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Europe
United Kingdom
Metals & Mining

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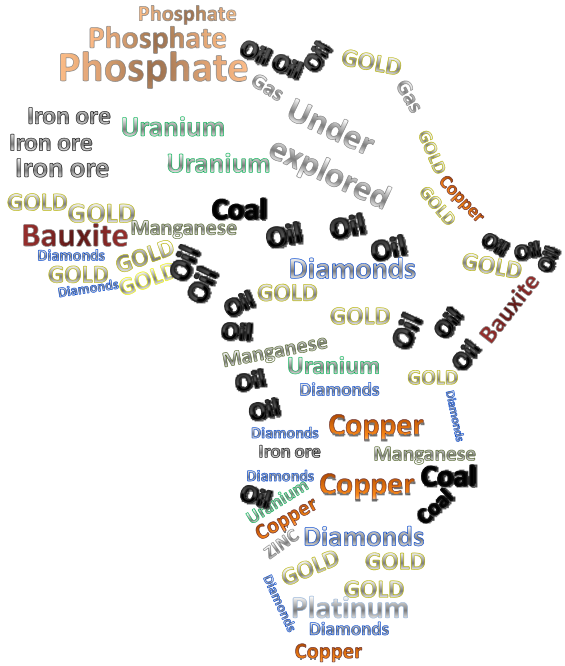

F.I.T.T. for investors

Africa: The next frontier

Mining companies need to be in Africa, the next frontier for growth

Growth is not a focus of the miners or investors today. However, the cycle will turn and our focus will move back to volumes. Africa is host to a multitude of minerals, is under-explored, under-developed, and will offer significant volume growth from the next decade, in our view. The challenges are numerous and will require deep pockets of capital, reserves of patience and relationships with stakeholders in order to be overcome. We assess the prospects for a set of 12 African countries and look at lessons from four pioneers: Randgold, Glencore, Rio Tinto and South32. We think RRS has the right approach for generating high returns from its African-focused strategy. Buy.

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Mining companies need to be in Africa, the next frontier for growth

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We need to talk about growth

The miners have cut capex drastically as commodity prices have tumbled since the 2008 peak. Production growth has plateaued as a result, lagging the capex cuts by 2-3 years. However, it can take 10-25 years to bring on new mines from scratch, and the world will need new mines: by 2025, for example, the world will need around 500kt copper, or more than one new Collahuasi-sized mine, each year. We estimate global reserves of copper ex-Africa will cover only ten years of demand by 2030 – focus must shift to African deposits.

Africa's promise: perception is not always reality

Despite the many dire statistics, we believe Africa offers a multitude of opportunities and on many fronts is moving in the right direction. One impressive fact is that the number of violent conflicts in the continent has halved between 1990 and today. This provides stability for growth. Sub-Saharan Africa GDP grew at a 5.3% CAGR from 2000 to 2014, with six of the world's fastest-growing economies in Africa in that period. And the continent's Debt-to-GDP ratio was below 70% by 2014 (US 88%, EU 87% today).

Vast potential mineral wealth

Africa hosts 90% of the world's known platinum, 65% of its manganese, 50% of its gold and diamonds, 40% of cobalt, 30% of uranium, and 10% of copper. Despite this, today Africa supplies just 11% and 12% of global copper and gold, and only 9% of its thermal coal. The attraction is clear: Africa's copper reserve grades, for example, are at least double the current RoW average.

Africa's perils: some major challenges

There are reasons that the minerals have not yet been fully developed: (i) lack of geopolitical stability, (ii) risk to security of tenure, (iii) large infrastructure needs, and (iv) mining input requirements. Today, only two of the 50 lowest-cost mines globally are in Africa. Why? The minerals require a mining or processing method that makes the cost prohibitive, the mines are too small to generate economies of scale, or logistics are insufficient or non-existent.

There are countries that offer attractive risk-adjusted rewards

We rank a set of 12 countries across the four main challenges. Ghana and Namibia rank best, with Cote d'Ivoire third. Guinea and DRC, despite massive resource endowments, rank at the bottom, due mainly to lack of infrastructure.

Lessons from the pioneers: we upgrade RRS to Buy; reiterate Buy on South32

We reiterate Buy on Rio Tinto and Hold on Glencore. Our investment theses and TP derivations and risks are detailed from page 92. We use life-of-mine DCF; risks include commodity prices, FX, labour costs, capex, project delays.

Key Changes

Company	Target Price	Rating
RRS.L	4,640.00 to 5,050.00(GBP)	Hold to Buy

Source: Deutsche Bank

Top picks

Randgold (RRS.L),GBP4,487.00	Buy
Rio Tinto (RIO.L),GBP2,440.00	Buy

Source: Deutsche Bank

Companies Featured

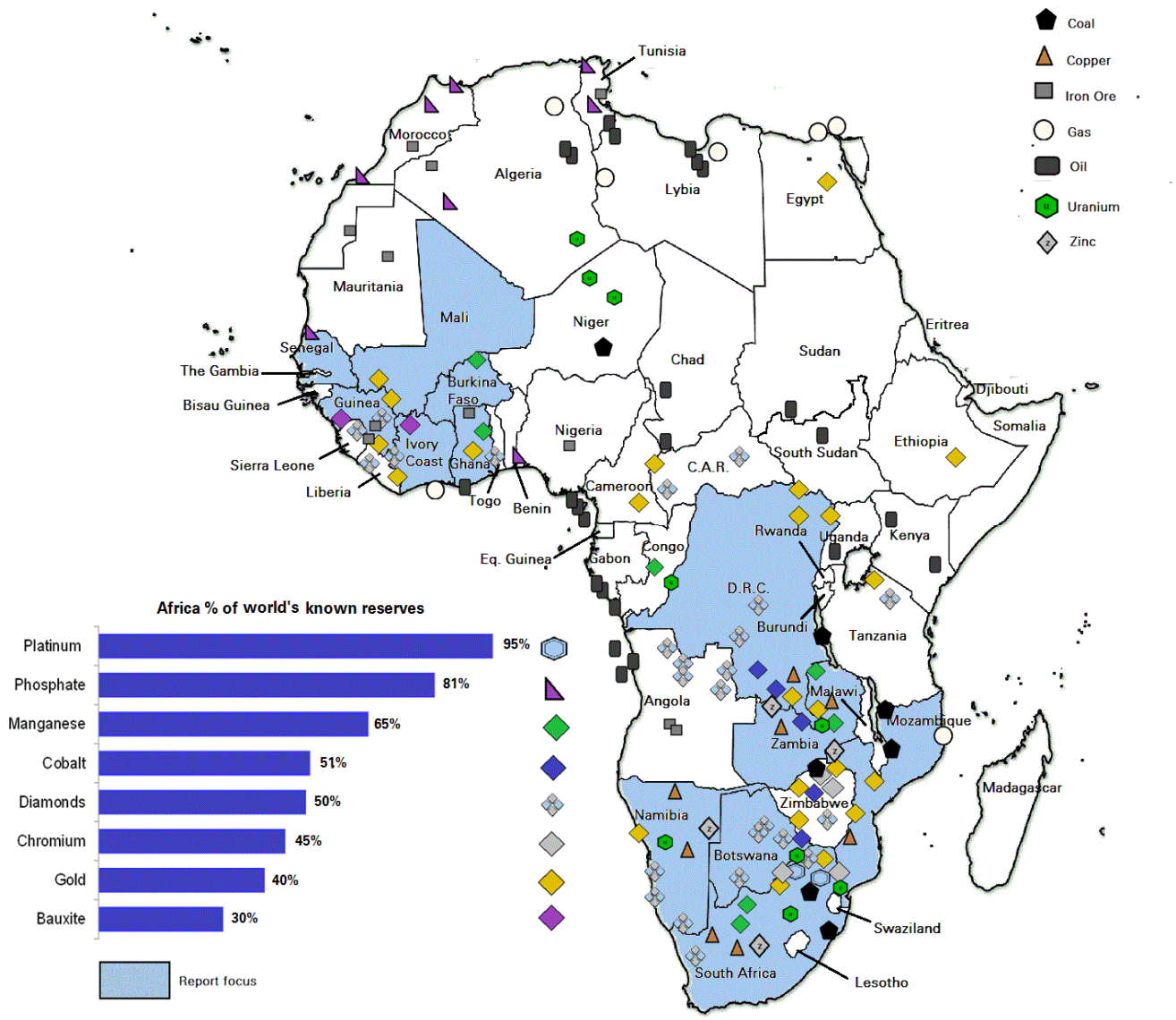
Anglo American (AAL.L),GBP625.50	Buy
BHP Billiton Plc (BLT.L),GBP1,096.00	Hold
Glencore (GLEN.L),GBP110.00	Hold
Randgold (RRS.L),GBP4,487.00	Buy
Rio Tinto (RIO.L),GBP2,440.00	Buy
South32 (S32.L),GBP70.00	Buy

Source: Deutsche Bank

Table Of Contents

Table Of Contents (Cont'd)

Figure 1: Africa's known mineral resources



Source: Deutsche Bank, USGS

Of the world's known mineral reserves, Africa hosts 95% of its platinum, 81% of its phosphates, 65% of its manganese and half of the world's diamonds and cobalt. Much of the continent remains to be explored.

Africa: The next frontier

Under-explored, under-developed: a must for future growth

This report is about the next, perhaps last viable, frontier for mining companies' growth: Africa. At this point of the cycle, growth is not a focus of the miners or investors. However, the cycle will eventually turn and our collective attention will focus back on volumes: where will the next stage of production come from and who is best positioned to deliver?

As shown on the preceding page, Africa is host to a multitude of mineral riches, is under-explored and under-developed, and could offer significant volume growth from the next decade onwards. The challenges are numerous, however, and need deep pockets of capital, deep reserves of patience and deep relationships with stakeholders in order to be overcome.

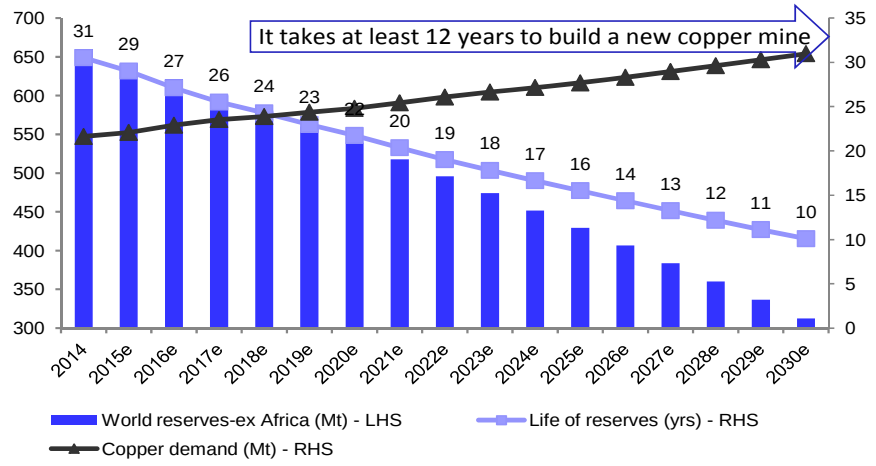
In this report we focus on:

- (i) **Africa's supply potential:** what can the continent offer to meet the world's commodity needs?
- (ii) **The challenges of doing business in Africa;** we look at four key risks;
- (iii) **Africa's return potential:** is Africa 'worth it'? Here we look at four case studies of the pioneers: Randgold, Glencore, Rio Tinto, and South32;
- (iv) **The existing African footprints** of the big UK-listed miners.

African supply: a necessity by the end of the decade…

Using copper as an example, we calculate that world reserves ex-Africa will drop to 10 years of demand by 2030. Clearly, the time frame appears long, and we're not including resources here. But considering it now takes at least 12 years to build out a Greenfield copper mine from scratch, we believe the mining companies' growth plans need to include Africa soon – by the end of this decade on our numbers:

Figure 2: The world's copper reserves ex-Africa to fall to 10 yrs of demand



Source: Deutsche Bank estimates

…and too attractive to ignore

There is a lot of upside potential from today's very low base

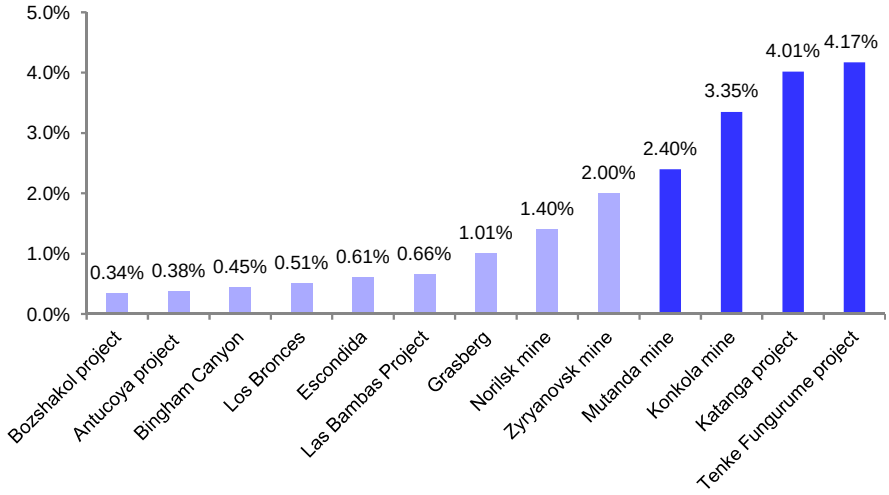
Despite Africa's resources, only two of the 50 lowest-cost copper/gold/iron ore/coal mines globally are located there at the moment: the Akyem gold mine in Ghana, owned by Newmont; and the Black Mountain zinc/copper mine in Namibia, owned by Vedanta/Exxaro. There are of course low-cost platinum mines (namely Anglo American's Mogalakwena in South Africa) and low-cost diamond mines (notably Anglo American's Jwaneng and Orapa mines in Botswana).

The reasons for this are that the best mines in the world have (i) infrastructure – logistics, power, water, export channels – for efficient and low-cost logistics (bulk commodities); (ii) large ore bodies for economies of scale, or high-grades; (iii) by-product credits that facilitate mining of lower-grades (base metals); and (iv) security of tenure: minimal government/stakeholder interference, consistent and fair mining codes/taxation systems.

Given the low number of high-margin mines in Africa today, we surmise that either the minerals require a mining or processing method that makes the cost prohibitive, the ore bodies are too small to generate economies of scale, or logistics required are insufficient or nonexistent.

Yet, the necessity for supply to come from Africa in the medium term will force solutions to these issues. There are extremely attractive ore bodies – Figure 3 illustrates the very high grades in African copper reserves compared with mines and projects elsewhere – which will keep pressure on the mining companies to maintain and grow their exposure to the continent.

Figure 3: African copper reserve grades are unsurpassed



Source: Deutsche Bank, Company data, Woodmac

The Five Commandments

Across our coverage universe there is a wide variety of approaches to the higher risk-reward profile that mining in Africa has to offer. We assess four different approaches in four case studies in this note.

We have distilled lessons from our four pioneers into Five Commandments for successful mining in Africa:

1. **Pay the rent**: Maintain your fiscal licence to operate through deep, transparent relationships with host governments;

2. **Start small to go big:** Large ore bodies generate higher returns but a phased build-out approach is more successful;

3. **Invest in infrastructure:** mines need an efficient logistics system and stable power: whether state-funded and run, or owner-operated;

4. **Up-skill your communities:** Create jobs for stakeholders in the zone of impact around your mine. Transfer skills;

5. **Patience required:** Successful exploration, development and operation of a mine can take at least a decade.

The challenges and headwinds remain substantial for now

We would put the key challenges and risks into four 'buckets':

- **Political stability:** the risk from changing governments, instability in political regimes, and conflicts;
- **Security of tenure:** the risk from changing mining and environmental legislation, increased taxes or 'resource nationalism' in general, with expropriation as the extreme example; the cost of maintaining a 'social licence to operate';

- **Infrastructure requirements:** the availability of transport links, power, water, import and export routes;
- **Mining input requirements**: the availability of grid power or need to invest in own power source; availability of water; and availability and cost of labour and skills.

But there are countries that offer attractive risk-adjusted rewards

We would look for countries with (i) stable and compelling mining codes, supported by (ii) existing infrastructure or in-progress build-out of infrastructure that facilitates access to resources, and (iii) existing or developing skilled and competitive mining workforces.

We have weighted the four key challenges in terms of our view of their relative importance in making a mining investment decision, and ranked the 12 countries to score them as investment destinations: Ghana and Namibia rank best, and Cote d'Ivoire third. Guinea and DRC, despite massive resource endowments, rank at the bottom of the pack, due primarily to lack of infrastructure:

Figure 4: Summary ranking of challenges for mining investments per country

Weighting	*20%*	*30%*	*30%*	*20%*	
	Geopolitics	Security of tenure	Infrastructure	Mining inputs*	Average rank
Ghana	3	2	2	3.5	2.5
Namibia	1	4	3	4.5	3.2
Cote d'Ivoire	6	1	5	5	4.0
South Africa	5	7	1	3.5	4.1
Botswana	2	6	6	6	5.2
Senegal	4	3	10	7	6.1
Mali	10	5	7	3	6.2
Zambia	8	9	4	9.5	7.4
Mozambique	7	10	9	3.5	7.8
Burkina Faso	11	8	8	9	8.8
Guinea	9	11	11	10.5	10.5
DRC	12	12	12	11	11.8

*Source: Deutsche Bank; *Primarily power and labour availability and stability*

Upgrade Randgold to Buy. Reiterate Buy on South32

Our in-depth case studies can be found from page 52 onwards.

Randgold has had exceptional success: Buy, TP £50.50

Randgold has been successful in delivering an Africa-focused strategy that is simple (on paper) and adhered to it consistently: Employ the right people to find and develop gold deposits with more than 3moz R&R, which make a minimum 20% IRR at a US$1,000/oz gold price. Do this through partnership with governments, NGOs, regulators, employees, communities and investors.

Randgold's discovery of gold deposits that fit those criteria has occurred, so far, in West and central Africa. The successful development of those discoveries in extremely difficult and risky jurisdictions is testament to Randgold's ability to work in partnership with all the stakeholders listed above.

So, how does Randgold do it? We assess its approach: each of its mines will be the centre of an impacted zone, and Randgold is responsible for the economic viability of that zone and the communities/stakeholders therein.

We conclude that Randgold's best option for its next +20% IRR mine is the Obuasi JV, as long as government agreement to use the existing tax-losses is secured. Building in Cote d'Ivoire would just reach a 20% IRR on our estimates and could be the group's second option.

South32 has all to play for: Buy, TP £0.91

South32 remains in the "Crawl" phase of its approach of "Crawl, Walk and then Run" since its spin-out from BHP Billiton in May 2015. In terms of the groups' African assets – in South Africa and Mozambique – we think that 'crawling' means a focus on cost-cutting and decisions on committing capex to life-extension projects in SA coal.

On our estimates, South32's production declines from 2016 on. FCF builds up quickly, however, and whilst we think that management's appetite for M&A is low currently, we believe the group could consider moving into new African countries and commodities. This would likely be in the 'Running' phase of the strategy, and thus 3-4 years away. To us, building out a larger base metals portfolio via zinc in Namibia or copper in central Africa makes sense.

The jury is out on Glencore's African growth: Hold, TP £1.90

One of Glencore's engines of growth is copper in the Central African Copperbelt across Zambia and DRC. We conclude that the high-grade potential of the district can only be delivered fully if infrastructure, especially power, is invested in and made more reliable. Given our placement of DRC at the bottom of our ranking table, building up a successful mining position there will be high-risk, expensive and likely to take a very long time. Glencore has a high-quality asset in Mutanda (DRC) – which it built out fully – but its other mines in Zambia and DRC are on care and maintenance while it completes projects to deliver medium-term growth.

Rio Tinto's experience provides useful lessons: Buy, TP £34.00

Rio's only major current project in Africa is the Simandou South iron ore project in Guinea. With Guinea ranking second-bottom in our country ranking table, it is clearly a tough place to do business. Rio has de-risked its exposure over time and, to a large extent, the ball is now in the government's court to push forward investment in the surrounding infrastructure of the potential 100mtpa mine.

We conclude that the project is unlikely to deliver first production before the end of the decade and, offering a 16% IRR for Rio on our estimates, is not compelling enough for the group to bring this project forward into this decade. The benefit from going more slowly and at a smaller scale in order to improve Rio's African capital allocation record is also clear: one of the company's other forays into Africa was a US$4bn purchase of Riversdale Coal in Mozambique in 2011– sold for US$50m in July 2014. Once bitten, twice shy.

Figure 5: Valuation metrics for companies

Company	Rating	Target price	Current price	Up/downside	Market cap (US$m)	P/NPV	PE (x) 2014	PE (x) 2015	PE (x) 2016	EV/EBITDA (x) 2014	EV/EBITDA (x) 2015	EV/EBITDA (x) 2016	Free Cash flow Yield (%) 2014	Free Cash flow Yield (%) 2015	Free Cash flow Yield (%) 2016	Net debt to EBITDA (x) 2014	Net debt to EBITDA (x) 2015	Net debt to EBITDA (x) 2016	Div. Yield 2015
Anglo	Buy	1,190	675	76%	13,434	0.51	13.8	11.1	21.3	16.5	21.3	6.4	NM	NM	NM	4.3	8.7	2.7	3.1
BHP Billiton	Hold	1,310	1,130	16%	95,138	0.86	12.3	15.7	35.2	6.3	8.7	8.3	6.8	5.7	7.2	0.8	1.3	1.7	4.9
Glencore	Hold	190	116	64%	26,133	0.57	16.7	15.7	15.5	9.1	6.7	5.9	NM	24.9	17.3	4.2	5.4	4.5	3.3
Rio Tinto	Buy	3,400	2,493	36%	71,624	0.73	10.5	12.5	14.9	6.3	6.5	6.9	6.5	7.8	6.9	0.7	1.0	1.0	5.8
South32	Buy	91	70	30%	5,756	0.77	NM	15.1	21.4	NM	4.9	4.2	NM	13.9	11.2	-0.2	0.2	-0.1	0.0
Randgold	Buy	5,050	4,572	10%	6,511	0.98	29.6	41.2	49.2	16.5	21.9	18.5	1.4	1.4	2.3	-0.2	-0.5	-0.7	0.9

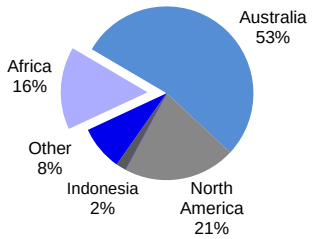
Source: Deutsche Bank estimate;, Current prices as at COB 16/10/2015

Existing African footprints of UK-listed Diversified Miners

Rio Tinto: A concentrated footprint, with big potential

Rio Tinto management has stated THAT it is content with its Emerging Market exposure. In Africa this comprises five operating assets across five different countries (see Appendix for full list) and one major growth project, Simandou South iron ore in Guinea. At present we estimate that African-based operating assets make up 16% of Rio's group NAV (Figure 6). Within Africa, the vast majority of NAV is from Rio's mineral sands business, with a small amount from diamonds and uranium.

Figure 6: Rio Tinto split of NPV (2016e) by geography



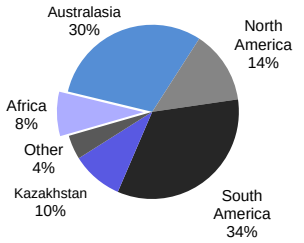
Source: Deutsche Bank estimates

Glencore: Present across the continent

Glencore has the largest and widest-spread African portfolio of assets and projects of the big FOUR diversified miners. Figure 133 in the Appendix sets out the group's 30 operating assets (we do not include Glencore's marketing assets in this summary).

Despite its long list of operations across the continent, in aggregate we estimate that African assets account for 8% of total group mining NAV (i.e. excluding marketing and agriculture), because of a large number of coal mines being loss-making/negative NPV. We estimate the majority of African NAV for Glencore comes from copper, oil and alloys (chrome, manganese): Figure 7.

Figure 7: Glencore split of NPV (2016e) by geography

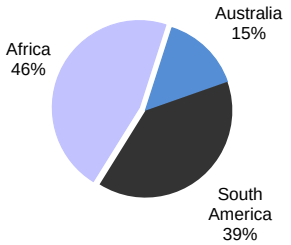


Source: Deutsche Bank estimates

Anglo American: the original African miner

Anglo American was formed in South Africa in 1917 by Sir Ernest Oppenheimer and J. P. Morgan, mining diamonds initially and then moving to the Zambian copper belt in the late 1920s. This was followed in the 1940s and 50s by a move into coal and then gold and platinum mining. From the 1970s on, the group diversified into industrial activities, but now has a smaller more concentrated portfolio after a series of divestments including stakes in Mondi, AngloGold and Scaw Metals. Today, Anglo's exposure to Africa is contained to three countries and five commodities: diamond mines in Botswana, Namibia and South Africa, and iron ore, platinum and coal mines plus a non-operating stake in Samancor Manganese in South Africa – the details are in the Appendix.

Figure 8: Anglo split of NPV (2016e) by geography



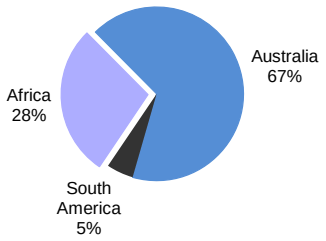
Source: Deutsche Bank estimates

South32: new kid on the block

South32 was demerged from BHP in 2Q15 and houses assets in Africa, Australia and South America. The group has operating assets across three main product groups: thermal coal, aluminium and manganese, all in South Africa apart from the Mozal aluminium smelter in Mozambique. South32 is expanding the capacity of the Hotazel manganese mine, and has one probable and two possible coal mine life extension projects (see Appendix for details).

We estimate that 28% of group NAV is derived from African-based assets (Figure 9) with 80% of that African NAV coming from SA and the rest from Mozambique.

Figure 9: South32 split of NPV (2016e) by geography



Source: Deutsche Bank estimates

BHP Billiton: all but out of Africa

With the spin-out of African assets into South32 in 1H15, BHP reduced its exposure to Africa to near zero. The company now has one operating asset in Oil & Gas in Algeria, and one suite of exploration licences for iron ore in Liberia. BHP exited from its Guinea iron ore exploration project in FY14, selling its 43.5% stake to partner Arcelor Mittal. And it divested its holding in Richards Bay Minerals in FY13.

Perception vs. reality: the Africa you rarely hear about

Doing business in Africa: two sides to every coin, and each side is extreme

Across our coverage universe we have a wide variety of approaches to the higher risk-reward profile that mining in Africa has to offer.

On the one hand – a cursory search of the internet using the search term "Africa" could take you to the likes of Wikipedia where Africa is described as follows:

Although it has abundant natural resources, Africa remains the world's poorest and most underdeveloped continent, the result of a variety of causes that may include corrupt governments that have often committed serious human rights violations, failed central planning, high levels of illiteracy, lack of access to foreign capital, and frequent tribal and military conflict (ranging from guerrilla warfare to genocide).

On the other hand, as described by Kingsley Chiedu Moghalu, ex-Deputy Chairman of the Bank of Nigeria:

"....Africa captures the world's imagination... Africa is the new frontier – the last, really, since virtually all the others have opened up – in the relentless march of globalisation. It is, in this view, a frontier of limitless opportunities for wealth creation for the agents of global capital...This marker is all the more imperative because the Western world epicentres of the global economy have recently been battered by an economic and financial crisis the magnitude of which just slightly fell short of the Great Depression".

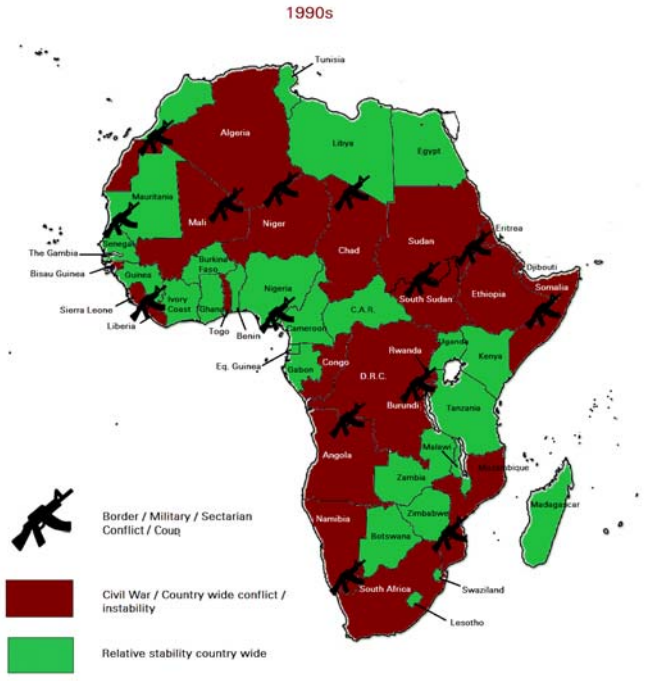
Some statistics: challenge your perceptions

Amidst the many dire statistics, we think Africa can offer a multitude of opportunities and on many fronts is moving in the right direction: perception is not always reality.

Fewer conflicts…

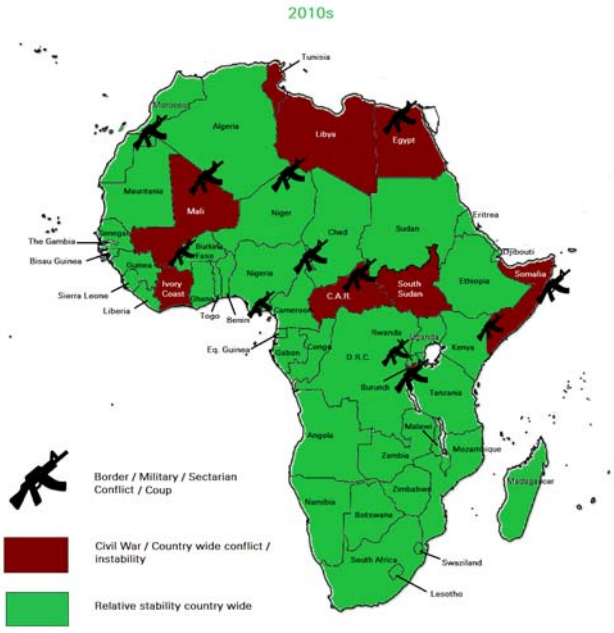
The clearest example of this is the perception of Africa as a conflict-ridden continent of civil wars, uprisings and coup d'états: not a place to do business. And yet the current reality is different: the occurrence of conflicts/civil wars, border contests and violent events has dropped by half over the last 20 years, from two-thirds of countries having violent conflicts in the 1990s, to one-third in the 2010s as we show in Figure 10 and Figure 11:

Figure 10: African conflicts in the 1990s



Source: Deutsche Bank

Figure 11: African conflicts in the 2010s

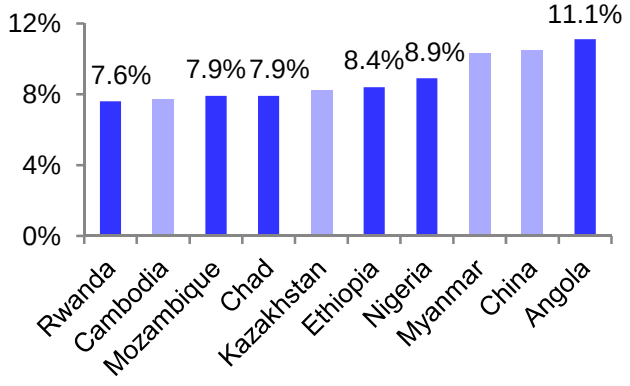


Source: Deutsche Bank

…means stability to deliver higher economic growth.

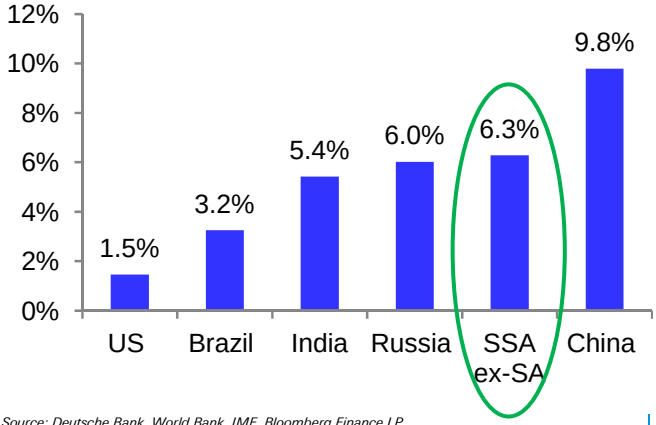
Sub-Saharan Africa GDP grew at 5.3% CAGR from 2000 to 2014 and 6.3% excluding South Africa, with six of the world's fastest-growing economies in Africa in that period – see Figure 12. In 2015, we expect growth in sub-Saharan Africa (SSA) excluding South Africa to be higher than the EM average, with eight of the 12 countries in our sample growing more than 5%.

Figure 12: World's 10 fastest-growing economies: GDP growth 2000-2014: six were in Africa



Source: Deutsche Bank, World Bank, IMF, Bloomberg Finance LP

Figure 13: Developed and emerging countries' GDP growth 2000-2014



Source: Deutsche Bank, World Bank, IMF, Bloomberg Finance LP

Figure 14: Real GDP growth, 2011-17e

	2000-2010	2011	2012	2013	2014	2015e	2016e	2017e	2014 GDP* (US$b)
Sub-Saharan Africa	**5.7**	**4.0**	**4.1**	**4.2**	**4.6**	**4.2**	**4.6**	**5.0**	**1,728**
SSA excl. South Africa	6.7	4.6	4.7	6.0	5.7	5.0	5.4	5.8	1,378
Mining countries (our sample)	3.9	4.0	3.8	4.1	3.5	3.7	4.0	4.4	575
Mining countries ex South Africa	4.7	5.5	6.7	7.4	6.8	6.4	6.8	7.3	225
Botswana	4.2	6.1	4.8	9.3	4.4	4.3	4.2	4.2	16
Burkina Faso	6.3	6.5	6.5	6.7	4.1	5.0	6.2	6.5	13
D.R.C	4.7	6.9	7.2	8.5	9.1	8.0	8.5	9.0	33
Ghana	5.8	14.1	9.3	7.3	4.2	3.5	5.9	7.8	39
Guinea	2.6	3.9	3.9	2.3	-0.3	-0.3	2.3	2.5	7
Ivory Coast	1.1	-4.4	10.7	9.2	9.0	8.0	7.7	7.5	34
Mali	6.0	2.7	-0.4	2.1	7.2	5.6	5.1	5.2	12
Mozambique	7.7	7.4	7.1	7.3	7.4	7.2	7.3	7.3	16
Namibia	4.8	5.2	5.2	5.1	4.5	5.5	5.3	5.1	13
Senegal	4.1	2.1	3.5	3.5	3.9	4.8	5.0	5.2	16
South Africa	3.5	3.2	2.2	2.2	1.5	2.0	2.1	2.4	350
Zambia	7.5	6.3	6.7	6.7	6.0	5.6	6.2	6.9	27
Rest of the World									
World			2.4	2.5	2.6	3.0	3.3	3.2	
Developed countries			1.4	1.4	1.8	2.2	2.4	2.2	
Developing countries			4.8	4.9	4.4	4.8	5.3	5.4	

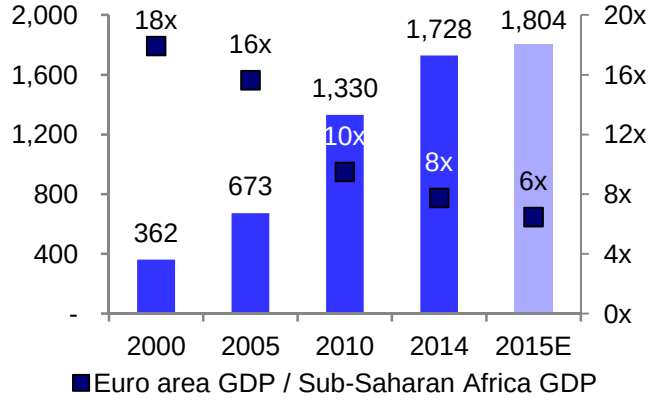
*Source: Deutsche Bank, World Bank, IMF, Bloomberg Finance LP; *Nominal*

In addition, over the last 10-15 years:

- The continent's Debt-to-GDP ratio declined to below 70% by 2014, after the successful implementation of debt relief programs at the beginning of the 2000s (US 88%, EU 87% today);
- There is a growing middle class, rising from 110m in the 1980s to 310m in 2010, which suggests medium- to longer-term demand potential in terms of energy and consumption (the middle class is defined as earning between US$2 and US$10 a day);
- With regard to governance, according to the World Bank, the continent has improved in terms of transparency and government effectiveness. Rwanda, for example, was ranked No. 7 in the most efficient governments globally at the 2014-2015 World Economic Forum;
- Foreign capital investment: in 2014, the number of FDI projects in Africa fell 8.4% year-on-year but the value increased by 136% to US$128bn, with only Asia-Pacific attracting more FDI than Africa. FDI was split evenly between north Africa and SSA;

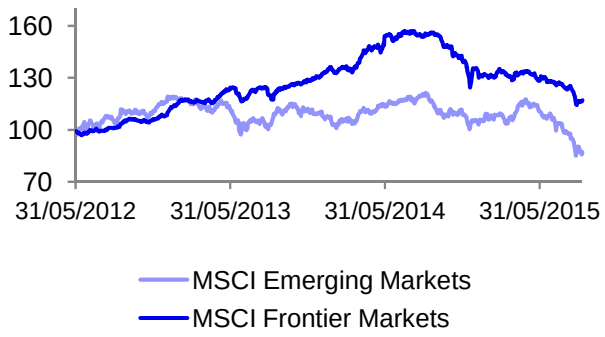
- Sub-Saharan African GDP is now worth one-sixth of Eurozone GDP. As we show in Figure 15, SSA's nominal GDP was worth one-twentieth of the Eurozone level in 2000,
- In terms of stock performance, frontier market stocks, which have the highest exposure to Africa, have outperformed emerging markets since the Euro sovereign crisis in 2012 – see Figure 16.

Figure 15: SSA GDP (US$b) vs. Euro area GDP 2000-2015e



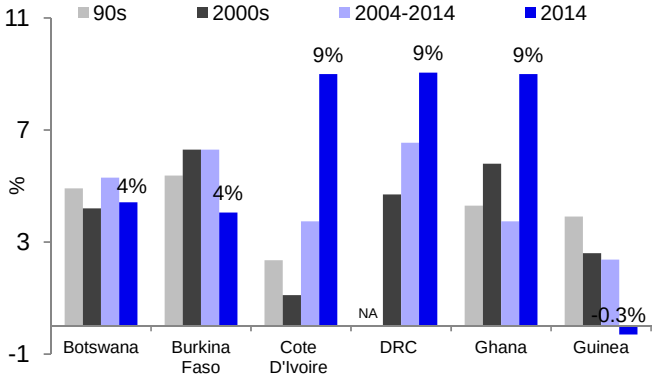
Source: Deutsche Bank, World Bank, Bloomberg Finance LP

Figure 16: Outperformance of Frontier stocks since 2012



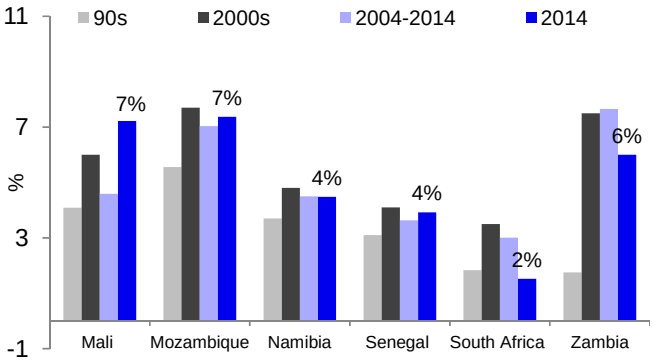
Source: Deutsche Bank, Bloomberg Finance LP

Figure 17: GDP growth in our sample of African countries



Source: Deutsche Bank, World Bank

Figure 18: GDP growth in our sample of African countries



Source: Deutsche Bank, World Bank

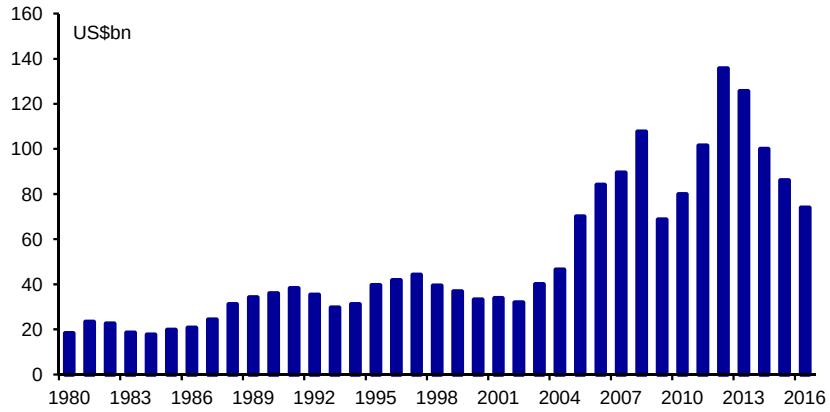
Our attention *will* shift back to growth

Today, "growth" is a dirty word

"Growth" is *persona non grata* in mining company boardrooms and investor meeting rooms across the sector. To preserve cash, protect margins and improve returns, the miners have cut capex drastically as commodity prices have tumbled since the peak of the Chinese demand-driven 'super cycle' in 2008. As shown below, total capex spent globally has dropped in each of the four years since the 2012 peak, and we expect a further drop in 2016, to 2004 levels.

***We need to talk about growth**: it can take 10-25 years to bring on new mines from scratch, and the world does need new mines*

Figure 19: Global mining capex plans have been cut for five years since the 2012 peak



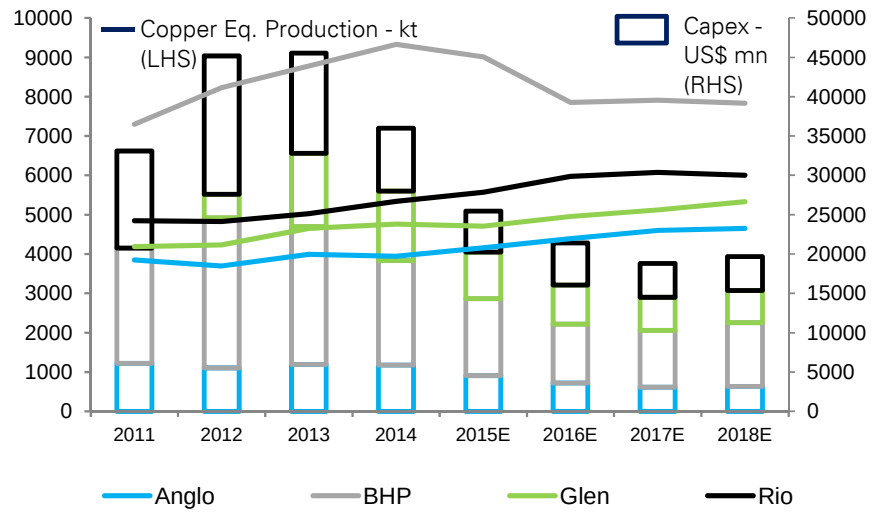
Source: Deutsche Bank estimates, CRU

Volume growth to plateau from 2016

As Greenfield projects have been delayed or cancelled, forecast production growth has plateaued. As shown below, aggregate capex of the Big Four peaked in 2013 and, on our estimates, will drop each year from 2014 to 2017, representing a 54% cut from peak to trough over the 2011-2018 period.

Volume growth should lag the capex trend – as shown in the chart overleaf, production from each of the Big Four continued to climb after capex started to fall, and will only drop or plateau, on our numbers, two to three years later, from this year on.

Figure 20: Volume growth to plateau for the Big Four from 2016 on



Source: Deutsche Bank estimates, Company data

The focus of management has changed…

Current management has a job to do – cut costs

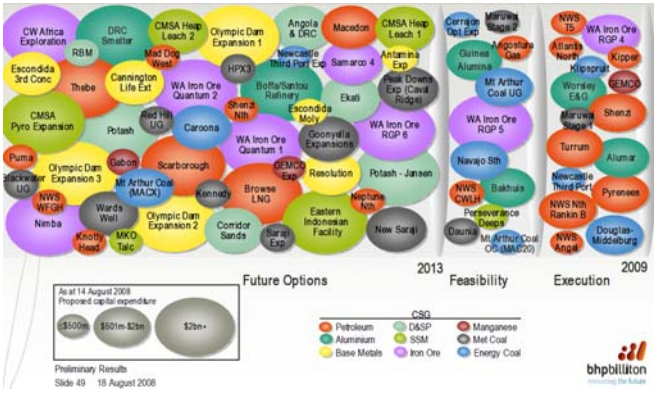
And this is having a direct impact on production growth and communication of growth prospects:

The name of today's game is: finish in-progress projects, shelve all Greenfield options for now, and generate further cash from disposal of non-core assets

The big five diversified miners presented to the market in 2Q15. Vale alone presented its production profile – out to 2019. And this growth comes from projects that are essentially all paid for. Elsewhere, the name of the game is finish in-progress projects, shelve all Greenfield options for now, and generate further cash from disposal of non-core assets. The top-of-the-cycle "jelly bean" charts, laying out scores of projects across various commodities well into the future, have been replaced by jelly beans representing the size of non-core assets to be disposed:

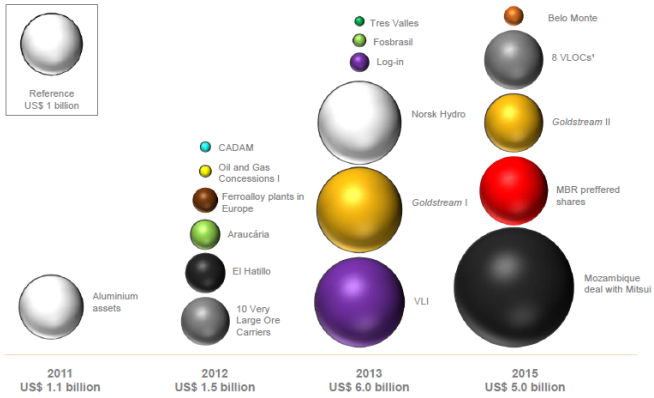
Same jelly beans, different flavours

Figure 21: 2008 BHP's jelly beans: planned projects



Source: Company data

Figure 22: 2015 Vale's jelly beans: planned disposals

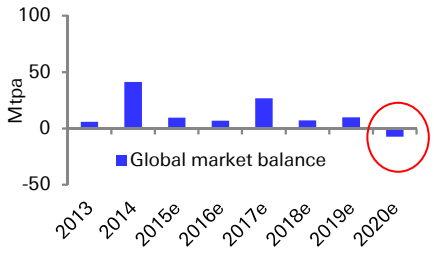


Source: Company data

…and there is more than enough supply to meet demand, for now

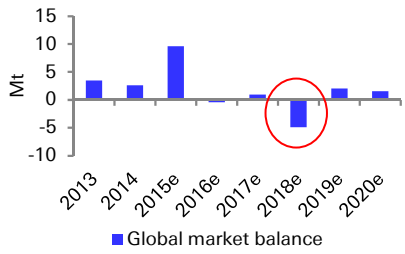
We forecast the major commodities to be in surplus until at least 2017 (2016 for nickel), and well into the next decade in some cases:

Figure 23: Iron ore surplus until 2019



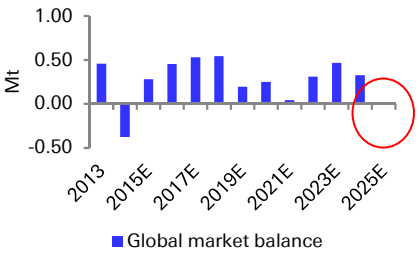
Source: Deutsche Bank estimates, Woodmac

Figure 24: Coking coal surplus until 2017



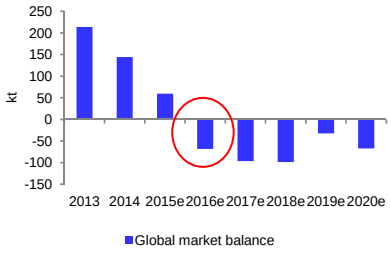
Source: Deutsche Bank estimates, Woodmac

Figure 25: Aluminium surplus until 2024



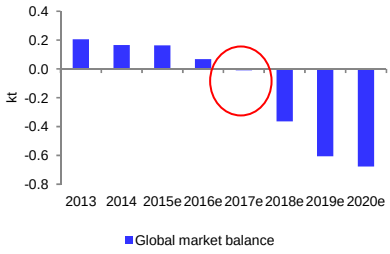
Source: Deutsche Bank estimates, Woodmac

Figure 26: Nickel surplus until 2015



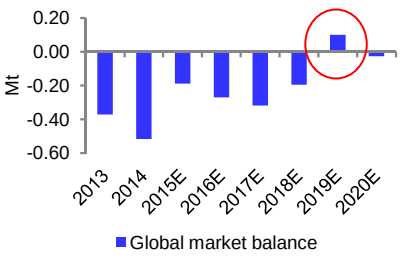
Source: Deutsche Bank estimates, Woodmac

Figure 27: Copper surplus until 2017



Source: Deutsche Bank estimates, Woodmac

Figure 28: Zinc deficit until 2018



Source: Deutsche Bank estimates, Woodmac

But the world will need more minerals eventually

Copper provides us with a good example of the need to supply the world's metal needs from new mines, even after secondary supply from recycling and substitution by other metals have been taken into account.

The world will need an estimated 5mt of additional mined copper by 2025

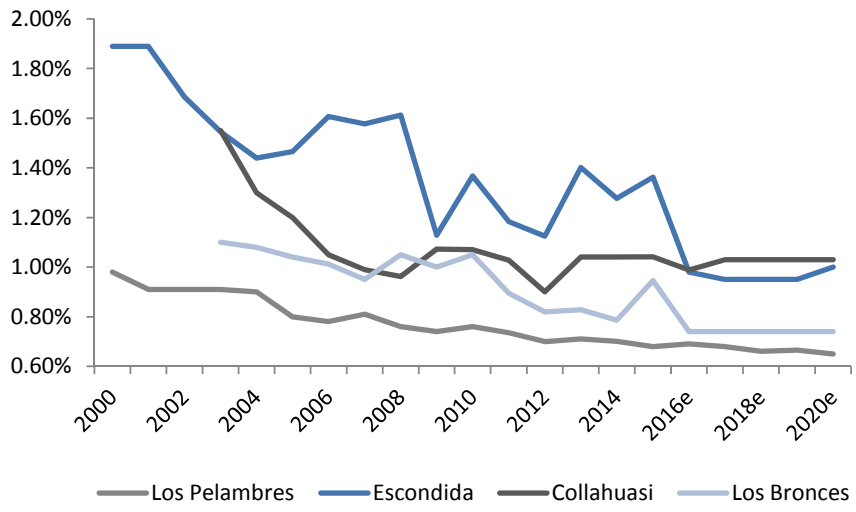
Copper demand has grown 3.2% each year since the end of WWII. However, we estimate that this growth rate will drop over the next 15 years to be below trend at 3%. This takes into account our GDP expectations, ongoing industrialisation of the emerging market economies and further substitution.

Despite the strong growth in copper demand in China over the past decade (2000-2010, near 15% CAGR), global copper demand was a more muted 2.4%. The high price environment of 2005-2008 led to demand destruction of around 2.2mtpa, with widespread substitution.

Taking into account increased secondary supply (+3% pa), mine depletion from falling grades (see Figure 29) and supply additions already underway, we estimate the world will need an additional 5Mtpa of mined copper by 2025, or around 500kt each year. This is more than a Collahuasi-sized mine each year (445kt in 2014) or two Andina-sized mines (232kt in 2014).

From now until 2025, the world should need around 500kt copper per annum, or more than one new Collahuasi-sized mine every year.

Figure 29: Copper grade at major Chilean copper mines over last 20 years



Source: Deutsche Bank estimates, Company data

Decisions need to be taken soon

Time to first production is now at least 12 years

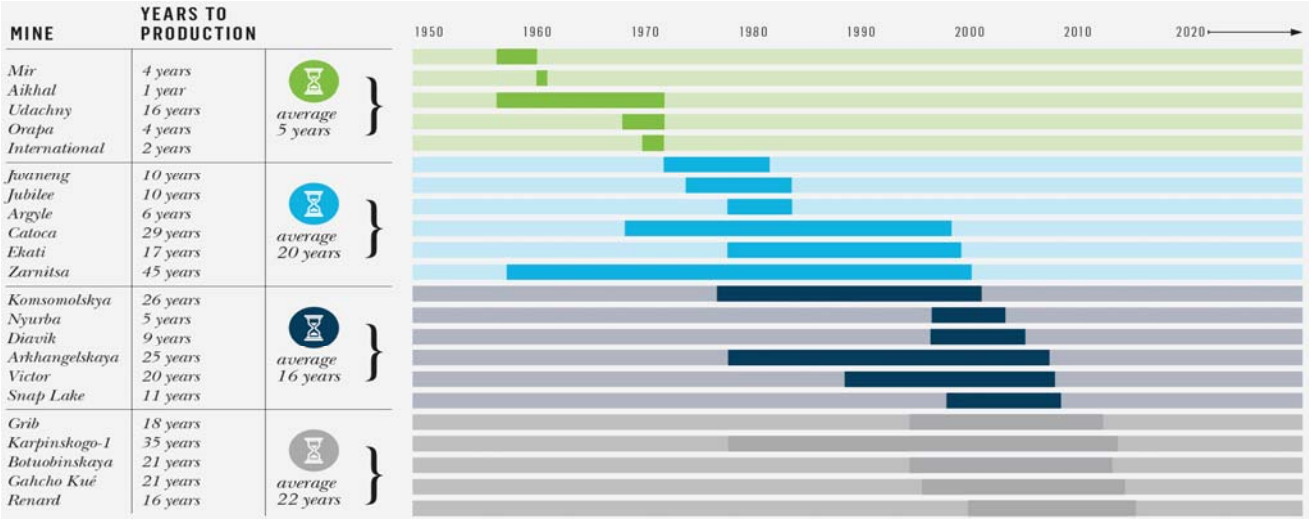
As shown here, for a typical Greenfield copper mine, the time to first production is at least 12 years. For diamond mines, the time frame has extended to an average of 22 years. For gold mines, the average time frame for the mines currently producing in Cote d'Ivoire was 15 years to get to first production (see Figure 32).

Figure 30: A typical timeline for the development of a copper project in 2012: 12 years

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Discovery	*											
Early stage exploration or	Drilling programme & resource development											
Purchase of potentially economic mineralisa	Drilling programme & resource development											
Community engagement												
Government engagement												
Scoping Study / Pre-feasibility		Resource delineation, basic sizing and basic engineering										
Feasibility study					Reserve delineation, technical and economic evaluation							
Ordering of equipment							Long lead-time equip.					
Permitting						Financing and permitting (EIA)						
Go-ahead								*				
Engineering & Construction								Building & Pre-strip				
Commissioning												
Start-up												*

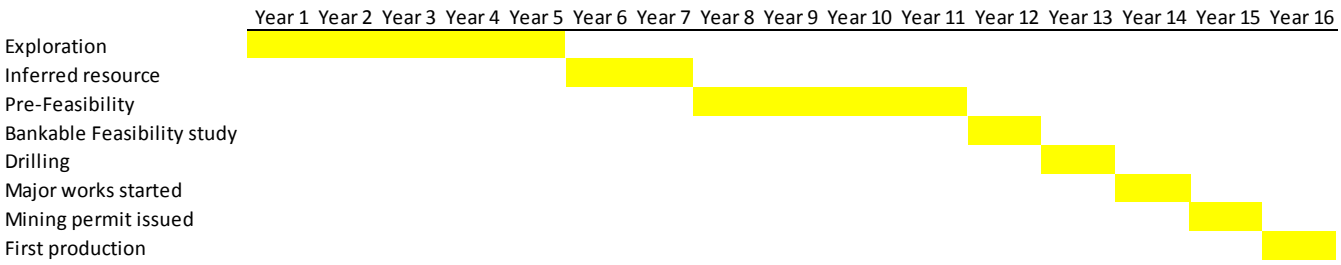
Source: Deutsche Bank

Figure 31: The average time for a diamond mine to reach production has extended to 22 years



Source: De Beers

Figure 32: A typical timeline for the development of a Greenfield gold mine in Cote d'Ivoire: 15 years



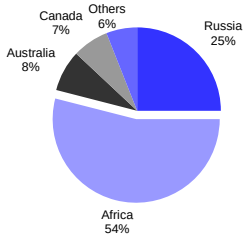
Source: Deutsche Bank, Randgold

So, where will growth come from?

Most major known deposits are currently exploited across Chile, Australia, North American, Russia and China.

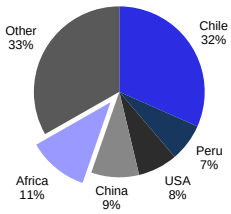
As shown earlier (in Figure 1 on page 4), Africa has a wealth of mineral resources, hosting 95% of the world's known platinum, 65% of its manganese, 50% of its diamonds and cobalt, 40% of its gold, 30% of the world's bauxite, and approximately 10% of the world's known copper sits in the Central African Copperbelt. Yet today, Africa supplies only 11% and 12% of the world's copper and gold respectively, plus just 9% of its thermal coal.

Figure 33: Split of global diamond supply



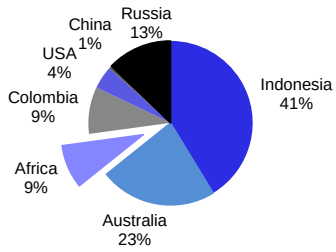
Source: Deutsche Bank estimates, Woodmac

Figure 34: Split of global copper



Source: Deutsche Bank estimates, Woodmac

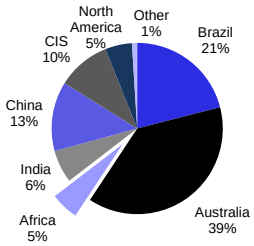
Figure 35: Split of global thermal coal supply



Source: Deutsche Bank estimates, Woodmac

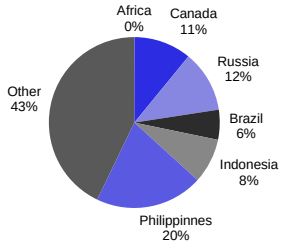
In terms of other major commodities, however, African supply accounts for very little or none at all – as shown in Figures 36-38, African supply accounts for only 5% of the world's iron ore output, around 1% of its zinc and none of its coking coal or nickel.

Figure 36: Split of global iron ore supply



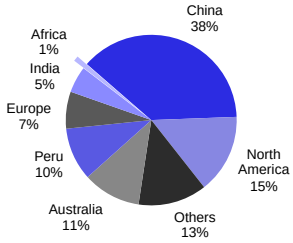
Source: Deutsche Bank estimates, Woodmac

Figure 37: Split of global nickel supply



Source: Deutsche Bank estimates, Woodmac

Figure 38: Split of global zinc supply



Source: Deutsche Bank estimates, Woodmac

Can Africa provide? Harnessing the potential

The best ore bodies and mines in the world have the following characteristics:

- Infrastructure for efficient and low-cost logistics (bulk commodities);
- They are large, for economies of scale, or high-grade;
- By-product credits that facilitate mining of lower-grades (base metals);
- Security of tenure: minimal government/stakeholder interference; consistent and fair mining codes/taxation systems

In the next section of the report we assess where the world's current top 10 mines in each major commodity are and what the potential is from ore bodies in Africa to join their ranks.

What can Africa offer? The supply potential

Can Africa offer the next top mines globally?

There are common characteristics across the ten lowest-cost mines globally for each commodity that drive their low-cost/high-margin position. In general, and at risk of stating the obvious:

- **for bulk commodities** (iron ore and coal) efficient logistics infrastructure is imperative to make distance manageable and lower-grade deposits viable. Current operating mines are concentrated in only four countries globally;
- **for base metals,** polymetallic ore bodies are more prevalent than high-grade single-product ore bodies, which makes it possible to mine deposits that have low-grade copper. This also means there is a wide spread of geographic locations for current operating mines;
- **for precious metals,** low-grade deposits are viable due to economies of scale and lower-cost open-pit mining methods; logistics are less important;
- **for all the mines** mentioned, government ownership does not figure. Non-operating stakes, where they exist, are held by financial or trading houses (e.g. Mitsui, Mitsubishi).

We set out the full detail in the Appendix. In summary:

Iron ore: Control and efficient rail needed

The top ten lowest-cost iron ore mines globally are in Brazil and Australia. They are all 100% owned and operated, other than Rio's Robe River Pannawonica mine. Distance presents little issue, with all but one of the ten mines using rail up to 700km to ship the iron ore.

Coal: Concentrated geographically in Indonesia (Thermal) and Australia (Metallurgical)

The world's 10 lowest-cost thermal coal mines are all in Indonesia, and eight of the ten lowest metallurgical coal mines are in Australia. Barges, road and rail (shorter distances than for iron ore) are all used. The vast majority of the mines are surface operations that are truck and shovel or dragline operations i.e. they have lower operating costs.

Base metals: by- or co-products for copper mines make low grades economic

We have assessed the 20 lowest-cost copper mines globally, which all exploit polymetallic ore bodies, with various amounts of zinc, nickel and gold as by- or co-products. Given that the presence of the by-products makes the mining of polymetallic ore bodies more feasible, there is a much wider spread of geographic location for these mines compared with the iron ore and coal mines discussed above. As with the bulks mines, though, with a few exceptions, the mines are 100% owned and operated. Grades are low for all top 20 mines.

Gold: high grades needed for underground mines; reliable power vital

The world's lowest-cost gold mines are in eight different countries. The majority are underground mines with costs driven by silver or copper by-product credits in many cases. There are two leach operations that result in very low gold grades being economically viable. No real logistics infrastructure is required – the gold is normally trucked or flown out to refineries but a reliable power source for mills is vital.

What operating mines exist in Africa today? Very few

Given all the mineral wealth of Africa, only two of the 50 mines we look at above are located there: the Akyem gold mine in Ghana, owned by Newmont; and the Black Mountain zinc/copper mine in Namibia, owned by Vedanta/Exxaro.

So, why would this be? We surmise that the minerals require a mining or processing method that makes the cost prohibitive, the ore bodies are too small to generate economies of scale, or logistics required are insufficient or nonexistent.

This is not to say that Africa has a low number of mines. In Figure 39, we set out the top five mines (by cost) for each major commodity in Africa, showing:

- South Africa's dominance in coal and iron ore: this is understandable for bulk commodities given the necessary logistics infrastructure;
- DRC's dominance in copper with three high-grade copper mines in the top five;
- The involvement of host governments or para-statals in owing stakes in many of the mines;
- Only 10 of the continent's 54 countries figure in this top 25;

Figure 39: Top five mines per commodity and lowest cost in Africa

Copper Top 5

Mine	Location	Ownership	%	Remarks
Black Mountain	South Africa	Vedanta/Exxaro	74/26	Copper by-product
Palabora	South Africa	Hebei Iron & Steel/SA IDC/Palabora	59.6/14.9/25.5	End of life 2016
Kipoi	DRC	Tiger Resources/Gecamines	60/40	
Mutanda	DRC	Glencore/Rowny Assets Ltd	69/31	
Kinsevere	DRC	MMG	100	Ramping up

Zinc Top 5

Mine	Location	Ownership	%	Remarks
Black Mountain	South Africa	Vedanta/Exxaro	74/26	
Skorpion	Namibia	Vedanta	100	
Guemassa	Morocco	Managem/BRPM*	76.91/23.08	
Rosh Pinah	Namibia	Glencore/Various	80.1/19.9	
Perkoa	Burkina Faso	Glencore/Government of Burkina Faso	90/10	

Iron ore top 5

Mine	Location	Ownership	%	Remarks
Ouenza	Algeria	Arcelor Mittal/Government of Algeria	70/30	
Beeshoek	South Africa	Assmang/African Rainbow Minerals	50/50	
Yekepa (Mt Nimba)	Liberia	Arcelor Mittal/Goverment of Liberia	30/30	
Kolomela	South Africa	Kumba Iron Ore	100	
M'Haoudat	Mauritania	SNIM	100	

Thermal coal top 5

Mine	Location	Ownership	%	Remarks
Goedgevonden	South Africa	Glencore/African Rainbow Minerals	74/26	
Impunzi Surface	South Africa	Glencore/African Rainbow Minerals	80/20	
Inyanda	South Africa	Exxaro	100	End of life 2015
Klipspruit	South Africa	South 32/Pembani/S32 employment plan	90/8/2	
Zibulo	South Africa	Anglo American/Inyosi Coal	73/27	

Gold top 5

Mine	Location	Ownership	%	Remarks
Akyem	Ghana	Newmont	100	
Ahafo	Ghana	Newmont	100	
Chirano	Ghana	Kinross Gold/Govt of Ghana	90/10	
Tasiast	Mauritania	Kinross Gold	100	
Agbaou	Ivory coast	Endeavour Mining/Govt of Cote d'Ivoire/SODEMI	85/10/5	

*Source: Deutsche Bank, Woodmac, * Bureau des Recherches et des Participations Minières*

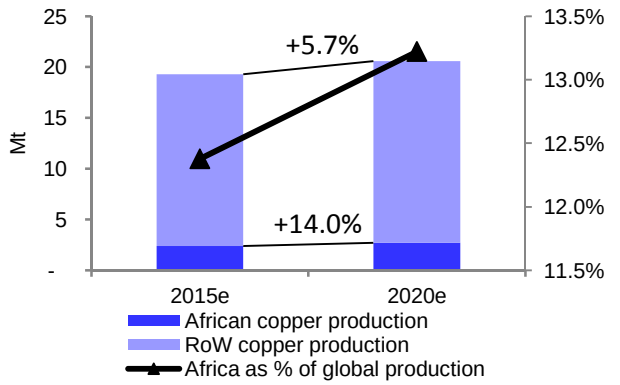
What is coming down the pipe? Lots of potential with copper most attractive

Given the relatively low number of operating mines in Africa today, are there any projects underway that could see low-cost/high-margin mines coming on stream in the near term (three to five years)?

Using Woodmac's categorization of Base Case, Probable and Highly Probable projects, there are 30 projects in a realistic pipeline for Africa – set out by capital investment size, commodity and planned timeframe in the Appendix.

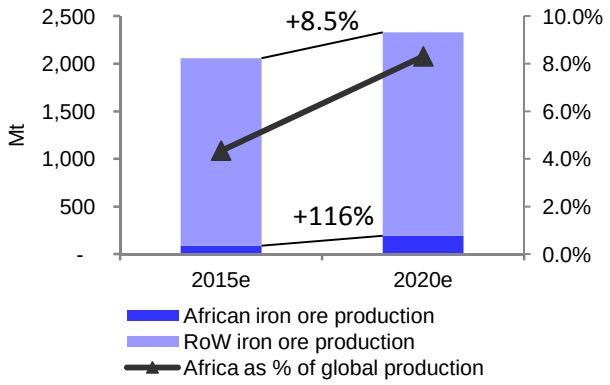
Looking at potential growth in copper, iron ore and zinc, as shown below, Africa's share of global copper, zinc and iron ore production could increase markedly – especially from the very low base in iron ore, and with no growth expected from zinc mines outside the continent.

Figure 40: African copper growth could be double RoW



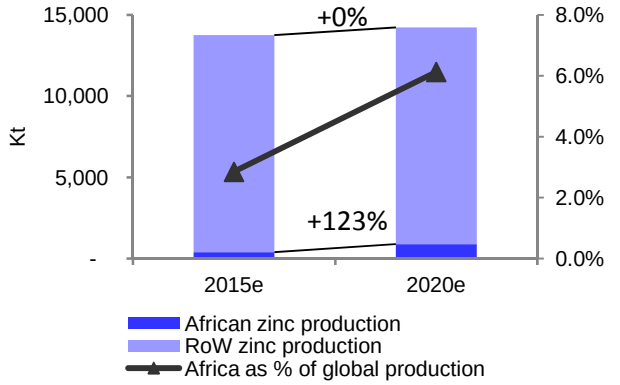
Source: Deutsche Bank, Woodmac

Figure 41: African iron ore market share could double



Source: Deutsche Bank, Woodmac

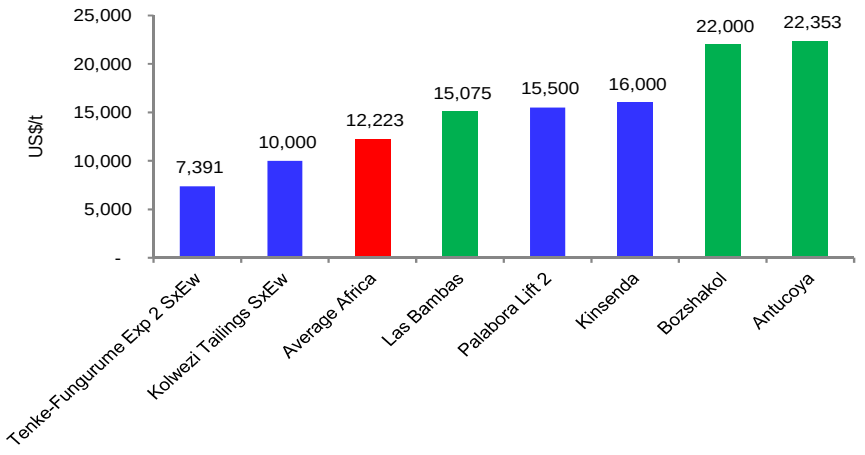
Figure 42: African zinc growth from a small base



Source: Deutsche Bank, Woodmac

Is the growth too expensive to deliver, however? Well, for copper, as shown in Figure 43, the average capital intensity (total capex per tonne) compares favourably to recently completed or ongoing Greenfield projects outside of Africa (shown in green), brought down by the low-cost, but as yet unapproved, expansion at Freeport's Tenke Fungurume in DRC.

Figure 43: Capital intensity of copper growth is below recent global projects

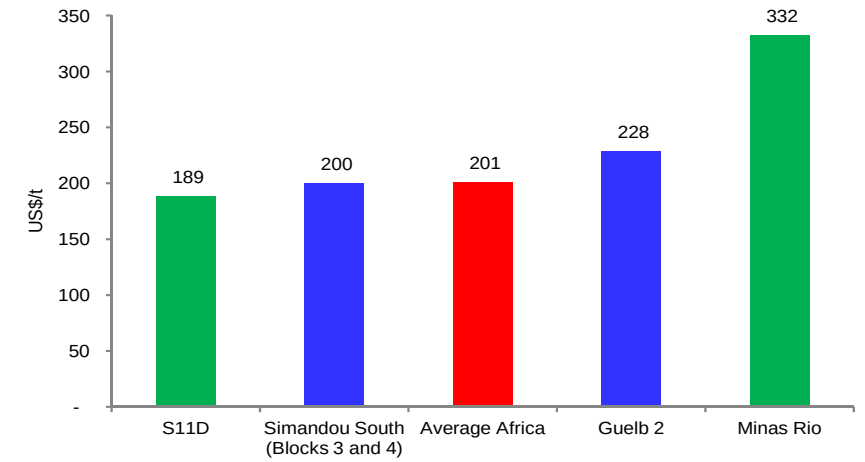


Source: Deutsche Bank, Company data, Woodmac

The capex per tonne of copper looks artificially high for Kaz Mineral's Bozshakol mine, which will actually benefit from producing by-product credits.

In terms of iron ore, Rio Tinto's Simandou South project is expensive on a US$/t basis, due to the required infrastructure capex, but still ranks around the capital intensity of other large iron ore mines now ramping up such as Vale's S11D and Anglo's Minas Rio:

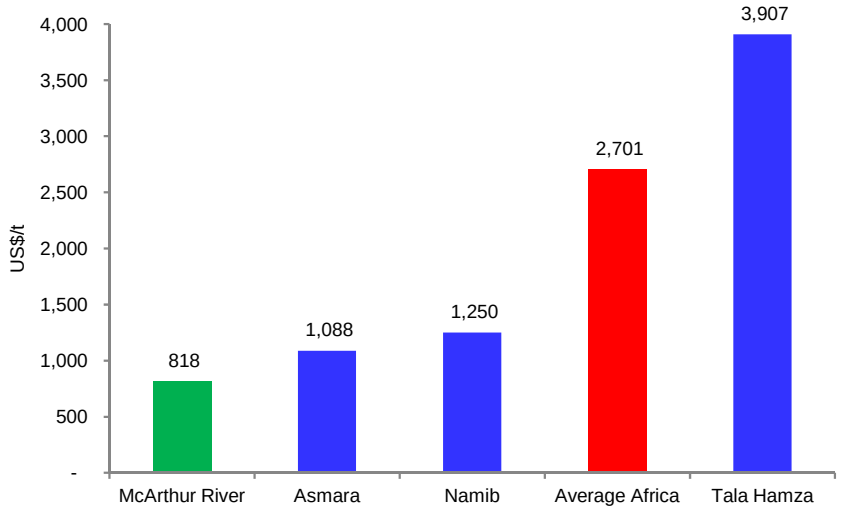
Figure 44: Simandou is expensive but no more than other global projects



Source: Deutsche Bank, Company data, Woodmac

The zinc mines that could be brought on are more expensive than recent projects, such as Glencore's McArthur River in Australia, but the more southerly ore bodies look to be viable – the northern ones less so:

Figure 45: Zinc: southern ore bodies cheaper than northern ones



Source: Deutsche Bank, Company data, Woodmac

Therefore the potential growth looks attractive, but given the challenges of delivering required IRRs, is it worth the risk?

Challenges and headwinds

A decision to invest in the continent's vast mineral and natural resources clearly requires some tolerance or appetite for the risks associated with the many uncertainties. The concept of risk is obviously subjective to some degree, but mining companies typically make a qualitative assessment based on factors such as infrastructure availability or requirements, political stability and security of tenure, and the economic and fiscal regime.

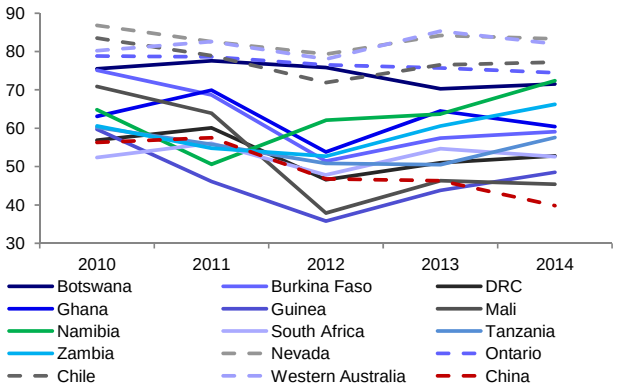
What is the status today?

The Fraser Institute conducts a yearly survey of mining companies for their opinions about each of the above factors, with a resultant ranking of the attractiveness of mining jurisdictions globally.

In the most recent survey (2014), African countries such as Namibia and Botswana rank towards the top with similar rankings to places like Chile and Ontario. In Figure 46 we look at the rankings of the African countries in our scope. We note the sustained progress of Namibia's ranking since 2011; only Namibia and Zambia have seen rising scores from 2010 to 2014. We also note countries like Mali and Guinea rank toward the bottom as they have seen some specific military (in the case of the former) and political events over the past three years.

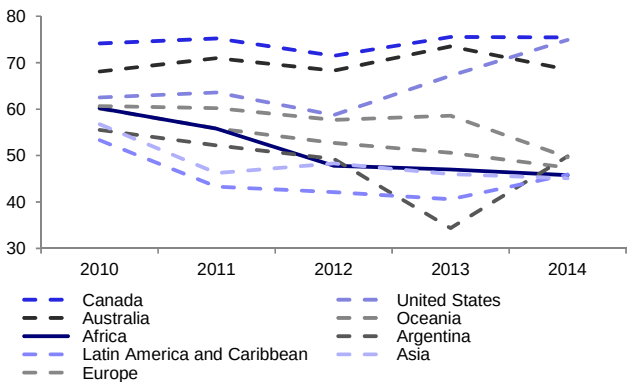
Looking at the median score of Africa compared to other regions in Figure 47, the continent ranks similar to Asia and Latin America, whilst being well below the established mining centers in the developed world (Australia, Canada, United States).

Figure 46: Fraser Institute scores for African countries vs other mining jurisdictions



Source: www.fraserinstitute.org

Figure 47: Median score Africa vs other regions



Source: www.fraserinstitute .org

Four key challenges need to be addressed

We would put the key challenges and risks into four 'buckets':

- **Geopolitical stability:** the risk from changing governments, instability in political regimes, and conflicts;
- **Security of tenure:** the risk from changing mining and environmental legislation, increased taxes or 'resource nationalism' in general, with expropriation as the extreme example; the cost of maintaining a 'social licence to operate';
- **Infrastructure requirements:** the availability of transport links, power, import and export routes;
- **Mining input requirements**: the availability of grid power or need to invest in own power source; availability and cost of labour and skills; presence of labour unions.

Ranking our focus countries as investment destinations

We have provided detail on each of the above factors and set out the information in a table in each section.

We have weighted the four key challenges in terms of our view of their relative importance in making a mining investment decision, and ranked the 12 countries to score them as investment destinations: Ghana and Namibia rank best, and Cote d'Ivoire third. Guinea and DRC, despite massive resource endowments, rank at the bottom of the pack, due primarily to lack of infrastructure:

Figure 48: Summary ranking of challenges for mining investments per country

Weighting	*20%*	*30%*	*30%*	*20%*	
	Geopolitics	Security of tenure	Infrastructure	Mining inputs*	Average rank
Ghana	3	2	2	3.5	2.5
Namibia	1	4	3	4.5	3.2
Cote d'Ivoire	6	1	5	5	4.0
South Africa	5	7	1	3.5	4.1
Botswana	2	6	6	6	5.2
Senegal	4	3	10	7	6.1
Mali	10	5	7	3	6.2
Zambia	8	9	4	9.5	7.4
Mozambique	7	10	9	3.5	7.8
Burkina Faso	11	8	8	9	8.8
Guinea	9	11	11	10.5	10.5
DRC	12	12	12	11	11.8

Source: Deutsche Bank

We will now look at each of the above challenges in depth.

Geopolitics: we rate Botswana, Senegal, Ghana, Namibia

Young democracies in charge of huge resource wealth

The obvious challenge for the "typical" African nation in terms of managing its resource endowment is to walk the tightrope between getting full and fair value for its countries' wealth and receiving nothing at all due to an inability to attract the investment needed to access that resource wealth. In its annual survey regarding the attractiveness of Africa, EY.com cited by far the largest barrier to investing in the continent was an "Unstable political environment".

This is particularly important for the mining sector given the very long investment horizon for the majority of mines and projects.

In Figure 49 we have summarised some of the key geopolitical data for our set of 12 countries: a brief description of the country's political history and/or approach to mining and resources, when it achieved independence and when its next general election or parliamentary elections are due, tenure of parliament/presidents plus national languages.

Figure 49: Summary of geopolitical factors

Country	Country resources and geopolitics	Independence	Next elections	Tenure (yrs)	National language(s)
Botswana	Botswana is the world largest diamond producer. The country is often referred to as Africa's role model for developement, stability and shared prosperity . With sound management of the high-margin diamond industry, Botswana has among the highest per capita GDP in Africa . AIDS prevalence is a constant challenge, nontheless, the country offers one of the most favourable environments for mining.	1966	2019	5	English, Tswana
Burkina Faso	Burkina Faso is a gold producing country in West Africa. The country is landlocked, sharing a border with Cote d'Ivoire and Ghana in the South, and Mali and Niger in the North. Burkina Faso is progressively returning to a civilian regime after mass protests in 2014 prevented the former president from modifying the country's constitution to seek re-election. The country made some progress in terms of self-sufficiency in the 80s under the leadership of Thomas Sankara until a coup erupted in 1987. At the time of writing, another coup erupted in the country thus halting the progress made as Burkina Faso was trying to return to civilian rule.	1960	2015	5	French
Ivory Coast	Whilst Ivory Coast is rich in gold, copper and other minerals, the mining sector in the country is still nascent. The world's largest cocoa exporter, Ivory Coast had notable economic success during the 70s and the 80s driven by successful resource planning and cocoa exports. Commodity prices decline, currency devaluation and mismanagement after the country's leadership transfer in the 90s halted the progress. With a coup d'etat taking place in 2000, a decade of instability followed. The country is now returning to civilian rule. Current president Alassane Ouattara, an economist by trade and former deputy head at the IMF, has taken numerous measures to attract more investments and revamp the business climate in Ivory Coast. Among them is a new version of the country's mining code, implemented in 2014.	1960	Oct-15	5	French
DRC	The DRC is the largest country in sub-Saharan Africa by land area, and with 70-75 million people, is the region's third largest country by population, the fourth largest in Africa, almost 7% of the continent. The DRC is among the most resource-rich countries globally. 16th-century Italian explorer Filippo Pigafetta reported that the people of the Kingdom of Congo were trading using gold, copper, and iron ore. Under King Leopold of Belgium during the 19th century, the country, as a Belgian colony, was the world's largest rubber producer. The DRC also provided uranium as part of the Manhattan project during the Second World War. Post independence, DRC had short-lived economic success driven by rising commodity prices. With the epicenter of civil/political troubles in the Great Lakes region, a long-lasting civil war took place in the DRC from 1996 till 2003. In its early post-independence years (from 1960), copper was the DRC's primary export, leading to relative prosperity until the collapse of copper prices in the mid-1970s. The situation was then exacerbated by a collapse in the cobalt price (another primary export), which dropped 58% in 1986 alone. This had a severe knock-on effect on investment from internal and external parties into the mining sector and associated infrastructure. During the last 10 years, there have been international efforts to stabilize the country in terms of peacekeeping efforts after it emerged from years of civil war (1996-97, 1998-2002) – given the country's borders with nine other African countries in terms of regional stability, and not least because of the DRC's to-date relatively unexploited natural resources. DRC's largest exports are raw minerals –today, primarily copper, cobalt, gold and diamonds – with China accepting over 50% of DRC's exports in 2012.	1960	Dec-16	5	French
Ghana	Formely known as the Gold Coast, Ghana is the second largest gold producer on the continent. Since the return of civilian rule in 1980s, the country has benefited from a stable macro-economic and socio-political environment.	1957	2020	4	English
Guinea	Guinea is the largest bauxite exporter on the African continent. The country is also rich in gold and diamonds, though still unexploited due to a lack of infrastructure and other political hurdles. Under current president Alpha Condé, the country is transitioning to democracy with the next elections set for Nov-15. The current civil regime followed a military junta which briefly held power in 08/09. Sekou Toure, father of the country's independence, and Lansana Conte, president from 1984 to 2008, each held an undisputed lead of the country at that time.	1958	Nov-15	5	French
Mali	Mali is an emerging democracy and the third largest gold exporter on the continent. In the 13th century, the medivial Empire of Mali was well known for its wealth, trading gold and salt. Post-independence, Mali had a track record of peace and stability until 2013 when insurgent combats and terrorist attacks in the north triggered a coup d'etat. The country is now progressively returning to civilian rule. The troubles in the northern part of the country have not affected mining activities which are mainly concentrated in the south.	1960	Jul-18	5	French
Mozambique	Mozambique is rich in coal, gold, and tantalum. A stable country with a growing economy, Mozambique is the gateway to many countries, including north-eastern South Africa, Swaziland, Zambia, Zimbabwe and Malawi. "Development corridors" have been created at Maputo (the capital) Beira and Nacala to facilitate access to remote african territories. Further rail investments are planned in order to support the development of the coal mining industry.	1975	Oct-19	5	Portugese
Namibia	Namibia is rich in diamonds, gold, copper and other minerals. The country has been stable and democratic since the end of the war of independence in 1990. Infrastructure is developing to facilitate mining growth in Namibia. At the time of writing, the government of Namibia is reviewing mining and taxation laws to improve the country's attractiveness to foreign investors.	1990	Nov-14	5	English
Senegal	Senegal has reserves of phosphates, iron ore, gold and the mining industry is still relatively undeveloped. With that in mind, current president Macky Sall, a geologist by background, has pledged to revamp the country's untapped potential. Senegal sits on the West African atlantic coast. Since its independence in 1960, the country has had a track-record of stability, peace and strong democratic institutions.	1960	Mar-19	7	French, Wolof
South Africa	South Africa is the continent's most developed mining jurisdiction.The discovery of gold in the country during the 1880s sparked a rush which further led to the birth of the Johannesburg Stock Exchange in 1887. South Africa is Africa's largest gold producer and it also has the largest reserves of platinum (c.80% of world reserves). Post-apartheid South Africa benefited from a renewed inflow of capital following the lifting of international sanctions, with investors looking at the country for its mining industry and as a compelling entry point to the continent. The country has a long tradition of mining, with a well developed manufacturing sector and a mature financial services industry. South Africa has consistently topped Africa's ranking in terms of the ease of doing business.	1910, majority rule 1994	May-19	5	English
Zambia	Land-locked Zambia has substantial reserves of copper. The country has been stable over the years, emergingas the natural hub for diverse activities in the southern part of the continent. Since the liberalization of its economy at the beginning of the 90s, Zambia has been undergoing a vast infrastructure development programme.	1964	Sep-16	5	English

Source: Deutsche Bank, World Bank, African Election Database, Bloomberg Finance LP

Ease of doing business: Africa has a wide range of rankings

The World Bank conducts an annual survey regarding the 'ease of doing business'. A high ranking means the regulatory environment is more conducive to the starting and operating of a local firm. More specifically, survey participants are asked about getting electricity, dealing with permits, protecting minority investors, paying taxes, trading across borders and enforcing contracts.

As shown to the right, four of the African countries in our sample rank in the top half of the 189 countries surveyed. The remaining eight, and all other African countries for that matter, are in the bottom half of the rankings:

2015-16 has a busy election calendar: DRC is likely to pose the highest risk

As shown in Figure 49 above and in more detail in the map and table below, there are a host of presidential and parliamentary elections scheduled across the continent from now throughout 2016.

For 11 of the 12 countries in our focus, we would not expect any issues, with all elections happening due to the expiration of the preceding four- or five-year term in each case. We would, however, highlight the forthcoming DRC presidential election, due to be held in December 2016. Current president Joseph Kabila has ruled DRC since 2011, winning disputed elections in 2006 and 2011. DRC's constitution states that he cannot run for another term, but there has not been a direct statement of intent to step down by Kabila, thus far. In mid-September 2015, Reuters reported that seven senior political figures were forced to leave the DRC for signing a letter urging Kabila to step down once his term expires.

Figure 50: Ease of doing business

Country	#Rank
Singapore	1
United States	7
United Kingdom	8
Australia	10
Peru	35
Chile	41
South Africa	**43**
Russia	62
Ghana	**71**
Botswana	**74**
Namibia	**88**
China	90
Zambia	**111**
Brazil	120
Mozambique	**127**
Mali	**146**
Cote D'Ivoire	**147**
Senegal	**161**
Burkina Faso	**167**
Guinea	**169**
DRC	**184**
Eritrea	189

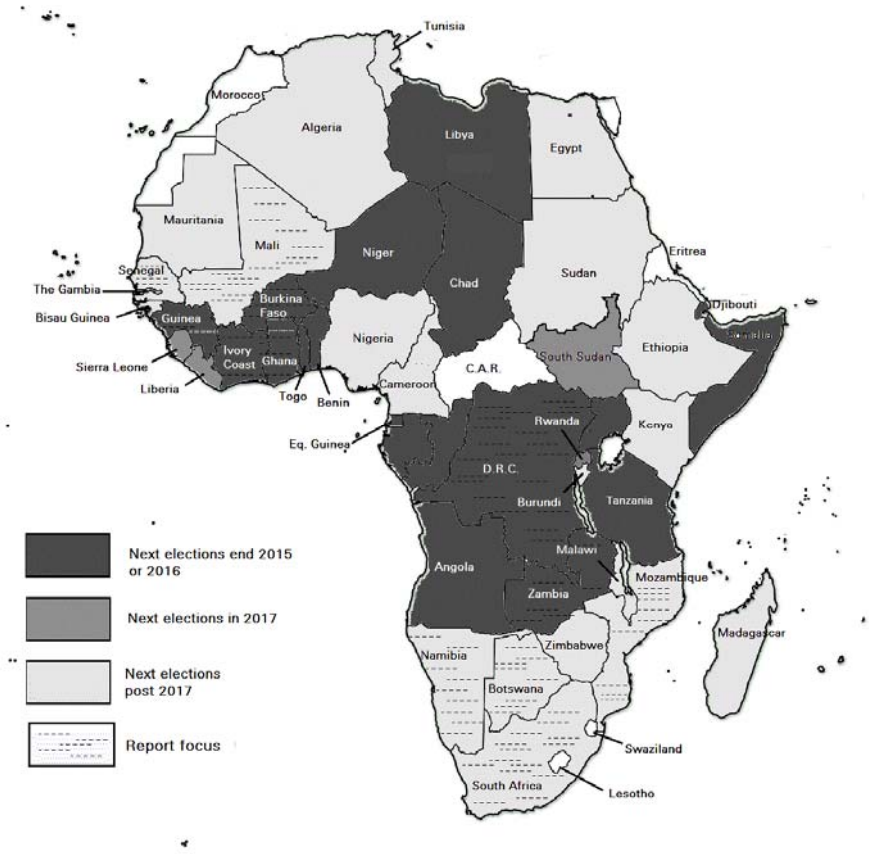
Source: World Bank 2014 rankings

Figure 51: Timetable for forthcoming presidential/general elections 2H15-19

Country	Type of election	Last held	Schedule Date	Tenure (yrs)	Current leader
Tanzania	General	Oct-10	Oct-15	5	Jakaya Kikwete
Cote d'Ivoire	**Presidential**	**Nov-10**	**Oct-15**	**5**	**Alassane Ouattara**
CAR	General	Jan-11	Oct-15	4	Catherine Samba-Panza
Guinea	**Presidential**	**Nov-10**	**Oct-15**	**5**	**Alpha Condé**
Burkina Faso	**Presidential**	**Nov-10**	**Oct-15**	**5**	**Michel Kafando**
Ghana	**Presidential**	**Feb-12**	**Feb-16**	**4**	**John Dramani Mahama**
Uganda	Presidential		Feb-16		Yoweri Museveni
Benin	Presidential		Feb-16		Thomas Boni Yayi
Niger	Presidential		Feb-16		Mahamadou Issoufou
Chad	Presidential		Apr-16		Idris Déby
Djibouti	Presidential		Apr-16		Ismail Omar Guelleh
Liberia	Referendum on constitution		May-16		Ellen Johnson Sirleaf
Congo	Presidential		Jul-16		Denis Sassou Nguesso
Angola	Presidential	Aug-12	Aug-16	4	José Eduardo dos Santos
Zambia	**Presidential**	**Sep-11**	**Sep-16**	**5**	**Edgar Lungu**
Gabon	Presidential		Oct-16		Ali Bongo Ondimba
Gambia	Presidential		Nov-16		Yayha Jammeh
DRC	**Presidential**	**Nov-11**	**Dec-16**	**5**	**Joseph Kabila**
Ghana	**Presidential**		**Dec-16**		**Alassane Ouattara**
Mali	**Presidential**	**Jul-13**	**Jul-18**	**5**	**Ibrahim Boubacar Keita**
Zimbabwe	Presidential	Jul-13	Jul-18	5	Robert Mugabe
South Africa	**Presidential**	**May-14**	**May-19**	**5**	**Jacob Zuma**

Source: Deutsche Bank

Figure 52: Forthcoming elections



Source: Deutsche Bank

Security of tenure: we rate Ghana, Cote d'Ivoire, Senegal

Security of tenure is really a sub-set of Geopolitical risk, but it is, in our view, by far the most important consideration in assessing prospective mining investment in Africa.

In our summary table (Figure 56) we assess the key parts of existing mining legislation: when codes were implemented, revised, the key points and tax/royalty levels.

"Resource nationalism" is a threat in times of good and bad commodity prices

As we argue in this note, miners operating in Africa need reliable, stable and pro-investment mining legislation. This is even more the case in the current environment where depressed commodity prices have reduced profits and visibility, and increased competition for more scarce capital.

From the viewpoint of the host nations, those with a high portion of their GDP from resources will also be impacted by the decline in commodity prices. The desire/need to raise royalties and mining taxes, change capital tax deduction rules and introduce more forms of 'rent' can increase when commodity prices are declining. This in turn sends the wrong signal for prospective FDI in good times.

We highlight Ghana (25% corporate tax, 5% royalties) as having relatively stable investor-friendly mining legislation; Cote d'Ivoire, which introduced a new mining code in 2014 with high support from mining companies; and Senegal, which is intent on attracting more mining investment to drive targeted 7% GDP growth. A new version of Senegal's mining code is expected to be published by the end of this year. These countries are obviously in West Africa and it may be coincidence that most West African governments have signed—or pledged to sign—the Extractive Industries Transparency Initiative.

In terms of higher-risk countries, the DRC is currently drafting a revised mining code (as shown in the map below), engaging with those companies that are active in the country already.

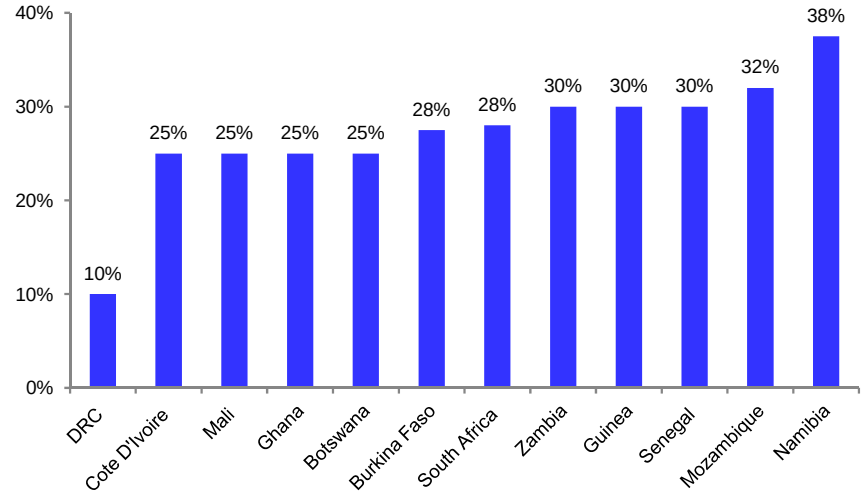
Free carry, beneficiation and "strategic minerals"

There are three concepts to consider that either raise the required return for mining investment or raise the risk to security of tenure:

- **Free carry**, whereby the host state/government gets a stake in the mine/project without putting in a commensurate share of capital. The stake is normally held by a state-run/owned mining company. Of the countries in our sample, free carry is part of the legislation in most (Burkina Faso, Cote d'Ivoire, DRC, Ghana, Guinea, Mali, Senegal). This is offset in some countries by lower corporate taxes, notably in the DRC (see Figure 53) and is also offset by tax shields on capex or accelerated depreciation allowances;
- **Beneficiation:** this is the concept of legislating to force the development of downstream industries in a country, e.g. smelting and refining a mineral in the country in which it was mined, rather than the export of the mineral in concentrate form. Beneficiation would normally be enforced via export restrictions (the most notable recent example being the export ban on nickel and copper concentrate by the Indonesian government in early 2014). In Africa there are fewer examples, given the infrastructure and inputs required to build the downstream industries – a lack of or instable power is a key part of this; on the positive side, where some processing infrastructure does exist, royalties are then reduced accordingly (e.g. in Guinea where royalties on bauxite processed into alumina are lower than for exported bauxite);
- **Strategic minerals:** the concept of governments declaring some minerals 'strategic' has not yet been applied in any meaningful way across Africa but it is discussed periodically by governments – we have seen this in South Africa regarding coal and iron ore, and also in Namibia three years ago when the Mining Minister stated the country intended to declare copper, coal, gold, uranium and zinc strategic minerals and thus subject to additional national protection. This would see Namibia's state-owned mining company holding exclusive exploration and mining rights to these strategic minerals, with investors wishing to acquire them having to partner with the state.

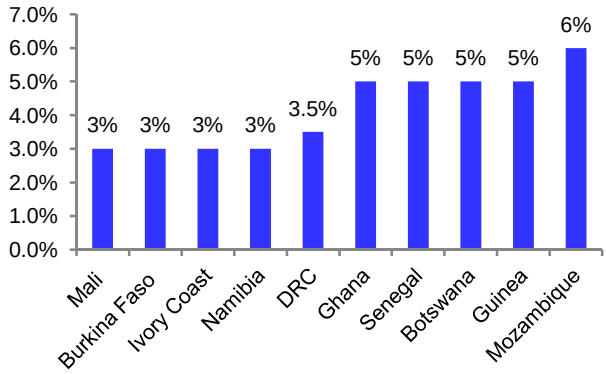
All three of the above concepts can be used by the government to revoke mining permits/licences, removing security of tenure. This happened in Mali, in 2014, for example, when the government cancelled 130 mining permits, about 30% of existing permits, with a view to renegotiating permits that were 'not in the country's interest'. In essence, the permits targeted areas where no development had taken place – so the government used the stick rather than the carrot – and were re-awarded to investors with more technical and financial capability to develop them.

Figure 53: Corporate tax rates



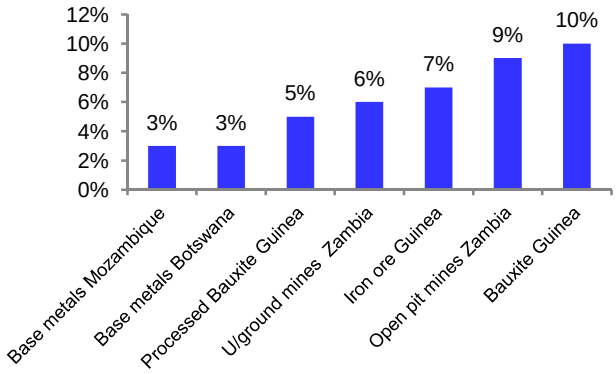
Source: Deutsche Bank, Company data

Figure 54: Gold/precious metals royalties (% of revenue)



Source: Deutsche Bank, Company data

Figure 55: Base metals/other metals royalties (% of revenue)



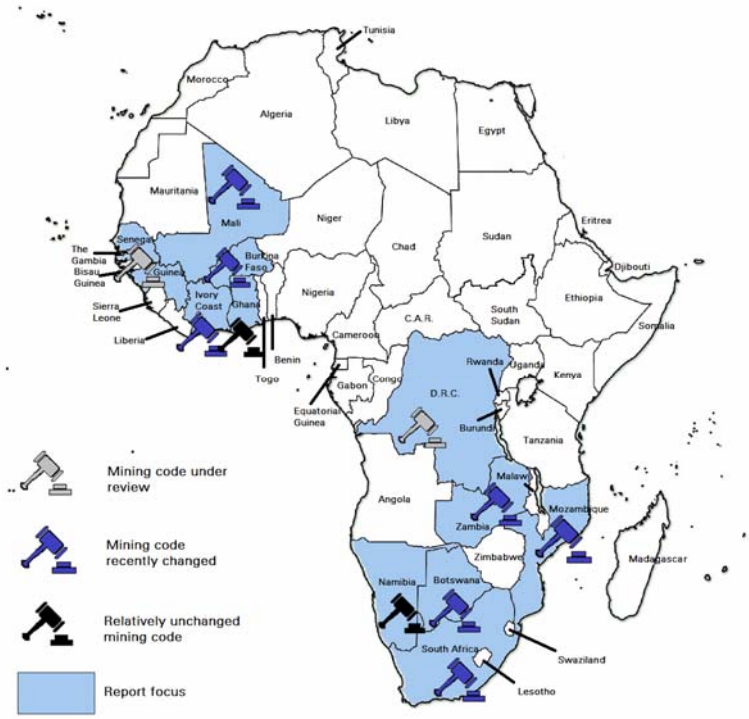
Source: Deutsche Bank, Company data

Figure 56: Summary of Security of Tenure factors

Country	Mining code?	When?	Changes/revisions	Mining code key points	Taxes and royalties
Botswana	YES	NA	1999, 2011	Mining rights vested in the state.	Variable tax rate equal to the higher of 25% or that derived by a formula. Royalties, precious stones: 10%, precious metals: 5%, other minerals (3%).
Burkina Faso	YES	1997	2015	Industrial mining license owners pay 1% of monthly turnover (or equiv. value of extracted minerals into a local development fund). 10% state share in mining companies capital. 20% capital gain tax on transfer of mining titles.	Corporate tax rate: 27.5%. 3% Royalties to be paid to the government.
Ivory Coast	YES	1995	2014	10% non-dilutable state participation. Additional state participation capped at 15%.	Corporate tax rate: 25%. Net return based loyalty of 2.5% - 3%
DRC	YES	2002	2011, Ongoing	10% state share of projects: 10%, corporate tax rate: 30%, gold mining royalties: 3.5%. At time of writing a leaked version of the new DRC mining code suggest several increases in royalties, tax and state stake in future projects. Mining code under revision	Corporate tax rate: 10%. Gold mining royalties: 3.5%. Mining code under revision
Ghana	YES	1986	2006	The government of Ghana is entitled to acquire a 10% interest in the rights and obligations of the mineral operations in respect of a mining lease.	Corporate tax rate: 25%. Royalties : 5%
Guinea	YES	1986	1995, 2011, 2013	15% state share in mining companies capital, applicable in the 2013 Mining Code only	Corporate tax rate: 30%. Tax on extraction: 3% for iron ore, 0.075% for bauxite, 3% base metals, 3.5-5% for diamonds. 10% Royalties: 10% Bauxite, 5% Bauxite processeed into alumina, iron ore 7%, gold 5%, diamonds 5-10%, cut stone 2%
Mali	YES	1999	2012	10% state share in mining companies capital.	Ad valorem tax of 3% for group 1 and 2 minerals, and 1% for others. Capital gain tax: 20%. Corporate tax rate: 25% (for the first 15 years of production).
Mozambique	YES	2002	2006, 2014	50% production tax relief for Mineral products benefiting local industry development.	Corporate tax: 32%. Royalty precious metals: 6%. Diamonds: 8%. Royalties other minerals: 3%. Indirect transfers subject to capital gain tax of 32%.
Namibia	YES	1992			Corporate tax rate: 37.5% for mining other than diamonds, 50% for diamonds. Royalties: 3% precious metals, 2% semi-precious stones, 3% nuclear fuel minerals, 5% oil and gas.
Senegal	YES	2003	New mining code expected for end 2015	State share in mining companies capital: 10%.	Draft mining code, Royalties gold and precious metals 5%.
South Africa	YES	NA	2002, 2014	26% of mining assets must be 'sold' to Black Economic Empowerment companies/partners	Corporate tax rate: 28%, special rules can apply to gold miners. Capital gain tax rate: 14%.
Zambia	YES	1995	2008, 2014	All rights of ownership of minerals vested in the President on behalf of the Republic.	Corporate tax rate: 30% for mining companies. Royalties: 6% for underground operations, 9% open-pit operations

Source: Deutsche Bank, World Bank, Company data

Figure 57: Mining codes and changes to legislation



Source: Deutsche Bank, Company data

Infrastructure: we rate Ghana, South Africa, Zambia

Africa's resources, in general, are relatively cheap to mine. The issue is one of logistics infrastructure and transportation. Randgold's CEO Dr. Mark Bristow describes the situation well:

"…Mr. Bristow said the "most frustrating thing about Africa" is the lack of investment in capacity."The thing that is going to develop Africa is capacity building. You can't build Africa with a carrot and a stick. "There are too many sticks and the carrots are really misleading." He said the continent had all the right ingredients for success, including natural resources and human capital, but there was a lack of infrastructure as well as capacity problems". Business Day 12 August 2014

To match the rate at which developed markets are spending, Zambia would need to spend US$1.6bn each year – double its rate of spend prior to 2011 or around 20% of its GDP. The need for an investment climate that encourages FDI to help lift the state's burden is clear.

Let's use the DRC as an (admittedly extreme) example. The 'national' route to export goods out of the country via its only seaport at Matadi, even before the damage to infrastructure from the 1996-2003 civil wars, consisted of eight stages of loading and unloading goods: rail, riverboat, rail, riverboat, rail, boat, road, port. In general, that journey would take many months. Commodities are exported by rail or road through other countries, but this extreme example shows the large gap between resource potential and ability to create wealth and encourage investment (as Dr Bristow says: sticks and carrots).

To rank our sample countries, we have looked at the existing infrastructure used by the companies – paved roads, railways, ports and coal terminals – plus infrastructure being invested in to serve future projects – see Figure 58 below for the summary:

Figure 58: Summary of infrastructure factors

Country	Land mass ('000 Km2)	Landlocked?	Sea port / Deep sea port	Coal terminal	Major infrastructure project(s)	Railroad network (km)	Railroad network / Land mass	Road network (km)	% paved
Botswana	600	Yes	Landlocked		Botswana Integrated Transport Project (modernization of existing infrastructure); modernization of Trans-Kalahari, Mmamabula-Ellisras, Mosetse-Kazungula rail lines	888	1.5	17,916	34.0
Burkina Faso	274	Yes	Landlocked			622	2.3	12,506	16.0
Ivory Coast	322	No	Port of Sassandra (12m anchorage); other minor ports with no anchorage			639	2.0	81,996	7.9
DRC	2345	No	No deep sea ports - the largest port is Matadi with a draft of 6.4m only		Chinese-funded building and rehabilitation of 3,500km of roads, 3,200 km of railway; World Bank funding for rehabilitation of hydropower plants (US$150m), roads (US$165m) and infrastructure improvement on Rwanda-DRC border (US$180m)	3641	1.6	153,497	1.8
Ghana	239	No	Port of Saltpond (anchorage 13m); other minor ports with anchorage < 10m (Tema: 10m; Sekondi-Takoradi: 6 - 8m)			953	4.0	109,515	12.5
Guinea	246	No	Autonomous Port of Conakry (11m anchorage, > 500f); Port of Kamsar (9.4-10m, 500f)		Simandou iron ore project infrastructure: new 650km multi-user railway to transport ore from mine to coast; new deep-water multi user port in the Forécariah prefecture	317	1.3	44,348	9.8
Mali	1240	Yes	Landlocked			641	0.5	22,474	24.6
Mozambique	802	No	Port of Mozambique (21m anchorage);11 other ports in the country with anchorage from 5 to 16m	Port of Nacala: capacity of 30mtpa. Deepest port in southern Africa; served	Thai-Mozambiquan consortium funding US$4.5bn build of 537km rail line from Moatize coal mines to Macuse coal terminal (min capacity 25mtpa): target commission 2018	3116	3.9	30,331	20.8
Namibia	825	No	Port of Luderitz (Anchorage 16m); Port of Walvis Bay (Anchorage 8m)		New Port of Walvis Bay Container Terminal Project	2382	2.9	44,138	14.5
Senegal	196	No	Port of Dakar (15m anchorage); 6 other minor ports within the country with anchorage < 12m		Biggest wind farm in West Africa: Taiba Ndiaye, E350m, 50.8MW capacity to be built 2015-18, to sell to national utility under a 20-yr PPA	683	3.5	15,000	35.3
South Africa	1221	No	4 major ports (Durban, East London, Mossel Bay, Cape Town) with anchorage > 20m; Saldanha Iron Ore Terminal largest natural deep-water port in South Africa	Richards Bay Coal Terminal (RBCT): largest single coal export terminal globally, capacity of 91mtpa	Transnet spending R100bn (US$7bn) 2012-2019 to upgrade commodity freight rail and port infrastructure	20500	16.8	747,014	21.2
Zambia	753	Yes	Landlocked		Rail line build out and rehab: (i) five new lines to be built 2015-18 including a new US$1bn line from copper province through to Lobito Port in Angola; (ii) US$120m pledged to revamp the railway link to South Africa to move copper transport from road to rail; (iii) new US$500m 250km line from Chingola to Lumwana	1875	2.5	40,454	23.2

Source: Deutsche Bank, The World Factbook (CIA), World Bank

Exporting production: railways and ports

As shown below, the primary commodities are exported via air (precious metals), road (base metals) and rail (bulks and base metals):

Figure 59: Export routes for primary commodities

	Primary product(s)	Export route	Detail
Botswana	Diamonds	Air	
Burkina Faso	Gold	Air	
Ivory Coast	Gold	Air	
DRC	Copper/cobalt	Road	Copper is transported ~3,500km by road from Katanga province to South Africa's port city of Durban, or east to Dar es Salaam, Tanzania
Ghana	Gold	Air	
Guinea	Gold	Air	
Mali	Gold	Air	
Mozambique	Coal	Rail/port	Port of Nacala: capacity of 30mtpa, served by the 900km Nacala rail line (in ramp up). Port of Beira: capacity of 6mtpa
Namibia	Gold/uranium	Air	
Senegal	Gold	Air	
South Africa	Coal/iron ore/gold/PGMs	Rail/port/air	Coal via RBCT, served by state-run (Transnet) rail lines (580km from Mpumalanga coal mines); iron ore/manganese and base metals via Saldanha Port, served by Transnet Ore Export Line from Sishen (861km)
Zambia	Copper/cobalt	Road/rail	Majority of copper/cobalt is transported by road to South Africa's port city of Durban; some transported by 1,860km Tazara railway to Dar es Salaam, Tanzania

Source: Deutsche Bank, Company data

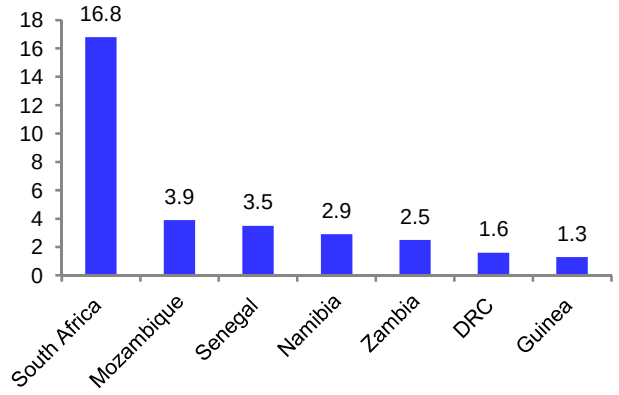
Railways: either in need of repair or to be built from scratch

For base and especially bulk commodities, a functioning railway network is critical. As shown in our summary table above and in the charts that follow, for each of the countries in our scope, we take the total rail network (in km) and divide by the country's land mass (sq km) to show the density of each network.

Figure 60 shows the established network in South Africa, which ranks well versus other emerging markets such as China and Brazil (Figure 61). The other countries we look at have very low rail density – the low score in Guinea, for example, highlights the need for Rio Tinto and its partners to build out a new railway in order to progress the large Simandou iron ore project.

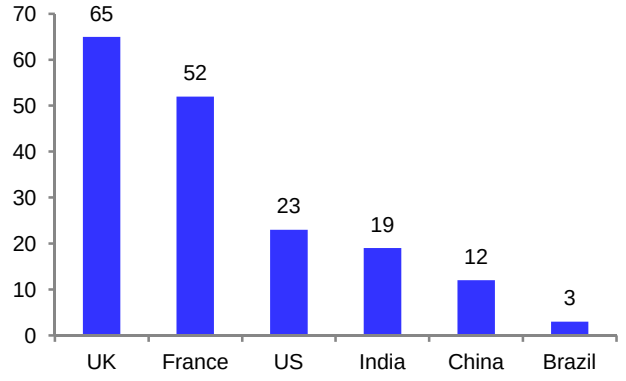
Existing railways are generally in need of significant rehabilitation – we mention some of the ongoing or planned rehab investment in Figure 58. The state of disrepair is due to low traffic densities: a certain volume per kilometer is needed to ensure each network generates enough revenue to maintain the assets: at present, this is rare. One option is to forge cross-border co-operation. An example of this is the so-called "North-South corridor" for copper exports, which is considering linking the existing rail network linking the DRC and Zamibia to join up, via Zimbabwe, the South African rail system, taking copper down to the Port of Durban.

Figure 60: Rail network density* - bulk and base metals exporters



*Source: Deutsche Bank, World Bank database, *Rail network km / land mass sq km*

Figure 61: Rail network density* - developed and emerging markets



*Source: Deutsche Bank, World Bank database, *Rail network km / land mass sq km*

As an example of the large investment required in infrastructure build-out and rehabilitation across the continent and the challenge of limited state budgets, we show Zambia's planned infrastructure spend between 2011 and 2015 here:

Figure 62: Zambia's planned infrastructure spend

US$m	2011	2012	2013	2014	2015	Total
Transport infrastructure*	616	983	903	1,079	1,120	**4,700**
Water	0	2	3	5	7	**17**
Energy**	64	406	39	56	68	**633**
Housing	1	5	5	5	5	**21**
Other	1	376	7	22	22	**428**
Total	**682**	**1,772**	**956**	**1,168**	**1,221**	

Source: Sixth National Development Plan, World Bank, January 2011

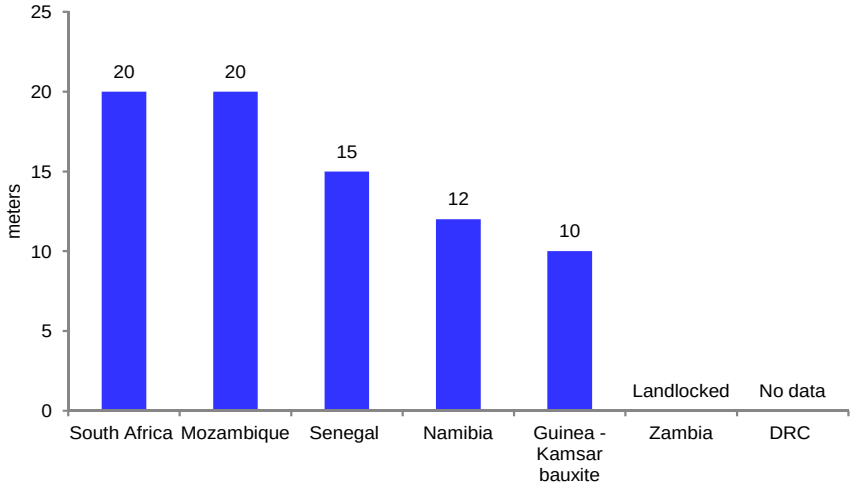
To match the rate at which developed markets are spending, Zambia would need to spend US$1.6bn each year – double its rate of spend prior to 2011 or around 20% of its GDP. The need for an investment climate that encourages FDI to help lift the state's burden is clear.

Deep-water ports: only in South Africa and Mozambique

Deep-water ports are required for the very large ships (Panamax, Cape-size vessels) that transport base metals and bulk commodities. Unlike for shallow-water ports where the anchorage is usually not significantly more than 20 feet (6m), deep-water ports must be compatible with the draft of heavily loaded ships and may require 60 feet (20m) water depth or more.

Within our scope of work in this report, South Africa and Mozambique both have port infrastructure with the greatest water depth, with anchorage of 20m. In Figure 63, we show the different anchorage levels for the African bulk and base metals exporters in our scope.

Figure 63: Port anchorage, bulk and base metals exporters



Source: Deutsche Bank, ports.com

Mining inputs: Focus on power and labour

Labour: we rank Mali, Cote d'Ivoire, and South Africa

It is perhaps easy to use negative adjectives when it comes to the issue of labour in the African mining industry – with low levels of education, skills and productivity – but the historical reasons behind this relative lack of development are well documented. The headwind to having a productive and efficient workforce in mines where wages represent 30-60% of operating costs (mine-type dependent) is thus quite high. On the positive side, there is a history, particularly in South Africa, of in-depth mining engineering education (for the top layers of mine management and above), but there is also, without doubt, huge variation in skill and productivity levels.

To assess the countries in our sample regarding labour, we have looked at median age and life expectancy of the population, percentage of population in secondary and tertiary education, and whether labour is unionised, as summarised below in Figure 64:

Figure 64: Summary of Labour factors

Country	Median age (yrs)	Life expectancy (yrs) at birth	Unemployment (%)	% of population in secondary education*	% of population in tertiary education*	Unionized labour
Botswana	22.7	54.5	17.9	NA	24.8	YES
Burkina Faso	17.0	53.9	3.1	28.4	4.8	NA
Ivory Coast	20.3	53.0	15.7	39.1	9.1	Nascent/fragmented
DRC	17.7	56.1	73.0	43.4	6.9	Fragmented
Ghana	20.8	62.7	3.6	67.1	14.3	YES
Guinea	18.6	48.7	9.0	38.1	10.4	NA
Mali	16.0	50.0	8.2	44.9	7.5	Fragmented
Mozambique	16.8	52.8	27.0	26.0	5.2	YES
Namibia	22.8	51.9	29.6	NA	NA	YES
Senegal	18.4	58.2	10.2	41.0	7.6	YES
South Africa	25.7	49.5	25.2	110.8	19.7	YES
Zambia	16.5	52.6	15.0	NA	NA	YES

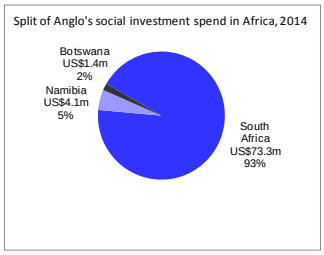
*Source: Deutsche Bank, World Bank, WHO, *% of secondary school age portion of population enrolled in secondary education: can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition; **% of the total population of the five year age group following on from secondary school leaving*

The cost of labour and a social licence to operate

For the mining companies in Africa today, the key considerations regarding labour are intertwined with social commitments (housing), politics (union and labour relations), salary inflation (often CPI +5% minimum per annum) and lack of skills to help drive safety and productivity (especially through technical innovation). In addition, many companies fund healthcare for their employees for HIV and related illness, and there is an onus on companies to educate and train their employees, particularly with regards to safety. The total cost of employment is illustrated by the examples in Figure 65 from Anglo American's spend in South Africa, Botswana and Namibia:

Figure 65: The cost of labour and a social licence to operate

Anglo American 2014 global spend	US$m
Community development	66
Education and training	27
Other	13
Health and welfare	10
Institutional capacity development	6
Sports, arts, culture and heritage	5
Environment	2
Employee matched giving	2
Water and sanitation	2
Disaster and emergency relief	1
Total	**136**



Anglo American social investment output indicators, 2014	
Total number of community development projects delivering benefits to communities	3,047
Total number of businesses supported	58,257
Jobs created/maintained through enterprise development initiatives	96,873
Beneficiaries of education projects	127,369
Beneficiaries of sports, arts, culture and heritage projects	263,062
Beneficiaries of community development projects	691,502
Beneficiaries of disaster and emergency relief projects	335,936
Beneficiaries with improved livelihood	121,005

Source: Company data

The multiplier effect brings community relations to the fore

Mining companies' labour costs are increased when one considers the multiplier effect. In the South African platinum industry, for example, which is heavily labour intensive, 136,000 people are employed directly. Each of those jobs supports a further 2.4 jobs on average, or 325,000 indirect jobs up- and down-stream of the platinum mines. Each of those 450,000 individuals supports 4 to 10 people with their salary. The figures increase when looking at the more mature gold mining industry in South Africa – each of the 132,000 jobs sustains at least 5 more indirectly, and presumably with a similar number of dependents in families. This can force community relations to the fore, with the need to invest in housing, schools, clinics, hospitals, and transport infrastructure all part of the cost to mining companies.

Stagnant or declining productivity is the key issue

So what do the mining companies get back from their employee and community investments? Generally, productivity is low and hard to improve, with a lot of mature, conventional mines that are hard to mechanise or make more productive through safety improvements.

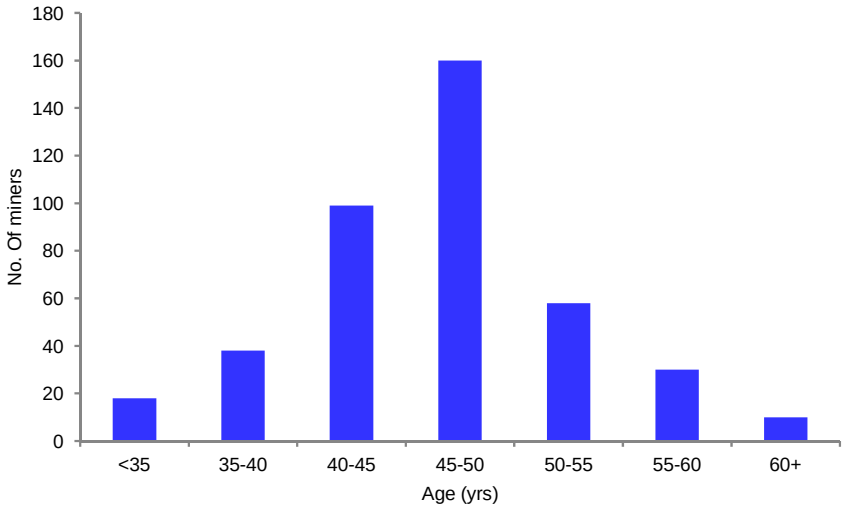
The downward productivity spiral

As we show earlier in the report and on the next page in the margin, the average age of Africa's total population, and within the countries we're looking at, is very low. With investment in education and in the mining industry, the future could look very bright for mining companies training and up-skilling very efficient workforces. Obviously, this will only happen with a favourable investment climate.

"The [South African] mining industry experiences skills shortages in areas such as professionals, technicians and trades workers, directors and corporate managers, machine operators and drivers. In addition, a recent study found that the average age of mining professionals in South Africa is between 50 and 55 years. The sector has among the highest number of illiterate employees, high levels of HIV/AIDS infections and a high incident of respiratory health conditions"
The Mining Sector Innovation Strategies Implementation Plan 2012/13-2016/17

Today, however, we think the average age in the mines is high. We don't have a lot of data for this in each of our countries, but we can use two examples from South Africa – where as the quote above states the *"average age of mining professionals in South Africa is between 50 and 55 years"* and Mozambique which has an average age between 40-50:

Figure 68: Average age of miners in Mozambique

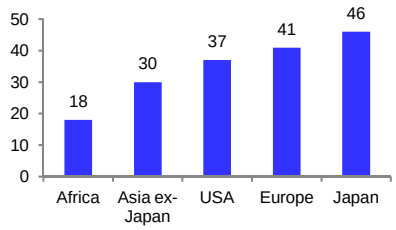


Source: Southern African Migration Project report

An aged and aging workforce can lead to a vicious circle in productivity, which we've illustrated in Figure 69:

- An aging workforce with no investment to attract younger employees leads to a skill gap;
- Inexperienced staff is filling that gap;
- Leading to less efficient working practices;
- This can be compounded by government and company focus on safety standards and improvements;
- Which is harder to achieve with more inexperienced and older staff;
- To try to combat the drop in productivity and impact of safety stoppages, companies move to incentivise with variable pay and safe production-linked bonuses;
- As employees fall short of meeting their bonus targets, demands for increases in base salaries ratchet up.

Figure 66: Africa: average age of 18



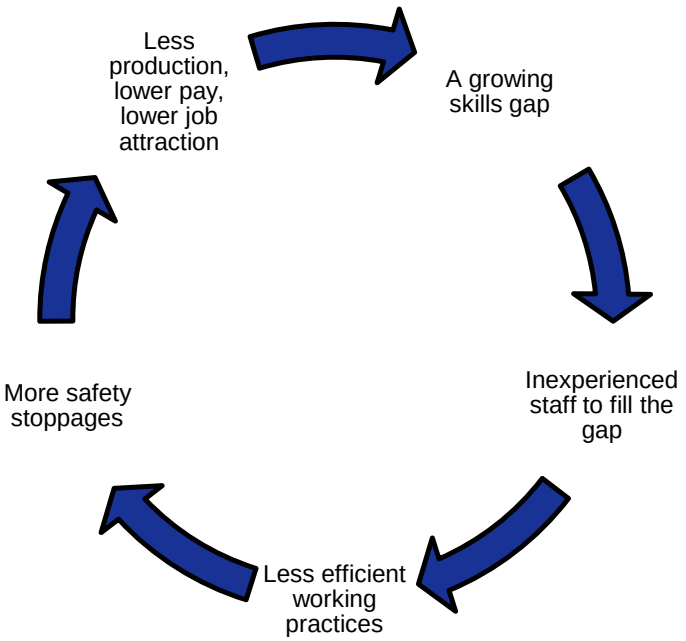
Source: World Bank

Figure 67: Median age per country

	Yrs
Botswana	22.7
Burkina Faso	17.0
Cote d'Ivoire	20.3
DRC	17.7
Ghana	20.8
Guinea	18.6
Mali	16.0
Mozambique	16.8
Namibia	22.8
Senegal	18.4
South Africa	25.7
Zambia	16.5

Source: World Bank

Figure 69: The cycle of low labour productivity

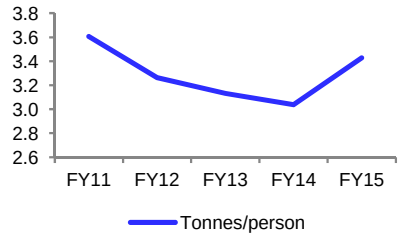


Source: Deutsche Bank

Productivity is pretty static across the board

To illustrate with some examples across our sample countries and companies, we show the tonnes produced per employee at South32's coal mines in South Africa (Figure 70), tonnes produced per employee at Glencore's Katanga mine in DRC (Figure 71) and ounces produced per employee at Randgold's Loulo-Gounkoto complex in Mali (Figure 72):

Figure 70: Coal productivity: South32 SA coal mines

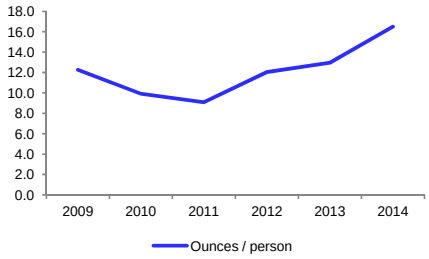


Source: Company data

Figure 71: Copper productivity: Glencore Katanga copper mine

Source: Company data

Figure 72: Gold productivity: Randgold Loulo-Gounkoto gold mine



Source: Company data

Power: we rank Ghana, Botswana, South Africa

As with the African mining labour situation, the negative adjectives continue when it comes to meeting power needs: *unavailable or unreliable from the state but cheap where you can get it, expensive to self-provide.*

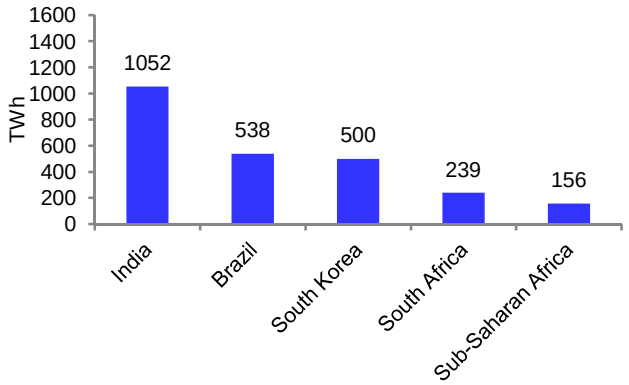
The big picture is an extremely challenging one. In general, in West Africa, mining companies have built their own diesel or heavy fuel oil generating capacity (even if just for back-up, as is the case for Randgold in Cote d'Ivoire). In southern Africa, national grids are established but under severe strain from a lack of maintenance investment over the past couple of decades.

The big picture: over 50% (621m) of Africans do not have access to electricity

As quoted in the 2015 Africa Progress Panel report, sub-Saharan Africa is extremely short of electricity. The region's grid has a power generation capacity of just 90 gigawatts (GW) and half of it is located in one country, South Africa. 90 GW compares to 200 GW in India, 220 GW in Russia, 1040 GW in the US and 1146 GW in China.

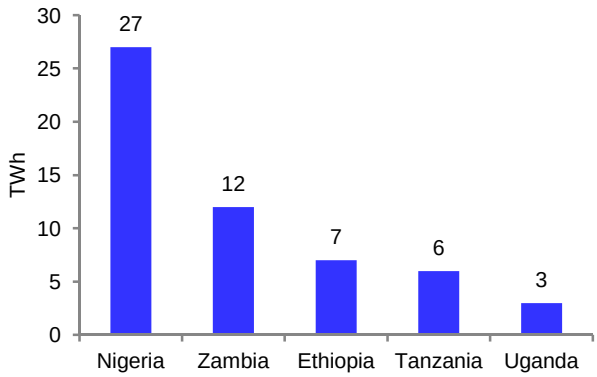
Electricity consumption in Spain exceeds that of the whole of SSA. Ex-SA, consumption averages around 162 kilowatt-hours (kWh) per capita per year. This compares to a global average of 7,000 kWh.

Figure 73: Total electricity net generation



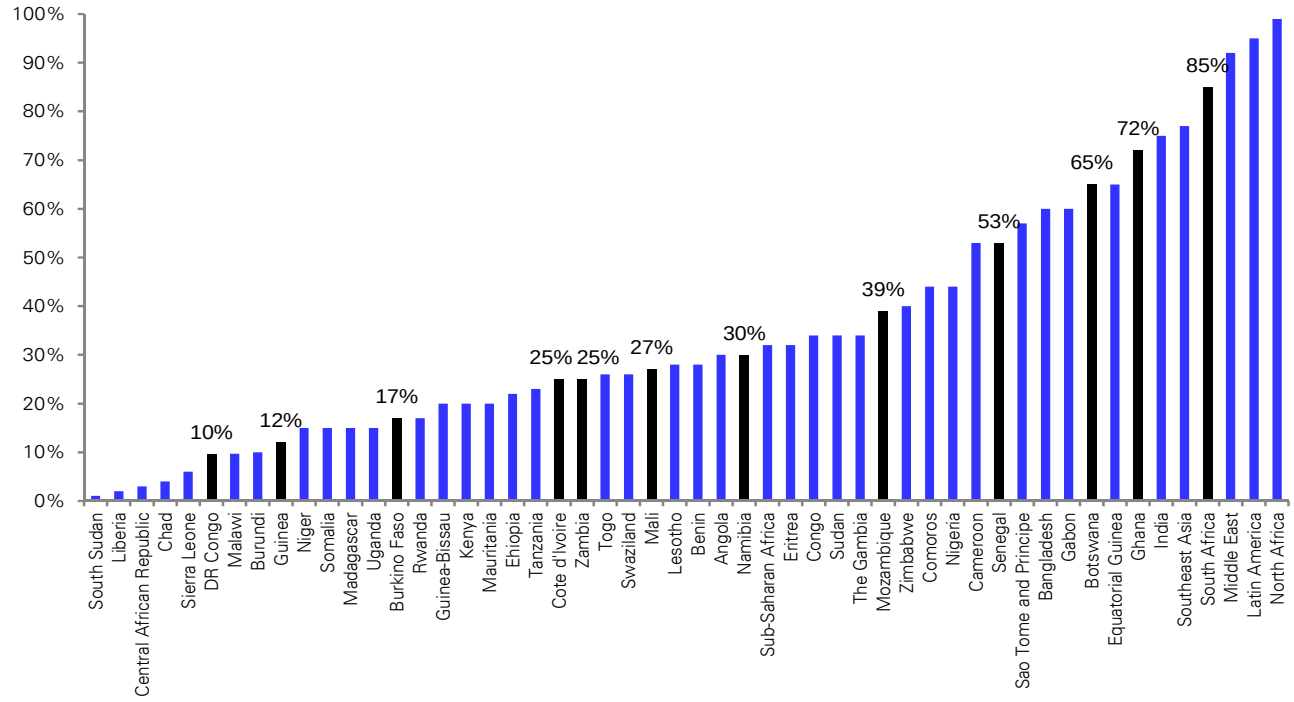
Source: Africa Progress Panel 2015 Report

Figure 74: Total electricity net generation of selected SSA countries



Source: Africa Progress Panel 2015 Report

Figure 75: Access to electricity by country population (2012)



Source: Africa Progress Panel 2015 Report

As with the railways and road infrastructure we mention above, a lot of Africa's energy infrastructure is also dilapidated. As cited in the Africa Progress Panel report for 2015, according to the IEA, the average efficiency of Sub-Saharan Africa's gas-fired power plants is around 38%, impacted by the use of outdated technologies, generating much lower amounts of electricity from the same amount of coal – recent super-critical coal-fired power plants built in China generate on average 30% more electricity than those operating in Africa.

What exists today?

In Figure 76 below we show the existing power infrastructure and generation capacity by type plus the ongoing major projects in our sample of countries. Overall for Africa, the current generation capacity is as follows:

- **Southern Africa**: The 40-42GW grid in South Africa is dominated by coal, followed by hydro-power and oil. Mozambique and Zambia add to the region's capacity via hydropower, with exports and imports cross-border with South Africa and Namibia;
- **West Africa:** Around 50% of the region's 20GW grid is gas-fired, with oil accounting for about a third and hydro the remainder. The reliance on oil and gas results in higher generation costs compared with southern Africa;
- **East Africa***:* Grid capacity has increased with a number of hydropower stations being commissioned in recent years including the Merowe dam in Sudan and Ethiopia's Beles II and Gilgel Gibe II dams. Generating capacity is driven by hydropower and oil;
- **Central Africa***:* The region has the most limited grid capacity of 4GW, dominated by hydropower.

Figure 76: Summary of existing power capacity

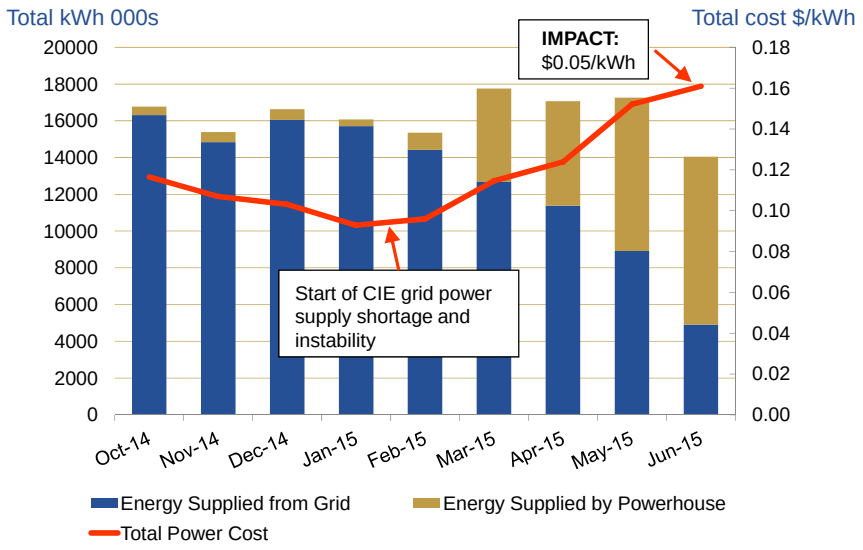
Country	Access to electricity (%)	Sourced from:	Existing power plant(s)	Installed capacity (MW)	Projects
Botswana	65	1 power plant (30%) Imported from South Africa (70%)	Morupule A (coal)	132	Adding 1200MW to grid 2011-2017: Morupule B (600mw) New plant I (300mw) commission due 2015/16 New plant II (300mw) commission due 2018/19
Burkina Faso	17	2 hydropower plants 3 diesel plants	Hydro plants (30mw) Diesel plants (87mw)	117	2 solar plants (42mw), 2 diesel plants in development (15mw)
Ivory Coast	25	3 gas plants 3 hydropower plants	Gas plants (598mw) Hydro plants (551mw)	1149	Addition of 150mw turbine planned to Azito power station
DRC	10	State producer: SNEL 15 hydropower stations (98.5% of total installed capacity) 24 coal plants	Inga 1 and 2 (1994mw)	2540	Grand Inga Hydro Plant: phase III Currently on hold: last estimate US$12bn required; Target capacity 4800mw, timeframe 2020
Ghana	72	2 oil/gas fired power plants 3 hydropower plants	Tema diesel plant (70mw) Takoradi oil/gas plant (330mw) Akosombo hydro plant (1020mw) Kpong hydro plant (160mw) Bui hydro plant (400mw)	1980	
Guinea	12	State producer: GEC 3 hydropower plants 2 coal plants	Garafini hydropower (75mw) Tombo coal plants I, II, III (57mw) Aggreko coal plant (50mw)	182	Guinea Sea Wave power station (100mw) Boke hydropower station (130mw) due 2016 Kaleta hydropower station (240mw) due 2016
Mali	27	1 hydropower station: Mantali exports 15% of power to Mauritania and 33% to Senegal	Manatali Dam (200mw)	200	
Mozambique	39	State producer: EDM 4 lg hydropower plants 65% power from Cahora Bassa exported to South Africa	Hidroelectrica de Cahora Bassa (2075mw) Mavuzi (52mw) Chicamba (38mw) Corumana (17mw)	2200	Moatize (600mw) coal plant due 2016 Zambezi River hydroplant (1245mw) Mphanda Nkuwa hydroplant (1500mw)
Namibia	30	30% from 1 hydropower plant, 3 coal plants 60% imported from South Africa, Zimbabwe, Zambia, Mozambique	Ruacana hydropower (330mw) 3 x thermal power plants	400	
Senegal	53	2 IPPs (20% from GE/GTI Dakar IPP; 47% from Kounoune IPP) Manatali Dam in Mali (33% to Senegal)	GE/GTI Dakar IPP: 56mw Kounoune IPP: 67.5mw Manatali Dam: 66mw	633	Mboro (300mw) due 2017
South Africa	85	State producer: ESKOM	17 coal plants > 1mw 5 gas plants 10 hydropower plants	42000	Building two new plants: Medupi (4.8gw) due 2016 Kusile (4.8gw) due 2017
Zambia	25	State producer: ZESCO 95% of power generation from hydro Imports from South Africa (100mw) Imports from Mozambique (100mw)	5 lg hydropower plants 1 lg coal plant	2400	Itezhi-Tezhi dam (120mw) due 2015/16 Maamba phase 1 (300mw) due 2016/17 Mumbotuta hydro (300mw) Kabompo Gorge hydro (40mw)

Source: Deutsche Bank, Africa Progress Panel 2015 Report, Company data, World Bank

The economic impact of unreliable or non-existent state power

High cost and unreliable electricity supply adds to the cost of doing business in Africa. The World Bank has estimated losses at 2-4% of African GDP each year across industries, with the Africa Progress Panel stating that *"frequent power cuts result in losses estimated at 6% of turnover for large firms and as much as 16% for enterprises in the informal sector"* (2015 Report). A good example in the mining space to illustrate the difference between the cost of grid power, when it's available, and self-funded diesel-powered generation is at Randgold's Tongon mine in Cote D'Ivoire:

Figure 77: Impact of shortage of grid power on Tongon power costs



Source: Company data

On average, electricity provided through diesel-fuelled back-up generators costs four times as much as power from national grids.

Projects in progress: focus on hydropower and sharing power across borders

In Figure 78 we set out the 22 different new power plants that are being built across the countries we're looking at for this research, with a couple of 'on hold/deferred' exceptions. As we show in the summary above, the total current installed capacity for our 12-country sample is 54 GW. Thus the new capacity would increase installed capacity by a further 21 GW, or almost 40%.

Given the tight time frames, and slippage to date, plus growing pressure on government budgets from the weak commodity price environment, it's unlikely that all of the incremental generation capacity planned will come on stream.

Figure 78: Adding 21GW of power into 2020s with a hefty +US$30bn bill

	Power plant	Incremental MW	By	Cost (US$bn)
Botswana	Morupule	600	2017	
	New plant I	300	2017	
	New plant II	300	2017	
Burkina Faso	2 solar plants	42	NA	
	2 diesel plants	15	NA	
Cote d'Ivoire	New turbine at Azito plant	150	NA	
DRC	Inga hydro phase III	4,800	2020s	12
Guinea	Sea wave power station	100		
	Boke hydroplant	130	2016	
	Kaleta hydroplant	240	2016	
Mozambique	Moatize	600	2016	0.80
	Zambezi River hydroplant	1,245	US$1.8bn required: no current commissioning plans	
	Mphanda Nkuwa hydroplant	1,500		
Senegal	Mboro	300	2017	0.61
South Africa	Medupi	4,800	2016	8.08
	Kusile	4,800	2017	9.12
Zambia	Itezhi-Tezhi dam	120	2015	0.25
	Maamba phase 1	300	2016	0.80
	Mumbotuta hydroplant	300	+2020	
	Kabompo Gorge hydroplant	40	+2020	
Total		**20,682**		**33.5**

Source: Deutsche Bank, Africa Progress Panel 2015 Report, Company data

The alluring promise of hydropower: Inga 3 case study

As can be seen above, almost half of the planned plants are to be hydro-powered. In general, to bring the larger plants online, development costs and then capacity will have to be shared across nations and via public/private partnerships.

A good example is the huge hydropower potential of the DRC. Over seven phases of development, for US$80bn capital, the Grand Inga project (on the Congo River) could generate 40,000mw, twice that of the Three Gorges dam in China (currently the world's largest hydro project) and the equivalent of 20 large nuclear power stations. This would be equivalent to supplying 500m people with power, doubling the continent's power production, and making Inga the world's largest infrastructure project.

At present, the Inga 1 and 2 hydropower plants are in operation. They have a combined generating potential of 1,994mw but have been operating at only 40% of their capacity – all power goes to the copper mines in the south of the country. Following the civil war in 2003, plans were revived to build Inga 3. Two funding plans fell through, however – the first was due to be a consortium of five southern African countries (signatories to the Southern African Power Pool); the second was BHP, which won a tender in 2009 but withdrew from the project in 2012. Those plans stated that a capacity of 4,800mw would be targeted, with 2,500mw going to South Africa. A timeframe of 2020 was mooted with a total of US$12bn required.

Inga 3 is part of the *Priority Action Plan of the Programme for Infrastructure Development in Africa* (PIDA). It also includes substantial cross-border projects such as the North-South Power Transmission Corridor and the West African

Power Transmission Corridor – these, plus Inga 3, must be under way by 2020 according to the plan. For Inga, the potential link with South Africa is of huge importance – additional hydropower from the DRC would replace coal-fired power generation in SA, lowering costs and expanding affordable energy.

Is Africa worth it? The return potential

Lessons from the pioneers: four case studies

What does it take to succeed?

We think the approaches and models used by Randgold in West Africa and Glencore in the DRC and Zambia have been successful – notwithstanding the current pressure on some of Glencore's copper mines in the region – and can provide a framework for future investment by others. In the following pages we look at the Randgold and Glencore experiences in our first two Case Studies.

We then turn to Rio Tinto for our third Case Study, looking at the torrid time it has had thus far in getting its mega iron ore project Simandou South off the ground in Guinea.

Finally, we look at newly created South32 in our fourth Case Study – present in two African countries so far (South Africa and Mozambique) but with a balance sheet it could use to establish a pan-African presence.

By country we focus on the 12 places where the above four companies are active – see Figure 79:

Figure 79: We focus on 12 countries

Source: Deutsche Bank

Case study 1: Randgold

Next leg of growth coming; upgrade to Buy

In this case study we look at how Randgold has been successful in delivering an Africa-focused strategy.

Randgold adheres to all Five Commandments: Pay the rent, start small, invest in infrastructure, up-skill your communities, exercise patience.

Randgold has had exceptional success

Randgold's Africa-focused strategy is simple (on paper) and the company has adhered to it consistently: Employ the right people to find and develop gold deposits with more than 3moz R&R, which make a minimum 20% IRR at a US$1,000/oz gold price. Do this through partnership with governments, NGOs, regulators, employees, communities and investors.

Randgold's discovery of gold deposits that fit those criteria has occurred, so far, in West and central Africa. The successful development of those discoveries in extremely difficult and risky jurisdictions is testament to Randgold's ability to work in partnership with all the stakeholders listed above.

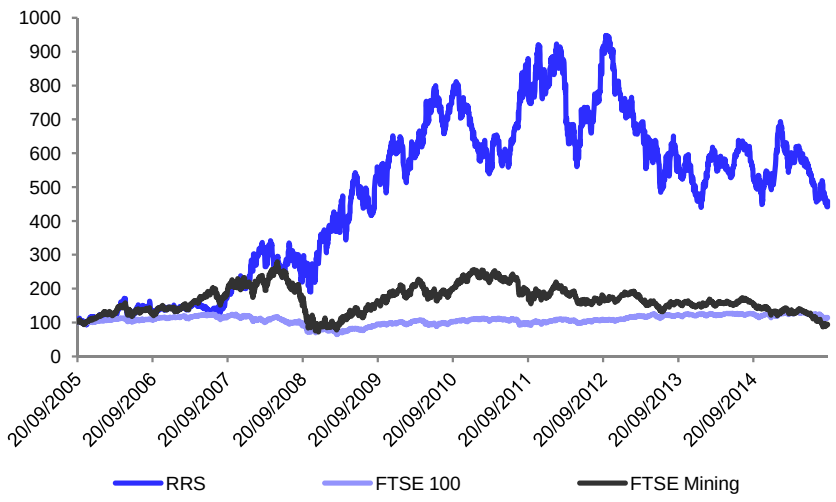
We conclude that the company's success is driven by its approach: each of its mines is the centre of an impacted zone, and Randgold is responsible for the economic viability of that zone and the communities/stakeholders therein.

Randgold's proposed next move, into Ghana via a JV of the Obuasi mine with AngloGold, adds US$858m to our NPV Sum of the Parts for the group, or £6.15 per share, on our estimates. On this basis, Randgold is trading at 0.85x 2016e NPV with improving FCF and low gearing. We have raised our price target 9% to £50.5, implying 13% upside, and we upgrade to Buy.

How to win friends and influence people in Africa

At Randgold's 2014, CEO Mark Bristow's introductory presentation stated that "Past actions brought us here; future success depends on what we do now" – and tellingly, not one slide referenced or mentioned the role of Africa or Randgold's actions in Africa. Randgold has a strict blueprint for a successful strategy, which it has applied in the continent to considerable success – as borne out by its shares' clear outperformance of the UK market overall and the UK mining sector:

Figure 80: Randgold's clear 10-yr outperformance of the market and sector



Source: DataStream

We have distilled the company's approach into three buckets which enable the delivery of its targeted 20% IRR at a US$1,000/oz gold price:

- **Security of tenure:** dealing with all stakeholders:
  - Fiscal licence to operate: Deal honestly and transparently with host governments
  - Social licence to operate: Create jobs and transfer skills
  - Set boundaries: miners' responsibilities and others
  - Invest now for after the mine has gone
- **Investing in infrastructure**
- **Spread risk and maintain control via the JV model**

In essence, Randgold's assumption is that each of its mines is the centre of an impacted zone and that it is responsible for the economic viability of that zone and the communities/stakeholders therein.

1) Securing tenure: dealing with all stakeholders

This is about ensuring fiscal stability to enable the delivery of Randgold's targeted/minimum IRR.

Fiscal licence to operate: Deal honestly and transparently with host governments

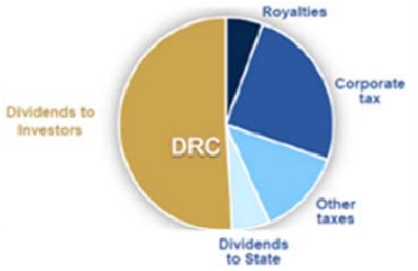
"When you pay rent, the landlord doesn't ask you to leave" Mark Bristow, Randgold Investor Day 4Q14

Mining companies need to retain their fiscal licence to operate – as we quote here, they have to pay the rent. Randgold works across the industry and within countries to ensure this. Its approach is as follows:

- **Regular disclosure of the benefits to the host state** through payment of taxes, royalties, and dividends, including disclosure of when governments have a free carry stake in a mine or project. The Kibali life of mine expected contribution to the DRC is a good example – see Figure 81 here:
- **Open communications:** Randgold has a country manager in each country who manages its relationship with the host government; Randgold's CEO hosts quarterly open days in each country for all stakeholders.
- **Implement a two-way street**: Randgold seeks written governmental approval for transactions (such as it acquisition of Kibali mine in DRC), tax stability agreements entrenched in law, and in extreme cases, the company will seek agreements regarding the actions of national armies in the event of armed conflict (as it did for Kibali mine).

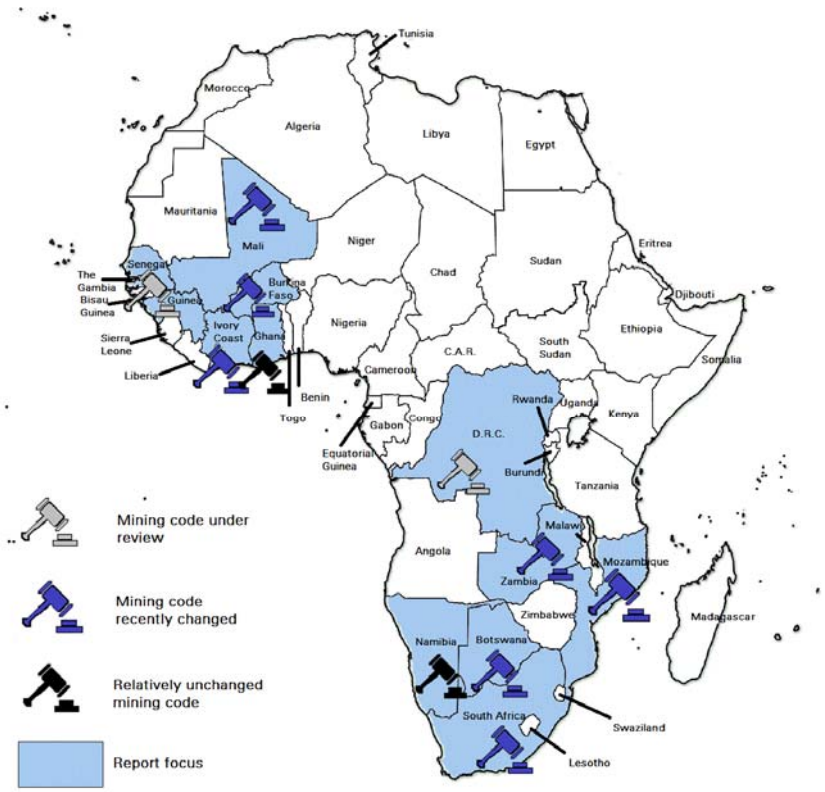
Figure 82 shows the changing landscape of mining codes and legislation across the continent over the past seven years.

Figure 81: LoM benefits to state from Kibali mine



Source: Company data

Figure 82: Recent mining code and legislation changes across Africa



Source: Deutsche Bank, Company data

Social licence to operate: Create jobs and transfer skills

Randgold sets a footprint around each of its mines in terms of the impacted zone. This leads it to extensive engagement with its local communities which become stakeholders in the mine. In essence, Randgold invests in:

- **Up-skilling the local community:** this provides jobs which serve the mining community but also alternative livelihoods – especially important when there are not enough mining jobs to go round;

- **Supporting local businesses:** Randgold sets up business entrepreneurships and spends on local development projects;
- **Improving the health of its employees and their dependents:** via clinics and also establishing food security through the training of farmers (Loulo) and establishing community livestock projects and building dams (Tongon).

In 1H15 at its Loulo-Gounkoto mine in Mali, Randgold spent US$1m on an agri-business school, US$240k on community projects, built a primary school, provided internet access for the local high school, distributed fertilizer and donated a tractor in order to improve food supply and security. At its Kibali mine in DRC, Randgold repaired dysfunctional water bore holes, completed a feasibility study on its palm oil factory project for the local community, committed US$1m to the Local Economic Development initiatives, and the list goes on.

Set the boundaries: miners' responsibilities and others

Despite the wide range of investment from Randgold, the company aims to establish a "social contract" at each of its mines in order to set the boundaries of responsibilities. At Kibali for example, Randgold has a tripartite agreement with the communities, the mine and the local government.

Invest now for after the mine has gone

Morila mine, a 50/50 JV between Randgold and AngloGold Ashanti, will close during 2017. The partners are investing in agribusiness projects to ensure the employees and local communities are sustained after Morila's closure, including poultry, honey, fish farming, millet, rice, maize, sesame and mango farming.

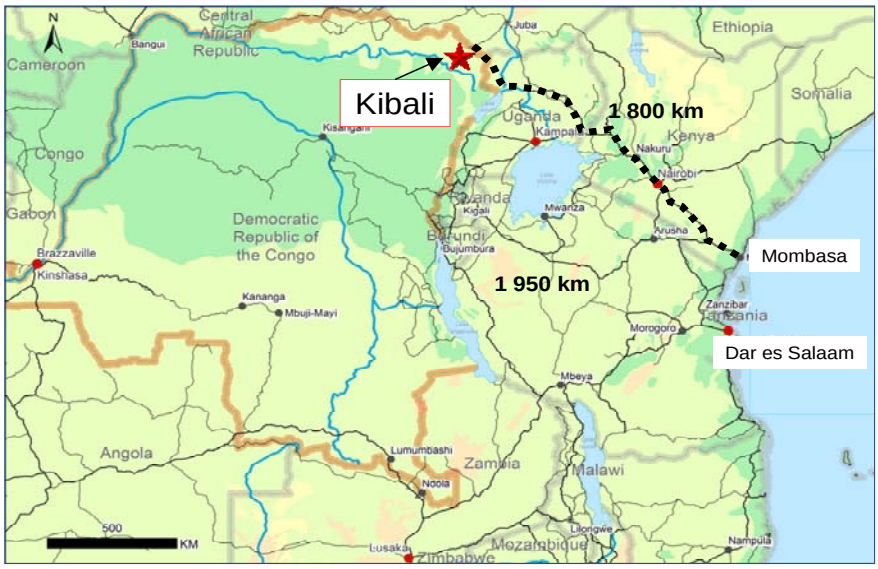
2) Investing in infrastructure: The Kibali example

Randgold's newest mine, Kibali, in the DRC, provides an excellent example of the wider investment required to develop Greenfield mines in Africa.

Firstly, the site has to be accessible

In constructing the mine between 2010 and 2013, Randgold (and 50/50 JV partners AngloGold Ashanti) spent US$52m on roads, power lines and aggregates to access the project site. In effect, the project team needed to create all infrastructure around the site and supply roads to the coast, opening supply routes from Mombasa and Dar es Salaam. This was particularly challenging given that the routes passed through three countries - Figure 83 shows the supply routes that Randgold and partners established. Figure 84 and Figure 85 the challenge of building viable roads in and out of the mine site.

Figure 83: Kibali supply routes



Source: Company data

Figure 84: Starting to create a 350km road network

Source: Company data

Figure 85: The road to site upgraded

Source: Company data

Secondly, local communities have to be moved properly and fairly

At Kibali, Randgold needed to move over 20,000 people, and initiated a Resettlement Action Programme (RAP) which reflected World Bank and IFC guidelines and principals, the DRC constitution and its mining code. The following table sets out the needs and achievements:

Figure 86: Kibali RAP

The challenges	Selected achievements to 2014
21,000 people/4,216 households to be relocated	4,216 houses built in three years
Over 2,000 artisanal miners within mine's planned footprint	21 co-ops creating 400 non-mining related jobs
14 schools	Completed
Very low income base, <US$30pm on average	
80% of population using non-potable surface water sources	60 bore holes drilled and equipped
2,408 graves to be relocated	Completed
39 places of worship	Roman Catholic Church completed
No security of tenure	All keys handed over, all compensation claims finalised

Source: Company data

Thirdly, the mine will need power

Randgold believes that expertise and self-sufficiency in power supply for Kibali will be a competitive advantage. It plans to harness the area's considerable water supply to supplement and then eventually replace diesel generated power. It will spend c. US$80m on four hydro stations, the first of which (Nzoro 2) has been commissioned this year, with an estimated 18 month payback. In total, 55mw of (peak) output should be supplied. This will reduce total power costs to c.USc12/kwh, with diesel generation at USc45/kwh and hydro at USc10/kwh.

3) Spread the risk, maintain control: the JV model

Randgold operates both the Morila and Kibali mine in an equal-share JV structure with AngloGold Ashanti. The burden of capital is therefore halved but Randgold controls of operations. As we discuss in more detail below, Randgold and AngloGold intend to become JV partners at the Obuasi mine in Ghana.

Upgrading to Buy: a focus on Randgold's next mine

West Africa will be the focus for next leg of growth for our covered Gold miners

We think the discovery, or purchase, and development of gold mines in West Africa will provide the next leg of production, and therefore earnings, growth for the Africa-focused gold miners under our coverage.

After the announcement on 15 September 2015 that Randgold is seeking to become a JV partner in AngloGoldAshanti's Obuasi mine in Ghana, we upgrade our recommendation to Buy.

We have added in a mid-range scenario valuation for Randgold's potential 50% stake in Obuasi. This would add US$858m to our NPV Sum of the Parts for the group, or £6.15 per share. On this basis, Obuasi is 12% of Randgold's NPV – as shown in Figure 88.

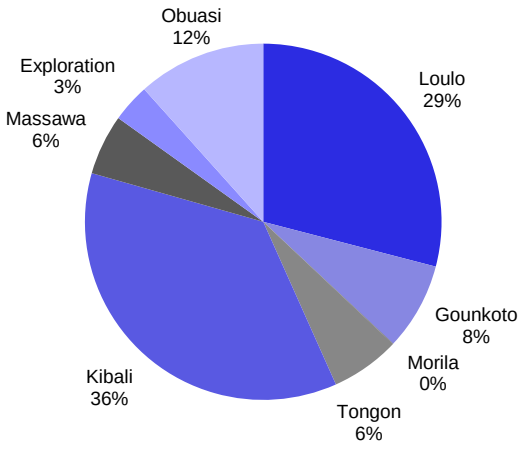
We already include US$404m for Randgold's next possible Greenfield mine Massawa in Senegal.

Figure 87: Split of Randgold NPV

As at end FY16	US$m	US$ps	£ps	% of value
Loulo	2,141	23.02	15.35	*30%*
Gounkoto	585	6.29	4.20	*8%*
Morila	2	0.02	0.01	*0%*
Tongon	465	5.00	3.33	*7%*
Kibali	2,660	28.61	19.07	*38%*
Massawa	404	4.35	2.90	*6%*
Exploration	256	2.75	1.83	*4%*
Obuasi	858	9.23	6.15	*12%*
Total Operational	**7,372**	**79.3**	**52.8**	
Corporate costs	-105	-1.13	-0.75	*-1%*
Environmental rehab provision	-56	-0.60	-0.40	*-1%*
Net (Debt)/Cash	-167	-1.80	-1.20	*-2%*
Total with Obuasi	**7,044**	**75.74**	**50.49**	***100%***

Source: Deutsche Bank estimates

Figure 88: Split of NPV for Randgold



Source: Deutsche Bank estimates

Catalysts in the next 12 months

- Obuasi feasibility results and JV decision: due by end January 2016;
- Kibali underground progress: we look for an update from 3Q15 on;
- Dividend increase: this could come as early as February 2016 when the Obuasi capex commitment becomes clearer;

Valuation: Attractive P/NPV; improving FCF yield and low gearing

Randgold is trading on 0.85x NPV on our estimates which we think is cheap given its potential growth from Obuasi whilst maintaining a strong balance sheet and improving FCF:

Figure 89: Key financials and valuation metrics

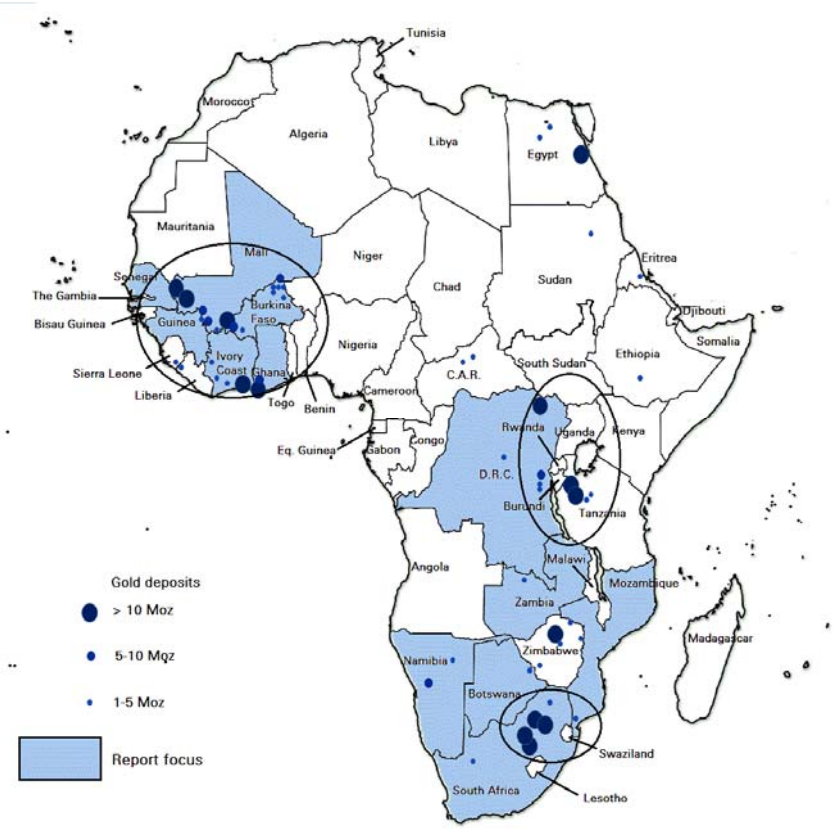
US$m	2010	2011	2012	2013	2014	2015e	2016e	2017e	2018e	2019e	2020e
EBITDA	164	570	700	485	426	301	352	431	485	498	549
EBIT	136	488	568	355	279	108	102	183	219	204	211
EPS	1.13	4.09	4.66	2.99	2.54	1.71	1.43	1.93	2.34	2.49	2.95
FCF	-208	140	-38	-291	88	105	141	78	188	284	453
DPS	0.20	0.40	0.50	0.50	0.60	0.62	0.64	0.66	0.68	0.70	0.72
Net debt/(cash)	-366	-488	-373	-38	-83	-149	167	148	21	-199	-588
P/NPV							**0.85**				
P/E	89.2	24.0	26.4	24.1	26.8	35.3	42.1	31.3	25.8	24.3	20.4
EV/EBITDA	38.4	11.1	9.0	13.0	14.8	21.0	17.9	14.6	13.0	12.7	11.5
FCF yield	**-3.7%**	**2.5%**	**-0.7%**	**-5.2%**	**1.6%**	**1.9%**	**2.5%**	**1.4%**	**3.3%**	**5.0%**	**8.1%**
Dividend yield	0.3%	0.7%	0.8%	0.8%	1.0%	1.0%	1.1%	1.1%	1.1%	1.2%	1.2%

Source: Deutsche Bank estimates, DataStream

Focus on West Africa

There are three main gold basins in Africa – as shown in Figure 90. The southern African basin has been mined extensively since its discovery in Johannesburg in the late 19th century. The eastern African basin has been mined in Tanzania since the early 2000s. The West African basin has become the industry's next focus for the continent's gold production, starting with Ghana (now the second biggest gold producing country in Africa) and now focusing on the development of reserves in Mali, Ivory Coast, Senegal and Burkina Faso in particular.

Figure 90: Major gold basins in Africa



Source: Deutsche Bank

The region has a number of long-established gold mines but importantly it also remains highly prospective. Ghana has the most mines per country, currently, with nine. The average 2013 (or last reported annual) production was 186koz. Reserve grades average 2.17g/t but with a wide range - Mali has the highest average reserve grades at 2.72g/t and Guinea the lowest at 0.7g/t. The mines in Ghana and Mauritania have the longest lives, at 2027 and 2034 respectively, and those in Burkina Faso the shortest at 2019 (on average).

Randgold's next mine: Buy Obuasi, build Massawa?

For this case study, we assess Randgold's options for its next mine. The company's preferred portfolio configuration is to have five mines. Once the group's Morila mine in Mali is closed in 2016/17, management will be looking to development a new fifth mine.

Over the past 18 months, CEO Mark Bristow set out some of the group's active options for that fifth mine including exploration to find a Greenfield site in Cote d'Ivoire (CdI) and develop Randgold's most advanced Greenfield project, Massawa in Senegal. Most recently (15 September 2015) Randgold announced it is seeking to become a JV partner in AngloGoldAshanti's Obuasi mine in Ghana.

Focus on Obuasi: well known to Randgold

Randgold aims to move into Ghana

Randgold has entered an investment agreement with AngloGold Ashanti (Buy, ZAR105) aiming to form a 50/50 joint venture to redevelop AngloGold's Obuasi mine in Ghana. Upon completion of a bankable Feasibility Study (FS), with South African Reserve Bank approval, and agreement with the Government of Ghana, Randgold would operate the mine, after implementing a re-designed development plan. The cost of completing the new feasibility study is US$4m.

RRS/ANG JV model is proven; Obuasi on Randgold's backburner since 2003?

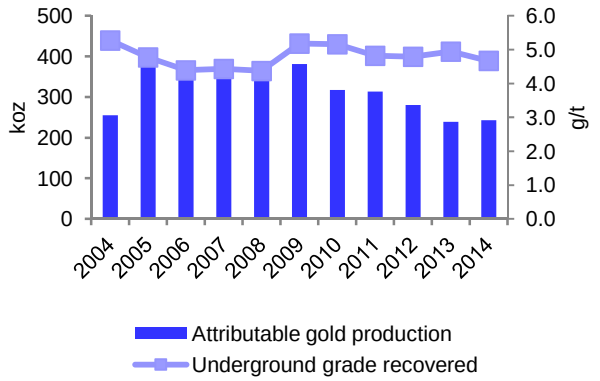
As we mention earlier in the note, with Randgold as operator, the two companies have operated the Morila mine in Mali and ramped up the Kibali project in DRC, both 50/50 JVs. Obuasi was the subject of a bidding war between the two back in 2003, when the Ashanti assets were finally bought by AngloGold.

Zero upfront cost to Randgold: up to US$500m capex required?

Randgold will not pay any upfront cash or capital to enter into the JV if it goes ahead. The group's CEO has commented that total capital to develop the mine would not exceed US$1bn and Randgold's US$500m share certainly fits the investment size that it has signaled for its next potential mine development.

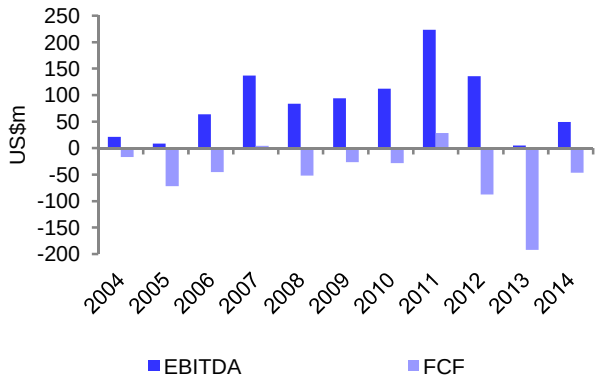
As shown here, the mine has significantly underperformed AngloGold's plan since it acquired the Ashanti assets in 2004, with falling production since 2005 (Figure 91) and only two years of ten with positive FCF (Figure 92).

Figure 91: Obuasi: 10-yr history of production and grades



Source: Company data

Figure 92: Obuasi: 10-yr history of EBITDA and FCF



Source: Company data

Current feasibility study (FS): 400-500koz at AISC of US$750-850/oz

AngloGold has an FS in place to scope out a mine plan for Obuasi, targeting 400-500kozpa at an All-In Sustaining Cost (AISC) of US$750-850/oz. There is no capex guidance presently. Randgold will now evaluate and revise the plan to develop an underground mechanised mine, likely to use medium-hole stoping, specifically to increase mined grades towards the attractive 6-7g/t reserve grade.

A signal that Obuasi can work with Randgold's investment criteria

These are set in stone: any investment must yield a 20% IRR at a gold price of US$1,000/oz and needs a reserve of at least 3moz. With a 5.3moz reserve, the challenge/focus will be to lower costs in order to meet the 20% IRR hurdle.

If we assume that the JV partners spend a total US$800m on the mine's development, production at steady-state is 500kozpa, royalties remain at 3% and the mine pays tax, the following IRRs would result at various gold prices and levels of AISC:

Figure 93: IRR of Obuasi mine: only above 20% if gold is US$1,300/oz

		Gold price (US$/oz)				
	%	900	1,000	1,100	1,200	1,300
AISC (US$/oz)	750	3.2	8.9	13.7	18.2	22.6
	775	1.3	7.4	12.4	17.0	21.4
	800	(0.9)	5.9	11.1	15.8	20.2
	825	NM	4.3	9.7	14.5	19.0
	850	NM	2.5	8.3	13.2	17.7
	900	NM	(2.0)	5.3	10.5	15.2
	950	NM	NM	1.7	7.7	12.7
	1,000	NM	NM	(3.2)	4.6	10.0

Source: Deutsche Bank estimates

At spot gold, use of tax losses plus AISC of US$750 needed for 20% IRR

The formation of the Obuasi JV is contingent upon revised stability and development agreements with the Ghana government, and the issue of all necessary environmental licenses and permits.

In particular, an agreement with the government to include Obuasi's tax losses and capital allowances in the JV structure is likely critical to reaching Randgold's 20% IRR hurdle: if we take our near-term gold price forecast of US$1,100/oz and assume AISC in the middle of the FS target range, at US$800/oz, the NPV of not paying corporate tax for the first ten years of life adds US$300m to our total mine NPV, boosting the IRR from 11.1% to 15.2%. To reach an IRR of 20%, a drop in AISC to U$750/oz would then have to be delivered.

Three execution risks

If the JV goes ahead, we think the execution risks for Randgold are threefold:

- **Underground mining**: With its forte in open-pit gold mining, Randgold had a shaky start going underground at Loulo, but has learnt from its mistake to the point where it is now confident enough to become owner-operator of the mine from 4Q15. In addition, it is on target with sinking the shaft to go underground at Kibali.
- **Not a blank canvas**: To date, Randgold has developed Greenfield mines from its own exploration successes. Clearly Obuasi comes with underground infrastructure already in place, an in-progress development decline and, perhaps most importantly, there is an existing operating culture which Randgold will need to change.

Starting with a canvas that isn't blank but needs to be re-designed will be a new challenge for the group.

- **A new jurisdiction:** As we discuss in our "Challenges and headwinds" section, we rank Ghana highly as a supportive mining jurisdiction. It is, however, a new destination for Randgold (albeit it bid for the Ashanti assets in 2003) and thus will need to initiate new stakeholder relations.

The attractions of Cote d'Ivoire

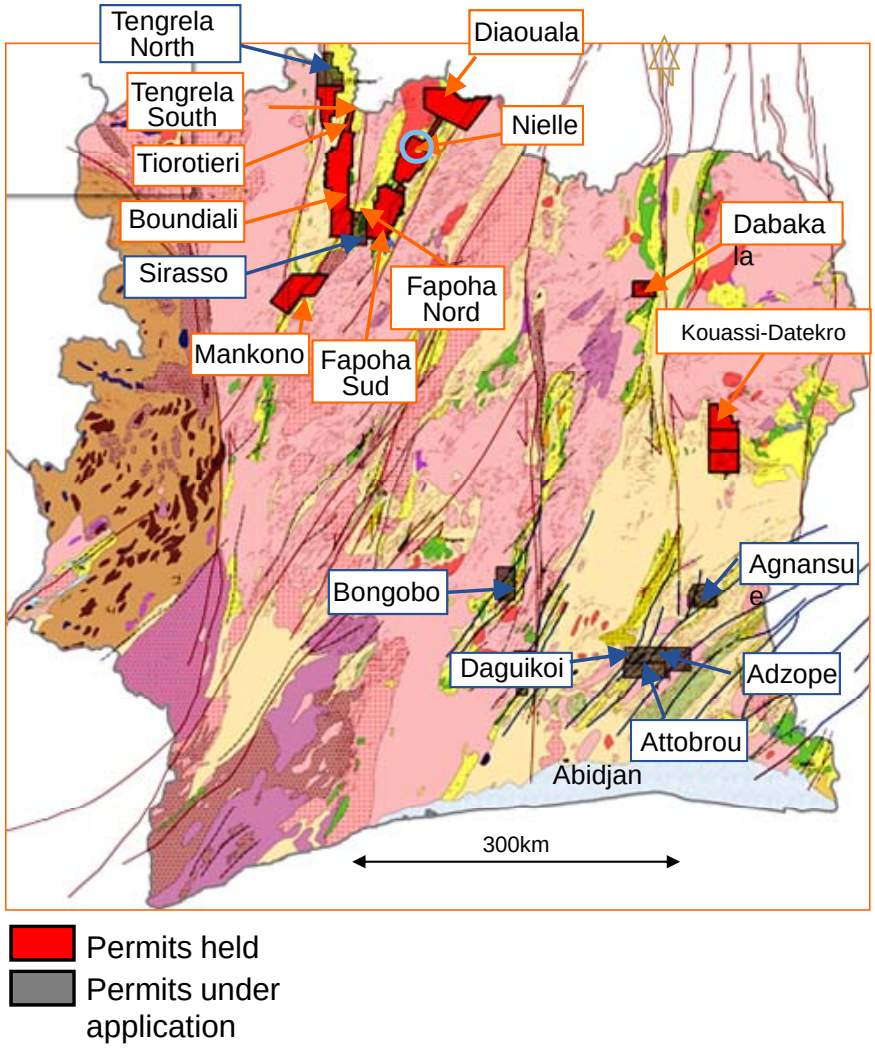
Randgold believes Cote d'Ivoire to be a more attractive investment destination than many countries in Africa, and has built up the largest land position of mining companies there as a result. Whilst its resources, including gold, are much less developed than other African countries, Randgold believes that the combination of sophisticated infrastructure including a full power grid (the only fully operational power grid in West Africa) and ports, deep and long-established bureaucracy, plus what it sees as low border-crossing risk, reduces the overall investment risk profile.

Importantly, the Government reviewed and implemented a revised Mining Code in 2014 which was taken positively by mining companies who engaged extensively with the government to ensure the revised code is workable and financially viable.

Randgold has an existing mine in Ivory Coast, Tongon. It holds ten exploration permits and is focused on six pending applications for permits (down from ten in 2013) - its footprint is shown in Figure 94.

In terms of exploration, Randgold recently announced a change in its strategy to concentrate its resources on the most promising areas for new discoveries in the country. This has led to the rapid development of two of the group's three projects, Mankono and Fapoha, with the third being Boundiali. Deeper parts of the existing Tongon mine are also being tested under the base of the US$1,000/oz pit shell.

Figure 94: Randgold's footprint in Cote d'Ivoire



Source: Company data

Building in Cote d'Ivoire passes the 20% IRR test, just

In order to assess Randgold's build vs. buy choice, we have built a DCF model for building a mine in Cote d'Ivoire organically. We have based our assumptions on:

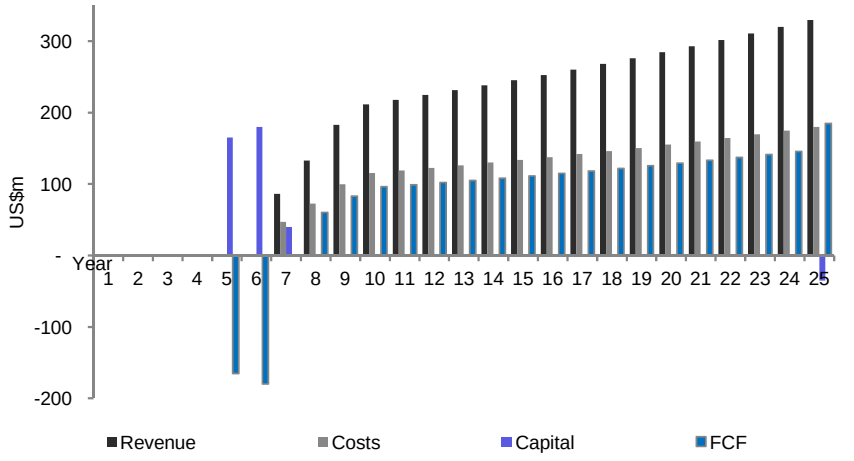
- 100% basis for all cash flows (in practice, there could be a10% free carry option for the government);
- A 3moz resource base, in line with Randgold's target investment criteria;
- An average 2.0g/t reserve grade, in line with the average for current operating mines in Cote d'Ivoire;
- Mining starts when reserves are 70% of resources, and that this takes 7 years - we have based this on Randgold's delivery at Tongon;
- An 18-year life, in line with the average life span of currently operating CdI mines;

- Development capital requirements of US$280m –this is the average of the capital to develop Tongon plus the current Yaoure and Tengrela projects (owned by Amara Mining and Perseus Mining respectively).
- We have included feasibility study costs of US$30m and initial working capital requirements of US$35m.
- Infrastructure includes a 2,500ktpa mill, and we assume this runs at 90% capacity at steady-state;
- Recoveries are assumed to be 88%, the average of currently operating Cote d'Ivoire mines;
- We use the average 2015e total cash costs and All-in Sustaining costs (which includes sustaining capex and royalties) for currently operating Cote d'Ivoire mines, inflated by 3% per annum;
- We have assumed the project would be eligible for a 5 year corporate tax holiday; thereafter, we apply a corporate tax rate of 25%.

We assume it takes seven years to advance from declaring a Measured Resource position to complete a pre-feasibility and feasibility, receive a mining permit, build main infrastructure and declare first production. We then assume a further two years to ramp-up to full production.

Our FCF estimates for the mine are shown in Figure 95. If we apply an 8% nominal WACC to the cash flow stream, we derive an NPV of US$500m. The IRR is 20%. On this basis, building a new mine in Cote d'Ivoire would just scrape through Randgold's 20% IRR hurdle for investment in new mines.

Figure 95: FCF model for a typical CdI gold mine



Source: Deutsche Bank estimates

Build in Senegal: Massawa falls short of 20% hurdle

Massawa is a potential Greenfield project for Randgold with inferred resources. The deposit is situated in eastern Senegal within the 150km long Mako greenstone belt, and is around 90km due west of Randgold's Loulo mine over the border with Mali.

Senegal has been a stable country, relative to neighbours Mali and is a relatively undeveloped mining destination, with significant hurdles to investment especially in terms of lack of infrastructure and some uncertainty around an ongoing review of the country's Mining Code.

The initial prefeasibility study for Massawa was completed on the open pit mineral reserves in 2010. In 2011, Randgold decided to delay the feasibility study and focus instead on understanding the geological and metallurgical controls as well as growing the resource base of the project.

Focus on Central Zone which hosts high-grade veins

There are two zones to the delineated ore body at Massawa: north and central. Randgold's focus is on the Central Zone (CZ) because in-fill drilling in the last 12 months has revealed very high-grade shears in a number of the six ore zones defined in the CZ. The infill drilling showed the veins to be more continuous than previously interpreted and also highlighted the possibility of the gold being amenable to gravity recovery.

The most recent results from the Central Zone have allowed a significant improvement in Randgold's understanding, with closer spaced drilling highlighting the potential to materially improve the economics of the project with further infill drilling.

The most recent plan includes a Resource of 3.7moz at an average grade of 2.7g/t. The inclusion of the high-grade zones would see this increase to 4moz at 4.5g/t – a significant increase. Randgold is confident enough in the potential economic viability of the project to include it in its Ten-Year Plan for the group

Adding the nearby Sofia target could mean a Bankable Feasibility

In 1H15 Randgold started to review a non-refractory ore source, the Sophia deposit, about 10km from the Massawa orebody, with an inferred resource of 736koz at 1.7g/t. A 600m long section of the orebody contains 0.24moz at 3.96g/t – this is being drill tested this quarter (3Q15).

Capital cost of US$500m, IRR of 16.2% at present

In terms of the total potential capital cost, Randgold guided at its November 2014 Investor Day that a project similar in scope and economics to Massawa would likely cost in the region of US$500m to develop.

We value the project at US$487m (100% basis, Randgold owns 83%) and derive an IRR of 16.2%. Thus in its present form (i.e. without higher grade reserves delineated) the project falls short of Randgold's 20% IRR hurdle.

Obstacles to project approval

There are three, inter-related, issues which we see as hurdles to approval for the Massawa project: (i) the availability of power and water, needed for (ii) grinding of hard ore, which is (iii) due to the refractory nature of much of the deposit.

- **Ore hardness**: Randgold's Bond work grindability tests in 2012 confirmed abnormal hardness of the Massawa ore due to silica flooding.
- **Refractory ore:** Outside of the higher-grade zones, the ore body is essentially refractory in nature – i.e. it contains ultra-fine gold locked in arsenopyrite and thus is only recoverable by means of a pre-oxidative step

to liberate the gold prior to leaching. Batch testwork has shown pressure oxidation to be very effective in releasing the gold from the sulphides but this is power intensive and also new technology to Randgold.

To extract the gold from hard, refractory ore will likely require ultra-fine grinding and pressure oxidisation – making the Massawa project a high energy user. This is a potential problem given the energy situation in Senegal:

- **Power and water:** In the country at large, water and power are scarce with regular blackouts and prolonged water shortages. The International Monetary Fund estimated in 2013 that the situation in the energy sector is costing Senegal 2% growth per year. This does not mean that Randgold cannot generate its own power needs (as it does in Mali) but this obviously adds costs, lowering returns. There is the possibility of a hydroelectric scheme for the larger region (Senegal, Guinea, Gambia and Guinea Bissau), with the Organisation pour la Mise en Valeur du fleuve Gambia (OMVG), charged with developing the Sambangalou project, 60 kilometres south east of Massawa.

Case study 2: Glencore

Pockets of excellence

In this case study we focus on one of Glencore's engines of growth, copper in the Central African Copperbelt across Zambia and DRC.

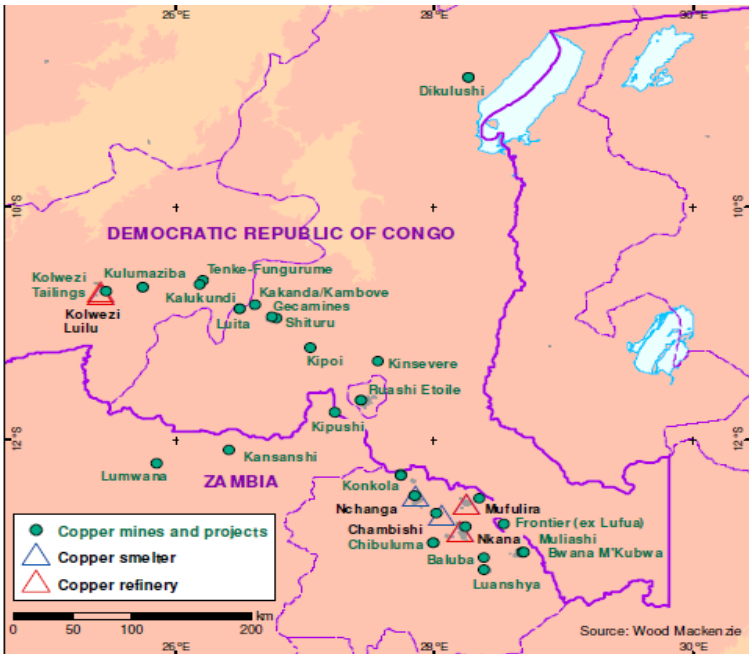
Glencore has been successful in delivering to four of our Five Commandments for Mining in Africa but has been scuppered by the need to Invest in Infrastructure.

We conclude that the high-grade potential of the district can only be delivered fully if infrastructure, especially power, is developed and made more reliable. Given our ranking of DRC at the bottom of our Ranking table (see Figure 4), building up a successful mining position there will be high-risk, expensive and likely to take a long time. Glencore has a high quality asset in Mutanda (DRC); but its Mopani operation has been placed on care maintenance in light of the current low copper price. The Katanga operation is also on care and maintenance, due to ongoing power outages, while it upgrades its processing to be less sensitive to power cuts.

Central African copper: High grade, high risk

The Central African Copperbelt runs in a NW-SE direction through the middle of Zambia and the south of DRC:

Figure 96: Africa's central copper belt



Source: Woodmac

There are declared Reserves and Resources of just over 100mt – this represents around 3.5% of global copper reserves, making the Copperbelt the largest single resource base of copper (and of by-product cobalt) in the world. In the DRC, oxide deposits are very high grade (2.5-3% Cu). In Zambia, reserves are mainly sulphides with between 1-2% Cu.

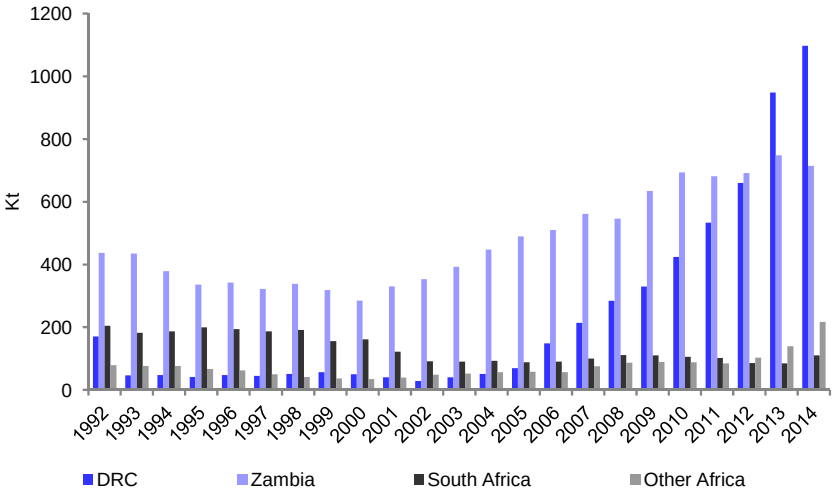
Copper mining in Zambia and DRC:

The African Copperbelt is home to the largest single copper resource globally

We estimate that Africa's production of copper in 2014 was 2.14mt, 11.4% growth year on year and second only to Chile in terms of percentage of global production of the five main copper producing regions (see Figure 97).

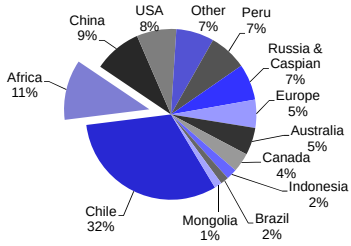
The main copper producing regions are Zambia, DRC and South Africa. In 2013, DRC's production overtook that of Zambia for the first time:

Figure 98: Growth in African copper output over last two decades



Source: Deutsche Bank, Woodmac

Figure 97: Split of global copper production by region in 2014



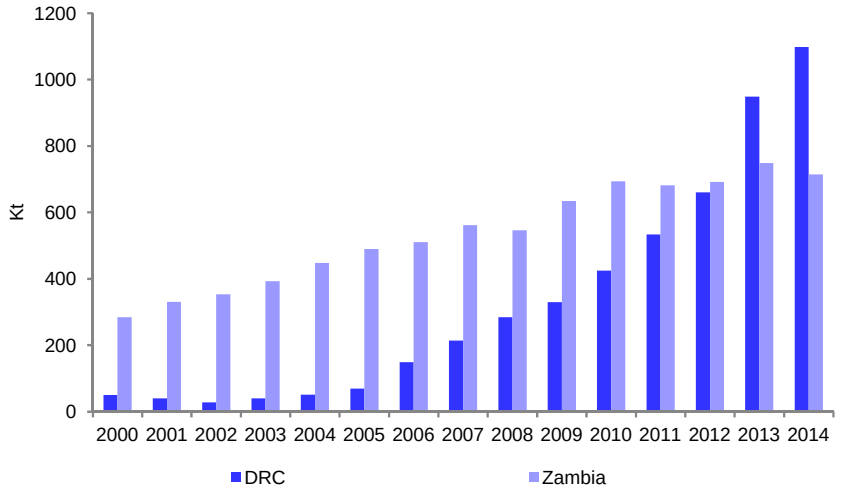
Source: Deutsche Bank, Woodmac

High grade, but high cost and infrastructure development needed

Growth of 12.8% pa since 2000 will not be sustained

Copper output from Zambia and DRC hit a low point in 2000, as the mines were privatized (in the late 1990s) and mining plans were reviewed. Since then, as shown in Figure 99, production has shown a steady upward trend, with a CAGR of 12.8% between 2000 and 2014.

Figure 99: Growth in output from DRC and Zambia since 2000



Source: Deutsche Bank, Woodmac

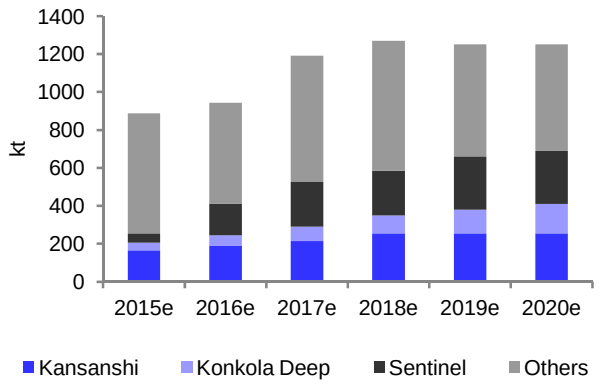
In Zambia, the growth has been driven primarily by Kanshanshi cathodes (First Quantum), and Lumwana (Barrick Gold), and steady production from Mufilira (part of Mopani (73% Glencore, 17% First Quantum, 10% ZCCM), and Nchanga (concentrate and cathodes (part of Konkola (79% Vedanta, 21% ZCCM))). ZCCM is 87.6% owned by the Government of Zambia, with private equity firms holding the remainder.

In DRC, the growth has come from the start of up Freeport's Tenke-Fungurume mine (Freeport-McMoRan 56%, Lundin Mining Corp24%, Gecamines 20%), Frontier mine (ENRC 95%, Government 5%), and Glencore's two DRC mines Mutanda mine (Glencore 69%, Rowny Assets 31%) and Katanga (Glencore 75%, Gecamines 25%).

Growth rate to more than half to 5.3% 2015-2020e

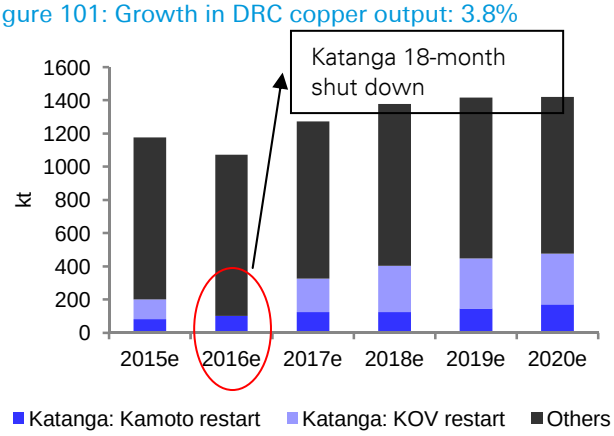
We forecast a slowdown in production growth over the next five years, to a CAGR of 5.3% for Zambia and DRC in total. In Zambia – as shown in Figure 100 - driven by the Sentinel mine (First Quantum-owned) reaching steady state of 280ktpa by 2018, the peaking of production from Kanshanshi, and the ramp-up of Konkola Deeps to a steady-state of 190kt by 2017. And in DRC (Figure 101), growth will be even lower, at 3.8% per year, reflecting the planned 18 month stoppage at Katanga, which reduces from 2015e output of 119kt to zero next year.

Figure 100: Growth in Zambian copper output: 7.1%



Source: Deutsche Bank estimates

Figure 101: Growth in DRC copper output: 3.8%



Source: Deutsche Bank estimates

Costs: Zambia has high-cost underground mines, DRC lower cost open-pits

Below we summarise the mine type, grades, cost and remaining life of mine of each of the top seven Zambian copper mines/complexes and the top five in DRC (ranked by 2015e production):

Figure 102: Top copper mines in Zambia by production

	Owner	Mine type	2015e Production (kt)	2015e Grade (%)	Average C1 cost (USc/lb)	Remaining LoM (yrs)
Kansanshi	First Quantum Minerals 80%/ZCCM 20%	Open pit	260	1.20	194	16
Nchanga*	Vedanta 79.4%/ZCCM 20.6%	U/g and open pit	174	1.60	298	9
Lumwana	Barrick Gold	Open pit	82.2	0.43	242	17
Konkola Deep	Vedanta 79.4%/ZCCM 20.6%	Underground	78.1	3.35	238	25
Lubambe (Konkola North)	Vale 40%/ARM 40%/ZCCM 20%	Underground	42	2.02	290	26
Muliashi SxEw	China Nonferrous Metal Mining 85%/ZCCM 15%	Open pit	38.1	1.00	192	11
Sentinel	First Quantum Minerals	Open pit	29	0.60	210	14
Average				**1.46**	**238**	**17**

*Source: Deutsche Bank; Woodmac; *Production includes RLE feed and SxEw ; ZCCM: Zambia Consolidated Copper Miners*

Figure 103: Top copper mines in DRC by production

	Owner	Mine type	2015e Production (kt)	2015e Grade (%)	C1 cost (USc/lb)	Remaining LoM (yrs)
Kamoto KOV Minesite	Glencore 56.4%, Gecamines 25%, Katanga mining 18.60%	Open pit	264.6	4.3	208	15
Mutanda	Glencore 69%, Groupe Bazano 31%	Open pit	200	2.4*	225	15
Tenke Fungurume SxEw	Feerport-McMoRan 56%, Gecamines 20%, Lundin Mining Corp 24%	Open pit	197.1	4.17*	145	24
Frontier	ENRC 95%, Gecamines 5%	Open pit	92.3	1.1	188	14
Kinsevere Minesite	MMG Limited 100%	Open pit	62.7	4.5*	181	9
Average				**3.3**	**189**	**15**

*Source: Deutsche Bank; Woodmac, * leach head-grade*

On average, the copper mines in both countries are high-cost, with Zambia more so given the underground mines. For the latter, this is due to age of the infrastructure, plus the depth which means higher de-watering and ventilation costs. The open pit mines consume more diesel and electric power for both mining and haulage. Some newer mines, such as Sentinel, will use in-pit crushing to further reduce haul costs.

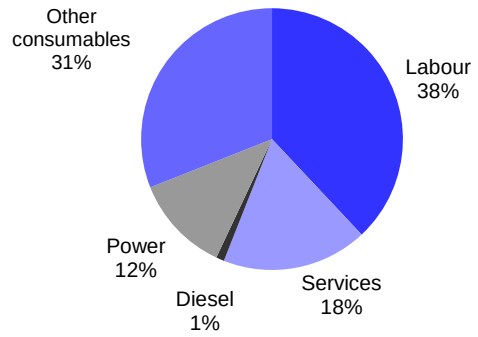
Using Konkola as an example of an underground mine, and Kansanshi as an example of an open pit mine, we have set out the typical mine cost split of each below:

Figure 104: Example of underground cost structure

Underground - Konkola	US$m	% of total
Labour	177.1	38.1%
Services	85.7	18.4%
Diesel	2.7	0.6%
Power	57.3	12.3%
Other consumables	142.2	30.6%
Total	**465.0**	
Power - unit cost (c/kWh)	8.8	

Source: Deutsche Bank, Woodmac

Figure 105: Split of underground mining costs



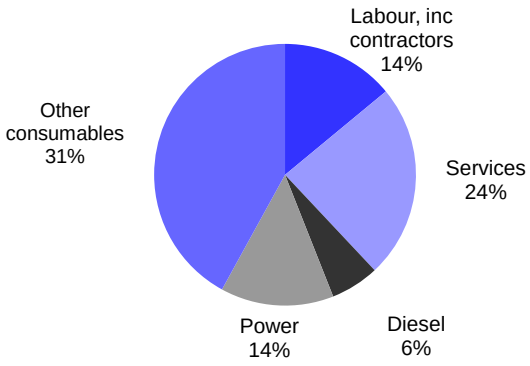
Source: Deutsche Bank, Woodmac

Figure 106: Example of open-pit cost structure

Open-pit -Kansanshi	US$m	% of total
Labour, inc contractors	103.4	13.5%
Services	179.1	23.5%
Diesel	47.3	6.2%
Power	110.1	14.4%
Other consumables	323.3	42.4%
Total	**763.2**	
Power - unit cost (c/kWh)	11.6	

Source: Deutsche Bank, Woodmac

Figure 107: Split of open-pit mining costs



Source: Deutsche Bank, Woodmac

Processing: smelters and refineries

In line with most other governments, the Zambian government tries to encourage as much local beneficiation as possible and in that regard it has imposed a 15% export tax on concentrates. This fact, combined with the land locked location of Zambia and its remoteness from major copper consuming markets, means that the vast majority of the concentrate output from the country's copper mines is treated at local smelters, thus depriving miners of relatively low spot custom TCs and RCs. Smelters in Zambia benefit from a site allowance in their processing of third party concentrates. Specifically, the freight saving gained by the concentrate seller in transporting cathode, as compared with concentrate, is shared with the smelter.

Glencore in Central Africa: largely on hold in DRC

Current assets: Zambia

Mopani Copper Mines is owned by Glencore (73.1%), First Quantum Minerals (16.9%) and state mining company, ZCCM (10%).

The complex consists of:

- the Mufulira underground mine (down to 1700m with Deeps project) and mill operation, with copper concentrate treated at the Mufulira smelter.;
- the Nkana facility of four underground mines, various small open pits, a concentrator and a cobalt plant.

Current (2014) production from Mufulira is 26.8kt (copper grade is 2.7%), and 55.6kt from Nkana at a 1.9% copper grade.

Mopani has two recent or in progress projects: a new shaft at Nkana called the Synclinorium Project; and the Mopani Deeps project.

The Synclinorium shaft is set to extend the life of Nkana to 2040 and increase concentrate production to 70ktpa, for around US$323m capex. The shaft was completed at end 2014 and is due to be commissioned in 2016. The Mopani Deeps project is scheduled to be commissioned during 2016. The project includes construction of new shafts at the Mufulira and Mindola mines and a 16.5ktpd concentrator to be located at Nkana. Adding in the Deeps production would take total production from Mopani (Nkana, Mufulira and Mindola) to over 160ktpa.

The projects remain in progress whilst Mopani's current output has been halted for 18 months by Glencore due to the persistent low copper price environment.

DRC current assets: Mutanda

Mutanda mine in DRC is one of Glencore's key growth assets. The mine is currently ramping up to a production rate of 200ktpa of copper cathode and 23ktpa of contained cobalt (for US$1.5bn capex). With a run of mine grade of 3.5% for copper and an equally impressive >2% cobalt grade, the ore quality is extremely high.

Figure 108: Mutanda's location

Source: Company data

In 2013, Glencore targeted a steady-state operating cost of USc160/lb for Mutanda, which is high given the high grades, but reflects the negative impact of logistics. The mine is now producing at a C1 cost of USc133/lb. By way of example on the logistics impact, the cost to get the copper from the mine gate to port is around USc40-50/lb. Power supply also remains challenging. While Glencore and the World Bank are working to refurbish the nearby hydro power station, it will remain close to maximum load for the next 2-3 years. In 2013, Katanga lost 59 days from power disruptions and Mutanda four days.

The current copper oxide, solvent extraction electro winning (SX:EW) operation will run for at least 10 years while the oxide ore remains and then the operation could develop into a sulphide processing operation with further capital (the sulphide resource is around double the current oxide resource). The three open pits (two of which are currently mined) are expected to form one large open pit by 2018. The recent Mtanda and Kansuki merger (with its adjacent property) has increased the lease area from 8km2 to 180km2. While the Mutanda property had the highest prospectivity, the significant increase in the lease area is expected to yield additional resources.

Overall, Mutanda is a good example of staged, Glencore mine ramp-up with cash delivered early in the project to help fund the ongoing development.

DRC current assets: Katanga

The Katanga mines are more a struggle for Glencore in the DRC. In 2011, the complex consisted of a number of prospective concessions (including the water-filled KOV pit) and aging infrastructure. Glencore has worked to upgrade

and develop the mine towards a targeted 300ktpa of copper cathode production and 13ktpa of cobalt over 2013-16.

Glencore owns 75.2% of Katanga Mining Limited, which in turn owns 75% of the Kamato Copper Company. The company currently operates 3 mines, a concentrator, roaster and electrowinning plant in the Kolwezi region of the DRC and has a number of other prospects in the region.

The original ramp-up plan for Katanga was to expand to 300ktpa from just over 50kt in 2010, via a staged/phased plan: (i) rehabilitation of the KOV pit, (ii) the ramp-up of the Kamoto underground operations to 2.2Mtpa @ 3.9% Cu, and the development of the T-17 underground, which is planned to run at 1.2Mpta @ 3.6% copper by 2018. Total capex for the expansion was budgeted to be US$967m.

Above ground, the company has refurbished the 7.2Mtpa Kamoto concentrator and is currently upgrading it with a large mill and additional sulphide flotation capacity to take ore throughput up to 9Mtpa. It has also upgraded its refinery to include solvent extraction capacity to increase efficiencies and quality and refurbished and installed additional electrowinning capacity to take the total to 300ktpa cathode capacity.

Katanga's viability has been impacted by persistent power outages which interrupted the oxide floatation circuit (much longer than the sulphide one), to the extent that Glencore will now leach oxides on surface. Whilst this "Whole Ore Leach" project is completed (US$360m capex), Katanga output is halted.

Case study 3: Rio Tinto

Once bitten, twice shy?

In this case study we focus on Rio's only major project in Africa, the Simandou South iron ore project.

Rio's history in Africa has been excellent in parts – the delivery of a successful BEE deal at Richards Bay in South Africa and delivery of the QIT Madagascar Minerals project – but in the case of Simandou, the company has needed a lot of patience and the project is beholden to huge infrastructure investment by other stakeholders. Most importantly for Simandou, Rio has learnt to shrink its proposed footprint, to start small and go more slowly.

With Guinea ranking second bottom in our Country Ranking table (see Figure 4), this is clearly a tough place to do business and get this project off the ground. Rio has de-risked its exposure over time and, to a large extent, the ball is now in the Government's court to push forward investment in the surrounding infrastructure of the potential mega mine.

We conclude that the project is unlikely to deliver first production before the end of the decade and, offering a 16% IRR for Rio. This is not compelling enough for the group to bring this project forward into this decade.

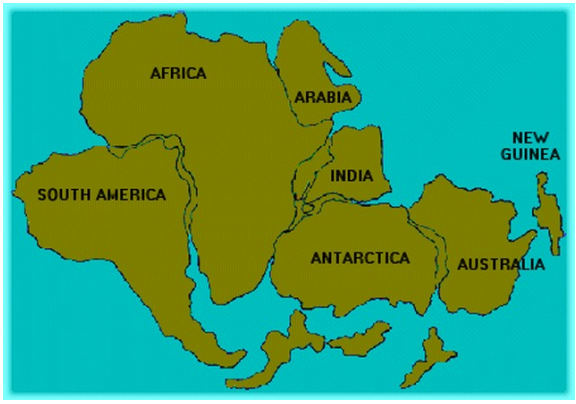
The benefit from going more slowly and at a smaller scale in order to improve Rio's African capital allocation record is also clear: the company's other major foray into Africa was a US$4bn purchase of Riversdale Coal in Mozambique in 2011– sold for US$50m in July 2014 when it was clear the resource base was not as good as thought, and infrastructure routes were not viable. Once bitten, twice shy?

Iron ore mining in Guinea: Pilbara-esque potential

The legacy of Gondwana

Gondwana is the more southerly of the two supercontinents which formed the Pangaea supercontinent. It included most of the landmass in today's southern hemisphere, as shown in Figure 109. And in the context of this note, it shows how the iron ore rich region of Brazil and West Africa were once one and the same.

Figure 109: The Gondwana supercontinent



Source: Deutsch Bank

Rio Tinto's only major project in Africa is the Simandou South iron ore project in Guinea. The group has been involved since 1996 when the Government of Guinea invited Rio to explore a 1,500 sq kilometer area around Mount Simandou. The story thereafter is convoluted and ultimately frustrating for Rio, which, 20 years later is moving ahead with a smaller Simandou South, at a slower pace determined by the government. For this case study we look into the history of Rio's major step into African resources and where we expect it to go.

The opportunity with a US$20bn price tag

Simandou is in south-eastern Guinea (see Figure 110) and is one of the largest undeveloped high grade iron ore deposits globally. At the currently estimated total capital needed to develop the mine and associated infrastructure – US$20bn – Simandou South would be Africa's largest ever mining project.

Figure 110: Location of the Simandou mine in Guinea

Source: Company data

The Simandou South project will comprise:

- An iron ore deposit with 1.8bt of reserves at 65.5% grade. The current plan is to produce ore from two open pit mines for 25-30 years, dropping to one open pit thereafter, across 'Blocks 3 and 4'. Total steady-state output of 100mtpa is targeted, thus life of mine is over 40 years. Product is sinter fines;
- A new multi-use, multi-user 650km railway from the mine to the coast;
- A new deep-water port, again multi-use and user, which will be the first in Guinea to be able to provide access to large cargo ships.
- Given the mountainous terrain, 35 bridges and 21 km of tunnels will also be required.

The current ownership structure (agreed in 2014) and plan for the mine's key operating metrics is set out below

Figure 111: Simandou project summary table

Ownership (Mine)	Guinean Government 7.5% (with option to increase to 35% over 20 years), Rio 46.6%, Chinalco 41.3%, IFC 4.625%
Ownership (rail and port)	TBC: consortium to be formed
Mining method and strip ratio (waste: ore)	Two open pits (truck and shovel), SR 0.3:1 (0:1 for first 2 decades)
Initial production	TBC (possible 1-2Mtpa of early production from a trucking operation)
Steady state production: sinter fines	100Mtpa (100% basis), Rio's initial share 46Mtpa
Capex	US$20bn (US$6bn mine (DBe) and associated infrastructure)
Reserves: Probable	1,844mt @65.5 Fe
Resource: Measured, Indicated and Inferred	835Mt @65% Fe (5Mt Measured, 107Mt Indicated, 723Mt Inferred)
Mine life	~40 years
Cash costs (US$/t) – DB estimate	US$35/t from 2016e
Infrastructure	650km of rail, 35 bridges, 21km of tunnels, 4km jetty and deep water port
Valuation (US$m) - Rio's share: NPV as at end 2016	**US$1,864m**
IRR (%) – as at end 2016, excluding capex since 2009 and the US$700m "settlement"	**15.9%**

Source: Deutsche Bank; Company data

Currently Rio is finalising the project's Feasibility Study – originally due in 2015. We do not include the project in our Rio Tinto valuation, apart from a small (US$(105m)) negative NPV which accounts for two years of US$60mpa costs in 2017 and 2018.

The 20-year story so far

The road to this point has led to Rio sink US$2.5bn and has by no means been smooth sailing. The following table sets out Rio's 20 year involvement in the project:

Figure 112: Project milestones and notable events

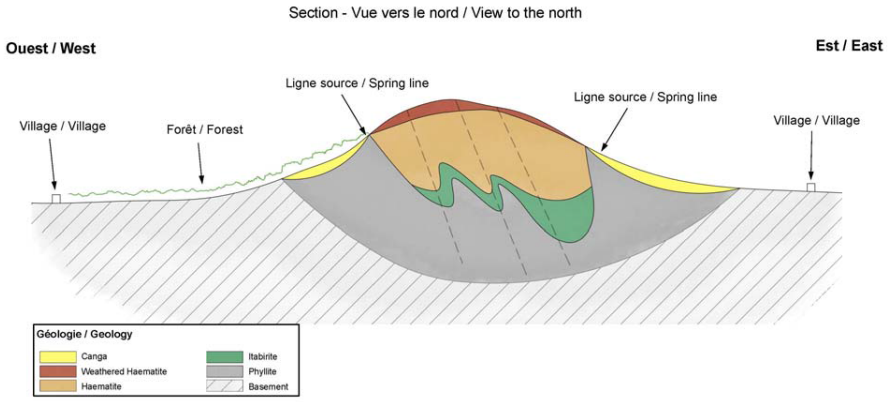
	Official project milestones	DB comments/ other notable events
1996		
	Initial exploration work commenced after Government of Guinea invites Rio Tinto to explore a 1,500km2 area of Mount Simandou	
2002	Government of Guinea and Rio Tinto sign Basic Convention, outlining the principles of mine development	
2003	Guinean National Assembly ratifies terms of exploration following the Government's approval	
2005	Rio Tinto announces identified resource of 1bt - enough to consider development	
2006	Simandou concession granted to Rio Tinto, to be developed by its subsidiary Simfer S.A.	
	The IFC becomes partner in Simandou with a 5% interest.	
2008		Rio receives correspondence from Guinean Ministry of Mines that it must relinquish the northern half of the Simandou Mining Concession, whilst retaining its rights to the southern half
2010	Engineering study begins	From 2006 to this point, Rio had invested US$650m. Mining was anticipated to start within five years, with a steady state production of 70mtpa
2011	Settlement Agreement signed between Government of Guinea and Rio Tinto outlining principles of development of Simandou (mine and infrastructure)	Simfer paid US$700m to the Guinean Government
	Rio Tinto commits further funding for continued studies and for early works	By beginning of 2011, Rio total spend was US$820m; total capex estimate at this stage: US$10bn
2011/2012	Social and Environmental Impact Study carried out, approved by the Government of Guinea in February 2013; over 10,000 people consulted nationally	
2012	Rio Tinto completes formation of Simandou JV with Chalco	
	Government of Guinea declares Simandou as a Project of National Interest	
	Draft Engineering Study completed	First production target: mid-2015
2013	Signing of a letter of Mutual Intent, which sets out the principles of the Investment Framework for the development of Simandou	
2014	Signing and ratification of an 'Investment Framework' forming the legal basis for the various parties for investment in and development of the project; submitted to Guinea's National Assembly for ratification.	Rio seeks compensation and damages from Vale and BSG Resources from the 2008 decision to rescind the northern part of Simandou, citing illegal actions
	Start of the Bankable Feasibility study that will define the project costs and the construction parameters.	The northern part of Simandou remains at the centre of an array of legal cases involving Rio, Vale and BSGR.
		Guinean Government is tendering the northern concession. Vale has sunk US$1.2bn into the project before the legal dispute/concession rescindment – the company has taken a partial write-down on its investment

Source: Deutsche Bank, Company data

A simple, large ore body to mine, with standard processing

There are three main geological units in the ore deposits at Simandou: one of the two pits to be mined, Pic de Fon, is comprised largely of very high grade haematite, with the Ouéléba pit is mainly haematite-goethite of a similar high quality.

Figure 113: Generalised cross-section through the Simandou range



Source: Company data

Crushing and processing is standard. The strip ratio will be low, at 0.3:1.0. There will be primary crushers in each pit and an in-pit secondary crusher at the head of two 13.5km conveyors. Ore will be stacked and ore reclaimers will then run 500m to the rail wagon loading area.

Working with the government

After the previous difficulties with the investment framework, the 2014 Investment Framework set out the ownership structure. The project will now only move forward once the infrastructure is in place. Rio is no longer directly involved in that part of the project. However, the consortium or group of companies to fund the railway, bridges and port has yet to be announced. So far, the government has stuck to its condition that infrastructure must be kept within Guinea, and not take a shorter route through neighbouring Liberia, and that the rail and port will be multi-use and –user. Rio has previously stated that opening up Guinea's interior via the project infrastructure will could eventually double the size of the Guinea economy.

IRR of 15.9% from 2016 onwards

The project price tag of US$20bn includes the mine and all infrastructure, with the latter now for the account of a yet to be announced consortium. We have assumed that the mine build out costs US$60/tonne, equating to US$6bn (100% basis), of which US$3.5bn is left to spend.

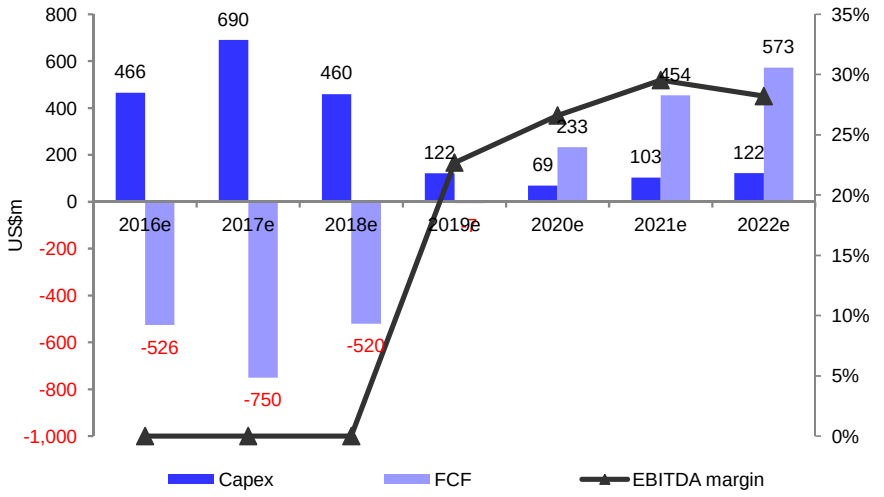
To model the NPV and IRR of the project for Rio we have assumed the following:

- Remaining capex to be spent between 2016-2019
- First production from 2019
- Steady state 100mtpa production reached in 2022
- Life of mine until 2060
- The government of Guinea increases its stake from 7.5% to 35% over 20 years from 2014-2034
- Mine unit costs of US$35/t from 2019
- Royalties of 3.5% of revenue

- The agreed 8-year tax holiday from the first year of positive EBIT, which we calculate to be 2019

On this basis, the mine is free cash flow positive from 2020, and makes an average 30% EBITDA margin over its life:

Figure 114: Simandou South: possible ramp-up model



Source: Deutsche Bank estimates

Case study 4: South32

Not ready to run, yet

In this case study we focus on the newly-created South32, which houses the African assets previously owned by BHP Billiton.

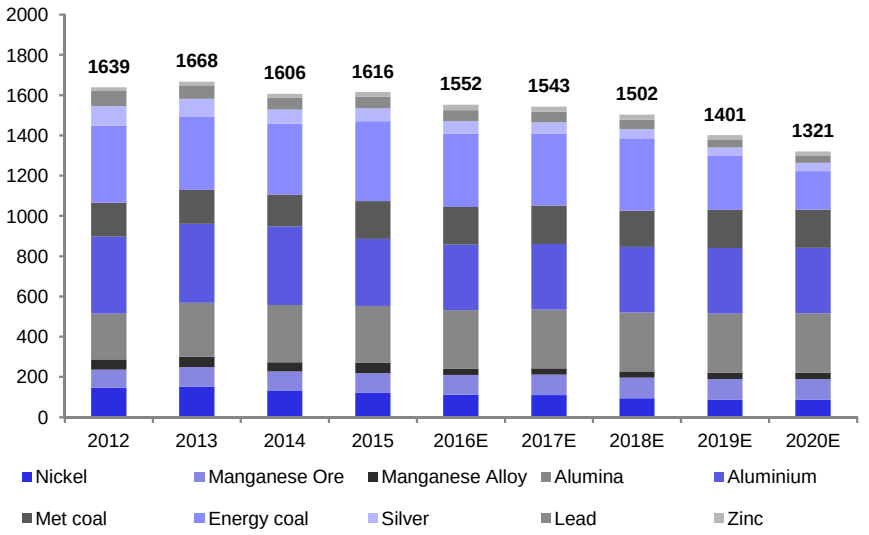
We conclude that South32 remains in the "Crawl" phase of its strategy of "Crawl, Walk and then Run". In terms of the groups' African assets – in South Africa and Mozambique – we think that 'crawling' means a focus on cost cutting, and decisions on committing capex to life extension projects in SA coal.

On our estimates, South32's production declines from this year onwards. FCF builds up quickly however, and whilst we think that management's appetite for M&A is low currently, we believe the group could consider moving into new African countries and commodities. This would likely be in the 'Running' phase of the strategy, and thus still 3-5 years away however.

Options to grow into a pan-African play

Figure 116 shows how South 32's production peaked in 2013 and falls away from 2016 on our estimates.

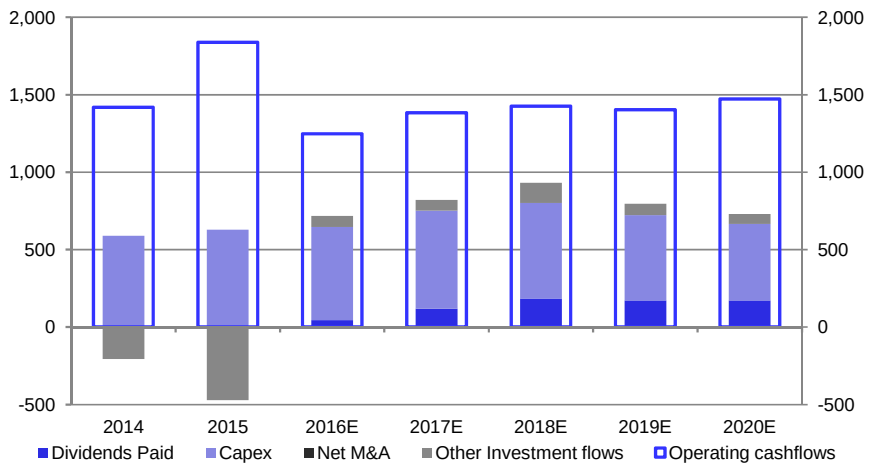
Figure 115: Copper Eq production growth (kt)



Source: Deutsche Bank estimates, Company data

Due to cost cutting, tailwinds from FX, and rising commodity prices into the medium-term, we forecast a 30% increase in free cash flow for the group from 2016-2020, despite the drop off in volumes:

Figure 116: South32 Free cash flow set to build



Source: Deutsche Bank estimates, Company data

Corporate strategy: more growth needed

As shown above, South32 will be able to fund its sustaining capex and mine replacement program out of OCF, as it has no debt to service. Management has highlighted three projects that are under evaluation (see below in Figure 117) however all are mine life extension projects, not growth.

We therefore think South32 is in an excellent position to pursue value-accretive acquisitions. In our view, assets matching South32's current country focus in Africa or current commodity exposure would make sense as the next source of growth for the group. Branching out into other base metals or iron ore could also be considered.

Figure 117: South32 growth projects: limited options

Source: Company presentation

Figure 118: Summary of completed and ongoing growth projects

Asset/Commodity	Project	South32 share	Capacity	Capex (South32 share)		Date of initial production		
				Budget (US$m)	Actual (US$m)	Target	Actual	
Execution								
Manganese Australia	GEMCO Expansion	60%	Stand-alone PC02 plant that will produce 0.2Mtpa of premium concentrate in FY16 and ramp-up to 0.5Mtpa in FY17. Increases Groote Eylandt production from 4.8Mt to 5.3Mtpa	83		Q1 2016		
Manganese SA	Wessels	60%	Expands the UG mine from 1Mt to 1.5Mtpa (100% basis)	55		Q3 2016		
Illawarra Coal	Appin Area 9	100%	New 3.5Mtpa longwall at Appin. Maintains Illawarra Coal's production capacity at 9Mtpa and replaces production from West Cliff which is scheduled to close in 2016/2017	845		2016		
Probable								**In DB Model (Y or N)**
SA Energy coal	Wolvekrans: VDDC project	100%	Maintaining existing production levels from Wolvekrans/Middelburg Colliery at 14-15Mtpa. Would replace the 7-8Mtpa Middelburg mine in 2025 and extend the life of Wolvekrans until 2040. Requires the construction of a water treatment plant	250 (DBe)		24 months from start date		Y
Groote Eylandt (GEMCO)	Manganese	60%	Mine life extension from 2026 to 2031 by developing the Eastern leases (being approved by the Federal Government)	100 (DBe)		2020 (DBe)		Y
MRN	Bauxite		Mine life extension from 2021 to 2043					Y
Possible								**In DB Model (Y or N)**
SA Energy coal	Weltevreden project (Extension of Klipspruit)	100%	Could extend the life of Klipspruit mine by 25 years to 2045	450 (DBe)		2020 (DBe)		N
SA Energy coal	Naudesbank project (Extension of Khutala)	100%	Could extend the life of Khutala mine by 20 years to 2040	300 (DBe)		2020 (DBe)		N
Cerro Matoso	La Esmeralda deposit	99.9%	Could improve grade from FY18-FY24	50 (DBe)		2017 (DBe)		N
Cerro Matoso	Third furnace and life extension	99.9%	Could extend the life of the mine and plant by 15 years to 2044	1500 (DBe)		2022 (DBe)		N
Groote Eylandt (GEMCO)	Manganese	60%	The crushing, road and port have capacity to 6Mtpa. This project would involve an expansion of the mine to above 9Mtpa (ROM) and plant from 5.2Mt to 6Mtpa	100 (DBe)		2020 (DBe)		N
Cannington	Underground extension	100%	Could extend the life of UG mine by 12 years to 2035	250 (DBe)		2022 (DBe)		N

Source: Deutsche Bank, Company data

Acquisitions more likely than organic growth

With its strong balance sheet, we think South32 is in an excellent position to pursue value-accretive acquisitions at a point in the cycle where the majors are not acquiring but are selling non-core assets. Strategically we believe South32 will seek to acquire both operating assets and Greenfield projects. The company has a US$1.5bn undrawn multicurrency revolving syndicated debt facility available, and we think South32 could make acquisitions up to US$3bn in value. Assets will be the first target rather than companies, in our view. Potential targets include:

1. Anglo American's 40% stake in Samancor Manganese, which we value at US$270m (Anglo's share). At the right price, we think Anglo could be a seller of its stake;

2. Australian coal assets, preferably UG mines considering South32 operates four longwall operations at Illawarra. Anglo, Peabody, Vale and Rio Tinto have all expressed the desire to divest assets in NSW and Queensland. The Moranbah South project may also provide an opportunity;

3. Nickel and copper assets in Latin America, with Anglo American's Barro Alto a possible target in our opinion, helping to offset the decline in production from Cerro Matoso.

4. Early-stage Greenfield projects in Africa and Latin America

Given its existing presence in South Africa (25% of NPV on our estimates) and the various headwinds facing the group there (short lives of mines, union negotiations, rising unit costs, declining grades), we think management could seek growth outside of the country in the first instance but ultimately use its balance sheet to grow into a pan-African play. Its current expertise is across base metals – albeit with no copper – and in coal. We believe Namibia, with its high zinc reserves, offers one growth option. Mozambique with high reserves of coal could be another.

Figure 119: South32 Cash flow statement (US$m)

	2014	2015	2016E	2017E	2018E	2019E	2020E
Operating cash flows	**1,077**	**1,401**	**1,126**	**1,223**	**1,226**	**1,171**	**1,235**
Other operating cash flows	342	-1,401	122	162	200	233	237
Cash flow from operating activities	1,419	0	1,248	1,384	1,426	1,404	1,472
Purchase of PP&E	**-590**	**-629**	**-602**	**-633**	**-617**	**-552**	**-494**
Other investing cashflows	206	629	-70	-69	-131	-73	-65
Cash flow from investing activities	-384	0	-672	-702	-748	-625	-560
Funds from borrowings	251	0	0	0	0	0	0
Dividends paid	**0**	**0**	**-45**	**-118**	**-184**	**-172**	**-171**
Repayment of borrowings	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0
Cash flow from financing activities	-899	0	-45	-118	-184	-172	-171
Net change in cash held	**136**	**1,023**	**531**	**564**	**494**	**607**	**741**
Cash held at beginning of period	0	364	644	1,175	1,738	2,232	2,839
Cash held at end of period	364	644	1,175	1,738	2,232	2,839	3,580

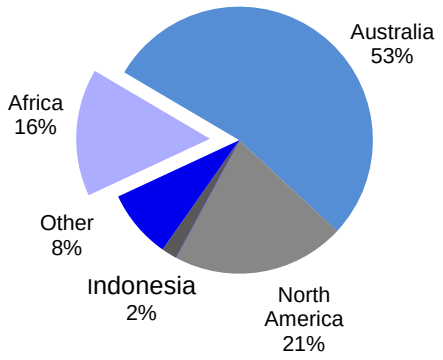
Source: Deutsche Bank estimates, Company data

African footprints of Big 4

Rio Tinto: A concentrated footprint, with big potential

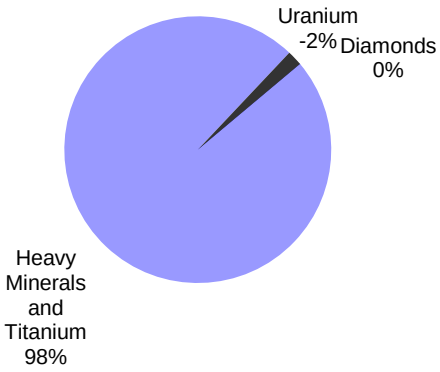
Rio Tinto management has stated it is content with its Emerging Market exposure. In Africa this comprises five operating assets across five different countries (see Appendix for full list) and one major growth project, Simandou South iron ore in Guinea. At present we estimate that African-based operating assets make up 16% of Rio's group NAV (Figure 120). Within Africa, the vast majority of NAV is from Rio's mineral sands business, with a small amount from diamonds and uranium.

Figure 120: Rio Tinto: 16% of NPV from Africa (2016e)



Source: Deutsche Bank estimates

Figure 121: Rio Tinto: split of African NPV by commodity (2016e)



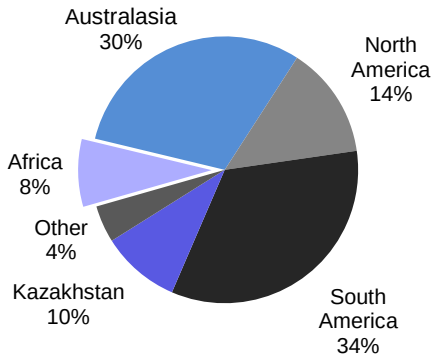
Source: Deutsche Bank estimates

Glencore: Present across the continent

Glencore has the largest and widest-spread African portfolio of assets and projects of the big 4 diversified miners. Figure 133 in the Appendix sets out the 30 operating assets which the group has (note we do not include Glencore's marketing assets in this summary).

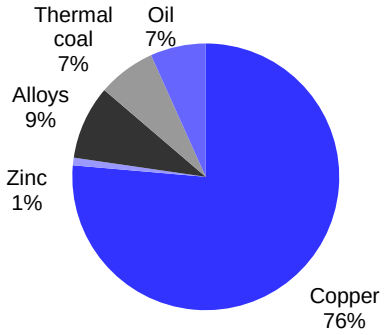
Despite its long list of operations across the continent, in aggregate we estimate that African assets account for 8% of total group mining NAV (i.e. excluding marketing and agriculture), because of a large number of coal mines being loss making/negative NPV – see Figure 4. We estimate the majority of African NAV for Glencore comes from copper, oil and alloys (chrome and manganese) - Figure 123.

Figure 122: Glencore: 8% of NPV from Africa (2016e)



Source: Deutsche Bank estimates

Figure 123: Glencore: split of African NPV by commodity (2016e)



Source: Deutsche Bank estimates

Figure 124: Glencore's current projects in Africa

Commodity/Region	Project	Glencore share	Country	Description	Capex (US$m) (Glen share)	Target first production	Status	Comments
Copper/cobalt	Katanga	75.2%	DRC	Ramping up to 300kt Cu and 5.5kt Co		2017	Execution of Phase V	Production on the site stopped until the expansion is complete
Copper/cobalt	Mopani	73.1%	Zambia	Increasing output to 250ktpa Cu	320	First ore by 2015, full ramp up by 2018	Implementation	A new shaft development at the Nkana operation, which is expected to replace some of the older operations
Nickel	Kabanga	50%	Tanzania	Up to 40-45ktpa Ni concentrate	Phase 1: 330 Phase 2: 470	2020	Feasibility stage	Expected life is 30 years; 50% owned by Barrick Gold. A phased development approach is being proposed. Phase 1: 10ktpa Ni in concentrate. Phase 2: incremental 2.2Mtpa ore for 40-45ktpa Ni in concentrate
Iron ore	Askaf	44%	Mauritania	7mt in concentrate	TBC	2021	Deferred in light of low iron ore prices; FS stage	10% government free carry; awaiting finalisation of tax terms with government
Iron ore	El Aouj	44%	Mauritania	TBC	TBC	TBC	Deferred in light of low iron ore prices; PFS stage	Initial FS proposed 17mtpa open cut mining for 30 years
Iron ore	Zanaga	50%	Republic of Congo	13mt in concentrate	TBC - project requires substantial port upgrades and a c.350km project pipeline	2022	FS completion and decision due December 2015	7 billion tones resources; feasibility on initial 14 mtpa started in 4Q 2014

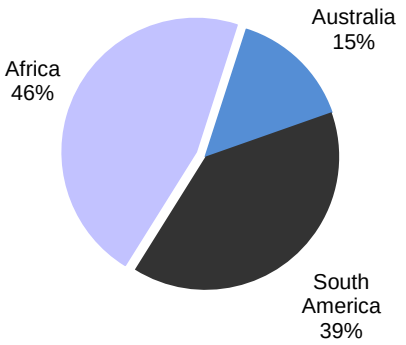
Source: Deutsche Bank, Company data

Anglo American: the original African miner

Anglo American was formed in South Africa in 1917 by Sir Ernest Oppenheimer and JPMorgan, mining diamonds initially and then moving to the Zambian copper belt in the late 1920s. This was followed in the 1940s and 50s by a move into coal and then gold and platinum mining. From the 1970s on, the group diversified into industrial activities, but now has a smaller more concentrated portfolio after a series of divestments including stakes in Mondi, AngloGold and Scaw Metals. Today, Anglo's exposure to Africa is contained to three countries and five commodities: diamond mines in Botswana, Namibia and South Africa, and iron ore, platinum and coal mines plus a non-operating stake in Samancor Manganese in South Africa – the details are in the Appendix.

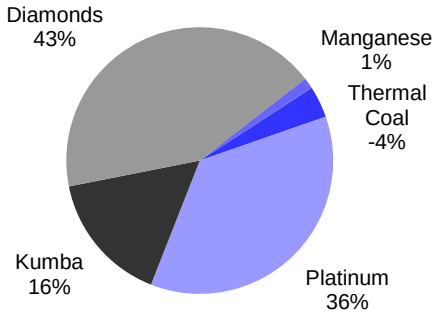
We calculate that Africa accounts for 46% of Anglo's total group NAV – split as shown here:

Figure 125: Anglo: 46% of NPV from Africa (2016e)



Source: Deutsche Bank estimates

Figure 126: Anglo: split of African NPV by commodity (2016e)



Source: Deutsche Bank estimates

Figure 127: Anglo's current African projects

Commodity/Region	Project	Anglo share	Country	Description	Capex (US$m) (AAL share)	Target first production	Status	Comments
Thermal Coal	New Largo	73%	South Africa	10mtpa domestic thermal	2000 (100%)	TBC	Feasibility completed; awaiting Board approval	Mining right granted Aug 2013
	Elders Multi-product project	73%	South Africa	Now combined open-pit and underground projects being evaluated as a multi-product underground mine, producing a lower grade export and middlings product	450	TBC	Scoping	
Iron Ore	Kolomela expansion	70%	South Africa	Increase production from 11 to 13mtpa	500	2017	Execution	
Platinum	Twickenham	100%	South Africa	3mtpa mining steady state from mechanised mine	640	2020	Scoping	Ideal scale being established; decision 2017
	Mogalakwena	100%	South Africa	Three stage potential expansion to 600kozpa refined platinum	R2bn to 420koz; R30bn for 600koz	420koz from 2017	Decision to increase to 420kozpa 2016	600koz would require full downstream processing expansion
	Amandelbult ore replacement	100%	South Africa	Investment in Tumela replacement ounces; potential to expand	TBC	TBC	Feasibility study to be completed 2016	Decision 2017
	Der Brochen/ Mototolo	100%	South Africa	Increase Mototolo reserves for life expansion; Der Brochen expansion as per market demand	TBC			
Diamonds	Jwaneng - Cut 8	50%	Botswana	Total project expected to treat 112m carats over its life; extends mine life to 2031	3000	2017	Waste mining	
	Venetia Underground Project	74%	South Africa	Total project expected to treat 94m carats over its life; extends mine life to 2044	2000	2021	Development	Full production 2024
	Letlhakane	50%	Botswana	New treatment plant to process the tailings mineral resource	100	NM	Execution	

Source: Deutsche Bank; Company data

BHP Billiton: all but out of Africa

With the spin-out of African assets into South32 in 1H15, BHP reduced its exposure to Africa to near zero. As shown in Figure 128 below, the company now has one operating asset in Oil & Gas in Algeria, and one suite of exploration licences for iron ore in Liberia. BHP exited from its Guinea iron ore exploration project in FY14, selling its 43.5% stake to partner Arcelor Mittal. And it divested its holding in Richards Bay Minerals in FY13.

Figure 128: BHP's African footprint

Operating assets

Product	Asset	Ownership	Managed by	Country	Commodities	Annual Capacity	Expected life (yrs)
Oil & Gas	ROD Integrated Development (Onshore Berkine Basin)	38% Effective Interest	Joint Sonatrach/ENI entity	Algeria	Oil	Approx 80 Mbbl/d	12

Development projects

Commodity/Region	Project	BHP share	Description	Capex (US$m) (BHP share)	Target date of initial production	Status
Oil & Gas/South Africa	Block 3B/4B	100%	Exploration rights	NA	NA	Evaluating results of 3D seismic survey
Iron ore/Liberia	Various mineral leases	100%	Mineral Development Agreement with government	NA	NA	Further exploration

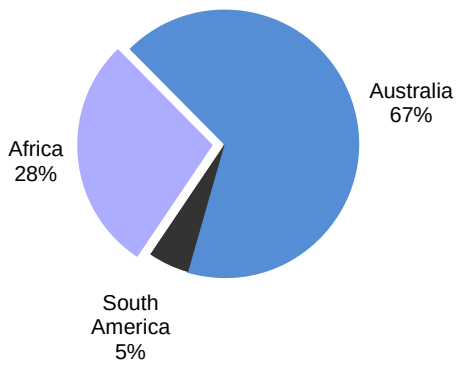
Source: Deutsche Bank, Company data

South32: the new kid on the block

South32 was demerged from BHP in 2Q15 and houses assets in Africa, Australia and South America. The group has operating assets across three main product groups: thermal coal, aluminium and manganese, all in South Africa apart from the Mozal aluminium smelter in Mozambique. South32 is expanding the capacity of the Hotazel manganese mine, and has one probable and two possible coal mine life extension projects (see Appendix for details).

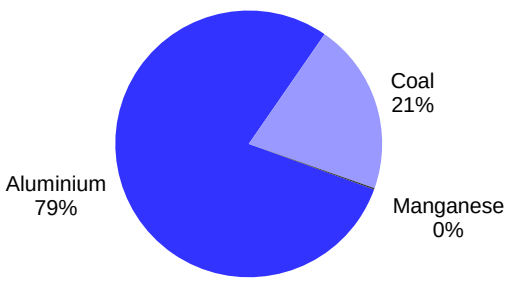
We estimate that 28% of group NAV is derived from African-based assets (Figure 129) with 80% of that African NAV coming from SA and the rest from Mozambique.

Figure 129: South32: 28% of NPV from Africa (2016e)



Source: Deutsche Bank estimates

Figure 130: South32: split of African NPV by commodity



Source: Deutsche Bank estimates

Investment Thesis: RRS

Outlook

Randgold has a strong exploration and operational track record in Africa, particularly West Africa. Group production exceeded 1moz in 2014 and will plateau around 1.2moz for the next two years on our forecasts. Cost control is excellent and, after the successful delivery of the Kibali mine on time and on budget in 2014, capex should decline during 2015 and 2016. We expect this to result in solid free cash flow and scope for Randgold to invest in growth and/or increase dividends significantly on an 18- to 24-month view. In the medium to long term, we believe Randgold has a high-quality mix of assets. The portfolio of reserves is stress-tested down to US$1,000/oz gold, for a 20% IRR. This should mean Randgold can generate higher margins and return on capital than peers. Randgold's proposed next move, into Ghana via a JV of the Obuasi mine with AngloGold, adds US$858m to our NPV Sum of the Parts for the group, or £6.15 per share, on our estimates. On this basis, Randgold is trading at 0.85x 2016e NPV with improving FCF and low gearing. We rate the shares Buy.

Valuation

We derive our 12-month TP from a DCF model of life of mine cash flows. We use a long-term gold price of US$1,300/oz and a WACC of 5% (based on a risk-free rate of 4%, a market risk premium of 6%, a beta of 0.3x and a 30% target gearing).

Risks

Key risks include lower-than-expected gold prices, higher-than-expected costs, particularly due to labour inflation, and volatility in the Euro/Dollar exchange rate.

Model updated:07 October 2015

Running the numbers

Europe

United Kingdom

Gold

Randgold

Reuters: RRS.L Bloomberg: RRS LN

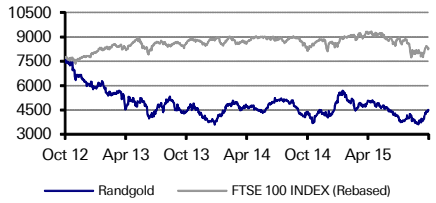
Buy

Price (15 Oct 15)	GBP 4,494.00
Target Price	GBP 5,050.00
52 Week range	GBP 3,625.00 - 5,685.00
Market Cap (m)	GBPm 4,144
	USDm 6,405

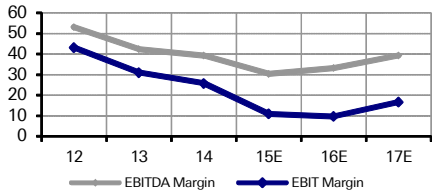
Company Profile

Randgold Resources is a gold exploration and mining company focusing on prospective regions in West Africa and the Congo Craton. The company currently has three operating mines and one low-grade stockpile processing facility in Mali and the Cote d'Ivoire, producing c.750koz of gold in 2011F. The company plans to ramp up its newly commissioned mines and grow the portfolio to five mines producing c.1.2Moz of gold by 2014.

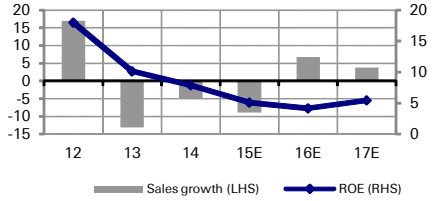
Price Performance



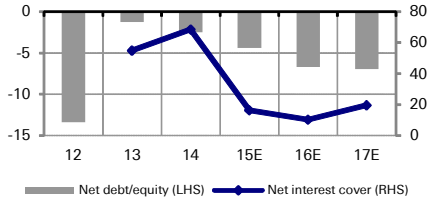
Margin Trends



Growth & Profitability



Solvency



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Fiscal year end 31-Dec	2012	2013	2014	2015E	2016E	2017E
Financial Summary						
DB EPS (USD)	4.65	3.00	2.53	1.71	1.44	1.93
Reported EPS (USD)	4.65	3.00	2.53	1.71	1.44	1.93
DPS (USD)	0.50	0.50	0.60	0.62	0.64	0.66
BVPS (USD)	28.5	31.2	33.6	34.5	35.3	36.6
Weighted average shares (m)	92	92	92	92	92	92
Average market cap (USDm)	9,332	7,089	6,907	6,405	6,405	6,405
Enterprise value (USDm)	9,122	7,227	7,027	6,468	6,397	6,397
Valuation Metrics						
P/E (DB) (x)	21.9	25.6	29.6	40.5	48.4	35.9
P/E (Reported) (x)	21.9	25.6	29.6	40.5	48.4	35.9
P/BV (x)	3.39	2.01	2.03	2.02	1.97	1.90
FCF Yield (%)	nm	nm	1.4	1.4	2.3	1.4
Dividend Yield (%)	0.5	0.7	0.8	0.9	0.9	1.0
EV/Sales (x)	6.9	6.3	6.5	6.5	6.0	5.8
EV/EBITDA (x)	13.0	14.9	16.5	21.5	18.2	14.9
EV/EBIT (x)	16.1	20.4	25.2	59.8	62.4	35.0
Income Statement (USDm)						
Sales revenue	1,318	1,145	1,087	990	1,058	1,098
Gross profit	735	536	462	352	417	490
EBITDA	700	485	426	301	352	431
Depreciation	132	131	147	193	249	248
Amortisation	0	0	0	0	0	0
EBIT	568	355	279	108	102	183
Net interest income(expense)	1	-6	-4	-7	-10	-9
Associates/affiliates	0	54	78	102	83	77
Exceptionals/extraordinaries	0	0	0	0	0	0
Other pre-tax income/(expense)	0	0	0	0	0	0
Profit before tax	569	403	353	204	175	250
Income tax expense	58	77	82	30	28	52
Minorities	80	47	36	15	14	19
Other post-tax income/(expense)	0	0	0	0	0	0
Net profit	432	278	235	159	133	180
DB adjustments (including dilution)	0	0	0	0	0	0
DB Net profit	432	278	235	159	133	180
Cash Flow (USDm)						
Cash flow from operations	494	445	317	318	376	421
Net Capex	-561	-728	-222	-228	-227	-333
Free cash flow	-67	-283	96	90	148	87
Equity raised/(bought back)	14	1	2	0	0	0
Dividends paid	-62	-73	-53	-49	-64	-68
Net inc/(dec) in borrowings	15	0	0	0	0	0
Other investing/financing cash flows	0	2	1	25	0	0
Net cash flow	-100	-353	45	66	84	19
Change in working capital	*0*	*0*	*0*	*0*	*0*	*0*
Balance Sheet (USDm)						
Cash and other liquid assets	387	38	83	149	233	252
Tangible fixed assets	1,742	1,458	1,495	1,501	1,479	1,565
Goodwill/intangible assets	0	0	0	0	0	0
Associates/investments	4	2	1	1	1	1
Other assets	994	1,879	1,954	2,103	2,111	2,131
Total assets	3,127	3,377	3,533	3,754	3,824	3,949
Interest bearing debt	15	0	0	0	0	0
Other liabilities	327	319	230	263	250	245
Total liabilities	342	319	230	263	250	245
Shareholders' equity	2,620	2,879	3,098	3,178	3,252	3,371
Minorities	166	179	205	213	227	245
Total shareholders' equity	2,786	3,058	3,303	3,391	3,479	3,617
Net debt	*-373*	*-38*	*-83*	*-149*	*-233*	*-252*
Key Company Metrics						
Sales growth (%)	17.0	-13.1	-5.1	-8.9	6.8	3.8
DB EPS growth (%)	13.6	-35.5	-15.6	-32.2	-16.3	34.7
EBITDA Margin (%)	53.1	42.4	39.2	30.4	33.3	39.2
EBIT Margin (%)	43.1	31.0	25.7	10.9	9.7	16.7
Payout ratio (%)	10.6	16.6	23.5	35.9	44.3	33.9
ROE (%)	18.0	10.1	7.9	5.1	4.1	5.4
Capex/sales (%)	42.7	63.6	20.4	23.0	21.5	30.4
Capex/depreciation (x)	4.3	5.6	1.5	1.2	0.9	1.3
Net debt/equity (%)	-13.4	-1.2	-2.5	-4.4	-6.7	-7.0
Net interest cover (x)	nm	54.8	68.4	16.3	10.2	19.5

Source: Company data, Deutsche Bank estimates

Investment Thesis: South32

Outlook

South32 is a new global mid-cap mining company with a strong balance sheet and reasonable cash flow from what we see as a mixed asset base. We think the group's three most valuable assets are the Worsley alumina refinery, the Hillside aluminium smelter and the Alumar alumina refinery. We forecast South32's copper equivalent production to fall around 3% per year, so commodity prices, fixed cost reductions and currency deprecation are the key drivers of earnings growth. The two areas of upside are cost-cutting and mine-life extensions - we expect cost-cutting to be management's focus over the next 12 months. South32 faces a number of challenges in the next year, including uncertainty over its status within BEE legislation and steep power price increases in South Africa, plus grade declines at Cannington. We are positive on the outlook for alumina, aluminium and nickel over the medium term but are cautious on manganese and coal. We rate South32 a BUY on valuation.

Valuation

We derive our valuation for South32 from a sum-of-the-parts DCF model, aggregating life of mine cash flows for each asset. We derive a group NPV using a nominal WACC of 10.5% (CoE 11.5%, Rf 4%, Rp 6.0%; CoD 6% on a D/E of 15%; Beta of 1.25) and assuming real long-term FX and prices of: AUD/USD of 0.80, ZAR/USD 12.88, aluminium US96c/lb, nickel US967c/lb, manganese US$3.30/dmtu, alumina US$360/t, coking coal US$150/t, export South African thermal coal of US$70/t and zinc of US105c/lb. We set our target price in line with our NPV.

Risks

The key downside risks to our estimates are:(i) higher sustaining capex, particularly for the aluminium assets; (ii) more severe grade declines, resulting in larger falls in copper equivalent production; (iii) changes in BEE legislation in South Africa; (iv) more severe electricity price increases in South Africa; and (v) lower commodity prices and stronger FX rates than we forecast.

Model updated:25 September 2015

Running the numbers

Europe

United Kingdom

Metals & Mining

South32

Reuters: S32.L Bloomberg: S32 LN

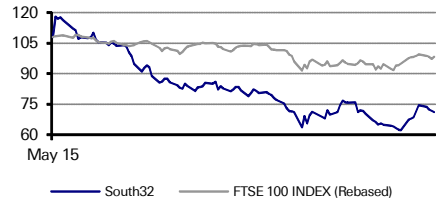
Buy

Price (15 Oct 15)	GBP 71.00
Target Price	GBP 91.00
52 Week range	GBP 62.25 - 118.00
Market Cap (m)	GBPm 3,780
	USDm 5,843

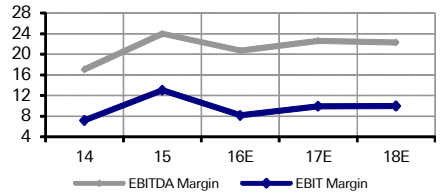
Company Profile

South32 is a diversified miner whose assets were previously owned by BHP Billiton. The portfolio includes the Illawarra met coal complex, Cannington base metals mine, GEMCO manganese mine, the Worsley bauxite mine and alumina refinery all in Australia; Energy Coal mines and Samancor Manganese in South Africa, Mozal aluminium smelter in Mozambique, MRN bauxite mine in Brazil, Cerro Matoso nickel mine in Colombia.

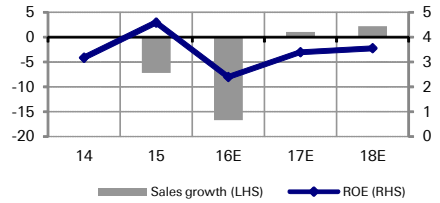
Price Performance



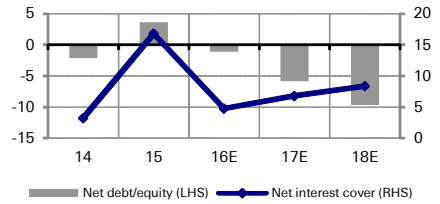
Margin Trends



Growth & Profitability



Solvency



Anna Mulholland, CFA
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Fiscal year end 30-Jun	2014	2015	2016E	2017E	2018E
Financial Summary					
DB EPS (USD)	0.08	0.11	0.05	0.07	0.08
Reported EPS (USD)	0.08	0.11	0.05	0.07	0.08
DPS (USD)	0.00	0.00	0.02	0.03	0.03
BVPS (USD)	2.6	2.1	2.2	2.2	2.3
Weighted average shares (m)	5,321	5,324	5,324	5,324	5,324
Average market cap (USDm)	na	8,681	5,843	5,843	5,843
Enterprise value (USDm)	na	9,006	5,637	5,074	4,580
Valuation Metrics					
P/E (DB) (x)	na	15.1	21.7	14.8	13.6
P/E (Reported) (x)	na	15.1	21.7	14.8	13.6
P/BV (x)	0.00	0.65	0.51	0.49	0.48
FCF Yield (%)	na	13.9	11.1	12.9	13.9
Dividend Yield (%)	na	0.0	1.8	2.7	2.9
EV/Sales (x)	nm	1.2	0.9	0.8	0.7
EV/EBITDA (x)	nm	4.9	4.2	3.4	3.1
EV/EBIT (x)	nm	8.9	10.7	7.8	6.9
Income Statement (USDm)					
Sales revenue	8,344	7,743	6,450	6,515	6,656
Gross profit	1,715	1,840	1,314	1,475	1,504
EBITDA	1,421	1,855	1,336	1,472	1,486
Depreciation	823	848	811	826	822
Amortisation	0	0	0	0	0
EBIT	598	1,007	526	647	664
Net interest income(expense)	-187	-60	-111	-96	-79
Associates/affiliates	62	-6	19	55	68
Exceptionals/extraordinaries	343	547	0	0	0
Other pre-tax income/(expense)	-323	-482	0	0	0
Profit before tax	150	459	434	606	652
Income tax expense	47	431	165	210	223
Minorities	0	0	0	0	0
Other post-tax income/(expense)	0	0	0	0	0
Net profit	446	575	269	396	429
DB adjustments (including dilution)	0	0	0	0	0
DB Net profit	446	575	269	396	429
Cash Flow (USDm)					
Cash flow from operations	1,419	1,838	1,248	1,384	1,426
Net Capex	-590	-629	-602	-633	-617
Free cash flow	829	1,209	646	751	809
Equity raised/(bought back)	0	0	0	0	0
Dividends paid	0	0	-45	-118	-184
Net inc/(dec) in borrowings	-205	0	0	0	0
Other investing/financing cash flows	-488	-658	-70	-69	-131
Net cash flow	136	551	531	564	494
Change in working capital	*1,562*	*136*	*0*	*0*	*0*
Balance Sheet (USDm)					
Cash and other liquid assets	364	644	1,175	1,738	2,232
Tangible fixed assets	13,393	9,550	9,341	9,148	8,943
Goodwill/intangible assets	290	306	306	306	306
Associates/investments	107	77	77	77	77
Other assets	2,887	4,912	4,912	4,912	4,912
Total assets	17,041	15,489	15,810	16,181	16,470
Interest bearing debt	62	1,046	1,046	1,046	1,046
Other liabilities	2,904	3,408	3,311	3,229	3,152
Total liabilities	2,966	4,454	4,357	4,275	4,198
Shareholders' equity	14,075	11,035	11,453	11,906	12,272
Minorities	0	0	0	0	0
Total shareholders' equity	14,075	11,035	11,453	11,906	12,272
Net debt	*-302*	*402*	*-129*	*-692*	*-1,186*
Key Company Metrics					
Sales growth (%)	nm	-7.2	-16.7	1.0	2.2
DB EPS growth (%)	na	29.3	-53.2	47.2	8.4
EBITDA Margin (%)	17.0	24.0	20.7	22.6	22.3
EBIT Margin (%)	7.2	13.0	8.1	9.9	10.0
Payout ratio (%)	0.0	0.0	40.0	40.0	40.0
ROE (%)	3.2	4.6	2.4	3.4	3.6
Capex/sales (%)	7.1	8.1	9.3	9.7	9.3
Capex/depreciation (x)	0.7	0.7	0.7	0.8	0.8
Net debt/equity (%)	-2.1	3.6	-1.1	-5.8	-9.7
Net interest cover (x)	3.2	16.8	4.7	6.8	8.3

Source: Company data, Deutsche Bank estimates

Investment Thesis: Rio Tinto

Outlook

Rio Tinto has a very high-quality suite of assets that are generally low operating cost, long life, expandable, and mostly located in low-risk countries, offering above-average returns and operating margins. Rio is pushing ahead with a clear strategy in 2015. This is to reduce costs (sustaining capex, operating costs, head office and exploration expenditure), keep the best growth (push iron ore growth as hard as possible, at the lowest capital intensity, and pursue copper and bauxite growth), pay down debt (gearing is now at the bottom of the 20-30% target range), rebase the dividend and buy back stock (US$2b announced). They have reduced costs by over US$5b since the cost-out drive commenced and are aiming to reduce costs by a further US$1b in 2015. The aluminium division is now outperforming peers and the market's expectations. The new strategy is a dramatic (positive) change for Rio Tinto and management are delivering on their promises. We expect the stock to re-rate in 2015 and into 2016 as commodity markets rebalance. We believe Rio Tinto is undervalued on most metrics (P/E multiples, DCF valuation), and we rate the stock a Buy, trading at a discount to our NPV.

Valuation

We value Rio Tinto using discounted cash flow analysis of each of its assets. Our target is in line with our valuation using life of mine cashflows (9.3% WACC, CoE 10.5%, CoD 3.6%, RFR 3.0%, ERP 6%, beta 1.25), as the rapidly improving balance sheet re-opens significant growth opportunities.

Risks

Key risks to our view include movements in iron ore, copper, coal and aluminium prices away from those that we currently forecast. Earnings for the group are strongly biased to iron ore and copper (c. 75% of operating earnings) therefore production levels, prices for those commodities are an important consideration. Specifically, for the aluminium division risks include reduced Chinese demand for bauxite, alumina and aluminium, delays to expansion projects and weakness in prices.

Model updated:16 October 2015

Running the numbers

Europe

United Kingdom

Metals & Mining

Rio Tinto

Reuters: RIO.L Bloomberg: RIO LN

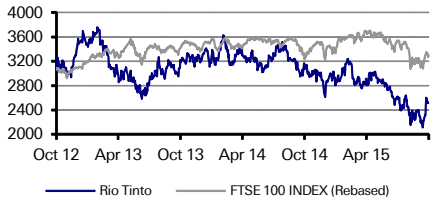
Buy

Price (15 Oct 15)	GBP 2,513.00
Target Price	GBP 3,400.00
52 Week range	GBP 2,111.00 - 3,237.50
Market Cap (m)	GBPm 45,626
	USDm 70,525

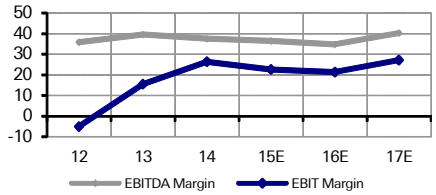
Company Profile

Rio Tinto is a global diversified mining company with interests in aluminum, borax, coal, copper, diamonds, gold, iron ore, titanium dioxide feedstock, uranium and zinc. Its key mining operations are located in Australia, New Zealand, South Africa, South America, the United States, Europe, and Canada. Rio Tinto's management structure is based primarily on six principal global products businesses Aluminium, Diamonds, Copper, Energy (coal and uranium), Industrial Minerals, and Iron Ore supported by worldwide exploration and technology groups.

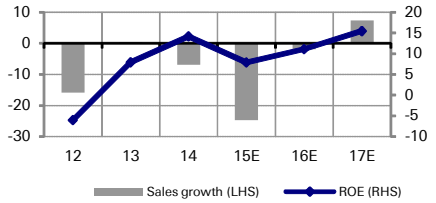
Price Performance



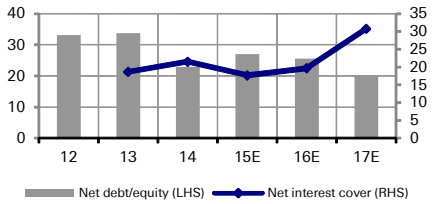
Margin Trends



Growth & Profitability



Solvency



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Fiscal year end 31-Dec	2012	2013	2014	2015E	2016E	2017E
Financial Summary						
DB EPS (USD)	5.01	5.50	5.02	3.08	2.58	3.69
Reported EPS (USD)	-1.61	1.97	3.52	1.91	2.58	3.69
DPS (USD)	1.67	1.92	2.15	2.24	2.30	2.35
BVPS (USD)	25.3	24.8	25.0	23.3	23.4	24.5
Weighted average shares (m)	1,852	1,852	1,853	1,816	1,805	1,805
Average market cap (USDm)	94,549	91,212	97,549	70,525	70,525	70,525
Enterprise value (USDm)	117,000	110,477	111,964	85,957	85,234	82,889
Valuation Metrics						
P/E (DB) (x)	10.2	9.0	10.5	12.6	15.0	10.5
P/E (Reported) (x)	nm	25.0	14.9	20.3	15.0	10.5
P/BV (x)	2.25	2.27	1.88	1.67	1.66	1.59
FCF Yield (%)	nm	2.6	6.5	7.7	6.9	9.3
Dividend Yield (%)	3.3	3.9	4.1	5.8	5.9	6.0
EV/Sales (x)	2.3	2.2	2.3	2.4	2.4	2.2
EV/EBITDA (x)	6.4	5.5	6.3	6.6	7.0	5.4
EV/EBIT (x)	nm	14.0	8.9	10.6	11.4	8.1
Income Statement (USDm)						
Sales revenue	50,967	51,171	47,664	35,880	35,181	37,773
Gross profit	17,872	19,858	18,614	13,057	12,641	15,633
EBITDA	18,275	20,234	17,893	13,091	12,239	15,214
Depreciation	4,441	4,791	4,860	4,550	4,739	4,971
Amortisation	16,410	7,531	473	439	0	0
EBIT	-2,576	7,912	12,560	8,103	7,500	10,243
Net interest income(expense)	-160	-425	-585	-459	-381	-333
Associates/affiliates	0	0	0	0	0	0
Exceptionals/extraordinaries	-7	0	0	0	0	0
Other pre-tax income/(expense)	168	-3,982	-2,423	-1,815	-382	-382
Profit before tax	-2,568	3,505	9,552	5,828	6,737	9,527
Income tax expense	429	2,426	3,053	2,212	2,088	2,954
Minorities	-14	-2,586	-28	146	-15	-93
Other post-tax income/(expense)	0	0	0	0	0	0
Net profit	-2,990	3,665	6,527	3,471	4,664	6,667
DB adjustments (including dilution)	12,293	6,552	2,778	2,117	0	0
DB Net profit	9,303	10,217	9,305	5,588	4,664	6,667
Cash Flow (USDm)						
Cash flow from operations	9,368	15,078	14,286	10,600	9,616	11,518
Net Capex	-17,575	-12,720	-7,990	-5,173	-4,790	-5,015
Free cash flow	-8,207	2,358	6,296	5,427	4,826	6,503
Equity raised/(bought back)	1,474	0	0	-2,021	0	0
Dividends paid	-3,038	-3,322	-3,710	-4,125	-4,111	-4,203
Net inc/(dec) in borrowings	7,888	2,122	-3,034	-3,598	-1,193	-1,740
Other investing/financing cash flows	-666	1,756	2,639	15	0	0
Net cash flow	-2,549	2,914	2,191	-4,302	-478	559
Change in working capital	*401*	*557*	*1,519*	*737*	*449*	*-674*
Balance Sheet (USDm)						
Cash and other liquid assets	7,082	10,216	12,423	8,101	7,623	8,183
Tangible fixed assets	75,131	70,827	68,693	65,875	65,926	65,971
Goodwill/intangible assets	9,402	6,770	7,108	6,539	6,157	5,775
Associates/investments	7,966	6,406	6,389	6,188	6,188	6,188
Other assets	17,992	16,806	13,214	11,755	11,538	12,107
Total assets	117,573	111,025	107,827	98,458	97,433	98,223
Interest bearing debt	26,343	28,271	24,918	21,659	20,466	18,726
Other liabilities	32,915	29,425	28,315	26,689	26,721	27,260
Total liabilities	59,258	57,696	53,233	48,348	47,187	45,986
Shareholders' equity	46,865	45,886	46,285	42,048	42,191	44,229
Minorities	11,156	7,616	8,309	8,062	8,055	8,008
Total shareholders' equity	58,021	53,502	54,594	50,110	50,246	52,238
Net debt	*19,261*	*18,055*	*12,495*	*13,558*	*12,843*	*10,543*
Key Company Metrics						
Sales growth (%)	-15.8	0.4	-6.9	-24.7	-1.9	7.4
DB EPS growth (%)	-37.9	9.8	-8.7	-38.7	-16.0	42.9
EBITDA Margin (%)	35.9	39.5	37.5	36.5	34.8	40.3
EBIT Margin (%)	-5.1	15.5	26.4	22.6	21.3	27.1
Payout ratio (%)	nm	97.0	61.1	116.9	88.9	63.6
ROE (%)	-6.0	7.9	14.2	7.9	11.1	15.4
Capex/sales (%)	34.5	25.3	17.1	14.4	15.3	13.3
Capex/depreciation (x)	4.0	2.7	1.7	1.1	1.1	1.0
Net debt/equity (%)	33.2	33.7	22.9	27.1	25.6	20.2
Net interest cover (x)	nm	18.6	21.5	17.6	19.7	30.7

Source: Company data, Deutsche Bank estimates

Investment Thesis: Glencore

Outlook

Glencore's integrated business model allows the company to leverage not only the growth in global commodity demand, but also growth in global commodity trade. Its merger with Xstrata has transformed the business from a trading-dominated (by earnings) business to a fully fledged miner. Its large group of industrial or producing assets offers price exposure to a diversified basket of commodities including metals, agricultural products and energy products. Its trading business is a key differentiator versus the diversified miners, able to leverage the trend of increased commodity price volatility and the preferential growth of commodity trading; however, this has not been performing as expected. Indeed, the key reasons for equity preference have been severely tested over the last few quarters: 1) the trading business has fallen short of the guidance range, 2) acquisitions (Xstrata and Caracal) have proven to be poorly timed, and 3) key operations have been operating poorly. The recent emergency actions proposed to shore up the balance sheet by US$10b should ease balance sheet concerns and debt investors, but do not provide longer-term equity investors with any confidence on the equity story for the company, we believe. With its main commodity (Coal) likely to suffer ongoing price declines over the next 3 years, in our view, catalysts for further outperformance are difficult to see. Hold.

Valuation

We value Glencore using discounted cash flow analysis on its life of asset cash flows. We use a WACC of 8.6% (CoD 4%, Gearing target 20%, Tax rate 20% and RFR 3%). Our price target is set at our valuation in line with the sector.

Risks

Weaker/stronger commodity prices or operating currencies than expected are key risks to our earnings and valuation forecasts. Key stock-specific downside risks: Some of Glencore's key growth assets are in less politically stable regions, such as the Democratic Republic of Congo (DRC) and Equatorial Guinea, which introduces a higher degree of sovereign risk. If the recently proposed equity raising is unsuccessful, this could have a negative impact on the ratings agencies ratings and therefore cost of debt for the company.

Model updated:09 October 2015

Running the numbers

Europe

United Kingdom

Metals & Mining

Glencore

Reuters: GLEN.L Bloomberg: GLEN LN

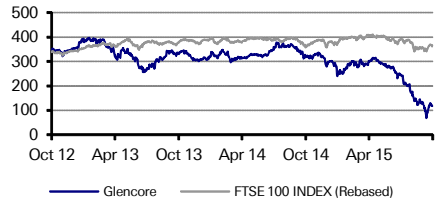
Hold

Price (15 Oct 15)	GBP 117.75
Target Price	GBP 190.00
52 Week range	GBP 68.62 - 336.25
Market Cap (m)	GBPm 15,619
	USDm 24,142

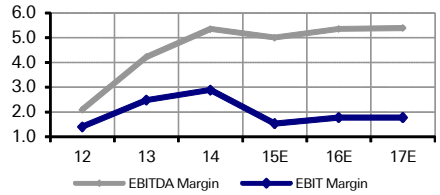
Company Profile

Glencore is one of the world's leading integrated producers and marketers of commodities, covering metals and minerals, energy and agricultural commodities. The company has worldwide activities in production, sourcing, processing, refining, transporting, storage and financing of commodities. The recent merger with Xstrata has significantly increased its mining output and moved it from a trading dominated to mining dominated company.

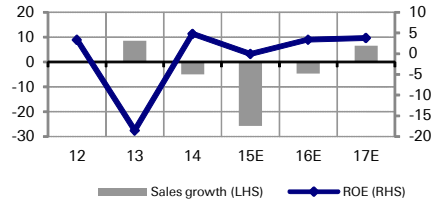
Price Performance



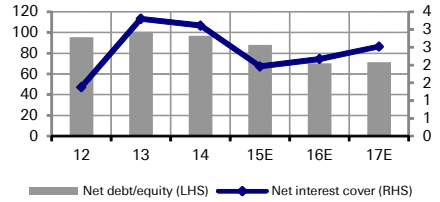
Margin Trends



Growth & Profitability



Solvency



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Fiscal year end 31-Dec	2012	2013	2014	2015E	2016E	2017E
Financial Summary						
DB EPS (USD)	0.07	0.32	0.33	0.11	0.12	0.13
Reported EPS (USD)	0.14	-0.65	0.18	0.00	0.12	0.13
DPS (USD)	0.16	0.17	0.18	0.06	0.12	0.19
BVPS (USD)	4.4	3.7	3.7	3.2	3.5	3.4
Weighted average shares (m)	7,011	11,141	13,099	13,264	14,245	14,245
Average market cap (USDm)	40,987	57,866	71,207	24,142	24,142	24,142
Enterprise value (USDm)	51,412	92,485	107,112	55,598	49,826	49,633
Valuation Metrics						
P/E (DB) (x)	80.7	16.1	16.7	15.9	15.7	13.7
P/E (Reported) (x)	43.3	nm	31.0	nm	15.7	13.7
P/BV (x)	1.30	1.41	1.28	0.56	0.52	0.53
FCF Yield (%)	3.4	nm	nm	24.5	17.0	10.8
Dividend Yield (%)	2.7	3.2	3.3	3.3	6.6	10.2
EV/Sales (x)	0.2	0.4	0.5	0.3	0.3	0.3
EV/EBITDA (x)	11.5	9.4	9.1	6.8	5.9	5.5
EV/EBIT (x)	17.1	16.0	16.8	22.1	17.9	16.7
Income Statement (USDm)						
Sales revenue	214,436	232,694	221,073	164,364	156,715	167,098
Gross profit	5,474	9,825	11,825	8,218	8,395	9,010
EBITDA	4,477	9,825	11,825	8,218	8,395	9,010
Depreciation	1,473	4,049	5,448	5,697	5,609	6,037
Amortisation	0	0	0	0	0	0
EBIT	3,004	5,776	6,377	2,520	2,786	2,973
Net interest income(expense)	-2,184	-1,751	-2,050	-1,286	-1,285	-1,181
Associates/affiliates	367	0	0	0	0	0
Exceptionals/extraordinaries	0	-11,068	-74	-1,027	0	0
Other pre-tax income/(expense)	-111	-1	0	-256	0	0
Profit before tax	1,076	-7,044	4,253	-49	1,501	1,792
Income tax expense	-76	254	1,809	210	-7	62
Minorities	148	104	136	-220	-143	-170
Other post-tax income/(expense)	0	0	0	0	0	0
Net profit	1,004	-7,402	2,308	-39	1,651	1,900
DB adjustments (including dilution)	-466	11,068	1,977	1,558	0	0
DB Net profit	538	3,666	4,285	1,519	1,651	1,900
Cash Flow (USDm)						
Cash flow from operations	4,381	9,184	8,136	11,237	7,731	6,696
Net Capex	-3,005	-9,329	-8,854	-5,331	-3,318	-3,885
Free cash flow	1,376	-145	-718	5,906	4,412	2,811
Equity raised/(bought back)	0	10	-767	2,191	0	0
Dividends paid	-1,066	-2,062	-2,244	-2,348	0	-2,656
Net inc/(dec) in borrowings	6,123	558	-559	-3,421	-3,020	-2,352
Other investing/financing cash flows	-4,956	1,706	4,263	-493	1,360	38
Net cash flow	1,477	67	-25	1,836	2,752	-2,159
Change in working capital	*727*	*2,599*	*-703*	*5,227*	*784*	*-883*
Balance Sheet (USDm)						
Cash and other liquid assets	2,782	2,849	2,824	4,660	7,412	5,253
Tangible fixed assets	23,238	67,233	70,110	68,492	67,201	65,049
Goodwill/intangible assets	2,664	9,158	8,866	8,707	8,707	8,707
Associates/investments	25,353	21,073	16,902	16,420	15,770	15,770
Other assets	51,500	53,799	53,503	47,642	46,991	49,408
Total assets	105,537	154,112	152,205	145,921	146,081	144,187
Interest bearing debt	35,526	55,173	52,693	49,143	45,473	43,121
Other liabilities	35,711	47,008	48,032	46,297	46,422	47,957
Total liabilities	71,237	102,181	100,725	95,440	91,895	91,078
Shareholders' equity	31,266	48,563	48,542	47,088	50,793	49,716
Minorities	3,034	3,368	2,938	3,393	3,393	3,393
Total shareholders' equity	34,300	51,931	51,480	50,481	54,186	53,109
Net debt	*32,744*	*52,324*	*49,869*	*44,483*	*38,061*	*37,868*
Key Company Metrics						
Sales growth (%)	nm	8.5	-5.0	-25.7	-4.7	6.6
DB EPS growth (%)	na	345.9	0.9	-65.0	1.2	15.1
EBITDA Margin (%)	2.1	4.2	5.3	5.0	5.4	5.4
EBIT Margin (%)	1.4	2.5	2.9	1.5	1.8	1.8
Payout ratio (%)	111.0	nm	102.2	nm	103.5	139.7
ROE (%)	3.3	-18.5	4.8	-0.1	3.4	3.8
Capex/sales (%)	1.5	4.1	4.1	3.3	2.8	2.3
Capex/depreciation (x)	2.1	2.4	1.7	0.9	0.8	0.6
Net debt/equity (%)	95.5	100.8	96.9	88.1	70.2	71.3
Net interest cover (x)	1.4	3.3	3.1	2.0	2.2	2.5

Source: Company data, Deutsche Bank estimates

Appendix: Supplementary information and data

Anglo American's African footprint

Figure 131: Anglo's African footprint

Product	Asset	Ownership	Managed by	Country	Commodities	Annual Capacity (AAL share)	Expected life	Comments
Iron Ore	Kumba Iron ore	69.7%	Kumba Iron Ore	South Africa	Iron ore	70 mtpa	Sishen: 10; Kolomela: 19	Kumba has two mines - Sishen and Kolomela - plus Thabazimbi which is being closed
Manganese	Hotazel Manganese Mines	44.40%	South32	South Africa				
	- Wessels Underground mine				Mn ore (lump and fines)	45		
	- Mamatwan openpit mine				Mn ore (lump and fines)	17		
Coal	Goedehoop	100.0%	Anglo	South Africa	Thermal Coal - Export	5 mtpa	11	
	Greenside	100.0%	Anglo	South Africa	Thermal Coal - Export	3 mtpa	14	
	Isibonelo	100.0%	Anglo	South Africa	Thermal Coal - Synfuel	6 mtpa	13	
	Kleinkopje	100.0%	Anglo	South Africa	Thermal Coal - Export and Domestic	3.7 mtpa	11	
	Landau	100.0%	Anglo	South Africa	Thermal Coal - Export and Domestic	4.5 mtpa	4	
	New Denmark	100.0%	Anglo	South Africa	Thermal Coal - Domestic	4 mtpa	25	
	New Vaal	100.0%	Anglo	South Africa	Thermal Coal - Domestic	16.5 mtpa	17	
	Mafube	50.0%	Anglo	South Africa	Thermal Coal - Export and Domestic	4.3 mtpa	17	
	Kriel	73.0%	Anglo	South Africa	Thermal Coal - Domestic	9.5 mtpa	6	
	Zibulo	73.0%	Anglo	South Africa	Thermal Coal - Export and Domestic	6.5 mtpa	21	
	Richards Bay Coal terminal	23.2%	RBCT	South Africa	Port			
	Phola plant	50.0%	Anglo/BHP	South Africa	Coal Processing plant	16 mtpa		
PGMs	Anglo American Platinum Ltd	79.9%			PGM (3PGE +Au)	2 moz (PlatiniumEquivalent)	>25	
	- Bathopele Mine	100%	Amplats	South Africa				To be sold to Sibanye Gold by early 2017
	- Thembelani Mine	100%	Amplats	South Africa				
	- Siphumelele Mine	100%	Amplats	South Africa				
	- Tumela Mine	100%	Amplats	South Africa				
	- Dishaba Mine	100%	Amplats	South Africa				
	- Mogalakwena Mine	100%	Amplats	South Africa				
	- Unki Mine	100%	Amplats	Zimbabwe				
	- Twickenham Mine	100%	Amplats	South Africa				
	- Western Limb Tailings Retreatment	100%	Amplats	South Africa				

Source: Deutsche Bank; Company data

Figure 131: Anglo's African footprint (Cont'd)

Product	Asset	Ownership	Managed by	Country	Commodities	Annual Capacity (AAL share)	Expected life	Comments
	- Waterval Smelter (Including Converting process)	100%	Amplats	South Africa				
	- Mortimer Smelter	100%	Amplats	South Africa				
	- Polokwane Smelter	100%	Amplats	South Africa				
	- Rustenburg Base Metals Refinery	100%	Amplats	South Africa				
	- Precious Metals Refinery	100%	Amplats	South Africa				
	- Union Section	85%	Amplats	South Africa				For sale or to be listed by early 2017
	- Masa Chrome Company	50%	Amplats	South Africa				For sale or to be listed by early 2017
	- Modikwa Platinum	50%	ARM	South Africa				
	- Kroondal PSA	50%	Aquarius Platinum	South Africa				
	- Mototolo	50%	Glencore	South Africa				
	- Bokoni	49%	Atlatsa	South Africa				
	- Pandora	43%	Lonmin	South Africa				
Diamonds	De Beers	85%	Anglo		Diamonds	35 mn ct		
	De Beers Consolidated Mines	74%		South Africa				
	- Venetia						30	
	- Voorspoed						7	
	- Kimberley						4	
	Debswana	50%		Botswana				
	- Orapa Mine						15	
	- Lethakane						3	
	- Jwaneng						19	
	- Damtshaa						18	
	Namdeb Holdings 50%	50%		Namibia				
	- Namdeb						17	
	- Debmarine Namibia						15	

Source: Deutsche Bank; Company data

Coal: South Africa: 10 mines

Anglo wholly owns and operates seven mines which produce thermal coal for both export and domestic use, the latter going to Eskom and Sasol. In addition, two mines, Kriel and Zibulo, are part of Anglo American Inyosi Coal, a BEE company, 73% owned by Anglo. Inyosi also holds the greenfield projects Elders, New Largo and Heidelberg. Finally, Anglo has a 50% interest in the Mafube colliery and the Phola washing plant.

Six of the mines collectively supply 23mtpa to both export and local markets. New Vaal, New Denmark and Kriel collieries are domestic product operations supplying 29mtpa of thermal coal to Eskom, the state-owned power utility. Isibonelo mine produces 5mtpa of thermal coal for Sasol Synthetic Fuels, the coal-to-liquids producer, under a 20-year supply contract.

Iron ore: South Africa: Kumba Iron Ore

Anglo's Iron Ore portfolio in South Africa comprises a 69.7% shareholding in Kumba Iron Ore Limited (Kumba), which is listed on the Johannesburg Stock Exchange. Kumba operates three mines – Sishen mine in the Northern Cape, which produced 35.5mt of iron ore in 2014, Thabazimbi mine in Limpopo, with

an output of 1.1mt, and Kolomela mine, also in the Northern Cape, which produced 11.6mt during 2014.

Sishen produces a leading quality lump ore. Export ore is transported via the Sishen-Saldanha Iron Ore Export Channel to Saldanha Port. The rail and port operations are owned and operated by the South African parastatal Transnet.

Platinum: South Africa, Zimbabwe

Anglo American owns 79.9% of Amplats, listed on the Johannesburg Stock Exchange. Amplats wholly owns 8 mining operations currently in production, a tailings re-treatment facility, three smelters, a base metals refinery and a precious metals refinery. Concentrating, smelting and refining of the output are undertaken at Rustenburg Platinum Mines' (RPM) metallurgical facilities. In addition, Amplats has an 85% stake in Union Mine (BEE partner, the Bakgatla-Ba-Kgafela traditional community, holds the remainder), and 50% non-operator stakes in three JV mines. Finally, Amplats holds a 33% stake in the combined Bafokeng- Rasimone platinum mine (BRPM) and Styldrift properties, with 67% held by RBPlat which operates the mines.

Anglo has agreed to sell its three Rustenburg mines: Bathopele, Thembelani and Siphumelele to Sibanye Gold, likely by early 2017. Union Mine and its stake in the Masa Chrome Company is for sale also.

Diamonds: South Africa, Botswana, Namibia

Anglo owns 85% of De Beers, with the remaining 15% held by the Government of Botswana. De Beers generates about 35% (by value) of global rough diamond production from its operations in Botswana, Canada, Namibia and South Africa.

Within Africa, De Beers holds 50% of the Debswana Diamond Company in Botswana, and 50% of Namdeb Holdings in Namibia, owned jointly with the Government of the Republic of Botswana and the Government of the Republic of Namibia respectively. Namdeb Holdings owns 100% each of Namdeb (land mining) and De Beers Marine Namibia (marine mining).

In addition, De Beers has a 74% shareholding in South African-based De Beers Consolidated Mines Limited, with the Ponahalo group, a BEE consortium, holding the balance.

Manganese: South Africa

Anglo owns a 40% stake in Samancor Manganese, with the remaining 60% held by South32 which operates the assets.

Other African exposure

Anglo holds 10% of Exxaro Resources, locked up until 2016. In addition, through Amplats, it holds 27% of Atlatsa Resources Corporation, 13% of Wesizwe Platinum Limited and 12.6% of RBPlat.

Ten capital projects, all longer dated with majority of capex on hold for now

Figure 127 sets out the ten current projects Anglo has in South Africa and Botswana, with most on hold due to the lower price environment. The exception being the diamonds projects which are, respectively, a cut back of the Jwaneng open pit mine in Botswana and a transition underground at the Venetia mine in South Africa.

South32's African footprint

Figure 132: South32's African footprint

Operating mines

Product	Asset	Ownership	Managed by	Country	Commodities	Annual Capacity (S32 share)	Expected life	Comments
Coal	Khutala	90%	South32	South Africa	Thermal coal	9-9.5 mt	7	Life can be extended via the Naudesbank project
	Middelburg/Wolvekrans	90%	South32	South Africa	Thermal coal	14-15 mt	Up to 23 years	40-50% of product is exported
	Klipspruit	90%	South32	South Africa	Thermal coal	7-8 mt	6	Life can be extended via the Weltevreden project
Manganese	Hotazel Manganese Mines	44.4%	South32	South Africa				
	- Wessels Underground mine				Mn ore (lump and fines)	1mt	45	
	- Mamatwan openpit mine				Mn ore (lump and fines)	3.5mt	17	
	Metalloys	60%	South32	South Africa	High- and medium-carbon ferromanganese	500kt: 410kt of high carbon, 90kt of medium carbon (100% basis)	14	2029 closure stated in South 32 IM
Aluminium	Hillside (aluminium smelter)	100%	South32	South Africa	Aluminium Ingots	720kt	35	S32 states that the power contract with Eskom expires in 2028, however Eskom believes it is 2020
	Mozal (aluminium smelter)	47%	South32	Mozambique	Aluminium Ingots	270kt	35	25% Mitsubishi, 24% Mozambique IDS of SA, 4% Govt

Development Projects

Commodity/ Region	Project	S32 share	Description	Capex (US$m) (S32 share)	Target date of initial production	Status
Manganese/ South Africa	Wessels	60%	Expands the mine from 1Mt to 1.5Mtpa (100% basis)	55	Q3 2016	In execution
Energy Coal/South Africa	Wolvekrans: VDDC project	100%	Maintaining existing production levels from Wolvekrans/Middelburg Colliery at 14-15Mtpa. Would replace the 7-8Mtpa Middelburg mine in around 2025 and extend the life of Wolvekrans until 2040	100 (DBe)	24 months from start date	Probable
Energy Coal/South Africa	Weltevreden project (Extension of Klipspruit)	100%	Could extend the life of Klipspruit mine by 25 years to 2045	450 (DBe)	2020 (DBe)	Possible
Energy Coal/South Africa	Naudesbank project (Extension of Khutala)	100%	Could extend the life of Khutala mine by 20 years to 2040	300 (DBe)	2020 (DBe)	Possible

Source: Deutsche Bank estimates, Company data

Glencore's African footprint

Figure 133: Glencore's operating assets in Africa

Product	Asset	Ownership	Managed by	Country	Commodities	Annual Capacity	Expected life (yrs)	Comments
Zinc	Rosh Pinah	80.1%	Glencore	Namibia	Zinc / lead	89ktpa of zinc concentrate and 16ktpa of lead concentrate	4	Acquired in 2012 from Exxaro
	Perkoa	90.0%	Glencore	Burkina Faso	Zinc	60ktpa	8	Started production in 2013
Copper	Katanga	75.2%	Katanga	DRC	Copper and cobalt	Copper metal: 300ktpa; Cobalt: 5.5ktpa	15	Currently expanding to 300kt by FY17e but running at 190kt due to power outages
	Mopani	73.1%	JV	Zambia	Copper and cobalt	Copper metal: 250ktpa; Cobalt: 1ktpa	10	140kt of copper from own mines; First Quantum owns 16.9% and ZCCM 10%
	Mutanda	69.0%	Glencore	DRC	Copper and cobalt	Copper metal: 200ktpa; Cobalt: 15ktpa	16	
	Sable Zinc	100%	Glencore	Zambia	Copper and cobalt	Copper: 500ktpa;Cobalt: 20ktpa	>15	
Thermal Coal	Impunzi Division	100%	Glencore	South Africa	Thermal coal	6Mt	>30	
	Tweefontein		Glencore	South Africa	Thermal coal		>25	
	– Open Cast	79.8%	Glencore	South Africa	Thermal coal	5.5Mt		
	– Underground	79.8%	Glencore	South Africa	Thermal coal	2.5Mt		
	Goedgevonden	74.0%	Glencore	South Africa	Thermal coal	8Mt	>50	
	Shanduka	50.0%	Glencore	South Africa	Export & Domestic Coal	7Mtpa (1Mtpa export)	>30	
	Umcebo	48.7%	Various	South Africa	Export & Domestic Coal	6.2Mtpa (1.5tpa export)	>30	
	Kangra Coal	15.0%	Various	South Africa	Export & Domestic Coal	3.3Mtpa (1.7Mt export)	20	
Alloys/PGMs	Waterval mine	79.5%	Glencore	South Africa	Chrome ore	220kt		
	Kroondal mine	79.5%	Glencore	South Africa	Chrome ore	800kt		
	Boshoek plant	79.5%	Glencore	South Africa	Ferro Alloys	150kt		
	Lion plant	79.5%	Glencore	South Africa	Ferro Alloys	300kt		
	Lydenburg plant	69.6%	Glencore	South Africa	Ferro Alloys	350kt		
	Rustenburg plant	79.5%	Glencore	South Africa	Ferro Alloys	340kt		
	Wonderkop plant	79.5%	Glencore	South Africa	Ferro Alloys	370kt		
	Thorncliffe mine	79.5%	Glencore	South Africa	Chrome ore	850kt		
	Helena mine	79.5%	Glencore	South Africa	Chrome ore	490kt		
	Rhovan V2O5 FeV	74.0%	Glencore	South Africa	Ferro Alloys	26Mlb		
	Char Technologies	100.0%	Glencore	South Africa	Char	50kt Cu in conc		
	African Carbon Manufacturers	100.0%	Glencore	South Africa		75kt		
	African Carbon Producers	100.0%	Glencore	South Africa		110kt		
	African Fine Carbon	100.0%	Glencore	South Africa		55kt		
	African Carbon Union	74.0%	Glencore	South Africa		65kt		
	Mototolo	37.0%	Mototolo	South Africa	PGMs	200koz		
	Eland	74.0%	Glencore	South Africa	PGMs	100koz		

Source: Deutsche Bank; Company data

Rosh Pinah zinc-lead mine: Namibia

The Rosh Pinah mine is situated 600km from Windhoek, the capital of Namibia, and 216km from Luderitz Bay, the nearest port. Glencore acquired a controlling stake in the mine from South African-listed Exxaro in 2011 for US$150m. At the time of writing, eight principle ore bodies have been outlined, five of which make up the current reserves.

Perkhoa zinc mine: Burkina Faso

Perkhoa zinc mine is 90% held by Glencore. The asset is situated in the Sanguie region, in the center of Burkina Faso, 129km from the capital Ouagadougou and 805 km from the nearest port, Tema in Ghana. The deposits sit in the Birimian belt, which has similarities with the gold deposits that can be found in Ghana and Mali.

Katanga copper mine: Democratic Republic of Congo (DRC)

Katanga Mining plc is held 75% by Glencore and 25% by the state-owned Gecamines. The company manages the largest copper mining complex in the DRC in the Katanga region, in the south east of the country. At present, the Katanga copper mine production has been stopped and is not expected to restart until the ongoing expansion project completes.

Mopani copper concentrate mine: Zambia

The Mopani mine is the largest copper concentrate mine in Zambia. The asset is operated by a joint venture between Glencore (73%), First Quantum (17%) and ZCCM (10%). With production of 150ktpa and a total ore reserve of 154 Mt, the mine is situated 280km from Lusaka.

Mutanda copper mine: DRC

The Mutanda copper mine is located in the Katanga province, with the majority of the deposit sitting in the Copperbelt. Glencore completed the merger between Mutanda and Kansuki in June 2013.

Sable Zinc: copper / cobalt mine: Zambia

Sable is a copper and cobalt producing mine located in the Kabwe region in Zambia, fully held by Glencore. The asset comprises a mine, a smelter, and a refinery. It has a remaining life of 10 years, with an annual production of 0.6mtpa.

Impunzi complex: South Africa

The Impunzi mining complex, held by Glencore, is a thermal coal facility located 110km east of Johannesburg, in the Mpumalanga province. The mine mainly supplies the export market.

Tweefontein coal mine: South Africa

Tweefontein coal mine is located 110km north-east of Johannesburg in the Mpumalanga province. The mining complex comprises open pit, underground and surface operations. It is one of the largest coal assets of Glencore with operations expected to continue for another 24 years.

Goedgevonden complex: South Africa

Goedgevonden complex, situated 25km from the town of Ogies in Mpumalanga, began coal production in 2004. The mine is owned by Glencore and ARM with production of 7.7mtpa of thermal coal. Around half of the mine's output is exported.

Shanduka coal mine: South Africa

The Shanduka coal mine, located near Middleburg and Kendal in South Africa, started production in 2003. Glencore has a 50% stake in the asset. The mine supplies Eskom (South African electricity public utility), inland South African markets and international markets through the Richards Bay Coal Terminal.

Umcebo coal mine: South Africa

In 2011, Glencore acquired a 44% stake in the Umcebo coal mine for R900mn.

Kangra coal mine: South Africa

Glencore owns a 15% stake in the Kangra coal mine in the Mpumalanga province.

Waterval chrome mine: South Africa

The Waterval chrome mine, held 79% by Glencore, is situated in Rustenburg, in the North West of South Africa. The mine's fully mechanized underground operations utilize board and pillar methods.

Kroonal chrome mine: South Africa

The Kroondal mine is owned and managed by Glencore. The mine is situated on the main Kroondal Platinum Mine block and extracts chrome.

Boshoek plant: South Africa

Boshoek plant, a chrome smelter, started operations in 2003. The plant is held 80% by Glencore and produces 240 ktpa.

Lion plant: South Africa

The Lion smelting complex of Glencore is situated in the Mpumalanga region, South Africa. The plant uses Glencore's proprietary Premus technology to produce ferrochrome.

Lydenburg ferrochrome plant: South Africa

The Lydenburg plant, located 300km north east of Johannesburg produces granulated and lumpy ferrochrome which it then supplies to the steel market. The plan started operations in 1977 and became part of Xstrata in 1998. Glencore now holds a 69.6% share in the asset.

Rustenburg ferrochrome plant: South Africa

The Rustenburg plan is 79.5% held by Glencore. Located in the town of Rustenburg. The plant started in 1989. The smelter receives ore from Glencore's nearby mines and is part of the chrome venture with Merafe.

Wonderkop ferrochrome plant: South Africa

The Wonderkop ferrochrome plant operated by Glencore is situated in the Marikana Area of the North West province. The complex comprises sinter and smelter plants which are close to raw material supplies.

Thorncliffe chrome mine: South Africa

Thorncliffe is a chrome producing mine situated in the Mpumalanga region in, 350km from Johannesburg. It started production in 1997 and is 79.5% owned by Glencore.

Helena chrome mine South Africa

Helena is an underground chrome mine lying to the south of the Thorncliffe chrome mine.

Rhovan ferroalloy mine: South Africa

Rhovan is an opencast mine situated in the North West province of South Africa. The mine is 74% held by Glencore and primarily produces ferrovanadium and vanadium pentoxide. The local Bakwena Ba Mogopa community owns the property with an effective 26% stake.

Char Technologies: South Africa

Char Technologies is a char producer owned by Glencore. With its facility situated in Witbank, Mpumalanga, the asset produces electrode paste and char used in the production of ferrochrome.

Africa Carbon Manufacturers, Africa Carbon Producers, African Fine Carbon: South Africa

These assets are mainly involved in coal devolatilization and other coal washing.

Mototolo PGM mine: South Africa

Mototolo is a PGM mine on the Eastern Limb of the Bushveld Complex. The asset is held 37% by Glencore. With annual production of 200 moz, the mine which started production in 2006 has a remaining life of eight years.

Eland platinum mine: South Africa

Eland is on the eastern side of the Western limb of the Bushveld Complex. The mine produces a platinum concentrate which is sold to third-party refiners for further processing. Glencore placed the mine on care and maintenance in 3Q15.

Rio Tinto's African footprint

Figure 134: Rio's African footprint

Operating mines

Product	Asset	Ownership	Managed by	Country	Commodities	Annual Capacity	Expected life (yrs)	Comments
Bauxite	CBG Sangaredi	23%	Halco	Guinea	Bauxite	17Mt	25	Rio owns 45% of Halco, which own 51% of CBG Sangaredi. Rio has an agreement to take 45% of the Bauxite
Mineral Sands	QIT Madagascar	80%	Rio Tinto	Madagascar	Ilmenite	750kt mineral sands	40	
	Richards Bay	74%	Rio Tinto	South Africa	TiO2 slag, iron, zircon	1Mt slag	17	
Uranium	Rössing	69%	Rio Tinto	Namibia	U3O8	7.5Mlbs	7	
Diamond	Murowa	78%	Rio Tinto	Zimbabwe	Diamonds	0.4Mct	15	Mining leases under Zimbabwe Mines and Minerals Act issued in 2001 and valid for 25 years

Capital Projects

Product	Project	Ownership	Managed by	Country	Capex (US$bn)	Capacity	First production	Comments
Iron Ore	Simandou South (Blocks 3 and 4)	46.6%	Rio Tinto	Guinea	20	100Mtpa by 2024	2019	Ownership split: Rio Tinto 46.6%; Chinalco 41.3%; Republic of Guinea 7.5%; IFC 4.625%

Source: Deutsche Bank, Company data

Sangaredi bauxite mine: Guinea

The Sangaredi bauxite mine, in Guinea's Sangaredi Plateau, opened in 1973. Rio Tinto has a 22.95% stake via its stake in Halco, which in turn holds 51% of the mine. The other 49% is held by the Guinean Government's Compagnie des Bauxites de Guinée (CBG), which operates a port at Kamsar, where bauxite is dried and shipped to refineries around the world. The mine has a capacity of 13mtpa.

QIT Madagascar Minerals: Madagascar

QIT Madagascar Minerals (QMM), held 80% by Rio, is a mineral sands operation based around an ilmenite orebody near Fort Dauphin, southern Madagascar. It comprises a mine, separation plant and port facilities.

Richards Bay Minerals: South Africa

Rio owns 74% of Richards Bay Minerals, which produces ilmenite from mineral sand deposits

Murowa diamond mine: Zimbabwe

Murowa is located near Zvishavane in south-central Zimbabwe. Production began in 2004 and the mine has a current capacity of around 400k carats per annum of large gem-quality diamonds. Rio holds 78% of Murowa, with the remaining 22% owned by Riozim Limited, an independent Zimbabwean owned and listed company.

Rossing Uranium: Namibia

Rössing is the world's longest-running open pit uranium mine. Operating since 1976, Rössing has produced the most uranium of any single mine.

Simandou South iron ore project:Guinea

Rio has a 47% stake in the Simandou South iron ore project. This is the subject of a separate case study in this note.

Mutamba titanium dioxide feedstock project: Mozambique

Mutamba is in the Inhambane Province of southern Mozambique. This mineral sands deposit was discovered by Rio Tinto Exploration, and contains the titanium-bearing mineral ilmenite. Rio Tinto began the project in 2002, and in June 2015 formed a JV with Savannah Resources whereby Savannah can earn up to 51% of the project in stages through undertaking scoping, pre-feasibility and feasibility studies.

Ten low cost mines globally by commodity

Figure 135: Top10 iron ore mines with lowest C1 cost

Mine	Ownership	%	Location	C1 cost (US$/t)	Reserve grade (%)	Reserve (Mt)	Transportation
Mariana-Fazendao	Vale	100	Brazil	8	55.5	311	Conveyor: 10km to Samarco pellet plant
Andrade	Arcelor Mittal	100	Brazil	14	64.5	62	Rail: 11km to Joao Monlevade plant
Hamersley - Yandicoogina	Rio Tinto	100	Australia	16	58.7	900	Rail: 447km to Cape Lambert port
Carajas - Serra Norte	Vale	100	Brazil	17	66.7	2399	Rail: 892km to Ponta da Maderia
Paraopeba - Capao Xavier	Vale	100	Brazil	17	65.0	47	Rail: 594km to Guaiba port
Robe River - Pannawonica	Rio/Mitsui/Nippon/Sumitomo	53/33/10.5/3.5	Australia	17	56.8	245	Rail: 245 to Cape Lambert port
Minas Centrais - Brucutu	Vale	100	Brazil	17	51.1	331	Rail: 542km to Tubarao port
Hamersley - Brockman 4	Rio Tinto	100	Australia	18	61.9	554	Rail: 291km to Port Dampier
Serra Azul	MMX	100	Brazil	20	52.4	149	Rail: 509km to Itaguai
Pedra de Ferro	ENRC	100	Brazil	35	64.8	229	Rail: 530km to Aritagua

Source: Deutsche Bank, Woodmac

Figure 136: Top10 thermal coal mines with lowest C1 cost

Mine	Ownership	%	Location	C1 cost (US$/t)	Reserve (Mt)	Transportation
Garda Tujuh Buana	Oswal	100	Indonesia	19.2	105	Barge: 8km to Tarakan
Lamindo Inter Multikon	Adani	100	Indonesia	19.4	114	Barge: 8km to Tarakan
Pesona Khatulistiwa Nusantara	Energi Nusa Mandiri	100	Indonesia	21.2	94	Barge: 50km to Tanjung Batu
Kintap ADK	Mega Coal/Orpheus Energy	50/50	Indonesia	21.4	3	Road: 13km, then barge: 5km to Muara Satui
Arutmin Mulia	Bumi Resources/Tata	70/30	Indonesia	21.8	220	Barge: 35km to Satui
Mitra Energi Agung	Indika /private shareholders	60/40	Indonesia	23.6	40	Barge: 50km to Lubuk Tutung
Baramulti Suksessarana	Baramulti Suksessarana	100	Indonesia	23.9	54	Barge: 80km to Muara Berau / Jawa
Bhumi Rantau Energy	Hansur Group/Padang Karunia	50/50	Indonesia	25.9	56	Road: 32km, then barge 110km to Tabonea
Arutmin Sarongga	Bumi Resources/Tata	70/30	Indonesia	26.0	60	Barge: 30km to North Pulau Laut
Titan Mining Sangkulirang	Titan Mining Indonesia	100	Indonesia	33.6	36	Road: 120km then Barge: 30km

Source: Deutsche Bank, Woodmac

Figure 137: Top10 coking coal mines with lowest C1 cost

Mine	Ownership	%	Location	C1 cost (US$/t)	Reserve (Mt)	Transportation	Remarks
Hunter Valley Operations	Rio Tinto/Mitsubishi	80/20	Australia	40	86	Rail: 110km to Kooragang (Newcastle)	
South Walker Creek	BHP Billiton / Mitsui	80/20	Australia	44	64	Rail: 137km to Hay Point Coal Terminal	Surface mine
Ravensworth North	Glencore / Itochu	90/10	Australia	46	42	Rail: 95km to Newcastle port	Surface mine
PTBA Air Laya	PBTA	100	Indonesia	52	11	Two rail options: 1) 200km to Kertapati, 2) 420km to Tarahan	
Jelinbah East	Anglo American/Marubeni/Sojitz/Zashvin	23.3/38.3/15/23.3	Australia	53	39	Road: 22km, then Rail 282km to RG Tanna & Barney Point	
Bara Prima Mandiri	Pacific Samudra Perkasa / Rohit Ferro Tech	60/40	Indonesia	56	9	Road: 62km, then Rail: 378km to Taboneo	Surface mine
Bulga Underground	Glencore / JFE / JX Nippon Oil & Energy Corp / NSSMC / Toyota Tsusho	68.3 / 1.6 /13.3 / 12.5 / 4.4	Australia	57	110	Rail: 90km to Port Waratah (Newcastle)	
Daunia	BHP Billiton / Mitsubishi	50 / 50	Australia	57	110	Rail: 172km to Hay Point Coal Terminal	Surface mine
West Wallsend	Glencore /Marubeni / Kokan Kogyo	80/17/3	Australia	66	5.4	Road: 5km, then Rail: 17km to Kooragang (Newcastle)	Longwall
Werris Creek	Whitehaven	100	Australia	70	17.8	Rail: 270km to Kooragang (Newcastle)	PCI

Source: Deutsche Bank, Woodmac

Figure 138: Top 20 copper/polymetallic mines with lowest C1 costs

Mine	Ownership	%	Location	Reserve Grade	C1 Cost (c/lb)	Reserve size (Mt)	Type
Garpenberg	Boliden	100	Sweden	0.1%	(19,123)	38	Zinc/copper
Rosebery	MMG Limited	100	Australia	0.3%	(4,182)	6	Zinc/Copper
Al Amar	Ma'aden	100	Saudi Arabia	0.8%	(2,448)	3	Zinc/Copper
Doe Run	The Doe Run Co	100	US	0.2%	(2,038)	76	Zinc/Copper
Raglan	Glencore	100	Canada	0.8%	(3,490)	7	Nickel/Copper
Zinkgruvan	Lundin Mining	100	Sweden	0.5%	(1,280)	15	Zinc/copper
Khandiza	Almalyk (AGMK)	100	Uzbekistan	0.9%	(1,199)	8	Zinc/copper
Santa Barbara	Grupo Industrial Minera Mexico SA	100	Mexico	0.5%	(890)	21	Copper/Zinc
Jinchuan	JNMC	100	China	0.7%	(1,560)	185	Nickel/Copper
Voisey's Bay	Vale	100	Canada	1.3%	(1,121)	17	Nickel/Copper
Zyryanovsk	Glencore Subsidaries /Tau-Ken Samruk/ Verny capital	69.6/29/1.4	Kazakhstan	2.0%	(591)	14	Copper/Zinc
Norilsk	RAO Norilsk	100	Russia	1.4%	(623)	873	Copper
Wolverine	Jinduicheng Xise	100	Canada	0.9%	(383)	4	Copper/Zinc
Ridder	Glencore Subsidaries /Tau-Ken Samruk/ Verny capital	69.6/29/1.4	Kazakhstan	0.4%	(261)	100	Copper/Zinc
Varvara	Polymetal	100	Kazakhstan	0.2%	(139)	42	Copper
Boddington Expansion	Newmont	100	Australia	0.1%	(38)	622	Gold/copper
Boliden Mill	Boliden	100	Sweden	0.4%	(440)	15	Copper/Zinc
Cadia Hill	Newcrest	100	Australia	0.3%	(113)	1690	Copper/gold
Chelopech	Dundee Precious Metals	100	Bulgaria	1.0%	(159)	24	Copper
Black Mountain	Vedanta / Exxaro	74/26	South Africa	0.3%	(497)	15	Zinc/copper

Source: Deutsche Bank, Woodmac

Figure 139: Top10 gold mines with lowest C1 cost

Mine	Ownership	%	Location	C1 Cost (US$/oz)	Reserve grade (g/t)	Reserves (M oz)	Mine type	Mining method	Remarks
Sanxin	Hubei Sanxin	100	China	(1578)	2.15	1.303	UG	Room and pillar, cut and fill	Copper by-products
Casposo	Troy Resources	100	Argentina	(304)	4.75	0.176	UG	Uphole retreat stoping	Silver by-products
Al Amar	Ma'aden	100	Saudi Arabia	(120)	4.59	0.486	UG	Uphole retreat stoping	Silver, zinc by-products; Depth of 300m
Yuanyang	Yuanyang Huaxi Gold	100	China	24	7.00	1.428	UG	Cut and fill	Silver, zinc, copper by-products
Belaya Gora (White Mountain)	Highland Gold Mining	100	Russia	167	3.58	0.374	OP	Heap leach	
Hishikari	Sumitomo Metal Mining	100	Japan	172	44.36	2.720	UG	Trackless, fully mechanised	Silver by-products
Cerro Negro	Goldcorp	100	Argentina		9.70		UG/OP	5 UG, 1 OP	Silver by-products
North Lanut	J & Partners LP / PT Lebong Tandai	80/20	Indonesia	220	1.56	0.05	OP	Dump leach	
Akyem	Newmont	100	Ghana	263	1.70	6.67	OP	Carbon in leach	
El Limon-Guajes	Torex Gold Resources	100	Mexico	378	2.61	4.08	OP	Carbon in pulp	Silver by-products

Source: Deutsche Bank, Woodmac

African project pipeline

Figure 140: African projects pipeline

Type of mine	Project Status	Name of project	Location	Ownership	Ownership split (%)	Brown/Greenfield	First production	Total Production/ Capacity	Total Capex (US$ mn)	Capital intensity (US$/t)	Comments
Copper	Highly probable	Palabora Lift 2	South Africa	Hebei Iron & Steel/S.A. IDC/Palabora	59.6/14.9/25.5	Brown field	2016	50	775	15,500	
	Probable	Kolwezi Tailings SxEw	DRC	ENRC/Gecamines	70/30	Brown Field SxEw	2016	70	700	10,000	
	Probable	Kinsenda	DRC	Miniere De Mushoshi et Kinsenda SARL	100	Brown field	2017	20	320	16,000	
	Probable	Bouskour	Morocco	Managem/(BRPM)	76.91/3.08	Green field	2016	25	na		
	Probable	Mwekera	Zambia	Macrolink Resources Limited	100	Green field	2016	7	na		
	Probable	Etoile Phase III Exp SxEw	DRC	Jinchuan Group/Gecamines	75/25	Brown Field SxEw	2016	22	na		
	Probable	Kipoi SxEw Expansion	DRC	Tiger Resources	100	Brown Field SxEw	2018	25	70	2,800	
	Probable	Tenke-Fungurume Exp 2 SxEw	DRC	Freeport McMoran / Lundin Mining / Gecamines	56/24/20	Brown Field SxEw	2020	115	850	7,391	
Total Copper								**334**	**2715**	**12,223**	
Iron ore	Highly probable	Guelb 2	Mauritania	SNIM	100	Brownfield	2016	4	913	228	
	Probable	Simandou South (Blocks 3 and 4)	Guinea	Rio Tinto/Chinalco/Govt of Guinea/IFC	46.6/41.3/7.5/4.6	Greenfield	2020	100	20,000	200	
Total Iron Ore							**104**	**20,913**	**201**		
Zinc	Probable	Gamsberg	South Africa	Vedanta/Exxaro	74/26	Greenfield	2019	250	630	2,520	
	Probable	Namib	Namibia	North River Resources	100	Greenfield	2016	20	25	1,250	Existing UG mine to be reopened; 20ktpm for first 2 years
	Probable	Tala Hamza	Algeria	Terramin/Algerian Govt.	65/35	Greenfield	2019	151	590	3,907	
	Probable	Asmara	Eritrea	Sunridge Gold/Govt	60/40	Greenfield	2016	50	54.4	1,088	
	Probable	Kabwe Washplant Tails	Zambia	Berkely Minerals	100	Washplant	2018	10	na		
Total Zinc								**481**	**1,299**	**2,701**	
Gold	Base case	Asanko - Obotan Project	Ghana	Asanko Gold Inc.	100	Greenfield	2018	411	565	1,375	
	Base case	Asmara	Eritrea	Sunridge Gold Corp. / Government of Eritrea	60/40	Greenfield	2016	26	76.3	2,935	
	Base case	Karma	Burkina Faso	True Gold Mining	100	Greenfield	2016	97	132	1,361	
	Base case	Koka Project	Eritrea	China SFESCO Group / ENAMCO	60/40	Greenfield	2015	80-140	172	1,564	

Source: Deutsche Bank, Woodmac, Company data

Figure 140: African projects pipeline (Cont'd)

Type of mine	Project Status	Name of project	Location	Ownership	Ownership split (%)	Brown/Greenfield	First production	Total Production/ Capacity	Total Capex (US$ mn)	Capital intensity (US$/t)	Comments
	Base case	Namoya Project	DRC	Banro Corp	100	Greenfield	ramp-up	108-120	225	1,974	
	Base case	New Liberty Project	Liberia	Aurus Mining	100	Greenfield	ramp-up	100-130	172	1,496	
	Base case	Yaramoko	Burkina Faso	Roxogold	100	Greenfield	2016	100	92	921	
	Highly probable	Bombore	Burkina Faso	Orezone Gold / Government of Burkina Faso	90/10	Greenfield	2018	116	260	2,241	
	Highly probable	Fekola	Mali	B2Gold Corp	100	Greenfield	2018	333	395	1,186	
	Probable	Baomahun	Sierra Leone	Amara Mining	100	Greenfield	2020	98.5	143	1,452	
	Probable	Hounde	Burkina Faso	Endeavour Mining	100	Greenfield	2017	190	300	1,579	
	Probable	Kiaka	Burkina Faso	B2Gold Corp / GEP Mines SARL	90/10	Greenfield	2018	329	705	2,143	
	Probable	Tengrela Project	Ivory Coast	Perseus Mining / SOMICI	85/15	Greenfield	2017	75	106	1,413	
	Probable	Tulu Kapi Project	Ethiopia	KEFI Minerals	100	Greenfield	2017	88	238	2,705	
Total Gold								**1893**	**3081**	**1,628**	

Source: Deutsche Bank, Woodmac, Company data

Appendix 1

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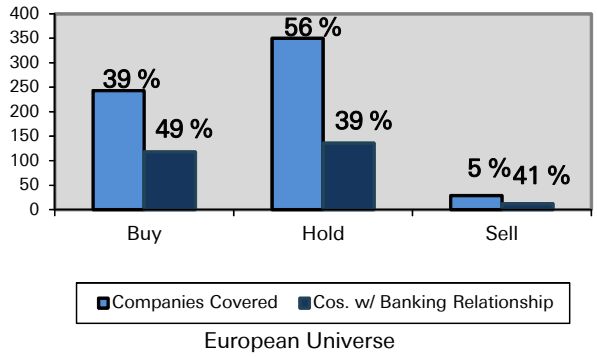

European Universe

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