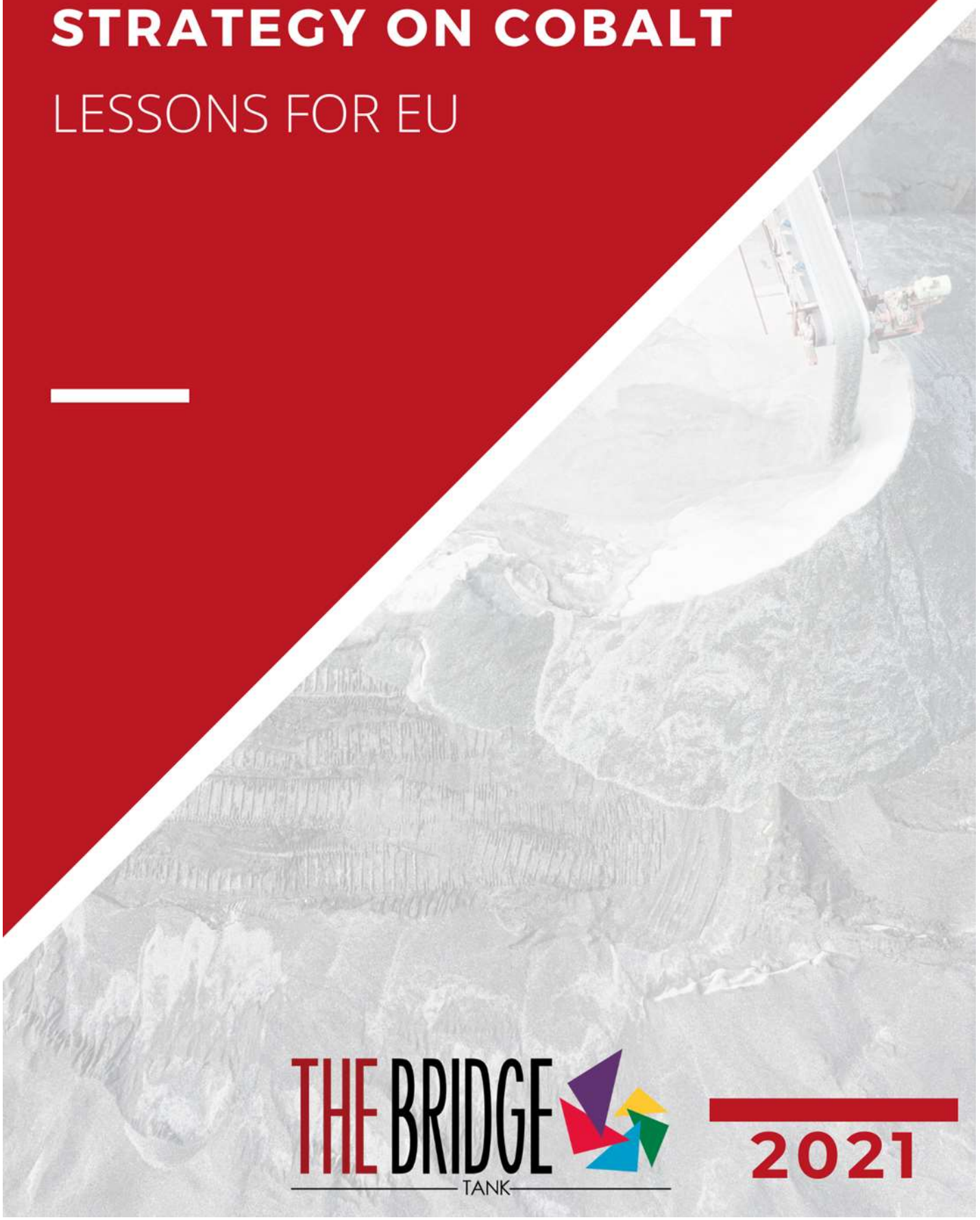
CHINA'S VALUE CHAIN STRATEGY ON COBALT

LESSONS FOR EU



THE BRIDGE TANK

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Contents

INTRODUCTION

Strategic materials are ubiquitous in all sectors relevant to the green economy and the energy transition. The OECD published 2018 study[1] addressing the use of raw materials which is expected to double globally by 2060. Regarding metals, consumption should increase from 7 to 19 billion tons per year, inducing serious tensions on the supply side. Between 2019 and 2020, the volume of cobalt used globally for the production of electric and hybrid vehicles went from 14.5kt to 18.5 (+29%). Following these tendencies and anticipations, several states expressed their fears regarding difficulties in the realization of transitions (ecological and energetical) because of material shortages.[2]

A recent World Bank report titled "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition" highlights that "the production of minerals [...] is expected to increase by almost 500% by 2050, to meet the growing demand for clean technologies. It is estimated that more than 3 billion tons of minerals and metals will be needed to deploy wind, solar and geothermal energy, as well as storage, in order to limit warming to 2°C."[3]

The energy transition will require a lot of minerals and metals; consequently, securing supplies and organizing responsible and sustainable value chains are becoming crucial issues. The notions of dependence, strategic metals and supply risks are becoming clearer and public policies are seeking responses to correct vulnerabilities.

The example of Japan is uplifting. Indeed, it was the first state to develop an integral, thought through strategy regarding the securitization of its materials imports, and implement public policies to manage this dependence. In fact, Japan's *Genso Senryaku* (elements strategy initiative) is based on the extensive use of "urban mines", the search for substitutes, the constitution of strategic stocks as well as the recycling of critical metals.[4]

This strategic shift is mostly driven by the development of new digital and low-carbon technologies, urban expansion and sophisticated weapon systems which all contribute to the consumption of more and more

[1] OECD. (2018). Global Material Resources Outlook to 2060 Economic drivers and environmental consequences. https://www.oecd.org/environment/waste/highlights-global-material-resources-outlook-to-2060.pdf
[2] CESE. (2019). *La dépendance aux métaux stratégiques : quelles solutions pour l'économie ?* https://la1ere.francetvinfo.fr/sites/regions_outremer/files/assets/documents/2019/01/22/2019_03_metaux_strategiques-997661.pdf
[3] World Bank group. (2020). *Minerals for Climate Action : The Mineral Intensity of the Clean Energy Transition*. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf
[4] IFRI. (2021). *La stratégie de souveraineté minérale américaine Une mobilisation tous azimuts*. https://www.connaissancedesenergies.org/sites/default/files/pdf-pt-vue/laplane_strategie_souverainete_minerale_americaine_2021.pdf

raw materials. This is especially the case for a material such as cobalt which is used in mobility electrification, first and foremost for electric vehicles' (EVs) production.

Cobalt owes its current visibility to its increasing use in low carbon technologies (as mentioned previously), also called green technologies (renewable energy and rechargeable batteries).[5] Cobalt is used as an input in the magnets of wind turbines, and for the production of the cathodes of lithium-ion and nickel metal hydride batteries, which are then incorporated in electric or hybrid vehicles. In the current context of the electrification of mobility, cobalt is therefore regarded as a strategic material.

The production of cobalt is however one of the prime examples of the unequal distribution of the earth's resources, the metal being extremely concentrated in one country: the Democratic Republic of Congo (DRC), who represents 70% of global production. The DRC's reserved are controlled substantially by what has now become an unavoidable actor in the cobalt value chain: China.

In this report, we will therefore proceed to an analysis of how China has imposed itself on the cobalt value chain, both upstream and downstream, and has progressively managed to build itself a comparative, if not absolute, advantage. It will be necessary to conduct a combined analysis of the strategies that have been implemented both by the Chinese government as well as industrial actors in order to gain this hegemonic position on the value chain. These strategies have allowed for the constitution of a resilient and dominant Chinese ecosystem around the cobalt value chain on the international stage.

I- STRATEGIC MATERIAL: FROM NATIONAL STRATEGIES TO INDUSTRIAL AMBITIONS & DEPLOYMENTS

A. GLOBAL POLITICAL STRATEGIES TO SECURE VALUE CHAINS FROM UPSTREAM TO DOWNSTREAM

So as to accelerate the path to a green economy and new energies, countries have now understood the importance of securing their supply of materials and to adopt a new kind of strategic positioning towards the entire value chain of strategic materials.

Governments will secure supply and more broadly to ensure the resilience of their supply chains are not new phenomena. States are willing to adapt to the commodity and raw materials markets and to

[5] *Le cobalt dans la transition énergétique : quels risques d'approvisionnements ?* (2020). IFPEN. https://www.ifpenergiesnouvelles.fr/article/cobalt-transition-energetique-quels-risques-dapprovisionnements#

strengthen their strategic autonomy in order to avoid monopolies from certain countries or industries at certain stages of the value chain. For instance, China is dominating the strategic materials market by having control over between 50 to 95% of the global production of 32 out of the 43 individuals' elements. As a consequence, the EU depends on Chinese imports for 62% of its strategic materials procurement.[6] This advantage provides Beijing great political leverage. It was for instance the case in 2010 when a dispute occurred between China and Japan regarding sovereignty over the Senkaku-Diaoyu islands. In response, Beijing stopped rare earths exports towards Japan in September, on which Japan is highly dependent (overall, in 2010 Japan imported 82% of its rare earths directly from China). This situation potently highlighted Japan's vulnerabilities and in the end prompted the government to progressively develop its own industry and strategic autonomy regarding material supplies.

Additionally, states' supply chain securing strategies have taken more and more importance following the COVID-19 pandemic, which boosted pre-COVID trends and "has highlighted how quickly and deeply global supply chains can be disrupted".[7] It activated a global movement towards industrial autonomy and material sovereignty which became a leitmotiv of diplomatic, trade and policy strategies. The specific objectives in this regard are[8]: reduce dependence on third countries, especially from China; diversify primary and secondary sources of supply; improve resource using efficiency; improve circularity while promoting responsible sourcing around the world.

To build their own competitive advantage, countries, such as the EU countries, the US or Japan are rethinking their model with regard to strategic materials and identifying the trajectories towards which they could counter the Chinese industrial strength. In this sense, we have identified 5 key strategic orientations towards which these countries will have to concentrate their efforts:

1. **Complete mapping by relaunching geological prospects to identify new mineral resources and deposits**

A simple fact shows that "as each economy has its own geological endowments and industrial structure, which natural resources qualify as critical varies between countries"[9]. This quote brings to light that the

[6] Fondation pour la recherche stratégique. (2021). *The European Union between strategic autonomy and technological sovereignty : impasses and opportunities*. https://www.frstrategie.org/sites/default/files/documents/publications/recherches-et-documents/2021/102021.pdf
[7] Fondation pour la recherche stratégique. (2020). La stratégie des approvisionnements en matières premières de l'Union européenne : le cas du secteur automobile. https://www.frstrategie.org/sites/default/files/documents/publications/recherches-et-documents/2020/212020.pdf
[8] IFPEN. (2020). Une géopolitique des matériaux de la transition énergétique? (course)
[9] Perth USAsia Centre. (2020). STRATEGIES FOR SECURING CRITICAL MATERIAL VALUE CHAINS. https://perthusasia.edu.au/getattachment/Our-Work/Strategies-for-Securing-Critical-Material-Value-Ch/Final-Strategies-for-securing-critical-material-value-chains-PUSAC-WEB.pdf.aspx?lang=en-AU

notion of critical materials is not a universal concept. First, it differs from each actor's dependency on a material or not. Secondly, it depends on the materials' consumption.

Additionally, it seems essential now for countries to better manage "robust geological data"[10] by relaunching geological prospects in order to identify new mineral resources and deposits, which are currently sought by the EU countries. So far, Finland has made progress in this area by having identified or relaunched exploration for 6 deposits across the country.[11] In fact, the underlying idea of this geological data management is composed of 2 key elements:

- to secure a sustainable supply between European partners by supporting the extractive sector in the adoption of new technologies or exploration methods;[12]
- as far as possible, to create a strategic stockpile, similar to a materials bank as already exists for uranium.

2. Accelerate R&D programmes to bridge the technological gap and to adapt the structural change of value chain

Between 2000 and 2018, China has massively invested in R&D for materials (+ 900%), in particular by developing cobalt transformation and refining capacities. Unlike other countries on the global stage, China has allowed itself to gain a leadership role on processing and refining. This has granted China to develop a comparative advantage (if not absolute). Suffering from a methodological delay, a technological gap and a poor geo-industrial positioning, the EU countries are now beginning to attempt to acquire sufficient knowledge and capacities to counter Chinese monopolies. Recently, industrial investments have been mainly oriented towards R&D and the UE has mobilized the European Institute of Innovation and Technology to lead research in concert with the scientific and entrepreneurship communities. The core issue of this collaboration is to identify possible methods of material substitution, in particular towards EV batteries, and therefore favor strategic material autonomy.

[10] World Bank. (2020). Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf
[11] Institut EGA, Conférence « Les métaux rares : géoéconomie et conséquences environnementales » Frédéric Goettmann - Exctracthive , 17 mai 2021, 90 min.

[12] Fondation pour la recherche stratégique. (2020). La stratégie des approvisionnements en matières premières de l'Union européenne : le cas du secteur automobile. https://www.frstrategie.org/sites/default/files/documents/publications/recherches-et-documents/2020/212020.pdf

3. Rethinking material consumption and industrial (re)use models to include recycling

International organizations and States have agreed on the fact that is necessary to review alternatives and implement sustainable productions and consumption practices, as well as policy processes (e.g evaluate carbon cost). The valorization and rationalization of raw materials stocks, such as cobalt stocks located in Europe, is an important perspective to introduce a circular economy and reuse/recycling for low-carbon minerals, in a climate mitigation prospect.[13] Pushed by public policies, this new thinking must be integrated into industry strategies and standards.

4. Develop new cooperation

There is a huge untapped potential for building sustainable and responsible strategic partnerships with resource-rich countries and countries that have developed sufficient industrial capacities to ensure autonomy. One of the main aim is to "offer fair conditions of access to the resources of third countries through a strategy of opening up markets during bilateral and multilateral negotiations by imposing "raw materials diplomacy""[14]. Some experts have recently discussed the desire to create an Atlantic alliance between the US and the UE as part of this material diplomacy. There are also other existing cooperation ensembles: the annual trilateral (US/EU/Japan) conference on materials, discussions in the frameworks of OECD, WTO, UN, G20 e.g. However, it is important to take into account the geopolitical risks underlying these different cooperation ensembles.

5. Countries' strategic intelligence relating to critical raw materials market

States are looking at methods that were initially intended for companies, i.e. they wish to accelerate the development of tools aimed at strategic monitoring, economic and market intelligence. For instance for this purpose, the European Commission has begun establishing information systems and building information networks between countries. The European Commission is willing to intensify its collaboration with policy intelligence networks "to develop sound evidence and scenario planning on the supply, demand and use of raw materials for strategic sectors", i.e. energy and EVs markets.[15]

[13] World Bank. (2020). Minerals for Climate Action : The Mineral Intensity of the Clean Energy Transition. https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf
[14] Fondation pour la recherche stratégique. (2020). La stratégie des approvisionnements en matières premières de l'Union européenne : le cas du secteur automobile. https://www.frstrategie.org/sites/default/files/documents/publications/recherches-et-documents/2020/212020.pdf
[15] Commission Européenne. (2020). COMMUNICATION DE LA COMMISSION AU PARLEMENT EUROPÉEN, AU CONSEIL, AU COMITÉ ÉCONOMIQUE ET SOCIAL EUROPÉEN ET AU COMITÉ DES RÉGIONS Résilience des matières premières critiques : la voie à suivre pour un renforcement de la sécurité et de la durabilité. https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:52020DC0474&from=EN

B. COBALT MARKET ANALYSIS & CHALLENGES

Demand for cobalt has been constantly increasing in recent years reaching a market value of 8.8 billion dollars in 2018 (against 2.7 billion dollars in 2014). The increase has been mostly driven by the growth in demand of lithium-ion batteries used for the production of electric vehicles (EVs). With the ecological transition, the electric vehicles market is constantly expanding (and previsions anticipate exponential growth in years to come worldwide) therefore indirectly impacting demand for cobalt which is used in the composition of cathodes for lithium-ion batteries. The tonnage increased by 30% in five years.

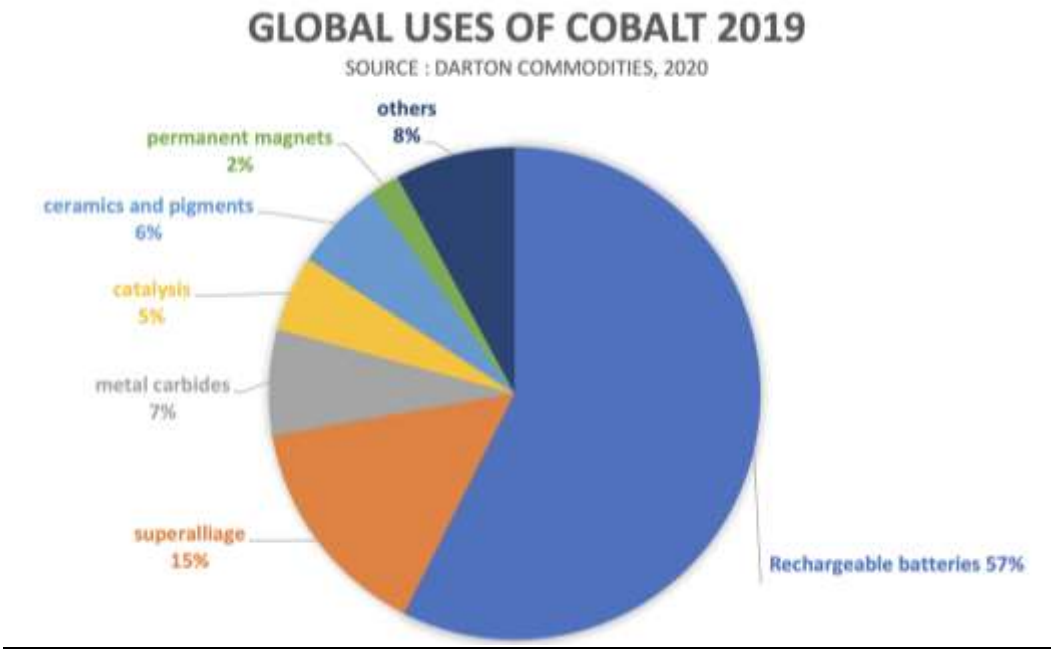

Figure 1. Global uses of cobalt in 2019

If cobalt is used primarily nowadays by car manufacturers for their batteries as they have higher energy density compared to other batteries, it is not, however, a battery component that is irreplaceable. Alternatives exist which will most likely be developed as cobalt resources become scarcer. Therefore, EV battery producers' dependence on Cobalt isn't absolute.

Cobalt resources worldwide are extremely concentrated. 72% of cobalt comes from Copper mines, 26% from nickel mines and 1% from cobalt ones. In 2020, global cobalt mining production amounted to 140kt of which 95kt (68%) came from the DRC.

The Democratic Republic of Congo (DRC) is therefore the first mining producer worldwide by far, accounting for 60% of global production in 2016. In 2017, Congolese mines produced 81kt of cobalt against 5.6kt for the Philippines, 5.4 kt for Cuba, 4.9 kt for Russia and 3.6 kt for Australia.

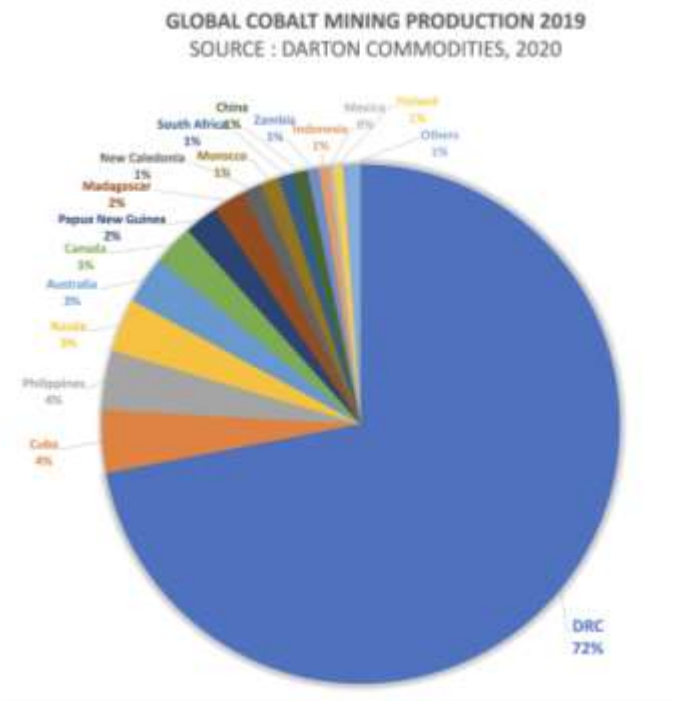

Figure 2. Global cobalt mining production in 2019

	Global cobalt mining production 2020 (140kt)	2019-2020 production gap (2019 production = 144kt (-3%))
DRC	95kt (68%)	-5 %
Australia	5,7kt (4%)	0 %
Russia	6,3 kt (4,5%)	0 %
Philippines	4,7 kt (3,3%)	-8 %
Cuba	3,6kt (2,6%)	-5,3 %
Canada	3,2kt (2,3%)	-4,2 %

Figure 3. Cobalt mining production by countries in 2020

Congolese resources come from the renowned Copper Belt which provides the DRC with a unique comparative advantage on cobalt prices that explains its market domination. Indeed, besides representing 50% of world reserves, cobalt extracted from the Copper Belt mines is considerably cheaper, for geological reasons, compared to the rest of the world. On average, its cost amounts to USD 28k per ton against USD 62k for the costliest mine (Ambatovy in Madagascar).

If the current cobalt official price at the London Metal Exchange (LME) remains high (it was set at 74k$ per ton in 2017 and at 51k$ on average during the last 15 months) allowing for most mines to make a profit, a decrease might induce an even higher dependence to Congolese cobalt. At a price of USD 29k per ton (which was the official LME price in 2012), only the Copper Belt mines remain profitable, while the current average LME price of USD 51k makes only 5% of the production unprofitable.

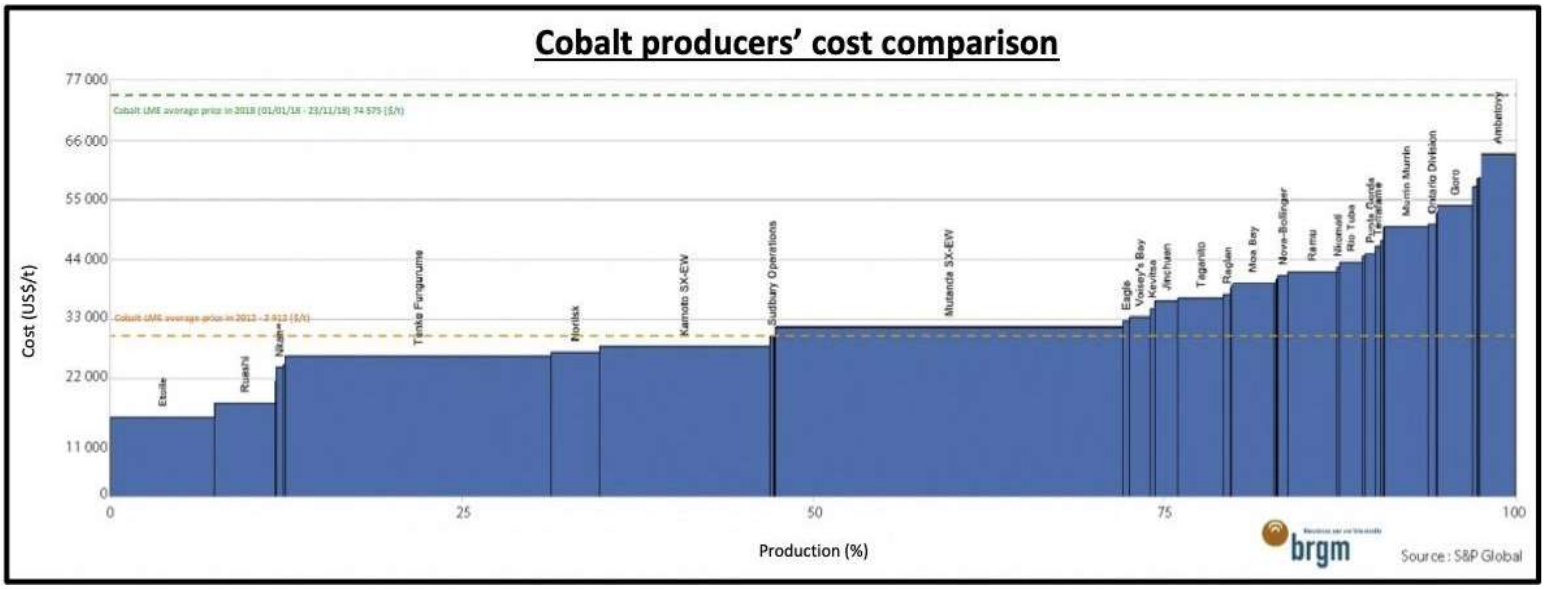

Figure 4.Cobalt producers' cost comparison

Figure 5. Historical prices graph from 2010 to 2021

A limited number of actors have significant control on the DRC's cobalt resources, the first of which being Glencore. Glencore is an Anglo-Swiss multinational company specialized in commodity trading as well as mining. Its asset in cobalt production allows the company to control as much as 30% of total global cobalt production (around 38kt). In the DRC alone, Glencore controls the Mutanda mine (world first cobalt producer with 23.9kt in 2017) and the Kamoto/KOV copper mine (11kt). Its position ensures Glencore with a significant market position and a control on cobalt prices worldwide. Glencore's interests in Cobalt production remain solely speculative and it does not intend to control the value chain any further. It has therefore very limited interests in cobalt refineries.

On the other hand, major actors in the DRC are Chinese companies that have gained influence in the Copper Belt in recent years. In 2016, China Molybdenum bought an 80% share in the world's second largest Cobalt mine, Tente Fungurume, consequently controlling as much as 15% of world's production. Furthermore, other Chinese companies have progressively increased their investment in the DRC, such as Huayou Cobalt and Jinchuan group.

DRC's biggest mines	**Owning companies**	**Cobalt annual mine production (DRC's 2019 production = 100kt*)**
Etoile mine	95 %= Chemaf, that is itself owned by Shalina Resources society (India) 5 % = DRC's government	5kt in 2017
Tenke Fugurume mine	80% = China Molybdenum (China) 20% = Gecamines (DRC)	16kt in 2019 (16%)
Ruashi mine	75% = Jinchuan (China) 25% = Gecamines (DRC)	5kt in 2019 (5%)
Mutanda mine	Glencore (Switzerland)	27kt in 2018 25kt in 2019 (25%) *=> the Mutanda mine was temporarily suspended at the end of 2019 following cobalt's price drop. It should be put back into operation in the second part of 2022*
Kamoto mine	Belongs to the Kamoto copper company (KCC), that is itself owned by : • 75% = Glencore (Switzerland) through Katanga Mining Ltd. • 25% = Gecamines (DRC)	17kt en 2019 (17%)
Deziwa mine	Belongs to the Somidez mining society, a joint venture co-owned by : • 51% = China NonferrousMetal Mining Company (CNMC) (China) • 49% = Gecamines (DRC)	*-> production started in 2020.* *Expected annual production = 8kt*

Figure 6.DRC's cobalt mines synthesis

*It is necessary to note that a WEF report (*Making Mining Safe and Fair: Artisanal Cobalt Extraction in the Democratic Republic of the Congo*. WEF, 2020) highlights that between 15 to 30% of all cobalt production in the DRC comes from small-scale mining (artisanal mining).

Biggest international cobalt producing societies	2018 or 2019 production (in tons)
Glencore (Norway, DRC, Australia)	46 300
China Molybdenum (China, Finland)	18 747
Umicore (Belgium, China)	6 360
Jinchuan (China)	6 000
Vale (Canada, New Caledonia)	4 378
Sumitomo Metal mining Co. (Japan)	3 669
Sherritt (Canada and Madagascar)	1 956
Norilsk (Russia)	1 800
CTT (Morocco)	1 619
Eurasian Ressources Group (Zambia)	1 613

Figure 7. Main international cobalt producing societies's synthesis

An important subject concerning the cobalt market is the stock exchange listing of intermediate cobalt products (hydroxide and sulfate cobalt) which would be an important step towards more transparent and accurate pricing for intermediates.

Indeed, until now, cobalt stock listing has only been set for metallic cobalt at the London Metal Exchange (LME). Metallic cobalt pricing is used afterward as reference for the pricing of intermediate cobalt products (intermediate products pricing is set as a percentage of metallic cobalt pricing). However, with the rise of electric vehicles (EVs), there has been a growing demand for intermediate cobalt products used in batteries by car manufacturers. A specific listing of intermediate products at the LME is therefore an important

subject regarding the Cobalt market as it will favor a more accurate pricing and will prevent a hypothetical impact on intermediates would metallic cobalt face production difficulties for example.

A decisive dynamic regarding the selling and buying of cobalt are off market agreements. Most contracts concerning cobalt occur outside the official LME listing directly between producers and buyers. The preferred method is offtake agreements which are arrangements between a producer and a buyer to purchase or sell portions of the producer's upcoming goods. Therefore, the sale is secured for both parties beforehand at a defined price, which ensures the buyer's supply security.

This specificity induces a dominant position of a limited number of actors on the cobalt supply chain. These actors control a significant proportion of cobalt stocks, bought in advance, that are therefore withdrawn from the official market. This state of affairs can pose supply issues to newer actors on the market and has most notably led to price tensions and fear of shortage by car manufacturers.

In order to limit supply uncertainties, the predominant strategy adopted so far by EV makers has been to sign contracts with « intermediate » companies that have easier access to cobalt production (being established actors on the cobalt market), namely battery precursors manufacturers.

For instance, Volkswagen has signed agreements with Contemporary Amperex Technology (CATL, a Chinese company), Samsung, or LG Chem. Daimler and BMW also have signed contracts with CATL.

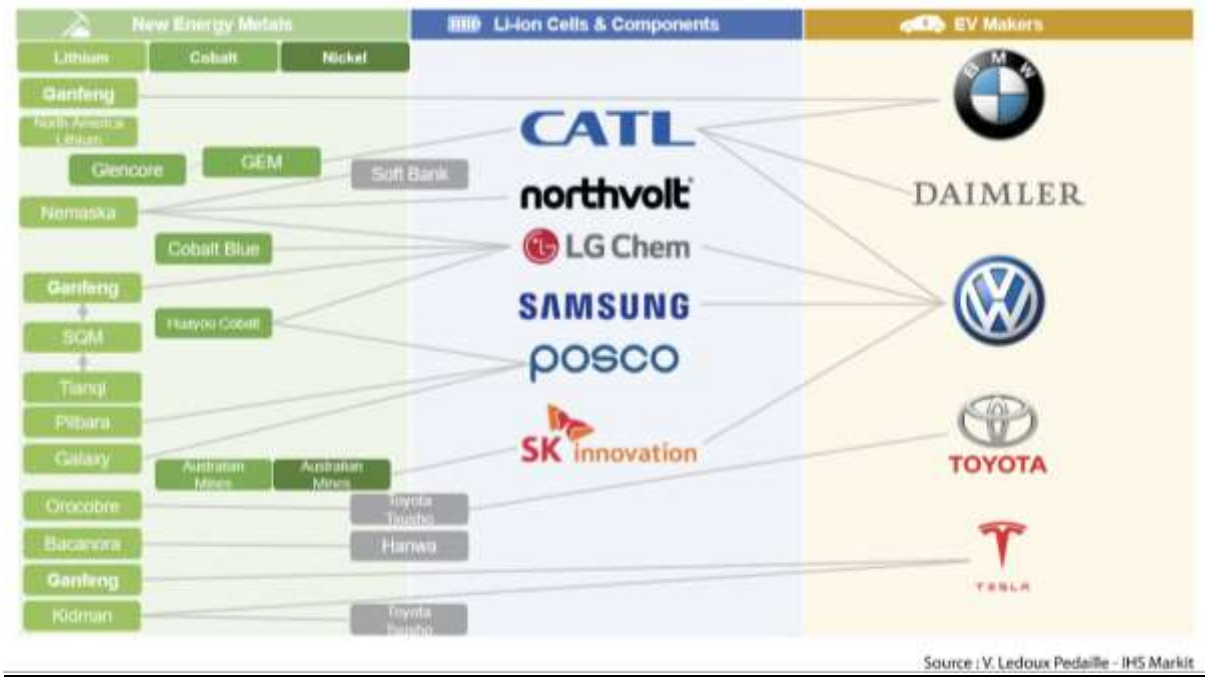

Figure 8. Announcement of the key partnerships in the lithium-ion battery market in 2018

II- THE CHINESE VALUE CHAIN IN THE COBALT INDUSTRY BETWEEN INDUSTRIAL COMPARATIVE ADVANTAGE & GLOBAL

Between 2000 and 2016, China's production of refined cobalt grew thirty four times and its share in the global refinery capacity increased to 50% (against 3% in the 2000s). In less than two decades, the country's importance on the cobalt value chain therefore grew exponentially. That growth was most pronounced during the years 2010s: in 2013, China accounted for 41.3% of the production of cobalt metallurgic products in the world, against 53.4% in 2016 and 64% in 2019[16]. Similarly, its annual refinery capacity represented 41.3% of global production in 2013, 51.7% in 2016, and 63.5% in 2019[17].

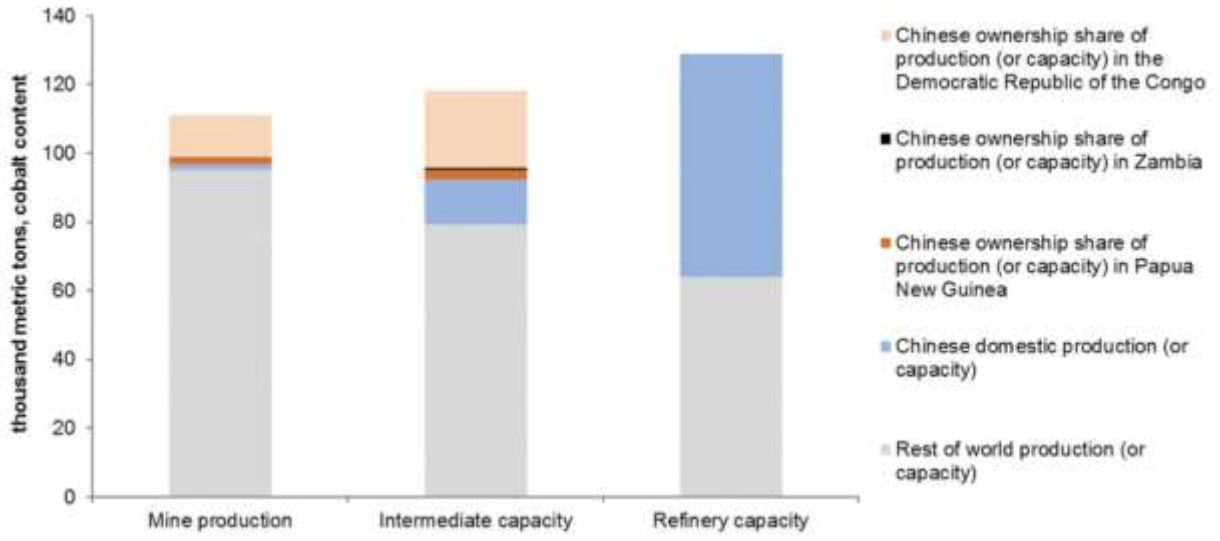

Figure 10. China's production of cobalt

In 2016, Darton commodities estimated that China had control over 85% of global cobalt supply and was heading towards 90%. Such numbers highlight what could almost be qualified as a « hegemonic » Chinese influence on the cobalt value chain. Surprisingly however, contrary to other mineral resources where China had a domestic comparative advantage *a priori* (namely rare earths with 37% of global reserves being located in China), it had basically none in the case of cobalt resources. Indeed, China has a 90% import

[16] BRGM
[17] Darton commodities.

dependency for its cobalt needs. If we look at china's domestic cobalt mine production, it therefore only accounts for 2% of the world total[18].

This quantitative photography of China's position on the cobalt value chain underlines that the comparative advantage it now possesses was built from scratch, and may not be attributed to any initial "head start" based on domestic resources. China has acquired what we call a *built comparative advantage*.

It is therefore necessary to both describe how China has progressively managed to impose itself on the cobalt value chain and to characterize the interests and issues at stake motivating this control. A picture of the state of the cobalt value chain nowadays from China's point of view will also be drawn.

China's cobalt strategy: from "resource seeking" to comparative advantage building

It is necessary to contextualize quickly what prompted China's domination on the cobalt value chain; even if it is not clear to what extent it was planified beforehand, meaning the object of a conscious, rationally conducted government strategy. At the turn of century, China launched its "Going out strategy". Aware that with its economic development, it would become more and more dependent of foreign imports, which might induce strategic vulnerabilities in the long term, the Chinese government prompted its state owned enterprises (SOE) to expand their overseas investment in order to secure raw materials supply. This strategy has been regularly described as "resource seeking" in the academic literature and is what marked the beginning in the following years of the "minerals for infrastructure" deals.

China's progressive influence on the cobalt value chain that expanded through the beginning of the 21st century can be mostly understood as an effort to mitigate its exposure to raw material supply risk[19]. However, additionally, part of the academic literature has also described that effort as being possibly aimed at restricting the access of potential future competitors to mineral resources, therefore structurally limiting their margin of commercial expansion[20]. Moreover, that hypothetical supplementary motivation of China to control the cobalt value chain only seems more credible in the context of the Made in China (MIC) 2025 initiative. The MIC 2025 initiative, framed in 2015 by the government, intends to place China as the dominant force in the EV industry (and more generally to place China as a high-value products producer globally).

[18] Andrew L. Gulley, Erin A. McCullough, Kim B. Shedd. *China's domestic and foreign influence in the global cobalt supply chain*. Ressource Policy, April 2019.
[19] Ibid
[20] (Sanderson et al., 2017; Patterson and Gold, 2018)

That strategy is preoccupying for western economies and their national car manufacturers. In 2018, Ivan Glasenberg, CEO of Glencore, declared that "Europeans are waking up too late". Anthony Milewski, the CEO and director of Cobalt 27 Capital Corp, which owns the world's largest private stock pile of cobalt, further stated that China is going to become "the Silicon Valley of electric vehicles" and consequently plans to "secure the raw materials that ultimately compromise that enterprise"[21].

The establishment of China's built comparative advantage on the cobalt value chain has been possible first and foremost through the control of one critical source of supply: Congolese cobalt or more precisely, cobalt extracted from the renowned Copper Belt. Indeed, global cobalt reserves are concentrated up to 50% in the DRC[22]. In 2020, Congolese cobalt production accounted for 68% of global production[23], and it is estimated by the USGS that between 40 and 50% of that production is owned by Chinese companies[24]. Consequently, the progressive growth of China's influence on the cobalt value chain since the 2000s was concomitant with the increase of Congolese cobalt production during the same period. As a matter of fact, between 2006 and 2019, the DRC's share in global mining production increased from 45% to 71.9%[25] to the detriment of other historical producers.

[21] Inside China's move to monopolise cobalt. Mining Technology, 4th June 2018.
[22] 47,89% precisely according to Mineral Commodity Summaries, January 2016
[23] USGS
[24] According to Nedal Nassar, chief of the Materials Flow Analysis Section at the National Minerals Information Center at the USGS (Luiza Savage, *How America got outmaneuvered in a critical mining* race. Politico, February 2020)
[25] Darton commodities

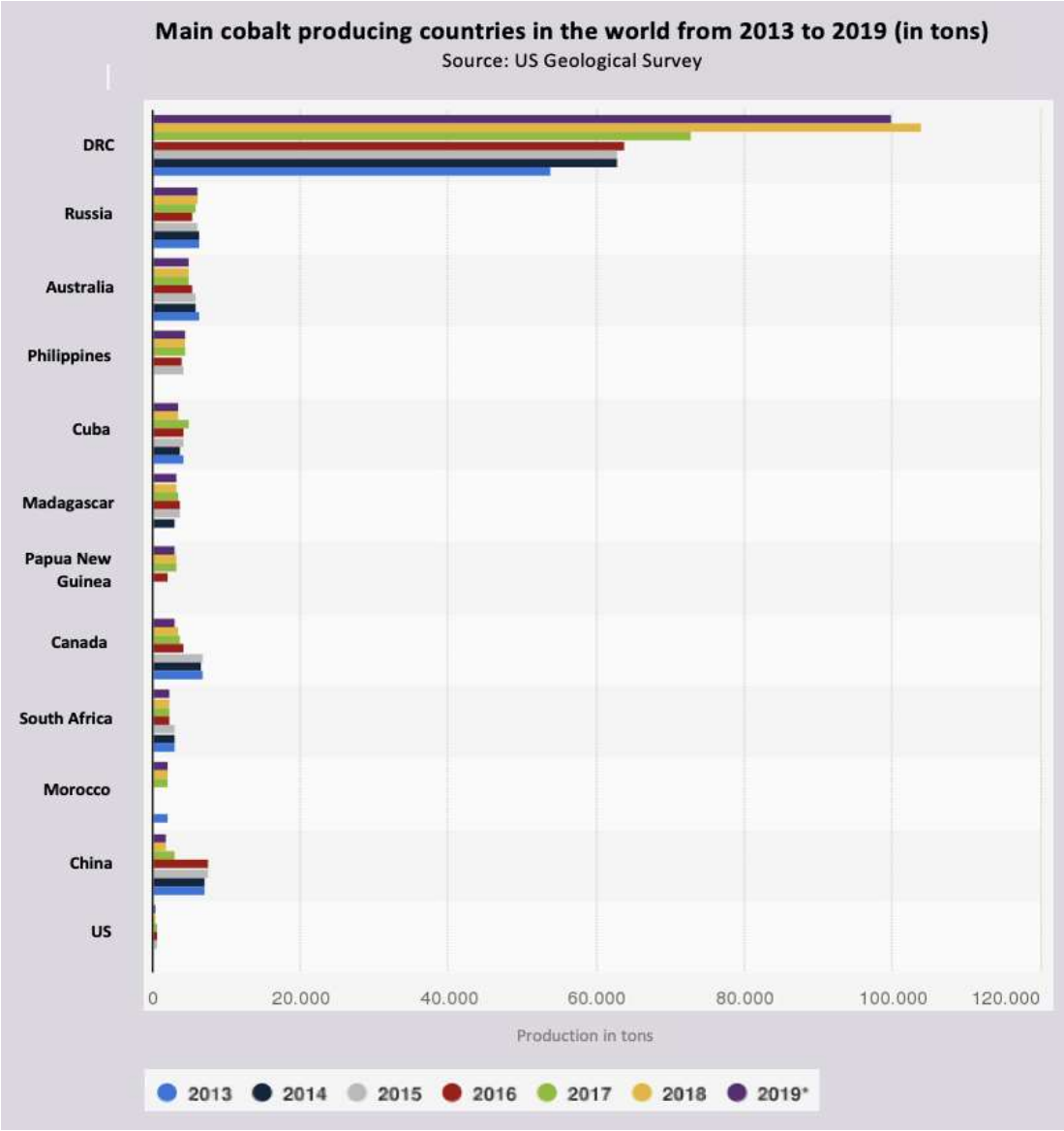

Figure 9.Main cobalt producing countries in the world from 2013 to 2019

Moreover, China constituted its built comparative advantage thanks to cobalt's specific market structure. In fact, even though cobalt disposes of an official quotation on the London Metal Exchange, most of the commercial exchanges still occur off market, namely through contracts established beforehand between buyers and cobalt miners. This preponderance of off-market contracts and negotiations is even more patent in less developed economies, such as the DRC.

Because prices and exchanges are not strictly set on the basis of classic supply and demand market-dynamics, China has been able to lay-out a long term strategy to establish itself on the forefront of the cobalt value chain and become a predominant actor.

In the end, when asked how China built its comparative advantage on the cobalt value chain, what needs to be interrogated more specifically is how it managed to establish its control over Congolese cobalt.

State-owned enterprises' role for securing cobalt resources

China's strategy that aimed to secure the DRC's cobalt resources was steered through Chinese enterprises: state-owned enterprises (SOEs) mostly but leading private Chinese companies as well.

Major SOEs function as operating platforms of both the industrial integration and the strategic resource management directed by the Chinese state. Chinese SOEs are prominent actors of the implementation of all major central plans established by the party such as Made in China 2025, supply-side reforms, the electric vehicle program or emission reduction programs. In the case of cobalt, leading Chinese SOEs are China Minmetals, China Nonferrous Metal Mining Group (CNMC), Chinalco or Jinchuan. SOEs benefit from considerable financial means that favor their bargaining power in order to obtain control over resources. Their financial means are mostly obtained through capital raised on financial markets during IPOs. Investors are mainly institutional investors (banks, pensions, funds) which have central or local Chinese government support.

Leading private actors also play a decisive role in securing of cobalt resources by Chinese actors, among which Huayou Cobalt, GEM and China Molybdenum are major players. They often have their own overseas subsidiaries that operate at close proximity with raw material reserves in order to ensure direct supply to their own refinery lines. Private Chinese companies also invest massively to secure upstream resource supply. They are more deeply integrated in the global supply chain than the SOEs, mostly through the constitution of strategic alliances with downstream or upstream actors. For instance, in 2018, Huayou Cobalt established four joint ventures with two South Korean groups in order to produce battery cathode materials.

In order to acquire control over Congolese cobalt mines and cobalt production, Chinese SOEs and private companies managed to establish themselves in the country and gain influence through three major strategies:

- development financing and infrastructure development in the DRC in exchange for access to mineral resources (resource-for-infrastructure deals),
- the acquisition of equity shares in a majority of mines as well as the obtention of ownership,
- the signing of off-market long-term contracts.

A. FIRST STRATEGY: RESOURCE-FOR-INFRASTRUCTURE

Resource-for-infrastructure deals were decisive in the first fifteen years of Chinese establishment as a key player of the cobalt sector in the DRC. As the Congolese government was looking for financial means in order to pursue its economic development, China offered to conduct overseas direct investments in exchange of a prioritized access to cobalt resources, and more informally, in order to gain influence. While other states and financial actors remained reluctant to invest in unstable countries with political and security risks, such as the DRC, China has on the contrary been willing to provide great amounts of investments, as has shown by the Belt and Road Initiative. In this way, China could also gain political influence and ensure itself an edge against future possible competitors. As a consequence, it quickly established itself as an unavoidable economic partner for the DRC which became reliant on Chinese capital. The first and biggest 'minerals for infrastructure' deal between China and the DRC is an often-cited example of China's resource-seeking behavior via *the Going Out Strategy*[26]. In 2007, the two states signed an initial understanding of a $9 billion (later reduced to $6 billion) mines-for-infrastructure deal where China provided favorable loans in exchange for access to copper and cobalt mineral development rights[27]. The Export Import Bank of China issued $3 billion for infrastructure development and $3 billion for copper and cobalt mine development. The projects were run by Sinohydro and China Railway Group. In exchange, a joint venture was established with Gecamines (the 100% governmentally owned Congolese mining company) under the name of Sicomines (sino-congolaise des mines) that operates mines in the copper belt. The company's profits being used to reimburse the Chinese loans[28]. Sicomines' equity is shared between China Railway Group (41.72%), China Power Construction (25.28%), Huayou Cobalt (1%) and Gecamines (32%). The DRC agreed to use 10.6M tons of copper and 627k tons of cobalt to pay back the $3 billion infrastructure loans. In 2016, Sicomines operated a $3.2 billion mining project which accounted for 25% of the DRC's total exports.

Another recent example of the resource-for-infrastructure strategy is the Deziwa mine in Kolwezi that is run by a joint venture between CNMC (51%) and Gecamines (49%). According to Global Witness[29], the deal was part of a broader "strategic cooperation agreement" worth over 2 billion dollars that was signed in 2015 between the two companies. The understanding supposedly covers five mining projects (which the Deziwa mine is part of) through a deal structure known as "Build Own Operate Transfer" (BOOT) financing. CNMC built and runs the mine and constructed a refinery on the site in return for rights to extract and sell a

[26] BBC, 2007; Kaplinsky and Morris, 2009; Jansson, 2011
[27] Andrew L. Gulley, Erin A. McCullough, Kim B. Shedd. *China's domestic and foreign influence in the global cobalt supply chain*. Ressource Policy, April 2019.
[28] *A State Affair: Privatizing Congo's Copper Sector*. The Carter Center, November 2017.
[29] *The deal for Deziwa. CNMC, Gecamines and the future of DRC's copper trade*. Global Witness, August 2020.

portion of the output. Similar to the Sicomines deal, the loan was funded by CNMC, the project having required a $880 million investment, and will be paid using the mine's profits. However, the collaboration has a fixed-end-date demanded by the Congolese government: CNMC will operate the Deziwa mine for nine years only, with a possible two-year extension, before transferring it to Gecamines.

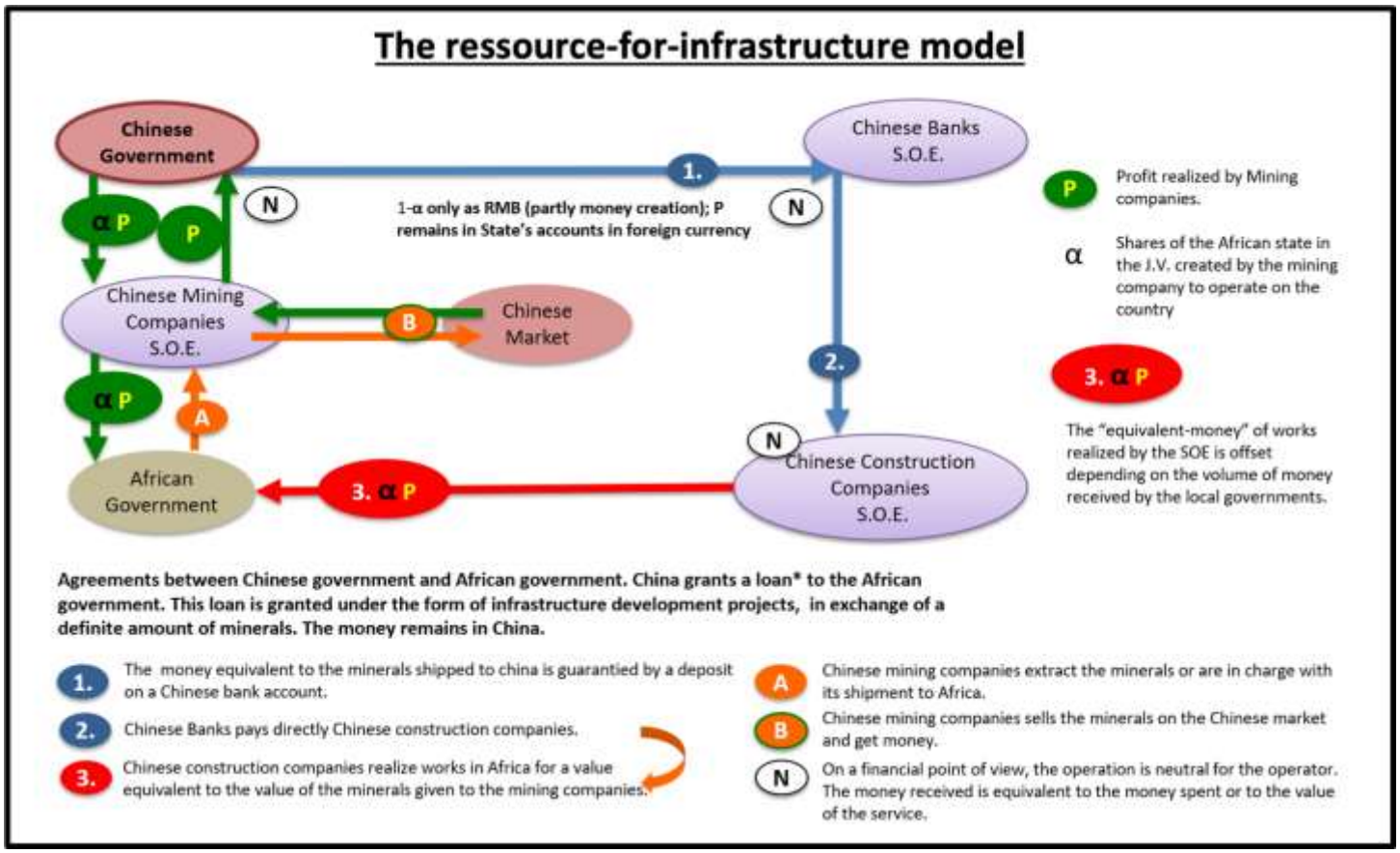

Figure 11. The resource for infrastructure model

B. SECOND STRATEGY: THE ACQUISITION OF EQUITY SHARES OR THE OBTENTION OF FULL OWNERSHIP

The second strategy applied by Chinese companies in order to reinforce their control over Congolese cobalt is the acquisition of equity shares of Copper Belt mines, or even the obtention of full ownership. That strategy, as we have highlighted, might operate as a follow up to an initial investment in the state's economy that then provided a priority access to the equity of a specific mining Congolese society, but it might also operate as a standalone strategy. While the first strategy relied more heavily on off-market dynamics (economic and political influence, bargaining power), in this case, it is a more market based strategy that makes use of IPOs and equity shares exchanges on financial markets. In the last seven to nine

years, Chinese actors increasingly acquired mining ownerships in order to insure cobalt rock supply from the DRC. In 2016, China Molybdenum bought the majority stake (56 percent) in the Tenke Fungurume mine from U.S company Freeport-MacMoRan, shortly followed by the acquisition of a further 24% stake from Chinese private-equity firm BHR Partners. Besides China Molybdenum, Huayou Cobalt wholly-owns the Congo Dongfang international mining (CDM) that produces around 12k tons of cobalt hydroxide annually and owns 72% in the DRC's Minière de Kasombo (Mikas), equivalent to 4,684 tons of cobalt metal annually. In 2011, Jinchuan acquired Metorex, a South African mining company that has assets in the DRC's, most notably the Ruashi mine, with a 75% share alongside the remaining 25% belonging to Gecamines. All in all, China has managed to secure ownership of over 10 out of the DRC's 18 major operational mines[30].

Such a dynamic might only take further importance depending if the evolutionary regulatory environment of the DRC's economy threatens Chinese interests in the country. Indeed, newly established regulations such as the Congolese mining law of March 2018 have shown a willingness of the Congolese government to try partly reestablishing control over its domestic mines and resources. In response, Chinese companies started increasing their control of the upstream supply chain.

C. THIRD STRATEGY: OFF-MARKET LONG TERM CONTRACTS

The last of the three major strategies used by Chinese actors in order to solidify their control of Congolese cobalt supplies takes the form of off-market long term contracts. Chinese companies do not only control a vast number of mining assets in the DRC's cobalt sector but have also secured part of the cobalt production from mines outside their asset portfolio. As a matter of fact, major Congolese mine owners have agreed to sell a significant share of their production to Chinese companies. This includes first and foremost agreements with Glencore which owns 30% of global primary cobalt production. In fact, in October 2016, CATL signed a four-year provision agreement with the Swiss multinational that secured cobalt supplies of up to 20k tons (5k tons per year, which represented 4.5% of the global annual production). Moreover, on March 15th, 2018, Glencore signed a three year contract with GEM, agreeing to sell 52,8k tons of cobalt hydroxide (a third of Glencore's total planned production during the same period[31]).

Beijing Easpring Material Technology signed a five-year nickel and cobalt sulphate provision agreement with Scandium21 in august 2017. And in February 2018, SMCO (subsidiary of Shanghai Pengxin Resources)

[30] Mining the future. How China is set to dominate the next Industrial Revolution. Foreign Policy, May 2019.
[31] *Inside China's move to monopolise cobalt*. Mining Technology, June 4th, 2019.

signed a 15-year copper-cobalt provision agreement with Vincent Mining for up to 1.5k tons per year (about 1.2% world cobalt metal).

The signing of these long-term purchase contracts is a stabilizing new practice for both parties that has taken importance in recent years. Indeed, the three strategies we have presented also represent a temporal evolution of Chinese companies' strategies to impose themselves in the Congolese cobalt economy. There was a progressive shift from the initial politically based resource-for-infrastructure deals to more business-based long-term purchase contracts and equity shares acquisitions in a second phase that has now been developing for half a decade. If, in the beginning, the minerals-for-infrastructure deals allowed China to develop strong political ties in the DRC and establish a dominant position, the economic efficiency of the deal remains uncertain, justifying a transition to a more business-based approach afterwards. In fact, with these resource-for-infrastructure deals, Chinese companies might have in the end made a negative profit from a purely economic point of view as a consequence of the sharp price drops of copper and cobalt that occurred between 2008 and 2016.

CONCLUSION & OPENING

What conclusions can be drawn out of China's value chain strategy on cobalt from the European point of view?

As the ecological transition is becoming ever more crucial overtime and GHG emissions still increasing, Europeans are slowly starting to take action in order to mitigate global warming and reach climate neutrality by mid-century. In that context, rare metals, lithium, copper, rare earths, nickel and obviously cobalt are materials often essential for the ecological transition technologies, such as wind turbines, PVs or electric batteries. Consequently, with limited reserves and a demand that is only going to grow, these metals are becoming "strategic materials", which prompted the EU to establish a critical raw materials list that is regularly updated. Such perspectives imply that a strategic long-term vision now needs to be adopted by European states, and by the European Union, in a world with limited resources that is going to be characterized by scarcity, and where logics of power and of economic competition won't suddenly disappear. This situation is partially why Joël Ruet and al.[32] argued in a report for the establishment of

[32] Joël Ruet and al. *Le capital patient - un horizon pour la France et pour l'Europe*. Terra Nova, May 11th, 2016.

"patient capital", by opposition to the current economic and financial logic where assets are sometimes exchange within seconds for purely speculative purposes. As our current growth model has proved its unsustainability, capital must now be considered in the long-term, serving essential needs, for the benefit of everyone, or at least not at the detriment of everyone as for carbonized assets for instance.

The example of China's stranglehold on the cobalt value chain underlines what the lack of long-term vision by Europeans regarding scarce resources can lead to, with a single country gaining what could be deemed as an excessive control on the supply chain of a material that the Union European could hypothetically not do without. Hoping market dynamics will freely and automatically regulated exchanges for the better and lead to a balanced competition is now known to be blindness. The UE seems to have acknowledged this vulnerability, launching the European Battery Alliance in response, and its public policies now appear to be on the right path (the critical raw materials list exemplifying this change).

Regarding the cobalt value chain specifically, can the Europeans change the current state of affairs in their advantage in order to counterbalance China's control on the material? And how long would such an initiative take? What is interesting in the case of cobalt is that China had virtually no domestic resources and still managed to control most of the production of refined cobalt (China has a 90% import dependency for its cobalt needs). And despite this inexistence of any domestic comparative advantage, the French BRGM[33] estimated that in 2019, China accounted for 64% of cobalt metallurgic products in the world. We have seen that this dominance was mostly rendered possible by controlling a large part of Congolese cobalt resources. But we can note that for all that, a large proportion is still out of Chinese control, and Congolese resources, if considerable, represents "only" around 50% of global cobalt resources. Therefore, it would appear that with strong will, Europeans could well gain control and secure a significant portion of the resources, probably under less economically advantageous conditions however, as Congolese cobalt is the cheapest to extract. But on a strategic point of view, we see that it could be considered.

It is not on the production segment (the control of the extraction of primary resources) that China established its comparative advantage but rather on cobalt metallurgic products, that needs refining. It is on that segment that it gained its hedge: the BRGM estimates that China's share in global refinery capacity amounts to 63.5%. Therefore, the comparative advantage is first and foremost technological, and therefore neither absolute nor necessarily eternal, although it could prove arduous to match that technological advance.

[33] Bureau de recherches géologiques et minières

China's comparative (or maybe hegemonic) advantage on the cobalt value chain might not be that problematic and could be resorbed under strong state leadership notably by developing non-Congolese mines and signing bilateral partnership with territories that detain cobalt resources. It is certain however that it won't be compensated without willing governmental action.

Cobalt might actually not be that strategical for the ecological transition, or at least for the production of batteries for electric vehicles and the different technologies that have been using cobalt-intensive lithium-ion batteries. For instance, Tesla, the Californian electric vehicles manufacturing company, announced in September 2020 that it will start making EVs batteries with cobalt free cathodes, in order to avoid the expensive material and achieve lower prices. To achieve this objective, the company is working with CATL to develop lithium iron phosphate (LFP) batteries which are cobalt free. This technology is already used for the majority of electric buses for example. Another cobalt free existing technology are the LMP (lithium metal polymer) batteries, but which have technical limitations and have not convinced consumers, public or private.

Researchers are actively trying to develop alternatives to cobalt intensive batteries and cobalt-free battery technologies are beginning have begun to be announced in the last months: in July 2020, researchers at the University of Texas announced having found a way to produce cobalt-free cathodes using nickel while in April 2021, the University of Hong Kong announced it had developed a manganese-based cathode material that could replace cobalt for lithium batteries. If lithium-ion batteries using cobalt intensive cathodes remain the privileged solution for EVs so far, alternatives are beginning to develop and cobalt's importance in the sector might decrease in the years to come.

Studies and expertise we've analyzed throughout this report have shown two possibilities to reduce European cobalt, and more broadly others raw materials, import dependency:

- The first one, and the most emphasized, is **rethinking the material use and the development of recycling** to favor complete life cycles of technologies, from upstream to downstream. In a concern of supply chain management, capacity management and anticipation of resources and geo-economic risks, it is crucial to rethink the ways of using materials. This understanding could allow the use of alternative material products, as mentioned above, and to go further towards eco-design for industries in order to produce in a more sustainable. But also, it would allow to engineer the products' recycling from its very eco-design stage. In 2020, only about 5% of transformed critical materials are recycled. At the European level, recycling is one of the central pillars of its Battery Alliance.

- The second one would be **reopening mines in Europe**. Historically, if the European construction was at first initiated by a trade agreement based on coal and steel, mining activities slowly went out of fashion in Europe in the following decades. Mining activities were gradually abandoned in favor of more profitable and less polluting, and delocalized this sector in more profitable territory. In France, but this observation also applies to the European level, two reasons explain the mining shutdown: [34] [35]
    - First, little economic profitability in the face of declining imports and not because of the depletion of mineral deposits, which means there is still underexploited or even unexploited mining potential in Europe.
    - Second, a general climate of mistrust towards the mining industry, safety regulation for workers and local populations living near the mines, environmental management regarding health, pollution, resources and biodiversity impacts.

By relaunching exploration in order to establish up to date inventories of resources, identifying needs and hypothetical economic and technical profitability, real reforms could be envisaged for the mining industry in Europe. Initiatives are emerging in Europe. For instance, in France the draft climate law, under Parliamentary discussion since March 2021, reforms the mining code and aimed at reviving a responsible mining industry. It would also contribute to mitigate our dependence on strategic materials. In Finland, more concrete projects have emerged, based on its long historical mining activity. In order to position itself on the international markets and among the world leaders in the mining industry, Finland has always been able to adapt to the reality of this ecosystem, especially since the European Commission launched its first communication on critical materials in 2008. Thanks to its exploration and exploitation projects, Finland has become one of the most attractive countries in the mining sector and has become a success story of the renewed mining industry in Europe. Finland knows that it will play a crucial role in the years to come to counterbalance current Chinese control of European material supply and provide local response consumption needs.

[34] Matthieu Jublin. (2021). Rouvrir des mines en France, une idée en or ? Alternatives économiques, N°412.
[35] La dépendance aux métaux stratégiques : quelles solutions pour l'économie ? (2019). Le Conseil économique social et environnemental. https://www.lecese.fr/travaux-publies/la-dependance-aux-metaux-strategiques-quelles-solutions-pour-l-economie

Figure 12. Current mine development projects (left) & current exploration projects (right) in 2021[36]

[36] Opportunities. (2021). Mining Finland. https://www.miningfinland.com/opportunities#current-mine-development-projects

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