FORAM

TOWARDS A WORLD FORUM ON RAW MATERIALS

GLOBAL RAW MATERIALS POLICIES

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 730127

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Deliverable D.3.1

Global Raw Materials Policy Context Report

Project:	Towards a World Forum on Raw Materials
Acronym:	FORAM
Grant Agreement:	730127
Funding Scheme:	Horizon 2020
Webpage:	www.foramproject.net
Work Package:	WP3
Work Package Leader:	EFG
Deliverable Title:	Global raw materials policy context report
Deliverable Number:	3.1
Deliverable Leader:	EFG
Involved beneficiaries:	MinPol, EFG
Dissemination level:	Public
Version:	3.0
Status:	Final
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Approved by:	WRFA
Date:	14.12.2017

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Acronyms and abbreviations

AMV	African Mining Vision
ASM	Artisanal and small-scale mining
BRICS	Brazil, the Russian Federation, India, China and South Africa
CRM	Critical raw material
CSR	Corporate social responsibility
DRC	Democratic Republic of Congo
EC	European Commission
EU	European Union (EU-28)
EV	Electric vehicles
EEE	Electrical and electronic equipment
EOL-RR	End of life recycling rate
FPIC	Free Prior and Informed Consent
FTA	Free-trade agreement
FYP	Five-Year-Plan (Chinese plans)
GDP	Gross domestic product
GHG	Greenhouse gas
IGF	Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development
IRP	International Resource Panel
ISA	International Seabed Authority
LA	Latin America
METS	Mining equipment, technology and services sector (a term mainly used in Australia)
MSs	Member States
NEEI	Non-energy extractive industry
NGO	Non-governmental organisation
NIMBY	Not-in-my-backyard
PGMs	Platinum Group Metals
REE	Rare earth elements
R&I	Research and innovation
RMSG	Raw Materials Supply Group (an expert group on non-energy minerals supporting the EC)
SLO	Social licence to operate
TFEU	Treaty on the Functioning of the European Union
WEF	World Economic Forum
WEEE	Waste electrical and electronic equipment
WTO	World Trade Organisation

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About the FORAM project

The project Towards a World Forum on Raw Materials (FORAM) will develop and set up an EU-based platform of international experts and stakeholders that will advance the idea of a World Forum on Raw Materials (WFRM) and enhance the international cooperation on mineral policies and investments. The global use of mineral resources has drastically increased and supply chains have become ever more complex. A number of global initiatives and organizations have been contributing to knowledge and information transfer, including the EC, UNEP International Resource Panel, the World Resources Forum, the World Material Forum, the OECD and others. It is widely felt that improved international resource transparency and governance would be beneficial for all, since it would lead to stability, predictability, resource-efficiency and hence a better foundation for competitiveness on a sustainable basis.

The FORAM project will contribute to consolidate the efforts towards a more joint and coherent approach towards raw materials policies and investments worldwide, by closely working with the relevant stakeholders in industry, European and international organisations, governments, academia and civil society. Synergies with relevant EU Member States initiatives will be explored and fostered. The project will in particular seek to engage the participation of G20 Member countries and other countries active in the mining and other raw materials sectors, so that experiences will be shared and understanding of all aspects of trade in raw materials will be increased.

By implementing this project an EU-based platform of international key experts and stakeholders is created, related to the entire mineral raw materials value chain. This platform will work together on making the current complex maze of existing raw material related initiatives more effective. As such, the FORAM project will be the largest collaborative effort for raw materials strategy cooperation on a global level so far.

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Executive summary

This report is part of FORAM´s work package titled 'Strategic Planning'. The overall objective of this deliverable is to provide a review of changing international mineral policy contexts and their expected evolutionary pathways as the background for the discussion and establishment of FORAM´s long-term vision. The report is built upon literature review and interviews conducted with experts intended to validating the identified key challenges and emerging trends.

The global economy now shows some signs of improvement and is expected to remain around 2.9 % in 2018-19. Yet, despite fluctuations in economic growth, global trends foresee a rising long-term global demand for (energy and non-energy) minerals based on an increasingly growing and urbanizing population (expected to reach 8.6 billion by 2030 from the current 7.6 billion) and the emergence of a new 'global middle class' pushing new sustainable transportation, consumption and production modes. Thus, on an overall long-term basis, the global demand for minerals is expected to remain robust (e.g. platinum, palladium, tin), and even in some cases (e.g. aggregates, iron, bauxite, nickel, lithium) to keep increasing.

The global metals and industrial minerals market remains characterized by complex and non-transparent global value chains which render the monitoring of global mineral flows daunting. Governments, companies, NGOs and the civil society are facing different challenges: while developing countries (especially in Africa, Asia and Latin America) still struggle with poverty, hunger, inequality, malnutrition and other social problems, weak governance, corruption, illegal mining and trade of 'conflict minerals', developed countries need to tackle trade distortions, protectionism and risk of minerals supply (of importance for 'critical raw materials') and increasing strictness of environmental regulations. Transversal issues to all nations are threats posed by volatilities in commodities prices, insufficient access to finance, climate change and the loss of biodiversity, a widespread social opposition to mining projects, difficulties in access to land, water and energy supply as well as declining ore grades and productivity and an ageing mining workforce.

On a global level the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change represent the guiding policy frameworks for the coming years. In a multipolar world with a global economy whose gravity centre is shifting southeast, China, the EU, India and Japan are leading the way towards low-carbon and green growth economies whereas the USA and Russia are more reluctant to follow a similar path of strong political commitment to reduce greenhouse gas emissions (see Figure 1 below). It is clear, and has been directly advocated by the minerals industry, that mining can make a strong contribution to achieve the Sustainable Development Goals. However, that can be achieved only if a stronger cooperation (and not only competition) among nations helps overcome the previously mentioned challenges.

The last decades have shown successful examples of cooperation in advancing towards greater transparency in the management of revenues with the Extractive Industries Transparency Initiative

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(EITI), now implemented in 52 countries, many of them mineral-rich and with weak governance problems (e.g. Democratic Republic of Congo). This initiative also inspired others which have been instrumental in improving governance in source and processing countries (e.g. EU Transparency and Accounting Directives, Canada´s Extractive Sector Transparency Measures Act).

Likewise various responsible sourcing initiatives (e.g. OECD Due Diligence Guidance, Kimberley process) and networks (e.g. Responsible Sourcing Network) were established which have helped avoiding conflict minerals from entering into value chains. Africa has become (and is expected to remain) the centre of such initiatives. Yet, other governance challenges are still unsolved such as the need to enhance transparency in the global pricing of raw materials, mechanisms to deal with new potential severe trade distortions of strategic or critical minerals, mechanisms to reduce pressures by the mining sector in high biodiversity areas, the management of the artisanal and small-scale mining sector and human rights violations related to mining operations. Another key issue remains the role of industrialised nations in the industrialisation plans of developing countries (e.g. African Mining Vision).

Global trade of minerals remains a key cornerstone of modern societies. While free trade is often advocated as the best pathway for prosperity (e.g. G20, WTO), protectionism remains a key dynamic feature of developed (e.g. USA, Japan) and developing countries (e.g. China, India). In the last years evidence has shown a surge in protectionist measures around the world; recently, it appears that the Trans Pacific Partnership (TPP) between the USA, Japan and a group of Asian countries, and the Transatlantic Trade and Investment Partnership (TTIP) between the USA and the EU will not be ratified. In the field of raw materials, rules regarding export restrictions of minerals may often change, as exemplified by restrictions in Indonesia (tin) and China (rare earths). Thus, it seems that global trade is heading towards a greater protectionism in the coming years. The topic of 'critical raw materials' (understood as materials of economic importance and whose supply is at risk) has also come to the fore in recent years (Europe, USA, India) and is expected to remain an important one.

On the recycling side, policies and strategies to increase resource efficiency in the production and consumption systems are now gaining a place among the top priorities of industrialised nations (e.g. via the G7 Alliance on Resource Efficiency, the EU´s Circular Economy Action Plan, Japan´s Sound-material cycle society policy) while developing countries, which still have to build their stocks of metals, are not treating it as a priority (with some exceptions such as China´s Circular Economy Development Strategy) (see Figure 1 below). Globally, recycling nowadays has a modest place in the supply of minerals to the national economies (e.g. recycling caters nowadays for between 25 and 50% of the demand for the most widely-employed metals such as iron and aluminium but caters only below 1% for lithium and rare earths). Even though the rate of input supplied by recycling is expected to increase in the next decades, forecasts agree that mining will keep on having a leading role in the foreseeable future to ensure that such minerals remain available to the industry and the economy. A similar scenario is generally agreed upon for deep-sea mining techniques.

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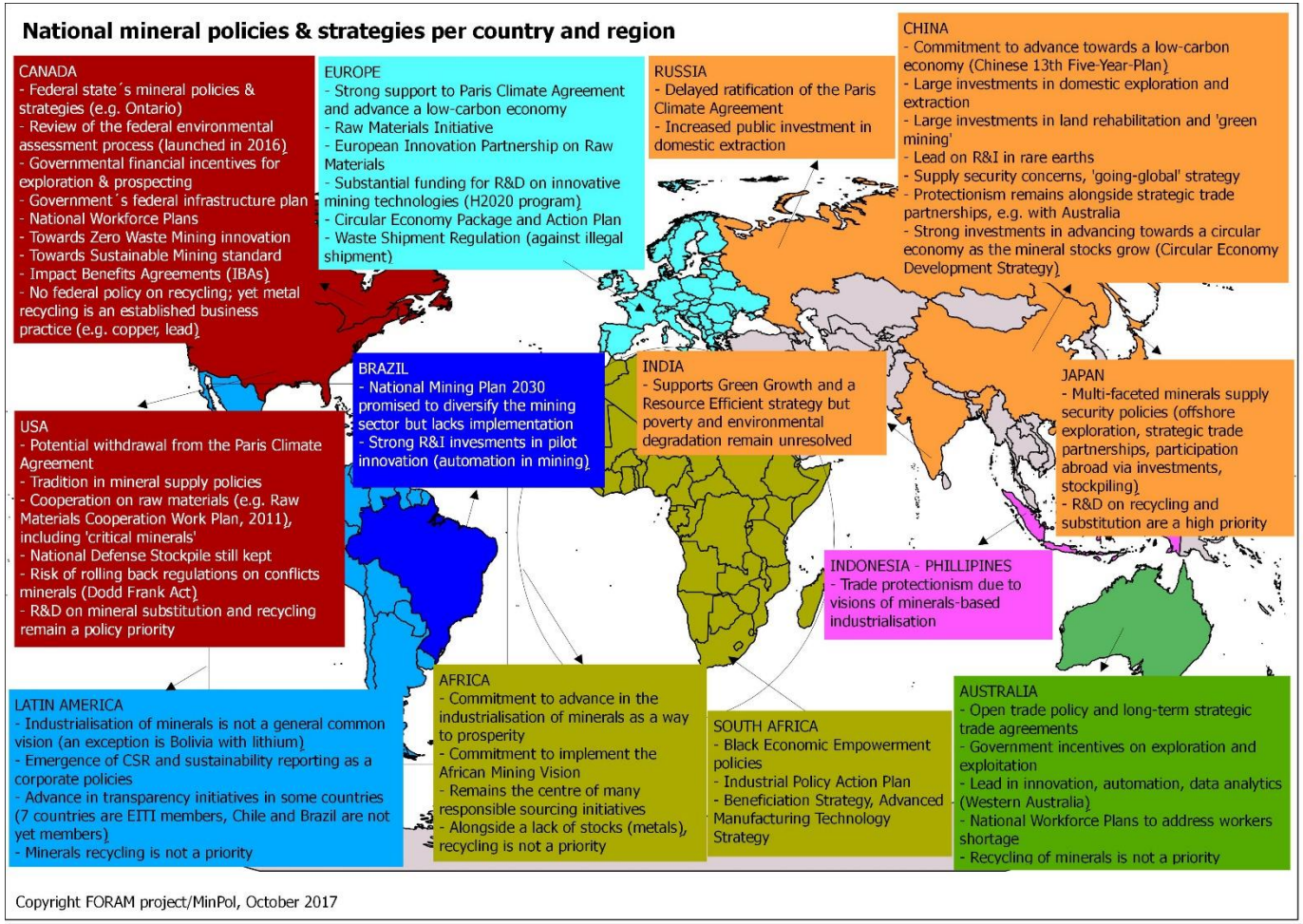
Figure 1: National mineral policies and strategies around raw materials.



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Why a World Forum on Raw Materials?

Many initiatives and multi-stakeholder international fora exist where such challenges are being discussed (e.g. World Resources Forum, World Materials Forum, Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development, OECD Policy dialogue on Natural Resource-based Development, etc.). However, there still **remains a need for greater international policy cooperation and coordination** focused on:

- how mineral supplying and importing countries can better coordinate actions for mutual gains in apparent contradictory visions (e.g. accelerating industrialization and green growth in African developing countries under the African Mining Vision and under the Sustainable Development Goals while improving ways to avoid unilateral trade distortions such as export restrictions); this could be achieved by better connecting platforms via international stakeholders and by the agreement on clear targets, ways of implementation and monitoring of the progress;
- further explore ways to develop transparent price mechanisms capable of ensuring fair terms of competition for mineral producing and mineral importing countries;
- ensuring a better transfer of knowledge (e.g. on best practices in different regions) on how to strengthen the legal and institutional mineral policy framework between developed (Australia, Canada) and developing countries (African, Latin American ones)
- disentangling the complexity of value chains and initiatives to improve mineral resource governance by a clearer, more transparent mapping of who-is-doing-what and where improvement potential is;
- promote smart regulations and a better coordination of mineral development and biodiversity conservation between developed and developing countries (e.g. how to create economic incentives or trade-offs between countries to minimize mining in high-biodiversity areas such as the Brazilian rainforest and promote shifting of operations towards low-biodiversity areas)
- promoting resource efficiency in developing countries buildings their metal stocks, e.g. following China´s example.

Implementing the WFRM via international key experts and stakeholders considering the entire minerals value chain will consolidate the current complex maze of minerals initiatives. This will increase international resource transparency and improve governance which would contribute to stability, predictability, resource-efficiency and hence a global more balanced (developing versus developed countries) supply basis. As such, the FORAM project will be the largest collaborative effort for minerals strategy cooperation on a global level so far.

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1. Introduction

The global minerals policy context is changing at a rapid pace in an era of dynamic innovation, automation and digitalisation which co-exists with unresolved social and environmental issues such as hunger, poverty, inequality, environmental degradation and climate change. Since 2015, and until 2030, the United Nations Sustainable Development Goals (SDGs) is expected to remain the guiding policy framework for all economic sectors, including the raw materials one, in terms of orientating economic, social and environmental policies. At the same time, the Paris Agreement on Climate Change will also remain a fundamental overarching framework for the global economy as signatory countries seek to honour their commitments in terms of greenhouse gas emissions reduction.

The new global landscape is now evolving towards a global multipolar system with the rise of China, India and other powers with an emerging potential for conflicts and the re-emergence of (trade) protectionism. National governments and the minerals extractive industry are constantly adapting their policies and strategies to cope with the mega-trends that shape the global landscape: a quickly growing, urban and ageing world population, rising income and wealth disparity, increasing migration flows, the wide-ranging effects of climate change on temperatures, sea level and the water cycle, the accelerated loss of biodiversity, the rise of a new 'global middle class' and of the millenials who have new communication, consumption and production patterns, among others.

The growing population, the increasing urbanisation and the general dependence on technology and electrical and electronic devices is expected to keep driving the rising global minerals demand. This represents many challenges for governments and the industry alike in the face of complex and opaque global value chains difficult to monitor, weak governance, corruption and mismanagement of revenues accrued from the minerals extraction (particularly in mineral-rich developing countries), the fight against illegal mining and 'conflict minerals', all against a scenario of increasing societal awareness and scrutiny of the positive and negative impacts of the mining industry.

The overall objective of this deliverable is to provide a review of changing international mineral policy contexts and their expected evolutionary pathways. This report is linked to FORAM´s Task 3.1 "Defining a long-term vision" and its first phase, i.e. the analysis of key social, technological, economic, environmental and political framework conditions for the global mineral raw materials vision. In focus is also the evaluation of potential future agendas, ambitions, goals and development in the next decades (2030/2050) based on current trends and initiatives. The specific objective of this report is to provide a global and continental overview of key challenges faced by national governments and the minerals industry which orientate the development of FORAM project´s vision.

This deliverable will be used as a baseline for Phase 2: Strategic Visioning and creating a strategic position for the World Forum on Raw Materials (WFRM) future agenda. Such overview of the policy context can help a better understanding of stakeholders´ needs, threats, priorities and preferences to facilitate a future interactive dialogue with the stakeholders (cf. FORAM´s WP 2). For the report

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development, the information about current initiatives in the global regions (cf. FORAM´s WP1) was used, considering priority criteria for the FORAM project discussed in the task 1.2 as well.

Scope

The global production of energy minerals, both by tonnage and value, is far higher and more important in economic terms than that of non-energy minerals. **However, the FORAM project is focused only on (abiotic) non-energy and non-agricultural raw materials** (land-based and marine mineral resources). Thus, this document addresses policy context issues only related with such raw materials, including primary (metals, industrial and construction minerals extracted in mines or quarries) and secondary minerals (minerals extracted from waste facilities such as tailings dams or waste heaps in closed or abandoned mines, including also manufacturing waste or scrap, e-waste, etc.).

Globally, and in terms of tonnage, aggregates are by far the most extracted mineral resource. The extraction of industrial minerals is also of importance in terms of tonnage and financial revenues for countries; however, the focus of attention often is set on metals because of their high economic value, relative scarcity, rapid and cyclical changes in price and high importance for key industries such as technology, infrastructure and defence. For instance, those raw materials considered 'critical' (due to supply risks) by the European Commission (Deloitte et al., 2017; European Commission, 2014) or the US Department of Defense (US Department of Defense, 2013) include mainly metals. Thus, **the focus of this Deliverable is on issues around metals**, specifically on those 10 non-energy minerals of highest economic and tonnage importance in the global trade: iron, bauxite (aluminium), copper, manganese, nickel, lead, zinc, tin, gold, silver and PGMs. **Yet, due to their economic importance, policy context issues around minerals considered 'critical' are also covered**.

The report is focused around the policy of those countries which are major global non-energy mineral suppliers (China, Australia, Canada, USA, Brazil, Russia, South Africa, India, Chile, Peru, Indonesia) and mineral consumers (China, the EU, USA, India, Japan, South Korea, Brazil, Germany[1]). Such countries were identified via an analysis of the production and consumption of metal (see the analysis in Annex 4). Those countries (including Turkey) also are major players in the scrap recycling business. However, other countries (e.g. Kazakhstan, Democratic Republic of Congo or countries included in the G20) are also covered to provide a fuller picture.

[1] Other countries with large and growing populations, e.g. Nigeria, Pakistan or Bangladesh, are not in the main focus as they are not major mineral consumers (importers).

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Methodology

The information collected is based on a review of existing literature and policy papers. The findings are supported and complemented by a series of interviews with different experts. The initial list of experts identified and their main areas of expertise related to resource governance are provided in Table 2 (see Annex 1). The first interviews were already held by contacting the interviewees with a list of questions to be answered, and then by conducting approx. 30 minutes interviews. The information from these interviews is included in the report. The rest of consultations are planned to be conducted during the next weeks and will support the WP2 Structure and dialogue objectives.

The report is organised in 10 chapters. First, concepts framing the discussions on mineral policies are briefly addressed in **Chapter 2**. The relation between the mineral policy concept and mineral policy instruments is explained along with the concept of strategic and critical minerals. **Chapter 3** provides, first, an overview of trends which frame the global minerals industry and its governance. Chapters 4 to 9 cover the issues and challenges of highest importance framing the policy context (for government, industries and other stakeholders) organised per continent (excluding Antarctica and the Artic, but including the oceans as a potential source of minerals). For this report, the countries and regions covered have been classified as in Table 1:

Continent	Countries/regions it includes
Europe	The EU-28 and Turkey
America	Canada, USA and Latin America (from Mexico to Argentina)
Asia[2]	China, Japan, India, South Korea, Russia, Kazakhstan
Africa	South Africa, DRC, Guinea, Sierra Leone and others
Oceania	Australia, Indonesia, Philippines, Malaysia, New Zealand

***Table 1**: Countries considered per continent.*

For each of the five continents/regions (Europe, America, Asia, Africa and Oceania) and for the marine resources (Chapter 9 – deep sea mining) the analysis aimed to identify the current and future (based on forecasts) policy context. Contextual matters are the drivers for different policy actions and incentives. **Chapters 4 to 9** were written based on existing literature and complemented with insights from the interviewed experts. **Chapter 10** presents an international overview of national policies and strategies, and challenges of the mining industry. **Chapter 11** closes the deliverable with conclusions.

[2] The Middle East and Central Asia (except for Kazakhstan) are not included

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Annex 1 lists those experts interviewed and the chapters they contributed to; Annex 2 provides some estimations of the future global minerals demand; Annex 3 provides a brief overview of the mineral potential per continent and Annex 4 an overview of the major countries in the global minerals market (primary and secondary minerals). Annex 5 presents an overview of transversal challenges faced by the mining industry while Annex 6 a summary of selected policy instruments.

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2. On mineral policies and strategies

2.1. On mineral policy and raw materials policy

A minerals policy is part of an economic policy, which is assigned to political economy in the scientific sense (Siebert, 1983). In other words: economic policy is the part of state politics which deals with the shaping of national economy (Tuchtfeldt, 1984). It seems appropriate to refer to any state activity aiming directly at influencing extent, composition or distribution of the national product as economic policy (Molitor, 2006). Generally speaking, economic policy is a policy including all measures with which the state (in coordination with non-state actors) intervenes regulating and arranging the economy. Economic policy specifies the rules, within which the (to a large extent) privately organized economy can act. This leads to the following **general definition of a minerals policy**:

"*A statement or statements of agreed objectives for the management of mineral resources which aim to ensure their supply to meet the needs for those minerals*" (Ad-Hoc Working Group of the RMSG, 2010)

Modern mineral policies need to be framed within the sustainability paradigm. Thus, a **sustainable minerals policy** needs to (as defined by the Ad-Hoc Working Group of the RMSG, 2010):

- facilitate the transformation of natural mineral capital into built physical, economic, environmental or social capital of equal or greater value;
- ensure that environmental and negative social impacts of mining are minimised and their costs incorporated into production functions;
- require transparency and information-sharing;
- reconsider the allocation of rights and the availability of resources across generations;
- address benefit risk trade-offs from the perspective of multiple stakeholders and create contingency plans that will ameliorate the effects of mineral market booms and busts.

Furthermore, **mineral policies are a cross-cutting topic** (see Figure 2) **and thus** need to be adequately coordinated and consistent with other governmental sectoral policies such as economic, environmental, social, defence, technology and land-use planning policies (ERECON, 2015; Marinescu et al., 2013; Tiess, 2010, 2011). It has to be highlighted that **mineral policy does not mean mining policy** (which is focused on mineral extraction aspects/issues). The term 'mineral policy' is related to the establishment of a minerals policy framework which in turn, is based on (analyses of)

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minerals consumptions[3] and considers the internal (national territory) and external (beyond) component of a mineral policy framework as foreign affairs (cf. Tiess, 2011).

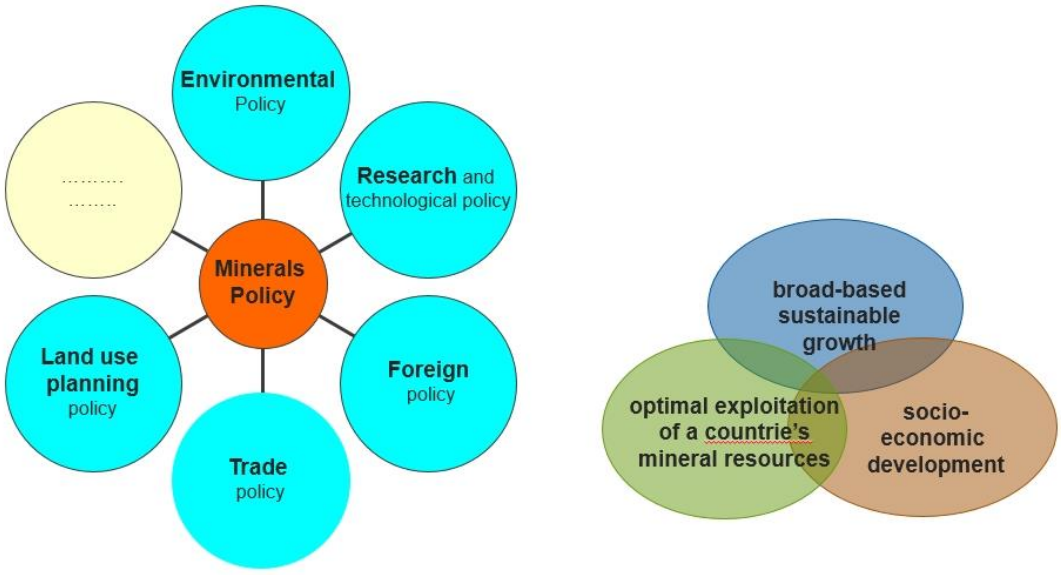

Figure 2: Minerals policy – a cross cutting subject Falck/Tiess et al., (2017)

Usually, 'mineral policy' covers only primary minerals but it was suggested in several publications (e.g. Tiess and Kriz, 2011; Tiess and Shields, 2014) to consider **primary and secondary** mineral raw materials equally when framing a minerals policy framework. It has also been suggested (e.g. Tiess, discussions, e.g. during ERECON work progress 2015) to consider/include the whole minerals value chain when discussing and establishing a mineral policy framework. Otherwise, we cannot understand the "whole picture" (isolated issues versus broad context). We believe this means a **paradigm shift** in the general mineral policy discussion but is absolutely necessary because of the (increasing) interrelated value chain aspects.

The third term that appears usually in connection of this broader concept is **raw materials policy** that many countries are using. It includes generally biotic and abiotic raw materials, as well as primary and secondary. As in the scope of the FORAM project are only non-energetic and non-agricultural raw materials, **we will use the term 'mineral policy' referring to such primary and secondary raw**

[3] Mineral consumption (MC) = (primary+secondary) production + imports – exports (EU vs MS)

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materials to avoid confusions. All three terms, however, have the common target of an overall well-being of the society and economic growth of the country.

2.2. Minerals, stakeholders and the raw materials sector

Mineral policies must be viewed from a value chain perspective, i.e. ranging from up-stream activities (exploration, extraction, processing) and down-stream industries (refining, manufacturing) to lifecycle of the final products to their end-of-life and transformation into secondary raw materials or waste (see Figure 3, cradle-to-cradle approach). Different groups of stakeholders in the sector are having different interests. These are the main types of stakeholders' groups with identification of their main interests:

- *Producers* – their objective is generally increasing/sustainable production, getting the highest possible benefit, having access to innovations and technologies,
- *Consumers* – they aim to achieve security and diversification of supply, stable prices, to decrease import dependency via recycling effectiveness and substitution,
- *Warehouses* – they are focusing on the control on stocks and market prices,
- *Others (consultancy companies, investors, NGOs, inter-governmental organisations, local government, public bodies, etc.)* – they are interested in having access to information about flows, fair playing rules and having the possibility to influence that.

2.3. Mineral policy context and mineral policy instruments

Thus, minerals policy is a cross-cutting topic and features many links to other branches of politics (sectoral policies). The concepts of minerals policy and other (related) policies involved need to be coherent since the former is part of these policies and use their instruments (Tiess, 2011). Examples of sectoral policies that aim towards the goal of a European minerals policy include (Figure 2):

- *Minerals planning policy*: encouraging exploration, identification and protection of mineral deposits in the context of land-use planning and environmental policy
- *Environmental policy*: commitment of an organization to the laws, regulations, and other policy mechanisms concerning environmental issues such as the European principles underlying the European environmental policy
- *Research & Technology policy*: increasing efficiency of minerals and related products
- *Foreign policy*: diplomatic dialogue with EU non-member countries setting objectives for trade and development
- *Trade policy*: one of the problems of supply concentration is resource nationalism, i.e. export restrictions; securing access to minerals, for example through bi-, multilateral contracts, etc.;
- *Defence policy*: ensuring the supply security of raw materials necessary for the European defence industry (especially those considered critical or strategic)

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- *Development policy*: building capacities (e.g. cooperation of geological surveys) in non-member countries to support political stabilisation and access to minerals
- *Circular economy strategy*– a paradigm towards a sustainable development via resource efficiency gains

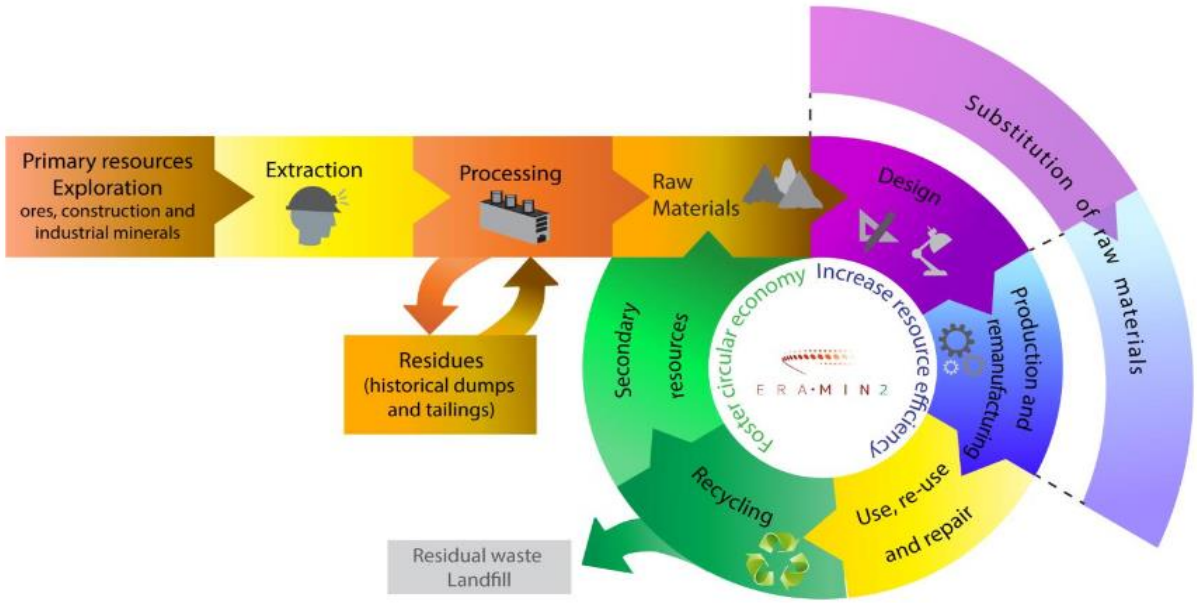

Figure 3: Circular Economy concept (https://www.era-min.eu/)

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3. Trends framing the global policy context

3.1. Global mega-trends[4]

The global population is increasing, urbanising, ageing and on the move. The global population (currently nearly 7.6 billion) continues to grow and is expected to reach 8.6 billion by 2030 (and 9.8 billion by 2050[5]) (United Nations, 2017). More than half of the anticipated growth between 2017 and 2050 is expected to occur in Africa followed by Asia[6], where by 2024, India´s population is expected to surpass China´s. Among the ten largest countries of the world, Nigeria (currently 7th largest) is the one growing most rapidly: its population is projected to surpass that of the USA shortly before 2050, at which point it would become the third largest country in the world (United Nations, 2017).

Population grows and keeps urbanising in mega-cities and mega-regions: the current global urban population (54%) is expected to reach 66% by 2050 and 3 developing countries (India, China, Nigeria) together are expected to account for 37% of the projected growth of the world's urban population between 2014 and 2050[7]. What´s more, partly driven by national urbanisation policies (e.g. China, Japan), there is a clear trend of concentration in mega-cities and urban corridors: by 2030 the world is projected to have 41 mega-cities with more than 10 million inhabitants (UN-Habitat, 2016). Likewise some mega-cities are expected to keep growing and eventually merge into 'mega-regions'[8], which are of key economic importance: even though they cover a tiny fraction of the land, the world's 40 largest mega-regions account for 66% of global economic activity and about 85% of technological and scientific innovation (Harrison and Hoyler, 2015). Urbanisation is subsequently contributing to pushing the demand for raw materials such as aggregates, iron, manganese, copper and aluminium.

Due to a generalised higher life expectancy, **the global population is ageing**: the number of persons aged 80 or over is projected to triple by 2050, and by then the older population (80+) will be predominantly female (60 to 40% ratio). In almost all countries worldwide and due to the general

[4] These can be defined as '*large-scale social, economic, political, environmental or technological changes that are slow to form but which, once they have taken root, exercise a profound and lasting influence on many if not most human activities, processes and perceptions*' (OECD, 2016). As argued by OECD, such relative stability in the trajectory of major forces of change allows some elements of a likely medium-to-long term future to be envisioned, at least with some degree of confidence or certainty.

[5] According to UN´s medium-variant projection of the 2017 Revision

[6] Actually, from 2017 to 2050, it is expected that half of the world's population growth will be concentrated in just nine countries: India, Nigeria, Democratic Republic of the Congo (DRC), Pakistan, Ethiopia, the United Republic of Tanzania, the USA, Uganda and Indonesia.

[7] India is projected to add 404 million urban dwellers, China 292 million and Nigeria 212 million

[8] The world's first mega-region is comprised of Hong Kong, Shenhzen and Guangzhou (Pearl River Delta in China) and is home to about 120 million people. Other ones include the Nagoya-Osaka-Kyoto-Kobe mega-city in Japan expected to grow to 60 million people, and the urban corridor in West Africa linking Nigeria, Benin, Togo and Ghana.

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trend of an ageing population, per capita healthcare spending is rising faster than per capita income. At the same time, there continue to be large movements of migrants between regions, often from low- and middle-income countries toward high-income countries. **Such migration flows are expected to remain high during the next two decades** as people seek economic opportunity and flee conflict and worsening environmental conditions (National Intelligence Council (U.S.), 2017).

Growth in population will be accompanied by **a rising income and the emergence of a new 'global middle class'**: the move to urban living is lifting the incomes of millions of people around the world, and, it is forecast that one billion people will enter the global "consuming class" by 2025, with incomes high enough to become significant consumers of goods and services (McKinsey Global Institute, 2012), of which 90 % will be living in developing countries (European Commission, 2009). However, **wealth disparity (inequality) and an increasing polarization of societies** is also expected to remain in the following decade (WEF, 2017); in fact, income inequality increased in most OECD and BRICS countries (OECD, 2016).

Part of the new 'global middle class' will be embodied in the 'millennials'[9]: by 2020 it is expected a global population of 2.56 billion 'millenials', i.e. persons in the Age Group 15 to 34 (in comparison to the 2.24 billion in 2010) (Singh, 2011), 37% of which are located in China and India. Millenials are of importance as they are a new generation of consumers and have different values and lifestyles, e.g. they care about the purpose of the companies they buy from and work for, and are expected to be users of smart homes, mobile working, mobile banking, autonomous cars, e-learning, smart transportation, 3D and 4D printing, internet of things, "gamification" (e.g. for training), etc.

Digitalisation and innovation are growing on importance. Innovation, automation and digitalisation of production along value chains has now become central in companies (e.g. Industry 4.0 frameworks, autonomous vehicles, 'digital mines') and governments strategies as a fundamental way to boost productivity and efficiency, e.g. as explicitly stated in G20´s Roadmap for Digitalisation, China´s 13th Five-year-plan or the EU´s Digital Single Market strategy. Robotics have a far-reaching potential to transform the minerals industry (e.g. via the internet of things, machine learning artificial intelligence algorithms, edge computing, etc.). However, while technology is accelerating progress, it is also causing discontinuities. Rapid technological advancements will increase the pace of change and create new opportunities but will aggravate divisions between winners and losers. Automation, robotics and artificial intelligence threaten to change industries faster than economies can adjust, potentially displacing workers and limiting the usual route for poor countries to develop (National Intelligence Council (U.S.), 2017). These trends are also heavily influencing the mining industry (see Table 5 in Annex 5).

[9] Refers to those born between 1980 and 2000

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A **global multipolar system** is emerging with the rise of China, India, and others, i.e. multipolarity means regions that are distinct in terms of their economies, laws, cultures and security networks (Credit Suisse, 2017). The USA-EU-Japan triad will no longer dominate, even if the USA preserve their leadership. The centre of gravity of the world economy is shifting southeast, e.g. defence spending by Asian states is expected to grow strongly, signalling a global shift in state power (National Intelligence Council, 2008). China is poised to have more impact on the world over the next 20 years than any other country. If current trends persist, by 2025 China will have the world's second largest economy and will be a leading military power. It also could be the largest importer of natural resources and the biggest polluter. India probably will continue to enjoy relatively rapid economic growth and will strive for a multipolar world in which New Delhi is one of the poles. China and India must decide the extent to which they are willing and capable of playing increasing global roles and how each will relate to the other (National Intelligence Council, 2008).

At the same time, some analysts foresee **increasing difficulties to cooperate**. Under a rules-based international order different to that which emerged after World War II, it is foreseen that it will be much harder to cooperate internationally and govern in ways publics expect. Underlying this crisis in cooperation will be local, national, and international differences about the proper role of government across an array of issues ranging from the economy to the environment, religion, security, and the rights of individuals (National Intelligence Council (U.S.), 2017). Difficulties to cooperate, conflicts and protectionism are reflected in the scenario "National walls" developed by the INTRAW project (http://intraw.eu/scenario-3-national-walls/) and in the "The end of globalization" scenario by the Credit Suisse Research Institute (Credit Suisse, 2017).

Climate policy – towards low-carbon economies. Defined as one of the SDGs, climate change has become a major cause of concern and action for all government and industries. Warming of the climate system is unequivocal and affects the global economy and all industries, including the mining one, by posing threats and risks to operations. Climate change places pressure on housing, water and food production systems, e.g. due to increased frequency and intensity of extreme weather events (floods, storms, etc.). The Paris Agreement on Climate Change (came into force in 2016) is currently the principal global climate policy framework. Its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius by requesting signatory countries to follow a plan to lower their greenhouse gas emissions (GHG). The Agreement is ratified by 169 parties (including China and the EU, first and second largest GHG emitters globally, but excluding the USA, third largest emitter[10]). The commitments to reduce GHG emissions is one of the main drivers behind multiple government strategies to achieve low-carbon (or zero carbon in the longer-term) economies (e.g. China and India´s Green Growth

[10] President Trump stated that the USA will withdraw from the Paris Agreement unless some the terms are improved on the USA´s side.

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strategies, EU´s 2030 Climate & Energy Framework[11]), of which renewable energies and e-mobility are key pillars (the last two are strategically relevant for raw materials as they drive the demand for metals such as lithium). Other key issues of concern that are expected to change living patterns are sea-level rise, ocean acidification and glacial melt (National Intelligence Council (U.S.), 2017)

3.2. Trends framing the minerals industry

Conflicts over resources and terrorism will remain key concerns. Growing tensions and conflicts around strategic resource issues (energy, food, water and land) will gain prominence on the international agenda (OECD, 2016). The need for water will increase sharply with the increases in world population and the rise in the standard of living in emerging countries, creating strong tensions with the quantities available which are likely to decrease due to climate change. The potential for conflict will increase owing to rapid changes in parts of the greater Middle East. Terrorism is unlikely to disappear by 2025, but its appeal could lessen if economic growth continues in the Middle East and youth unemployment is reduced (National Intelligence Council, 2008).

Biodiversity loss remains a serious global environmental change process. Despite numerous global responses, there is an ongoing biodiversity crisis (Cardinale et al., 2012) and an overall reduction of biodiversity loss rates has not yet occurred (Butchart et al., 2010). Future prospects show only slight chances of improvement by 2020 if current trajectories continue (Tittensor et al., 2014). The greatest threats to biodiversity remain human-induced habitat loss and degradation, overexploitation, invasive alien species, and pollution (Armenteras and Finlayson, 2012). Even though mining does not represent one of the greatest threats to biodiversity, recent research shows that it is a major cause of deforestation in the Amazon rainforest (Sonter et al., 2017); research also shows that there exist options to shift mining to less biodiverse areas, yet, this is unlikely under a business as usual scenario. In other words, such a shift is "*unlikely to occur in the absence of an international biodiversity price tag, bank-financing standards, a strong international coordinator of global mining activities, or other economic incentives encouraging mining in low biodiversity regions (e.g. adding formal costs to mining in high biodiversity areas)*" (Murguía et al., 2016:418).

Increasing global energy demand and prospects of a renewable energy revolution. The global demand for energy is forecast to rise by 25 % by 2040 (Exxon Mobil, 2017), with renewable energies as the fastest growing sector in the IEA´s main scenario (IEA and OECD, 2016). Fuelled by the need to reduce GHG emissions, the renewable energy market is growing and China emerges as a leader: unlike USA, China seeks to shift away from coal (e.g. due to pollution and goals of reducing GHG emissions) and for that the government plans to investment USD 361 billion in renewable energy generation by 2020

[11] Such policies contrast with President´s Trump Executive Order on Energy Independence and Economic Growth (March 2017) which supports the development of USA´s domestic coal market.

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(Brittlebank, 2017). As stated in the Chinese 13th FYP, the government increased clean energy use targets in the 13th FYP from 12 percent under the 12th FYP to 15 percent by 2020 (a binding target).

E-mobility and the electric vehicle revolution. Promoted by the Paris Climate Agreement, government and the automotive industry are increasingly investing towards low-carbon and zero emission technologies: while governments are mandating aggressive emission targets that can only be met by alternative forms of mobility, automotive players are now accelerating their investment in electric vehicle (EV) technologies. The global stock of registered EVs surpassed the two million mark in 2016 (IEA, 2017); however, this still represents a tiny fraction of the global vehicle stock (0.1% for cars); yet the global electric car stock is forecast to range between 9 million and 20 million by 2020 and between 40 million and 70 million by 2025 (IEA, 2017). Signs of improvements from technologies being researched confirm that this trend will continue, narrowing the cost competitiveness gap between EVs and internal combustion engines. China is emerging as the global leader in EV with only a market share of 1.3% with a high growth potential. China was by far the largest electric car market in 2016, with 336 thousand new electric cars registered. Electric car sales in China were more than double the amount in the USA. Globally, 95% of electric car sales are taking place in just ten countries: China, the United States, Japan, Canada and the six leading European countries (IEA, 2017).

The global demand for minerals is expected to remain high. As a result of the trends previously mentioned, the global demand for minerals is expected to remain high. On an overall long-term basis, the **global demand for metals** is expected to remain robust (e.g. PGMs, tin), and even in some cases (e.g. iron, bauxite, nickel, lithium or cobalt) keep on increasing (a more detailed analysis is available in Table 3, in Annex 2). Likewise, the **global demand for construction aggregates** is projected to advance to more than 51 billion metric tons in 2019 (compared to 48 billion tons in 2015), and China is expected to remain by far the largest national consumer of aggregates in 2019 (Freedonia, 2016).

China´s urbanisation is expected to keep pushing the global metals demand. Nowadays the global economy is showing signs of improvement, the global GDP growth has picked up to an annualised rate of over 3% (OECD, 2017)and is expected to remain around 2.9 % in 2018-19 (World Bank, 2017); yet, policy support is needed for a durable and sustainable recovery (OECD, 2017). The global demand for mineral resources is expected to remain, at least, stable while the Chinese housing investment is booming and infrastructure investment is picking up on the back of regional initiatives, e.g. the Belt and Road, the Beijing-Hebei-Tianjin Corridor (OECD, 2017). Recent announcements (April 2017) by the Chinese government of plans to create the Xiongan New Area, a state-level new area south of Beijing and a 2,000 km^2 (three times the size of New York City) technology and innovation hub, will boost the metals demand. According to estimates by Wood Mackenzie (base case), the new project will add (to the global demand) around 20 Mt of steel demand, 400 kt of aluminium demand and 250 kt of copper demand during the first 10 years of its establishment (Wood Mackenzie, 2017).

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China maintains a leading role due to its urbanisation and further material development. China´s accumulated stock of metal in use is still far from reaching per-capita saturation[12] levels and is expected to continue growing, driving the global metals demand. For instance, steel in use is currently between 5 and 6 tonnes per capita, a stock that is about half of the current USA level and less than half the German and Japanese levels. Per capita in-use stocks of steel in several developed countries have levelled out in the range of 14 ± 2 tonnes (Pauliuk et al., 2013), so it is expected that Chinese stock will at least double.

The minerals industry´s agenda is set around the Sustainable Development Goals. The 2015 adopted United Nations Sustainable Development Goals (SDGs) is expected to remain until 2030 the guiding policy framework to keep fighting against persisting problems such as, i.a., poverty, hunger, lack of access to clean water, increasing wealth and income inequality, indecent work. The need for water will increase sharply with the increases in world population and the rise in the standard of living in emerging countries. Malnutrition affects 2 billion people today. With the predicted growth of world population, one can fear that in 2025, this number will increase (European Commission, 2009) Government and companies have endorsed the SDGs and have been working on mapping how best the SDGs can be incorporated into their strategies and operations.

After a long period of steady trade liberalization, **a surge in trade protectionism is nowadays apparent**. The WTO's Report on G20 Trade Measures (November 2016) reported that, for the seven months reviewed, G20 countries applied 85 new trade-restrictive measures, averaging almost 17 new measures per month; in the last report available (June 2017) the number of new measures was 42, averaging 6 per month (OECD et al., 2017). In the last years evidence has shown a surge in protectionist measures around the world; recently, it appears that the Trans Pacific Partnership between the US, Japan and a group of Asian countries, and the Transatlantic Trade and Investment Partnership (TTIP) between the US and the EU will not be ratified (Credit Suisse, 2017). A similar trend is taking place in the field of raw materials where there is a growing number of trade restrictions all over the world (BDI, 2015). Rules regarding export restrictions may often change, as exemplified by export restrictions which were placed and then lifted in Indonesia (tin) and China (rare earths, due to complaints by the USA, Japan and the EU to the WTO) (see Table 5 in Annex 5). To avoid the harmful effects of competition and ensure satisfactory trade conditions for both sides, countries have historically increasingly diversified their strategies to achieve their goals ranging from strategic trade partnerships (e.g. intergovernmental long-term trade agreements USA-Canada for many minerals, China, Japan and South Korea with Australia for the supply of iron ore and coal, Europe with South Africa for the PGMs supply), stockpiling (Japan, the USA) and direct capital participation in abroad (foreign direct) investments (e.g. China´s 'Going global' policy). The topic of 'critical raw materials'

[12] Saturation means that the increase in the amount of stocks of a certain metal (e.g. steel) reaches a point where it no longer grows as the region or country has developed and has sufficient infrastructure (buildings, transportation, communication, etc.)

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(understood as materials of economic importance and whose stable supply is at risk) has also come to the fore in recent years (Europe, USA, India).

Transparency, complex value chains and weak governance remain a challenge. In the last decades governments and the industry alike have taken further actions in recognition that political instability, lack of transparency and weak governance (involving corruption and mismanagement of revenues generated by the extraction of raw materials) remain key challenges of the minerals industry, especially in developing countries in Africa, Asia and Latin America (see Table 5 in Annex 5). The Extractive Industries Transparency Initiative (EITI) is nowadays the most widely implemented global standard to promote the open and accountable management of oil, gas and mineral resources. It is being implemented in 52 countries, many of which are known for weak governance problems (e.g. DRC), and has inspired a number of (EU Transparency and Accounting Directives, Canada´s Extractive Sector Transparency Measures Act). Complex global value chains represent a difficulty to monitor the sourcing and handling of minerals, which has enabled the proliferation of "conflict minerals" (minerals whose extraction is framed by armed conflicts e.g. cobalt in DRC, diamonds in Zimbabwe) and also allowed continuation of illegal mining operations (Latin America, Africa, China). Both activities are coupled with environmental problems and detrimental labour and social conditions. Responsible sourcing initiatives (e.g. OECD Due Diligence Guidance, Kimberley process) and networks (e.g. Responsible Sourcing Network) were developed aiming to avoid conflict minerals from entering into value chains. Africa has become (and is expected to remain) the centre of such initiatives. Another issue which remains a challenge is the need to enhance transparency in the global pricing of raw materials.

Minerals-based industrialization. Industrial policies remain at the centre stage of economic growth goals in industrialised nations, e.g. in Europe (EU´s Industrial Policy for the Globalisation Era). Yet, industrialization also remains a goal of some developing nations in Asia, Africa and Latin America. While many of such countries historically have showcased commodity export-led economies, there is a recurrent trend of new policies seeking different ways to add value to the domestically extracted raw materials and rely on that to progress towards a socio-economic development (the Africa Mining Vision, Chinese 13th Five-year-plan and the Made in China 2025 Action Plan, in Indonesia the Mining Law of 2009, in Bolivia the Sectoral Plan of Mining and Metallurgy Integral Development 2016-2020). While progress is slow in most of the developing countries, China has shown a different behaviour, e.g. while smelter and refinery production remains located mainly in developed countries, China has led a quick growth of refined copper and aluminium production (Ericsson and Hodge, 2012).

Social conflicts around mining operations remain a key challenge in the policy arena. Large-scale metal mining operations, due to the risk of creating long-term environmental pollution problems and the perception that they do not promote a true development, are now increasingly being scrutinized by the civil society, NGOs and international organisations. Moreover, in many mineral-rich developing

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countries government and companies need to deal with social opposition and violent conflicts with local communities who are against this type of extractive activities. While governments have adopted different measures to strengthen its regulatory role (e.g. by ratifying international conventions and agreements, by adhering to the EITI, by engaging in policy dialogues, e.g. OECD´s one), companies have implemented auto-regulation strategies (often generated in partnership with international organisations and governments) such as standards and guidelines, sustainability reporting (e.g. the Global Reporting Initiative), corporate social responsibility programs, responsible sourcing initiatives, etc. Yet, despite these initiatives, social conflicts, sometimes very violent ones, are still reported all around the world, with major ones in Latin America (especially in Peru), in Asia and Africa (see Table 5 in Annex 5).

Resource efficiency is increasingly being placed in the agenda of developed countries, yet mining expected to continue. Policies and strategies to increase resource efficiency (to increase the output with equal or less input) in the production and consumption systems (also called resource-efficient economies) are now gaining a place among the top priorities of industrialised nations (e.g. via the G7 Alliance on Resource Efficiency, the Chinese Circular Economy Development Strategy, the EU´s Circular Economy Action Plan, Japan´s Sound-material cycle society policy). In the field of metals recycling caters nowadays for between 25 and 50% of the demand for the most widely-employed metals (iron, aluminium, manganese, nickel, cobalt, gold, silver, tungsten) but it is much lower selenium, osmium, and very low (below 1%) for lithium and rare earths. Despite the efforts devoted to research into recycling, substitution and re-use technologies in the coming years, it is expected that mining will keep on having a leading role in the foreseeable future to ensure that such minerals remain available to the industry and the economy.

4. European mineral policy context

4.1. Current policy context

The **2030 Agenda for Sustainable Development** and the SDGs are the international guiding policy framework for the European Union (EU) as it has committed to implement the SDGs both in its internal and external policies, e.g. via its Communication "*Next steps for a sustainable European future*" (SWD (2016) 390 final). As one of the SDGs and as a signatory to the Paris Climate Change Agreement, the **EU is also committed to implementing a low-carbon economy**, as described in its low-carbon economy roadmap[13] which set the targets of reducing its GHG emissions to 80% below 1990 levels by 2050 (through domestic reductions alone rather than relying on international credits).

[13] See COM (2011) 112: A Roadmap for moving to a competitive low carbon economy in 2050 (08 Mar 2011)

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The EU belongs to the world´s most technologically advanced regions and is the world´s second (after China) largest consumer (and importer) of many of the most-widely employed minerals such as iron ore, primary aluminium, nickel, etc. Despite a long mining history, nowadays Europe cannot be described as a key mineral producer at a world scale, despite its mineral potential (see Annex 3). The EU is close to being self-sufficient in construction minerals and most industrial minerals (Vidal-Legaz et al., 2016); however, it shows a clear dependence on imports of metals because the domestic metallic resources are covering only a minor part of its actual demand. For instance, in the period 2000-2014, the average import dependency[14] of the EU for non-metallic minerals reached 2.3 % whereas for metal ores it was on average 59 % (MinPol, 2017a). For many metals (e.g. antimony, vanadium, REE) the dependency reached 100 % (MinPol, 2017a).

Aware of such dependency, the EU is seeking to reduce it by investing in improving import conditions, domestic conditions for mining and increasing the resource efficiency, all under the umbrella of the *Raw Materials Initiative* (RMI), launched in 2008[15], and supporting actions along three pillars:

- Fair and sustainable supply of raw materials from global markets;
- Sustainable supply of raw materials within the EU;
- Resource efficiency and supply of "secondary raw materials" through recycling.

The EU is supporting objectives of the RMI intensively by different channels such as R&I funding programmes (HORIZON 2020) which cover research aiming to advance in the three pillars as mandated in the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials. Those three pillars are also framed by the regular identification of a number of 'Critical Raw Materials' (CRMs) which are considered a priority and are selected based on their economic importance and supply risk to the EU; the methodology for the selection of minerals (Blengini et al., 2017) and the list of CRMs are regularly updated (2017 update by Deloitte et al., 2017).

Main policy actions along the first initiative involve strategic dialogues (Raw Materials Diplomacy) with major global and EU suppliers of minerals (China, USA, South Africa, Russia, Turkey), also of materials considered 'critical' (e.g. cobalt from the DRC), via trade policies focusing on transparency, e.g. of value chains, as in the 'Trade for All' strategy launched in 2016, and via agreements/partnerships with countries and regions, e.g. encouraging free trade.

The EU also supports the fostering of (sustainable) domestic extraction by collaborating with Member States to improve the framework conditions for the minerals industry, e.g. by improving the mineral policy framework, permitting procedures, exchanging best practices, etc. Results of an EU-

[14] Understood as the percentage of EU imports in total materials made available to the EU28´s economy.

[15] European Commission, DG Enterprise and Industry (2008): The Raw Materials initiative – Meeting our critical Needs for Growth and Jobs in Europe, COM (2008) 699

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commissioned recent study on the EU´s legal framework determined that it is well-developed and adequate for the non-energy extractive industry (NEEI) sector but permitting procedures are undermined by the lack of a level-playing field. The study concluded that the TFEU, relevant conventions, and the EU Internal Market, Environmental, Nature Conservation, Water, Emissions, Chemical Safety, Extractive Waste and Occupational Health & Safety Directives provide an adequate legal framework for the NEEI sector and establish principles (e.g. legal certainty, equal treatment, transparency) and guarantees aligned with globally accepted mineral investment criteria. However, it was also identified that the EU´s legal framework is undermined by several issues which restrict permitting procedures and act against a level playing field for the NEEI sector (e.g. the industry has frequently reported 'overly restrictive' approach in the implementation of the Birds and Habitats Directives) (MinPol, 2017a).

A key constraint across the EU regarding mining and mineral policy approaches is the heterogeneity found at national level. Mining and mineral policy are competences of the EU´s MSs and approaches differ by country ranging from up-to date, green and efficient ones taking into account sustainability and RMI targets (e.g. Finnish Mineral Strategy and Green Mining Concept, Austrian Mineral Resources Plan and others - see Annex 6.) to less developed ones with regulatory frameworks that render permitting process time-consuming, complex and with quite unpredictable outcomes (Eunomia et al., 2015). Delays in permitting procedures, e.g. due to successive appeals to permits granted by permitting authorities (mining or environmental) coupled with well-known judicial cases (e.g. Rosia Montana in Romania, Nora Kärr in Sweden) adversely influences the investment attractiveness of some EU jurisdictions (MinPol, 2017a).

Social acceptance problems as deterrent to mining investments. Europe is one of the most densely populated and developed regions in the world. The use of land and the ability to agree on the trade-offs between competing land uses is crucial to meet the socio-economic needs of its citizens as well as the conservation of nature and biodiversity, cultural heritage, and other aspects of overall wellbeing. Conflicts of interests appear quite regularly when it comes to any development project, especially mineral development ones, and the lack of early instances for stakeholders to engage in meaningful dialogues is often a cause of delays of permitting procedures, e.g. due to appeals to granted permits (MinPol, 2017a). **There is currently a lack of social acceptance of new mining projects in various European jurisdictions**. It has now become clearer for mining companies (not only in Europe) that successful mining project needs to be accompanied by a good reputation of the company and good relationships with the local communities, i.e. they need to obtain a "social licence" to operate (Bice, 2014; Falck, 2016; Koivurova et al., 2015). In several jurisdictions, where the public awareness about mining is very low (due to non-presence of mining culture, previous experienced accidents), there exists the possibility of a lack of social acceptance, or even the opposition to new projects by part of the population especially due to fears of environmental pollution. Well-known cases where

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the lack of social licence to operate has deterred mining investments are the Roşia Montană[16] or ElDorado´s Skouries gold-copper deposit in Greece whereas in Poland social opposition and the Not In My Backyard (NIMBY) syndrome have been reported (Nieć et al., 2014).

The topic of resource-efficiency is a priority in the EU´s agenda for years now: The European Commission fosters R&I on recycling and resource efficiency, thereby pushing for transition towards a circular economy (European Commission, 2011, 2012a, 2015). There is a wide encompassing legal framework pushing for resource-efficient economies framed under the EU´s 2020 Strategy (resource-efficient Europe flagship initiative) and EU Directives such as the Directives on End-of-Life Vehicles from the year 2000, Batteries Directive from year 2006, Waste Framework Directive from year 2008, Eco-design Directive from year 2009, the Circular Economy Package, etc. This direction may be compared with the scenario 2 "EU goes ahead" of the POLFREE project (see http://polfree.seri.at/eu-goes-ahead-in-short/). To avoid the illegal exports of hazardous wastes, e.g. illegal exports of high-value waste streams such as WEEE or of end-of-life vehicles, has enacted the Waste Shipment Legislation (Regulation (EC) No 1013/2006) implementing the provisions of the Basel Convention.

E-waste management is a central topic in Europe due to the large amount of metals involved in it; in the last years some progress in Europe has been done mainly pushed by the WEEE Directive (from 2003, amended in 2012 2012/19/EU) which provided for the creation of collection schemes where consumers return their WEEE free of charge. Yet, gaps remain in the implementation by national economies, particularly in the achievement of collection targets. Other positive recent developments which are expected to improve the e-waste management situation are the technical standards WEELABEX first, now adopted by CENELEC (Interview F. Magallini, 2017).

4.2. Emerging trends and potential future development

Policy frameworks and government policies remain a key driver towards a sustainable minerals supply to Europe. Various scenarios were developed for Europe´s future development such as Global Europe 2050 (European Commission, 2012b), scenarios by the POLFREE[17] and INTRAW[18] projects, among

[16] As promoted by campaigns, reasons for the opposition are fears of potential pollution caused by the technique to be employed in the project (gold cyanidation). Such concerns are framed within a historical context in which Romania experienced serious environmental incidents (Certej in 1971, Baia Mare in 2000) involving pollution and fatalities caused by cyanide spills in the tailings dam of mines which are still present in the memory. However, it has also been reported that part of the population is in favour as they prioritize jobs over environmental pollution fears (cf. http://www.mining.com/web/social-licence-to-operate-trust-before-gold/).

[17] The finished POLFREE project (Policy Options for a Resource-Efficient Economy, http://polfree.seri.at/) investigated the 'web of constraints' behind why we do not use natural resources as efficiently as we might, and how a resource-efficient economy looks like, and how may we get there.

[18] The ongoing INTRAW (International Cooperation on Raw Materials, www.intraw.eu) project aims to map best practices and boost cooperation opportunities on raw materials with technologically advanced non-EU countries; the ultimate goal is to set up and launch the International Observatory for Raw Materials as a definitive raw materials knowledge management infrastructure.

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others. All of them are dependent on the level of policy dialogue between industry and government towards the sustainable supply and the right public engagement in achieving resource efficiency. Also the latest Join Research Centre (JRC) report about visions of 2050 of the non-ferrous metals manufacturing states that *"There is a call for policy to further develop trade policies favouring a level-playing field, including enhancing transparency in the global pricing of raw materials, developing trade defence measures, and further negotiating free trade agreement to offset protectionism"* (Dessart and Bontoux, 2017). The importance of policy frameworks and the role of governments in the mineral sector is therefore one of the key drivers of the future development.

The importance of land use planning to facilitate access to land for the mining industry: the European example. The transition to a Circular Economy is not the only instrument that could lead the European society to a sustainable development path. The EU´s future growth also depends on how its member states will restart its exploration activities and mining industry. In this point, the key role will be how they will manage to handle the harmonisation of well-established nature protection and civil society engagement with higher national interests. One possible way would be the definition of ´mineral deposits of public importance´ and its proper implementation into land-use planning, the objective of the MINATURA 2020 project (www.minatura2020.eu). Innovative and green technologies allowing to mine and refine low-grade or problematically accessible deposits together with indispensable effort in substitution of less abundant minerals could also improve outlooks significantly *(*www.slim-project.eu; www.intmet.eu). For the highest import-dependent minerals it is essential the diversification of import channels to minimize the supply risk.

5. American mineral policy context

5.1. United States of America (USA)

Withdrawal from the Paris Agreement. USA is the world´s third largest GHG emitter (Ge et al., 2014) and signed the Paris Agreement on Climate Change. Yet, recently, President Trump stated that the USA will withdraw from the Paris Agreement unless some the terms are improved on the USA´s side.

Tradition in minerals supply security policies. The debate on a secure supply of raw materials has a long tradition in the USA and is strongly linked to military and security interests in USA policymaking. Since the 1970s (and before), the USA have pursued an exemplary strategy of securing their raw and base materials supply. Traditionally, this policy aimed at (Tiess, 2011):

- creating or maintaining a capacity of producing minerals and base materials which is sufficient to withstand a political or economic pressure from outside, including a limited protection of their own resources; the so-called national defence stock pile, a system of strategic mineral reserves intended to support military and civilian needs at times of national emergency.

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- comprehensive politically-based efforts to obtain the best possible access to supply sources in other countries, particularly by promotion of direct investments of American companies (on the part of the State) for prospecting, exploration, and exploitation of foreign mineral deposits, which includes an expensive geographical diversification of supply sources[19].

The overall strategy to reduce USA´s reliance on uncertain sources of supply of strategic materials is based on a combination of three approaches (USGS Department of Energy, 2010): (i) increase the diversity of world supply of strategic metals through exploration and development of promising deposits, both foreign and domestic; (ii) decrease demand for strategic metals through the implementation of improved manufacturing processes and recycling of strategic materials from scrap and waste; (iii) identify and test substitute materials for current applications and develop new materials with reduced strategic material content for future applications . Compared to the EU, the USA have other advantages which bring them in a better position to effectively secure their mineral supply. Those are: a) less dependency on mineral imports (larger domestic mining industry), b) an economic potential which allows to develop cheaper local resources and create large stocks, c) the performance of multinational companies which have their decision-making centres in the USA, d) the existence of a "decision making authority" with full powers centralized in Washington (Tiess, 2011).

On 29 November 2011, the Transatlantic Economic Council (TEC) agreed to a Raw Materials Cooperation Work Plan, which included common issues such as trade cooperation, resource efficiency and recycling, research and development on raw material substitution and reduction, waste shipment and examined best ways to share raw materials data in a way which supports policies promoting a sustainable supply of raw material. As part of this effort, the two sides were instructed to consider the results of ongoing EC and United States Government studies of raw materials resource availability, trade flows, and criticality and of other supply and demand analyses.

Concerns over supply security of 'critical minerals' and substitution/recycling as priority areas. The U.S. Department of Energy (DOE) commissioned in 2010 and 2011 reports to evaluate materials considered 'critical' for a clean energy economy concluding that diversified supply sources are essential, and that substitution and recycling should be promoted. The USA is a world leader and has a long-lasting R&I culture, much of it powered by military research alongside national security and defence goals. The DOE remains interested in criticality issues and remains involved in international discussion and collaboration through the annual Trilateral US-EU-Japan Conference on Critical Materials for a Clean Energy Future, the US-Australia Joint Commission Steering Committee Meeting

[19] See INTRAW´s report on the USA where it was shown that the USA relies a lot on imports of raw materials, especially from Canada which is its main source (e.g. wood, minerals, oil); available at http://intraw.eu/wp-content/uploads/2015/04/INTRAW_WP1_Countryreport_USA_LR.pdf

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on Science and Technology, the US-Japan Roundtable on Rare Earth Elements Research and Development for Clean Energy Technologies, and the Trans-Atlantic Workshop on Rare Earth Elements and Other Critical Materials for a Clean Energy Future (Barteková and Kemp, 2016). Moreover, the USA still retains, like Japan, the National Defense Stockpile administered by the Defense Logistics Agency. DLA-Strategic Materials currently stores 37 commodities. The commodities are stored at 6 locations throughout the USA and have a current market value of approximately USD 1.1 billion. Commodities range from base metals such as zinc, cobalt, chromium and manganese to the more precious metals such as iridium and platinum (DLA, 2017).

Rolling back the Dodd-Frank Act´s Section 1502 endangers progress in the fight against conflict minerals in Africa and elsewhere. In early 2017 President Trump ordered a review of the 2010 Dodd-Frank Act. Even though the Act serves as a comprehensive set of financial regulatory laws seeking to prevent future financial instability in the USA, Section 1502 has been of substantial importance in the fight against conflict minerals as it mandates that corporations are responsible for reporting on their supply chains such that they disclose whether or not they are buying minerals from armed groups. It has been claimed that Section 1502 should be repealed or replaced due to various reasons such as costs of implementation or apparent lack of clarify of whether such section has reduced the control of armed gangs or eased human suffering in the Congo (Compere and Jurewicz, 2017).

Ageing workforce and shortage of skilled workers. The mining industry is coming under pressure due to an ageing workforce and a potential shortage of skilled labour. Some studies project the mining industry to be growing by about 50,000 workers by 2019 but the industry will need 78,000 additional replacement workers due to retirement (total of 128,000 new positions by 2019). By 2029, more than half the current workforce will be retired and replaced creating a skill and knowledge gap the industry may be challenged to accommodate (Brandon, 2012). This is also true in the geoscientists labour market, where there were approximately 324,000 geoscientists employed in the USA in 2014, but over the next decade 48% of the workforce will be at or near retirement, with a predicted shortage of around 90,000 geoscientists (Wilson, 2016).

Deficit in transportation infrastructure investments appears to remain a problem for the mining industry. For decades it has been claimed that public spending in transportation infrastructure in the USA has remained too low, having reached 1% of the GDP from the 1960s until the mid-1970s, and having stagnated around 0.8% from the 1980s (Markovich, 2014). The current Trump administration has promised to reach a target of USD 1 trillion investment (over 10 years) in transportation infrastructure funded via public-private partnerships, of which USD 200 billion will be invested as

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public spending in the period 2018-2027[20]. Such target appears, though, lower in comparison to public spending in transportation infrastructure in 2014 (USD 279 billion)[21].

Long permitting times remains a major concern for the mining industry. The industry believes that the USA has an inefficient permitting system which requires multiple permits and multiple agency involvement, involvement of other stakeholders, including local indigenous groups[22], the general public and NGOs, which makes an average of 7 to 10 years to secure the permits needed to commence mining operations, whereas, in comparison, Canada or Australia it is believed to be an average of two-year's time (SNL Metals & Mining, 2015). The introduction of the 'National Strategic and Critical Minerals Production Act' bill[23] to the national Congress in January 2017 seeks to reduce permitting times by requesting the Bureau of Land Management (BLM) or the Forest Service to appoint a project lead for the mine permitting process to coordinate with other agencies to ensure that the agencies minimize delays, set and adhere to timelines for completion of the permitting process, set clear permitting goals, and track progress against goals (Amodei, 2017).

5.2. Canada

The mining industry plays an essential role in Canada´s economy, at the federal and provincial level. **Canada´s mining policy framework** establishes that ensuring a responsible mineral development is a shared responsibility of the federal and provincial governments. The framework highlights the importance of a mature modern legislative regime (one that provides clear lines of responsibility and accountability and provides the foundation of good governance), promotes financial benefit optimisation (for companies and for society at large, e.g. via impact benefit agreements with communities), duty to consult with local communities and aboriginal peoples, of environmental management and post-mining transitions, as exemplified by Ontario´s approach (Ontario´s Mineral Development Strategy) (Walters, 2013).

Regulatory burdens remain a challenge. New mines and major expansions must undergo federal reviews and approvals in addition to the review and permitting requirements of their provincial or territorial jurisdiction. The industry has claimed that the efficiency and predictability of these processes are an important determinant for mining projects globally and Canada persists in a

[20] https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/budget.pdf (accessed 08.09.2017)

[21] https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/49910-infrastructure.pdf (accessed 08.09.2017)

[22] Many different words and phrases are used to describe people who have an ancestral connection to a particular territory. In Canada and Australia, many use the term 'Aboriginal' or 'Aboriginal Peoples'. In the United States, the most common term is 'Native American'. Internationally, the most commonly used term is 'Indigenous', 'indigenous peoples' or 'tribes'. In this deliverable, the term 'indigenous people' is employed

[23] https://www.congress.gov/bill/115th-congress/house-bill/520 (accessed 08.09.2017)

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prolonged period of uncertainty. The industry claims that under the Canadian Environmental Assessment Act it has seen a deterioration in federal and provincial coordination and among federal government departments, which has created delays and uncertainty. There has also been duplication in provincial processes and federal intrusion into provincial jurisdiction, resulting in inefficient and costly impacts to project economics (Marshall, 2016). These issues are expected to be improved with the on-going review of the federal environmental assessment process launched in 2016.

Shortage of skilled labour. For more than a decade, the Canadian mining sector has been involved in a skills shortage process with fierce competition from companies in other countries recruiting Canadian graduates and workers. The Canadian mining industry foresees that it will require between 87,000 and 130,000 new workers over the next decade (baseline and expansionary scenarios) (MiHR, 2017), a demand which is not expected to be catered by new entrants into the labour market, and which will be pushed by a growing number of retirements: by 2025 the Canadian Mining Industry Human Resources Council forecasts that more than 51,000 employees will retire from the sector (Marshall, 2016). Thus, the main challenge of the industry is establishing a sustainable supply of labour that is able to withstand the economic volatility that characterizes the sector.

Conflicts with First Nations remains a challenge in many provinces and territories. The Canadian government has been working to advance reconciliation and renew a nation-to-nation relationship with Indigenous peoples. Land claims stand at the centre of conflicts and claims, and mining companies are pushed to go beyond benefit-sharing agreements such as Impact Benefit Agreements (IBA) as the way to build partnerships and avoid First Nations opposition. An example of good practice is Saskatchewan province where, unlike the British Columbia (B.C.) where disputed land claims are affecting the perceptions of miners, it is covered by historic treaties and Treaty Land Entitlement agreements. These agreements allow First Nations to purchase Crown land anywhere in Saskatchewan to convert to reserve land, providing land certainty not currently found in provinces like B.C., where more than 100 % of the land is under claim with very few historic or modern treaties. This has made Saskatchewan the most attractive jurisdiction for mining investment in Canada and a top one in the world according to the Fraser Institute. However, conflicts sustain in many territories and provinces which is also expected to continue in the coming years.

Conflicts with Canadian mining companies' performance abroad. Canadian (Canada-based) mining companies represent a strong global player: Canadian financial markets in Toronto and Vancouver are the world's largest source of equity capital for mining companies undertaking exploration and development and it is estimated that in 2013 over 50% of the world's publicly listed exploration and mining companies were headquartered in Canada (Government of Canada, 2016). Such a global participation in the industry is coupled with many social and environmental conflicts related to operations worldwide, including multiple accusations of human rights violations, participation in corruption, and other violent episodes associated with how operations work in each territory. The

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'Open for Justice' campaign by Mining Watch Canada, the Canadian Network on Corporate Accountability and the Working Group on Mining and Human Rights in Latin America have collected dozens of examples (see the cases analysed in JCAP, 2016; Working Group, 2014). The Canadian government has acknowledged this situation and launched in 2014 the strategy '*Doing Business the Canadian Way: A Strategy to Advance Corporate Social Responsibility in Canada's Extractive Sector Abroad*' which shows the government´s expectation that Canadian companies will promote Canadian values and operate abroad with the highest ethical standards.

Transportation infrastructure deficits in northern and remote regions are expected to be reduced via public investments. The Canadian industry has often called for improvements in the transportation infrastructure, especially in northern and remote regions where the cost to explore and build and operate new mines is as much as 2.5 times higher in northern Canada, largely as a result of a lack of critical infrastructure (MAC, 2015). The federal government has now created the Canada Infrastructure Bank (CIB), an arm's-length organization dedicated to increasing investment in growth-oriented infrastructure managing funds from the federal government which shall be invested through loans, loan guarantees and equity investments. The government has also recently launched the "Invest in Canada Plan" allocating over CAD 10 billion for trade and transportation (half of it financed by the CIB) and CAD 2 billion over 11 years to support a broad range of infrastructure projects in rural and northern communities.

5.3. Brazil

Brazil is expected to remain a major global minerals supplier despite corruption. Brazil´s high-level recent corruption and money laundering scandals reduced the country´s political stability (Long, 2017); however, it is unclear to what extent such scandals will negatively affect mining investments.

New mineral policy in force but actions lacking implementation. Since 2008, the proposal of a New Regulatory Framework in replacement of the current Federal Mining Code (Decree-Law No. 227/1967) has been often discussed but only in 2011 the first concrete step was taken by means of the issuance of the Ministry of Mines and Energy Ordinance No. 121/2011 which ratified the 2030 National Mining Plan ("PNM 2030"). The plan aimed to guide the policies and rules for the development of the mining sector in Brazil for the next 20 years. The PNM 2030 officially introduced the proposal of creating the National Council for Mineral Policy and the National Mining Agency in replacement to the National Department of Mineral Production. Also the PNM 2030 proposed a set of objectives to diversify the mining sector, encourage R&I, give proper treatment to minerals deemed as strategic, and support small producers, among other actions. Yet, in practical terms, most of the proposed actions still lack implementation (Trindade, 2017).

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Further promotion of mining, e.g. at the expense of protected areas. As previously mentioned, despite corruption scandals, the government keeps promoting the mining sector. The National Mining Plan towards 2030 foresees growth in mining investments to be around 36% for iron, 6% for gold and copper (in comparison to 2010 levels) (Ministerio de Minas e Energia, 2011). Yet, this happens at the expense of other land uses: in August 2017 Brazil's government abolished a vast national reserve in the Amazon rainforest (National Reserve of Copper and Associates, roughly 4.6 million hectares, the size of Estonia) to open the area to metal exploration (WWF, 2017). This is in line with recent findings which show that mining is a major driver of deforestation (and consequently exerts strong pressure on biodiversity) in the Amazon rainforest (Sonter et al., 2017).

Vale is heavily investing in pilot innovation programs. Vale´s S11D iron ore project is nowadays its landmark innovation in which it is introducing a truckless system which replaces traditional off-highway trucks for conveyor belts and is expected to reduce diesel consumption by about 70 %. Another innovation is the dry processing which is expected to cut water consumption by 93 %, also avoiding the need of tailings dams and reducing the risk of catastrophes (e.g. Samarco accident).

Lack of SLO. Just like in other LA countries, in Brazil there´s a growing movement of grassroots organisations (networks such as those Affected by Vale) which oppose large-scale mining activities. Some of the reasons behind such opposition include the forced selling of properties, conflicts with indigenous peoples, lack of meaningful consultation and environmental concerns.

5.4. Latin America

Weak governance, mismanagement and the emergence of CSR. With some exceptions like Chile or Uruguay, in general countries of the Latin America region have problems in the enforcement of the rule of law and with the control of corruption, as indicated annually by the Resource Governance Index of the Natural Resource Governance Institute. According to Transparency International´s 2016 Corruption Perceptions Index, all Latin American countries (except for Uruguay, Chile and some islands) rank with a high level of corruption[24]. Mismanagement of revenues has also been commonly reported as a serious problem which prevents a fair distribution of economic benefits to the local communities where projects are placed. As a response to that and also as a strategy to gain legitimacy, CSR has emerged as a leading practice among most companies operating in the region.

Human rights violations, illegal mining and resistance to 'extractivism'. Associated with social conflicts, abuses and human rights violations have been alleged extensively in Latin American countries, both associated with legal and illegal operations. Illegal mining has grown in the last years especially for

[24] https://www.transparency.org/news/feature/corruption_perceptions_index_2016

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gold as shown in large illegal areas such as Madre de Dios in Peru or the Chocó region in Colombia (e.g. in Colombia close to 80% of all the gold produced in Colombia comes from operations without mining titles) (Bustos, 2017). Movements pursuing a resistance to 'extractivism' (an economic strategy in which the goal of a country is to attract FDI and extract and export commodities without any long-term goal of advancing in the value chain of the extracted raw materials) grew in the region. Forms of resistance include land and territory struggles, struggles for water and the environment, i.a. The role of women should be underlined here.

Recycling of minerals not yet a priority. Latin American countries are still in an early stage of growing their stock of minerals, e.g. of metals, as urbanisation increases. For instance, for steel, modelling predicts that (per-capita) steel stocks in China will saturate by 2050 while those in Latin America only by 2100 (Pauliuk et al., 2013). Thus, in comparison to developed countries which tend to have a much larger option to move towards a circular economy, Latin American countries are less advanced and the recycling of minerals (and resource efficiency strategies in general) are only becoming a priority in selected countries and for selected waste stream. Some advances can be seen e.g. in e-waste management in countries such as Colombia, Chile and Peru.

5.5. Emerging trends and potential future development

Some countries are advancing towards a greater transparency in the management of revenues. By 2017, Mexico, Peru, Colombia, Honduras, the Dominican Republic, Suriname and Guyana are members of the EITI, while big players like Chile and Brazil are not members.

Unlike Africa, there is no regional common policy framework to advance towards an industrialisation of mineral resources. An exception to this rule is Bolivia which has been keeping a steady commitment to advance in the industrialisation of some of its resources, most importantly with lithium via the Sectoral Plan of Mining and Metallurgy Integral Development 2016-2020.

In Latin America, there is a trend of increasing mineral investments despite unresolved social conflicts. Mining investment in LA increased by more than 100 % between 2002 and 2012, and investments in exploration have remained strong in the region, especially led towards Chile, Peru, Mexico and Brazil. China has recently become one of the main actors with increasing FDI, besides capital lending, but has been associated with detrimental social and environmental impacts (Ray, 2016). The mining boom in LA has happened alongside a growing number of social and environmental conflicts associated with the industry (Bebbington, 2011): by September 2017 the database of the Environmental Justice Atlas[25] reported 256 cases of conflict related to the extraction of mineral ores and building extractions. Conflicts have sometimes escalated to very high levels and often environmental activists have been killed: according to Global Witness, of the 185 environmental defenders killed worldwide

[25] https://ejatlas.org/

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in 2015, 122 were in LA. Some of the main reasons underpinning conflicts are land claims, benefits distribution, disputes over water shortages, risks of pollution and pollution incidents (e.g. the Samarco tragedy where 19 persons died) and created more resistance against new projects. A remarkable case is Peru which, despite being a 'hot-spot' of conflicts, has increasingly become a main destination for investments (Figure 15).

6. Asian mineral policy context

6.1. China

Planning is a key element of a socialist economy, although China embraces more and more market economy paradigms, combining the two in a 'Chinese Style' economy. Since 1953 a series of 5-Year-Plans were developed by China's Communist Party, the current 13th edition covering the years 2016 to 2020. The 13th Five-Year Plan acknowledges and promotes the fact that China has become a major player in the world economy and abandons some of the earlier policies.

Mineral resources and sustainable development as cornerstones of Chinese economic policy development. China attaches great importance to sustainable development and the rational utilization of mineral resources, and has made sustainable development a national strategy and the protection of resources an important part of this strategy. Immediately following the UN Environmental and Development Conference in 1992, the Chinese government took the lead in formulating the "China Agenda 21 -- the White Paper on China's Population, Environment and Development in the 21st Century". It approved and implemented the "National Program on Mineral Resources" in 2001, and, in 2003, began to implement "China's Program of Action for Sustainable Development in the Early 21st Century". To build a well-off society in an all-round way is China's objective in the first 20 years of the new century. China will depend mainly on the exploitation of its own mineral resources to guarantee the needs of its modernization program. The Chinese government encourages the exploration and exploitation of the mineral resources in market demand, especially the dominant resources in the western regions, to increase its domestic capability of mineral resources supply. At the same time, it is an important government policy to import foreign capital and technology to exploit the country's mineral resources, make use of foreign markets and foreign mineral resources, and help Chinese mining enterprises and mineral products enter the international market (Falck et al., 2017).

Strong policy support to increase domestic exploration and extraction. The Chinese government has intensified geological exploration and improved the conservation and comprehensive utilization of mineral resources. The geological service was further strengthened, and as a result, the regional geological survey of 1:1,000,000 has covered the entire marine area under the jurisdiction of China for the first time. During the 12th Five-Year-Plan (2011-2015) the Chinese government spent EUR 73

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billion (RMB 568 billion) on geological exploration having achieved substantial increases in the mineral reserves of key metals: iron ores 85.08 billion tons, up by 17%; copper 99.10 million tons, up by 23%; tungsten 9.588 million tons, up by 62%, i.a. (Chinese Ministry of Land and Resources, 2016).

China invests heavily in R&I on REE. Since the creation of the Chinese REE innovation system in the 1960s, China has been continuously supporting investments in research on industrial uses of rare earths such as metallurgy, environmental protection, new materials and application in traditional industry. The Chinese Society on Rare Earths publishes the only two peer-reviewed journals on rare earths in the world: Journal of Rare Earths (both in English and Chinese) and Chinese Rare Earths (in Chinese only). Increased research funding and the foundation of national rare earth research centres, as well as transfer of R&I bases to China, have made China to become the global centre of research for rare earth science and technology (Barteková and Kemp, 2016).

Transition towards a low-carbon economy. In 2014 China published the Energy Development Strategy Action Plan (2014-2020) which aims to reduce China's high energy consumption through a set of measures and mandatory targets, promoting a more efficient, self-sufficient, green and innovative energy production and consumption (IEA, 2015). Given that China emerges as the world second largest economy and the first largest carbon emitter, the country is moving onto a low-carbon development path by setting targets to energy intensity reduction and carbon intensity reduction. On 3 September 2016, China ratified the Paris Agreement, and it has policies in place to reach its Nationally Determined Contribution (NDC) goals. These policies are currently centred around the targets set in its NDC, which include a commitment to peak CO_2 emissions by 2030 at the latest, lower the carbon intensity of GDP by 60%–65% below 2005 levels by 2030, increase the share of non-fossil energy carriers of the total primary energy supply to around 20% by that time, and increase its forest stock volume by 4.5 billion cubic metres, compared to 2005 levels (Climate Action Tracker, 2017).

Large investments in land rehabilitation and 'green mining'. During the 12th Five-Year-Plan (2011-2015) the Chinese government assigned EUR 2.3 billion (RMB 18.07 billion) subsidies for geological environment renovation projects. By the end of 2015, about 810,000 hectares of land damaged by mining development had been restored across China (Chinese Ministry of Land and Resources, 2016). At the same time China has been pioneering pilot programs of national green mines focused on improving mining image and livelihood, strengthening ecological protection (emphasize clear production, energy-saving and emission-reduction, promote recycling) and promoting social harmony as well as a green label for the standard operation, transition and upgrading, financing and listing and overseas development of mining enterprises (Lei et al., 2016).

Participation abroad – "going global" strategy. China´s participation in abroad markets (via direct investments, capital lending, e.g. infrastructure loans from the Chinese EXIM Bank to resource-rich countries from Australia to Zimbabwe) has rapidly increased in the last years. For instance, in Africa,

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Chinese mining companies control a mineral output outside of China to a value of 11 billion USD 2014 and China is expected to control 30-35% of African copper production in 2018 (Ericsson and Löf, 2017). Under the 'Going-global' strategy (first launched in 1999) China encouraged Chinese enterprises — primarily state–owned ones — to invest overseas. The majority of state-owned oil and mining companies now operate within a rapidly evolving strategic framework established by the SASAC (State-owned Assets Supervision and Administration Commission of the State Council). These companies are expected to focus on becoming internationally competitive and internationally listed corporations. The objectives of the 'Going global' strategy were, i.a., to ensure a continuous and competitive supply of minerals for its industry, via: 1) proactively participating in international exploration of natural resources, 2) by supporting downstream processing of steel, non–ferrous metals, oil and timber in resource–rich countries.

Threats of protectionism for minerals where China has a dominant supply position. Even though China´s protectionist policies cutting down its REE export quotas are already 7 years in the past, China´s dominant position as a global supplier of various minerals, including critical raw materials such as REE (China accounts for roughly 88 % of global REE production), indicates the latent supply risk if China decided to apply again restrictive export policies.

International cooperation. The Chinese 'Capacity Cooperation' policy aims to build partnerships between domestic and overseas firms, elevate Chinese industry in global value chains by boosting technology and investment, promote high-speed rail, nuclear energy and major construction projects and develop third country industries and markets to sustain China's growth. Projects are scattered around the world, with each province connected to a series of countries (China Policy, 2017).

China is strongly investing in a circular economy – global role in e-waste management. The Chinese government has been attaching much importance towards greater resource efficiency and the development of a circular economy under the understanding of modernization in an 'all-round way', i.e. facilitating industrialization, urbanization, informatization and ecological modernization synchronously with the aims of avoiding an environmental collapse in the country. China is still in a very initial phase towards a circular economy, but the impetus has been given by the Circular Economy Promotion Law (2009) and the Circular Economy Development Strategy and Immediate Plan of Action (2013) through which China established mid- and long-term goals. Actually, a circular economy stands in the centre of Chinese growth expectations: China has placed its hope on the circular economy development to achieve an economic growth rate of 6 % in the coming 17 years based on continuous reduction of waste discharges (Qi et al., 2016). Part of that is related to e-waste as China is one of the world's largest producers, consumers and exporters of electrical and electronic equipment as well as one of the largest importers of e-waste (Wang et al., 2013).

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6.2. Japan

Japan´s very high mineral import dependency and submarine mineral wealth. Japan´s industry is dependent on minerals imports almost to a 100%: the domestic mining sector contributes only with 0.1% to the GDP and the mining activity is mostly focused on the active Hishikari gold mine. The land-based portion of the country hosts very negligible reserves of bulk metals such as iron, lead, zinc and bauxite; yet Japan is an important world producer of some less abundant and small volume metals such as tellurium and selenium (2nd largest global producer) gallium, cadmium and bismuth (3rd world´s largest producer) and has considerable reserves of iodine. On the other hand, Japan´s marine territory could host significant submarine mineral reserves (polymetallic sulphides, cobalt-rich crusts, manganese and polymetallic nodules and REE), a potential explored via JOGMEC with promising results. For instance, JOGMEC successfully carried out the world's first crawl and mining test using a small test mining machine and started to develop actual machines; in 2014 JOGMEC pioneered the signing of the world's first cobalt-rich ferromanganese crust exploration area contract with the International Seabed Authority (ISA) and secured exclusive interests for Japan.

Japan´s successful multi-faceted minerals security policy. The development of Japan as a "processing country" has been enabled by a successful long-term policy of securing a stable supply of mineral commodities, particularly via securing imports. Japan, which, because of it unfavourable geologic structure, depends more than other countries on imports of mineral resources, has aimed for years to gain a foothold in developing countries and to develop joint venture structures to become an equal partner in the international mining companies, to develop marine transport and terminal equipment and thus reducing the load on inputs. The responsible Japanese Ministry achieved these goals in an exemplary collaboration with the industry under the motto "on the domestic market competition and outwards coordination of actions" (OECD, 1994). Japan's economic security relies on the stability of its foreign resource supplies. Defining the national goal as comprehensive security including mineral security, the main objectives of the country's mineral policy are the following: secure stable sources of minerals; systematically develop domestic mineral resources; actively promote development of overseas mineral resources through economic co-operation with mineral-rich developing countries; and stockpile rare metals (OECD, 1994).

Strategic trade partnerships remain Japan´s lead strategy to secure the minerals supply. Japanese authorities administer their overseas exploration and development assistance programmes so as to diversify sources of supply of minerals and metals. The aim is to increase the number of countries supplying a particular mineral to Japan and to diversify sources among the greatest number of countries. Bilateral agreements with Australia on commerce and business have a long history due to proximity and cost advantages as well as political stability and openness to foreign investment. The main imported commodities from Australia are iron ore, coal and manganese. The commercial

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agreement between Japan and Australia from 2005 has to be seen against this background: Japan, with 40% of iron ore imports and 30% of aluminium imports, is a major market for Australia in the mid- and long-term[26]. The Japan-Australia Economic Partnership Agreement (JAEPA) signed in 2014 entered into force in 2015 is one of several bilateral agreements. Since 2007, Japan entered into the Strategic Economic Partnership with Chile in order to support mutual exploration and development assistance programmes. Memorandum of Understanding between Japan and Iran, signed in 2016 is providing cooperation in steel and aluminium sector. Japan has signed bilateral economic partnership agreements with ASEAN, Singapore, Mexico, Malaysia, Thailand, Indonesia, Brunei, Philippines, Switzerland, Vietnam, India, Peru and from November 2015 also Mongolia. Japan was one of twelve signatories of the largest trade agreement on Trans Pacific Partnership on February 2016 in Auckland.

Direct investments in overseas mines and support to overseas R&I. Japanese trading companies and industrial groups invest in mining and petroleum projects run by international groups with the active support from the Japanese government through the Japan Bank for International Cooperation (JBIC), NEXI (trade insurance) and JICA (staff training, organizational training classes). Furthermore, international cooperation via agencies such as JOGMEC[27] and SOJITZ[28] has been crucial to achieve Japan´s objective of securing its mineral supply. Japan promotes exploration and exploitation of overseas mineral resources through economic cooperation with mineral-rich developing countries via resource diplomacy and commercial agreements (e.g. with Australia since 1957) (Murguía, 2015a) and via exploration in international deep-sea floor resources. For REE, JOGMEC strives to strengthen relationships with Bolivia, Southern African countries (e.g. Republic of Botswana), Vietnam, Central Asian countries and Canada. In the latter, for instance, JOGMEC has a joint venture with the Montreal-based Midland exploration company in the Ytterby project. For copper, most of the cooperation is with Chile: almost 40% of Japan´s copper imports are sourced from there. Japanese companies own shares in many of Chile´s major copper producing mines: Pelambres (40%), El Tesoro (30%), Escondida and Collahuasi (12%) (Murguía, 2015a). JOGMEC also works to ensure the supply of strategic minerals,

[26] Australia-Japan Free Trade Agreement – The Minerals Industry Case, October 2005; Submission to the Department of Foreign Affairs and Trade.

[27] Japan´s main raw materials-related agency which implements a multi-faceted approach to oil, gas and coal resource-rich countries to ensure a stable supply of resources for Japan. The strategy encompasses joint operations, training for experts, providing equity capital and liability guarantees, conducting joint venture geological surveys, among others.

[28] The Sojitz Group consists of approximately 400 subsidiaries and affiliates located in Japan and throughout the world, developing wide-ranging general trading company operations in a multitude of countries and regions. Sojitz often partners with JOGMEC providing financial support in initiatives seeking to secure the supply to Japan of strategic minerals like coal, iron ore, lithium, ferro-alloys, REE, industrial minerals, niobium, non-ferrous and precious metals. Examples include the Lynas Corp. REE processing plant in Malaysia, buying of shares in Brazil´s CBMM company (world´s largest niobium producer), etc.

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e.g. of lithium where JOGMEC built multiple processes for manufacturing lithium carbonate from brine water in the Uyuni salt lake in Bolivia.

Stockpiling of rare metals to continue in Japan. JOGMEC is in charge of promoting a rare metal stockpiling project as a safeguard against short-term supply disruptions from overseas or shortages in domestic supply of rare metals. This stockpiling system works since 1983 as a cooperative system between the government and the private sector to ensure stability of the Japanese economy.

Strong support to recycling and substitution. Japan is a world leader in terms of metal recycling: under the policy of establishing a 'sound-material cycle society', Japan recycles 98 % of its metals (Benton and Hazell, 2015). The government supports R&I efforts related to the recycling and substitution of metals, among which the "Elemental Strategy" (Nakamura and Sato, 2011) is the most well-known initiative. The starting point of the "Elemental Strategy" is to understand the function of each element deeply. Then through utilizing such functions of the element, Japanese scientists aim at substituting, reducing and recycling critical raw materials. Since 2012, JOGMEC has been developing recycling technology for recovering tantalum and cobalt.

6.3. Russia

Russia delays its ratification of the Paris Agreement on Climate Change. The Russian Federation is the world´s fifth largest GHG emitter (Ge et al., 2014) and one of the largest fossil fuels producers. Thus it has a large mitigation potential, yet Russia is the only big emitter that has not yet ratified the Paris Agreement, and instead has presented a strategy that may delay ratification until at least 2019.

Russia´s mineral policy seeks to increase its domestic mineral resource base. Currently the mineral policy of the Russian Federation is governed by the "Strategy of the geological industry development until 2030" (2012) and the "Reproduction and use of natural resources" state program (2014), both published by the Government of the Russian Federation (Nurgalieva and Silantiev, 2016). The strategic goal of the geological sector until 2030 is to create a high-performance, innovation-oriented system of geological study and reproduction of the mineral resource base. The main objective of the mineral policy is to ensure the country's economic reserves of minerals and geological information on mineral resources. These goals are achieved by solving problems on improvement of geological exploration in Russia and its continental shelf and the Arctic and Antarctic, obtaining geological information, ensuring the reproduction of the mineral resource base.

Government increased spending in exploration with public funds. The Russian government created in 2011 the Russian State Geological Company (ROSGEO), a state-owned exploration company to deal with various problems such as the lack of general geological knowledge of the country (land-based and submarine resources), lack of reserves in the state of large and medium-sized mineral deposits, reducing size of the newly discovered mineral deposits, in-completeness organisational form of the public sector geological industry and poor technical condition of its member organisations

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exploration, the loss of a significant part of the scientific and techno-logical capacity, aging, and shortage of staff (Nurgalieva and Silantiev, 2016).

Pollution problems associated to the mining industry. The mining industry has been facing environmental pollution claims for long, especially related to air and water quality. Examples include the nickel smelter of Kola GMK which has long been a controversial issue between Norway and Russia due to the extreme pollution levels, and the city of Norilsk polluted due to nearby nickel, copper and PGM factories which, by 2014, was producing 44% of the world's palladium (Luhn, 2016).

6.4. India

India is supporting a green growth strategy, but poverty and environmental degradation remain structural problems alongside economic growth trajectories.

India´s mineral policy encourages sustainability, privatisation and resource efficiency. India had already defined its National Mineral Policy in 1993. A new version was released in 2008, taking account of the significance of sustainability ("zero waste mining"), use of modern exploration and mining technology, considering environmental issues and establishing the necessary political framework to ensure transparency and support of private and state-run mining activities. It also proposes to substantially increase the scale of privatisation. A futuristic policy is based on a strategy of cooperation with other nations for sustaining India's growing needs. The National Mineral Policy 2008 states that the import of machinery and technology would be freely allowed, use of foreign state of the art technology and "participation for this purpose" is to be encouraged, in order to increase productivity, safety and minimise ore waste. Resource efficiency is to be achieved by the development of a recycling industry by 2050 and beyond (Tiess and Tiewsoh, 2011). Recently in 2016 National Exploration Policy was released by the government (an update to National Policy). It is mostly a technical document dealing in detail with geological potential, mapping and encouraging private players in exploration. The national mineral policy is not applicable to energy minerals.

India faces unique challenges in land acquisition and executing resettlement and rehabilitation. One of the reasons is that original settlers do not always get long-term jobs and hence do not want to vacate their land. Both public and private mining companies face delays to the tune of several years to start mining on the identified land in India (McKinsey, 2014).

India lacks advanced technology to mine resources that are difficult to access. Deep seated resources (e.g., coal) or minerals located in eco-sensitive areas have not been considered for mining due to lack advanced and eco-sensitive technology (McKinsey, 2014).

The Indian mining industry faces growth challenges and is expected to rely on imports. India's mining sector has traditionally been relatively small and has been growing slower than other major mining jurisdictions. Recent estimates warn that without accelerated growth in mining, India will have to further rely on heavy imports—175 Mt of iron ore import/yr, 300 Mt of thermal coal import/yr. Of

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concern are India´s CRMs, defined by economic (and import-dependency) importance to the manufacturing industry and their supply risk: rhenium, beryllium, REE, germanium, graphite, tantalum, zirconium, chromium, limestone, niobium, silicon and strontium (Gupta et al., 2016).

India lags in baseline geophysical and geochemical data generation, for e.g., only 2 % area is covered for gravity and magnetic analysis, only 4 % for sediment data and very little seismic data has been collected compared to countries such as Australia where 100 % of the area is covered for gravity and magnetic analysis (McKinsey, 2014).

Long lead time for environmental clearances/forest clearances, mining lease procedures. Long clearance time for different licenses and limitations like captive use also hamper mining output. E.g., it takes 4+ years to get a mining lease.

7. African mineral policy context

Many undeveloped countries still shape the African landscape coupled with weak governance and the emergence of CSR. The African continent is the region with the highest number (33 out of 47) of least developed countries listed by the UN (UNCTAD, 2017). Despite relatively strong economic growth performances over the past decade, many countries in the continent are facing structural and historical development challenges such as political instability, food and water insecurity, high unemployment, poverty and inequality, commodity dependence, environmental degradation, armed conflicts (risk), illegal exports (e.g. conflict minerals), violation of human rights, and low integration of the continent in the global economy. Weak governance remains one the central challenges in many African jurisdictions where there is a long history of mining and lack of social development. Due to the lack of government´s responses and in order to gain legitimacy mining companies have now made CSR the "new normal" in their operations in Africa (actually worldwide).

African economies remain dominated by exports of mineral commodities. African countries have a strong mineral potential (see Annex 3) and have traditionally been inserted in the international arena as raw material suppliers, e.g. since the year 2000, agricultural commodities, timber, metals and minerals, and hydrocarbons, natural resources have accounted for roughly 35% of Africa's economic growth. Resource-based raw and semi-processed goods accounted for about 80% of African export products in 2011, compared with 60% in Brazil and 40% in India (AfDB et al., 2013). At a global scale, African countries continue dominating the ICMM´s 2016 global Mining Contribution Index (MCI)[29]: the DRC is in the first place, followed by Mauritania, Burkina Faso, Madagascar, Botswana, Guyana, Uzbekistan, Liberia, Kyrgyz Republic, Tajikistan, Australia and Mozambique to name the top twelve.

[29] The ranking elaborated by the ICMM shows those countries most economically dependent on mineral production. It synthesizes into a single number the significance of the mining and metals sector's contribution to over 180 national economies

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Ghana appears in the 14th place, Guinea and South Africa appear in the 29th and 30th position (ICMM, 2016).

The African Mining Vision (AMV) – towards resource-led industrialization. For almost a decade now there has been an ongoing debate and political movements in Africa to add value to their domestic minerals before they are exported, i.e. a strategy to move forward in the value chain under a policy framework called the African Mining Vision (AMV). The AMV was adopted by the Heads of State in 2009, it is powered by the African Development Bank Group and aims to integrate the exploitation of the minerals endowment with larger scale for the industrialisation and how mining can be used to drive continental broad-based inclusive development at local, national and regional levels specifically: infrastructure, human resources, local beneficiation and value addition for the local production and manufacturing feedstock. It charts a path for generating and realizing various types of linkages arising from the mineral sector through industrial development and technical upgrading. The AMV recognizes the contribution of ASM to local economic development, and promotes women's rights and gender justice. It establishes a progressive fiscal regime to fight against tax evasion and avoidance and illicit financial flows from the mineral sector. It upholds FPIC principle for mining-affected communities and addresses the social and environmental impacts of mining.

However, eight years after its inception, questions remain over the slow pace of implementation and whether it is meeting the purposes for which it was created. Although 24 out of the 54 African Union member states are in various stages of nationally implementing the AMV, the progress has been slow and therefore out of step with the feverish expectations surrounding its creation. Only one country, Lesotho, has fully adopted the AMV through the development of a Country Mining Vision (Ushie, 2017). Yet, the AMV is expected to keep leading the political orientation of mineral-specific initiatives.

ASM presents both a significant opportunity and challenge to many African countries. The sector is counting a significant share of the global production in minerals and metals, and it means (directly and indirectly) livelihoods of many (not only) Africans. However, the lack of management and governance can be a source of risk and impact, socially, economically and environmentally. The IGF released the IGF Guidance for Governments: Managing Artisanal and Small-Scale Mining in 2016 to help the governments capture the positive benefits of ASM while ensuring that any negative environmental, social and economic risks are minimized or eliminated.

Africa remains the centre of many responsible sourcing initiatives. Due to the importance of Africa as the source of many high-value and conflict minerals such as cobalt and tantalum (from DRC) or diamonds (Zimbabwe) often mined under illegal and appalling social and environmental conditions, Africa has become (and is expected to remain so in the near future) the centre of responsible sourcing initiatives along the minerals value chain. These include those related to extraction (e.g. BGR´s Certified Trading Chains, Kimberley Process) and trading (responsible supply chains, e.g. OECD, Dodd-Frank Act Section 1502), as well as those to smelter verification (conflict free smelter program).

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Formal recycling systems are not a priority and informal recycling dominates in most African countries. The stock of metals (per-capita) in Africa is one of the world´s lowest (Graedel, 2010), i.e. African countries have historically exported their domestically extracted metals and do not have large stocks to recycle. Formal recycling systems are not a priority in most African political agendas and other social and economic urgencies such as poverty, hunger, malnutrition, inequality, instability, etc. are more important. As a result, informal recycling fills a vacuum that is left by municipalities that are often lacking the legal framework, resources, and capacity to implement a formal waste collection and treatment system. As such, the informal sector contributes to waste reduction, reduces costs related to municipal waste management, and recovers valuable materials which otherwise would be lost. High waste collection rates of up to 80% have been reported for various waste streams, including metals (Schluep, 2014). In the case of special waste streams, such as e-waste, this development is further triggered by often illegal shipment of second-hand goods from OECD countries on one hand side and through a high domestic demand for new electronic devices on the other hand side.

Informal recycling is an issue in almost all developing countries and strongly related to adverse effects for humans and the environment. Due to their daily contact with garbage, people working in informal waste management, including children, are exposed to various health threats. In the absence of rules and regulations, materials with no monetary incentive are either not collected, get dumped or are burned, leading to various adverse effects on the environment. In addition, hazardous chemicals are not removed in the recycling process, cross-contaminating recovered materials in the value chain (Schluep, 2016). Most critical are the impacts on vulnerable workers in the informal sector, such as children and women.

7.1. South Africa

South Africa's mining industry is supported by an extensive and diversified resource base, and has since its inception been a cornerstone of South Africa's economy. South Africa is part of the BRICS countries and is a middle income, emerging market with abundant minerals: it produces around 70% and has 94% of the global PGM reserves, it produces around 30% of the global manganese supply (and hosts around 29% of global reserves), produces around 5% of the global gold output, among others. It is the most developed country in the Sub-Saharan Africa with developed infrastructure and skilled work force. Yet, employment has declined (59,407 jobs lost in mining between 2012 and 2015) alongside a falling productivity over the last decade (e.g. due to intermittent labour unrest) reported for gold (Neingo and Tholana, 2016) and PGMs. The Industrial Policy Action Plan supports agriculture and mining and seeks to strengthen the competitiveness, productivity and trade performance of the core productive sectors of the economy. Relevant research and technology development continues to be supported through tax incentives (Falck et al., 2015). Yet, currently, South Africa´s mining industry competitiveness is being undermined by structural, energy shortages, electricity supply

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disruptions and increasing electricity prices, frequent labour unrest and lack of adequate infrastructure (e.g. rail, electricity) (Findt, 2017; Ramsbottom et al., 2015; Topf, 2016).

Aligned with Africa´s AMV, South Africa pushes ahead a beneficiation strategy which seeks to advance development through the optimisation of linkages in the mineral value chain, facilitation of economic diversification, job creation and industrialisation. It also aims to expedite progress towards knowledge based economy and contribute to an incremental GDP growth in mineral value addition per capita in line with the vision outlined in the National Growth Path, National Industrial Policy Framework and the Advanced Manufacturing Technology Strategy (Department of Mineral Resources, 2011).

The Black Economic Empowerment policies – the last Mining Charter amendment is a subject of criticism. The primary objective of the Mining Charter is to promote equitable access to the nation's mineral resources to all people of South Africa, to expand opportunities for Historically Disadvantaged South Africans (HDSA's) to enter the mining and minerals industry and to benefit from the exploitation, to promote employment and advance the social and economic welfare of mine communities and labour sending areas etc. The *Broad-based black socio-economic empowerment charter for the South African mining and minerals industry* was firstly published in 2004, amended in 2010 and most recently in June 2017. The reactions on the last amendment have not met the mining industry´s expectations. Especially the HDSA ownership in the mining sector requirements (now 30% from previous 26%) and revenue distribution are criticized as the new rules are the reason that *"South Africa continues to be a terrible destination for mining investment"* (Yeomans, 2017). The criticism came also because the industry was not involved in the discussion during the development stage (The Economist, 2017).

Corruption and poor administration from within the current government continue to be perceived on the increase and it is doubtful if announcements from South African government officials announced in 2013 that mining companies guilty of misrepresentation will have their licenses revoked will have the desired effect. Anticorruption measures that were put in place have not yet seen significant response and corruption charges plague the seat of government till present day.

Managing adverse environmental impacts and the safe and secure closure of mines remains a challenge. Long-standing water pollution problems by (acid mine drainage) are a key problem in the Witwatersrand basin (Durand, 2012; Naidoo, 2014).

7.2. Democratic Republic of Congo (DRC)

The DRC sustains a large mineral potential but such is undermined by instability and weak governance (conflict minerals). The DRC is designated by the OECD as one of the least developed countries. Its mineral potential is based on resources coming from the Central African copper belt (copper, cobalt) and the Zinc Zone in the eastern part of the country, which is associated with so called ´conflict

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minerals´- 3T (tin, tantalum, tungsten) and gold. DRC is leader in the production of some CRMs such as cobalt (50% of the global production in 2016). The country is well known because of its diamonds reserves (globally 2nd largest) (USGS, 2017) mostly in kimberlitic and alluvial deposit types. Given its vast mineral potential, it is expected to keep playing a lead role in those commodity markets.

Conflict minerals and regulations on responsible sourcing are moving on. This big country in Sub-Saharan Africa is at the same time lacking political stability and infrastructure. Mines in the east of country are located on the area considered being a source of ´conflict minerals'. New EU legislation EU/2017/821 from May 2017 will enter into force by January 2021 and imposes due diligence obligation for EU importers to ensure the materials supply from responsible sources with the aim to avoid minerals from conflict-affected and high-risk areas enter into the EU market. The EU this way continues with the effort of the U.S. Dodd-Frank Act (Section 1502) from 2010, and OECD´s supply chain due diligence. However, as previously mentioned, there is a risk that the USA will repeal or replace Section 1502 of the Dodd-Frank Act which might endanger progress achieved so far.

Illegally mined and traded cobalt is still being largely sourced from the DRC. A recent report by the Good Electronics Network (SOMO, 2016) claims that that foreign cobalt mining companies "*are involved in labour rights violations*" and companies using cobalt from DRC in their products have so far failed to conduct adequate human rights due diligence on their cobalt supply chains, i.e. they are still unable to determine from which mines their cobalt originates, making it impossible for them to identify and address human rights risks in those mines. The report states that most of the people, especially in ASM, including women and children are working in very hard environmental conditions and suffering unjust mining practices.

The implementation of OECD´s due diligence has been successful but progress is still needed. The report on five years of implementation of OECD´s supply chain due diligence was published by the EU Instrument for Stability. The report states that *"Significant gains have been made in raising the volume of responsible 3T (tin, tantalum, tungsten) minerals produced in eastern DRC, though criminal networks within the DRC's public security forces - and to a lesser extent non-state armed groups - continue to benefit from 3T production and trade in a number of localities"* (OECD, 2015).

DRC -- a member of the Extractive Industries Transparency Initiative (EITI). The DRC became an EITI member in 2008. The aim of the EITI Standard can help transparency and accountability about how a country's natural resources are governed (e.g. how the mineral rights are issued, how the resources are monetized and how they benefit the citizens and the economy). The latest EITI DRC Report shows a more resilient mining sector, characterized by increased production, employment and revenues i.e. due to new investments, and competitive fiscal regime. Through the EITI process, relevant stakeholders from companies, government and civil society organizations meet regularly to determine whether companies are paying their duties and whether these payments are being transferred to the state treasury.

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7.3. Other African countries

The mining industry of **Mozambique** plays a significant role in the world's production of aluminium, beryllium, and tantalum, and has commercially important deposits of coal (high quality coking coal and thermal coal), graphite, iron ore, titanium, apatite, marble, bentonite, bauxite, kaolin, copper, gold, and tantalum. **Guinea** is an important player in the bauxite production and hosts around 25% of the world´s known bauxite reserves (USGS, 2017). It is the largest bauxite producer in the African continent and one of the key producers worldwide after Australia, China and Brazil. **Sierra Leone** is having minerals production focused on diamonds (industrial and gemstone), iron (with excess production between 2012 and 2014) and bauxite that counted 1,435 Mt in 2015 (Reichl et al., 2017).

7.4. Emerging trends and potential future development

The Implementation of the AMV is moving at a slow pace. Eight years after its inception, 24 out of the 54 African Union MSs are in various stages of nationally implementing the AMV within their national policy agenda, notably by pursuing a country mining vision (CMV) (Ushie, 2017). The process is coordinated at the institutional level by the African Minerals Development Centre. However, the progress has been slow and is not achieving the expected impact. Only Lesotho has fully adopted the AMV through the development of a Country Mining Vision. According to a recent paper (Ushie, 2017), generally, there is a lack of awareness of the AMV among key stakeholders in Africa's mining sector and civil society engagement in grassroots mobilization and policy advocacy. On the other hand, there are some companies that run their own local 'suppliers' development initiatives' to stimulate or facilitate supply chain development as these are part of the CSR initiatives (e.g. Newmont in Ghana or AngloGold Ashanti in South Africa). But taking a CSR approach is not sufficient to trigger long-term industrial development, although it is necessary to maintain the local footprint and hence the much-needed SLO within mining communities (Ramdoo, 2017). There is still big potential to move forward the AMV targets at both the governments and private sector sites to comply with the provisions of the AMV on human rights, corporate accountability, gender justice, social impacts, etc.

The countries grouped as the "African Lions" retain a key role in Africa´s economic growth. High prices and demand for minerals could help African economic growth as it is most recently happening e.g. in Botswana[30]. Estimates by the OECD Development Centre (OECD, 2010) suggest that developing and emerging countries could likely account for nearly 60% of the world´s GDP by 2030. Increasing income in these countries means also a growing demand for manufactured industrial goods, which opens new trade options for the goods export-oriented European industry. Measured by their population, the leading African markets are the so-called 'African Lions' Algeria, Botswana, Egypt, Libya, Mauritius, Morocco, South Africa and Tunisia (have even overtaken the BRIC states related to their

[30] "IMF has revised Botswana´s economic growth forecast for 2017 and 2018 due to rising demand for diamonds, investment in the water and power sector and reforms to attract investment" (Reuters, 2017)

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economic performance per capita in 2008). China has become the major trade partner of Brazil, India and South Africa; South-South links are of increasing importance as a motor of growth in developing and emerging countries (Falck et al. 2017).

Employment crisis in South Africa. In South Africa more than 70,000 mining jobs have been lost in the past few years and this trend is expected to continue following the announcement by numerous companies of intentions for mass retrenchments. The country is facing a record unemployment rate of 27.7% and re-orientation to imports rather than to export. The Association of Mineworkers and Construction Union is claiming for structural changes of FTAs (Odendaal, 2017). The education and stable employment opportunities, especially of the young generation, needs to become one of the priorities of all African governments as it is key to break from the cycle of poverty. It is also considered by the UN as crucial to allow many other Sustainable Development Goals (SDGs) to be achieved.

8. Oceania mineral policy context

8.1. Australia

Australia is the only developed economy to have recorded consecutive economic growth (no annual recessions) during the past 25 years. Australia´s history depicts a clear account of an economy and an institutional context showing adaptability to international conditions and shifting its bases of prosperity through time by changing its economic and trade policies (Murguía, 2015). Australia was comparatively unaffected by the global financial crisis of the years 2008/2009 as the banking system remained strong, inflation was under control and the export of mineral commodities to China (iron ore, coking coal) kept flowing. Besides its rich mineral endowment, such stable mining-led economic growth has been achieved due to sustained policies (such as high credit ratings, fair taxation system, open environment to foreign investments or floating exchange rate) (Deloitte, 2017a) which have enabled a competitive investment climate to sustain exploration and discovery of more mineral resources and reserves and further exploitation of known deposits.

Besides an active exploration and mining industry**, Australia´s continuous expansion of the mining sector has been accompanied by the development of a mining equipment, technology and services (METS) sector** which has in the last three decades covered a life of its own as a strong component of the Australian economy, i.e. providing services not only to the mining industry (Deloitte, 2017a).

Australia maintains and regularly strengthens its open trade policy and its bilateral trade agreements, using its suitable geographical position to the fast growing Asian market. The Australian national government has ratified FTAs with the most important Asian players (mineral consumers) – South Korea (KAFTA) and Japan (JAEPA) (both in 2014) and with China (2015) (ChAFTA). Australia's FTAs with China, Japan and South Korea mark a new phase in Australia's integration with three North Asian economic powerhouses. They reinforce a minerals trade worth approximately AUD $120 billion a year to Australia. FTAs with other important regional economics e.g. India or Indonesia are under

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negotiation. An FTA for the whole Asian market is the goal of the platform called Regional Comprehensive Economic Partnership (RCEP), where Australia as a member state of the ASEAN (Association of Southeast Asian Nations) is one of the original signatories. A widening of FTA space beyond the Asian market is the target of another negotiation platform – the Trans-Pacific Partnership Agreement (TPP), adding to FTA the "cross Pacific" countries like Canada, Mexico, Peru, Chile (recently – January 2017 USA new administrative decide to withdraw its membership in TPP).

Australia´s mining industry competitiveness is being undermined by an energy crisis, due to closing of some aging coal-fired power plants (Hazelwood in Victoria in 2017 and Port Augusta in South Australia 2016) and pushing to transition to the renewable sources of energy, insufficient for the high energy demanded mining related industry (Slezak, 2017).

Recycling of metals appears not to be a priority. Australia is primarily a mineral resources exporter yet it has a well-developed per-capita stock of metals (Graedel, 2010) and recycling appears not to be at the top of the agenda, e.g. the legislation for the management of WEEE is in its infancy and has received minimal review (Morris and Metternicht, 2016), Australia´s management of e-waste is not effective, lags behind international best practice, and is based on outdated recycling targets (Gough, 2016).

8.2. Indonesia

Indonesia´s mineral policy fosters domestic economic development. Indonesia is a fast-growing democratic developing country comprising more than 17,000 islands, founding member of ASEAN and a member of the G20. It is one of the most highly mineralised countries in the world, the mining sector playing a pivotal role in the country's economy. The Indonesian reform era began in 1998 after the fall of President Suharto, with a significant change in Indonesia's political and administrative system. The most notable policy change was the shift from a highly centralised system of administration to a decentralised and democratic system. In the decentralised architecture, full autonomy is being placed at the regency/municipal level, with limited autonomy power at the provincial level. In 2001, the Decentralization Law No. 22/1999 came into force and caused a transfer of authority and responsibility from central to regional and local administrative governments. The new Mining Law of 2009 substituted its 40 year old predecessor, but lacked detailed regulations for its implementation. These were only issued in 2010, which lead to a period of great uncertainty for investors in the mining industry. The new legislation intends to foster domestic economic development, which may be interpreted as protectionist policy. For the development of a sustainable mineral resources policy, further endeavours need be made (Tiess and Mujiyanto, 2011).

Large mineral potential but resource nationalism threat. Indonesia is the world´s largest mine producer of tin, has the world´s second largest tin reserves (after China) and is a large producer of nickel, gold and bauxite (USGS, 2017). Yet, its mineral potential is adversely affected by its political instability and

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changing political orientations, i.e. threat of institutional ambiguity, or resource nationalism. An example of the changing conditions took place in 2014: although in 2009 foreign investors heralded the mining law as a breakthrough in Indonesia's extractive sector (it allowed foreigners to obtain full mining licenses for the first time), in 2014 the government in line with the spirit of the new Mining Law, imposed a partial ban on exports of unprocessed ore (mainly nickel and bauxite) with the aims of promoting the development of a domestic processing industry. That move, which was initially opposed by many mining companies, later prompted pledges of billions of dollars of investment in smelters and other processing facilities. Due to industry unrest and gaps in the state budget, the Indonesian government announced easing the export ban for nickel and bauxite in 2016. The government decided that over the next five years miners will be permitted to export mineral ore, including nickel ore, bauxite and concentrates of other minerals, provided they can show progress toward smelter development.

8.3. Philippines

Large mineral potential, threats of resource nationalism and restrictive policies towards mining. Like Indonesia, the Philippines also has a large mineral potential (large reserves of nickel, gold, copper, chromite) and it´s the world´s largest producer of nickel ore (USGS, 2017). Currently the mining industry is struggling because the Philippines' new President Duterte argues that mining companies´ tax payments are insufficient to compensate mining communities that suffer environmental damage, with mining representing 0.7% of the GDP. Based on such argument, Mr. Duterte has imposed a ban on open pit mining project (only affecting new projects, not mines currently in operation). However, its continuity threatens major planned mines including Philex Mining's Silangan copper-gold project and Sagittarius Mines's Tampakan gold-copper project (Jamasmie, 2017). More recently, lawmakers have filed a bill seeking to ban mining in watershed areas and exports of unprocessed ores and will require miners to get legislative approval before operating, in line with President Duterte's pledge to overhaul the sector (Serapio Jr, 2017).

8.4. Other Oceanic countries

Malaysia has a large mineral potential, is an important producer of manganese, bauxite and tin and belongs to the countries with less developed minerals policy (uncertainty of government decisions, rapidly changing legislation). Malaysia's largely unregulated bauxite mining industry in Kuantan, port capital of key bauxite producing state Pahang, ramped up output starting in 2014 to fill a supply gap after Indonesia banned exports and to meet demand from top aluminium producer China (Chow, 2017a). Yet, water pollution events linked with the bauxite industry led the government to impose (in January 2016) a three-month ban on the mining of bauxite in an attempt to regulate mining practices and tackle pollution of its rivers and coastline. Exports have been granted during this period to clear existing stockpiles at ports where run-off after monsoon rains had polluted waters. Yet, after over one and a half year of the ban, the stockpiles are the same size as they were at the start of the ban

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and Malaysia has exported more than 9 million tonnes of bauxite to China according to Chinese import data, i.e. illegal export of bauxite has been ongoing (Chow, 2017b).

8.5. Emerging trends and potential future development

Australia sees the shift in the world economy towards the east and the emergence of a growing middle income class (Asia, Africa, South America) as a great potential for new export markets, trade relations and business models (Hajkowicz et al., 2012).

Australia is leading R&I and innovation in automation pilot programs for the mining industry. Mining and the METS sector in the Pilbara region are of uttermost importance for Australia because much R&I, technological and even employment innovations in the METS sector are taking place there. Main on-going innovations include new processing methods of low-grade ore (heap-leaching), automatisation in transport (autonomous technologies like driverless haul trucks, an automated wheel changer for haul trucks, remote train and ship loading, remotely operated drill and smart blast activities) e.g. BHP´s autonomous trucks and autonomous trains in Jimblebar or Rio Tinto´s "Mine for the Future" programme. Such programme was created under the conviction that productivity and cost control are critical business drivers, and that technologically advanced operations are more productive, safer, yield higher value, are internationally competitive (Murguía, 2015b).

9. Deep sea mining mineral policy context

Deep sea mining[31] **activities awake an increasing interest but no commercial exploitation yet**: exploration and exploitation of the deep-seas in search of marine minerals (and genetic resources) have over the past 15 years received increased attention. The number of contractors' interested in claiming large tracts of seafloor with exclusive rights for exploration went from just eight in the four decades between 1970 and 2010 to 25 in the next 4 years (2011–2015), most of it in the Pacific Ocean, concentrated in polymetallic nodules in the Clarion-Clipperton Fracture Zone (Sharma, 2017). Ferro-manganese crusts are explored by Russia, China and Japan in the Pacific Ocean and hydrothermal sulphides by France, Russia, Korea, China, India and Germany in the mid-Atlantic range, and the Indian ridges. Despite the potential, up until now there are no commercial activities and prospects have been delayed (Rademaekers et al., 2015).

The cost challenge - terrestrial operations considerably cheaper and lower risk: despite the large potential in deep sea resources, it is uncertain whether the enormous investments required for

[31] Deep-sea mining is a term used to describe the extraction of minerals (usually metalliferous) from the deep ocean. The deep-sea starts where the continental shelf ends, i.e. at depths greater than 200 meters, and thus deep-sea resources are generally found in the high-seas and beyond the Economic Exclusive Zone's (EEZs) of nation states (Rademaekers et al., 2015).

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starting up operations are economically viable. Exogenous forces, including resources prices and cost of capital, are important factors in the equation. For the mining itself, the initial invested capital (CAPEX) for building ships and developing the technology needed are substantive. Not all projects are commercially viable but decisions to go offshore are in many cases strategic. For instance, during exploration, for sampling it is estimated a cost of up to US$ 1 million per day (excluding maintenance costs); for nodules exploration approx. 20 months of cruise needed to identify the nodules. The right equipment costs € 10 -15 million per month (Rademaekers et al., 2015). For exploitation, the costs run in hundreds of millions of euro. Fluctuating metal prices as well as recycling, new onshore deposits, and technological developments are the main factors deterring new potential projects.

Knowledge gap of deposits: Industry and researchers, in terms of the location of mineral deposits, have a fairly good overview of proven and inferred sites that could be interesting for further exploration. Yet, one important knowledge gap is around the concentration and size of the resources. This is a major impediment because uncertainty in terms of concentrations and magnitude hinders a robust cost and benefit assessment to be carried out at the individual project level.

Uncertainty in the environmental impacts: sea-floor ecosystems are adversely affected by human activities. Deep-sea mineral exploration and extraction activities will also impact marine ecosystems and new environmental impacts have to be considered such as the large surface areas affected by nodule mining, the potential risk of submarine landslides through sediment destabilisation in gas hydrate extraction (MIDAS, 2016). Deep-sea ore deposits comprise complex mixtures of potentially toxic elements, which may be released into the sea during different stages of the mining process. The mining of SMS or cobalt crusts will involve fragmented ore being pumped from the seafloor to the surface as a slurry. Whilst nodules may be collected whole, the transfer of nodules up the riser pipe will likely result in them also turning to slurry. Consequently, for all three ore types, there is a risk that the mining process will release metal ions into the water column (MIDAS, 2016). The main problem is that there is very little knowledge on how potentially dramatic perturbations will affect the deep-seabed and it is difficult to fully estimate the real environmental impact of activities due to the fragility of these ecosystems, the unknown resilience of this system and as well as the effectiveness of the anticipated efforts to assist natural recovery (Sharma, 2017).

10. International overview on national policies and challenges of the mining industry

The global minerals policy framework is characterized by a mixture of challenges which are transversal (apply to the industry all over the world) and others more of a regional nature, compounded by the fact that some are more of a short-term range, while others are of a structural, long-term nature.

At a global scale, major transversal long-term policy challenges which frame the mining industry sector´s agenda are the UN Sustainable Development Goals and the commitments under the Paris Climate Change Agreement. At the same time, governments need to acknowledge and collaborate

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with mining companies to address major **long-term challenges which frame the mining industry**[32] (see Table 5 in Annex 5): 1) Innovation, automation, digitalisation and data analytics are key productivity drivers, 2) there is a trend of declining ore grades, rising waste volumes and declining productivity, 3) there is a global problem of an ageing workforce and skilled labour shortages; 4) climate change poses new severe risks to operations, 5) there exist difficulties in access to land, water and energy supply, 6) there is a wide social opposition to the large-scale metals industry, 7) illegal mining (and illegal recycling) still represents a challenge, especially in developing countries.

Yet, the scale and intensity of those challenges varies per region and country, according to the development stage of each country and its global positioning in the global landscape (geographic, in terms of political power, in the value chain, etc.). The issue of investments in R&I on automation and digitalisation (via public and private funding in a complex interplay of different organisations, i.e. 'innovation systems[33]') is being led worldwide mainly by industrialised nations (EU, USA, Japan, Australia), but there exist also considerable investments in a few developing countries (e.g. China with R&I in rare earths, Vale in Brazil´s S11D project).

Mineral supply risks, e.g. of critical raw materials, remains a concern of most industrialised nations, but also of some developing countries like China and India who are highly import-dependent of important minerals. Even though free trade is advocated as a potential solution by the G20 or the WTO to avoid trade distortions, many developed (USA, Japan) and developing countries (China, Indonesia, Philippines) still keep protectionist policies in place (with varying degrees of strictness). This becomes a challenge whenever strict export restrictions are placed in non-competitive markets dominated by a one or few suppliers. Despite existing mechanisms (e.g. complaints to the WTO), countries remain subject to new potential threats. Likewise, in the case of some minerals such as rare earths, there remains a lack of transparency in the pricing of minerals.

Supply risks are also heavily influenced by the 'industrialising visions' of various big mineral suppliers such as South Africa, the African continent (African Mining Vision), Indonesia, Malaysia. The success of advancing towards those 'visions' is conditioned by the socio-cultural conditions which frame those countries with a known past of weak governance, mismanagement and corruption alongside poverty, inequality, political instability, and in the worst cases, risk of armed conflicts, e.g. around 'conflict minerals' (Figure 4).

[32] In contrast, on a rather short-term basis, the industry is struggling with low (but gradually recovering) commodity prices and restraints in the access to venture capital, at times facing resource nationalism policies in several countries

[33] "*The concept stresses the fact that innovation is not only the result of new knowledge creation, but rather of knowledge being 'used' in a variety of ways and by different actors. It puts emphasis on the quality and depths of interactions and the efficiency of knowledge creation and knowledge diffusion among the relevant organizations*" (Sturm and Schimpf, 2016:8)

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In relation to resource efficiency, trends show that Europe, China, Japan, South Korea and the USA are leading R&I towards closing the material loop whereas other countries like Australia or Canada are more focused in maintaining a competitive mining industry. In Latin America and Africa recycling or re-use of metals does not appear a priority in the R&I agenda as these countries have historically been exporters of commodities and do not have large metal stocks that could be recycled. In contrast, China, who is rapidly building its stock of metals, is already implementing policies to ensure progress towards a circular economy (Figure 5).

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Figure 4: Key challenges and trends in the minerals industry (2017).

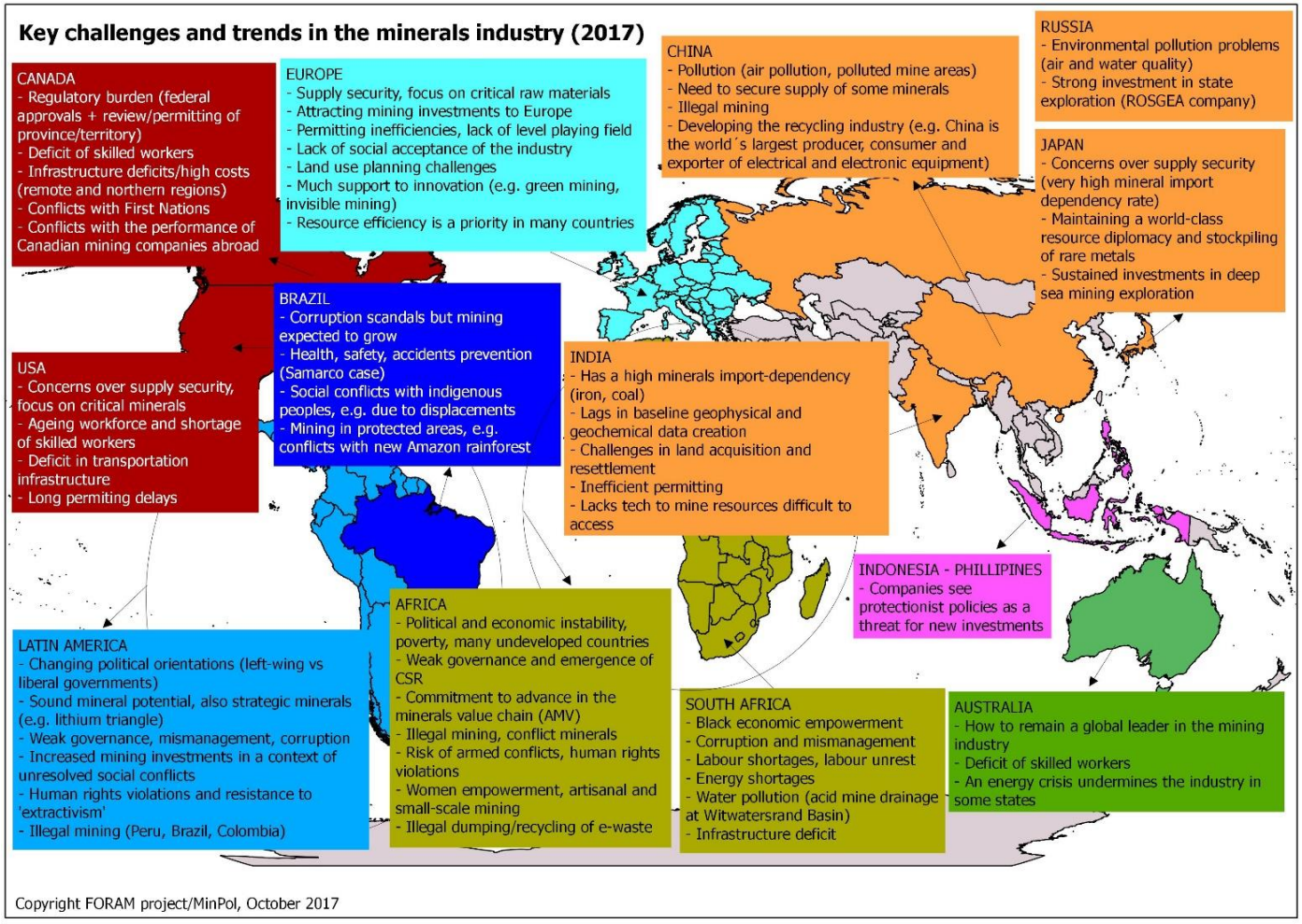

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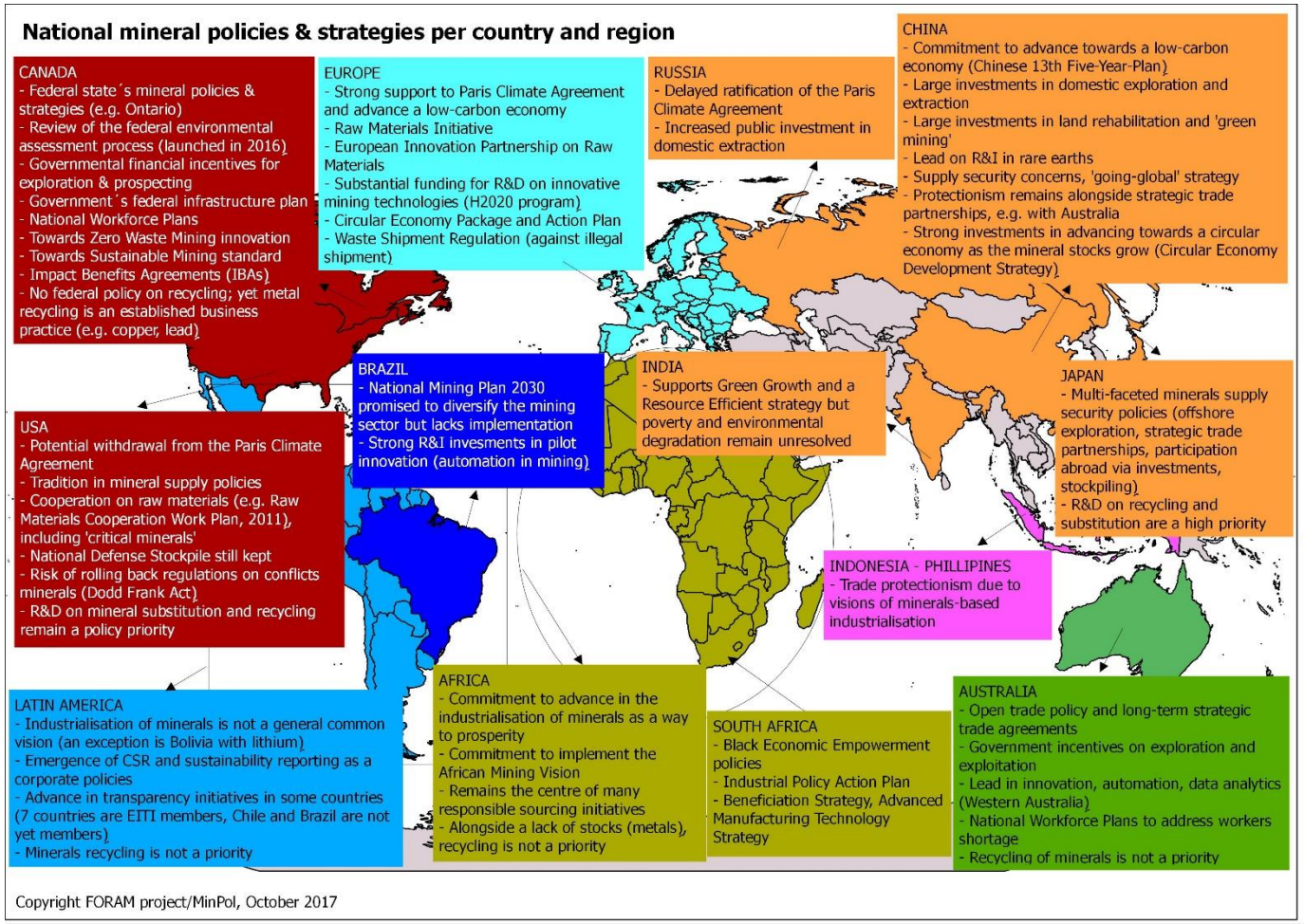
Figure 5: National mineral policies and strategies per country and region (selection).



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11. Conclusions

The global minerals policy context is expected to remain heavily influenced by trends which are shaping the future, i.e. a growing, urbanising and ageing global population led by India, China and Nigeria; a sustained (energy and non-energy) minerals demand with a higher potential for conflicts (e.g. resource conflicts due to scarcity, rising wealth disparity and inequality) framed by a growing digitalisation and automation (as the leading ways to increase productivity) and new lifestyles of a growing middle income class (millenials) driving new consumption patterns and production patterns.

Measures to reduce GHG emissions and mitigate anthropogenic-caused global warming are expected to remain a commitment in most countries, and this appears to converge in common strategies to achieve green growth and low-carbon economies (embodied in sustainable energy generation/distribution, sustainable transportation and resource efficiency solutions).

All countries, both raw material importing and exporting ones, are linked in complex global raw material value chains and contrasting visions between developing countries seeking to keep exporting commodities (and some of them industrialise) and developed countries seeking to remain competitive. Thus, many mineral-rich developing countries, despite global transparency and responsible sourcing initiatives, still allow extraction under weak governance, insufficient mineral policy frameworks (if existent), unfair terms of trade, resource-inefficient and environmentally degrading conditions. In contrast, minerals import-dependent countries (and their companies) are constantly developing strategies to avoid trade distortions and minimise supply risks, e.g. on critical raw materials. Thus, the future supply of minerals is expected to be derived from a global raw materials market without a level playing field, i.e. where stakeholders of all levels need to keep aligning their cooperation to ensure compromises are done to ensure mutual gains.

Many initiatives and multi-stakeholder international fora exist where such challenges are being discussed (e.g. World Resources Forum, World Materials Forum, Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development, OECD Policy dialogue on Natural Resource-based Development, WEF´s Responsible Mineral Development Initiative, etc.). However, there still remains a need for **greater international policy cooperation and coordination** focused on:

- how mineral supplying and importing countries can better coordinate actions for mutual gains in apparent contradictory visions (e.g. accelerating industrialization and green growth in African developing countries under the African Mining Vision and under the Sustainable Development Goals while improving ways to avoid unilateral trade distortions such as export restrictions); this could be achieved by better connecting platforms via international stakeholders and by the agreement on clear targets, ways of implementation and monitoring of the progress;
- further explore ways to develop transparent price mechanisms capable of ensuring fair terms of competition for mineral producing and mineral importing countries;

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- ensuring a better transfer of knowledge (e.g. on best practices in different regions) on how to strengthen the legal and institutional mineral policy framework between developed (Australia, Canada) and developing countries (African, Latin American ones)
- disentangling the complexity of value chains and initiatives to improve mineral resource governance by a clearer, more transparent mapping of who-is-doing-what and where improvement potential is;
- promote smart regulations and a better coordination of mineral development and biodiversity conservation between developed and developing countries (e.g. how to create economic incentives or trade-offs between countries to minimize mining in high-biodiversity areas and promote shifting of operations towards low-biodiversity areas)
- promoting resource efficiency in developing countries buildings their metal stocks, e.g. following China´s example.

Implementing the WFRM via international key experts and stakeholders considering the entire minerals value chain will consolidate the current complex maze of minerals initiatives. This will increase international resource transparency and improve governance which would contribute to stability, predictability, resource-efficiency and hence a global more balanced (developing versus developed countries) supply basis. As such, the FORAM project will be the largest collaborative effort for minerals strategy cooperation on a global level so far.

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Annex 1 – List of Experts interviewed

Table 2: List of experts interviewed (to be defined).

Expert name	Affiliation	Area of expertise	Contributed to which section of this report?
Nikolaos Arvanitidis	Chair of the EGS Mineral Resources Expert Group	Also Executive Secretary of the European Technology Platform for Sustainable Mineral Resources (ETP SMR) and operational member of the European Innovation Partnership on Raw Materials (EIP RM) Strategic Implementation Plan (SIP).	International, Europe (primary minerals)
Ana E. Bastida	Centre for Energy, Petroleum and Mineral Law and Policy (CEPMLP) University of Dundee, UK	Expertise in the law and governance of natural resources and the design of resource regimes, particularly in the extractive industries. Participates in the STRADE project - Strategic Dialogue on Sustainable Raw Materials for Europe (http://stradeproject.eu/index.php?id=4)	International, Europe, Latin America (primary minerals)
Magnus Ericson	Luleå University of Technology	Expert mineral economist, specialist in the iron ore market, one of the co-founders of the Raw Materials Group (RMG), which developed Raw Materials Data containing information on practically every mine in the world. Since 2009 he is a consulting professor of mineral economics at Luleå University of Technology, Sweden. At present he is active in a Stockholm based independent network of advisors to the mining cluster. Also MinFuture project Advisory Board member http://minfuture.eu/advisory-board	International, Europe (primary minerals)
Dr. Daniel Franks	Centre for Social Responsibility in Mining (CSRM),	Programme Manager of Stones for Development at the United Nations Development Programme (based in Brussels), Manager of the ACP-EU Development Minerals Programme	Australia (primary minerals)
Federico Magalini	UNU, Associate Program Officer since 2005 at UNU-IAS SCYCLE	**FORAM Member** and WP1 leader. Member of Scientific Committee of Italian Recycler's Association ASSORECUPERI. Expert in e-waste and zero waste.	International (secondary minerals)

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Annex 2 – Global demand for minerals forecasts

Construction minerals

The **global demand for construction aggregates** is projected to advance to more than 51 billion metric tons in 2019 (compared to 48 billion tons in 2015), and China is expected to remain by far the largest national consumer of aggregates in 2019 (Freedonia, 2016)

Metals

On an overall long-term basis, the **global demand for metals** is expected to remain robust (e.g. PGMs, tin), and even in some cases (e.g. iron, bauxite, nickel, lithium or cobalt) keep on increasing (Table 3), despite short-term downturns.

Table 3: Forecasts for the global demand of selected metals.

Metal	Expected global demand behaviour
Iron and manganese	In the short-term, forecasts sustain that global steel demand will increase by 1.3% in 2017, and by 2018 the demand will grow by 0.9% (World Steel Association, 2017). Manganese ores, ferroalloys, metal and chemicals are also expected to enjoy modest increases in 2014-2020 (Roskill, 2015). On a long-term some models forecast the iron demand will keep on increasing as the global average per capita stock of steel increases (Pauliuk et al., 2013).
Bauxite	The global aluminium demand is expected to remain encouraging and production is forecast to grow at over 5% per year (Roskill, 2016), e.g. due to a demand driven by the transport sector and strong substitution trend for aluminium in automotive (Fog, 2016). In the long-term models forecast an increasing global annual demand, e.g. due to China´s increasing per capita in-use stock (Liu et al., 2012), especially for vehicles (Stringer, 2016)
Cobalt	A strong demand from the aerospace and industrial manufacturing sectors is expected to lead a steady growth in demand over the period to 2026 (Roskill, 2017a).
Copper	In the short-term world mine production is expected to decline by 1% in 2017 and remain essentially unchanged in 2018 (ICSG, 2017) due to China´s (copper biggest consumer worldwide) slower growth in demand. However, in the long-term demand is expected to gradually grow, with some models indicating a peak by 2030/2033 (Northey et al., 2014).
Nickel	Similar to aluminium, the global demand for nickel has grown in the last 3 years more than other base metals. Nickel demand growth remains robust – will require 400-500 kt of new supply by 2021 – much more if battery forecasts are realized (Selby, 2017).
Lithium	The demand is rising rapidly and the lithium supply is ramping up to meet the explosive growth forecasts for lithium-ion (Li-ion) batteries. By 2026, the transportation market for Li-ion batteries could reach over 1TWh—a 40% increase over 2026 (Roskill, 2017b).
PGMs	The global demand for platinum until 2025 is expected to remain steady (or increase slightly, e.g. from 8.1 million ounces to 8.63 million ounces) (Jollie, 2016a) whereas that of palladium is expected to increase slightly (Jollie, 2016b).

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Metal	Expected global demand behaviour
Tin	The outlook for consumption suggests moderate growth, depending on the outcome of conflicting trends in the electronics industry, and with threats of substitution in applications such as tinplate packaging offset by increasing use lead-acid batteries (Roskill, 2017c).
Tungsten	China's increasing focus away from heavy manufacturing to value-added goods production and a service economy may affect its tungsten use towards the end of the outlook period. However, heavy industry is a cornerstone of any advanced society and should there be in slowdown in China, other countries will emerge to take up its position – which will ensure that growth in demand remains on an overall positive trajectory (Roskill, 2017d).

Annex 3 – Mineral potential per continent

Europe

The volume of minerals extracted in Europe is not sufficient to satisfy its demand for minerals and therefore the demand is covered by imports. However, Europe´s mineral potential is of importance for many minerals, e.g. zinc and lead (Sweden, Ireland, Poland), copper (Poland, Iberian Copper Belt, Bulgaria, Sweden), and even some CRMs such as tungsten deposits (Figure 6) or the discovery of lithium deposits in the Czech Republic, Serbia and Portugal which are attracting FDI to Europe.

For the hi-tech industry Finland has strategic importance due to germanium production and due to its production of gold, silver, chromium, nickel, and zinc, PGM (selenium) and cobalt (the only producer in the EU). The strongest economies in the EU – Germany, France and UK – are, first of all, the biggest mineral consumers but they are rich in industrial minerals e.g. Europe is key player in feldspar production (Germany is 1st largest producer). Turkey has significant reserves of base metals, some industrial minerals (baryte, bentonite, diatomite) and has gold and silver deposits (Figure 9).

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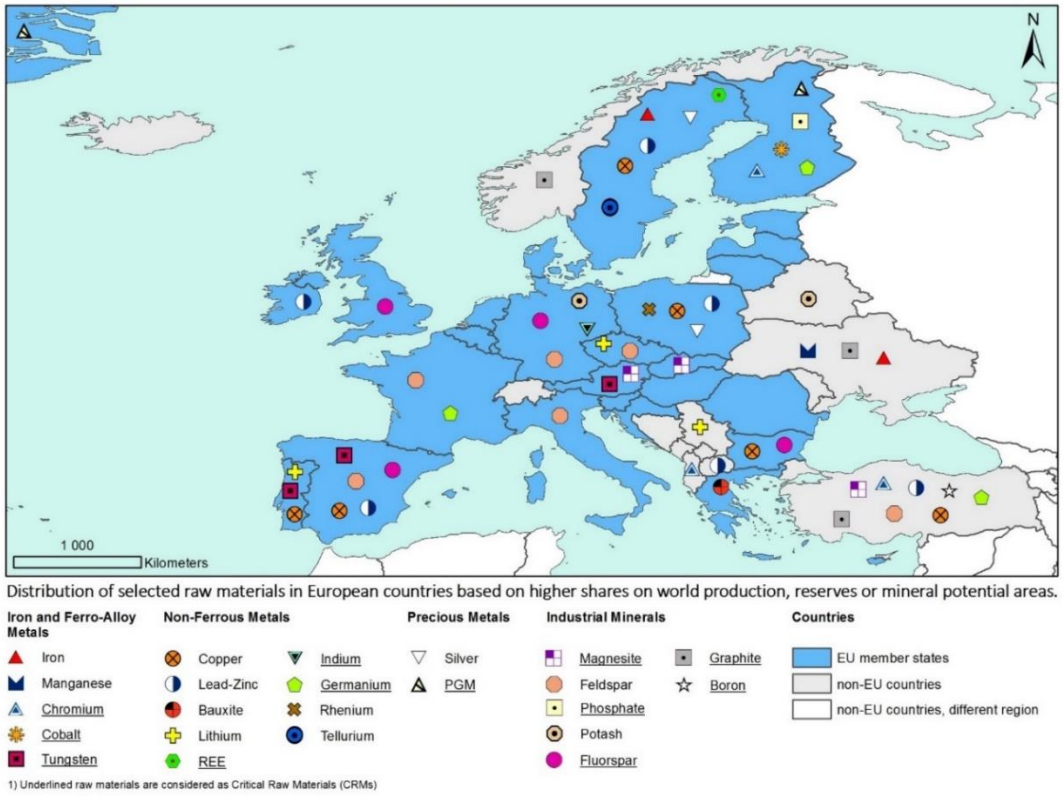

Figure 6: Mineral potential of selected minerals in Europe (MinPol, based on USGS and WMD, 2017)

America (North and Latin America)

The mineral potential of North America (USA, Canada) and LA (including Mexico[34]) is vast though yet unknown in various countries. The USA and Canada have a long history of exploration and exploitation of its non-energetic mineral resources; yet, they still have much discovery potential which, coupled with attractive conditions, makes those countries attractive for further exploration. The Latin America (LA) region is also a leading global player: in 2015, LA produced 92% of the world´s niobium output, 44% of the world's copper and lithium, 54% of the silver, 32% of the molybdenum, 22% of zinc and 20% of the global gold and iron output (MinPol based on Reichl et al., 2017). The region also attracts a considerable part of mineral exploration budgets: in 2016 it attracted a 28% of the global exploration expenditure in non-ferrous metals, and this is because large portions of the land remain

[34] Mexico is considered part of Latin America, and not of northern America

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unexplored, e.g. countries like Argentina or Paraguay have a large portion of their territory yet unexplored[35].

Asia

Large mineral potential in China, Russia and Kazakhstan. China features among the countries with rich metallic and non-metallic mineral resources. It has proven reserves, more or less, of all kinds of metallic mineral resources. Of these, the proven reserves of tungsten, tin, antimony, rare earth, tantalum and titanium rank first in the world; those of vanadium, molybdenum, niobium, beryllium and lithium rank second. Russia is a global leader in mineral reserves of iron ore, PGMs, gold, nickel and copper whereas Kazakhstan is important in lead-zinc, chrome, manganese and India of iron ore and bauxite (Figure 10). It is also worth highlighting the production of germanium, gallium, tellurium and cadmium in Japan (all from recycled scrap) and of cadmium in South Korea.

Africa

Large mineral potential. The African territory hosts around 30% of the world´s mineral reserves, around 50% of the world's PGMs, cobalt and diamond reserves, 40% of world's gold reserves and the largest reserves of manganese and chromium in the world. The biggest mining countries (in terms of production value, 2014) in the continent are South Africa, the DRC and Mozambique (ICMM, 2016).

[35] E.g. in Argentina, it is estimated by GEMERA that 75% of Argentina's land with geological potential remains unexplored. http://www.e-mj.com/features/583-argentina-and-the-mining-opportunity.html?showall=1#.WclXLdFx02w

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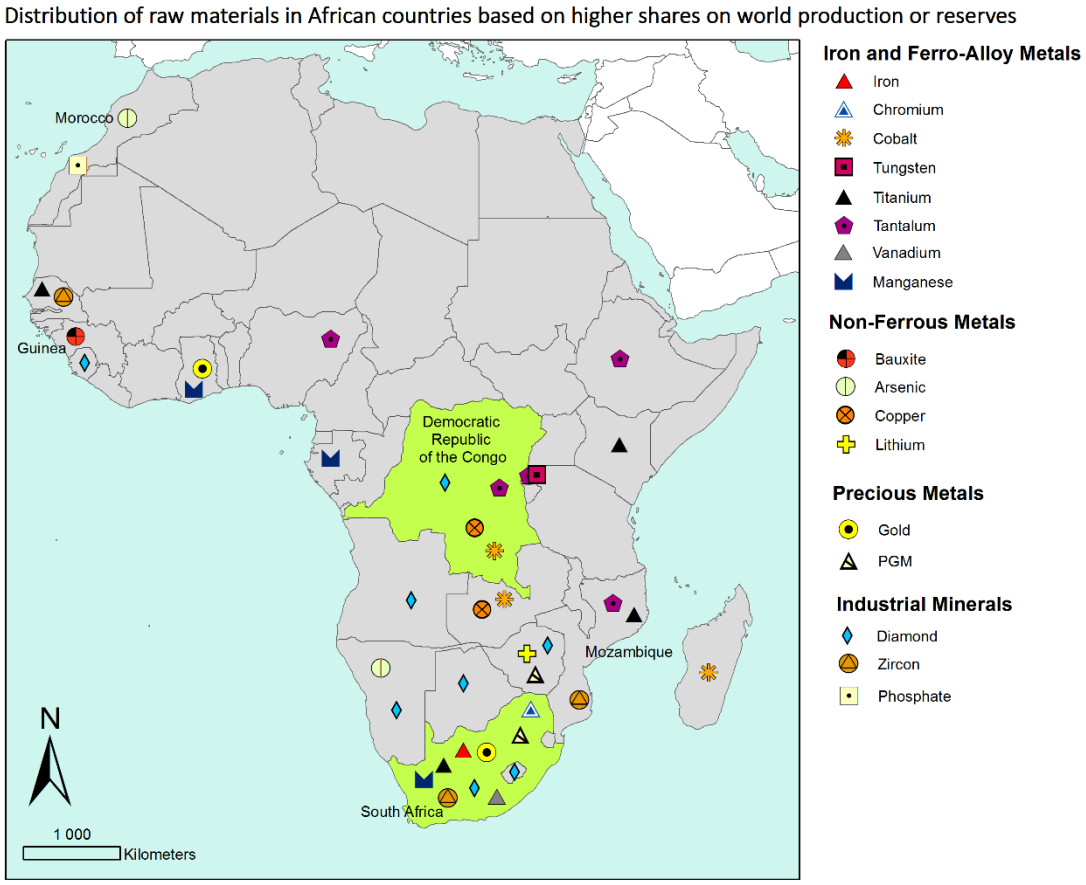

Figure 7: Mineral potential of selected minerals in Europe (MinPol, based on USGS and WMD, 2017)

Oceania

Australia is the largest mining country in the Oceania region and it ranks the 2nd largest global non-energy minerals supplier after China, e.g. it was the global leader (2015) in the production iron ore, bauxite, lithium, zircon and opal, and ranked 2nd for gold, lead-zinc and REE (Table 4, Figure 9).

Australia is expected to remain in the leading position in the coming years due to its large mineral reserves: the country hosts the world´s largest reserves of iron ore, nickel, lead-zinc, zircon, diamonds, among other minerals (Table 4). In the region Australia is followed by Indonesia which is important at a global scale due to the mining and exports of nickel and tin, and only then by the Philippines (important in the production of nickel and cobalt), Malaysia (tin, bauxite), New Caledonia (nickel and cobalt), Papua New Guinea and New Zealand (Figure 8).

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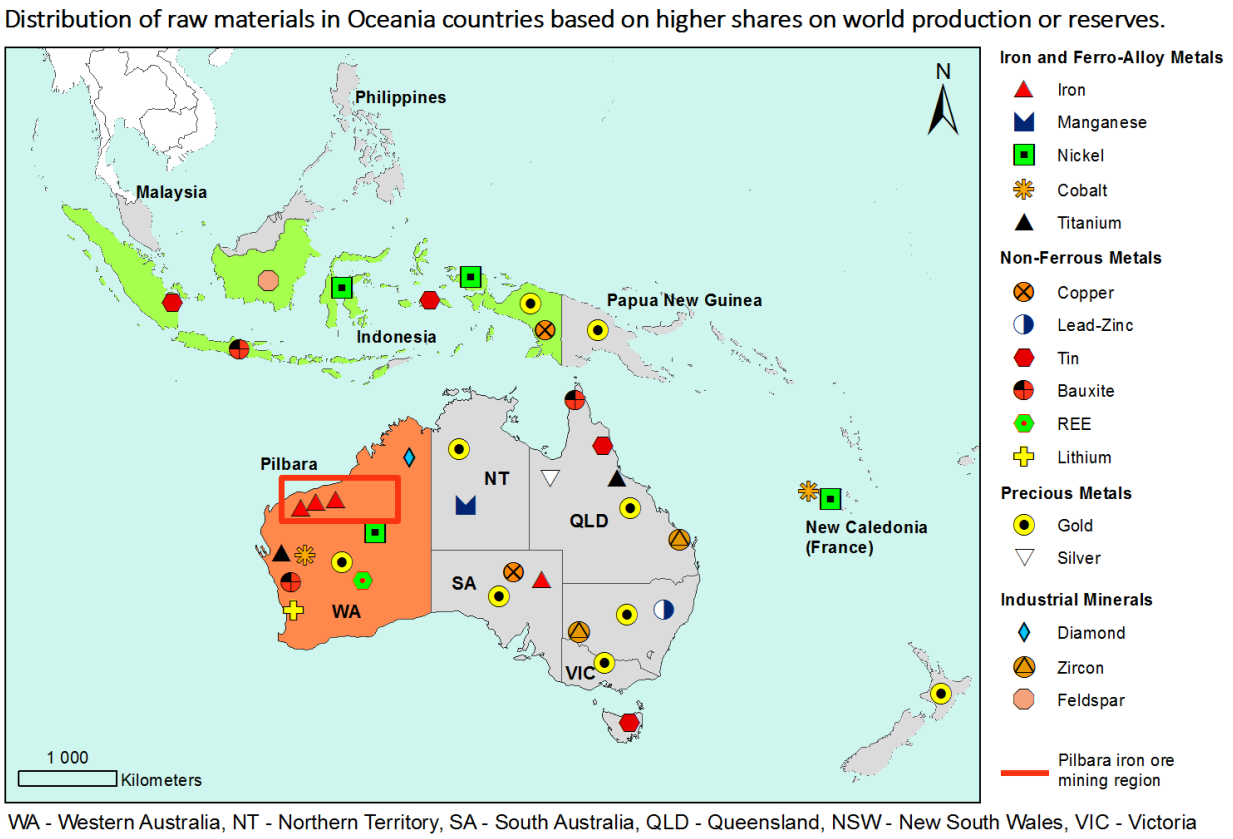

Figure 8: Map of mineral potential of selected minerals in Oceania. (MinPol based on WMD and USGS data)

Table 4: Australia´s global ranking in minerals production and mineral reserves (2015). Source: Reichl et al., (2017); USGS, (2017)

Commodity	Production (2015)	Reserves (2015)	Observation
Iron (Fe-Content)	1	1	-
Bauxite (crude ore)	1	2	Larger reserves only in Guinea
Lithium (Li2O-Content)	1	4	Chile, China and Argentina have larger reserves
Zircon	1	1	Largest both production and reserves
Opal	1	N/A	Australia produces 95% of global production
Gold	2	1	Largest reserves, higher production only in China
Lead	2	1	Higher production only in China

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Zinc	2	1	Higher production only in China
Rare Earth Elements	2	5	Second largest producer after China
Nickel	3	1	Larger production in Canada and Russia
Titanium	3	2	Higher production only in South Africa and China
Manganese	3	4	Production larger in South Africa and China
Diamonds (industrial)	3	1	Production larger only in Russia and Congo
Cobalt	4	3	Only Congo has larger reserves
Antimony	5	4	Larger reserves only in China, Russia and Bolivia

Western Australia is the leading jurisdiction in exploration, mining and processing of non-energetic minerals in the whole Oceania region. The most important mined ore is iron, mined above all in the Pilbara region (96% of iron ore export). Western Australia appears as one of the most important mining regions in the world with over 104,000 people employed in the mining industry and over half of those in the iron ore sector. WA hosts world-class iron ore deposits (especially in the Pilbara region) plus considerable resources of diamonds, nickel, lithium, cobalt, titanium, gold, REE and bauxite.

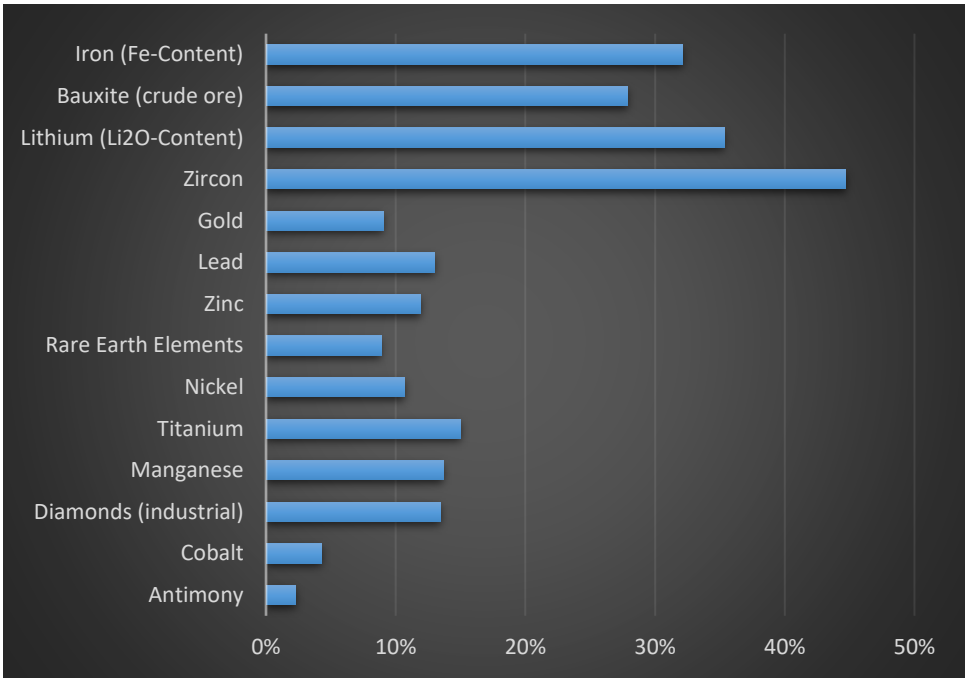

Figure 9: Australia´s global share of production in 2015 (Source: MinPol based on Reichl et al., 2017; USGS, 2017)

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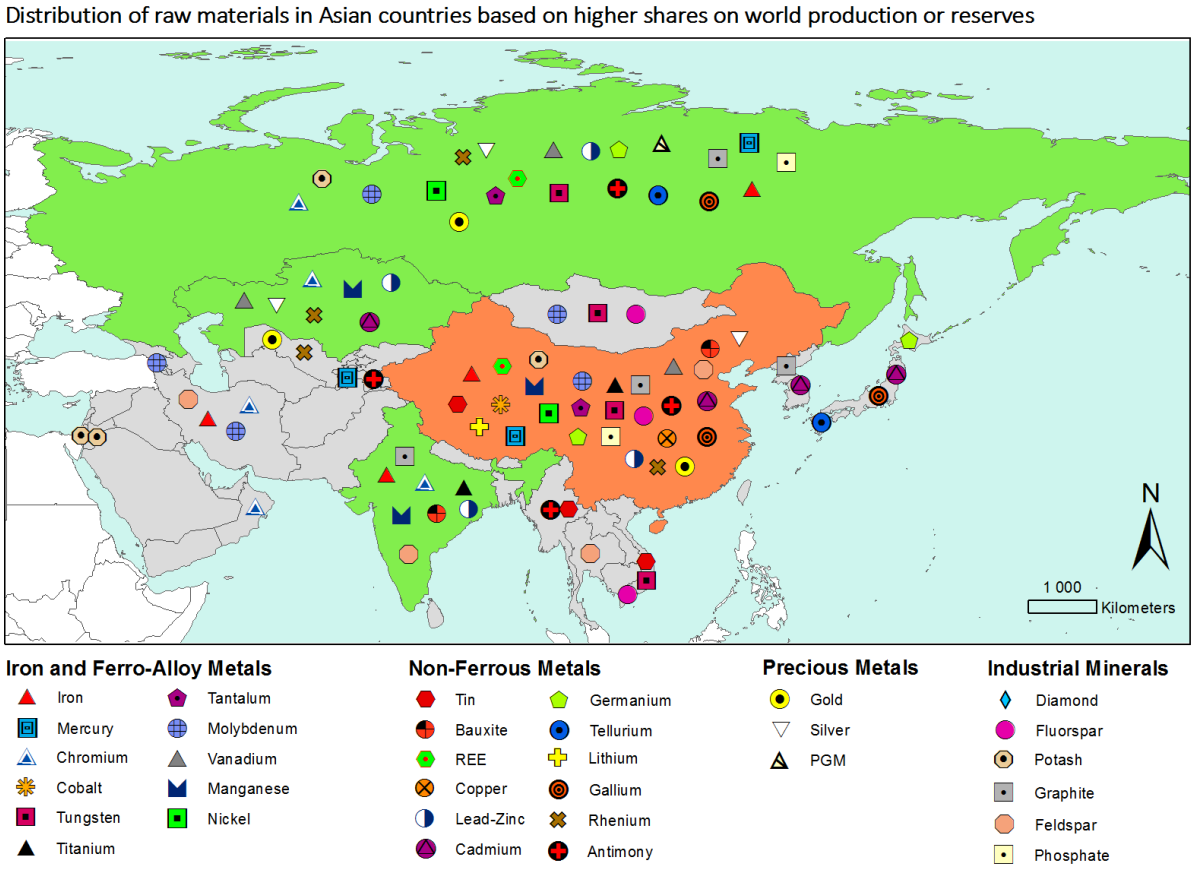

Figure 10: Mineral potential of selected minerals in Asia (MinPol, based on USGS and WMD, 2017).

Deep sea mining

In addition to biological and genetic resources (outside FORAM´s scope), **deep-sea raw material resources** generally cover 3 kind of resources: 1) **poly-metallic** (ferro-manganese) **nodules**, 2) **poly-metallic sulphides** (often referred to as **seafloor massive sulphide** deposits) and 3) **cobalt-rich ferromanganese crusts**, which contain valuable minerals such as silver and gold but in particular copper, manganese, cobalt, zinc and rare earths. Additionally, there is some interest in exploring for metal-rich muds under dense brines in the Red Sea and for mining deep ocean sediments to recover REEs (MIDAS, 2016).

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Ferro-manganese nodules occur in many marine regions, but they are found in significant abundances in four regions of the ocean (Figure 11). Manganese nodules occur as potato-shaped concretions on the seafloor of abyssal plains in about 4000–6000 m water depth in all major oceans Apart from manganese, metals of economic interest are nickel, copper, and cobalt, but the nodules also contain interesting amounts of molybdenum, titanium, lithium, and REE. The Clarion-Clipperton Zone, with an area of around 9 million km^2 (approximately the size of Europe), is the world's largest manganese nodule region, with an estimated amount of nodules of 21 billion tons (World Ocean Review, 2017).

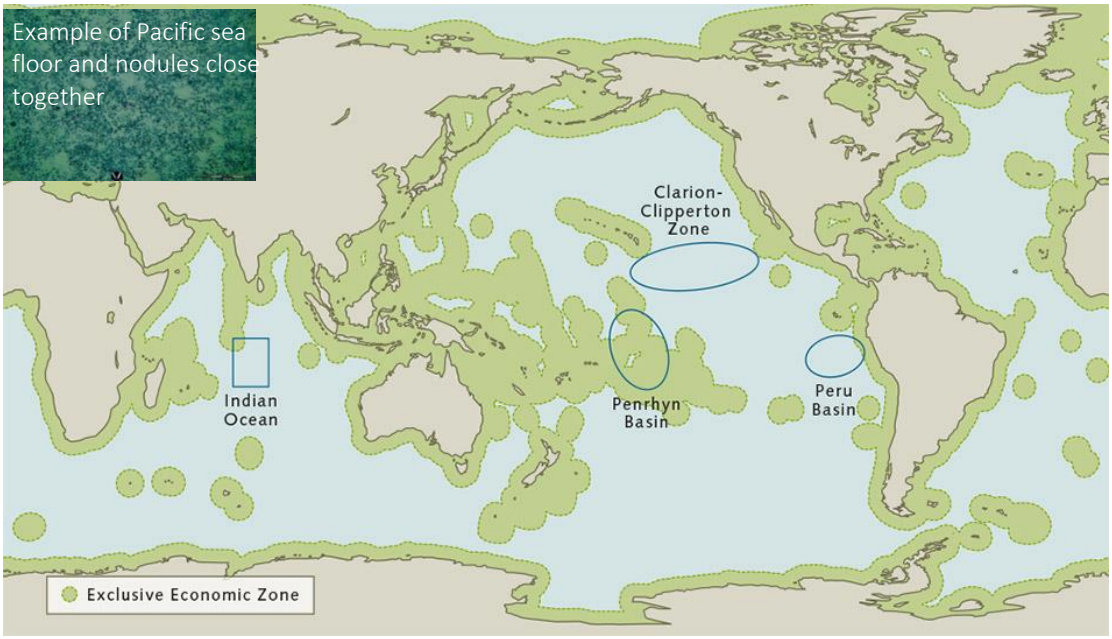

Figure 11: Global distribution of manganese nodules. Source: World Ocean Review (2017).

Almost all **seafloor massive sulphide** deposits have been found at the plate boundaries: most of the deposits have been found on the mid-ocean ridges (65%), many also occur along the volcanic arcs (12%) and at backarc spreading centres (22%). Of the known SMS deposits, the one at the Solwara-1 site is the most advanced one. Such site is located 25 km off the Papua New Guinea coast and a Canadian company has now been recently granted the mining and environmental permit to develop a production system using existing technologies adapted from the offshore oil and gas industry and the dredging and mining industries to enable the extraction of the high-grade deposit (7% Cu where land-based mines average 0.6%) on a commercial scale (Nautilus, 2017).

Cobalt crusts are rock-hard, metallic layers that form on the flanks of submarine volcanoes, called seamounts. The most important cobalt crust area is the Prime Crust Zone (PCZ) in the western Pacific.

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In the Pacific Ocean, there are more than 11,000 seamounts, representing 57 % of the global total (Rademaekers et al., 2015)

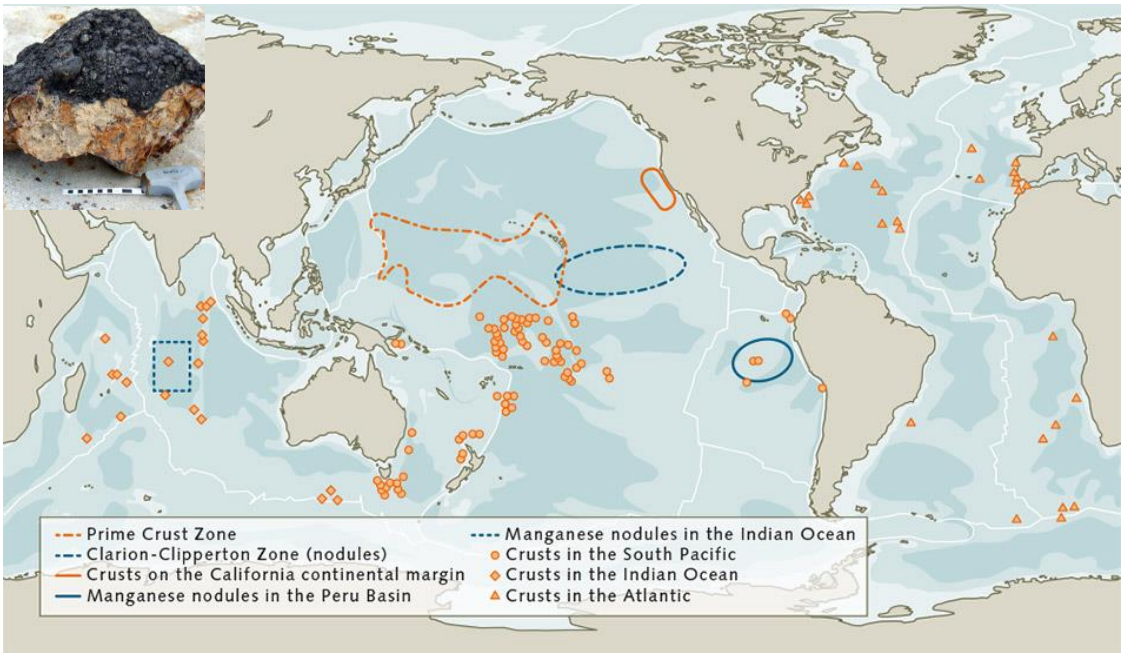

Figure 12: Global distribution of cobalt-rich crusts. Source: World Ocean Review and SPC, (2013).

Annex 4 – Major players in the global minerals market

Mining industry

The **global supply of metals** is dominated by around a dozen countries, with China and Australia as the leading ones. **China is the world´s largest producer of non-energy minerals (e.g. is the largest producer of gold, of refined copper and refined tin, etc.) and Australia is the largest producer of iron ore and bauxite**, with much of the Australian iron ore being imported by China itself (by far the world´s largest producer of crude steel), and also by Japan, both countries which have close trade agreements with Australia. Other major global players in the metals supply are South Africa (world leader in the production of manganese, chromium and precious metals such as PGMs and gold), Russia (nickel, PGMs), Chile (copper, silver), USA (copper, lead, gold, beryllium), Brazil (iron ore, bauxite, manganese, nickel, niobium), Canada (nickel, gold, germanium), India (iron ore, bauxite, chromium, natural graphite), Peru (copper, gold, silver) and Mexico (silver, refined lead) (source: MinPol database 2017).

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The **global production of iron and ferro-alloys** is (in monetary terms) dominated by South Africa, followed by Australia, China, Brazil and India whereas **the global production of non-ferrous metals** is led by China, followed by Chile and the USA (Figure 13).

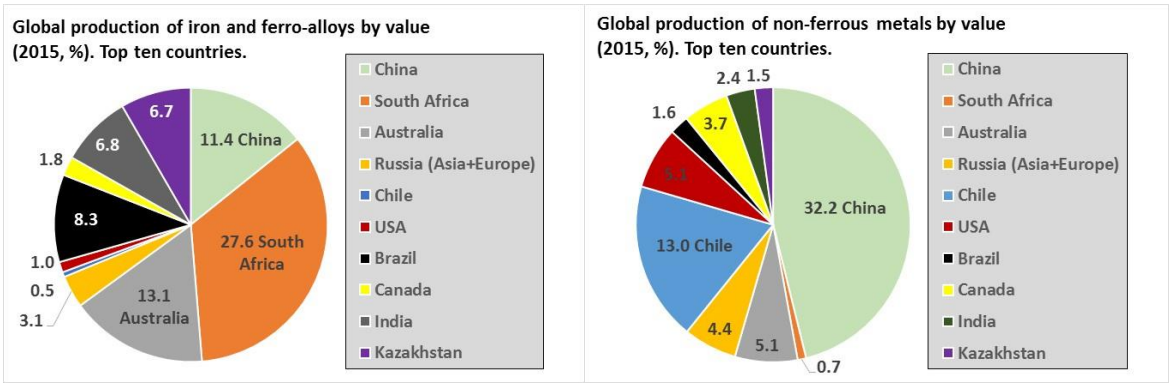

Figure 13: Production of iron and ferroalloys and non-ferrous metals in the top ten global players of the non-energy minerals industry. Source: MinPol, 2017a[36].

The precious metals supply is also dominated by China, Russia, South Africa and Australia which cater for almost 40 % of the global supply. Likewise, **China, Russia, Canada and the USA are the major global players in the supply of industrial minerals** (Figure 14).

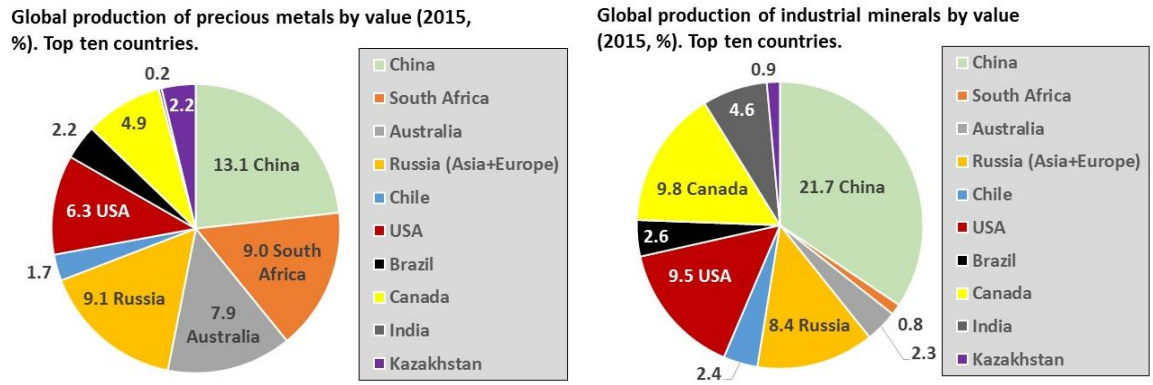

Figure 14: Production of precious metals[37] and industrial minerals in the top ten global players of the non-energy minerals industry. Source: MinPol 2017a

[36] Diamonds excluded. Iron and ferro-alloys include: Iron, Chromium, Cobalt, Manganese, Molybdenum, Nickel, Niobium, Tantalum, Titanium, Tungsten, Vanadium; non-ferrous metals include: Aluminium, Antimony, Arsenic, Bauxite, Bismuth, Cadmium, Copper, Gallium, Germanium, Lead, Lithium, Mercury, Rare Earth Minerals, Rhenium, Selenium, Tellurium, Tin, Zinc.

[37] Precious metals include gold, silver and PGMs.

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Global exploration expenditures also indicate the leading role of Canada and Australia followed by the USA, China, Russia, Chile, Peru, Mexico and South Africa (Figure 15). **The EU attracts a decent amount of exploration investment but it is not considered as a top attractive destination for mineral exploration.** Europe accounts for a 5% of the global exploration expenditure on non-ferrous metals whereas other jurisdictions appear much more attractive (Canada leads with a 14% followed by Australia 13%, USA 7%, Chile, Peru, Mexico and China 6%) (Figure 15).

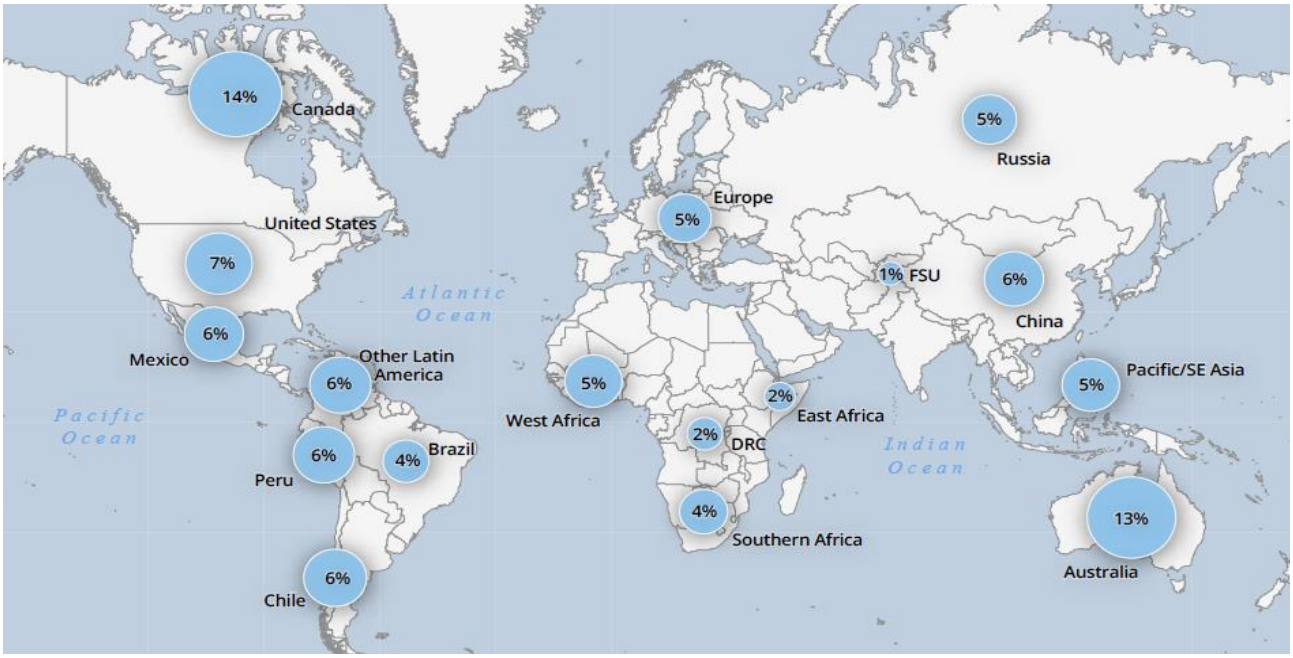

Figure 15: Global non-ferrous exploration expenditure. Source: S&P (2017)

If raw material minerals considered 'critical' (CRMs) by the European Commission are considered (Deloitte et al., 2017), **China also has a remarkable leading role in the global supply of most CRMs**, with some exceptions such as beryllium and helium (supply concentrated in the USA), hafnium (France), natural rubber (Thailand), tantalum (Rwanda), niobium (Brazil), borates (Turkey), or cobalt (DRC) (Figure 16).

On the **global metals demand side**, the situation is also closely tied to the demand for mineral resources by China, the EU, the USA, India and Japan which are the world´s major metal consumers, followed by South Korea, Brazil, Russia and Germany (to account for the ten largest consumers). **China**

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remains the world´s largest consumer (importer) of non-energy minerals, demanding over 50 % of the world´s supply for iron, refined copper, refined zinc and primary aluminium (Figure 17).

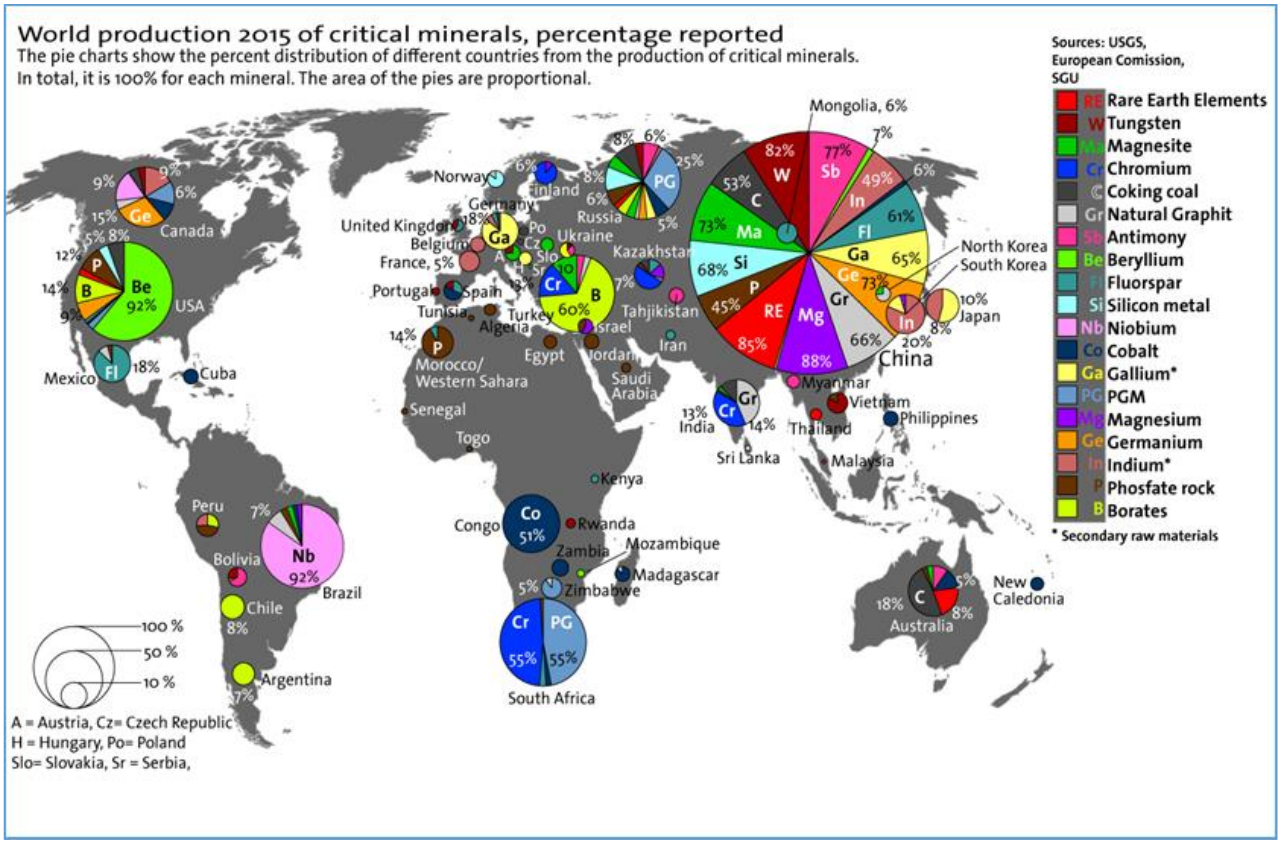

Figure 16: World production of CRMs (2015, in %). Source: Geological Survey of Sweden (SGU).

Other minerals of special importance in the global economy are potash and lithium. Potash (part of industrial minerals / EU classification) is essential for the world´s food supply and its global demand is expected to continue growing driven by the demand for fertilizer nutrients which has been growing continuously since 2009 and is expected to keep on growing at least until 2019 (FAO, 2016). Potash´s global leading producers are Canada and the former Soviet Union countries (Russia, Belarus) which have small domestic requirements while most of the global demand is led by Asia (China, India, Japan), Brazil, etc.

Lithium (battery grade lithium) is increasingly gaining in importance driven by the growing demand for lithium-ion batteries used for batteries and accumulators, currently expected to grow substantially in the coming decades due to the constant surge in the manufacturing of hybrid and

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electric vehicles (cars, buses, bikes, etc. driven by regulations/targets on CO_2 emissions, falling battery costs), for grid storage in the renewable energy market, consumer electronics and devices, among others.

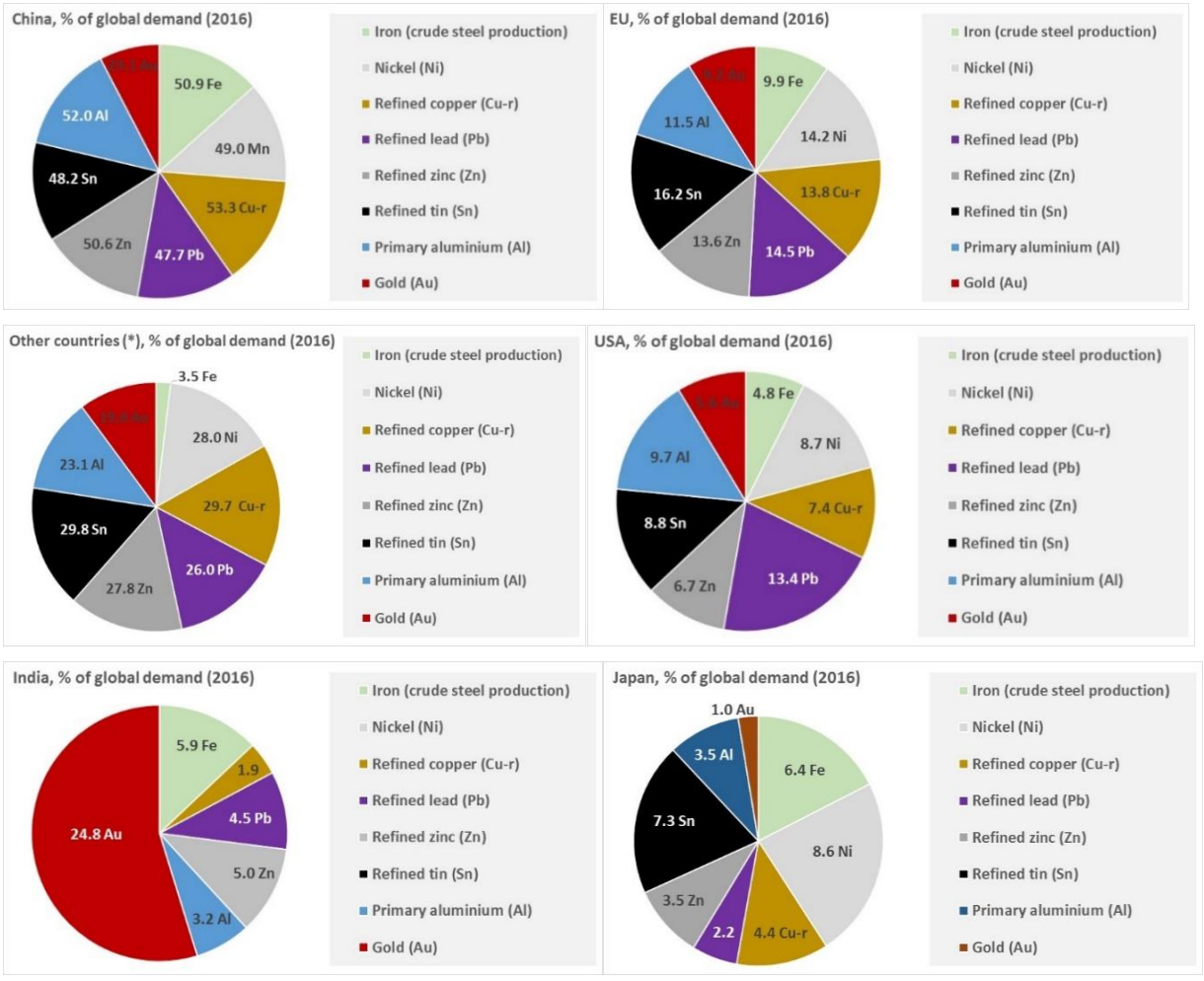

Figure 17: Global demand of selected minerals (2016, percentage) for six of the top ten consuming countries. Source: MinPol 2017 - MinPol based on data provided by the World Steel Association, the Intelligence Unit of the Economist and the World Gold Council. Note (*): "Other countries" includes the EU, except for iron.

Technology changes fast and new batteries that could eventually compete with lithium-ion ones appear frequently (e.g. graphene-enhanced Li-ion); yet, current forecasts are optimistic, e.g. expect an average annual growth rate of more than 10 % in the next ten years (Rongguo et al., 2016).

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Currently, around 80 % of the total lithium production worldwide originates in the South American triangle (brine deposits) plus Australia. As a result of this supply oligopoly, lithium is currently not traded in the market and the actual trading prices are strictly confidential, a situation similar to some CRMs (e.g. REE). The demand for lithium is rising continuously, with China as the main consumer (one third of the global demand, concentrates battery plants), followed by Japan, South Korea, the EU and the USA that plans to increase its share with the TESLA giga battery plant project (Tesla Motors alone is expected to consume over 13% of the annual lithium production). Recently Germany announced plans for the construction (2019) of a large battery factory to compete with TESLA (Parkin, 2017).

Metals recycling

The valorisation of recyclable minerals is continuously gaining importance in the agenda of developed countries: the EU adopted the Circular Economy Package in 2015 and has enforced other complementary legislation complementing it (e.g. WEEE and Batteries Directives), the Chinese Circular Economy Development Strategy and Immediate Plan of Action (2013), among others. Recycling is an essential part of a transition to a circular economy, yields cost advantages to companies and many environmental benefits, e.g. aluminium recycling uses only 5% of the energy needed for primary production and reduces energy consumption and lowers GHG emissions. One tonne of recycled aluminium saves up to 8,000 kilograms of bauxite and 14,000 kWh of energy (BIR, 2017a), and recycling 1 tonne of aluminium avoids the emission of about 9 tonnes of CO_2 emissions as recycling aluminium uses 95% less energy than producing aluminium using raw materials (EAA, IAI, OEA, 2009). Taking advantage of "anthropogenic mines" has great potential to reduce dependency on virgin metal resources and mitigate environmental degradation caused by mining. As an example, the largest municipal recycling park in China is capable of recovering 1 Mt of copper per year while the largest copper mine in China produces less than half of that (UNEP, 2011b).

Globally, steel is not only the most widely-used metal but also the most widely-recycled one with an end-of-life recycling rate (EOL-RR)[38] of 70 % and 90 % for iron and steel respectively (UNEP, 2011b); the latter value is one of the highest end-of-life recycling rates among all the industrially-used metals. According to UNEP´s IRP, only twelve of sixty metals investigated show an end-of-life recycling rate (EOL-RR) above 50 % (Figure 18A), including widely-used metals such as iron, aluminium, manganese, nickel, copper, zinc, gold, silver and the PGMs. In contrast, EU-listed CRMs display generally low recycling rates, e.g. of 0 % as they cannot be recycled (coking coal, fluorspar, magnesite, phosphate rock), less than 1 % in the cases of beryllium, borates, gallium, germanium, indium, bismuth, hafnium,

[38] The (functional) end-of-life recycling rate (EOL-RR) is the most important parameter to measure the efficiency of an overall recycling system. It can be defined as the portion of metal in discarded products (post-consumer or old scrap) which is separated and sorted to obtain recyclates that are returned to raw material production processes that generate a metal or metal alloy. This rate is strongly influenced by the least efficient step in the recycling chain, which is typically the initial collection activity.

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scandium, tantalum and vanadium or between 1 and 10 % (antimony) (Figure 18A). Some exceptions are PGMs, cobalt, chromium, niobium which have EOL-RRs > 50%, magnesium between 25 and 50%, and tungsten with an EOL-RR between 10 and 25%.

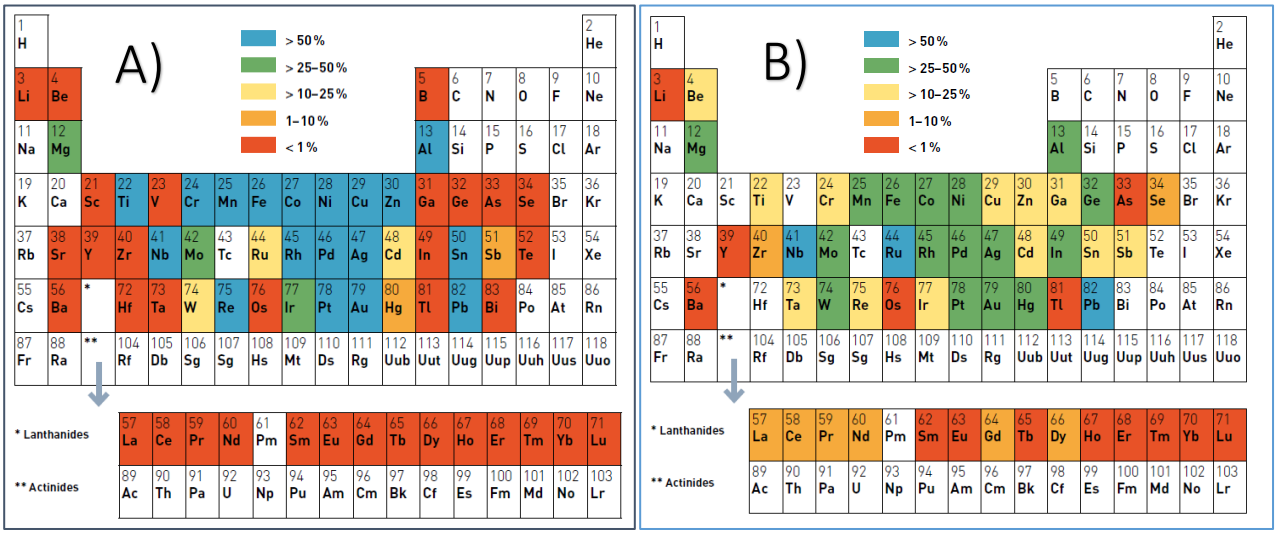

Figure 18: A) *Global average end-of-life recycling rates for sixty metals.* ***B)*** *Global average recycled content (RC) for sixty metals. Unfilled boxes indicate that no data or estimates are available, or that the element was not addressed as part of UNEP's study. Source: (UNEP, 2011b)*

The **proportion of the supply catered for by recycled metal** can be approached via the recycling input rate (RIR) defined as the fraction of secondary (scrap) metal in the total metal input of metal production (corresponds to the recycled content RC in the fabricated metal). For the most widely-employed metals (iron, aluminium, manganese, nickel, cobalt, gold, silver) **recycling caters for between 25 and 50% of the demand** (Figure 18B): the ratio steel scrap/crude steel in 2016 reached a 36% in the world and 54% in Europe (BIR, 2017b; Willeke, 2017), whereas for copper it was around 30% in Japan and USA, 25-30% in Europe, 10% in China (BIR, 2017c). Higher RC rates are found only for niobium, lead, and ruthenium for which the RC is above 50% (Graedel et al., 2011) (Figure 18B). In contrast, for zirconium and selenium the RC is between 1 and 10% or below 1% for lithium and REEs.

Major players in the scrap recycling business are China, the EU, the USA, Japan, Turkey and Russia (ISRI, 2017).

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Annex 5 – Transversal challenges of the mining industry

The globalised mining industry faces and constantly needs to adapt to short-term and long-term structural challenges as well as region-specific and ubiquitous challenges. With regards to **short-term** challenges (due to the current market conditions) the industry is struggling with low (but gradually recovering) commodity prices and restraints in the access to venture capital, at times facing resource nationalism policies in several countries. However, the industry also needs to address **long-term** challenges via long-term policies and strategies to overcome them. The main ones involve:

- ✓ Innovation, automation, digitalisation and data analytics as key productivity drivers
- ✓ Declining ore grades, rising waste volumes and declining productivity
- ✓ An ageing workforce and skilled labour shortages
- ✓ Climate change poses risks to operations
- ✓ Difficulties in access to land, water and energy supply
- ✓ Increasing social opposition and social conflicts, lack of social licence to operate
- ✓ Illegal mining and illegal recycling of metals

Table 5 below presents an overview of transversal challenges currently framing the mining industry´s operations.

Many of those transversal challenges are being addressed at the international level by multi-stakeholder platforms. A selection of some of the most relevant include (for a more comprehensive list the reader can consult FORAM´s Deliverable 1.3 Baseline report on mapping of initiatives and data availability):

- ➢ **WTO:** it is the only global international organization dealing with the rules of trade between nations. It is of particular importance as the organisation that can negotiate and act as intermediary in disputes related to minerals trading (e.g. export restrictions by countries with a supply monopolistic situation).
- ➢ **Sector-specific alliances led by the World Economic Forum** such as the Atlas (white paper) mapping the potential contributions of the mining sector to achieve the Sustainable Development Goals
- ➢ **Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development**: The IGF supports 60 nations committed to leveraging mining for sustainable development to ensure

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that negative impacts are limited and financial benefits are shared. It is devoted to optimizing the benefits of mining to achieve poverty reduction, social development and environmental stewardship.

- **UNEP´s International Resource Panel:** established in 2007, the panel´s mission is to consolidate and evaluate scientific data, with the aim of providing global guidelines for the sustainable management of natural resources. One of its first reports summarized the central message of the panel: the need to produce products and services with less environmental impact and degradation.
- **OECD Policy dialogue Natural Resource-based Development:** an intergovernmental platform for peer learning and knowledge sharing for crafting innovative and collaborative solutions for resource-based development. The work and analysis of the Policy Dialogue also feeds into other international processes such as the 2030 Agenda for Sustainable Development, the G7 CONNEX Initiative, the G20 Development Working Group and the G20 Anti-Corruption Working Group.
- **WEF´s Responsible Mineral Development Initiative:** launched to explore the views, priorities and concerns of key stakeholders on mineral development, and to seek answers on what works, where discontent most commonly arise, and where improvements should occur.
- **European WEEE Forum:** supports e-waste producer responsibility organisations to succeed operationally, take back and report e-waste efficiently.

However, as highlighted by a recent paper (Ali et al., 2017), **there remains a need for an international mechanism to govern how mineral supply should be coordinated** as international coordination is needed on where to focus exploration investment efforts, what kind of minerals are likely to be found in different locations and hence, what kind of bilateral agreements are needed between various countries, e.g. to harmonise global best practices for responsible mineral resource development.

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Table 5: Transversal challenges of the mining industry and policies or initiatives to address them (no order of importance).

	Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
ECONOMIC	**Cash and portfolio optimization**	Limited pricing and demand visibility as a result of ongoing market volatility (price and currency volatility) are challenging mining and metals companies as they plan for the future. It is expected that cash generation and preservation of attractive returns on invested capital will remain a key focus for the medium term due to ongoing market volatility.	Ubiquitous	Optimize portfolios (e.g. via brownfield expansions, strategic acquisitions and/or divestments), optimise mine schedules and grades, sustain the focus on costs, pursue innovative growth
	Capital raising - access to venture or risk capital	Over the past 12 months, as the risk of default has increased, banks are only extending trade and long-term financing at an increased cost to those mining companies with sufficient security to back the debt	Ubiquitous	Streaming deals, royalty agreements, off take and forward sales, asset-backed financing on inventory and trade receivables.
	Productivity increase	Productivity remains the primary operational challenge in the mining sector, with many still struggling to make an impact. Productivity in the mining sector has been on a steady decline over the past decade as miners focused on output at any cost in an unprecedentedly high commodity price environment.	Ubiquitous	Tailored approaches to innovation, digitalization, automation, promote 'mining innovation ecosystems' like the Canadian Mining Innovation Council, which has encouraged greater industry collaboration by setting up a series of 'Collaboration Laboratories'. Using technology and data to enhance integration, innovation (e.g. deep in situ mining, grade engineering, ultra-high intensity blasting, real-time planning and visualization, virtual reality mine training, vendor-managed inventory, etc.).
	Digitalisation	Trend analysis studies posit that in the future it is expected that a certain part of the core processes in mines will become fully integrated, autonomous, remote and automated—capabilities made possible by a network of low cost, highly capable sensors that use internet of things (IoT) technologies. For instance, Komatsu, a global mining and construction	Ubiquitous Australia, Canada, Europe (especially Sweden (e.g. SMIFU project),	Investing in innovation to embed digital thinking, processes and structures into the entire organization. Digitize the mining value chain, data and analytics solutions as a way of supplying real-time data, increasing productivity.

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Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
	equipment manufacturer, and General Electric announced plans to provide mining companies with big data analysis services using IoT technology to boost efficiency in mining operations. As a result of this shift, digital mines are expected to operate with fewer people who possess different skills than those required today. Robotics is being tested for sea-bed and deep-sea mining (e.g. VAMOS project)	and Consortia financed via H2020) and Brazil are leading innovations	
Declining ore grades and increased waste volumes	A trend of (mined) declining ore grades has been demonstrated for Australia's producing mines (Calvo et al., 2016; Mudd, 2007, 2004), and this is fairly typical of the international situation. A direct consequence is that more ore has to be processed to obtain the same amount of target metal which in turn leads to increasing production costs (e.g. higher energy needs) and higher waste rock (and tailings).	Ubiquitous, evidence from Australia is solid	Optimize mine schedules, grades products and stockpiling, minimize waste, innovation to improve resource efficiency (e.g. energy intensity) detecting saving potentials using data analytics, reduce pollution risks of waste rock and tailings (e.g. dry tailings technology)
Access to skilled labour	The global mining industry has been facing for a number of years continuous shortage of adequately trained and skilled workers. This has been reported as a problem in Canada, the USA, Australia, and South Africa. For instance, in Canada it is estimated that the mining industry will need to hire 106,000 new workers over the next decade to 2025 whereas by 2025 more than 51,000 employees will retire from the sector, which represents over 25% of the industry's current workforce. Skills change constantly, and the workforce needs to be continuously improving: today's mining industry relies on highly skilled workers with a diverse skill set, the ability to use	Ubiquitous, especially problematic now in South Africa and in the near future in Canada, USA, Australia	Mining education: Industry-government-education institutions (universities, technical colleges, training centres, apprenticeships, scholarships) need to collaborate to ensure that new entrants to the industry have the skills required by the industry. National Workforce Plans (e.g. in Canada, in Western Australia 'Skilling WA – A workforce plan'[39]): the planning process addresses the types of skills, number of people and locations at which they are required. It also audits existing skills supply, likely demand scenarios and training options;

[39] See Jeffrey, K., Hameed, A. and MacFarlane, D. 2016. Analysis of Education and Outreach. INTRAW Deliverable 1.4. Version 1.4. Available at www.intraw.eu

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Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
	sophisticated technology and operate in challenging environments. The staff must continuously upskill.		one of the most challenging issues is to assess workforce demand and design strategies that address the cyclicity in commodity prices and resultant mining activity.
Resource nationalism threat	Resource nationalism (rent-seeking strategies or strategies to advance in the value chain domestically by national governments as exemplified by China with REE or Indonesia with nickel and bauxite ores) seems to have recently been promoted in few places (Philippines), but it has generally retreated; however, it remains a latent threat if commodities should enter into a new super cycle of prices. It is implemented via countries announcing increases, or intended increases, in resource revenues via taxes, royalties, state ownership, tariffs, export restrictions (e.g. mineral export bans on unprocessed minerals), etc.	Currently reported in Philippines, but latent threat in Indonesia and China, also reported in Kenya	Lodging claims to the WTO, promoting cooperation and free trade agreements.
Efficient, clear and transparent permitting schemes	Inefficient permitting regimes as well as delays in the applications (due to procedural mistakes, incomplete applications, duplications in the procedure or insufficient staff in the processing authority) or in permits obtained (e.g. due to appeals) all represent a financial risk which compromises the legal certainty of an investor and the predictability of any project. In the USA, the higher costs and increased risk that often arise from a prolonged permitting process can cut the expected value of a mine in half before production even begins. Increasing permitting times have now become a global cause of concern as they have increased all over the world (mainly for the permitting of project already at the feasibility stage, i.e. ready to start construction and operation).	Ubiquitous, especially reported as problematic in the USA, India, Europe	To avoid procedural mistakes during applications, permitting regimes need to have clear and transparent rules/guidelines on what is needed. As a good practice, in Western Australia the government assigns case managers (or project officers) to complex projects (a service called comprehensive case management services in the Department of Mines and Petroleum). The case manager works closely with the company to assist in the resolution of bottlenecks and to negotiate agreed approval timelines across government. They support the company by ensuring that their permit application is fully aligned with the relevant state and Federal Government regulations and expectations. To avoid social opposition (or reduce the

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	Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
		Lack of efficient permitting regimes may also be related to a) non-existing mineral policy approaches (e.g. EU-MSs) b) weak mineral policies/governance. For instance, Sierra Leone issued in 2003 a Core Mineral Policy which was not successful in tackling problems related to mining, including permitting.		likelihood of conflicts to a minimum), good practice requires to engage in meaningful stakeholder engagement processes from the very early stages with the authorities and the public.
	Reliable and cost-effective transport infrastructure	Existing transport infrastructure of adequate quality has been reported as a problem in developing (e.g. South Africa) and developed countries (e.g. the USA, in Canada´s remote and northern regions).	Reported as problematic in South Africa, USA, Canada´s remote and northern regions	Direct public investment (or via public-private partnerships) to improve the quality of the transport infrastructure (benefit for all sectors, not just mining). Shared-use mining infrastructure to avoid duplication in investments: 'open access' regulation of rail and port logistics infrastructure used by 'bulk' mining operations.
	Access to energy	Energy consumption ranges between 15 to 40% of the operating budget of a mine. Access to a quality energy supply at competitive costs has been reported as a challenge (due to an energy crisis) in multiple jurisdictions around the world, e.g. South Africa, Australia (in the state of South Australia due to the closure of Hazelwood and Porta August coal-fired power generation plants in 2016), Chile or Zambia.	Energy shortages reported in Australia, South Africa	Invest in energy generation and distribution infrastructure, e.g. via shared-use mining infrastructure. Adopt renewable sources in the energy mix (smart energy solutions), modernise equipment making it more efficient (example of Rio Tinto´s modernisation of its Kitimat aluminium smelter in the British Columbia improving the energy intensity by 30 %).
SOCIAL	**Social licence to operate, social opposition and conflicts**	Resistance to 'extractivism', mine accidents and pollution legacies, lack of meaningful stakeholder engagement processes from the very beginning of the projects, mining-related diseases, community protests and neglecting mine rehabilitation obligations (compounded by campaigns usually led by NGOs) are all having a significant adverse impact on the sector's image (market reputation). Social opposition to poorly managed projects (in terms of stakeholder engagement) can create substantial delays to projects or even stop them	Ubiquitous, especially problematic in developing regions such as Latin America, Africa and Oceania countries	The mining industry has responded to the increased global scrutiny of operations, contentiousness of new mining in host communities and nations and the intensification of anti-mining social movements by creating voluntary international standards (self-regulation standards such as reporting ones like GRI or TSM) through private industry organisations and the emergence of CSR as a lead practice. Other strategies include new approaches to shareholder value.

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Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
	indefinitely, generating financial losses to investors. Research has found that the most frequent costs arise from lost productivity due to temporary shutdowns or delay. For example, a major, world-class mining project with a capital expenditure of between US$ 3-5 billion was reported to suffer costs of roughly US$ 20 million per week of delayed production in Net Present Value (NPV) terms, largely due to lost sales. Likewise, the greatest costs inflicted by social conflicts are the opportunity costs in terms of the lost value linked to future projects, expansion plans, or sales that did not go ahead. For instance, in Peru, according to data from the Peruvian Institute of Economics, the country lost (Peruvian peso) $ 14.9 billion between 2010 and 2014 in mining exports revenue.		
Access to land	Access to land (already at the exploration stage) may be constrained by not implementing a land use planning approach (mineral planning policy approach) that foresees and avoids potential conflicts between land uses. Thus, access to land for the mining industry may be restrained due to legal or planning instruments (e.g. areas for conservation of biodiversity or cultural heritage), by social opposition to projects or by biophysical constraints (hydrology including areas prone to be flooded, slopes, elevation, land use, transport infrastructure, urban areas, etc.).	Reported as a problem in Europe, Latin America, India	As being promoted by the MINATURA2020 project, access to land needs to be managed by land use planning/management considering different planning level (national/regional/local). Ensure high-quality environmental impact assessment reports are prepared during permitting procedures, engage in early and meaningful stakeholder engagement processes and community development agreements to prevent and avoid social opposition.
Lack of transparency in the supply chain and in the country´s	This becomes a problem alongside complex value chains for some minerals such as “conflict minerals” affected by armed conflicts (e.g. cobalt in DRC) due to the globalised sourcing of materials which makes it difficult to monitor the sourcing and handling.	Especially problematic in Africa, and to a lesser extent in Latin America and	Application of standards and guidance to increase the transparency (OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, Kimberly Process for diamonds, etc.). Application of legislation (e.g. EU

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Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
management of revenue, corruption	The lack of transparency in the payments made by mining companies to governments limits the monitoring of non-renewable resource revenue flows. The public reporting of country-by-country and project-by-project payment to government by extractive companies is widely recognised as an essential first step to ensure that governments and companies are accountable to citizens for the management of natural resources. This information benefits citizens by providing the information necessary to assess whether their national and local governments are managing the revenues in the public interest and whether their country is getting a fair deal for its resources. It helps citizens, governments, and companies identify instances of corruption and/or mismanagement.	South-east Asian countries	Accounting and Transparency Directives, Dodd-Frank Act, Canada´s Extractive Sector Transparency Measures Act (ESTMA). Promote the country to become a member of the EITI. Disclose payments to governments even without the country being an EITI member. Publish extractive contracts (Publish what you pay coalition, transparent contracts)
Illegal mining and illegal trade	Illegal mining (frequently artisanal and small-scale miners operating in low-grade areas or abandoned mining sites but not only) is often characterised by low efficient and productive operations in detrimental social, labour and environmental conditions. Minerals extracted illegally usually find a way to enter into the formal value chains via illegal trade practices. Usually in terms of high commodity prices (e.g. visible for gold), illegal mining increases considerably.	Especially problematic in Africa and Latin America (e.g. Colombia), also in China (e.g. illegal REE mining), India, Asia	Applications of standard and guidance as previously mentioned (OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, etc.). Governments are now using remote sensing techniques to early detect and monitor advances of illegal mining, e.g. in Peru or Brazil´s rainforest areas.
Indigenous people rights and claims	Mining activities can impact indigenous people´s rights if they: ➢ may have – or claim – some form of legally recognized ownership or control over the land, territories and	A topic of importance especially in Africa, Latin America, Canada	Apply good practices such as Community Development Agreements (CDAs), including Impact Benefit Agreements (IBAs) such as those applied in Canada (in Canada the mining industry is the largest private sector employer of Aboriginal people and employment is poised to increase),

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	Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
		resources that mining companies want to access, explore, mine or otherwise use ➢ may be customary owners of land, territories, and resources but without formal legal recognition of this ownership land ➢ may contain sites, objects or resources of cultural and spiritual/religious significance; and/or the landscapes have special significance because of association, tradition or beliefs ➢ may be employees of and/or suppliers to the mining operations, and potential receivers of taxes and royalties There exist many cases of conflicts between extractive activities and indigenous communities around the world, e.g. because land has been used without the consent of indigenous peoples.	and South-east Asian countries, also to a certain extent in Scandinavian countries	general guidelines (e.g. ICMM´s Indigenous peoples and mining good practice guide, World Bank´s Performance Standard 7 Indigenous Peoples, Akwé Kon guidelines). Ensure the United Nations Declaration on the Rights of Indigenous Peoples, ILO´s Convention 169 and Free Prior and Informed Consent (FPIC) practices are applied. Promote historical reconciliation policies such as those being implemented in Australia and Canada, including land claims issues.
ENVIRONMENT	**Environmental pollution risk and impacts on biodiversity and nature**	Major environmental issues facing modern mining include water resources risks & impacts, air pollution, greenhouse gas emissions & climate change, acid mine drainage, rehabilitation, growing energy needs, among others. There are many examples of poor environmental performance – right across the world – and this drives community concerns at existing or proposed projects. Rise of internet and the digital age – especially social media – means communities can learn of these examples easily and quickly.	Ubiquitous	Strong legal and regulatory framework and implementation/monitoring required (issue of capacity/resources apart from legal conditions). Apply best practices and best available technologies in the operations, e.g. paste & thickened tailings – which reduce water risks & rehabilitation costs as well as much lower failure risks or adoption of pit backfill for high risk AMD projects. Apply good practice guidelines for the conservation of biodiversity (e.g. IFC´s Performance Standards, ICMM´s Good Practice Guidance for Mining and Biodiversity, South Africa´s Mining and Biodiversity Guideline, etc.). Ensure

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Issue	Description	Focus on any region/country?	Policies, strategies or initiatives
			rehabilitation starts being implemented already at the planning phase of the extractive project and is properly implemented during the entire life cycle of any project.
Access to and impacts on water	Water scarcity is increasingly becoming a challenge mining operation in arid regions where mining competes with other land uses, e.g. in Chile. In some cases, conflicts with glaciers and peri-glacier environment may also become a problem too, such as in the Andes Mountain Range (frontier between Chile and Argentina).	Ubiquitous, especially problematic in arid regions	Engage in innovative approaches towards responsible water management (cf. case studies in ICMM´s 2012 study Water Management in Mining), Investments by companies to develop mine water treatment technology, design processing plants that use untreated seawater, build desalination plants (e.g. BHP´s plant for the Escondida mine), recycle and reuse water, set up water storage and distribution networks to ensure local communities have access to potable water.
Climate change	Climate change poses one of the most serious threats to societies, economies and environments across the globe. A changing climate creates significant challenges and risks for the mining and metals.	Ubiquitous	Promote and collaborate in achieving targets set by international conventions. Apply international frameworks, e.g. ICMM´s Framework for adapting to a changing climate.

Source: MinPol based on this report and on Davis and Franks, (2014); Deloitte (2017); Ernst & Young, (2017a, 2016); Jamasmie, (2015); Jeffrey et al., (2016); KPMG, (2016).

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Annex 6 – Summary of selected relevant policy instruments

Country/region	Policy instrument	Objectives
		Regional/International
African Union	**African Mining Vision (AMV)** Adopted in 2009	The AMV identifies a range of actions that should have priority: • Human resources development and skills formation through the facilitation of research and development (R&D) • Provide supporting infrastructure including roads, rail ports, energy and water and telecom; • Encourage a collaboration enhancing share of information, competency, reinvention, innovation, technology evolution and spill-overs, and diversification; • Promote local beneficiation and value addition of minerals to provide manufacturing feedstock and the development of mineral resources (especially industrial minerals) for the local production of consumer and industrial goods; • Encourage and support small and medium-scale enterprises to enter the supply chain and improve the quality of the business environment, • Ensure compliance of industry players with the highest standards of corporate governance, and environmental, social and material stewardship; Establish the requisite enabling markets and common platforms for services (raising capital, commodity exchanges, legal and regulatory support, marketing support and know-how); • Harness the potential of Public Private Partnerships (PPPs); etc. • http://www.africaminingvision.org/amv_resources/AMV/Africa_Mining_Vision_English.pdf
African Union	**Draft Action Plan for Implementing the AMV**	The Action plan consists of 9 Programme clusters: • Programme cluster 1 – Mining Revenues and Mineral rents management • Programme cluster 2 – Geological and mining information systems • Programme cluster 3 – Building human and institutional capacities • Programme cluster 4 – Artisanal and small-scale mining • Programme cluster 5 – Mineral sector governance • Programme cluster 6 - Research and development • Programme cluster 7 – Environmental and social issues • Programme cluster 8 – Linkages and diversification • Programme cluster 9 – Mobilizing mining and infrastructure investment http://www.africaminingvision.org/amv_resources/AMV/AMV_Action_Plan_dec-2011.pdf

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Country/region	Policy instrument	Objectives
IGF Members	IGF GUIDANCE FOR GOVERNMENTS: Managing artisanal and small-scale mining	In January 2017, Intergovernmental Artisanal and Small-Scale Mining (ASM) is a central theme of the IGF's Mining Policy Framework (MPF). The MPF outlines three key ways in which countries can govern their ASM sectors to ensure that they contribute to the country's sustainable development: • Integrate informal ASM activities into the legal system • Integrate informal ASM activities into the formal economic system Reduce the social and environmental impacts of ASM
EU	**Raw Materials Initiative (RMI)**	In 2008, the European Commission adopted the Raw Materials Initiative (RMI) which set out a strategy for ensuring the access to raw materials[40] in the EU. The strategy is crucial for increasing the competitiveness, securing a growth of the EU economy and meeting the objectives of the Europe 2020 strategy. As the consequence of that, the major EU stakeholder platform the **European Innovation Partnership on Raw Materials (EIP RM)** that brings together EU countries, companies, researchers, and NGOs was established to promote innovation in the raw materials sector and to dwell on the implementation of its three pillars: • Fair and sustainable supply of raw materials from global markets; • Sustainable supply of raw materials within the EU; • Resource efficiency and supply of "secondary raw materials" through recycling.
EU	**Resource Efficient Europe** EU strategy	A Roadmap to Resource-Efficient Europe (COM(2011) 571 final) and the next year published a Manifesto for a Resource Efficient Europe where is claiming a need of ***"transition to a resource-efficient and ultimately regenerative circular economy"*** that could be achieved through a *"systemic change in the use and recovery of resources in the economy."* The objective is to maintain the value of products, materials and resources in the economy for as long as possible and minimise the generation of waste.
EU	**Action Plan for the Circular Economy**	In 2015, EU presented in COM(2015) 614 an EU Action Plan for the Circular Economy. The plan consists on specific actions promoting **recycling, EcoDesign,** better **waste management**, encouraging **reuse activities**, developing rules for **energy labelling**, **quality standards** for secondary raw materials, etc.
EU	**NEEI & Natura 2000 Guideline**	To assist the non-energy extractive industry, the European Commission has published new guidance on how to ensure extraction plans and projects are in line with the requirements of EU nature legislation. The guidance document aims to give the economic operators and authorities concerned the clarity they need to ensure that the drive for further development, as promoted under the

[40] The strategy covers all raw materials used by European industry except materials from agricultural production and materials used as fuel

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Country/region	Policy instrument	Objectives
		relevant EU Raw Materials Initiative, is fully reconciled with the objectives of the EU Birds and Habitats Directives. http://ec.europa.eu/environment/nature/info/pubs/docs/leaflets/neei/en.pdf
EU	**Legislation**	Based on Treaty of Functioning of the European Union (TFEU) and International conventions regulating: • **Internal Market Directives** (Services, Concessions, Public Procurement, Utilities Procurement, Accounting, Transparency, and Professional Qualifications Directives) • **Environmental Directives** (EIA, Birds, Habitats, Extractive Waste, Environmental Liability, Seveso III, the Water Framework Directive, WEEE and Waste Shipment Directives) Health protection Directives (the European Framework Directive on **Safety and Health at Work** and the **Carcinogens** Directive)
EU	**HORIZON 2020** Research & Innovation Funding Programme	"Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020)." https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020 **Raw materials" in Horizon 2020** "In order to tap the full potential of primary and secondary raw materials and to boost the innovation capacity of the EU raw materials sector a number of challenges along the entire raw materials value chain will be addressed in the Raw materials part of the Societal Challenge 5: Climate action, environment, resource efficiency and raw materials." https://ec.europa.eu/programmes/horizon2020/en/h2020-section/climate-action-environment-resource-efficiency-and-raw-materials "It predominantly focuses on non-energy and non-agricultural raw materials used in industry (metallic minerals, industrial minerals, construction materials, wood and natural rubber)."
Selected relevant Research and Innovation projects		
EU	**BIOMOre** HORIZON 2020	The project is focused on **extracting metals** in an economically and ecologically optimized way **from deep mineralized zones** by developing an optimized technological concept for **in-situ recovering** of metals from the surface without the need of establishing an underground infrastructure. The concept will **reduce the environmental impacts of mining** exploitation as a whole and improve chances for **better public acceptance**. http://www.biomore.info/home/
EU	**CHPM2030** HORIZON 2020	The overall objective of CHPM2030 is to develop a novel and potentially disruptive **technological solution** that can help satisfy the European needs for energy and strategic metals in a single interlinked process. In the CHPM technology vision the metal-bearing deep geological formation will be manipulated in a way that the **co-production of energy and metals** will be possible, and may be optimised according to the market demands.

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Country/region	Policy instrument	Objectives
		http://www.chpm2030.eu/
EU	**EXTRACT-IT** 7th Framework Programme	EXTRACT-IT defines and develops a series of research topics that will provide foundational **Information and Communication Knowledge (ICT) for Europe's extractive sector** to meet future technological challenges. Focus is on identifying potentially disruptive trend supported by foresight exercise that includes surveys and a series of complementary workshops. http://www.extract-it.eu/
EU	**INTMET** HORIZON 2020	The INTMET project is working to achieve two major innovations: • A new and **efficient technology to deal with low-grade, complex ores** which will change the current and future operations of mineral deposits (including recycling of metals in tailings and metallurgical wastes) in Europe and elsewhere; • A **new mining (mine-to-metal) business model** based on the technology breakthroughs http://www.intmet.eu/
EU	**INTRAW** HORIZON 2020	The INTRAW project objective is **mapping best practices and boosting cooperation opportunities** on raw materials **with technologically advanced non-EU countries** (Australia, Canada, Japan, South Africa and the United States) in response to similar global challenges. The ultimate goal is to set up and launch the **European Union's International Observatory for Raw Materials** as a definitive raw materials knowledge management infrastructure. As a permanent international body, the Observatory will aim after the project completion for the establishment and maintenance of strong long-term relationships with the world's key players in raw materials technology and scientific developments. http://intraw.eu/
EU	**MICA** HORIZON 2020	The main objectives of MICA are: • Identification and definition of stakeholder groups and their Raw Material Intelligence (RMI) requirements • Determination of appropriate methods and tools to satisfy stakeholder RMI requirements • Consolidation of relevant data on primary and secondary raw materials • Investigation of (RMI-) options for European mineral policy development • Development of the **EU-Raw Materials Intelligence Capacity Platform** (EU-RMICP) integrating information on data and methods/tools with user interface capable of answering stakeholder questions • Linking the derived intelligence to the European Union Raw Materials Knowledge Base developed by the Minerals4EU project.

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Country/region	Policy instrument	Objectives
		http://www.mica-project.eu/
EU	**MINATURA 2020** HORIZON 2020	**Ensuring access to mineral deposits for future generations** The overall objective is to develop a concept and methodology for the definition and subsequent protection of **"Mineral Deposits of Public Importance (MDoPI)"** in order to ensure their "best use" in the future in order to be included in a harmonised European regulatory/guidance/policy framework. Duration: 2015-2018. http://minatura2020.eu/
EU	**MINERALS4EU** 7th Framework Programme	**Mapping of mineral resources in the EU** The Minerals4EU project is built around an INSPIRE compatible infrastructure that enables EU geological surveys and other partners to share mineral information and knowledge, and stakeholders to find, view and acquire standardized and harmonized georesource and related data. For this purposes, **The European Minerals Knowledge Data Platform** was established to provide data, map viewer, minerals yearbook and foresight studies. http://minerals4eu.brgm-rec.fr/
EU	**MinFuture** HORIZON 2020	The MinFuture project aims to develop an interactive platform that provides transparency about existing approaches and information gaps concerning global material flows is needed to understand these global supply chains; developing this capability is critical for maintaining competitiveness in the European economy. The Project objective is to identify, integrate, and develop expertise for **global material flow analysis and scenario modelling.** http://www.minfuture.eu/
EU	**MINGUIDE** HORIZON 2020	The MIN-GUIDE project is developing a **'Minerals Policy Guide'**. Duration:2016-2019 The Guide contains **information about mineral and related policies**, as well as governance at the Member State and EU level. http://www.min-guide.eu/sites/default/files/project_result/MIN-GUIDE_D2%202%20policy%20governance%20frameworks_final_0.pdf
EU	**SCRREEN** HORIZON 2020	**Solutions for Critical Raw Materials** The project objectives are: • to establish an EU Expert Network that covers the whole value chain for present and future Critical Raw Materials and encourage dialogue between stakeholders and support strategy and policy development and decision-making. • analyse pathways and barriers for innovation

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Country/region	Policy instrument	Objectives
		• study the regulatory, policy and economic framework • Identify the knowledge and ease the access to data developing a knowledge data portal http://scrreen.eu/
EU	**STRADE** HORIZON 2020	**Strategic Dialogue on Sustainable Raw Materials for Europe** (STRADE). The STRADE project is using a dialogue based approach to bring together governments, industry and civil society to deliver policy recommendations for an innovative European strategy on future EU mineral raw material supplies. http://stradeproject.eu/
EU	**VAMOS!** HORIZON 2020	VAMOS! will enable **access to high grade EU reserves of deeper seated minerals** by providing a new Safe, Clean and Low Visibility Mining Technique and will prove the Environmental and Economic Viability of extracting currently unreachable mineral deposits, thus encouraging investment and helping to safeguard the EU access to strategically important minerals. The ¡**VAMOS! mining technique** will enable: Re-opening abandoned mines; Extensions of opencut mines which are limited by stripping ratio, hydrological or geotechnical problems; and opening of new mines with limited environmental impacts in the EU. http://vamos-project.eu/
National Actions and Strategies		
Austria	**Mineral Resources Plan** Federal Minister of Economics and Labour	In 2001, the Federal Minister of Economics and Labour compiled mineral resources map of needed minerals for the future exploitation, establishing the Austrian Mineral Resources Plan. The Plan´s main purpose is to identify mineral occurrences using innovative, **objective and system-analytical methods identifying conflict free and safeguarding areas** taking into considerations the nature conservation, environment protection, ground water protection and other entitled claims to the open space in the spatial planning (Weber, 2007)
Finland	**Finish Mineral Strategy** **and Action Plan**	In October 2010, the **Finnish Mineral Strategy** was submitted to the Minister of Economic Affairs. The project assessed extensively Finnish and international preconditions for **development over the medium term and until 2050.** The Ministry of Employment and the Economy has published in April 2013 the **Action Plan**[41] based on round table discussions with representatives of extractive industry. The action plan consists **in steps towards improving the operating conditions for the extractive industry** with regard to administration, training and infrastructure. In addition, it proposes more active, open exchange of information and experiences, along with ongoing dialogue regarding the action plan's implementation and development within the industry.

[41] Making Finland a Leader in the sustainable extractive indusstry – Action Plan – 1812

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Country/region	Policy instrument	Objectives
		http://projects.gtk.fi/minerals_strategy/index.html
Finland	**Green Mining Programme** Innovation funding programme	The main objective of the Green Mining Programme, launched in 2011 by **Tekes (the Finnish Funding Agency for Innovation),** was to make Finland a global leader of sustainable mineral industry by 2020. The programme created new business that requires new, specialised expertise alongside the growing field of traditional mining. A central goal was to increase the number of SMEs targeting the export market in the mineral cluster. The programme aimed to achieve global leader status for the research in selected sectors. Duration: 2011-2016 The central content of the programme consists of two thematic areas: 1) Intelligent and minimum-impact mines 2) New mineral resources http://finlandinnovation.fi/greenmining/
France	**Committee for Strategic Metals (COMES)**	Established in 2011, with the decree n°2011-100. The aim of the Committee is to assist to the Minister for Industry in order to **strengthen the security of supply**, identify **needs of the industry** and French economy and to develop strategies. The working programme includes topics as: economic intelligence, international relationships, industrial needs, recycling, circular economy and European actions. http://www.min-guide.eu/mineral-policy/policye1-strategy-and-governance-committee-strategic-metals-1865
Germany	**Raw Materials Strategy**	In 2010, Germany published its Raw Materials Strategy which main goals are: • reducing trade barriers and distortion of competition • helping the commerce to diversify its raw material sources and to develop synergies towards sustainable economic activity, material efficiency including recycling and substitution • establishing bilateral raw materials partnership with selected countries • focusing research programmes in raw materials • integration national measures with EU policy on raw materials and creating transparency and good governance in extraction sector (Stuchtey and Below, 2015)
Ireland and Northern Ireland	**Tellus projects**	Tellus is a ground and airborne **geoscience mapping programme**, collecting chemical and geophysical data that will inform the management of Ireland's environment and natural resources. Duration: From 2004 (various stages, 50% of the entire island of Ireland expected to be completed in autumn 2017) http://www.tellus.ie/

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Country/region	Policy instrument	Objectives
Portugal	**National Strategy for Geological Resources**	The National Strategy for Geological Resources was published in 2012, as a Resolution of the Council of Ministers, aims to **promote a mining sector** that is: a) Dynamic, ensuring the uptake and holding of investment and proper exploitation of resources; b) Sustainable at economic, social, environmental and territorial levels; c) Promotes the growth of the national economy, by ensuring supply of essential raw materials and reinforces its importance in the national GDP and exports; d) Promotes regional development, guaranteed return and employment for local people and ensures the development of the communities where it operates. https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/community/document/portugalnational-strategy-geological-resourcesmineral-resources
Sweden	**Minerals Strategy For sustainable use of Sweden´s mineral resources that creates growth throughout the country**	This minerals strategy is expected to **increase the competitiveness of the Swedish mining and minerals industry**. Sweden's mineral assets are to be exploited in a long-term sustainable way, with consideration shown for ecological, social and cultural dimensions, so that natural and cultural environments are preserved and developed. http://www.government.se/reports/2013/06/swedens-minerals-strategy-for-sustainable-use-of-swedens-mineral-resources-that-creates-growth-throughout-the-country/
Turkey	**Istanbul Mineral Exporters´ Association (IMIB)**	**IMIB** is a professional non-profit association which deals with all export activities in minerals sector. The main objectives of the Association are to **increase exports** of mineral and natural stone industry, to **bring solutions to the problems of export-oriented activities** in the country and to **promote Turkish natural stones and minerals** in abroad, effectively. The Association among other provide statistics on mineral exports
Japan	**JOGMEC**	**Japan Oil, Gas and Metals National Corporation** is a Japanese government-created Independent Administrative Institution established on February 29, 2004 pursuant to the Law Concerning the Japan Oil, Gas and Metals National Corporation (2002). JOGMEC is in charge of: • securing a stable supply of oil and natural gas, nonferrous metal and mineral resources • implementing mine pollution control measures. • wide range of fields from surveying, exploration, development, production to stockpiling, recycling and environmental protection.
Southern African Development Communities	**Harmonisation of Mining Policies, Standards, Legislative and Regulatory Framework in Southern Africa'**	The themes and their objectives, as prioritised by the SADC experts are: • *Policy, Regulations and Administration*: the aim is to adopt similar objectives for national mining policies and align administration procedures in the sector; • *Geological and Mining Information Systems*: this aims at standardising geological data as well as increasing the availability of geological information to stimulate investment in the industry;

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Country/region	Policy instrument	Objectives
		• *Human Resources and Institutional Capacities*: this seeks to improve the quality and quantity of available skills, and standardise qualifications as a basis for the free movement of skills in the region; • *Safety, Health and Environment*: focuses on developing and implementing a common set of health, safety and environmental standards across the SADC mining industry; • Investment promotion: aims at institutionalising SADC-wide mining investment forums, providing investment related information and targeting infrastructure development in potential mining areas; • *Value Addition, Innovation and Research and Development*: to promote downstream value creation through the assembly of information on tariffs and market opportunities and developing a system of innovation to increase the competitiveness of SADC mineral value chains; • *Artisanal and Small-Scale Mining*: this targets the upgrading of the knowledge and skills of small-scale and artisanal miners, as well as providing information and services to address their traditional lack of access to such services; and • *Social Issues and Gender*: this seeks to encourage linkages between communities and mineral developments and uplift the role of women in mining. (UNECA, 2004)
South Africa	**Broad-Based Black Socio-Economic Empowerment Charter for the South African mining and minerals industry, 2017**	The new Government's Black Economic Empowerment (BEE) program is setting rules in relation to the mining and mineral industry and HDSA (Historically Disadvantaged South Africans) for the mining ownership, procurement, employment equity, human resources and mining community development, housing and living conditions and sustainable development and growth of the mining and minerals industry. http://www.dmr.gov.za/gazetted-mining-charter-2016/summary/24-mining-charter/8867-broad-based-black-socio-economic-empowerment-charter-for-the-south-african-mining-and-minerals-industry-2017.html

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