EIT Raw Materials
AWARE Project
Ethics Module

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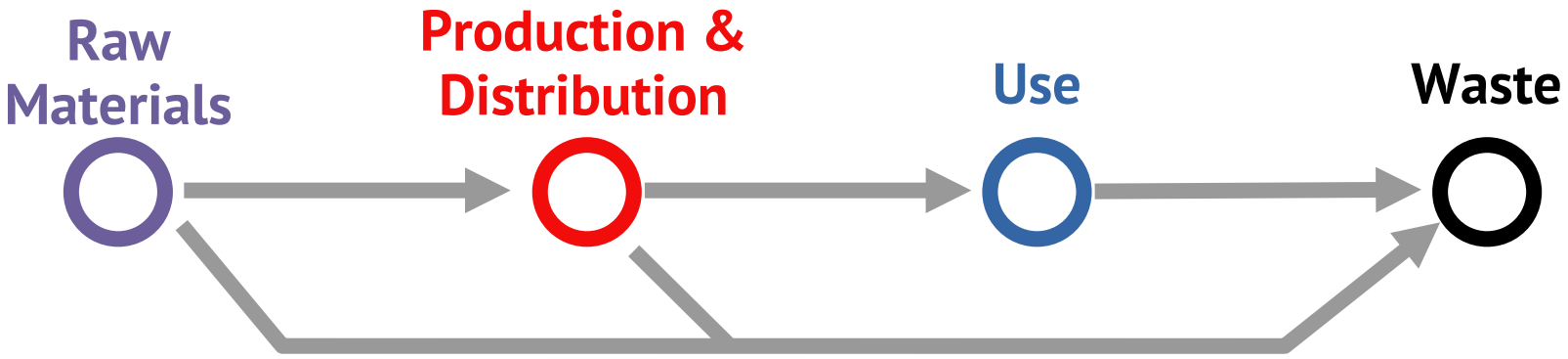
Linear Economy

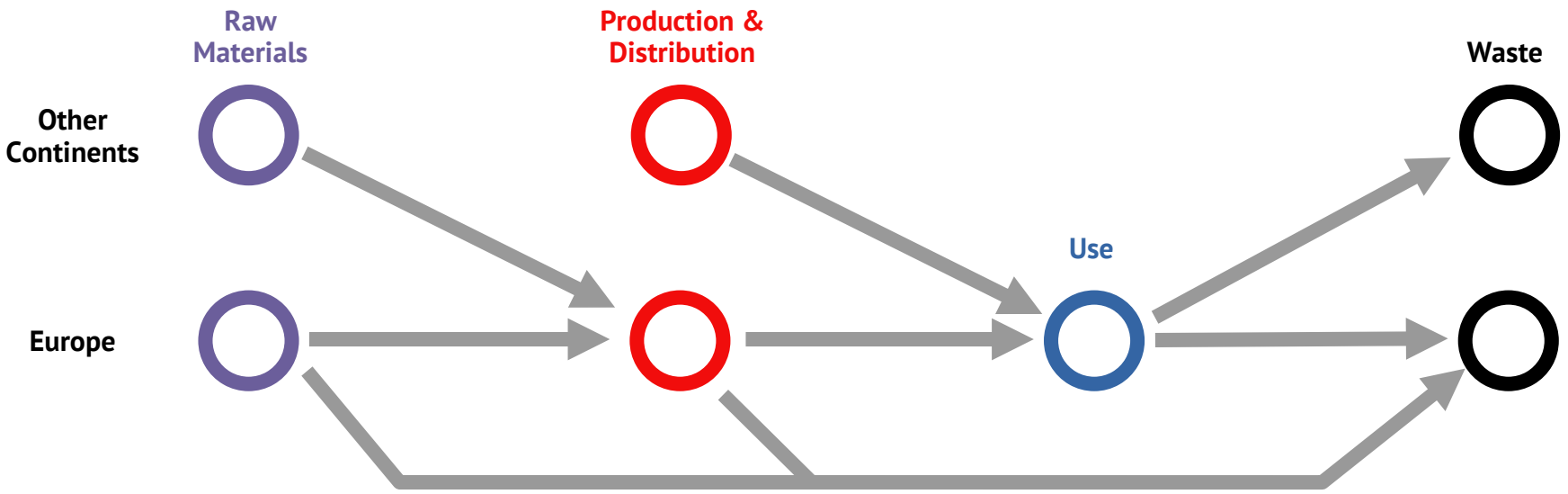
Is it really so linear, though?

Materials … get wasted



Waste is generated all along the chain

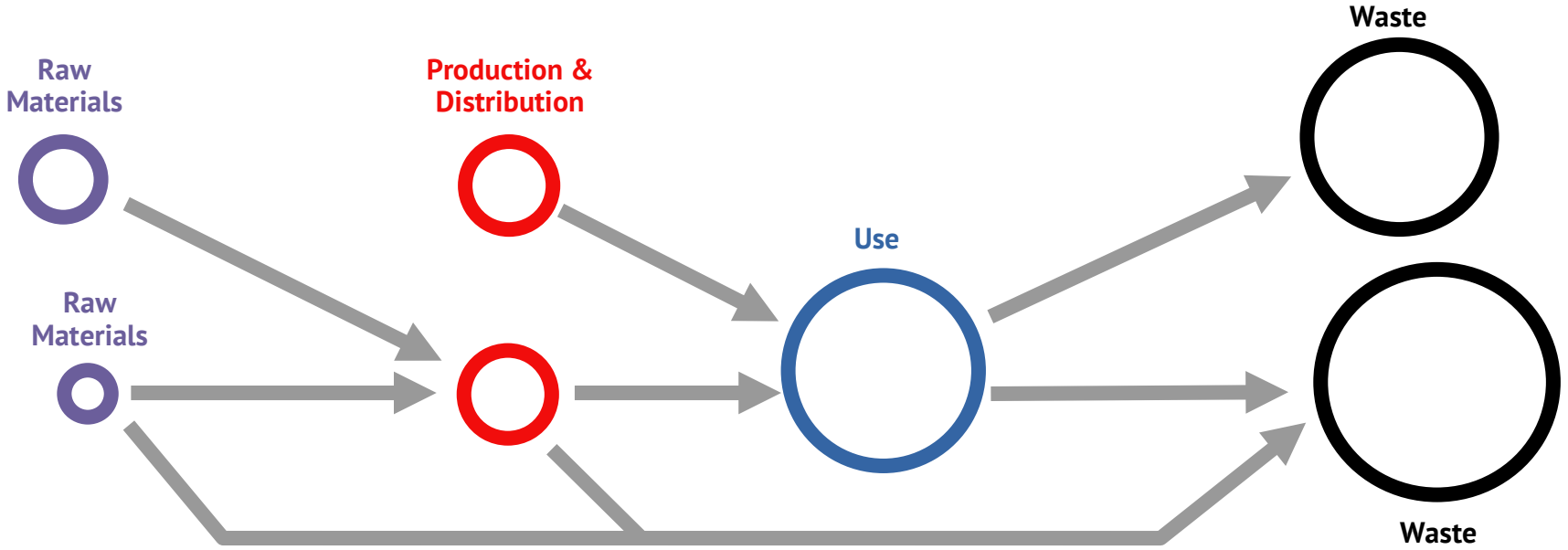
Materials … don’t know borders



Materials flow across countries

(arrows from Europe to other continents omitted)

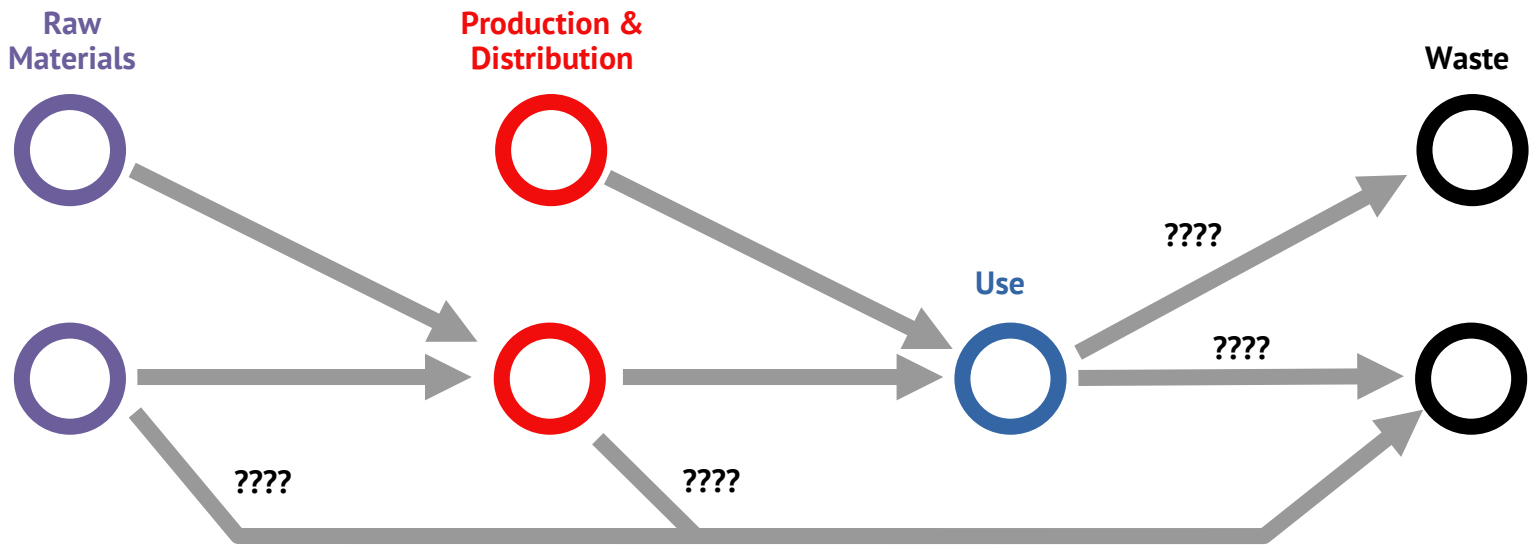
Materials … accumulate



Materials accumulate

(sizes are just indicative)

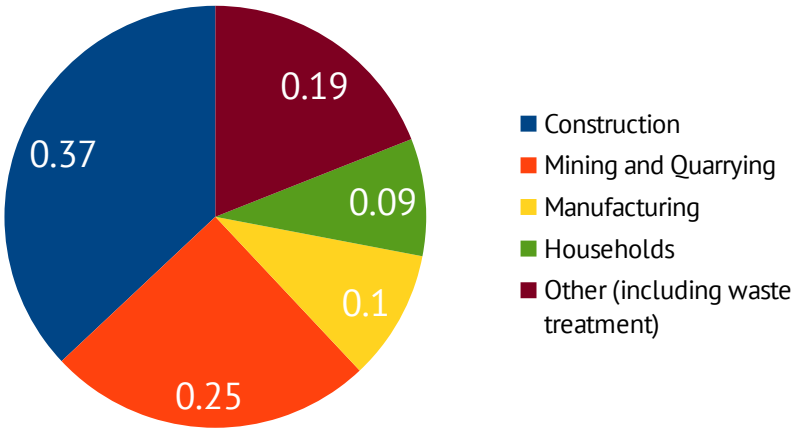
Materials … get lost



We lose track of part of the waste we generate

Materials get Wasted

Sector	%	Amount (Mt)
Construction	37%	925
Mining	25%	625
Manufacturing	10%	250
Households	9%	225
Others (including waste treatment)	19%	475
Total		**2500**

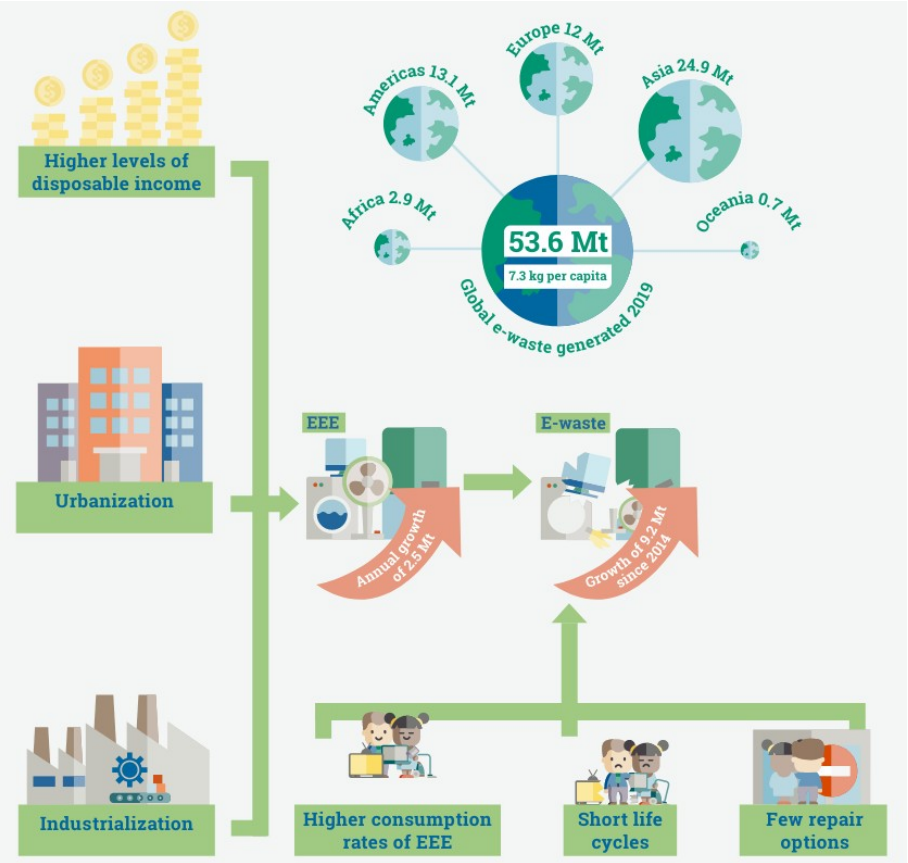


Materials get wasted (example)

Surplus streams in Italy in the food sector: 5.590.000 tons/year (*)

(*) Source: LIFE-Food.Waste.StandUp Project (2018)
Recent data (from other sources, Waste Watchers) seems to suggest waste reduced nearly by half: 2Mt/year

Materials Accumulate



- **Think:** economic growth/urbanization in China and developing countries
- **Think:** impact of electronics on our quality of life (from CAT scan to cellphone)
- **Think:** life span of electronics products, repairability

Forti V., Baldé C.P., Kuehr R., Bel G. The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam.

Questionnaire

https://www.ict4g.net/adolfo/work/ewaste/e-footprint.html

Materials Accumulate

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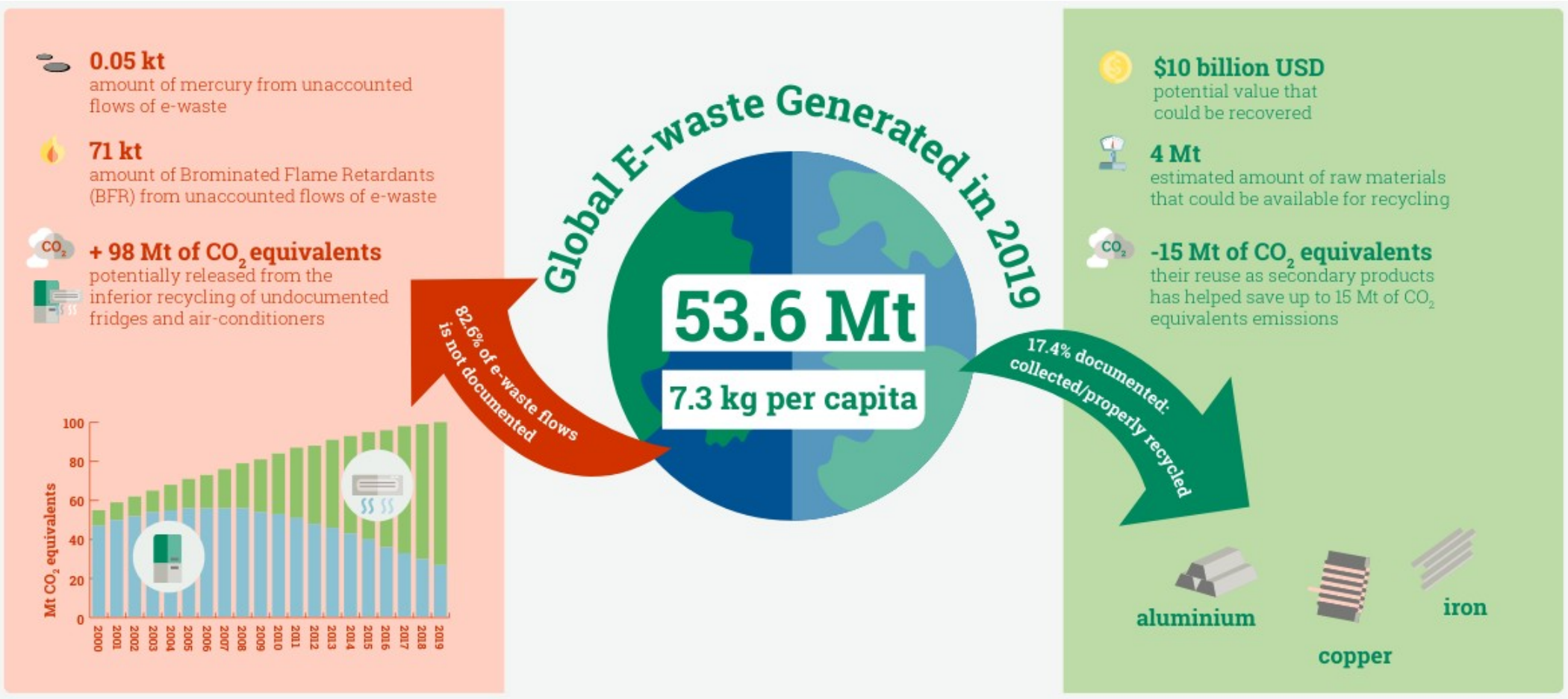
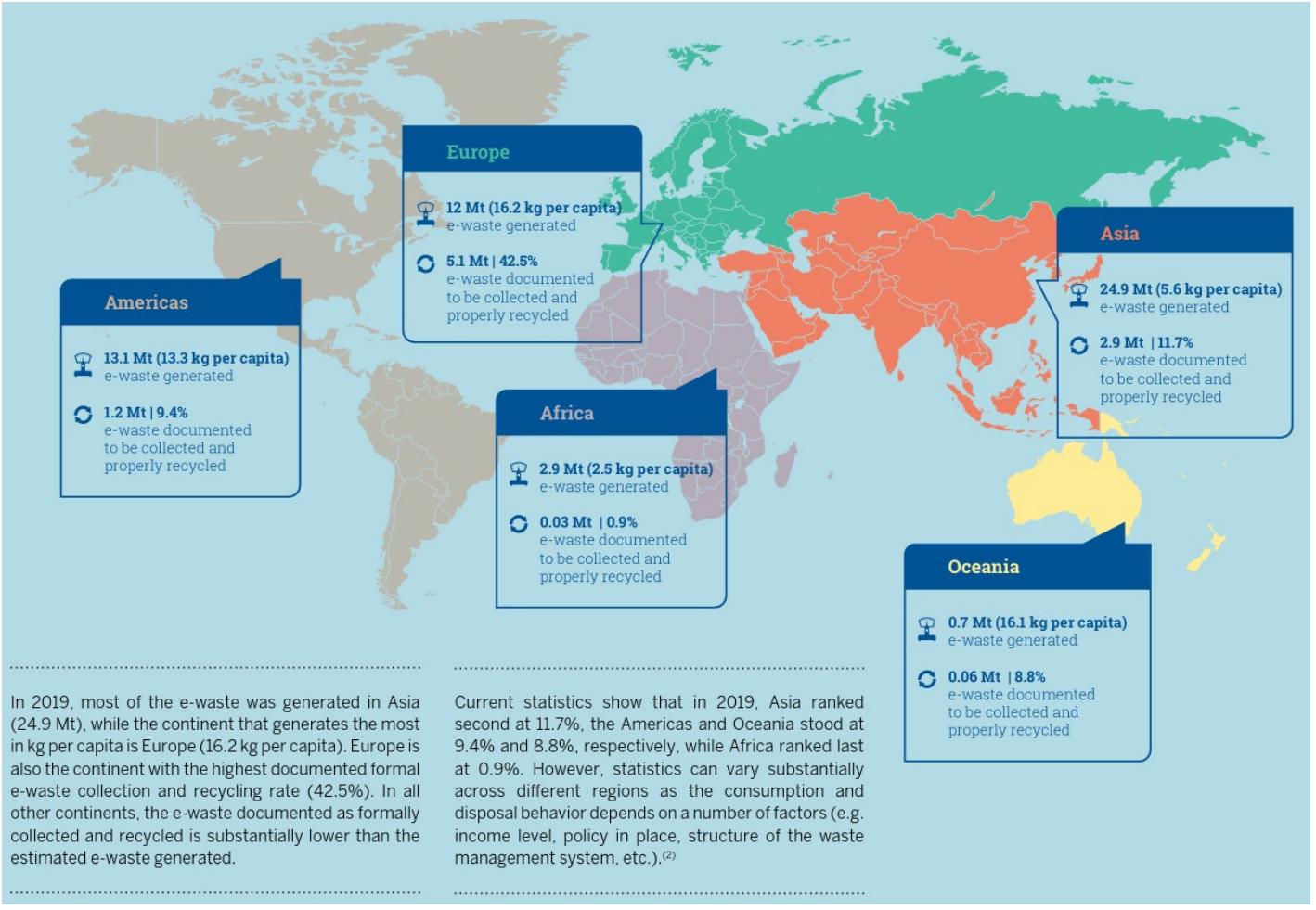
Materials … get lost



Materials gets… lost



In 2019, most of the e-waste was generated in Asia (24.9 Mt), while the continent that generates the most in kg per capita is Europe (16.2 kg per capita). Europe is also the continent with the highest documented formal e-waste collection and recycling rate (42.5%). In all other continents, the e-waste documented as formally collected and recycled is substantially lower than the estimated e-waste generated.

Current statistics show that in 2019, Asia ranked second at 11.7%, the Americas and Oceania stood at 9.4% and 8.8%, respectively, while Africa ranked last at 0.9%. However, statistics can vary substantially across different regions as the consumption and disposal behavior depends on a number of factors (e.g. income level, policy in place, structure of the waste management system, etc.).[2]

Forti V., Baldé C.P., Kuehr R., Bel G. The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam.

… and some arguments in favor …

- A model as old as man is (but is it, really?)

  https://www.weforum.org/agenda/2020/05/circular-economies-ancient-history-recycling/

  https://www.history.com/news/recycling-history-america

- Throwing away might be better than recycling?

  https://abcnews.go.com/US/story?id=91824&page=1

  https://www.npr.org/2020/09/11/897692090/how-big-oil-misled-the-public-into-believing-plastic-would-be-recycled?t=1603881660645

- The theory of substitutions
  (e.g., aluminum replacing copper)

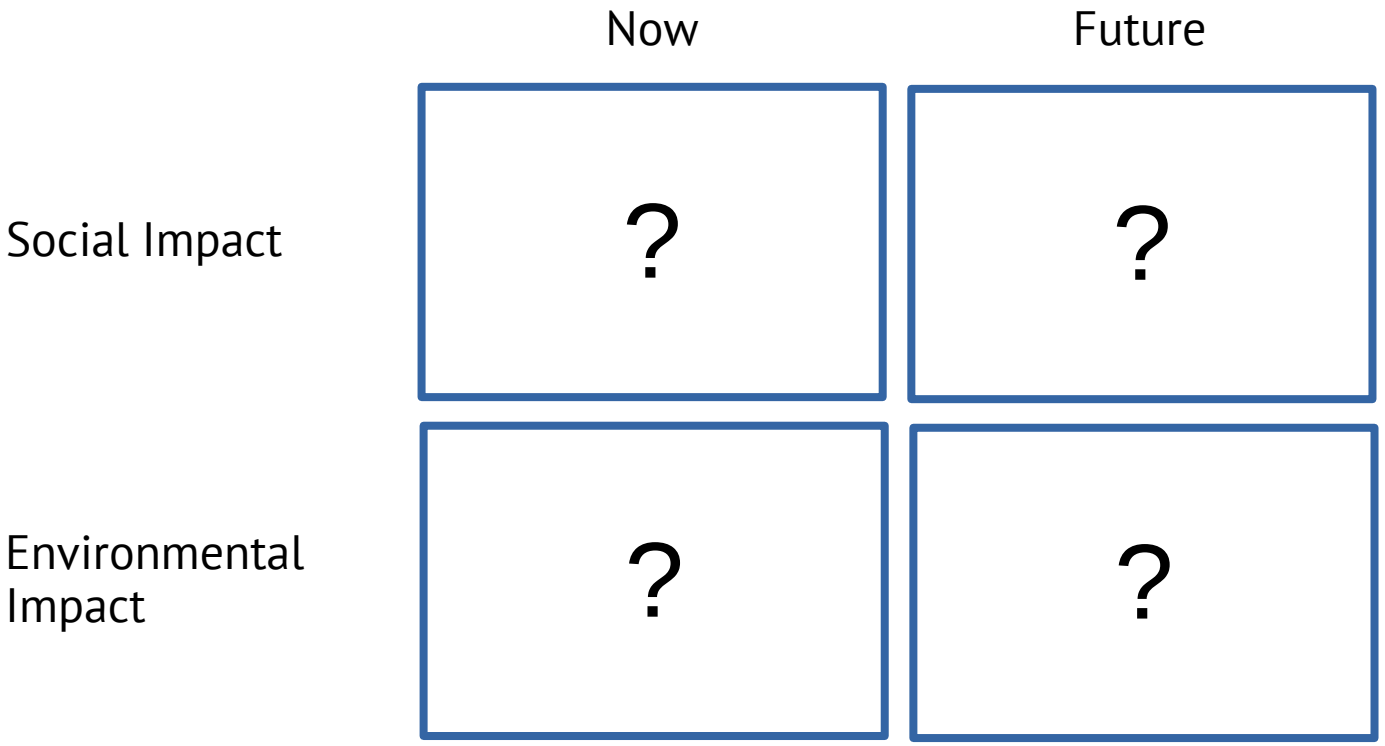
Planned Obsolescence

- Policy of planning or designing a product with an artificially limited useful life
- Devised in the 1930:
  - Alfred Sloan Jr. (to push sales in the automotive sector)
  - Bernard London (to boost economy during the depression)

- Contrived durability (e.g., inferior materials)
- Prevention of repair
- Non-replaced batteries
- Perceived (design, fashion)
- Systemic obsolescence (plugs)
- Programmed (chips in ink-cartridges)
- Legal

https://en.wikipedia.org/wiki/Planned_obsolescence

A different perspective

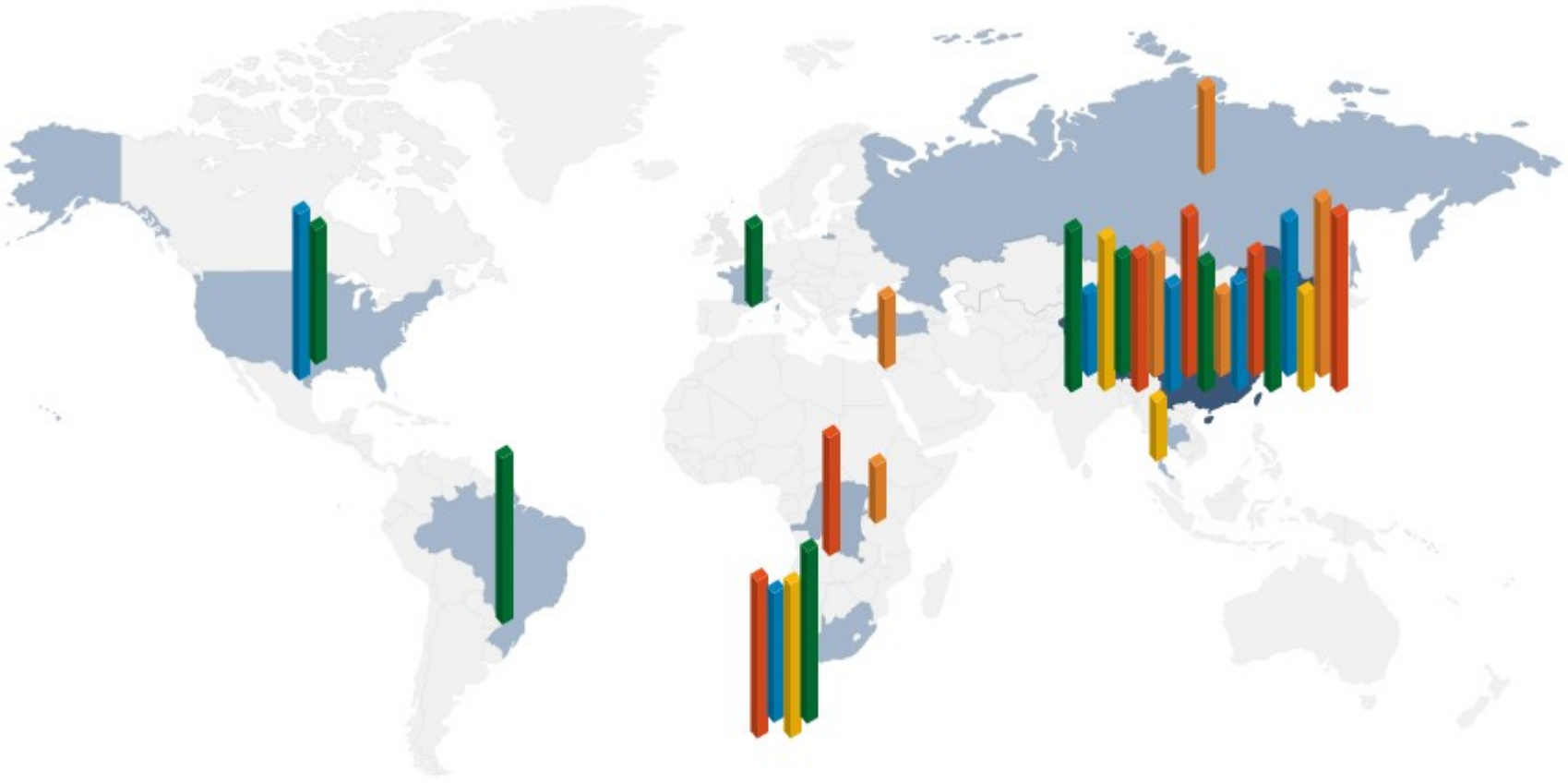


A Quiz

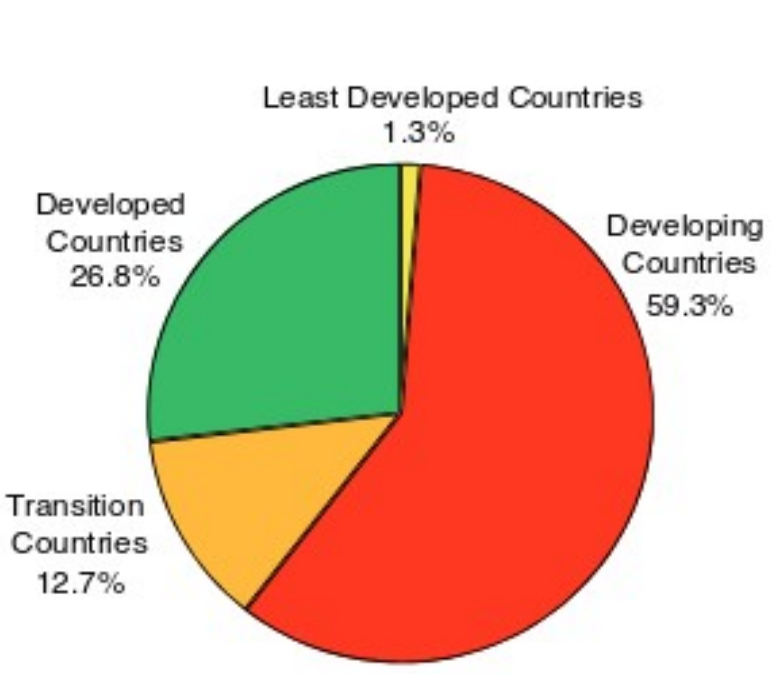
https://www.ict4g.net/adolfo/work/ewaste/ewaste-quiz-reveal.html

Raw Materials

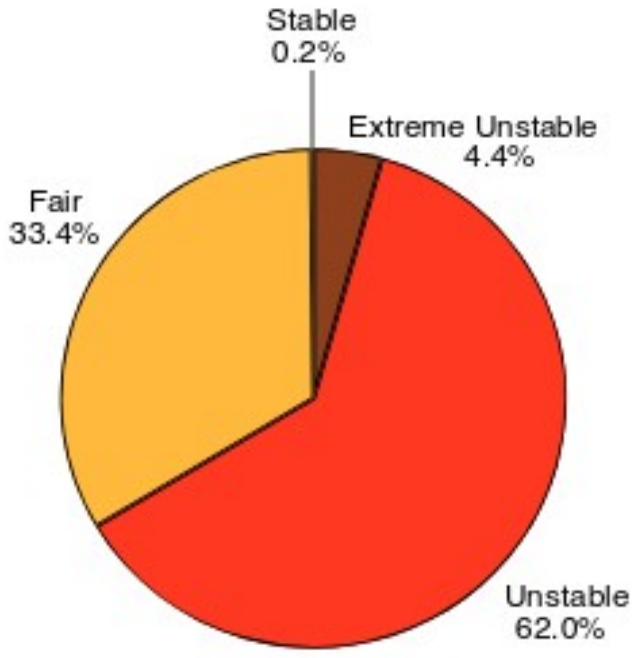
Where from



Where From



Developing countries share around 60 % of global production.



2/3 of global production is mined in politically unstable countries.

http://www.wmc.org.pl/sites/default/files/WMD2018.pdf

Mining main methods

- Open pit
- Underground
- Placer
- In situ

(See also: https://nayturr.com/types-of-mining/)

Raw Materials

Main Impacts: Environmental

- Air pollution
- Water pollution
- Damage to land
- Loss of bio-diversity

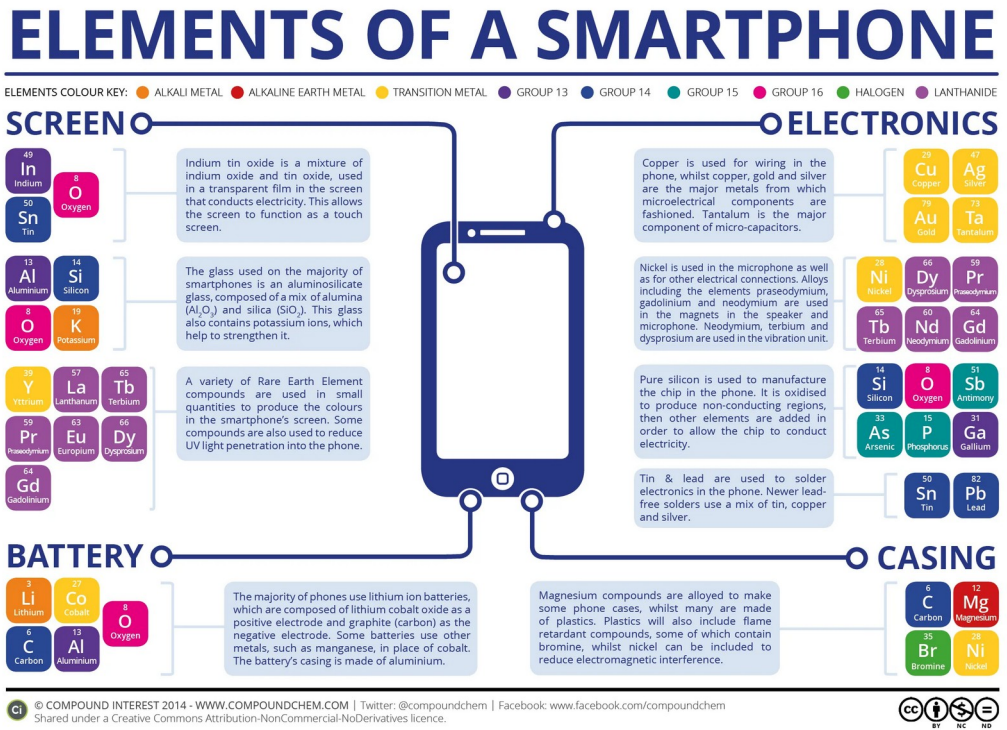
- Examples:
  - Acids and heavy metals used for extraction
  - Radioactive byproducts when extracting Rare Earths
  - Lithium extraction: brines to ore is between 38% and 62%
  - Gold extraction 1-5t/1g

Example: Gold Mining

- Impact of mining **1 ton** of gold:
  - 18,000 tons of CO_2e released (car emits 4.6 t/year)
  - 260,000 tons of water
  - 200,000 GJ of energy
  - 1,270,000 tons of waste solids produced

https://www.quora.com/How-much-water-is-needed-to-produce-a-ton-of-gold-in-mining
(another computation of water needed for extracting gold)
https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
(emission of cars)

Mining vs “Urban” mining



Raw Materials in iPhones (for 10.000 devices)

- Aluminum 1900kg
- Gold 0.97kg
- Silver 7.5kg
- Rare earth elements 11kg
- Tungsten 93kg
- Copper 710kg
- Palladium 0.10kg
- Tin 42kg
- Cobalt 770kg
- Tantalium 1.8kg

Social Impacts

- Child labour

- Example:
  - Mining in Burkina Faso
  - https://youtu.be/zmkR_EyRf9A
  - https://www.ict4g.net/adolfo/work/ewaste/links_and_videos.html

Raw Materials

Social Impacts

- Informal mining:
  - Run by individuals or small groups as a way to find subsistence
  - Legal and illegal
  - Manual labour
  - Little concern for safety
- Some estimations:
  - 10-25% of cobalt pipeline
  - 17-40% of production in Congo

Raw Materials

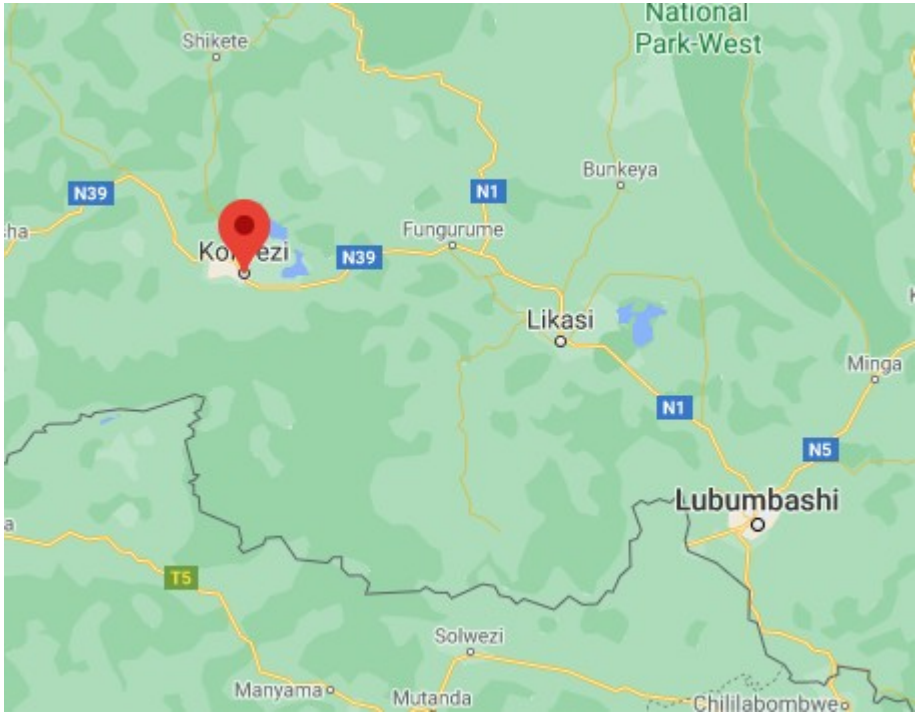
Social Impacts

- Conflict materials:
  - Raw materials extracted in war or unstable areas
  - It might finance guerrilla/terroristic groups
  - It might employ forced labour

Raw Materials

Social Impacts: Fair price

- Example: Cobalt (data from an article run on tne NY Times):
  - Kolwezi, Congo
    ($2-$3 / day)
  - Musompo
    ($881 / ton 16% cobalt rock)
  - Zambia, Tanzania
  - Zhejiang Huayou Cobalt, China
    ($20,000 to $26,000 per ton)
  - LG Chem
  - Tesla, Apple, …



https://www.google.it/maps/place/Kolwezi,+Repubblica+Democratica+del+Congo/@-0.8896887,23.9204147,3.59z/data=!4m5!3m4!1s0x1979e57971072e4f:0xa23ff3e3cd0d2277!8m2!3d-10.7275273!4d25.5088914

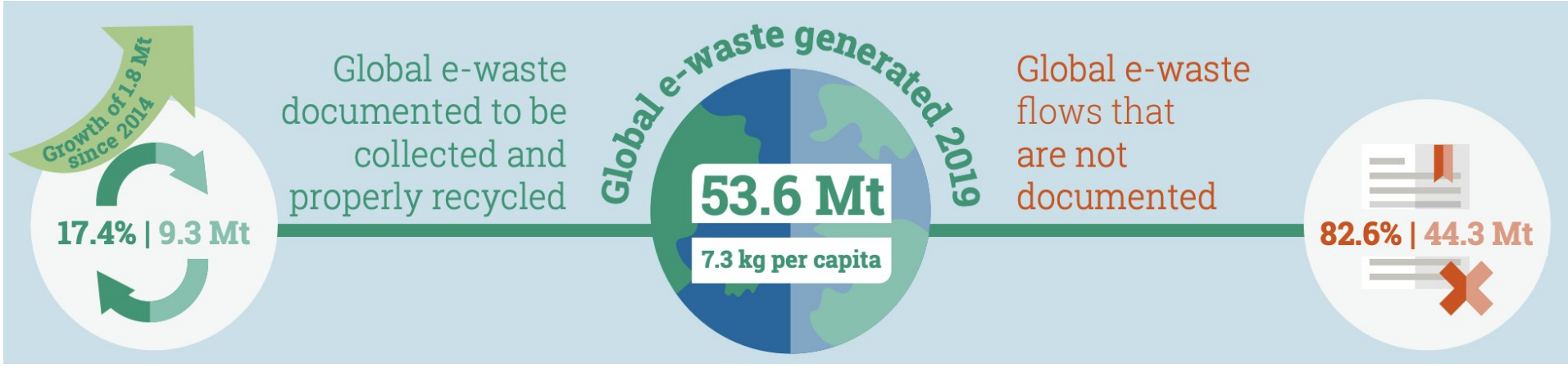
Raw Materials

Resource Curse

- The paradox of plenty:
  - Corruption
  - War/Instability
  - Reliance on few resources and consequent volatility (think oil, think also cane sugar in Cuba)

Waste

The other end of the spectrum



Waste

E-Waste disposal

- Many electronic devices shipped to third countries as second-hand devices or waste
- Legal and illegal dumping
- Many informal recycling operations
- Health and safety hazards for workers and the environment
- https://youtu.be/s8pXUrXpj7I

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Waste

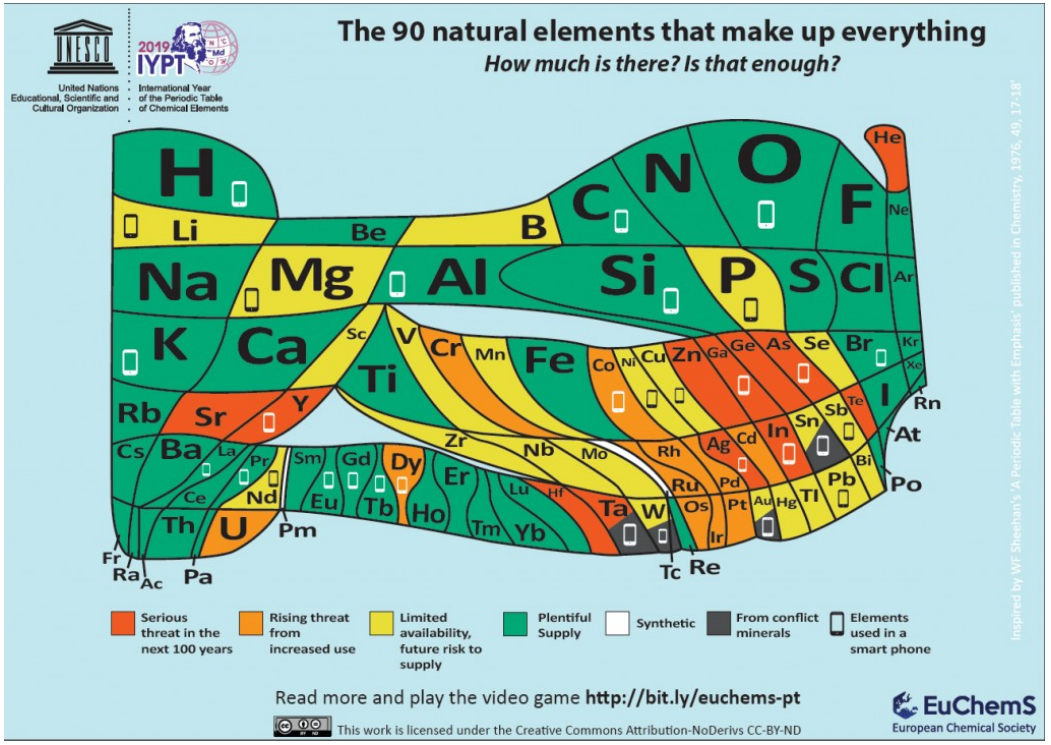
Agbogbloshie

- 15% of e-waste dumped in Agbogbloshie comes from outside Ghana
- In 2009 Ghana imported 215,000 metric tons of “electric and electronic equipment”:
  - 30% new equipment
  - 70% used:
    - 20% needed repairs
    - 15% (22,575 tons) bound for the dump

Workers salvage metal from broken tools. (Jon Spaull/SciDev.Net)

https://www.smithsonianmag.com/science-nature/burning-truth-behind-e-waste-dump-africa-180957597/

Future: no alchemists here



- Raw materials are not “destroyed”, their extraction/reuse might become impractical
- Critical Raw Materials

Critical Raw Materials

- Two dimensions:
  - Economic importance
  - Difficulties in procurement

- 2011 → 14
- 2014 → 20
- 2017 → 27
- 2020 → 30

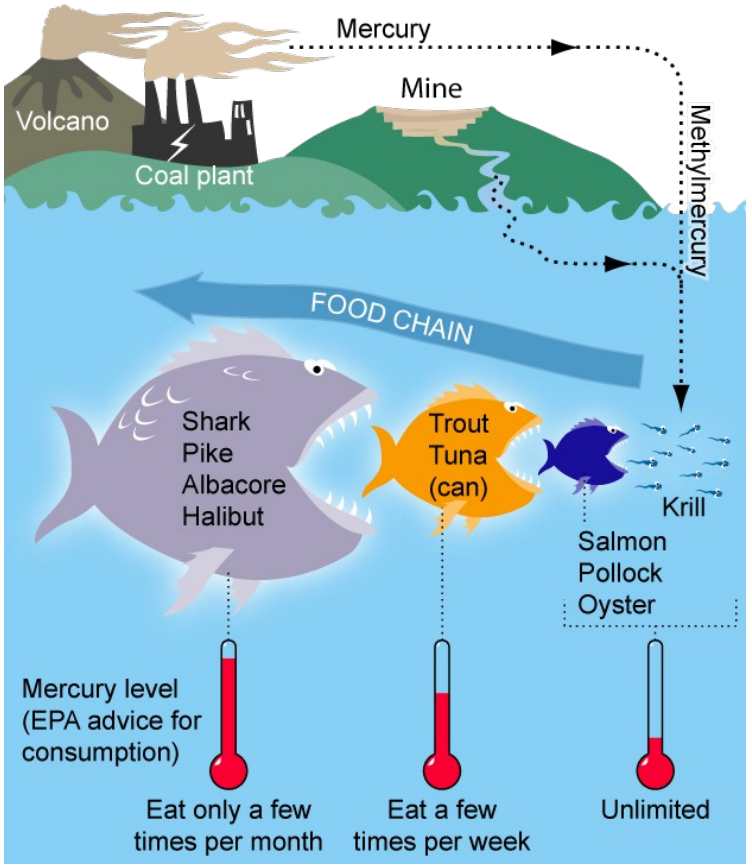
https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

Thought Experiments

- **Think** about a world with no electronics. How would your day look like?

- **Think** about a world where one or more raw materials required for building electronic components come from just one country. How would this world look like?

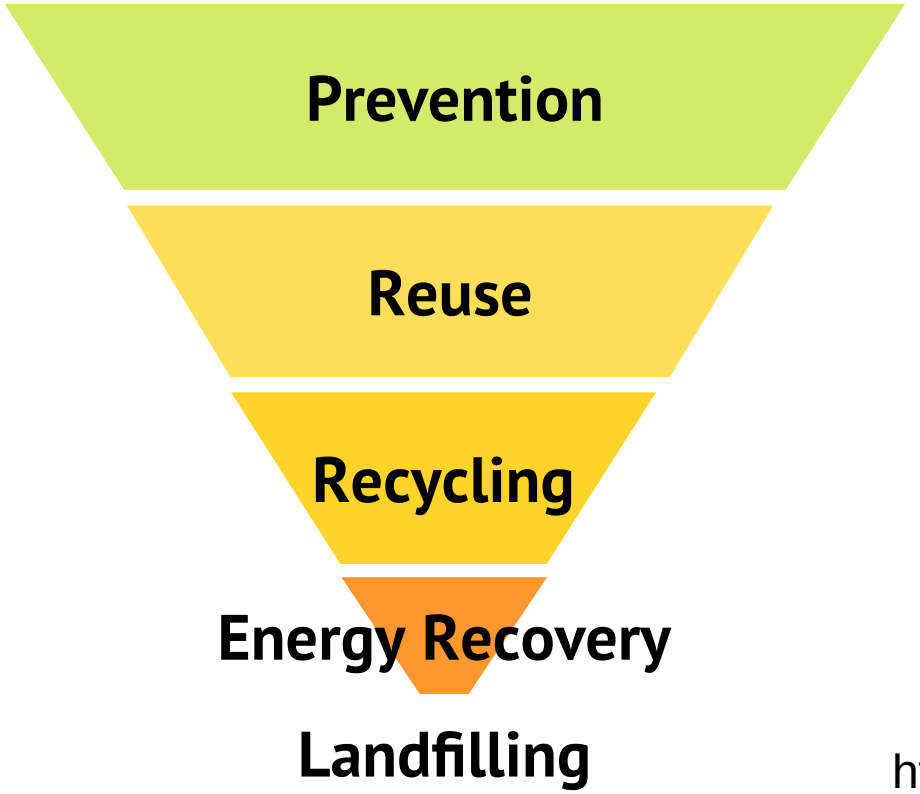
Environment Impact and Climate Change



- Global warming:
  - Changes in climate (fertile, desert areas)
  - Dislocation of people
  - Changes to ecosystems and diversity
  - Stronger meteorological events

Is there a different model?

Smarter Use of Resources



Design products with longer lifespans
Reduce packaging

Design for repair/scavenging
Deposit schemes (pallets, packaging)

Aluminum, Paper
Glass

Electricity generation from waste

https://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html

At the individual level

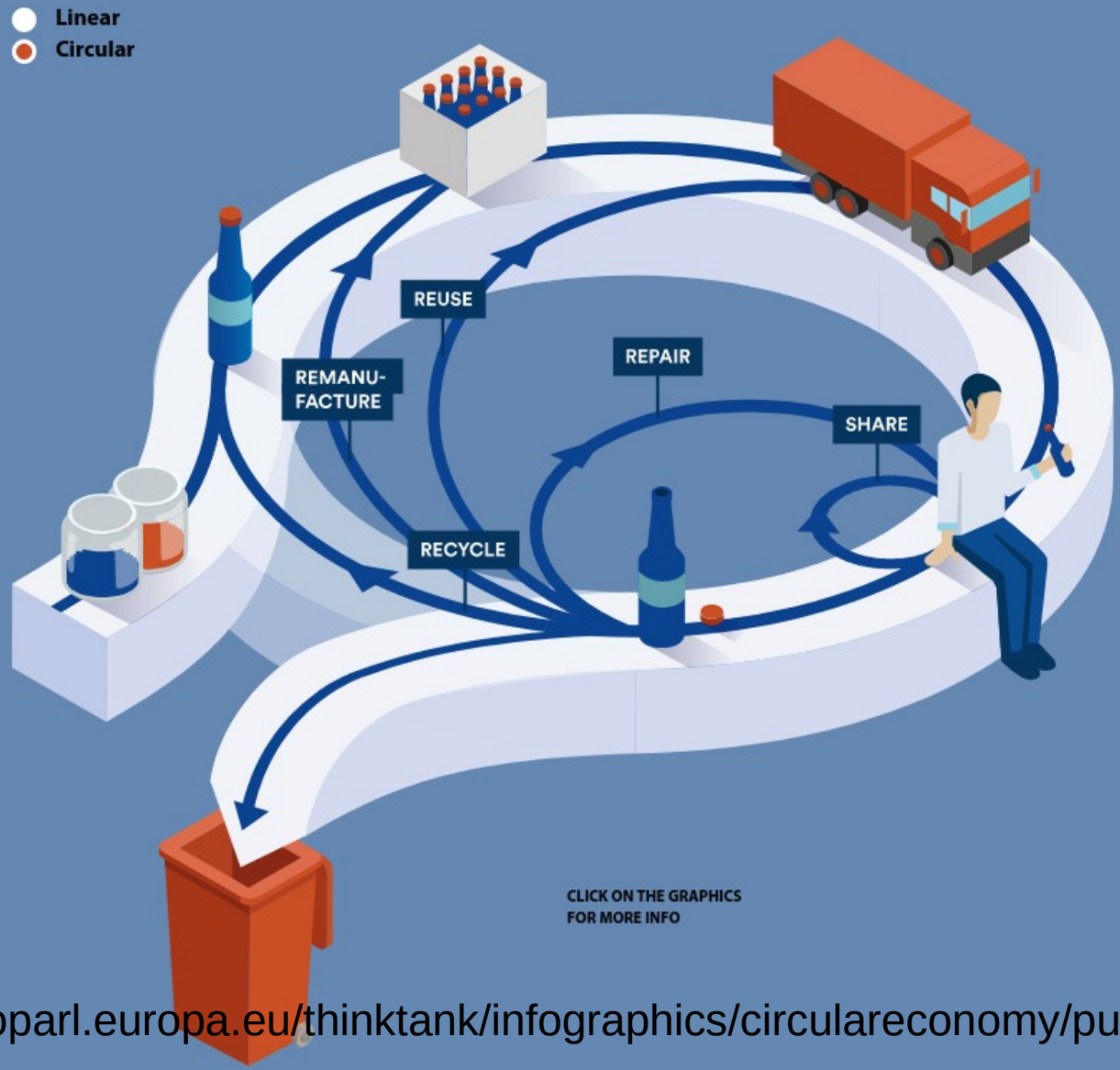
- Use products longer
- Choose according to environmental footprint
- Make alternative choices when buying (various services available)
- Sharing platforms

Reconditioned products: typically like new, with small defects (esthetics) or serviced and restored like new

Open-Box: returned by customers, with no original box

Used: second-hand

Surplus: unsold new products



https://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html

Resources and License

- European Parliamentary Research Service
  Circular Economy
  https://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html
- ITU - Global E-waste Monitor 2020
  https://www.itu.int/en/ITU-D/Environment/Pages/Spotlight/Global-Ewaste-Monitor-2020.aspx
- Resources on e-Waste (various of which mentioned also in this presentation
  https://www.ict4g.net/adolfo/work/ewaste/

Questions?

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