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## Futures food for thought



# A low-carbon sunrise for the mining industry

Takeaway

The transition to a low-carbon economy presents new opportunities for South Africa's extractive industries, provides a possible lifeline to the languishing mining sector, and offers a potential strategic advantage in the clean technology space.

The Paris Agreement seeks to restrict the global average temperature increase to the 'safer' limit of 1.5 °C above pre-industrial levels. This will lead to the large-scale adoption of low-carbon and energy efficient technologies. Using the electricity sector as an example, this paper illustrates how these technologies are wholly dependent on the availability of metals and minerals, and thus offer South Africa the potential to revitalise its extractive industries.

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# SUMMARY

South Africa is one of the leading mining and mineral-processing countries in the world.<sup>1</sup> Significant deposits of minerals and metals have meant that its extractive industries are “one of the government’s strategic tools for the economic emancipation of its people”.<sup>2</sup>

The shift to a low-carbon transition economy is *fully* compatible with the country’s endowment of mineral resources and its reliance on extractive industries. After all, the transition is contingent on the availability of metals and minerals to manufacture clean technologies. If anything, the transition opens new opportunities for economic growth, for tackling the socio-economic challenges of income and wealth inequality, and the persistent patterns of poverty and high unemployment.



1 OECD, 2013. *Environmental Performance Reviews: South Africa, Highlights*.

2 South African Government, undated. *Mineral resources*; Department of Mineral Resources, 2016. Media Statement.

# DECARBONISING THE ELECTRICITY SECTOR: LIGHTING THE WAY FOR MINING

Using the example of decarbonising the electricity sector helps to illustrate the opportunities for the mining sector.

Decarbonising the electricity sector depends on, among other things, technologies that decrease dependence on polluting fossil fuels, that reduce greenhouse gas (GHG) emissions, and that increase energy efficiency. All these technologies cannot be built without conventional metals such as steel and aluminium as well as rare earth elements (REEs) (critical metals).



**Steel** is key for building foundations, towers, gear boxes, hydraulic systems for wind energy technologies, and barrages and turbines for tidal energy.

**Aluminium** is required for rotor blades and pumped storage hydropower.<sup>3</sup>

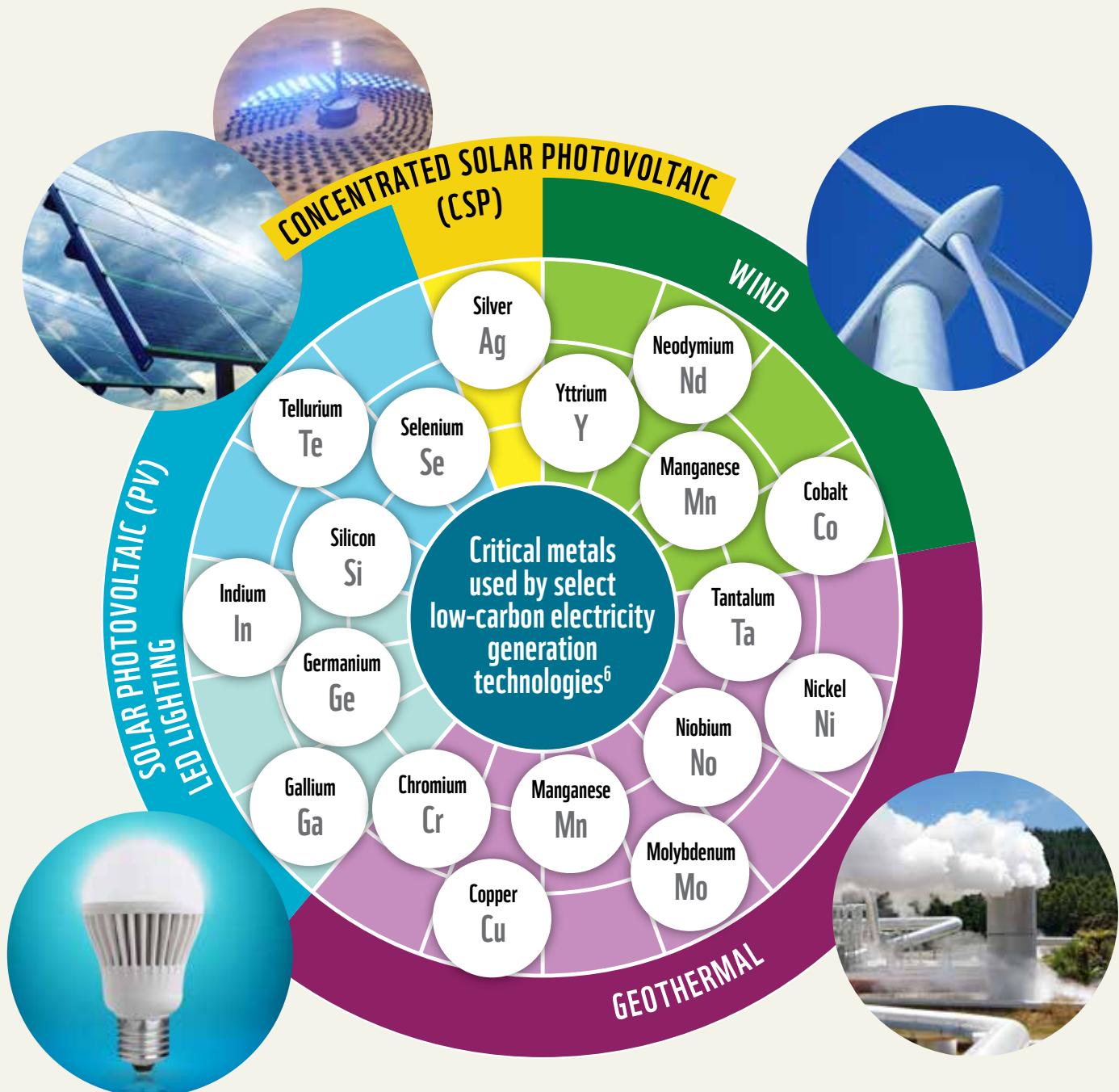
**REEs** are a group of 17 chemically similar elements including for example, indium, gallium, tellurium and germanium. (Despite the name, not all metals in the group are rare.) Some of these play a major role in the manufacturing process of photovoltaic (PV) technologies.<sup>4</sup>

3 Moss, R.I., et al, 2013. *Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector. Assessing Rare Metals as Supply-Chain Bottlenecks in Low-Carbon Energy Technologies*. Joint Research Centre (JRC), Institute for Energy and Transport (IET).

4 WWF, 2014. *Enabling Renewable Energy in South Africa Assessing the Renewable Energy Independent Power Producer Procurement Programme*.



A recent World Bank (2017) report shows that the technologies that will play an important role in the clean energy shift are “more material intensive in their composition than current traditional fossil fuel-based energy supply systems”.<sup>5</sup>



5 World Bank, 2017. *The Growing Role of Minerals and Metals for a Low Carbon Future*.

6 WWF, 2014. *Enabling Renewable Energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme*; Moss, R.I., et al, 2013. *Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector*. JRC, IET.

# METAL REQUIREMENTS FOR LOW-CARBON ELECTRICITY GENERATION TECHNOLOGIES

Different technologies have different metal and mineral requirements. A range of estimates are available for the material intensity of these technologies.

## Metal requirements for solar PV technologies

- For concentrated solar power (CSP) technologies, the specific demand for **copper** varies and is estimated at an average of 4 t/MW (Megawatts).
- The **silver** content of solar mirror also varies from 0.008 t/MW for tower technologies to 0.01 t/MW for fresnel technologies.<sup>7</sup>

### Average demand for select metals used in solar photovoltaic systems (in t/MW)<sup>8,9</sup>

Technology type	Demand (t/MW)
<b>Crystalline-silicon technologies:</b> a semi-conductor made with silicon, with crystalline solar panels arranged in repetitive units.	Silicon: 6.6 Silver: 0.08
<b>Cadmium telluride technologies:</b> a thin semi-conductor layer that uses cadmium telluride to absorb and convert sunlight into electricity.	Tellurium: 0.16
<b>Copper indium gallium diselenide:</b> a thin-film solar cell with a thin layer of copper, indium, gallium and selenide on a glass or plastic backing.	Indium: 0.03 Gallium: 0.01 Selenium: 0.16

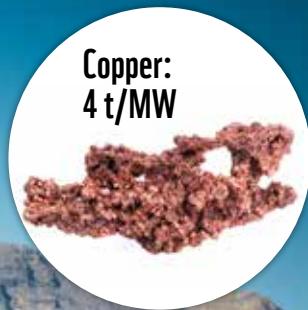
<sup>7</sup> Teske, S., et al, 2016. *Renewable Energy and Deep Sea Mining: Supply, Demand and Scenarios*. ISF, University of Technology, Sydney. Australia.

<sup>8</sup> Teske, S., et al, 2016. *Renewable Energy and Deep Sea Mining: Supply, Demand and Scenarios*.

<sup>9</sup> National Renewable Energy Laboratory; <https://www.nrel.gov/pv/cadmium-telluride-solar-cells.html>.



*Concentrated solar power – tower technologies*



**Copper:**  
**4 t/MW**

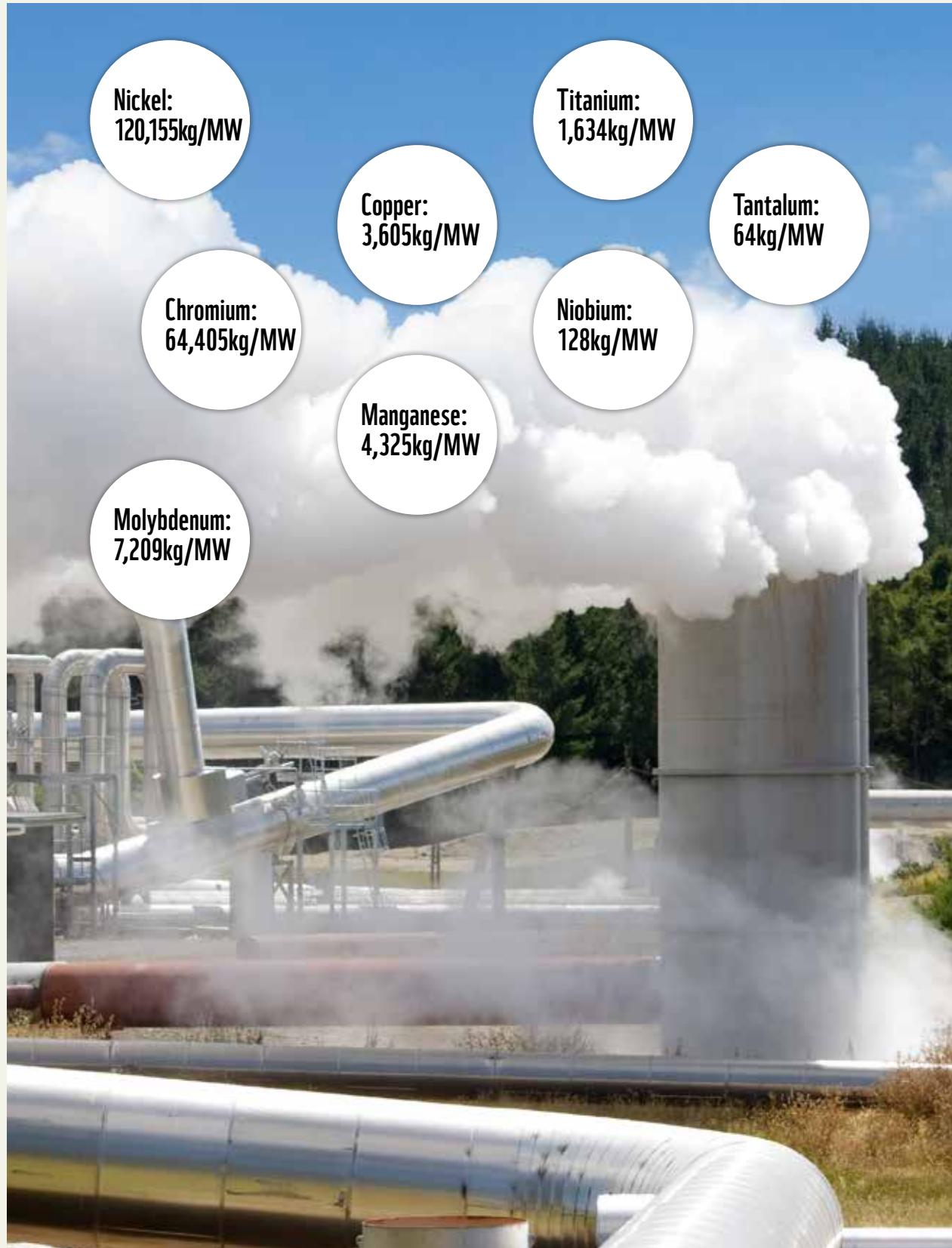


*Concentrated solar power – fresnel technologies*

**Silver:**  
**0.01 t/MW**



## Metal requirements for geothermal energy





## Metal requirements for wind technologies

Practical examples suggest that a single 3 MW industrial wind turbine uses:

- 335 tonnes of steel
- 4.7 tonnes of copper
- 13 tonnes of fibreglass
- 3 tonnes of aluminium
- 1 200 tonnes of reinforced concrete
- 500kg of REEs.<sup>10</sup>

These figures are likely to increase for bigger turbines, and whether they are off-shore or on-shore.

## Metal requirements for other technologies

Relatively new technologies and those under commercialisation, also exhibit enormous metal demands.<sup>11</sup>

- **Geothermal energy:** a renewable energy that makes use of the heat inside the earth. It requires high metal usage because of the alloys used in well piping such as chromium, molybdenum, nickel and copper.
- **Tidal energy:** a form of hydropower that converts the energy from tides into electricity. It requires significant quantities of materials for the construction of a tidal barrage.

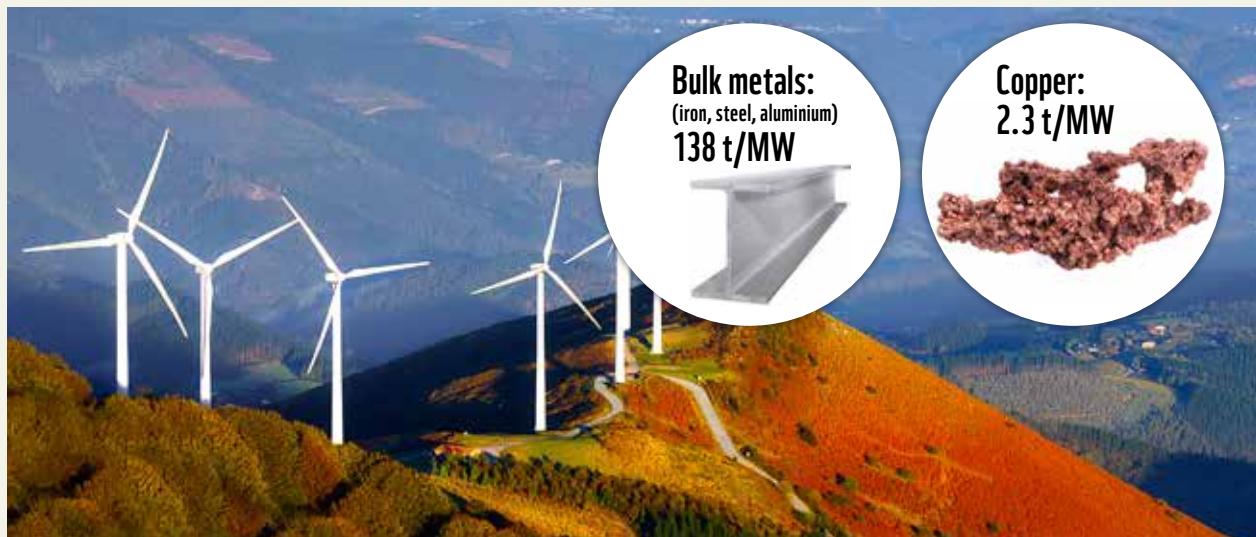
10 Baxter, R., 2016. *Mining in South Africa: The challenges and the opportunities*.

11 Moss, R.I., et al, 2013. *Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector*.

### Average demand for select metals used in wind turbines



Off-shore wind turbines



On-shore wind turbines



Direct drive turbines



## Metal and mineral requirements for infrastructure development

Apart from the technologies, their infrastructure and power storage also require metals and minerals:<sup>12</sup>

- The increasing share of renewable energy will necessitate the expansion of transmission grid infrastructure and the creation of a more flexible, decentralised energy system.
- This will create additional material demand, especially for copper which is critical for the system as a whole and for individual technologies. Copper is needed for wiring in solar technologies, for transformers for wind turbines, and for heat exchangers in geothermal power. Copper and lead are also critical for smart grids.
- Power storage also has high metal requirements, including hydrogen storage systems, lead acid batteries, nickel-cadmium batteries and lithium-ion batteries.

## Mineral and metal requirements for a carbon-constrained future

The Paris Agreement seeks to restrict the increase of the global average temperature to the ‘safer’ limit of 1.5 °C above pre-industrial levels.<sup>13</sup> Several scenarios have been developed to estimate the share of different technologies required to decarbonise the electricity sector. While the estimates of the demand for metals and minerals for decarbonisation vary, little attention is paid to the materials needed to realise the carbon-constrained future.<sup>14</sup> This is complicated by the fact that the metal and mineral requirement for each technology also varies depending on the specific sub-technologies, the design and manufacturing process, and the performance characteristics.

The demand for metals is particularly dependent on two independent variables:

- How many wind turbines, solar panels, electric storage batteries and electric vehicles will be deployed?
- Which technologies will play a dominant role in the growth of the sector?<sup>15</sup>

For example: An off-shore wind turbine (including foundation, tower, nacelle, gearbox and generator) comprises of 80% steel by mass; while the share of metal for on-shore turbines is usually lower depending on the foundation, tower technology (reinforced concrete) and the grid connection. The average copper requirement for a single 5 MW on-shore turbine is 8 tonnes compared to 30 tonnes for an off-shore turbine, as a result of the grid connection requirements.<sup>16</sup>

<sup>12</sup> Moss, R.I., et al, 2013. *Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector*.

<sup>13</sup> UNFCCC, 2015. Paris Agreement: FCCC/CP/2015/L.9/Rev.1.

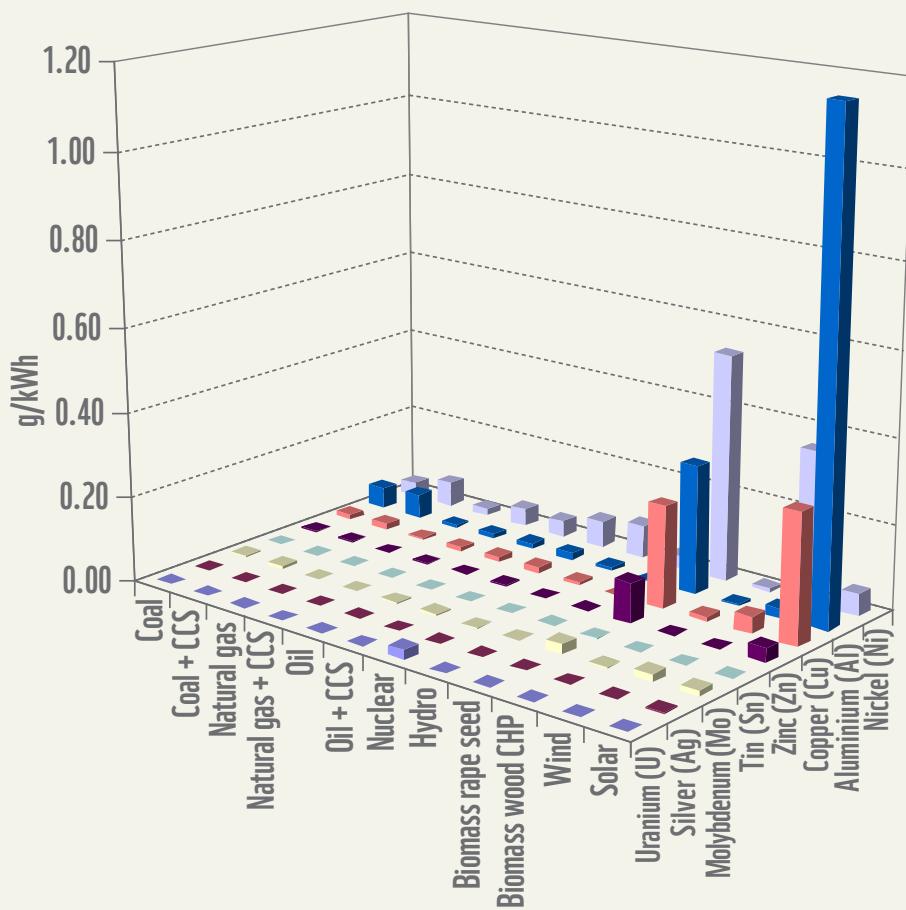
<sup>14</sup> World Bank, 2017. *The Growing Role of Minerals and Metals for a Low Carbon Future*.

<sup>15</sup> World Bank, 2017. *The Growing Role of Minerals and Metals for a Low Carbon Future*.

<sup>16</sup> VDI, 2014. In: Teske, S., et al, 2016. *Renewable Energy and Deep Sea Mining: Supply, Demand and Scenarios*. ISF, University of Technology, Sydney, Australia.

Nevertheless, all estimates point towards a rapid and steep growth in the deployment of low-carbon electricity generation technologies. Furthermore, several of these generation technologies require more metals than conventional ones, as shown in the graph below. Clearly, this suggests that demand for many metals will be maintained while demand for others will grow rapidly.

#### Metals intensity of different electricity generation technologies<sup>17</sup>



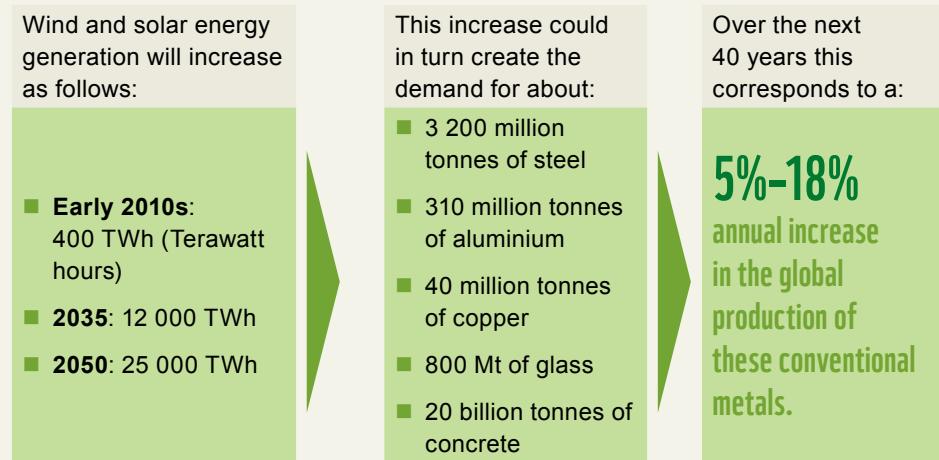
While it is difficult to accurately estimate the demand for metals and minerals for clean energy technologies, drawing on examples provides insights.

<sup>17</sup> Kleijn, R., et al, 2011. Metal requirements of low-carbon power generation. *Energy*. 36. pp 5640–5648.



### Example 1: Estimated increase in production of metals

The International Energy Agency (IEA) considers the following scenario:<sup>18</sup>



### Example 2: The growing role of metals for a low-carbon future

In the event of a 2 °C increase in average global temperature, the World Bank estimates that the demand for relevant metals needed to produce wind technologies will increase by 250%, whereas for solar PV the output of relevant metals is projected to increase by 300%. In a 4 °C scenario, it is estimated that the demand for key metals needed for producing wind technologies as well as for supplying solar photovoltaics will increase by 150%.<sup>19</sup>

*“Given recent increases in emissions and current energy policies, the possibility of a four-degree increase in global temperature is growing.”*

(Benoit, 2013)<sup>20</sup>

18 IEA, 2015. World Energy Outlook Special Briefing for COP21. In: Vidal, et al, 2013. Metals for a low-carbon society. *Nature Geoscience* 6, 894–896.

19 World Bank, 2017. *The Growing Role of Minerals and Metals for a Low Carbon Future*.

20 Benoit, 2013. *Energy Efficiency and Environment Division and Richard Baron, Environment and Climate Change Unit (ECCE), OECD/IEA*.

# CARBON CAPTURE AND STORAGE (CCS):

the process of capturing  
waste CO<sub>2</sub> from large  
sources and transporting  
and depositing it  
where it will not enter  
the atmosphere, for  
example underground

## Example 3: Metals requirement for low-carbon power generation<sup>21</sup>

A 2011 study compared the metals requirement in the global electricity mix in 2009 to the following:

- (i) The 2050 electricity mix described in the IEA Blue Map Scenario<sup>22</sup>
- (ii) A scenario where the electricity mix consists of only existing non-fossil technologies
- (iii) Decarbonisation based on the deployment of Carbon Capture and Storage (CCS) for all fossil fuel-based electricity.

The metals requirement was highest for scenario (ii). It was estimated that switching to an electricity mix consisting of non-fossil fuel, low-carbon alternative energy technologies would increase the demand for aluminium by up to 15%, silver by up to 44%, and nickel by up to 250%. The demand for molybdenum would almost double.

Numerous other studies that examine either the metals requirement for a specific scenario or the demand for individual metals in the event of the scaling up of specific technologies, have reached similar conclusions.



21 Kleijn, R., et al, 2011. Metal requirements of low-carbon power generation. *Energy*. 36. pp 5640–5648.

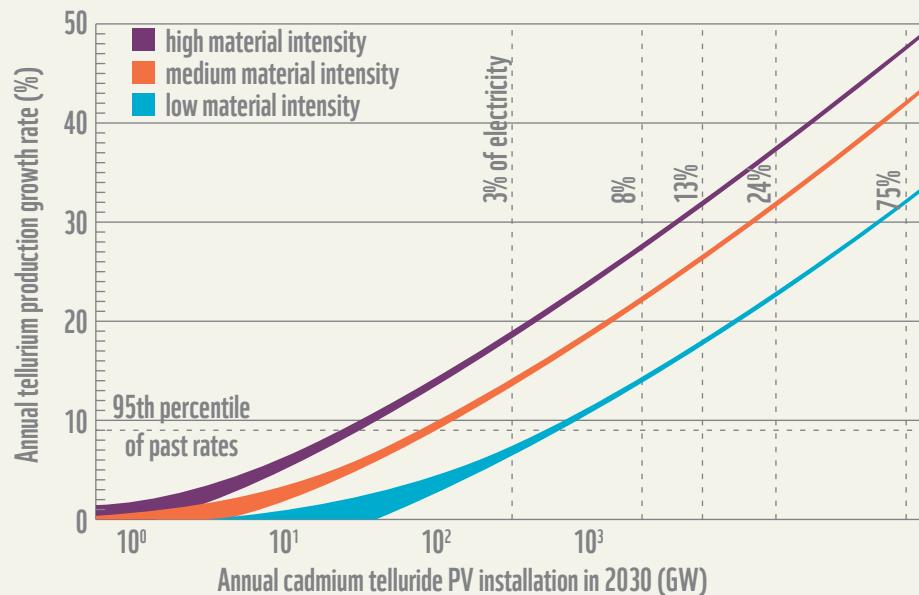
22 The IEA Blue Map scenario (with several variants) sets the goal of halving global energy-related CO<sub>2</sub> emissions by 2050 (compared to 2005 levels) and examines the least-cost means of achieving this goal through the deployment of low-carbon technologies. It also enhances energy security by reducing dependence on fossil fuels and proposes other benefits such as improved health due to lower air pollution to draw the link to economic development.



#### Example 4: Growth in metal production for solar PV<sup>23</sup>

One study concluded that for solar PV to supply even a small share of global electricity in 2030, several thin-film PV technologies would require metals production growth rates that exceed those observed historically (see below).

#### Growth rates needed in production of tellurium to match PV deployment projections in 2030 for a range of future energy scenarios<sup>24</sup>



#### Example 5: Carbon Capture and Storage (CCS)

Even a controversial technology such as CCS increases the metals requirement by 10–30%.<sup>25</sup> The requirement for steel alone goes up by 30–60% per unit of electricity generated on account of capture installation, pipelines, and injection well requirements.<sup>26</sup>

23 Kavlak, G., et al, 2014. *Growth in Metals Production for Rapid Photovoltaics Deployment*. IEEE.

24 Kavlak, G., et al, undated. *Metals Resource Requirements for a Rapidly Growing Photovoltaics Industry*.

25 International Council of Mining and Metals (ICMM). 2012. *The role of minerals and metals in a low carbon economy. Mining's contribution to sustainable development*.

26 Kleijn, R., et al, 2011. Metal requirements of low-carbon power generation. *Energy*. 36. pp 5640–5648.

# SOUTH AFRICA'S MINING SECTOR

The estimates presented so far for demand for metals and minerals are extraordinary even though they are only indicative. The increased demand will not be maintained indefinitely but the scale and pace of the low-carbon transition set in motion by the Paris Agreement suggests that demand will be substantially high in the near- to medium-term.

## Platinum group metals (PGMs)

The PGMs include six metals:

- Platinum (Pt)
- Palladium (Pd)
- Rhodium (Rh)
- Iridium (Ir)
- Osmium (Os)
- Ruthenium (Ru).

With each five-year review measuring progress towards the realisation of the goals committed to under the Paris Agreement, countries will be expected to enhance their commitment, and set increasingly ambitious goals.

Yet, not all countries produce the metals and minerals required to support these goals, or if they do, they produce them in marginal quantities. For example, European mines produce only 1.5% of iron and aluminium and 6% of copper. Furthermore, many metals do not occur as stand-alone deposits but are by-products from the production of other metals. Gallium for example, is a by-product of zinc and aluminium production.

Although South Africa's market share of global commodity production and reserves has declined, the potential continues to be huge because access to metals and minerals, and their stable supply and prices will soon begin to dominate the global agenda. South Africa has the mineral deposits, already produces some of them, and has the infrastructure and skills required for the development of these minerals, which lie at the heart of the low-carbon transition.

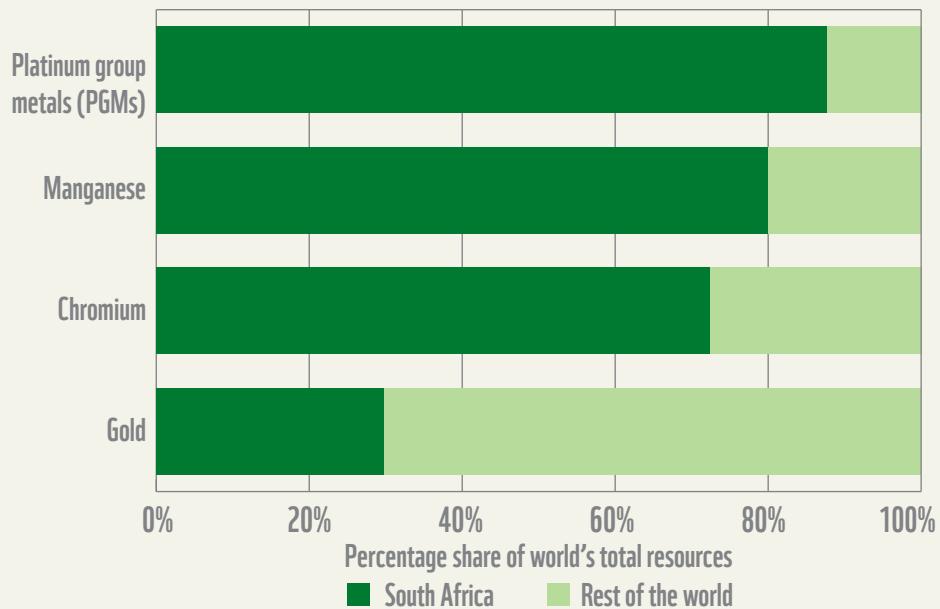
*Workers drilling in a platinum and chrome mine in South Africa*





## South Africa's metal and mineral advantage

**South Africa's percentage share of world's total resources of specific metals**



**South Africa's mineral resources (percentage of world's total reserves)<sup>27</sup>**



27 Baxter, R., 2016. *Mining in South Africa: The challenges and the opportunities*.

In addition:

- The Bushveld Complex is thought to contain some of the richest ore deposits on earth, including the PGMs, tin, iron, titanium and chromium.<sup>28</sup>
- South Africa accounts for 80% of identified manganese resources. The cumulative demand for manganese in 2013–2050, in the 2 °C scenario compared with the 6°C scenario is expected to increase by 2 590%.<sup>29</sup>
- Deposits of heavy rare earth oxides such as europium, terbium and dysprosium are thought to be available.<sup>30</sup>

In terms of global production of mineral resources, South Africa accounts for:

- Over 40% of ferrochromium, PGMs and vanadium
- 51,7% of global ferrochromium exports and 54% of alumino-silicates.

## Opportunities for the mining sector

### Creating new markets

China is South Africa's largest trading partner, with 90% of South Africa's exports to China consisting of minerals.<sup>31</sup> With China's economic slowdown, its demand for metals and minerals has tapered, leading to a slump in South Africa's mining industry. Rapidly escalating operating costs have added to the industry's problems.<sup>32</sup>

However, low-carbon technologies can provide a new and sizeable market for the country's mining industry or allow the country to increase or rebuild trade linkages with other countries that seek to manufacture these technologies. In fact, with China becoming a leading manufacturer of low-carbon technologies, demand from China for metals could see an upturn in the future.

### Anticipated increase in commodity prices

China's economic slowdown not only affected South Africa, but led to a decline in global prices for metals and the end of the global mining super-cycle. In 2015, for example, commodity prices for iron ore fell by 41%, for platinum by 19%, and for copper by 18%.<sup>33</sup>

However, the manifold increase anticipated in the scale and pace of the low-carbon transition means that commodity prices could rise once again, thereby providing a new lease of life for the country's mining industry.

28 Hydrogen South Africa (HySA), 2015. *Hydrogen and Fuel Cell Technologies. Frequently Asked Questions*. Department of Science and Technology, Republic of South Africa and South African Agency for Science and Technology Advancement (SAASTA).

29 World Bank, 2017. *The Growing Role of Minerals and Metals for a Low Carbon Future*.

30 Frontier Rare Earths, undated. Zandkopsdrift rare earth project comprises an area of approximately 60,000ha in the Namaqualand region of the Northern Cape Province, of the Republic of South Africa and includes the Zandkopsdrift rare earth deposit.

31 Igbinoba, E., 2016. CCS Commentary: Beijing's policy impact on South Africa's mining industry.

32 Baxter, R., 2016. *Mining in South Africa: The challenges and the opportunities*.

33 Igbinoba, E., 2016. CCS Commentary: Beijing's policy impact on South Africa's mining industry.



## **Investing in modernisation**

The interplay of falling commodity prices and increasing operating costs means that the industry in general has made limited investment in the modernisation urgently needed so as to enhance productivity and improve competitiveness. Investment has not been economically viable. The growing market for low-carbon technologies and rising demand for metals can provide the incentive for such investment.

## **Engaging in exploration and development**

Rising demand for metals from low-carbon technologies and the resulting increase in commodity prices could be the incentive the mining industry needs to engage in further exploration and development to overcome the problems of aging mines and declining metal grades. The size of demand for some metals may mean that the industry could potentially bring lower-grade mineral deposits into production.

## **Investing in refining infrastructure**



*Bauxite is the main source of the rare metal gallium*

Given that the country has an established mining industry, it can create the infrastructure required to refine specific metals and to extract metals that are by-products of other metals production. For example, less than 10% of gallium in bauxite is currently recovered, mainly due to a lack of refining equipment.<sup>34</sup> South Africa's aluminium-related industrial base could provide an opportunity to set up the refining infrastructure required for the extraction of gallium.

## **Developing a low-carbon technology manufacturing base**

Deployment of low-carbon technologies within the country, such as wind and solar, under the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has been accompanied by local content requirement that seeks to promote the domestic manufacturing of these technologies. Increased domestic ambition for renewable energy and the low-carbon transition have the potential to provide a double dividend by way of reduced GHG emissions and reindustrialisation, on the back of a revitalised mining industry. In addition, the global ambition influenced by the Paris Agreement would provide a major impetus for the growth of a low-carbon technology manufacturing base, ably supported by the country's metal and mineral resources.

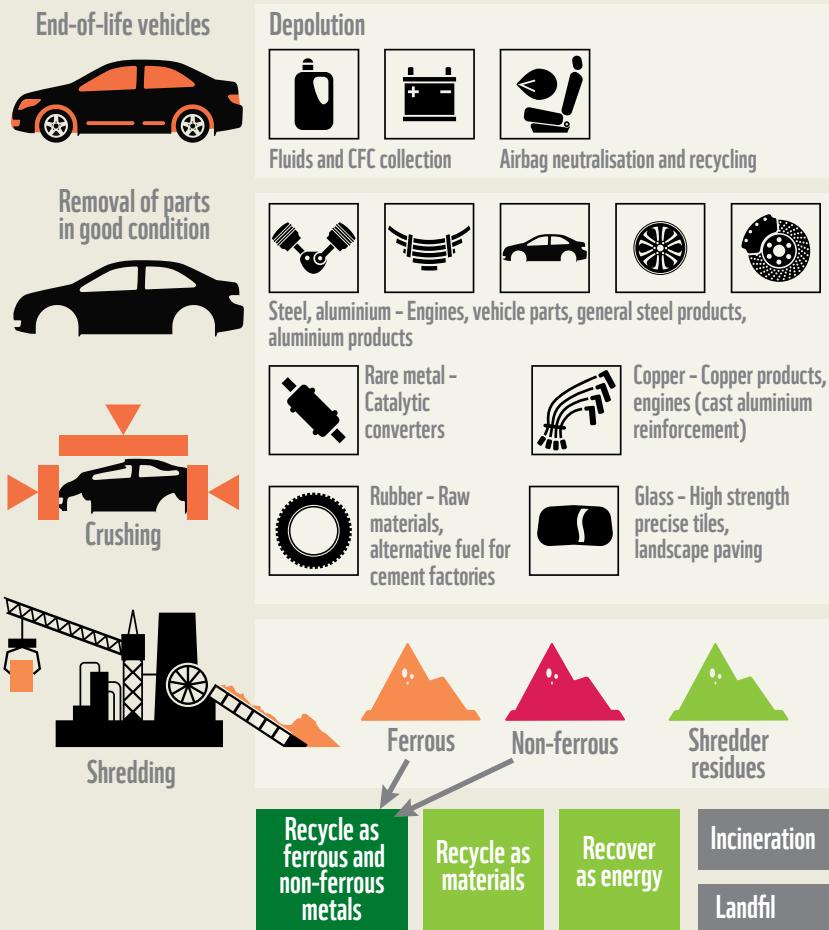
## **Renewable energy for cheaper electricity**

A growing domestic low-carbon manufacturing base would lead to economies of scale and catalyse price reduction for energy produced by renewable energy technologies. With the South African mining industry turning to renewable energy for cheaper electricity in light of grid-based electricity prices increasing by almost 20% from 2008 to 2014,<sup>35</sup> the industry only stands to benefit from the low-carbon transition.

<sup>34</sup> JRC, 2011. In: WWF, 2014. *Enabling Renewable Energy in South Africa Assessing the Renewable Energy Independent Power Producer Procurement Programme*.

<sup>35</sup> Baxter, R., 2016. *Mining in South Africa: The challenges and the opportunities*.

## Recycling of metals



**The metals and critical raw materials in vehicles are 95% recyclable.**

Recycling is at the heart of the green economy. Many metals, including iron and steel, lead, copper and aluminium, can be recovered from products at the end of their life without impacting their quality. Recycling these products provides an important additional supply of metals to complement that derived from mining. It may also be more cost-effective than mining.

However, in the near-term, recycling may not be sufficient to meet the scale of dramatic demand for growth. Often, waste streams contain limited amounts of valuable metal by mass, making transport uneconomical over large distances. In the medium-term, recycling can play a valuable role in improving the security of metal supply, particularly for countries or regions that rely on imports as their primary source of critical metals. But even then, it cannot meet all demand.<sup>36</sup>

<sup>36</sup> European Environment Agency (EEA), 2011. Earnings, jobs and innovation: the role of recycling in a green economy. *EEA Report*. No. 8/2011.



# BEYOND THE MINING SECTOR

Historically, South Africa has used its cheap and ample supply of coal to drive industrial development in a form of capital accumulation dependent on vested interests around mineral extraction and processing.

This system has come to be defined as the Mineral Energy Complex (MEC). The coming carbon-constrained future makes it imperative for the MEC to also shift, for example towards using clean technology, amongst other things.

## Expanding clean energy technologies

In recent years South African industries have faced electricity shortages as well as electricity prices that are increasing at a significantly faster rate than average prices.<sup>37</sup> These are barriers to continued industrial production and seriously threaten growth. Expanding the country's renewable energy offers a great opportunity.

South Africa has some of the highest levels of solar irradiation in the world, and in line with global trends, the price of renewable energy-based electricity is rapidly declining.<sup>38</sup> These factors suggest that the country can continue to use its value proposition of abundant mineral resources and the low-carbon transition to regain and develop a thriving industrial base, while reviving its offering of cheap and abundant energy for such a base.

## Re-developing the manufacturing industry

The shift towards clean technology presents many advantages:

- The country will be able to re-develop the **manufacturing sector**, thereby enabling higher growth rates in the economy.
- Manufacturing will shift towards to **high value-added activities**. Historically, most of the country's minerals have been exported in primary metal forms. This prevents the country from reaping the full benefit of its very rich resource base. A manufacturing base built on minerals and clean technologies can add value to these exports by converting ores to primary metals and primary metals to higher value-added manufactured products. As it stands, failure to upgrade its resource-based industries has made the country vulnerable to the global trend of deteriorating terms of trade for commodity producers. Manufacturing will also complement the service sector because high-value

<sup>37</sup> WWF, 2017. *Industrial Scale Solar Heat in South Africa: Opportunities in agri-processing and textiles*.

<sup>38</sup> WWF, 2014. *Enabling Renewable Energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme*.

manufacturing will generate demand for the provision of technology-intensive and high-value services.

- Finally, a clean technology manufacturing base could **drive down the prices of clean energy technologies** within the country, thereby generating further benefits of energy security, supply of affordable energy, and cheap energy for attracting industrial investments.

## FOOD FOR THOUGHT

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- The low-carbon transition of the South African economy is often portrayed as being in conflict with mining and as such is criticised for being ‘anti-development’. However, the transition is actually **contingent on the availability of the metals and minerals** necessary for the manufacturing of clean technologies.
- The low-carbon transition will lead to **increased demand for metals and minerals** on several other counts as part of the green economic transition. For example, platinum-based fuel cells are being explored to supply heat (and decentralised power) to buildings and industries, especially in colder countries, offering high efficiency and low emissions.<sup>39</sup>
- Hybrids and plug-in hybrids, full electric vehicles and fuel cell vehicles require:
  - **Metals in high tech parts** like batteries, electro-motors and fuel cells<sup>40</sup>
  - PGMs for exhaust system catalysts, catalysed particulate filters and emission absorbers that convert 99% of combustion engine pollutants and enable emissions reductions for vehicles
  - Chromium, manganese, aluminium, iron ore and coal for the body of the car
  - Copper, gold platinum and tungsten for the wiring and circuitry, and cobalt, lead, lithium, and rare earth oxides for batteries.<sup>41</sup>
- The transition to a largely electric vehicle fleet would create a generous demand for certain minerals and metals. For example, estimates for copper used in different cars include:
  - 20kg used in an average gasoline-powered car
  - 40kg used in a hybrid car
  - 80kg used in a fully electric car – four times the amount of copper used in a conventional car.

Mining is at the heart of the South African economy, and will remain crucial for the low-carbon transition in the country. Irrespective of the future mix of low-carbon technologies, **the demand for metals and minerals will abound**. South Africa needs to embrace this opportunity to revive its mining industry to become a leader in the manufacturing of low-carbon technologies, to re-industrialise its economy.

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39 HySA, 2015. *Hydrogen and Fuel Cell Technologies. Frequently Asked Questions*. Department of Science and Technology, RSA and SAASTA.

40 Kleijn, R., et al, 2011. Metal requirements of low-carbon power generation. *Energy*. 36. pp 5640–5648.

41 ICMM, 2012. *The role of minerals and metals in a low carbon economy. Mining's contribution to sustainable development*.



# TALKING POINTS

- How can the available knowledge regarding the required scale and pace of a low-carbon transition set in motion by the Paris Agreement be used to re-develop the national agenda for mining?
- What would it take for South Africa to become a competitive supplier of metals and minerals for the global low-carbon transition?
- Given South Africa's minerals resources, what is a realistic estimate of the global market share for the country?
- Does the mining industry have access to efficient and cost-effective infrastructure to meet the demand associated with the achievement of the Paris Agreement?
- Can the low-carbon transition coupled with the country's rich minerals base restore the country's energy rich status?
- How can the low-carbon transition be used to manage risks and create growth opportunities for the mining sector in the South Africa?
- How does the domestic ambition for low-carbon transition change in light of the abundance of metals and minerals that are critical for this transition?
- What will be the impact of exporting these metals and minerals to other countries, when South Africa itself needs to transition towards a low-carbon future?
- How can the country ensure secure and sustainable production of metals, while minimising the environmental challenge associated with tapping the potential global market for low-carbon technologies?
- What are the challenges facing the sustainable development of mining?
- To what extent can recycling end-of-life metals supplement or substitute the demand for metals and minerals, for which ones, and over what timeframe? Does the country's mining industry provide a base for the creation of a metals recycling industry?
- How can the country's abundant wealth of minerals and low-carbon energy sources reinforce each other to develop and advance a clean technology manufacturing base?
- With increased mining leading to additional energy use, how can the deployment of renewable energy technologies support the sector's energy needs and mitigate its high GHG emissions?



## Futures food for thought

The climate change mitigation debate in South Africa needs to move from improving efficiency within a projection of the existing economy, to innovation and options beyond the constraints of the current dispensation and structure of the economy. It may take step changes in the development path to achieve mitigation adequate to South Africa domestic and international commitments, and maximise economic development and social wellbeing. Business models presently unconsidered may be waiting in the wings.

The ‘Low-carbon development frameworks in South Africa’ project seeks to deepen understanding of, and reveal opportunities for, transitions to a low-carbon economy. It facilitates and develops contributions at the intersection of climate change mitigation, economic development and socio-economic dimensions, across immediate, medium and long-term horizons.

Working variously with government, business and labour, the project reaches from providing input to emerging government mitigation policies and measures; through investigating the business and socio-economic case for selected mitigation initiatives which hold growth potential in energy, transport, industry, waste, and land use; to analysing potential future economic trajectories and the systemic opportunities offered by these.

This paper is one in a set of ‘Futures food for thought’ papers. It examines how mining, which is at the heart of the South African economy, will remain crucial for the low-carbon transition in the country.

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TOPICS IN SERIES	
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	LABOUR MARKET
	CONSUMPTION
►	INDUSTRIALISATION
	NEEDS
	POLITICAL ECONOMY
	TRADE
	INEQUALITY

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**WWF South Africa’s Policy and Futures Unit** undertakes enquiry into the possibility of a new economy that advances a sustainable future. The unit convenes, investigates, demonstrates and articulates for policy-makers, industry and other players the importance of lateral and long term systemic thinking. The work of the unit is oriented towards solutions for the future of food, water, power and transport, against the backdrop of climate change, urbanisation and regional dynamics. The overarching aim is to promote and support a managed transition to a resilient future for South Africa’s people and environment. The organisation also focuses on natural resources in the areas of marine, freshwater, land, species and agriculture.

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