Mining is the business of extracting useful minerals from the earth’s crust. Since minerals, once exacted, cannot be extracted again, a preoccupation of the industry historically has been the continued physical availability of resources in the ground. Would resources be sufficient to meet society’s long-term requirements or would the depletion of these resources eventually result in shortages of mineral products and escalating prices?

In recent years, there has been a growing realisation that this might not be the right question. The matter of minerals availability, it turns out, is more complex than previously thought. For one thing, it is evident that improvements in productivity have served to offset the effects of resource depletion with the result that production costs have not risen in the manner that early analysts of the industry had supposed they would. For another, and of greater significance for the future, there is a growing awareness that the recovery of minerals is more heavily dependent than previously thought on developments in other parts of the resource nexus; moreover, that the integration of the various parts of the nexus in relation to mining poses major challenges for corporate policy and for governance in mineral host countries.

The activity of mining is keyed into the resource nexus at several points. Most obviously, mining requires land for the exploitation of ores and for the disposal of wastes. These wastes are substantial, and become more so as ore grades decline, so this remains a challenging area. But mining also requires considerable amounts of water for washing and processing minerals. Large amounts of energy are required to recover minerals and even more to smelt and refine them to finished marketable forms. The connection between minerals and food is more tenuous, although it should be observed that mining is the source of two of the three key plant nutrients: potassium, phosphates and nitrogen. Over time, the linkages between mining and these other resource systems have become progressively more important. Indeed, it is argued here that over the long-term pressure on these other resource systems may turn out to be more critical in conditioning, and possibly constraining, the development of mining than is the physical availability of mineral ores.

Tectonic shift

The first decade of the new millennium was a momentous one for the mining industry. As a consequence of China’s rapid industrialisation, demand for mineral products surged and mineral
prices surged with it. Caught unprepared, the mining industry moved fast to step up its rate of exploration and investment. Some companies sought to boost their production and capture the benefit of the boom by buying up competitors. There was a wave of mergers and acquisitions (M&A) in the industry between 2005 and 2008.

The growth in demand for minerals from China and from other emerging economies brought with it a decisive shift in the customer base of the mining industry, away from traditional consumers in the advanced economies towards the emerging market and developing economies (henceforth emerging economies). During the mid-1990s, advanced economies accounted for a half to two-thirds of global consumption for the major metals (Figure 18.1). Only 20 years on, the position has been wholly reversed and three-quarters of consumption takes place in emerging economies.

This shift in the locus of mineral consumption gave mining new economic relevance. Whereas in earlier years the fate of the industry had been largely tied to the fortunes of a few hundred million people living in slow-growing and dematerialising advanced economies, suddenly it was being associated with the aspirations of billions of people striving to lift themselves out of poverty and to raise their material standards of living. Investors were quick to grasp the significance of the shift and to take a renewed interest in the mining sector. There developed a narrative of a prolonged commodity ‘super-cycle’ underpinned by material-intensive, investment-heavy growth in emerging economies, and of commodities as a ‘new asset class’. Investment funds poured into the industry.

A similar, albeit rather less dramatic, shift was taking place on the supply side of the industry. Mine production too was moving away from the advanced economies towards emerging economies.

![Figure 18.1 Distribution of global mineral consumption, 1995 and 2015](source: WBMS, WSA)
In part, this simply reflected the dictates of geology. Emerging economies collectively account for around three-quarters of the world’s land area and three-quarters of its resources, so it should not be too surprising that they were gradually moving towards a situation where they accounted also for around three-quarters of global mineral production. (Humphreys, 2015) The exception to this trend was iron ore, where rapid growth in production in Australia led to the advanced economies increasing their share of global production over the period shown in Figure 18.2. Alongside the growth in mine production from emerging economies was growth in the global role played by emerging economy mining companies, including those from the former Soviet Union (Russia, Kazakhstan, Ukraine), from formerly non-aligned countries (India, Mexico, Peru) and from China.

A distinct, but related trend, and one that is relevant to some of the developments discussed later in the chapter, is that more mineral production was taking place in mineral-driven economies; that is, in economies that depend heavily on the mining sector for their growth and exports. Historically, most mineral production took place in mineral-consuming areas. European, US and Soviet industrialisation was largely based on local resources. But, with the opening up of global trade and cross-border investment, more of the world’s mineral supplies started to come from mineral-driven economies. Thus, in 1960, 52% of the world’s copper and 79% of nickel originated in the major consuming countries. By 2010, the proportion had roughly halved, to 27% and 38% respectively. (Humphreys, 2013b) According to consultants McKinsey, by 2011 the world had 81 resource-driven countries, up from 58 in 1995, although it should be noted that their analysis included oil and gas producers as well as mining countries. (McKinsey, 2013)

The industry was moving into new territory and it was having to change.
Triggers of change

In point of fact, pressures for the industry to adapt to the new conditions had begun to emerge some time earlier. The 1980s and 1990s had been difficult years for mining. De-industrialisation in the US, Western Europe and Japan, coupled with the economic collapse of the Soviet Union, served to depress the demand for minerals and mineral prices. Countries in which government had taken a big stake in the mining industry during the commodities boom of the 1970s, in the hope that this would foster their development, had instead found the sector a burden on their public finances and sought to disengage from it through a series of privatisations. Indeed a view began to take hold that mining, far from bringing benefits to less-developed economies, often distorted them and corrupted them in ways that inhibited rather than promoted growth. Development economists pointed to negative correlation between resource endowment and rates of economic development and began to talk of a ‘resource curse’ (Auty, 1993; Sachs and Warner, 1995).

Against this background, the mining industry faced a crisis of trust. After years of weak prices and poor profits, investors had lost interest in the industry. Technology provided them with a much more compelling investment story. The public, never much enamoured of the industry anyway because of its conspicuous environmental impacts, was increasingly critical of it. The flames of this disenchantment with the sector were fanned by lurid tales about how revenues from the mining of diamonds and other high-value minerals were being used to fund rebel groups in Africa. New communication technologies were increasing the ability on non-governmental organisations (NGOs) to monitor mining activities around the globe and to draw the spotlight of public opinion onto mining industry transgressions. The legitimacy of mining was under attack along a broad front. This legitimacy had historically been a utilitarian one, one rooted in means and ends. Mining was a dirty activity but society needed the products of mining to support economic growth. However, this was no longer enough. The public was less and less impressed by justifications for the industry based on what it produced. They were increasingly interested in how it produced.

By the late 1990s, the mining industry realised it could no longer ignore these pressures. Moreover, it was becoming increasingly apparent that the many problems it confronted were interconnected. To attract money from investors and to fulfil their social obligations, companies in the industry needed to be profitable. In order to be profitable, they needed to manage better the operational risks associated with their environmental performance and their community relations. In order to gain access to the best mineral deposits, they had to persuade host countries that they understood the importance of operating in an environmentally and socially sensitive fashion and that they were ready to collaborate constructively in the promotion of national economic development.

Awakening to the nexus

Accompanying this growing awareness of the interconnectedness of the business challenges facing the industry, there was a growing awareness in the industry of the interconnectedness of the various resource systems with which it interacted. It was, in effect, waking up to the imperative of the resource nexus, albeit that this was not necessarily the term used to describe it.

Historically, the primary resource issue preoccupying the mining industry was geological availability. Were there sufficient mineral resources in the ground to sustain future production and could they be economically recovered? The economist W Stanley Jevons was the first to
articulate concerns about mineral depletion in his 1866 book *The Coal Question* – the ‘question’ being whether Great Britain was going to run out of coal. The Club of Rome returned to the question in its landmark study *The Limits to Growth* in the early 1970s, (Meadows et al., 1974) More recently, concerns about physical availability of minerals have resurfaced in the guise of the theory of ‘peak’ minerals, the theory that production naturally peaks as the better, more accessible, resources are used up and producers have to move to lower quality or deeper resources. (Bardi, 2014)

However, the industry was gradually being drawn to the realisation that resource availability was no longer the central issue it had to deal with. The resource equation was becoming a whole lot more complex. For sure, miners needed ore in the ground but their activities impact on a whole raft of other resource systems, the relationships with which needed to be managed just as much as did those with their ore resources. Specifically, they had to manage their impacts on land, on water and on energy and emissions.

Mining is an intensive user of land and miners have to compete with other land users for space in which to locate their mines and related infrastructure and on which to dispose of the considerable amount of waste that mining generates. And they have to do this in a way that does not detract from the biodiversity of the areas in which they operate, despoil water resources or pose physical threats such as subsidence. Pressures from this source occur everywhere but are particularly acute in the more advanced economies where pressures from alternative land uses are often greatest and organised opposition most acute.

Some appreciation of the scale of mine waste can be obtained by reference to a typical copper mine. The average ore grade of copper mines around the world is approximately 0.7% copper while the recovery rate of the copper from the ore is around 84%. Assuming an open-pit mine with a strip ratio of 2.5:1 (this is a measure of the amount of waste rock which has to be removed to recover one tonne of copper-containing ore), a miner needs to remove nearly 600 tonnes of waste material to produce one tonne of refined copper metal. For gold, where grades are measured in parts per million (grams per tonne) rather than in percentages, the proportion of waste generated to product recovered is significantly higher. For bulk commodities, like iron ore and coal, where most of what is dug up is useable product, it is significantly lower. Across the mining industry as a whole, it is estimated that some 60 billion tonnes of material are removed from the earth each year. (Ericsson, 2016)

Mining also uses a lot of water, this for concentrating minerals into a marketable form and, in the case of coal, for washing. The range of water use varies enormously from mine to mine, and many mines have highly sophisticated systems for recovering water used in their processes, but to give some idea of what is at issue here, it is estimated on average to take around 172 tonnes (thousand litres) of water to produce one tonne of copper and 107 tonnes to produce one tonne of nickel. For precious metals, the amount required per unit of output is significantly higher, although obviously the amount of metal produced is very much smaller. Some 600–700 tonnes of water are required to produce 1 kilogram of gold. Only 0.3 tonnes of water are required to produce a tonne of black coal, but, then again, the tonnages of coal produced are very large. (Mudd, 2008) The challenges of water to mining are compounded by the fact that mining occurs in some of the most water-stressed places on earth. The Atacama Desert in Northern Chile is at once both one of the world’s most important areas for producing copper globally as well as one of driest places on the planet. Other important mining regions facing water stress are southern Africa, the southern states of the US, Australia and northern China.

The third major resource system which mining impacts is energy. Substantial quantities of energy are required to dig out mineral ore, to dispose of mine waste, to crush and to grind the ores to liberate the sought-after minerals and, in the case of metals, to power the metallurgical
Mining and the resource nexus

Plants that convert ores into finished metal. Very approximately, energy represents a quarter of the total cost of producing the major metals. Associated with this use of energy, the industry is responsible for significant emissions of greenhouse gases to the atmosphere. Figure 18.3 shows the energy required to produce a number of important metals and the associated global warming potential (GWP) of that energy use expressed in tonnes of CO₂ equivalent. The experience varies widely between metals. The production of a tonne of steel results in the generation of around two tonnes of carbon dioxide, while the production of aluminium results in the generation of over 20 tonnes of carbon dioxide. It should be pointed out, however, that this analysis assumes all power is generated using coal. If the aluminium is produced using hydroelectric power, then the associated carbon emissions are reduced by half. (Norgate et al., 2007)

The mining of coal, which does not feature in Figure 18.3, is not particularly energy intensive but the burning of the coal is, of course, one of the world’s principal sources of greenhouse gases.

These other resource systems, land, water and energy, are, in their own way, as essential to mining as is the availability of mineral ore in the ground. Moreover, problems with any of them have the capacity to constrain investment and production in mining just as surely as does the depletion of mineral ore. In some parts of the world, these other resource systems represent a potentially greater challenge to miners than do the technical demands of mining itself. In short, in conducting its business it was becoming essential that the industry consider all of these resource systems and the connections between them in an integrated fashion.

Industry response

Collectively the issues outlined above represented a serious challenge for the mining industry. It could not simply respond by claiming to be misunderstood and address the issue with a programme of public education. Yes, the industry faced a problem of perception but this was
rooted in an underlying problem of performance. The mining industry had simply not adapted to society’s changing expectations of it. Some of the issues it faced, notably the negative image projected by artisanal mining (low-technology, pick-and-shovel operations), were somewhat beyond what the large miners could do anything about, but, with respect to what was within their power to manage, it was clear that they needed to raise their game.

The demand for business to give greater focus to the social and environmental dimensions of its activities was not, of course, restricted to the mining industry. The Rio Earth Summit of 1992, which did much to popularise the notion of sustainable development, put strong emphasis on the role that businesses of all kinds could play in helping to deliver growth in an environmentally and socially responsible fashion. Business is an integral part of the economic and social fabric and it needs a good-quality environment and social cohesion if it is to flourish. To build good environmental and social practices into its behaviour was therefore good business. This insight, and a desire to institutionalise and promote further the thinking behind it, led, subsequent to the Rio summit, to the creation of the World Business Council for Sustainable Development (WBCSD), based in Geneva.

The big mining companies were similarly being drawn to the conclusion that they needed to address their many challenges within a framework of sustainable development. However, as a business which involves the depletion of non-renewable resources, this represented a special challenge. It meant, in practice, that the focus of the industry’s efforts towards sustainable development would have to be on minimising the negative impacts of its activities on the environment and on the communities in the vicinity of their operations, while ensuring that a large part of the wealth generated by the drawdown of natural capital through mining was invested in other forms of capital which could continue to deliver returns after the mine was exhausted. (This notion of the conservation of the total capital stock is sometimes referred to by economists, somewhat unhelpfully, as ‘weak sustainability’.) These ‘other’ forms of capital include built capital, human capital, social capital and financial capital.

To assist with the development of its thinking on this matter, the industry launched a process of analysis and engagement called the Global Mining Initiative (GMI). The centrepiece of the GMI was a worldwide research and consultation exercise entitled Mining, Minerals and Sustainable Development (MMSD). The work took place over two years and the final report was presented at a major conference in Toronto in 2002. At the meeting, the industry announced (in a move paralleling the creation of the WBCSD) the setting up of a CEO-led organisation, the International Council on Mining and Metals (ICMM) to take the agenda of sustainable development in the mining industry forward on a continuing basis.

The MMSD report was the first ever attempt to examine the mining industry holistically, in all its forms and with all its ramifications. On the basis of this examination it sought to identify paths by which the industry could contribute to the global transition to sustainable development. In line with nexus thinking it urged the industry to better manage its interactions with other resource systems.

Managing [mining] impacts more effectively requires dealing with unresolved issues of handling immense amounts of waste, developing ways of internalizing the costs of acid drainage, improving both assessment and environmental management systems, and doing effective planning for mine closure.

It also urged companies to look beyond the mine site towards the entire life cycle of the minerals they were producing. “Companies at different stages in the minerals chain can benefit from learning to work together exploring further recycling, re-use, re-manufacture of products
and developing integrated programmes of product stewardship and supply chain assurance.” (MMSD, 2002).

Another key strand of the report focused on the social and political dimensions of mining. Companies and the communities in which they operated should seek to build partnerships to ensure that the community’s voice was heard in the design and development of mining projects and that the communities benefited fully from them. Tax revenues from mining should be transparent and should be used to improve social conditions of host nations as well as being invested in other activities that could generate streams of income for the future. “Minerals have the potential to contribute to poverty alleviation and broader economic development at the national level.” However, it also emphasised that this was not a matter wholly in the gift of mining companies. To realise the full economic and social value of mining, the sector required consistent, honest and informed governance, something which had all too frequently been lacking in the past.

The MMSD process, quite apart from its success in opening up a constructive dialogue with all parties affected by the mining industry’s activities, also encouraged the industry to address its broader interactions with other resource systems and with the societies in which it operated in a much more thorough and systematic way than it had done hitherto. Subsequent to the MMSD, the monitoring and reporting of companies’ social and environmental programmes improved dramatically. The ICMM collaborated in the development of a special supplement to the Global Reporting Initiative’s (GRI’s) Sustainability Reporting Guidelines, launched in 2010, to ensure that reporting covered such sector-specific matters as biodiversity management, community consultation, indigenous peoples’ rights, land disputes, mine closures and materials stewardship, in addition to the more regular reporting of its generation of wastes, its use of water, its emissions to the atmosphere, and its employment practices and health and safety performance. The industry also increasingly sought to be more proactive in its development and implementation of voluntary codes of conduct, as, for example, with the International Cyanide Management Code. (Franks, 2015)

This activity was not, of course, altruistic. It was done because the informed public had come to expect higher standards of mining companies than previously and, also perhaps, because by being proactive in adopting rigorous voluntary standards, the industry hoped to avoid having less well-thought-through legislative measures thrust upon it. Mining companies undoubtedly hoped that, by showing responsibility and demonstrating their commitment to the values of sustainable development, they would make themselves more acceptable as inward investors in mineral host countries and welcome and respected partners with local and regional communities.

**Consequences of the commodity boom**

The commodities boom referred to in the first section, which took off around 2004, had several important implications for mining and the resource nexus.

First, it deepened the geographic interconnectedness of the industry. Although itself a major producer of mineral raw materials, China’s demand far outstripped its capacity to supply the raw materials it required from domestic sources, giving a major boost to international trade in minerals and to the prospects of countries with significant mineral endowments. The principal flows of minerals (including fuels) to China are illustrated in Figure 18.4. Note the particular importance of Australia, Africa and Latin America to the trade in non-fuel minerals. Some 70% of the world’s annual production of iron ore is today traded across national boundaries. Thirty years ago the proportion was half this. In short, the boom served to increase further the mutual dependency of mineral-producing and mineral-consuming countries.
Second, the boom significantly raised the stakes in dealings between mining companies and mineral host countries and communities, generating tensions with regard to the terms on which the companies operated and the nature and scale of their contributions to local economic and social development. A study by Chatham House found that disputes in the resource sector increased dramatically in the 2000s relative to the previous decade. (Stevens et al., 2013)

While commodity prices were low there was not much to argue about but, with commodity prices soaring, everything about the industry became more important and many mineral host countries determined that they were not getting an appropriate share of the benefits. Taxes and royalties on mining were raised pretty much everywhere. Concerns also emerged in mineral host countries about ownership in the sector and a number of countries, including the Democratic Republic of the Congo, Zimbabwe, Kenya, Guinea, Burkina Faso, Madagascar, Sierra Leone, South Africa, Mongolia and Indonesia, enacted legislation requiring that a certain percentage of new mining projects be reserved for indigenous investors. Elsewhere, mining countries sought to ensure that minerals mined within their borders were processed domestically so as to capture the associated value added. Most dramatically, Indonesia banned the export of unprocessed mineral raw materials such as nickel ore and bauxite from the start of 2014. These developments, collectively referred to as expressions of resource nationalism, served to politicise the relationship between mineral host countries and inward investors in the mining sector. (Humphreys, 2015)

Below the national level, the new, higher profile of the industry and the emergence of plans to build new mines sometimes sparked a response from communities affected by mine developments. On the face of it, the engagement of communities with large mining companies was...
about ensuring that the companies behaved responsibly towards their neighbours and that the communities secured the best possible deal for their members. In practice, the situation was often more complex, with community opposition to mining being sometimes used to bring pressure to bear on government authorities to grant concessions on wholly other agendas, such as regional or indigenous peoples’ rights. Peru, which became a target for significant new investment in copper mining, was the scene of numerous local disputes based around environmental concerns (often water) and the rights of indigenous peoples, as well as the authority of the central government to make decisions about mine development in the regions. There were major outbreaks of violent unrest at the Tia Maria copper mine in the Moquegua Region, at the Conga gold mining project in the northern region of Cajamarca and at the Las Bambas mine in the Apurímac region of southern-central Peru (Economist, 2016). An official government report in 2015 stated that the country was subject to around two hundred incidents of civil unrest a month, of which half were associated with mining (Telesur, 2015).

A third consequence of the boom was that it encouraged the development of small-scale, high-cost, and often badly polluting mine producers. Modern large-scale mine production is highly capital intensive and, accordingly, new mines often take many years to build and bring into production. Because of the speed and extent of the surge in demand and prices in the middle part of the 2000s, the large established producers were simply unable to respond with new supply in a timely fashion. As a result, smaller, more labour-intensive low-technology operations stepped in to plug the gap. This happened across many regions, including Africa, India and Indonesia, but the biggest surge in this type of production was in China, which was determined that shortages of mineral raw materials should not inhibit its industrial development. Between 2002 and 2013, China’s mine production of copper tripled from 0.6 million tonnes to 1.7 million tonnes, while its iron ore production rose from 145 million tonnes in 2002 to a peak of 400 million tonnes in 2007 before dropping back. The surge in production propelled China into the front ranks of miners for a number of commodities but it came at a high environmental price, with the upsurge in mining, much of it unregulated or poorly regulated, doing extensive damage to water systems and to the health of employees and those living in the vicinity of mining operations. (Humphreys, 2015)

A fourth consequence was that the big mining companies were finding that the effort they had put into raising their standards of environmental and social performance was not paying the dividends they had hoped for with respect to relations with mineral host countries. Far from making these companies more attractive as inward investors, many mineral host countries viewed their fastidious and cautious behaviour as interfering and bureaucratic, preferring the engagement of investors with a more pragmatic (‘no strings’) approach to investment. The ability and willingness of Chinese companies to involve themselves in infrastructure projects, often with the support of state-backed development agencies and banks, often made them more attractive investment partners than their Western counterparts. While Western companies would doubtless argue that they were doing what they had to do anyway, since they could not be seen to be adopting different standards in different parts of the world, there was inevitably some disillusion about the fact that pragmatism and politics were frequently trumping the progressive business practices in which they had invested so much effort. In Africa in particular, big companies struggled to find and to commit to major investments, leaving large parts of the field to an assemblage of smaller opportunist companies, oligarchs, traders and middleman. (Burgis, 2015)

A fifth, and final, consequence of the boom was the politicisation of the issue of mineral supply in mineral-consuming countries. Rising commodity prices and the resurgence of resource nationalism triggered concerns in importing countries about the potential implications of these developments for their economic security. A number of studies in the US and European Union
(EU) pointed up their exposure to potential supply disruptions for a number of so-called critical minerals, many of these sourced from China. (Abraham, 2015) Despite widespread expressions of official concern, this did not result in many practical initiatives, save that in 2010, and again in 2012, the US and EU brought cases against China at the World Trade Organisation (WTO) challenging their imposition of export restrictions on a range of mineral products including rare earth minerals, molybdenum, tungsten, manganese and magnesium. These governments were, however, visibly reluctant to address the threat to their supplies through the active encouragement of domestic mining activity, presumably in part because of public antipathy towards the sector in these areas.

Where they were rather more active was with regard to the governance of mining companies listed on their stock markets and to the provenance of minerals used by their manufacturing industries. Thus there were significant efforts made through the Extractive Industries Transparency Initiative (EITI), launched in 2003, the 2010 Dodd-Frank Act in the US and under the EU Accounting Directive of 2013 to improve the transparency of payments made by companies to mineral host nations and to prevent the payment of bribes by companies domiciled in their jurisdictions. The Kimberly Process, launched in 2000, created a certification scheme designed to prevent the import of so-called conflict diamonds from regions where the revenues from diamond sales were believed to be supporting rebel activities. A similar certification scheme was introduced by the 2010 Dodd-Frank Act to restrict the import into the US of minerals such as tin, tungsten, tantalum and gold produced by rebel groups from the eastern provinces of DR Congo.

In short, the commodity boom created a whole new series of challenges with respect to the management of the nexus. The sudden and pressing requirement for mineral supplies which resulted from China’s rapid industrialisation produced a response in some regions which harked back to an earlier, more rugged, type of industry practice when ends dominated means in the mining sector, this even as major mining companies and the governments of advanced economy countries pushed ahead with their attempts to encourage sustainable development and raise industry standards. It also injected a new, more political, dimension into the business of resource development.

After the boom

The commodity price boom peaked in 2011, while the peak in industry investment came the following year. China’s growth rate began to slacken at the same time that production from new mines, the construction of which had been stimulated by higher prices, began to impact on mineral supply. Markets moved into balance and then into surplus with the result that mineral prices declined across the board, drastically reducing the profitability of the sector. As tends to happen at such times, the focus of the industry shifted from volume growth towards capital conservation and productivity improvement.

However, if prices were displaying their normal cyclical pattern, there was little likelihood that the larger companies in the mining industry could revert to their pre-boom, 1990s, behaviour in respect of the nexus. A line had been crossed. The nexus had become an integral part of the industry’s understanding of the world and its role within it; it could not unlearn the insights that the nexus had given it. In time, growth would return and the industry would have to think about expanding again. Moreover, rising population, increased standards of living across the globe and the push for a lower carbon economy, meant that pressures on land use, on water resources and industry emissions would only increase, and these issues become increasingly politicised.
An illustration of how perspectives had changed was provided by the collapse of a tailings dam at the Samarco iron ore mine owned by two of the world’s largest miners, BHP Billiton and Vale in the state of Minas Gerais in Brazil in late 2015. (Tailings dams are dams behind which mining companies accumulate liquid wastes arising from the process of concentrating ores so as to allow suspended solids to settle out.) Tailings dams are an undeniable weak point in the mining industry’s environmental defences and history has witnessed a number of such failures before in many countries, including Papua New Guinea, the Philippines, Romania, Guyana, Canada and Spain. (Franks, 2015) However, the public reaction to the new disaster suggested that the world had moved a long way from the point where such a collapse could be regarded as ‘just one of those things’, an unfortunate side effect of a necessary activity. Influenced no doubt by the public outcry in the US to the oil spill at the Deepwater Horizon drill rig in the Gulf of Mexico in April 2010, the public and government reaction was sudden and severe. Although a relatively small part of BHP Billiton’s portfolio, the company’s share price fell 25% as the government launched a multi-billion dollar case against the companies involved. The eventual settlement for damages came to over $5 billion. The message was clear. Events of this sort are no longer an acceptable part of the cost of our mineral supplies; they simply should not happen.

Although slower market conditions and lower profitability will add challenges to the mining industry, they will also provide opportunities for positive change. They will reduce the pressure to build new mines and encourage the consolidation and rationalisation of existing enterprises. Some of the more marginal and less reputable companies will be driven from the business while in countries such as China and India, which saw uncontrolled mining growth in the boom years, there will be opportunities to close small inefficient and polluting mines and to focus production on larger, better regulated, and cleaner mines.

None of this, of course, will relieve the leading companies in the industry of their obligation to lift their standards with respect to its environmental and social performance still higher. The agenda of the MMSD, while it prompted major improvements in industry practices, still remains highly relevant to the next stage in its development. Events like Samarco notwithstanding, the industry has done much to persuade the public that it is serious in its attempts to minimise the negative impacts of its activities on the environment and on the communities among which it works. But it still has much to do to move beyond the defensive posture of mitigation of impacts towards a focus on the positive contributions the sector can make to sustainable development through the transformation of natural capital into increased wealth and enhanced well-being.

There is also much still to learn about the implications of the shift that has taken place from the industry’s traditional preoccupation with below-ground resource issues to above-ground resource issues, and the constraints on its development potentially arising from the growing stresses on these above-ground resources. It is already clear that a significant proportion of the coal resources in the ground will remain there as ‘unburnable carbon’ since their recovery and use is incompatible with policies designed to combat global warming. In Chile, the world’s largest copper producing country, there is simply insufficient freshwater available to support continued growth of production and many future projects will have to factor into the costs of development the procurement of water supplies from elsewhere or the construction of water desalination facilities.

In addressing pressures on these other resource systems with which mining interacts, greater emphasis will doubtless come to be placed on reducing the demand for minerals through increased resource efficiency and the push to a circular economy. (McKinsey, 2011) This still has a long way to run and in some emerging economies has scarcely even been embarked upon but the pressure for it will grow with time and there is significant research being undertaken to expedite its progress. The ultimate objective is to decouple the use of mineral raw materials from
economic growth. Following the example of coal, it seems entirely plausible, after decades of worrying about the availability in the ground of minerals such as copper, that a certain amount of the resources we know about may turn out to be unusable long before physical exhaustion becomes an issue. (Humphreys, 2013a)

Perhaps the biggest outstanding challenge for mining and the nexus is that of governance; this at both international and national levels.

China has emerged in a relatively short space of time as much the largest consumer of the world's mineral raw materials. For many of the major base metals it accounts for almost 50% of global consumption; for seaborne iron ore its share is 70%. This is a degree of market dominance unparalleled in recent history (or at least since the US dominance of mineral markets in the 1950s). The speed of China’s economic emergence and the urgency of its requirement for raw materials to support its industrialisation resulted in it adopting pragmatic policies towards trade and investment which have sometimes strained established multilateral arrangements and understandings intended to govern these matters. Its trade in minerals has, for example, on several occasions, brought it in conflict with the rules of the World Trade Organisation, while its practices of using large amounts of ethnic Chinese workers in Africa have brought it into conflict with local populations. The fact that non-transparent state organisations have been behind many of these activities has added a further difficulty. There is a need for the institutions governing trade and investment in minerals to be updated to reflect the new economic and political realities and, if they are to stand any chance of working, China and its principal raw materials suppliers need to play a central role in helping to design them. (Preston et al., 2016)

With respect to governance at the national level, while there is much that industry can contribute, here also the primary responsibility for channelling the preferences of society, and signalling to industry what it expects from it, rests with government. Although, as remarked above, mining has become increasingly political in recent times, the involvement of government in the affairs of the industry has often been piecemeal and confused. During the boom years, too much of the effort of mineral host countries was directed towards extracting quick gains from the industry rather than considering how mining could best contribute to long-term national economic development, a tendency which too often favoured less transparent and less scrupulous investors.

To serve a country’s long-term interests, mining policy needs to incentivise good investors who are prepared to work closely with governments and communities in constructive and long-lasting partnerships. This implies a need to establish for those investors conditions of stability, transparency, security and predictability. This means good mining law, effectively and honestly enforced. Despite all the information about past events and behaviours which is available, it is noticeable how few countries have broken through to become attractive destinations for mining investment in recent times. The list of countries deemed attractive to investors by research organisations such as the Fraser Institute has changed little over the years and most investment in mining still goes to the same established mining countries with a proven track record as reliable, trustworthy hosts. (Figure 18.5) Among emerging economies, only Chile and Botswana have consistently been deemed to have attractive regimes for inward mining investment. Lower commodity prices will reinforce the tendency for investors to focus on the tried-and-tested, depriving other mineraly well-endowed countries of the opportunity for development.

Good governance is also key to the effective management of mining and the resource nexus. Well-thought-through and properly implemented regulations for mining are critical to ensuring the internalisation of environmental costs of mining, acid drainage and use of land for waste. In approaching these matters, countries can usefully draw on the experiences of other countries which have successfully addressed these issues, as well as guidance from schemes such as the
Mining and the resource nexus

World Bank's Extractive Industries Value Chain. (World Bank, 2009) Good property law is needed to ensure that a company's entitlement to mine is matched by a responsibility for ensuring that the property is not subject to abuse at the cost to the wider community. Governments need to co-opt the power of the market to ensure that the economic factors used in mining fully reflect their social and environmental costs. Much of world's freshwater is under-priced leading to its inefficient use. Carbon emissions are under-priced everywhere and in some cases, as a result of poor energy policies, their generation continues to be subsidised.

The policies of the major mineral-consuming countries have scarcely been more coherent than those of the mineral-producing countries and too often the policies adopted have become victims of the law of unintended consequences. The initiatives described above to improve the transparency of payments made by companies to mineral host nations may be laudable but the primary impact of these measures all too often falls on the companies which are already the most responsible and the most heavily regulated. Little good is served by tightening rules for listed companies to a point where these companies are incentivised to delist from the stock market and go private. Moreover, as has been pointed out by one of the EITI's early advocates, greater transparency in these payments has sometimes had the perverse effect of putting political pressure on host governments to direct tax revenues from resource projects to higher wages and vanity projects rather than invest for the longer term, precisely the opposite of the effect intended. (Collier, 2015) The same applies to the schemes to suppress the trade in conflict minerals. The Kimberley Process, although it has generally been a success, has seen its credibility badly dented by the recognition of diamonds produced by the government of Zimbabwe as an
approved source. Meanwhile, the attempts by the US government under the Dodd-Frank Act to restrict the import into the US of conflict minerals from the eastern provinces of DR Congo have proved so complex and unwieldy as to lead would-be buyers of these minerals to avoid purchases from all producers in that part of the world, both legitimate and illegitimate. (Thomson Reuters, 2014)

Conclusion

Recent years have seen a growing awareness of the extensive and complex manner in which mining interacts with other major resource systems. This has shifted the mining industry’s focus away from its traditional concerns about physical mineral depletion towards pressures arising from the resource nexus more broadly, and on those from land use, water and energy in particular. This shift in focus has necessitated the development of business strategies and systems of governance which address the whole network of interactions between mining and other resource systems in a systematic and integrated fashion.

Significant advances have undoubtedly been made by the mining industry in understanding and addressing the challenges posed by this shift in focus. However, the results have been patchy and much remains still to be done. While some of the larger companies have made great strides in placing their activities into the broader framework of the nexus, large parts of the industry, in employment numbers and environmental impact if not necessarily in terms of value added, remain largely untouched by its exigencies. But perhaps the biggest gap to be bridged in advancing the cause of the nexus in mining is the gap in governance. All companies operate within an institutional context established by government, and the commodity boom exposed major deficiencies in this area. China’s emergence as the world’s dominant mineral consumer has shown that there is a pressing requirement to look at the institutional arrangements which govern international trade and investment in mined products. At the same time, governments in many mineral-rich parts of the world still have much to do to develop effective policies which extract the full economic and social benefits which mining potentially has to offer while at the same time supporting companies’ efforts to manage the nexus by way of well-thought-through sector schemes and regulation.

Notes

1 The chapter follows the IMF distinction between advanced economies and emerging market and developing economies, save that in the interests of consistency over time the advanced grouping is held to include only the ‘old’ OECD countries. For brevity, the emerging market and developing economies are referred to simply as ‘emerging economies’.

2 We are grateful to Chatham House, the Royal Institute of International Affairs, for permission to reproduce the figure entitled ‘Chatham House and the DRC (2016)’ in ‘Navigating the New Normal: China and Global Resource Governance, 2016, Felix Preston, Rob Bailey, Siân Bradley, Dr Wei Jigang, Dr Zhao Changwen.’

References


