

Strategic Metals:

Cobalt

Lithium

Product:

Batteries

Ethics

Social Responsibility

**1) Climate Change
&
Global Energy Transition ...
&
Demand for Metals**

Climate Change & Mining ...

- Many countries try to decarbonize their economies by using **wind, solar, and battery technologies**.
- But this **global energy transition** also has a trade-off: **to cut emissions, More minerals are needed**.
- Πολλές χώρες προσπαθούν να απανθρακοποιήσουν τις οικονομίες τους χρησιμοποιώντας τεχνολογίες **αιολικής, ηλιακής και μπαταριών**.
- Αλλά αυτή η παγκόσμια ενεργειακή μετάβαση έχει και ένα αντίκρισμα: για τη μείωση των εκπομπών, ... **Χρειάζονται περισσότερα ορυκτά**.

Wind, Solar & Batteries technologies need METALS such as ...

Wind power technology

A single 3 MW turbine requires:

1. *4.7 tons of copper* - χαλκού
2. *335 tons of steel* - χάλυβα
3. *1,200 tons of concrete* - σκυροδέματος
4. *2 tons of rare earth elements* - σπάνιων γαιών
5. *3 tons of aluminum* - αλουμινίου

Wind, Solar & Batteries technologies need METALS such as ...

Solar

PV cells require:

- 1. Polymers* - πολυμερή
- 2. Aluminum* - αλουμίνιο
- 3. Silicon* - πυρίτιο
- 4. Glass* - γυαλί
- 5. silver* - άργυρος
- 6. Tin* - κασσίτερος

especially **Batteries technologies** need METALS such as ...

Batteries

- Everything from your home, your vehicle, and your everyday devices will require battery technology to keep them powered and your life on the move.
- The following metals are at the center of battery technology that will see the greatest explosion in demand in the coming energy transition.

Batteries require:

1. ***Lithium*** - Λίθιο
2. ***Cobalt*** - Κοβάλτιο
3. ***Nickel*** - Νικέλιο

Top Five Minerals for Energy Technologies			
	2017 Production	2050 Demand from Energy Technology	Percentage Change (%)
Lithium	43 KT	415 KT	965%
Cobalt	110 KT	644 KT	585%
Graphite	1200 KT	4590 KT	383%
Indium	0.72 KT	1.73 KT	241%
Vanadium	80 KT	138 KT	173%

**Electric Vehicles
Drive up
Metals Demand**

Demand for Metals on the Rise

- Demand from the EV industry for key metals is on a swift upward trajectory.
- Copper, nickel, and lithium are some of the key metals required for EV battery production.
- As a result, demand growth for nickel from EVs is expected to increase **14 times** between 2019-2030.
- **Lithium** and **copper** are expected to experience a growth in demand of **9-10x**.
 - Η ζήτηση από τη βιομηχανία **ηλεκτρικών οχημάτων (EV)** για βασικά μέταλλα βρίσκεται σε ταχεία ανοδική πορεία.
 - **Ο χαλκός, το νικέλιο και το λίθιο** είναι μερικά από τα βασικά μέταλλα που απαιτούνται για την παραγωγή μπαταριών ηλεκτρικών οχημάτων (EV).
 - Ως αποτέλεσμα, **η αύξηση της ζήτησης για νικέλιο** από ηλεκτρικά οχήματα αναμένεται να αυξηθεί 14 φορές μεταξύ 2019-2030.
 - **Το λίθιο και ο χαλκός** αναμένεται να σημειώσουν αύξηση της ζήτησης κατά 9-10 φορές.

Demand for Metals on the Rise	
Metal	Expected Demand Growth Increase to 2030 in the EV Industry
Nickel	14x
Aluminum	14x
Phosphorus	13x
Iron	13x
Copper	10x
Graphite	10x
Lithium	9x
Cobalt	3x
Manganese	3x

Why? What's Driving Demand?

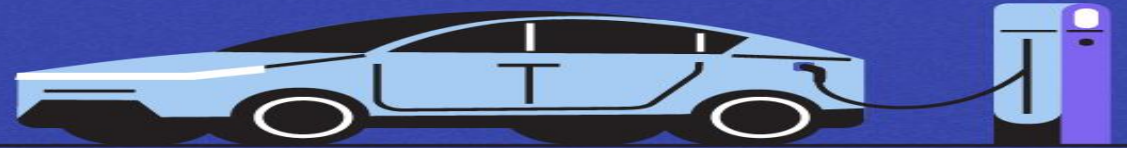
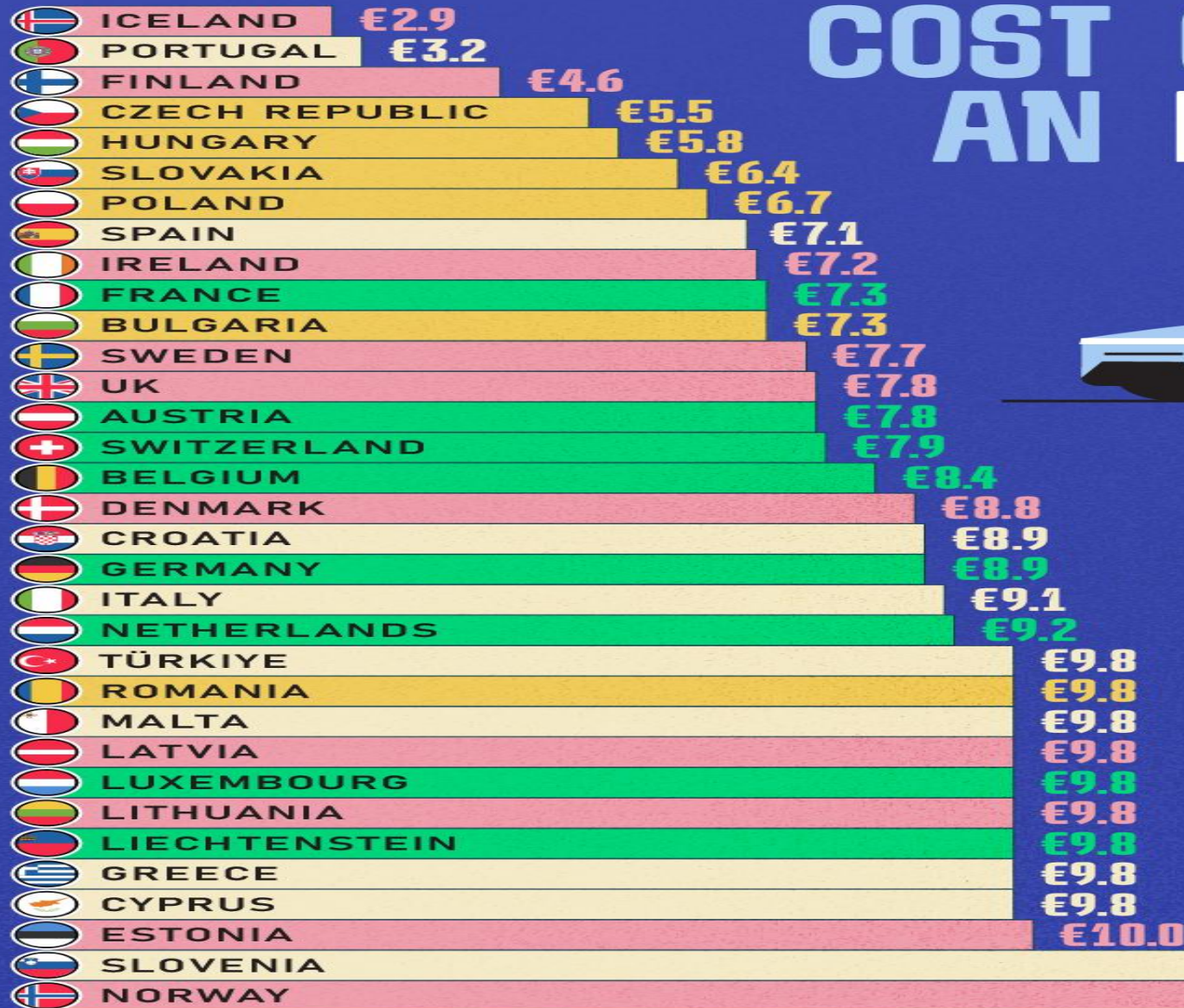
- As consumer awareness increases around climate change and demand shifts away from the oil and gas industry, the demand for EVs grows immensely.
- **According to some estimates, EVs are expected to make up over half of all passenger vehicle sales by 2040.**
- Additionally, many governments have committed to the production of EVs in a bid to decrease their dependency on fossil fuels.
- **China, for example, has a goal of having EVs make up 20% of new car sales by 2025.**
- Tesla is leading the momentum among manufacturers and investors clearly see the opportunity, having driven up Tesla's shares by over **1,000%** since March 2020.
- But there are other up-and-coming players in the EV market like NIO in China, as well as traditional car makers that are shifting their focus to EVs.

Why? What's Driving Demand?

- Καθώς η ευαισθητοποίηση των καταναλωτών σχετικά με την κλιματική αλλαγή αυξάνεται και η ζήτηση μετατοπίζεται μακριά από τη βιομηχανία πετρελαίου και φυσικού αερίου, η ζήτηση για ηλεκτρικά οχήματα αυξάνεται δραματικά.
- Σύμφωνα με ορισμένες εκτιμήσεις, **τα ηλεκτρικά οχήματα αναμένεται να αποτελούν πάνω από το ήμισυ όλων των πωλήσεων επιβατικών οχημάτων έως το 2040.**
- Επιπλέον, πολλές κυβερνήσεις έχουν δεσμευτεί για την παραγωγή ηλεκτρικών οχημάτων σε μια προσπάθεια να μειώσουν την εξάρτησή τους από τα ορυκτά καύσιμα.
- Η Κίνα, για παράδειγμα, έχει ως στόχο τα ηλεκτρικά οχήματα να αποτελούν το 20% των πωλήσεων νέων αυτοκινήτων έως το 2025.
- Η Tesla ηγείται της δυναμικής μεταξύ των κατασκευαστών και οι επενδυτές βλέπουν ξεκάθαρα την ευκαιρία, έχοντας αυξήσει τις μετοχές της Tesla κατά πάνω από 1.000% από τον Μάρτιο του 2020.
- Ωστόσο, υπάρχουν και άλλοι ανερχόμενοι παίκτες στην αγορά ηλεκτρικών οχημάτων, όπως η NIO στην Κίνα, καθώς και παραδοσιακοί κατασκευαστές αυτοκινήτων που μετατοπίζουν την εστίασή τους στα ηλεκτρικά οχήματα.

Costs for Electrical Vehicles

COST OF CHARGING AN ELECTRIC CAR IN EUROPE



SUBREGION



* For a Tesla Model 3. Public DC charging outlets considered only.
Charging time is 25 minutes. Source: European Alternative Fuels Observatory (2024)



But**Ethical Issues** ...

- Many of these raw materials come from low to lower-middle-income countries and are essential to their economies.
- For example, around **50%** of the world's cobalt, another key material for EV manufacturing, is found in the **Democratic Republic of the Congo**.
- **Investors and mining companies stand to gain from this increased demand for EVs and they**
 - exploit people
 - topple governments
 - use children for labor
 - sabotage economic development
 - disapprove of social policies

ΗΘΙΚΑ Θέματα & Διλήμματα

- Πολλές από αυτές τις πρώτες ύλες προέρχονται από χώρες χαμηλού έως μεσαίου εισοδήματος και είναι απαραίτητες για τις οικονομίες τους.
- Για παράδειγμα, περίπου το 50% του παγκόσμιου κοβαλτίου, ενός άλλου βασικού υλικού για την κατασκευή ηλεκτρικών οχημάτων, βρίσκεται στη **Λαϊκή Δημοκρατία του Κονγκό**.
- Οι επενδυτές και οι εταιρείες εξόρυξης πρόκειται να επωφεληθούν από αυτήν την αυξημένη ζήτηση για ηλεκτρικά οχήματα και αυτοί
 - ☐ εκμεταλλεύονται ανθρώπους
 - ☐ ανατρέπουν κυβερνήσεις
 - ☐ χρησιμοποιούν παιδιά για εργασία
 - ☐ σαμποτάρουν την οικονομική ανάπτυξη των χωρών αυτών
 - ☐ δεν εγκρίνουν τις κοινωνικές πολιτικές

2) Critical Inputs & Resources ...

ΑΥΤΑΡΚΙΑ & ΕΞΑΡΤΗΣΗ

- **Some countries have developed the manufacturing sector.**
 - *Therefore, they have & control of factories (transformation processes).*
- **But NO individual country has autarky of resources, esp. strategic metals.**
- **Countries are searching globally for resources they do not have.**

- **Ορισμένες χώρες έχουν αναπτύξει τον μεταποιητικό τομέα.**
 - Επομένως, έχουν και τον έλεγχο των εργοστασίων (διαδικασίες μετασχηματισμού).
- **Αλλά ΚΑΜΙΑ μεμονωμένη χώρα δεν έχει αυτάρκεια πόρων, ειδικά στρατηγικών μετάλλων.**
- **Οι χώρες αναζητούν παγκοσμίως πόρους που δεν διαθέτουν.**

Superpowers & Metal Reign

- Countries and esp. World Powers have two main and imperative objectives:
 - 1. to secure necessary Inputs – Raw Materials &*
 - 2. to secure markets to sell their Products & Services*
- Depending on the Technology stage, every strategic resource has its time:
 - Coal: 200 years before.
 - Oil & Gas: 100 years before up to now.
 - Cobalt: Currently, to immediate future
 - **Rare Earth metals:** Currently to distant future

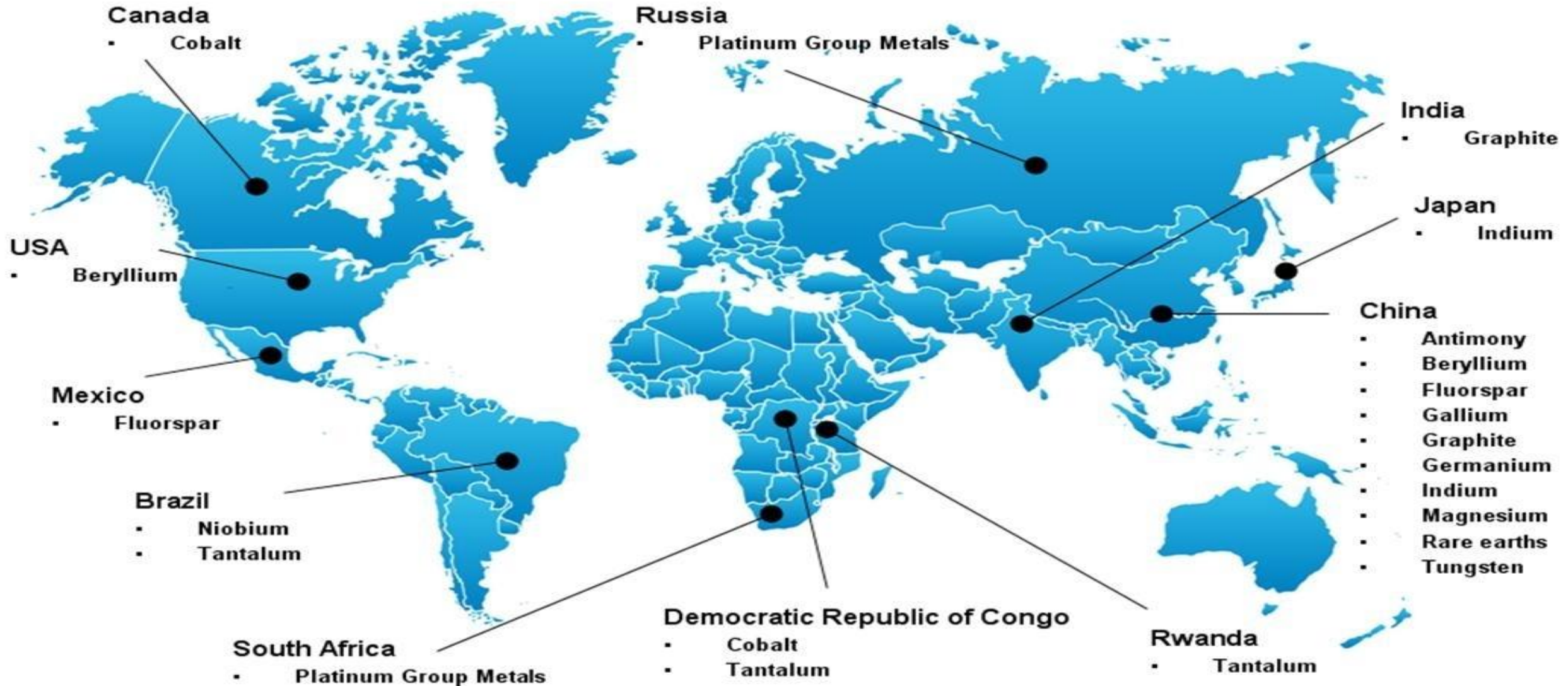
ΙΣΧΥΡΕΣ & ΑΝΙΣΧΥΡΕΣ ΔΥΝΑΜΕΙΣ

- Οι χώρες και ιδιαίτερα οι παγκόσμιες δυνάμεις έχουν δύο κύριους και επιτακτικούς στόχους:
 1. να εξασφαλίσουν τις απαραίτητες εισροές - πρώτες ύλες και
 2. να εξασφαλίσουν αγορές για την πώληση των προϊόντων και των υπηρεσιών τους.

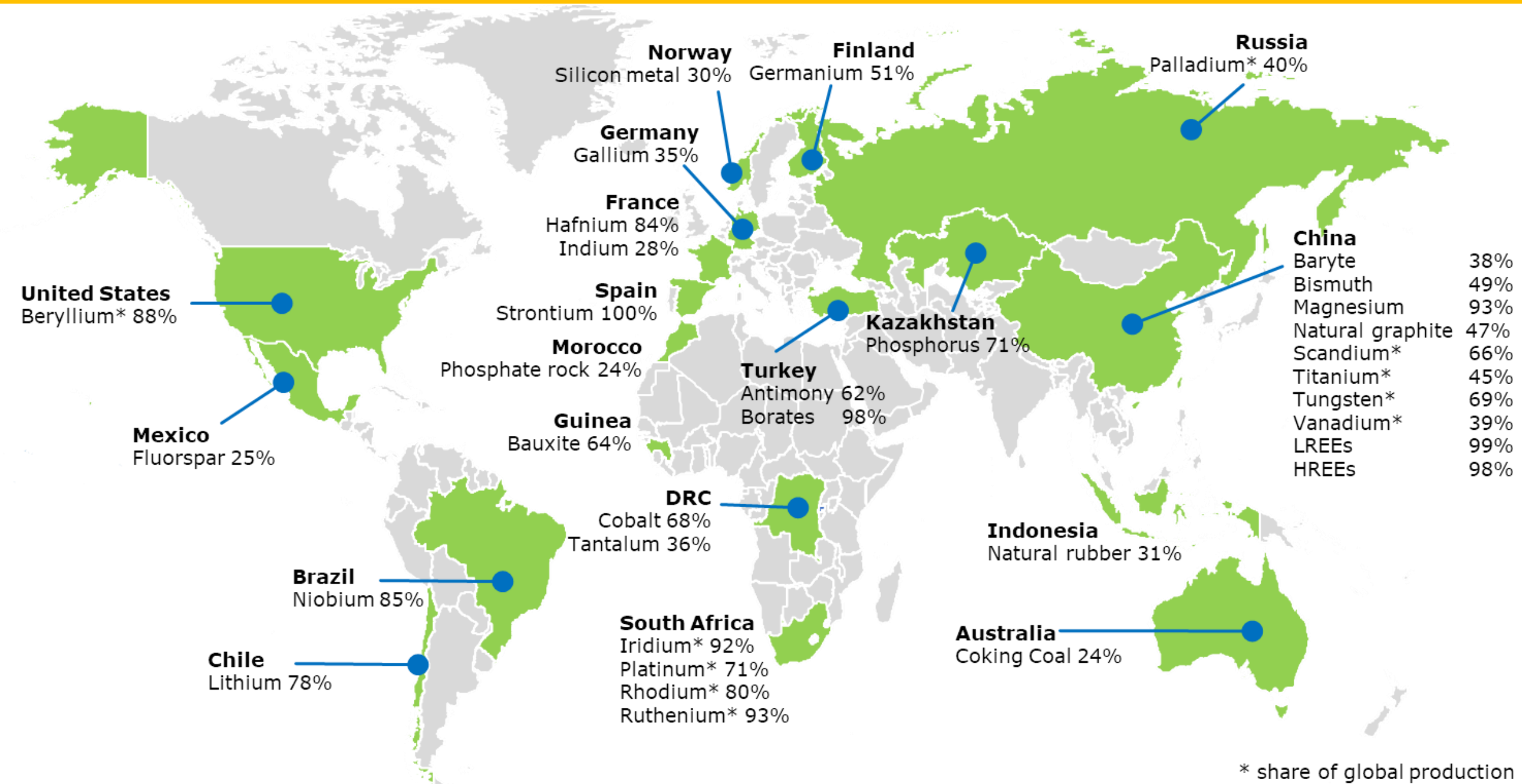
- Ανάλογα με το τεχνολογικό στάδιο, κάθε στρατηγικός πόρος έχει τον χρόνο του:
 - Άνθρακας: 200 χρόνια πριν.
 - **Πετρέλαιο και φυσικό αέριο**: 100 χρόνια πριν μέχρι σήμερα.
 - **Κοβάλτιο**: Από σήμερα έως το άμεσο μέλλον.
 - **Σπάνιες γαίες**: Από σήμερα έως το μακρινό μέλλον.

Critical Inputs & Resources ... *(Today)*

Production concentration of critical raw mineral materials

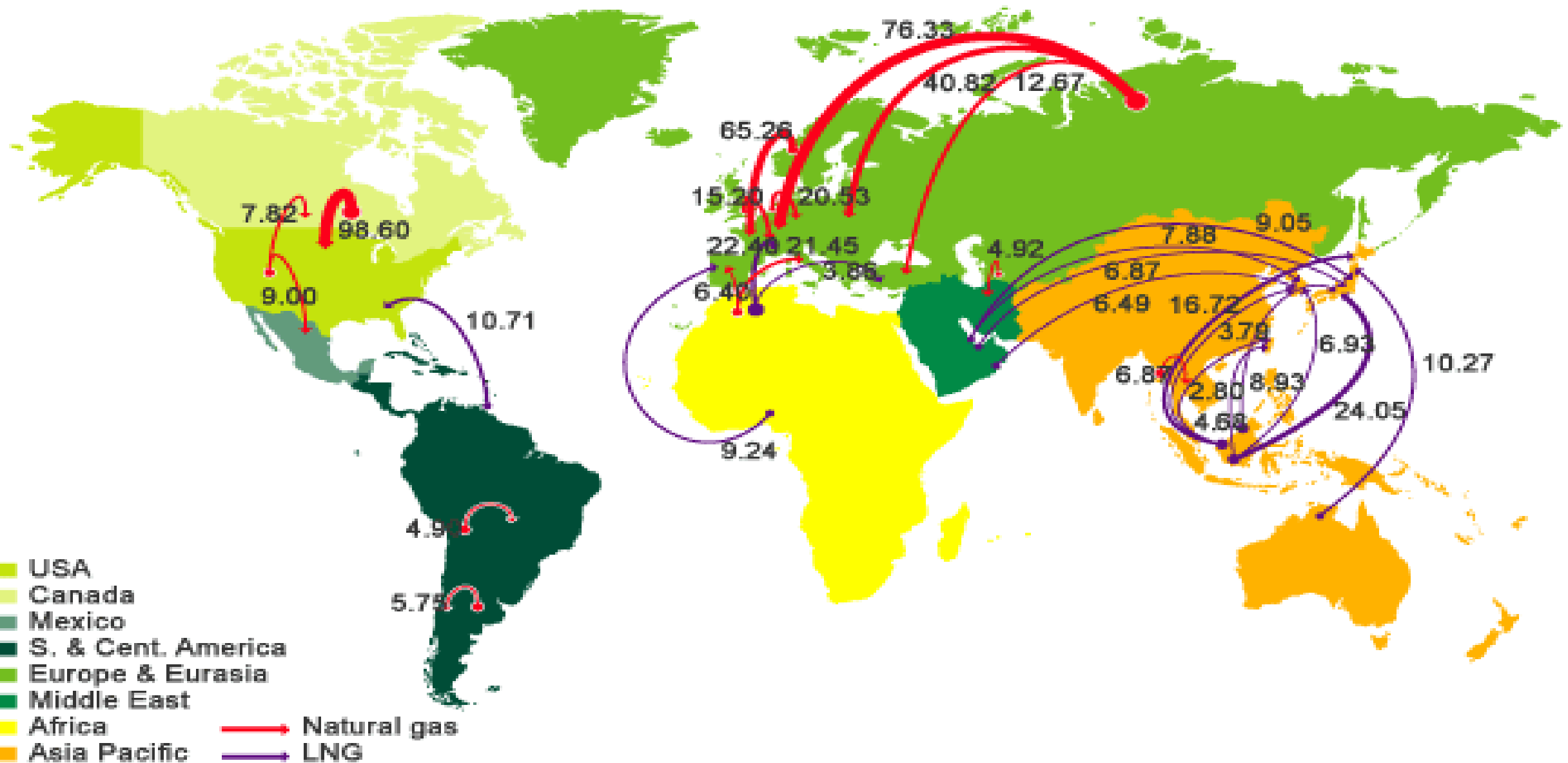


Producers of Critical Inputs & Resources ...



Gas as a resource ... *(for 30 years more?)*

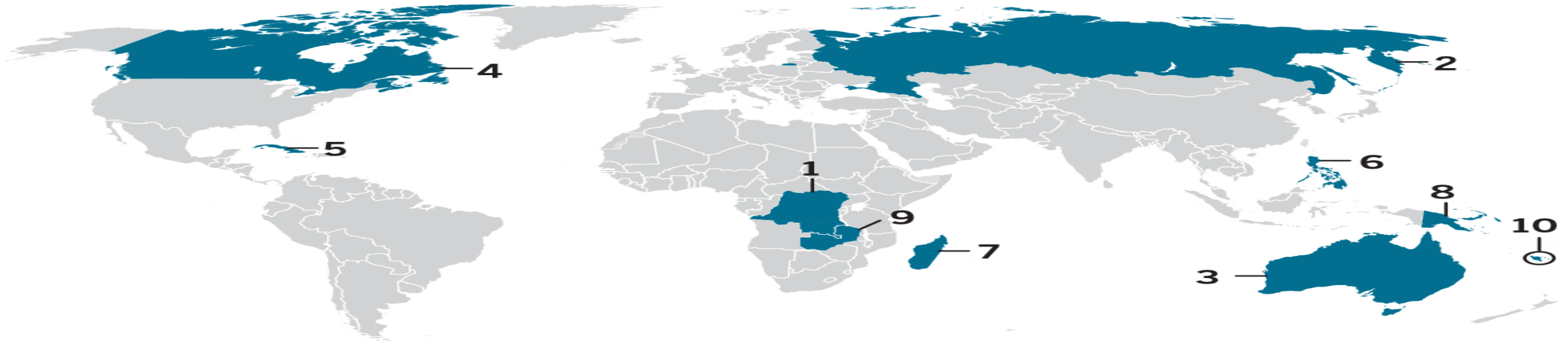
Natural gas & LNG major trade movements
Trade flows worldwide (billion cubic metres)



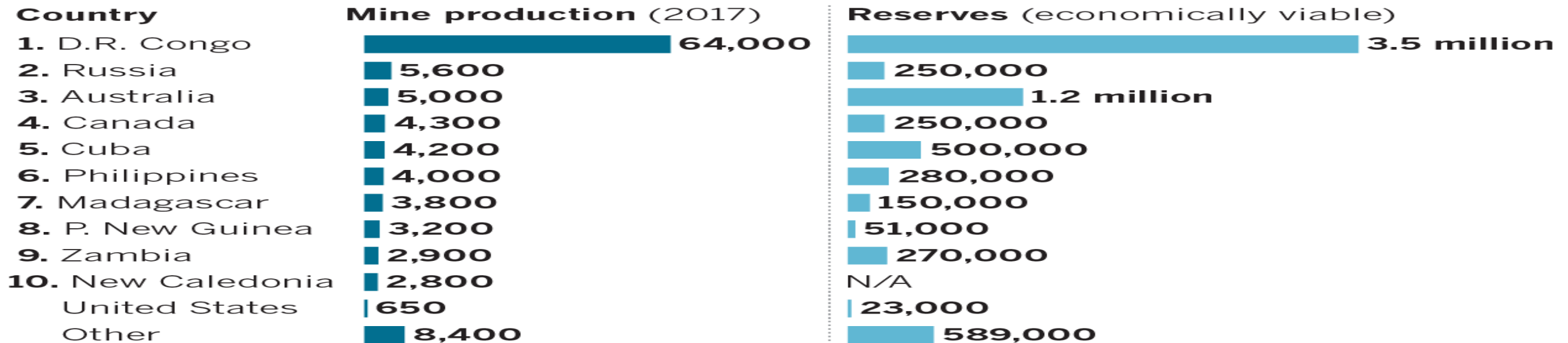
Cobalt as a strategic resource ... *(Today & Tomorrow)*

Cobalt mining centers

Car and cellphone batteries have sent the price of cobalt soaring. Production is concentrated in the unstable Democratic Republic of the Congo.



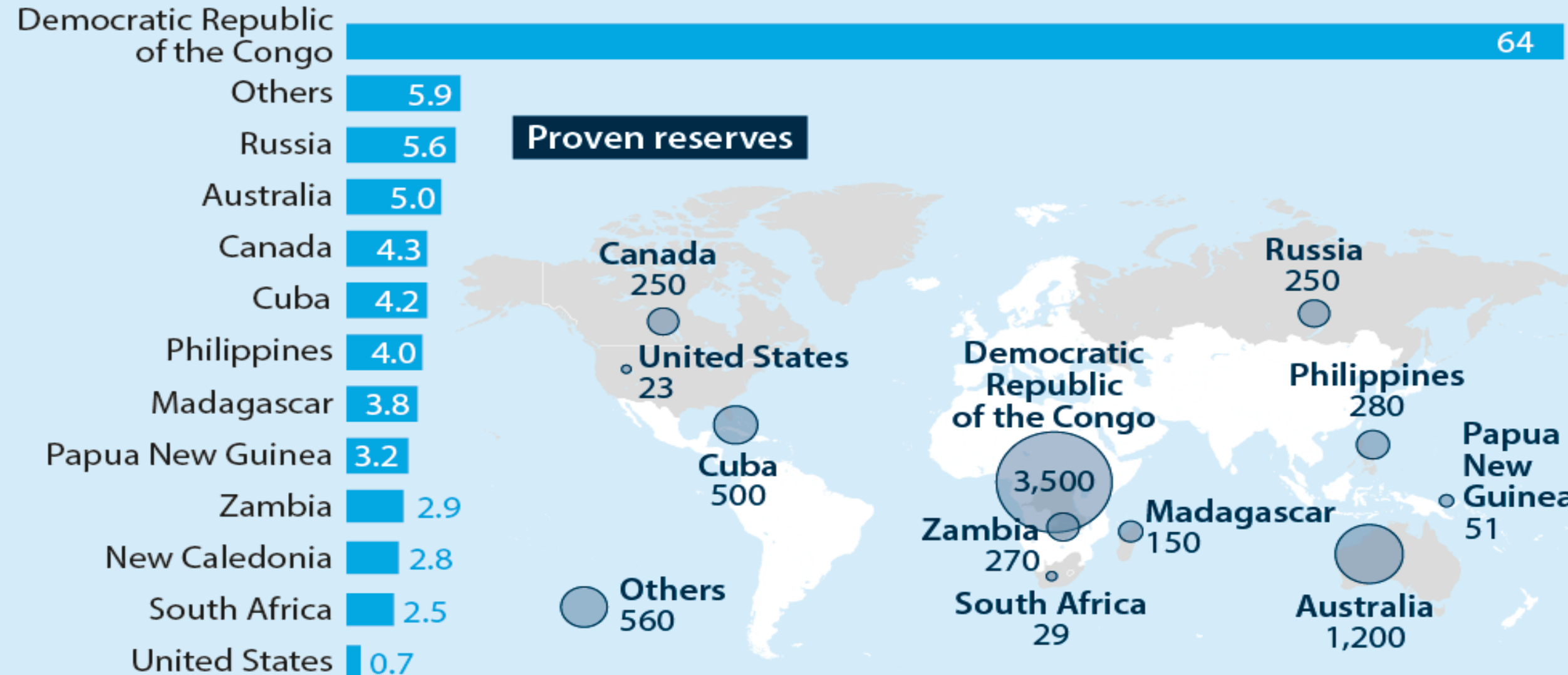
Cobalt mining and reserves (in metric tons)



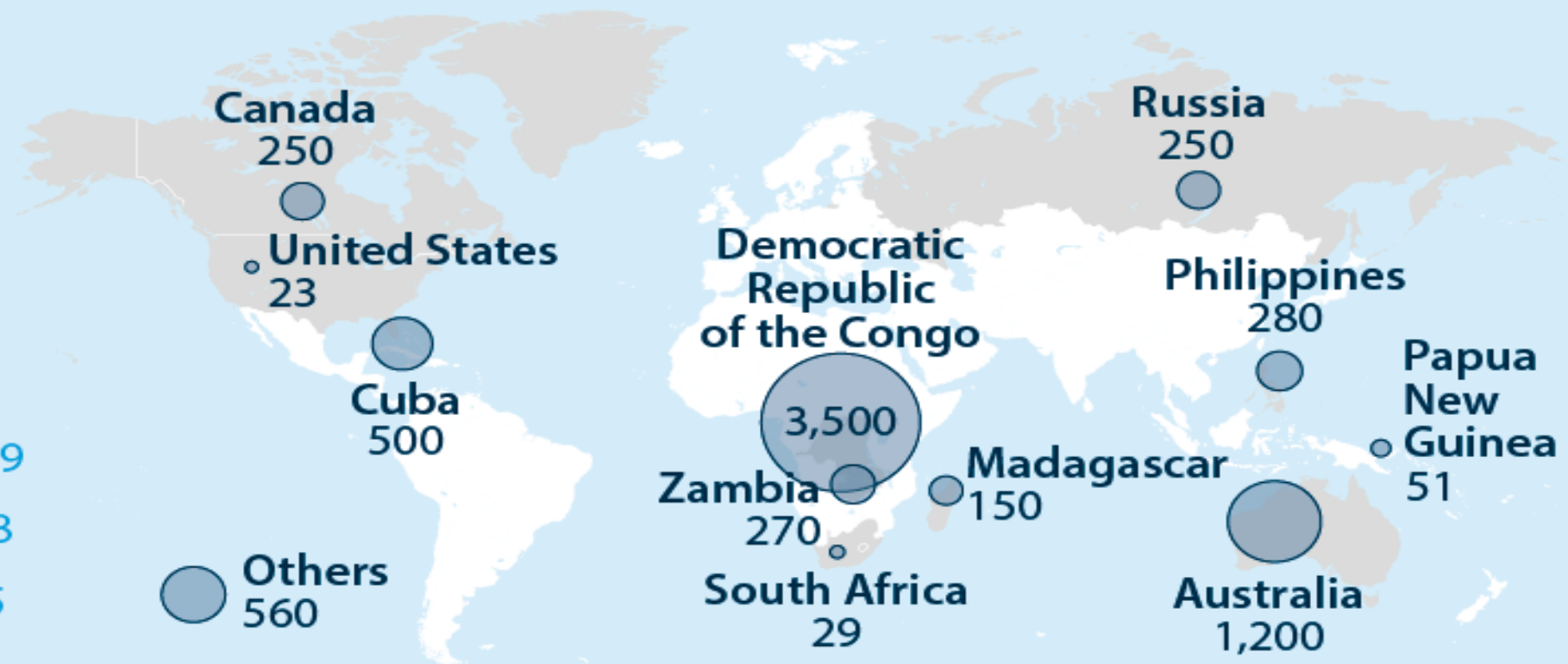
Who has (*NOT* who Controls) the Cobalt ...

Global cobalt reserves and production (thousand tons)

2017 production

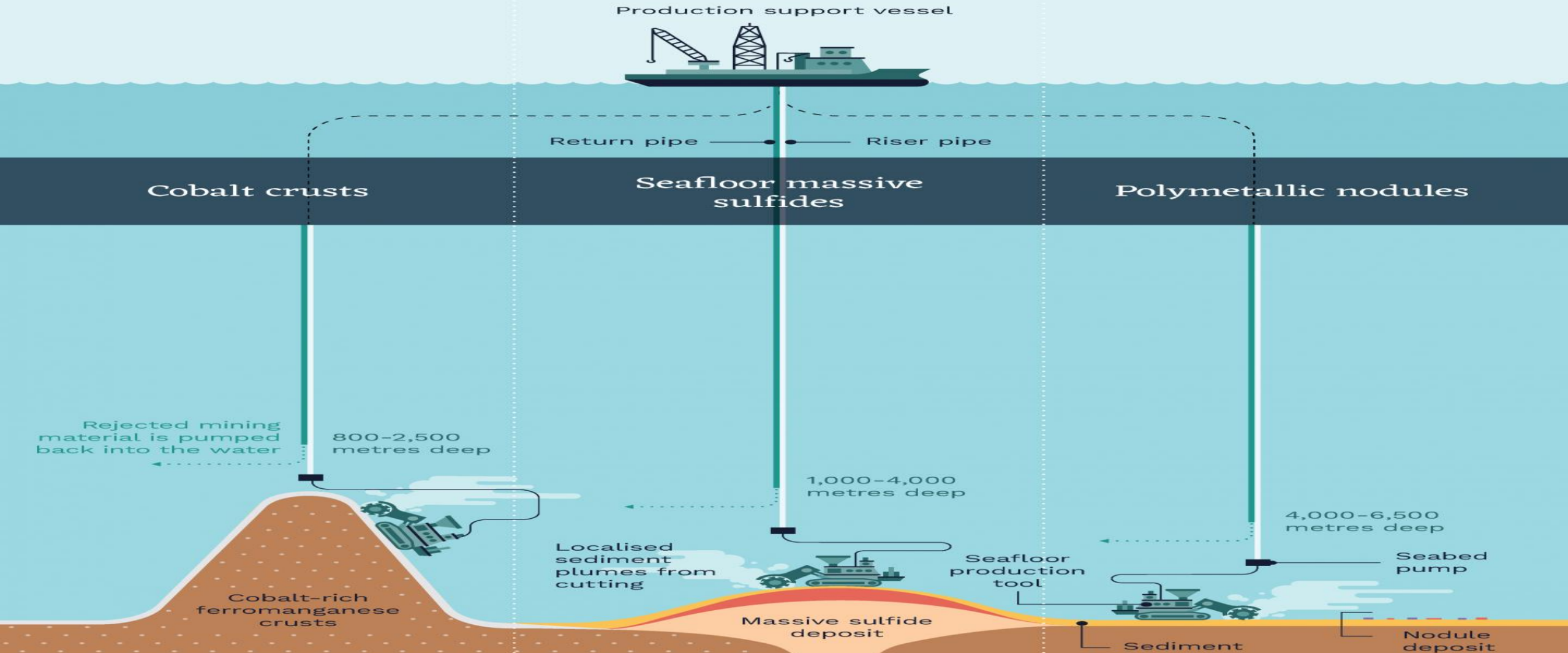


Proven reserves



Searching for Cobalt ... Undersea ...

How minerals could be mined from the seabed



Producers of Rare Earth Inputs & Resources ... *(Today & Future)*



● REE Production

● Significant projects

● Other resources

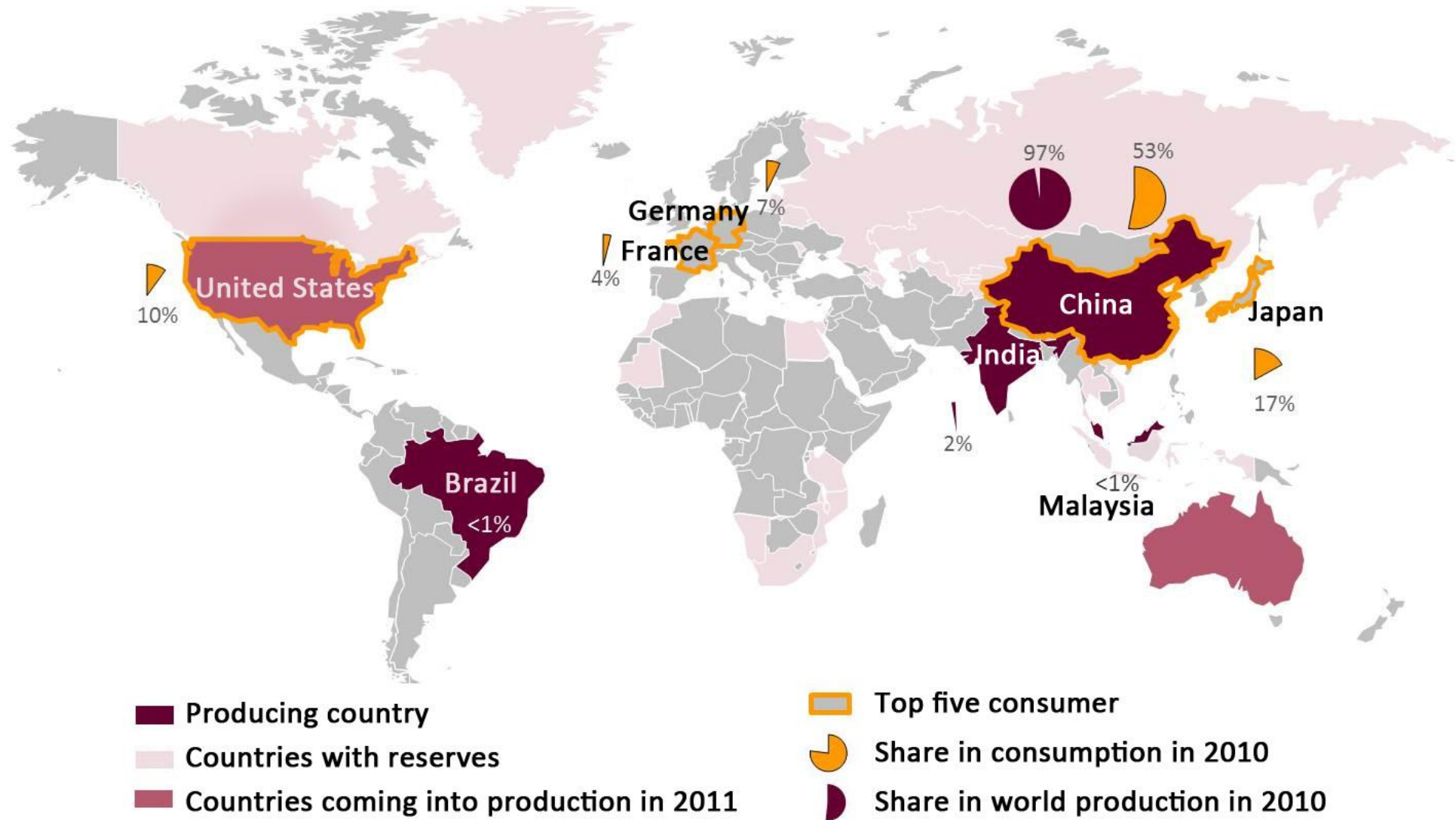
1. Mountain Pass (USA)
2. Lovozero (Russia)
3. Khibiny (Russia)
4. Bayan Obo (China)
5. Weisan Lake (China)
6. Maoniuping (China)

7. Longnan (China)
8. Odisha (India)
9. Chavara (India)
10. Manavalakurichi (India)
11. Mount Weld (Australia)

12. Bokan-Dotson (USA)
13. Hoidas Lake (Canada)
14. Bear Lodge (USA)
15. Motzfeldt (Greenland)
16. Kvanefjeld (Greenland)

17. Norra Kärr (Sweden)
18. Lofdal (Namibia)
19. Zandkopsdrift (South Africa)
20. Nolans Bore (Australia)

Producers & Consumers of Rare Earth elements...

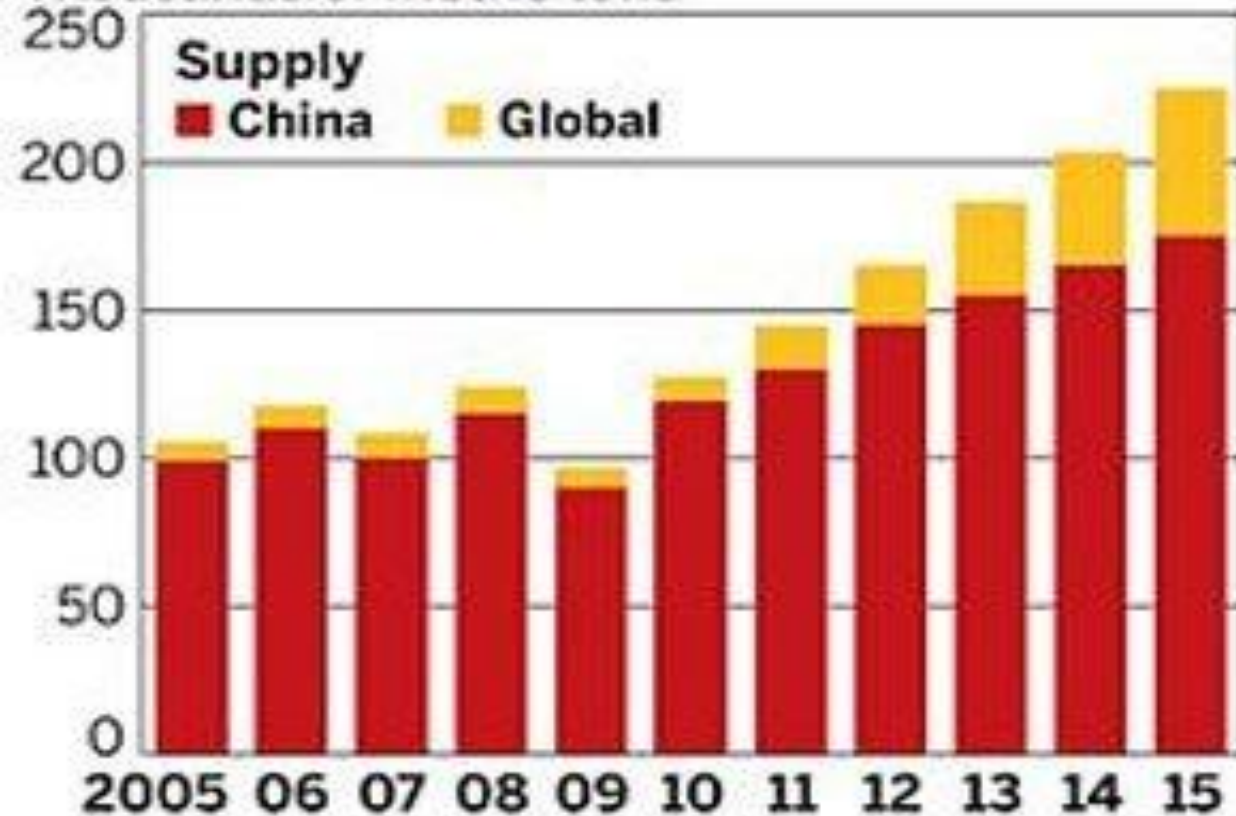


Imagine what will happen to the factories in China without inputs ...

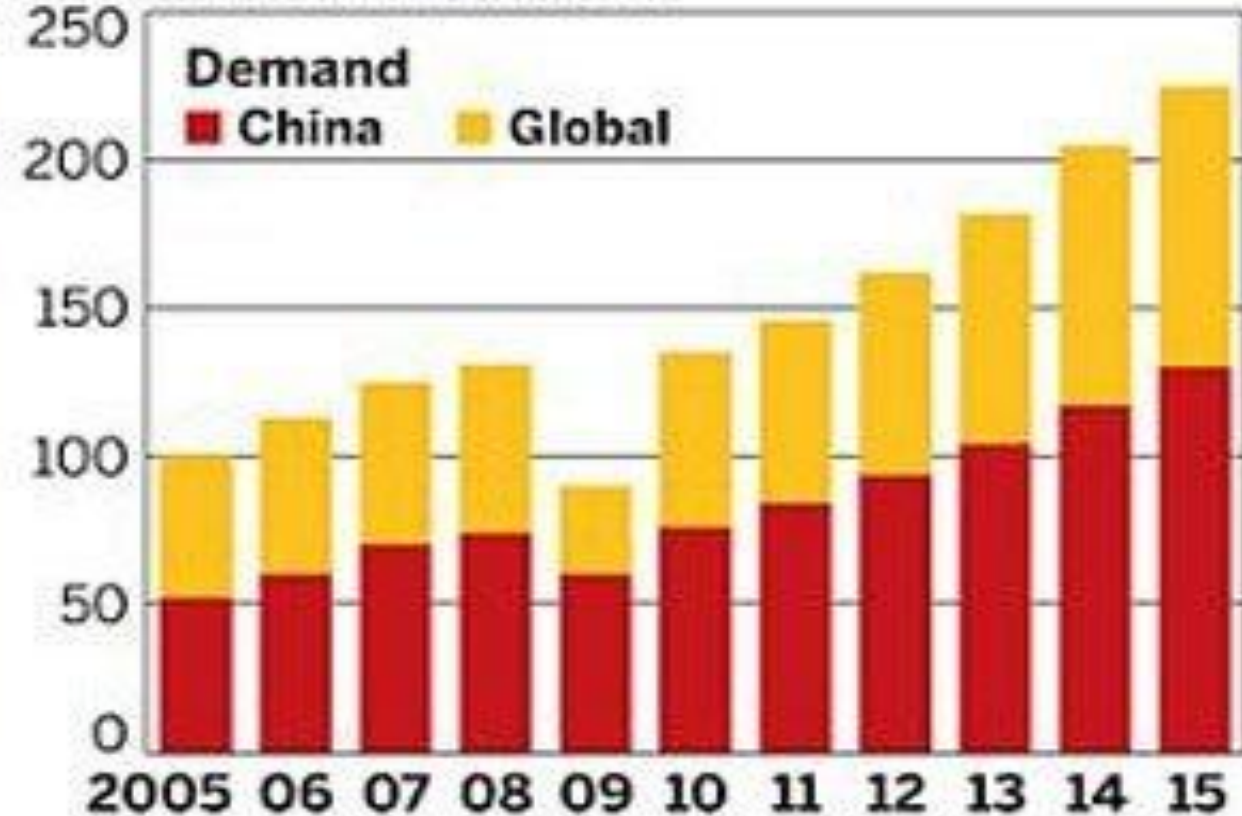
RARE-EARTH SUPPLY AND DEMAND

China's increasing demand for its own rare-earth materials is predicted to drive production in other countries

Thousands of metric tons



Thousands of metric tons

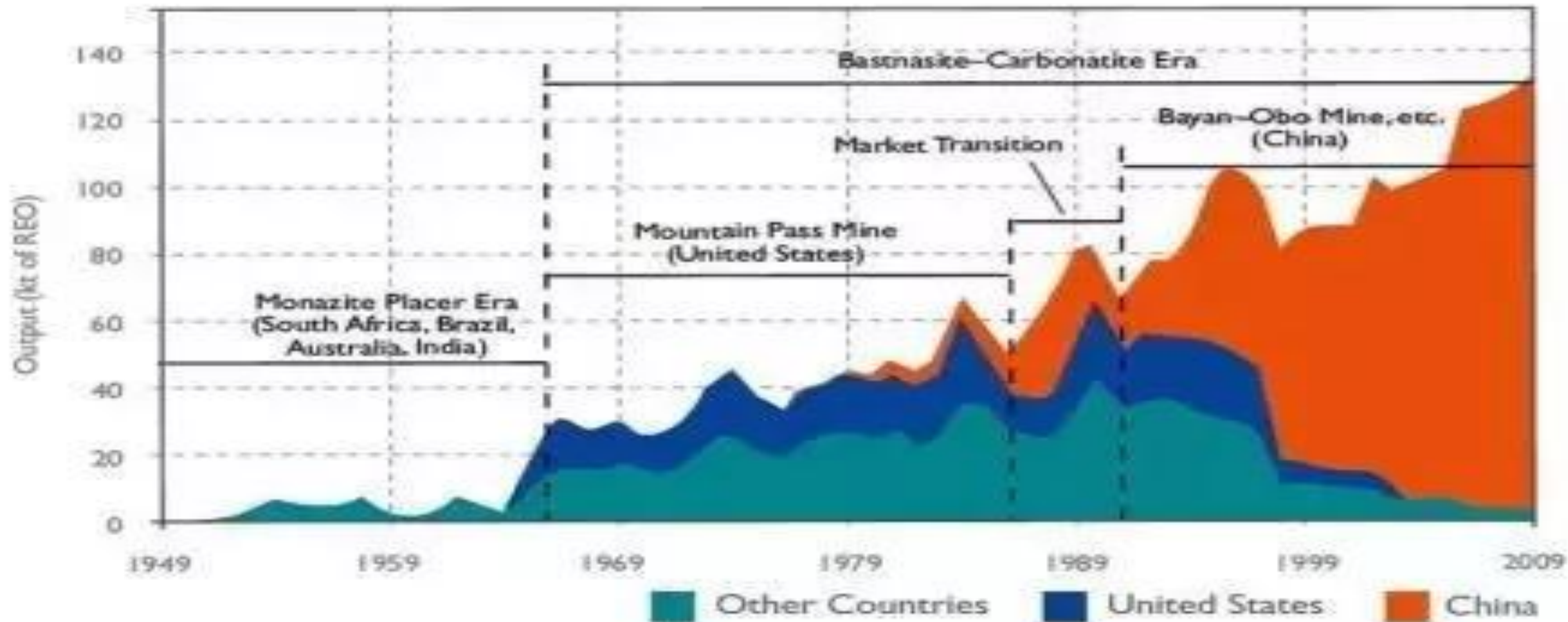


SOURCE: Dudley Kingsnorth/Industrial Minerals Co. of Australia

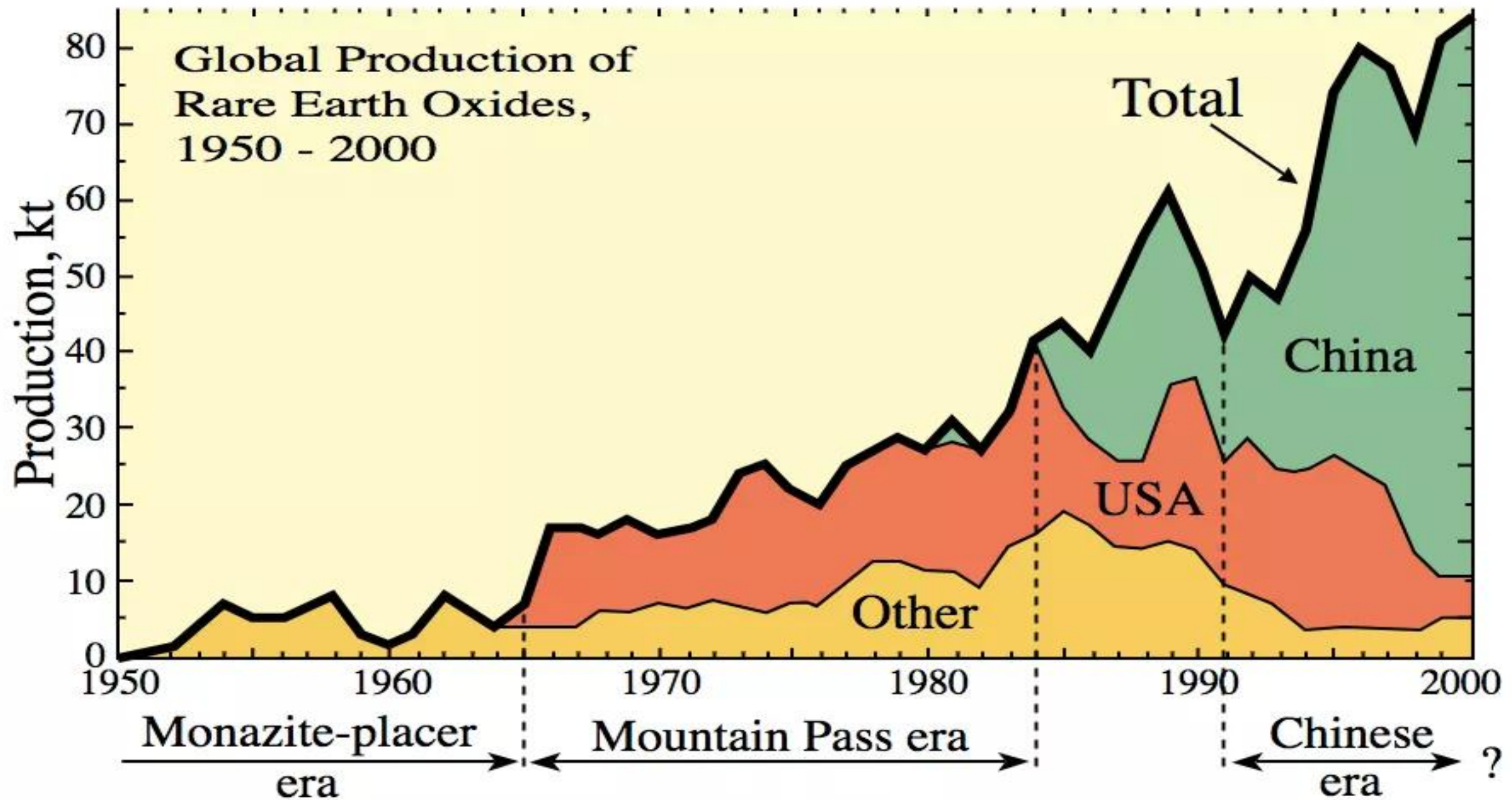
Does it say ... anything for the future?

China controls 97% of the world supply of REO

Global rare earth oxide production trends

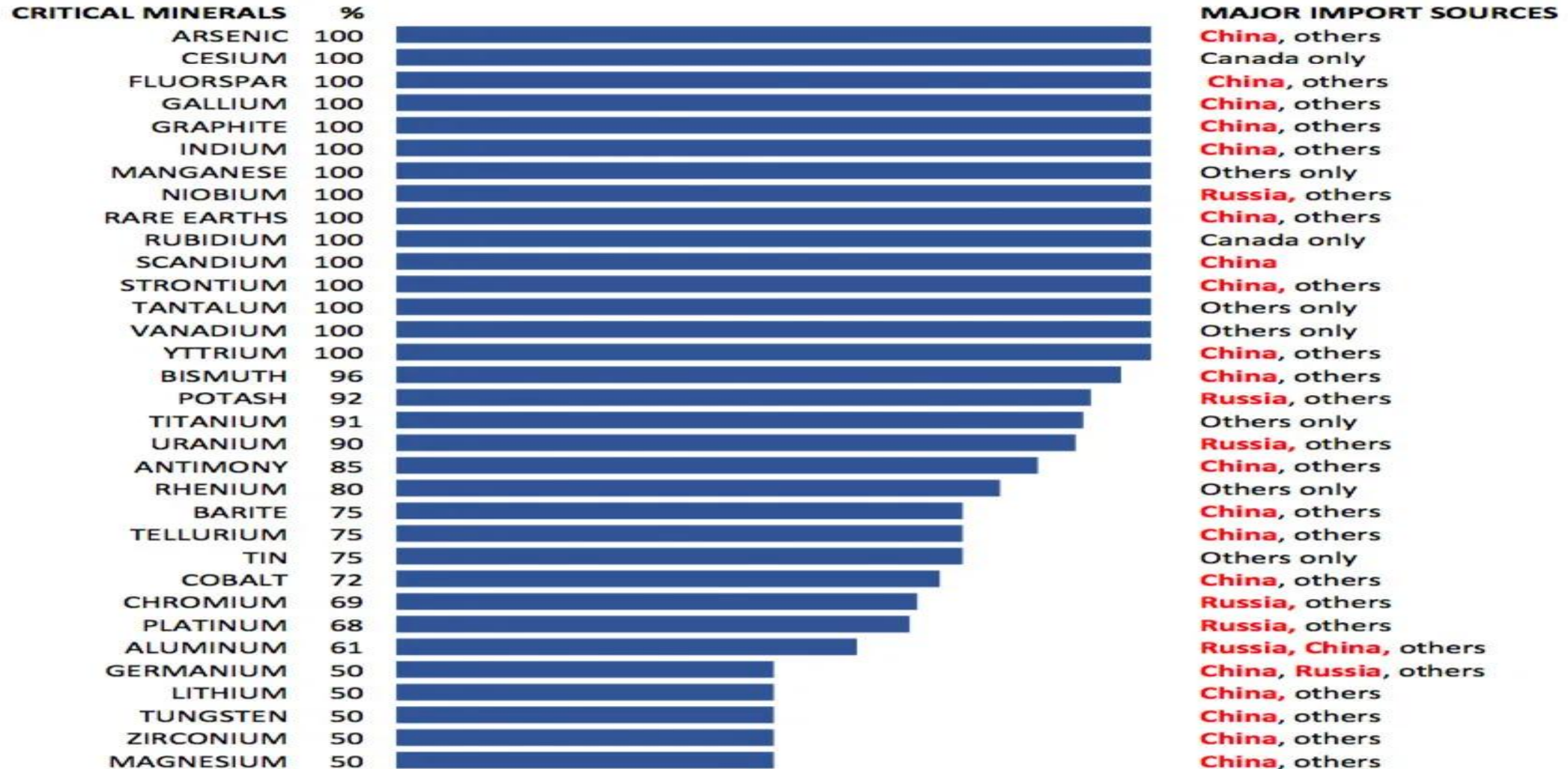


The trend is there...



USA imports Critical Inputs & Resources ...from ... enemies ...

U.S. Critical Mineral Import Dependence: All Over 50%, Many at 100%, Too Many From Adversaries

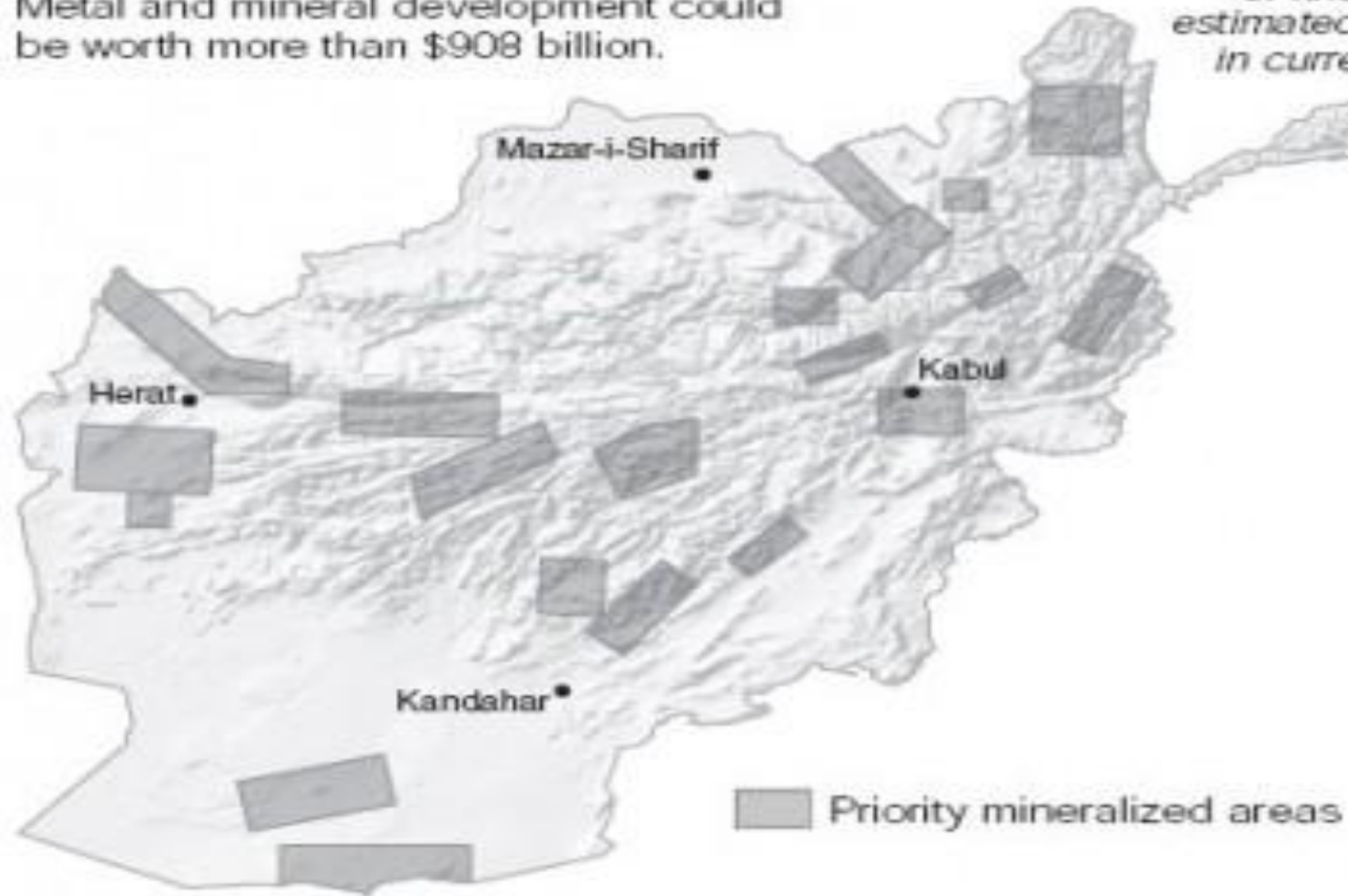


After U.S. Geological Survey (USGS) 2017 Mineral Commodity Summaries, U.S. Net Import Reliance; and Department of the Interior, February 15, 2017 Federal Register "Draft List of Critical Minerals"

...like Congo ..some countries have Resource potential ...

Minerals in Afghanistan

Metal and mineral development could be worth more than \$908 billion.



Potential value
of known and
estimated resources,
in current prices

Iron	\$420.9 bil.
Copper	274.0
Niobium	81.2
Cobalt	50.8
Gold	25.0
Molybdenum	23.9
Rare earth elements	7.4
Asbestos	6.3
Silver	5.3
Potash	5.1
Aluminum	4.4
Graphite	0.7
Lapis lazuli	0.7
Fluorite	0.6
Phosphorus	0.6
Lead and zinc	0.5
Mercury	0.5
Strontium	0.4
Sulfur	0.2
Talc	0.2
Magnesite	0.2
Kaolin	0.1

Sources: U.S.G.S; Afghanistan Geologic Survey; Department of Defense

THE NEW YORK TIMES

indeed ... Some even look further ...

Table 8-1. Distribution of Materials by Criticality Category

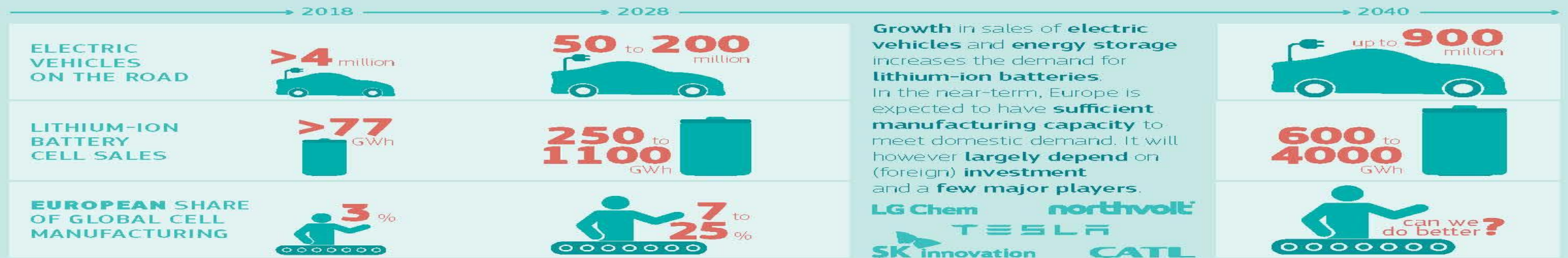
Short Term	Medium Term
Critical	Critical
Dysprosium Europium Indium Terbium Neodymium Yttrium	Dysprosium Europium Terbium Neodymium Yttrium
Near-Critical	Near-Critical
Cerium Lanthanum Tellurium	Indium Lithium Tellurium
Not Critical	Not Critical
Cobalt Gallium Lithium Praseodymium Samarium	Cerium Cobalt Gallium Lanthanum Praseodymium Samarium

Energy storage ... *a new challenge*

Lithium-ion batteries for mobility and stationary storage applications

SCENARIOS FOR COSTS AND MARKET GROWTH

Global supply and demand of lithium-ion batteries today and in the future



Implications of growth on costs and market size

Due to **increase in mass manufacturing**, **costs of battery packs** are expected to **decrease**



The **global market size will increase** and **Europe** has the **opportunity** to tap into a **market of billions**



WHAT CAN EUROPE DO?



Ensure **long-term engagement** and commitment of all relevant stakeholders (e.g. industry, energy system providers, policy makers and citizens) to establish a **competitive and sustainable European battery value chain**

Stimulate **cost reduction** for battery energy storage solutions by also tackling **non-battery components** (e.g. balance of plant, energy management system)



Exploit opportunities in cost reduction from other **synergies across the value chain** (e.g. re-use)



3) Cobalt ...& Lithium ...

Importance of Cobalt ...

Cobalt's Growing Demand

Cobalt's specialized properties make it crucial for rechargeable batteries, metal alloys, and EVs:

- *Thermal stability*
- *High energy storage*
- *Corrosion resistance*
- *Aesthetic appeal*

As the markets for EVs and rechargeable batteries grow, the demand for cobalt is expected to surge to **220,000 metric tons** by 2025, a **63%** increase since 2017.

But can industry meet its demand with a supply of ethically mined cobalt?

A Precarious Supply Chain

- In 2019, the DRC produced **70%** of global mined cobalt—a majority of which went to China, the leading importer of mined cobalt and an exporter of refined cobalt.
- Moreover, 8 of the 14 largest cobalt mines in the DRC are owned by Chinese companies, resulting in a highly controlled supply chain.
- But all major powers like the USA, EU, Japan and main producers like Korea are cooperating on the exploitation of Cobalt.

□ The issue is:

Are we willing to pay 10x (ten more) for a price of a cell phone, a TV, or a Laptop or even an EV car?

Μια επισφαλής αλυσίδα εφοδιασμού

- Το 2019, το Κονγκό παρήγαγε το 70% του παγκόσμιου εξορυγμένου κοβαλτίου — η πλειοψηφία του οποίου πήγε στην Κίνα, τον κορυφαίο εισαγωγέα εξορυγμένου κοβαλτίου και εξαγωγέα εξευγενισμένου κοβαλτίου.
- Επιπλέον, 8 από τα 14 μεγαλύτερα ορυχεία κοβαλτίου στο Κονγκό ανήκουν σε κινεζικές εταιρείες, με αποτέλεσμα μια αυστηρά ελεγχόμενη αλυσίδα εφοδιασμού.
- Όμως, όλες οι μεγάλες δυνάμεις όπως οι ΗΠΑ, η ΕΕ, η Ιαπωνία και οι κύριοι παραγωγοί όπως η Κορέα συνεργάζονται για την εκμετάλλευση του Κοβαλτίου.

□ Το ζήτημα είναι:

Είμαστε διατεθειμένοι να πληρώσουμε 10 φορές (δέκα φορές περισσότερο) για την τιμή ενός κινητού τηλεφώνου, μιας τηλεόρασης ή ενός φορητού υπολογιστή ή ακόμα και ενός ηλεκτρικού αυτοκινήτου;

Indeed,
**Inexpensive Supply of Cobalt ...
and Cheap Devices for all of us, the Consumers**

Or

**Economic Development and
Social Policies in Congo?**

Τι Θέλουμε?

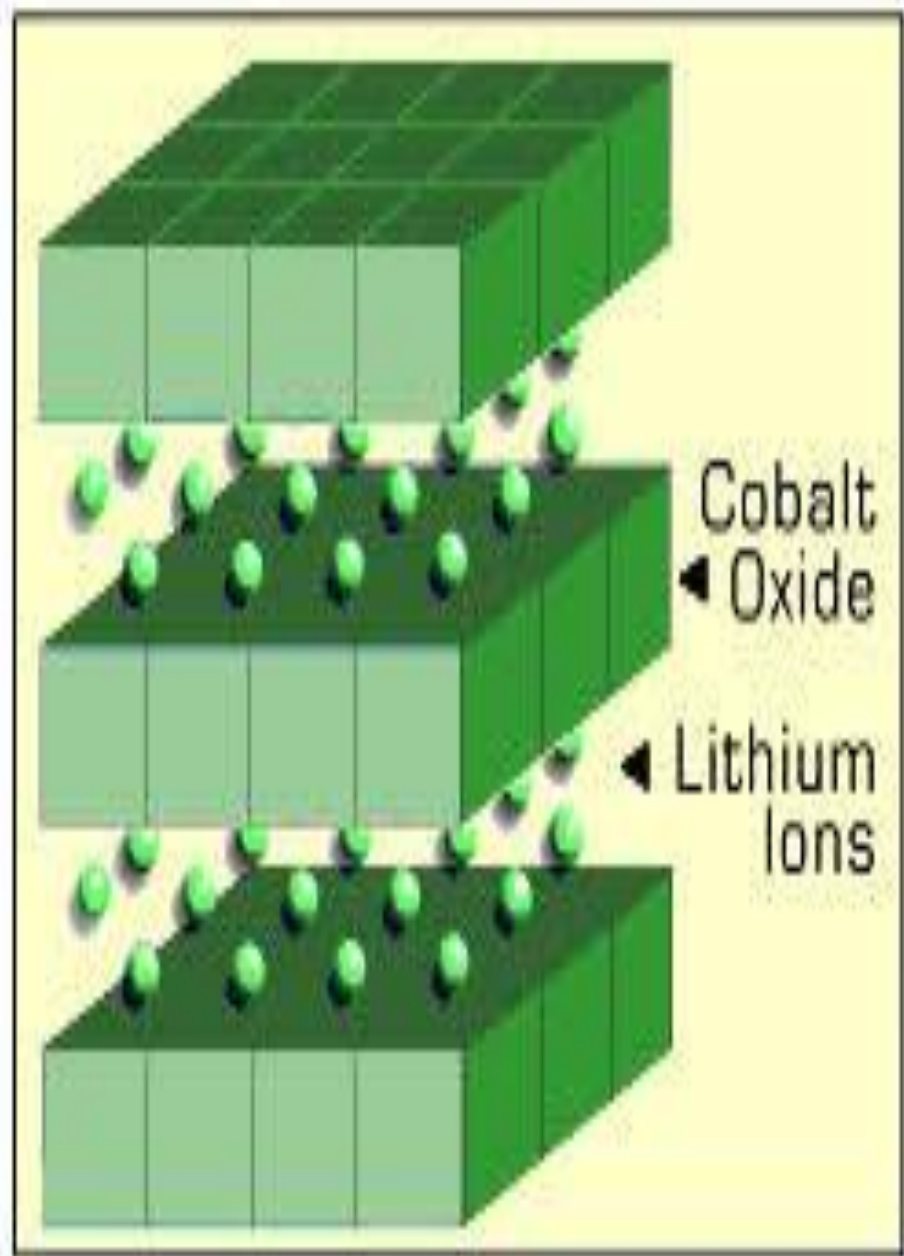
Φθηνή προμήθεια
Κοβαλτίου...

και φθηνές συσκευές για όλους εμάς, τους καταναλωτές

Ή

Οικονομική ανάπτυξη και
Κοινωνικές πολιτικές στο Κονγκό;

Importance of Cobalt today as “The METAL”



How Much Cobalt?



SMARTPHONE
0.3 ounce
(the weight of
three pennies)



LAPTOP
1 ounce
(the weight of
one slice of bread)

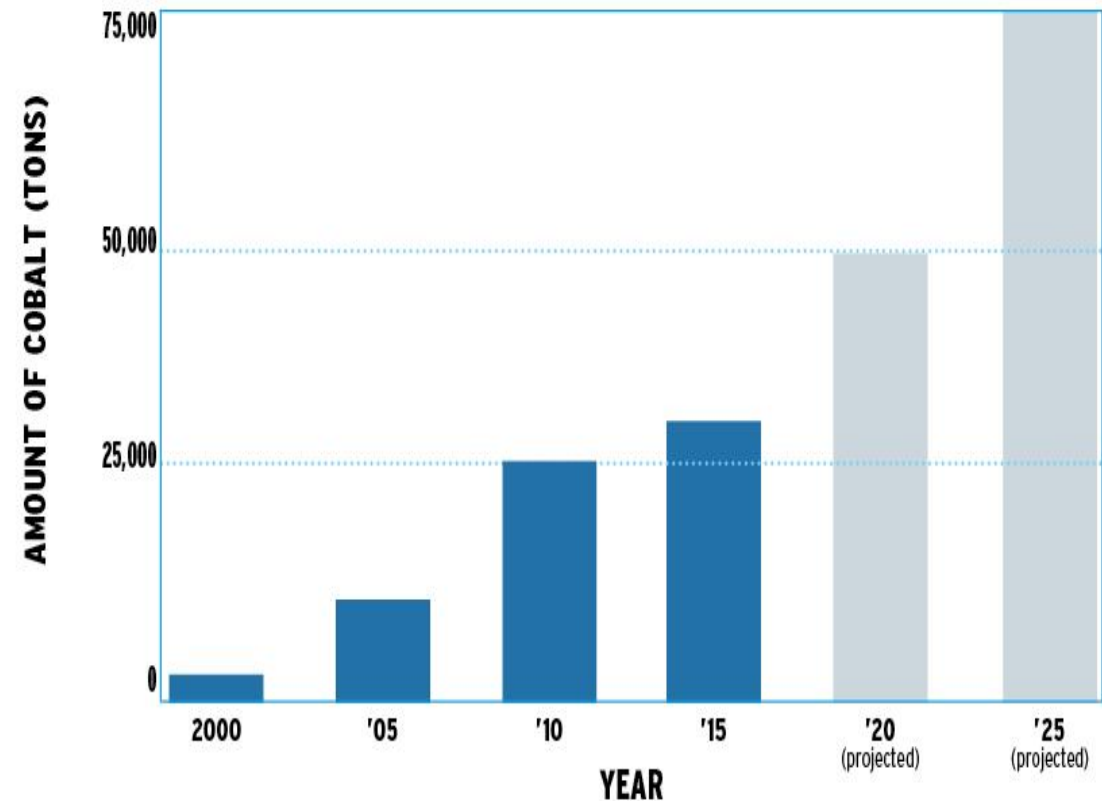


ELECTRIC CAR
15 pounds
(the weight of about
two gallons of milk)

SOURCE: THE WASHINGTON POST

Booming Cobalt Demand

This graph shows the amount of cobalt used worldwide for batteries since 2000 (with projections through 2025).



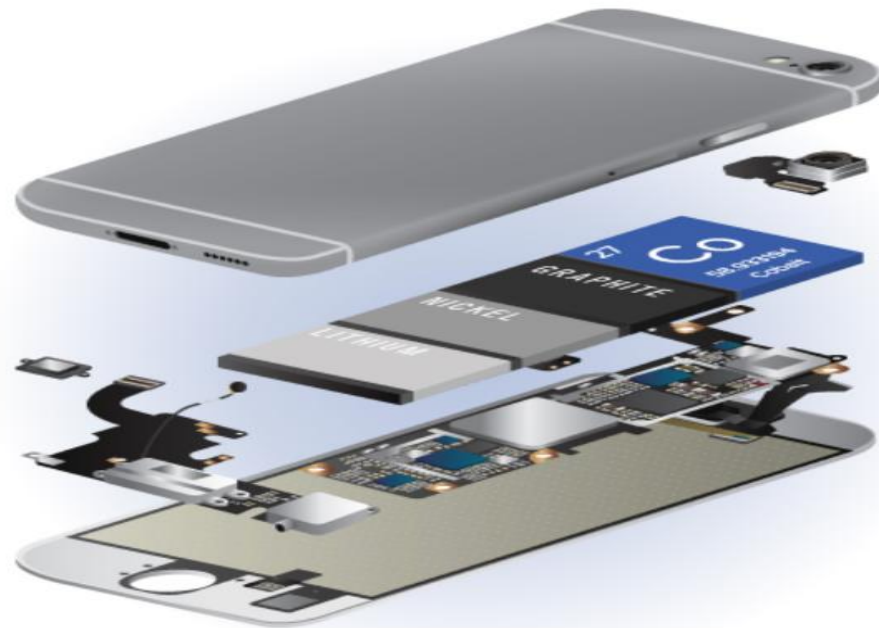
SOURCE: THE WASHINGTON POST



ΤΙ ΒΑΣΙΖΕΤΑΙ ΣΤΟ ΚΟΒΑΛΤΙΟ



Importance of Cobalt today as “The METAL”



How does your mobile phone last for 12 hours on just one charge?

It's the power of cobalt, along with several other battery metals, that keeps your lithium-ion battery running.

The only problem?

Getting cobalt from the source to your electronics is not an easy feat – which makes for an extremely precarious and questionable supply chain.

Cobalt other uses ... TVs-Laptops-Mobiles

Top 5 Cell Suppliers by Cobalt Deployed in 2019

CATL

> 3,000

LG Chem

Panasonic



SAMSUNG
SAMSUNG SDI

< 1,400



Adamas Intelligence

Top 5 Models by Battery Cobalt Deployed in 2018



Nissan Leaf

> 600



Tesla Model 3



Tesla Model X



BMW i3



Tesla Model S

< 400



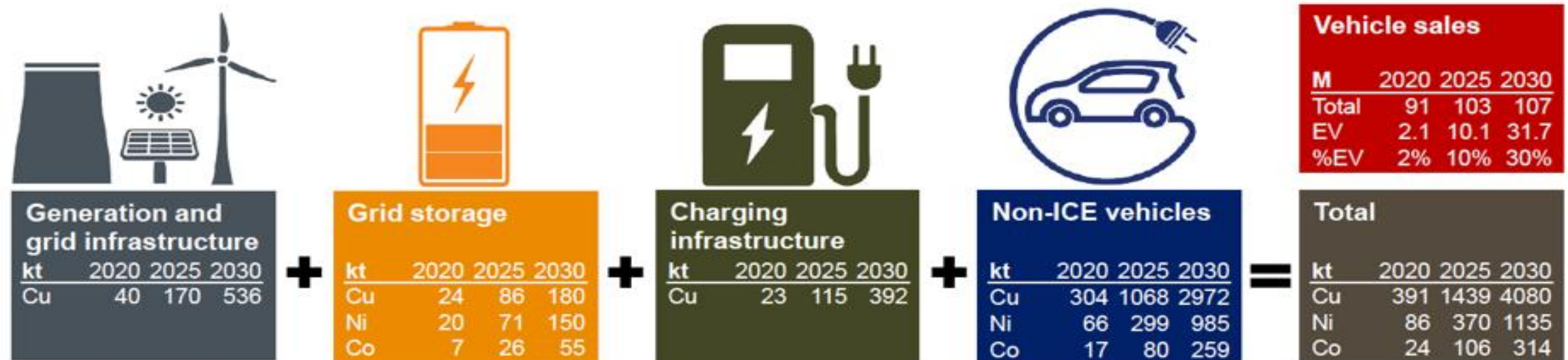
Adamas Intelligence

Electric Vehicles ... *plus* ...

The world is changing; electric vehicles will be a disruptive force

How much metal is required to realise the Electric Vehicles Initiative target⁽¹⁾ of 30 million electric vehicle sales by 2030?

- We commissioned CRU to model the metal requirements across the supply chain, from generation and grid infrastructure through to storage, charging and vehicles
- In 2030, forecast metal requirements are c.4.1Mt of copper (18% of 2016 supply), c.1.1Mt of nickel (56% of 2016 supply) and 314kt of Cobalt (314% of 2016 supply)
- As early as 2020, forecast EV related metal demand is becoming material, requiring an additional c.390kt of copper, c.85kt of nickel and 24kt of cobalt
- Transportation/mobility will be transformed – driven by environmental pressures, political mandates, consumer experience and technological progress



Μαζί με το

Κοβάλτιο

χρησιμοποιείται και το

Λίθιο

Cobalt & Lithium ... *plus*

The Underlying Metals for Lithium-ion Batteries

Atomic Number 3 Standard Weight  Atomic Mass 6.94 Lithium [Li] A soft, silvery-white alkali metal. Lithium is the lightest of all metals, has the greatest electrochemical potential, and provides the largest specific energy per weight. BATTERY USE [LCO - LMO - LFP - NMC - NCA]	Atomic Number 27 Standard Weight  Atomic Mass 58.93 Cobalt [Co] Hard, lustrous silver-gray metal extracted as a by-product when mining nickel and copper. Used as a cathode material in Li-ion batteries, but is very expensive. BATTERY USE [LCO - NMC - NCA]	Atomic Number 28 Standard Weight  Atomic Mass 58.68 Nickel [Ni] A silvery-white lustrous metal with a slight gold tinge that can be traced back to 3500 B.C. Found in large nickel-iron meteorites on earth and found in combination with iron. BATTERY USE [NMC - NCA]	Atomic Number 25 Standard Weight  Atomic Mass 54.94 Manganese [Mn] Produced by mining iron and other minerals, it is relatively abundant. Steel manufacturing uses roughly 90% of manganese production. Also used as a cathode material. BATTERY USE [LCO - NMC]	Atomic Number 6 Standard Weight  Atomic Mass 12.01 Graphite [C] Graphite is an allotrope and stable form of carbon. Used as an anode, it is heat-resistant, electrically and thermally conductive, chemically passive, and lighter than aluminum. BATTERY USE [LCO - LMO - LFP - NMC - NCA]
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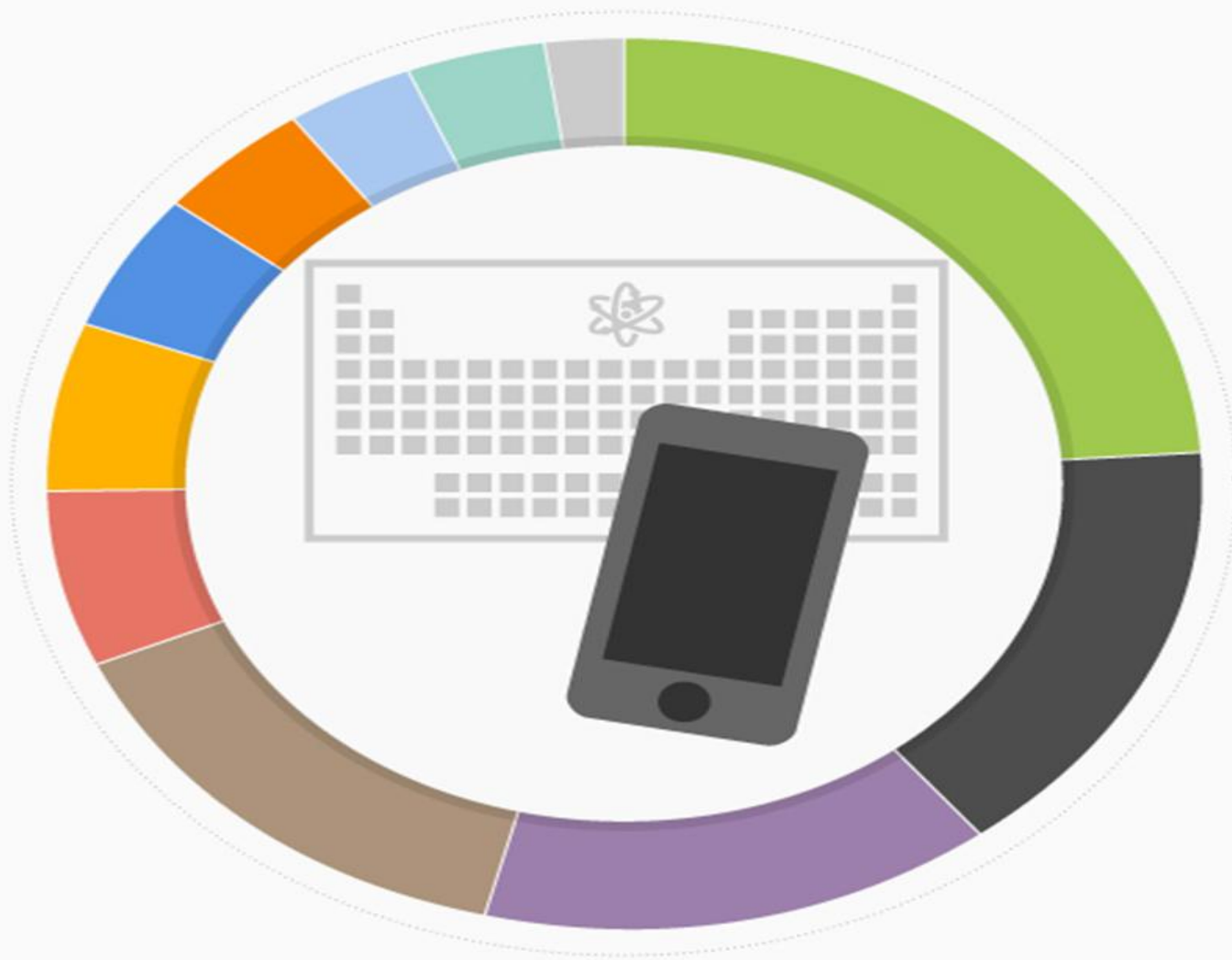
BATTERY TYPE: LCO - Lithium Cobalt Oxide / LMO - Lithium Cobalt Oxide / LFP - Lithium Iron Phosphate / NMC - Lithium Nickel Manganese Cobalt Oxide / NCA - Lithium Nickel Cobalt Aluminum Oxide

129 Grams: The Materials That Make Up The iPhone

Materials used in iPhone 6, 16GB model

- 31.1 g Aluminium
- 19.9 g Carbon
- 18.7 g Oxygen
- 18.6 g Iron
- 8.1 g Silicon
- 7.8 g Copper
- 6.6 g Cobalt
- 5.5 g Hydrogen
- 4.9 g Chrome
- 4.9 g Others
- 2.7 g Nickel

129.0 g Total



Total value
of elements
\$1.03

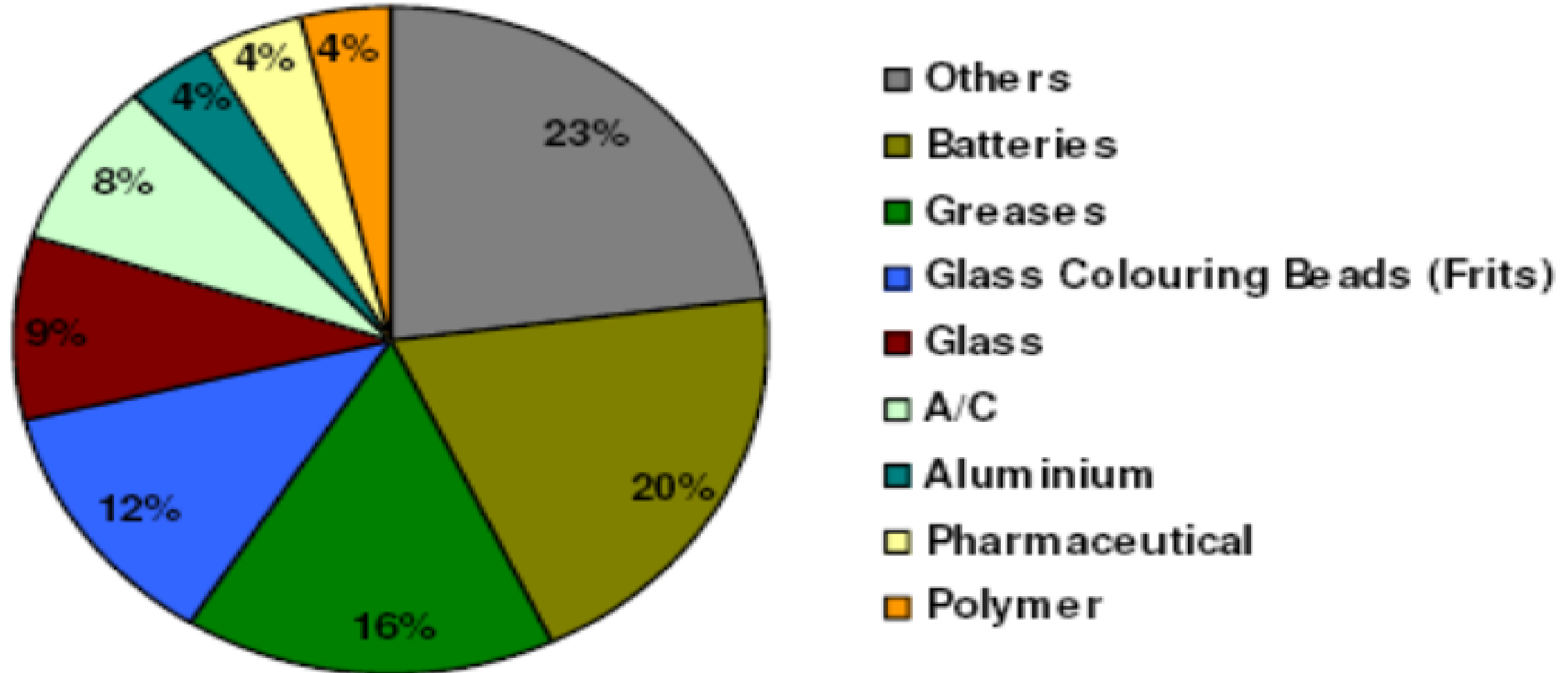


@StatistaCharts

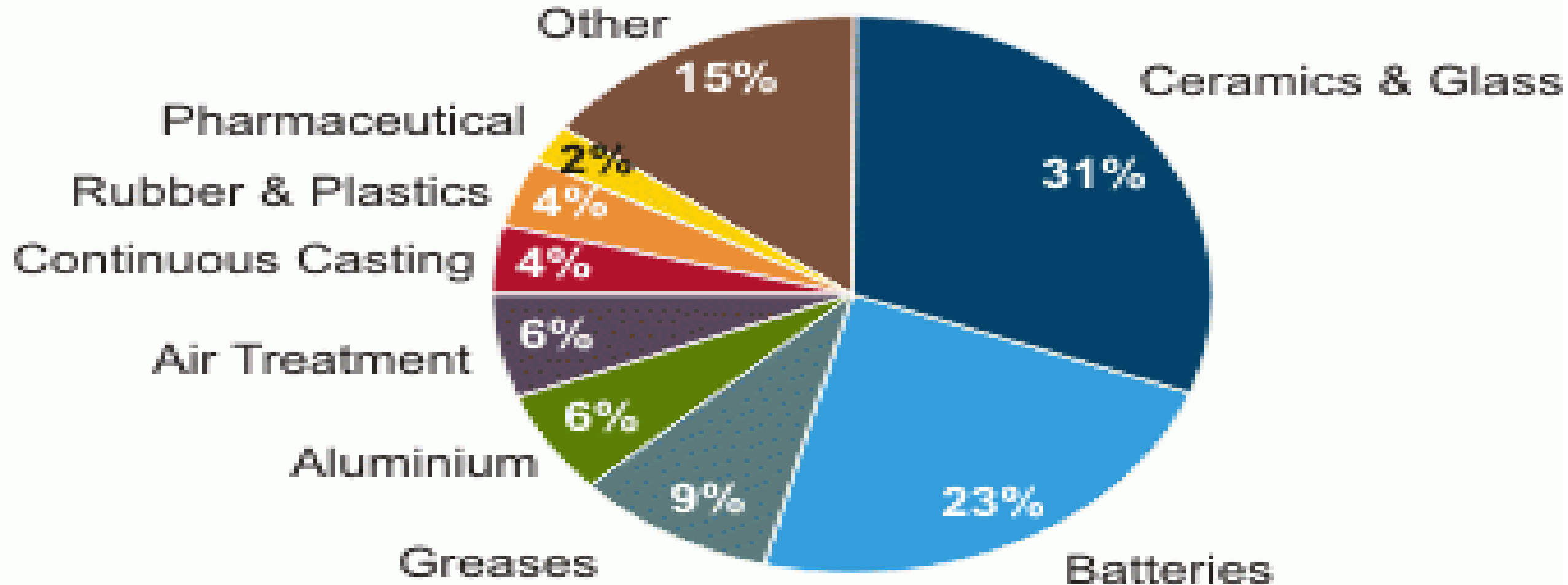
Source: 911 Metallurgist

statista

CURRENT LITHIUM APPLICATIONS

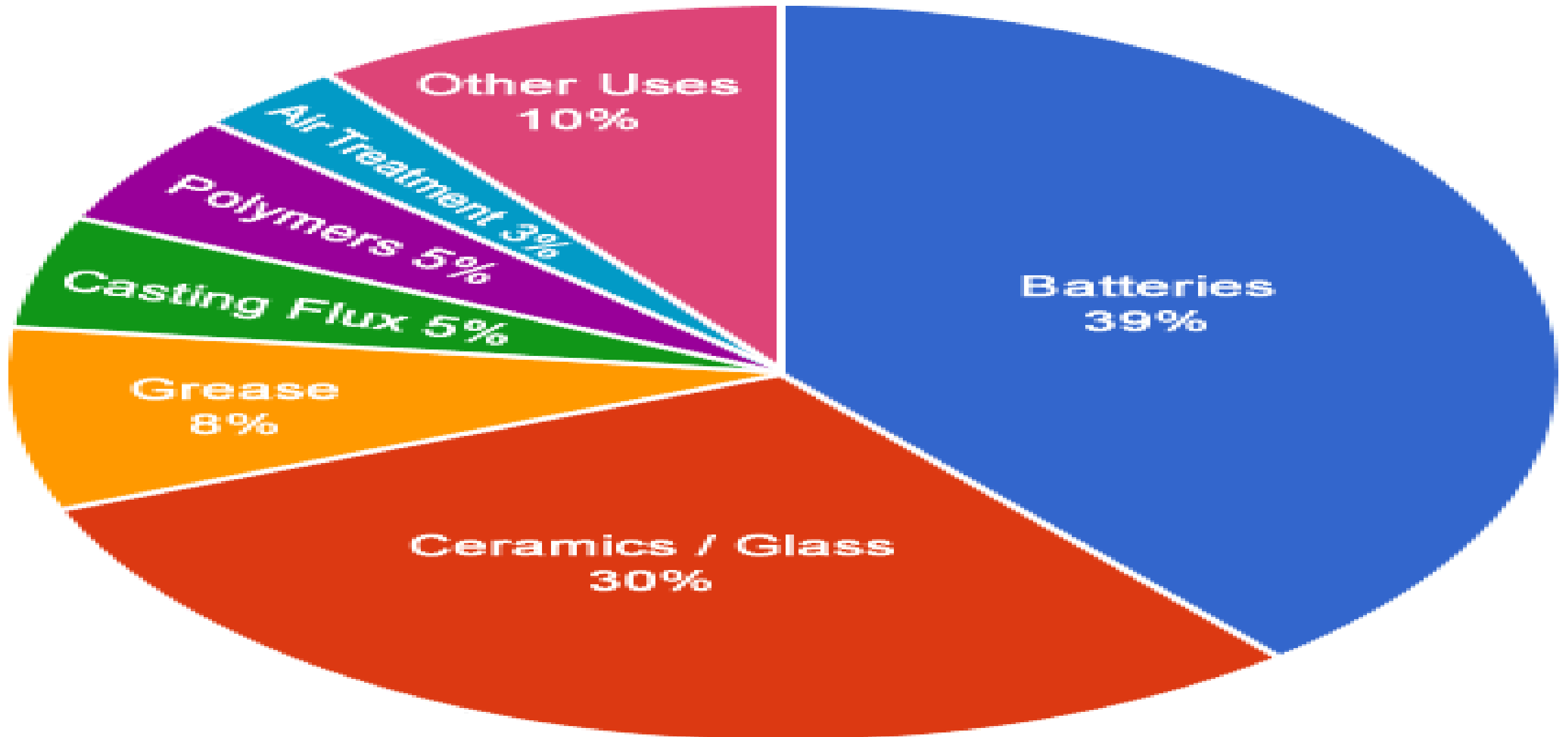


Current Lithium by End Use



Lithium Uses (2019)

Uses of Lithium



Demand Forecasting for Cobalt-Lithium & Nickel

Battery Demand Will Also Surge Global Demand For Essential Metals

Annual Demand Increases Through 2030

+ 7%

Cobalt

+ 15%

Lithium

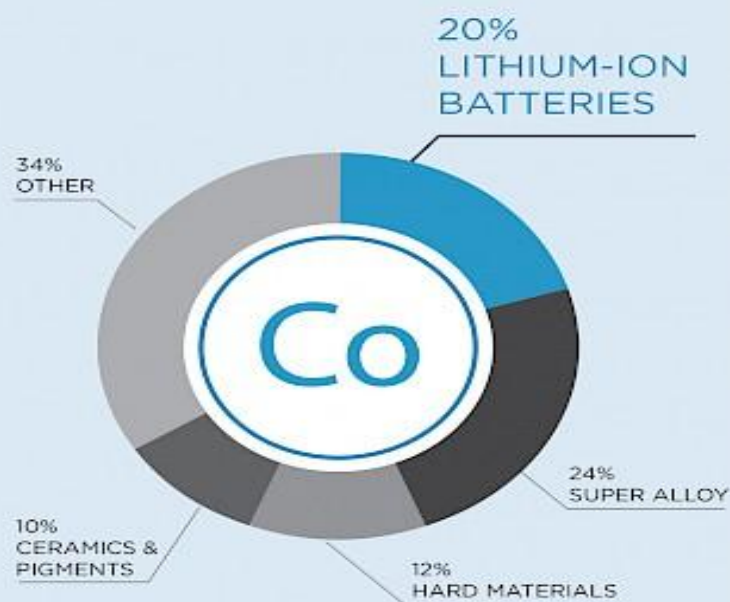
+ 19%

Nickel

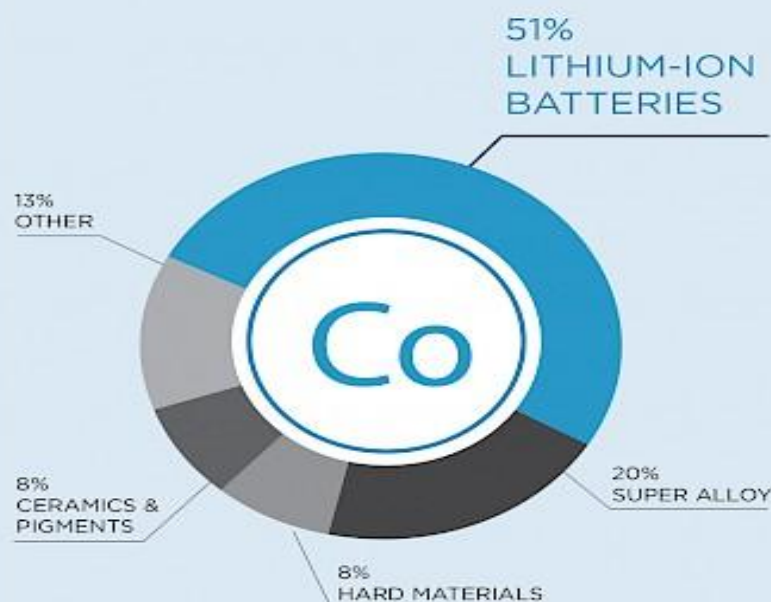
Demand Forecasting for Batteries-Lithium & Cobalt

Cobalt's End Market

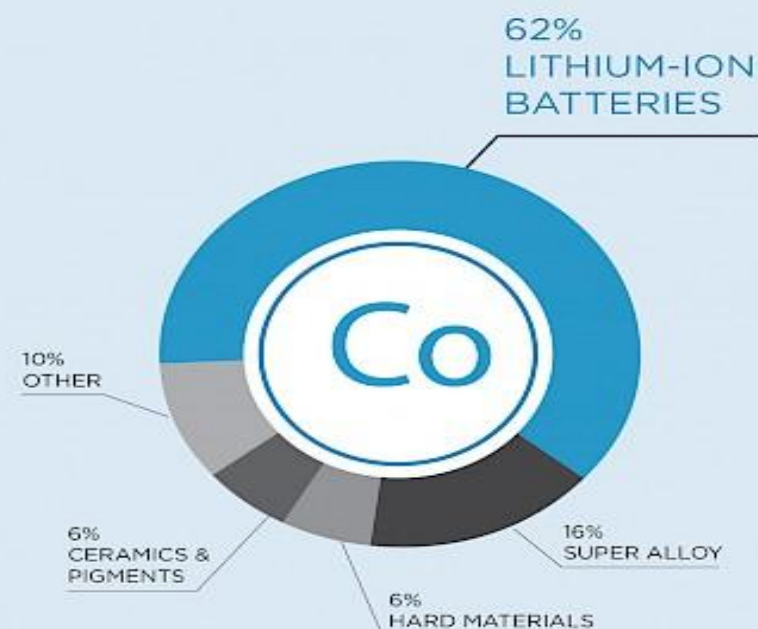
BATTERIES BY DOMINANCE



2006

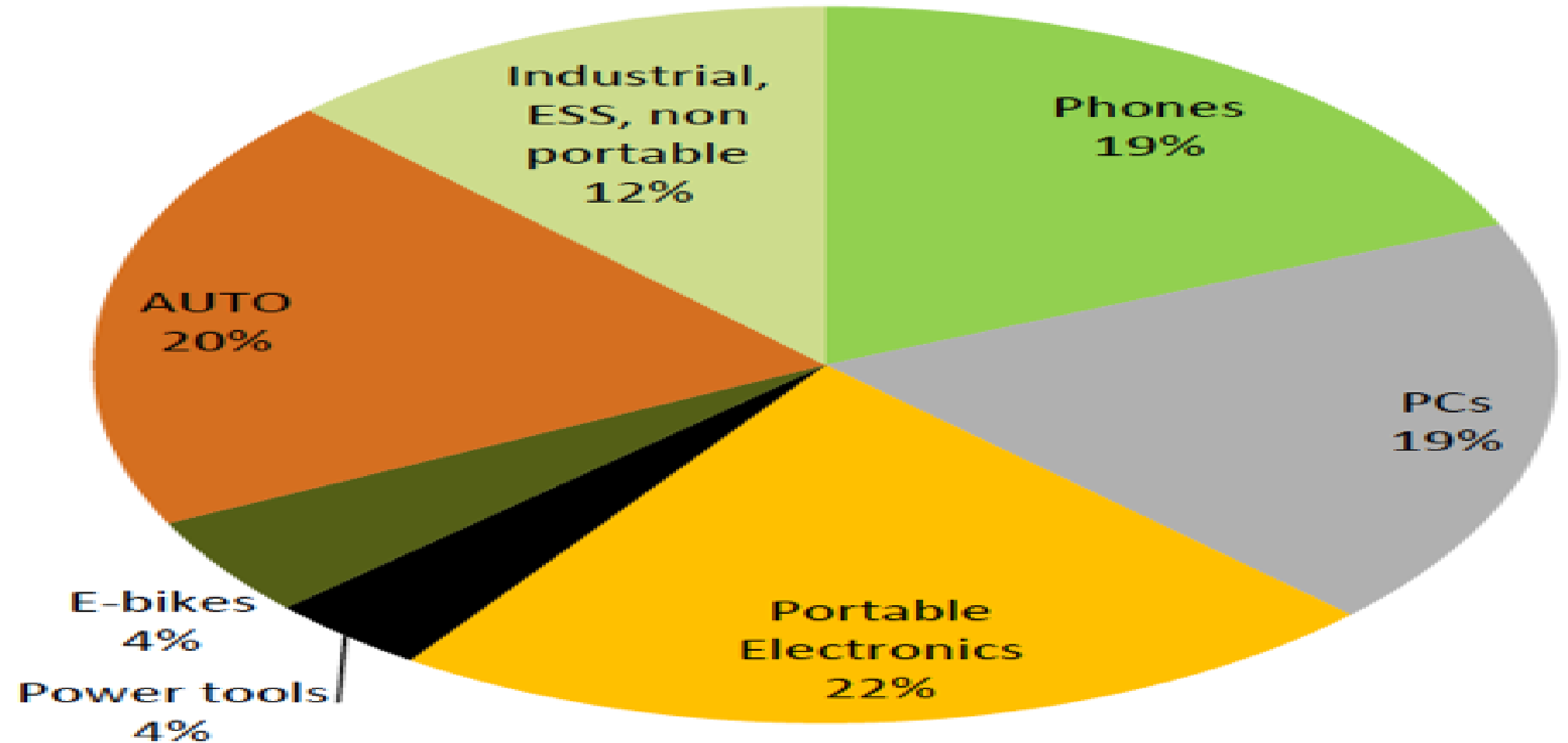


2016

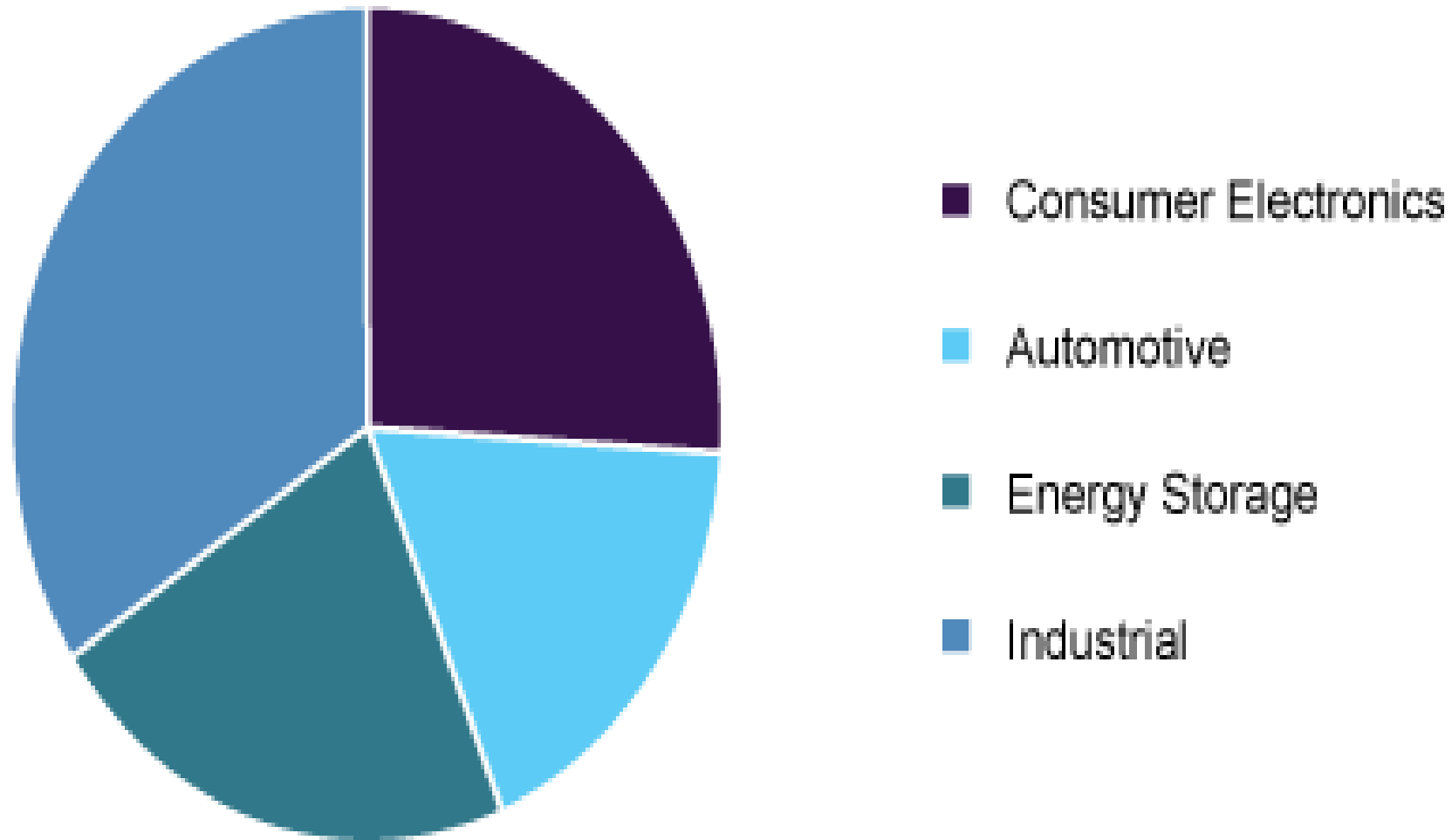


2020f

Battery market by application (2014)



Battery market **by application** (2019)



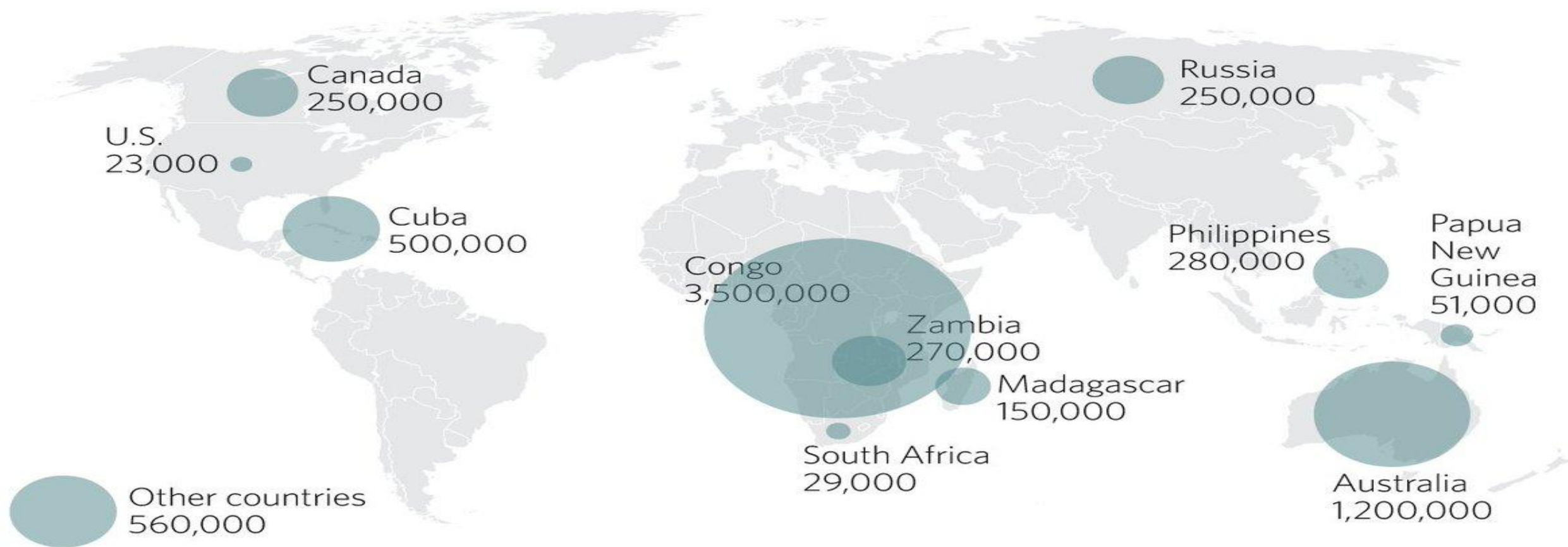
4) Cobalt Supply ...

Cobalt reserves (2018)

Cobalt Reserves

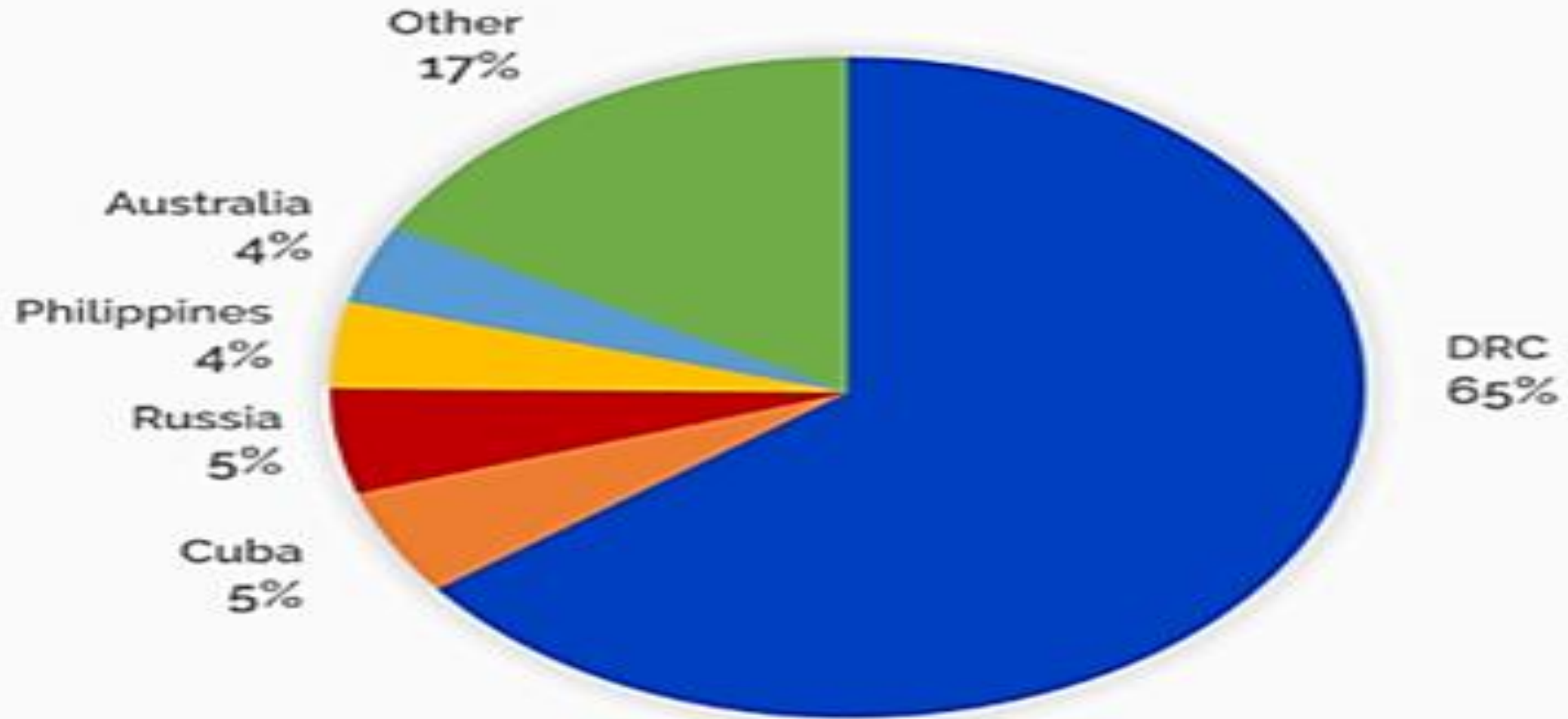
Cobalt is a key raw material for many lithium-ion battery chemistries. At present, global reserves and production are heavily concentrated in the politically unstable Democratic Republic of the Congo. Its importance, however, could shrink, as some current batteries do not use cobalt at all, while research breakthroughs could reduce and eventually eliminate the demand for the metal.

Metric tons



Cobalt production (2018)

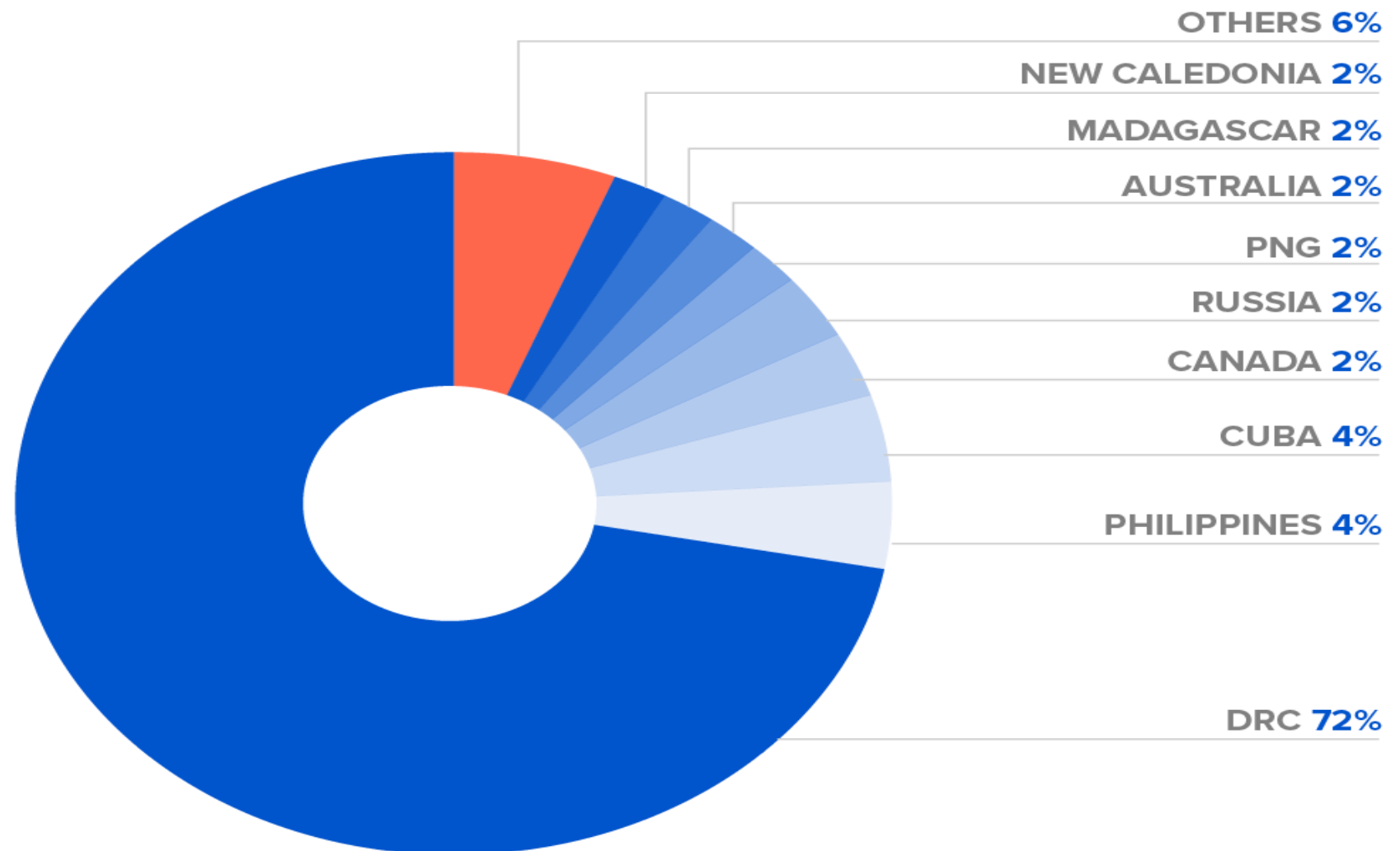
Mined Cobalt Supply



...even more ... Cobalt production (2019)

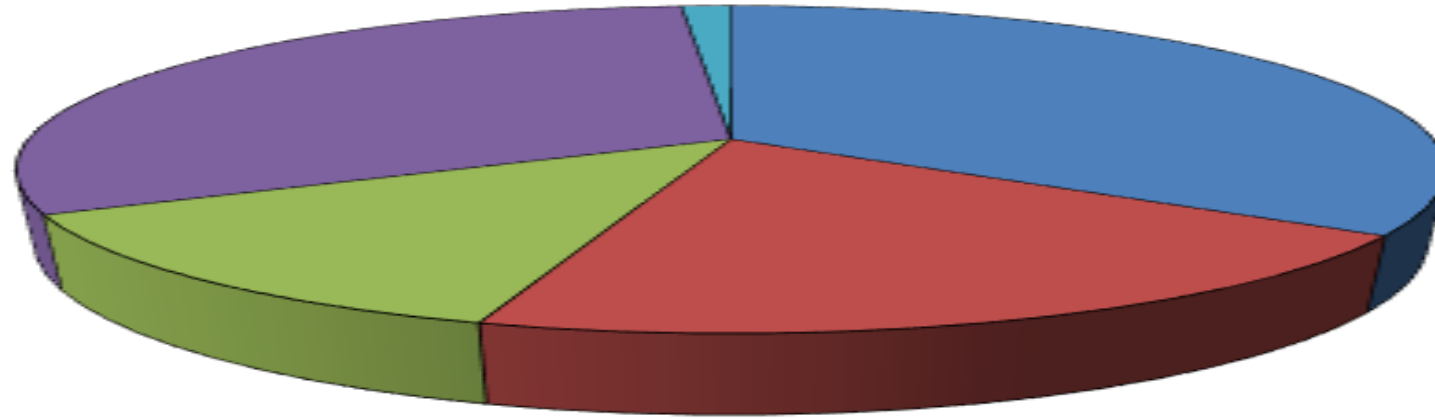
2018 GLOBAL MINED COBALT BY COUNTRY - DRC DOMINATES MINE SUPPLY

Source: Darton, 2019



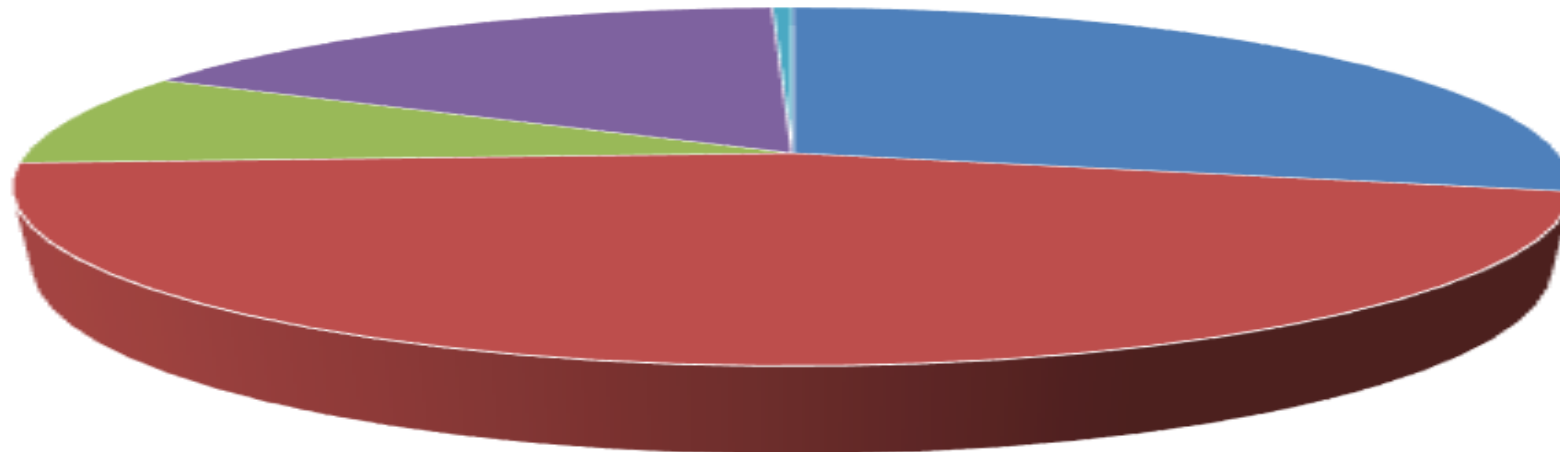
Cobalt Demand Forecasting *(by application)*

Cobalt Demand in 2020
Source: CRU



■ Mobile devices and energy storage ■ Electric vehicles ■ Superalloys ■ Industrial ■ Other Batteries

Cobalt demand in 2025
Source: CRU



■ Mobile devices and energy storage ■ Electric vehicles ■ Superalloys ■ Industrial ■ Other Batteries

Supply Chain of Cobalt

Tracing Cobalt From the DRC to Your Smartphone

2. China

Most of this cobalt is sent to processing plants in China, where it's used to make rechargeable lithium-ion batteries.

3. United States

The batteries are then sold to companies that make smartphones, laptops, and other devices. Eventually, the finished products make their way to consumers around the world, including in the U.S.

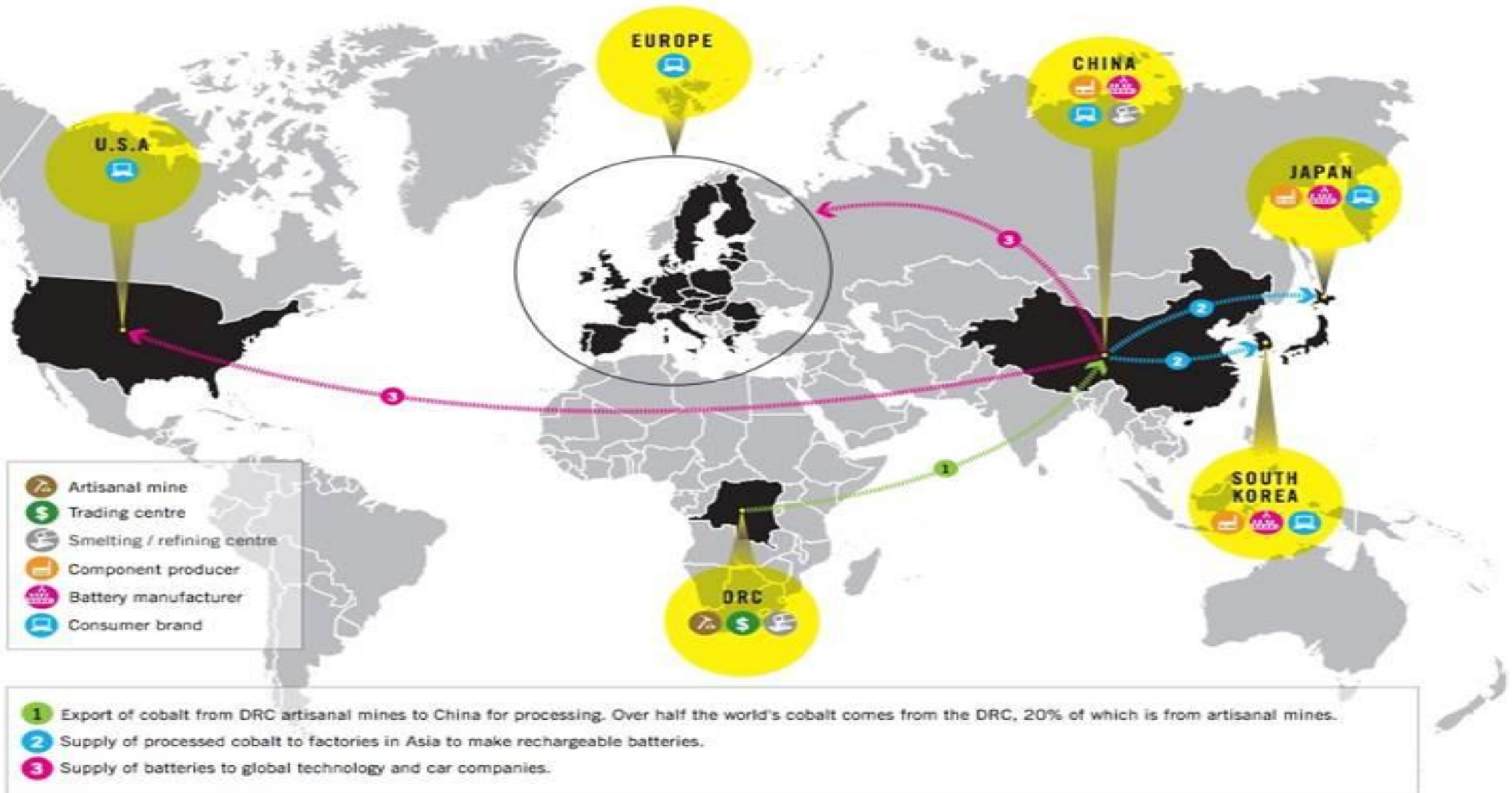
1. DRC

Sixty percent of the world's cobalt originates in the DRC.



Cobalt Supply Chain

Movement of cobalt from artisanal mines in the DRC to the global market

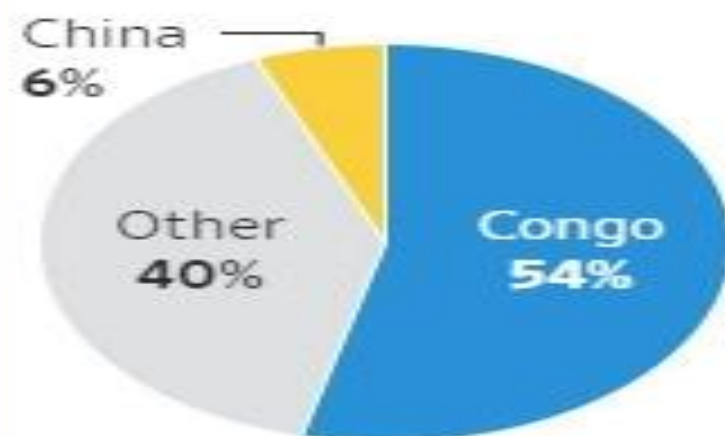


Cobalt Supply Chain

From Congo to China

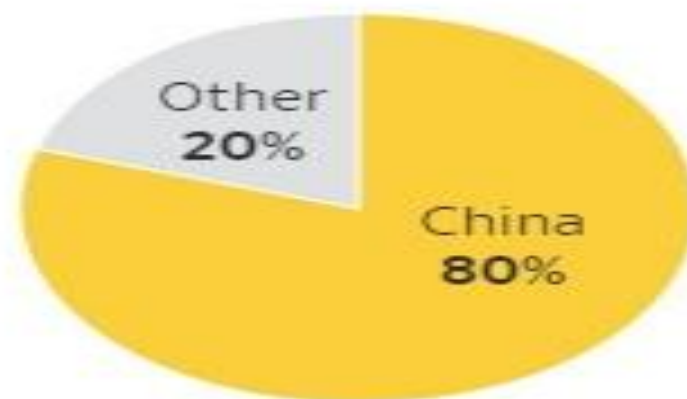
Congo produces more than half of the global supply of cobalt.

Percentage of raw cobalt production, by country



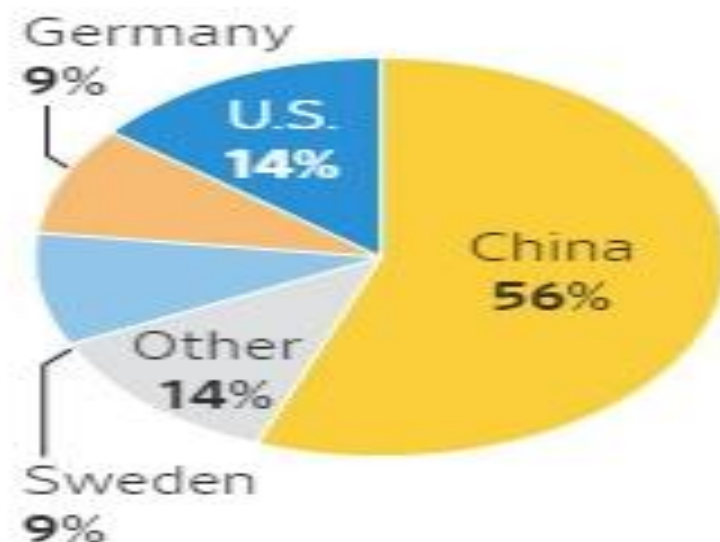
Much of Congo's cobalt winds up in processed cobalt sulfate.

Percentage of worldwide cobalt sulfate production



Lithium-ion battery production is concentrated in four countries.

Percentage of global production capacity*



*2020 forecast

Sources: U.S. Geological Survey (cobalt production); Benchmark Mineral Intelligence (cobalt sulfate, production forecast)

but ..Problematic Supply Chain from the King of Cobalt ...

Problematic Supply Chain

60% OF COBALT RESOURCES ARE IN THE DRC

WAR-TORN COUNTRY

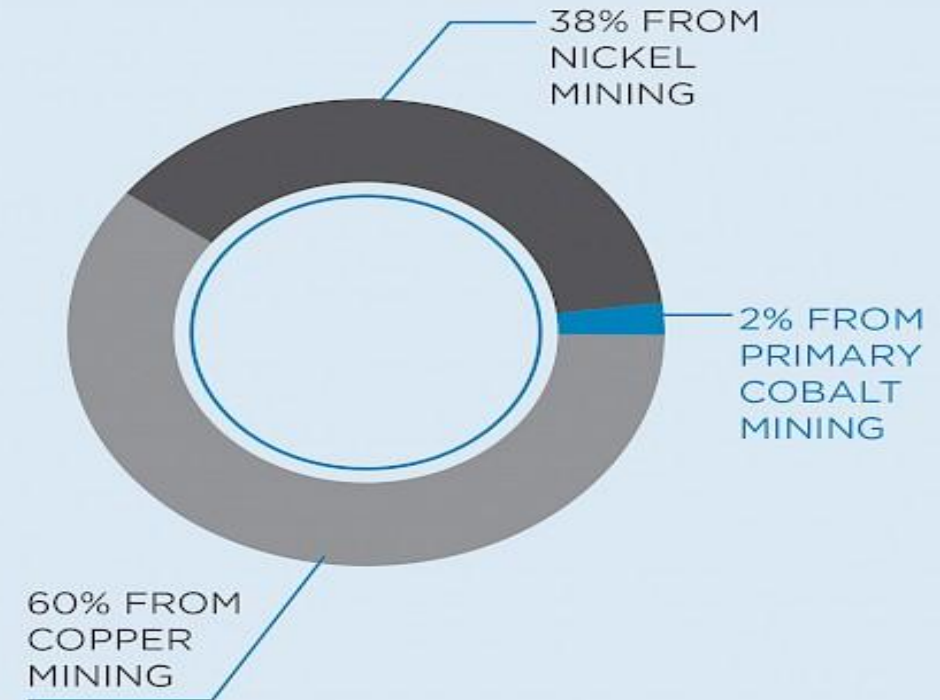


ARTISINAL MINING & CHILD LABOUR

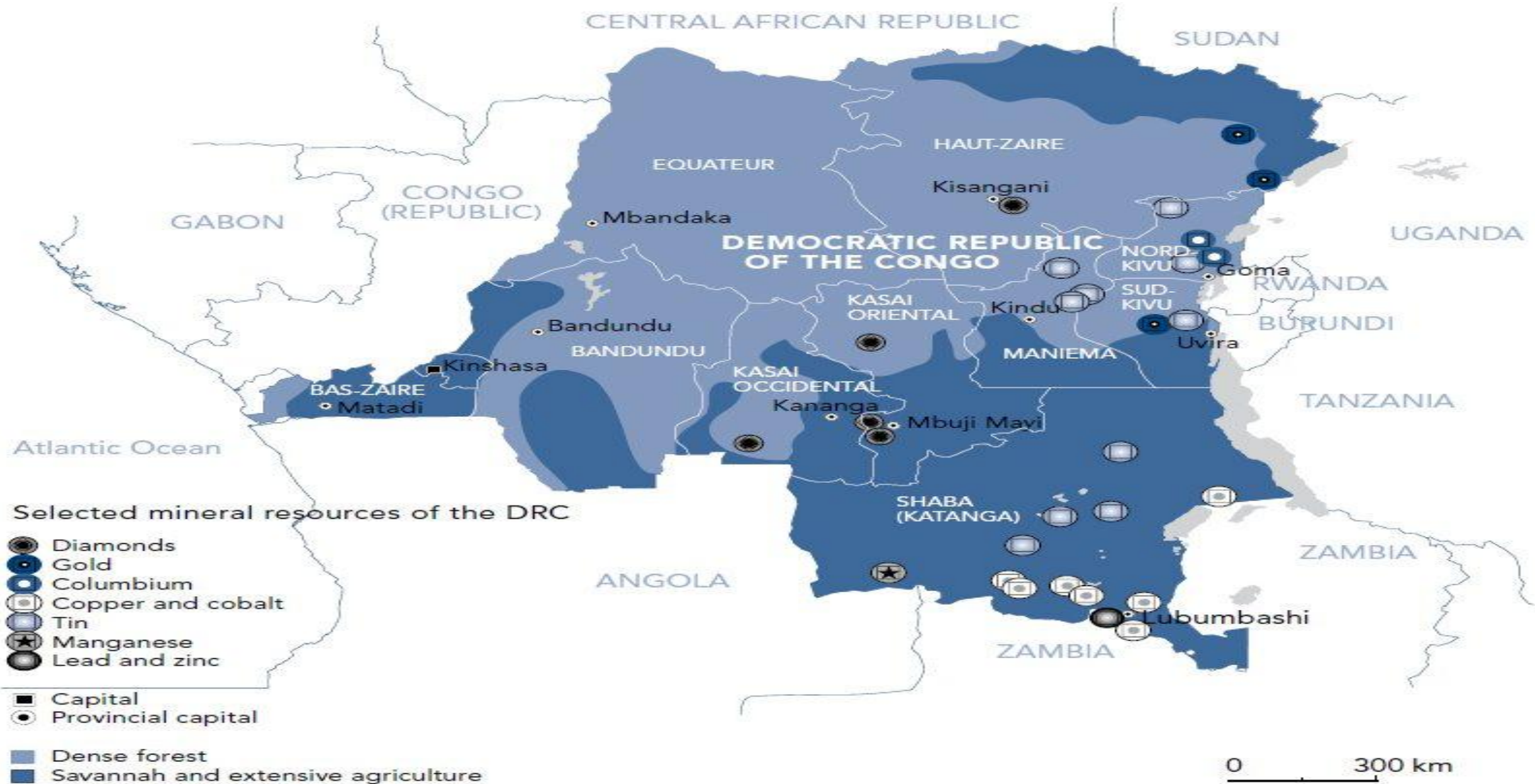


FAILING INFRASTRUCTURE

98% OF COBALT PRODUCTION IS MINED AS A BY PRODUCT



Congo – The Cobalt Mother / Tarzan



5) Cobalt Ethical Issues ...

An Unethical Supply Chain

- The African Copper Belt hosts the majority of the DRC's cobalt deposits, where it is primarily mined as a by-product of copper and nickel mining.
- **Low labor costs, loose regulations, and poor governance in the DRC allow for the flourishing of artisanal mining and cheap sources of cobalt.**
- However, cobalt from the DRC is tainted by ethical and humanitarian issues, including:
 - *Child labor*
 - *Corruption*
 - *Crime*
 - *Poverty*
 - *Hazardous artisanal mining*
- With the current supply chain of cobalt facing scrutiny and criticism, a transformation in the cobalt universe is well underway.

An Unethical Supply Chain

- Η Αφρικανική Ζώνη Χαλκού φιλοξενεί την πλειονότητα των κοιτασμάτων κοβαλτίου του Κονγκό, όπου εξορύσσεται κυρίως ως υποπροϊόν της εξόρυξης χαλκού και νικελίου.
- Το χαμηλό κόστος εργασίας, οι χαλαροί κανονισμοί και η κακή διακυβέρνηση στο Κονγκό επιτρέπουν την άνθηση της βιοτεχνικής εξόρυξης και των φθηνών πηγών κοβαλτίου.
- Ωστόσο, το κοβάλτιο από τη ΛΔΚ μολύνεται από ηθικά και ανθρωπιστικά ζητήματα, όπως:
 - Παιδική εργασία
 - Διαφθορά
 - Έγκλημα
 - Φτώχεια
 - Επικίνδυνη βιοτεχνική εξόρυξη
- Καθώς η τρέχουσα αλυσίδα εφοδιασμού κοβαλτίου αντιμετωπίζει έλεγχο και κριτική, ένας μετασχηματισμός στο σύμπαν του κοβαλτίου βρίσκεται σε πλήρη εξέλιξη.

The real cost of your phone ...



The real cost of your electric car ...



The real cost of your TV ...



The real cost of your Laptop ...



The real cost of your PC ...



Are we willing to pay more or ...



6) Cobalt in the near future ...

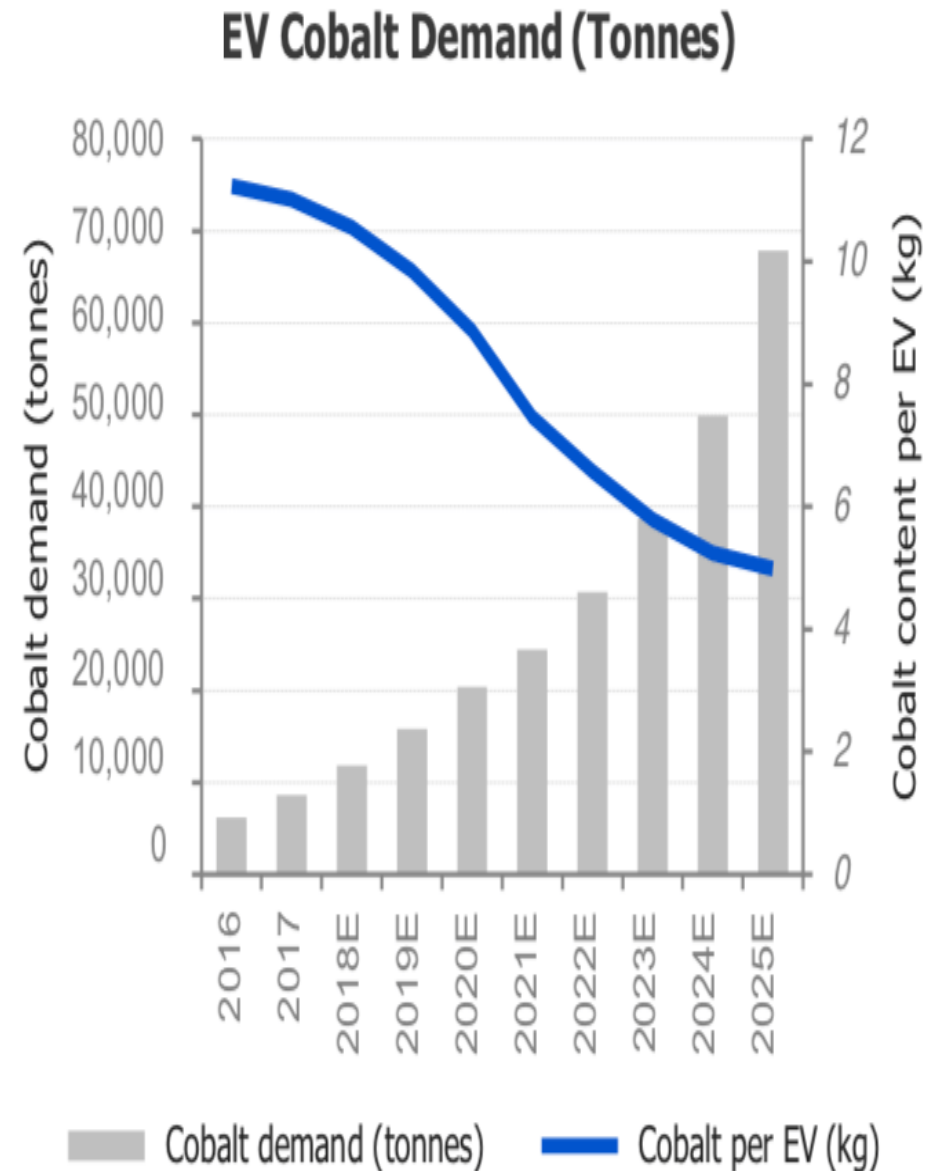
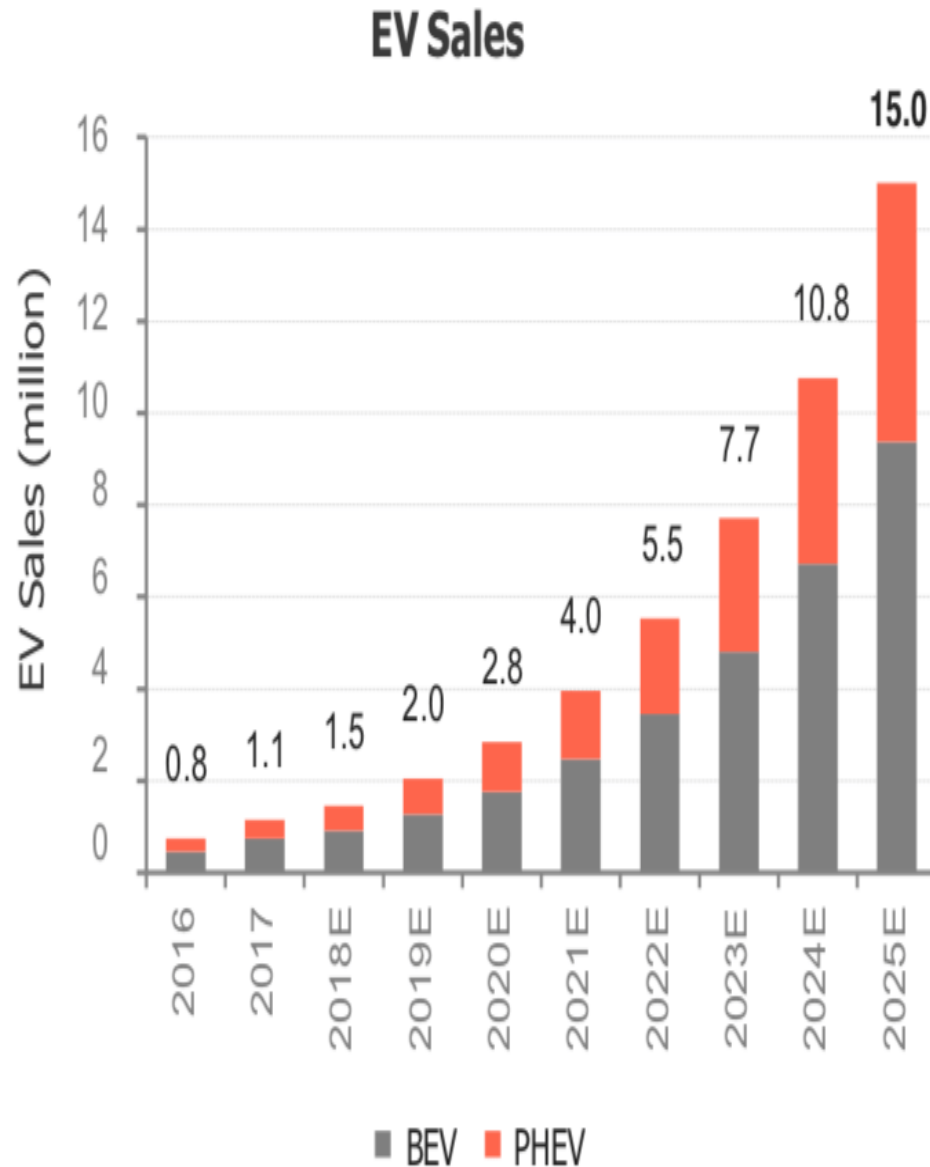


RCS GLOBAL
Making Sure.

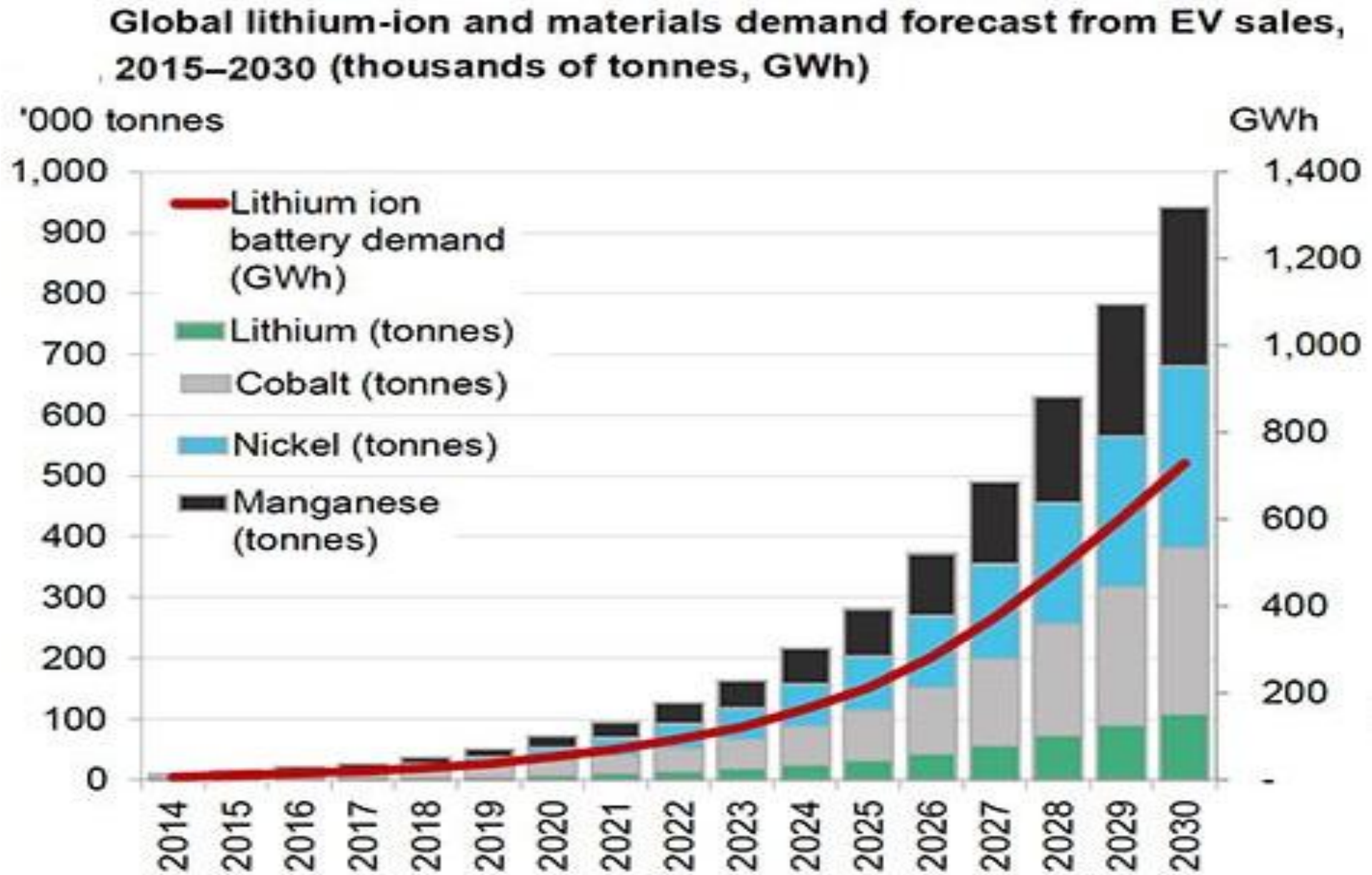
THE EMERGING COBALT CHALLENGE

COMPETITION, CONCENTRATION, AND
COMPLIANCE. UNDERSTANDING THE COBALT
SUPPLY CHAIN AND HOW TO RESPOND

Cobalt Demand Forecasting



Batteries Demand Forecasting ... *based on EV sales*



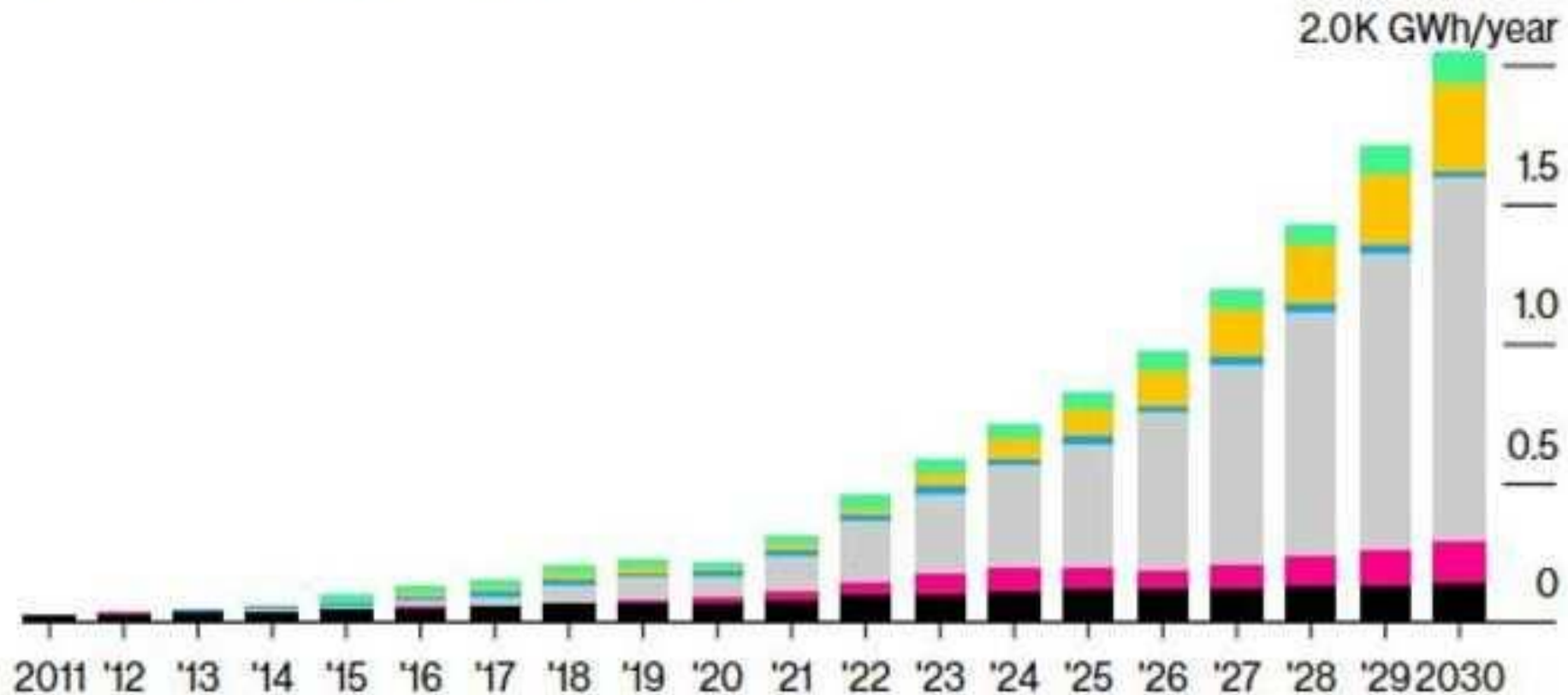
Source: Bloomberg New Energy Finance

Batteries Demand Forecasting ... *based on many products*

More Batteries Everywhere

Demand for lithium-ion batteries is forecast to surge after a virus-linked stumble in 2020

■ Consumer electronics ■ Stationary storage ■ Passenger EVs ■ E-buses
■ Commercial EVs ■ Electric two-wheelers

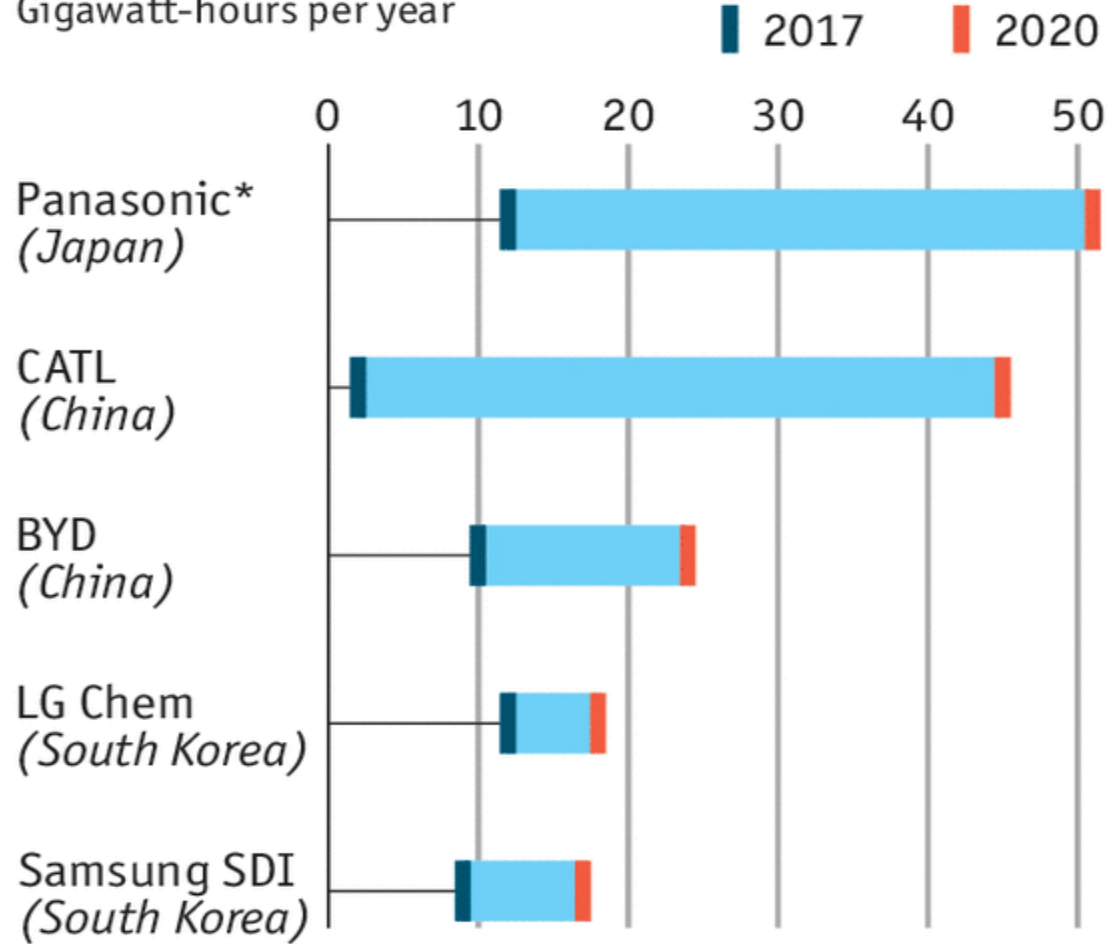


Source: BloombergNEF

Capacity of producing batteries ...

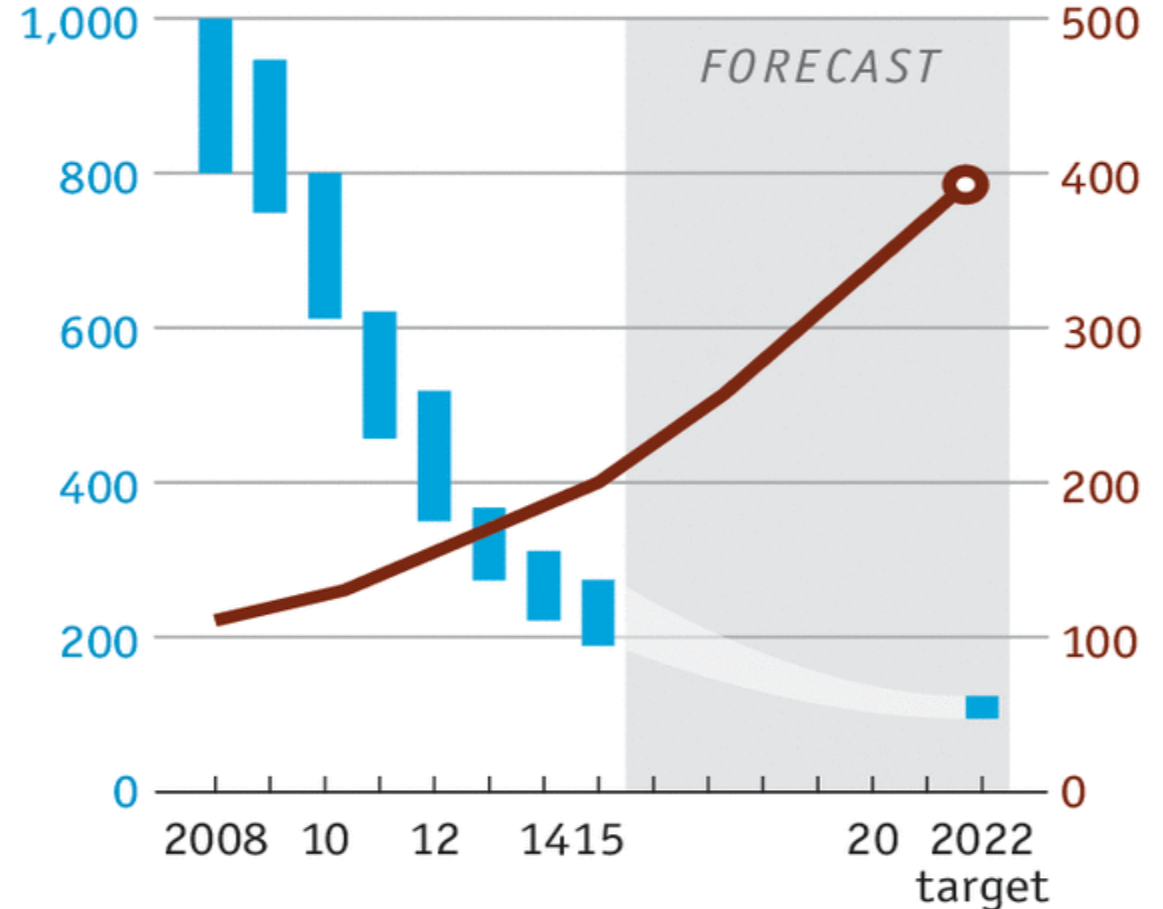
Electric dreams

Manufacturing capacity
Gigawatt-hours per year



Sources: Cairn ERA; US Department of Energy

Battery cost
Worldwide, \$/kWh

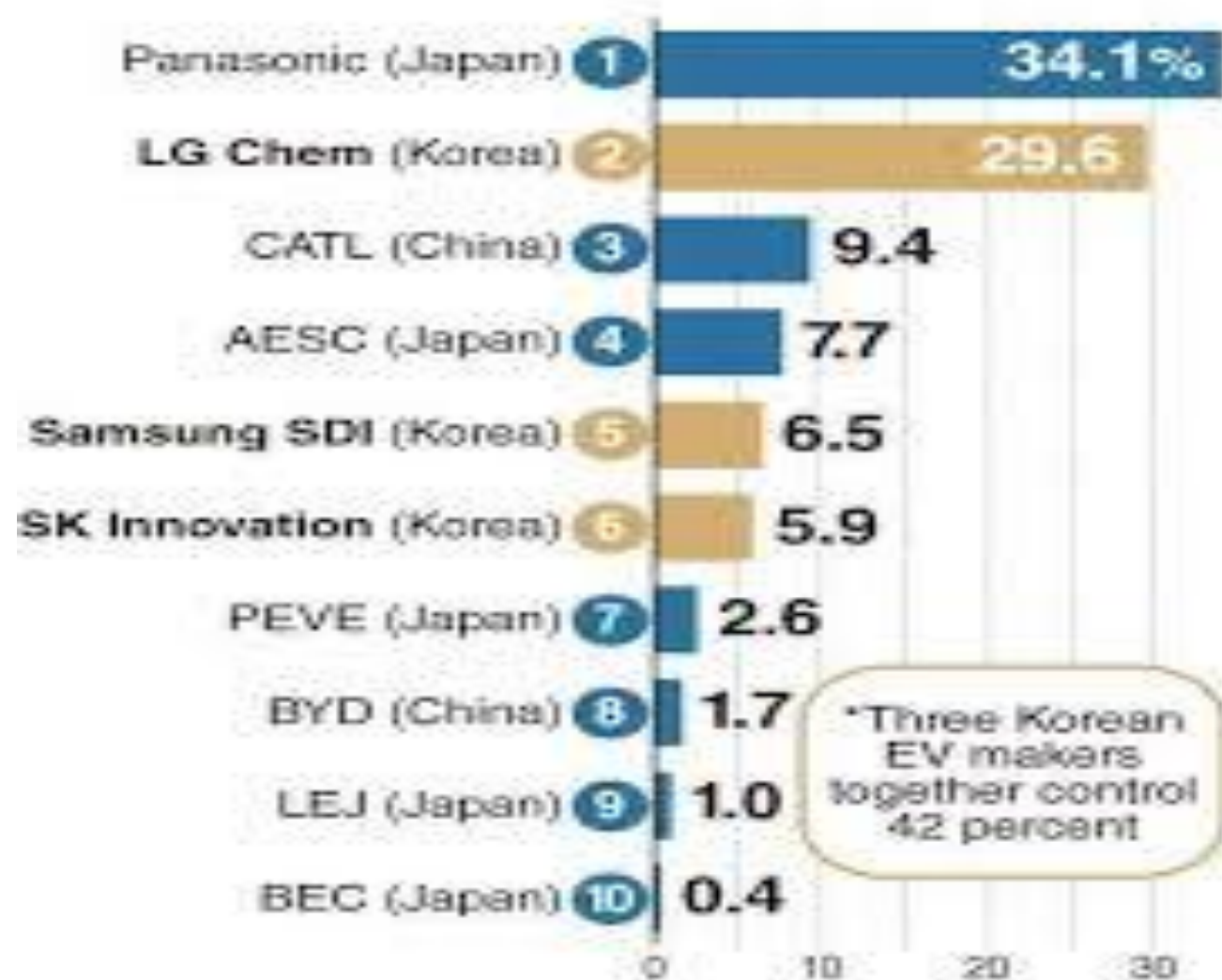


*Includes Tesla gigafactory

Producers of Batteries ...

Top 10 EV battery firms worldwide

(Unit: %, as of February)

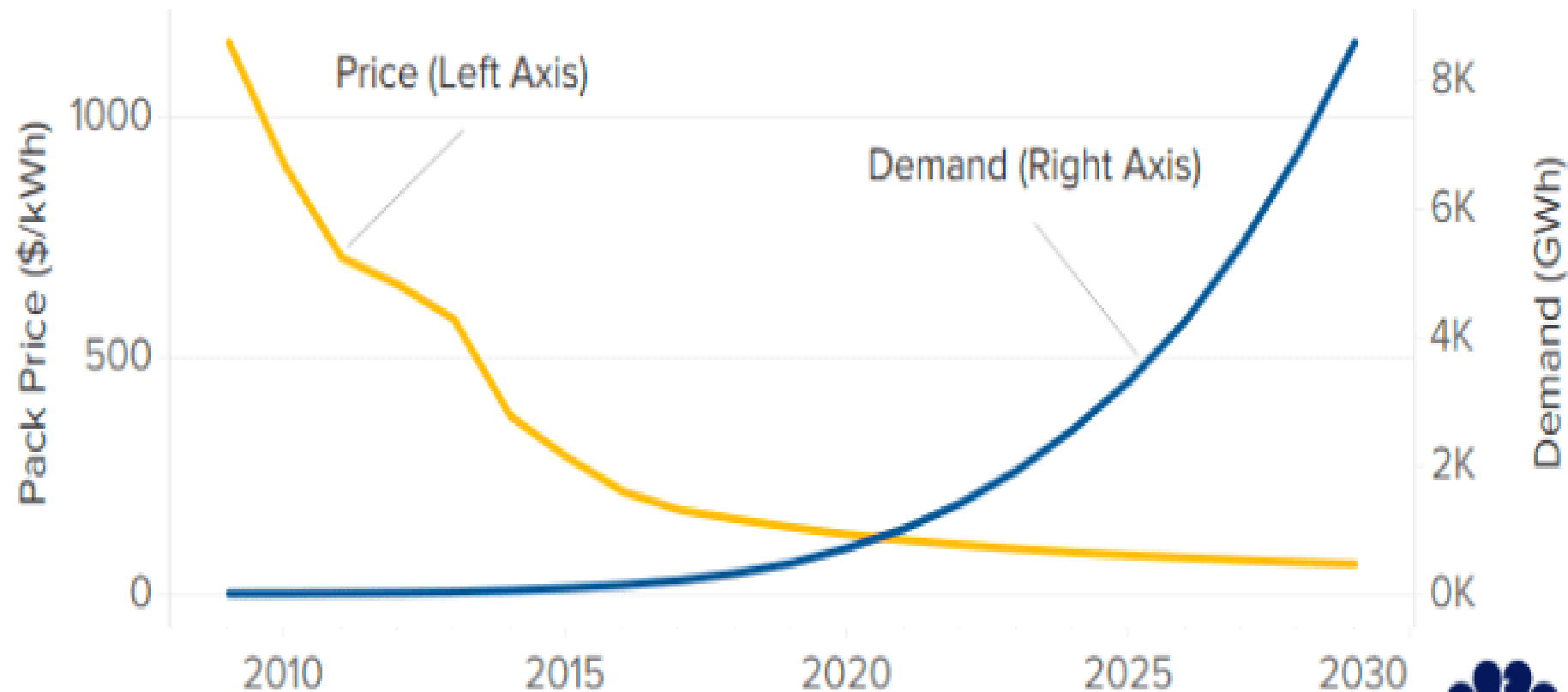


*Three Korean EV makers together control 42 percent

Source: SNE Research

Price Forecasting ...

Li-ion battery market development for electric vehicles



SOURCE: Rocky Mountain Institute/BloombergNEF. Data is projected starting with 2020.



Sources

- 1) Copyright © 2021 Visual Capitalist, All rights reserved.
- 2) Wikipedia
- 3) References at Slides

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