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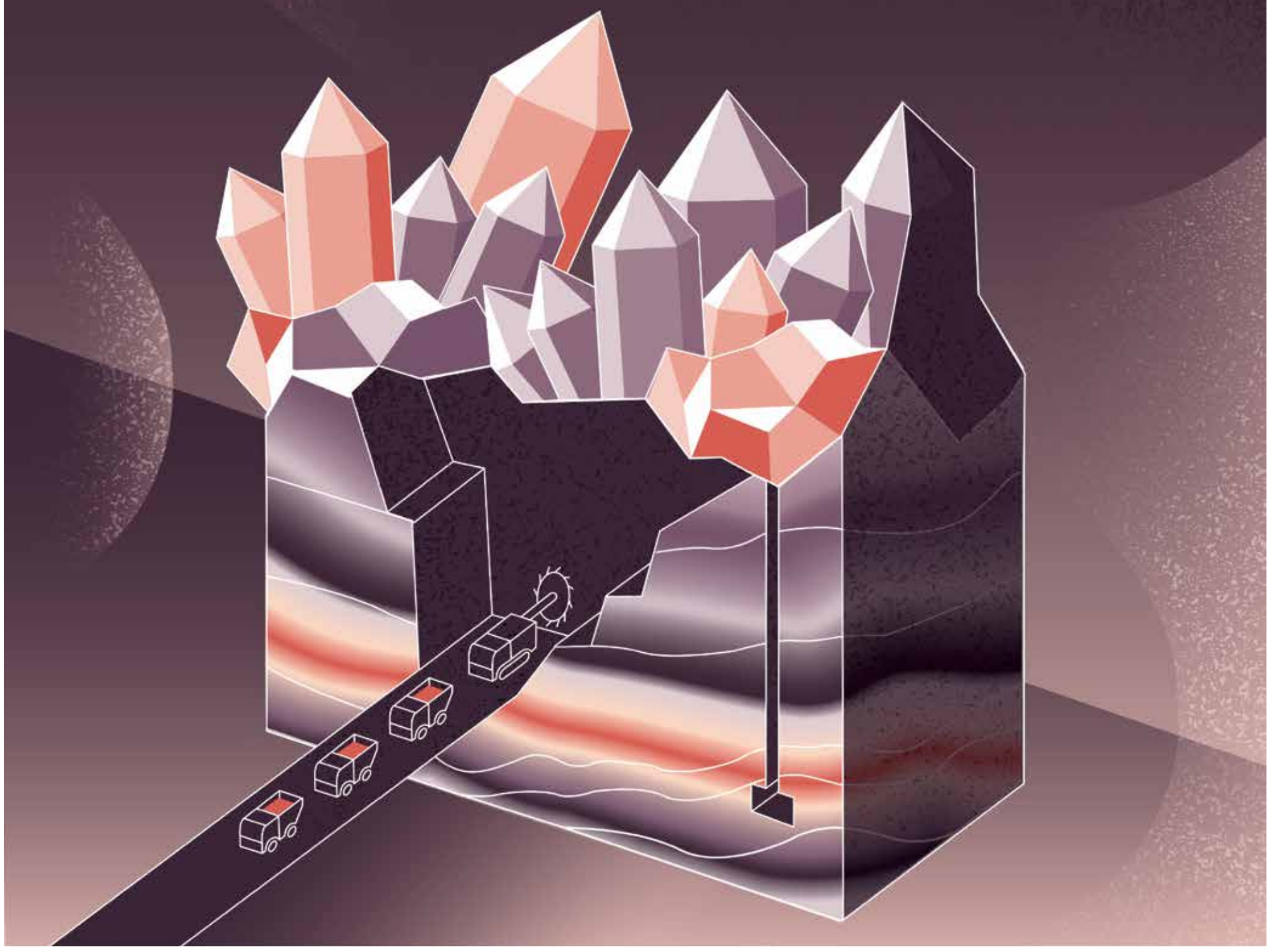

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Digging for economic and social victory

Mining has a major impact on the environment, but it also represents a valuable opportunity to benefit national economies and local communities

SHARON THIRUCHELVAM

Even in the so-called digital age, the mining sector remains fundamental to almost every aspect of the economy. For every job created in mining, the International Council on Mining and Metals (ICMM) estimates a further two to five are created in other sectors. And yet, even as mining technologies grow more sophisticated, the sector remains highly diversified and its problems highly complex.

Risk is endemic. With revenues buffeted by the stock market, reserves diminishing and new mines often taking decades to become operational, mining companies must also navigate complex political, environmental and social governance issues at every stage of the mine's lifetime.

For all the challenges it poses, responsible mining is "a realistic goal", according to the inaugural Responsible Mining Index (RMI). Launched in April, the RMI ranks 30 multinational mining companies against benchmarks in economic development, environmental responsibility, business conduct, working conditions, labour conditions, community wellbeing and lifecycle management.

Anglo American was the standout performer in 2017, owing to its investment in the economies of producing countries, its human rights due diligence and engagement with local communities, the RMI shows. Yet, the fact that almost two thirds of indexed companies performed well in at least one area, but poorly in others, demonstrates how difficult it is to balance the demands of responsible business.

Getting this balance right is crucial, especially in low-income countries where the multinational mining sector has the greatest potential to do good or harm. Low-income nations are disproportionately dependent on mining exports as a source of revenue; a dependence that has increased over the last two decades even as commodity prices have fallen, the ICMM's *Role of Mining in National Economies* report says.

Good governance is the real determinant of the economic and social contributions of mining, such as the prevalence of corruption, and a country's capacity to estimate returns from mining and negotiate mining taxes effectively. The majority of governments, some 66 countries out of the 81 assessed by the 2017 Natural Resource Governance Index (NRGI), inadequately govern their oil, gas and mining sectors. Fewer than 20 per cent were good or satisfactory.

Conveyor belt moving rock ore in the production plant at Randgold Resources' Loulo-Gounkoto complex in Mali

Simon Dawson/Bloomberg via Getty Images

Efforts to improve reporting have had an enormous impact on holding all stakeholders, whether mining companies, government officials or other contractor, to account. The hallmark Extractive Industries Transparency Initiative requires countries to file annual reports on mining data along the extractive industry value chain, from contracts and licences, production, and revenue collection and allocation, to social and economic spending.

Multinational mining companies, if they themselves are compliant and accountable, have an opportunity to encourage and build capacity in their host nations. "In countries or regions where government is weak or unable to provide basic services to its citizens, communities often look to mining companies to fill gaps with corporate social and infrastructure investment," says Professor Neville Plint, director of the University of Queensland Sustainable Minerals Institute. Indeed, the mining sector impacts 11 out of 17 of the millennial sustainability goals, according to the United Nations Development Programme.

Many of the most successful case studies profiled by the ICMM are in fact partnerships between mining companies and host governments, and civil society, says Professor Plint. Mining companies have realised that communities living adjacent to operations typically bear the highest costs and see the fewest benefits from extractive enterprises, which accrue nationally and internationally. In Peru, for example, Glencore has worked to support the capacity of local communities through agricultural and business training.

Poverty does not have to be an insurmountable barrier to managing the mining sector sustainably. Burkina Faso was ranked highest among the low-income countries covered by the NRGI, with its mining sector ranked 20th overall. By the same measure, developed economies are by no means immune to a governance shortfall.

The NGRI notes that the trend towards silencing civic dissent in resource-rich countries is troubling. Daniel Kaufmann, NRGI president and chief executive, says: "Where freedoms of citizens and journalists are under attack, governance of the extractives sector is fundamentally impaired."

Indeed, many of the systemic issues facing the mining sector are true irrespective of where a mine is located. The fallout from the sudden loss of employment to communities when a mine closes is one of the thorniest issues facing mining companies looking to improve their social and environmental impact, according to the ICMM, with 75 per cent of mines closing prematurely.

Companies further along the supply chain also have an important role to play in leading the demand for ethical supply, particularly if sourcing from intermediaries, which usually buy from artisanal and small mines (ASMs).

For all the headlines the top five multinational mining companies – Glencore, BHP, Rio Tinto, China Shenhua Energy and Vale – attract, the ASM sector employs more than 90 per cent of the world's 40 million miners, according to Human Rights Watch (HRW). Often unlicensed and unregulated, working conditions in small mines are among the world's worst. Child labour persists in ASMs in Mali, Ghana, Nigeria, Zimbabwe, Tanzania, Papua New Guinea and the Philippines, HRW says.

Public pressure from consumers and investors also drives change. Consumer-facing industries such as luxury jewellery were the first to inspire "ethical sourcing" initiatives in diamonds and gold. This year the Better Cobalt pilot launched with the support of Chinese mining company Huayou Cobalt in the Democratic Republic of Congo, where at least a fifth of the cobalt that is exported, and will end up in smartphones and electric vehicles, comes from ASMs.

In the near future, automation, sensors, robotics and bio-technologies will boost the mining sector's efficiency and ability to measure performance. But its potential to do overall good will still hang on human decision-making. "We often underestimate our ability to make technological breakthroughs and overestimate our ability to make the social changes required to benefit from the new technologies," Professor Plint concludes. ◆

75%
of all mines close prematurely, which can often lead to a sudden loss in employment
ICMM

2-5
jobs are created in other sectors when one mining job is created
ICMM

9/10
miners worldwide are employed by artisanal and small mines, often known for poor working conditions
Human Rights Watch

Commercial feature

Portuguese mining at centre of secure, affordable lithium

Iberian mining is critical to ensure a reliable supply of lithium for car batteries and renewable energy as a strong European value chain emerges to counterbalance Asia-Pacific production

A confluence of demand factors is opening up enormous new opportunities throughout the lithium supply chain in Europe.

While the nexus between Australian suppliers and Chinese processors remains the foremost lithium supply chain set-up in the world, as a result of the strategic emphasis placed on its progress by the Chinese government, the balance is changing.

For now at least, the European lithium value chain is in development, but that could soon advance with the help of traditional open cut mines. A leading example of this is the mine being developed by Savannah Resources at its Mina do Barroso project in northern Portugal.

Evaluation of the mine has been fast-tracked, with around nine million tonnes of material defined to date and expectations that there will prove to be up to 20 million tonnes of material at the site. The aim for Savannah Resources is that the mine should become a leading major source of lithium spodumene concentrate in Europe, with a wealth of downstream opportunities expected to spring from that basis.

Key to the potential profitability of the mine and of Savannah Resources as an AIM-listed operation, is the growing demand for batteries capable of storing energy for electric vehicles and industrial-scale renewable energy supply facilities.

"The unique factor about the Mina do Barroso project is that it is the only open cut mine in Europe which has all the characteristics that make it identical in many ways to a very successful Australian lithium mine," explains David Archer, chief executive of Savannah Resources. "We believe it is potentially the centre piece to the upstream part of the lithium value chain in Europe."

The downstream end of the lithium value chain is currently only "partially complete", but nonetheless very significant, Mr Archer says, pointing to Europe's active and profitable motor vehicle industry as a key driver of demand for the material.

"European car manufacturers are clearly looking to eventually substitute electric cars for traditional internal combustion engine vehicles, so we think that our project will be a very important part of creating a more continuous lithium value chain," he says.

For the European Union, the issue of establishing a complete lithium supply chain has very broad strategic importance, given the significance and scale of the Continent's car manufacturing. "It's a big-ticket issue," says Mr Archer. Creating a full lithium supply chain in Europe would lower transport costs for those involved, and add valuable supply chain security and autonomy in decades to come.

The benefits of these developments are likely to be felt not just by car makers, but also by renewable energy operators, for which lithium plays an important role in storage, management and redistribution processes. All this underpins environmental sustainability strategies and carbon emission reduction efforts.

Mr Archer is in no doubt about the prospects for the region as pioneered by the Mina do Barroso project. "I certainly think that the northern part of Portugal will soon be the major lithium producing region of Europe," he concludes. "And there is undoubtedly potential for Portugal to host downstream industries associated with that production on a significant scale."

For more information please visit savannahresources.com

Uses of lithium

3-5g
Smartphones

40-60g
Power tools

40-80kg
Hybrid and electric vehicles

~200kg
E-buses

COBALT

Race is on

Major market drivers are manoeuvring for pole position in the race for control of sought-after cobalt supplies

HEIDI VELLA

Cobalt is vital for jet engine alloys and everyday electronics, like smartphones and laptops. But it's the chemical element's part as a key component in lithium-ion batteries (LIB), accounting for around 20 per cent of the raw material needed for cathodes, which has seen interest in the commodity reach feverish heights.

Presently the electric vehicle (EV) battery market only accounts for around 10 per cent of total cobalt usage, but sales of EVs are skyrocketing – up 58 per cent globally in 2017, according to Darton Commodities – driven primarily by China.

The huge sums of money being pumped into EV development by the automotive sector and announcements of several new LIB production factories planned has shaken the market.

Because eventual widespread EV adoption is now considered a certainty, with some reports forecasting the technology will reach price parity with conventional cars by 2025, since January 2016, cobalt's market price has surged around 280 per cent, Darton Commodities says.

The race to secure supplies of cobalt has become urgent and China has taken the lead. Chinese chemicals firm GEM recently secured a deal with Glencore, the largest producer globally, for more than 50,000 tonnes of cobalt over three years, which represents around a third of the company's total planned production during this time.

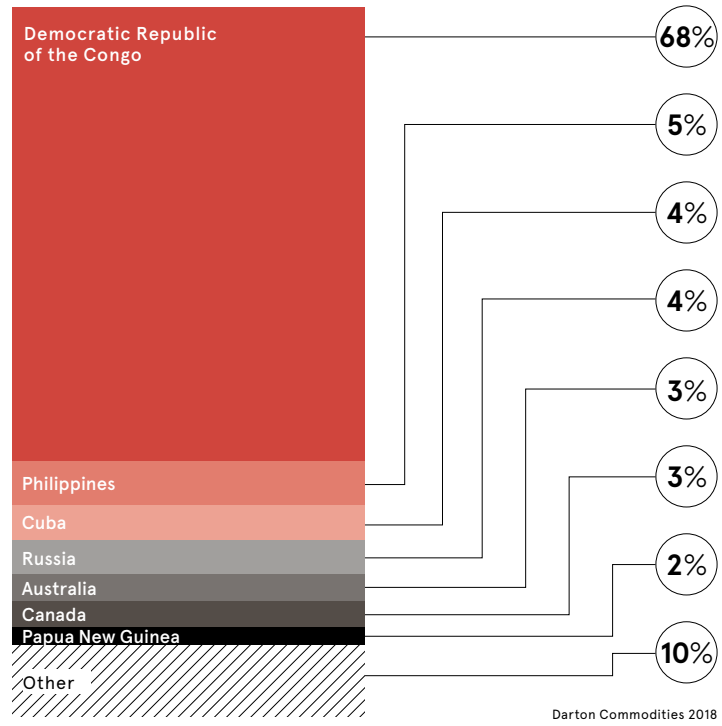
Apple has reportedly been in talks to buy long-term supplies of cobalt directly from miners for the first time ever and Volkswagen has had several failed attempts to lock in supply deals.

As the race for cobalt revs up, its production is getting evermore complex. Most major cobalt producing mines are located in the Democratic Republic of Congo (DRC) where roughly 52 per cent of the world's reserves lie in the African copper belt that also includes northern Zambia. Last year, 67 per cent of global mined supply came from the DRC, which is seen as politically insecure.

The next two big production expansion projects are also in the DRC: Eurasian Resources Group's Roan Tailings Reclamation (RTR) project and Glencore's Katanga, both of which would increase the concentration of cobalt coming from the country to around 75 per cent of the global total.

Knowing it effectively has a monopoly, the DRC government recently passed a new mining code that will, when enacted, ramp up royalties on the commodity from 2 to 10 per cent if it is labelled as "strategic". An adviser to the mining minister has told *Reuters* that this is likely. Other new terms include a 50 per cent super profit tax on what the government deems excess profits and a 10 per cent

Mined cobalt by country of origin 2017



Darton Commodities 2018

for key element in EV batteries


Photoshot/Alamy

Konkola Copper Mines' Nchanga copper-cobalt mine in Zambia

capital stake of a company to be held by Congolese private citizens.

A delegation of mining executives was visiting the DRC negotiating for the new terms to be revised.

Nick French, director at Cobalt27, which manages a portfolio of cobalt royalties as well as physical reserves, says overall there will be three main impacts of the new code: an upward pressure on price; a disincentive for new investors; and potential postponement of projects coming online.

Glencore, for example, could delay production at Katanga or choose to stockpile reserves as ongoing negotiations provide little incentive to rush the project, even if demand is growing.

Peter Ruxton, principal at Tembo Captial, a private equity firm with interests in Nuzuri Copper, which owns the Kalongwe Copper Cobalt project in the DRC, says the new mining code will mean fewer projects are economically viable in the country, especially the smaller ones. Furthermore, if copper, which cobalt is a by-product of, is also branded strategic, the economics will be even more challenging.

"In high-risk destinations like the DRC, companies look for high rewards. Under these new terms, it will become difficult to justify investment there based on the risk-reward

$100k

estimated price per tonne of cobalt by the end of 2018, almost double the price this time last year

Capital Economics 2018

> **As the race for cobalt revs up, its production is getting evermore complex**

equation," says Mr Ruxton, adding that the firm will not seek future investments if nothing changes.

Increasing taxation in the DRC, shortage of supply, coupled with China's growing dominance and an anticipated exponential increase in demand have created a "perfect storm", says Mr French. "All these factors need to be seen holistically. Individually they may not have had a major effect, but the cumulative impact is significant," he says.

Most major analysts agree there will remain an upward pressure on price. Capital Economics' end-of-2018 forecast for prices is $100,000 per tonne, up from $94,000.

Could high prices and a shortage of supply negatively impact the forthcoming EV revolution? Potentially, but price is much less an issue than access to supply.

Andries Gerbens, head of sales at Darton Commodities and author of the firm's 2017-2018 *Cobalt Market Review*, says with higher prices there is only likely to be a $70 to $80 deferential per battery from today's prices, which wouldn't have a huge impact on the overall cost of an EV. Furthermore, the expenditure associated with battery technology is routinely falling.

High prices could greenlight production not normally considered economically viable and bring more supply on to the market, but that would be much further down the line.

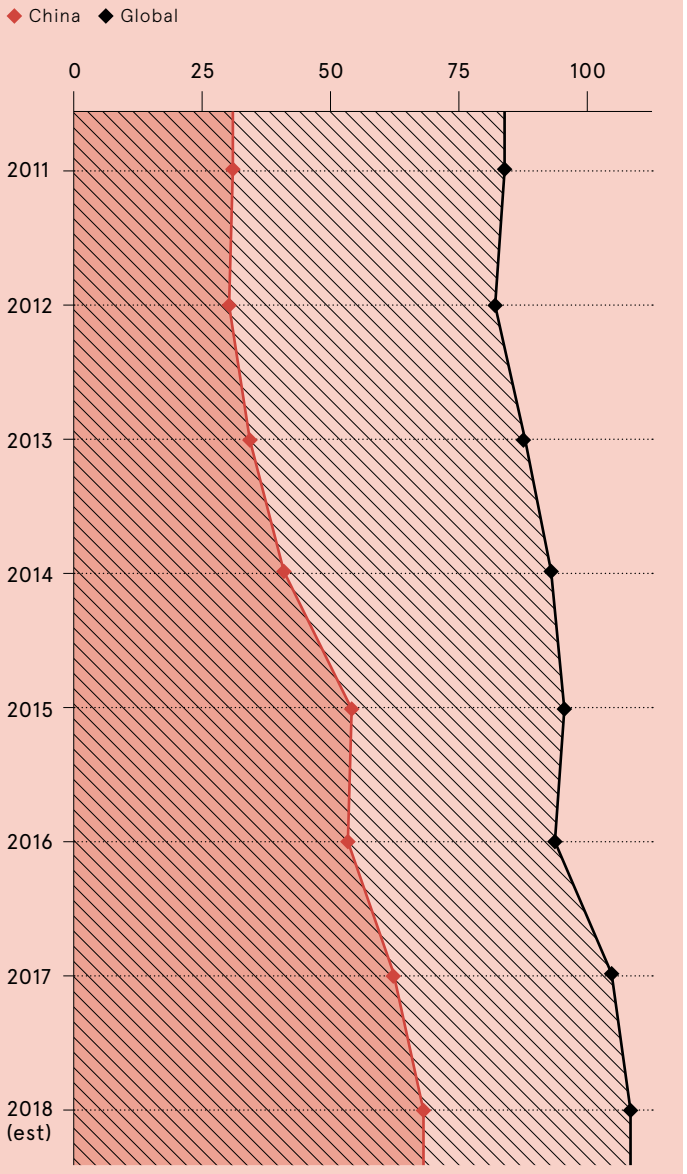
For now, Mr Gerbens says Katanga and RTR, the latter anticipated to come online in 2019, will ease present shortages in the market, but after 2020, around 2022, when the exponential increase in demand for EVs is expected to kick off, is when the deficit will widen. Especially as near-term surplus supply will probably be pre-emptively purchased, as is already happening.

"What will happen then? Will car manufacturers be unable to produce the number of cars they want to or will there be new technology that designs cobalt out of lithium batteries altogether?" asks Mr Gerbens.

The latter is possible, though he doesn't back this outcome. Perhaps EV predictions will fall short? Or, as many are starting to suspect, the majority of EVs will be made in China by the Chinese companies who currently have dominance over cobalt supply. ◆

Refined cobalt output

Total global production in billion tonnes



Darton Commodities 2018

Insight

What is China's cobalt caper?

According to Glencore chief executive Ivan Glasenberg: "If cobalt falls into the hands of the Chinese, yeah you won't see EVs being produced in Europe."

The Chinese one-party state wants 12 per cent of all cars produced by manufacturers in the country to be electric by 2020. It needs cobalt to achieve this and is already way ahead of competitors in securing it.

China has control of around 85 per cent of cobalt in the form of its own production, stockpiles and offtake agreements, including its recent deal with Glencore. This could easily increase with new acquisitions and deals.

At present, 49 per cent of planned capacity of lithium-ion battery production to come into operation is in China and Chinese production accounted for 58 per cent of global refined cobalt output in 2017, with 98 per cent of its feed requirement coming from imports.

Anthony Milewski, chairman, chief executive and director of Cobalt27, says China will be "the Silicon Valley of EVs".

"It is building the industrial processes, the capacity and ultimately will control the raw materials; when you go to buy an EV, you'll have to buy it from a Chinese company," he says. "It's a political and environmental decision."

Commercial feature

Fuelling Europe's clean energy future

The opening of a new uranium mine in Spain next year will help address some of the deepening concerns about uranium supply to Europe

A major source of zero-carbon electricity generation, Europe's uranium supply is especially important given the increasing tensions between Russia and the West.

The European Union is currently able to supply just 1.5 per cent of the feed needed for its 128 reactors and it relies largely on supply from the Russian sphere of influence. But these reactors provide 27 per cent of the region's overall power requirements.

Foratom, the European nuclear trade body, has therefore called for a "substantial" increase in the level of EU funding for future research programmes if the region is to maintain its output of nuclear power.

The discovery of a shallow, high-grade deposit of uranium in Salamanca, Spain is set to have a significant impact on this scenario.

Energy company Berkeley Energia has been developing a mine at the site. Having arranged financing last year, the company has begun initial construction and plans to start production late next year.

The mine's location is just three hours from Madrid, so it will provide an accessible, secure and local supply of uranium to European and global utilities.

The Salamanca mine is set to become one of the top ten uranium mines in the world and a significant long-term global producer. It will be able to supply more than four million pounds in weight of the metal a year, equivalent to 10 per cent of Europe's total requirement.

> **"Only with the highest quality assets can you consider development of a mine through a decade-long low in the commodity price**

Berkeley Energia believes the Salamanca mine will also be opening at an ideal time for investors, as it will help fill a supply deficit that industry experts have called "fundamental" and "unavoidable".

The price of uranium has been in decline since 2007, due to factors such as the rapid rise of output from Kazakhstan, which is now reversing, the Fukushima earthquake in 2011 and associated decline in demand from Japanese reactors, and Germany's plan to shut its nuclear programme by 2022. But large supply cuts from uranium providers in Kazakhstan and elsewhere in the world are potentially tipping the market into a long-awaited supply deficit and signaling a turnaround in price.

The Salamanca mine also has some of the lowest operating and capital costs in the world, aided by the project's proximity to outstanding infrastructure in the region. This has enabled it to proceed with construction even while other mines are ceasing production due to the low uranium price.

As Michael Stoner, mining analyst at Berenberg, says: "Only with the highest quality assets can you consider development of a mine through a decade-long low in the commodity price."

The Salamanca project also has a robust governance framework and strong support from stakeholders, including local communities. The mine is in the region of Castilla y Leon, which has suffered from some of the highest levels of unemployment in the EU. As such, there is widespread support for the project among local residents, politicians at varying levels of government and the Spanish media.

Large investors also back the project and major institutions, such as Fidelity, River & Mercantile, Majedie, Anglo Pacific and Resource Capital Funds, own a majority of the shares.

Last year, it received an investment of up to $120 million from the sovereign wealth fund of Oman. This investment, made at a time when the uranium price was at a 12-year low, was a strong endorsement of the economics of the Salamanca project.

More recognition came last year when Berkeley Energia was awarded the Mines & Money 2017 Corporate Development Award for its efforts with the mine, fighting off tough competition from other top mining groups.

Salamanca is the only uranium mine in the world currently under construction. But Berkeley Energia is continuing with its exploration programme, looking for further high-grade deposits, some intersections of which have been reported.

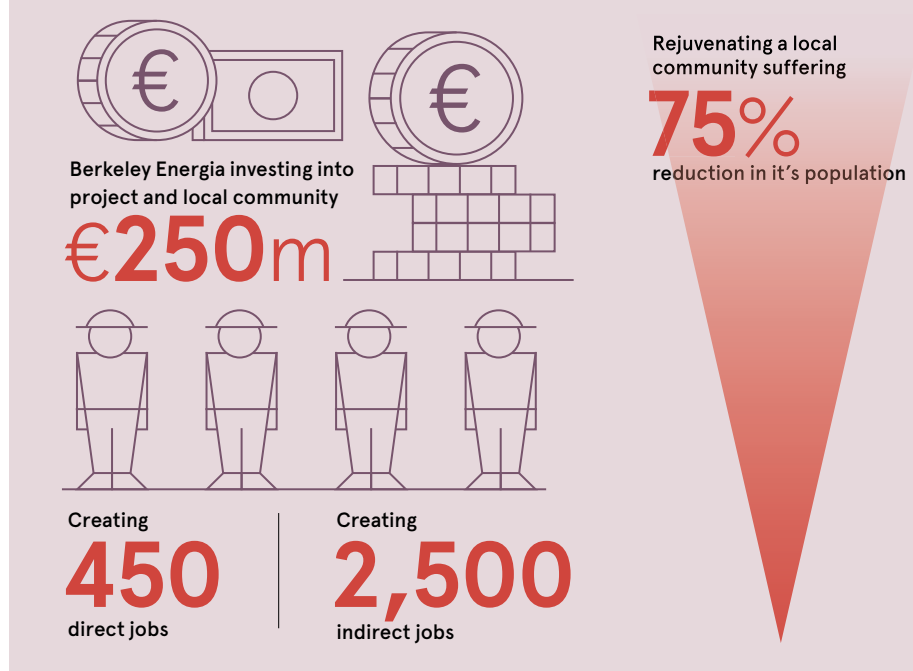
Chief executive Paul Atherley says this strategy will be key to maintaining employment and the positive impact of the mine in the area.

"We are starting with an anticipated mine life of 14 years, but it is an historic uranium mining area that has considerable geological potential," he says. "Part of our sustainable business plan is therefore to keep reinvesting in exploration to maintain the mine life.

"This investment will help us generate income, and maintain employment and investment in the area for a considerable time. We have a large landholding in the area, and as long

67%
held by institutions and management

$120m
financing from Oman sovereign wealth fund



Paul Atherley

Q&A

Paul Atherley, chief executive of Berkeley Energia, answers central questions about the market for uranium and nuclear energy

The price of uranium has been in decline since 2007. How do you see the medium and long-term future market for nuclear energy and uranium?

There is a lot of news every day, from industry and from governments, about renewable energy sources. But the reality is more prosaic. According to the International Energy Agency, renewables will account for only around 26 per cent of global energy generation by 2020. And Imperial College's Grantham Institute, a world-leading authority on climate change and energy, has said it is wishful thinking to assume that renewables can meet 100 per cent of our power generation needs.

That is because when the wind is not blowing and the sun is not shining, we still need base-load electricity and you can only get that from coal, gas or zero-carbon nuclear. This is why 58 nuclear reactors are being built around the world.

Germany is a good example of why closing down nuclear energy does not work. It is now mining more coal and lignite, the dirtiest type of coal, than it did before because, when you close nuclear reactors, you still need a base load.

We think the trend towards a falling uranium price is now set to change as we are starting to see some major supply cuts. So we are "pouring concrete" [building a new mine] at the bottom of the uranium price cycle. No one ever made money by investing in a commodity at the top of its cycle.

Will technology improvements solve the problems with renewables?

Batteries could be developed that store electricity from wind and solar energy, but I believe technology of that scale could be up to 20 years away. For now, the only scalable, zero-carbon electricity base load is nuclear. That is why nuclear energy for most developed countries still supplies around 10 to 20 per cent of the total electricity mix.

What other factors will affect the nuclear energy market?

In the last two to three years, developed economies such as the UK have been making plans to remove all internal combustion engines from the transport system and replace them with electric motors. To achieve this, we need another 30 gigawatts above the existing 65 gigawatts installed capacity. That is the equivalent of ten more nuclear reactors.

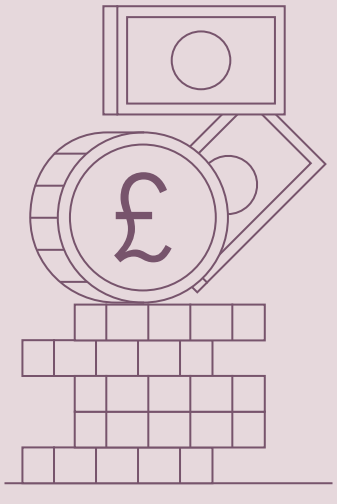
So the electronic vehicle story plays strongly to nuclear power, especially in the context of the disaster unfolding in Germany where even environmental groups are saying the answer is renewables plus nuclear.

What other factors should those looking to invest in uranium mining consider?

We are building our mine in Salamanca, Spain, which means we are meeting all the environmental and human rights standards required of European Union countries. It will be the only uranium mine in Europe, even though Europe has 184 nuclear reactors. Some 128 of these are in the EU, where 27 per cent of electricity comes from nuclear power.

Compare that to mines in Russia and Kazakhstan, which have lower environmental standards, and also to mines in countries that have poor human rights records.

Deteriorating political relations with countries such as Russia make it increasingly important that the EU should have its own domestic supply of uranium rather than relying on Russia.



Market cap company

£120m

as we are smart geologically, we will be able to maintain the operation and investment in the community."

Mr Atherley says the mine's positive impact on the community will be dramatic.

"Because it has such high unemployment, the region has suffered alarming levels of depopulation as people leave to work in cities," he says. "Some villages have lost 75 per cent of their population in 25 years. We are investing €250 million.

"We have employed 68 people on the Salamanca project already and plan to increase that quickly when we move into production, as well as creating up to 2,500 indirect jobs during construction. That should also bring a supporting economy with it, helping to stem that depopulation."

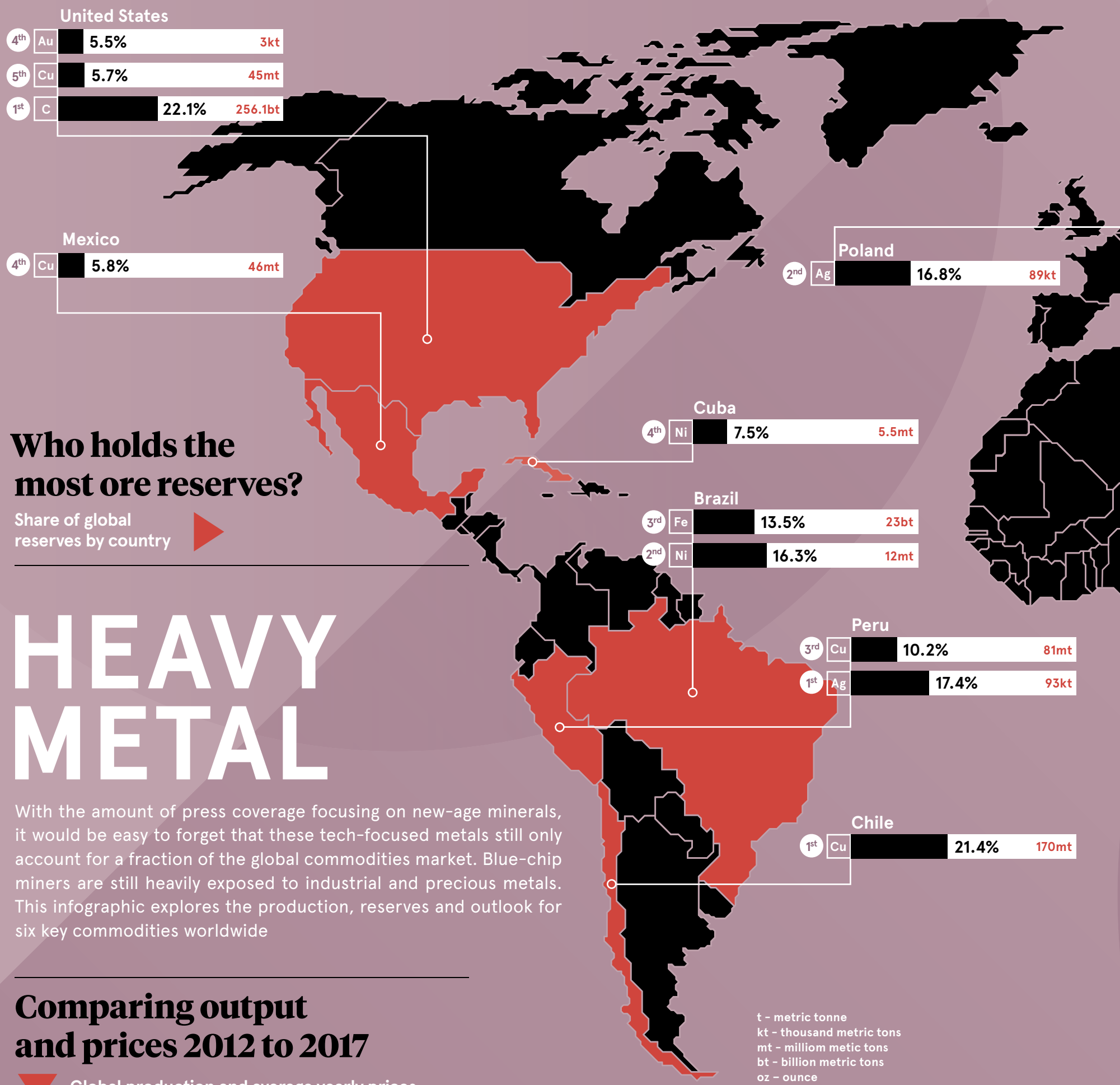
He adds that Berkeley Energia's commitment to the local communities extends before and after operation of the mine; the company already provides free wifi for local villagers, and is a significant contributor to schools and recreation facilities in the area. On site, the mine will be continuously rehabilitated, leaving a positive legacy in the region.

"We are a temporary land user, but will give our local communities something better when we leave," he says.

Lack of transparency has been an issue for investors in some mining companies, but Mr Atherley highlights that the project is listed in London, so will have all the associated disclosure requirements.

"We will have full disclosure on all the important issues, including environment, relationship with government and regulators, and employment of gender and minorities to name a few," he says. "We also invite politicians and other interested persons to the site. Once they see the operation and meet the team they go away happy."

BERKELEYenergia



Who holds the most ore reserves?

Share of global reserves by country

HEAVY METAL

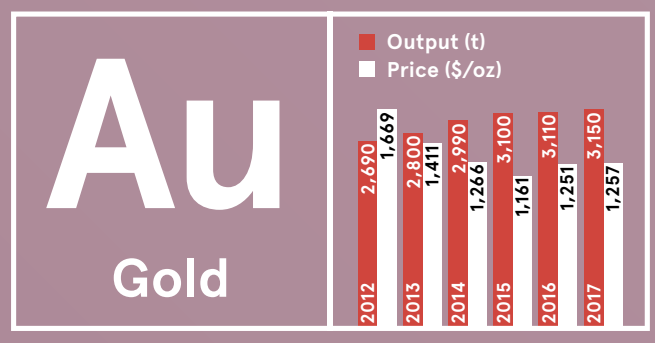
With the amount of press coverage focusing on new-age minerals, it would be easy to forget that these tech-focused metals still only account for a fraction of the global commodities market. Blue-chip miners are still heavily exposed to industrial and precious metals. This infographic explores the production, reserves and outlook for six key commodities worldwide

t - metric tonne
kt - thousand metric tons
mt - milliom metic tons
bt - billion metric tons
oz – ounce

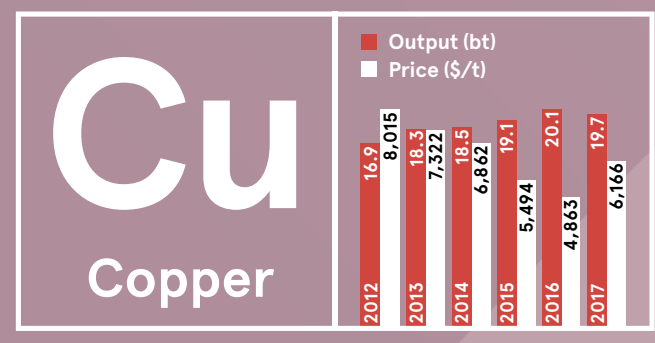
Comparing output and prices 2012 to 2017

Global production and average yearly prices

US Geological Survey/Index Mundi/Thomson Reuters 2018



US Geological Survey/London Gold Fixing 2018



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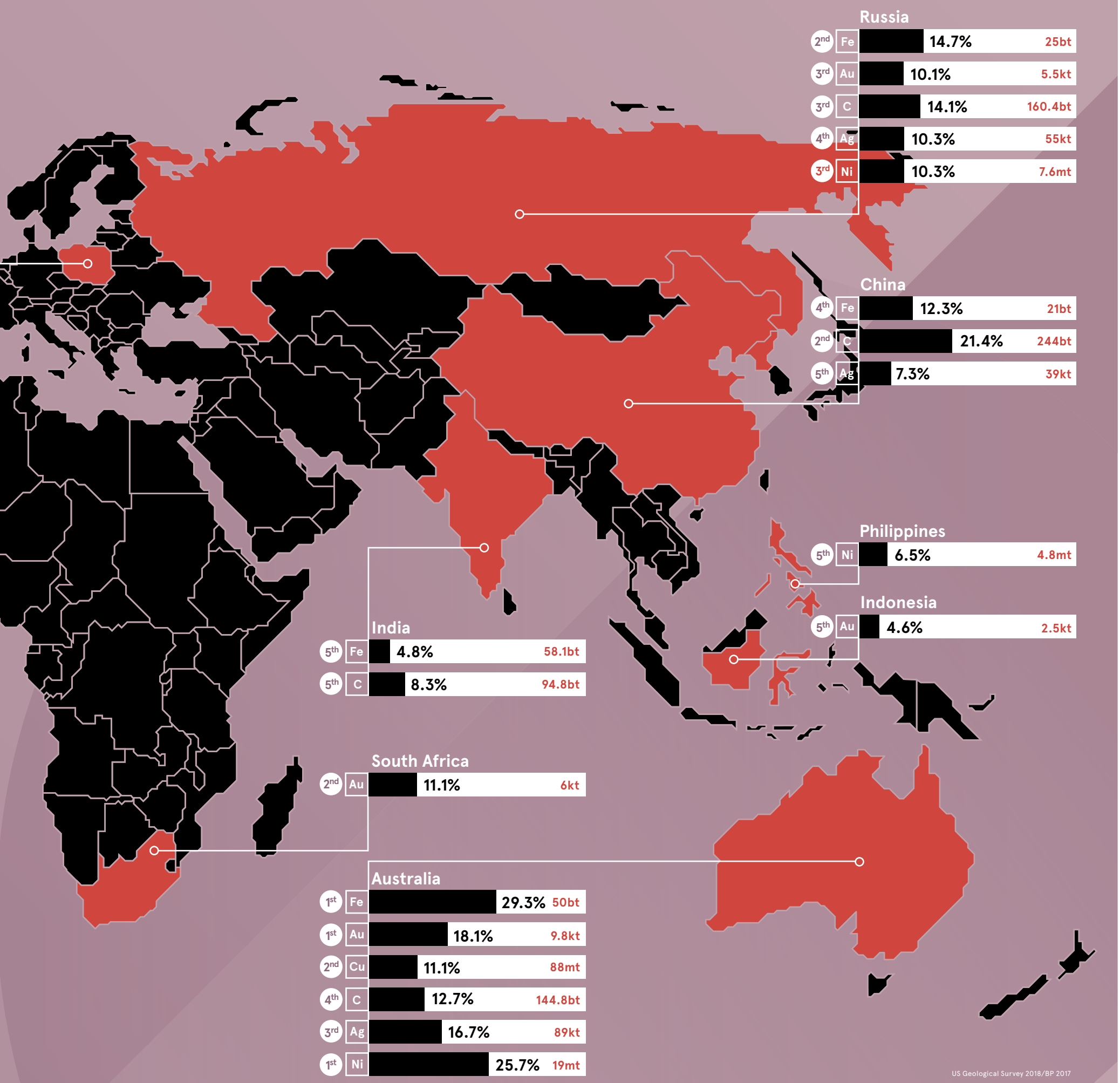
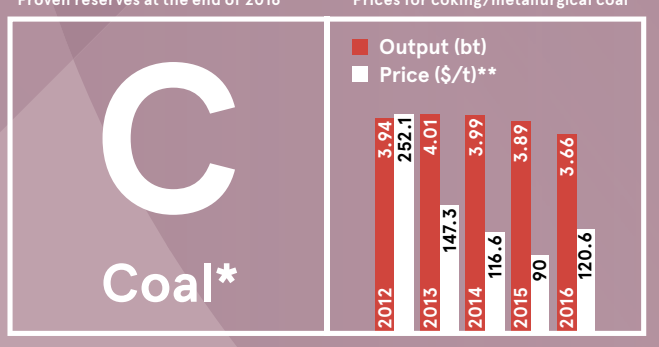


US Geological Survey 2018/BP 2017

*Proven reserves at the end of 2016 **Prices for coking/metallurgical coal



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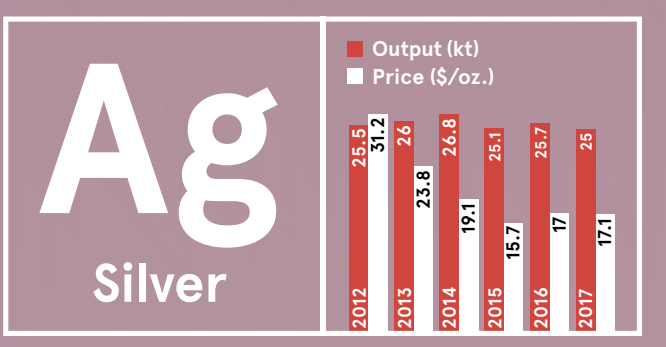
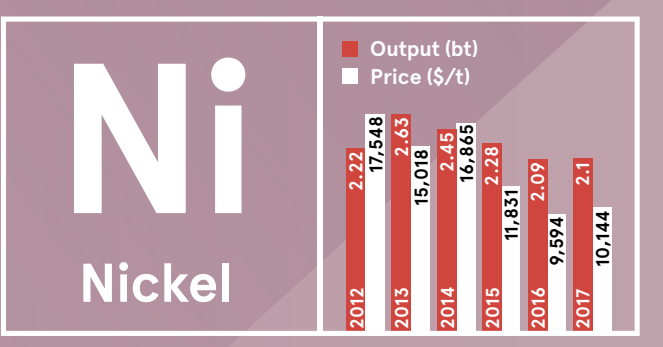


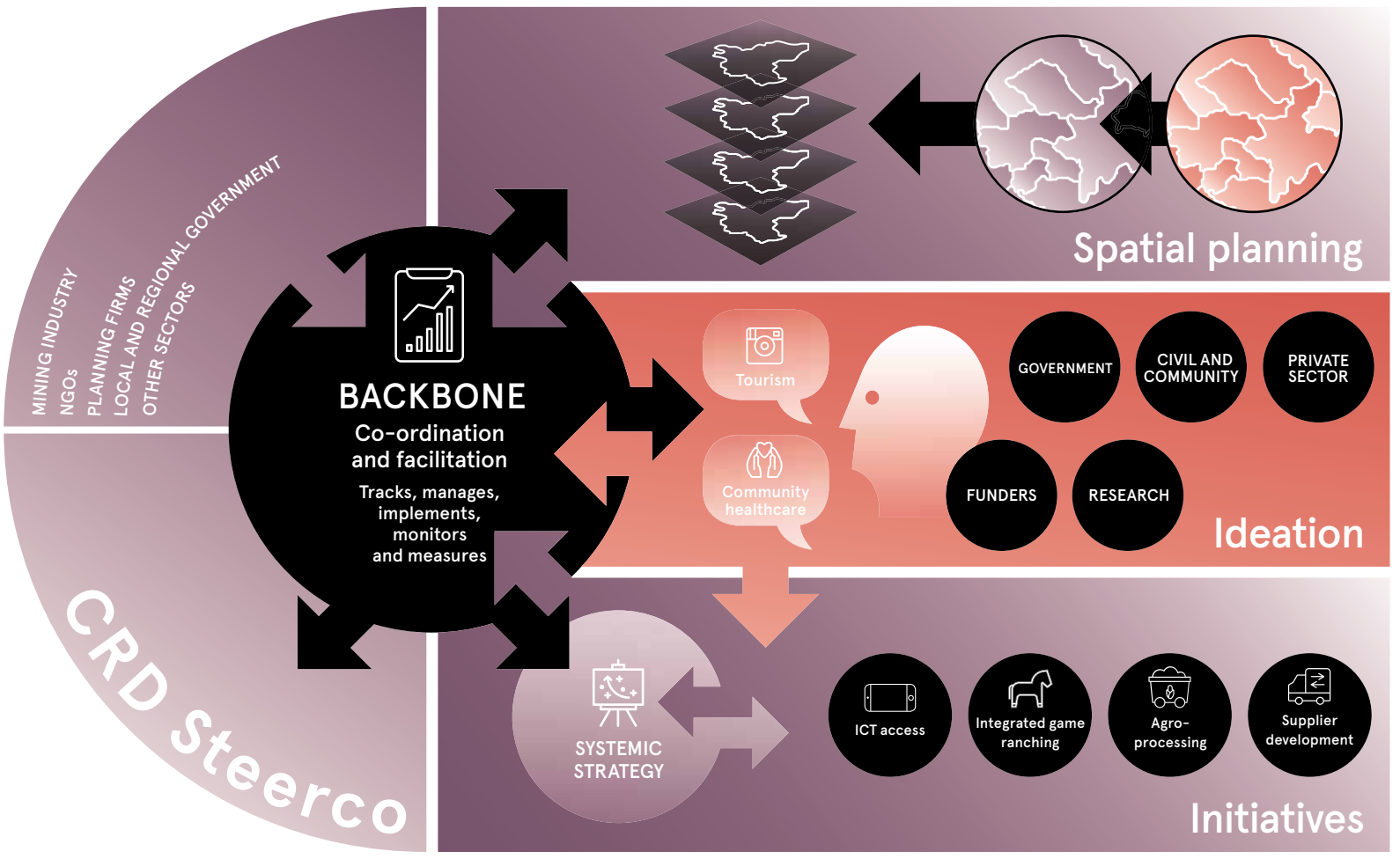
US Geological Survey/World Bank 2018



US Geological Survey 2018

Re-imagining mining to improve people's lives

Collaborative regional development is essential to mining's positive impact, says Anglo American's chief executive **Mark Cutifani**



Partnership platform design: co-designed, co-funded and co-implemented

I have dedicated more than 40 years of my life to a wonderful industry that has helped lift countries out of poverty, providing the raw materials which make modern life possible and playing a significant role in the world's economic activity.

But mining is also an industry at a crossroads as society's expectations of business rightly grow. For us in mining, we must never think that the status quo is enough. We must strive for step changes in how we mine, how we can enable the full benefits and how we engage with society as a whole.

Put simply, we are the custodians of many of the world's precious resources. It is with that great responsibility that we must lead our industry with the expectation that mining should be a trailblazer in social and community developments. In our industry, sustainability is not a luxury, it is a business imperative.

At Anglo American, we have recently set out an ambitious sustainability strategy, to transform how our stakeholders experience our business, both locally and globally. Our approach goes far beyond compliance with mining law or regulatory requirements. It is about making a more strategic, holistic, positive and lasting impact – sustainable business in its full and proper sense.

Partnership and engagement are at the heart of this transformative approach. Our efforts to realise long-term and truly sustainable development opportunities are centred on what we call collaborative regional development.

This innovative approach identifies socio-economic development opportunities with the greatest potential in a region, through spatial planning and analysis, and was originally inspired by the Kellogg Innovation Network's Development Partner Framework.

Spatial planning enables us to start addressing issues in space and context. We can gather, collate, clean, improve and analyse large quantities of spatially referenced data from across a single region. This integrated approach supports us to answer such questions as what and where are the economic opportunities or social challenges? And how are they inter-related?

This work creates the catalyst for partnerships with a broad range of stakeholders, from business to government, researchers to practitioners, and from community representatives to faith groups. By working through partnerships, we are better able to deliver on our commitment to help catalyse and facilitate long-term, sustainable development in our host regions, far beyond the life of the mine.

We began this approach in 2016 at Mogalakwena, our largest platinum operation in the Limpopo province of South Africa. And we are now considering ways to extend it to other countries, including Botswana, Peru and Colombia.

At Mogalakwena, we work with a broad range of stakeholders, including the charity World Vision, the Council for Scientific and Industrial Research, planning firm Dobbin International, mining company Exxaro Resources and the Office of the Premier in Limpopo Province. A dedicated support organisation staffed by representatives from these partners ensures we all pursue a co-ordinated agenda, measure impact consistently and communicate openly.

It is early days, but we have a chance to work towards the long-term socio-economic development of this region in South Africa. We have already begun pilots in supplier development, agro-processing, the biodiversity economy and access to information technology. And we are exploring other opportunities.

The upside is clear as such a strategy could create substantial economic benefit and employment across Limpopo province. Collaboration isn't just the right thing to do; it makes good business sense for everyone.

As with any new approach, we have learnt a great deal. Firstly, we've recognised that focusing solely on development closest to the mine is not a recipe for success. There is a much wider area of impact that we have a responsibility to consider, which also has a bearing on the local infrastructure and our own.

Secondly, as collaboration evolves, our partners are discovering that the timeframes of different parties can be restrictive. For many organisations, it is tempting to think in short-term cycles. But in reality, we cannot be particularly strategic in short timespans or deliver the most effective outcomes. We need to look at socio-economic development in a different way, where we try to lead developments over a much longer timeframe.

Of course, the realities of collaborating with disparate partners can be challenging. Global organisations are usually not geared up for working in a truly collaborative way at the regional level. However, we are already seeing the situation shift in a positive direction within our industry.

Other businesses, including those from the tourism, pharmaceutical and agricultural sectors, are also recognising the intrinsic value of this approach. We need to be working together across industrial sectors, which share a physical space, to maximise the benefits that can be achieved.

In collaborative regional development, the various parties involved are all accountable to their own constituents, which will inevitably mean different organisations have particular motivations. But having different motivational drivers does not mean you cannot collaborate on a shared vision.

Many governments, when they think about development, look to the local mine. This is evidence of a history of tangible benefit. But we also need to encourage people to look at all the communities and opportunities around them, to see the potential of the region, both as a whole and in its constituent parts.

The industry of more than 40 years ago is similar in many ways to the mining industry today. My hope is that it will be unrecognisable 40 years from now and that mining will be world leading in technical sophistication, the quality of products, environmental footprint, and in relationships with host governments, communities and society more broadly.

Mining must transform in the decades ahead – we must re-imagine it. Success is being built upon collaboration and partnership between many obvious and not-so-obvious partners. In our world, the future really can be something we shape together.

To find out more about sustainability and mining at Anglo American please visit angloamerican.com/sustainability

AngloAmerican

TECHNOLOGY


Rio Tinto has announced plans to retrofit some of its Caterpillar trucks for automated operations from mid-2018 as part of a $5-billion productivity drive

Developing digital mines of the future

After weathering an economic downturn, global mining companies are preparing to spend big on technology

JOE McGRATH

Between 2012 and 2016, the global mining industry found itself in a battle with market economics. Falling commodity prices, slowing demand from China and a resulting market oversupply forced miners to cut costs, rebuild balance sheets and spend 2017 refocusing business strategy.

But this financial rationalisation triggered a new technology cycle as companies sought to improve efficiency and make savings through new innovations.

"We have seen mining companies and their employees optimise mills, manage flowsheets, grade profiles and analyse exploration results long before these methods were labelled 'big data'," says Evy Hambro, manager of the BlackRock World Mining Trust. "However, the processing power available today should enable this to be done more efficiently than ever before."

With economic conditions looking more favourable for miners, there is renewed appetite for growth, encouraging mining groups to be far more ambitious with their technological aspirations in the years ahead.

"Different sectors in the mining industry have faced cost pressures in recent years," explains Guy Turner, director of management consulting group Partners in Performance. "That forced a bunch of tactical cost-reductions. As the profits come back, businesses are saying 'how do we enable the people that we have with technology?'"

Mr Turner stresses that technological adoption varies by region, but notes the largest mining companies have made significant capital investments in robotics, autonomous vehicles, drones for stock pile measurement and embraced a host of wearable technologies to enhance safety.

"Corporate strategy has reacted to an economic cycle in mining that originally said reduce your costs quickly. Now we are in happier times, we can grow and build businesses, and this is being done through technology," he says. "Innovation is happening in every dimension, whether the focus is on safety, quality measurement, automation, use of predictive data or adoption of digital solutions."

As mining companies become more ambitious with their capital investments, the difficulty for management teams is prioritising those technologies with the potential for the biggest impact.

"Get a good understanding of your company's starting point, relative not only to other miners, but also to digitally literate companies in other sectors," says Konrad von Szczepanski, partner at Boston Consulting Group. "Then it's a question of experimenting, piloting, learning and adapting in developing solutions."

He says involving the workforce in any new technological developments through both on-the-job and classroom-based training can have a radical impact on the successful implementation of new strategies. Also additional benefits can be gleamed by partnering with new companies in the technology sector, such as data analytics startups.

Some of the largest players have been making headlines with substantial investments to improve operations in remote locations. Mining groups BHP and Rio Tinto, for example, have spent considerable sums on embracing autonomous vehicles.

Last July, *Mining* magazine reported that BHP was embarking on a substantial training programme to upskill its workforce to enable them to handle a rapidly expanding fleet of autonomous vehicles. Rio Tinto, meanwhile, announced plans to retrofit some of its Caterpillar trucks for automated operations from mid-2018 as part of a $5-billion productivity drive.

The company says automation elsewhere is already improving productivity. "Rapid advances in technology are continuing to revolutionise the way large-scale mining is undertaken across the globe," according to Rio Tinto's iron ore chief executive Chris Salisbury. "The expansion of our autonomous fleet via retrofitting helps to improve safety and unlocks significant productivity gains."

Mr Salisbury says the company will be considering making future additions to its autonomous fleet as part of a commitment to deliver an additional $5 billion of free cash flow by 2021.

Both BHP and Rio Tinto have earmarked operations in the Pilbara region of Western Australia as ideal sites for expanding its autonomous operations, due to the difficulties in recruiting staff in what is a relatively remote location.

"At the mines, automation and remote operation are important tools for mining companies to increase productivity, reduce costs and improve safety in the workplace, which is of paramount importance to all stakeholders," says BlackRock's Mr Hambro.

"If these technological enhancements are integrated alongside upskilling of experienced employees, it could have a compounding effect on the entire asset base. Lower costs, improved safety records and reduced environmental impact might be able to unlock further gains, which in turn would allow formerly uneconomic deposits to be developed."

> **Rapid advances in technology are continuing to revolutionise the way large-scale mining is undertaken across the globe**

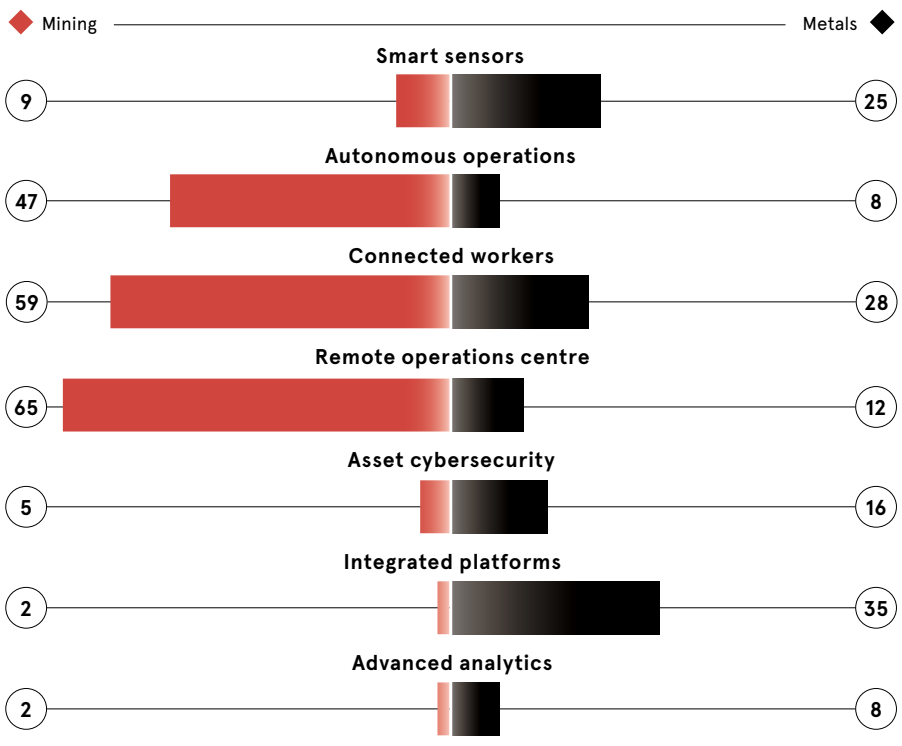
While much of the focus of digital innovation has been focused on the technology or the process, the human element of staff recruitment and retention remains vital to the successful implementation of new processes within mining companies. Industry analysts say that competition for top talent is as severe as ever.

"Even large, global miners struggle to attract top-notch data scientists," says Mr von Szczepanski. "Miners are competing not with other miners for employees, who by education have already decided they want to work in the mining industry, but with the likes of GE, Google and Facebook."

While the landscape for staff recruitment may be fierce, it is clear there are bold ambitions for yet more additions to corporate technology programmes at the world's largest mining companies. If they can find or train the right staff to handle modern technologies, the outlook for the digital mines of the future looks very bright indeed. ◆

Most valuable digitalisation technologies in mining and metals

Estimated value the following could add between 2016 and 2025 ($bn)



World Economic Forum/Accenture 2017

MINERALS

Stakes are high mining for tech minerals

Not all miners are betting on cobalt and lithium as winners in the technological age – others favour copper, nickel, zinc and palladium


Glencore

ALASTAIR FORD

Amid the clamour for cobalt and lithium, two commodities needed for the development of electric vehicles, there is also fresh demand for other minerals.

According to Danny Malchuk, president of operations at Minerals Americas, a regional subsidiary of mining giant BHP, the global electric vehicle fleet could rise to an estimated 140 million by 2035 from about one million today.

But rather than making a major move into lithium and cobalt, Mr Malchuk says BHP will instead look for copper projects. "We want more copper resources in our portfolio," he told an audience of industry specialists gathered in London.

It's a low-risk approach to an emerging new technological space that's nevertheless likely to pay off. That's because around 105 kilogrammes of copper will be required for each new electric vehicle made, according to Mr Malchuk.

Substantial amounts of lithium and cobalt may be required too, but here the commercial risk is greater, because the future of the supply-demand dynamic is so hard to read. In the case of copper, First Quantum's $6.3-billion Cobre Panama mine is the only new large project likely to come on stream in the next couple of years.

With lithium it's different. While it's true the lithium price has more than tripled in the last three years and continues to trade at comfortably above $20,000 a tonne, it's also true that there is a lot more lithium around than copper.

For one thing, the Chinese are emerging as a major producer and it's hard to predict how Chinese supply will affect markets when production data is often opaque.

But perhaps more critical than this is the straightforward abundance of lithium in the earth. It is, in fact, the third most plentiful element.

So for now the major miners are staying out of the lithium business, content to let specialists and speculators take the risks on a possible future glut.

> **Increased production of electric vehicles will not offset the forecast increase in lithium supply**

Instead, the field has been left clear for those with established market presence, such as the $10-billion American company Albemarle and the Chilean company Sociedad Química y Minera, which is the world's biggest supplier.

A plethora of smaller explorers and developers have also arrived on the scene, looking to capitalise on predictions like Mr Malchuk's. But the risks are already apparent.

Shares in European Metals Holdings, a company with a major development project in the Czech Republic, have fallen by more than 75 per cent since highs hit last year.

In February, Morgan Stanley forecast that the lithium price would drop by 45 per cent by 2021, as supply from the major producing region, the so-called Lithium Triangle in South America, steps up rapidly.

Increased production of electric vehicles will not offset the forecast increase in lithium supply, Morgan Stanley analysts forecast.

Experienced industry investors are already following that line. Julian Treger, a former fund manager at Audley Capital, who now runs boutique mining finance house Anglo Pacific, says he's wary of metals like lithium and cobalt that have been caught up in the electric vehicle hype. "We want to grow in copper, nickel and zinc," he says.

These are metals that are likely to be used in new technologies too, but which also have a broad appeal across the board in older sectors such as construction and engineering.

But while there is wariness about so-called "fashionable" metals, there is also cautious positioning taking place.

Glencore, the mining and trading major, produces more cobalt than any other company, but that's primarily because the cobalt comes as a by-product of its Congolese copper production.

Copper is far more central to Glencore's offering. The metal leads when the company is briefing investors on production highlights and accounts for the major proportion of its profits, alongside zinc. In the 12 months to December 2017, Glencore produced 1.3 million tonnes of copper and just 27,000 tonnes of cobalt.

Glencore's Collahuasi copper operation in Chile; the mining giant produces more cobalt than any other company as the mineral is a by-product of its mammoth copper operations

Nevertheless, like many of the major companies in the industry, Glencore remains open to new ideas.

"The electric vehicle upheaval continues to unfold, with the scale of market penetration, and investment by battery and automotive manufacturers and infrastructure players adjusting progressively upwards," the company says. "This provides an additional dimension of future demand growth for a number of our key commodities."

Meanwhile, another of the world's largest mining companies, Russia's Norilsk Nickel, has signalled its openness to the opportunities presented by the new battery market.

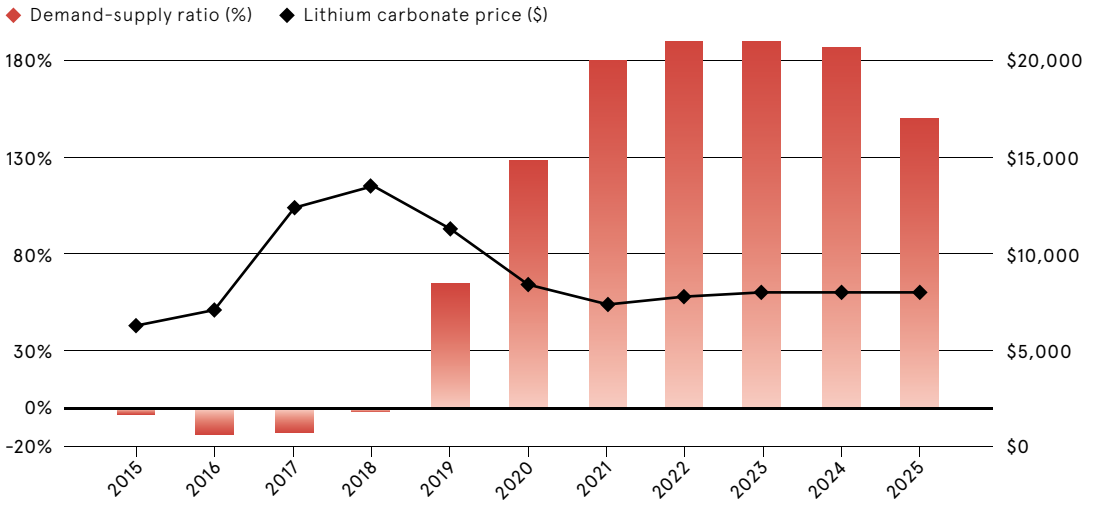
Gareth Penny, Norilsk's chief executive, expects the biggest near-term market will be in hybrids rather than electric vehicles, and he is positioning his company accordingly to supply both nickel and palladium into this market.

This is partly a market-facing response to a perception that the rise in electric vehicles will decimate the market for catalytic converters and the profitability of mining platinum and palladium, which are the key elements that go into them. But there's more to it than that.

"Norilsk will definitely look at some form of partnership at different levels in the industry to maximise the value of its product," says Mr Penny, citing a potential relationship with BASF, the European chemicals company, as a possible route forward. ◆

Lithium prices set to peak this year

Morgan Stanley expects prices to drop as supply surges



Morgan Stanley Research/CRU/Roskill 2018

OPINION COLUMN

‘We will have to show that the metals needed are mined with principles’

The UK and France plan to phase out new petrol and diesel cars within 25 years. That’s 60 million cars in Britain and France, and many more if other countries follow suit. The change may happen sooner as already one third of all new cars sold in Norway are electric powered.

While the media and investors have focused on the consequent demands for lithium and cobalt, other metals will also be needed if we are to achieve the Paris Agreement’s climate change targets. For example, a 3-megawatt wind turbine requires more than 300 tonnes of steel, 4 tonnes of copper and over 200 tonnes of metallurgical coal to make the steel.

Helping the world decarbonise is just one important role that mining will play in the coming decades. Another driver of demand for mined products is older than mining itself: population growth.

The United Nations (UN) estimates 83 million more people share our planet every year. To put this in perspective, global population is increasing by the size of Birmingham every five days.

While demand for metals will continue to grow, so too will the performance expectations placed by society on the miners who will supply those metals from our evermore crowded planet.

The social contract between mining companies, and host countries and communities has vastly evolved over the last few decades. It used to be considered sufficient to pay taxes and dividends, while producing the materials the world needed.

Now, and even more so in the future, companies are expected to deliver on a much more holistic set of environmental, social and governance (ESG) objectives including, among other things, conserving resources, addressing human rights issues and partnering with others to maximise local economic benefits.

These objectives are at the forefront of the minds of the chief executives of our members. They recognise that getting the ESG side of their operations right is not just a nice to have, but is crucial for the long-term viability of their operations.

The 25 company members of the International Council on Mining and Metals (ICMM) are committed to integrating sustainable development in their corporate strategy and decision-making, and to pursuing continual improvement. This is enshrined in ICMM’s ten principles that all our company members commit to, as well as additional binding policies that cover issues such as water stewardship, the transparency of mineral revenues, indigenous peoples, and not mining in protected areas.

Looking ahead, helping to achieve the UN’s Sustainable Development Goals (SDGs) will become increasingly important. These global goals provide a once-in-a-lifetime opportunity for us all to align in tackling the biggest challenges faced by both people and planet, and ICMM is determined to play its part. We have mapped our principles against the SDGs and believe that mining can play an invaluable role in helping deliver on all of them.

The mining and metals industry is at least 5,000 years old, but it is also an industry of the future with extraordinary potential to improve human wellbeing.

In fact, the lives of large numbers of ordinary people around the world, in even the most troubled developing countries, have been improved as a result of mining by responsible companies.

There is still a long way to go, but when mining is done properly it can bring great benefits to host countries and communities, and allow them to diversify their economies, develop their education and social services, and develop sustainable energy supplies, housing and infrastructure.

In future it will no longer be enough to say mining will supply the metals needed for modern lives. We will have to show that the metals needed are mined with principles.

Tom Butler
Chief executive
International Council
on Mining and Metals

CLIMATE CHANGE

Cleaning up for the sake of the planet

The mining industry is learning to adapt to a carbon-conscious world and play its part in combating global warming


Jonathan Wood/Getty Images

01

OLIVIA GAGAN

The global mining industry consumes vast amounts of resources from water and electricity to land and labour, not to mention the metals, minerals and earth it digs up.

This makes mining a heavy emitter of carbon. In the wake of the Paris Agreement in December 2015, when 174 countries and the European Union committed to limit global temperature rises to a maximum of 2C above pre-industrial times, the environmental impact of mining is becoming more significant than ever.

It might make sense, then, to start reducing or limiting global mining activity, but this is easier said than done as we are all reliant on the products of the mining industry. From the steel holding up buildings to diamonds set in rings and the rare earths which are essential components in smartphones, many of the materials we live with and use every day have been extracted from the earth.

Martijn Wilder, head of international law firm Baker & McKenzie's environmental markets and climate change practice, and ranked as one of the world's leading climate change lawyers, does not think mining should be demonised. Rather that it should adapt and improve, to meet the demands of a more carbon-conscious world.

"The mining industry is not going to disappear," he argues. "It's one of the most important sectors in many global economies. There is now an expectation, however, that it will become more sustainable."

This expectation comes from consumers, and also governments, who are increasingly aware of the consequences of failing to curb carbon emissions. Unlike mining of the past, where carbon was produced indiscriminately and without financial consequence, a political, social and economic cost is now being placed on carbon.

Mr Wilder says the simple fact that governments are now placing a price tag on carbon makes climate change impossible for the mining industry to ignore. "Nowadays, if you emit greenhouse gases, you will increasingly become exposed to some form of regulation," he says. "It's going to pose a financial risk to your business."

In addition, whether a small firm or a stock exchange-listed conglomerate, miners have to grapple with the fact that climate change presents a very physical risk to their output. Lukas Rüttinger, climate security expert at independent think-tank Adelphi, explains: "In addition to reducing greenhouse gas emissions, mining companies have to get serious about adapting to climate change in terms of extreme weather events," he says.

These can simply be changes to previously predictable patterns. "Heavy rainfall and storms can damage infrastructure, leading to the flooding of open-pit mines," says Mr Rüttinger. "Climate change can also have negative impacts on natural resources, such as land and water, increasing the competition between mining companies and local communities."


AHMED OUOBA/AFP/Getty Images

02


MOMI[illegible]HUIYAN/AFP/Getty Images

03

"The industry's slow shift towards renewable technologies comes laced with the irony that renewable energy generators are themselves often mineral and metal hungry

The combination of being both a potential cause and a recipient of the negative effects of climate change means "all global mining companies are now under pressure to cut their carbon emissions", says Mr Wilder.

His law firm works with "proactive companies which have developed pretty comprehensive climate change strategies". He says mining firms are combating the issue via numerous methods. "Some have exited from coal or created an internal price on carbon emissions," says Mr Wilder. "Others are trying to be more sustainable in the way they mine – the way they transport materials, for instance, or by switching to renewable energy to power some of their operations."

Some are offsetting their carbon emissions by buying, protecting or planting forests. A number of firms are even developing new technologies to improve their carbon footprint.

Diamond giant De Beers is trying to make some of its mines in South Africa and Canada carbon neutral by 2021. To achieve this it has hired geologists and academics to refine a method of storing carbon, rather than releasing it into the air. Carbon-capture and storage research is fearsomely expensive – the UK government abandoned a

01 Submerged mining equipment under flood water in Rockhampton, Australia in 2011

02 Solar power plant supplying power to IAMGOLD's Essakane gold mine near Dori, Bukina Faso operations

03 Diamond miner De Beers is aiming to make some of its mines in South Africa and Canada carbon neutral by 2021 through carbon storage


Shutterstock

Insight

Will mining profit from a clean-energy climate?

Can adapting to cleaner technologies drive higher returns for the mining industry or is it a cost they have to absorb just to stay in business? It is a question which may not be answered for a while. Coal is still being mined in huge quantities and advocates of low-carbon mining are up against a significant flow of investment into coal mining projects; an estimated $57.92 billion was lent between 2014 and 2016, according to watchdog Banktrack.

Martijn Wilder, head of Baker & McKenzie's environmental markets and climate change law practice, says although mining companies have enjoyed easy access to loans while mining or using coal, this could soon change.

"Companies are starting to sell their coal assets to reduce their exposure to carbon," he says. "As people divest, anything coal-related becomes less attractive and it becomes harder to access finance. In contrast, lower-carbon technologies are finding they have access to large pools of capital now. As the use of renewable energy, electric vehicles and battery technology accelerates, capital will start to flow to those industries instead."

Banking's appetite for high-carbon emitting mining projects is already beginning to wane. After the Paris Climate Agreement, 11 major international banks, including some of the world's biggest infrastructure lenders, from Deutcshe Bank to Commerzbank, committed to stop direct finance for new coal mines.

billion-pound plan to develop the technology back in 2015 – but if successful, De Beers can no doubt sell its proprietary technology on to other mining companies.

The industry's slow shift towards renewable technologies comes laced with the irony that renewable energy generators are themselves often mineral and metal hungry. "Minerals are critical to renewable energy's future," says Mr Wilder. Iron ore is needed to make the steel foundations for offshore wind plants, with financial analysts Platts estimating wind turbine manufacturing will gobble up tens of millions of metric tons of steel between now and 2021. Solar panels need rarer metals indium and tellurium, and the battery storage industry, which stores wind and solar power, and is spearheaded by brands such as Tesla, needs lithium.

Countries with mineable reserves of these resources may profit from a lower-carbon mining industry. China, for example, is currently home to most rare earth mining and production, and other mineral-rich countries could also capitalise on the growth in demand for the mined resources renewable energy needs.

According to World Bank senior director Riccardo Puliti: "Countries with capacity and infrastructure to supply the minerals and metals required for cleaner technologies have a unique opportunity to grow their economies, if they develop their mining sectors in a sustainable way."

Sustainable is the operative word. For renewables and the mining industry to retain their low-impact, low-carbon reputation, these minerals and metals will have to be mined carefully.

The global mining industry suffered a five-year period of heavy losses and depressed commodity prices, before rebounding to profit in 2016, so financial stability is no longer a given in this industry. Adding to this volatility is the emerging challenge of adapting to a new, lower-carbon future.

A cleaner, lower-carbon global mining industry is still in its infancy and, in the short-term at least, cutting carbon may cost the industry as it comes up with the technologies, techniques and strategies needed to do it. If mining fails to evolve and decarbonise, however, the cost could be far higher, both to the environment and itself, further down the line. ◆

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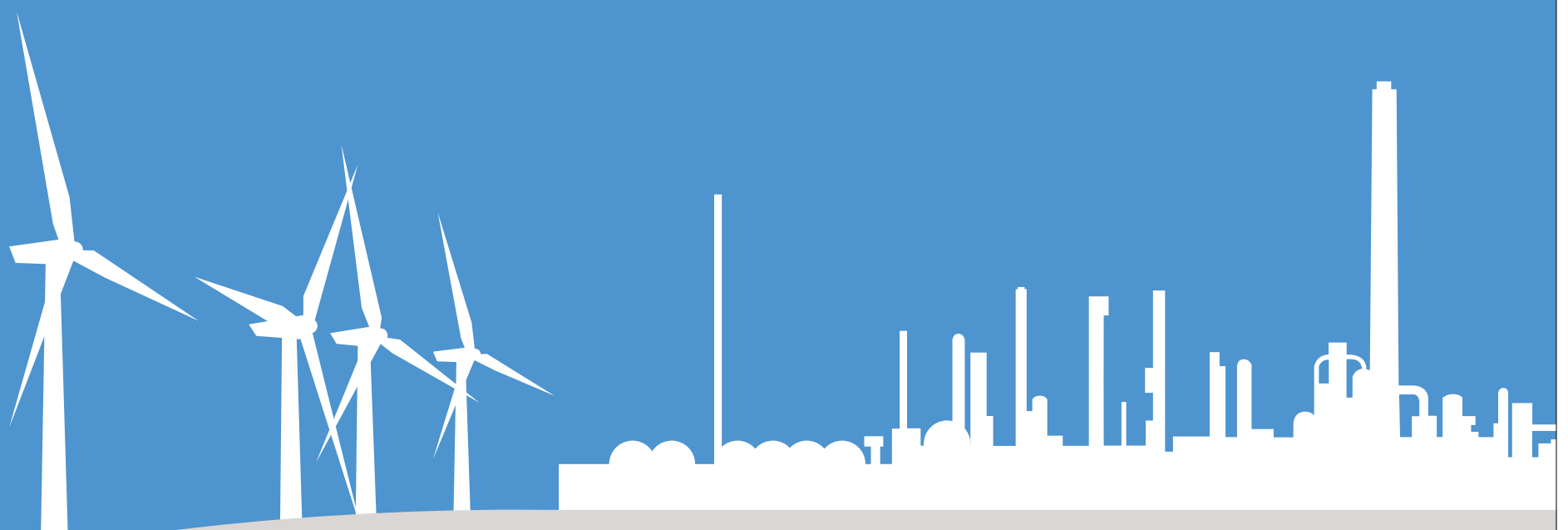

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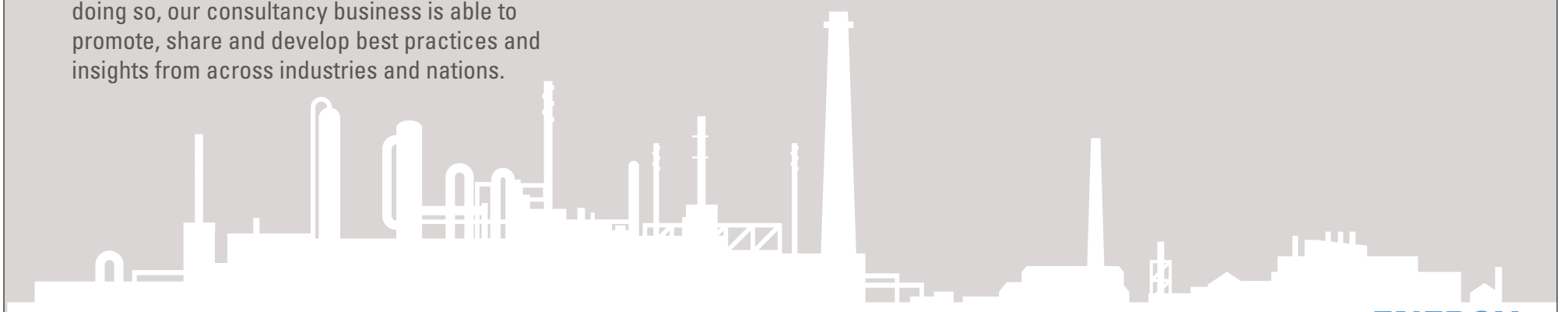

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