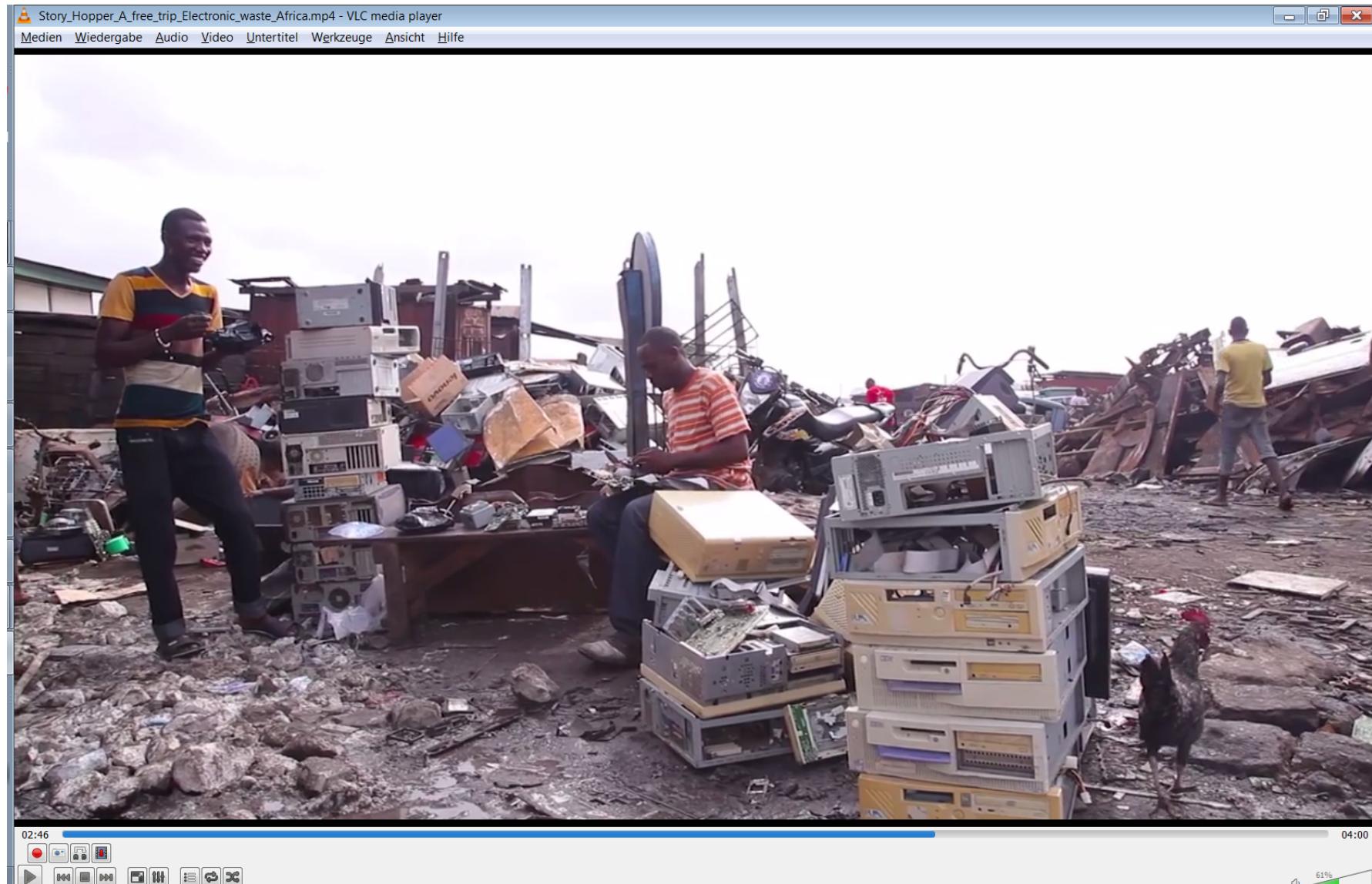
Key ingredients in the iPhone include so-called **rare-earth minerals**, elements whose properties make it light, bright and loud.



Source: <http://www.cnet.com/news/digging-for-rareearths-the-mines-where-iphones-are-born/> (8.5.2016)



# E-WASTE



Source: <https://davehakkens.nl/news/a-free-trip/> (22.6.2016)

# APPROACH 1: RESPONSIBLE SUPPLY CHAINS

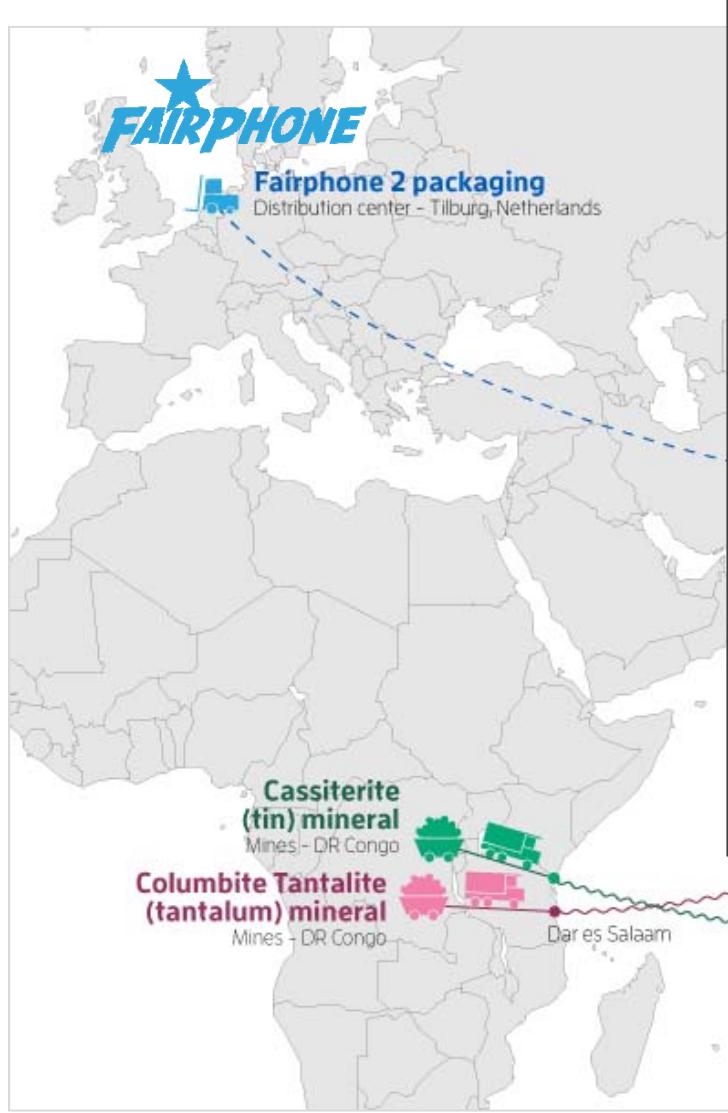


**GeSI**  
GLOBAL e-SUSTAINABILITY  
INITIATIVE

**Responsible Supply Chains of ICT Products**  
Luis Neves, GeSI Chairman

Innovationsverbund Nachhaltige Smartphones  
Lüneburg, 23 June 2016

# CONFLICT FREE SOURCING AND RELATED TRACKING



Source: <https://www.fairphone.com/2015/08/20/supporting-fairer-mineral-initiatives-with-the-fairphone-2/> (20.01.2016)

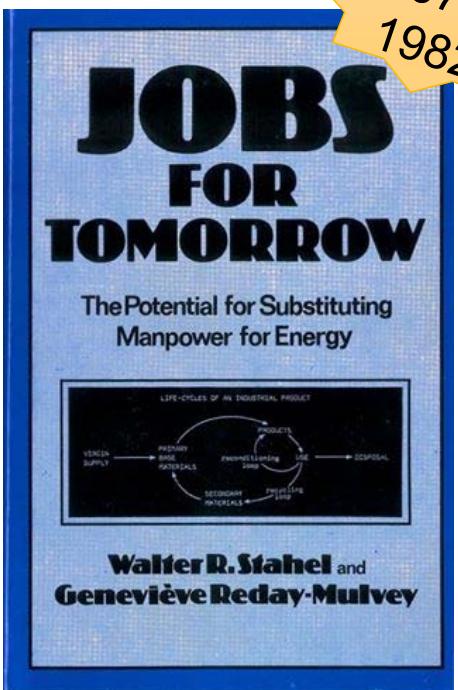
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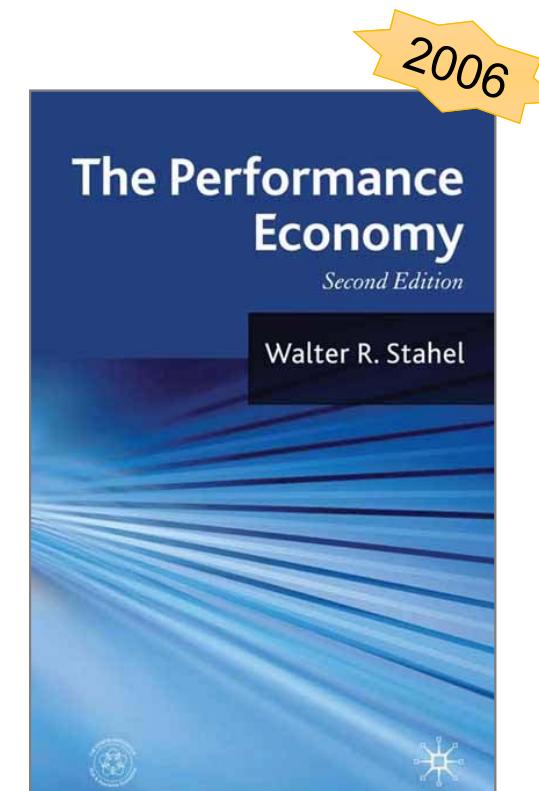
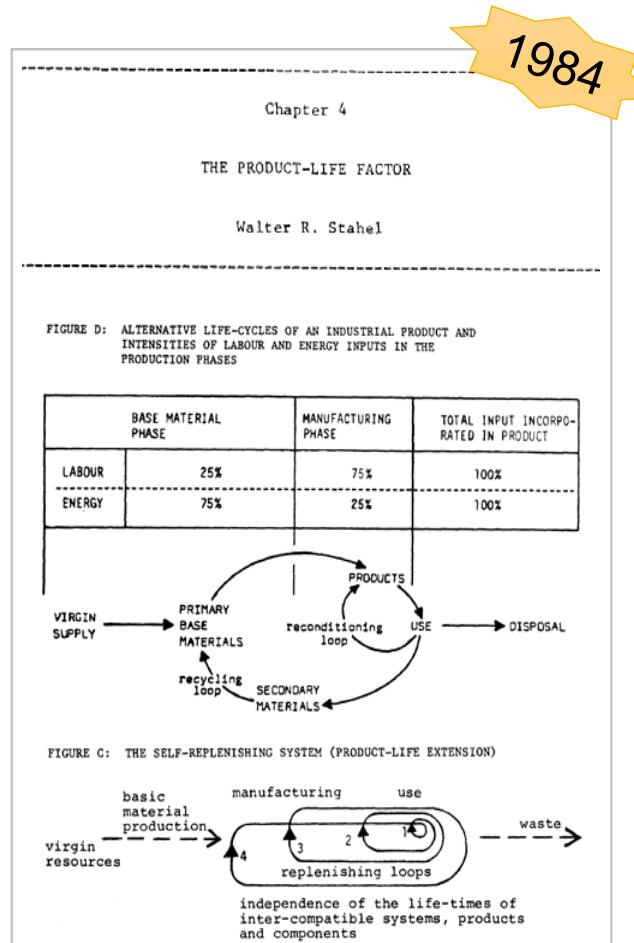
## APPROACH 2: CIRCULAR SUPPLY/VALUE CHAINS



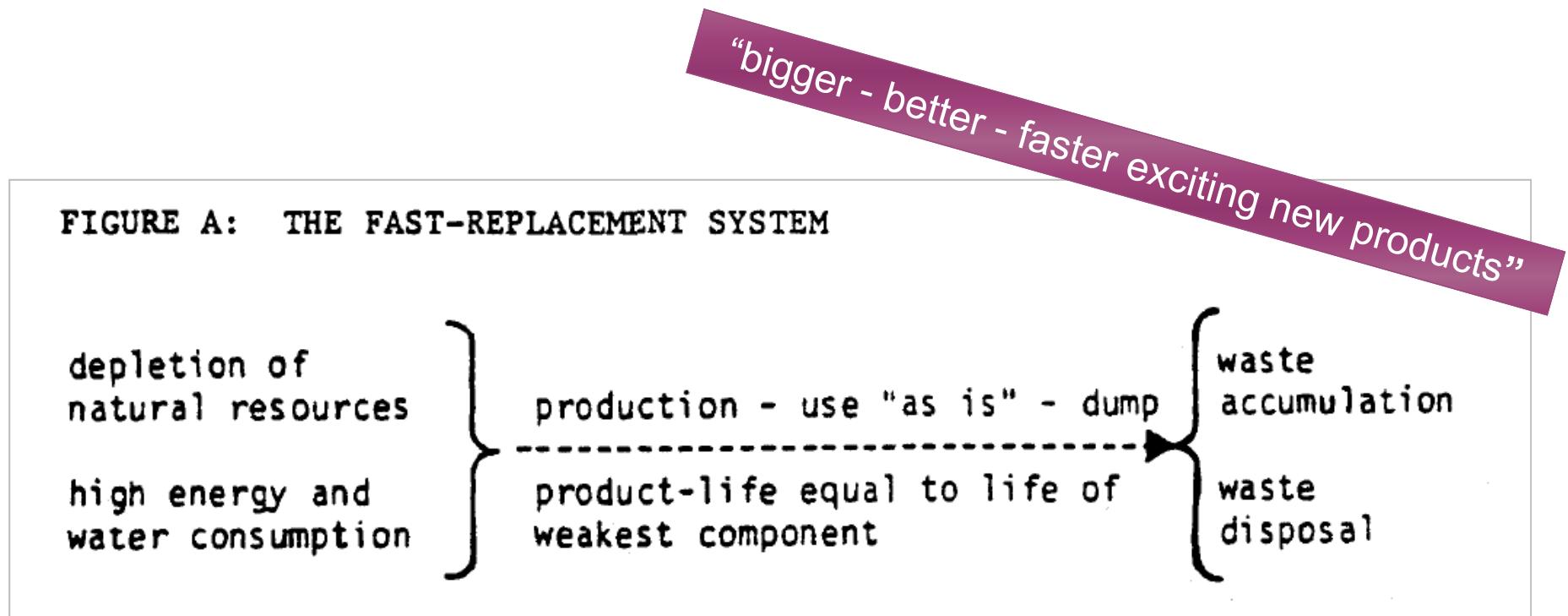
Walter Stahel



1976/  
1982



# 1. STATUS QUO ("FAST-REPLACEMENT SYSTEM")

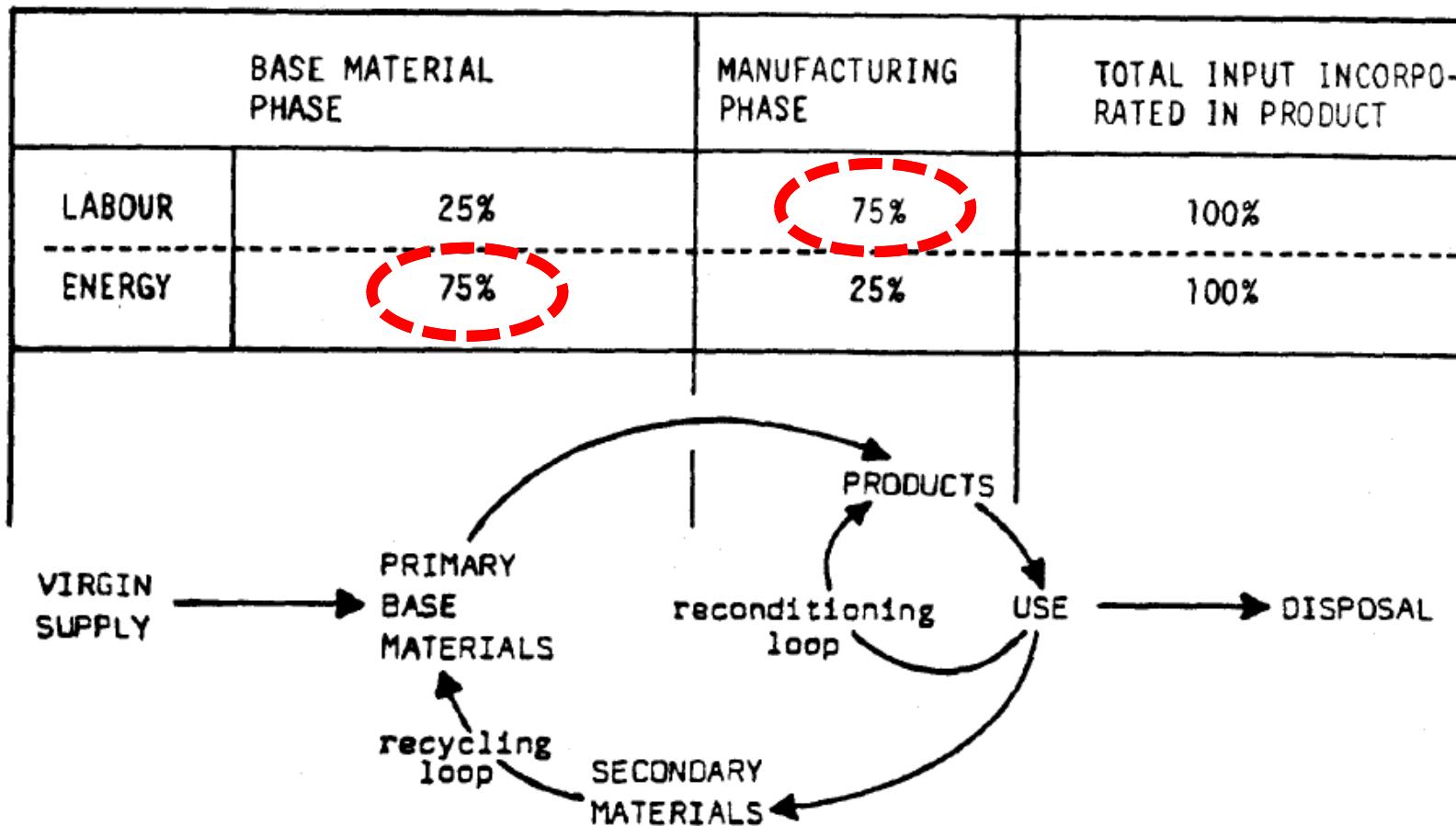


## Assumptions and mechanisms:

- Growth understood as higher production volume
- In stagnant markets, growth only possible by shortening the design life of products → speeding up replacement  
→ short-life, incompatible products, lack of reparability

Source: Stahel 1984, p.73

# ENERGY AND LABOUR INTENSITY OF DIFFERENT PRODUCT LIFE-CYCLE STAGES

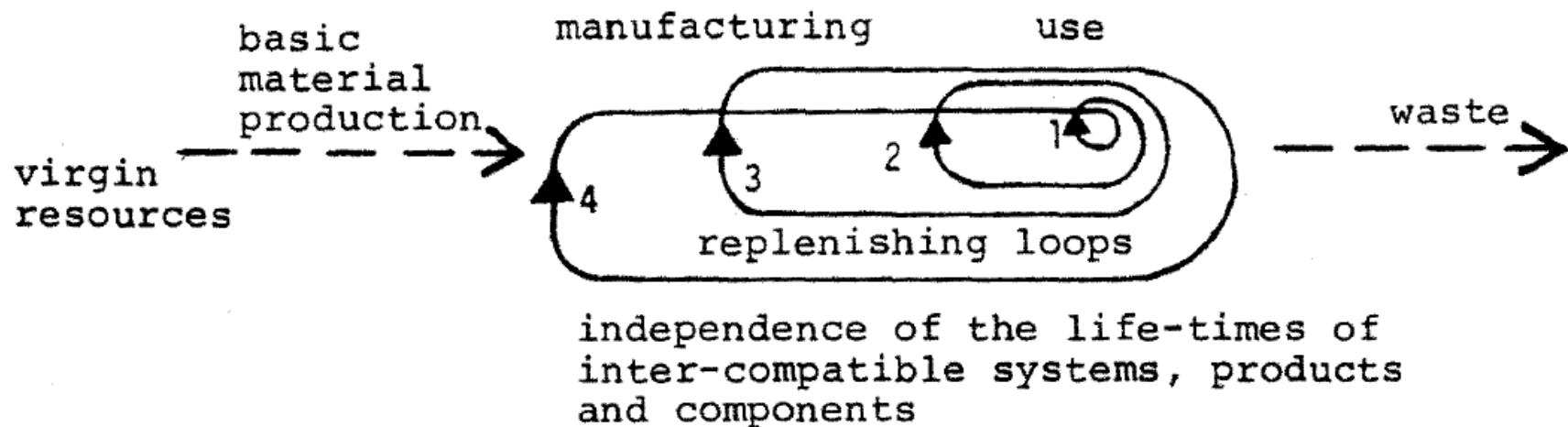


→ Circular economy: Substituting manpower for energy

Source: Stahel 1984, p.76

## "SELF-REPLENISHING SYSTEM": SERVICES FOR THE CONTINUOUS EXTENSION OF PRODUCT-LIFE ("

FIGURE C: THE SELF-REPLENISHING SYSTEM (PRODUCT-LIFE EXTENSION)



### Assumptions and mechanisms:

- Goal: Minimisation of matter, energy-flow and environmental deterioration
- Reuse, Repair, Reconditioning, Recycling (loops)
- Keep the loop as small as possible for maximum resource efficiency!  
(e.g. reuse before remanufacture)
- Application to smallest possible unit: component, product, system
- No restriction of growth or social and technical progress

Source: Stahel 1984, p.74



**ELLEN  
MACARTHUR  
FOUNDATION**  
Rethink the future

SCHMIDT  FAMILY FOUNDATION

Berkeley **Yale**  
UNIVERSITY OF CALIFORNIA

Imperial College  
London

Stanford  **TU Delft**  
Delft University of  
Technology

 **Technische  
Universität  
Berlin**

*Cranfield*  
UNIVERSITY 

  
**LEUPHANA**  
UNIVERSITY OF LÜNEBURG

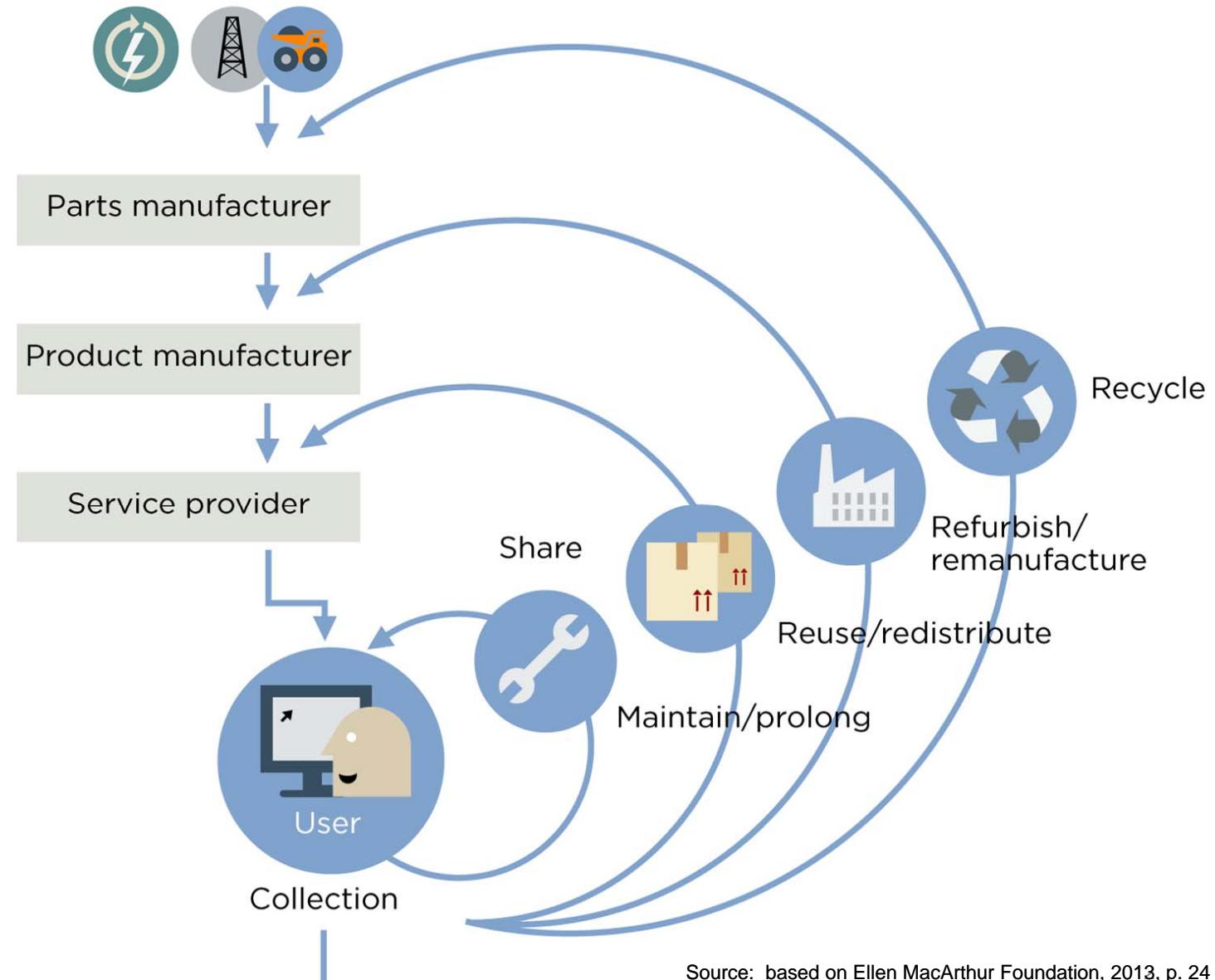
  
**JKU**  
JOHANNES KEPLER  
UNIVERSITY LINZ

**JKU IQD** Institute for  
Integrated Quality  
Design

23.6.2016



## CIRCULAR ECONOMY: LOOPS



# THE CIRCULAR ECONOMY IN DETAIL

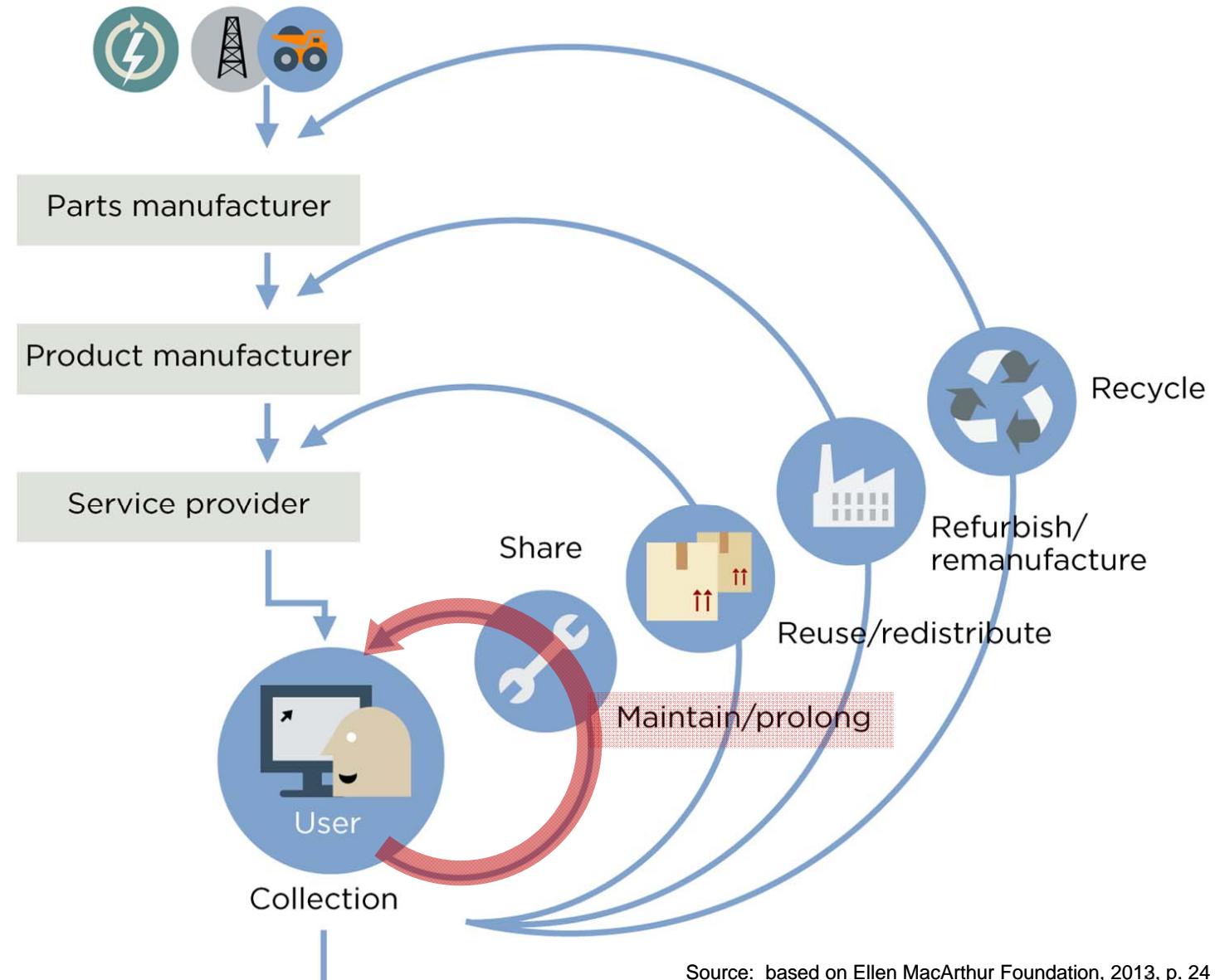


Source: based on Ellen MacArthur Foundation, 2013, p. 24

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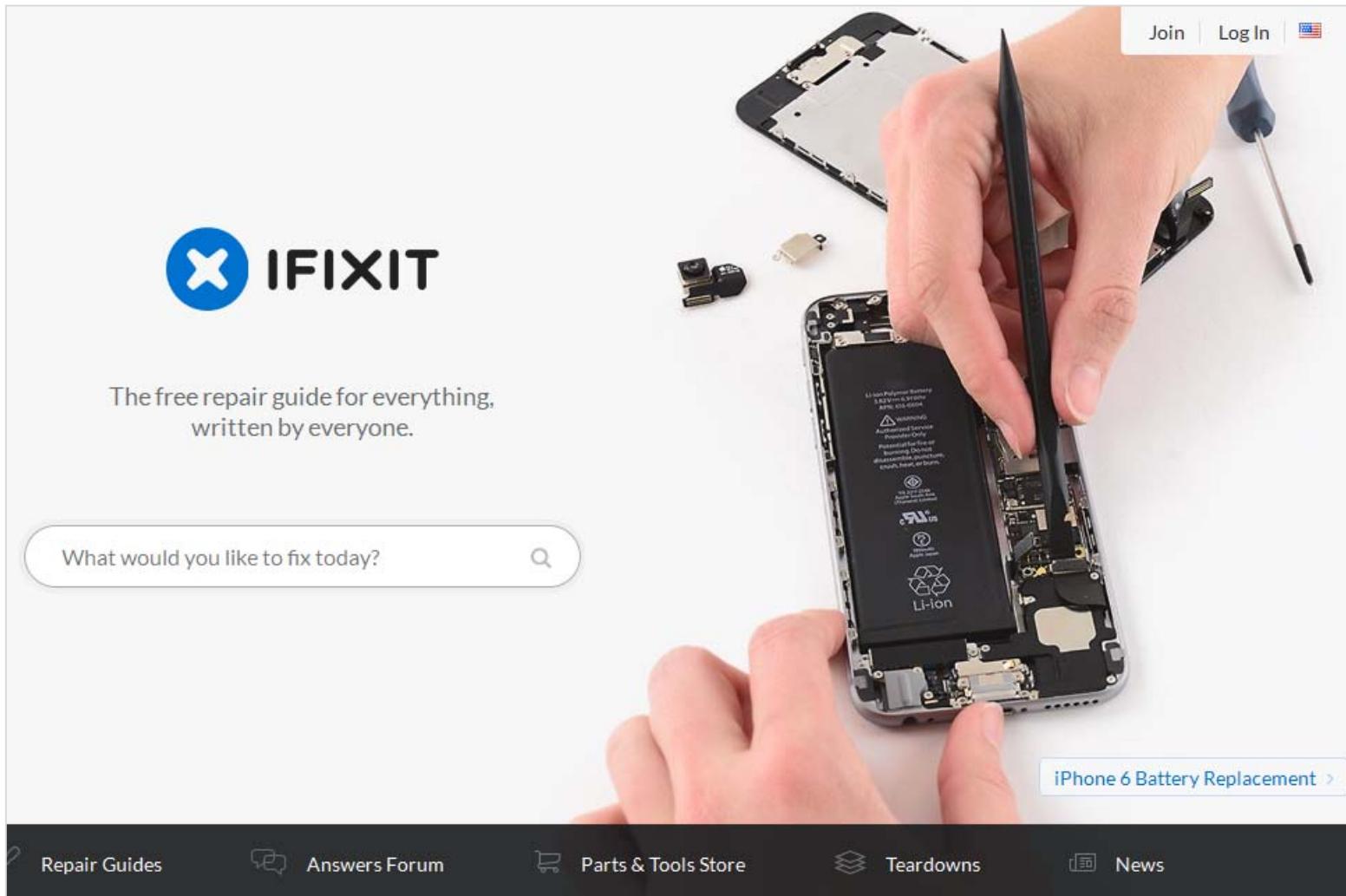
# CIRCULAR ECONOMY: LOOPS





Source: <http://www.express.co.uk/life-style/science-technology/641336/Broken-iPhone-Screen-Apple-Store-Reuse-and-Recycling> (21.6.2016)

# GLOBAL REPAIR COMMUNITY



Source: <https://www.ifixit.com/> (14.12.2015)

# GLOBAL REPAIR COMMUNITY

Smartphone Repairability Scores	
Our engineers disassembled and analyzed each device, awarding a repairability score between zero and ten. Ten is the easiest to repair.	
Fairphone 2 2015	 <ul style="list-style-type: none"><li>+ Modular design allows replacing battery and screen in seconds.</li><li>+ Smaller modules can be removed with a standard Phillips #0 screwdriver.</li><li>+ Disassembly instructions are printed on the phone.</li></ul> 10
Motorola <b>Droid Bionic</b> 2011	 <ul style="list-style-type: none"><li>+ Battery can be removed in seconds.</li><li>+ Modular design allows replacement of many individual parts.</li><li>- Rear camera replacement requires removing an EMI shield.</li></ul> 9
[....]	
Apple <b>iPhone</b> 2007	 <ul style="list-style-type: none"><li>+ Standard Phillips screws used throughout.</li><li>- Hidden clips make it nearly impossible to open rear case without damaging it.</li><li>- Soldered battery is very difficult to replace.</li></ul> 2
HTC <b>One</b> 2013	 <ul style="list-style-type: none"><li>+ Solid external construction improves durability.</li><li>- Virtually impossible to open without extreme damage to rear case.</li><li>- Battery is buried under motherboard and adhered to midframe.</li></ul> 1

Source: <https://de.ifixit.com/Smartphone-Repairability> (14.12.2015)



<https://www.youtube.com/watch?v=6DW733G76BY> (10.04.2016); 0:37

# PRODUCT DIFFERENTIATION THROUGH DESIGN FOR REPARABILITY



<https://www.youtube.com/watch?v=6DW733G76BY> (10.04.2016); 0:37

Image sources:  
<https://www.fairphone.com/2015/11/18/guest-blog-ifixit-on-fairphone-2-the-first-truly-smart-smartphone/>  
(14.12.2015)

# SPARE PARTS - ONLINE STORE



Fairphone 2 Camera Module



Fairphone 2 Bottom Module



Fairphone 2 Top Module



Fairphone 2 Display Module

€34.00

[More information](#)

€19.99

[More information](#)

€25.00

[More information](#)

€85.00

[More information](#)

FP2



Fairphone 2 Battery

€19.99

[More information](#)

FP1 FP1U



Volume and Power button

€2.28

[More information](#)

FP1 FP1U



Midframe

€11.75

[More information](#)

FP1 FP1U



Back Cover

€7.44

[More information](#)

FP1 FP1U



FP1 FP1U



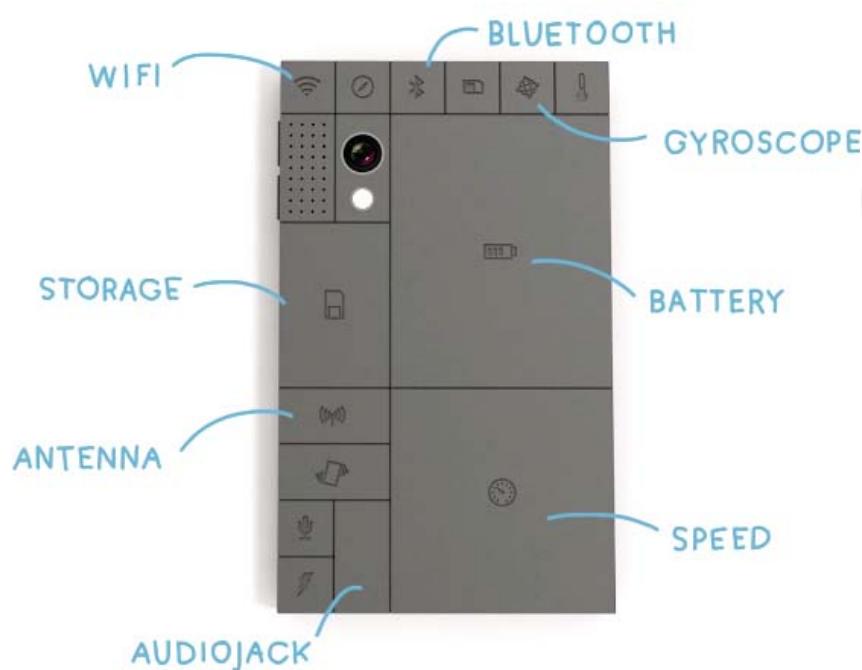
FP1 FP1U



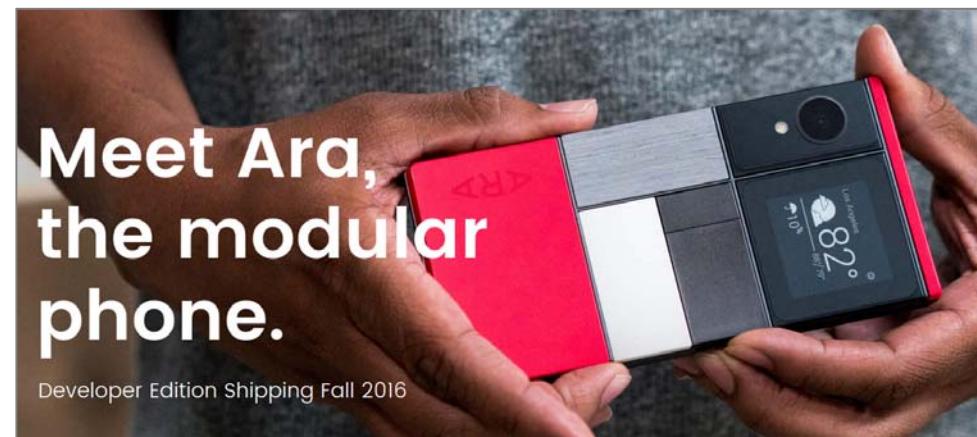
FP1 FP1U

Source: <http://shop.fairphone.com/spareparts.html> (2.5.2016)

## THE MODULAR PHONE?

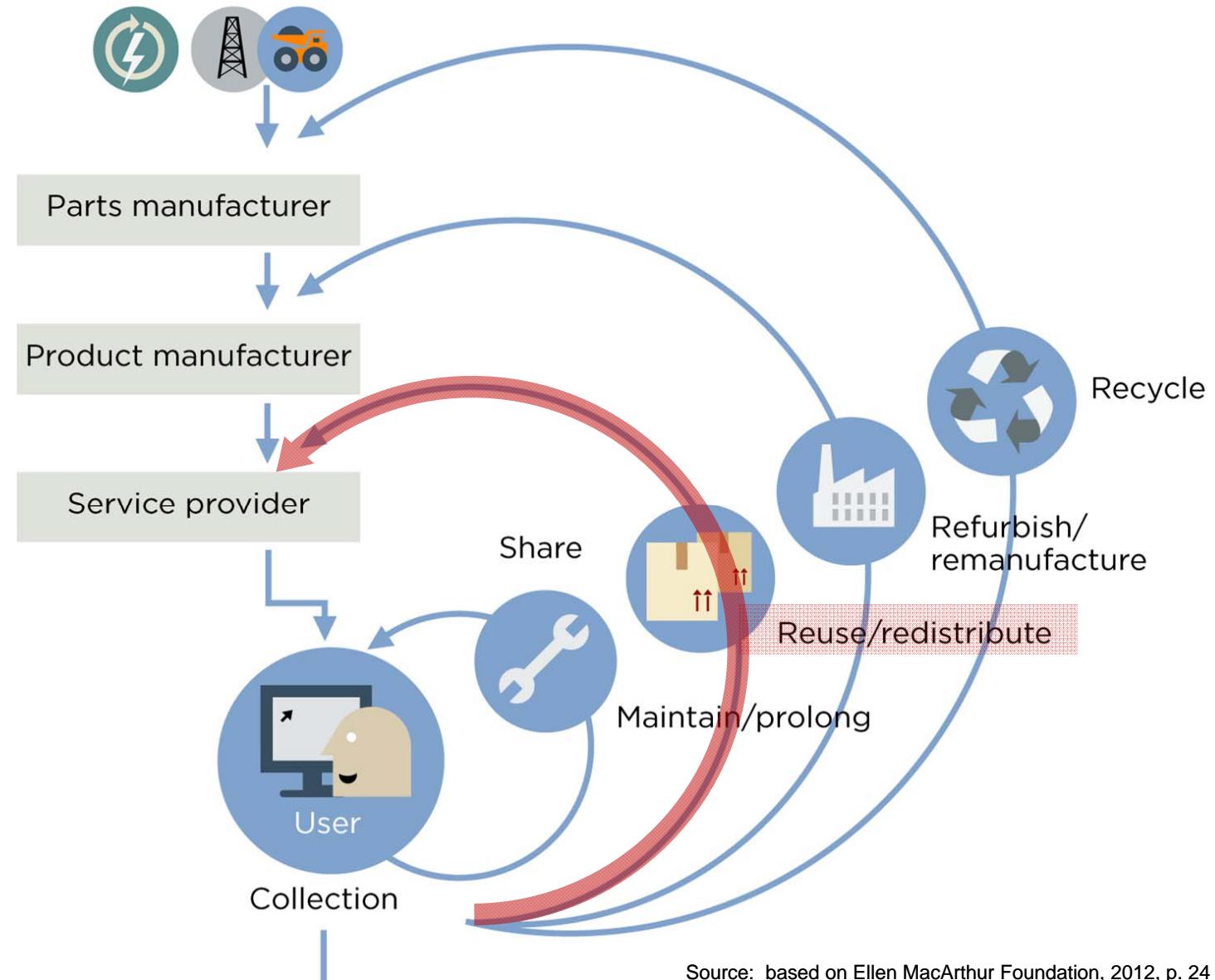


Source: <https://phonebloks.com/> (21.6.2016)



Source: <https://atap.google.com/ara/#about> (23.6.2016)

# CIRCULAR ECONOMY: LOOPS



## 2ND HAND MARKETS

### Ratenzahlung

#### Monatliche Rate

- ✓ Handy einfach und bequem in 24 Monatsraten bezahlen
- ✓ Einmalige Anzahlung im ersten Monat
- ✓ Effektiver Jahreszins (0,00%)

#### Handytausch Option

Mit der Handytausch Option jedes Jahr das aktuellste Smartphone!

[mehr Details](#)

5,00 €<sup>®</sup> mtl. / 12 Monate

10,00 €<sup>®</sup> mtl. Rate / 24 Monate

29,99 € Einmalige Anzahlung

269,99 € Gesamtpreis



Das **alte Gerät wird dann von congstar dem Gebraucht-Handymarkt zugeführt**. Das Tauschverfahren funktioniert laut Anbieter aber nur, sofern das Smartphone lediglich über normale Gebrauchsspuren verfügt. Bei schweren Schäden, wie einem kaputten Display oder Rissen im Gehäuse gibt es kein Tauschgerät.

Source: <http://www.all-net-flat.de/news/congstar/congstar-startet-handytausch-option-jedes-jahr-ein-neues-handy/> (21.6.2016)

## REUSE ORGANIZED BY NON-PROFIT



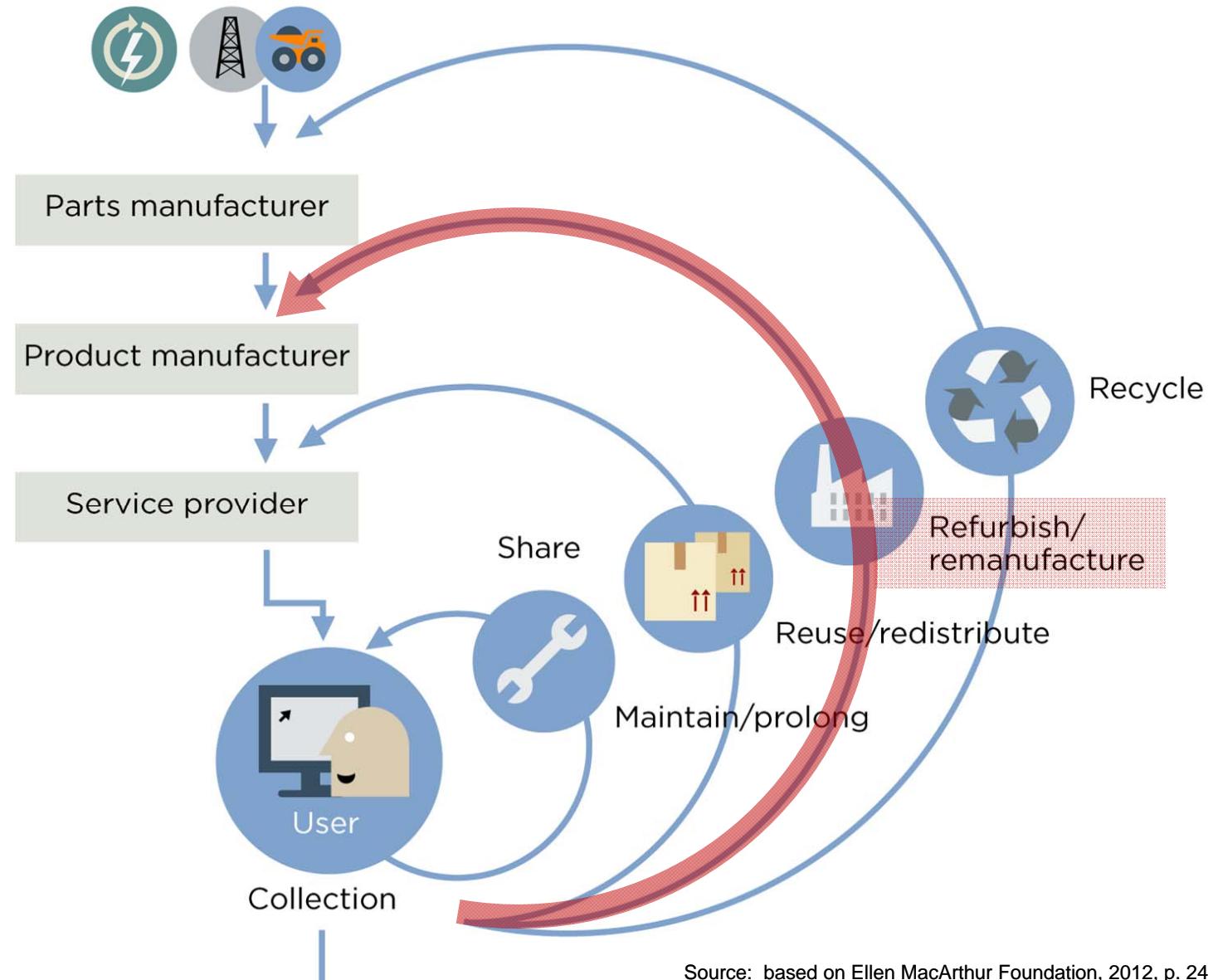
## ReVital-Box

### Wiederverwenden statt Wegwerfen



Source: <http://www.revitalistgenial.at/> (12.11.2015)

# CIRCULAR ECONOMY: LOOPS



# MOBILE PHONE REFURBISHING



<http://oe3.orf.at/wundertuete/stories/2593378/> (21.6.2016)



Foto (c) Erik Hansen

- 11. Ausgabe der Ö3-Wundertüte präsentieren: **388.000 Handys** sind insgesamt in Haushalten, Firmen, Abfallsammelzentren und Schulen gesammelt worden
- Noch **funktionierende Handys werden aufbereitet**
- Die Geräte werden an **spezialisierte Großhändler in Asien** verkauft
- und gehen nach dem Aufbereitungsprozess in **Schwellen- und Entwicklungsländer** - nur dort gibt es einen **Markt für große Mengen an Secondhand-Handys**

# REMANUFACTURE POTENTIAL OF SMARTPHONES

- Key components: camera, display, battery, charger
  - most valuable
  - easy to disassemble
  - potential for use in production of new devices/aftermarkets
  
- Need of
  - standardized components across brands (industry standards)
  - Design for disassembly

Source: <https://www.ellenmacarthurfoundation.org/circular-economy/interactive-diagram/in-depth-mobile-phones> (21.6.2016)

## REMANUFACTURE: SEE ALSO

<http://www.remanufacturing.org.uk/pdf/story/1p291.pdf> (22.6.2016)

### Investigation of commercial remanufacturing business models and complementary product design for a Mobile Broadband handset

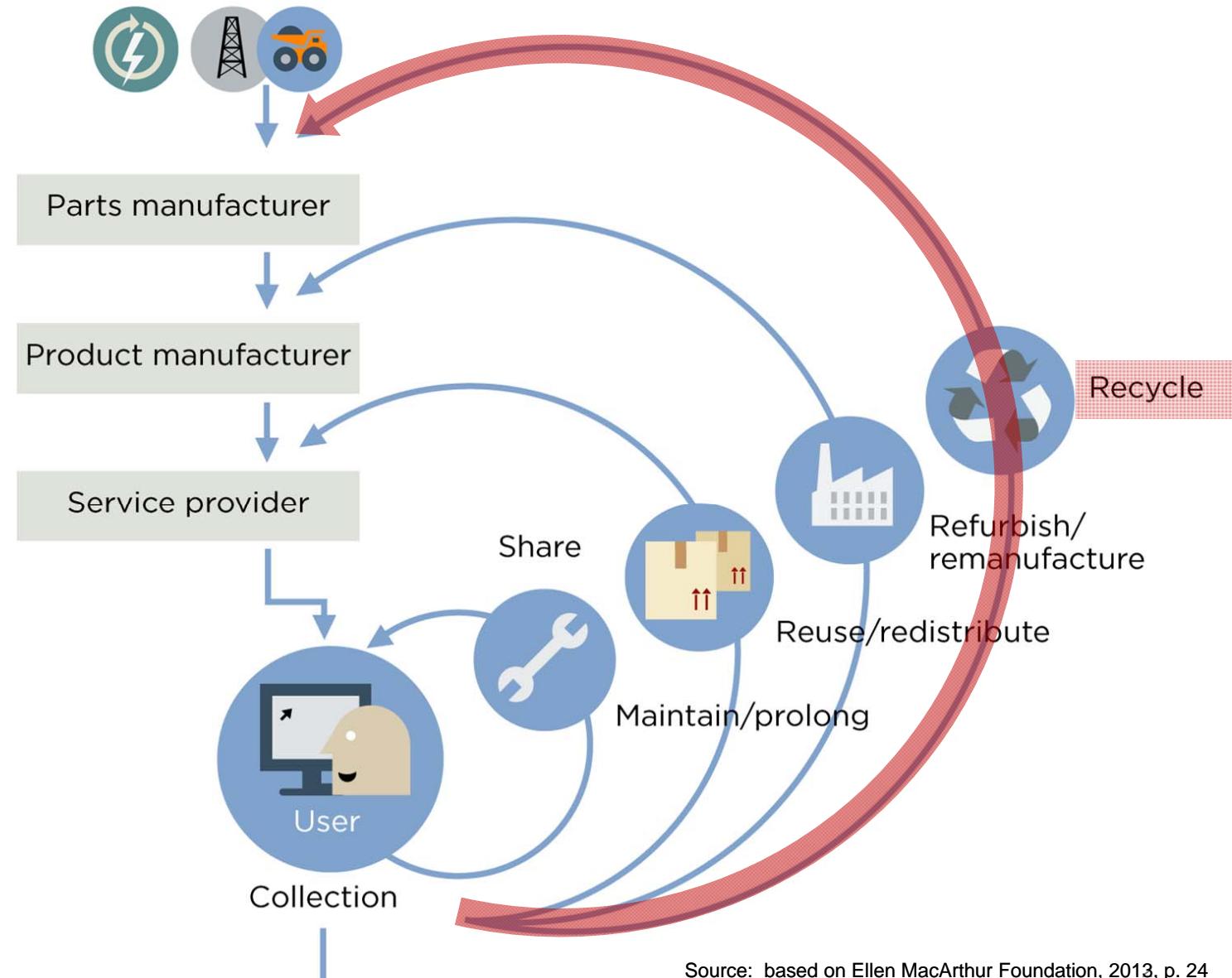
*Final Report*



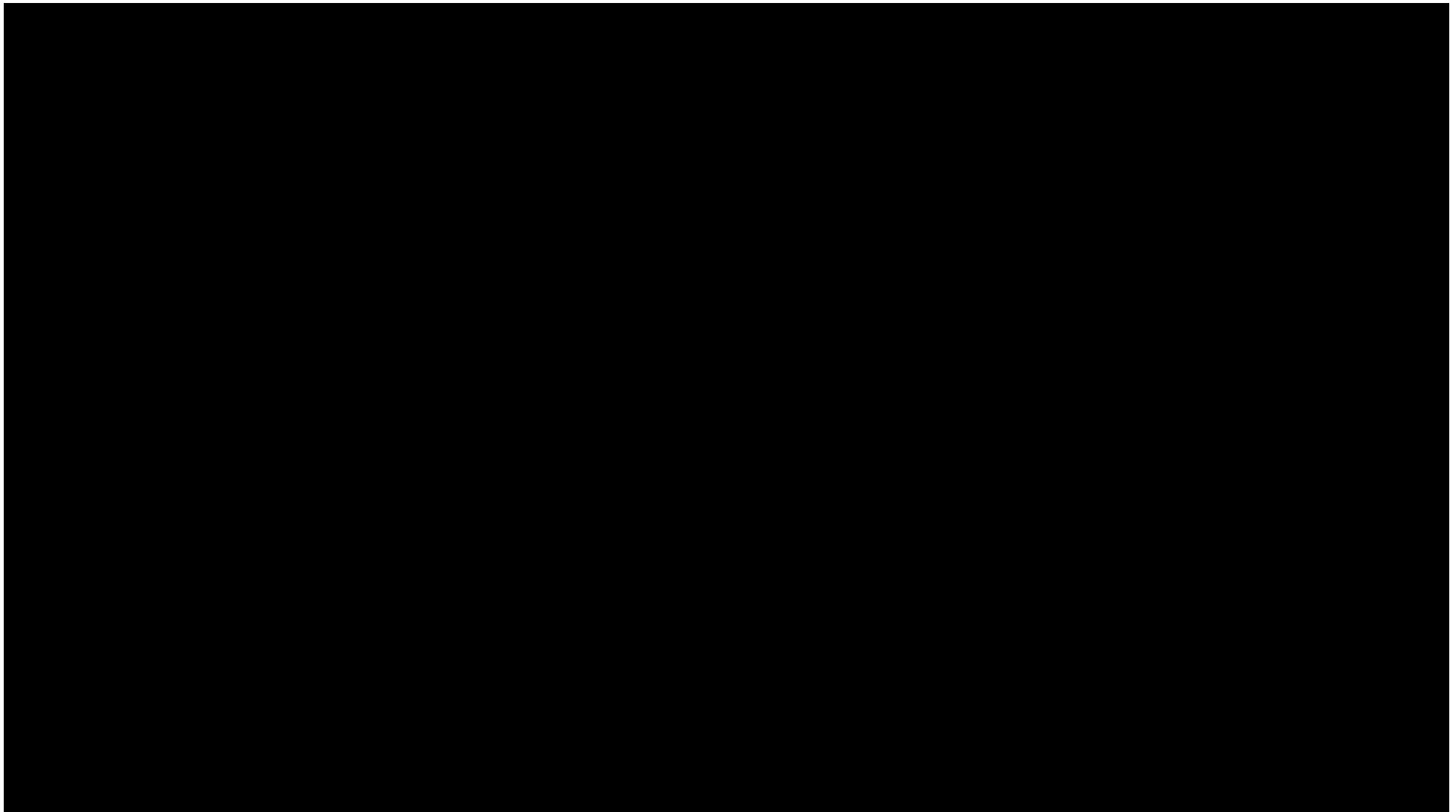
Funded by The Centre for Remanufacturing and Reuse



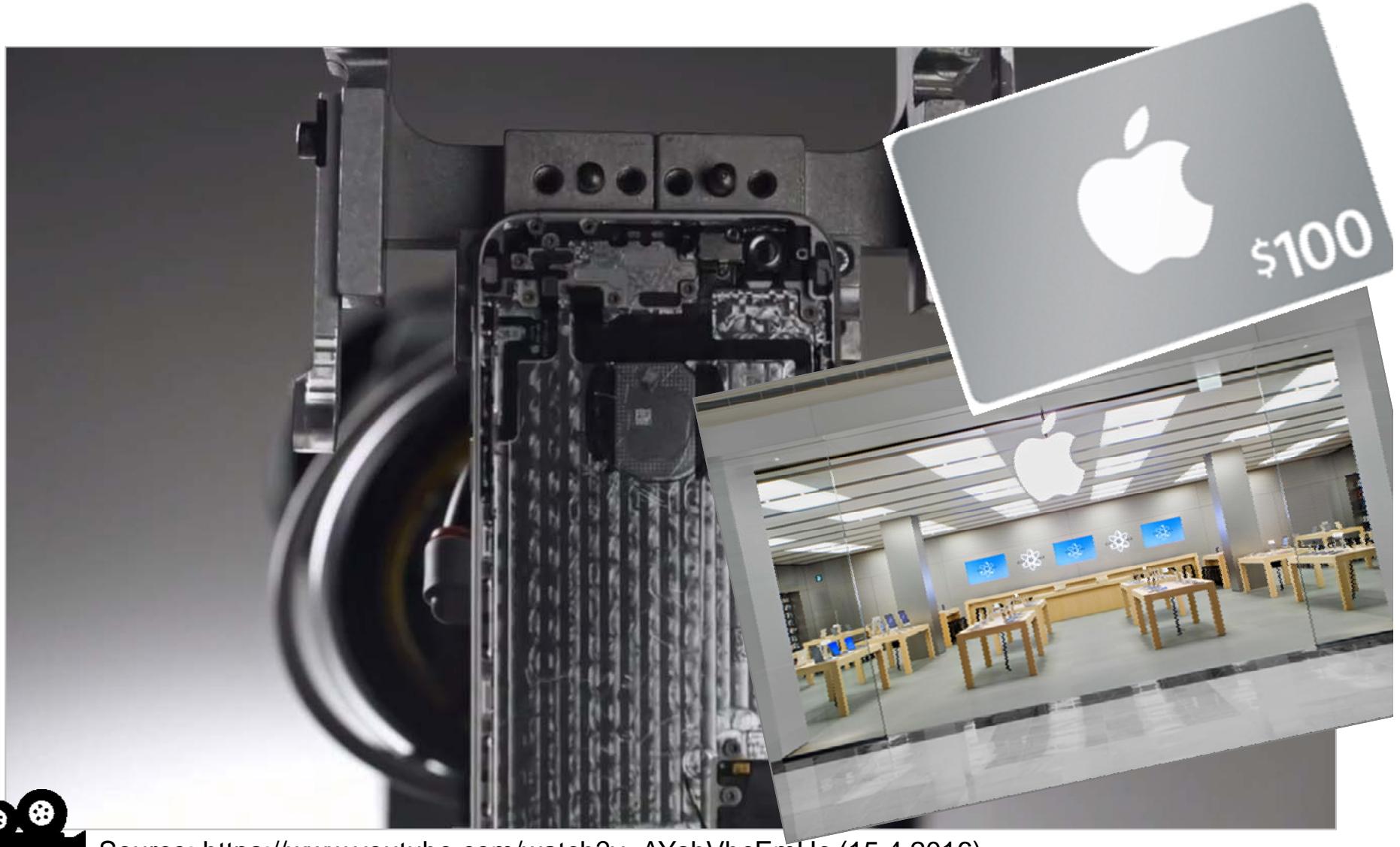
# CIRCULAR ECONOMY: LOOPS



## MEET LIAM



## TAKE-BACK SERVICE INFRASTRUCTURE, AUTOMATED DISASSEMBLY, AND RECYCLING



Source: <https://www.youtube.com/watch?v=AYshVbcEmUc> (15.4.2016)

# TRADE-IN OF DAMAGED PHONES



GETTY • STOCK IMAGE

Apple is rumoured to be upgrading its existing Reuse and Recycling scheme

Apple is rumoured to be launching a revamped Reuse and Recycling trade-in scheme that will allow customers with smashed or broken iPhones to trade-in their smartphones for credit towards a brand-new iPhone.

Until now, the Reuse and Recycling program has only accepted undamaged iPhones.

But starting this week in the United States, iPhones with cracked screens, faulty cameras and broken buttons will be eligible to trade-in toward the latest iPhone models at Apple Retail stores.

Cred  
\$200

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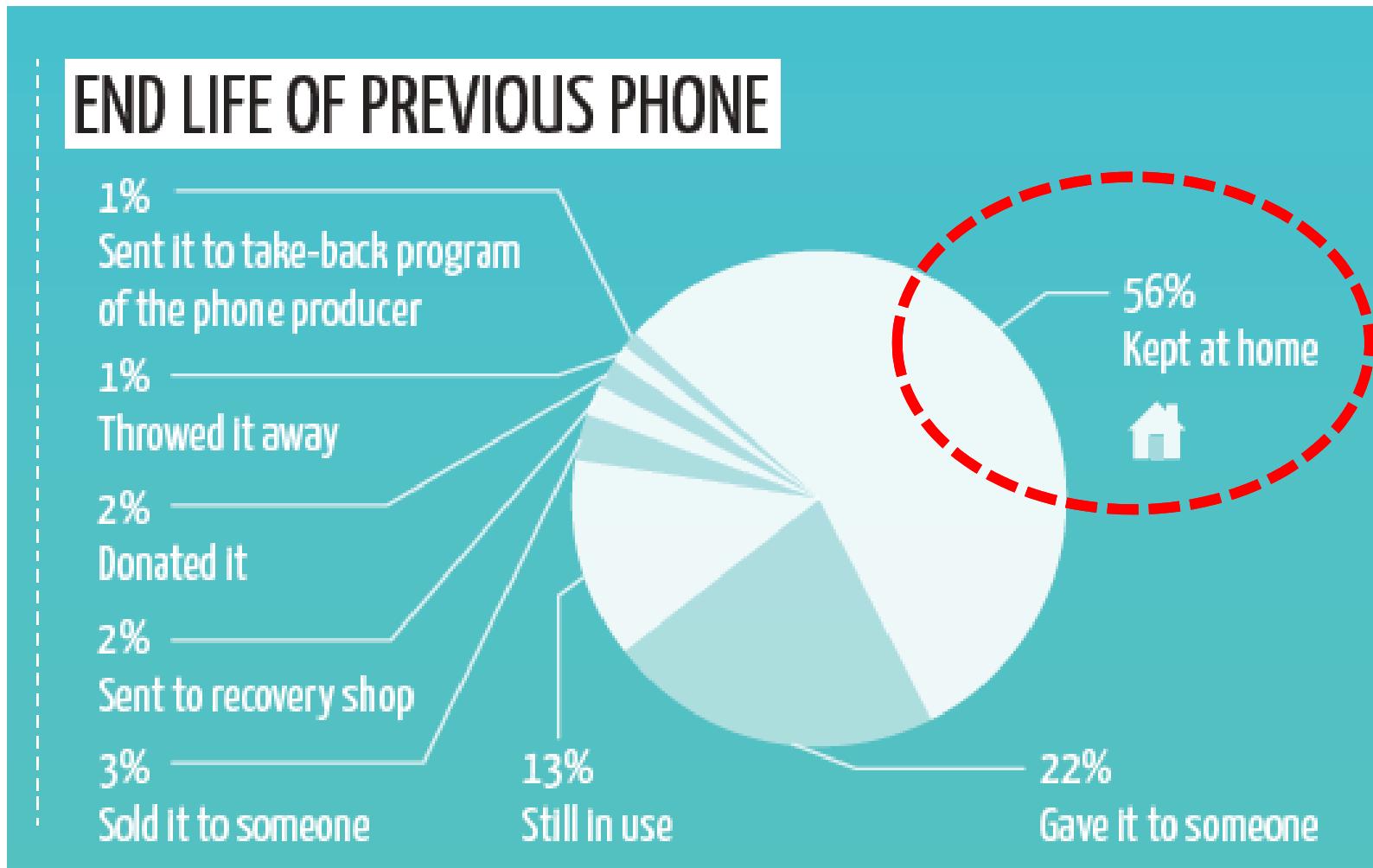
But starting this week in the United States, iPhones with cracked screens, faulty cameras and broken buttons will be eligible to trade-in toward the latest iPhone models at Apple Retail stores.

Credit depends on the storage options and model, but trade-ins range from \$50 for a broken iPhone 5S, to some \$200 for the iPhone 6, and up to \$250 for the iPhone 6 Plus.

Source: <http://www.express.co.uk/life-style/science-technology/641336/Broken-iPhone-Screen-Apple-Store-Reuse-and-Recycling> (21.6.2016)

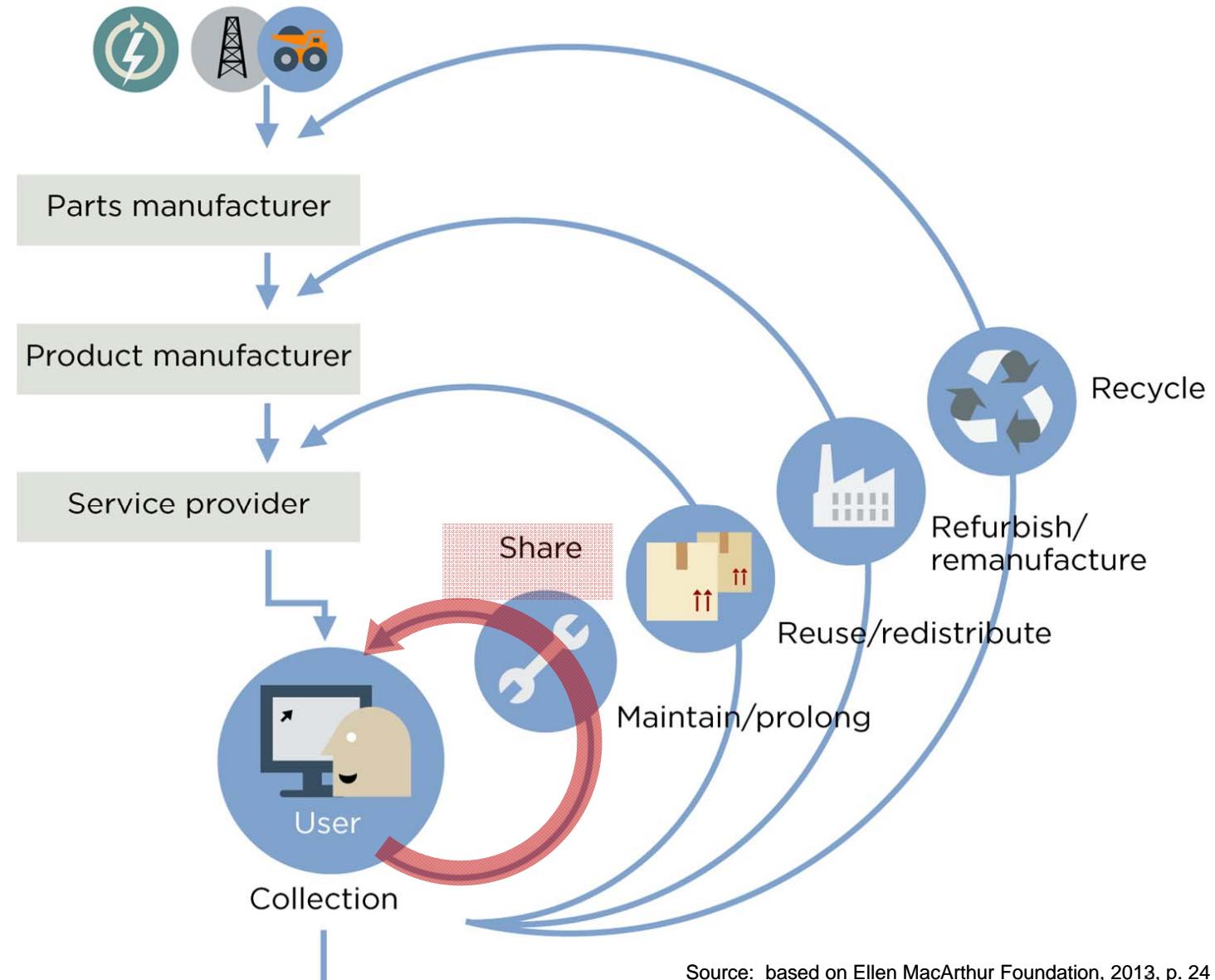


# ELECTRONIC WASTE COLLECTION @HOME



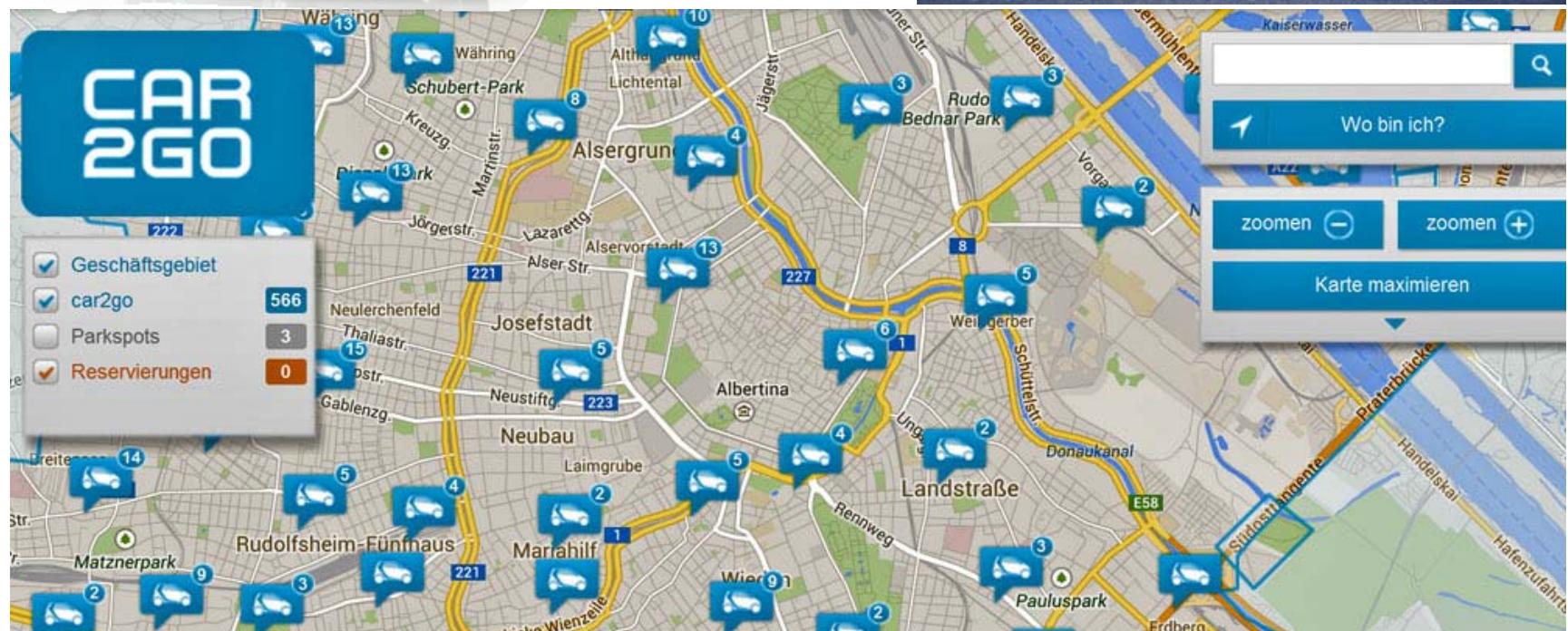
Source: Infographic by Youge Xiao

# CIRCULAR ECONOMY: LOOPS



# SHARING ECONOMY: CAR2GO CARSHARING

With your  
**car2go App ...**



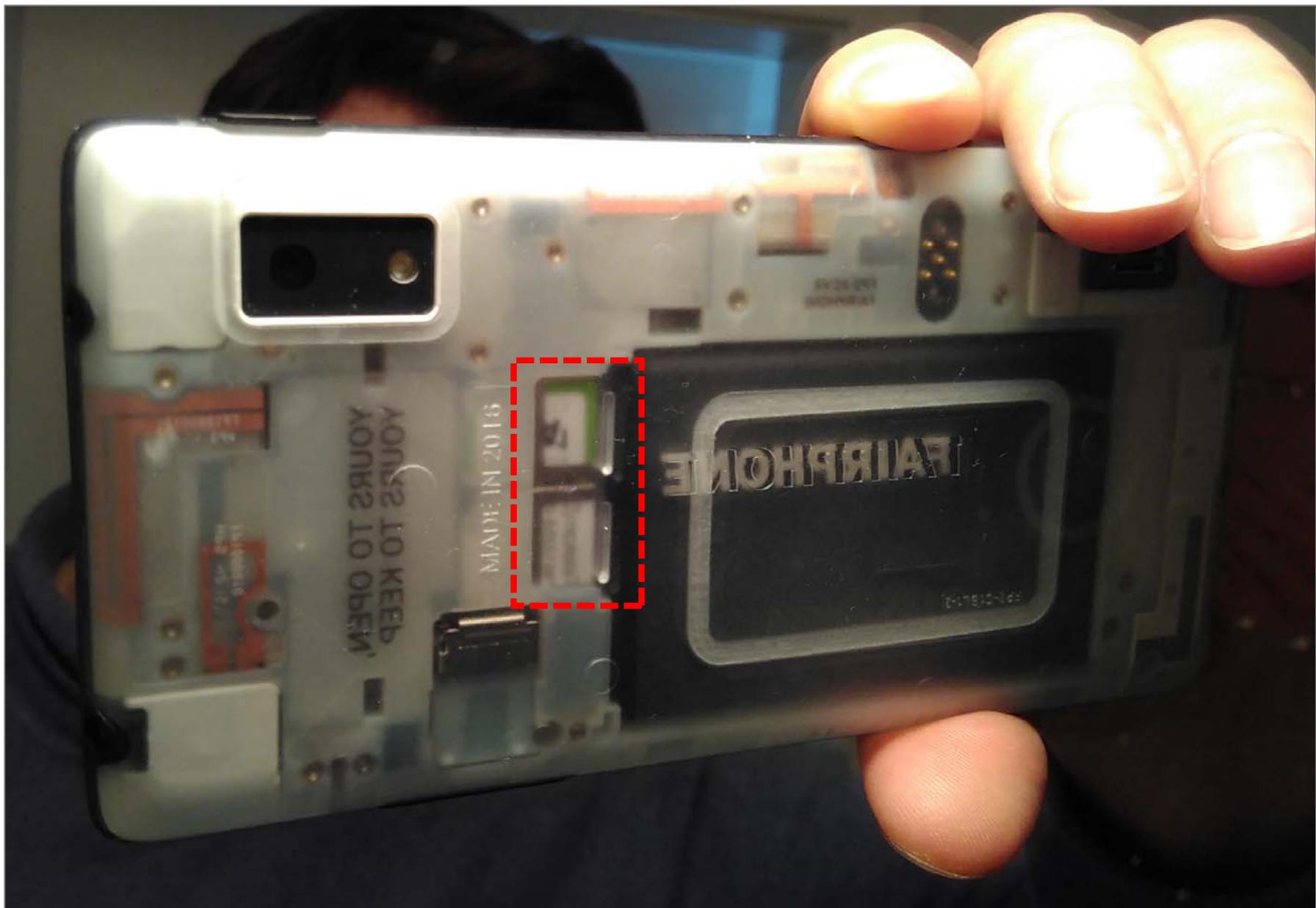
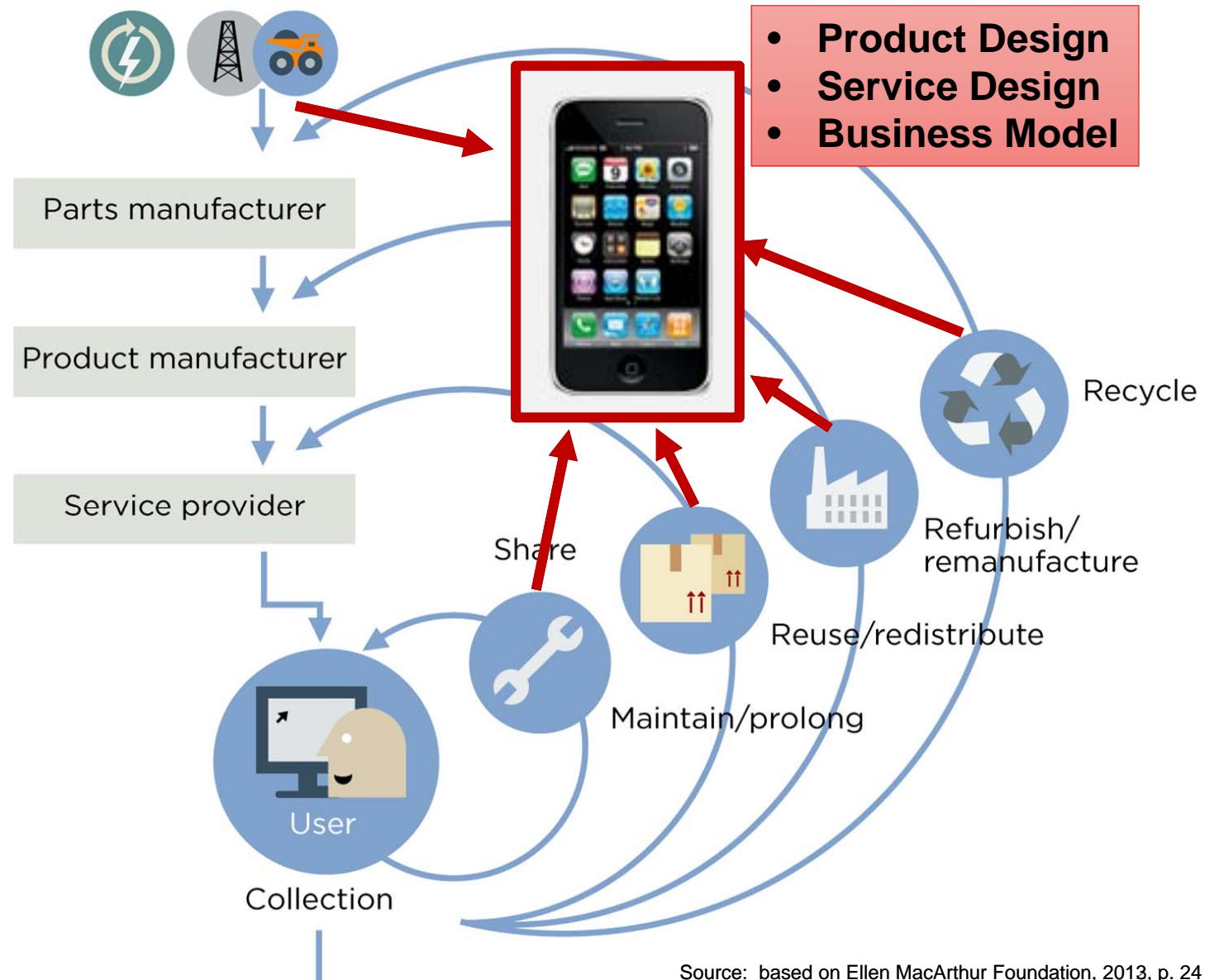


Foto (c) Erik Hansen

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## CIRCULAR ECONOMY: LOOPS



# INNOVATION COMMUNITY: WORKSHOP SERIES

## Fokusthemen

Workshop I – 23. Juni 2016

### AUFTAKT

#### Nachhaltige Produktdesigns und Lieferkette

Workshop II - 2. Dezember 2016

#### Vom Gerät zur Lösung: Produkt-Service Systeme als Basis nachhaltiger Nutzungssysteme

Workshop III - April/Mai 2017

#### Endgeräte als «Materialdatenbanken» – Wie Altgeräte für die Wertschöpfung erhalten bleiben

Workshop IV - Oktober/November 2017

### INTEGRATION

#### Wertschöpfungsarchitekturen und Geschäftsmodelle für den «Service Point of the Future»

# CONCLUSION

- Shortening product lifetimes
  - Accelerates resource consumption and waste streams
- Improving sustainability in supply chains alone does not suffice
- Circularity with high potential to decouple consumption from resource extraction/waste
  - (Sharing), Maintenance/Repair, Reuse, Reman, Recycle (4R)
- Requires innovation in
  - Product and service design
  - Business models

# GETTING IN TOUCH

**Prof. Dr. Erik G. Hansen**

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T: +43 (0)732 2468-5520

Email: [erik.hansen@jku.at](mailto:erik.hansen@jku.at)

Web: <http://www.jku.at/iqd>



*Visiting Professor*

Centre for Sustainability Management (CSM)  
Leuphana University Lüneburg

Web: <http://www.leuphana.de/csm/>



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- Prakash, Siddarth; Dehoust, Günther; Gsell, Martin; Schleicher, Tobias; Stamminger, Rainer (2016): Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz“. Umweltbundesamt (UBA). Available online at [http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte\\_11\\_2016\\_einfluss\\_der\\_nutzungsdauer\\_von\\_produktten\\_obsoleszenz.pdf](http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_11_2016_einfluss_der_nutzungsdauer_von_produktten_obsoleszenz.pdf), checked on 2/17/2016.
- Stahel, Walter R. (1984): The Product-Life Factor. In Susan Grinton Orr (Ed.): An Inquiry Into the Nature of Sustainable Societies: The Role of the Private Sector. The Woodlands, TX: Houston Area Research Center, pp. 72–96.
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