# Introduction

## Raw materials in modern society

Raw materials are more than ever **the lifeblood of the economy.** In the past few years, we have seen an important shift in perspective from 'raw materials are what the objects all around us are made of' to 'raw materials are key enablers of many **critical sectors of the economy,** such as the automotive, chemical and manufacturing industries' (see Figure 1). This shift highlights the need to look beyond what is happening today to take a forward-looking approach to address future challenges.

By 2050, there will be 9.7 billion people in the world. The annual increase in population is equivalent to a country the size of Germany. Projections indicate that resource use could double between 2010 and 2030. This would mostly be driven by increasing demand in developing regions, where up to 3 billion people will move from low to middle class levels of consumption by 2030. Supply of raw materials will have to match the demand. Consequently, by 2050, global metals extraction and biomass production will need to increase by at least 50 % and non-metallic minerals production by at least 100 %[1].

Urbanisation will be a key driver of industrial mineral and base metal consumption. More than 50 % of urban areas projected for 2050 have not yet been built. Whereas in 2015 around 54 % of the population lived in cities, in 2050 the share will increase to 66 %[2]. Urbanisation will also increase the competition for land, with possible negative impacts on access to raw materials.

**Decarbonisation** will also be a key driver in many raw material value chains. The EU is strongly committed to the Paris Agreement to decarbonise the economy and to meet the ambitious target of cutting greenhouse gas emissions to 80-95 % below 1990 levels by 2050. The International Energy Agency's '2°C Scenario' calls for an unprecedented energy transition to decarbonise the power sector by 2060[3]. This could be achieved particularly through the large deployment of renewable energy sources and through energy efficiency in general. EU industries, particularly energy-intensive industries that process raw materials, are also on their way to decarbonisation.

The European Commission adopted a renewed EU industrial policy strategy[4] in September 2017. This acknowledges that embracing technological breakthroughs while making the **transition to a low-carbon and circular economy by 2050** is a major challenge for EU industry. This transition relies on the EU's raw materials policy[5] to help ensure a secure, sustainable and affordable supply of raw materials for the EU's manufacturing industry. This will be supported through, for example, the circular economy action plan, fostering domestic production as part of the responsible sourcing mix, due diligence policy and the 'single market for green products' initiative.

The EU is also committed to implementing the 2030 Agenda for Sustainable Development, including the Sustainable Development Goals (SDGs), and to developing cooperation with partner countries in this respect. The raw materials sector, being global by definition, is and will be a key contributor to all 17 SDGs.

**Figure 1:** Raw Materials — Key enablers of all industrial value chains.

1 http://www.resourcepanel.org/reports/assessing-global-resource-use
2 https://population.un.org/wup/Publications/Files/WUP2018-KeyFacts.pdf
3 https://www.iea.org/publications/insights/insightpublications/Renewable_Energy_for_Industry.pdf
4 COM(2017) 479 final.
5 See: https://ec.europa.eu/growth/sectors/raw-materials/policy-strategy_en

## Global material use

The **last 4 decades** have witnessed a considerable **increase in global demand for raw materials**[6].

Figure 2 shows trends in global material extraction for biomass, fossil fuels, metallic and non-metallic minerals. It presents historical world estimates from the United Nations Environment Programme International Resource Panel (IRP-UNEP[7]) (as in the 2016 Scoreboard) and projected estimates based on scientific research[8].

Global material extraction has grown from 6 billion tonnes in 1900 to around 84 billion tonnes in 2015 (a 14-fold increase). The biggest increase was observed for non-metallic minerals with a 45-fold increase, followed by a 39-fold increase for metallic minerals, a 15-fold increase for fossil fuels and a more than 5-fold increase for biomass.

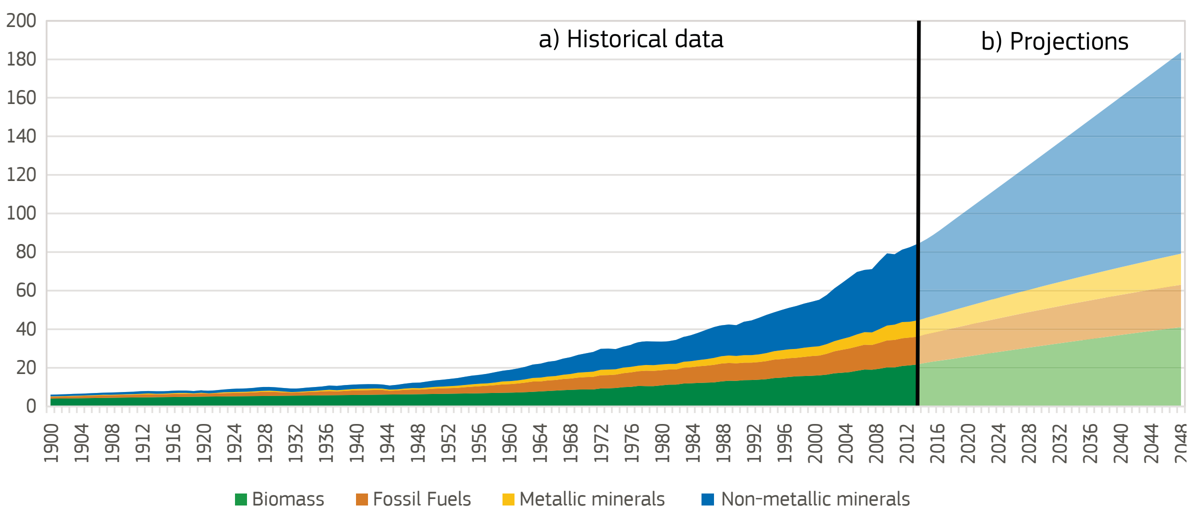
Following current trends, global resource extraction is projected to increase 119 % between 2015 and 2050, reaching an estimated value of 184 billion tonnes. This increase reflects a 28 % rise in the global population and a 72 % increase in the per capita resource use. According to these projections, biomass extraction will go up by 87 % between 2015 and 2050, fossil fuels extraction by 53 % and metallic minerals extraction by 96 %. Non-metallic minerals will continue to account for the highest increase of material extraction, with an estimated increase of 168 %. The global implementation of measures for resource efficiency, including development of circular economy, may contribute to attenuating this increasing trend, whereas low-carbon energy technologies essential to mitigate climate change will put an upward pressure on the demand for non-fuel raw materials.

Figure 3 presents the domestic material consumption[9] for different world regions. Since the 1970s, material consumption fluctuated between 6 and 8 billion tonnes in the EU-28, between 6 and 9 billion tonnes in North America and between 4 and 6 billion tonnes in the rest of the EU. Material consumption in Africa and Latin America and the Caribbean increased modestly but continuously (from 2 to 6 and 2 to 8 billion tonnes respectively) during the same period. In Oceania, material consumption rose at a very low rate from 0.4 in 1970 to 1.1 billion tonnes in 2017.

The comparison between materials consumption in Asia and the rest of the world is striking (see Figure 3b). In Asia it has increased exponentially in the last decades, surpassing the rest of the world back in 2006. This increase is mainly due to China's rapid industrialisation and urbanisation, which requires a considerable amount of raw materials such as steel and concrete.

Indeed, trends indicate that developing regions will drive up global resource demand in the coming decades.

Figure 2: Global material extraction by resource type: a) historical (world, 1900-2015) and b) projected data (world, 2015-2050)[10].




6 EEA, 2015, 'Global Megatrends: Intensified global competition for resources', State of the Environment Report, European Environment Agency.

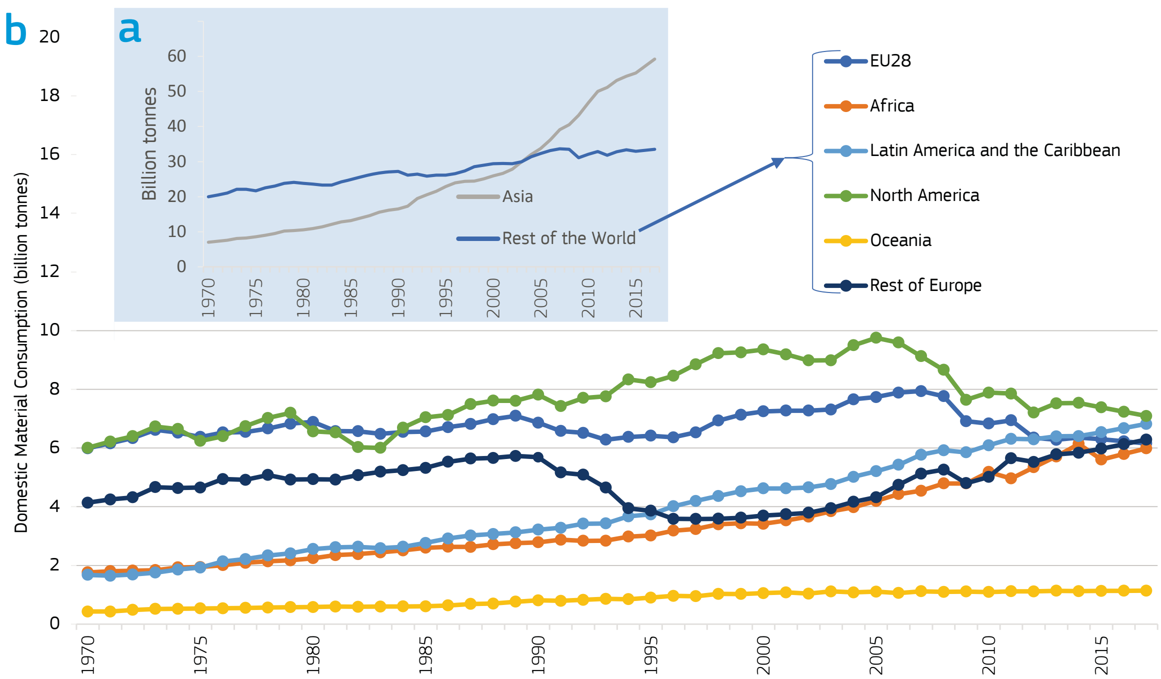
7 UNEP, 2017, 'Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel'. Ekins, P., Hughes, N., et al. This report presents the historical time series data and global aggregated projections (without separation by resource type).

8 Hatfield-Dodds et al., 2017, this paper presents the methodology followed to produce the projections showing the global results and disaggregated by resource type.

9 Domestic material consumption measures a region's domestic extraction, plus its imports of materials, minus its exports of materials

10 Source: EU's Joint Research Centre (JRC) elaboration, based on data from the United Nations environment programme, International Resource Panel, Material Flows and Resource Productivity Database (see https://environmentlive.unep.org/). For the projections Hatfield-Dodds et al., 2017, 'Assessing global resource use and greenhouse emissions to 2050, with resource efficiency and climate mitigation policies', Journal of Cleaner Production 144, 403-414.

Figure 3: Domestic material consumption per region (1970-2017): a) shows material consumption from Asia and the rest of the world; b) shows material consumption from the EU-28, Africa, other European countries, Oceania, Latin America and the Caribbean, and North America[11].




## Measures to secure supply of raw materials to the EU economy

In view of the importance of raw materials to the EU economy, and the need to ensure a secure supply, the EU adopted the **Raw Materials Initiative (RMI)** in 2008 [12]. For an example, see box 1: '**Raw materials used in low-carbon mobility'.**

The RMI is based on **three pillars:**

- Fair and sustainable supply from global markets;
- sustainable supply of raw materials within the EU;
- resource efficiency and supply of secondary raw materials.

2018 marks the 10th Anniversary of the EU Raw Materials Initiative and it is, in this particular moment, important to look at was has been achieved so far.

The launch of the **European Innovation Partnership on Raw Materials (EIP-RM)** in 2012 has been one of the main milestones. This partnership marked a new approach for streamlining efforts and accelerating the market take-up of innovations that address the EU's main challenges. The EIP-RM addresses the entire raw materials value chain, from the extraction (exploration, mining, quarrying and wood harvesting) to the processing of raw materials to make intermediate materials as well as recycling. It covers all non-energy, non-agricultural raw materials, i.e. metals, minerals and biotic materials:

- **Metals** include iron, aluminium, copper, zinc and nickel, which all have a wide range of applications. Also included are specialty metals such as indium, cobalt, tellurium, palladium, ruthenium and magnesium, which are increasingly used in high-tech applications.
- **Minerals** include construction minerals such as sand, gravel and gypsum; and industrial minerals such as silica, which is used for example in paints and plastics, glass, ceramics and filtration.
- **Biotic materials** include natural rubber and wood that is not used for its energetic value.

Another key milestone was the Circular Economy Action Plan[13]. In the EU, recycling is a key component of the Action Plan and of the 3rd Pillar of the RMI. It provides an important source of secondary raw materials. Recycling has great potential to improve Europe's resource efficiency, as argued in the third pillar of the **Raw Materials Initiative.** The market for recycled or 'secondary' raw materials can be boosted through various initiatives, including the improvement of waste management practices, facilitating cross-border circulation and ensuring the quality of secondary raw materials through e.g. standards. Improving the availability of data on secondary raw materials is also important according to the Circular Economy action plan. (see text box: **Data on raw materials in the urban mine**)

11 Source: JRC elaboration, based on data collected from United Nations Environment Programme, Environment live platform (see https://environmentlive.unep.org/).

12 COM(2008)699 final. 'The Raw Materials Initiative — meeting our critical needs for growth and jobs in Europe'..

13 COM(2015) 614 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Closing the loop — An EU action plan for the Circular Economy'.


## Box 1. Raw materials used in low-carbon mobility

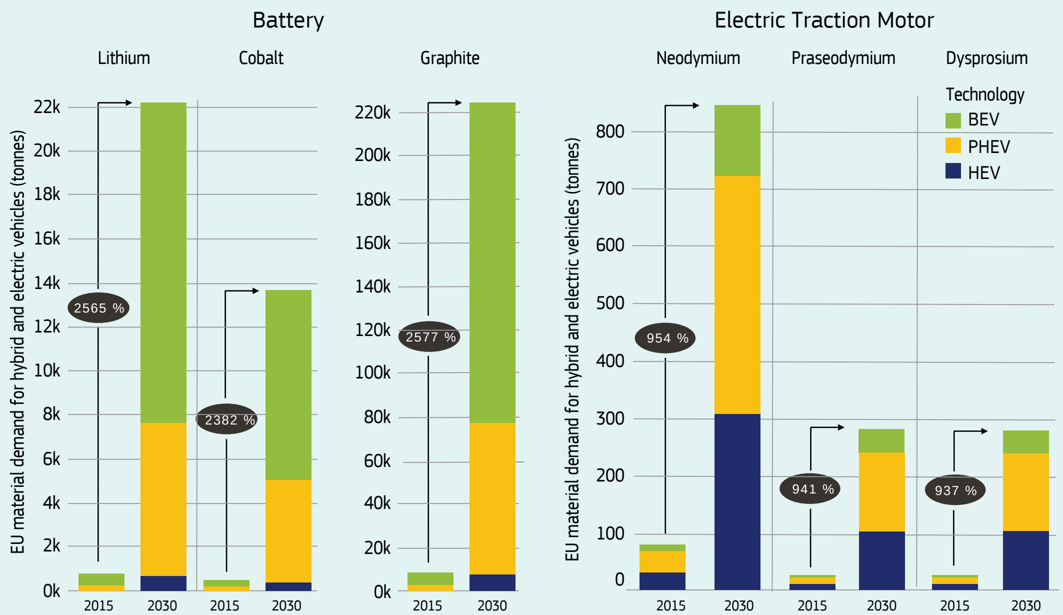
Electro-mobility is essential for a broader shift towards the type of modern, low-carbon and circular economy needed for Europe to stay competitive and able to cater to the mobility needs of current and future generations in a sustainable and inclusive manner. By increasing access to affordable, innovative and cleaner forms of mobility[14,15], electro-mobility can help reduce Europe's greenhouse gas emissions and increase our quality of life through cleaner air in our cities. As a key driver of low-carbon mobility, electro-mobility can allow the European automotive industry to innovate and become more competitive. This would create jobs while restoring consumer confidence[16].

In 2015, approximately 150 000 electric vehicles were sold in the EU. This represented around 30 % of the global market. By contrast, the EU represents around 20 % of the market for traditional vehicles. Of the electric vehicles sold, 60 % were plug-in electric vehicles (PHEV) and the rest were battery electric vehicles (BEV). In addition, about 192 000 hybrid electric vehicles (HEV) were sold in the EU in 2015[17]. According to the European roadmap for electrification of road transport, over 5 million electric vehicles should be on EU roads by 2020, increasing to 15 million by 2025. To accomplish the emission reduction goals, even more ambitious targets are sometimes put forward, e.g. as many as 8-9 million electric vehicles on the road by 2020[18], with further increases in electric vehicles sales beyond 2025[19].

14 COM(2016)501 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'A European Strategy for Low-Emission Mobility' {SWD(2016) 244 final}.
15 COM(2017)675 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Delivering on low-emission mobility. A European Union that protects the planet, empowers its consumers and defends its industry and workers'.
16 COM(2017) 479 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Investing in a smart, innovative and sustainable Industry. A renewed EU Industrial Policy Strategy'.
17 Blagoeva, D. T., Aves Dias, P., Marmier, A. and Pavel, C. C., 2016, 'Assessment of potential bottlenecks along the materials supply chain for the future deployment of low-carbon energy and transport technologies in the EU. Wind power, photovoltaic and electric vehicles technologies, time frame: 2015-2030', JRC-EC (Joint Research Centre (European Commission)), available at https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/assessment-potential-bottlenecks-along-materials-supply-chain-future-deployment-low-carbon, doi:10.2790/08169.
18 COM(2013) 17 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Clean Power for Transport: A European alternative fuels strategy' {SWD(2013) 4 final}.
19 Blagoeva, D. T., Aves Dias, P., Marmier, A. and Pavel, C. C., 2016.

Higher quantities of critical and non-critical raw materials will be necessary to sustain this future uptake of electro-mobility. These raw materials would, for example, be integrated into electric traction motors (e.g. neodymium, praseodymium, dysprosium), into batteries (e.g. cobalt, graphite, lithium) and even into lightweight body structures (e.g. niobium). In the transition period, platinum and palladium will continue to play a major role in auto-catalysts. Figure 4 shows the current (2015) and projected demand of several of these raw materials for 2030 for hybrid and electric vehicles segments.

**Figure 4:** Demand forecast in the EU for selected critical raw materials for the hybrid and electric vehicles segments (BEV: battery electric vehicle; PHEV: plug-in hybrid electric vehicle; HEV: hybrid electric vehicles)[20].




Securing sustainable and undistorted access to these raw materials is very important to meet the EU's ambition to become competitive in the global battery sector by establishing a full value chain in Europe, with large-scale battery cell production and the circular economy at the core[21]. Europe has major opportunities along this battery value chain to capture sizeable markets and boost jobs, growth and investment[22,23]. Closing the loop by using waste as resources is an important strand of the circular economy action plan[24]. In this respect, the EU recycling industry could become a relevant supplier of secondary raw materials for the battery value chain in Europe[25]. These issues are set out in the EU battery alliance action plan adopted in May 2018[26] and the report on raw materials for battery applications[27].

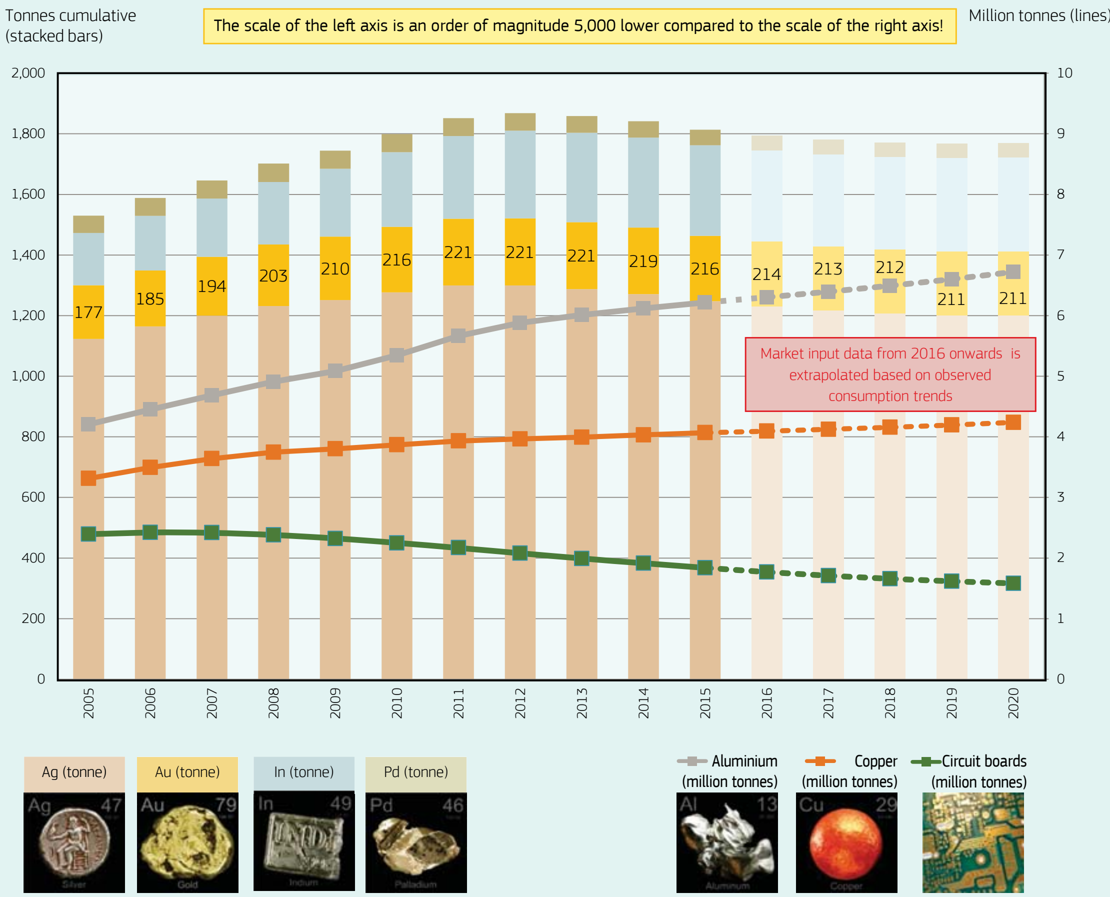
20 Source: JRC, based on Mathieux, F., et al., 2017, 'Critical Raw Materials and the Circular Economy — Background report'. EUR 28832 EN, Publications Office of the European Union, Luxembourg.
21 Statement by Vice-President for Energy Union Maroš Šefčovic following the high-level meeting on battery development and production in Europe, 11 October 2017, Brussels, http://europa.eu/rapid/press-release_STATEMENT-17-3861_en.htm.
22 Lebedeva, N., Di Persio, F., Boon-Brett, L., 'Lithium ion battery value chain and related opportunities for Europe', EUR 28534 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-66948-4, doi:10.2760/6060, JRC105010.
23 Steen M., Lebedeva N., Di Persio F., Boon-Brett L., 'EU Competitiveness in Advanced Li-ion Batteries for E-Mobility and Stationary Storage Applications – Opportunities and Actions', European Commission, Petten, 2017, JRC108043.
24 COM(2015) 614 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Closing the loop — An EU action plan for the Circular Economy'.
25 Mathieux, F., Ardente, F., Bobba, S., Nuss, P., Blengini, G., Alves Dias, P., Blagoeva, D., Torres De Matos, C., Wittmer, D., Pavel, C., Hamor, T., Saveyn, H., Gawlik, B., Orveillon, G., Huygens, D., Garbarino, E., Tzimas, E., Bouraoui, F. and Solar, S., 'Critical Raw Materials and the Circular Economy — Background report'. JRC Science-for-policy report, EUR 28832 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-74283-5 (print); 978-92-79-74282-8 (pdf), doi:10.2760/977855 (print), 10.2760/378123 (online), JRC108710.
26 COM(2018) 293 final. Annex to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: 'Europe on the Move - Sustainable Mobility for Europe: safe, connected and clean.
27 SWD(2018) 245 final. 'Report on Raw Materials for Battery Applications'.

## Box 2. Data on raw materials in the urban mine

By the end of 2017, the H2020 ProSUM project[28] had developed an EU-wide open-access portal which covers structured secondary raw materials data of the 'urban mine[29]' for: (i) electrical and electronic equipment (EEE); (ii) vehicles and (iii) batteries (BATT[30]). The portal contains data for: (i) market inputs; (ii) in-use and hibernated stocks present in households, businesses and public spaces. Composition data for associated products and their (potential) waste flows are available for the EU plus Switzerland and Norway.

The platform shows a considerable and growing urban mine. For example, for EEE, the average person owns: (i) close to 44 EEE products (excluding energy saving lamps and light fittings); (ii) approximately half a vehicle; and (iii) around 40 batteries. This represents between 700 to 1100 kg of valuable materials per person.

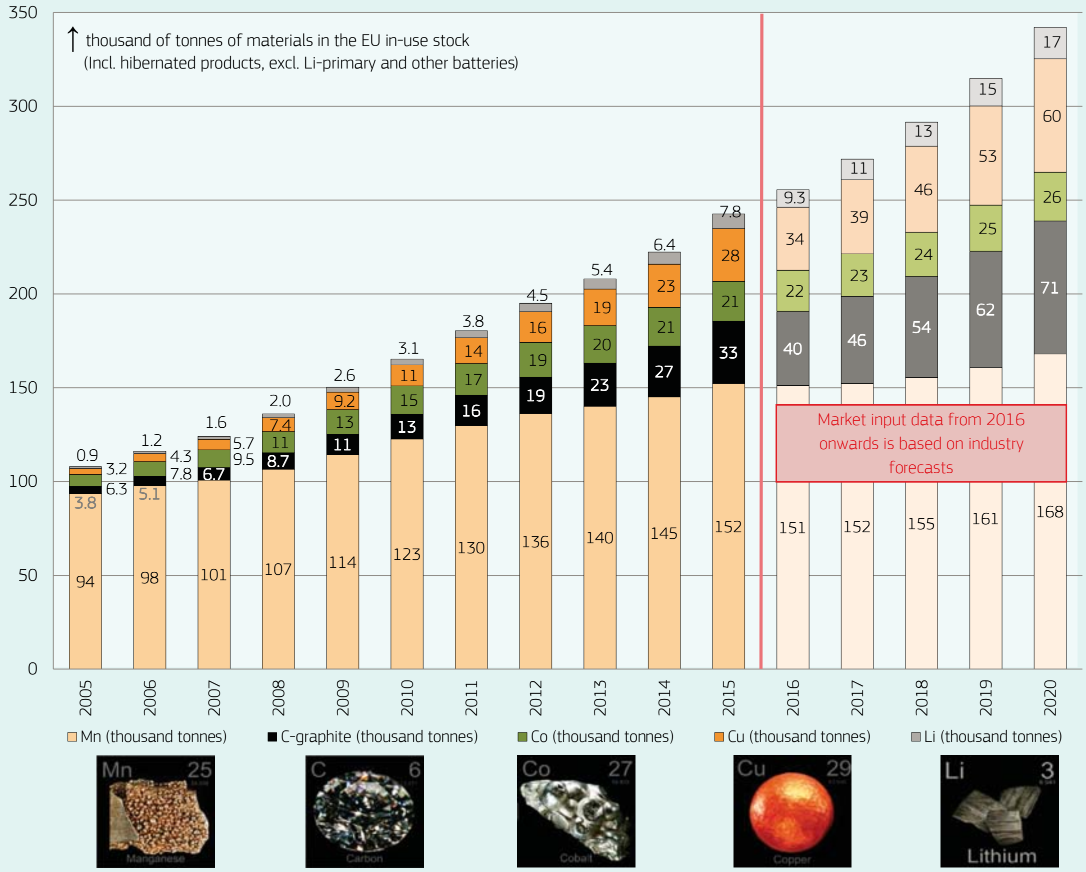
**Figure 5:** The EU urban mine development from 2005 to 2020 for selected elements, materials and components in electric and electronic equipment[31].




There is a growing stock of products, as well as a rapidly changing urban mine in terms of composition and thus presence of raw materials. In Figure 5, this is projected for EEE for the years 2005 to 2020. The left axis of Figure 5 shows precious metals and indium (stacked bars in tonnes), the right axis illustrates the base metals aluminium and copper and circuit boards as components (in million tonnes).

28 http://www.prosumproject.eu/ [accessed on 5/4/2018].
29 The 'urban mine' represents the compounds and elements from any kind of anthropogenic stocks, including buildings, infrastructure, industries and products (in and out of use), Definition adapted from: Cossu, R., Williams, I.D., Urban mining: Concepts, terminology, challenges. Waste Management 45, 2015 1-3, https://doi.org/10.1016/j.wasman.2015.9.040
30 http://www.urbanmineplatform.eu/homepage [accessed on 5/4/2018].
31 Source: J. Huisman, P. Leroy, F. Tetre, M. Ljunggren Söderman, P. Chancerel, D. Cassard, A. Løvik, P. Wäger, D. Kushnir, V.S. Rotter, P. Mählitz, L. Herreras, J. Emmerich, A. Hallberg, H. Habib, M. Wagner, S. Downes, 'Prospecting Secondary Raw Materials in the Urban Mine and mining wastes (ProSUM) — Final Report', ISBN:978-92-808-9060-0;978-92-808-9061-7, 2017/12/21.

Figure 6: The EU urban mine development from 2005 to 2020 for selected elements in batteries[32].




There are new EEE products entering the market and there is a significant rise in the number of products. However, due to rapid product miniaturisation in recent years there is at the same time less weight consumed per person. Products tend to be lighter, smaller, smarter, more multi-functional as well as more complex in their composition. This affects the raw materials consumption, stockpiling, and ultimately waste generation. Figure 5 shows, for example, that: (i) the total stock of printed circuit board is decreasing; (ii) the total stock of gold and copper is stabilising; and (iii) aluminium volumes are increasing.

The ProSUM project also classifies and quantifies batteries into three main categories according to main chemistries and applications: (i) primary batteries (zinc- and lithium-based); (ii) rechargeable batteries (lithium, lead, nickel metal hydride and nickel-cadmium) and; (iii) other batteries. Lithium battery use is clearly growing due to electric mobility and portable applications. However, there have been relatively large fluctuations. For example, lithium cobalt dioxide batteries are quickly losing market share to lithium manganese oxide and lithium nickel manganese cobalt oxide batteries. This affects total raw materials consumption over time.

Figure 6 shows that the total stock of secondary lithium and natural graphite will grow roughly 500 % between 2010 and 2020, and cobalt roughly 200 %. Looking forward: With increasing demand as projected, the stock to demand ratio in 2020 will be between 300% and 600%, dependent on the element. This illustrates the magnitude of the future recycling potential of the urban mine when collection amounts, recovery technologies and ultimately recycling rates improve. This also highlights the importance of access to resources in order to increase the available stock for recycling.

32 Source: http://www.urbanmineplatform.eu/homepage [accessed on 5/4/2018].

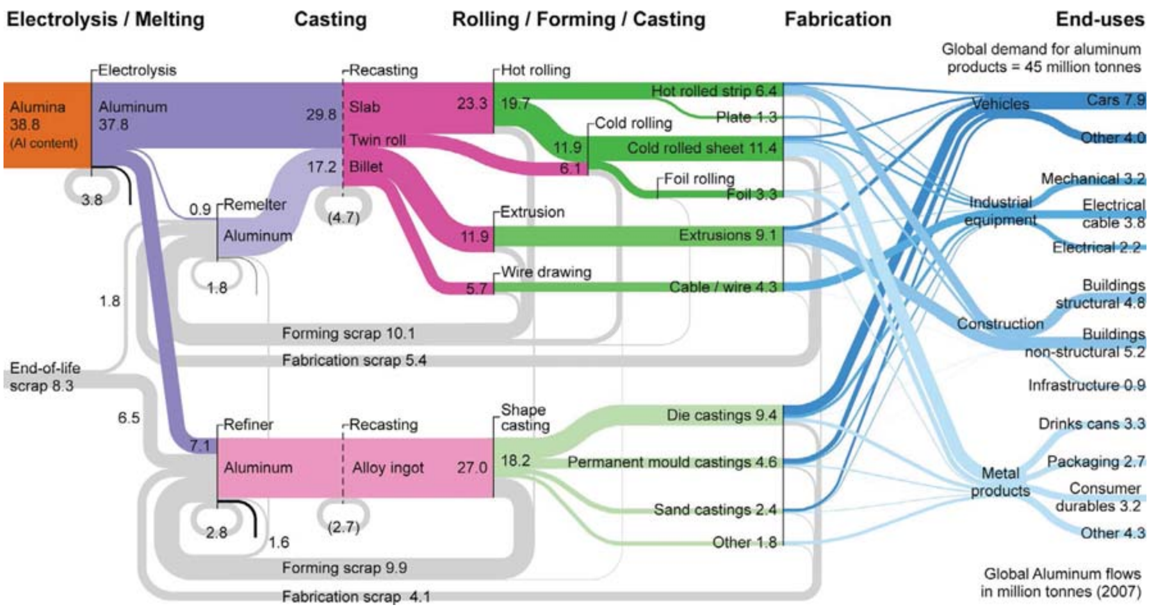
## A sector characterised by complex value chains

**Raw materials are at the origin of all value chains.** As an example, **Figure 7** presents the flow of aluminium along the global value chain from alumina to end-use goods. It shows that **material flows along the value chain are very complex and** illustrates the **interdependencies between the different stages of the value chain.** In the case of alumina, once it has been obtained and processed from bauxite, it is melted and refined into aluminium metal. This is then rolled or cast into various semi-finished products.

Aluminium is widely used in the global economy in diverse industries such as automobile manufacturing, construction of buildings and infrastructure, packaging and industrial equipment. Figure 7 shows that aluminium is shared roughly equally between these industries.

The physical trade networks of aluminium for different life-cycle stages also demonstrate the complexity of global value chains (see Box 3).

Figure 7: Global material flows across the value chain for aluminium (world, 2007)[33].




### Box 3: Trade networks of aluminium's value chain

Figure 8 presents trade flows of aluminium-containing products at different stages in their life cycles. It highlights that the EU is highly interconnected and dependent on the imports and exports of materials. Arrows reflect the bilateral trade flows between countries (nodes). Country node size indicates the overall aluminium turnover (i.e. the sum of imports and exports) of each country. EU countries are shown in green, and the links between countries are coloured by the source node.

Globally, the bulk of bauxite/alumina and aluminium are traded by only a few countries, e.g. China, Indonesia, Australia, Canada, USA and Norway. Europe's involvement in trade at the early stages of the aluminium supply chain (i.e. mining and aluminium metal production) is relatively small.

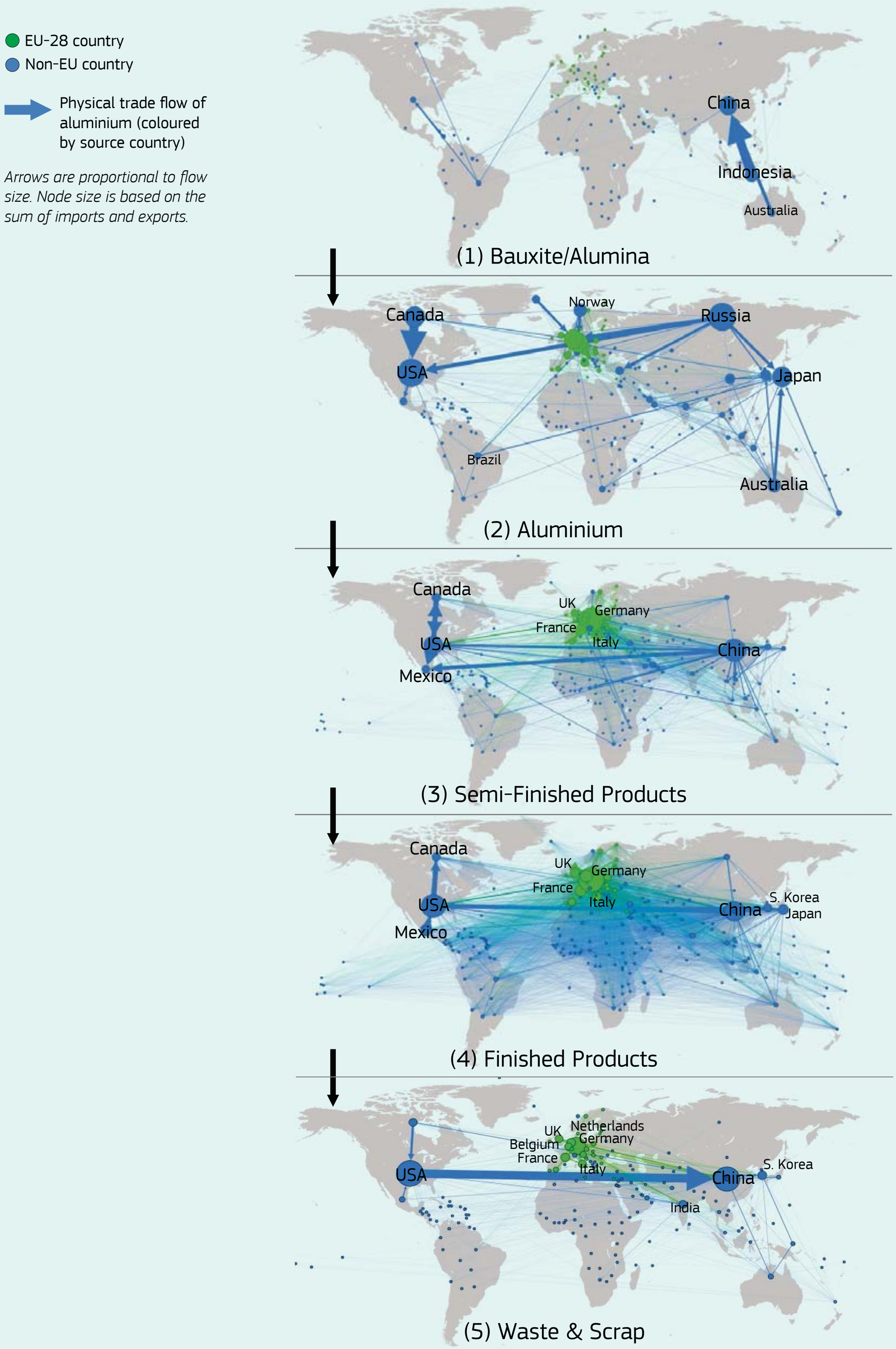
Moving down the value chain to semi-finished and final products, Europe has an increasing role in the bilateral trade of aluminium. While the EU imports the majority of aluminium metal, it acts both as an importer and exporter of aluminium-containing products during the subsequent value chain stages.

The trade networks increase in density when moving down the value chain (i.e. towards the manufacturing stages of semi-finished and finished products). This reiterates that the majority of countries play a role in the trade of aluminium-containing semi-finished and finished products. This is largely due to aluminium's widespread use in modern economies.

33 Reprinted with permission from Cullen, J.M. and J.M. Allwood, 2013. 'Mapping the Global Flow of Aluminum: From Liquid Aluminum to End-Use Goods'. Environmental Science & Technology 47(7) (pp. 3057-3064). Copyright 2013 American Chemical Society.

The trade of waste and scrap materials is dominated by China, South Korea, USA, India and several EU countries. The EU trades aluminium waste and scrap internally, but also exports to countries outside of the EU.

Figure 8: Global physical trade networks of aluminium-containing products at different life cycle stages (world, 2012).



## A sector paying great attention to sustainable and responsible sourcing of raw materials

Government and industry are increasingly motivated to source raw materials responsibly and sustainably. This is fundamental in the context of the sustainable development goals, as highlighted in Box 4.

Responsible or sustainable sourcing takes environmental and social aspects into consideration when assessing and managing supply chains. The respect and protection of the interests of all stakeholders, human health and the environment as well as the contribution to the local sustainable development are the core principles of responsible mining[34]. In the case of minerals supply chains, the OECD's guidance[35] flags human rights abuses, conflicts, bribery and corruption as key risks that should be assessed through due diligence processes.

Many European companies integrate the concept of responsible and sustainable sourcing into their corporate social responsibility (CSR) strategies, as reflected in the increasing sustainability reporting practice (Indicator 24). Many of them work together on platforms such as the European platform on responsible minerals (EPRM) and the 'Drive Sustainability' group to create synergies. Greater consumer awareness of sustainable consumption is one incentive for this. Companies equally increasingly want to avoid use of raw materials in their supply chains if they are linked with human rights violations or harmful environments. Moreover, rules are increasingly being strengthened to ensure greater transparency and supply chain due diligence, for example with the Conflict Minerals Regulation[36], the Timber Regulation[37], the Forest law enforcement, governance and trade (FLEGT) Regulation[38] and Non-Financial Transparency Directive[39].


### Box 4: Raw materials and Sustainable Development Goals

In September 2015, the UN adopted 17 Sustainable Development Goals (SDGs) to end poverty, protect the planet, and ensure prosperity for all[40].

Although the UN SDGs framework does not include an explicit goal on raw materials, the raw materials sector contributes directly or indirectly to all goals. In November 2016, three international organisations published a study mapping the relationships between mining and the SDGs by using examples of good practice in the industry[41].

Based on a literature review and expert opinion, Figure 9 illustrates potential contributions of raw materials supply chains to different SDGs. This figure also highlights examples of European policies that enhance the positive contribution of the raw materials sectors to the SDGs, or prevent/mitigate their potential negative impacts.

34 Arvanitidis N, Boon J, Nurmi P, Di Capua G. 'White Paper on Responsible Mining', 2017.
35 Organisation for Economic Cooperation and Development (OECD). 'Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas' [Internet]. 2013. Available from: http://dx.doi.org/10.1787/9789264185050-en.
36 European Union. Regulation (EU) 2017/821 of the European Parliament and of the Council of 17 May 2017 laying down supply chain due diligence obligations for Union importers of tin, tantalum and tungsten, their ores, and gold originating from conflict-affected and high-risk areas. 2017.
37 European Union. Regulation (EU) 2010/995 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. 2010.
38 Council Regulation (EC) No 2173/2005 of 20 December 2005 on the establishment of a FLEGT licensing scheme for imports of timber into the European Community.
39 Communication from the Commission C/2017/4234 — Guidelines on non-financial reporting (methodology for reporting non-financial information).
40 UN General Assembly. Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations. 2015.
41 Columbia Centre for Sustainable Investment, UN Development Programme, UN Sustainable Development Solutions Network, World Economic Forum. Mapping Mining to the Sustainable Development Goals: An Atlas [Internet]. Cologny/Geneva Switzerland; 2016 [cited 2016 Sep 21]. Available from: http://unsdsn.org/wp-content/uploads/2016/08/Mapping_Mining_SDGs_An_Atlas.pdf.

Figure 9: Raw materials potential contributions to the SDGs along the value chain. The lighter central area illustrates more directs links with the SDGs. The box on the bottom shows examples of EU policies contributing to the SDGs[42].


The annual monitoring of the EIP-RM[43] equally highlights the SDGs to which the raw materials sectors predominantly contribute through EIP-RM commitments[44]. In the 2016 monitoring, the goals most frequently addressed were: goals 12 (sustainable production and consumption); 8 (decent work and economic growth); and 9 (industry innovation and infrastructure).

It should be noted that both positive and negative outcomes for the same goal are possible. For example, for goal 13, greenhouse gas emissions from the mining and materials manufacturing sectors can hinder progress on climate action. However, the mining industry provides the materials required for the transition to a low-carbon economy, e.g. rare earths, lithium and cobalt used in wind energy and electric vehicles (see Box 1). The forestry sector also positively contributes to goal 13, having a major role in climate change mitigation.

42 Source: Mancini L, Vidal Legaz B, et al., 2018, 'Mapping the role of raw materials in Sustainable Development Goals', JRC Science-for-policy report JRC 112892. See also 'Sustainable Development Goals and the raw materials sectors' in the Raw Materials Information System, http://rmis.jrc.ec.europa.eu/?page=sdg-18f0ad.

43 EC — European Commission. 'European Innovation Partnership on Raw Materials: Annual Monitoring Report 2016'. EUR 28839. Luxembourg: Publications Office of the European Union; 2017.

44 Commitments are joint undertakings by several partners who commit themselves to carrying out activities that contribute to achieving actions and targets of the EIP. https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/eip-raw-materials-monitoring-and-evaluation-scheme.

### Box 5: The EIP's objectives

[From the EIP's Strategic Implementation Plan Part I, Section 2.1 p. 13]

'The overall objective of the EIP on Raw Materials is to contribute to the 2020 objectives of the EU's Industrial Policy — increasing the share of industry to 20 % of GDP — and the objectives of the flagship initiatives 'Innovation Union' and 'Resource Efficient Europe', by ensuring the sustainable supply of raw materials to the European economy while increasing benefits for society as a whole.

This will be achieved by:

- Reducing import dependency and promoting production and exports by improving supply conditions from EU, diversifying raw materials sourcing and improving resource efficiency (including recycling) and finding alternative raw materials.
- Putting Europe at the forefront in raw materials sectors and mitigating the related negative environmental, social and health impacts.'

## The Raw Materials Scoreboard

The Raw Materials Scoreboard ('the Scoreboard') is an initiative launched by the EIP-RM[45]. It is part of the EIP's monitoring and evaluation scheme and is published **every 2 years**. The Scoreboards purpose is to provide **quantitative data on the issues referred to in the EIP's objectives.** However, it is not intended **to measure the EIP's achievements,** which are assessed in the EIP-RM's Strategic Evaluation Reports.

The Scoreboard covers all aspects of the EIP-RM's **general objectives,** the raw materials policy context and other criteria related to the **competitiveness** of the EU raw materials sector. As a result, it increases the **visibility** of the challenges related to raw materials and provides relevant and reliable **information that can be used in policymaking in a variety of areas.** The Scoreboard helps, for example, **to monitor progress towards a circular economy**, a crucial issue for which the European Commission adopted an ambitious action plan in 2015[46] and a new set of measures in 2018[47].

## The search for suitable data …

An **ad hoc working group** was set up to help select the indicators to be included in the Scoreboard. The group, which was comprised of almost 30 experts representing a balanced range of interests, considered close to 70 different indicators. Before being selected, indicators were evaluated against the 'RACER' criteria[48], which set out that each one is:

- **R**elevant
- **A**ccepted (by all stakeholders)
- **C**redible (i.e. independent from interest groups)
- **E**asy (to compute and to understand)
- **R**obust.

During the selection process, it became clear that **the data and indicators available are subject to certain limitations,** especially in the case of raw materials.

**By definition, all indicators are imperfect proxies of complex phenomena.** For example, the level of reporting on sustainability in a particular sector is measured here by the number of companies adhering to the Global Reporting Initiative, while the level of innovation is assessed here using data on the number of patent applications and on the level of corporate R&D investment.

**Very few data sets can be perfectly disaggregated in such a way as to provide answers to specific policy questions.** For example, very few data sets can be disaggregated to isolate non-energy, non-agricultural raw materials. Similarly, very few data sets can give a complete picture of the entire secondary raw materials sector (i.e. beyond waste collection and treatment), and not all data sets make the distinction between energy and non-energy extraction.

**Most data sets suffer from a certain degree of imperfection and incompleteness.** Almost all data sets used for the Scoreboard have certain gaps (e.g. data for certain countries are not available), suffer from lack of harmonisation and/or are produced with significant time lags.

45 European Innovation Partnership on Raw Materials, 2014, 'Monitoring and evaluation scheme'.
46 European Commission, 2015, 'Closing the loop — An EU Action Plan for the Circular Economy', COM(2015) 614.
47 '2018 Circular Economy Package', http://ec.europa.eu/environment/circular-economy/index_en.htm.
48 European Commission, 2009, Impact Assessment Guidelines.

During the discussions with the ad hoc working group it was agreed that **these limitations are unavoidable** (even commonly used indicators such as GDP are affected by these same issues), but that **they can be partly overcome** as follows:

**By compiling a set of complementary indicators in different clusters,** each with their strengths and weaknesses. For example, the issue of 'framework conditions' is covered by a set of complementary indicators on public acceptance, mining and metals production in the EU, and exploration activities, which together provide a more complete picture.

**By explaining** the data limitations clearly and providing the 'story behind the data' in the accompanying text.

It was also found that **for some issues there are no data available that sufficiently meet the RACER criteria.** Where this relates to **important environmental or social impacts** it was decided to either provide a **qualitative description** of the issue or to use the best available data in the Scoreboard, with a view to replacing them with an indicator as and when suitable data become available. Accordingly, several Commission services are working on developing new or improving existing data, which may be included in future Raw Materials Scoreboards.

## The Raw Materials Scoreboard at a glance…

The Scoreboard contains 26 indicators, which are grouped into five thematic clusters:

- Raw materials in the global context
- Competitiveness and innovation
- Framework conditions for mining
- Circular economy and recycling
- Environmental and social sustainability.

Figure 10 provides an overview of how the indicators are linked to the EU economy.

Figure 10: The Raw Materials Scoreboard at a glance.