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A discourse analysis on how the sustainability agenda is defined within the mining industry

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**Abstract**

The mining industry has positioned itself within the sustainability agenda, particularly since the establishment of the International Council of Mining and Minerals (ICMM). However, some critics have questioned this position, since mining requires the extraction of non-renewable finite resources and commercial mining companies have the specific responsibility to produce profit. Complicating matters is that terms that represent the sustainability such as 'sustainability' and 'sustainable development' have multiple definitions with varying degrees of sophistication. This work identifies eleven sustainability agenda definitions that are applicable to the mining industry and organises them into three tiers: first, Perpetual Sustainability, that focuses on mining continuing indefinitely with its benefits limited to immediate shareholders; second, Transferable Sustainability, that focuses on how mining can benefit society and the environment and third, Transitional Sustainability, that focuses on the intergenerational benefits to society and the environment even after mining ceases. Using these definitions, a discourse analysis was performed on sustainability reports from member companies of the ICMM and the academic journal Resources Policy. The discourse analysis showed that in both media the definition of the sustainability agenda was focussed on Transferable Sustainability, with the sustainability reports focused on how it can be applied within a business context while the academic journal took a broader view of mining's social and environmental impacts.

## **A discourse analysis on how the sustainability agenda is defined within the mining industry**

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**Abstract**

The mining industry has positioned itself within the sustainability agenda, particularly since the establishment of the International Council of Mining and Minerals (ICMM). However, some critics have questioned how mining, a process that requires the extraction of a non-renewable finite resources, can be described as sustainable or how commercial mining companies, which have the specific responsibility to produce profit, can contribute to sustainable development. Complicating matters is how terms that represent the sustainability agenda, such as ‘sustainability’ and ‘sustainable development’, have multiple definitions with varying degrees of sophistication, particularly when used in the context of the mining industry. This work identifies eleven sustainability agenda definitions that are applicable to the mining industry and organises them into three tiers: first, Perpetual Sustainability, that focuses on mining continuing indefinitely with its benefits limited to immediate shareholders; second, Transferable Sustainability, that focuses on how mining can benefit society and the environment and third, Transitional Sustainability, that focuses on the intergenerational benefits to society and the environment even after mining ceases. Using the definitions, a discourse analysis was performed on sustainability reports from member companies of the ICMM and the academic journal Resources Policy. The discourse analysis showed that in both media the definition of the sustainability agenda was focussed on Transferable Sustainability, with the sustainability reports focused on how it can be applied within a business context while the academic journal took a broader view of mining’s social and environmental impacts. However, since neither media widely discussed Transitional Sustainability, this research indicates that a greater emphasis is needed by mining companies and academia to understand how the mining industry can optimally contribute to intergenerational sustainable development and implement this understanding within operations.

**Keywords**

Sustainability

Sustainable Development

Mining

Minerals

Discourse Analysis

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**Highlights**

- Eleven broad definitions of how the sustainability agenda is used in the mining industry were identified and organised into three tiers of sophistication: Perpetual Sustainability, Transferable Sustainability and Transitional Sustainability.
- The eleven definitions were then applied to two forms of media: company's sustainability reports and a research journal to understand how the sustainability agenda in mining is defined by industry and academia.
- The most commonly used definitions from industry and academia refer to how the benefits of mining can be transferred to society and the environment in the short term (Transferable Sustainability), rather than mining perpetually (Perpetual Sustainability) or how the mining industry can help society transition to long term sustainable development (Transitional Sustainability).

## 1. Introduction

The establishment of the International Council on Mining and Metals (ICMM) (International Council of Mining and Metals (ICMM), 2012a) in 2001 and the Mining, Minerals and Sustainable Development (MMSD) project in 2002 (International Institute for Environment and Development, 2002) acted as a catalyst for the mining industry to position itself within the sustainability agenda (which encompasses concepts such as ‘sustainability’ and ‘sustainable development’). From a communication standpoint, this can be seen at the corporate level with mining companies producing sustainability reports and reporting to international frameworks (Pellegrino and Lodhia, 2012) including the Global Reporting Initiative (Global Reporting Initiative, 2013).

Some critics have questioned mining’s sustainability claims (Kirsch, 2009; Power, 2002; Whitmore, 2006; Young and Septoff, 2002) since mining requires the extraction of finite natural resources and results in significant, at times negative, environmental and social impacts. However, the minerals industry has clearly made contributions to the development of society. In particular, mining produces the minerals, metals and energy that have been the central driver of development since before the industrial age (International Council of Mining and Metals (ICMM), 2012a) as well as providing employment and training (Lawrence, 2005; Trigger, 2003), paying taxes and royalties (Auty and Warhurst, 1993; Mikesell, 1994), providing vital infrastructure to local communities (Günther et al., 2008) and providing the materials needed for a low carbon economy (International Council of Mining and Metals (ICMM), 2012b). In addition, there is a compelling business case for mining to embrace the sustainability agenda within operations particularly in terms of lower costs (Van Berkel, 2007a, b) and lower risks (Esteve, 2008; Hamann, 2003).

Establishing corporate level sustainability goals is a fundamental early step in mining’s contribution to the sustainability agenda. Some have questioned if corporate level sustainability goals are currently being implemented at an operational level (Adams and Evans, 2004; Dando and Swift, 2003; MacLean and Rebernak, 2007), highlighting that once goals have been established further effort is required for them to be realised (Corder et al., 2010; Hilson and Murck, 2000; McLellan et al., 2009; Tuazon et al., 2012). However, language has both a reflective and constructive facility (Berger and Luckmann, 1967; Fairclough, 1992; Hajer, 1997; Hall, 1997), and therefore, can play an important factor in not only establishing corporate sustainability goals (Kemp et al., 2012; Laine, 2005; Schrettle et al., 2014) but also to setting the responsibilities of companies to achieve those goals (Buhr and Reiter, 2006; Laine, 2005) and promoting their implementation (Lodhia, 2012; Thøger Christensen et al., 2013). An example of the use of language to set and implement corporate goals can be seen in safety, whereby, a step change from the nomenclature of ‘acceptable risk’ (Furter, 2010) to the declaration of ‘zero harm’ as a corporate goal (Anglo American, 2013; McLeod, 2008) and commitment to implement this goal within operations (Anglo American, 2009) reduced fatalities by 70% in a five year period compared to almost no reduction in the previous 5 year period, as shown in Figure 1, despite some resistance to the appropriateness of such a strong goal within a mining context (Carroll, 2012).

<< Insert Figure 1 >>

A complication in establishing corporate sustainability goals and communicating progress in achieving these goals is the number of definitions used for terms such as ‘sustainability’ (70 different definitions (Lozano, 2008) and ‘sustainable development’ (over 100 (Dale, 2001)). Despite being distinct concepts, these terms are often used interchangeably (Lozano, 2008), contradictorily and sometimes to infer existence of other concepts (Carew and Mitchell, 2008). The lack of clarity surrounding these definitions has been mentioned and criticised previously (Hopwood et al., 2005; Lele, 1991; Mebratu, 1998; Robinson, 2004). A key reason for the magnitude of definitions is that the meaning of these terms is inherently context dependent (Bebbington, 2001; Hopwood et al., 2005; Kirsch, 2009). Here, a discourse analysis (Brown and Yule, 1983; Gee, 2005; Wetherell et al., 2001) has been performed that examines the use of these terms within a particular context, thereby, indicating how the mining industry positions itself within the sustainable agenda. The discourse analysis was performed on sustainability reports from ICMM member companies articles from the Resources Policy journal (Elsevier, 2013) to provide perspectives from both the industry and academia. This work provides eleven definitions of the sustainability agenda that are then grouped into three tiers:

- Tier 1 – Perpetual Sustainability, which focuses on benefits to shareholders and the continuation of mining;
- Tier 2 – Transferable Sustainability, which extends benefits to the broader community and environment; and
- Tier 3 – Transitional Sustainability, which focuses on providing intergenerational benefits to the broader community and environment, including after the completion of mining.

The analysis showed that the common definitions of the sustainability agenda lay within Tier 2, an intermediate level of sophistication that identifies the role of mining in maintaining or improving environmental and social standards without fully considering its intergenerational benefits and impacts. This indicates that more work needs to be performed at both at a corporate and operational level to fully align the contributions of mining to the sustainability agenda.

The rest of this article is organised as follows. First, it describes the methodology of the work, outlining how the definitions were derived and then applied to media as well as outlining limitations of the study. Second, it describes each of the definitions and provides examples of their use in the media. Finally, it presents the results of the discourse analysis first, in each medium separately and second, in a cross media analysis.



## **2. Material and methods**

### **2.1 Defining the sustainability agenda in a mining context**

The first stage of the research was to identify a set of definitions that describe how the sustainability agenda is defined within the mining industry. This was performed in the following steps.

First, a set of definitions for the sustainability agenda was derived by investigating its general use from a social (Jenkins and Yakovleva, 2006; Vallance et al., 2011), environmental (Goodland, 1995; Pearce, 1987), business (Mort, 2010), and micro/macroeconomic perspective (Nafziger, 2012) as well as its use in a mining context (Department of Resources, 2011; Fonseca et al., 2012; Hilson and Murck, 2000; Laurence, 2011; Owen and Kemp, 2013)

Next, the definitions were analysed to determine their suitability to the mining industry. Definitions that overlapped each other were combined while certain definitions were redefined. Ultimately, eleven definitions were chosen that could accurately represent the sustainability agenda in a mining context.

The final step was to organise the definitions into a hierarchy, based upon the level of sophistication from a very narrow scope, focussed on ensuing continuous mining or benefits delivered solely to direct shareholders, to a broader view, which described how mining could provide short or long term benefits to society and the environment.

The definitions and their tiers are described in Section 3.

### **2.2 Application of sustainability definitions to mining media**

After identifying the sustainability agenda definitions they were applied to media related to the mining industry. Two media were analysed: sustainability reports from member companies of the ICMM and the academic journal Resources Policy.

Sustainability reports outline the environmental and social performance of mining companies. Sustainability reports were a suitable medium for this study since they provide a pertinent indication to how the sustainability agenda is defined by major mining companies. Table 1 shows the number of reports published by different mining companies according to the year of publication. Only sustainability reports that were publically available on companies' websites were analysed. Sometimes, these reports used different titles than "Sustainability Report" such as: "Responsible Growth Report"; "Environmental Report" or "Corporate Social Responsibility Report" but all of them are in accordance with the reporting requirements of the ICMM and for the purpose of this study were considered equivalent. A smaller number of reports were analysed in 2012 than previous years as they were not published when the research was performed. An increased number of reports were published by Rio Tinto from 2009 onwards because it changed its corporate policy from producing a single report for the whole company to producing a report for each separate group.

<< Insert Table 1 >>

Academic journals provide an independent source to verify and compare the mining industry's position within the sustainability agenda, while also being of higher quality than alternative sources such as grey literature. *Resources Policy* is an international journal devoted to minerals policy and economics that has been published since 1974. *Resources Policy* is a suitable medium to review the use of the sustainability agenda in the mining context from an academic perspective since it covers a broad scope of topics, has a high academic ranking and a long period of publication.

Sustainable agenda terms have often multiple meanings (Bebbington and Thomson, 1996; Gray and Milne, 2004; Lele, 1991; Robinson, 2004; Tregidga and Milne, 2006), which are inherently shaped by their context (Kirsch, 2009). Based on this, discourse analysis is a suitable methodology for investigating how the sustainability agenda is defined within the media since it requires the assessor to analyse the use of terms within a specific context. Discourse analysis has previously been applied to exploring sustainability agenda issues within mining industry such as: perception of gender roles (Mayesa and Pinia, 2010); western influence on engagement with Indigenous People (Parsons, 2008); company ideology (Buhr and Reiter, 2006) and imbalance of power in company/community relations (Livesey, 2001). However, this presents the first time that a discourse analysis has been performed to define the sustainability agenda within the mining industry.

The discourse analysis applied here is best described as a micro-discourse approach (Alvesson and Kärreman, 2000) that investigates the detailed study of language at the micro level similar to previous studies (Buhr and Reiter, 2006; Tregidga and Milne, 2006). The discourse analysis was conducted as follows. First, terms that fit within the broad concept of the sustainability agenda such as: 'sustainability', 'sustainable' and 'sustainably' were located in the media. Then, their surrounding paragraphs were extracted and compiled into a list. Next, the extracted paragraphs were manually assigned definitions by the assessor. For the paragraphs that implied more than one definition, all implied definitions were assigned.

### **2.3 Limitations of Study**

Despite best efforts there are some limitations with study. The first is a lack of validation since the discourse analysis of the sustainability reports just investigates what companies are reporting, and not the extent to which companies are actually implementing the sustainability agenda in their operations. The cross-analysis of academic journal papers partially addresses this point, by providing an independent peer-reviewed analysis of the mining industry. A deeper analysis connecting reporting to implementation is worthwhile and has been studied previously (Deegan et al., 2002; Fonseca, 2010; Fonseca et al., 2012; Mudd, 2008; Pearce, 2012; White A.L, 1999), but it is beyond the scope of the paper. However, the authors believe that exploring how the sustainability agenda is defined in mining, one of the world's

largest, most impactful and contentious industries (Cowell et al., 1999) is worthwhile in itself. Furthermore, as language has a constructive function then a more sophisticated understanding of the sustainability agenda within the mining industry could lead to better implementation (Milne et al., 2009; Thøger Christensen et al., 2013).

The second limitation is that only one assessor performed the discourse analysis which could skew the results. However, this allowed for decisions to be made more with less variability than if multiple if multiple assessors perform the analysis. Finally, only two types of media were examined, which limits the coverage of the analysis. It was decided that while other media, such as grey literature, might offer alternative perspective they could potentially be less reliable than either company reports or academic papers, potentially magnifying the difference between reporting and implementation. Based on this, other media was also deemed to be outside of the scope of the research.

### **3. Results and discussion**

#### **3.1 Sustainability definitions**

Eleven definitions, organised into three tiers of sophistication, were identified to describe how the sustainability agenda is used within the context of mining. In addition, an additional definition was added to categorise instances that could not be assigned to other definitions. Here, the definitions and justifications for inclusion in their respective tier are described.

##### **3.1.1 Tier One – Perpetual Sustainability**

Tier One is Perpetual Sustainability, which categorises a processes sustainable if it can continue everlastingly. The idea of a process continuing indefinitely is borrowed from strong sustainability, with mostly technocentric (O'Riordan, 1981; Papert, 1990) solutions offered to resolve the inherent conflict of a practically finite resources being extracted indefinitely. It also takes a pristine capitalistic view of corporate responsibility, limiting it to making a continuous profit (Friedman, 1970; Gray et al., 1996) and largely ignoring environmental or general social impacts. Tier One is the least sophisticated tier since it has a narrow scope and has lower utility when applied to real-world 'wicked' problems, such as the complex social and environmental impacts of mining.

###### **3.1.1.1 Viable business (1)**

A viable business is one that is able to continuously make a profit (Thompson, 2003). This definition limits the social responsibilities of a company to create profit for its immediate shareholders (Friedman, 1970; Gray et al., 1996) rather than consider the broader social and environmental impacts of a business. It is this limited view of sustainability that places viable business in Tier One. There were no examples of sustainability agenda terms being used to infer a viable business within the examined media

### 3.1.1.2 Strong sustainability (2)

Natural capital is the stock of natural ecosystems that provides valuable ecosystem goods or services. Strong sustainability is a theoretical framework that states that the existing stock of natural capital must be maintained because the functions it performs cannot be duplicated by manufactured capital (Dietz and Neumayer, 2007). The ozone layer is one example of an ecosystem service that cannot be duplicated. Strong sustainability has been placed in Tier One since it solely focuses on maintaining natural capital, and does not consider that natural capital can be traded for greater short/long term environmental or social benefit. Furthermore, it is of limited utility since most industrialised human activity, for example industrialised agriculture or urbanisation, requires natural capital to be traded for other forms, and therefore, induces that most industrialised human activity cannot be considered sustainable.

“...*Sustainable development* requires that natural resources be regarded as capital assets whose value must be maintained by investment...” – (Mikesell, 1989) – Resources Policy

### 3.1.1.3 Resource replenishment (3)

Resources replenishment equates sustainability with the extraction of natural resources (Lozano, 2008) at a rate lower than their replacement. While it may be practical to apply resource replenishment in the mining context in terms of water or land use (Cote et al., 2010; Jankovic and Valery, 2002), it is impractical when applied to the replenishment of minerals themselves as it requires millions of years. This impracticality and its sole focus on a process are the reasons why resource replenishment is placed within Tier One.

“...Instead, that new model concentrate on looking for opportunities to increase economic activity through the careful management of natural resources. In particular, the model stresses *sustainable* resources use. All this means is that, where a resource is intrinsically renewable, it should be harvested or used in such a way that a given stock is always maintained (or even increased)...” – (Pearce, 1987) – Resources Policy

“...How can we maximize mineral use? How can other natural resources such as water be used in an increasingly *sustainable* way? We have broadened the scope of the Department of the Vale Technological Institute to include analysing these future scenarios...” – (Vale, 2009) – Sustainability Report

### 3.1.1.4 Technological advancements (4)

Technical advancement equates a process as sustainable if it can continue indefinitely by using technology to overcome constraints. Mining is often limited by the ability to identify, extract and process material at a cost that is economically and practically viable. Technical advancements can help to overcome constraints, thereby, allowing for increased production (Gunson et al., 2012; Van Berkel, 2007b). Some (Lawson, 2012; Viner, 2013) have argued that mining can be seen as sustainable as long as these advancements allow the production of material at a greater rate than their consumption. However, this argument ignores the fact that mining requires extraction of finite material, and even if technical advancements allow for the extraction of material at a lower quality for a longer period, it does not mean that extraction can continue infinitely. Furthermore, even with technological improvements, extracting and processing lower grade material often comes at a higher social and environmental cost in

terms of higher waste, water, energy and land use than prior technology (Mudd, 2007; Powell and Bye, 2009). Not considering these factors is the reason that this definition has been placed in Tier One.

“...jumps in productivity due to the development of new technologies and other innovations were essential to overcome the drop of competitiveness caused by the declining in mining conditions...innovation, development and diffusion of technology were essential for meaningful and *sustainable* improvements over time...” – (Joaquín Jara et al., 2010) – Resources Policy

“...if there is a sharp increase in the use of nuclear energy, then this period of two centuries shrinks. But within this time frame, and this is the second answer to the question, we will have new technology available, fourth generation technology on which we have already started to work, that will allow us to extract a hundred times as much energy from the same quantity of uranium as we can today. Which will mean that our stocks will last not several hundred years, but several thousand. That is what I call *sustainable* energy...” – (AREVA, 2009) – Sustainability Report

### 3.1.2 Tier Two – Transferable Sustainability

The definitions of sustainability contained in Tier Two broaden the scope of the sustainability agenda to consider the impacts of mining on society and the environment. This tier fits within the sustainability agenda by acknowledging that there are different types of capital that can be traded in order to achieve greater social or environmental benefits (Porritt, 2005), borrowing from the concept of weak sustainability (Adams, 1995; Bebbington, 2001; Common, 1995; Dobson, 1995; Ekins, 1993; Hajer, 1997; Meadowcroft, 2000; Pearce and Barbier, 2000; Von Weizsäcker et al., 1998). From a mining industry perspective, it requires companies to take more responsibility for their actions by acknowledging and minimising their (potential) negative environmental (Akerman, 1998; Carbon, 1997; Sánchez, 1998) and social impacts (Jenkins, 2004) or to consider and implement ways to make positive impacts (Epps, 1996; Hilson and Murck, 2000; Rajaram et al., 2005; Shrivastava, 1995).

#### 3.1.2.1 Sustainable business (5)

A sustainable business is one that strives to meet the triple bottom line in a safe and efficient manner (Laurence, 2011). This requires a broader scope for defining sustainability than in the definition of viable business, hence the reason for placing it within Tier Two. In the context of mining, a sustainable business requires that extraction practices takes into consideration the external impacts of the mine while maintaining their regulatory and social license to operate.

“...Traditionally, due diligence assessment for mining projects has been restricted to a review of the technical and financial aspects of a project such as the nature of ore body, processing technology, the financial model and the prevailing tax regime. However, mining companies are increasingly realising that failure to explicitly consider risks associated with non-financial issues (such as environmental, socio-economic and *sustainability* performance) may affect the economic viability or operability of a project...” – (Reichardt, 2006) – Resources Policy

“...Building a *sustainable* business requires ARM to continue to create and acceptable return for shareholders while at the same time understanding, managing and mitigating the impacts of its mining and smelting operations on the environment and societies in which it operates...” – (African Rainbow Minerals (ARM), 2012) – Sustainability Report

### 3.1.2.2 Weak sustainability (6)

Weak sustainability is a conceptual framework that allows for the replacement or duplication of natural materials and services with manufactured goods and services of equal or greater value (Cabeza Gutiérrez, 1996). When applied within the mining context, weak sustainability requires consideration to be placed upon the social and environmental impacts of mining. This is a broader definition of sustainability which considers the benefits of transferring natural capital to other forms of capital, placing it in Tier Two.

“...a weak *sustainability* argument that supports the substitution of natural capital rule, whereby depletion of natural capital can be replaced with an increase in other capitals (economic and social). This permits the extraction of mineral resources to be seen as *sustainable* as it does not compromise the ability of future generations to meet their needs...” – (Mutua et al., 2012) – Resources Policy

### 3.1.2.3 Economic development (7)

Economic development is improving the standard of living and economic health of a society (Nafziger, 2012). Such actions can involve multiple dimensions including development of human capital, critical infrastructure, regional competitiveness, job creation and other initiatives. The wealth creation associated with mining can promote economic development either on the micro or macro level. This may provide benefits for those outside the immediate scope of the company’s shareholders and for this reason been placed in Tier Two.

“...mines can also enhance major community infrastructure projects such as road and rail development, hospital and school construction, and housing development. Labonne (Labonne, 1999) argues that mining can foster *sustainable development* if the accrued rent from the depletion of mineral resources is continuously reinvested into sustainable economic undertakings and in community support services similar to those identified. The financing of such projects and operations, therefore, would improve the quality of life in the community...” – (Hilson and Murck, 2000) – Resources Policy

“...we continued expansion of our local supplier development programs aimed at stimulating economic growth and creating business opportunities in communities where few economic opportunities previously existed. These programs are designed to generate business benefits and *sustainable development* for local communities by increasing the capacity of local suppliers. ...” – (Barrick, 2011) – Sustainability Report

### 3.1.2.4 Environmental sustainability (8)

Environmental sustainability involves protecting or improving the natural world, such as preservation of ecosystem services (Goodland, 1995). Environmental sustainability demands that human activity is able to meet its needs while indefinitely preserving the life support systems of the planet either on a local, regional or global scale. For the mining industry to consider the environmental impacts of its operations requires a higher level of sophistication than just extraction of resources, and so it has been placed in Tier Two.

“...Wealthier societies have an increased environmental preference, which means that they not only can adapt the environment to suit their needs, but that preferred environment may well be ‘cleaner’ than that occurring naturally. An example here is mine discharge water quality standards that mandate a lower heavy metal content than that found in natural streams in the same area. Radetzki (Radetzki, 2001) ends with a chapter on the *sustainability* of what he sees as a well-functioning, human-directed management of the environment...” – (Davis, 2005) – Resources Policy



“...Mining operations inevitably have environmental impacts but we believe that over the lifecycle of our operations, we can approach environmental *sustainability*. Xstrata aims to preserve or restore the long-term health, function and viability of the natural environment affected by its operations. This means that, while we are operating and after we have closed a site, environments should be able to sustain biodiversity and ecosystem functions and in the long term return to as close to their former state as possible....” – (Xstrata, 2008) – Sustainability Report

### 3.1.2.5 Social sustainability (9)

Social sustainability is about ensuring that people have access to resources to meet current and future needs. (Vallance et al., 2011). This addresses both tangible and less tangible necessities such as essential needs for food, jobs, energy, water, shelter and sanitation as well as distribution of power and influence within the society, traditions, practices, customs, preferences and places that people would like to see maintained or improved (Fitzpatrick et al., 2011). In order for a mine to contribute to social sustainability it needs to provide benefits that are not just its immediate shareholders but also to members of its community and society in general, which places this definition into Tier Two.

“...its commitment to social responsibility, providing jobs, care for the environment, support for indigenous communities and for local *sustainable development*. Mining was presented merely as a means to an end...” – (Warnaars, 2012) – Resources Policy

“...Part of Argyle Diamonds’ ongoing commitment to social *sustainability* and community contribution lies in its close working partnerships with bodies such as the not-for profit organisation Jawun. In partnership with corporate business, Jawun works to help break the cycle of welfare dependency and to develop long-term outcomes designed to help empower Indigenous communities...” – (Rio Tinto, 2011) – Sustainability Report

### 3.1.3 Tier Three – Transitional Sustainability

Tier Three is most sophisticated tier involving multiple dimensions that describes how the mining industry can best contribute towards intergenerational sustainable development. It acknowledges that mining is a finite activity (Clark, 1997; Krautkraemer, 1985; Opschoor, 1997), considers the intergenerational impacts of mining across the value chain (Clift and Wright, 2000; Howarth, 1996) and describes how the benefits of mining can help transition society and the environment to a sustainable future (Gerlagh and Keyzer, 2001; Howarth, 1991; Howarth and Norgaard., 1990; Measham et al., 2013) beyond the viability of a single mine (La Croix, 1991; Rajaram et al., 2005), commodity (Alonso et al., 2012; Kharecha and Hansen, 2013) or the process of extraction (Ayres, 1997; Reck and Graedel, 2012; Wernick and Themelis, 1998)

#### 3.1.3.1 Life cycle assessment (10)

A life cycle assessment identifies opportunities for improvement by quantifying the impacts that a product has on the environment throughout its full life cycle, from resource extraction, production and manufacturing to disposal (Horne et al., 2009). Within mining, a life cycle assessment assesses the materials and energy used in mining operations (McLellan et al., 2012; Northey et al., 2013), the products formed from the material mined (Fleury and Davies, 2012; Responsible Jewellery Council, 2013; Silvestre et al., 2014) and the emissions generated through the combustion of its extracted fossil fuels (The Green House, 2011). Life

cycle analysis employs a high level of sophistication since it requires considering multiple social and environmental impacts, including those beyond a single mine, company or mining industry itself, and therefore, is placed within Tier Three.

“...the continued use of lead in lead-acid batteries remains *sustainable* due in part to the ability to maintain high recycling rates of batteries, thus minimising the amount of material for disposal and reducing potential risk to the environment...” – (Fleury and Davies, 2012) – Resources Policy

“...Life cycle assessments were also conducted in 2010 for talc products made at our operations in France, Austria and Italy...Improvements developed through Rio Tinto Minerals’ process are passed along to customers, who also conduct life cycle assessments in their ongoing efforts to heighten their products’ *sustainability*...” – (Rio Tinto, 2010) – Sustainability Report

### 3.1.3.2 Transitional development (11)

Transitional development is the ability of mining to provide an intergenerational environmental and social benefit beyond the lifetime of a single mine, commodity or the act of extraction as a whole. It is this long term focus that places transitional development within Tier Three. Transitional development has been seen at a micro level, where communities are created or enhanced within the vicinity of a mine (La Croix, 1991). The extraction of metals and minerals requires infrastructure such as settlements/houses for workers and rail lines/transportation for moving the ores and minerals. This infrastructure can be used by the local community during and after the extraction of minerals (Pamela, 2008; Veiga et al., 2001). Likewise, the mined land can be used for other purposes after mining has ceased (Worralla et al., 2009). Transitional development can also be seen at a macro level, the mining industry provides the foundation for the nation to transition from a mining based industry to a more comprehensive and diverse set of industries such as services, tourism and agriculture (Cleary, 2011) or fully transitioning to a low carbon economy (International Council of Mining and Metals (ICMM), 2012b).

“...a contribution to *sustainable development* can be made through the development of mineral resources that are managed at a local level such that a lasting legacy of diversified economy activity, education, skills, public health and rehabilitated land remains once mining activity ceases...” – (Cowell et al., 1999) – Resources Policy

“...We recognize that by collaborating with our neighbours we can play a role in building *sustainable* communities long after mining activities cease. Operations typically support local indigenous people, municipal authorities, other government agencies and community organisations in their efforts to achieve *sustainable* economic development...” – (Teck, 2005) – Sustainability Report

## 3.2 Discourse analysis results and discussion

The sustainability definitions were applied on sustainability reports and articles from the Resources Policy journal. The first medium analysed was the sustainability reports from member companies of the ICMM. These reports range from the years 2000 to the 2012 taken from 21 mining companies with a total of 128 sustainability reports assessed. The second medium analysed was the Resources Policy journal. The articles from the journal range from the years 1974 to 2012 with a total of 1,660 articles assessed.



### 3.2.1 Sustainability Reports

Figure 2 illustrates the results of frequency of sustainability definitions found in the sustainability reports. The definition of a viable business was not seen in the sustainability reports nor was the explicit discussion of strong or weak sustainability, although, weak sustainability is often implicitly inferred when discussing some other definitions such as social or environmental sustainability. The results indicate that the main focus of the mining companies' lies within Tier Two, with the most commonly used (60%) definition being sustainable business. This indicates that companies understand the need to improve their social and environmental performance; however, it is embedded within a business perspective.

<< Insert Figure 2 >>

Figure 3 shows the percentage use of each definition on a yearly basis. This shows that the definitions are used relatively consistently throughout the years, with the sustainable business definition used about 60% of the time each year, similar to the overall use.

<< Insert Figure 3 >>

Table 2 outlines the results of the discourse analysis by company and year. The trend across the companies is similar, with most definitions lying within Tier Two and sustainable business being the most widely used definition. BHP Billiton and Rio Tinto contributed the most number of occurrences to the discourses analysis, with Rio Tinto producing a sustainability report for each of their groups. This may have potentially skewed the results of the discourses analysis towards these companies. Hence, a further examination was conducted without those companies, the results of which are shown in Table 3. The examination shows that when BHP Billiton and Rio Tinto were removed from the discourse analysis the variation in terms of definition frequency was less than 1%. This indicates that their presence did not significantly alter the discourse analysis.

<< Insert Table 2 >>

<< Insert Table 3 >>

### 3.2.2 Resources Policy

Figure 4 presents the frequency of sustainability definitions found in the Resources Policy journal, which shows the use of all the definitions mentioned with the exception of viable business. Here, the definition of weak sustainability has been assigned to instances that explicitly discuss its representation as a theoretical framework; whereas, instances that discussed its individual dimensions (environmental sustainability, economic development and social sustainability) are assigned to their individual categories. The main focus of the Resources Policy journal is in the fields of environmental and social sustainability as they are most frequent definitions used in the journal.

<< Insert Figure 4 >>

Table 4 presents the frequency of the definitions within Resources Policy on a year-by-year basis. The results show three important ‘peaks’ in terms of overall frequency of use:

1. 1993 - 1995. The period correlated with the United Nations Conference on Environment and Development (UNCED) (Halpern, 1992), which, lead to the development of the Rio Declaration on Environment and Development, Agenda 21 and Forest Principles, the Convention on Biological Diversity, Framework Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification;
2. 1999 - 2000. This period correlated with the drafting of the Mining, Minerals and Sustainable Development report of the International Institute for Environment and Development, just preceding the formation of the International Council on Mining and Metals. After these dates there is a notable increase in the use of definitions throughout the rest of the analysis – highlighting the contribution of these events to the discussion of the sustainability agenda within the mining industry; and
3. 2007 - 2008. The period correlated with the publishment of the fourth assessment report of the Intergovernmental Panel on Climate Change.

<< Insert Table 4 >>

Figure 5 shows the percentage use of each definition within Resources Policy group by year (roughly five years). As with the overall figures, the Tier Two sustainability definitions tend to be the most commonly used each year. Within the early years of the analysis (1974-1979) there is a greater emphasis on Tier One definitions than in later years, while Tier Three definitions aren’t used until the 1995 onwards. This could indicate that as time progress there emerges a more sophisticated understanding of the sustainability agenda within this medium, however, given the small number of occurrences of sustainability agenda terms in the early

years analysed (only 1% of occurrences in the first 10 years) and Tier 3 occurrences overall (2% of occurrences overall), it is difficult to draw a definitive conclusion.

<< Insert Figure 5 >>

### 3.2.3 Cross-Media Comparison

The main difference between the two media was that the sustainability reports were heavily focussed on the definition of sustainable business while the academic journal had a broader view on the environmental and social aspect of the mining industry. Also time progressed, the academic journal discussed less Tier One definitions and more Tier Three definitions, a trend not seen in the sustainability reports. Finally, the academic journal also explicitly discussed both strong and weak sustainability, reflecting their positions as conceptual frameworks that are more likely to be discussed in academia.

Neither of the media used sustainability to infer the viable business definition, which could indicate that the minerals industry has matured from this definition (Sustainable Minerals Institute, 2012). Alternatively, little mention of the definitions relating to Tier Three sustainability were located in either media, which may indicate an unwillingness to fully include considerations about the sustainability agenda within the minerals industry. Alternatively, the lack of discussion on either definition could have been limited by the scope of the media assessed.

## 4. Conclusion

This work used a discourse analysis to explore how the minerals industry defines the sustainability agenda. It identified eleven sustainability definitions that are used in the mining industry to infer its sustainability agenda and organised them into three tiers of increasing sophistication. This investigation showed that the mining industry is focused mostly on how the sustainability agenda can co-exist with traditional profitability while academia takes a broader view. It also showed at while the industry and academia have moved beyond the narrow focus of sustainability just being equivalent to profitability or mining continuously, there is still a lack of discussion on how the minerals industry can full contribute to the sustainability agenda.

Future studies should look to further examine how the sustainability agenda is defined within the mining industry beyond the media studied here. Such media could include publications from prominent mining magazines, newspaper articles, blog posts and other industry reports or journals. Furthermore, multiple assessors could contribute to the discourse analysis in order to assess the robustness of the results.

It is hoped that greater understanding of how the mining industry can best contribute to sustainable development will promote greater sustainability agenda considerations within operational practices, thereby, improving the social and environmental performance of the

mining industry (Carroll, 2012; Corder et al., 2010; Hilson and Murck, 2000; Livesey, 2001; Milne et al., 2009; Thøger Christensen et al., 2013; Tuazon et al., 2012). Currently, this is largely a hypothesis, however, some related work is showing that this could be the case (Carroll, 2012; Thøger Christensen et al., 2013). Further work is required by both industry and academia to improve the mining industry's understanding of the sustainability agenda and its incorporation into operations.

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## List of Tables

Organisation	Year												Total	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011		2012
African Rainbow Minerals	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Anglo American	0	0	0	0	0	0	0	0	0	0	0	1	0	1
AngloGold Ashanti	0	0	0	0	0	0	0	0	0	0	1	1	0	2
AREVA	0	0	0	0	1	1	1	1	1	1	1	1	0	8
Barrick	0	0	0	0	0	0	0	0	0	0	0	1	0	1
BHP Billiton	0	0	0	0	0	1	1	1	1	1	1	1	1	8
Codelco	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Freeport-McMoRan Copper and Gold	0	0	0	0	0	0	0	0	1	1	1	1	0	4
Gold Fields	0	0	0	0	0	0	1	1	1	1	1	0	0	5
Goldcorp	0	0	0	0	0	1	1	1	1	0	1	0	0	5
Hydro	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Inmet	0	0	0	0	0	0	0	1	1	1	1	1	0	5
JX Nippon Mining and Metals	0	0	0	0	0	0	0	1	1	1	1	1	0	5
Lonmin	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Minerals and Metals Group	0	0	0	0	0	0	0	0	0	1	1	1	0	3
Mitsubishi Materials	1	0	0	1	0	0	1	0	0	0	0	0	0	3
Rio Tinto	0	0	0	0	0	0	0	0	0	17	17	15	0	49
Sumitomo Metal Mining	0	0	0	0	0	0	0	0	1	1	1	1	1	5
Teck	0	0	0	0	0	1	1	1	1	1	0	1	0	6
Vale	0	0	0	0	0	0	1	1	1	1	0	0	0	4
Xstrata	0	0	1	1	1	1	1	1	1	1	1	1	0	10
Total	1	0	1	2	2	5	8	9	11	28	28	30	3	128

**Table 1. The number of Sustainability Reports published by mining companies by year and used in the research.**

Organisation	Sustainability Definition No.												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
African Rainbow Minerals	0	0	1	2	46	0	14	6	1	0	0	2	72
Anglo American	0	0	0	0	46	0	2	3	4	0	3	4	62
AngloGold Ashanti	0	0	0	2	48	0	2	6	8	0	1	2	69
AREVA	0	0	1	23	68	0	16	5	5	0	0	14	132
Barrick	0	0	0	1	12	0	2	7	4	0	1	0	27
BHP Billiton	0	0	4	22	437	0	48	55	48	1	9	38	662
Codelco	0	0	0	0	22	0	6	0	2	1	0	7	38
Freeport-McMoRan Copper and Gold	0	0	0	3	55	0	7	6	9	0	0	4	84
Gold Fields	0	0	0	0	79	0	8	14	9	0	2	11	123
Goldcorp	0	0	0	1	52	0	5	9	3	0	1	1	72
Hydro	0	0	0	1	5	0	1	0	0	0	0	1	8
Inmet	0	0	1	2	65	0	15	5	11	0	2	9	110
JX Nippon Mining and Metals	0	0	0	10	45	0	7	11	23	0	2	4	102
Lonmin	0	0	0	0	33	0	1	0	1	0	0	5	40
Minerals and Metals Group	0	0	1	4	67	0	7	6	2	0	1	7	95
Mitsubishi Materials	0	0	1	5	6	0	10	0	4	0	1	1	28
Rio Tinto	0	0	3	16	302	0	70	31	52	4	14	30	522
Sumitomo Metal Mining	0	0	2	3	73	0	6	5	6	2	1	2	100
Teck	0	0	3	25	194	0	24	22	30	2	5	18	323
Vale	0	0	9	11	184	0	34	25	28	1	8	15	315
Xstrata	0	0	0	30	248	0	31	40	21	3	5	10	388
<b>Total</b>	0	0	26	161	2,087	0	316	256	271	14	56	185	3,372

**Table 2. Frequency of definitions in Sustainability Reports by companies.**

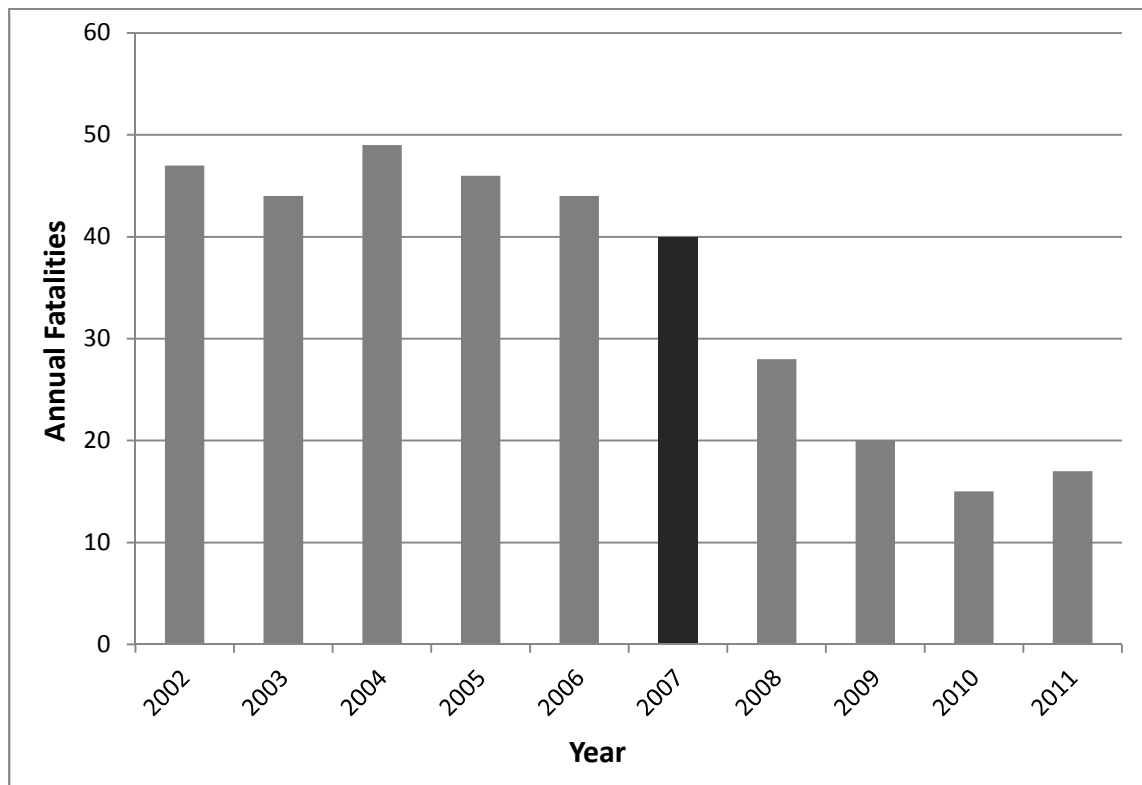
Scenario	Sustainability Definition No. (%)											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>With RT and BHP</b>	0	0	0.8	4.8	61.9	0	9.4	7.6	8.0	0.4	1.7	5.5
<b>Without RT</b>	0	0	0.8	5.1	62.6	0	8.6	7.9	7.7	0.4	1.5	5.4
<b>Without BHP</b>	0	0	0.8	5.1	60.9	0	9.9	7.4	8.2	0.5	1.7	5.4
<b>Without BHP and RT</b>	0	0	0.9	5.6	61.6	0	9.1	7.8	7.8	0.4	1.5	5.3

**Table 3. Variation in results under scenarios that include or remove BHP Billiton/Rio Tinto Reports**

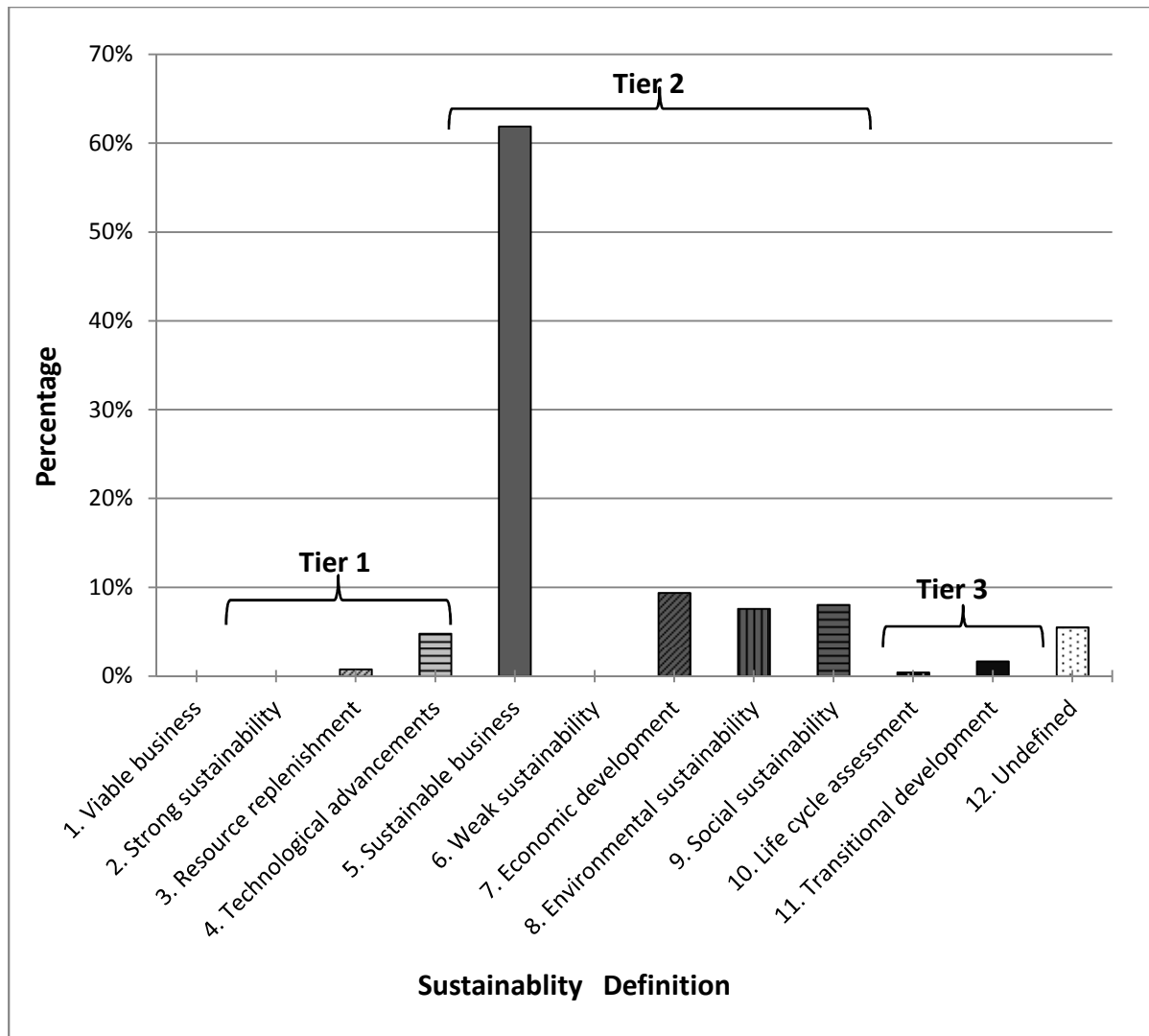


Year	Sustainability Concept No.												Total	No. of Reports	
	1	2	3	4	5	6	7	8	9	10	11	12			
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78
1977	0	0	3	3	0	7	0	0	0	0	0	0	0	13	47
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56
1979	0	0	1	1	0	0	0	0	0	0	0	0	0	2	56
1980	0	0	1	0	0	0	0	0	0	0	0	0	0	1	60
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61
1983	0	0	0	0	0	3	0	0	0	0	0	0	1	4	66
1984	0	0	0	1	0	1	0	0	0	0	0	0	0	2	54
1985	0	0	0	2	1	0	4	0	2	0	0	0	0	9	50
1986	0	0	0	0	0	0	1	0	0	0	0	0	0	1	55
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45
1988	0	0	0	1	1	0	2	0	0	0	0	0	0	4	60
1989	0	0	1	1	0	0	2	2	2	0	0	3	11	56	
1990	0	0	0	0	3	0	0	1	0	0	0	0	4	42	
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47
1992	0	0	1	0	0	0	0	2	2	0	0	0	5	42	
1993	0	0	6	0	10	20	9	12	12	0	0	3	72	38	
1994	0	0	2	5	7	50	14	10	6	0	0	3	97	55	
1995	0	1	5	9	4	30	11	8	11	0	0	4	83	53	
1996	0	1	4	1	3	9	3	1	6	0	0	1	29	39	
1997	0	0	0	0	3	3	2	0	1	0	1	1	11	43	
1998	0	6	4	4	9	17	9	10	12	1	0	5	77	35	
1999	0	0	2	0	3	12	1	0	2	1	0	1	22	33	
2000	0	1	0	1	4	4	1	1	3	1	0	0	16	35	
2001	0	0	9	4	10	4	8	11	15	0	0	6	67	38	
2002	0	1	1	1	0	10	1	1	2	0	0	1	18	20	
2003	0	0	0	0	1	1	1	1	2	0	0	4	10	19	
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2005	0	0	0	2	6	0	6	6	6	0	0	3	29	29	
2006	0	0	12	1	6	2	3	2	2	0	0	3	31	25	
2007	0	3	2	7	27	24	16	10	8	2	6	9	114	19	
2008	0	0	1	2	19	7	7	14	22	2	1	8	83	32	
2009	0	0	5	1	16	2	1	8	10	1	0	6	50	32	
2010	0	1	3	7	22	12	16	12	14	1	1	6	95	35	
2011	0	0	4	2	18	4	13	5	9	0	0	4	59	47	
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	11	
<b>Total</b>	0	14	67	56	173	222	131	117	149	9	9	72	1,019	1,636	

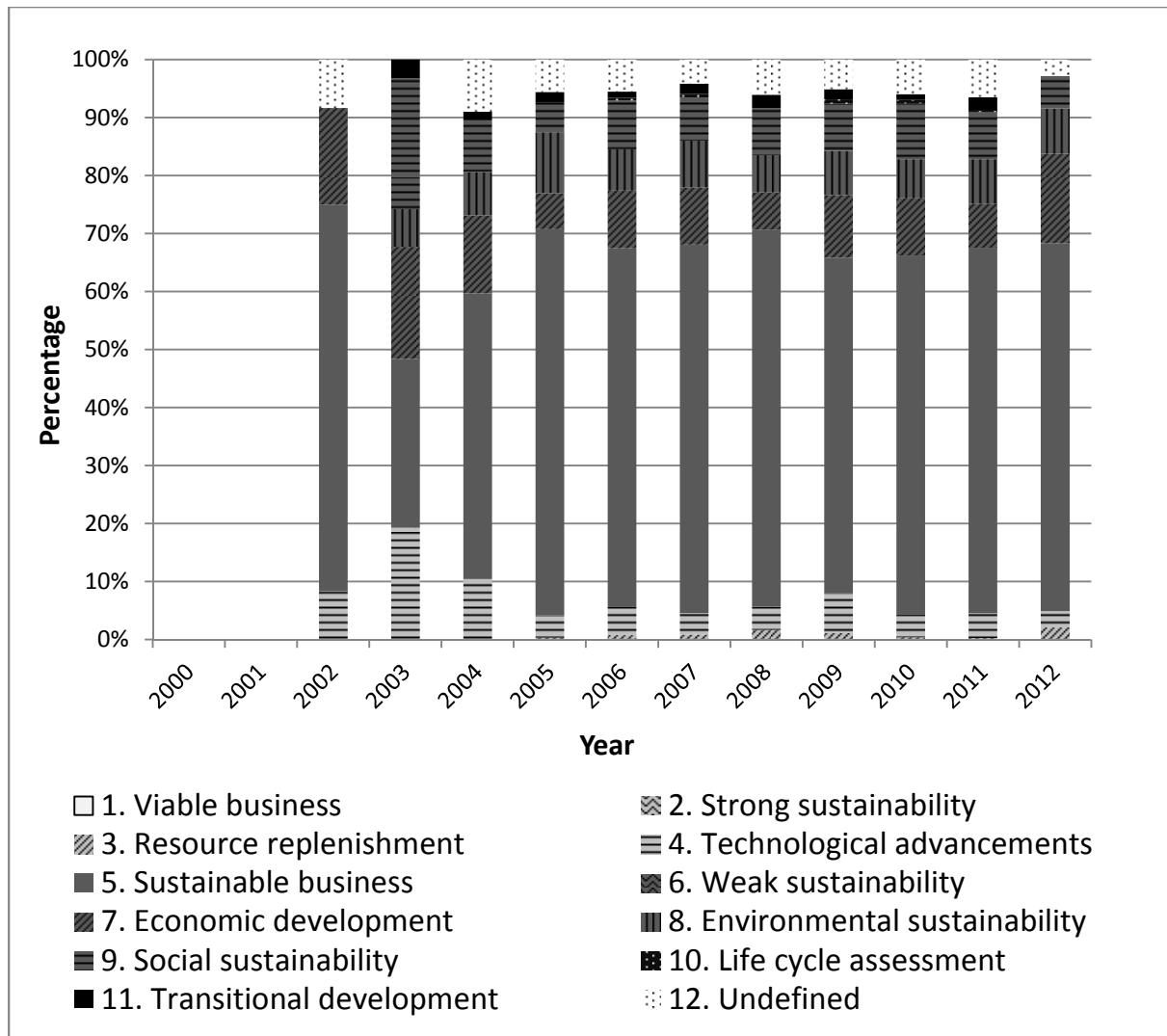
Table 4. Annual frequency of definitions in Resources Policy.

**List of Figures**

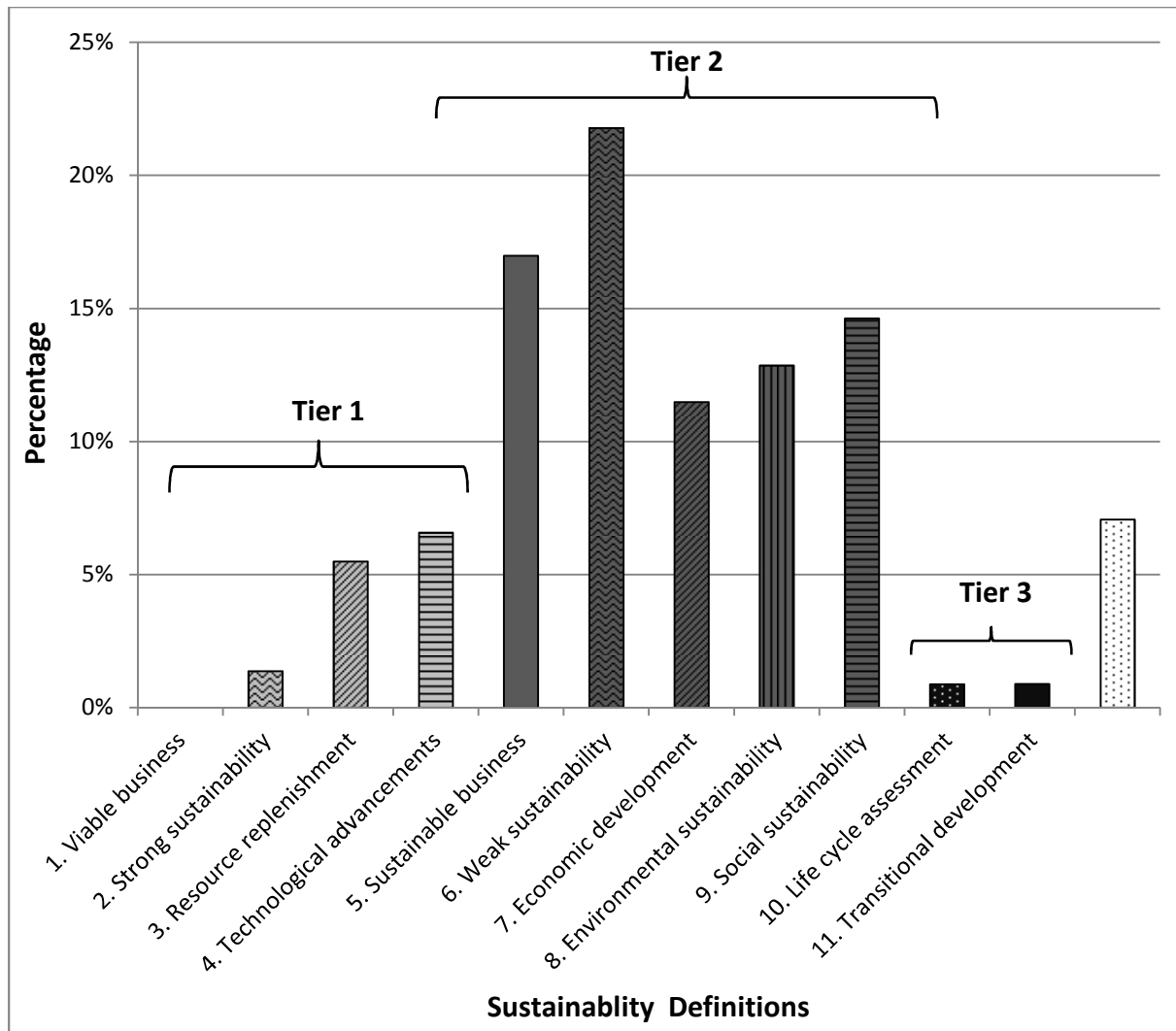
**Figure 1. Number of annual fatalities in Anglo American before and after the declaration of 'Zero Harm' in 2007 (Anglo American, 2003, 2007, 2013)**



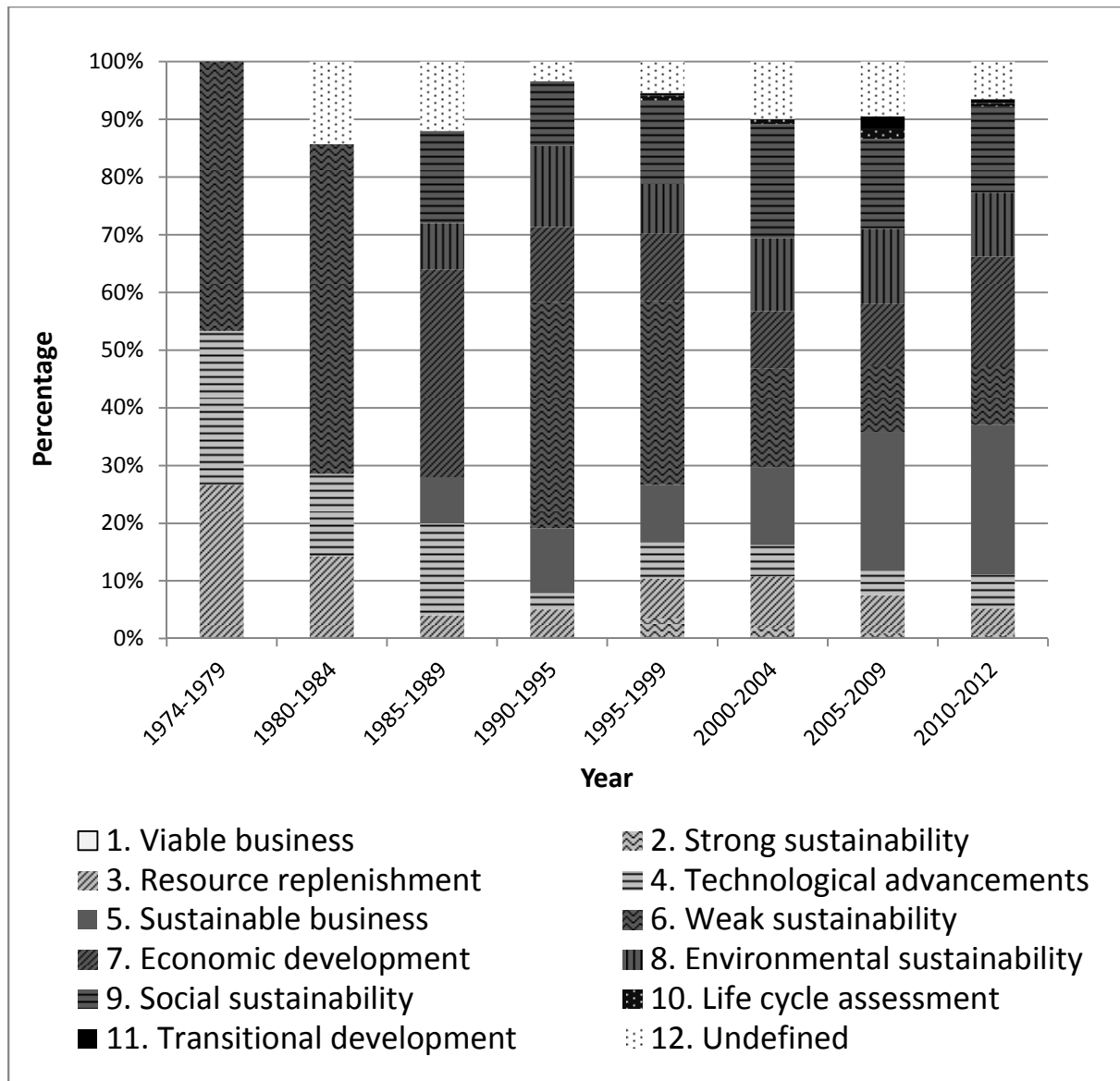
**Figure 2. Percent that occurrences of the sustainability agenda terms in the Sustainability Reports were categorised as a particular definition**



**Figure 3. Percent that occurrences of the sustainability agenda terms in the Sustainability Reports were categorised as a particular definition on a year by year basis**



**Figure 4. Percent that occurrences of the sustainability agenda terms in Resources Policy were categorised as a particular definition**



**Figure 5. Percent that occurrences of the sustainability agenda terms in Resources Policy were categorised as a particular definition grouped by years**

**Highlights**

- Eleven definitions of sustainability agenda terms in mining were identified.
- The definitions were organised into three tiers of sophistication.
- A discourse analysis applied the terms to industry and academic media.
- In both media an intermediate level of sophistication was the prominent use.

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