

What's in a mobile phone?

by Britta Bookhagen and Heike Ellbrunner

Raw Materials- Expedition

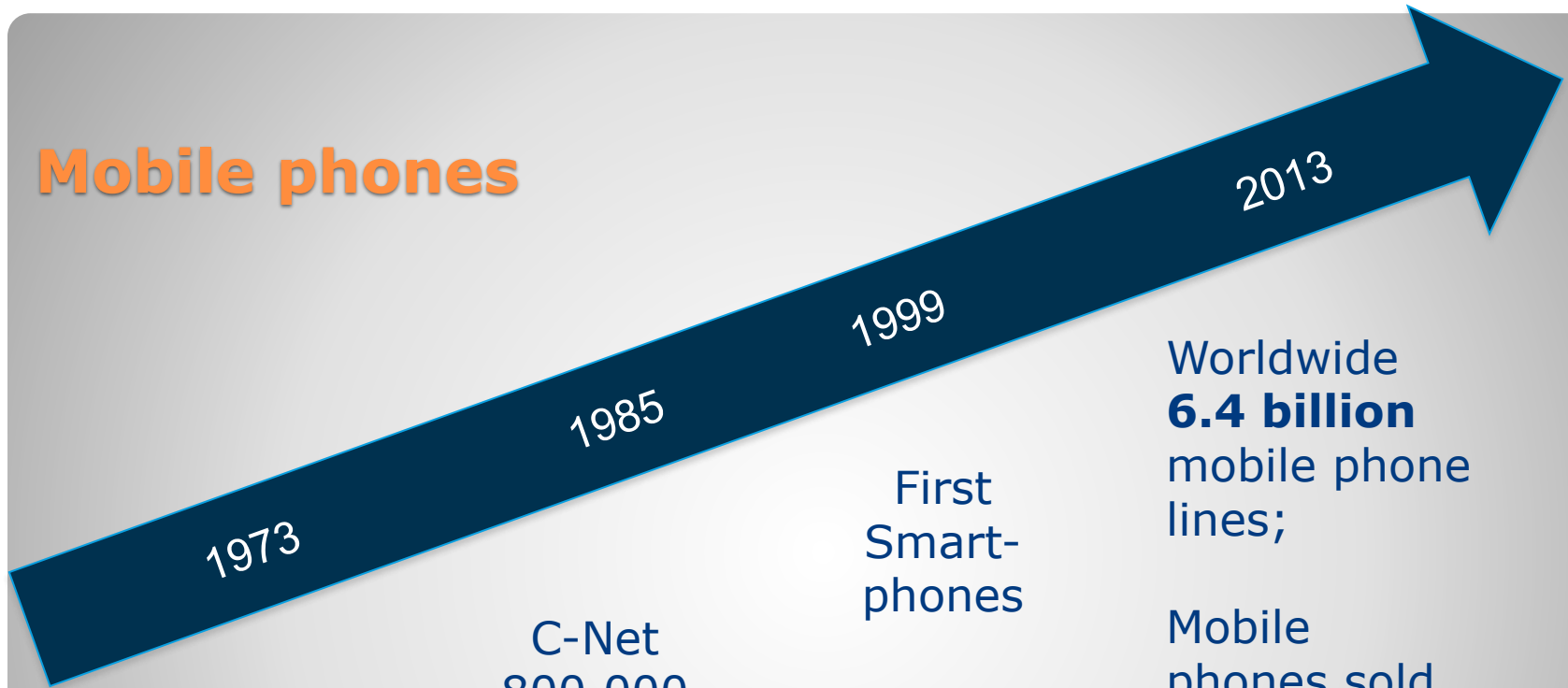
Project was part of the BMBF-funded „Raw Materials Expedition“ in the

Science Year 2012: Project Earth – Our Future

- Project partner: Wuppertal Institute
- Targeted at young people aged 14-19
- Campaign included:
 - consumer studies based on
 - dialoge forum with students
 - polls and surveys in households and schools
- development of teaching material
 - teaching in schools
 - teacher workshops
 - Collection of mobile phones
- Mobile phones as representatives for ICT (**Information and communications technology**) (netbooks, tablets, laptops etc.)



Mobile phones



3 April
1973: First mobile phone call

C-Net
800 000 mobile telephones

First Smart-phones

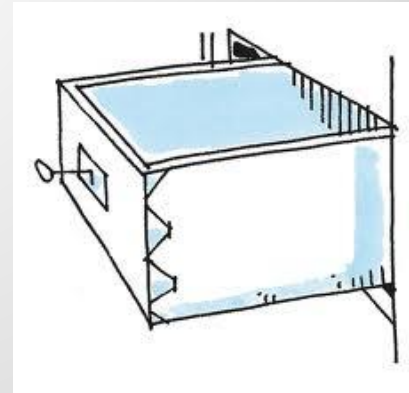
Worldwide **6.4 billion** mobile phone lines;

Mobile phones sold per year: **1.7 billion**

Recycling-rate 3%



- In 2015 more than 1.4 billion smartphones were sold
- In Germany, estimated ~ **100 million** unused mobile phones are being stored in drawers...





**Chris Jordan:
Intolerable Beauty: Portraits of American Mass Consumption (2003 - 2005)**

Connection...

... between mobile phones and
raw materials ?



- **Raw materials in everyday life ...**



- **Why mobile phones?**

- many people use mobile phones
- 98% of persons over 14 years use a mobile phone in Germany
- commonly just 18-24 months in use
- used old phones end up in drawers
- Recycling-rate 3-10% worldwide
- more than 60 materials are used in a mobile phone
- more than 30 metals are used in a mobile phone
- Mobile phones are composed of about 50% plastics, 30% metal; 20% glass and ceramics (average values)

Mobile phones and raw materials

Only one century later ...

We use nearly every element and many of them can be found in our cell phones!

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac-Lr	Rf	Dd	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Uuq	Uup	Uuh	Uus	Uuo

Lanthanide:

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
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Actinide:

Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
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One century later

Group work part one

Disassemble the mobil phone and fill in the blanks

1. Which parts do you find?
2. What could these parts be made out of (material)?

Please disassemble the phone CAREFULLY – and remember how you did it, at the very end you will need to reassemble it



Smartphone vs. mobile phone



An average smartphone weighs about 100 g

-> more raw materials will be needed

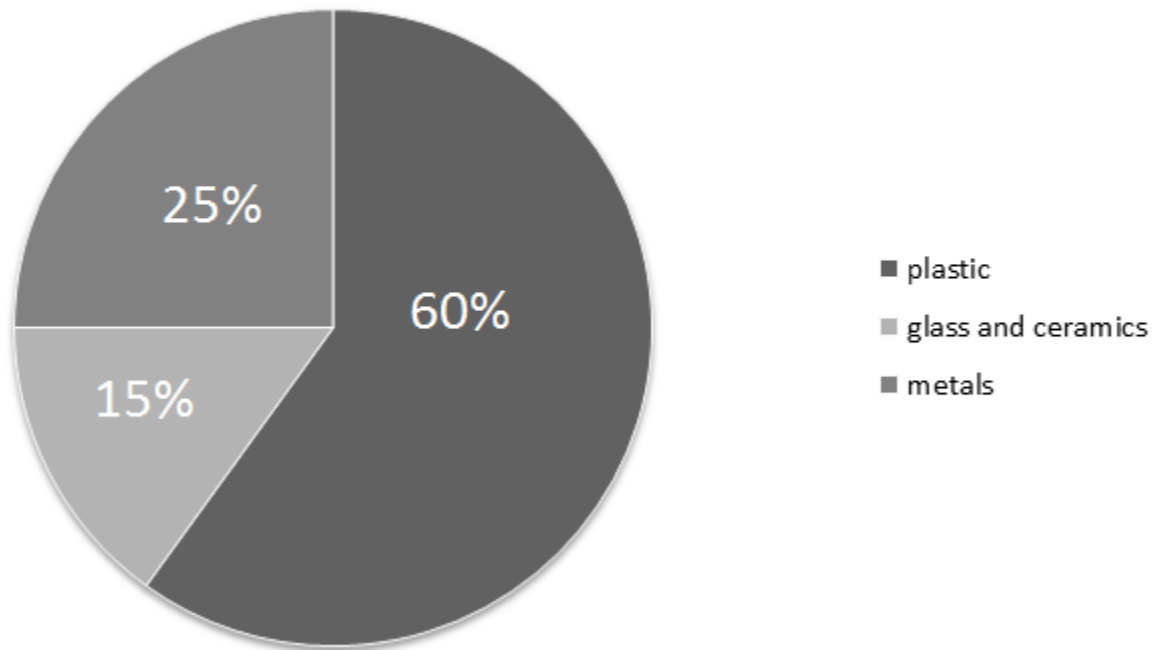
-> 2015: ~ 1.48 billion

-> 2020: ~ 1.84 billion

7.4 billion world population
More than 7 billion mobile phone lines

What a mobile phone is made of

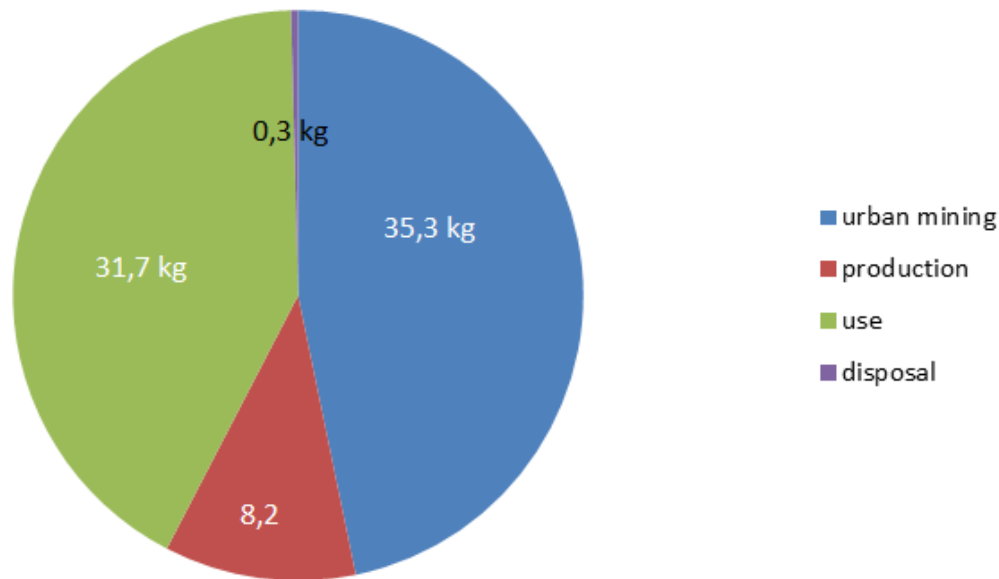
Materials in a mobile phone



average values

Ecological backpack

Ecological backpack ~ 75,5 kg



average values

All energy used by mining, production, use and disposal is called „the ecological backpack“ of a product. The backpack of an average smartphone of a weight of ~ 100 g is about 75.5 kg.

Group work

- Take out the rocks/minerals and name them using the quiz
- Use the playing cards or the handout (and your smartphone as searching tool) to answer the following questions:
 - 1. Which element/resource is the rock a representative for?
 - 2. What usage does it find in the mobile phone?



ELEMENT /
ROHSTOFF

ANWENDUNG
IM HANDY

BENENNE DIE ROHSTOFFE.

A. ERSCHEINUNG In welcher Form liegt der Rohstoff vor?	B. MAGNETISMUS Ist der Rohstoff magnetisch?	C. STRICHFARBE Welcher Rohstoff hinterläßt auf Papier einen Abdruck?	D. FARBE Welche Farbe hat der Rohstoff?	E. HÄRTE Welcher Rohstoff ritzt den anderen Rohstoff und ist damit härter?	NAME
Pulver					TONMINERALE
Blättchen					GOLD
anders	Ja				MADNETIT
anders	Nein	rotbrauner Strich			BAUKIT
anders	Nein	anders	schimmert in mindestens drei verschiedenen Farben	ritzt den anderen groben Rohstoff	CHALKOPYRIT
anders	Nein	anders	(dunkel-)grau	weicher als der andere grobe Rohstoff	„COLTAN“
anders	Nein	anders	(dunkel-)grau	ritzt den anderen harten Rohstoff	ÖLSCHIEFER
anders	Nein	anders	lila oder weiß/farblas	weicher als der andere helle Rohstoff	QUARZ
anders	Nein	anders	lila oder weiß/farblas		LEPIDOLITH

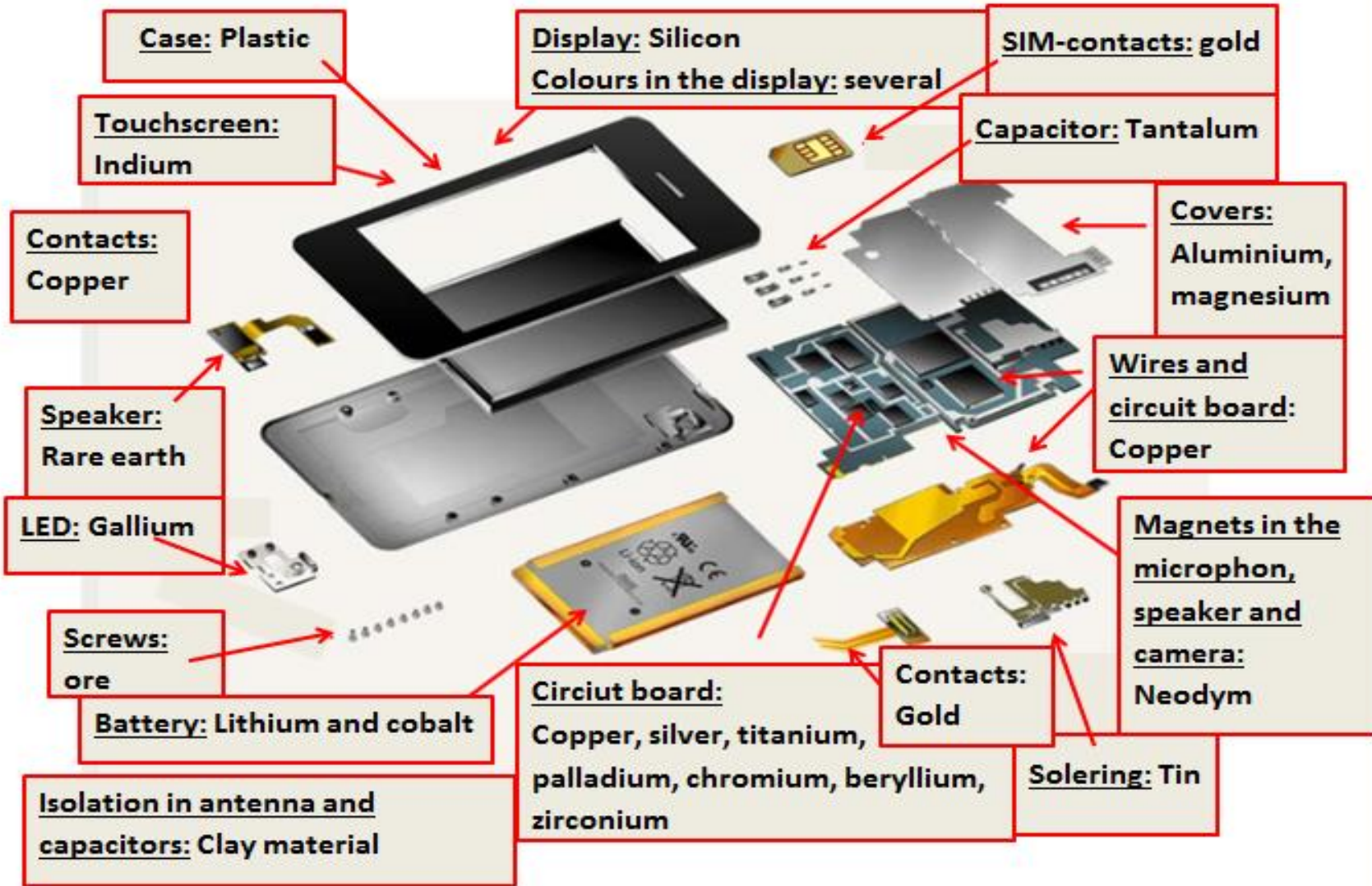
zum Start alle Rohstoffe hierher und teste die Eigenschaften nacheinander (folge der Reihenfolge oben), um den Namen zu halten.

Eine Initiative des Bundesministeriums für Bildung und Forschung
Wissenschaftsjahr 2012
Zukunftsprojekt
ERDE

- TONMINERALE
- GOLD (Au)
- EISEN (Fe)
- ALUMINIUM (Al)
- KUPFER (Cu)
- TANTAL (Ta)
- ERDÖL (Kunststoffherstellung)
- SILIZIUM (Si)
- LITHIUM (Li)

- Isolatoren in der Antenne
- Kontakte
- Schrauben, Federn
- Aku-Abdeckungen
- Leiterplatte, diverse Drähte und Verbindungen
- Kondensatoren
- Gehäuse
- Display (Glas), Mikrochips und Prozessoren
- Akku

Raw Materials Expedition German version



Parts of a mobile phone

40 mobile phones



1 g gold



This is approx. \$ 50

~ 800 kg gold ore



Value metals per mobile phone:

- copper 9 g
 - silver 0,25 g
 - gold 0,024 g
 - palladium 0,009 g
-
- In 2015, 1.5 billion smartphones were sold
4.15 billion \$ worth of gold, silver, palladium

15 750 t copper 280 t silver 42 t gold 9 t palladium

Number rough estimations only!

And... how many mobile phones are in circulation?

What happens when you leave it in the drawer?

RECYCLING...

- Recycling is an important source for material!
- By recycling 100 million mobile phones, approximately 7 500 pounds of gold could be recovered
- hazardous substances can be removed
- important materials can be recovered
- Raw materials are not available eternally!
- **Up to 90% of the value of a mobile phone can be reused**

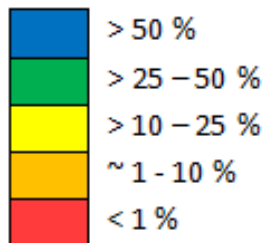
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Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Uuq	Uup	Uuh	Uus	Uuo

Lanthanide:

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Recycling rates

Resource recovery ...



source: BGR

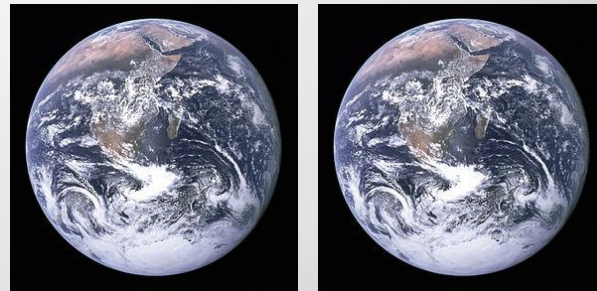
Problems in urban mining

- Environmental damage
- Social problems in the countries of origin
- High energy consumption
 - > energy savings recycling vs. primary production:
aluminium 95%, silver 96%, palladium 95%
- Consumption of exhaustible raw materials

Worldwide used resources

- ▶ Europa 43 kg person/day
- ▶ North America 88 kg
- ▶ Africa 10 kg

- ▶ If we continue like this, in 2030 we need 2 x Earth to cover our current needs





But we only have one ...

Thank you for your attention

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