

IN THE SPOTLIGHT

ALKALI METALS

ALKALINE-EARTH METALS

TRANSITION METALS

ALUMINUM
HALOGENS
NON-METALS

ATOMIC WEIGHT

ARTIFICIAL UNKN

6
VIB

VIII B

+2
+3

27

+2
+3

Co

Cobalt
58.933

Cr
Chromium
51.996

Mo
Molybdenum
95.94

W
Tungsten
183.84

26

42
Technetium
(98)

75
Re
Rhenium
186.21

28

44
Ruthenium
101.07

76
Os
Osmium
190.23

29

45
Rh
Rhodium
102.91

77
Ir
Iridium
192.22

30

46
Pd
Palladium
106.42

78
Pt
Platinum
195.08

31

47
Ag
Silver
107.87

79
Au
Gold
196.97

32

48
Cd
Cadmium
112.41

80
Hg
Mercury
200.59

106
Sg

107
Bh

108
Hs

109
Mt

110
Ds

111
Rg

112
Cn

113
Nh

114
Fl

115
Mc

116
Lv

117
Ts

118
Og

The Dark Side of Our Raw-materials Supply Chain

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Cobalt is a key raw material in the production of the lithium-ion batteries that power our electric vehicles. The connection between cobalt and electric vehicles would be unremarkable if it were not for the unsettling fact that cobalt is often mined in conditions marked by human rights violations. Research carried out by Amnesty International confirms the active involvement of children in the mining of cobalt in Congo. According to the human rights organization, many of the world's carmakers are aware of the exploitative conditions, but have nonetheless failed so far to implement sufficiently consistent and effective responses. As we pursue cleaner technologies, what can be done to clean up – in ethical terms – the supply of the raw materials on which these technologies depend?

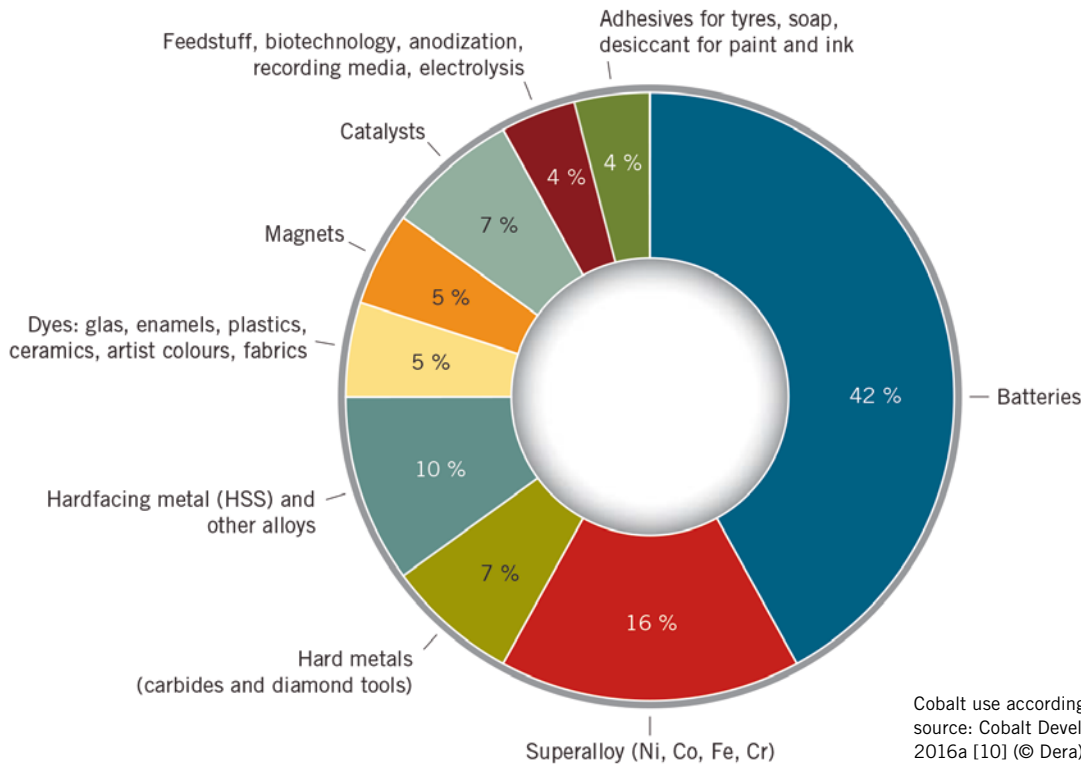
CONDITIONS AT THE SOURCE

Electric vehicles have been touted by lawmakers and automobile-industry representatives as the key to a successful transition to clean and sustainable energy use in the transportation sector. The promise is that when powered by renewable sources of energy, as opposed to fossil fuels, electric vehicles will help us achieve climate neutrality in the transportation sector and lower our dependence on petroleum imports. While the plan is certainly compelling, a closer examination of the transition so far reveals considerable drawbacks – not least in connection with our supply chains. Since engagement in climate protection does not automatically imply gaining independence from raw material imports. As it turns out, the production of batteries and fuel cells is highly dependent on a number of scarce, non-renewable raw materi-

als whose availability is linked to mineral reserves in a small number of countries. While the skeptic's doubts about the availability of a reliable source of power for electric vehicles after we have abandoned coal and nuclear technology have received the attention they deserve, the dark side of our raw-material supply chain for batteries has been extensively swept under the rug.

According to the new report "Time to Recharge" issued by Amnesty International, the hype surrounding electric vehicles has led us, for instance, to turn a blind eye to the welfare of the children in the Democratic Republic of Congo (DRC) who mine the cobalt that is so important to the production of lithium-ion batteries [1]. In its report, the human rights organization admonishes major companies like Microsoft and Samsung for not doing enough to prevent child labor at the mines that are the source of

IN THE SPOTLIGHT



Cobalt use according to application in 2014, source: Cobalt Development Institute (CDI) 2016a [10] © Dera

their cobalt supply. In addition to describing the efforts on the part of electronics companies such as Apple and German carmakers such as BMW, Volkswagen and Daimler to monitor their cobalt supply chains, the report's authors point out an inadequate commitment to effective inspections and a basic lack of transparency that essentially also keeps consumers in the dark about the prevalence of human rights abuses.

INCREASING DEMAND FOR COBALT

The global demand for cobalt has increased significantly in recent years as manufacturers intensify their efforts to source the cobalt they need to produce the efficient batteries that power our smartphones and electric vehicles, a trend that is expected to continue. Automobile manufacturers such as VW and Daimler, for instance, have signaled their intention to increase the share of electric vehicles as a percentage of total vehicles sold to 25 %. As reported by the German Mineral Resources Agency (Dera), more than 40 % of global cobalt production is already used as a cathode material to produce lithium-ion batteries [2]. With around 50 % of total global cobalt reserves, the DRC accounts for more than half of total global

cobalt supplies. The further processing of cobalt ore and concentrates takes place predominantly in China. According to Dera, cobalt demand is expected to increase to around 120,000 t by 2035, primarily propelled by selected future technologies. In light of these developments, it is rather conspicuous that cobalt is not among the minerals that are subject to the European Union's new conflict minerals law [3], a law which came into effect as recently as June 2017. The purview of the law includes only the four raw materials tin, tantalum, tungsten and gold.

The fact is that without cobalt from the DRC, it would be very difficult for European countries and the rest of the world to achieve their stated goal of transitioning to electric vehicles. In addition to cobalt, however, the automobile industry is dependent on a whole range of other raw materials such as lithium, graphite, nickel and manganese. Raw-materials specialist Jan Henning Seelig and expert for environmental and energy technology Martin Faulstich explain, "The use of precious metals and technology metals has also been on the rise as manufacturers equip their cars with ever more electronic components. A steady increase in metal contents had been recorded over the past model generation changes – a trend we

expect will continue in the wake of an expanded role for electric vehicles and driver-assistance systems" [4]. Seelig and Faulstich point to the use of cobalt and lithium in batteries, platinum and ruthenium in fuel cells and neodymium and dysprosium in electric engines as prime examples.

A LACK OF DUE DILIGENCE IN THE AUTOMOTIVE INDUSTRY

The Amnesty International report makes abundantly clear what the automotive industry's hunger for raw materials means for the source countries. While none of the 29 companies examined by the human rights organization was deemed to be satisfactorily meeting its due-diligence obligations to report and prevent human rights violations, the automotive industry was singled out as especially lacking in the matter of due diligence. The authors suggest that even BMW, which showed improvements in a number of areas and also received the most favorable rating among the automobile manufacturers, continues to do too little, while Volkswagen and Daimler show clear deficits.

And what do the automobile manufacturers say? When asked by our editorial

staff, a BMW spokesperson indicated that BMW had “essentially no tolerance for human rights violations in its supply chain” and that the cobalt used in BMW products was supplied exclusively by large-scale mining operations, and was therefore free of human rights violations. The spokesperson also pointed out that the cobalt for its vehicle batteries comes from seven refineries, including Freeport Cobalt and Norilsk Nickel in Finland, Ganzhou Tengyuan Cobalt Industrial in China and Umicore in South Korea [5]. BMW is not supplied directly with cobalt, but with cells that contain cobalt. “We are well aware that growing demand for electric vehicles also goes hand-in-hand with a responsibility for the extraction of relevant raw materials, such as cobalt,” says Ursula Mathar, Head of Sustainability and Environmental Protection at the BMW Group. According to Mathar, BMW aims to “establish a transparent and sustainable supply chain.”

Company representatives of the Daimler Group also emphasize the importance of a responsible supply of raw materials. “Child labor is expressly prohibited in the contracts we sign with our suppliers,” one spokesperson explained, before going on to concede that the supply chains

often include many subcontractors, making it difficult to seamlessly monitor the entire process, a point that was echoed by representatives at Volkswagen. “Aware of exploitative conditions in the mining of raw materials,” they seek to “implement comprehensive measures to secure a socially and environmentally sustainable procurement of raw materials,” as the company emphasized. In December, Garcia Sanz, Volkswagen’s Head of Procurement, introduced stricter procurement rules that expressly prohibit child labor and forced labor [6].

BINDING DUE-DILIGENCE OBLIGATIONS

Although Amnesty International recognizes the efforts that have been made, it insists that they have not gone far enough. Just two years ago, the human rights organization and African Resources Watch compiled documentary evidence indicating that children as young as seven years old continue to risk their lives and their health in small-scale, artisanal cobalt mining operations in the DRC. Amnesty International confronted multinational corporations with

the human rights violations in cobalt mines in the DRC for the first time at the beginning of 2016, and also documented how major corporations profit from high-performance batteries whose production is ultimately linked to the work of an estimated 40,000 children in Congolese mines.

“In the meantime, corporations like Apple, Samsung and BMW have improved their monitoring practices, but they are still far from achieving seamless controls,” says Mathias John, Expert for Economics and Human Rights at Amnesty International in Germany. “The monitoring practices of all of the corporations lack transparency. This means that the purchasers of smartphones, laptops and electric vehicles run the risk of unwittingly promoting child labor,” John explains. “That is why Amnesty International is demanding binding due-diligence requirements from Germany’s next governing coalition.”

THE “DRIVE SUSTAINABILITY” INITIATIVE

Ten automotive companies, including BMW, Daimler, Volkswagen, Volvo and Toyota, have now taken a step towards



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Holger Gritzka
CEO of TerraE Holding GmbH



2 QUESTIONS FOR ...

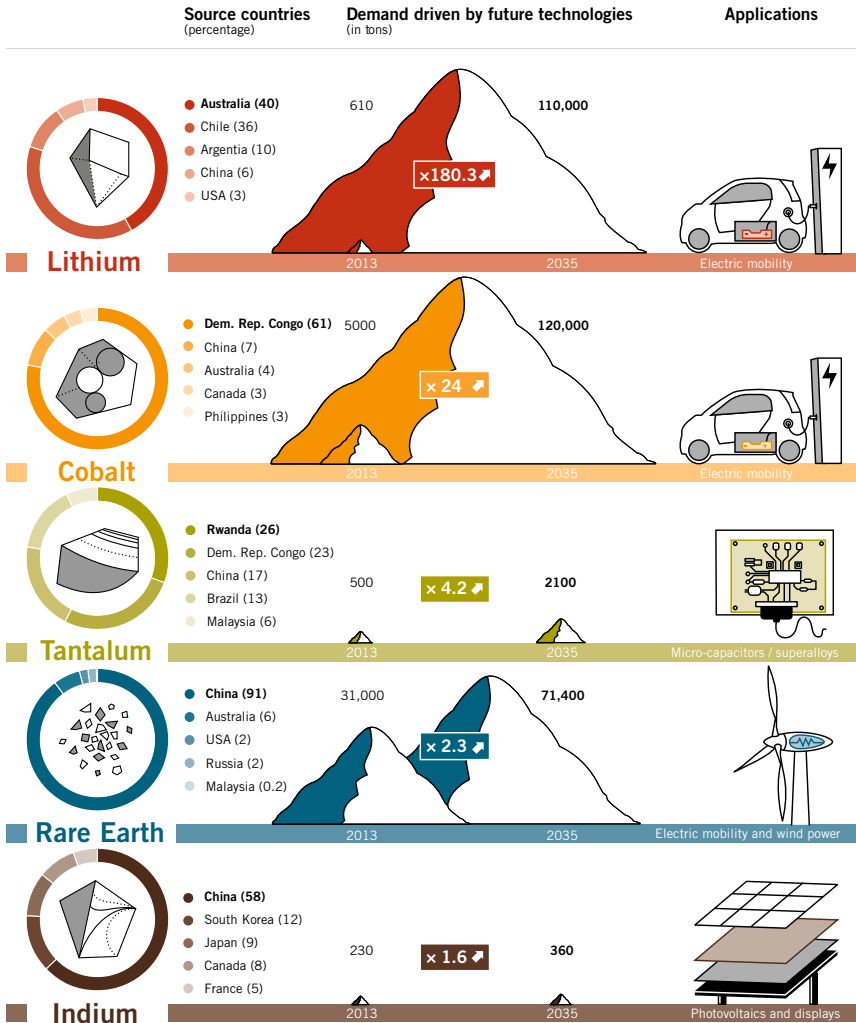
ATZelektronik _ TerraE is planning to build a large-scale production facility for lithium-ion cells in Germany. What are the project’s goals and prospects for success?

GRITZKA _ We plan to build our cell-production facility in two phases. During the first phase, we’ll build an engineering plant with a capacity of 1.5 GWh. This will then be followed by a sustained ramp-up phase. We expect to begin production from the fourth quarter of 2019 – by which time we expect to be in a position to provide our customers with initial samples. In 2020, we’ll then ramp up annual production to the nominal 1.5-GWh capacity, with the goal of reaching 34 GWh by 2028. In the first phase, we’ll restrict our supplies to non-automotive sectors before expanding our scope to include the automotive industry during the second phase.

How do you plan to secure a reliable supply of raw materials for your cell production?

While we see possible shortages especially in the case of cobalt, the available lithium reserves are big enough for TerraE, and we don’t expect to run in sourcing problems. Significant price increases can also be expected in the case of cobalt. We plan to respond to this by either doing without cobalt altogether or using very little cobalt, for instance, in the beginning. I don’t see any need to source raw materials in Congo. There are extensive reserves in Scandinavia, where it will also be easier to monitor the supply chain. Our aim is to establish a supply chain that involves no human rights violations. Cell production and electric-vehicle production in Europe do not depend on raw materials in Congo.

Raw Materials for Future Technologies



Selected results from the Dera study "Raw Materials for Future Technologies 2016" [11] © Dera [M]

ENVIRONMENTALLY SUSTAINABLE BATTERY PRODUCTION AND GREATER TRANSPARENCY

As the name suggests, the lithium-ion batteries (LIBs) that are used to power electric cars not only rely on cobalt, but also on lithium. In fact, lithium is the central element contained in all of the lithium-ion batteries used in electric cars. Scenario-based calculations published by the Institute for Applied Ecology in Freiburg, Germany, indicate that lithium production can be expected to grow from a total of 35,000 t in 2015 to nearly 160,000 t by 2030, i.e. as manufacturers intensify their production of electric vehicles, and nearly 500,000 t by the year 2050. The limiting factor in this development: total estimated global lithium reserves of around 47 million t [7]. While the Institute for Applied Ecology points out that the demand for raw materials can be lowered via recycling, no practice of lithium recycling has yet been established in Europe.

The lithium-ion battery currently delivers the best performance of all battery technologies and possesses a reliable degree of maturity. "The LIB can be expected to continue to dominate the market throughout the coming two decades," says Martin Winter, Scientific Director of the Meet Battery Research Center in Münster, Germany. "We therefore need to give far greater attention to the sources of raw materials to support the accelerated global production." As stated by Winter, some essential elements of LIBs are limited in their availability; and there are currently no sufficiently high-performance substitutes for lithium, nickel and cobalt [8].

This is also in the spotlight at the Reiner Lemoine Institute in Berlin, Germany. The research institute cites forecasts issued by the German Aerospace Center (DLR) and the Fraunhofer Institute for Systems and Innovation Research (ISI), which indicate that both reserves and resources for a few elements that are essential for battery production (including cobalt and lithium) could be exhausted before the end of the current century [9].

COBALT-FREE BATTERY MATERIALS

What is the best way to respond to the scarcity of raw materials while at the same time maintaining our commitment

ensuring the ethical integrity of the supply chain by launching the joint initiative known as Drive Sustainability. The goals of this sustainability partnership include the establishment of an observation center in order to identify and remediate ethical, ecological and labor-related shortcomings in the procurement of raw materials, including metals such as cobalt. With the help of CSR Europe, a European corporate network for corporate social responsibility, Drive Sustainability aims to establish greater transparency, improve conditions of labor and address many issues at all levels of the supply chain.

Volkswagen is also working in the framework of the Responsible Raw Materials Initiative (RRMI) on a certification system for cobalt refineries. This

would enable manufacturers to verify the source of the materials they use for their batteries, and thereby help to improve mining practices. As a member of the World Economic Forum's Global Battery Alliance, Volkswagen is also helping to secure a socially responsible, environmentally sustainable and innovative battery value chain – not only for cobalt. In addition to BMW and Daimler, Volkswagen is also a sponsor of the United Nations Global Compact. The aim of this sustainability initiative is to secure human rights and acceptable labor and environmental standards throughout the world. BMW also supports the Responsible Cobalt Initiative (RCI) whose aim is to mitigate social and environmental risks in the cobalt supply chain.

to human rights and environmental sustainability? What are the most promising strategies for a sustainable supply of raw materials for electric vehicles? Clearly, consideration is to be given to alternative sources of raw materials. Cobalt, for instance, is also mined in Norway and Finland. Parallel to this, work needs to be done on the development of materials efficiency, substitute materials and recycling technologies.

Much attention is being given to the notion of replacing certain raw materials. For instance, a manufacturing alliance formed by Renault, Nissan and Mitsubishi plans to invest up to one billion US dollars in start-ups over the next five years with the aim of developing new technologies. This newly established venture capital fund known as Alliance Ventures has already agreed to invest in the Ionic Materials, a US company that is developing cobalt-free materials for solid-state batteries.

RECYCLING AND REMANUFACTURING

Daimler also sees the possibility to circumvent the need for cobalt in the production of lithium-ion battery cells. The car-maker is convinced that the current mixture of equal parts of nickel, manganese and cobalt could soon be made obsolete by replacing cobalt with nickel. Daimler spokespersons also suggest that the so-called post-lithium-ion batteries, which make no use of nickel and cobalt, could make their market debut by 2025. They also point to the recycling and remanufacturing of batteries for further use as promising approaches to greater resource efficiency.

In the meantime, Amnesty International has called upon all cobalt-processing enterprises to meet their responsibility to comply with both the United Nations Guiding Principles on Business and Human Rights and the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict Affected and High-Risk Areas. In the case of battery production, this would obligate corporations to exercise due diligence along the entire supply chain – from mining and refining operations to production. They would also be required to identify and report any human rights violations (for example child labor) at any point in the value chain, implement countermeasures, and provide compensation whenever human rights are violated. Moreover, all findings and measures would have to remain transparent.

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WHAT DO WE THINK?

“The problematic side of electric-vehicle production is on display in Congo. German stakeholders determined to promote electric vehicles can hardly accept the human rights violations we see today in Africa, violations that are clearly associated with battery production. Due diligence and the rigorous monitoring of entire supply chains are absolutely necessary, as are battery recycling practices and the development of substitute materials. At the end of the day, however, consumers will decide the matter of acceptable production conditions. Enlightened consumers turn clean electric vehicles into a business model.”



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