

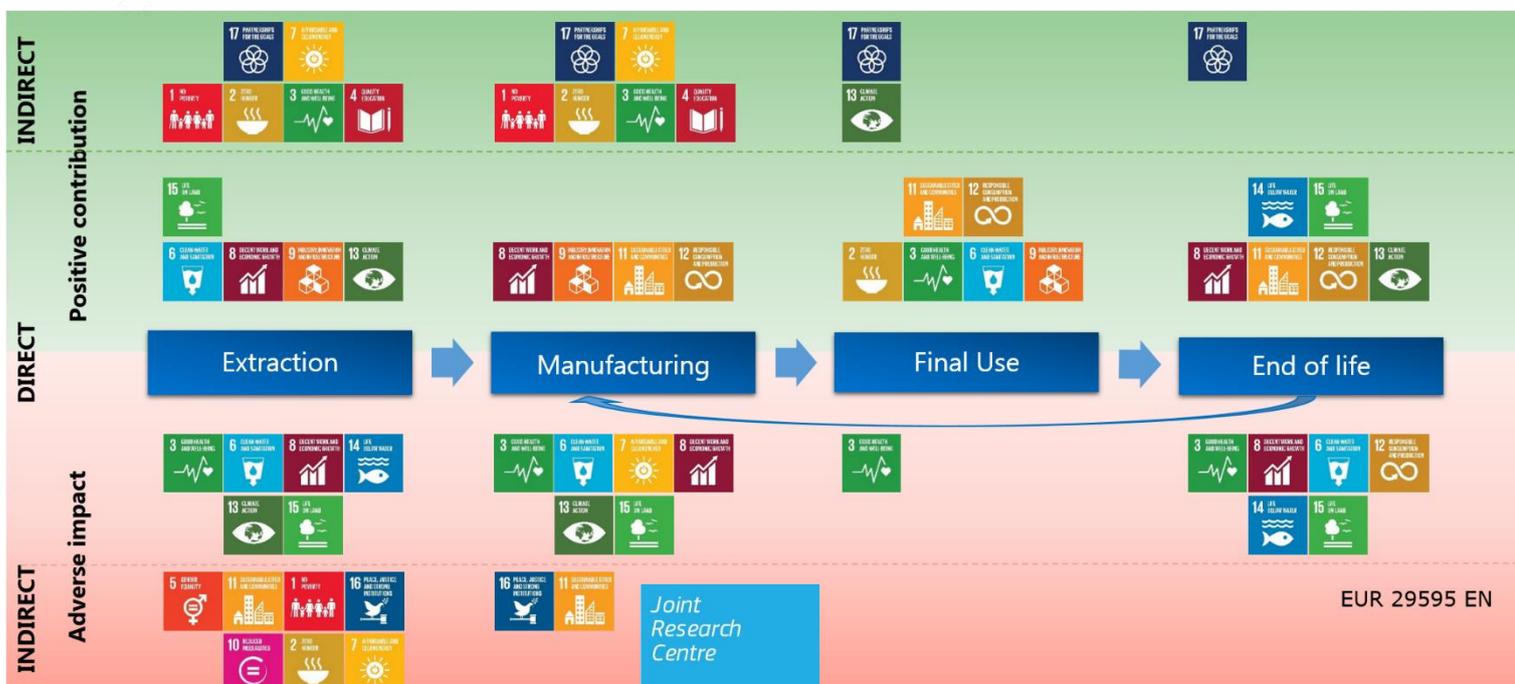
JRC SCIENCE FOR POLICY REPORT

Mapping the Role of Raw Materials in Sustainable Development Goals

A preliminary analysis of links, monitoring indicators, and related policy initiatives

Mancini, L; Vidal Legaz, B; Vizzarri M.; Wittmer, D.; Grassi G.; Pennington, D.

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Contents

- 1 Introduction 3
 - 1.1 The Contribution of Raw Materials to SDGs 4
 - 1.2 The European Strategy on Raw Materials 5
 - 1.3 Raw Materials Scoreboard 6
 - 1.4 The Structure of this Report 7
- 2 Methodology 8
- 3 Description of the supply chain 9
- 4 Contribution of raw materials to the SDGs 12
 - 4.1 SDG 1: End poverty in all its forms everywhere 13
 - 4.2 SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture 15
 - 4.3 SDG 3: Ensure healthy lives and promote well-being for all at all ages 16
 - 4.4 SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all 18
 - 4.5 SDG 5: Achieve gender equality and empower all women and girls 19
 - 4.6 SDG 6: Ensure availability and sustainable management of water and sanitation for all 21
 - 4.7 SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all 23
 - 4.8 SDG 8: Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all 25
 - 4.9 SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and fostering innovation 27
 - 4.10 SDG 10: Reduce inequality within and among countries 29
 - 4.11 SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable 31
 - 4.12 SDG 12: Ensure sustainable consumption and production patterns 34
 - 4.13 SDG 13: Take urgent action to combat climate change and its impacts 37
 - 4.14 SDG 14: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development 40
 - 4.15 SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss 42
 - 4.16 SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels 45
 - 4.17 SDG 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development 47
- 5 Role of European Policies 49

5.1 Raw Materials Initiative	49
5.2 European Innovation Partnership on Raw Materials	50
5.3 Resource efficiency and Circular Economy Action Plan	51
5.4 Conflict Minerals Regulation	53
5.5 European Pillar of Social Rights	53
5.6 Forest Strategy	54
5.7 Industrial policy.....	55
5.8 2030 Climate and Energy Framework	55
6 Analysis of SDGs and RM Scoreboard indicators.....	58
7 Conclusions	60
References	62
List of figures	69
List of tables	70

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Executive summary

The UN 2030 Agenda (UN General Assembly, 2015) established 17 Goals for implementing sustainable development by acknowledging the interdependency of society, environment, and economy, and by strengthening peaceful societies. The EU has a well-established development policy in place and the New European Consensus on Development means it has settled a shared vision and framework for action in development cooperation (European Union, 2017a). Through this document, the EU has aligned itself to the Sustainable Development Goals (SDGs) framework. Moreover, a set of indicators to monitor the SDGs at EU level has been published (Eurostat, 2017a).

Raw materials (RM) are ubiquitous in modern societies and essential to economic growth and well-being, and they contribute to the SDGs in different ways. The production of materials can generate severe environmental and social impacts, especially in developing and weak governance countries. However, their use for example in high-tech applications, transport and energy infrastructures, the construction sector, medical devices etc. demonstrates their crucial role for economic development and human well-being. The EU strategy on non-energy, non-agricultural raw materials tackles the challenges related to these sectors, promoting a secure and sustainable supply from domestic sources and international markets, and increasing the contribution of secondary materials. In support of this policy and in cooperation with DG GROW, the Joint Research Centre is developing an EU knowledge base that comprises the Raw Materials Information System and the Raw Materials Scoreboard. The latter is a collection of indicators on several aspects relating to the RM sectors, encompassing economic, environmental, and social considerations as well as aspects related to governance and the security of supply.

This study scrutinizes how raw materials hinder or contribute to the SDGs, and is based on a review of the literature and expert opinion. It considers the whole value chain (extraction, manufacturing, use, end-of-life) of biotic and abiotic materials.

The twofold role of raw materials emerges in many cases. For instance, production of raw materials results in greenhouse gas emissions, but their use in low-carbon energy technologies contributes to the fight against climate change. Extraction of materials and manufacturing can also pollute water bodies and create water stress, but some materials are essential for environmental technologies and water treatment techniques.

The outcome of the analysis stresses the potential of forestry to contribute to several SDGs, especially in relation to climate and biodiversity. However, it also highlights the importance of sustainable forest management to maintain the provisioning services of ecosystems. Overall, addressing interlinkages and trade-offs between different SDGs and the various phases of the supply chains appear to be crucial in promoting sustainable development.

This study also provides linkages with some current European policies and actions related to the sustainability of raw materials from extraction to consumption. In addition, it compares the indicators of the SDG framework with those present in the Raw Materials Scoreboard, an EC publication monitoring the main challenges of raw materials production in the EU.

1 Introduction

The UN Sustainable Development Goals (SDGs) have set out a vision for a future global society based on sustainability principles (UN General Assembly, 2015). The 17 SDGs (fig. 1) and 169 targets that compose the SDGs Agenda cover the ecological, economic, and social dimensions of sustainability, providing principles and a reference for national and local policy. The UN Agenda calls both governments and the private sector to engage in implementing the SDGs: companies are encouraged to commit to improving the sustainability of production processes and policy makers at all levels are asked to align their strategies to the Agenda's sustainable development principles.



Figure 1 UN Sustainable Development Goals

The European Union has actively contributed to the development of the 2030 Agenda for Sustainable Development, and the previous Millennium Development Goals which expired at the end of 2015. In the Commission communication "A Global Partnership for Poverty Eradication and Sustainable Development after 2015" (EC, 2015a) and in the Council conclusions on "a New Global Partnership for Poverty Eradication and Sustainable Development after 2015" (EC, 2015a), the EU has expressed its position on the adoption of the Agenda. In particular, the Council conclusions concern the guiding principles for the partnership, its monitoring, accountability, and review.

The EU has a well-established development policy in place based on the EU treaties¹ and the 2006 Consensus on Development (European Union, 2006). Since the adoption of the 2030 Agenda for Sustainable Development, the EU has expressed a vision for the development policy in a new European Consensus on Development (European Union, 2017a) aligning and integrating the 17 SDGs in the existing EU policy framework. The new Consensus on Development also supports the Global Strategy on the EU's Foreign and Security Policy presented by the High Representative in June 2016 (European Union, 2016).

¹ https://europa.eu/european-union/law/treaties_en

The Communication “Next steps for a Sustainable European future” (EC, 2016a) and the relative Staff Working Document (EC, 2016b) give an overview of the existing European initiatives relating to the achievement of the 2030 Agenda for Sustainable Development.

In order to monitor the progress towards the SDGs, Eurostat has published a set of 100 indicators for the European context, which cover the 17 SDGs. 41 of them are multi-purpose so they are used to monitor more than one SDG. The set of indicators is subject to periodical review in line with future policy developments and taking into account new indicators as they become available. The first assessment of progress towards the SDGs, referring to the previous 5 years, was published in 2017 (Eurostat, 2017b).

1.1 The Contribution of Raw Materials to SDGs

The UN SDGs framework does not include an explicit SDG on raw materials. However, raw materials are essential for the accomplishment of the SDGs, and can directly or indirectly contribute to all SDGs. As highlighted in the “European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy”, raw materials are indispensable enablers for carbon-neutral solutions in all sectors of the economy (EC, 2018c).

In preliminary studies, Mancini and Sala (2018) analysed the contribution of the mining sector to the SDGs. Similarly, a report by the UN and other international organizations shows how mining companies could contribute to the achievement of SDGs (UNDP et al., 2016). The International Council on Mining & Metals (ICMM) analysed the relevance of each SDG for the mining sector, providing guidance on how negative impacts can be minimized and positive contributions maximized². An ongoing study by the United Nations Environment Programme International Resources Panel assesses mineral resource governance and makes the links to the SDGs explicit³ (IRP-UNEP, forthcoming). The production of metals and minerals can have negative environmental and social impacts. At the same time, their use in high-tech applications or in other sectors like construction, transport systems etc. allows many human needs to be fulfilled, and can contribute to the achievement of several SDGs.

Forests positively contribute to SDGs through among other things biodiversity conservation, climate change mitigation, and provision of food and energy (Seymour and Busch, 2016). Of the others, wood is an essential raw material in the EU (e.g. wood-based products, bio-based products, and bio-energy). Understanding the trade-offs between wood provision and other goods and services, as well as maintaining the wood supply-demand balance, is fundamental to ensuring sustainability in wood production and consumption (EC, 2018a). Therefore, the forest sector faces challenges in order not to threaten these benefits and at the same time provide opportunities in terms of economic growth and employment.

The primary objective of this report is to understand how raw materials affect or contribute to the SDGs in the various phases of the supply chain. Building on previous studies, we extend the analysis of links and potential contribution of raw materials to the whole supply chain, therefore taking into account the extraction phase (mining and forestry), the manufacturing of biotic and abiotic raw materials, their use in final products, and the end of life phase. We highlight potential impacts and contributions of raw materials to each SDG, describing relevant issues of concern. We also mention the indicators used to monitor the SDGs that are relevant to the raw materials sectors, considering both the UN monitoring framework (UN General Assembly, 2017) and the Eurostat indicators’ set for the SDGs (Eurostat, 2017a).

² <https://www.icmm.com/sdgs> [Accessed on 02/08/2018]

³ A summary of this report is available at: <http://www.resourcepanel.org/reports/mineral-resource-governance-21st-century> [Accessed on 03/04/2019]

1.2 The European Strategy on Raw Materials

The Raw Materials Initiative (RMI) (EC, 2008) recognises that raw materials are the building blocks of the economy and consequently essential for the functioning of European industries (e.g. construction, chemicals, automotive, aerospace, defence, renewable energy, and the machinery and equipment sectors). The RMI has three pillars, which aim to ensure (1) the fair and sustainable supply of raw materials from global markets; (2) the sustainable supply of raw materials within the EU; and (3) resource efficiency and supply of secondary materials through recycling. The RMI focuses on non-energy, non-agricultural materials that are both abiotic (such as metals, non-metallic minerals, and industrial minerals) and biotic (such as wood, paper, cork, and natural rubber). Some of these materials are considered to be 'critical' (EC, 2017a) since they are very important to the EU economy while at the same time they show risk of supply disruption due to such things as poor governance conditions in supplying countries or the setting-up of trade restrictions. Therefore, reliable and undistorted access to raw materials is increasingly becoming an important factor in the competitiveness of the EU economy. Moreover, some materials are critical in the deployment of low-carbon and green technologies, which are essential to meet the climate and energy targets.

The EC promotes the competitiveness of industries producing raw materials. To this end, the European Innovation Partnership on Raw Materials (EIP-RM)⁴ has been established as a stakeholders' platform to reach the objectives of the RMI through research and innovation projects.

In order to count on a sound and continuously updated knowledge base for the support of the raw materials-related EU policies, the European Commission is developing the Raw Materials Information System (EC RMIS 2.0)⁵ (fig. 2). The EC RMIS is a reference web-based knowledge platform on non-fuel, non-agricultural raw materials from primary (e.g. extracted by mining), and secondary sources (e.g. recycled, recovered from mining waste). It supports EU policy, gathering and organizing data and information on raw materials covering the EU and putting the EU in a global context. Moreover, knowledge from different sources like Member States, industry representatives, and other stakeholders will be available in the RMIS.

⁴<https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/european-innovation-partnership-eip-raw-materials>

⁵ <http://rmis.jrc.ec.europa.eu/>

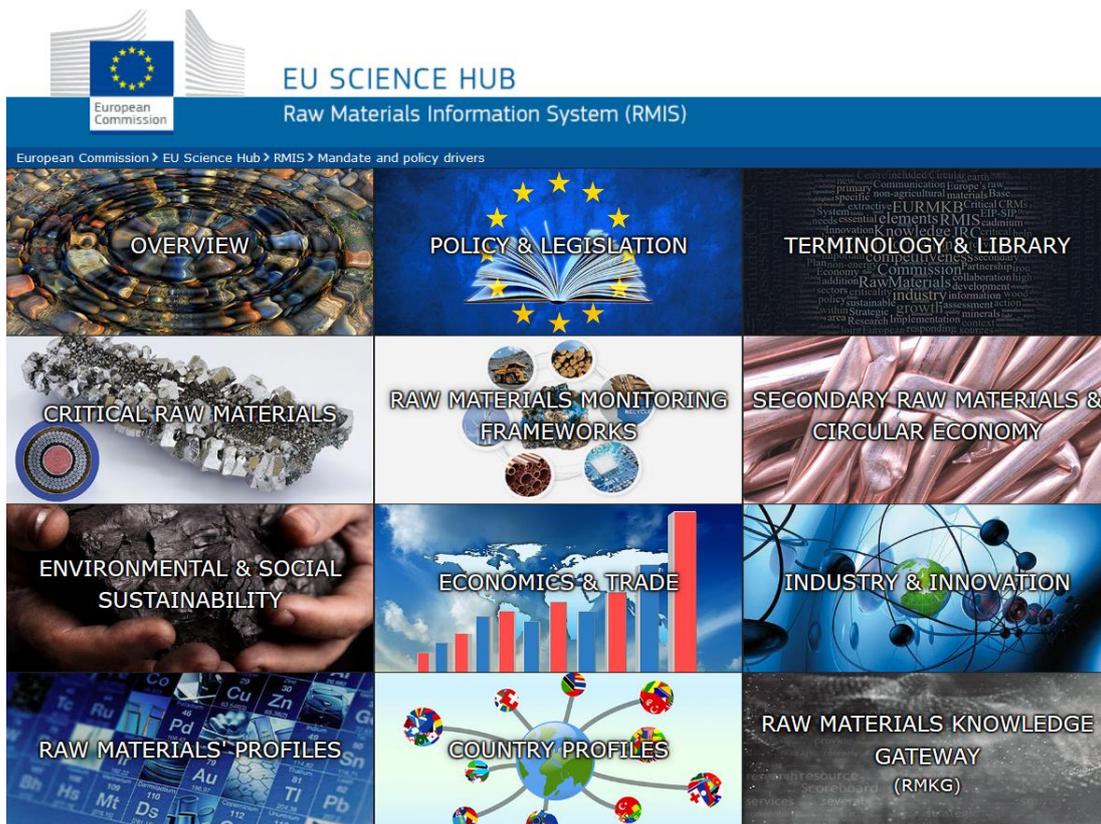


Figure 2 RMIS 2.0 structure⁶

1.3 Raw Materials Scoreboard

The European Commission produces biannual updates of the Raw Materials (RM) Scoreboard (EC, 2016c). The RM Scoreboard is a monitoring tool that provides reference information and data to follow on the challenges of the EU raw materials industry along their value chain. These challenges cover a comprehensive set of topics such as framework conditions of mining, materials' trade flows and end-uses, recycling, and environmental and social sustainability.

The RM Scoreboard is an initiative of the European Innovation Partnership on Raw Materials (EIP-RM)⁷ that aims to provide information for monitoring relevant industrial policies (EC, 2010a) and initiatives on raw materials. The objective of this policy area is to ensure the sustainable supply of raw materials to the European economy whilst increasing benefits to society as a whole. It is prepared in collaboration between DG Internal Market, Industry, Entrepreneurship and SMEs and the Joint Research Centre. Moreover, the Scoreboard presents information that can be used for key/overarching messages in policy/decision-making in a variety of areas (e.g. the monitoring of the circular economy).

The Scoreboard consists of a set of indicators (24 in 2016 and 26 in the 2018 version - published in November 2018) grouped into five thematic clusters: the global context, competitiveness and innovation, framework conditions for mining, circular economy and recycling, and environmental and social sustainability (fig. 3). All indicators are based on best-available data, consider the 'RACER criteria' (relevant, accepted, credible, easy to compute and understand, and robust), and are the result of an iterative and participatory process with the involvement of public and private stakeholders and policy makers (around 30 experts representing a balanced range of interests).

⁶ <http://rmis.jrc.ec.europa.eu/>

⁷ <https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/european-innovation-partnership-eip-raw-materials>

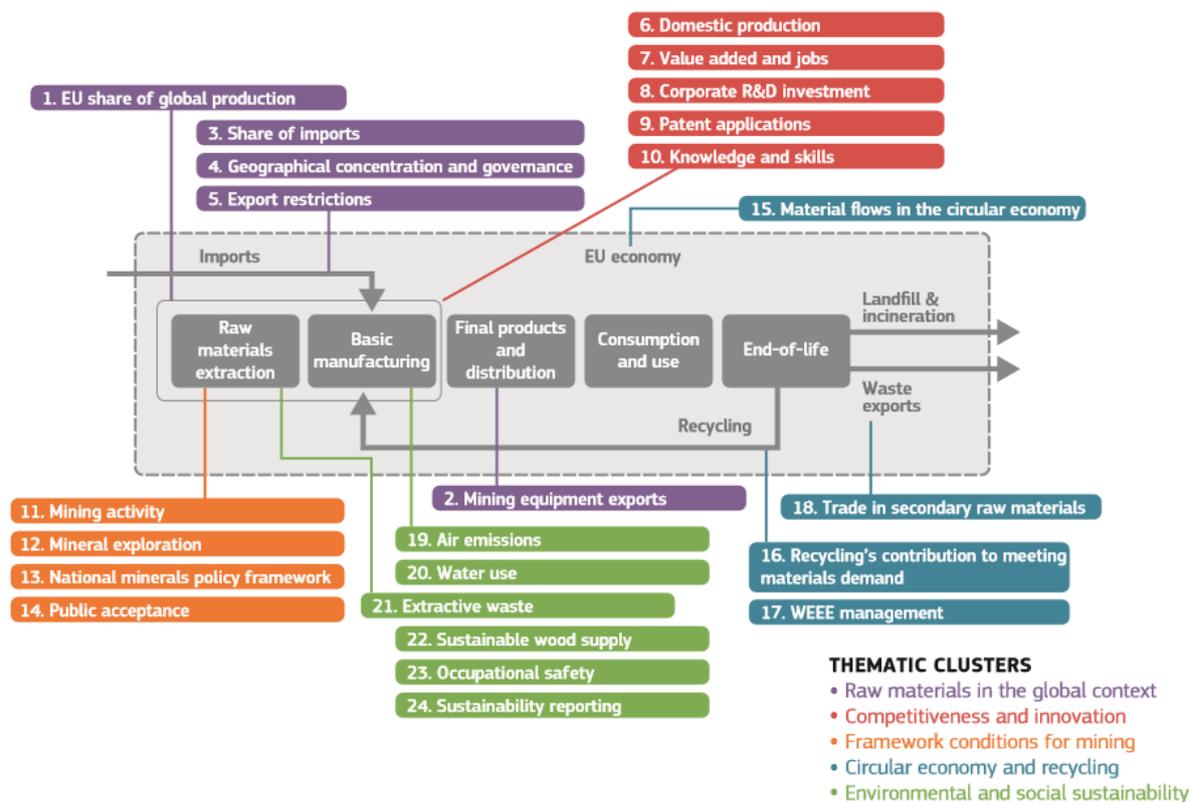


Figure 3 Indicators and thematic clusters of the 2016 Raw Materials Scoreboard⁸.

1.4 The Structure of this Report

The analysis presented in this report encompasses three main areas:

- The contribution of raw materials to each SDG, based on a review of the literature and expert opinions⁹
- The role of EU policies on resource efficiency and circular economy, the forest sector, industrial strategy, conflict minerals, climate change, and social rights.
- The comparison of indicators in the RM Scoreboard with correspondent SD goals and indicators

Section 2 explains the methodology, Section 3 describes the various steps of the value chain under consideration, and Section 4 presents relevant issues of concern for each SDG and the role of raw materials in the various supply chain stages. It also highlights the indicators used in the sets under consideration and the relevant EU policies. Section 5 shows examples of policies of interest for the raw materials sectors, and their contribution to the SDGs. Section 6 analyses monitoring indicators used in the RM Scoreboard and compares them with those used in the SDG framework. The last section presents conclusions and recommendations for enhancing the capacity of the RM Scoreboard to monitor SDG-related aspects.

⁸ Available at: <http://rmis.jrc.ec.europa.eu/?page=scoreboard>

⁹ With the exception of forestry (considered as a whole sector, producing a variety of products), the analysis focuses on non-energy, non-agricultural raw materials.

2 Methodology

The analysis presented in this report is partially based on previous studies which focused on the mining sector (Mancini and Sala 2018; Mancini et al. 2019). In order to expand this analysis to other raw material supply chain stages (extractive, manufacturing, use, end-of-life), the literature was reviewed and evidence gathered on potential impacts and contributions to each SDG.

Different types of sources have been consulted including predominantly scientific literature, reports from international organizations (such as the United Nations, the International Labour Organization (ILO), the World Bank, etc.), and reports from European institutions (e.g. Joint Research Centre (JRC), European Environmental Agency (EEA), European Agency for Safety and Health at Work (OSHA)). In some cases, reports by industry associations and NGOs have been also cited.

Two studies have been used several times along the analysis: the UNDP et al. report on mining and SDGs (UNDP et al., 2016) and the UNEP/IRP report on Minerals Governance (IRP-UNEP, forthcoming). The results of the literature review were submitted for expert opinion, and the relevance of the topics presented was discussed. The experts group included JRC researchers in the Raw Materials team of Unit D3 Land Resources and from other JRC Units.

Relevant indicators for each SDG have been highlighted, taking into account the UN monitoring framework on SDGs (UN General Assembly, 2017) and the Eurostat indicators set for monitoring the SDGs (Eurostat, 2017a). Sometimes, the highlighted issues of concern are not covered by any indicator, and therefore corresponding targets are referred to.

Each SDG chapter also mentions the main EU policies on that topic. Some of these policies are discussed in more detail in subsequent sections. The EU policies under consideration are those relating to economic, environmental, and social considerations relevant to raw materials. Some of them have a crosscutting approach, and embrace a broad range of aspects; others focus on more specific issues. Their contribution to SDGs is based on the analysis of their main objectives and expected outcomes. The assignment of the raw materials' contribution to each SDG is indicative and not exhaustive.

Among the policy initiatives under consideration, the contribution of the European Innovation Partnership (EIP) on Raw Materials to the SDGs is discussed. Specifically, the contribution of the voluntary initiatives developed by multiple stakeholders in the field of raw materials to the SDGs is analysed (the so-called commitments) (EC, 2017b). This information comes from the annual monitoring survey of the commitments which evaluates progress towards the objectives.

The analysis of correspondences between SDGs and the RM Scoreboard took account of both the 2016 and the 2018 editions (EC, 2018b, 2016c).

3 Description of the supply chain

The steps of the raw materials supply chain investigated in this analysis include both economic sectors (e.g. mining, forestry, manufacturing, etc.) and consumption-related activities (e.g. use, product disposal, etc.).

Firstly, there is a fundamental difference between abiotic and biotic materials. As outlined in Crenna et al. (2018), biotic resources are intrinsically renewable and therefore theoretically available in the future. However, if the carrying capacity of the ecosystems responsible for their provision is exceeded (when resources are extracted at a rate higher than their regeneration capacity, i.e., are overexploited) they can be also depleted (for instance, when commercially valuable species are harvested to extinction). Abiotic resources are non-renewable in a human timescale, and are therefore usually perceived as a finite stock. However, anthropogenic stocks (i.e. resulting from or produced by human beings) and recyclability can increase their availability.

The supply of raw materials involves various production stages which differ depending on the material under consideration, and can be very complex given the number of phases, activities, and actors involved.

For instance, in the case of wood-based products (fig. 4), after the forest management and harvesting, logs go into a sawmill where they are de-limbed and de-barked, graded and sorted into pieces before being cut into boards, dried, packaged and sent to processing. The boards will then be refined into various bespoke products, to be traded and used in joinery, and to manufacture a variety of timber-based components and products. After its use as material, the entire wood product (or its parts or components) can be used for a new product (reuse). It can be recycled or utilized in a cascading chain, meaning the use of wooden material for a lower grade purpose and a change in physical properties (e.g., wood products for particle boards or paper) (Jungmeier et al., 2001; Mair and Stern, 2017).

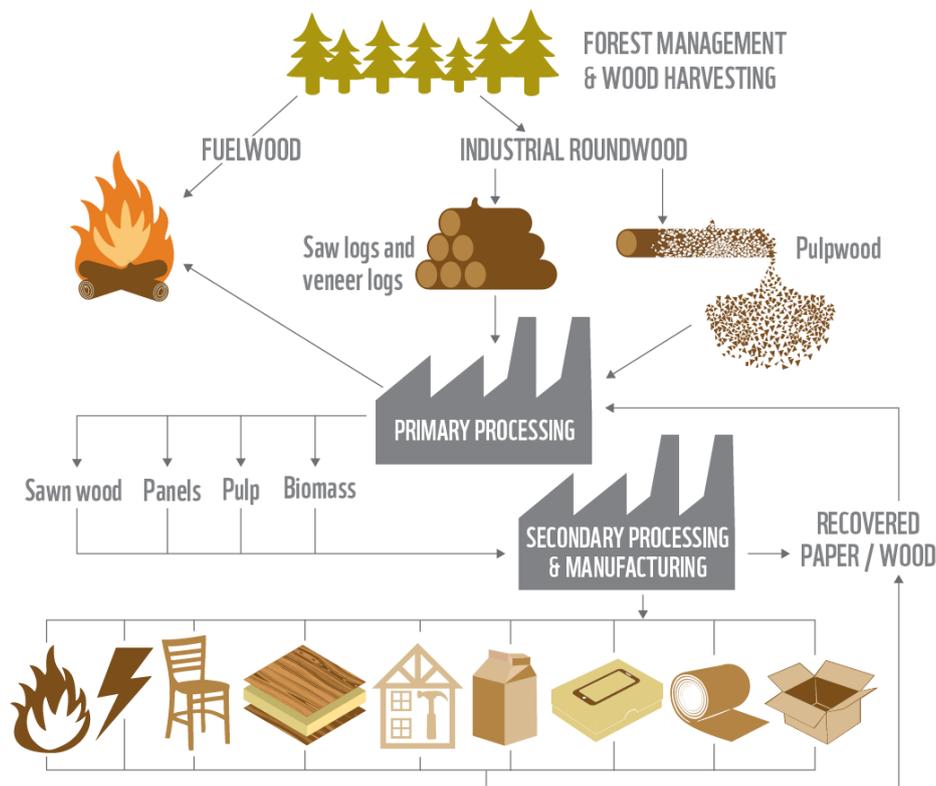


Figure 4 The forest products value chain (Source: WWF, 2012)

The supply chain in the case of metals and minerals starts with the exploration phase, which includes prospecting, detailed mapping, digging of trenches, geochemical and geophysical surveys, and preliminary drilling to identify the mineral deposit and determine its economic potential. After a design and planning stage, the construction of the mining site may occur. It involves building roads, processing facilities, employees housing, and other facilities as well as setting up environmental management systems. The mining production phase can be underground or surface, and consists of extracting the ore from rock using a variety of tools and machinery. Once a mining site has been exhausted of reserves, mine site closure occurs, with the dismantling of all facilities on the property. The reclamation stage of the mining site is the process of restoring land to a natural or economically usable state.

After the ore is extracted from the earth's crust, the metal-bearing minerals are separated from the material to form a concentrate in a process known as milling. Once the metal-bearing minerals are separated from waste materials to form a concentrate, the metal content must be removed and refined. A number of methods can be used to do this, one of the most common being smelting. In this phase, the concentrate is melted in a furnace in order to extract the metal. The material processing (metallurgical) phase also includes the mixing of metals to produce alloys with improved properties. In a next step, the metal manufacturing phase transforms unwrought metals into semi-finished products like sheets, foils, tubes, pipes etc. which will be purchased by downstream manufacturing industries for the production of components and final products. After use, metals contained in these products can often be recovered and recycled to produce secondary materials, which can in turn be used as inputs in manufacturing. Recovery and recycling rates vary from one material to another.

As an example, Fig. 5 illustrates the aluminium value chain.

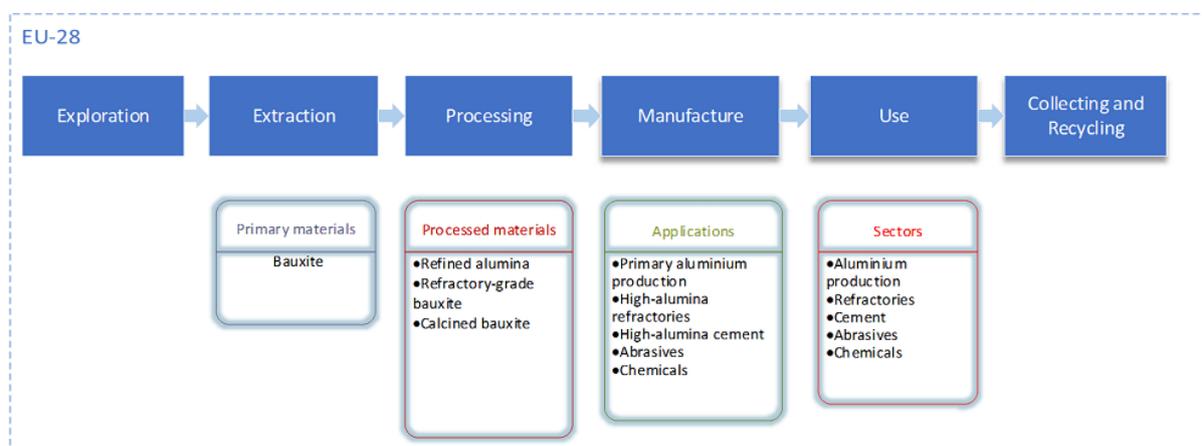


Figure 5 Aluminium supply chain (Source: RMIS¹⁰)

A simplified supply chain is taken into account in this study, including the following main phases and economic sectors:

- **Extraction phase:**
 - *Mining and quarrying:* extraction of stone or other materials from a quarry, and extraction of valuable minerals or other geogenic materials (usually extracted from an ore body, lode, vein, seam, reef, or placer deposits).

¹⁰ <http://rmis.jrc.ec.europa.eu/?page=rm-profiles#/Aluminium>

- *Forestry* (sustainable forest management¹¹): processes of production and extraction of harvested wood products¹² from forest ecosystems by silvicultural activities, felling, harvesting operations, extraction, and loading.
- **Manufacturing phase:**
 - *Non-metallic minerals*, used for construction (e.g. cement, concrete, glass, aggregates, etc.); as fertilizers (phosphate, nitrogen, etc.); or for ornamental scopes (e.g. marble, etc.).
 - *Metal production*, encompassing the activities of smelting or refining ferrous, non-ferrous, and precious metals from ore or scrap, using metallurgic techniques. It also includes the production of metal alloys and super-alloys by adding certain chemical elements to pure metals.
 - *Wood and wood products manufacturing sector*, including the first processing stages of sawmilling and planing of wood and the downstream activity of the manufacture of products made of wood, cork, straw, and plaiting materials.
 - *Paper and paper products manufacturing*, comprising companies that use wood as raw material and produce pulp, paper, paperboard, and other cellulose-based products.
 - Other industries processing biotic materials like natural rubber, cork, etc.
- **Use phase:** raw materials in the form of semi-finished products and components are supplied to downstream industries to manufacture final goods and services for consumers. Products incorporate a large variety of materials which are not even visible to the consumers in some cases (e.g. in electronics). The final use of products derived from abiotic or biotic raw materials is referred to in the analysis presented in this paper. The use of specific materials in products (replacement, substitution) can for example impact on the environmental performance of the use phase. The way products are designed will also determine the performance of the use phase.
- **End-of-life:** this phase includes different activities until the final product disposal, i.e. waste collection, energy recovery, and recycling. Waste flows not only occur after product use phase but also in previous steps of the supply chain (e.g. extractive waste). The way products are managed when they reach their end-of-life will for example determine their environmental impact and their economic potential. End-of-life management will be determined by the economic and technical feasibility of these processes, which also depends on how the product has been designed.

¹¹ FAO already provides a series of modules (e.g. agroforestry, forest and landscape restoration, community-based forestry) to support the implementation of sustainable forest management (SFM). The relevance of forest activities and processes for each SDG is available in the SFM toolbox (online at: <http://www.fao.org/sustainable-forest-management/toolbox/modules/en/>).

¹² In the case of forest resources, the raw materials are not limited to the harvested wood products but also for example include non-timber forest products (fruits, berries, mushrooms, truffles, etc.), cork, and rubber.

4 Contribution of raw materials to the SDGs

The contributions of raw materials to SDGs in each phase of the supply chain are identified in this chapter by considering the reference indicators under each SDG monitored by both the UN and in the Eurostat frameworks. The contribution may be positive or negative (i.e. have an adverse impact), and may also be direct or indirect. Often, it is possible for the same raw materials activity to have both positive and negative impacts, and they largely depend on the performance of companies, sectors, etc., legislation and governance of countries, as well as consumer behaviour. The details of the underlying analysis are provided below, specifying the links to indicators considered by the UN and Eurostat monitoring frameworks. The coverage of SDGs by the Raw Materials Scoreboard and relevant related EU policies is also mentioned below.

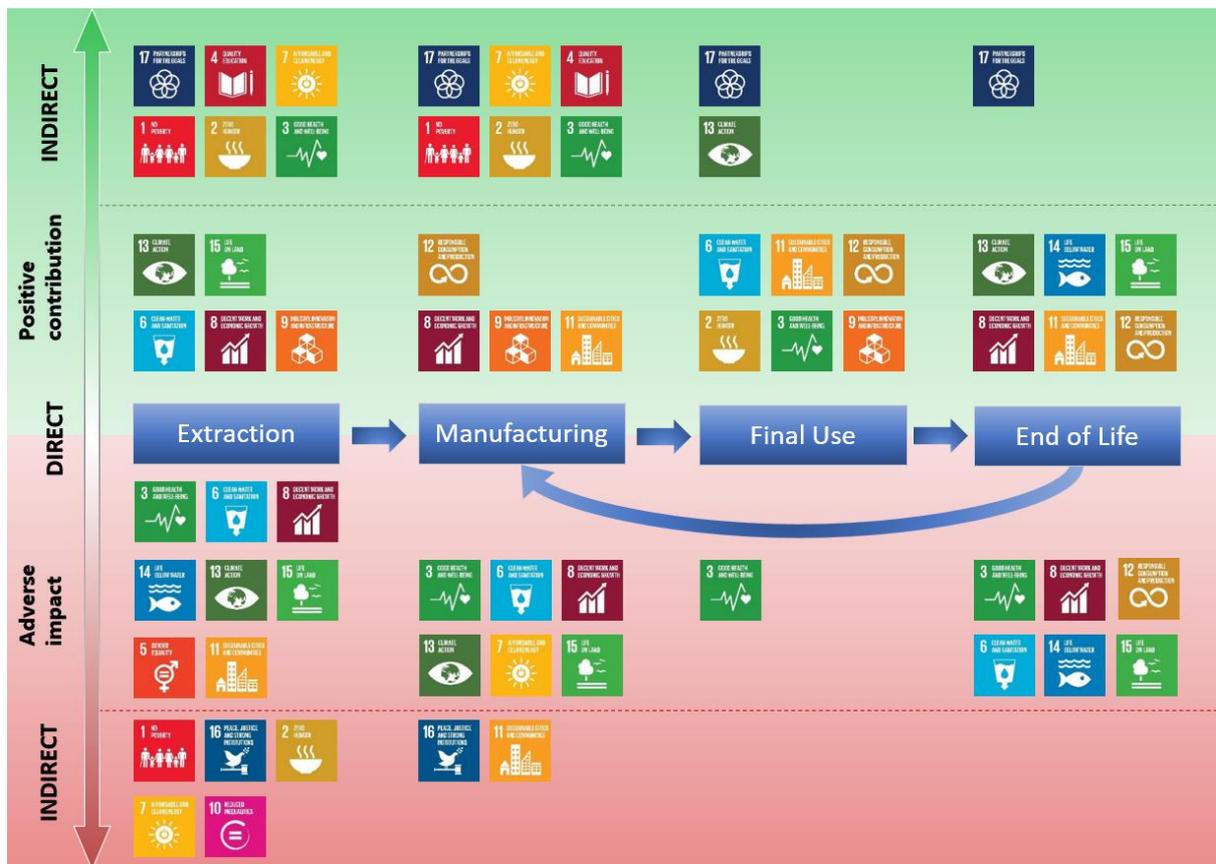


Figure 6 Potential contributions of raw materials to the SDGs along the supply chain. Chapter 4 describes the links with each SDG and related indicators in detail

4.1 SDG 1: End poverty in all its forms everywhere



CROSS-CUTTING ISSUES

- *(potential positive contributions)* Raw material sectors can stimulate the local economy, creating employment and also increase population income and business opportunities in other sectors.

MINING SECTOR

- *(potential adverse impacts)* The role of the mining sector in creating wealth and prosperity has been studied extensively in the literature as reflected in the scholarly debate on the “resource curse” theory. The “resource curse” is based on the observation that some countries rich in natural resources tend to grow more slowly than resource-poor countries (Anderson, 1998; Mikesell, 1997; Sachs and Warner, 2001). The “resource curse” hypothesis has been widely analysed and empirically tested in both developing and developed countries, with diverging conclusions being drawn in the literature. Some authors agree on the role of institutions and governance in determining the various outcomes (e.g., Mehlum et al., 2006; van der Ploeg, 2011).
- *(potential adverse impacts)* Mining projects can exacerbate land competition. For instance, the limited access to land for the rural population especially in developing countries can have negative impacts on livelihood and consequent food insecurity, endangering the well-being of the local population and leading to their impoverishment (e.g. Mancini and Sala, 2018; Owen and Kemp, 2015). [Indicator UN 1.4.2]

FORESTRY

- *(potential positive contributions)* Wood and non-wood forest products contribute to the livelihood of local communities (i.e. subsistence income), depending on market characteristics, availability of forest resources (e.g. in India; Belcher et al., 2015), ethnic/locational combinations, and remoteness (e.g. in Peru; Porro et al., 2015).
- *(potential positive contributions)* Community forestry improves and secures property and use rights and access to resources for rural poor households, especially regarding low value forest products (Anderson et al., 2015). [Indicator UN 1.4.2]

SDGs MONITORING INDICATORS

- UN Framework:
 - 1.4.2 Proportion of adult population with secure tenure rights to land, with legally recognized documentation, and who perceive their rights to be secure, by sex and by type of tenure

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Value added and jobs in the raw materials sectors (indicator 7 ‘Value added and jobs’, EC 2016; EC 2018a).

RELATED SDGs

- SDG 8 Decent work and economic growth
- SDG 2 Zero hunger

RELATED EU POLICY INITIATIVES

- Establishing a European Pillar of Social Rights, COM(2017) 250 final
- Monitoring the implementation of the European Pillar of Social Rights, COM(2018) 130 final
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013) 659 final

4.2 SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture



MINING AND MANUFACTURING SECTOR

- (*potential adverse impacts*) In the case of the mining industry, competition with the agricultural sector for water and land resources, and pollution of water bodies and farming land can affect food security. This is especially the case in local communities directly dependent on natural resources for their livelihood (e.g. Kitula 2006; Kumah 2006). [Indicator UN 2.4.1]

FORESTRY

- (*potential positive contributions*) Managed forests and agroforestry systems directly improve the diversification of dietary requirements, the quality and quantity of non-timber forest products (i.e. wild and cultivated fruit, vegetables, seeds, nuts, oils, roots, fungi, herbs, and animal protein), and food availability in times of seasonal and other scarcities (for an overview, see Vira et al., 2015). [Indicator UN 2.3.1]

USE PHASE

- (*potential positive contributions*) The extraction sector and the processing industry supply materials used as fertilizers in agriculture, for instance, phosphate and potash. Therefore, these sectors indirectly contribute to food security by fostering agricultural productivity. [Indicator UN 2.3.1]

SDGs MONITORING INDICATORS

- UN Framework:
 - 2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size
 - 2.4.1 Proportion of agricultural area under productive and sustainable agriculture

RELATED RAW MATERIALS SCOREBOARD INDICATORS

None

RELATED SDGs

- SDG 1 No poverty
- SDG 6 Clean water and sanitation
- SDG 14 Life below water
- SDG 15 Life on land

RELATED EU POLICY INITIATIVES

- EU policy framework on food security, COM(2010) 127 final
- Common Agricultural Policy (CAP)
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013) 659 final

4.3 SDG 3: Ensure healthy lives and promote well-being for all at all ages



MINING SECTOR

- *(potential adverse impacts)* Hazardous substances and wastes released in water, air, and soil by mining and manufacturing industries can have serious, negative impacts on public health (Environmental Law Alliance Worldwide, 2010). [Indicator UN 3.9.1; EUROSTAT 11.50]
- *(potential adverse impacts)* Population growth in mining communities caused by migration inflow and gender imbalance can create problems of a psychological and behavioural nature (e.g. alcoholism, drug addiction, and prostitution). Local communities in mining areas, especially in developing countries, can register a higher incidence of HIV/AIDS and sexually transmitted infections (e.g. Mactaggart et al., 2018). [Indicator UN 3.3.1]
- *(potential adverse impacts)* Artisanal and Small scale Mining (ASM), especially in developing countries, often operates outside health and safety standards and environmental legislation. ASM gold mining is responsible for one-quarter to one-third of global mercury pollution, which has severe health impacts on exposed workers and local communities (e.g. Hentschel et al., 2002).

MANUFACTURING SECTOR

- *(potential adverse impacts)* In comparison to other manufacturing sectors, risks of severe injuries are generally higher in basic metal production due to hazards such as molten metal (ILO, 2005). [Indicators EUROSTAT 08.30]

USE PHASE

- *(potential adverse impacts)* Some materials used in products and applications can be toxic and have harmful effects on consumer health. Innovation projects are in place for the substitution of toxic materials, as foreseen in the REACH Regulation adopted in 2007. This EU legislation aims to improve the protection of human health and the environment from the risks posed by chemicals and raw materials.
- *(potential positive contributions)* Some raw materials used in medical devices are indispensable for improving human well-being. This is the case of some critical metals like tantalum, used in prosthetic devices for humans, and niobium-titanium alloys used for superconducting magnetic coils in magnetic resonance imagers (Mancheri et al., 2018; T.I.C., 2018).
- *(potential adverse impacts)* Especially in developing countries, the extensive use of fuelwood for cooking or heating increases the exposure of poor women and young children to significant pollutants, therefore causing acute infections of the lower respiratory tract and chronic obstructive pulmonary disease (e.g. Smith, 2006). [Indicator UN 3.9.1]

END-OF-LIFE PHASE

- *(potential adverse impacts)* If not properly managed, waste can have negative health effects, especially in the case of handling hazardous waste. For instance, the treatment

of e-waste illegally shipped in developing countries is often managed using rudimentary techniques, causing adverse environmental and health implications (Lundgren, 2012).

SDGs MONITORING INDICATORS

- UN Framework:
 - 3.3.1 Number of new HIV infections per 1,000 uninfected population, by sex, age, and key populations
 - 3.9.1 Mortality rate attributed to household and ambient air pollution
- EUROSTAT Framework:
 - 08.60 People killed in accidents at work
 - 11.50 Exposure to air pollution by particulate matter

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Incidence rate of non-fatal accidents (indicator 23 'Occupational safety', EC 2016; indicator 25 'Occupational safety' EC 2018a)

RELATED SDGs

- SDG 6 Clean water and sanitation
- SDG 8 Decent work and economic growth
- SDG 15 Life on land

RELATED EU POLICY INITIATIVES

- Establishing a European Pillar of Social Rights, COM(2017) 250 final
- Monitoring the implementation of the European Pillar of Social Rights, COM(2018) 130
- Regulation (EC) No 1907/2006 of the European Parliament and by the Council on the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH)

4.4 SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all



CROSS-CUTTING ISSUES

- (*potential positive contributions*) Companies can provide training and educational opportunities to employees (Azapagic, 2004; Veiga et al., 2001)[Indicator UN 4.3.1; Eurostat 04.60]. For example, several NGOs and agencies in the wood-based product sector provide educational programs and allocate funds to improve the quality of life of the poorest people and their families in developing countries (*potential positive contribution*). Moreover, the investments in education from big companies help to bridge the gap between local knowledge-related (handmade) production and global production and trade, as is the case in the paper industry and manufacturing in Nepal (Biggs and Messerschmidt, 2005) [Indicator UN 4.3.1; Eurostat 04.60].

SDGs MONITORING INDICATORS

- UN Framework:
 - 4.3.1 Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex
- EUROSTAT Framework:
 - 04.60 Adult participation in learning

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Number of educational programmes related to raw materials by country (indicator 10 'Knowledge and skills', EC 2016)

RELATED SDGs

- SDG 8 Decent work and economic growth

RELATED EU POLICY INITIATIVES

- Establishing a European Pillar of Social Rights, COM(2017) 250 final
- Monitoring the implementation of the European Pillar of Social Rights, COM(2018) 130 final

4.5 SDG 5: Achieve gender equality and empower all women and girls



MINING SECTOR

- *(potential adverse impacts)* Historically, the mining sector has always been male-dominated. In the case of large scale mining, female employment is low, very rarely exceeding 10% of the total workforce (Jenkins, 2014). Many initiatives and programmes aimed at increasing women involvement in the sector are currently under way¹³.
- *(potential adverse impacts)* Some studies highlight the disproportionate effect of the negative impacts of mining on women, especially those affecting local communities, such as environmental degradation, loss of traditional means of livelihood, health, community displacement, and human rights abuses (Jenkins, 2014; Lozeva and Marinova, 2010; Reeson et al., 2012).
- *(potential adverse impacts)* Mining development in rural, isolated areas can bring widespread social change, which predominantly affect women. For instance, the in-flow migration of mineworkers and the consequent gender imbalance can cause diffusion of alcoholism, drug addiction, prostitution, etc. (Jenkins, 2014; Kitula, 2006).
- *(potential positive contributions)* Recently, attention has been given to the feminisation of the mining sector. This is especially the case in Artisanal Small scale Mining (ASM), where the number of women engaged in mining as a means of livelihood is increasing (Hayes and Perks, 2012; Lahiri-Dutt, 2015). [Indicator EUROSTAT 05.20; 05.30].
- *(potential adverse impacts)* However, Women working in ASM are often concentrated in the processing of minerals, carrying out hazardous manual tasks, and using extremely toxic substances like mercury. Due to the informal nature of women's labour in ASM, their status as mineworkers is not often recognized.

FORESTRY

- *(potential positive contributions)* Especially in developing countries, the availability and use of firewood and non-timber forest products (fruits of the forest, medicinal materials) improve access and incomes for women and the overall well-being of the household (Ingram et al., 2017; Marin and Kuriakose, 2017; Pierce Colfer et al., 2016). [Indicator UN 5.a.1]

SDGs MONITORING INDICATORS

- UN Framework:
 - 5.a.1 Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex.
- EUROSTAT Framework:
 - 05.20 Gender pay gap

¹³ For instance: https://www.mihr.ca/pdf/MiHR_Gender_Report_EN_WEB.pdf; <https://wimng.org/>; https://commdev.org/userfiles/files/2583_file_IFC_Case_study_CS4_7.pdf; <https://www.womeninmining.org.uk/>

- 05.30 Gender employment gap

RELATED RAW MATERIALS SCOREBOARD INDICATORS

None

RELATED SDGs

- SDG 8 Decent work and economic growth

RELATED EU POLICY INITIATIVES

- Establishing a European Pillar of Social Rights, COM(2017) 250 final
- Monitoring the implementation of the European Pillar of Social Rights, COM(2018) 130 final

4.6 SDG 6: Ensure availability and sustainable management of water and sanitation for all



MINING SECTOR

- *(potential adverse impacts)* Mining activities contribute to the release of pollutants to water, soils, and air during extraction, ore processing, etc. These pollutants contain acidifying and hazardous substances as well as other substances that have negative impacts on water quality. Toxic effluents and leakages from waste management or storage facilities can also penetrate groundwater resources (Northey et al., 2016; IRP-UNEP forthcoming) which are essential sources of clean water in many areas.
- *(potential adverse impacts)* Acid mine drainage, which can also occur post-closure, can have extensive impacts on water and soils quality (IRP-UNEP, forthcoming). [Indicator UN 6.3.1; 6.3.2; Indicator EUROSTAT 06.30]
- *(potential adverse impacts)* Mining operations can create local water stress (Northey et al., 2016). The mining and processing of certain commodities are among the most water-intensive economic activities (Eurostat, 2014; Zal et al., 2017), and these can be located in water-scarce environments. Decreasing ore grades probably lead to increased demand for water by the sector in the future, while climate change is expected to decrease water availability (ICMM, 2013). In the case of mining, there can also be pressure on water availability during exploration and post-closure stages. [Indicator UN 6.4.1; Indicator EUROSTAT 06.60]
- *(potential positive contributions)* Mine dewatering can provide additional water resources for other water uses. This water supply can also continue post-closure whenever the site post-closure management plan envisages the continuation of dewatering. [Indicator UN 6.4.2.; Indicator EUROSTAT 06.60]
- *(potential adverse impacts)* On the other hand, under certain circumstances mine dewatering can alter the groundwater table (Northey et al, 2016), which might reduce local water availability and have environmental impacts on related ecosystems. This can also affect transboundary water bodies. [Indicator UN 6.3.2; 6.4.1]
- *(potential positive contributions)* Relief alteration by extractive activities might result in the formation of pit lakes. [Indicator UN 6.3.2]

MANUFACTURING SECTOR

- *(potential adverse impacts)* Manufacturing industries are responsible for the release of pollutants into water, air, and soil. [Indicator UN 6.3.1; 6.3.2; Indicator EUROSTAT 06.30]

MINING AND MANUFACTURING SECTORS

- *(potential adverse impacts)* Reuse and recycling of water at mining and manufacturing facilities can contribute to reducing pressure on both quantity and quality of water resources. [Indicator UN 6.3.1; 6.3.2; 6.4.1; 6.4.2; Indicator EUROSTAT 06.30; 06.60]

USE PHASE

- *(potential positive contributions)* Some materials such as sand are essential for water treatment technologies and techniques. [Indicator UN 6.3.1; Indicator EUROSTAT 06.30]

END-OF-LIFE PHASE

- *(potential adverse impacts)* If not properly managed, waste can have negative impacts on water bodies and soils, especially in the case of hazardous waste handling. The treatment of illegally shipped e-waste in developing countries is often managed using rudimentary techniques, having adverse environmental and health implications (Lundgren, 2012). [Indicator UN 6.3.2]

SDGs MONITORING INDICATORS:

- UN Framework:
 - 6.3.1 Proportion of wastewater safely treated
 - 6.3.2 Proportion of bodies of water with good ambient water quality
 - 6.4.1 Change in water-use efficiency over time
 - 6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
- EUROSTAT Framework:
 - 06.30 Biochemical oxygen demand in rivers
 - 06.60 Water Exploitation Index

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Water (indicator 20 'Water', EC 2016; EC 2018a)

RELATED SDGs

- SDG 2 Zero hunger
- SDG 3 Good health and well-being
- SDG 12 Responsible consumption and production
- SDG 13 Climate action
- SDG 14 Life below water

RELATED EU POLICY INITIATIVES

- Industrial Emissions Directive (2010/75/EU) and Best Available Techniques (BAT) reference documents
- Water Framework Directive (2000/60/EC)
- European Innovation Partnership (EIP) on Water
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614 final

4.7 SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all



MINING AND MANUFACTURING SECTORS

- (*potential adverse impacts*) Extractive and manufacturing raw material activities are generally energy-intensive (EC, 2016c). This not only applies to onsite operation but also to transport of materials from sourcing countries, and other energy embodied in the production chain such as the energy required to produce the chemicals used for ore processing, etc. Moreover, the decrease in ore grades leads to increasing processing with associated increase in energy use. [Indicator UN 7.3.1; Indicator EUROSTAT 07.30; 07.40]
- (*both potential positive contributions and adverse impacts*) Raw materials are required for the deployment of low-carbon and renewable technologies (Blagoeva et al., 2016) [Indicator UN 7.1.2; 7.3.1; Indicator EUROSTAT 07.30; 07.40]
- (*potential positive contributions*) Mining operations create and maintain energy infrastructure such as electricity grids, which can also supply the local population [Indicator UN 7.1.1]

FORESTRY AND USE OF WOOD

- (*both potential positive contributions and adverse impacts*) Woody biomass (in the form of cut branches, wood chip and bark, and pellets) contributes to more than 10% of the annual global energy supply, and constitutes approximately 90% of total bioenergy sources (World Energy Council, 2016). According to recent estimates, forests will satisfy up to 18% of the global primary consumption in the next few decades (Lauri et al., 2014). The optimization of forest harvesting operations (e.g. use of residues for bioenergy purposes) in conjunction with the cascading use of wood is a key strategy in reducing energy consumption (e.g. use of recovered fibres or wood saved) and in saving the money of local communities in accessing energy sources. However, wood energy consumption and use strongly depend on market (supply/demand) and trade (import/export), which in turn may affect harvesting pressures on forests and GHG emissions (Bais-Moleman et al., 2018). The use of wood energy is indeed consistent with the concept of carbon neutrality (e.g. Cornwall, 2017). [Indicator UN 7.2.1] [Indicator EUROSTAT 07.40]

USE PHASE

- (*potential positive contributions*) The use of specific raw materials can have a strong impact on energy requirements during the product use phase. For instance, the use of aluminium in vehicles because it is lighter than other alternative materials can reduce energy demand. It is important to consider the associated energy requirements all along the material supply chain since the energy requirements for the production of aluminium might not be payed off by the reduction in energy requirements during the use phase. [Indicator UN 7.3.1; Indicator EUROSTAT 07.10; 07.20]

SDGs MONITORING INDICATORS

- UN Framework:
 - 7.1.1 Proportion of population with access to electricity

- 7.2.1 Renewable energy share in the total final energy consumption
- 7.3.1 Energy intensity measured in terms of primary energy and GDP
- EUROSTAT Framework:
 - 07.10 Primary and final energy consumption
 - 07.20 Final energy consumption in households per capita
 - 07.30 Energy productivity
 - 07.40 Share of renewable energy in gross final energy consumption

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Raw materials in low-carbon technologies (introduction, EC 2016)
- Demand forecast in the EU for selected critical raw materials for the hybrid and electric vehicles segments (introduction, EC 2018)

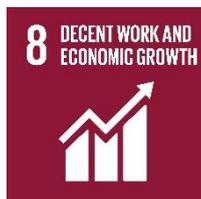
RELATED SDGs

- SDG 12 Responsible consumption and production
- SDG 13 Climate action

RELATED EU POLICY INITIATIVES

- The Paris Protocol – A blueprint for tackling global climate change beyond COM (2015)81
- Directive (EU) 2018/410 of the European Parliament and the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814
- The 2030 Climate and Energy Policy Framework
- Establishing a European Pillar of Social Rights COM(2017) 250 final
- Monitoring the implementation of the European Pillar of Social Rights COM(2018) 130 final
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013)659 final

4.8 SDG 8: Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all



CROSS-CUTTING ISSUES

- *(potential positive contributions)* According to Eurostat data, in 2014 economic activities relating to biotic and abiotic raw materials production employed more than 3.4 million people (EC 2018a) [Indicator EUROSTAT 08.30].
- *(potential positive contributions)* The contribution of raw materials sectors to EU employment goes far beyond economic activities strictly related to the production of materials. The number of jobs created downstream in the supply chain in the manufacture of semi-finished products is much higher than the number of jobs from production of materials alone (EC, 2016c).
- *(both potential positive contributions and negative impacts)* The raw materials sectors (especially mining and forestry) are characterised by a high degree of informality, particularly in developing countries. For instance, the global mining industry employs around 2.5 million people while according to estimates, informal mining activities provide jobs for 15–20 million people (ICMM, 2014). Informal work in the forest sector is fostered by the expansion of illegal logging. [Indicator UN 8.3.1]

MINING SECTOR

- *(potential adverse impacts)* Especially in developing countries, occupational hazards, work accidents, and child labour particularly affect the mining sector. According to the International Labour Organization (ILO), more than one million children work as miners worldwide. They are almost exclusively found in artisanal small-scale mining operations in Africa, Asia, and Latin America. [Indicator UN 8.7.1]

FORESTRY

- In Europe, forestry has the highest accidents rate among the raw materials sectors, but the trend is decreasing (EC, 2016c). Forestry work is generally considered hazardous (European Agency for Safety and Health at Work (EU-OSHA), 2013) due to the widespread use of manual operations in spite of the increasing mechanization in the sector. [Indicator UN 8.8.1; EUROSTAT 08.60]

MANUFACTURING SECTOR

- *(potential adverse impacts)* In comparison to other manufacturing sectors, risks of severe injuries are generally higher in basic metal production due to the presence of hazards such as molten metal (ILO, 2005).

END-OF-LIFE PHASE

- *(potential positive contributions)* The waste management and recycling sectors makes a significant contribution to employment. According to estimates from various sources, 3.4 million jobs have been created by circular economy-related activities in the EU (WRAP, 2015).

SDGs MONITORING INDICATORS

- UN Framework:
 - 8.3.1 Proportion of informal employment in non-agriculture employment, by sex
 - 8.7.1 Proportion and number of children aged 5–17 years engaged in child labour, by sex and age
 - 8.8.1 Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status
- EUROSTAT Framework:
 - 08.30 Employment rate
 - 08.60 People killed in accidents at work

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Number of jobs for a selection of raw material economic sectors in the EU (2008-2012) (indicator 7 'Value added and jobs', EC 2016; EC 2018a)
- Incidence rate of non-fatal accidents for a selection of economic sectors (indicator 23 'Occupational safety', EC 2016; indicator 25 'Occupational safety', EC 2018a)

RELATED SDGs

- SDG 3 Good health and well-being
- SDG 10 Reduced inequalities

RELATED EU POLICY INITIATIVES

- Establishing a European Pillar of Social Rights, COM(2017) 250 final
- Monitoring the implementation of the European Pillar of Social Rights, COM(2018) 130
- Raw Materials Initiative, COM(2008) 699 final
- Investing in smart, innovative and sustainable Industry - A renewed EU Industrial Policy Strategy, COM(2017) 479 final
- European Innovation Partnership on Raw Materials, COM(2012) 82 final
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614 final
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013) 659 final

4.9 SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and fostering innovation



MINING SECTOR

- (*potential positive contributions*) The presence of mining activities in a region can contribute to local and regional development by providing and improving related physical infrastructures. Road networks, power and water networks, and health care systems form the physical basis of society, and this basis allows the local population to access such things as health and education services, and have the economy for these to function (Hilson, 2002; Weldegiorgis and Ali, 2016). [Indicator UN 9.1.1].

FORESTRY

- (*potential positive contributions*) Innovation in machines used for harvesting operations contributes to a reduction of fuel consumption per unit of wood product and improves machine productivity (e.g. in Brazil; Spinelli et al., 2018). [Indicator UN 9.4.1].
- (*potential positive contributions*) The recently-developed concept of Sustainable Forest Operations (SFO) helps to (i) minimize the environmental impacts of forest operations, (ii) keep the forest sector economically viable, (iii) safeguard and protect forest workers from undue risks (ergonomics), (iv) optimize quality (e.g. improving harvesting rates), and (v) support additional goods and services for local communities (e.g. Marchi et al., 2018). Examples of sustainable forest resource allocation in Canada are provided by Boukherroub et al. (2017).

MANUFACTURING SECTOR

- (*potential positive contributions*) The average R&D investment in the EU raw materials sectors increased considerably during the last decade, especially for the mining and production of iron, base metals, other minerals, and coal (EC, 2018b). [Indicator UN 9.5.1; EUROSTAT 9.10]
- (*potential positive contributions*) Among different raw materials sectors, the number of worldwide¹⁴ patent applications are highest in the production and manufacturing of both metals and non-metallic mineral products (EC, 2018b). The relative increases are highest for mining and mineral processing, which are followed by recycling and production and manufacturing of non-metallic mineral products [Indicator EUROSTAT 9.40]

MANUFACTURING SECTOR (WOOD PRODUCTS)

- (*potential positive contributions*) Strategic transformation of wood product companies (from non-branded manufacturing to original equipment manufacturing, and further to original brand manufacturing) increases the availability of intangible resources (e.g. collaboration and reputation, management expertise, personnel know-how) (e.g. in China; Wan et al., 2015).

USE PHASE

- (*potential positive contributions*) Raw materials are widely used in various applications including physical infrastructure, machinery, and final use applications. Some metals and

¹⁴ The analysis refers to a selection of leading countries in the field of patent applications, i.e. Canada, the European Union, Japan, Russia, South Korea, and the United States.

materials are required for renewable energy componentry and related technologies such as batteries for energy storage. These include copper, cobalt, cadmium, tellurium, and rare earth elements (REEs) (Blagoeva et al., 2016). [Indicator UN 9.4.1]

SDGs MONITORING INDICATORS

- UN Framework:
 - 9.1.1 Proportion of the rural population who live within 2 km of an all-season road
 - 9.1.2 Passenger and freight volumes, by mode of transport
 - 9.2.2 Manufacturing employment as a proportion of total employment
 - 9.4.1 CO2 emission per unit of value added
 - 9.5.1 Research and development expenditure as a proportion of GDP
 - 9.5.2 Researchers (in full-time equivalent) per million inhabitants
- EUROSTAT Framework:
 - 09.10 Gross Domestic expenditure on R&D
 - 09.40 Patent applications to the European Patent Office

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Annual R&D investment by key EU-based investing companies by raw material sector group (indicator 8 Corporate R&D investment, EC 2016; EC 2018a)
- Comparison of the number of patent applications by the raw material sector, and its five contributing raw material categories (indicator 9 'Patent applications' EC 2016; EC 2018a)
- Emissions of greenhouse gases (indicator 19 'Air emissions' EC 2016; indicator 20 "Greenhouse gas emissions" and 21 "Air pollutant emissions" EC 2018a)

RELATED SDGs

- SDG 8 Decent work and economic growth
- SDG 7 Affordable and clean energy
- SDG 11 Sustainable cities and communities
- SDG 13 Take urgent action to combat climate change and its impacts

RELATED EU POLICY INITIATIVES

- Raw Materials Initiative COM (2008) 699 final
- Investing in smart, innovative and sustainable Industry - A renewed EU Industrial Policy Strategy, COM(2017)0479 final
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614 final
- The 2030 Climate and Energy Policy Framework

4.10 SDG 10: Reduce inequality within and among countries



MINING SECTOR

- *(both potential positive contributions and adverse impacts)* Mining can be a significant driver of export growth as well as income and employment. However, while income growth is an economic benefit, the high incomes associated with the mining sector may also lead to greater inequality (Fleming and Measham, 2015; Jenkins, 2014; Loayza and Rigolini, 2016).
- *(both potential positive contributions and adverse impacts)* Worldwide, the mining industry is characterised by the significant presence of foreign migrant workers. Working conditions usually vary in large-scale compared with small-scale mining as well as in developing compared with developed countries. In general, temporary low-skilled migrant workers are often more vulnerable to the risk of employer exploitation and are not always paid for the work at current market rates (Coderre-Proulx et al., 2016). [Indicator UN 10.7.1; 10.7.2].

FORESTRY

- *(potential positive contributions)* The *remittance forest*¹⁵ contributes to gender equality and diversification of wood and non-wood products (e.g. resin, understory biomass), improve the livelihood of local communities, and further enables access to resources for poor people or women (e.g. in Indonesia; Peluso and Purwanto, 2018).

SDGs MONITORING INDICATORS

- UN Framework:
 - 10.7.1 Recruitment cost borne by employee as a proportion of yearly income earned in country of destination
 - 10.7.2 Number of countries that have implemented well-managed migration policies

RELATED RAW MATERIALS SCOREBOARD INDICATORS

None

RELATED SDGs

- SDG 1 No poverty
- SDG 8 Decent work and economic growth

RELATED EU POLICY INITIATIVES

- Establishing a European Pillar of Social Rights, COM(2017) 250 final

¹⁵ The "remittance forest" is considered to be a part of the "remittance landscape", where changes linked to land use and social-economic frameworks are affected by the flow of remittances coming from people working abroad (migrants) (McKay, 2005; Peluso and Purwanto, 2018). Linked to outmigration and "forest transition" phenomenon, the effect of remittances is controversial: on the one hand, remittances reduce the pressure on land, and on the other, they improve the sustainable use of natural resources and local incomes as well as the diversification of bio-based products (Lambin and Meyfroidt, 2011).

- Monitoring the implementation of the European Pillar of Social Rights, COM(2018) 130

4.11 SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable



MINING SECTOR

- *(potential adverse impacts)* Mining activities in developing countries can contribute to the creation and expansion of slums around the operation facility and to local socio-economic inequalities (IRP-UNEP, forthcoming). [Indicator UN 11.1.1; 11.3.1; EUROSTAT 11.10]
- *(potential adverse impacts)* The development of mining activities can damage local cultural and aesthetic heritage (Mancini and Sala, 2018).
- *(potential adverse impacts)* In mining communities, population growth due to migration inflow and gender imbalance can lead to behaviours such as alcoholism, drug addiction, and prostitution, which in turn can also lead to higher rates of physical and sexual harassment. [Indicator UN 11.7.2]
- *(potential positive contributions)* Mining industries can invest funds in the preservation of the local natural and cultural heritage. Mines might be converted into parks and green spaces after closure. [Indicator UN 11.7.1]

MINING AND MANUFACTURING SECTORS

- *(potential adverse impacts)* Land use conversion into mining, processing, and/or manufacturing facilities increases the land footprint of the sector. [Indicator UN 11.1.1]
- *(potential adverse impacts)* Mining, processing, and manufacturing facilities can generate noise. [Indicator EUROSTAT 11.20]
- *(potential adverse impacts)* Accidents might occur at mining, processing, and manufacturing facilities. Often costs associated to the environmental and socio-economic recovery are not fully assumed by the operating companies, and can eventually become an economic burden for the public authorities in charge.
- *(potential adverse impacts)* Industrial facilities can contribute to the release and formation of particulate matter in populated areas. [Indicator UN 11.6.2; EUROSTAT 11.50]

FORESTRY

- *(potential positive contributions)* Besides urban forestry and greening and Nature-Based Solutions (Strohbach et al., 2016), the harvesting of non-wood forest products (e.g. through foraging activities) plays a key role in maintaining cultural, spiritual, and material services from urban green spaces (e.g. in Philadelphia; Hurley et al., 2015). Furthermore, foraging activities reduce maintenance costs in urban parks, remove undesirable species, and improve public education (e.g. in Seattle, USA; McLain et al., 2017). [Indicator UN 11.4.1]

USE PHASE

- *(potential positive contributions)* Raw materials are essential for the development of sustainable and resilient urban infrastructure, including adequate housing and public

transport networks, among other things. [Indicator UN 11.1.1; 11.2.1; 11.6.2] [Indicator EUROSTAT 11.30]

- *(potential positive contributions)* Raw materials are essential to the development of end-of-pipe technologies for pollution abatement. [Indicator UN 11.6.2]

END-OF-LIFE PHASE

- *(potential adverse impacts)* If not properly managed, waste disposal can create slums nearby and foster socio-economic imbalances and health concerns. [Indicator UN 11.1.1]

SDGs MONITORING INDICATORS

- UN Framework:
 - 11.1.1 Proportion of urban population living in slums, informal settlements, or inadequate housing
 - 11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities
 - 11.3.1 Ratio of land consumption rate to population growth rate
 - 11.3.2 Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically
 - 11.4.1 Total expenditure (public and private) per capita spent on the preservation, protection, and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed, and World Heritage Centre designation), level of government (national, regional, and local/municipal), type of expenditure (operating expenditure/investment), and type of private funding (donations in kind, private non-profit sector, and sponsorship).
 - 11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)
 - 11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex and age, and persons with disabilities
 - 11.7.2 Proportion of persons victim of physical or sexual harassment, by sex, age, disability status, and place of occurrence in the previous 12 months
- EUROSTAT Framework:
 - 11.10 Overcrowding rate
 - 11.20 Population living in households considering that they suffer from noise
 - 11.50 Exposure to air pollution by particulate matter

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Tropospheric ozone formation potential (TOFP) emissions (indicator 19 'Air emissions', EC 2016)
- Particulate matter emissions (indicator 21 'Air pollutant emissions', EC 2018a)

RELATED SDGs

- SDG 1 No poverty
- SDG 3 Good health and well-being
- SDG 6 Clean water and sanitation
- SDG 9 Industry, innovation, and infrastructure

- SDG 10 Reduced inequalities
- SDG 15 Life on land

RELATED EU POLICY INITIATIVES

- 7th Environmental Action Programme (7EAP) under Priority Objective 8, entitled, Sustainable Cities: "Working together for Common Solutions".
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614 final

4.12 SDG 12: Ensure sustainable consumption and production patterns



CROSS-CUTTING ISSUES

- *(potential positive contributions)* Resource efficiency is an objective in both the European environmental policy (EC 2011, 2015) and the industrial policy (EC 2017). The raw materials sectors have a key role in pursuing the resource efficiency SDG because they produce inputs for other end use sectors. Moreover, the amount of natural resources (land, water, energy, etc.) used to extract materials and produce semi-finished products can be optimized by using innovative and clean technologies [Indicator UN 12.2.1; 12.2.2; EUROSTAT 12.20; 07.30]. Addressing the full life cycle of raw materials is essential to ensure that resources are used efficiently along the entire supply chains.
- *(potential adverse impacts)* Mining and manufacturing activities can generate prominent amounts of waste, emissions, and effluents. Especially in the case of hazardous waste, the best available techniques are to be applied in order to minimize waste flows and related environmental impacts.
- *(potential positive contributions and adverse impacts)* Forest certification and traceability schemes applied to wood products' harvesting, production, and trade may ensure the implementation of sustainability principles in management and planning through reducing illegal logging (also positive implications for SDGs 13 and 15), may improve market opportunities for developing countries, may provide transparent information about harvested amount, suppliers, and beneficiaries as well as access to decent jobs (also positive implications for SDG 8). However, the effectiveness of certification schemes for sustainability targets (e.g. biodiversity conservation, and sustainable use of natural resources) depends on local circumstances (e.g. Rametsteiner and Simula, 2003). Indeed, in some cases, international and state initiatives for legality and traceability could limit the accessibility of smallholders to the market, and further create substrates for illegality (e.g. the Brazilian Amazon; McDermott et al., 2015).

MANUFACTURING SECTOR

- *(potential positive contributions)* Eco-design plays a key role in enhancing resource efficiency of products. It allows more energy and material efficient products to be made which are more durable, repairable, and easier to dismantle in the end-of-life phase (e.g. Tecchio et al. 2016).

USE PHASE

- The consumption phase has an important role in improving resource efficiency and reducing environmental impacts.
- *(potential positive contributions)* Re-using and repairing products extends their life span and reduces waste flows (including hazardous waste) and related environmental impacts [EUROSTAT 12.4.1].
- *(potential positive contributions)* In the construction sector, using wood instead of concrete and iron allows the environmental (and carbon) footprint and pollution to be reduced (Wang et al., 2016b, 2016a).

END-OF-LIFE PHASE

- *(potential positive contributions)* The waste management phase and the production of secondary raw materials have a crucial role in improving the circularity of the economy, and in reducing the environmental impacts caused by primary production (in terms of emissions to air, water bodies, and soil, biodiversity loss, etc.) (Huisman et al., 2008). Recycling materials is also important in improving sustainability, and contributes to the security of raw material supply. While the recycling contribution to meeting material demand is actually quite low (EC 2016), quality standards and eco-design can boost the market for secondary materials [Indicator UN 12.5.1; 12.6.1; EUROSTAT 12.41; 12.50; 12.60].
- *(potential positive contributions)* As stressed in the European strategic long-term vision (COM/2018/773), a resource-efficient and circular economy will improve the economy competitiveness, create business opportunities and jobs, and, requiring less energy, will reduce pollution and greenhouse gas emissions (EC, 2018c).
- The cascading use of wood (for instance, reuse and recycling of waste wood, for example, the production of particleboards) improves resource efficiency and contributes to reducing the environmental (and carbon) footprint. [Indicator UN 12.5.1; EUROSTAT 12.41].

SDGs MONITORING INDICATORS

- UN Framework:
 - 12.2.1 Material footprint, material footprint per capita, and material footprint per GDP
 - 12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP
 - 12.5.1 National recycling rate, tons of material recycled
 - 12.6.1 Number of companies publishing sustainability reports
- EUROSTAT Framework:
 - 12.20 Resource productivity and domestic material consumption
 - 07.30 Energy productivity
 - 12.41 Circular material use rate
 - 12.50 Generation of waste excluding major mineral wastes
 - 12.60 Recycling rate of waste excluding major mineral wastes

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Domestic material consumption by resource category (indicator 15 'Material flows in the circular economy', EC 2016; EC 2018a)
- End-of-life recycling input rates (EOL-RIR) for a selection of raw materials (indicator 16 'Recycling's contribution to meeting materials demand', EC 2016; EC 2018a)
- Electrical and electronic equipment put on the market, WEEE collected, reused, and recycled (indicator 17 "WEEE management, EC 2016; EC 2018a)
- Trade in selected waste materials to and from the EU (indicator 18 Trade in secondary raw materials, EC 2016; indicator 18 'Trade of waste and scrap', EC 2018a)
- Extractive waste management (indicator 21 'Extractive waste management', EC 2016; indicator 23 'Extractive waste', EC 2018a)

- Number of companies that have joined the Global Reporting Initiative (GRI) (indicator 24 'Sustainability reporting', EC 2016; indicator 26 'Sustainability reporting' EC 2018a)
- Construction and demolition waste (indicator 19, EC 2018a)

RELATED SDGs

- SDG 6 Clean water and sanitation
- SDG 7 Affordable and clean energy
- SDG 9 Industry, innovation, and infrastructure
- SDG 11 Sustainable cities and communities
- SDG 13 Climate action

RELATED EU POLICY INITIATIVES

- Roadmap to a Resource Efficient Europe, COM(2011) 571
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614 final
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013)659 final
- EU Eco-Management and Audit Scheme (EMAS)
- Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel
- Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
- Regulation (EU) 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market (Text with EEA relevance).

4.13 SDG 13: Take urgent action to combat climate change and its impacts



MINING AND MANUFACTURING SECTORS

- (*potential adverse impacts*) Mining, smelting, and refining are particularly energy-intensive industries which produce significant amounts of GHG emissions [Indicator EUROSTAT 13.20; 13.30]

FORESTRY

- (*potential positive contributions*) The forest sector can play a major role in climate change mitigation by reducing GHG emissions into the atmosphere (in particular, carbon dioxide (CO₂)). Forests accumulate large stocks of carbon in the form of woody biomass and in forest soils (Grassi et al., 2017; Le Quéré et al., 2017). [Target UN 13.1; Indicator EUROSTAT 13.30]
- (*potential positive contributions*) Forestry contributes to climate change mitigation in several ways, particularly through: i) sustainable forest management (including forest restoration); ii) afforestation/reforestation; iii) avoiding deforestation and forest degradation; and iv) material and energy¹⁶ substitution. there are many options Along the forest value chain (harvesting, manufacturing, use, and end-of-life) to reduce GHG emissions, such as making the machines more efficient (fuel consumption, emissions), wood products firms innovating by adopting climate-friendly technologies, and reusing or recycling waste wood.
- (*potential positive contributions*) The forestry sector also contributes to climate change adaptation. For example, forest restoration through planting (selection of less vulnerable species, weed and herbivore control, use of fertilizers such as biochar) improves the functionality and stability of forest ecosystems and local communities while combatting climate-related extreme events such as drought, wildfires, floods, avalanches, insect outbreaks, etc. [Target UN 13.2]
- (*potential positive contributions*) In the case of roundwood, harvested wood products contribute to climate change mitigation by storing carbon for long periods, and roundwood compensates for GHG emissions from other sectors when used to substitute other construction materials (substitution effect).
- (*both potential positive contributions and adverse impacts*) Fuelwood (for cooking or heating purposes) can support energy savings but can also contribute to increasing GHG emissions into the atmosphere, depending on the feedstock used, the material replaced, and the temporal scale analysed. [Indicator EUROSTAT 13.20]

USE PHASE

- (*potential positive contributions*) Power generation is one of the major contributors to climate change. Low-carbon energy technologies, which require specific raw materials including critical materials (Kleijn et al., 2011), can substantially reduce carbon emissions [Indicator EUROSTAT 07.40]. For instance, rare earths are used in wind energy turbine generators and electric vehicles; silicon is needed to

¹⁶ the contribution is highly context-specific (e.g. technology conversion, biomass sources, fuel replaced)

produce solar photovoltaic energy; lithium, cobalt and graphite are used in batteries. A JRC report addresses the EU resilience in view of supply of the key materials required for the large deployment of selected low-carbon technologies, namely wind, photovoltaic and electric vehicles (Blagoeva et al., 2016).

END-OF-LIFE PHASE

- Reuse, recovery, and recycling reduce emissions from the production of primary materials (Hestin et al., 2016).
- Reducing scavenging and the export of cooling and freezing appliances and treatment according to standards limits emissions of CFCs and besides ozone-layer depletion, reduces the release of gases with a very high global warming potential (Huisman et al., 2015).

SDGs MONITORING INDICATORS

- UN Framework:
 - Target 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
 - Target 13.2 Integrate climate change measures into national policies, strategies, and planning
- EUROSTAT Framework:
 - 13.20 Greenhouse gas emissions intensity of energy consumption
 - 13.30 Greenhouse gas emissions
 - 07.40 Share of renewable energy in gross final energy consumption

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Emissions of greenhouse gases (A) and gases with tropospheric ozone formation potential (B) (indicator 19 'Air emissions', EC 2016; indicator 20 "Greenhouse gas emissions" EC 2018a)

RELATED SDGs

- SDG 6 Clean water and sanitation
- SDG 7 Affordable and clean energy
- SDG 9 Industry, innovation, and infrastructure
- SDG 11 Sustainable cities and communities
- SDG 12. Responsible consumption and production
- SDG 15 Life on land

RELATED EU POLICY INITIATIVES

- Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814 (Text with EEA relevance).
- Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance).
- Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021

to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 (Text with EEA relevance).

- Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU (Text with EEA relevance).
- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance).
- Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance.
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013) 659
- A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy. COM(2018) 773.
- A sustainable Bioeconomy for Europe: Strengthening the connection between economy, society, and the environment, COM(2018) 673/2
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614 final

4.14 SDG 14: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development



MINING SECTOR

- *(potential adverse impacts)* Mining sites close to a marine environment may dispose tailings into the sea (seabed and deep-sea zone). This generally reduces the abundance of aquatic life (IRP-UNEP, forthcoming). Moreover, the entire range of impacts from waste disposal into the sea is not yet fully known. Discharges, leakages, and acid mine drainage can also contribute to sea pollution with toxic substances (IRP-UNEP, forthcoming). [Target UN 14.1]
- *(potential adverse impacts)* Sea dredging and deep-sea mining may have a negative direct impact on coastal lagoons and the seabed and can target areas with high nature conservation value and/or valuable fisheries (IRP-UNEP, forthcoming). Deep-sea mining is likely to cause a great many adverse impacts on deep-sea ecosystems by increasing release of toxic substances and the agitation of sediments (UNDP et al., 2016). The potential impacts of deep-sea mining are in focus, especially for governments of small island developing countries that depend on marine life. However, little is known about the full impacts of this practice (CCSI et al., 2016; IRP-UNEP, forthcoming). [Target UN 14.1; 14.2; 14.7]
- *(potential adverse impacts)* Materials are shipped via maritime transport, with the associated negative impacts on the marine environment [Target UN 14.1]
- *(potential adverse impacts)* Some mining activities might have radioactivity leaks that could end in the marine environment (IRP-UNEP, forthcoming) [Target UN 14.1]
- *(potential positive contributions)* Raw materials are essential for the development of new technologies to improve the environmental performance of minerals processing, possibly reducing disposal of tailings into the sea [Target UN 14.1]

MANUFACTURING SECTOR

- *(potential adverse impacts)* Raw material facilities release pollutants into soil, air, and water that may find their way into the marine environment, subsequently impacting life below water. [Target UN 14.1]
- *(potential positive contributions)* Raw materials are essential for the development of end-of-pipe technologies for pollution abatement and new technologies to optimize industrial processes, with the possible subsequent reduction of pollutant releases [Target UN 14.1]

END-OF-LIFE PHASE

- *(potential adverse impacts)* If not properly managed, waste disposal, especially hazardous waste handling, close to marine and coastal ecosystems can have negative impacts. [Target UN 14.1]

SDGs MONITORING INDICATORS

- UN Framework:

- (Target) 14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
- (Target) 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, strengthen their resilience, and achieve healthy and productive oceans
- 14.5.1 Coverage of protected areas in relation to marine areas
- (Target) 14.7 By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture, and tourism

RELATED RAW MATERIALS SCOREBOARD INDICATORS

None

RELATED SDGs

- SDG 2 Zero hunger
- SDG 6 Clean water and sanitation
- SDG 15 Life on land

RELATED EU POLICY INITIATIVES

- Industrial Emissions Directive 2010/75/EU and Best Available Techniques (BAT) reference documents
- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy"
- Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from extraction industries
- Blue Growth opportunities for marine and maritime sustainable growth, COM(2012) 494 final

4.15 SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss



MINING SECTOR

- *(potential adverse impacts)* Mining is one of the most widespread and invasive land uses that causes land degradation (Cherlet et al., 2018). Mining activities can lead to deforestation, desertification, and loss of biological productivity (UNDP et al., 2016). This arises out of practices such as land clearance (to access deposits, storage, waste management, etc.) and material extraction, which, apart from the direct removal of plant cover and material, also reduce soil particles size and subsequently favours erosion. These impacts also occur during exploration and post-closure.
- *(potential adverse impacts)* Abandoned sites, whose stabilisation and restoration typically requires long-term effort, have endemic problems such as the accumulation of large amounts of waste and reactive materials (e.g. tailings rich in sulphide minerals leading to acid mine drainage) (Cherlet et al., 2018).
- *(potential adverse impacts)* Artisanal mining presents another set of problems, e.g., soil pollution in gold extraction due to the uncontrolled use of chemicals (Cherlet et al., 2018).
- *(potential adverse impacts)* Loss of natural or agricultural land subsequently reduces the biomass provision capacity of the area and the carbon capture capacity (United Nations Development Programme (UNDP) et al., 2016). [Indicator UN 15.1.1; 15.3.1; 15.4.2] [Indicator EUROSTAT 15.10; 15.30; 15.50]
- *(potential adverse impacts)* Mining can cause biodiversity loss by negatively impacting forest, mixed agricultural/forest, and/or low impact agricultural areas. Ecosystems can be directly removed and/or fragmented, and/or affected by air, water, and soil pollution (IRP-UNEP, forthcoming), and by increasing vehicle traffic (UNDP et al., 2016). This can be particularly relevant in areas with high nature conservation value and high vulnerability. These impacts may be irreversible. They also take place during exploration and post-closure. Mining industries often invest fund activities to offset their negative impacts on biodiversity. [Indicator UN 15.a.1]

FORESTRY

- *(potential adverse impacts)* Forestry activities can lead to biodiversity loss through land clearance and cultivation of high yield/commercial forest species, which is sometimes based on alien species. [Indicator UN 15.1.1; 15.2.1; EUROSTAT 15.11]
- *(potential positive contributions)* Forest landscape restoration, continuous cover forestry, selective and mixed planting, close-to-nature silviculture, agroforestry systems, assisted natural regeneration, family forestry, community-based forest management, etc., are options/strategies to preserve biological diversity, diversify forest wood, and non-wood products, and promote additional ecosystem services such as cultural and

recreational opportunities and the preservation of historical/religious heritage. (Nature's Contributions to People; Díaz et al. 2018). [Indicator UN 15.2.1]

- (*potential positive contributions*) The demand for differentiated wood and non-wood products (mushrooms, truffles, berries, resins, etc.) requires a forest management targeting the valorisation of multiple species' stands or mix alternative activities (e.g. agroforestry systems).
- (*potential positive contributions*) Re-establishing active forest management in degraded or abandoned lands facilitates landscape heterogeneity and the subsequent creation of ecological hotspots and corridors (green infrastructure network; trees outside forests) for large mammals or migratory birds (increasing species richness and reducing biodiversity loss).

MANUFACTURING SECTOR

- (*potential adverse impacts*) Manufacturing facilities can impact biodiversity because they cause land use change, the release of pollutants into the air, water and soil pollution, and increased vehicle traffic (UNDP et al., 2016). However, the impacts are generally more localized in space and time than for mining activities. Accidents can pose large and/or acute impacts on biodiversity. [Indicator UN 15.1.1; 15.3.1; 15.4.2; 15.5.1] [Indicator EUROSTAT 15.10; 15.30; 15.60; 15.61]
- (*potential positive contributions*) Raw materials are essential for the development of end-of-pipe technologies for pollution abatement and new technologies to improve the environmental performance of mineral processing and production. [Indicator UN 15.3.1; 15.4.2; 15.51] [Indicator EUROSTAT 15.60; 15.61]

END-OF-LIFE PHASE

- (*potential adverse impacts*) If not properly managed, waste disposal can impact land ecosystems negatively, especially in the case of hazardous waste handling.

SDGs MONITORING INDICATORS

- UN Framework:
 - 15.1.1 Forest area as a proportion of total land area
 - 15.2.1 Progress towards sustainable forest management
 - 15.3.1 Proportion of land that is degraded over total land area
 - 15.4.2 Mountain Green Cover Index
 - 15.5.1 Red List Index
 - 15.8.1 Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species
 - 15.a.1 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems
- EUROSTAT Framework:
 - 15.10 Share of forest area
 - 15.30 Artificial land cover per capita
 - 15.50 Estimated soil erosion by water
 - 15.60 Common bird index
 - 15.61 Grassland butterfly index

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Felling rates as percentage of net forest increment (indicator 22 'Sustainable wood supply', EC 2016)
- Wood growing stock in forest available for wood supply (indicator 24 'Wood supply', EC 2018a)

RELATED SDGs

- SDG 2 Zero hunger
- SDG 6 Clean water and sanitation
- SDG 11 Sustainable cities and communities
- SDG 13 Climate action
- SDG 14 Life below water

RELATED EU POLICY INITIATIVES

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds
- Our life insurance, our natural capital: an EU biodiversity strategy to 2020, COM(2011) 244
- Thematic Strategy for Soil Protection, COM(2006) 231
- A new EU Forest Strategy: for forests and the forest-based sector, COM(2013) 659 final

4.16 SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels



MINING SECTOR

- *(potential adverse impacts)* Especially in mining communities in developing countries, conflicts and social tensions can arise due to the inequitable distribution of benefits and costs to communities or because of limited access to resources. Conflicts between companies and illegal miners as well as politically motivated killings of anti-mining activists may occur (e.g. Abuya, 2016; Oyarzún and Oyarzún, 2011; Switzer, 2001). [Indicator UN 16.1.2; 16.10.1].
- *(potential adverse impacts)* Human rights abuses related to mining activities can occur for different reasons. In the case of Large Scale Mining, mining-induced land loss can threaten the livelihoods of indigenous peoples as they rely on natural resources and land for their subsistence. Contamination and environmental destruction can similarly compromise the right to maintain access to existing water supplies and can cause severe health problems.
- *(potential adverse impacts)* In Artisanal and Small Scale Mining labour related human rights problems stand out. This is most apparent with problems of child labour and bad working conditions, which can be observed in many parts of the world. Poverty, a low level of mechanization, inefficient extraction methods, and insufficient knowledge and expertise are part of the root causes to these problems. A detailed analysis of the human rights risks in mining is available in a report by Max-Planck and BGR (2016). [Indicator UN 8.7.1]
- *(potential adverse impacts)* Corruption in the mining sector to obtain licences and permits or to sway judicial decision can occur. Corruption can create huge revenue losses for public coffers and is one of the main causes of the so called “resource curse” in resource-rich countries (Kolstad and Søreide, 2009; OECD, 2016a). Several initiatives are in place to improve transparency and good governance in the extraction sector. [Indicator UN 16.5.1; 16.5.2; EUROSTAT 16.50]

FORESTRY

- *(potential positive contributions)* Participatory and inclusive governance through forest management concessions may reduce conflicts between local stakeholders (private vs. public; large companies vs. smallholders), guarantee access rights to resources from local communities, and balance the economic revenues from forest management with local needs (e.g. Karsenty and Vermeulen, 2017).

MANUFACTURING SECTOR

- *(potential adverse impacts)* The so called “conflict minerals” can be traded internationally and finish in final products manufactured in the EU. However, importers of some minerals and metals (e.g. Tin, Tantalum, Tungsten, and Gold) from high-risk and conflict areas will have to perform due diligence in order to ensure that they source responsibly. This will be a legal requirement for the EU companies from 2021 (European

Union, 2017b) and other countries have similar regulations already in place. The OECD has published the “Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas” which is the technical basis of the EU Regulation.

- Similarly, the Council Regulation (EC) No 2368/2002 sets out the criteria for importing or exporting rough diamonds in order to ensure the requirements of the ‘Kimberley Process¹⁷ are adhered to’.

SDGs MONITORING INDICATORS

- UN Framework:
 - 16.1.2 Conflict-related deaths per 100,000 population, by sex, age, and cause
 - 16.10.1 Number of verified cases of killing, kidnapping, enforced disappearance, arbitrary detention, and torture of journalists, associated media personnel, trade unionists, and human rights advocates in the previous 12 months
 - 8.7.1 Proportion and number of children aged 5–17 years engaged in child labour, by sex and age
 - 16.5.1 Proportion of persons who had at least one contact with a public official and who paid a bribe to a public official, or were asked for a bribe by those public officials during the previous 12 months
 - 16.5.2 Proportion of businesses that had at least one contact with a public official and that paid a bribe to a public official, or were asked for a bribe by those public officials during the previous 12 months
- EUROSTAT Framework:
 - 16.50 Corruption Perception Index

RELATED RAW MATERIALS SCOREBOARD INDICATORS

- Geographical concentration and governance (Indicator 4, EC 2016; EC 2018a)

RELATED SDGs

- GSDG 8 Decent work and economic growth
- GSDG 10 Reduced inequalities

RELATED EU POLICY INITIATIVES

- Regulation (EU) 2017/821 of the European Parliament and of the Council of 17 May 2017 laying down supply chain due diligence obligations for European Union importers of tin, tantalum, and tungsten, their ores, and gold originating from conflict-affected and high-risk areas
- Council Regulation (EC) No 2368/2002 implementing the Kimberley Process certification scheme for the international trade in rough diamonds

¹⁷ <https://www.kimberleyprocess.com/>

4.17 SDG 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development



CROSS-CUTTING ISSUES

- All of the raw material sectors can contribute to the achievement of the SDGs. The European Innovation Partnership (EIP) on Raw Materials promotes innovation in the sector by financing the 'Raw Material Commitments' (see Section 5.2), which are joint undertakings by several partners that make a contribution to achieving the EIP actions and targets. The EIP annual monitoring survey revealed that in 2016 these Commitments were mainly contributed to SDG 12 (Responsible consumption and production), SDG 8 (Decent work and economic growth) and SDG 9 (Industry, infrastructure and innovation) (EC, 2017b).

MINING SECTOR

- Mining companies can play an important role in contributing to sustainable development. For instance, in order to convert mineral wealth into positive economic growth, it is crucial to pay a reasonable and fair share of taxes and promote transparency in the flow of mining revenues between the private sector and the state (ICMM, 2018).
- Deploying environmentally sound technologies in their operations, employing people, and sharing geological data are other ways of strengthening the partnership for the SDGs, and promote sustainable development according to CCSI et al. (2016). [Indicators UN 17.7.1; 17.11.1; EUROSTAT 17.30]

FORESTRY

- (*potential positive contributions*) The World Bank and the International Finance Corporation promote investments to support improved forest management in both forest conservation areas and productive forests, particularly in developing countries. The main purposes of this are to improve the competitiveness of small and medium enterprises, encourage private sector activity, guarantee good governance (improved forest management), and strengthen dialog between stakeholders in the forest sector (World Bank, 2011).

SDGs MONITORING INDICATORS

- UN Framework:
 - 17.7.1 Total amount of approved funding for developing countries to promote the development, transfer, dissemination, and diffusion of environmentally sound technologies
 - 17.11.1 Developing countries' and least developed countries' share of global exports
- EUROSTAT Framework:
 - 17.30 EU imports from developing countries

RELATED RAW MATERIALS SCOREBOARD INDICATORS

None

RELATED SDGs

- GSDG 16 Mining, peace, justice, and strong institutions
- GSDG 10 Reduced inequalities

RELATED EU POLICY INITIATIVES

- Next steps for a sustainable European future European action for sustainability, COM (2016) 739 final
- Proposal for a new European Consensus on Development Our World, Our Dignity, Our Future COM (2016) 740 final

5 Role of European Policies

This section briefly describes various EU policies that play a major role in strengthening the contribution of raw materials to the SDGs. Only those policies whose objectives and targets are explicitly oriented to maintaining, enhancing or further developing the economic, social, and environmental sustainability of the raw materials' supply chain were selected. The list of policies is not exhaustive as other policies currently in force may be pertinent to some specific SDGs.

Table 1 shows the linkages between the policies considered and the SDGs, according to their relevance to raw material sustainability.

Table 1 Examples of EU policies and potential contribution to SDGs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Raw Materials Policy (2008)								X	X				X				
Raw Materials Innovation Partnership (2013)								X	X				X				
Resource efficiency and Circular Economy Action Plan (2015)						X		X	X		X	X	X				
Conflict Minerals Regulation (2017)													X			X	
European Pillar of Social Rights (2017)	X		X	X	X		X	X		X							
Forest strategy (2013)	X	X					X	X	X			X	X			X	
Industrial policy (2017)								X	X			X	X				
Policies within the 2030 Climate and Energy Framework												X	X				

5.1 Raw Materials Initiative

The raw material markets have shown strong growth in demand over the last few years, especially from emerging countries. In addition, raw materials supply to the EU has been affected negatively by trade barriers. Due to the economic importance of manufacturing sectors and their sensitivity to trade of raw materials being hindered, in 2008 the European Commission adopted the Raw Materials Initiative (RMI) (EC, 2008).

The RMI is a communication from the EC which strives to secure reliable and undistorted access to raw materials to sustain and improve competitiveness and growth of the EU economy. Therefore, ensuring secure sustainable access to these raw materials is crucial to the success of the Lisbon Partnership for growth and jobs¹⁸ and to achieving the

¹⁸ EC (2005): Common Actions for Growth and Employment: The Community Lisbon Programme, COM(2005) 330 final

objectives of the Europe 2020 strategy (EC, 2010b). It covers all non-agriculture, non-energy raw materials used by the EU industry. The RMI proposes the establishment of an integrated strategy with three pillars, which aim to:

- ensure fair access to raw materials from global markets;
- set proper framework conditions within the EU to foster sustainable supply of raw materials within the EU;
- promote overall resource efficiency and recycling to reduce the EU's demand for primary raw materials.

As promoted by the RMI, the EC regularly publishes a list of critical raw materials (CRM), based on their economic importance and supply risk. The first list was published in 2011¹⁹ and revised in 2014²⁰. In 2017²¹ a third list of CRM was published based on a refined methodology (EC, 2017a).

Given the objectives of the RMI, the most explicit links to the SDGs are with SDGs 8, 9, and 12. An overview of policies and actions related to non-energy, non-agricultural raw materials (led by various Directorate Generals of the European Commission), and their contribution to SDGs has been published on the DG GROW website²². This document also links some policy actions to SDG 15 (because they aim to reconcile biodiversity protection and extractive activities or identify best practices for land rehabilitation and restoration by non-energy mineral extractive industry), and SDG 16 (for support for SMEs in the conflict minerals policy).

5.2 European Innovation Partnership on Raw Materials

The European Innovation Partnerships (EIPs) are a new approach to EU research and innovation. They “act across the whole research and innovation chain, bringing together all relevant factors at EU, national, and regional levels.” “EIPs streamline, simplify, and coordinate existing instruments and initiatives better and complement them with new actions where necessary. This should make it easier for partners to co-operate and achieve better and faster results compared to what is already in existence. Therefore, they build upon relevant existing tools and actions, and where this makes sense, they integrate them into a single coherent policy framework”²³. Up until now five EIPs have been established, the EIP on Raw Materials (EIP-RM) being one of them.

With regard to the general EU industrial policy, the EIP-RM plays an important role in meeting the objectives of the Commission's flagship initiatives Innovation Union and Resource Efficient Europe. More specifically, the EIP-RM is implementing the RMI stakeholder platform that brings together representatives from industry, public services, academia, and NGOs. Its mission is to provide high-level guidance to the European Commission, Members States, and private actors on innovative approaches to the challenges related to raw materials. To foster innovative solutions, the EIP-RM developed its Strategic Implementation Plan (SIP)²⁴ describing the specific objectives and targets as

¹⁹ Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Tackling The Challenges In Commodity Markets And On Raw Materials COM(2011) 25 final

²⁰ Communication On the review of the list of critical raw materials for the EU and the implementation of the Raw Materials Initiative COM(2014)0297 final

²¹ Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions On the 2017 list of Critical Raw Materials for the EU COM(2017)0490 final

²² Commission contributions to the implementing of SDGs in the scope of non-energy extractive industries - policies derived from the Raw Materials Initiative and trade, environmental, research and innovation, development, and fiscal transparency policies, Document date: 07/09/2017 - Created by GROW.DDG1.C.4 - Publication date: 12/09/2017 (https://ec.europa.eu/growth/sectors/raw-materials/policy-strategy_en)

²³ <https://ec.europa.eu/research/innovation-union/index.cfm?pg=eip>

²⁴ DG GROW (2013): Strategic Implementation Plan (SIP), endorsed by the EIP's High Level Steering Group on 25 September 2013. <https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/strategic-implementation-plan-sip-0#Read%20EIP%20docs>

well as how they plan to achieve these through a set of 95 concrete actions, which include research and innovation coordination, technologies for raw materials production, substitution, framework conditions, knowledge and skills, and international cooperation.

To implement these actions the European Commission launched several Calls for Commitments²⁵ to Member States, industry, academia, and other relevant stakeholders. The Raw Material Commitments (RMCs) are joint undertakings by several partners who commit themselves to carrying out activities that will contribute to achieving the actions and targets of the EIP within the period 2014-2020. The EC tracks the progress made by the RMCs by means of the Annual Monitoring Report.

For the first time, the Annual Monitoring Report 2016 (EC, 2017b) assessed what UN SDGs were addressed by the activities of the various RMCs as perceived by the RMC performers. More than 200 linkages were identified, which refer to all of the 17 SDGs, with significant differences between them. While all SDGs were addressed by at least three Commitments, almost half of the linkages (49%) are concentrated on three SDGs (SDG 8, SDG 9, SDG 12), outstanding from the remainders. SDG 12 was addressed by almost two out of three respondents (65%). A second group of frequently addressed SDGs comprised four SDGs (SDG 17, SDG 6, SDG 15, SDG 11), with each SDG showing more than 5% of the total linkages. The following observations were made about the three dominating SDGs:

- SDG 12 'Ensure sustainable consumption and production patterns': the key addressed targets concern the sustainable management of natural resources, waste reduction, and environmentally sound management of chemicals and wastes;
- SDG 8 'Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all': the focus is mainly on increasing economic productivity and improving resource efficiency;
- SDG 9 'Innovation and infrastructure': enhancing the scientific research and technological capabilities.

5.3 Resource efficiency and Circular Economy Action Plan

The resource-efficient Europe initiative (EC, 2011a) is part of the Europe 2020 Strategy for a smart, sustainable, and inclusive growth (EC, 2010b). One of the main building blocks of this initiative is the Roadmap to a Resource Efficient Europe (EC, 2011b). It proposes ways to increase resource productivity and decouple economic growth from resource use and its environmental impact. It sets out a framework for the design and implementation of future actions, outlining the structural and technological changes needed by 2050, including milestones to be reached by 2020. The roadmap identifies areas where policy action can make a real difference, and also identifies relevant bottlenecks like inconsistencies in policy and market failures. Key resources are considered from a life-cycle and value-chain perspective. Nutrition, housing, and mobility are identified as the sectors responsible for the greatest environmental impacts, and the roadmap has subsequently proposed specific actions for these areas.

Building of the Resource Efficiency Roadmap, the Circular Economy action plan (EC, 2015b) established a concrete and ambitious programme to stimulate Europe's transition towards a circular economy by contributing to 'closing the loop' of product life cycles (SDG 12). The action plan aimed to simultaneously boost EU competitiveness, foster sustainable economic growth, and generate new jobs (SDG 8).

The measures in the action plan cover the whole life cycle of products from production and consumption to waste management as well as the market for secondary raw

²⁵ Call for commitments were launched in October 2013 and December 2015. The current call was launched in June 2018. It is an open call with biannual cut-off dates.

materials. Innovation and investment in the field have been promoted through the H2020 programme²⁶. The annex to the action plan sets out a timeline showing when the actions are due to be completed. Among the topics included in the Circular Economy Action plan are:

- promotion of the reparability, upgradability, durability, and recyclability of products by developing product requirements relevant to the circular economy in its future work come under the Ecodesign Directive (European Union, 2009);
- revised legislative proposals on waste, which set targets to reduce waste and increase recycling²⁷, and which should also incentivise better product design;
- a new proposal for a directive on waste (EC, 2008);
- boosting the market for secondary materials and water reuse.

Together with food waste and plastics, the action plan considers the following to be priority action areas:

- critical raw materials: the Commission will encourage their recovery and action by Member States in its revised proposals on waste;
- construction and demolition waste: the Commission will take action to ensure the recovery of valuable resources and appropriate waste management. and facilitate the assessment of the environmental performance of buildings;
- biomass and bio-based products: the Commission will promote efficient use of bio-based resources²⁸ and will establish a target for recycling wood packaging and a provision to ensure the separate collection of bio-waste within the revised waste policies.

Furthermore, the more recent 2018 Circular Economy Package (EC, 2018c) has been developed in order to continue the implementation of the 2015 Circular Economy action plan. The package adopted an EU Strategy for plastics, developed a monitoring framework to measure progress toward a circular economy (EC, 2018d), and analysed the links between critical raw materials and the circular economy (EC, 2018e) among other actions.

The objectives of the resource efficiency and circular economy policies provides insight into SDG 12 on Responsible consumption and production, which includes the targets of sustainable management and efficient use of natural resources and the reduction of waste generation through prevention, reduction, recycling, and reuse. These targets are also relevant for Goal 11 on sustainable cities and communities. Other relevant links lie with SDG 8 (on economic growth) and SDG 9 (on industry and innovation) due to the important economic repercussion of this policy, and with SDG 13 on climate action due to the potential for a circular economy to reduce air emissions.

²⁶<http://ec.europa.eu/programmes/horizon2020/en/news/horizon-2020-work-programme-2016-2017-published>.

²⁷ a common EU target for recycling 65% of municipal waste by 2030; a common EU target for recycling 75% of packaging waste by 2030; a binding landfill target to reduce landfill to maximum of 10% of municipal waste by 2030; a ban on landfilling of separately collected waste; promotion of economic instruments to discourage landfilling; simplified and improved definitions and harmonised calculation methods for recycling rates throughout the EU; concrete measures to promote re-use and stimulate industrial symbiosis - turning one industry's by-product into another industry's raw material; economic incentives for producers to put greener products on the market and support recovery and recycling schemes (e.g. for packaging, batteries, electric and electronic equipment, vehicles).

²⁸ through a series of measures including guidance and dissemination of best practices on the cascading use of biomass and support for innovation in the bioeconomy.

5.4 Conflict Minerals Regulation

In conflict zones and politically unstable countries, forced labour and human rights abuses can occur in the extraction of metals and minerals. Moreover, mineral trade can finance armed groups and contribute to perpetuate wars and corruption. Conflict minerals came to public attention in the 1990s and 2000s when some NGOs denounced the way that the growing demand for mobile phones and other electronic products, as well as jewellery, was fuelling violence and atrocities in several African countries. In 1998, Global Witness published an alarming report on the role of diamonds in the Angolan conflict (Global Witness, 1998). Attention grew until reaching the UN General Assembly where the issue of “conflict diamonds” was more specifically discussed, leading to the formulation of its definition²⁹ and the establishment of sanctions in 2000. In 2003, outrageous situations were described in Sierra Leone by the non-governmental organisation Partnership Africa Canada (PAC)³⁰. In general, this media coverage proved that the illicit trade of diamonds also funded brutal wars in numerous African countries, including the Central African Republic, Democratic Republic of Congo, and Liberia, resulting in the death and displacement of millions of people. Following this, similar situations have been described in reports published by other NGOs on gold among others and the mineral ores that produce the metals tantalum, tin, and tungsten (often referred as 3TG).

In response to the conflict diamonds issues, the Kimberley Process Certification Scheme³¹ was set up in 2003 as a tripartite initiative, hence gathering governments, the diamond industry, and civil society organisations. The aim is to prevent the flow of conflict diamonds while helping to protect legitimate trade in rough diamonds.

Concerning conflict minerals (3TG), the EU Regulation (EU 2017) aims to stop conflict minerals and metals from being exported to the EU; preventing the use of conflict minerals in EU smelting and refining industries; avoiding the abuse of mine workers; and supporting local development. Therefore, it contributes to SDG 16 on peace, justice, and strong institutions, and to SDG 12 on responsible consumption and production.

The EU regulation, which will take effect in 2021, applies to companies importing tin, tantalum, tungsten, and gold (in the form of mineral ores, concentrates, or processed metals) from high-risk and conflict-affected areas. Guidelines for the identification of these areas are currently under development. The Regulation requires that EU companies in the supply chain ensure they import these materials responsibly and from conflict-free sources only. It is built upon the OECD Due Diligence Guidance for responsible mineral sourcing (OECD, 2016b). The due diligence is an “on-going, proactive, and reactive process through which companies can ensure that they respect human rights and do not contribute to conflict”. It is considered to be the international benchmark for supply chain due diligence.

5.5 European Pillar of Social Rights

The EU Pillar of Social Rights (EC, 2017c) aims to support fair and well-functioning labour markets and welfare systems in order to build a more inclusive and fairer Union. Following a broad public consultation in 2016, which involved citizens, social partners, civil society, Member States, and EU Institutions, the European Pillar of Social Rights was jointly proclaimed by the European Parliament, the Council, and the Commission at the Gothenburg Social Summit for Fair Jobs and Growth³² on 17 November 2017. The Pillar is conceived for the member states of the Euro area, but applies to any member state willing to adopt it. Regional and national authorities have a key role in implementing and delivering on the principles of the Pillar, which provides a framework and provides

²⁹ “Rough diamonds which are used by rebel movements to finance their military activities, including attempts to undermine or overthrow legitimate governments” United Nations, general Assembly Resolution 55/56, December 2000.

³⁰ PAC changed its name to IMPACT in 2017.

³¹ <https://www.kimberleyprocess.com/en/kpcs-core-document>

³² <http://www.socialsummit17.se/>

directions for establishing inclusive and socially sustainable policies. The Pillar is based on twenty principles and three areas:

- Equal opportunities and access to the labour market
- Fair working conditions
- Social protection and inclusion

The Pillar is supported by a Social Scoreboard³³ of key indicators which screen the employment and social performances of participating Member States. The scoreboard serves as a reference framework to monitor societal progress.

Given its nature, the Social Pillar is supposed to contribute to all SDGs related to social sustainability and the labour market, including no poverty (1), good health and well-being (3), quality education (4), gender equality (5), affordable energy (7), decent work and economic growth (8), and reduced inequalities (10).

5.6 Forest Strategy

In 2013 the Commission adopted a new EU Forest Strategy (building on the previous strategy adopted in 1998) (EC, 2013). Among other aspects, the new strategy identifies key measures to strengthen sustainability in the whole forest sector in the EU while increasing growth and jobs in rural areas.

The EU Forest Strategy considers that forest biomass is currently the most important source of renewable energy, which now accounts for around half of the EU's total renewable energy consumption.

The strategy was accompanied by a document analysing the state of the EU forests and the related policy environment, and by a blueprint for the EU forest-based industries. The latter describes the EU forest-based industries' overall sectoral economic and technological outlooks. It also provides sub-sectoral profiles and analyses the main challenges of its four component industries: woodworking industries, the furniture industry, the pulp and paper manufacturing and converting industries, and the printing industry, which represent about 7% of EU manufacturing GDP and nearly 3.5 million jobs. Forests are also affected by a broad array of sectoral EU policies and initiatives such as those concerning biodiversity, climate change, or energy.

Considering the wood products' chain, the pathways of the EU Forest Strategy mainly refer to improving the sustainability in the extraction, production, and use of wood to tackle social-economic, environmental and climate change issues in the EU. In particular, the Strategy aims to promote the use of wood as a renewable and climate-friendly material, along with maintaining the multi-functionality and resilience of forest ecosystems by applying sustainable forest management, which has a major relevance for SDGs 13 and 15. In this way, the substitution effects of wood products for building and heating are expected to be elicited (major relevance for SDGs 12 and 13). The EU Forest Strategy also suggests evaluating the potential for wood supply and sustainable wood mobilisation, and the efficiency of all of the manufacturing processes (SDG 9). Such targets may be achieved by creating good-practice guidance to incorporate the "cascading principle" along the value chain, which has a major relevance for SDGs 7 and 12. In the EU Forest Strategy, the European Commission, Member States, and stakeholders are also asked to stimulate innovation, competitiveness, and knowledge base in the entire forest sector, for example, by facilitating trade conditions for wood products as well as the internationalisation of EU Forest-based Industries (major relevance for SDGs 9, 12). In addition, access to third markets by EU forest-based industries, and exchange of information on traded products for consumers (import/export) (major relevance for SDG

³³<https://composite-indicators.jrc.ec.europa.eu/social-scoreboard/>;
<http://ec.europa.eu/eurostat/web/european-pillar-of-social-rights/indicators/social-scoreboard-indicators>

17) should be provided. The EU Forest Strategy is intended to promote cooperation and partnership between relevant stakeholders (private-public, productive-scientific) (major relevance for SDGs 8, 17). The progress made towards the strategic orientations of the EU Forest Strategy is being currently assessed.

Linked to the EU Forest Strategy, the EU Timber Regulation aims at limiting (or even prohibiting) the trade of illegally harvested timber mainly through a “due diligence” mechanism, and improving transparency of information about timber suppliers and customers. The EU timber Regulation applies to both imported and domestically produced timber. Indirectly, the EU Timber Regulation may improve sustainable forest management (SDGs 12, 13 and 15), strengthen access of local communities to using the resources (SDG 1), foster economic growth in the forestry sector especially in developing countries, including the availability of decent works (SDG 8), and develop the traceability of harvested wood products from sources to beneficiaries (SDG 12).

5.7 Industrial policy

The Communication ‘For a European Industrial Renaissance’ (EC, 2014) stresses the need to promote growth and modernization in the EU after the recent crisis period and called on EU countries to recognise the central importance of industry for creating jobs and growth. In this context, the EU’s Industrial Policy highlights the need to increase industry’s share of GDP to 20 % by 2020.

More recently, in September 2017 the Commission adopted a renewed EU industrial policy strategy (EC, 2017d), which further aims to empower European industries to continue delivering sustainable growth and jobs. The European strategy sets the framework for a series of related initiatives and actions. This strategy outlines the main considerations, directions, and priorities for creating jobs and growth, which relates to SDG 8; and for remaining competitive in a global context at the forefront of the low-carbon and sophisticated products industry, linked to SDG 9. The strategy acknowledges that embracing technological breakthroughs while making the transition to a low-carbon and circular economy by 2050 is a major challenge as well as an opportunity for EU industry, and relates to SDG 12. The strategy describes the challenges and opportunities associated to fulfilling the climate commitments, very much linked to SDG 13, where initiatives to count on a full value chain in the EU (e.g. for batteries) are considered to be crucial. The strategy also acknowledges the relevance of raw materials for the EU manufacturing industries, especially those critical to the economy (see Section 5.1 on the Raw Materials Initiative). It also highlights the relevance of investment and skills development in order to foster state of the art technologies and applications (SDG 4).

5.8 2030 Climate and Energy Framework

Direct greenhouse gas (GHG) emissions from the raw materials industries account for 8% of all GHG emissions in the EU³⁴. Most GHG emissions from these industries, which are generally considered energy-intensive, originate from the production and use of energy. So far, overall decreasing GHG emission trends have been observed for the EU raw materials sectors due to decreasing production volumes and efficiency improvements, particularly related to changes in the fuel mix (EC, 2016c).

The EU 2030 Climate and Energy framework³⁵ comprises cross-cutting strategies to further reduce the GHG emissions from all sectors by 2030 (on the basis of the EU 2020 Climate and Energy package³⁶ achievements), and improve energy efficiency and use of

³⁴ JRC calculations based on the Emissions Database for Global Atmospheric Research (EDGAR) version 4. Data for 2012. See also EC 2018b.

³⁵ https://ec.europa.eu/clima/policies/strategies/2030_en

³⁶ https://ec.europa.eu/clima/policies/strategies/2020_en

renewable sources in the EU. In particular, the targets for the year 2030 are to (i) reduce the GHG emissions of 40% (in comparison with 1990 levels), (ii) use 27% of renewable energy sources, and (iii) improve energy efficiency of 27%. Targets related to the second and the third points are currently under review and being further updated to meet the SDGs as set in the Energy Union framework³⁷ (see “progress” column in Table 2 for details). Table 2 summarizes the main climate policies concerning climate-friendly raw materials’ extraction, processing, consumption, and use.

Table 2 List of climate-related EU policies concerning the sustainability of the raw materials sectors.

	Relevance for raw materials	Relevance for SDGs	Progress
Emission Trading System (energy activities, production and processing of ferrous material, mineral industry, production plants for pulp, paper and board) – Directive (EU) 2018/410³⁸; Directive 2003/87/EC³⁹	The “cap and trade principle” applies: emissions exceeding the allowed cap may be traded and exchanged among companies producing and processing raw materials (e.g. mineral industry), or deriving energy from such processes (i.e. mineral oil refineries, coke ovens).	SDGs 12, 13	Approved in March 2018
Effort Sharing Regulation – (EU) 2018/842⁴⁰	Annual GHG emissions targets are established (30 % below 2005 levels in 2030) for the following sectors: transport, buildings, energy, industrial processes, and product use, agriculture and waste.	SDGs 12, 13	Approved in May 2018
LULUCF Regulation – (EU) 2018/841⁴¹	The accounting of GHG emissions and removals from land use, land use change, and forestry sector (LULUCF; including harvested wood products) is implemented. The GHG emissions savings associated with “substitution effects” of wood (for energy and materials) are implicitly accounted in other GHG sectors.	SDGs 12, 13, 15	Approved in May 2018
Renewable Energy Directive –2009/28/EC⁴²	By adopting national renewable energy action plans, MS set specific targets to fulfil at least 32% ⁴³ renewables in the final energy consumption, about average on an EU scale. For each MS, targets take into account the	SDGs 12, 13	A political agreement including a binding energy efficiency target for the EU for 2030 was reached

³⁷ https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

³⁸ Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814 (Text with EEA relevance). URL: <http://data.europa.eu/eli/dir/2018/410/oj>

³⁹ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance). URL: <http://data.europa.eu/eli/dir/2003/87/oj>

⁴⁰ Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 (Text with EEA relevance). URL: <http://data.europa.eu/eli/reg/2018/842/oj>

⁴¹ Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU (Text with EEA relevance). URL: <http://data.europa.eu/eli/reg/2018/841/oj>

⁴² Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance). URL: <http://data.europa.eu/eli/dir/2009/28/oj>

⁴³ http://europa.eu/rapid/press-release_STATEMENT-18-4155_en.htm

	Relevance for raw materials	Relevance for SDGs	Progress
	starting point and the overall potential for renewables		on 14 June 2018 ⁴⁴
Energy Efficiency Directive – 2012/27/EU⁴⁵	MS have to develop energy measures for improving energy savings for consumers and industry, such as to (i) improve the efficiency of heating systems, (ii) purchase energy efficient buildings (for the public sector), (iii) better manage energy consumption, (iv) monitor efficiency levels	SDGs 12, 13	Clean Energy for all Europeans package ⁴⁶
Adaptation Strategy – COM(2013) 216 final	Use of more resilient construction material	SDGs 13	N/A

⁴⁴ http://europa.eu/rapid/press-release_STATEMENT-18-4155_en.htm

⁴⁵ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance. URL: <http://data.europa.eu/eli/dir/2012/27/oj>

⁴⁶ <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans>

6 Analysis of SDGs and RM Scoreboard indicators

The indicators currently available in the UN and EUROSTAT frameworks to monitor the SDGs, and of relevance for the raw materials sectors, are summarized in this section.. Moreover, the monitoring indicators from the RM Scoreboard that have a direct link with the SDGs are identified (as already reported in each SDG section from 4.1 to 4.16).

Table 3 reports the framework of monitoring indicators as identified for each SDG that is relevant for the raw materials sector.

Table 3 SDG monitoring indicators (UN and EUROSTAT frameworks) that may be affected by raw materials activities (along their supply chain); related indicators in the Raw Materials Scoreboard (EC, 2016c).

	UN framework	EUROSTAT framework	RM Scoreboard 2016	RM Scoreboard 2018
GSDG 1 No poverty	1.4.2	-	7	7
GSDG 2 Zero hunger	2.3.1; 2.4.1	-	-	-
GSDG 3 Good health and well-being	3.3.1; 3.9.1	08.60; 11.50	23	25
GSDG 4 Quality education	4.3.1	04.60	10	-
GSDG 5 Gender equality	5.a.1	05.20; 05.30	-	-
GSDG 6 Clean water and sanitation	6.3.1; 6.3.2; 6.4.1; 6.4.2	06.30; 06.60	20	22
GSDG 7 Affordable and clean energy	7.1.1; 7.1.2; 7.3.1;	07.10; 07.20; 07.30; 07.40	Introduction	Introduction
GSDG 8 Decent work and economic growth	8.3.1; 8.7.1; 8.8.1	08.30; 08.60	7; 23	7; 25
GSDG 9 Industry, innovation and infrastructure	9.1.1; 9.1.2; 9.2.2; 9.4.1; 9.5.1; 9.5.2	09.10; 09.40	8; 9; 19	8, 9, 20, 21
GSDG 10 Reduced inequalities	10.7.1; 10.7.2	-	-	-
GSDG 11 Sustainable cities and communities	11.1.1; 11.2.1; 11.3.1; 11.3.2; 11.4.1; 11.6.2; 1.7.1; 11.7.2	11.10; 11.20; 11.50	19	21
GSDG 12 Responsible production and consumption	12.2.1; 12.2.2; 12.5.1; 12.6.1	12.20; 07.30; 12.41; 12.50; 12.60	15; 16; 17; 18; 21; 24	15; 16; 17; 18; 19, 23; 26
GSDG 13 Climate action	-	13.30; 13.20; 07.40	19	20
GSDG 14 Life below water	14.5.1	-	-	-
GSDG 15 Life on land	15.1.1; 15.2.1; 15.3.1; 15.4.2; 15.5.1; 15.8.1; 15.a.1	15.10; 15.30; 15.50; 15.60; 15.61	22	24
GSDG 16 Peace, justice and strong institutions	16.1.2; 16.10.1; 8.7.1; 16.5.1; 16.5.2;	16.50	4	4
GSDG 17 Partnership for the SDGs	17.7.1; 17.11.1	17.30	-	-

The indicators used in the RM Scoreboard cover most of the SDGs, with particularly good coverage of SDGs 12, 9, and 8. The SDGs that do not have corresponding indicators in

the Scoreboard are those related to zero hunger (2), gender equality (5), reduce inequalities (10), life below water (14), and partnership for the SDGs (17).

The RM Scoreboard includes various indicators related to SDG 12 on responsible consumption and production. This is the case for Domestic Materials Consumption (DMC, used in the both the UN and the EUROSTAT frameworks), recycling rates, trade of waste and scrap, and management of electronic waste.

The number of companies publishing sustainability reports is an indicator monitoring SDG 12 on responsible consumption and production. The same indicator is used in the RM Scoreboard in the cluster "Environmental and Social Sustainability". In this context, data from the Global Reporting Initiative database⁴⁷ is used.

The Scoreboard covers several indicators for SDG 9 on industry, innovation, and infrastructure: corporate R&D links to the UN indicator "research and development expenditure as a proportion of GDP" and to the EUROSTAT indicator "gross domestic expenditure on R&D". Innovation is also monitored in terms of number of patent applications in both the Scoreboard and the EUROSTAT framework. The Scoreboard indicator on greenhouse gas emissions related to production (an analysis that will expand in the 2018 update) relates to the UN indicator "CO₂ emissions per unit of value added".

SDG 8 (on decent work and economic growth) is represented in the Scoreboard by the indicator on occupational safety. While the Scoreboard focusses on non-fatal accidents at work in the raw materials sectors, the UN framework monitors both fatal and non-fatal injuries and EUROSTAT covers only fatal accidents. The number of jobs is also common to the three monitoring frameworks. However, while EUROSTAT and the Scoreboard consider employment, the UN also targets informal employment and child labour.

The Scoreboard indicator on particulate matter (PM) emissions relates to SDG 11 on sustainable cities and communities. It is noteworthy that the three monitoring frameworks focus on different components of the impact pathway: while the Scoreboard presents data on pressures (e.g. particulate matter emissions), the UN uses an air quality indicator, and EUROSTAT focuses on human exposure to pollutants.

The SDG 13 aims to increase initiatives to combat climate change. While the UN framework looks at the implementation of mitigation and adaptation strategies and the amount of resources mobilized to tackle the climate change, EUROSTAT accounts for the use of renewable energy and greenhouse gas emissions. The latter aspect is also addressed by the Scoreboard.

SDG 15 on life on land and SDG 6 on clean water and sanitation are partially addressed by the Scoreboard, also due to data limitations.

⁴⁷ <http://database.globalreporting.org/search/>

7 Conclusions

Raw materials play a fundamental role for human well-being and can substantially contribute to sustainable development. At the same time, their production, consumption, and end-of-life can generate several environmental and social impacts, especially in countries with weak governance. In this preliminary analysis, the potential impact and contribution of raw materials to each SDG are highlighted by considering the main steps of the value chain of abiotic and biotic materials. Given the ubiquity of raw materials in modern societies, numerous links emerge with SDGs, especially when taking indirect relations into account too. Here, the most relevant, evidence-based issues of concern are taken into consideration, as reported in the scientific literature and confirmed by experts in the field.

In many cases raw materials have a twofold role as they can both contribute to and hinder the achievement of SDGs. For instance, raw materials production originates GHG emissions but their use in low-carbon energy technologies contributes to fighting climate change. Materials extraction and manufacturing can also pollute water bodies and create water stress but some materials are essential for environmental technologies and water treatment techniques. The role of raw materials for employment is also twofold: while they contribute to job creation and economic growth, workers can be exposed to negative conditions causing injuries and affecting health. While the EU supports fair labour markets and welfare systems (for instance, through the EU Pillar on Social Rights), working conditions can be particularly bad in developing countries and in the informal economy.

The analysis repeatedly stresses the potential of the forest sector to contribute to several SDGs, especially in relation to climate and biodiversity. This may suggest that the substitution of abiotic, energy-intensive materials such as concrete and steel in construction with wood in some cases can be beneficial from the point of view of sustainability. However, we also highlight the importance of sustainable forest management in order to not compromise the ecosystem's functioning and resilience, and therefore the delivery of goods and services.

The above-mentioned considerations suggest that analysing trade-offs and interlinkages between different SDGs and the various stages of the supply chain is crucial in promoting sustainable development and identifying win-win policy solutions.

The role of EU policies in enhancing positive contributions and mitigating adverse impacts is also discussed by using various examples. While the list of policies under consideration is not comprehensive, those presented here are of particular relevance for raw materials and for the circular economy, responsible production and consumption, fair working conditions, employment, etc. Some of them have a broad spectrum of objectives and aim at enhancing the potential of certain economic sectors (for instance, the Forest Strategy and the Raw Materials Initiative). Others have a more definite objective and intervene in specific area to mitigate or end adverse impacts (for instance, the Conflict Minerals Regulation).

Supporting and monitoring policies with science-based metrics is crucial for their effective implementation. In the case of raw materials, fostering the knowledge of SDGs would contribute to understanding the effective contribution of the raw materials sectors to sustainable development, and to identifying critical areas for action. In this respect, synergies can be found with the existing RM Scoreboard, which monitors the main challenges of raw materials production in the EU along the entire value chain.

The analysis of correspondences between indicators used in SDGs monitoring (UN and EUROSTAT) and in the Scoreboard shed light on indicators used in the Scoreboard that are also linked to the SDGs monitoring framework.

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List of figures

Figure 1 UN Sustainable Development Goals	3
Figure 2 RMIS 2.0 structure	6
Figure 3 Indicators and thematic clusters of the 2016 Raw Materials Scoreboard.	7
Figure 4 The forest products value chain (Source: WWF, 2012)	9
Figure 5 Aluminium supply chain (Source: RMIS)	10
Figure 6 Potential contributions of raw materials to the SDGs along the supply chain. Chapter 4 describes the links with each SDG and related indicators in detail	12

List of tables

Table 1 Examples of EU policies and potential contribution to SDGs	49
Table 2 List of climate-related EU regulation, relevant for raw materials sectors sustainability	56
Table 3 SDGs monitoring indicators (UN and EUROSTAT frameworks) that may be affected by raw materials activities (over their supply chain); related indicators in the Raw Materials Scoreboard.....	58

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