



# Metals, a dangerous complacency?

Next steps towards a more resource-efficient technology industry

# Summary

## Use current low metal price environment to invest in a more efficient supply chain



### 1. Metal market turned upside down in past four years

Over a period of four years, the global metal market has changed significantly. In 2011, prices were high, geopolitical tensions led to trade restrictions and numerous investment plans were made to (re)open mines. The resultant substantial capacity expansion and further easing of trade barriers have, on average, halved metal prices since 2011.



### 2. Low prices mask long-term challenges

The current low price environment leads to 'tired' mining companies and results in the rest of the value chain being 'lazy'. Efforts to achieve more efficient use of raw materials are under pressure while over the longer term, the current price environment poses challenges and will leave the industry requiring investment. Metal mining is coming under increasing pressure from nature, from government regulations and from society. When exactly this will pinch, it is difficult to predict. However, companies that have efficiently organized their metal use throughout the value chain are, by definition, the least vulnerable. A very low metal price environment, which helps the profits of the European (importing) tech industry, is a good time to invest in a more efficient supply chain. Greater efficiency ultimately also reduces any supply risks associated with 'foreign' metal.



### 3. Specific responsibility and opportunities for end manufacturers

For end manufacturers there is a crucial role to play to get the whole value chain to a higher level of resource efficiency. With product design aimed at redeployment of (parts of) a product a circular economy can be brought closer. However, price incentives for this are currently limited with price and product functionality for most manufacturing companies the leading criteria. Yet there is a promising trend that might gradually change this, namely "from ownership to use". This trend does not stem directly from the "concept" of sustainability, but from the growing need for flexibility and focus on core competencies by users of machinery and equipment. Nevertheless, this trend creates new business opportunities to adjust product design and redeployment of machinery or equipment. It is a more holistic approach and a big step towards a more efficient supply chain.

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# Introduction

## Metals – a top priority for governments and multinationals

Longer term growth of the European technology industry is dependent on access to and use of metals. In the current low metal price environment, this would not appear to be an issue, however, it could prove perilous to become too complacent.

In Chapter one of this report, we describe the world of supply and demand for metals. That the topic is of major interest is demonstrated by the many strategic actions large countries and multinationals take in this respect. In our second chapter, we look at how a more efficient tech industry can reduce the use of raw materials, both from a suppliers' perspective as well as that of the end manufacturer.

In February 2014, the German agency for raw materials (DERA) came to the conclusion that the metal tungsten should be considered critical for Germany. The German government is trying to create supply security by giving support to the financing of a tungsten mine that opened in the UK in 2015.

The Qatar Mining Company, wholly-owned by the State of Qatar, was established in 2010 to undertake targeted investments in the mining and metals sector and to become an international, multi-commodity mining company by 2024.



Large final manufacturers purchase their own mines to have greater security over the supply of resources. Toyota invested in a lithium mine in Argentina and acquired a 20% share in a silica sand mine in Malaysia. Siemens AG has partnered with an Australian producer of rare earth metals, Lynas Corporation, to ensure the supply of neodymium for magnets.

As near monopolist, China put trade restrictions for rare earths in place in 2010. Japan has since approached several suppliers to secure a supply of rare earth metals; for example, signing a contract with India under which the supply of rare metals (representing approximately 15% of Japanese imports) started in 2015.

The largest Chinese steel company, state-owned Baosteel, and Australian transport company Aurizon Holdings acquired Aquila Holdings, a producer of iron ore and coal. This should ensure a secure supply of iron ore and coal for these companies.

# Metal market turned upside down

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# 1.1 Metal demand grows alongside global economic growth

## China pivotal in structural growth of demand for metals

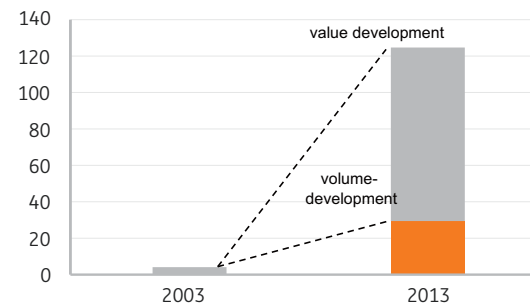
Over the past decade, the global market for metal raw materials has grown exponentially. The main structural trend is the continued growth in demand. Demand for the four metals shown in the right hand chart is now 1.5 to 2 greater than it was ten years ago. The main reason for this increase in demand is China. China's demand for aluminium is five times higher than it was ten years ago, and now represents half of the global demand. The import value of iron ore has increased from US\$4 billion in 2003 to US\$125 billion in 2013, which represents two thirds of the global imports flow. For other metal types, the import and production growth of China is also enormous and has completely disrupted the global ratios in terms of metal raw materials.

## Fast-growing middle class creates steady demand

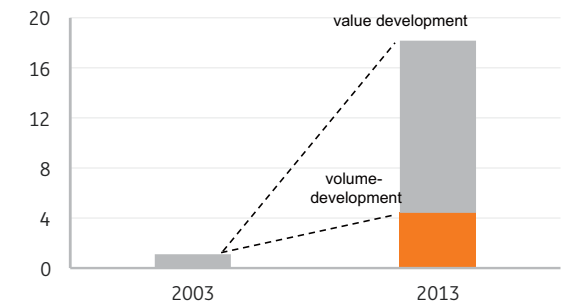
The demand for metals will continue to increase, due to an Asian middle class that is expected to grow in number from 600 million to 3 billion by 2030. In addition, there is the potential for high growth in Africa. For years to come, the demand for metals will move in one direction only and that is up.

## 2003-2013 Chinese import of iron ore explodes

Iron ore, Chinese imports  
value in billions of dollars



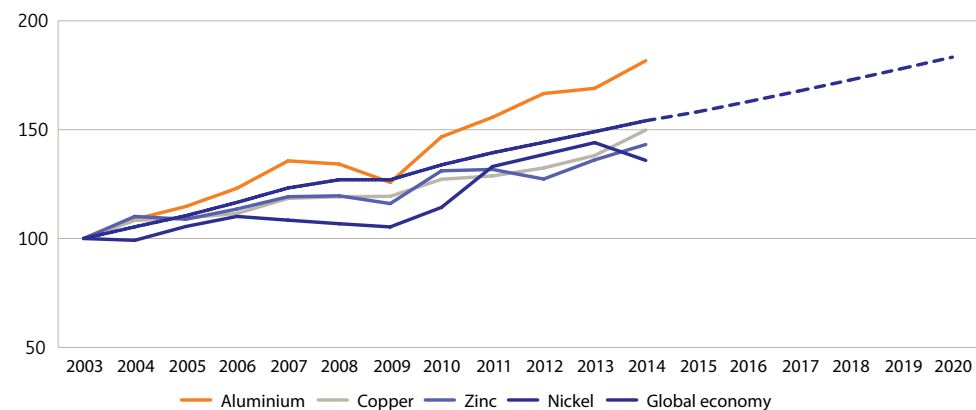
Copper ore, Chinese imports  
value in billions of dollars



Source: ING Economisch Bureau, UNCTAD

## Continued growth in global demand for metals

index 2003=100



Source: Bloomberg, ING Economics Department, UNCTAD

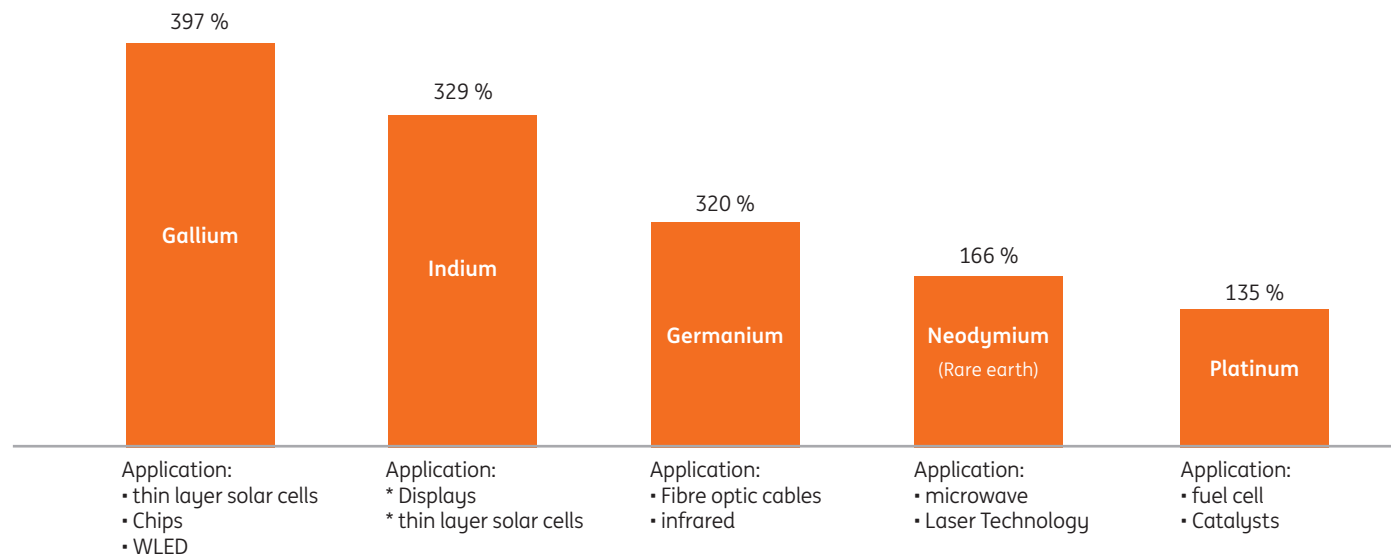
## 1.2 High demand for specific metals in 'sustainable' economy

### Critical metals are particularly common in products for which demand is increasing

In addition to the general increase in demand for metals, clear trends have emerged that will cause demand for specific metals to rise. The transition to a 'sustainable' energy supply and reduced harmful emissions is stimulating demand for wind turbines, LED lights, solar panels and electric vehicles. These products require a number of special rare earth metals (for example electric motors and permanent magnets require neodymium, LED lamps and solar cells require indium and gallium). Expected future demand will be far higher than current production, hence an increase in existing reserves will have to be addressed and more will have to be extracted from recycling or reuse.

### Five metals in new technology where future demand and current supply are far apart

Demand forecast for 2030 compared with current production



Source: EC, TNO, Fraunhofer

## 1.3 Mainly the monopolies are potentially disruptive

### Several mines outside China reopened

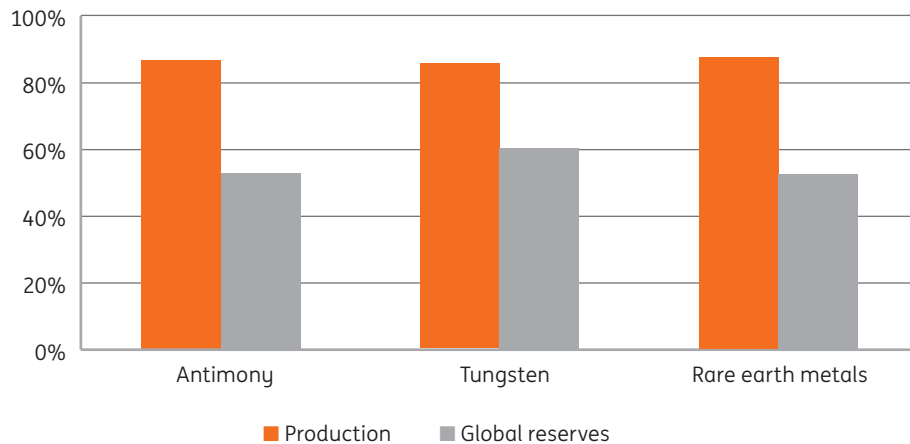
China has increasingly played a disruptive role since the 1990s, not only on the demand side but also on the supply side. China has a production share of more than 80% in several metals. What this can lead to, became evident in 2010-12, when China imposed strong restrictions on, for example, the export of rare earth metal neodymium. This resulted in a price explosion. Although China eased restrictions considerably after the intervention of the WTO and even eliminated them at the beginning of 2015, the price spike in 2011 did trigger a change. In large (industrial) countries, voices were raised to reduce the dependence on China for specific metals. After all, China is not the only country with

resources such as neodymium, tungsten or antimony, but, for a number of years, production in China received considerable subsidies as a result of which foreign mines were far from profitable.

The Californian Mountain Pass mine has been taken back into production (rare earth metals) and in south-west England, the Drakelands mine will produce tungsten as of 2015. Australia has the largest rare earth metal mine outside China (Mount Weld) and eyes are increasingly focusing on Greenland. Greenland has a wide range of metals, including the largest reserves of rare earth metals outside China.

### Share China high in production, lower in global metal reserves

China's share in global production/reserves



Source: USGS, 2013

### 2011: Policy change in China puts heavy pressure on price of rare earth metal neodymium

US\$/tonne



Source: Bloomberg

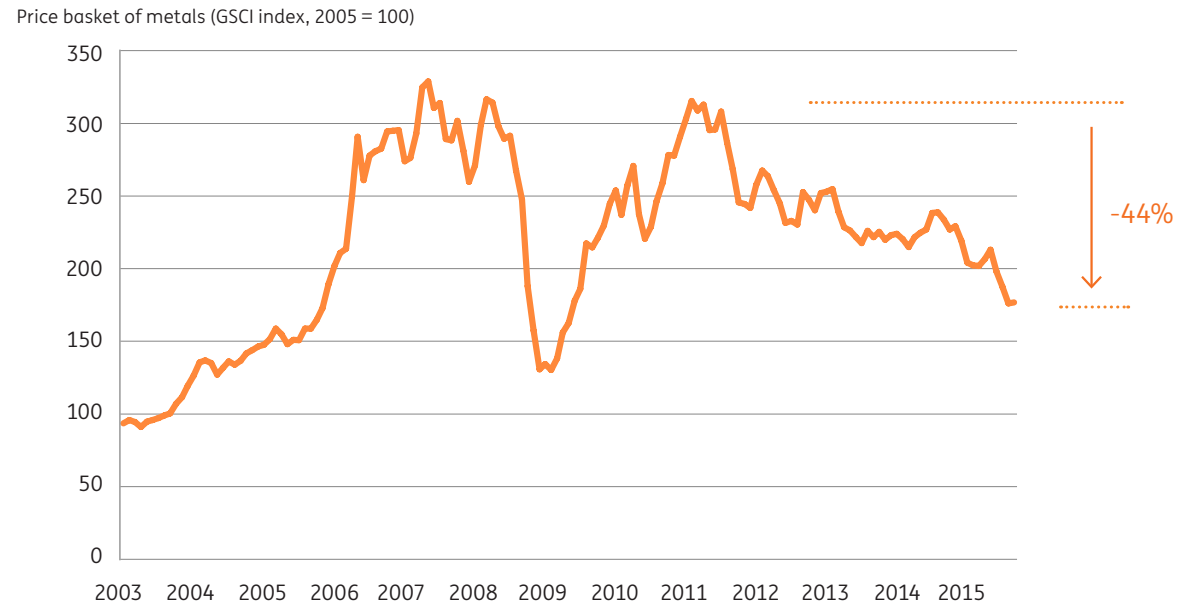


## 1.4 Metal market turned upside down within four years

### High prices on a broader front are an incentive to expand mining capacity

In addition to the 'strategic' reopening of mines, the relatively high metal prices in 2011 led to plans to increase supply on a broader front. Leading were major players such as Rio Tinto, BHP Billiton, Vale and Glencore Xstrata. Much of the then planned production is now in operation, such as the massive Oyu Tolgoi copper and gold mine in Mongolia (commenced operation in 2013, planned peak production in 2021). Such (re)openings, combined with a slowdown in the Chinese economy and a relatively favourable mood in the area of bilateral trade (with the elimination of export restrictions), have caused the prices of metals to decrease sharply across the board.

Figure: Metal prices in decline since 2011 due to the (re)opening of many mines and China's economic slowdown



Source: EcoWin

# 1.5 Pressure on industry from nature

## Nature and society force industry to invest

Despite the currently low prices and seemingly sufficient metal reserves, various longer term trends do point to future supply constraints, given the expected demand growth. This pressure has natural causes, but also stems from government regulation and societal pressure.

## Ore grades decline, 'waste' increases

In many of the mines in use the ore quality has decreased over a period of several decades. This means additional investment to get the same amount of pure product. In addition, it yields larger waste streams, because more rock remains. Mining companies have a greater responsibility to deal with these waste flows.

## Natural resources for production under pressure

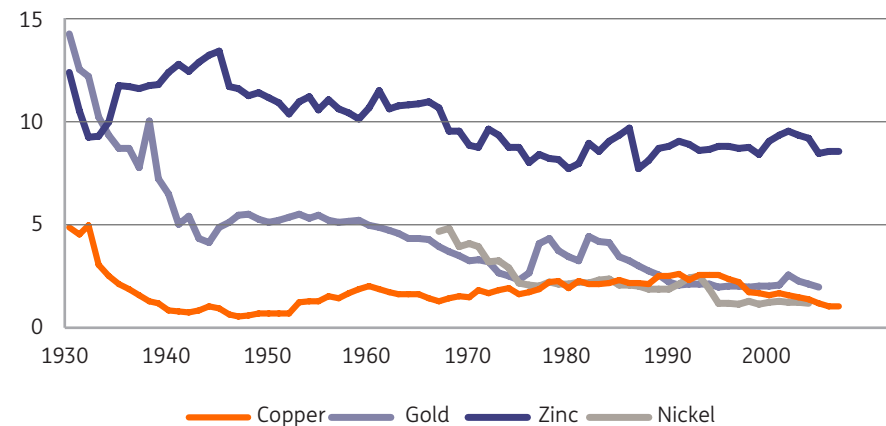
Metal mining is an energy and water intensive activity. At present, Australian mining uses 70% more energy for the same ore extraction than thirty years ago\*. And increasingly, the issue of 'water stress' needs to be put on the agenda. Costs of water infrastructure have already risen from an estimated US\$3.4 billion in 2009 to US\$12 billion in 2013\*\*. For seven of the top ten mining countries, the pressure on available freshwater by 2040 is estimated to be high to very high.

\* Source: <http://eex.gov.au/industry-sectors/mining>

\*\* Source: Ernst & Young, 2014

## Average grade of extracted metal ores increasingly lower

% copper, zinc, nickel, gold g/t



Source: Mudd, 2009, mining Australia

## Available fresh water challenge in many mining countries (metal)

Country	share of global metal mining *	Water stress 2040
United States	12.6%	● High
Brazil	12.2%	● Low
Australia	10.4%	● High
Canada	7.1%	● Low to medium
Russia	7.0%	● Low to medium
China	5.8%	● High
Chile	5.8%	● Extreme High
Indonesia	4.5%	● High
South Africa	3.6%	● High
Peru	3.5%	● High

\* added value

Source: ING Economics Department, Oxford Economics, WRI

# 1.6 Pressure on industry from regulation and society

## **Pressure from society and regulation: origin of metals and environmental impact of increasing importance**

In addition to limitations from nature that require the necessary investments, companies will face stricter rules. An example of this from the US is the Dodd-Frank Act in 2010. Companies that sell products in the US with tin, tungsten, gold or tantalum content, should be able to demonstrate that no conflict materials have been used. In addition, more accountability and transparency is demanded from businesses in terms of the environmental impact. This impact is significant with mining and increasingly the entire value chain, including processors and end manufacturers, are being held to account.

## **Low prices an attractive time to invest in a more efficient chain**

Low metal prices offer limited direct incentives for efficient behaviour or investments in recycling. At the same time, the (importing) European tech industry profits as low prices generally improve profit margins. It can, therefore, provide the financial room for necessary investment, given the future challenges that call for a more efficient supply chain.

# Investing in more efficiency and thus in lower dependency

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## 2.1 Reducing supply risk through a much more efficient supply chain

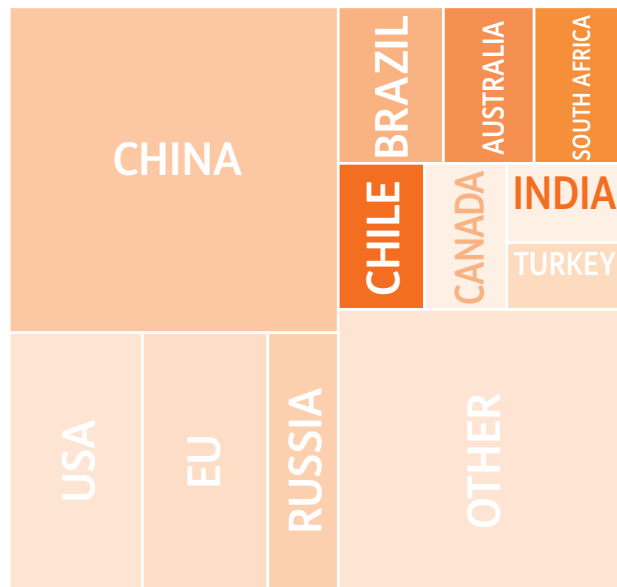
### The road to a more efficient use of resources

The position of the European technology industry in the world of metals is not an easy one. There is some production of copper, chromium, lead, silver, zinc and tungsten but the share in the world's production is limited to around 9%.

The EU adopted a Raw Materials Initiative (RMI) in 2008 based on three pillars:

- fair and sustainable supply of raw materials from global markets;
- sustainable supply of raw materials within the EU;
- resource efficiency and supply of 'secondary raw materials' through recycling.

EU's share in mining of metals limited to around 9%



Source: EC, based on list of 54 metals

### Gains to be made in resource efficiency

The reality is that when it comes to 'resource diplomacy' this is still primarily a national affair. Germany, as a manufacturing powerhouse, is relatively active, and France recently attempted to step up efforts. For countries with a smaller economy and/or relatively small technology industry resource diplomacy is much more difficult. However, in the last couple of years, the EU has signed political agreements with, for instance, some Latin American countries and Greenland. The latter has substantial reserves of rare earth and other metals.

Although the first two pillars of the RMI remain important and reflect current economic need and reality, the third is where the gains can and have to be made when striving for a more sustainable economy. Both suppliers (metal industry) and end manufacturers (electrotechnical industry, mechanical engineering, transport equipment industry) need to step up efforts to increase supply chain efficiency. This in the end not only influences demand for (foreign mined) metal, but also creates new business opportunities. We consider this more closely in the next pages.

## 2.2 Various strategies for material savings by suppliers

### 1. Use of scrap

For the metalworking industry, the purchase of equipment is a sizeable item in the income statement. Therefore, attention is already being paid to the most efficient possible use of resources. European foundries are already **using a lot of scrap**, simply because it is more efficient/cheaper. After all, aluminium, copper and other metals are easily recyclable. Large gains can be achieved in the production process: producing aluminium from (bauxite) ore, for instance, is an energy and capital intensive process while this step can be omitted when recycling aluminium. Overall, however, the share of recycling in supply is barely increasing and there is room for improved collection methods and infrastructure.

### 2. Improvements in product and/or process

In some areas of the metal industry, increasing attention is paid to further **product or process improvements** that increase resource efficiency. Tata Steel, for instance, was able to reduce the amount of zinc on steel sheets for the automotive industry without losing any functionality: a direct saving. In terms of process technology, 3D-printing can increase efficiency, both in reducing waste during the production process (which, incidentally, is generally reused) and in reducing material stocks. 3D-printing enables any design to be made from metal powder, while milling requires a number of metal blocks to be in stock in order to respond to incoming orders in good time. This also means more base material is needed.

### 3. Substitution of materials

**Substitution** of materials is another important way of optimising the use of raw materials. However, various important metals, such as antimony, indium, or tungsten, have unique properties. Other metals, such as niobium (mainly from Brazil), which is used in (stainless) steel, do appear to be replaceable. It is clear that more research is required to make progress in this area. Europe is making progress in this regard: metals are a priority and one of the focus areas of the EIT (European Institute of Innovation & Technology, with a budget of €2.7 billion until 2020) in Budapest.



## 2.3 Opportunity and responsibility for end manufacturers

### **End manufacturers are an important link in achieving efficiency and sustainability**

For links further down the chain, such as the engineering industry and transport equipment industry, the situation is different to that in metalworking. Material costs in these industries are a much smaller and decreasing part of the total cost and thus commodity prices are less relevant. Development costs and software and electronics are increasingly important.

End manufacturers play a pivotal role in realising a more efficient use of materials; perhaps the biggest step towards a circular economy can be made in the product design phase. However, to date the price and functionality of the end product are still paramount and 'design for recycling/ remanufacturing' only plays a role in niche products. An example is the market for smartphones or tablets. Competition for the consumer is so high that price and ease of use is leading. The result is a product in which components literally and figuratively are more closely connected and the recyclability is hampered. Small companies, such as FairPhone, are trying to do it differently with phones that are designed so that they are easy to disassemble and components can be reused more readily.

### **Promising trend: 'ownership to use'**

This may be changed by an important trend among the end users of machines and installations, a change from ownership to use. A trend that is not driven primarily by the sustainability concept, but due to the increasing need for flexibility and focus on core competencies by clients of tech companies.

## 2.4 Need for flexibility by end user stirs supply chain

### 'From ownership to use' for more user flexibility

Users of machinery and equipment, whether this is in the food industry, the manufacturing industry, construction or retail, are experiencing increasing competitive pressure and uncertainty regarding demand. This requires maximum flexibility in business operations and focus on core competencies. A machine is 'only' a tool to help a company deliver an end product or service. Owning this tool is not

1 2

necessary, but its use is. The machine manufacturer can remain responsible for maintenance, software updates, etc, in short, for the smooth operation of the machines, so the company that uses the machine can focus on other matters, such as product improvement/R&D or sales. Moreover, to save on costs during difficult times, the user can more easily switch back, which provides the user with more cost flexibility.

1 End market

**Trend:** Fragile economic situation

**Result:** Uncertain and volatile demand

2 End user machinery etc.

**Trend:** More flexibility required / focus on core activities

**Result:** Production equipment in use, not per se owned

3 Manufacturer of machinery etc.

**Trend:** Machinery remain possession, more control over machinery.

**Result:** Incentives for:

- Multi-usability
- Design for remanufacturing
- Building in modules

### New opportunities for end manufacturers 3

If machine manufacturers keep control over their machines and equipment, this will create new incentives to address the design and usability of the machines. Building in modules, a trend that is already in full swing to ensure efficient and customer-specific manufacturing, and thinking about multi-usability will become increasingly important. This will result in the optimal use of machines and an impetus for remanufacturing. What slows the 'circular' trend down, is that many entrepreneurs own machines or equipment that still play a major role and represent (emotional) value.

Companies that are more 'business-minded' are more open to exploring the 'circular' model. One notable example of where this is applied is Philips, which supplies lighting to Schiphol Airport as a service. Philips remains the owner of fixtures and installations. This is precisely where major gains can be achieved in terms of the circular economy and resource efficiency. But shifting to such practices means a huge impact on the (usual) business model. Also for financing the circular economy has great potential impact, concludes the ING-report '[Rethinking finance in a circular economy](#)'.

# 2.5 Conclusion

## Urgency for investments have faded, leaving future challenges unanswered

The current low price environment leads to 'tired' mining companies and the rest of the value chain being 'lazy'. Efforts to get to more efficient use of raw materials are under pressure, while in the longer term the current price environment poses challenges and investments will be required. Metal mining is coming under increasing pressure from nature, from government regulations and from society. When exactly this will pinch, it is difficult to predict. However, companies that have efficiently organized their metal use throughout the value chain are, by definition, the least vulnerable. The very low metal prices, that help increase the profits of the European (importing) tech industry, is a good time to invest in a more efficient supply chain. Increased efficiency will eventually also reduce the supply risks associated with 'foreign' metal.

For end manufacturers there is a crucial role to play in order to get the whole value chain to a higher resource efficiency level. With product design aimed at redeployment of (parts of) a product, a circular economy can be brought closer. Price incentives for this are currently limited, but the trend 'from ownership to use' creates new possibilities and new business opportunities for end manufacturers.

# Colophon

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