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Why the metals in your smartphone matter

By the end of this session, you will know:

- Which metals are hidden inside a smartphone, and what are they used for.
- Where do the metals in our smartphones come from.
- Simple actions you can take to reduce the impact of your smartphone use.

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How to study this DTM

Your path through the DTM:

1. Start with the intro slides and move forward using “Next”.
2. Reach the overview, “Components and metals”.
3. From the overview, open a topic – e.g. “Elements” for the periodic-table view.
4. Pick any metal and explore its page at your own pace.
5. Use “Return to Overview” to go back, then choose the next topic.
6. Work through the remaining topics and finish on “Key takeaways”.

Who it’s for

A broad audience – no prior knowledge of mining, geology or raw materials needed.

Time needed

About 45 minutes.

How to use it

Works for self-study or in class.

Topics

Everyday tech, raw materials, sustainability & recycling, and consumer choices.

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Life is centered around the smartphone

Around 70 % of the world's population owns a smartphone (≈ 5.7 billion users, 2026).

Around 1.2 billion smartphones are produced every year.

5G networks already cover around 60 % of the world's population (end of 2025).

Next

Why the metals in your smartphone matter

- **Everyday essential:** Smartphones are used for everything from banking to navigation, making them indispensable.
- **Hidden complexity:** Dozens of supply chains converge in one pocket-sized device.
- **Resource intensity:** Manufacturing one device requires the extraction and processing of vast amounts of raw material.
- **Environmental impact:** Mining and processing these metals consume energy, emit CO2 and can harm ecosystems.
- **Limited recycling:** Many of these metals are barely recovered, leading to growing demand for resources.

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Life is centered around the smartphone

A typical smartphone weighs around 110 g.

Yet, producing its 50+ metals requires moving about 143.4 kg of ore and waste rock.

This is roughly the weight of two average adults.

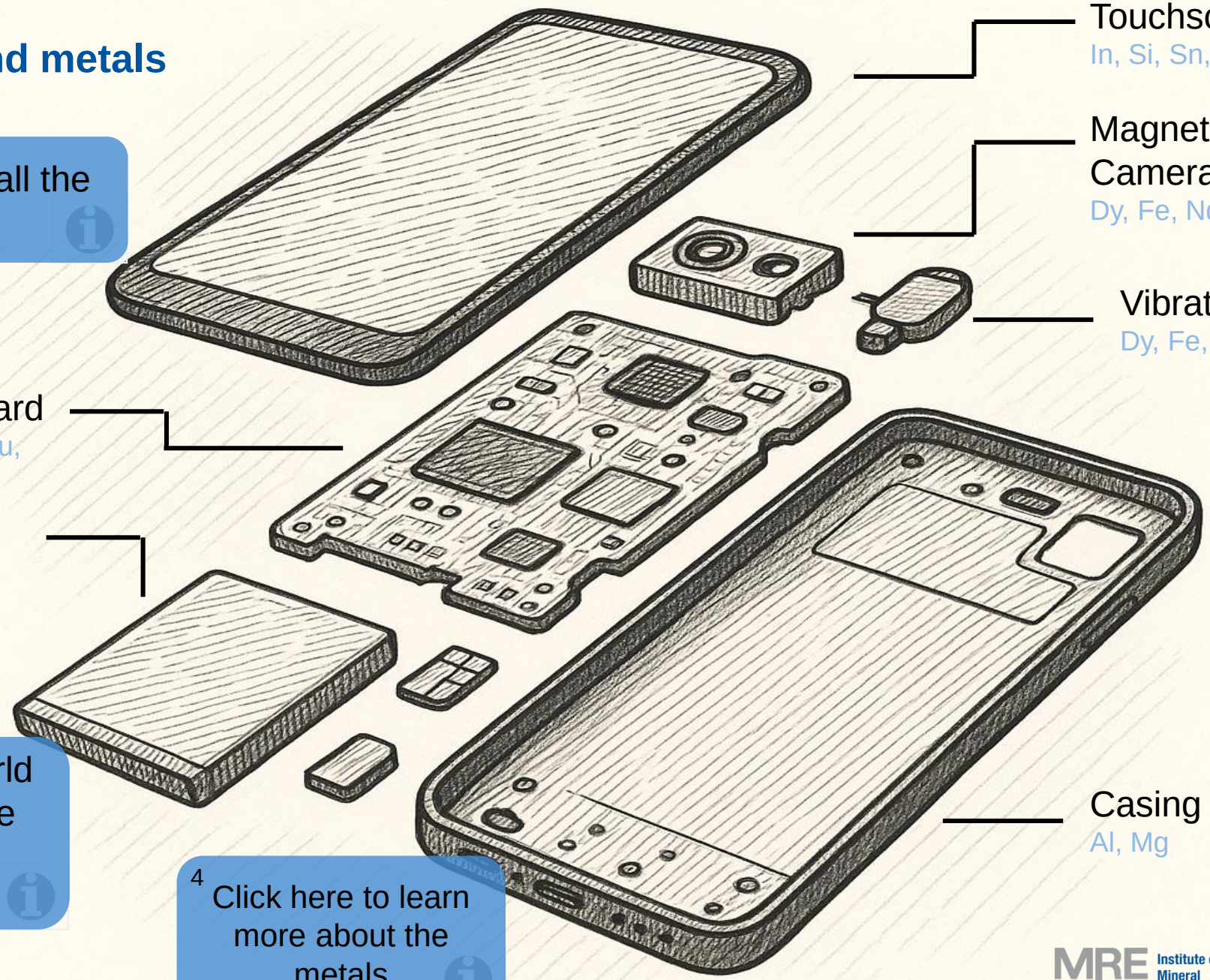
Next

What does this mean?

Source: [original study]

Components and metals

1 Click here to see all the metals



Touchscreen and Display
In, Si, Sn, La, Pr, Eu, Gd, Tb, Dy

Magnets in the Camera
Dy, Fe, Nd, Pr

Vibration Motor
Dy, Fe, Mo, Nd, W

Circuit Board
Ag, Au, Cr, Cu, Pd, Si, Ta, Ti

Battery
Co, Li, Mn, Ni

Casing
Al, Mg

2 Click here for world map showing the origin of these metals

3 Click here to learn more about the 12 most valuable metals.

4 Click here to learn more about the metals

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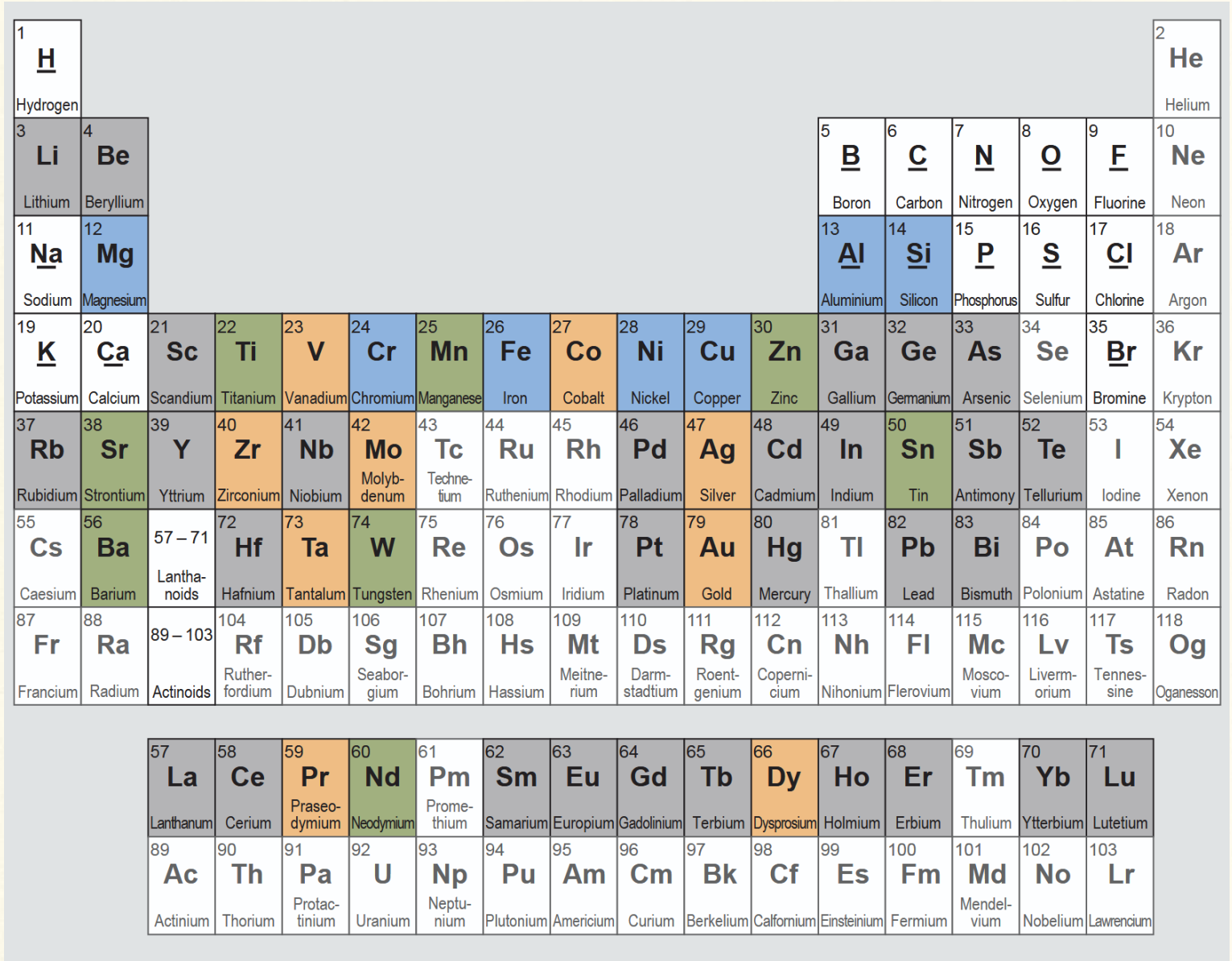

Metals contained in Smartphones

- > 1 g
- > 0.1 g
- > 0.01 g
- < 0.01 g

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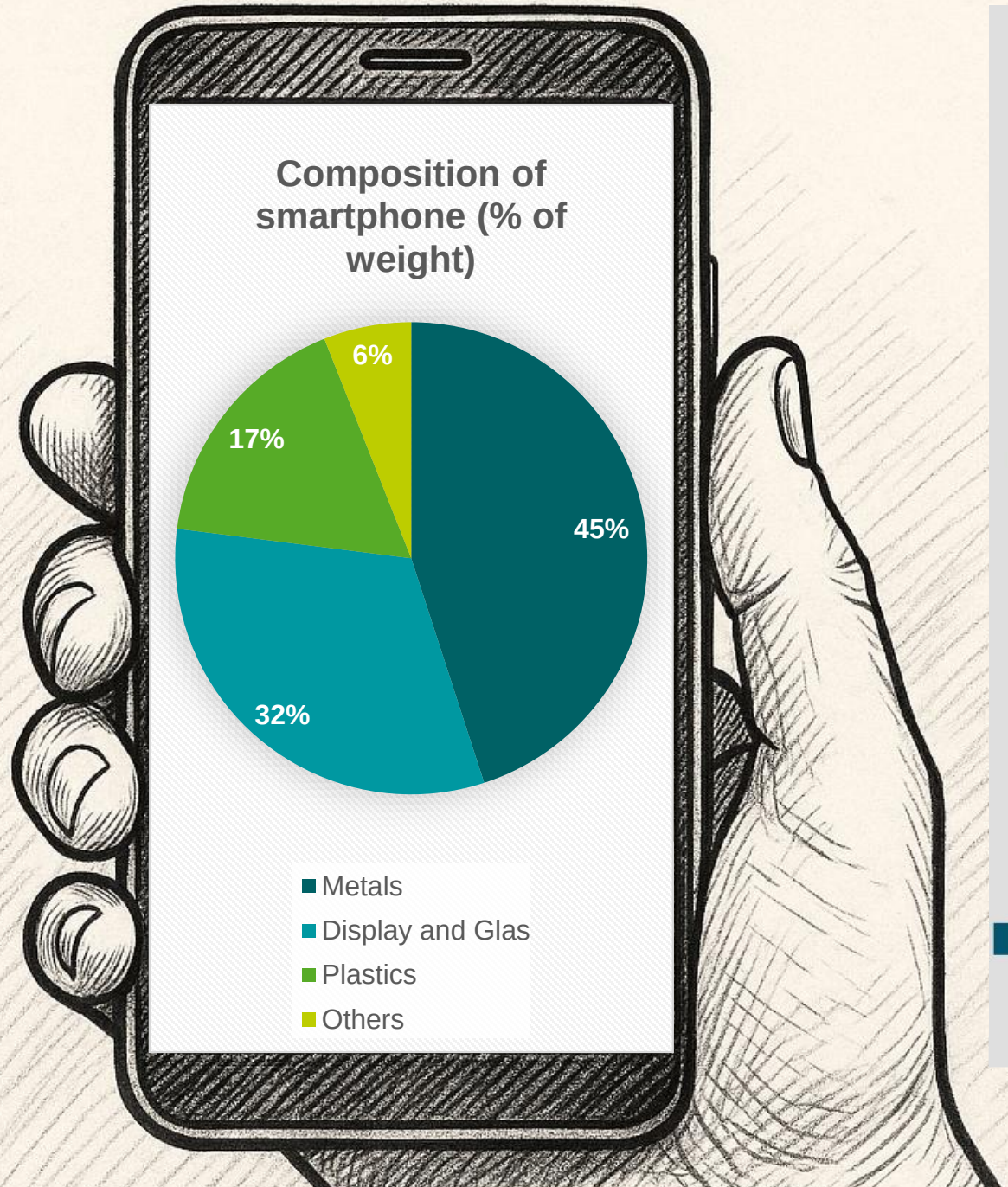
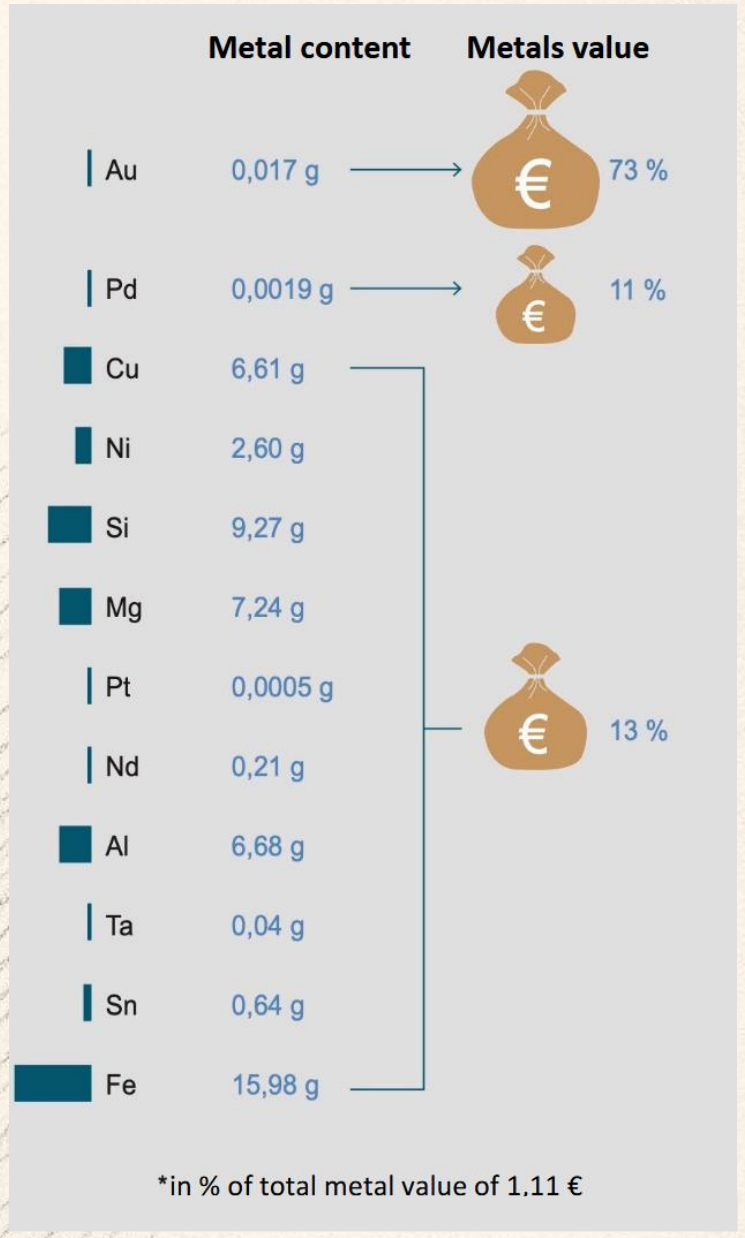
Statistics

- Average composition of smartphones (left); contents of 12 metals (right, ordered by descending values).
- These 12 of the 53 metals make up 97 % of metal value of 1.11 € in total (based on metal prices from 2020; gold and several other metals have risen sharply since, so the current value is considerably higher)





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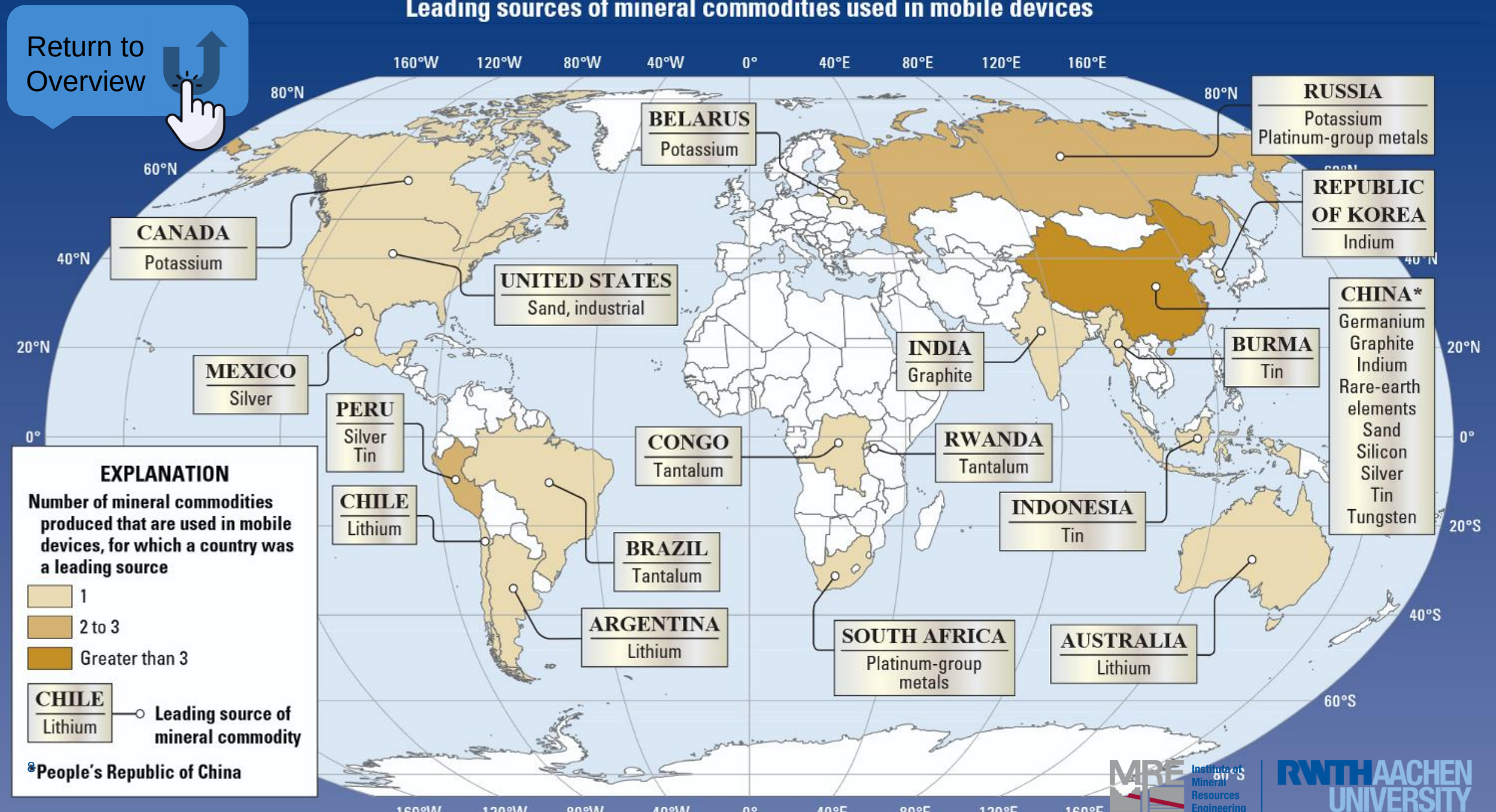
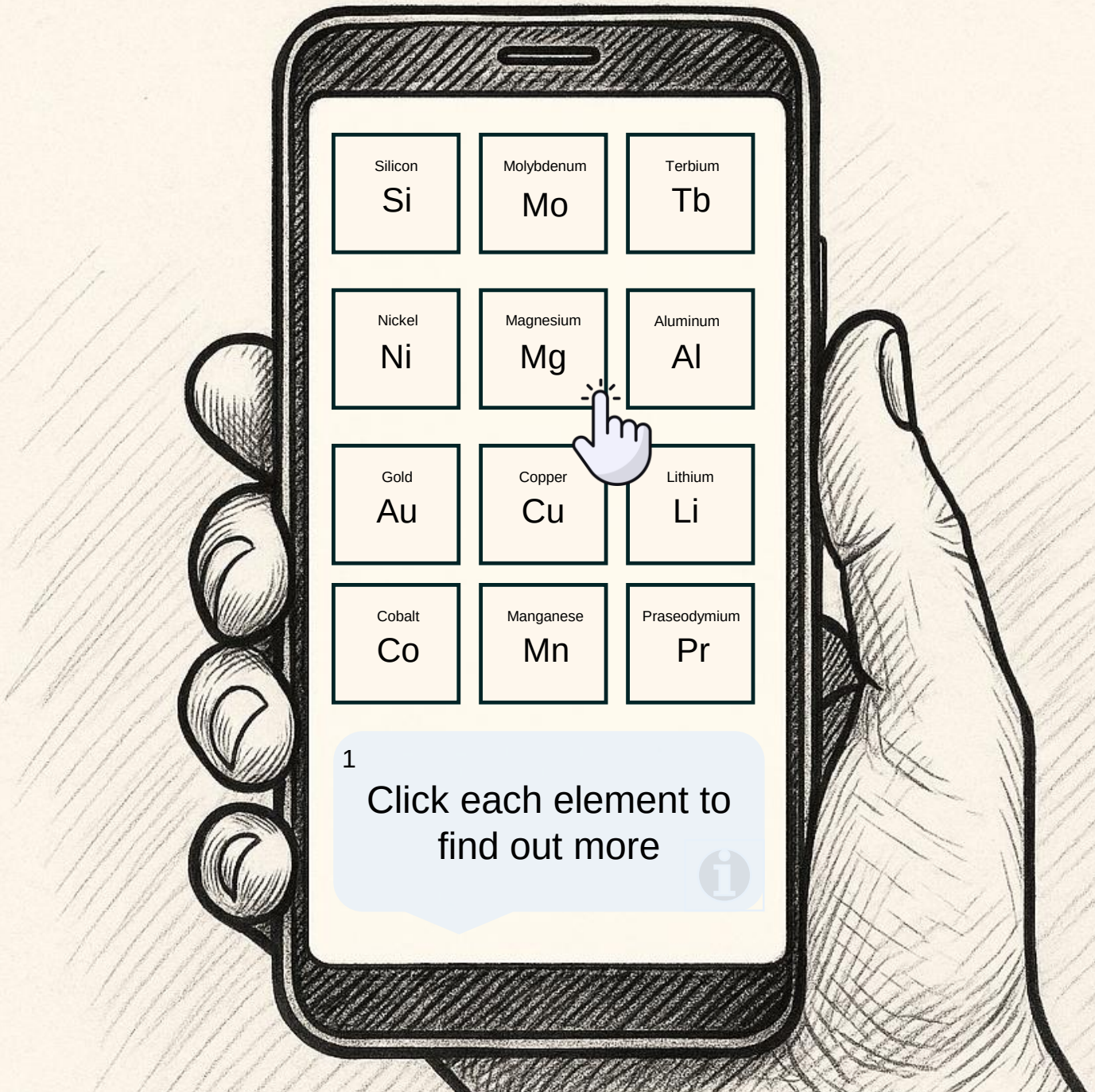
Leading sources of mineral commodities used in mobile devices



Elements



2

Click to learn about Replacement cycles of smartphones

Silicon

Silicon
Si

Smartphone part(s)
Chip and Screen glass

Amount in smartphone
9.29 g

Projected Demand Increase by 2030
+29 %

Found Primarily
N/A

Identified as a Clean Energy Metal?
Yes

Fun Fact
Silicon is the main component of sand. Chips are therefore made of sand and make your mobile phone smart.

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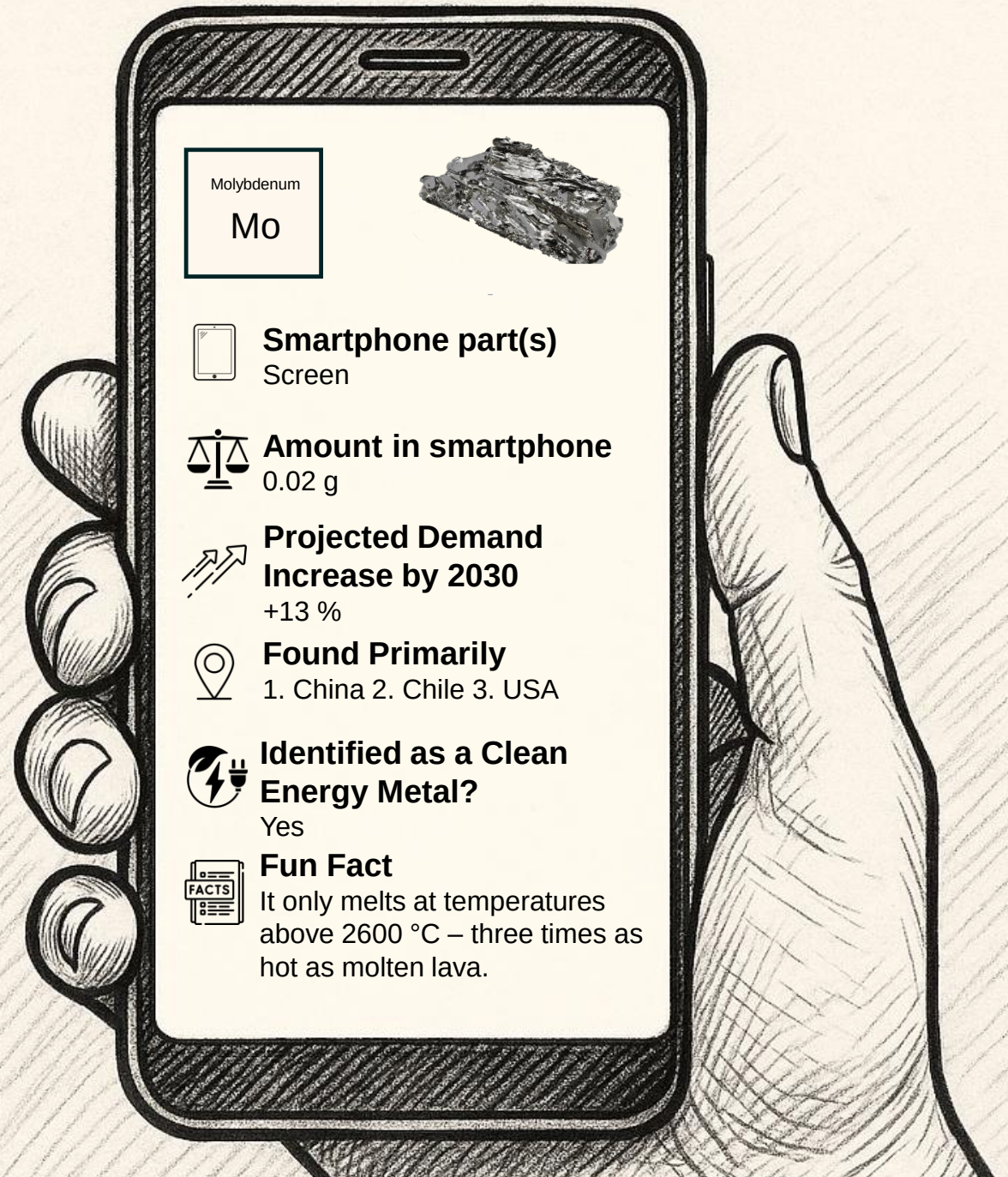
Molybdenum



Molybdenum

Mo

Smartphone part(s)
Screen

Amount in smartphone
0.02 g

Projected Demand Increase by 2030
+13 %

Found Primarily
1. China 2. Chile 3. USA

Identified as a Clean Energy Metal?
Yes

Fun Fact
It only melts at temperatures above 2600 °C – three times as hot as molten lava.

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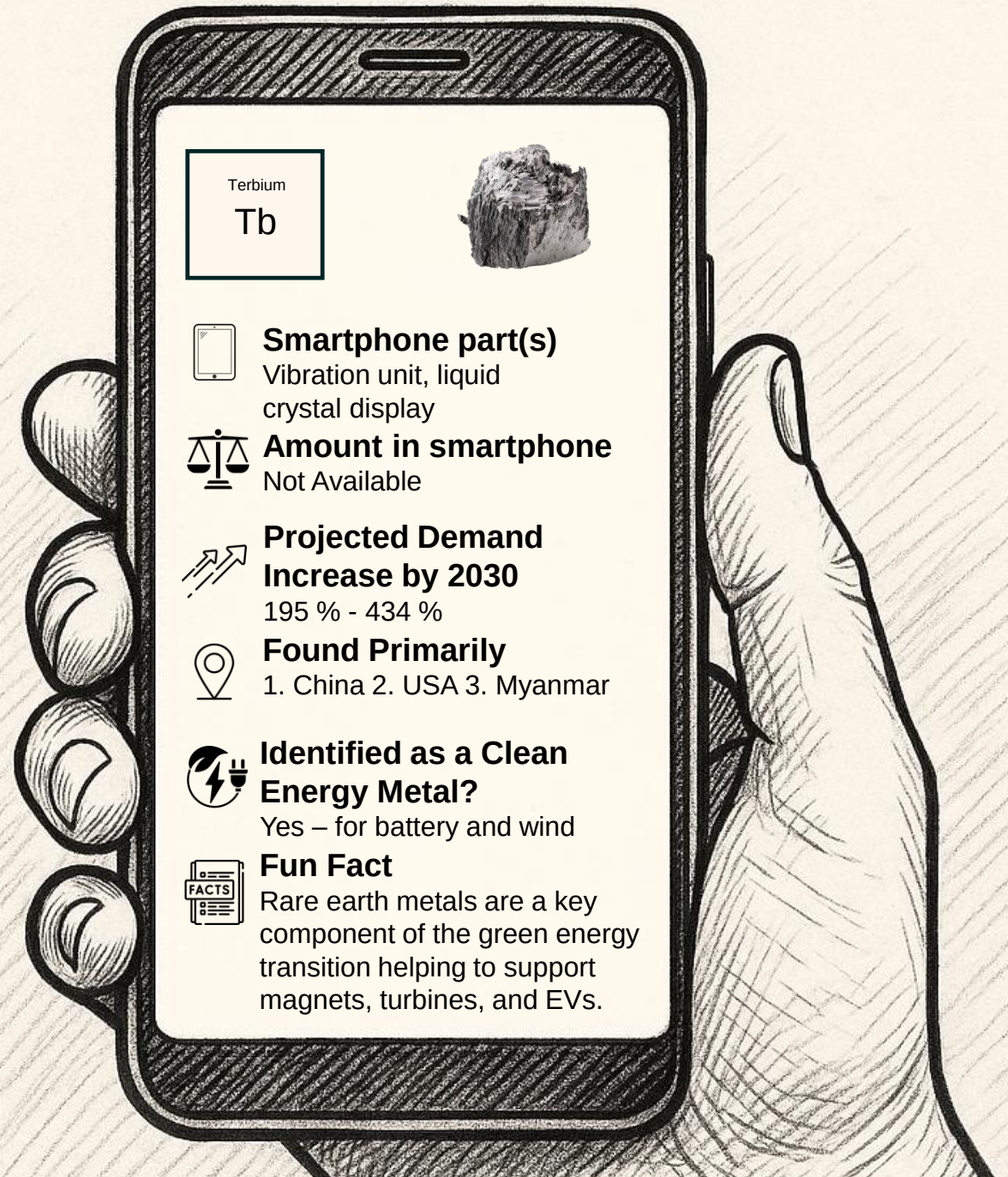
Terbium



Terbium
Tb

Smartphone part(s)
Vibration unit, liquid crystal display

Amount in smartphone
Not Available

Projected Demand Increase by 2030
195 % - 434 %

Found Primarily
1. China 2. USA 3. Myanmar

Identified as a Clean Energy Metal?
Yes – for battery and wind

Fun Fact
Rare earth metals are a key component of the green energy transition helping to support magnets, turbines, and EVs.

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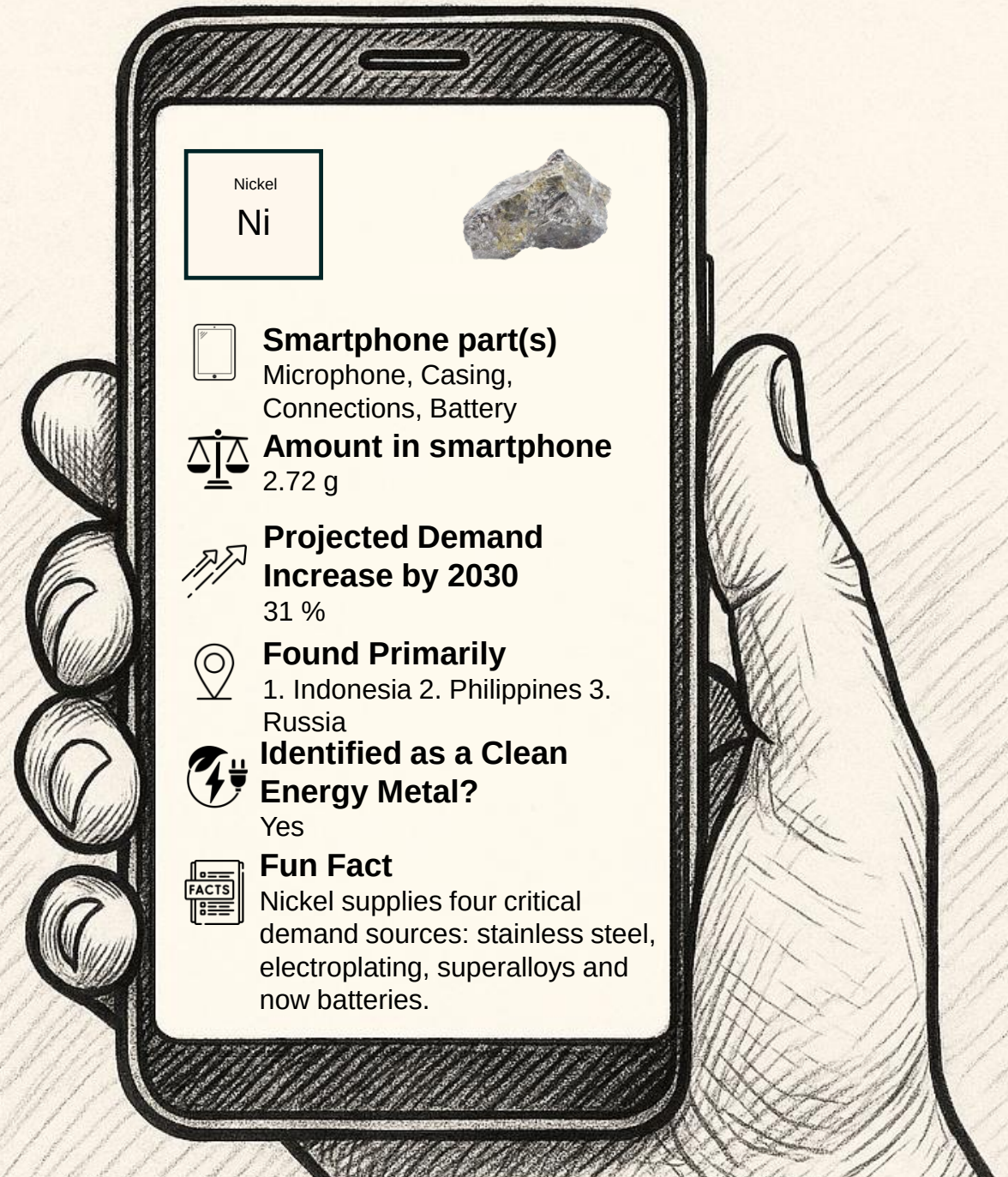
Nickel



Nickel
Ni

Smartphone part(s)
Microphone, Casing, Connections, Battery

Amount in smartphone
2.72 g

Projected Demand Increase by 2030
31 %

Found Primarily
1. Indonesia 2. Philippines 3. Russia

Identified as a Clean Energy Metal?
Yes

Fun Fact
Nickel supplies four critical demand sources: stainless steel, electroplating, superalloys and now batteries.

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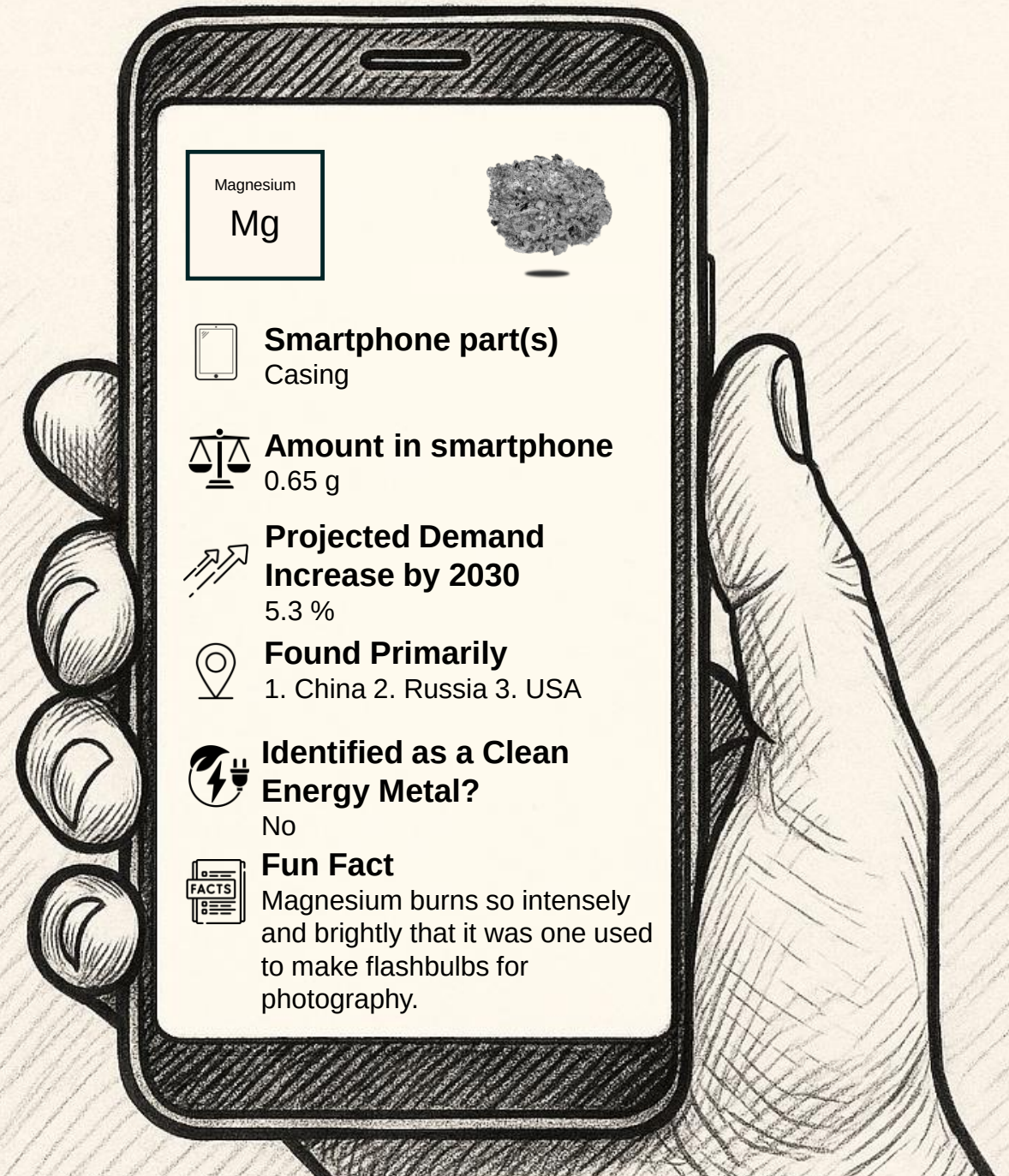
Magnesium



Magnesium
Mg

Smartphone part(s)
Casing

Amount in smartphone
0.65 g

Projected Demand Increase by 2030
5.3 %

Found Primarily
1. China 2. Russia 3. USA

Identified as a Clean Energy Metal?
No

Fun Fact
Magnesium burns so intensely and brightly that it was one used to make flashbulbs for photography.

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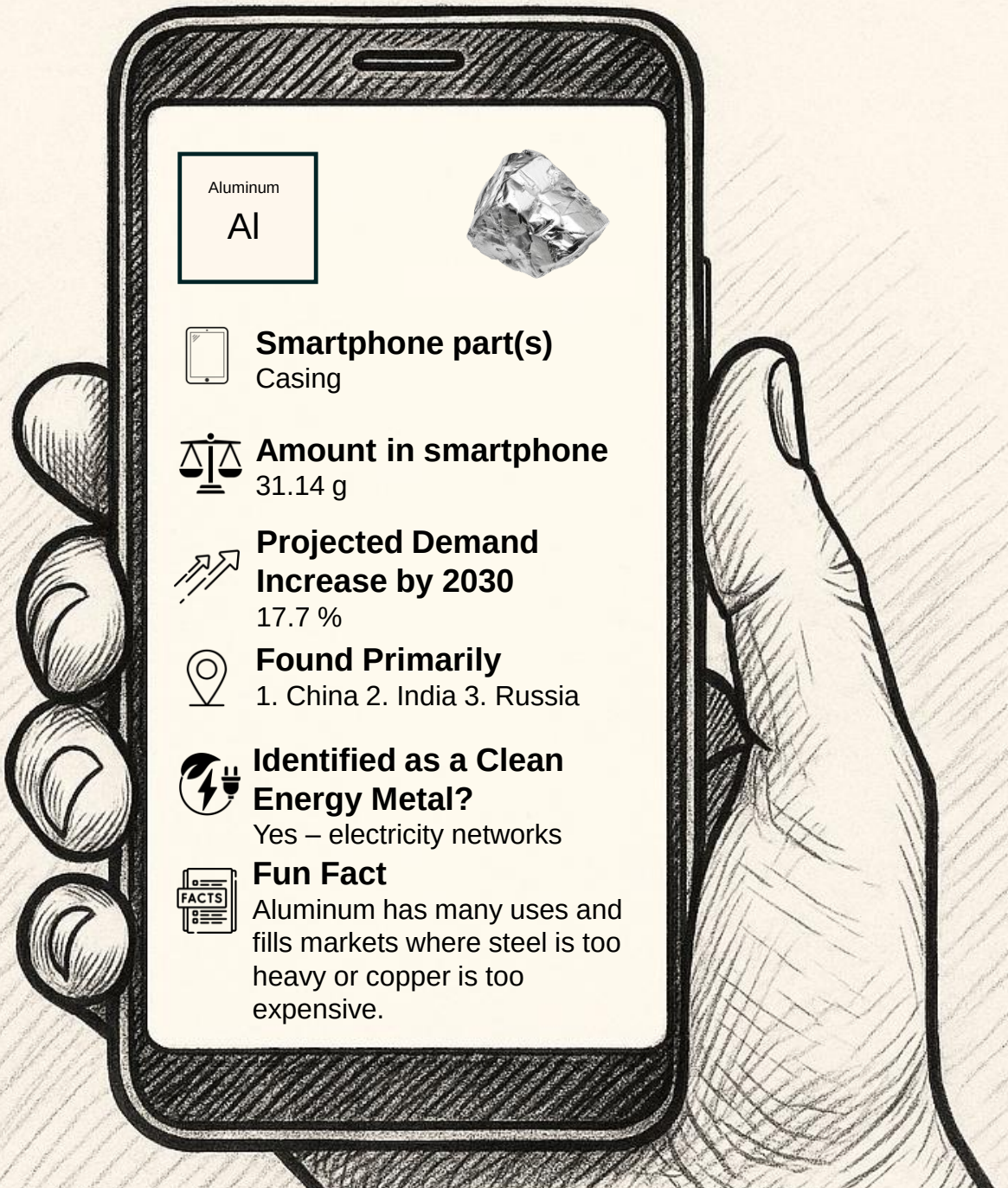
Aluminum



Aluminum

Al

Smartphone part(s)
Casing

Amount in smartphone
31.14 g

Projected Demand Increase by 2030
17.7 %

Found Primarily
1. China 2. India 3. Russia

Identified as a Clean Energy Metal?
Yes – electricity networks

Fun Fact
Aluminum has many uses and fills markets where steel is too heavy or copper is too expensive.

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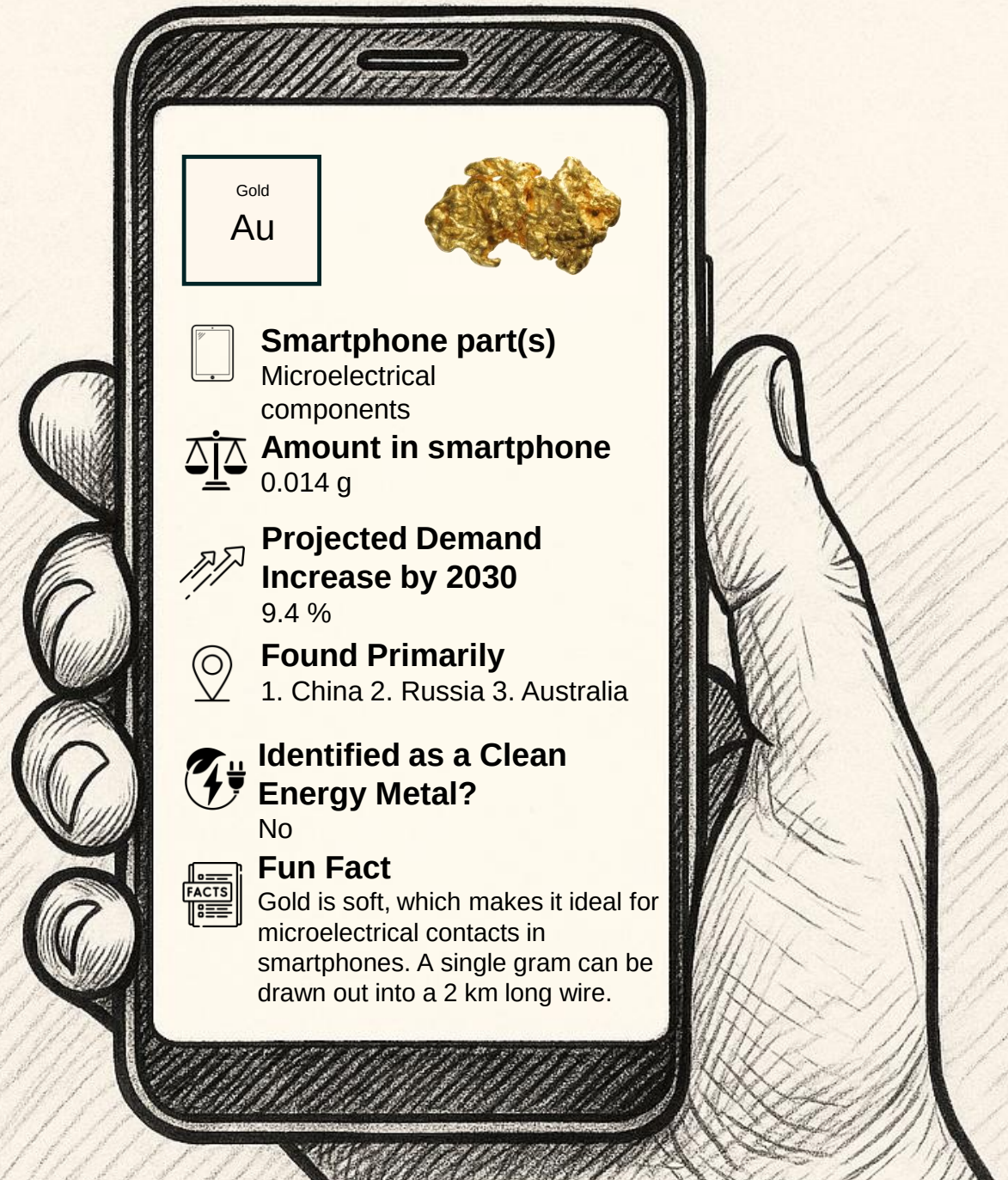
Gold



Gold
Au

Smartphone part(s)
Microelectrical components

Amount in smartphone
0.014 g

Projected Demand Increase by 2030
9.4 %

Found Primarily
1. China 2. Russia 3. Australia

Identified as a Clean Energy Metal?
No

Fun Fact
Gold is soft, which makes it ideal for microelectrical contacts in smartphones. A single gram can be drawn out into a 2 km long wire.

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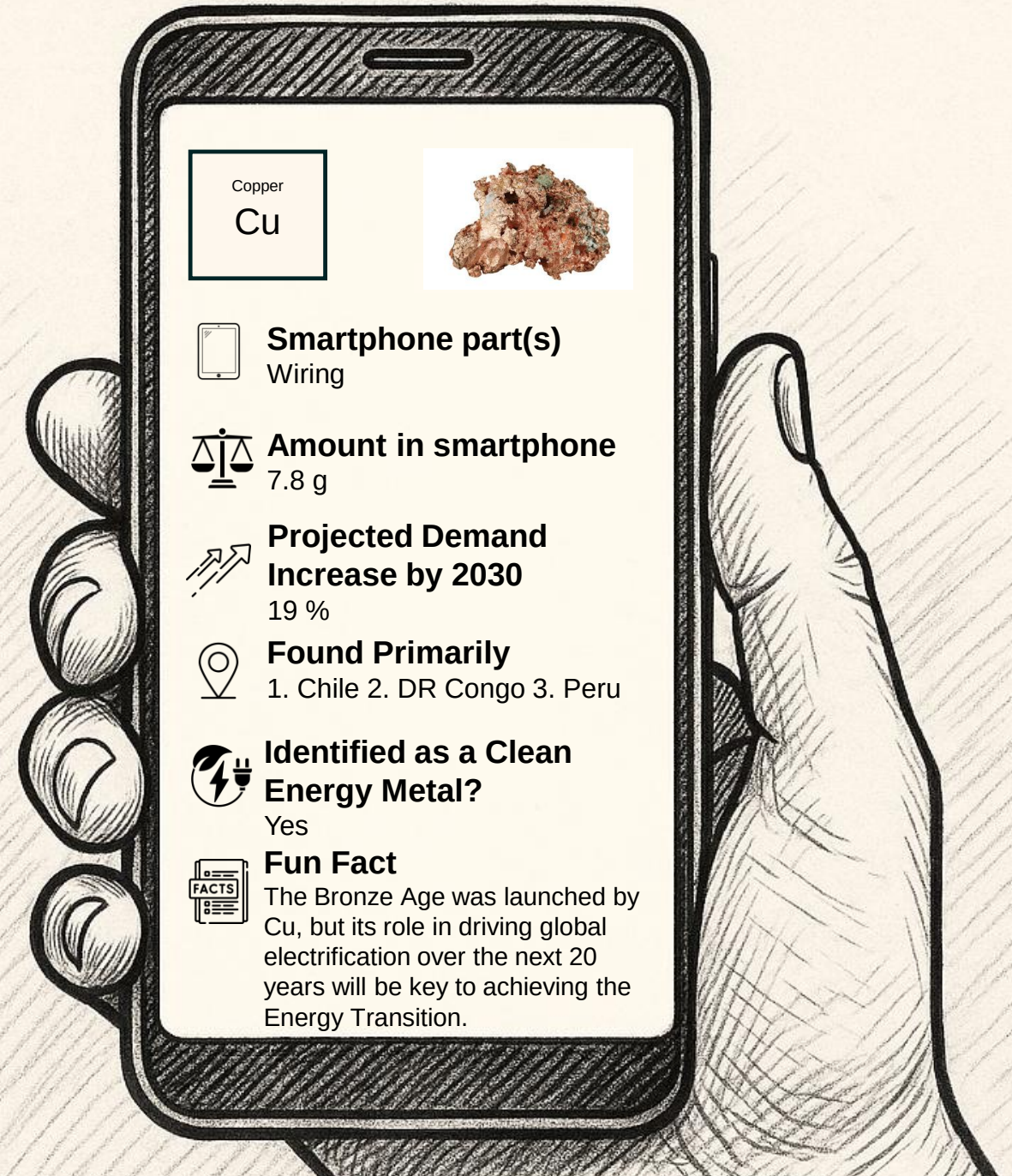
Copper



Copper
Cu

Smartphone part(s)
Wiring

Amount in smartphone
7.8 g

Projected Demand Increase by 2030
19 %

Found Primarily
1. Chile 2. DR Congo 3. Peru

Identified as a Clean Energy Metal?
Yes

Fun Fact
The Bronze Age was launched by Cu, but its role in driving global electrification over the next 20 years will be key to achieving the Energy Transition.

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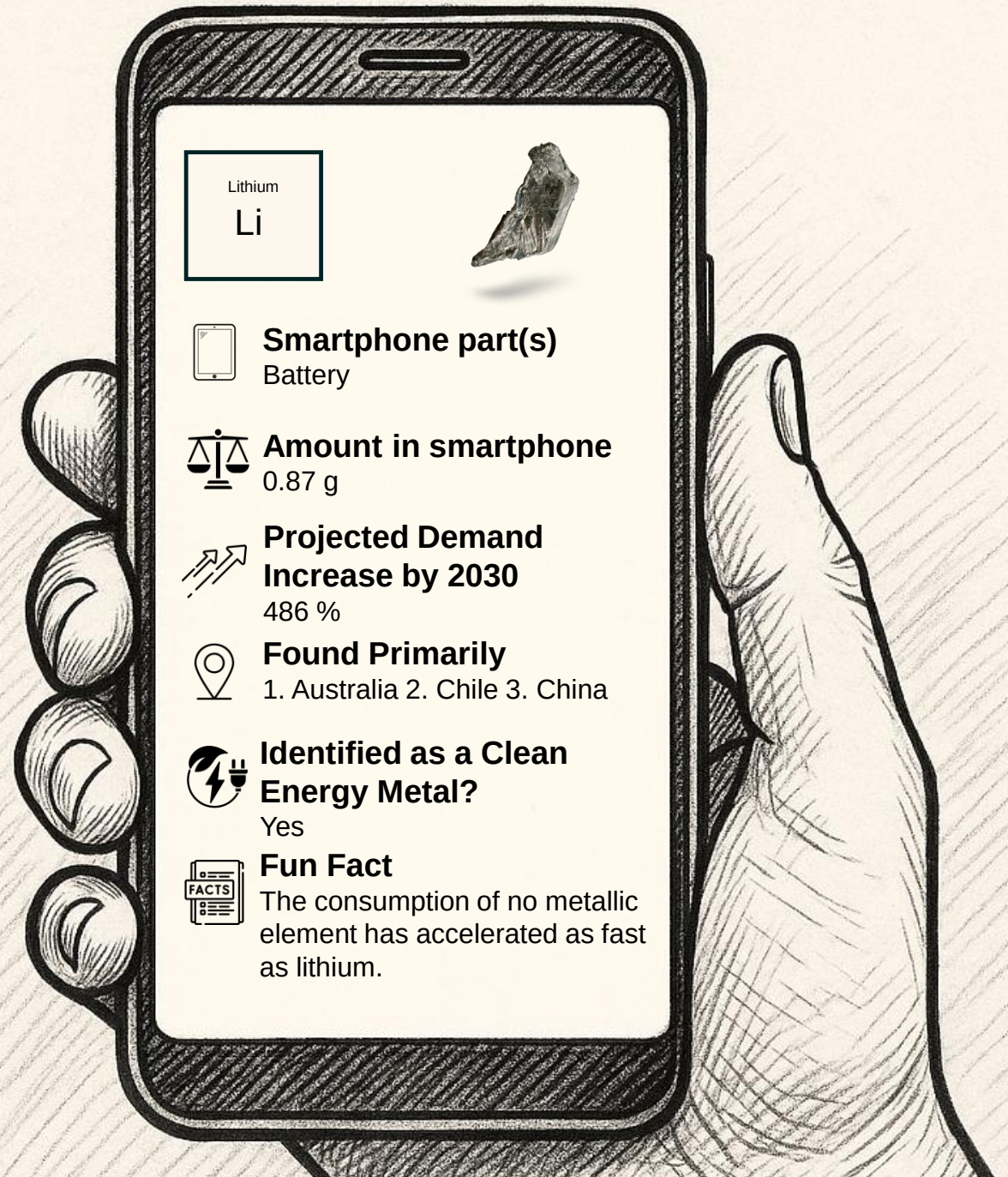
Lithium



Lithium
Li

Smartphone part(s)
Battery

Amount in smartphone
0.87 g

Projected Demand Increase by 2030
486 %

Found Primarily
1. Australia 2. Chile 3. China

Identified as a Clean Energy Metal?
Yes

Fun Fact
The consumption of no metallic element has accelerated as fast as lithium.

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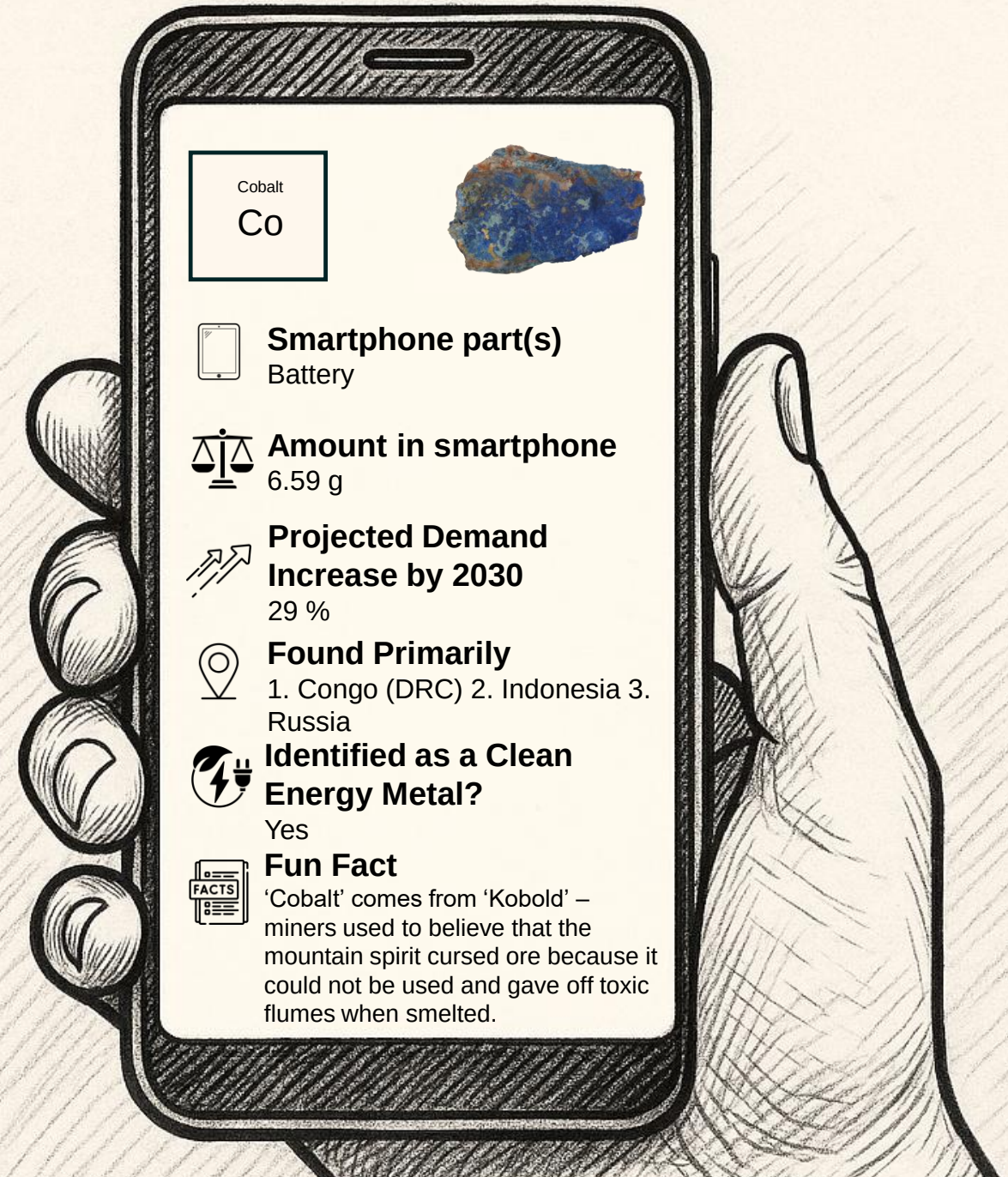
Cobalt



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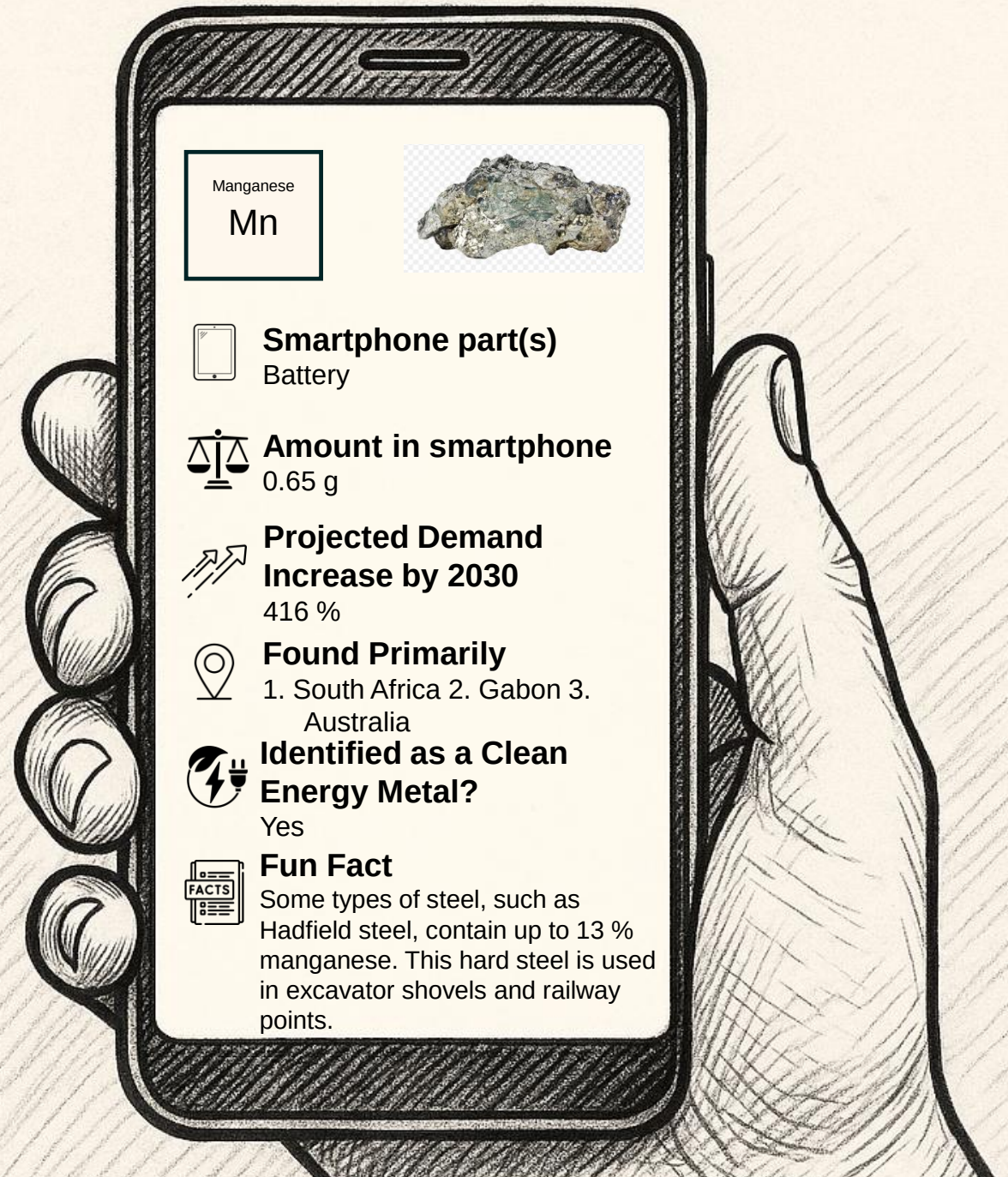
Manganese



Manganese
Mn

Smartphone part(s)
Battery

Amount in smartphone
0.65 g

Projected Demand Increase by 2030
416 %

Found Primarily
1. South Africa 2. Gabon 3. Australia

Identified as a Clean Energy Metal?
Yes

Fun Fact
Some types of steel, such as Hadfield steel, contain up to 13 % manganese. This hard steel is used in excavator shovels and railway points.

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Praseodymium

Praseodymium
Pr

Smartphone part(s)
Speakers, Microphones

Amount in smartphone
N/A

Projected Demand Increase by 2030
195 %

Found Primarily
1. China 2. USA 3. Myanmar

Identified as a Clean Energy Metal?
Yes

Fun Fact
It is combined with neodymium to create powerful magnets used in wind turbines, and it gives glass a bright green or yellow tint, as found in sunglasses and welding visors.

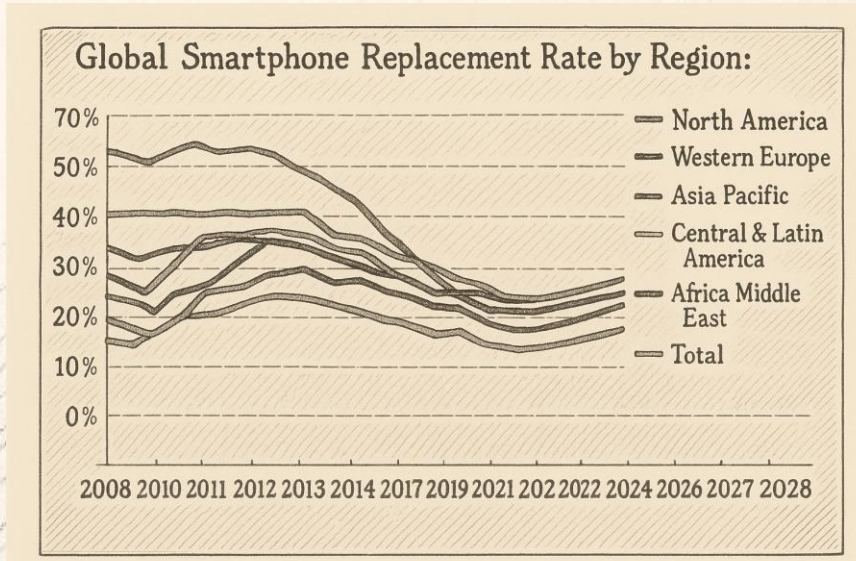
Return to Overview

Replacing an intact smartphone

1 Click here to find out why is it important to extend the life of a smartphone?

Smartphone replacement cycles have lengthened to roughly 2.5–3.5 years (2025), and the trend is still upward.

After declining at the beginning of the 2010s, the average selling price has been rising again since 2016, thus offsetting the falling sales figures.



In 2011, the replacement rate was about 66 %. This means that two-thirds were replaced, so the average usage time was 1.5 years.

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Extending the life of a smartphone

Click here to see how high Recycling rates are[1]

Why is it important to extend the life of a smartphone?

The longer a technical product remains in use, the more sustainable it becomes.

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Political initiatives in the EU

- **Strengthen consumer rights**
- **Establish European standards for devices.**
- **Provide knowledge about device maintenance and repair.**
- **Provide financial incentives for repairs.**
- **Make repair services accessible.**
- **A clear distinction between contracts and devices, as well as innovative bonuses for contract extensions, such as battery or display replacement.**

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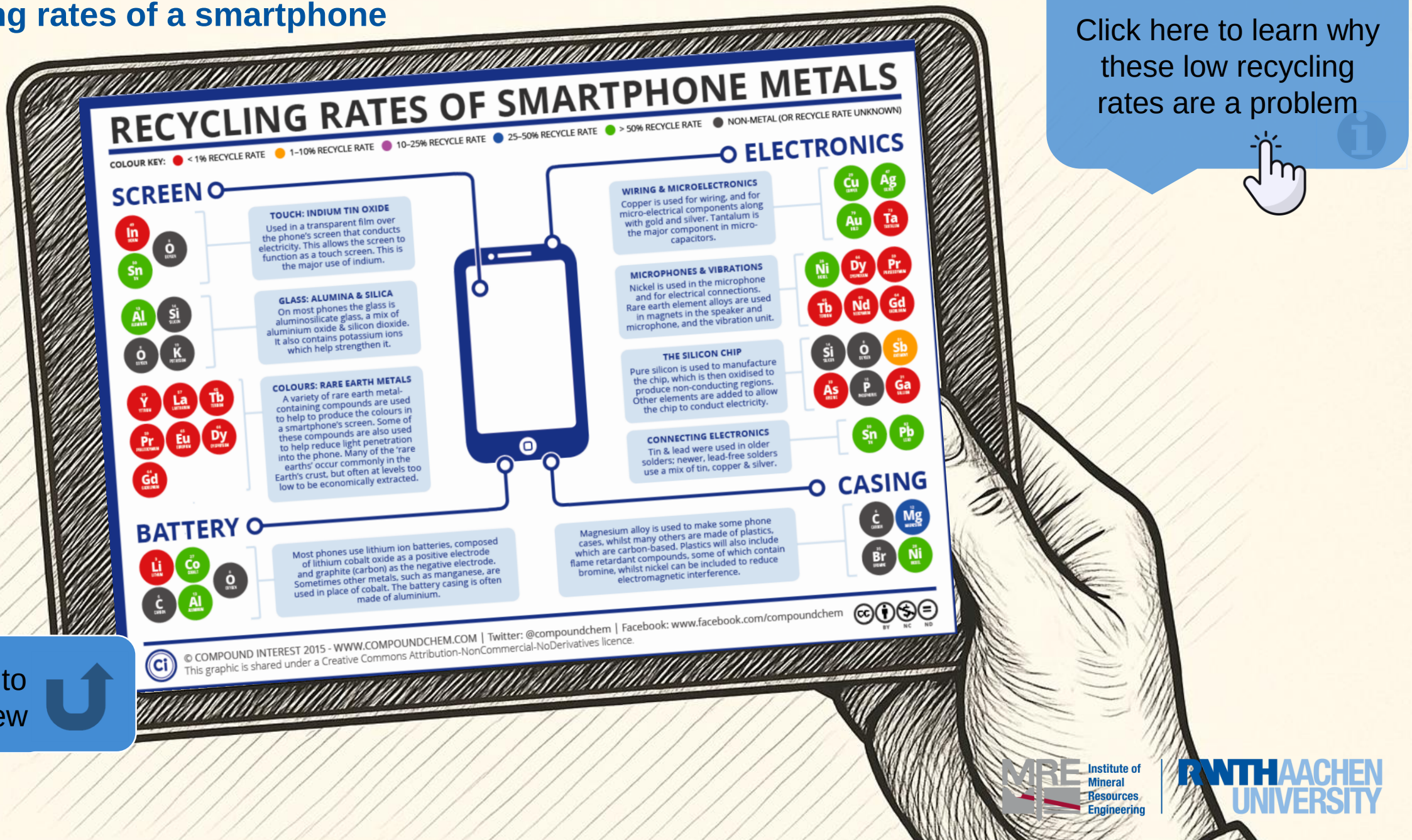
Recycling rates of a smartphone



1

Click here to learn why these low recycling rates are a problem

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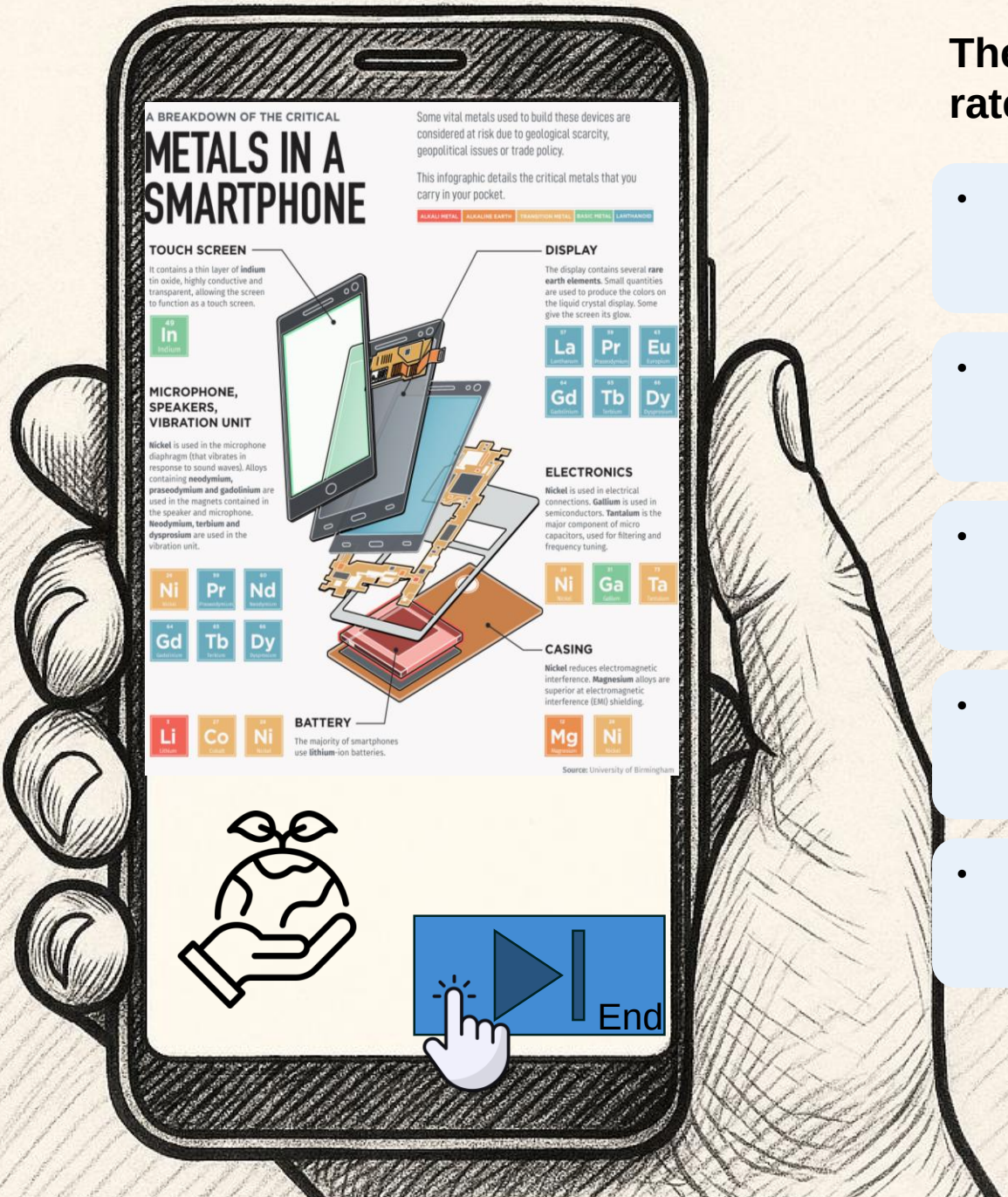
Challenges



The problem of low recycling rates

- Most metals in smartphones are not recycled at the end of their life cycle.
- Rare earths have a recycling rate of less than 1%, despite their high relevance.
- Main problems: lack of return, inefficient processes and economic barriers.
- Smartphones are considered unused ‘urban mines’ with high raw material potential.
- Growing scarcity is likely to drive innovation in recycling technologies.

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Key takeaways

A smartphone is a global product – its materials come from nearly every continent.

More **than 50 metals** are hidden in a device weighing just 110 g.

Recycling rates for many Metals are below 1 %, especially rare earths.

Extend device lifespans – keeping devices longer in use reduces resource demand.

Return old devices – they are valuable urban mines.

Want to learn more?
See the sources and exiting videos about metals in everyday tech!

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Sources & further reading

Data sources

- DataReportal – Digital 2026 Global Overview (smartphone users & ownership)
- Ericsson – Mobility Report, Nov 2025 (5G coverage)
- USGS – Mineral Commodity Summaries 2025 (metal production by country)
- Global E-waste Monitor 2024, UNITAR/ITU (e-waste & recycling rates)
- Compound Interest – Chemical elements of a smartphone (slide graphic, CC BY-NC-ND)

Learn more / videos

- TED-Ed – What's a smartphone made of? https://www.youtube.com/watch?v=eIdJ22AfsO8
- DW Documentary – Recycling e-waste (2023) https://www.youtube.com/watch?v=eT34ypRodB0
- Science Friday – How to recycle rare earth elements (2024) https://www.sciencefriday.com/segments/recycle-e-waste-rare-earth-elements/
- Global E-waste Monitor 2024 https://ewastemonitor.info
- EU raw materials: https://rmis.jrc.ec.europa.eu https://www.iea.org/topics/critical-minerals

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