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Circular materials use: the need for change

Key takeaways

- "Business as usual" for materials production and use is reaching its limit, implying major sectoral change ahead.
- We consider possible new approaches for production of aluminium, steel, cement and plastic along with related future investment opportunities.
- Emerging market firms are increasingly important in the materials sector. Their sustainability measures are improving but a number of market risks remain.

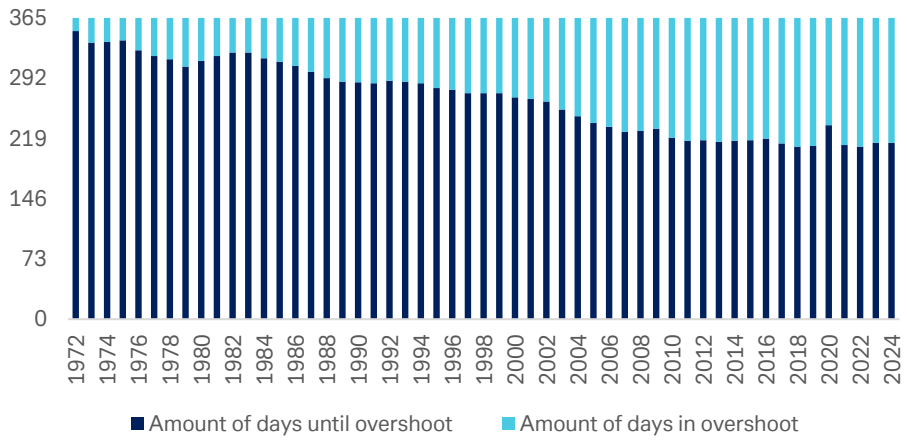
01 Earth Overshoot Day: setting the scene

This develops our report from August 2023 (CIO Special – Land resources: Conservation and regeneration) where we discussed the environmental consequences of excess use of resources and the business and investment opportunities potentially associated with adopting a circular economic model. This new report focuses on cement, steel, aluminium and plastic. We covered sustainable food systems in a separate report in March 2024 (CIO Special – LTIT: Sustainable Food Systems – favourable entry points ahead?).

Earth Overshoot Day (which this year falls on August 1) marks the date when humanity's consumption of ecological resources and services in a given year exceeds what Earth can regenerate in that year.[1] With 6 out of 9 planetary boundaries now being crossed, the relevance of this theme has arguably even increased in comparison to last year.[2] Debate about how to calculate Earth Overshoot Day [3] [4] should not distract from the fact that earth's capacities are limited and this will have implications for our current economic model. [5]

This report looks the issue from an investor's perspective, as "business-as-usual" reaches its limit. We need to identify which economic activities or sectors will be most affected by the restrictions imposed by the planetary boundaries, how these sectors can respond, and what investment opportunities are likely to arise in this new environment.

Figure 1: Earth Overshoot Day



Source: Earth Overshoot Day, Global Footprint Network, Deutsche Bank AG. July 2024.

Please use the QR code to access a selection of other Deutsche Bank CIO reports (www.deutschewealth.com).

02 Production and consumption outlook

For this analysis, we look first at the four categories set by the UN Environmental Program (UNEP): biomass, fossil fuels, metals and non-metallic minerals. Adding these four categories up, total material extraction more than tripled from 30.9bn tonnes in 1970 to 95.1bn tonnes in 2020 and is expected to reach 106.6bn tonnes in 2024 (Figure 2).

We cover fossil fuels within our CIO Special – Energy transition: investment perspective and biomass in our CIO Special – LTIT: Sustainable Food Systems – favourable entry points ahead?. In this report, we therefore focus on metals, non-metallic minerals and plastics.

One recent trend has been for the percentage share of non-metallic minerals in total global material extraction to rise (from 31% in 1970 to an expected 49.5% in 2024). This is because of rising levels of industrialization, creating higher demand for minerals-based materials and energy systems. UNEP projections clearly show that non-metallic minerals will be by far the most used materials in 2060 – regardless of the projection scenario. [6]

Metals are defined by UNEP as elements or mixtures of elements that are used for engineering, such as aluminium and steel. (A distinction is made with precious metals such as gold, palladium or silver, which are not covered by this report.)

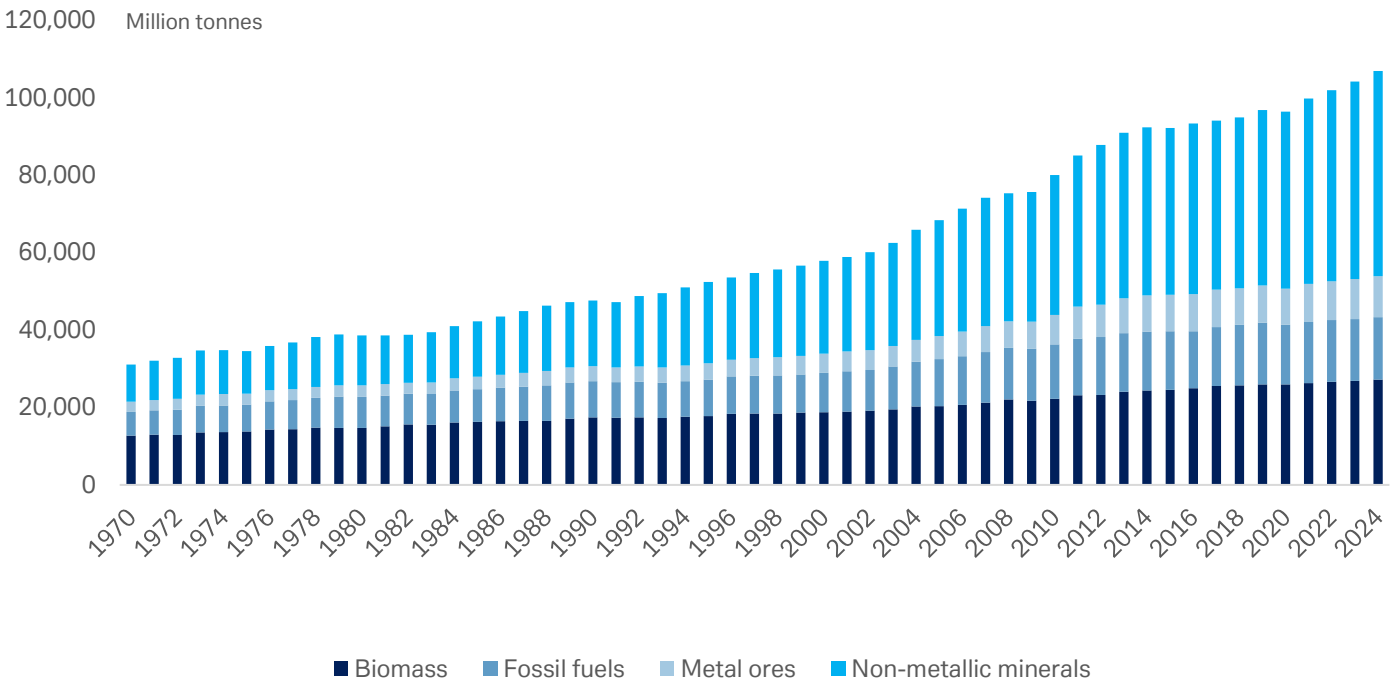
Aluminium: Alumina is chemically extracted from bauxite ore and then smelted into pure aluminium metal. Secondary production refers to recycling existing aluminium into a pure metal.[7]

In total, the aluminium industry generates around 2% of global anthropogenic (i.e., human-caused) emissions.[8] Furthermore, with around 15 tonnes of CO_2e per tonne of metal produced, aluminium has a **CO_2 intensity** ten times higher than steel (1.4 tonnes of CO_2 per tonne).[9] [10]

Within the production process, smelting alumina into aluminium is by far the most energy-intensive part.[11] More than 80% of emissions associated with aluminium production come from electricity use.[12] Therefore, decarbonizing electricity supply will be key to reducing emissions from the sector.

Aluminium is considered infinitely recyclable, and it is estimated that about 75% of the aluminium ever produced is still in use.[13] In addition, the secondary production process of aluminium accounts for only about 5% of the emissions of primary production.[14] However, demand growth projections discussed below suggest recycling alone will not be enough to cover future demand.

Figure 2: Global material extraction, four main material categories, 1970 – 2024, million tonnes.



Source: UNEP Global Resources Outlook 2024, Deutsche Bank AG. July 2024.

Between 2015 and 2020, global consumption of aluminium semi-finished products increased by ~8% to 86mn tonnes. Most aluminium is now consumed in construction (~25% of total aluminium semi-finished products consumption), followed by transport (~23%) and electrical (~12%). While total consumption is expected to grow ~40% from 2020 (~86mn tonnes) to 2030 (~120mn tonnes), most of this increase in demand is expected to come from transport (Figure 3 below).

China accounted for more than 50% of semi-finished aluminium products in 2020. Other regions such as Europe and North America played a smaller role, accounting for 15% and 13% of global consumption respectively. China's dominant position here can be contributed to its efforts to decarbonise its economy, boosting demand for metals (such as aluminium) which are key to renewable energy-related manufacturing (e.g., for EVs or solar panels).[15] China is expected to account for 40% of projected demand growth, with Asia as the key driver.[16]

Aluminium is also important because it is an input to several technologies that are critical to the **energy transition**.[17] Aluminium is especially critical for solar which will likely meet an increasing share of global energy demand.[18] [19] As technology now stands, aluminium accounts for over 85% of most solar PV components today. The World Bank estimates that demand for aluminium will more than double in a 2-degree climate scenario.[20]

Steel: This is responsible for 7% – 9% of global CO2 emissions. Around 71% of global steel is made using a **BF-BOF (Blast Furnace – Basic Oxygen Furnace)** method, while **EAF (Electric Arc Furnace)** accounts for ~29%.[21] **BF-BOF** relies on iron ore and coal for production, whereas **EAF** makes use of scrap steel and electricity, using only around 1/8th of the energy compared to BF-BOF route.[23] As a result, the BF-BOF method has a much higher CO2 emission intensity.[21]

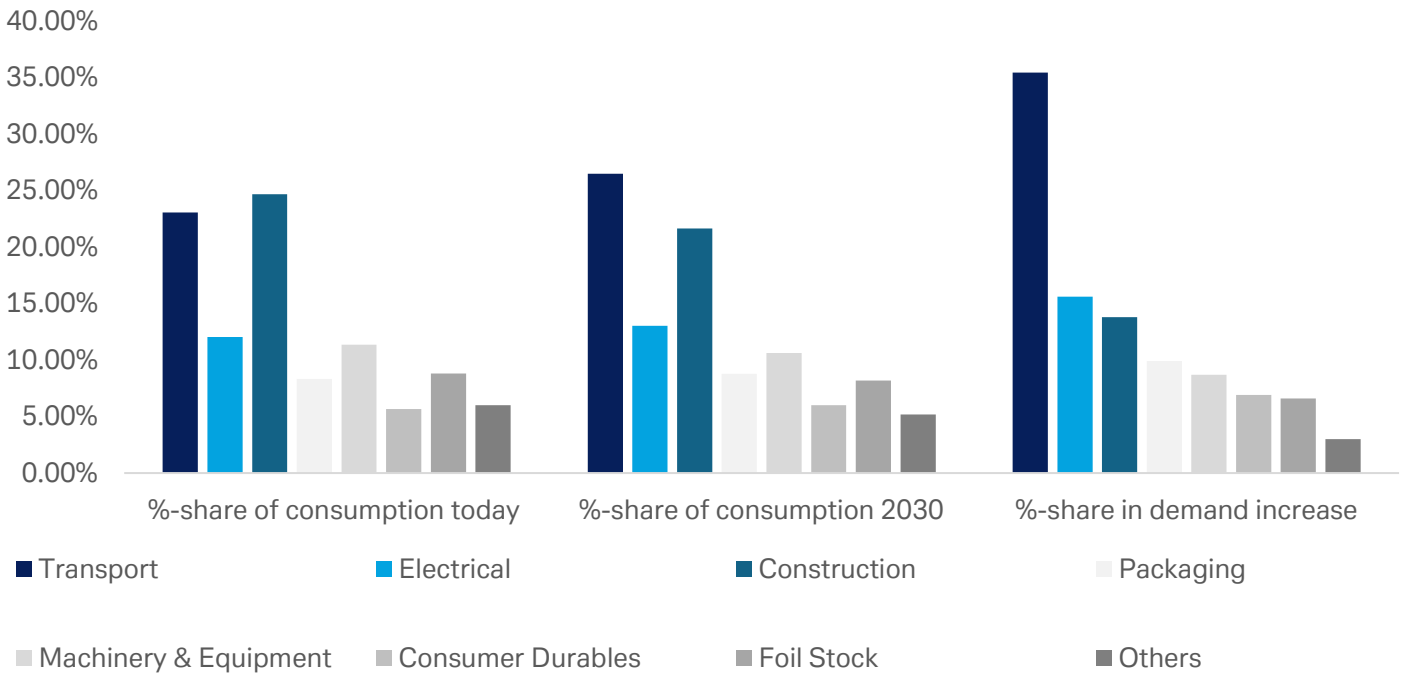
Half a century ago, the U.S. had a dominant position in global steel production.[22] But, at the turn of this century, China became the largest producer driven by its governments plans for the country's infrastructure, construction and manufacturing sectors. China now accounts for ~54% of total crude steel production (1892 Mt), followed by India (~7.4%) and Japan (~4.6%).[23]

China is also by far the largest steel consumer, accounting for ~51% of total consumption, followed by India (~7.6%) and the U.S. (~5.3%).[23]

Today, the majority of steel is being utilized in building and infrastructure sector (~52%), followed by mechanical equipment (~16%) and automobile sector (~12%). End-use demand shares are influenced by a country's level of economic development.[24]

IEA's **Stated Policy Scenario (STEPS)** incorporates countries' energy and climate related policy commitment and plans

Figure 3: Share of aluminium semi-finished products consumption by sector, 2020 vs. 2030



Source: CRU, Deutsche Bank AG. Data as of July 2024.

(includes nationally determined contributions). The **Sustainable Development Scenario (SDS)** is an integrated pathway for the global energy sector to reach the Paris Agreement goals.[23] Figure 4 provides steel use demand projections under these scenarios. These foresee further increases in steel production, but accompanied by an easing in China's dominance and a large increase in India's production.[25] [26] Emerging economies will drive the increase in steel demand.

The IEA divides steel use into four broad segments:

- **Construction**, which includes buildings, bridges, powerplants and sanitation systems and uses ~70% of steel in-use stock;
- **Vehicles**, which includes cars, trucks and ships and accounts ~15% of end-use demand and ~10% of the global in-use stock;
- **Machinery**, which includes mechanical and electrical equipment, using ~20% of end-use demand and ~15% of global in-use stock; and finally
- **Consumer goods,** which includes metal goods, domestic appliances and food packaging and accounts ~15% of end-use demand and ~5% of the global in-use stock.

Under STEPS, it is predicted by IEA that the relative demand for these four categories will remain relatively stable through to 2050. [22]

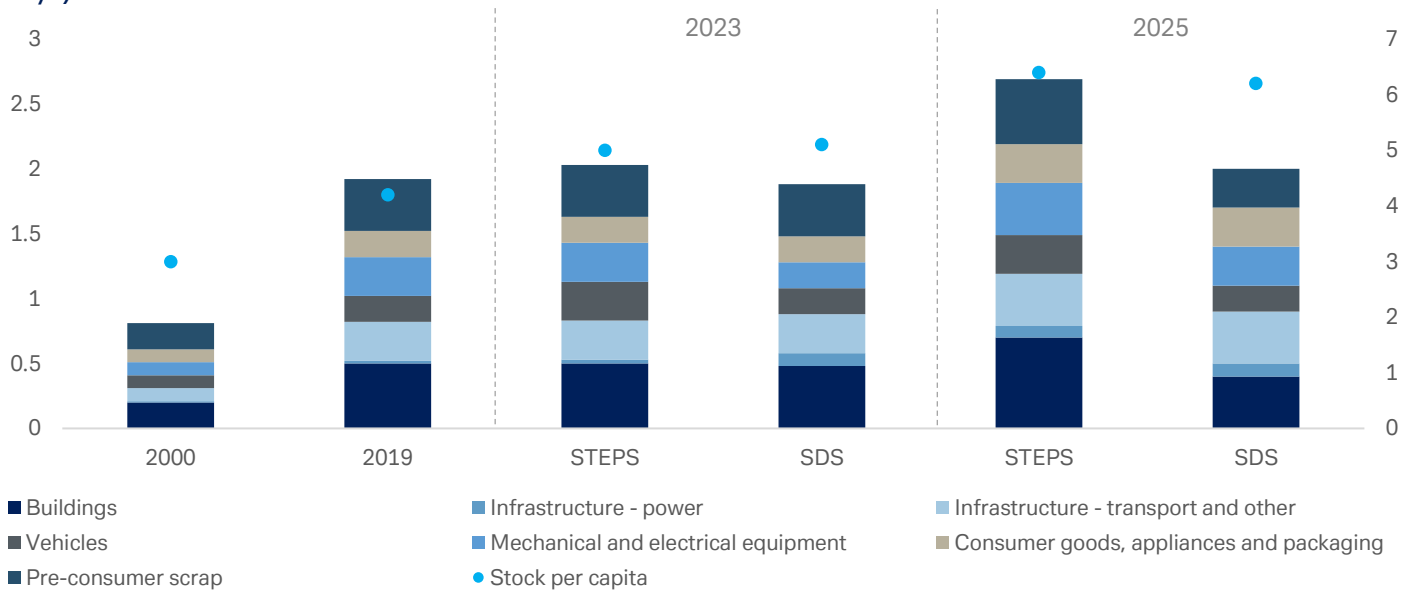
According to the UNEP definition, non-metallic minerals include sand, gravel, limestone, gypsum and clay and are mostly used for construction and industrial applications.

Cement: To produce concrete, raw materials such as limestone and clay are mined and ground to a fine powder, heated to a high temperature to produce clinker, which is ground up and mixed with gypsum to create cement powder, in turn mixed with water and aggregates (including sand) to form concrete.[27] [28] This is a basic material for all types of construction, including housing, roads, dams and ports, as well as many household items.[29]

Concrete is the second most consumed material in the world after water, with no scalable substitutes today.[30] [31] It is responsible for 7-8% of global CO2 emissions.[32] Most of these come from cement production, particularly the energy-intensive creation of clinker.[33] [34] It is argued that these emissions are hard to cut as 60% are due to the process chemistry of production, and 40% arise from the need to produce very high-temperature heat.[35]

Another major issue is the use of sand to produce concrete. Sand fulfills many important ecosystem services, e.g., protecting us against shoreline erosion.[36] But sand extraction is largely unregulated across the globe, causing significant damage to coasts, rivers, people and seas.[37] [38] Sand demand is likely to increase further with, for example, one projection suggesting a "~45% increase in global building sand use from 2020 to 2060 (…), with a 300% increase across low-and-lower-middle-income regions and a slight decrease in higher-income regions." The hope is that measures, such as extending building lifetime or switching to alternative materials could reduce the projected consumption in 2060 by almost 50%.[39] [40]

Figure 4: Projection of global end-use steel demand and in-use steel stock under STEPS and SDS (Gt/yr)



Source: IEA. Data as of July 2024.

The IEA's Net Zero by 2050 scenario requires that cement production will remain relatively constant over the next two and a half decades, increasing by about 2% to 4,260mn tonnes by 2030 (compared to 2022 levels), before declining by about 6% to 3,930mn tonnes (compared to 2022 levels).[41]

The top five cement producing countries (China, India, Vietnam, United States and Indonesia) accounted for almost 70% of global cement production in 2020. China alone accounted for over 60% of total global production.[42] [43]

However, it is expected that emerging and developing countries, particularly in South East Asia and Africa are going to be the primary drivers of future cement demand. Cumulative cement production in these countries from 2020 until 2050 could range, according to one study that focuses solely on emerging and developing countries, between ~55,000mn tonnes in their "business-as-usual" scenario (assuming a trajectory of infrastructure expansion that follows the historical trend) and ~106,000mn tonnes in their "developed average" scenario (assuming that these countries by 2050 have housing conditions equal to the average level in developed countries in 2020).[44]

Plastics: The first problem with plastics is that their production relies heavily on fossil fuels, which must be extracted and then refined and processed. "Cracking" petrochemicals into plastic building blocks such as ethylene is the part of plastic production with the largest emissions. Combining these into larger molecules that can be shaped into products, a process called polymerization, causes additional emissions.

A recent study estimates that global production of primary plastics contributed 5.3% of total global GHG emissions. To make matters worse, most of the fossil fuels used in plastic production serve as a raw material rather than a source of energy (~70%). As a result, decarbonising the power grid cannot by itself be the solution to plastics-related GHG emissions. As a result, plastic production may need to be cut by at least 12% annually to stay in line with the 1.5 degree goal of Paris.[45]

Production cuts look unlikely. OECD projections show global plastics use almost tripling between 2019 and 2060 in their baseline scenario, largely driven by economic and population growth. Demand will be much more evenly distributed in the future, with China (17%), India (13%), the U.S. (13%), and OECD EU countries (10%) being together responsible for 53% of demand. India's demand is projected to increase almost sixfold with sub-Saharan Africa up 7x.

As of 2019, packaging, construction and vehicles (on a broad definition) accounted for more than 60% of total plastics use. According to OECD projections, these ratios are expected to remain relatively unchanged in coming years.[46]

Second problem with plastics is that we throw away too much of it, resulting in leaching of toxic components as well as contamination with microplastics (among many other things).

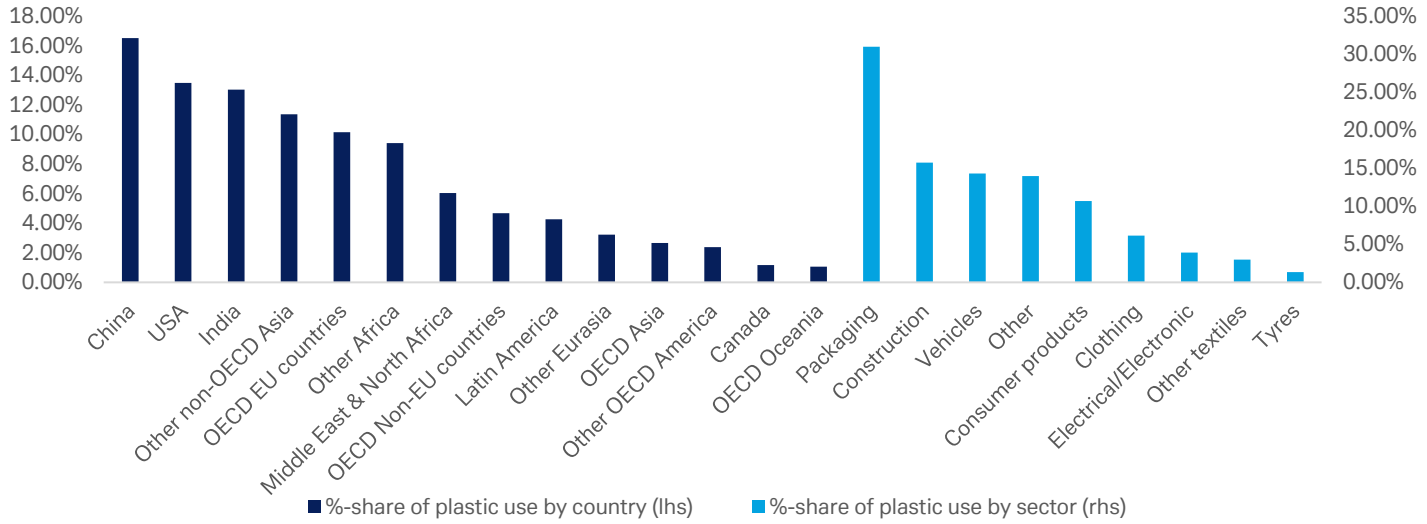
In fact, most plastic produced between 1950 and 2017 (roughly 7,000 million tons out of 9,200 million tons of global cumulative plastic production) became plastic waste. Most of this (around 75%) was discarded and ended up in landfills, dumps, uncontrolled or mismanaged waste streams, or the natural environment, including the oceans.[47]

Low recycling rates are likely to persist. In 2019, only 15% of plastic waste was collected for recycling and only 9% was actually recycled. The OECD projects that the share of secondary plastics (plastics made from recycled materials) in total plastics production will increase from 6% in 2019 to a still too low 12% in 2060.[48]

Recycling plastic currently has a number of problems. It requires that large amounts of chemically-different variations of plastic are sorted appropriately since they cannot be recycled together. Plastic also degrades through recycling, so it can generally only be reused once or twice.[49]

The overall conclusion is that companies must either find solutions to current recycling issues or a replacement product for plastic that is not made using fossil fuels. Given that 99% of plastics are made from fossil fuels, the sector seems to be facing one of the biggest transformation challenges.[50]

Figure 5: Percentage share of plastic use by country and sector in 2060



Source: OECD Global Plastics Outlook, Deutsche Bank AG. Data as of July 2024.

03 Transition Opportunities

Here is an overview of main proposed approaches to increasing sustainability.

Aluminium: reducing indirect emissions from electricity consumption through the use of **renewable energy** sources can be considered the biggest lever for decarbonising the sector, as these account for ~60% of sectoral emissions. Addressing the remaining ~40% of emissions is likely to be challenging and will require innovation. The most promising approaches may include:

- **Inert anodes:** Perhaps the best option to reduce direct emissions associated with carbon anode consumption – around 10–15% of sectoral emissions – assuming the use of renewable energy. Several aluminium manufacturers are actively working on research and development of inert anodes but this approach is not yet commercially available.
- **Hydrogen:** Green hydrogen could be the best to feed high-temperature processes at this time (e.g. as a fuel source for alumina refining). While currently cost-prohibitive, hydrogen is expected to become financially viable in the next decade.
- **Carbon capture, usage and storage (CCUS):** In the medium term, this could be a viable method of mitigating emissions for young assets with access to cheap fossil fuels and have access to affordable carbon transportation and storage. Absorption-based CCUS technology could be used in primary aluminium production during the refining process to capture emissions from fossil fuel-based thermal energy generation and during the smelting process to capture CO_2 from carbon anode consumption.
- **Mechanical vapour recompression (MVR):** This is used to recover waste heat from steam by capturing it and redirecting it to a compressor that raises the pressure and temperature of the steam, which can then be reused. MVR can be used to reduce the carbon footprint of existing operations, regardless of power source or geographic location. It may therefore be able to decrease the footprint of the industry while less mature, more capital-intensive technologies (e.g., green hydrogen) become economical. The technology has not yet proven to be cost effective, but it could have major potential. Beyond carbon savings, MVR could decrease operational costs through energy savings; in alumina refining, energy accounts for as much as 30-50% of the total production cost.[51]

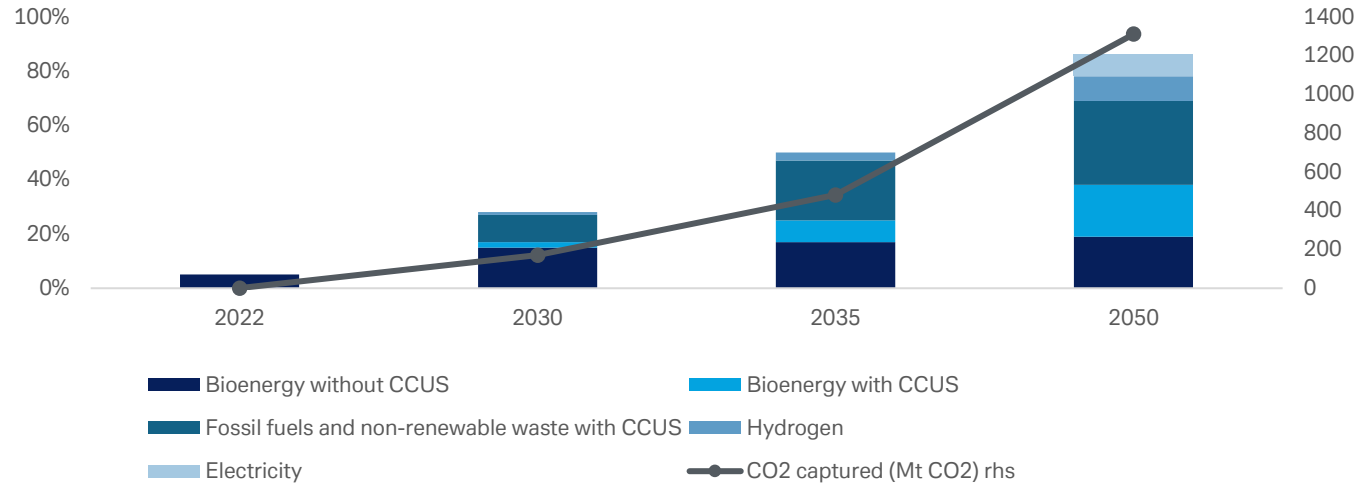
Steel: Steel (together with iron) has the highest CO_2 emissions amongst all heavy industries and ranks second in terms of energy consumption. Options for improving this situation include:

- **Increasing material efficiency:** One estimate is that improving material efficiency could reduce global steel demand by around a fifth in 2050, relative to baseline projections. Measures include those within the sector and its supply chains (e.g., improving manufacturing yields) and downstream changes (e.g., extending building lifetime), with the latter category thought likely to contribute the majority of the material savings. Material efficiency strategies contribute 40% of the cumulative emissions reductions in the Sustainable Development Scenario (SDS).
- **Improve energy performance of existing equipment:** New state-of-the-art blast furnaces are already approaching the practical minimum energy requirement for the processes involved. But, with energy making up a significant proportion of production costs, there remains an incentive to replace less-efficient process units. Improvements in operational efficiency, including enhanced process control and predictive maintenance strategies, together with the implementation of best available technologies contribute around 20% of cumulative emissions savings in the SDS.
- **Hydrogen, CCUS, Bioenergy and Direct Electrification:** Multiple new process designs involving these are being explored today. Energy prices, technology costs, the availability of raw materials and the regional policy landscape are all relevant factors. For example, access to low-cost renewable electricity (i.e., USD 20-30 per megawatt hour) may provide a competitive advantage to the hydrogen-based direct reduced iron (DRI) route. Innovative smelting reduction, gas-based DRI and various innovative blast furnace concepts, all equipped with CCUS, could prevail in areas where local policy is supportive and cheap fossil fuels are available. Hydrogen and CCUS together account for around one-quarter of the cumulative emission reductions in the Sustainable Development Scenario.[52]

Cement: In total, three strategies can be postulated – as has been done by the IEA – as ways to reduce direct emissions from cement production.

- **Increasing material efficiency:** The key aim here is to reduce the clinker-cement ratio, i.e., how much clinker is used to make cement. The IEA's Net Zero scenario envisages that clinker-to-cement ratio is reduced from 0.71 in 2022 to 0.57 in 2050.
- **Increasing energy efficiency** and **switching to lower-carbon fuels:** the IEA's Net Zero scenario requires a massive increase of the share of near zero emissions clinker production (from 0% in 2022 to 93% in 2050) as well as in the share of low-emissions fuel in thermal energy use (from 5% in 2022 to 86% in 2050).
- **CCUS:** material and energy efficiency are key measures in the short term, but in the long term, significantly more than half of the emission reductions in cement production are likely to come from CCUS, according to the IEA. Figure 6 shows that fossil fuel will continue to be a major source of energy, but needs to be combined with CCUS.[53]
- **Supplementary cementitious materials (SCMs):** these are used to reduce the share of cement in concrete, so reducing the carbon footprint from cement used. One SCM has managed to reduce CO_2 emissions by approximately 30%.[54]

Figure 6: Share of low-emissions fuel in thermal energy use (%) and CO_2 captured (Mt CO_2)



Source: IEA Cement Net Zero Emissions Guide, Deutsche Bank AG. Data as of July 2024.

Plastic: we discussed above the existing challenges with recycling plastic. A much-discussed alternative approach might be **bio-based plastics** or compostable plastic in general. But there are also several problems here. First, most bio-based plastic is only partially composed of bio-based materials (one popular one has 70% fossil-based plastic). Second, they contain toxic chemicals – bio-based/biodegradable plastics and conventional plastics are similarly toxic.[55] In reality, making plastic use sustainable will require a systematic approach that is likely to span many sectors and countries, with individual solutions difficult to highlight.[56] But the parameters within which plastic production will have to operate in the future can already be defined today. The European Environment Agency (EEA) defines three pillars:

- **Using plastics in a smarter way:** For example, through reducing unnecessary packaging and single-use products, as well as more circular design that makes products last longer and be easier to reuse and repair. Already existing approaches include gear rentals, car and tool sharing and, for example, reusing crates and pallets in the food sector.
- **Increasing circularity:** Requires longer use and reuse of products and better collection, sorting and recycling of plastics. Good practice examples include stores that offer to take back their own products at the end of product life-cycle, which can improve the quality of recycled materials or enable some type of reuse.
- **Increasing the use of renewable materials:** Using more recyclable, biobased plastics, instead of relying solely on fossil fuels and their imports. According to the EEA, renewable materials should focus on using second- and third-generation feedstocks that do not compete with food and feed production.[57]

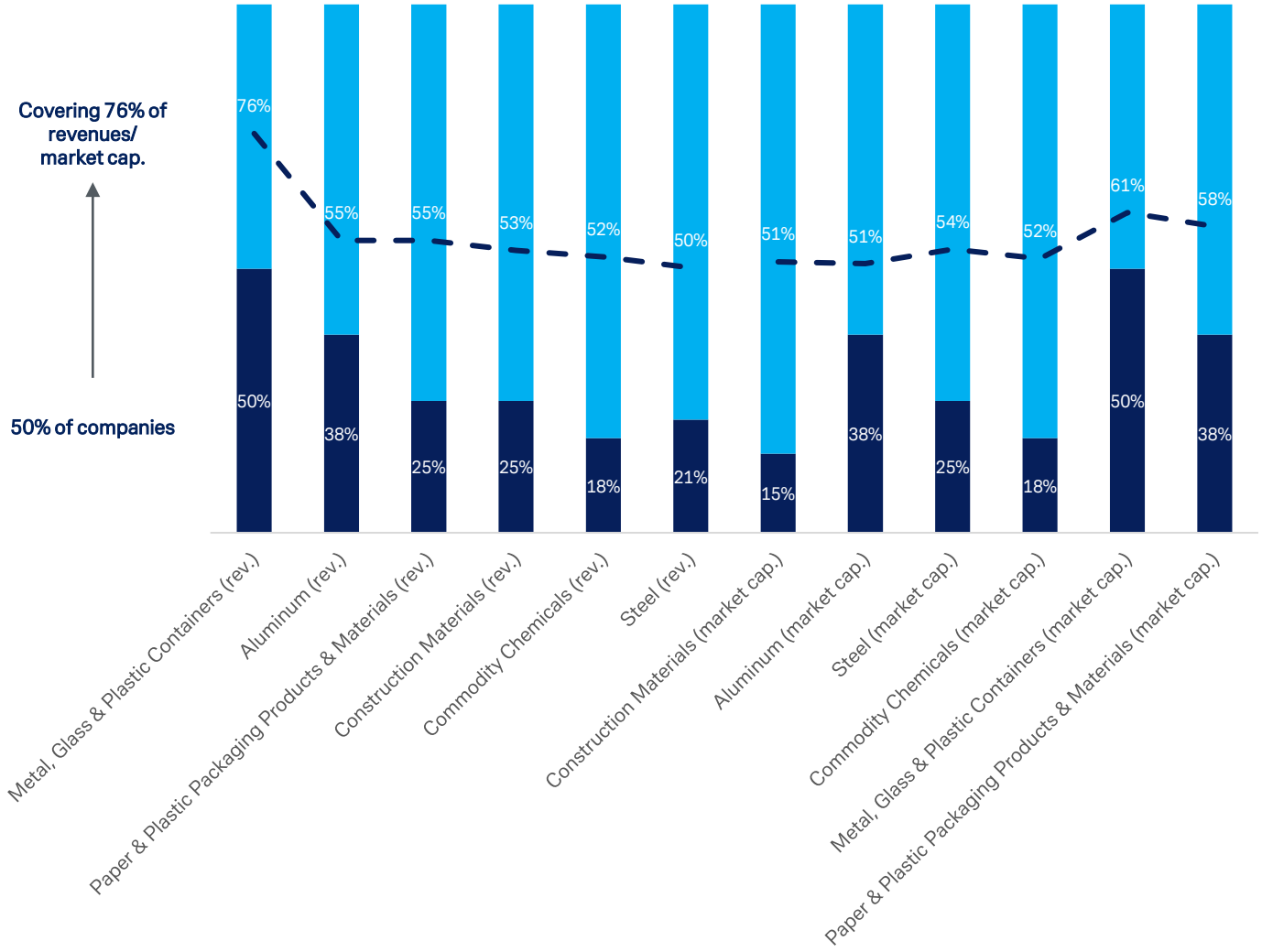
04 Investors perspective

The equity market is one way to potentially benefit from the increasing demand for materials and the sustainable transformation in this area. How we change the way we use materials will impact all other sectors downstream (to varying degrees). However, the focus of this report is on the producers of these materials, which, according to the Global Industry Classification (GICS) structure, all fall into different sub-industries within the Materials sector.

The Bloomberg World Index, which contains large and mid-cap companies from developed and emerging markets covering 85% of the market capitalisation of the markets included can be seen as a comprehensive representation of global equity markets. Filtering this index for producers of the materials subject to this report will thus provide a list of companies that can reasonably be expected to be most impacted by increased demand for these materials as well as the necessary efforts to sustainably transform their production and consumption. In total, this index includes 107 companies from different sub-industries within the Materials sector. Two observations can be made on the structure of these Materials sub-industries.

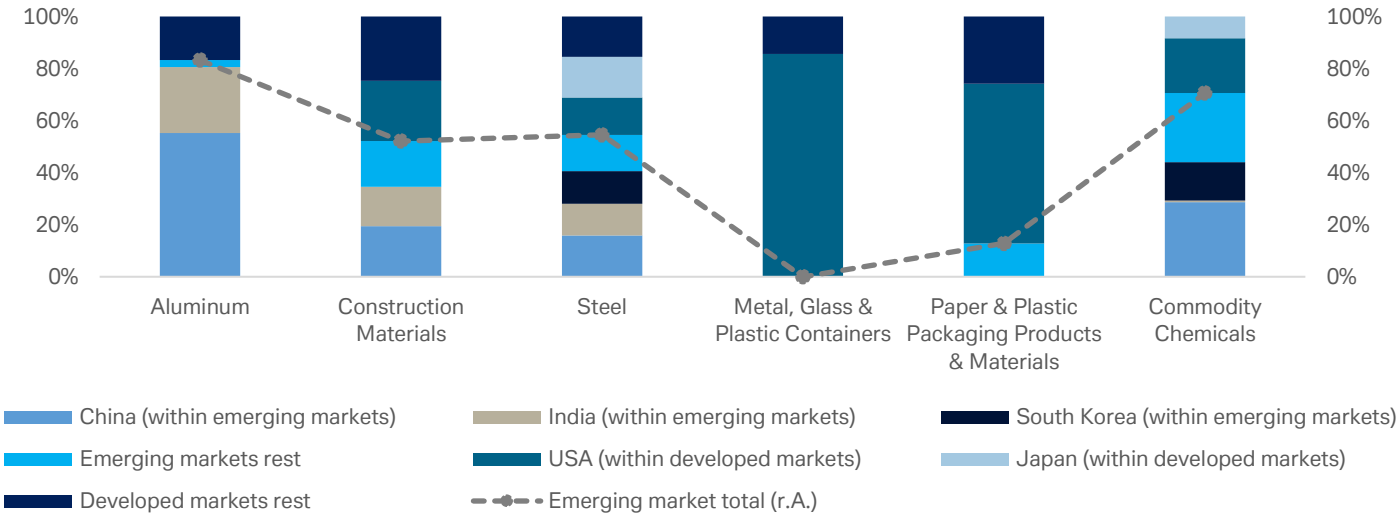
- First, **market concentration** is sometimes high either because not many listed companies exist in the first place (e.g., for Aluminium, for Metal, Glass & Plastic Containers, and for Paper & Plastic Packaging Products & Materials). An appendix at the end of this report provides an overview of the sub-industries covered in this report alongside with revenue and market capitalization concentration.
- Second, **emerging markets play a significant role** in almost every area. Some 22% of all revenues in 2022/2023 (from these 107 companies) were from Chinese companies. Other relevant emerging markets include India and South Korea (still an emerging market according to MSCI)[58], each accounting for around 9% of revenues. Of the developed countries, the U.S. (20% of revenues) and Japan (9% of revenues) have to be considered important as well. Figure 8 summarises.

Figure 7: Overview of relevant sub-industries (revenues and market capitalisation based on USD)



Source: MSCI, Bloomberg L.P., Deutsche Bank AG. As of July 2024. (See appendix for detailed table)

Figure 8: Share of total 2022/2023 revenues in USD terms by country



Source: MSCI, Bloomberg L.P., Deutsche Bank AG. As of July 2024.

Both of these observations seem credible since the very nature of the materials business often implies high entry barriers (e.g., via high upfront capital costs or the need for economies of scale). Rapid economic growth in emerging markets such as China and India helps explain the high share of these countries in particular sub-industries.

Some analysis of the performance of these 107 companies vs. their relevant **benchmarks** is also possible.

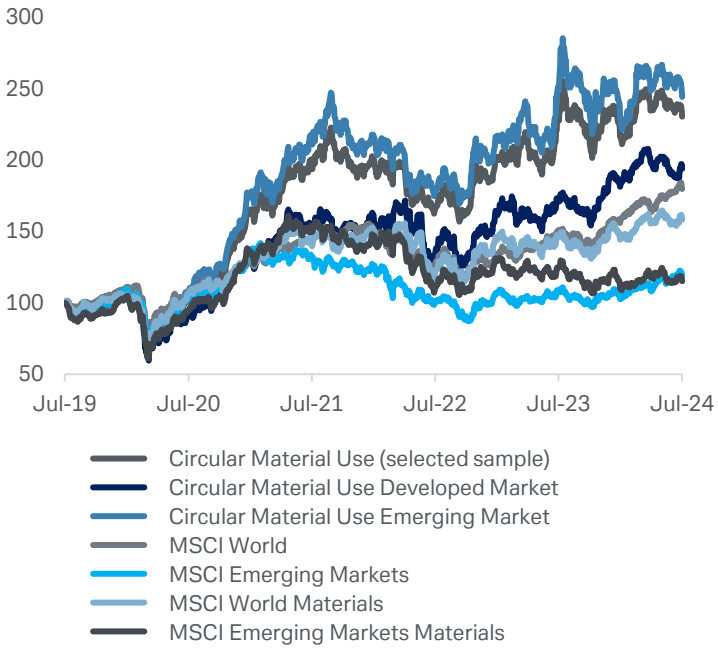
We compare companies domiciled in developed markets both to the global developed market (MSCI World Index) and to the global materials sector within developed markets (MSCI World Materials Index).

We compare companies domiciled in emerging markets both to the global emerging market (MSCI World Emerging Markets Index) and to the global materials sector within emerging markets (MSCI World Emerging Markets Materials Index).

In the past **five years**, these 107 companies, in aggregate, have outperformed both the global market as well as the Materials sector. As the chart below shows, this outperformance was largely driven by emerging markets companies with steel and commodity chemicals companies, mostly from India, as notable drivers. On a YTD basis, however, both the global market and the materials sector have outperformed our selection, with emerging markets and specifically commodity chemicals acting as a drag on performance, alongside with a few steel companies.

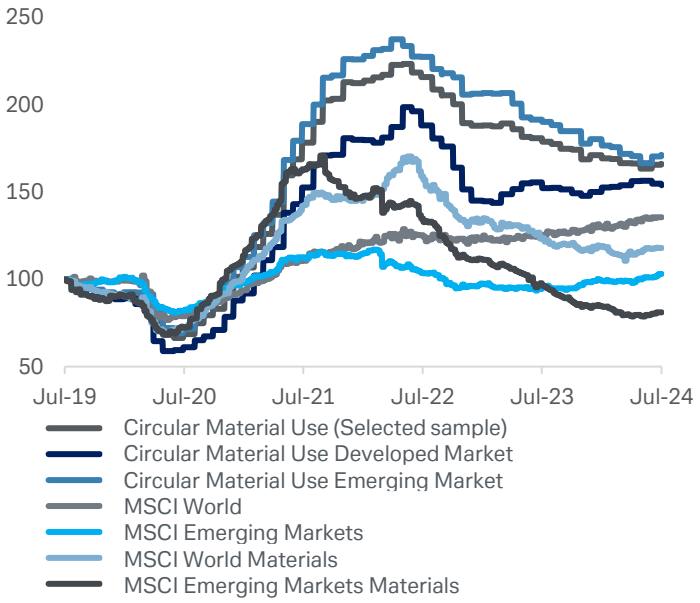
This pattern is broadly reflected, as might be expected, in the development of earnings expectation. As Figure 10 below shows, earnings expectations have grown stronger in our 107 selected companies, in aggregate than in the benchmarks, mainly driven by emerging markets and specifically, steel, commodity chemicals and some aluminium companies, mainly from China and India. In the course of this year, however, earnings expectations have decreased quite markedly relative to benchmark.

Figure 9: Total return of selected indices (in USD)



Source: LSEG Datastream, Deutsche Bank AG. Data as of July 2024.

Figure 10: 12-Month Forward EPS of selected indices (indexed, July 2019 = 100)



Source: LSEG Datastream, Deutsche Bank AG. Data as of July 2024.

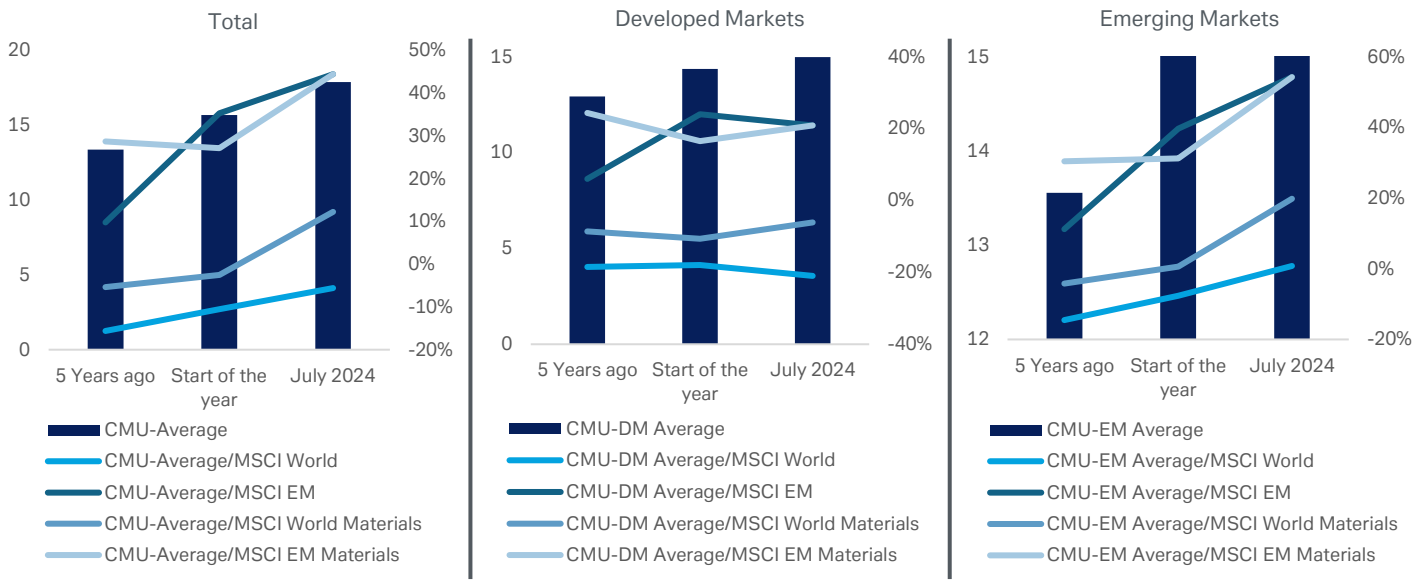
Figure 11 illustrates how forward-looking valuations have changed over time. To summarize, 12-month forward PE ratios increased on average so far this year, both in developed and emerging markets. At the same time, relative valuations, i.e., valuations premium/discount relative to relevant benchmarks also point higher.

Considering the negative performance and decrease in earnings expectations, the higher valuations may indicate that in the short run, further downside risk is possible.

One possible explanation for materials' negative performance YTD may be China's relatively weak economic development. As mentioned in chapter 1, China is a major player on both the supply and demand side. Figure 12 below shows YoY growth rates for key Chinese output indicators, which have been low or negative for much of the year.

Another reason for the negative performance could be changing expectations around rate cuts from the Federal Reserve (FED). At the beginning of the year, market consensus for was six interest rate cuts in 2024. These expectations have been scaled back, explaining why many investors have sold off certain sectors. It has also contributed to the poor performance of emerging markets, which are particularly dependent on interest rate trends in the U.S.

Figure 11: Development of 12-month forward PE ratios and relative valuation



Source: LSEG Datastream, Deutsche Bank AG. Data as of July 2024.

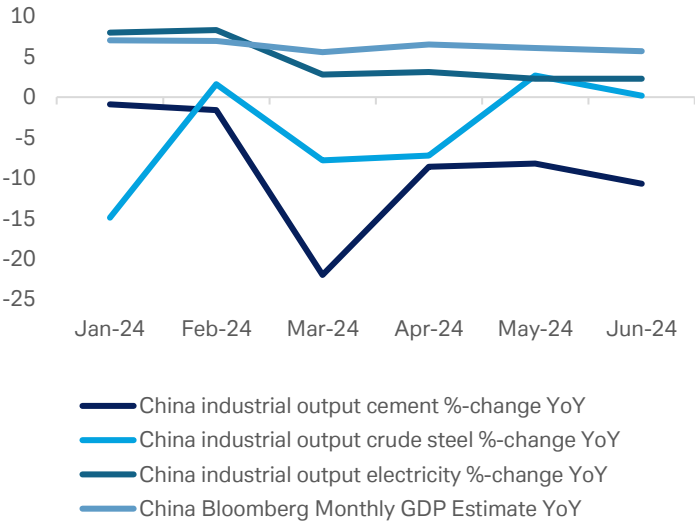
In the short term, much will depend on how the overall economy in China develops. Recently, China's central bank, the PBoC, cut key interest rates and the PBoC governor has highlighted potential supportive monetary policies and financial reforms to come. These would be on top of broader reforms to stimulate consumer and business confidence. We think there is scope for more rate cuts and reserve requirement ratio cuts by the PBoC in the coming months. Lower interest rates and easing credit conditions could boost domestic consumption and investment, benefiting cyclical sectors such as the materials sector.

Overall, we think that the global economy could grow more strongly in 2024 than in the previous year – although growth is likely to slow slightly again in 2025. Looking beyond near-term economic considerations, we believe that long-term investors should look at the sustainability ambitions of companies being considered for investment.

One way to do this is by using **ESG ratings**. These may be usable as a risk management tool (in combination with other indicators). For example, when we apply MSCI ESG ratings to our company selection, we see that over the past 5 years, the standard deviation of daily returns was lowest for "ESG leaders" (ESG rating AAA or AA) compared to average-rated companies (ESG rating A, BBB or BB), "laggards" (ESG rating B or lower) or unrated companies.

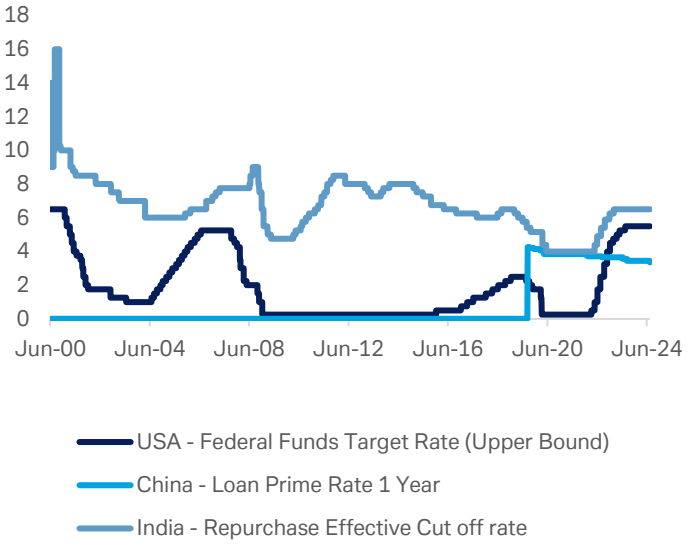
ESG ratings in emerging markets tend to be lower than those in developed countries. But, looking at recent developments, it is clear that emerging markets companies are delivering progress towards sustainable development.

Figure 12: China industrial output and GDP growth, selected indicators



Source: Bloomberg L.P., Deutsche Bank AG. Data as of July 2024.

Figure 13: Key interest rates of selected countries



Source: Bloomberg L.P., Deutsche Bank AG. Data as of July 2024.

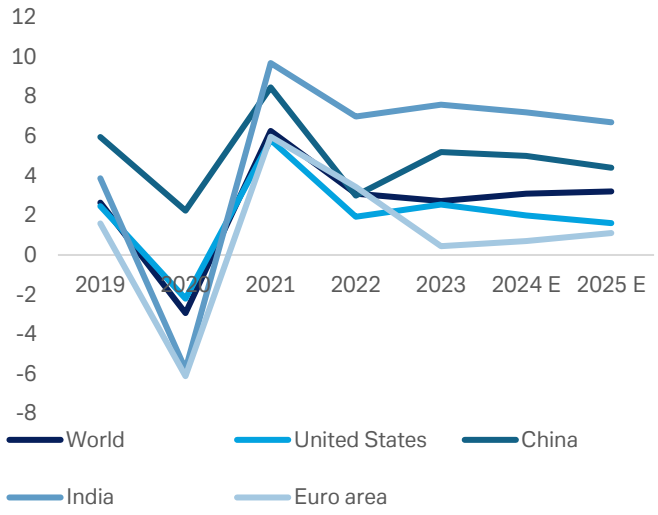
In the last one to two years, in our sample of 107 companies, around 3 times as many companies from emerging markets have been able to improve their ESG rating compared to developed countries (25% for emerging markets vs. 7% for developed).

Emerging market ESG rating improvements are partly due to starting from a low base, but do indicate that emerging countries are likely to play an important role in the future, not only in terms of demand for important materials, but also in terms of providing locations for sustainable production. Commodity chemicals companies improved most frequently.

Reasons for improvements included new strategic initiatives to promote existing sustainability programmes in various Asian countries, partnerships to replace fossil resources with renewable raw materials in the production of chemicals and plastics, plans to build advanced chemical recycling plants in countries with structural plastic pollution issues, and committing to large scale wind power purchase deals. [59] [60] [61] [62]

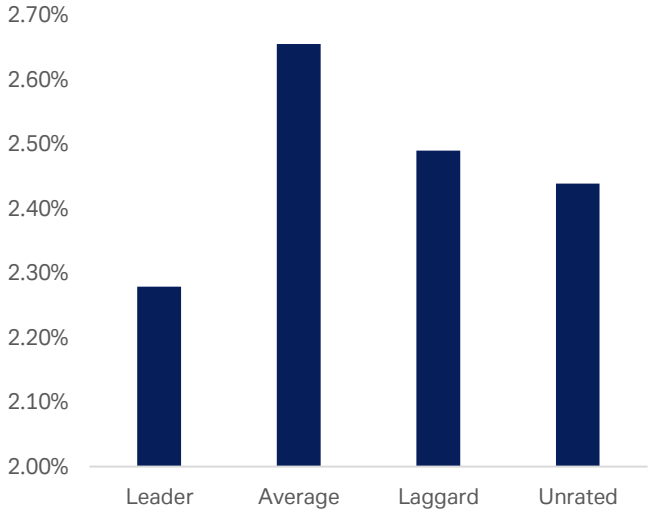
However, it is also important to emphasize that ESG metrics should be viewed as an additional metric to be considered alongside "traditional" financial metrics.

Figure 14: GDP growth of selected countries/regions



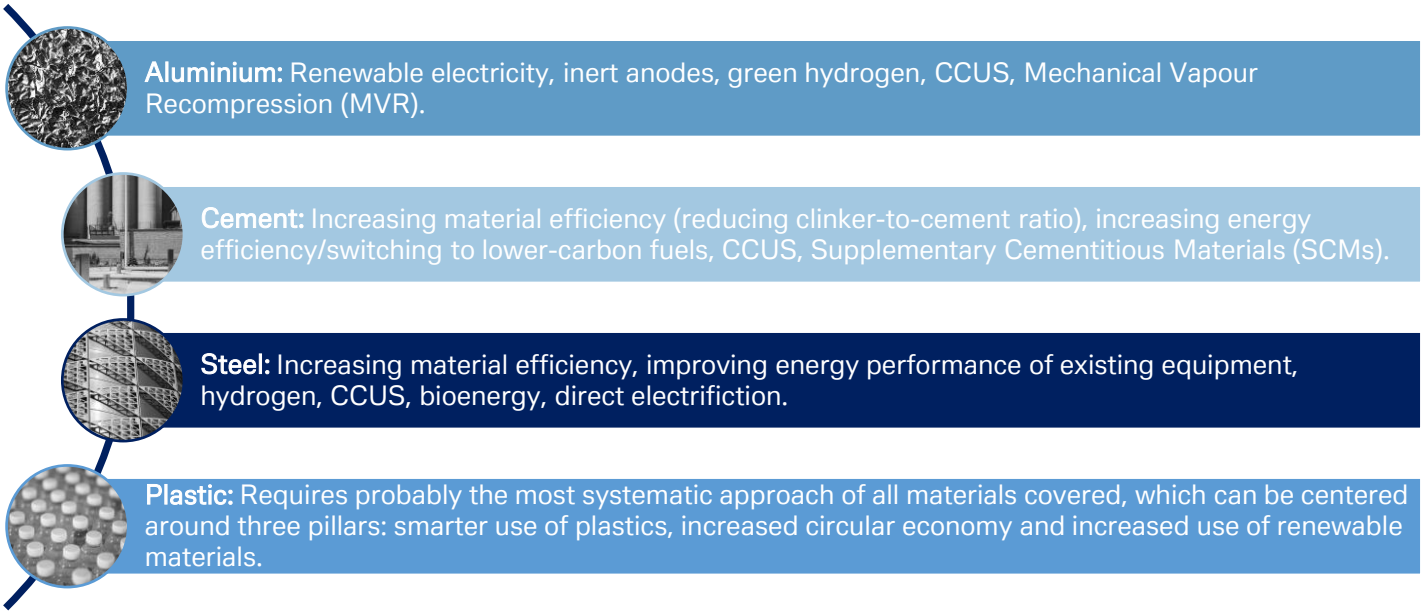
Source: World Bank, Deutsche Bank AG. Data as of July 2024.

Figure 15: Standard deviation of daily returns over the past five years grouped by ESG rating



Source: MSCI, LSEG Datastream, Deutsche Bank AG. Data as of July 2024.

Figure 16: Approaches to transform materials production



Sources: WEF, IEA, IEA and WEF, EEA, Unsplash (for images), Deutsche Bank AG. July 2024.

05 Conclusion

We summarize key approaches to transforming aluminium, cement, steel and plastic sectors in Figure 16. When considering investments, we think investors should consider firms' sustainability ambitions.

Many risks exist to materials sector investment. Prices could rise due to geopolitical tensions or persistent core inflation combined with tight labour markets. Still-high interest rates could have greater cooling effects than envisaged and, in China, a troubled property sector could have a further impact on growth, hurting trading partners. High government debt in many countries threatens disruption via tax hikes and spending cuts, weakening activity, eroding confidence, and sapping support for reform and spending to reduce risks from climate change.

In summary, although materials' share prices have fallen since the start of the year, further price declines cannot be ruled out based on current valuations. But sector growth seems likely to continue and there will be opportunities around the sustainable transformation. Long-term investors could therefore use further setbacks to add to positions in this theme.

Historical performance

Performance	31.07.2023 - 30.07.2024	31.07.2022 - 31.07.2023	31.07.2021 - 31.07.2022	31.07.2020 - 31.07.2021	01.08.2019 - 31.07.2020
MSCI World	14.11	14.11	-8.72	35.71	8.56
MSCI Emerging Markets	5.84	8.77	-19.81	20.98	8.17
MSCI World Materials	6.05	16.15	-12.35	38.86	8.45
MSCI Emerging Markets Materials	-12.54	10.11	-24.89	57.31	3.39

Source: Datastream, Deutsche Bank AG. Data as of July 30, 2024.

Appendix

Overview of relevant sub-industries (revenues and market capitalisation based on USD)

Material	Sub-industry	Description	Revenue concentration	Market cap. concentration
Aluminium	Aluminium	Producers of aluminium and related products, including companies that mine or process bauxite and companies that recycle aluminium to produce finished or semi-finished products.	**3 out of 8** companies covered **~51%** of the revenues in 2023.	**3 out of 8** companies covered **~55%** of the market capitalization in July 2024.
Cement	Construction Materials	Manufacturers of construction materials including sand, clay, gypsum, lime, aggregates, cement, concrete and bricks.	**3 out of 20** companies covered **~51%** of the revenues in 2023.	**5 out of 20** companies covered **~53%** of the market capitalization in July 2024.
Steel	Steel	Producers of iron and steel and related products, including metallurgical (coking) coal mining used for steel production.	**7 out of 28** companies covered **~54%** of the revenues in 2023.	**6 out of 28** companies covered **~50%** of the market capitalization in July 2024.
	Metal, Glass & Plastic Containers	Manufacturers of metal, glass or plastic containers. Includes corks and caps.	**2 out of 4** companies covered **~61%** of the revenues in 2023.	**2 out of 4** companies covered **~76%** of the market capitalization in July 2024.
Plastic	Paper & Plastic Packaging Products & Materials	Manufacturers of paper and cardboard containers and packaging.	**3 out of 8** companies covered **~58%** of the revenues in 2023.	**2 out of 8** companies covered **~55%** of the market capitalization in July 2024.
	Commodity Chemicals	Companies that primarily produce industrial chemicals and basic chemicals. Including but not limited to plastics, synthetic fibers, films, commodity-based paints & pigments, explosives and petrochemicals.	**7 out of 39** companies covered **~52%** of the revenues in 2023.	**7 out of 39** companies covered **~52%** of the market capitalization in July 2024.

Source: MSCI, Bloomberg L.P., Deutsche Bank AG. Data as of July 2024.

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Glossary

The Bloomberg World Index captures large and mid-cap companies from developed and emerging markets

CCUS: Carbon Capture, Usage and Storage

IEA (International Energy Agency) is an intergovernmental organization that focuses on energy policy, security, and sustainability. It provides research, analysis, and recommendations to member countries.

The European Economic Area (EEA) is designed to ensure the free movement of persons, goods, services and capital through Iceland, Lichtenstein and Norway and all member states of the European Union.

Earnings per share (EPS) are calculated as a companies' net income minus dividends of preferred stock all divided by the total number of shares outstanding.

ESG: The abbreviation "ESG" stands for Environmental, Social and Governance.

The Federal funds (Fed funds) rate is the interest rate at which depository institutions trade federal funds with each other overnight.

Gross domestic product (GDP) is the monetary value of all the finished goods and services produced within a country's borders in a specific time period.

Greenhouse gases (GHGs) traps heat in the earth's atmosphere.

The Global Industry Classification Standard (GICS) was developed by Standard and Poor's and Morgan Stanley Capital International (MSCI) to define equities sectors.

MSCI ESG ratings captures ESG risks and opportunities within multi-asset class portfolios.

The MSCI EM Index captures large and mid cap representation across 23 emerging markets countries.

The MSCI Emerging Markets Materials Index captures large and mid cap representation across 24 Emerging Markets (EM) countries.

MVR: Mechanical Vapour Recompression.

The MSCI World Index captures large and mid-cap representation across 23 developed markets countries.

The MSCI World Materials Index captures the large and mid cap segments across 23 Developed Markets (DM) countries.

The term "Net-zero-carbon-emissions" or "Net-zero" refers to a situation in which the economy, society, or a particular economic sector emits no carbon dioxide (CO2), either because it does not produce any or because it collects the CO2 it does produce for use or storage.

The Organisation for Economic Co-operation and Development (OECD) has 35 member countries and has the objective of encouraging economic progress and world trade.

The People's Bank of China (PBoC) is the central bank of the People's Republic of China.

Price/earnings (P/E) ratios measure a company's current share price relative to its per-share earnings. In this context, LTM refers to last twelve months' earnings.

The United Nations Environment Programme (UNEP) focuses on climate, nature, pollution and sustainable development within the United Nations system.

USD is the currency code for the U.S. Dollar.

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