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Including

Pressure Acid Leaching Forum

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Including

Pressure Acid Leaching Forum

20-22 May 2019

Perth, Australia

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THE CHANGING LANDSCAPE OF THE COBALT MARKET

By

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ABSTRACT

Cobalt is not an obvious metal like copper, aluminium or steel, but it imparts special properties to a wide range of end-use applications from high performance alloys, hard metals, prosthetic joints, ICT, surface treatment etc., to industrial chemical processes (catalysts, driers, adhesives etc) all the way to the subtlety of being essential for medical diagnostics and the production of vaccines - without cobalt there is no pharmaceutical industry. This means that cobalt is virtually essential to most of the products we use in our daily lives such as smartphones, laptops, electric vehicles, ceramics/pigments, tyres, car safety systems, energy storage units, wind turbines, motors, medical treatments, for health and vitality, among many, many others.

However, it is the use of cobalt in rechargeable batteries that has fundamentally changed the dynamics of the market, making it no longer the 'curiosity' metal it once was but one of the key ingredients for the highly sought after low-carbon economy. Here, its role in the advancement of electric mobility will be a paradigm shift from the old established market.

Moreover, the cobalt industry faces numerous challenges such as chemical regulation, where its hazard profile is coming under considerable scrutiny from regulators and legislators worldwide; the need to demonstrate a sustainable profile, such as integrating with the circular economic model that is gathering in importance and the focus by civil society on responsible sourcing.

The Cobalt Institute, aims *"to promote the sustainable and responsible use of cobalt in all forms"*, acts as a knowledge centre and represents the voice of the cobalt industry on cobalt related health, safety, and environmental issues together with sustainability, responsible sourcing, global advocacy and general information on this important, technology enabling metal. We also promote co-operation between members, especially on key issues, and provide a mechanism for the development of independent information and support concerning the resources, responsible production and safe use of cobalt.

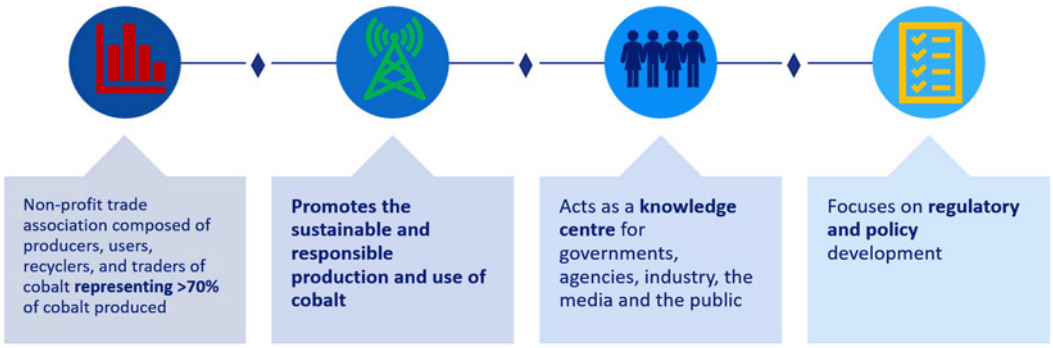
This presentation will look at the historical changes to the cobalt market, noting specifically the impact that cobalt containing Li-ion battery development has had, while looking at the challenges that cobalt faces in the global market place, from chemical management to responsible sourcing, and the role that cobalt plays in the development of the circular economy.

Keywords: cobalt, Cobalt Institute, lithium-ion, rechargeable battery, responsible sourcing, circular economy

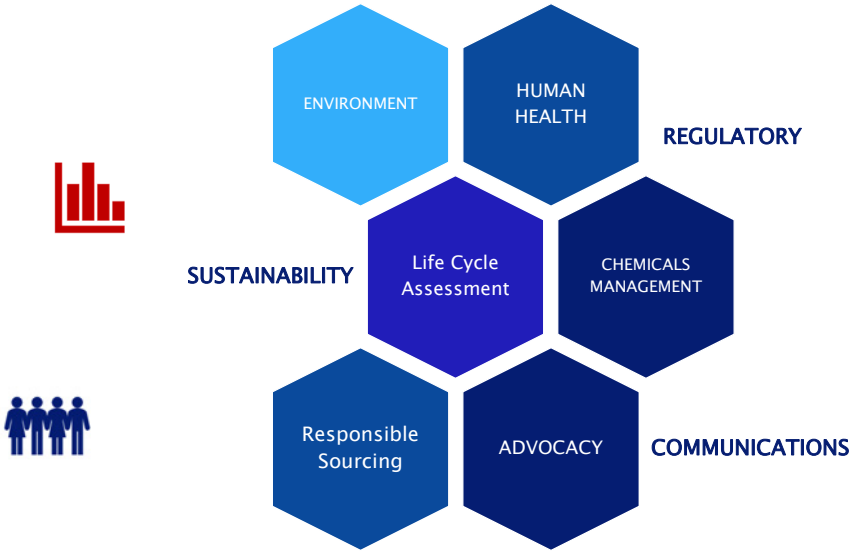
OVERVIEW

- **The Cobalt Institute: ~60 years of History**
- **Historical Changes of the Cobalt Market**
- **Challenges faced by Cobalt: the impact of Li-ion batteries**
- **Responsible Sourcing**
- **Sustainability**
- **Global Regulation Perspective**

COBALT INSTITUTE >60 YEARS OF HISTORY



COBALT INSTITUTE ~ 60 YEARS OF HISTORY



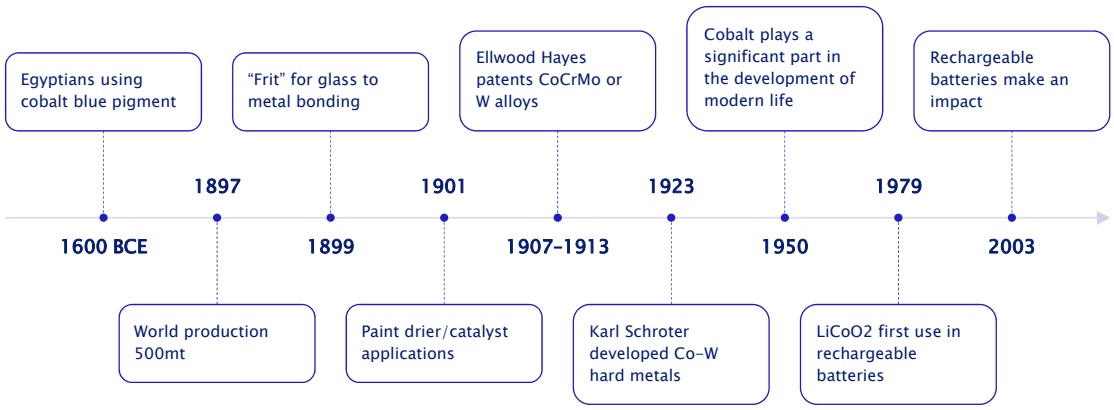
COBALT INSTITUTE MEMBERS

- Albemarle Europe SPRL
- Borchers America Inc.
- Chambishi Metals Plc
- CTT
- Dynatec Madagascar SA
- Eramet
- Freeport Cobalt Oy
- Glencore International AG
- ICoNiChem Widness Ltd
- Kennametal Inc.
- Metalkol SA
- New Providence Metals Marketing, Inc.
- Sandvik AB
- Shu Powders Limited
- Sumitomo Metal Mining Co, Ltd.
- Tenke Fungurume Mining SARL
- The Shepherd Chemical Company
- Umicore
- Vale Ltd

Associates: Battery Minerals Resources PTY; Belmont Cobalt Holdings Limited; Castle Silver Resources Inc; CIC LLC; Cobalt Blue Holdings; Cobalt 27 Capital Corp; Darton Commodities; eCobalt Solutions; Fortune Minerals; Venator UK; Honda Trading North America; JX Nippon; Less Common Metals; Mitsui & Co; Metals; Wogen Resources

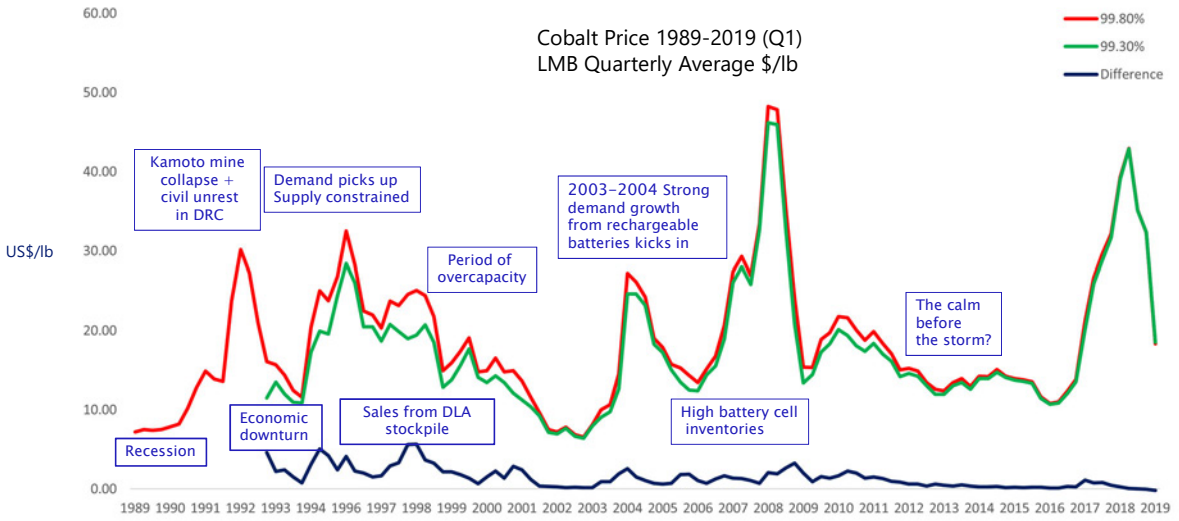
HISTORICAL CHANGES OF THE COBALT MARKET

COBALT CHRONOLOGY

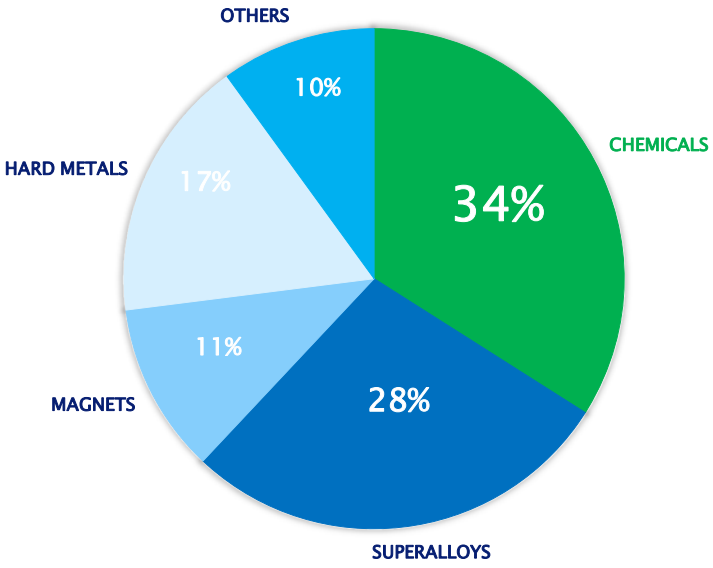


And the rest is history...

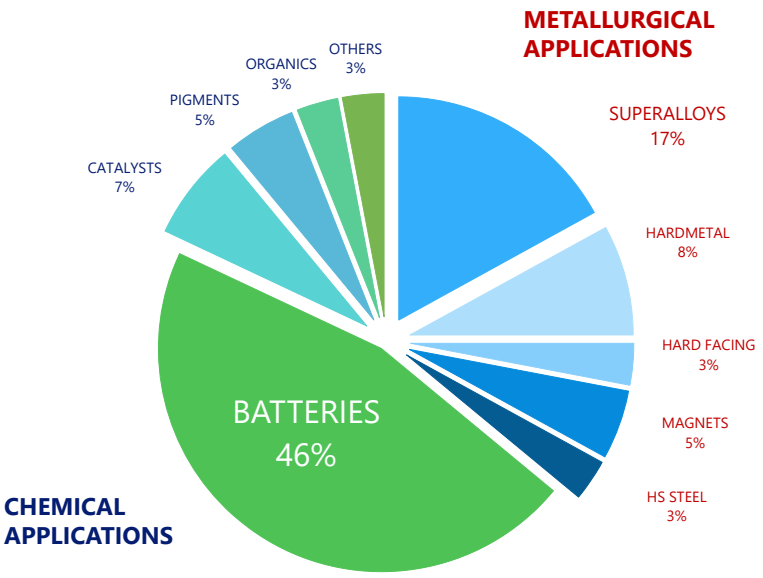
HISTORICAL COBALT PRICE



COBALT END-USE IN THE GOOD OLD DAYS! (1987)

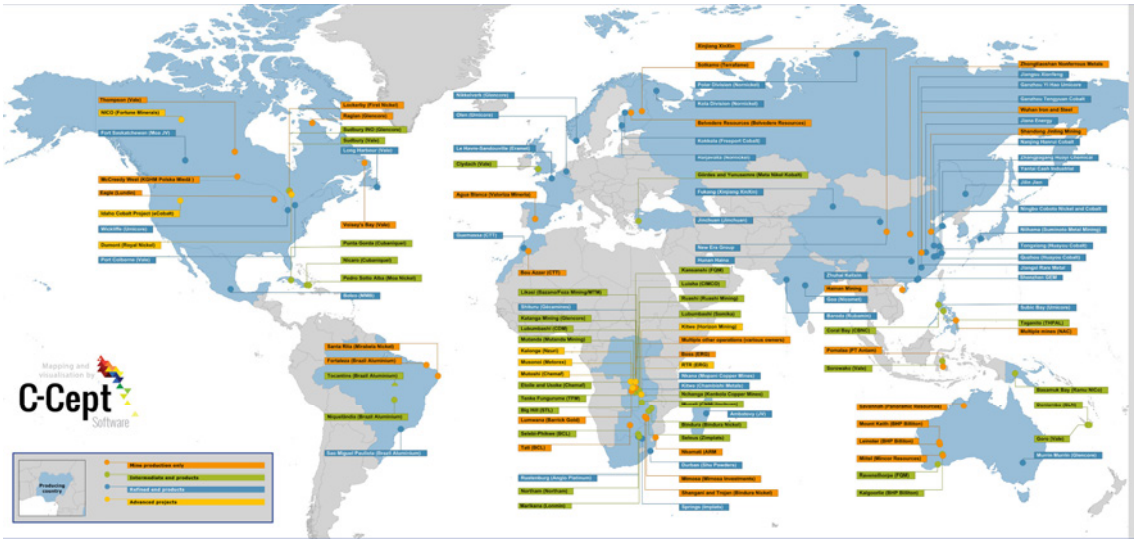


COBALT CONSUMPTION BY END USE 2017



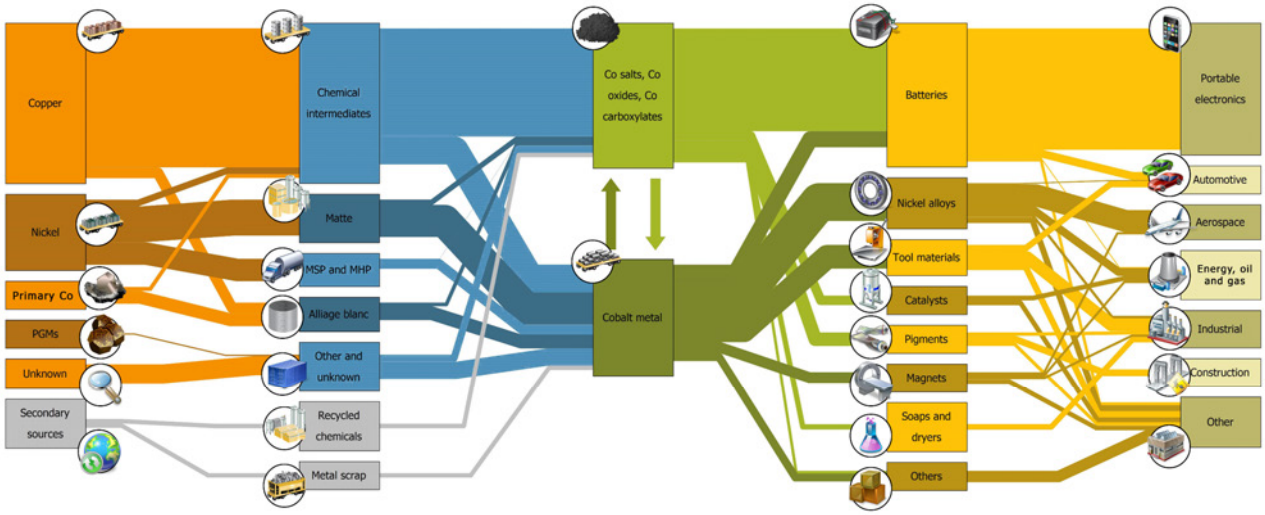
SOURCE: CI-CRU

THE COBALT MAP – COBALT PROJECTS



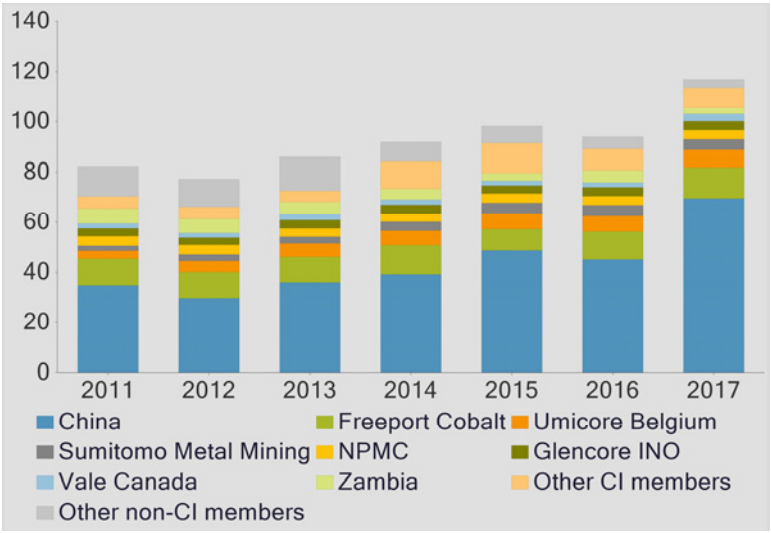
(SOURCE: ROSKILLS-COBALT INSTITUTE 2019)

OVERALL PICTURE OF GLOBAL COBALT PRODUCTION & END-USE APPLICATIONS



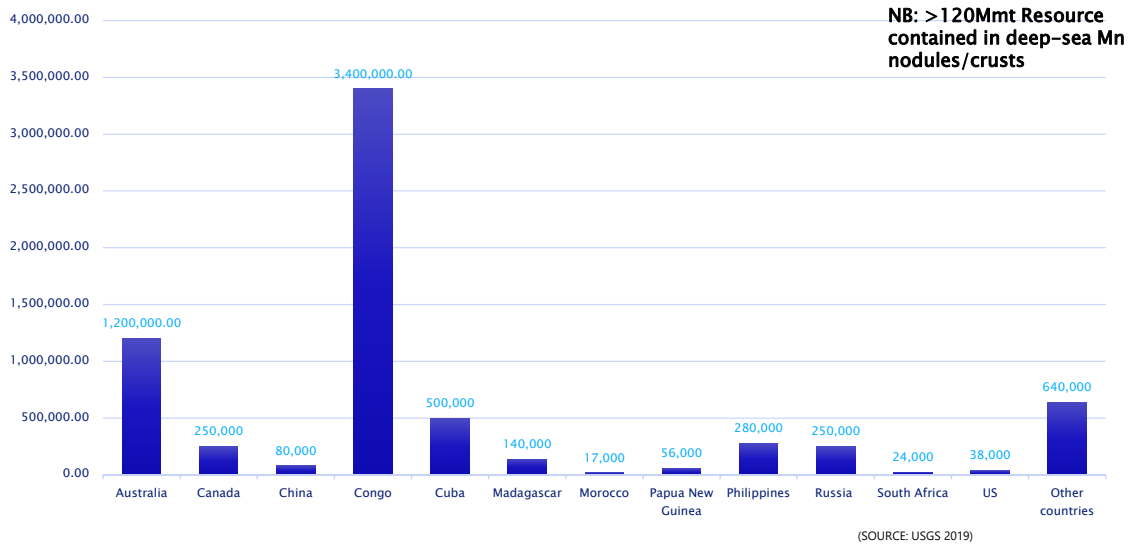
(SOURCE: ROSKILLS-COBALT INSTITUTE 2019)

GLOBAL COBALT PRODUCTION COBALT INTERMEDIATES



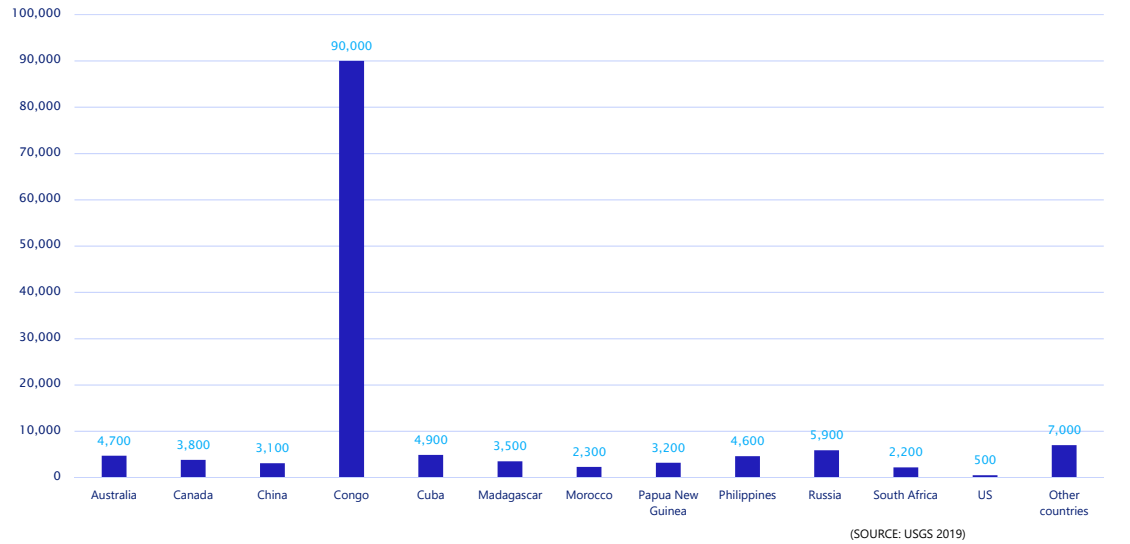
(SOURCE: ROSKILLS-COBALT INSTITUTE 2019)

WORLD MINE COBALT RESERVES



(SOURCE: USGS 2019)

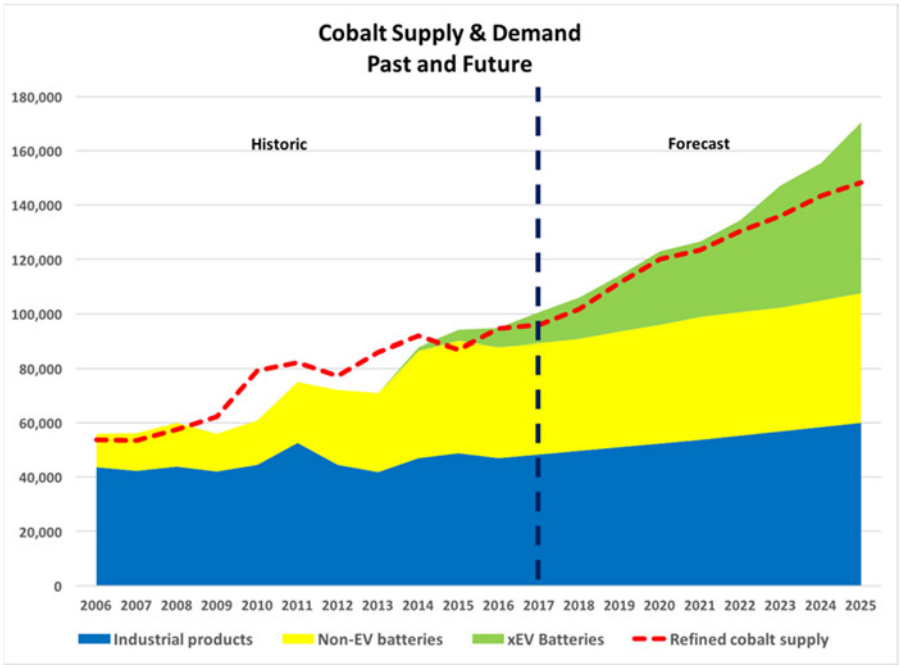
WORLD MINE COBALT PRODUCTION



(SOURCE: USGS 2019)

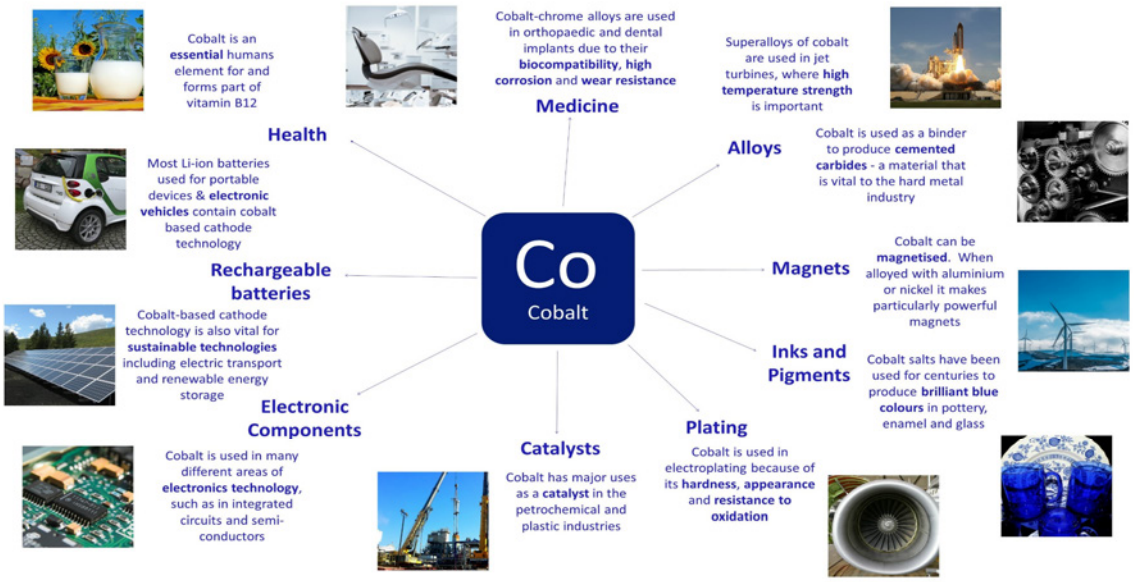
TIMELINE

(SOURCE: MORGAN STANLEY)



CHALLENGES FACED BY COBALT: THE IMPACT OF LI-ION BATTERIES

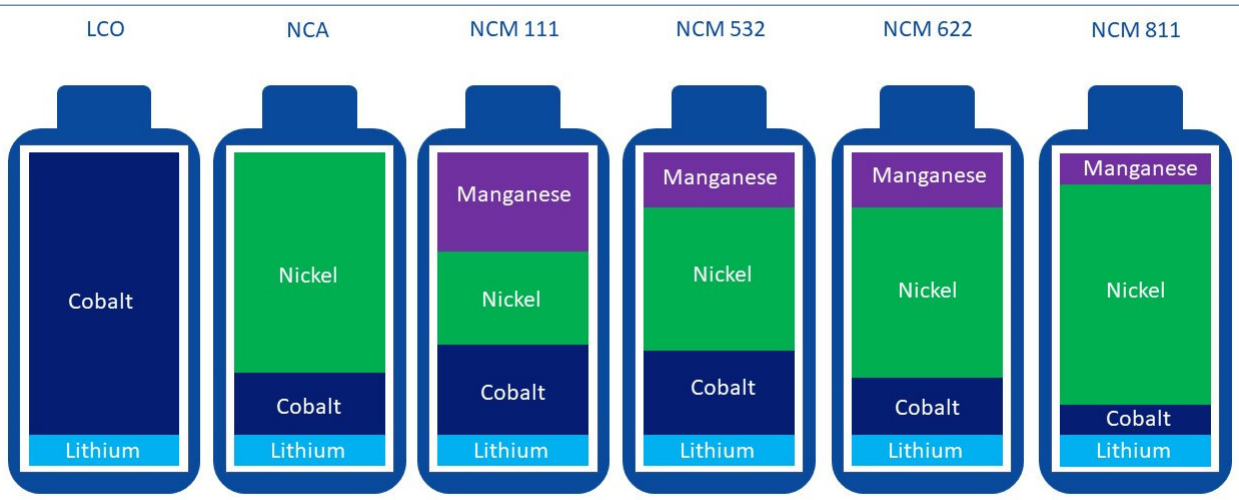
COBALT USES

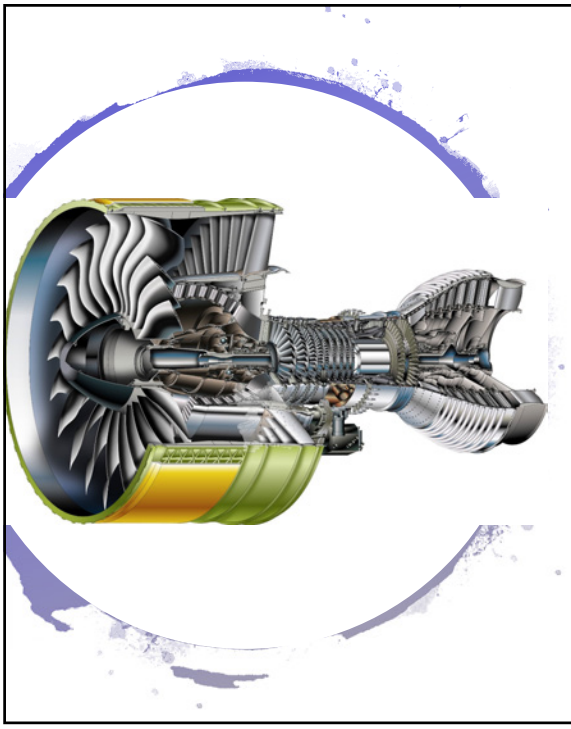


Rechargeable Batteries

- **Typical Raw Material for Lithium-ion Batteries:**
  - Cobalt metal or oxide/hydroxide
  - Converted to lithiated cathode material
- **2017 cobalt consumption:**
  - >53,700 MT
- **Use Tips:**
  - Active cathode material
  - Application requirements dictate the chemistry and physical properties
- **Comments:**
  - New chemical systems developed during high price period
  - Long-term growth

Lithium-ion Battery Types





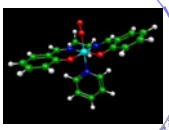
Superalloys

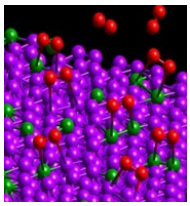
- **Main Metals:**
  - Titanium (compressor fan)
  - Ni/Co Superalloys (combustion chamber, turbine and exhaust area)
  - Aluminium & Kevlar/Composites (shroud)
  - Steel (shafts, piping & plumbing etc)
- **2017 Cobalt Consumption**
  - > 19,800 MT
  - Continual growth!

Hardmetals, Hard Facing Tools & High Speed Steel

- **Typical Raw Materials**
  - Cobalt oxalate
  - Converted to fine cobalt powders
- **Use**
  - Binder for cemented carbides (WC)
  - Powder metallurgical parts processing
- **2017 Cobalt Consumption**

  > 16,300 MT
- **Comment**
  - New alloy alternatives in development
  - Recycle plays an important role



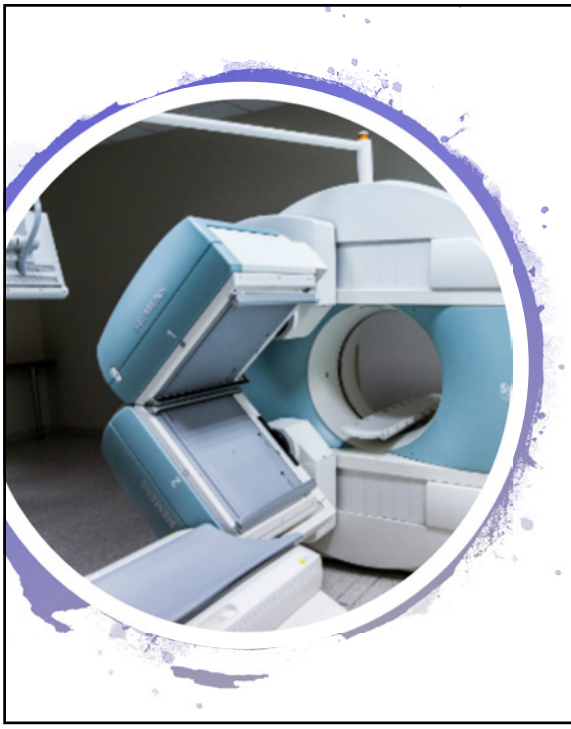


Catalysts

- **Market Trends**
  - **Polymerisation/Oxidation:**
    - Acetate/hydroxide/carbonate/nitrate/metal
    - PTA for textiles
    - UPR for plastics (molding)
    - Centered in Asia/Pacific
    - Recycle is important
  - **Hydroprecessing:**
    - Driven by tighter sulphur legislation
    - Goldilocks Principle
    - Re-use = Cyclical with catalyst change-outs
  - **Fischer Tropsch for GTL:**
    - GTL projects are more attractive with high oil prices
    - Recycle will be important
    - Long term growth potential
- **2017 Cobalt Consumption**
  - > 8,100 MT

Pigments

- **Typical Raw Materials**
  - Predominantly cobalt oxide
  - Some cobalt sulphate, carbonate, and hydroxide
- **Use**
  - Colorant additive
  - Ceramic tile, glass, and plastic
- **2017 Cobalt Consumption**
  - > 5,800 MT
- **Comment**
  - High cobalt price limits demand
  - Had seen strong growth in China, Asia, and Eastern Europe



Remaining Significant Applications

- **Magnets**
  - >5,800 MT
- **Organics (Rubber adhesion; paint driers…)**
  - >3,500 MT
- **Others (Coatings, Pharmaceuticals; Medical Prosthetics; ICT…)**
  - >3,500 MT

RESPONSIBLE SOURCING

Responsible Sourcing of Cobalt

Based on:

- Universal Declaration of Human Rights
- United Nations Guiding Principles for Business and Human Rights
- OECD Guidelines for Responsible Sourcing
- Extractive Industry Transparency Initiative (EITI)
- Equator Principles
- Global Reporting Initiative (GRI)
- ICMM Principles
- CI Principles – **Cobalt Industry Responsible Assessment Framework (CIRAF)**

- International pressure from civil society
- Regulatory and policy pressures
- LSM responsible/sustainable working practices
- CI strategy = CIRAF (working with upstream & downstream)

CIRAF* MAIN FEATURES

- It strengthens the ability of cobalt producers and buyers to assess, mitigate, and report on responsible production and sourcing risks in their operations and supply chain
- It also enables a more coherent and consistent approach to cobalt due diligence and reporting by the cobalt industry
- It is a management tool which allows participants to prove that they are aligned with global good practice on responsible production and sourcing with annual public reporting being a mandatory requirement

* The framework is now being applied by Cobalt Institute members in an initial implementation year. For further information, please refer to the CIRAF external primer

Risk Areas

CIRAF aims to provide guidance for how to respond to the following 9 priority risk areas:

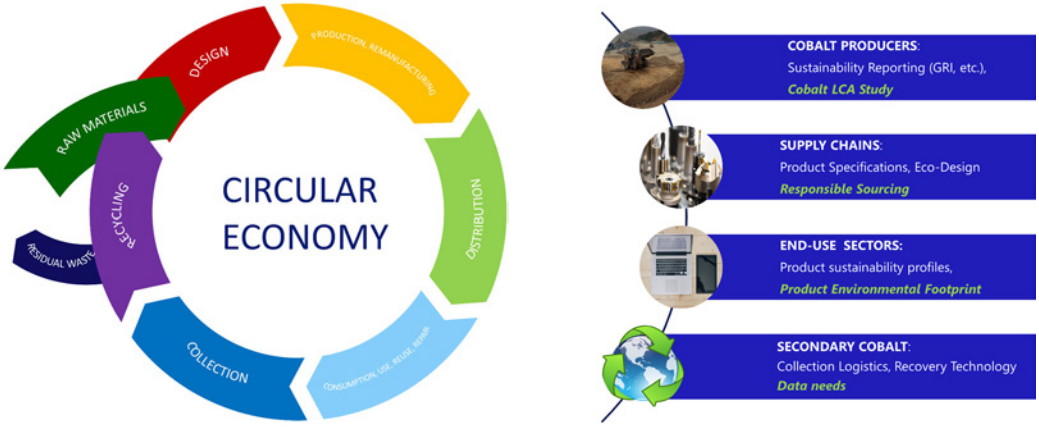
Risk category	Priority risk area
Environment	Air/water/soil environmental impacts
	Biodiversity impacts
Occupational Health & Safety (OHS)	OHS and working conditions
Human rights	Conflict and corruption
	Human rights impacts (aligned with Annex II Model Policy in OECD Due Diligence Guidance)
	Child labour
Community Engagement	Artisanal and Small-Scale Mining (ASM)
	Livelihoods
	Resettlement

Self-Assessment: CIRAF Core Elements

Level 1- Baseline Requirements & Human Rights (Annex II of the OECDG)	Level 2 – Priority Risks	Level 3 – All Risks
Statement of commitment to implement CIRAF Materiality assessment of the risk categories, based on a credible mechanism, including a public reporting of its summary Statement of compliance with applicable legal framework in country of operation	For 3 material risk areas:	For all risk areas:
For risk category "Human Rights": Evidence of risk-specific policy Evidence of risk-specific management system aligned with OECD DDG, verified by 3rd party Evidence of public reporting	Evidence of risk-specific policy Evidence of risk-specific management system Evidence of public reporting	Evidence of risk-specific policy Evidence of risk-specific management system Evidence of public reporting

SUSTAINABILITY

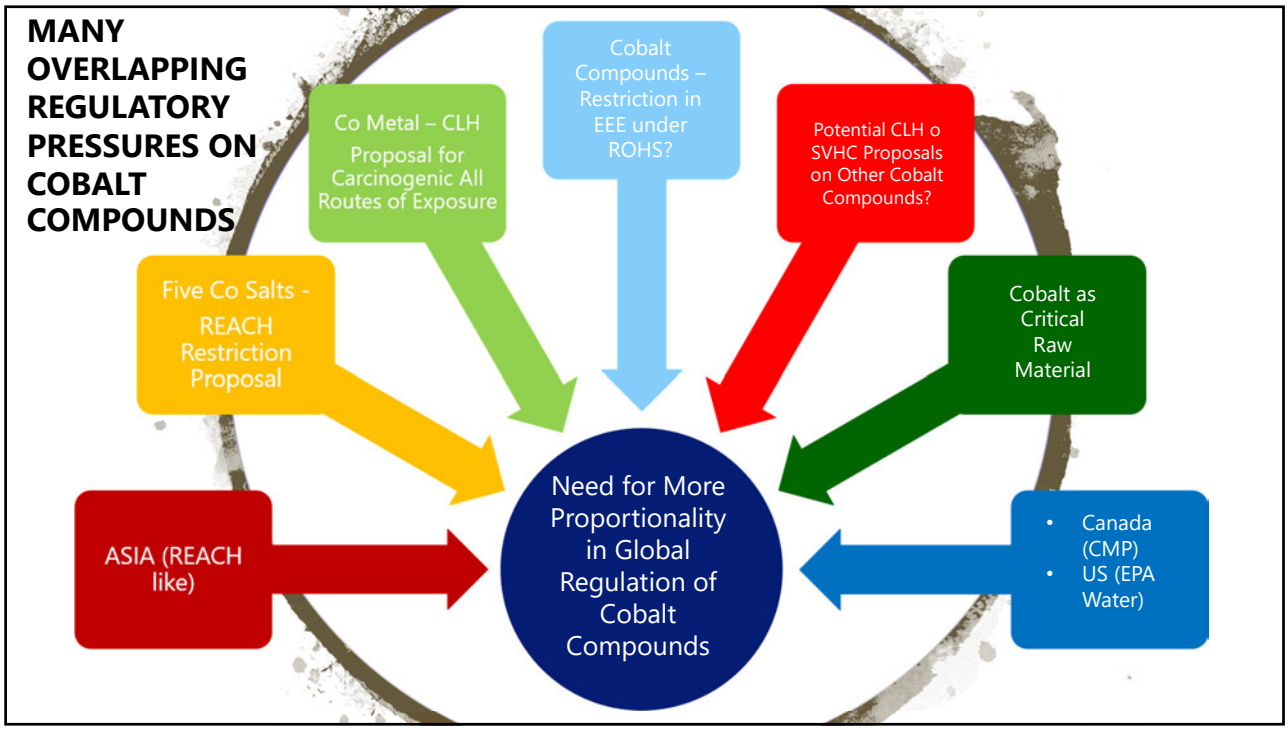
DEVELOPING THE SUSTAINABILITY PROFILE FOR COBALT



SOURCE EUROMETAUX

It involves taking a **Life Cycle Approach**, and applying the appropriate tools (e.g. LCA, MFA, SEA, etc.), to illustrate the **Role of Cobalt in the Circular Economy**

GLOBAL REGULATIONS PERSPECTIVE



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