

# Nickel Institute

## Socio-Economic Impact of the Nickel Industry and Nickel Value Chain in Brazil

February 2009



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# 1 Executive Summary

In this report we have examined the economic impact of the Brazilian nickel industry, (“the nickel industry”) and its associated value chain. Because Brazil is primarily a producer of nickel ore, the results of the analysis emphasize the importance of mining over other aspects of the value chain such as stainless steel production.

To provide context of the nickel industry’s operating environment, we also determined the key challenges experienced by the industry. Social contributions provided by the nickel industry to employees and communities was obtained to augment the value chain results and provide further insight into company activity.

## 1.1 Economic impact of the Brazilian Nickel Value Chain

The nickel value chain encompasses the flow of nickel and nickel-based products from the extraction of nickel ores to end-use products containing nickel as a material input, such as home appliances and industrial machinery. This study is primarily concerned with the evaluation of the impacts, both social and economic, of this value chain in Brazil.

Perhaps the most important measure of total economic impact is the value-added contributed by an industry. Value-added measures the contribution of the factors of production to raising the value of a product. Value-added corresponds with GDP, which is the most standard measure of national income. Value-added for an industry, therefore, can be thought of as its contribution to national income.

Total value-added generated by the nickel value chain in Brazil is estimated to be R\$ 16.5 billion (US \$7.6 billion). It is estimated that the nickel value chain generates employment of about 189,000, with associated salaries and wages of R\$ 3.0 billion (\$US 1.4 billion).

## 1.2 Opportunities and Challenges for the Nickel Industry

Worldwide growth in the demand for stainless steel and specialty alloy products increases provides ongoing development opportunities for Brazil’s nickel mining industry. The increase in nickel prices has lead to the development of previously marginal ore sites. Both industries have undergone considerable consolidation resulting in increased domestic and international competitiveness. Benefits realized from the consolidation include economies of scale, greater market control and international prominence.

A significant challenge for the Brazilian industry is to secure a stable supply of production inputs, such as energy and metals, at reasonable prices to maintain the competitiveness of the industry. Another challenge is the ability to recruit and retain a skilled labour force. For many companies, a focus of their social contribution is the provision of opportunities for education and training both in the community and at the work site.

Additionally, underdeveloped infrastructure and transportation networks create additional challenges for Brazilian nickel mining companies. Due to poor infrastructure in remote areas of the country, nickel deposits are not accessible without large up-front investments adding to the cost of mining development.

### 1.3 Industry Contribution to Social Development

Member companies of the nickel value chain report being actively involved in local communities through a variety of community outreach programs and policies. Active consultation with shareholders and communities provide direction for the type of economic and social contributions that will provide the greatest benefits. Companies form active economic relationships with goods and services firms, which provide opportunities for local businesses and employment. Company support for social development takes the form of funding, staff, equipment and logistic resources for community development. Development initiatives such as investment in infrastructure projects are typical of the projects undertaken. Companies make investments in education at all levels of the education system, in addition to providing ongoing workforce training.

## 2 Background and Study Purpose

### 2.1 Background

The Nickel Institute, has requested the development of a baseline analysis of the global socio-economic impact of the nickel industry including production, use and recycling of nickel and nickel-containing products and materials. The purpose of the analysis is to further promote the availability and quality of socio-economic data that supports evidence of the contribution that the nickel industry makes to the sustainability goals of society.

This analysis expands upon the work<sup>1</sup> that was undertaken in 2003/2004 to generate and analyze nickel end-use data and socio-economic data for the Member States of the European Union (pre-expansion).

This is the first report of a series of reports that will analyze the socio-economic impacts of the nickel industry for a selected group of countries representative of the global nickel industry. Individual country studies will be completed for Australia, Brazil, USA, Mexico, Japan, Korea, China (including Taiwan and Hong Kong), India, South Africa and Russia. From these analyses, regional roll-ups for the Americas, North Asia, and South Asia will be conducted. Afterwards, a global analysis of total socio-economic impact results will be completed.

### 2.2 Study Purpose

It is expected that the analysis generated through these studies will produce relevant and reliable data and fill some data gaps that currently exist associated with the socio-economic impacts of nickel. The analysis is intended to foster a greater understanding of the global nickel economy.

The Nickel Institute is the industry association representing the interests of companies within the global primary nickel industry. The Institute promotes the production, use and re-use of nickel in a socially and environmentally responsible manner.<sup>2</sup> The global nickel industry is faced with many sustainability challenges relevant to social, economic and environmental aspects of the entire life cycle of the element.

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<sup>1</sup> The Socio-economic impact of the Nickel Industry in the EU: A baseline analysis, prepared for the European Nickel Group, The Weinberg Group LLC, 2004.

<sup>2</sup> The Nickel Institute, About the Nickel Institute, [http://www.nickelinstitute.org/index.cfm/ci\\_id/2/1a\\_id/1.htm](http://www.nickelinstitute.org/index.cfm/ci_id/2/1a_id/1.htm), Accessed September 25, 2007

## 2.3 Scope of the Research and Analysis

The scope of this study was to produce a socio-economic impact analysis that would provide a country-specific analysis of the Brazilian nickel industry and associated value chain. The country-specific analysis includes the following subject areas:

- Value-added
- Employment
- Salaries and wages
- Capital expenditures
- Capital employed
- Taxes
- Research and development

Analysis was completed using the value chain methodology which follows the flow of nickel, from extraction of nickel ores to production of nickel concentrate through to fabrication and manufacturing then recycling of nickel from finished products.

The value chain methodology follows the distinct stages of production in the material flow. Stages are categorized into four stages: direct nickel industry, first-use, intermediate use, and end-use. The value chain can be further analyzed according to whether nickel use is part of the broad value chain, narrow value chain or that of critical dependency. Measuring the “narrow” value chain separate from the “broad” value chain would require not only industry, but product specific data. Unfortunately, industry data collected by the Brazilian Institute of Geography and Statistics (IBGE) does not provide this level of detail. Therefore, our estimates should be considered measures of the “broad value chain.”

Our scope of work included the following tasks:

- Reviewed background reports and information provided by the Nickel Institute, including the Weinberg study
- Assessed the availability of published data sources for all countries to be included as part of the study
- Attended a day-long session with members of the Nickel Institute’s Members Working Group. At this session, we discussed issues and potential resolutions to data access and availability
- Reviewed the methodology used in the Weinberg study for the European Union nickel industry
- Collected data on the economic and social measures specifically for the Brazilian nickel industry from published sources as well as PwC published and internal documents
- Developed an economic impact model for the Brazilian nickel industry
- Communicated with representatives of the Brazilian nickel and stainless steel industry to collect data and verify industry data

- Analyzed the economic impacts (e.g., output, GDP, employment and government tax revenue) for the direct, first-use and end-use nickel industry
- Prepared a report summarizing our key findings and conclusions

## 2.4 Data Collection, Availability and Reliability

The broad scope of this study required us to use data that are consistent and published with frequency. Our industry statistics were mainly sourced from the *Instituto Brasileiro de Geografia e Estatísticas* (IBGE) using the codes from the Brazilian classification of national economic activities (CNAE). All data specific to the nickel ore mining and processing industry were sourced from the *Department Nacional de Produção Mineral* (DNPM).

The primary source of nickel use data used in this report is from the Heinz H. Pariser Alloy Metals and Steel Market Research publication, “End-Use of Nickel.”

Furthermore, because it is our mandate to cover a diverse value chain that spans several industries, it is also necessary to use a consistent series of data. In this study we have used 2006 as our base year for measuring the economic impact of the nickel value chain, however we used 2005 industry level data on employment, salary and industrial value-added (IVA) as a proxy because IBGE has not released 2006 data yet. In a dynamic industry like nickel mining, this means that the numbers shown in the report may not be reflective of the current market, especially given the volatility in metal prices.

It is our hope that the impacts measured in this report will be viewed as an indication of the magnitude of the average economic contribution of the nickel value chain to the Brazilian economy, rather than as specific to one point in time.

## 2.5 Organization of the Report

The report begins with an introduction to nickel and the nickel value chain. Definitions are provided for the categories used to measure the value chain: direct nickel industry, first-use and end-use sectors, narrow and broad value chains. Further discussion on nickel pricing and a short-term outlook follows.

Section 4 contains an overview of the Brazilian nickel industry and provides information on nickel production, reserves, mining operations and export data that describe the size and characteristics of the industry.

Section 5 outlines Brazil’s nickel value chain and discusses the methodology used to measure the industry across the various components of the value chain. Definitions are also provided for the categories of economic impacts measured in the analysis.

Section 6 provides the results of the economic impact analysis for the direct, first-use, end-use and total economic impact. Results include output, value-added, wages and

salaries, and employment. Additional analysis on human resources discusses the number of employees attributable to the industry, salaries and wages for each use and compared to the national average, and quality of employment based on educational attainment. Also discussed are estimates for capital expenditures, capital employed, and estimated research and development spending by the industry.

Section 7 provides an overview of key factors identified as opportunities and challenges for the nickel mining industry in Brazil.

Section 8 includes an overview of the industry's contribution to social development for both employees and communities. Several examples of policies and initiatives supported by nickel value chain companies are presented.

## 2.6 Report Limitations

This Report is not intended for general circulation, nor is it to be published in whole or in part, without PricewaterhouseCoopers LLP ("PwC") prior written consent. We do not accept responsibility for any losses arising from unauthorized or improper use of this Report.

PwC has relied upon the completeness, accuracy and fair presentation of all the information, data, advice, opinion or representations obtained from public sources and the Client (collectively, the "Information"). The findings in the Report are conditional upon such completeness, accuracy and fair presentation of the Information. PwC has not verified independently the completeness, accuracy and fair presentation of the Information.

PwC reserves the right, at its discretion, to withdraw or make revisions to the Report should PwC be made aware of facts existing at the date of the report which were not known to PwC when it prepared the Report. The conclusions and recommendations are given as of the date hereof and PwC is under no obligation to advise any person of any change or matter brought to its attention after such date, which would affect the findings and conclusions, and PwC reserves the right to change or withdraw the Report.

## 3 Nickel

Nickel-containing materials are found in a multitude of applications including buildings and other infrastructure, chemical production, communications, energy supply, environmental protection (including water treatment) and food preparation.<sup>3</sup>

Nickel can be made available through either mining or recycling. Commercial nickel mining involves two types of mines; oxide ore mines and sulphide ore mines. Nickel is the fifth most common element in the earth although much less prevalent in the earth's crust. The relative scarcity of surface deposits, the high levels of energy needed to refine nickel and the high unit value of nickel mean that there is a strong commercial incentive for recycling nickel. Stainless steel producers across the globe purchase, on average, about 45% of their nickel supply from scrap sources and 55% from primary sources.

Nickel is rarely used in its purest form. Most nickel is combined with other metals to produce alloys with particular combinations of properties that cannot be achieved by pure metals. Nickel products, therefore, play important enabling roles in many technologies to provide corrosion resistance, strength at high temperatures, and other special properties.

Nickel is used extensively in the production of stainless steel, a first-use that accounts for over 60 percent of primary nickel use. Examples of products using stainless steel include: chemical and food-processing equipment, transportation equipment, building facings in construction and other architectural applications, and many consumer products.

Other nickel uses of note include various battery chemistries, fuel cell chemistries, petroleum and other catalysts, pigments, electro-magnetic shielding, surface polishing and a stream of innovative applications that increase efficiencies or reduce impacts. Nickel alloys other than stainless steel are particularly prominent in demanding environments such as turbines and corrosive atmospheres.

### 3.1 The Nickel Value Chain

Value chains are used to describe and analyze the range of activities required to bring products or services from inception, through production, to final use and disposal. Extended value chain frameworks are often used to provide a more holistic understanding of the socio-economic environment in which industries operate.<sup>4</sup>

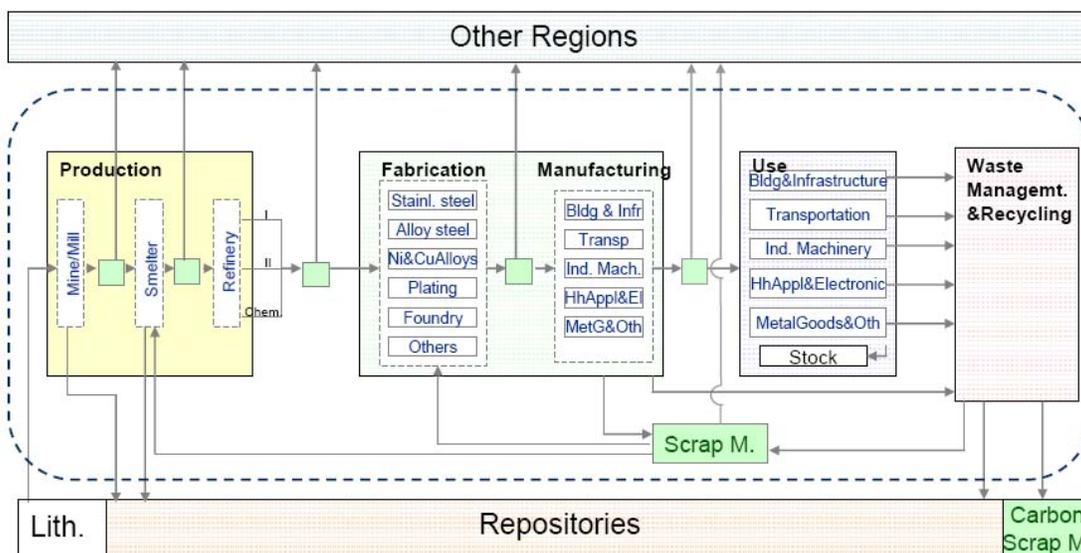
The diagram in Figure 3.1 presents a framework developed to describe the extended nickel value-chain. Our analysis uses this framework to estimate the economic impact of the Brazilian nickel value chain.

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<sup>3</sup> The Nickel Institute, Nickel and Its Uses, [http://www.nickelinstitute.org/index.cfm/ci\\_id/16/la\\_id/1.htm](http://www.nickelinstitute.org/index.cfm/ci_id/16/la_id/1.htm), Accessed September 25, 2007.

<sup>4</sup> A Value-Chain Analysis for the Sri Lankan Rambutan Subsector, Ismael Nicolas Barry, The International Centre for Underutilised Crops, 2006.

**Figure 3.1: The Extended Value-Chain Framework**



Source: Reck, et al (2006)

Figure 3.1 shows the material flow of nickel, from the extraction of nickel ores through to the recycling of nickel from finished products. There are three distinct stages or production in the material flow, representing a “value-chain” for the nickel industry. They are the “Direct Nickel Industry”, “First-Use Sectors” and “End-Use Applications”.

We have used the term “Direct Nickel” industry to describe the production stage, encompassing mining and mining services, smelting and refining, and other activities that facilitate the mining of nickel ores. It also includes the transport and logistical activities associated with the movement of nickel and the activities associated with the import of raw materials for refining and refined nickel.

The “First-Use” industry is comprised of fabrication and manufacturing of nickel-based products, most notably stainless steel. The nickel-containing alloys produced during this stage are sold to product manufacturers both directly and indirectly. Those that are sold indirectly go through distributors who serve smaller customers and fabricators, metal formers and surface engineering companies who undertake specialist services such as metal shaping, forming and sub-assembly.

“End-Use” describes a number of manufacturers of components, sub-assemblies, and other products that are then used in the manufacture of finished products.

The nickel value chain can be further described in terms of a “narrow” or “broad” value chain. The “narrow” value chain focuses on those products or processes that are critically dependent on nickel. That is, for cost or performance reasons, there are not other inputs that can be substituted for nickel.

The “broad” value chain includes all applications that contain nickel. This may include applications for which alternatives to nickel are possible but less preferred. The “broad” value chain is perhaps a better measure of the current overall economic contribution of nickel as it reflects present nickel use.

Measuring the “narrow” value chain separate from the “broad” value chain would require not only industry, but product-specific data. Unfortunately, industry data collected by the *Instituto Brasileiro de Geografia e Estatística* (IBGE) does not provide this level of detail. Therefore, our estimates should be considered measures of the “broad value chain.”

## 3.2 Overview of the World Nickel Industry

As of 2006, China was the world’s largest user of nickel, with Japan and the United States placing second and third respectively. Brazil, one of the world’s largest producers of nickel, is the 16<sup>th</sup> largest first user of nickel at 1.6% of global use.

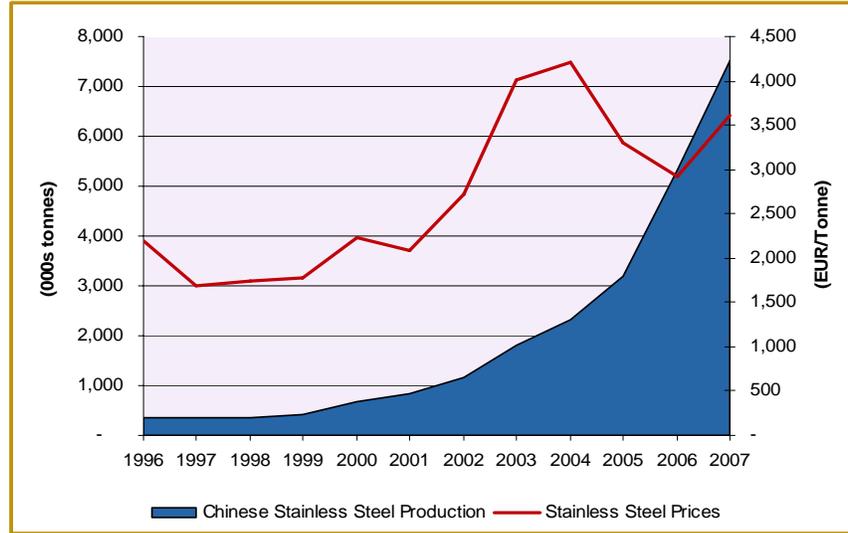
**Table 3.1: Worlds Largest First-Users of Nickel in 2006**

Rank	Country	% of World Nickel Use in 2006
1	China	19%
2	Japan	14%
3	United States	11%
4	Germany	9%
5	South Korea	7%
<b>16</b>	<b>Brazil</b>	<b>1.8%</b>

Source: Pariser (2007)

China’s growing stainless steel-producing industry has been a significant driver of the demand for nickel in recent years, and has contributed to rising nickel and therefore stainless steel prices, as shown in Figure 3.2

Figure 3.2: World and Chinese Stainless Steel Production



Source: Vale-Inco (2007)

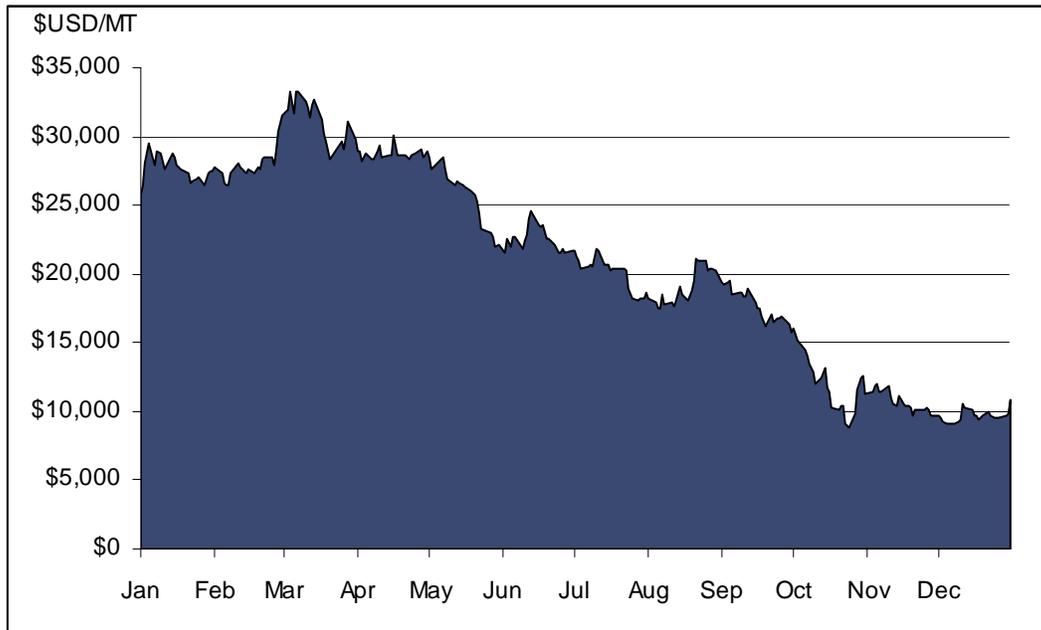
### 3.3 World Nickel Industry Outlook

It has become increasingly clear from the first three quarters of 2008 that the US economy is in what could be a protracted recession, induced by a collapsing housing market and turmoil in the credit markets. The once popular hypothesis that the world economy had decoupled from the US (and could continue to grow robustly in spite of a US recession) has been shown to be false as the global economy stumbles toward recession.

The global slowdown has wreaked havoc in commodities markets, with the price of virtually all major industrial metals plummeting. Nickel has not been spared from this turmoil, falling as much as 84% from US\$54,200/Mt in May 2007 to as low as US\$8,810/Mt in October 2008 before rallying slightly to finish 2008 at US\$10,810.

A socio-economic analysis is not a price forecast. Nonetheless, and to provide context to the socio-economic analysis, it is appropriate to observe the relevance of the attributes of nickel to sustainable economic and human development. It is reasonable to suggest that the role of nickel in society will not diminish, and may in fact increase.

**Figure 3.3. Decline in Nickel Prices in 2008**

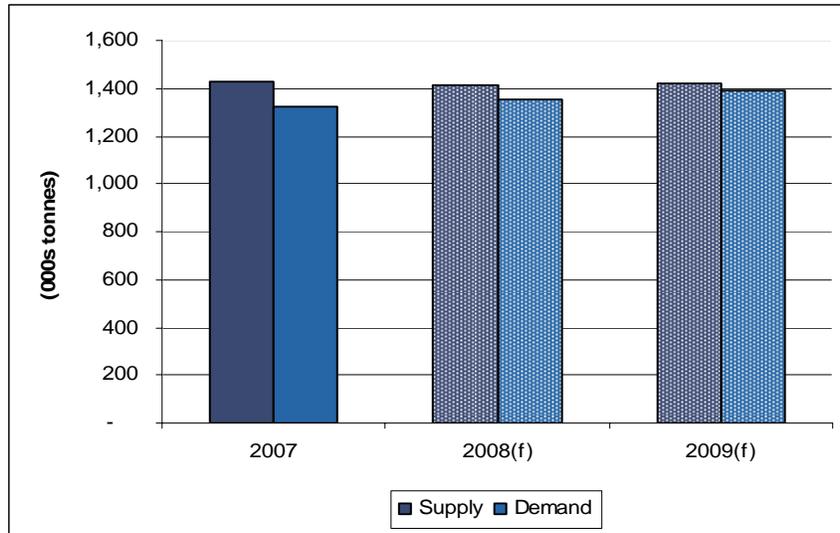


Some of the decline in price in 2008 can be interpreted as the impact of an excess of nickel supply over demand. Demand for nickel may remain light into 2009 as the effects of the global recession lead to reduced industrial production and demand for stainless steel.

New supply of nickel has been increasing with the commissioning of new mines and world nickel refineries operating near capacity. Production of nickel, however, is expected to moderate in 2008 and 2009 due to dramatically lower nickel prices and rising global inventories.

Projections for the supply, demand, and nickel prices in 2008 are shown in Figure 3.4 below.

**Figure 3.4: Global Nickel Supply & Demand Outlook**



Source: ABARE

## 4 Country-Specific Analysis - Brazil



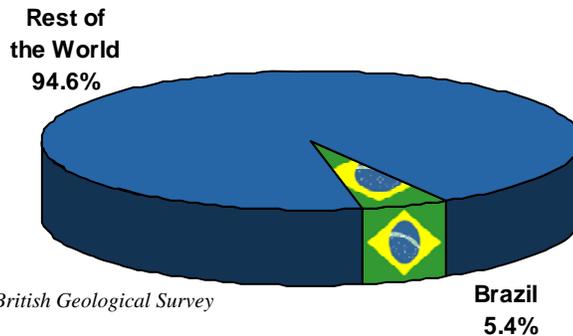
Annual Data	2006	% Share of World
Estimated Value-added of Nickel Value Chain (R\$ m)	16.5	n/a
Mine Production (tonnes)	82,500	5.4%
Nickel Reserves (tonnes)	9.5 b	6.7%
Nickel Use (tonnes)	22,300	1.8%
Exports of Nickel (tonnes)	28,867	n/a

In this section, we provide a brief outline of the nickel mining, smelting and refining activities in Brazil as well as discussion of nickel first-use, end-use, and trade flows.

### 4.1 Overview of the Brazilian Nickel Industry

Brazil has the seventh largest reserves of nickel in the world. These reserves are distributed across five states as follows: Goiás (40%), Pará (33.3%), Piauí (23.7%), Minas Gerais (2.5%) and São Paulo (0.5%). Production, however, is found only in two states: Goiás (83.5%) and Minas Gerais (16.5%).

**Figure 4.1 Brazilian Share of World Nickel Production**

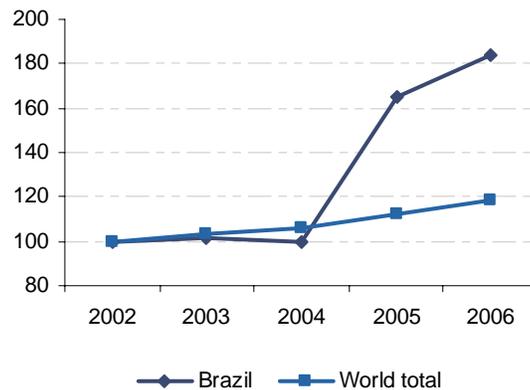


Source: British Geological Survey

### Domestic Production

In 2006, Brazil produced 82,500 tonnes of nickel, which represented 5.4% of the world's production (Figure 4.1). Since 2002, Brazilian production of nickel grew 84%, while total world production grew 18%. (Figure 4.2)

**Figure 4.2 Nickel Contained Production Index, 2002=100**



Source: British Geological Survey

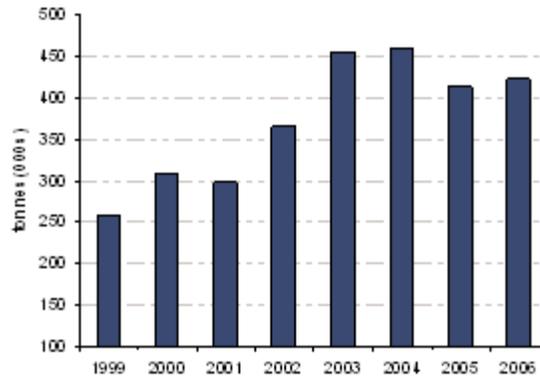
According to the 2007 Mineral Summary from the *Departamento Nacional de Producao Mineral*,

the main producers of nickel in Brazil are: *Votorantim Metais* and *Anglo American Brasil*. The group *Votorantim Metais* is the largest nickel producer in Brazil with 5 million tonnes of nickel ore and 17,000 tonnes of nickel matte. It owns and operates two mines, *Companhia Níquel Tocantins* and *Mineração Serra da Fortaleza*. Almost half of nickel production from these mines is exported to the United States.

As of this 2007 data, *Anglo American Brasil* was responsible for 488,000 tonnes of nickel ore with a content of 2.13% in Barro Alto, Goiás and processed 28,000 tonnes of ferro-nickel alloy in its plant in Niquelandia, Goiás. Anglo American allocated 85% of its production to supply the domestic market. ACESITA, the only producer of stainless steel sheets in South America, was its largest customer, absorbing 74% of Anglo American production.

According to the International Stainless Steel Forum (ISSF) in 2006, the world production of stainless steel was 28.4 million tonnes. Brazil produced 422,000 tonnes of stainless steel (Figure 4.3), which represented 1.5% of the world's production.

**Figure 4.3 Brazilian Stainless Steel Production, 1999-2006**



Source: [nucleinox.org.br](http://nucleinox.org.br)

## 4.2 Nickel Operations in Brazil

Figure 4.4 Brazil Nickel Operations



(Numbers refer to locations on the map)

### Nickel Mines (Operator)

- 3. Companhia Níquel Tocantins, Niquelândia – GO (Votorantim Metais)
- 3. Codemin Mine, Niquelândia - GO (Anglo American)
- 5. Santa Marta, Americano do Brasil – GO (Prometalica Mineração Centro Oeste)
- 6. Mineração Serra da Fortaleza, Fortaleza de Minas – MG (Votorantim Metais Níquel)
- 7. Companhia Nickel do Brasil, Liberdade – MG (Companhia Nickel do Brasil)

### Smelters

- 3. Níquel Tocantins, Niquelândia – GO (Votorantim Metais)
- 3. Codemin, Niquelândia - GO (Anglo American)
- 6. Fortaleza de Minas, Fortaleza de Minas – MG (Votorantim Metais Níquel)

## Refineries

8. Sao Miguel Paulista – SP (Vototantim Metais)

## Major Projects in Development (R\$ / US \$ = 2.17 in 2006)

2. Onça Puma, Ourilândia do Norte – PA (Vale-Inco), R\$ 3.0 billion (US \$ 1.4 billion)

1. Niquel do Vermelho, Carajás – PA (Vale-Inco), R\$ 2.6 billion (US \$ 1.2 billion)

4. Barro Alto, Barro Alto - GO (Anglo American), R\$ 3.3 billion (US \$ 1.5 billion)

3. FeNi production in Niquelândia (Votorantim), R\$ 558 million (US \$257 million)

6. FeNi production in Fortaleza de Minas (Votorantim), R\$ 82 million (US \$38 million)

### 4.3 Brazilian Nickel Exports

In 2006, Brazil nickel exports totaled 28,867 tonnes (US \$ 370 million). The majority of these exports were in the form of semi-manufactured goods (97.5%), while manufactured goods and chemical compounds together represented 2.5%. The main destinations for Brazilian nickel were Germany, Argentina, Austria, Finland, Italy, Japan, Korea, the Netherlands, the United States, Singapore, and Vietnam.

**Figure 4.3 Export Destinations for Brazilian Nickel by Volume**



## 5 The Nickel Value Chain in Brazil

### 5.1 Methodology

At each stage of the value chain, economic transactions take place. These transactions produce an array of economic impacts for the Brazilian economy. Like the material flow of nickel, the economic flows of nickel can be traced through the value chain using what are called input-output tables (or supply and use tables). Input-output tables are compiled by national statistical agencies and describe the underlying structure of the national economy by detailing the flows of production from industry to industry. What is produced by industry X is consumed by industry Y for use in its own production of goods and services, which are then consumed by industry Z and the cycle continues.

We have measured the economic impact of these economic flows using a combination of government statistics and industry expertise. The specific methodology for each segment of the value chain is outlined below.

#### 5.1.1 Direct Nickel Industry

We used production data from the *Instituto Brasileiro de Geografia e Estatística* (IBGE) and the *Departamento Nacional de Produção Mineral* (DNPM) to estimate the value of nickel ore mining and processing (smelting and refining) in the Brazilian nickel industry for 2006. The mining industry generates additional economic activity through “backward” linkages to industries supporting nickel mining. For the direct industry, these linkages include the transportation and logistics industry, services to mining (contract exploration and other services), and nickel scrap recycling.

Production in the nickel industry will also stimulate multiplier effects through the structural linkages of the Brazilian economy. For example, production in the mining industry will stimulate production by firms that provide materials and services to the mining industry. The effects of this production are referred to as “first round effects” and they will in turn stimulate production by firms that provide inputs to mining industry suppliers. These additional effects are known as “industrial support effects.” The multipliers were calculated using the latest input-output accounts, published by the Organization for Economic Cooperation and Development (OECD).

#### 5.1.2 First-Use and End-Use

Our estimates of the economic impacts of the first-use and end-use industries rely mainly on nickel use data compiled by Heinz Pariser. This data is widely accepted and used by the nickel industry.

Estimates for the first-use industry were made by first calculating the volume of metal products manufactured in Brazil based on ratios of nickel content in stainless steel, alloys steels, foundry and plating reported by Pariser. We then estimated total sales volume based on wholesale prices for each product. Value-added, employment and other

economic impacts were then calculated using industry ratios for the non-ferrous metal products industry in Brazil.

Estimates for the end-use industry were made by mapping Pariser end-use estimates to appropriate industry codes. Industry data is not published for individual goods and as a result an approximation was needed to be made for nickel-based goods. This was done using the ratio of purchases of nickel-based goods to all industry purchases of goods. Values for economic variables were then assigned to broad industry categories using relevant industry ratios.

As with the direct industry, we also applied multiplier effects to capture first round and industrial support effects stemming from first-use and end-use. Because much of end-use expenditure flows through first-use industries, there is a risk of double counting of impacts. We have therefore adjusted the multipliers to exclude the impacts already accounted for by the first-use industry.

## 5.2 Definitions of Economic Impacts

### 5.2.1 Output (Sales)

Output or sales refer to the total value of production attributable to nickel. In the case of nickel ore mining and processing, it is the value of mine and smelter production, whereas in the mining services sector and other retail sectors it is equal to total sales. In addition, we have included multiplier effects stimulated by nickel mining and processing activities.

### 5.2.2 Value-added

Value-added represents the marginal increase in value generated by an industry over and above the value of commodities it has consumed, that is, the contribution of the factors of production to raising the value of a product. It is also a measure of the contribution of an industry to Brazilian Gross Domestic Product (GDP).

### 5.2.3 Employment

Employment is the sum of all jobs that are directly related to, or dependent on nickel. Employment estimates are derived from the IBGE, and rely principally on published ratios of industry value-added per employee. We have also included employment generated by multiplier effects for each segment of the nickel value chain.

### 5.2.4 Salaries and Wages

This category encompasses total salaries and wages attributable to the nickel industry. It is estimated by multiplying the nickel employment estimates in each industry or segment of the value chain by the average salary and wages for that industry.

### **5.2.5 Capital Expenditures**

Capital expenditures are equal to the total amount of money spent on plant, machinery, and equipment, dwellings and business structures and intangible assets. Capital expenditures related to the nickel value chain are estimated by applying the industry average investment rate (as a % of value-added) to value-added attributable to nickel.

### **5.2.6 Research and Development**

Estimates for R&D expenditures are based on data from the IBGE for average industry spending on R&D as a percent of GDP (value-added).

### **5.2.7 Capital Employed**

Capital employed is equal to the sum of equity capital and long-term debt and provides a measure of the total financial resources dedicated to the nickel industry. The nickel industry is global in scope and populated by large mining and stainless steel conglomerates that make their capital structure decisions based on their aggregate business. Therefore, to estimate the capital employed that is attributable to nickel, we have relied on industry level debt-to- equity and financial leverage ratios. These estimates provide an indication of the magnitude of capital employed in the nickel value chain rather than a precise accounting of the book values of debt and equity.

### **5.2.8 Taxes**

Our estimates of taxes generated by the nickel industry include corporate income taxes (34%), resource royalties, and a national payroll tax equal to 37.3%.

### **5.2.9 Currency**

All economic impact estimates are in Brazilian Real (R\$). The conversion rate of Brazilian Real to American dollars (R\$ / US\$) is 2.17, which represents the average exchange rate in 2006.

## 6 Economic Impact of the Nickel Industry in Brazil

### 6.1 Economic Impact of the Direct Nickel Industry in Brazil

The Direct Nickel Industry comprises nickel mines, smelters and refineries. Also included are services to mining (contract exploration and other mining services), transportation and logistics, and activities related to recycling of nickel containing products (for more on nickel recycling see Box 1).

#### **Box 1: Nickel Scrap Recycling**

Nickel-containing scrap is generated via the production of nickel-based materials and products, and scrap generated at the end of a product's life. The latter is sometimes called post-consumer waste and includes nickel-based products such as batteries. Because scrap materials contain highly valuable nickel, there is extensive recycling and trading of nickel-based scrap materials.

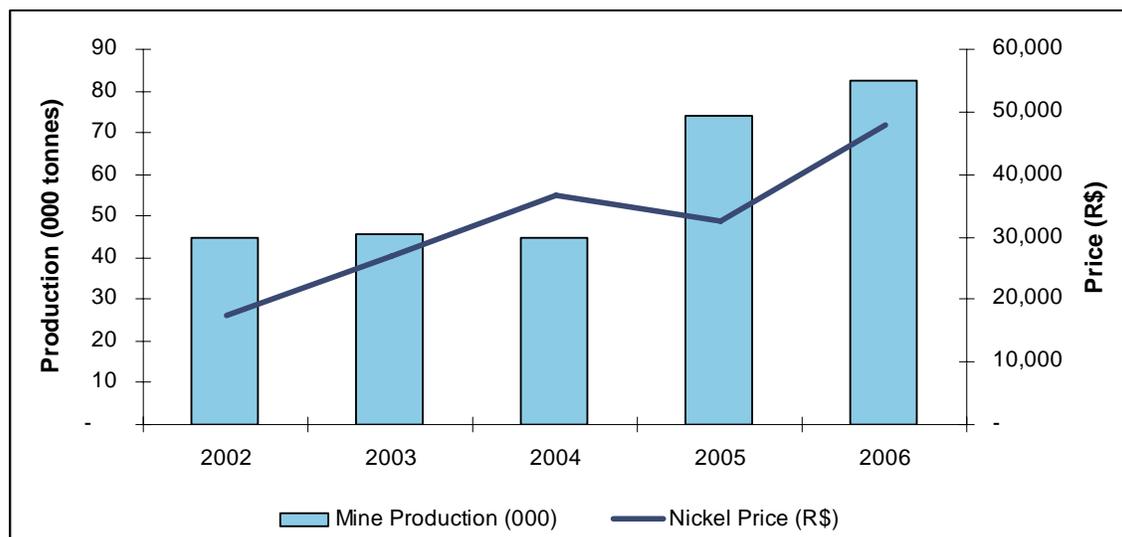
The majority of scrap and nickel contained in waste products such as spent catalysts end up as input for production of stainless steel. There is a continuous demand for nickel-containing end-of-life materials regardless of the market price for nickel or stainless steel. This is because the nickel in the scrap is not degraded: it still can reflect all the attributes of nickel. In addition, melting scrap instead of melting nickel and chromium and iron to make the same stainless steel requires approximately 30% less energy. Thus the higher the scrap ratio (scrap compared to raw materials) the greater the energy savings.

The International Nickel Study Group reports that in 2006, Brazil exported approximately 20,000 tonnes of stainless steel scrap. Approximately 80% of scrap exports were destined for Europe, with a little over half headed for the Netherlands, Belgium, and Luxembourg. About 10% of scrap exports were sent to India. Brazil imported approximately 4,600 tonnes of stainless steel scrap, primarily from Germany.

Trade in nickel waste and scrap was insignificant; Brazil exported 500 tonnes of nickel waste and scrap, while importing only 22 tonnes.

In 2006, the British Geological Survey estimated that total nickel mine production in Brazil was 82,500 tonnes, an increase of 11% from 2005. At the same time, the price of nickel increased 65%, while the Brazilian Real appreciated 12% against the US dollar. The five-year trend in mine production is compared against the nickel price in Brazilian Real in Figure 6.1.

**Figure 6.1: Nickel Mine Production vs. Average Nickel Prices (2002-2006)**



Source: Metalprices.com and British Geological Survey

Table 6.1 presents the estimates for the output and value-added contributed to the Brazilian economy by the direct nickel industry as well as employment and salaries and wages attributable to the direct nickel industry.

**Table 6.1: Economic Impact of the Direct Nickel Industry in 2006**

	Nickel Ore Mining and Processing	Recycling/ Scrap	Support Industries (includes multiplier effects)	Total Direct Industry
Output (\$ million)	R\$ 4,156 (US\$ 1,914)	R\$ 144 (US\$ 66)	R\$ 4,542 (US\$ 2,093)	R\$ 8,842 (US\$ 4,073)
Value-added (\$ million)	R\$ 1,622 (US\$ 747)	R\$ 62 (US\$ 29)	R\$ 2,030 (US\$ 948)	R\$ 3,714 (US\$ 1,724)
Employment	7,792	1,255	27,591	36,638
Salaries & Wages (\$ million)	R\$ 164 (US\$ 77)	R\$ 18 (US\$ 8)	R\$ 381 (US\$ 176)	R\$ 563 (US\$ 261)

### **6.1.1 Output (Sales)**

The estimated total output attributable to the Brazilian direct nickel industry, including multiplier effects, is approximately R\$ 8.8 billion (US \$ 4.1 billion). Much of this output is generated by nickel ore mining, and nickel smelting and refining, which directly account for 47% of output in the direct nickel industry segment of the nickel value chain. The activities of the nickel industry are supported by a number of industries. The most significant are services to mining, which encompasses contract exploration, and other services, as well as transportation and logistics. We have included the impact of these industries under “support industries” in Table 6.1. The estimated output attributable to nickel in all support industries is R\$ 4.5 billion (US \$ 2.1 billion) or 51% of total output generated.

### **6.1.2 Value-added**

The nickel ore mining and processing industry contributed approximately R\$ 1.6 billion (US \$ 747 million) of direct industry value-added. Additionally, it is estimated that support industries contribute a further R\$ 2.0 billion (US \$ 948 million) to industry value-added due to multiplier effects stimulated by production in the direct nickel industry. Total value-added in the direct industry is approximately R\$ 3.7 billion (US \$ 1.7 billion).

### **6.1.3 Employment**

Employment in nickel ore mining, smelting and refining in 2006 was 7,792. These employment figures are based on data from the IBGE as well as individual company reports. The estimated employment in support industries includes employment attributable to nickel in the mining services industry, transportation and logistics, as well as a multiplier effect for other industries that provide services to the nickel industry. The total employment in support industries is estimated at 27,591. Total employment attributable to the direct nickel industry is estimated to be approximately 36,638.

### **6.1.4 Salaries & Wages**

Average salaries in the nickel mining industry vary but are generally above the Brazilian industry average.<sup>5</sup> Salaries and wages in the nickel ore mining and processing industry accounted for R\$ 164 million (US \$ 77 million) or 29% of total salaries and wages in the direct nickel industry. Support industries contribute approximately R\$ 381 million (US \$ 176 million), including multiplier effects for a total of R\$ 563 million (US \$ 261 million) in salaries and wages.

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<sup>5</sup> This estimate assumes an average national annual salary of approximately R\$13,800 is earned by individuals employed through multiplier effects.

## 6.2 Economic Impact of the First-Use Nickel Industry Brazil

Brazil is one of a few countries that mines, smelters, and refines nickel to supply foreign and domestic first-use nickel industries.

Total use of nickel in the traditional first-use industries in Brazil in 2006 was approximately 24,000 tonnes.<sup>6</sup> Table 6.2 compares Brazil’s nickel use to the major nickel users around the world and it shows Brazil represents 1.8% of the world’s nickel use.

**Table 6.2: Worlds Largest Users of Nickel in 2006**

Rank	Country	% of World Nickel Use in 2006
1	China	19%
2	Japan	14%
3	United States	11%
4	Germany	9%
5	South Korea	7%
<b>16</b>	<b>Brazil</b>	<b>1.8%</b>

Source: Pariser (2007)

To estimate the value of nickel use in the key areas of first-use we have utilized both Pariser use data and consultation with industry experts.

Pariser categorizes first-use as follows:

- Iron and steel industry – includes stainless steel and steel alloys
- Non-ferrous metal product industry – includes nickel and copper based alloys
- Plating
- Foundry
- Other

Using Pariser estimates, we calculated cost of sales and the value of production for each of the above activities. Once production value was estimated, we then applied industry ratios for the metal products industry aggregation to assign estimates of value-added, employment, capital expenditures and other measures.

To capture the impacts of stainless steel and other imports, intermediaries or distributors of stainless steel have also been included in the first-use industry.

The economic impact of the first-use industry is presented in Table 6.3 below.

<sup>6</sup> Heinz Pariser, “The End Uses of Nickel 1996-2006”, 2007

**Table 6.3: Economic Impact of the First-Use Nickel Industry in 2006**

	First-Use Industry	Support Industries (Multiplier Effects)	Total
Output (\$ million)	R\$ 8,224 (US\$ 3,790)	R\$ 11,336 (US\$ 5,224)	R\$ 19,560 (US\$ 9,014)
Value-added (\$ million)	R\$ 2,474 (US\$ 1,140)	R\$ 4,195 (US\$ 1,933)	R\$ 6,669 (US\$ 3,073)
Employment	11,220	57,229	68,449
Salaries & Wages (\$ million)	R\$ 335 (US\$ 154)	R\$ 789 (US\$ 364)	R\$ 1,124 (US\$ 518)

### 6.2.1 Output (Sales)

Direct output in the Brazilian first-use industry amounted to R\$ 8.2 billion (US \$ 3.8 billion) in 2006, with an additional R\$ 11.3 billion (US \$ 5.2 billion) in support industry impacts. The total output from the first-use industry is estimated at R\$ 19.6 billion (US \$ 9.0 billion).

### 6.2.2 Value-added

The first-use industry contributed R\$ 2.5 billion (US \$ 1.1 billion) directly value-added to the Brazilian economy and stimulated a further R\$ 4.2 billion (US \$ 1.9 billion). Total contribution to GDP was R\$ 6.7 billion (US \$ 3.1 billion).

### 6.2.3 Employment

Activities in the Brazilian first-use industry are estimated to employ 11,220 persons directly, and 57,229 persons indirectly through multiplier effects. Total employment generated by first-use industries is estimated at 68,449.

### 6.2.4 Salaries & Wages

The employment generated by the first-use industry has associated salaries and wages equal to R\$ 1.2 billion (US \$ 518 million). Approximately 30% or R\$ 335 million (US \$ 154 million) of wages and salaries are generated directly and a further R\$ 789 million (US \$ 364 million) are generated through multiplier effects.

## 6.3 Economic Impact of the End-Use Nickel Industry Brazil

Our analysis of the end-use industry in Brazil follows the categorization used by Parisier. The major nickel using industries in Brazil include:

- **Transport** – includes automotive and accessories, railway, aircraft and aerospace, bicycles, containers, and shipbuilding
- **Electrical & Electronic** – includes home appliances (washing machines, dish washers, refrigerators), and data processing or consumer electronics
- **Engineering** – includes vessels, tanks, heat exchangers, chemical and petrochemical equipment, food processing, packaging, pulp and paper, and textile and laundry
- **Building & Construction** – includes lifts, escalators, chimney liners, sinks and bath tubs, window frames and panels
- **Tubular Products** – includes seamless tubes, welded tubes, and flanges and fittings
- **Metal Goods** – includes cutlery, catering, fasteners, stranded wire, cables and ropes, and coinage

The estimated economic impact of end-use producers is based on the magnitude of nickel used by the above listed sectors. To the extent that some of the products are nickel dependent, that is, that nickel is the integral input to production, the estimates here may understate the total value-added contributed by the end-use industry.

For each industry, the total expenditure on nickel goods and services is grossed up by average industry mark-ups.<sup>7</sup> Value-added and other measures of interest are then allocated according to industry ratios.

The results of this analysis are presented in Table 6.4.

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<sup>7</sup> The average industry mark-up is calculated as Sales/Cost of Goods & Services.

**Table 6.4: Economic Impact of the End-Use Nickel Industry in 2006**

	End-Use Industries	Support Industries (Multiplier Effects)*	Total
Output (\$ million)	R\$ 9,376 (US\$ 4,320)	R\$ 5,909 (US\$ 2,723)	R\$ 15,285 (US\$ 7,043)
Value-added (\$ million)	R\$ 3,448 (US\$ 1,589)	R\$ 2,657 (US\$ 1,224)	R\$ 6,105 (US\$ 2,813)
Employment	53,267	30,633	83,900
Salaries & Wages (\$ million)	R\$ 905 (US\$ 417)	R\$ 422 (US\$ 194)	R\$ 1,327 (US\$ 611)

\*Note: These estimates exclude the backward linkages already accounted for in first-use industries.

### 6.3.1 Output (Sales)

Total output from end-use industries in Brazil is equal to R\$ 15.3 billion (US \$ 7.0 billion). Approximately R\$ 9.4 billion (US \$ 4.3 billion) or 61% of end-use output is contributed directly, while R\$ 5.9 billion (US \$ 2.7 billion) is stimulated through multiplier effects.

### 6.3.2 Value-added

The total value-added contribution from end-use industries is about R\$ 6.1 billion (US \$ 2.8 billion). End-use activities generate over R\$ 3.4 billion (US \$ 1.6 billion) in Brazilian GDP and stimulate a further R\$ 2.7 billion (US \$ 1.2 billion) indirectly.

### 6.3.3 Employment

End-use industries tend to be fairly labour intensive and total employment in the end-use industry is estimated at 83,900 workers with approximately 53,267 persons employed directly by the end-use industry and a further 30,633 employed in support industries.

### 6.3.4 Salaries & Wages

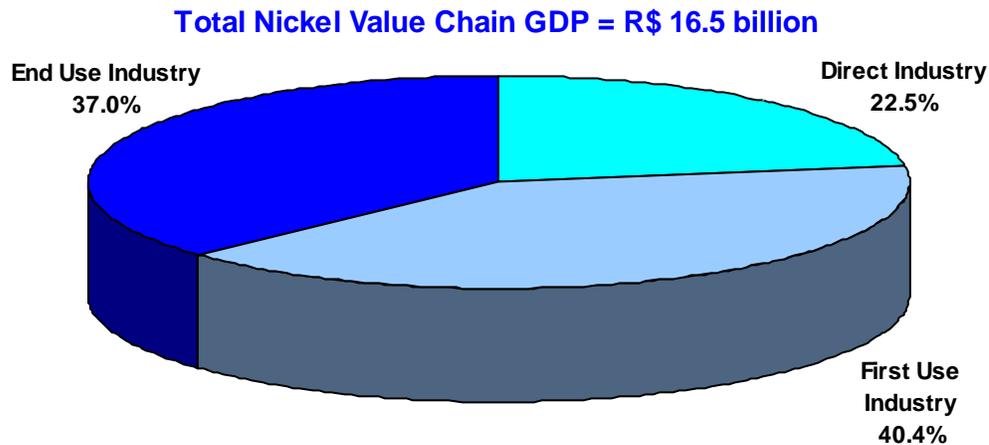
The employment generated by the end-use industry has associated salaries and wages of approximately R\$ 1.3 billion (US \$ 611 million). The end-use industry is estimated to contribute R\$ 905 million (US \$ 417 million) directly while support industries are estimated to contribute R\$ 422 million (US \$ 194 million).

## 6.4 Total Economic Impact of the Nickel Value Chain

Summing the economic impacts across the entire nickel value chain, the total estimated value-added attributable to the Brazilian economy by nickel is R\$ 16.5 billion (US \$ 7.6 billion) based on total output of R\$ 43.7 billion (US \$ 20.1 billion). The value-added produced by the nickel value chain in Brazil corresponds with approximately 0.7% of Brazilian GDP. The economic activities of the nickel value chain were responsible for the employment of approximately 189,000 individuals, earning R\$ 3.0 billion (US \$ 1.4 billion) in annual salaries and wages.

The impact of the nickel value chain is somewhat balanced between first-use and end-use nickel industries, which accounted for 40% and 37%, respectively, of the value-added generated by the nickel value chain. The distribution of impacts is shown in Figure 6.2

**Figure 6.2: Distribution of Value-added across the Nickel Value Chain**



In the following sections we have outlined in detail other economic and social impacts of the value chain, including employment, salaries and wages, educational attainment, capital activity, research and development, and social development.

## 6.5 Human Resources

The following section provides a profile of employment in the direct, first-use, and end-use nickel industries with a focus on the following categories:

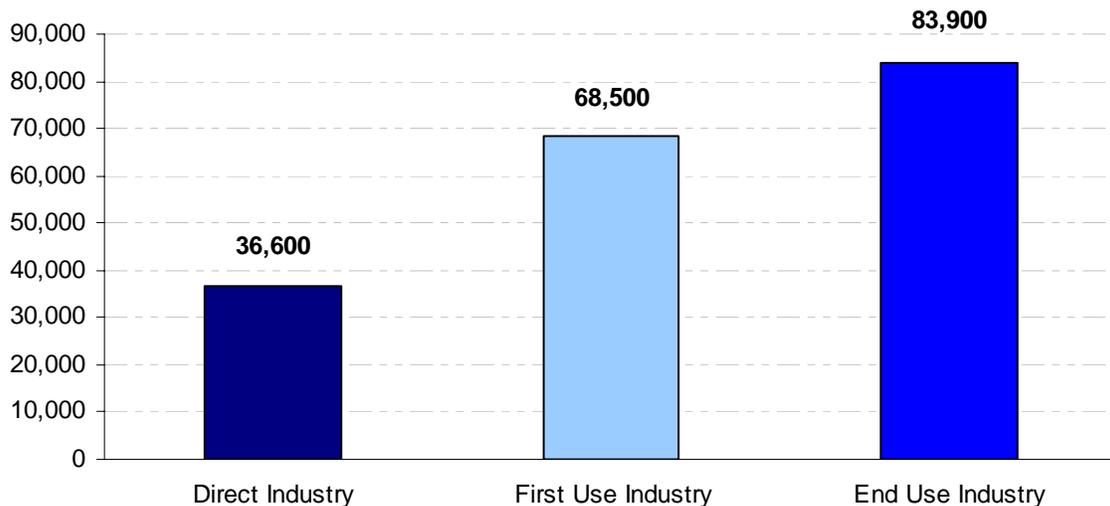
- Number of employees
- Average wages

### Number of Employees

Figure 6.3 illustrates the estimated employment attributable to the Brazilian nickel industry. It includes the number of employees estimated to be employed in the direct, first-use, and end-use industries, as well as employment created indirectly through multiplier effects.

Brazil not only mines and exports ore nickel, but it also produces manufactured products, such as stainless steel, to export and supply its domestic demand. The end-use nickel industry is by far the largest employer, employing about 83,900 people. The employment attributable to nickel in the first-use industry is 68,500 jobs, while the Brazilian direct industry employs over 36,600 people. These numbers reflect the complexity of the manufacturing industry in Brazil. Total employment attributable to the nickel value chain is estimated to be close to 189,000 jobs.

**Figure 6.3: Employment across the Nickel Value Chain**

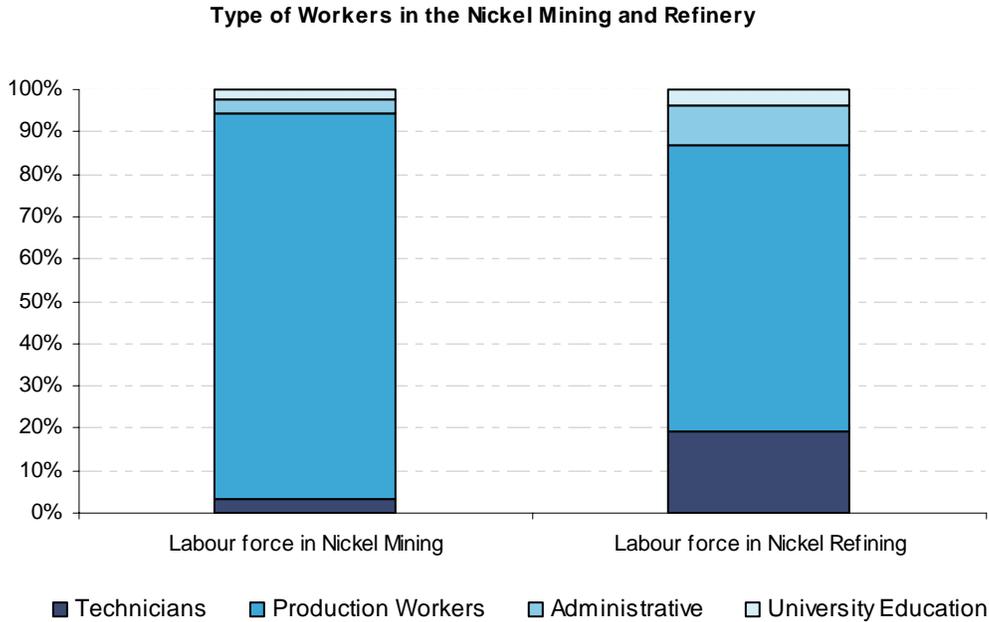


Source: PwC calculations

Figure 6.4 demonstrates the types of jobs found in the nickel mining, smelting and refining activities in Brazil. In the mining industry, only 2% of the work force has university degrees, while 89% of employees are production workers without university

degrees. In the smelter and refinery industries, 3% of workers have university degrees, 19% are technicians, and 65% are production workers.

**Figure 6.4: Employment across the Nickel Value Chain**



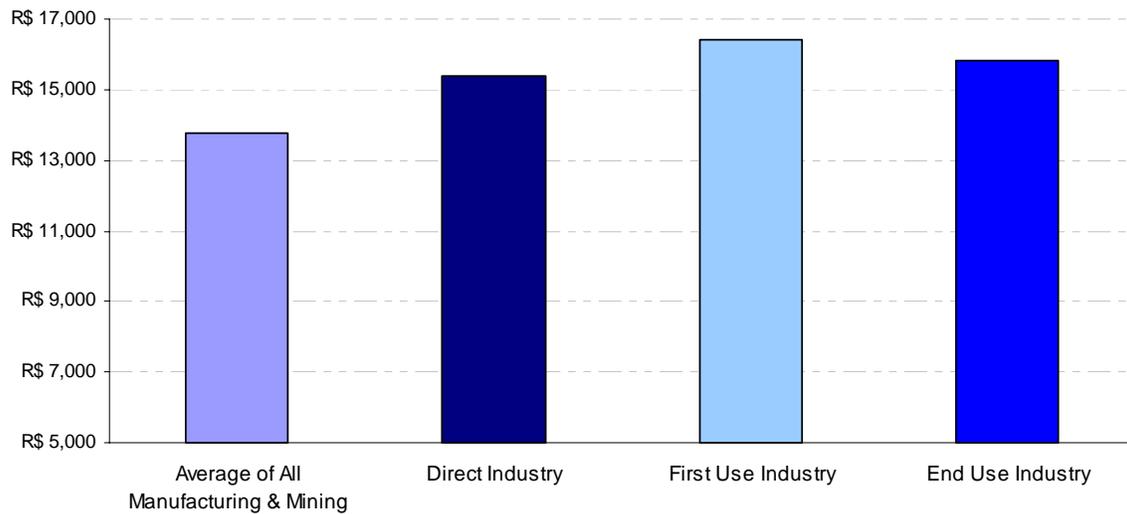
Source: Brazilian Mineral Yearbook 2006 - DNPM

**Salaries and Wages**

Figure 6.5 provides a salary comparison of direct, first-use, and end-use nickel industries (including multiplier effects) and the average salary of mining and manufacturing in Brazil. The average salary for workers in the first-use nickel industries was R\$ 16,400 per year, above the national average of R\$ 13,800. Salaries in the direct and end-use nickel industries were also above the national average, R\$ 15,400 and R\$ 15,800, respectively.

Total wages and salaries attributable to the nickel value chain are estimated to be R\$ 3.0 billion (US \$ 1.4 billion).

**Figure 6.5: Average Annual Salaries in the Nickel Value Chain**



Source: PwC calculations

## Taxes

Brazil's tax system is characterized by high rates and enormous complexity. In addition to corporate income tax and a consumption value-added tax (VAT), Brazil also has several indirect taxes.

The primary taxes incurred by firms in the nickel industry are corporate income taxes, natural resource royalties and payroll taxes. It should be noted that payroll taxes are paid by employers, and are not deducted from employee paycheques.

Our estimates of tax revenues do not include corporate income taxes generated by multiplier effects because the impacts are distributed across a diversity of industries and would therefore be difficult to calculate with a satisfactory degree of accuracy. The estimates do, however, include payroll taxes from wages and salaries produced by multiplier effects.

Taxes included in our calculations are shown in Table 6.5.

**Table 6.5 Taxes in the Brazilian Nickel Industry**

<b>Tax Type</b>	<b>Description</b>
Corporate Income Tax	Corporate Tax is 34% (15% basic tax, 10% surtax, and 9% social contribution)
Natural Resource Royalties	Royalties are between 0.2 to 3% based on gross revenue. Specifically for nickel mining royalties are 2%.
Employment Taxes	Employers contribute 37.3% of the employee gross salary (28.8% social security and 8.5% severance fund)

The largest contributor to tax revenues in the nickel value chain is the end-use nickel industry, which paid approximately R\$ 756 million (US \$ 348 million) in taxes in 2006. Direct and first-use industries are estimated to have contributed a further R\$ 967 million (US \$ 445 million) for a total of R\$ 1.7 billion (US \$ 793 million) generated by the nickel value chain.

## 6.6 Capital Activity

Capital expenditures reflect the value of fixed assets (including acquisitions) purchased by the nickel industry. Estimates of capital expenditures made by the Brazilian nickel industry across all uses are presented in the table below. These estimates are based on industry investment rates of value-added attributable to the nickel value chain. One should not take these estimates as precise, but rather they are illustrative of the magnitude of spending in the nickel value chain. These estimates do not include multiplier effects.

**Table 6.6: Capital Expenditures, 2006**

<b>Industry</b>	<b>Capital Expenditures</b>	<b>% of Total</b>
Direct	R\$ 279 million (US \$ 129 million)	22%
First-Use	R\$ 406 million (US \$ 187 million)	32%
End-Use	R\$ 567 million (US \$ 261 million)	45%

Source: PwC calculations

The end-use industry accounts for a significant proportion of capital expenditures in the nickel value chain at R\$ 567 million (US \$ 261 million) or 45% of total estimated capital expenditures. It is further estimated that approximately R\$ 685 million (US \$ 316 million) can be attributed to the direct and first-use industries in Brazil. Total capital expenditures in the nickel value chain are estimated to be R\$ 1.3 billion (US \$ 577 million).

Capital employed in the industry measures the ability of the industry to leverage debt and equity to support further investment. In the following table, estimates of capital employed by all uses of the nickel industry are shown. Given the high level of consolidation of the industry, and the global and diversified nature of many of the prominent firms, it is difficult to isolate capital employed with any precision as it relates to nickel operations. Therefore, the estimates provided should be viewed as approximations to the magnitude of capital employed rather than an exact accounting of debt and equity. These estimates do not include multiplier effects.

**Table 6.7: Capital Employed, 2006**

Industry	Capital Employed	% of Total
Direct	R\$ 1.3 billion (US \$ 604 million)	12%
First-Use	R\$ 2.6 million (US \$ 1.2 billion)	24%
End-Use	R\$ 6.9 billion (US \$ 3.2 billion)	64%

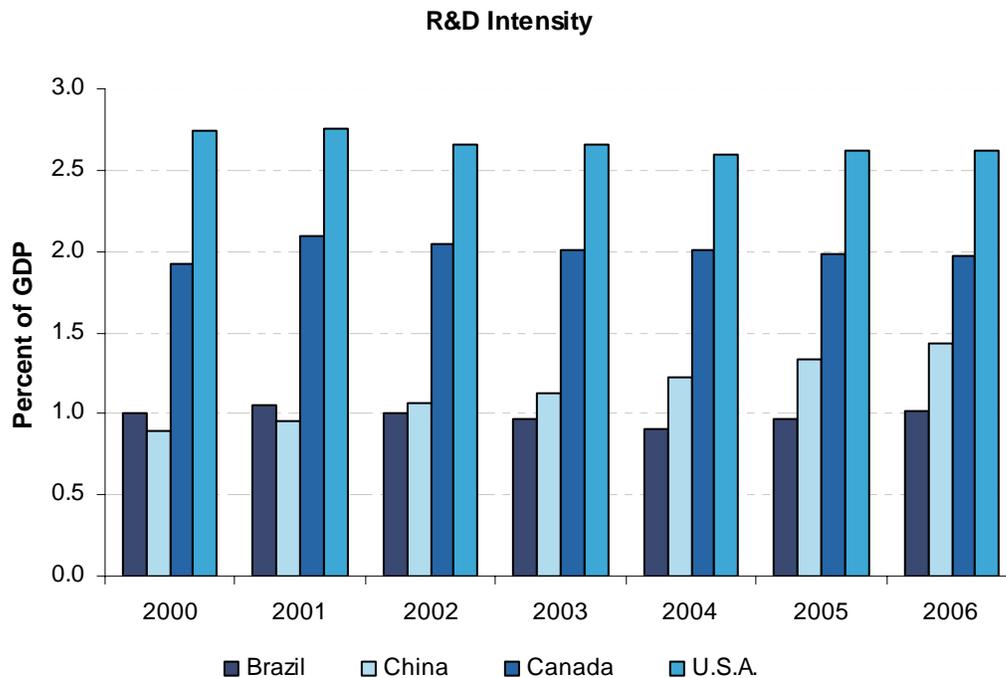
*Source: PwC calculations*

Total capital employed in the nickel chain is estimated to be R\$ 10.8 billion (US \$ 5.0 billion).

It is important to note that the estimates provided in this section represent the total capital activity that is attributable directly to nickel production or use. Although many industries in the first and end-use sectors may be capital intensive, their use of nickel may be relatively low and the estimated capital activity reflects that fact.

## 6.7 Research and Development

Figure 6.6: Total R&D Expenditure Share of GDP, 2000-2006



The “*OECD Science, Technology, and Industry Outlook 2008: Profile of Brazil*” mentions that in 2006 Brazil’s R&D intensity accounted for 1.02% of GDP, which is low relative to most OECD countries. Brazil R&D intensity was below that of China and Russia, but higher than that of Argentina and Mexico. The weight of public and business R&D are similar, where business R&D intensity was 0.49% of GDP.

According to a survey on technology innovation from the *Instituto Brasileiro de Geografia e Estatística (IBGE)*, in association with the Brazilian Ministry of Science and Technology, 3.7% of all business R&D expenditure in manufacturing was done by industries that produce metal and metal products. One third of the Brazilian firms with more than 10 employees engage in some type of innovation, where the purchase of equipment and machinery was considered the main source of innovation.

R&D in the nickel value chain has been estimated using industry ratios of R&D spending to GDP from the *Instituto Brasileiro de Geografia e Estatística (IBGE)*. Table 6.8 displays the composition of R&D spending in the nickel value chain. These estimates do not include multiplier effects.

**Table 6.8: Estimated R&D Spending in the Nickel Value Chain**

Industry	R&D Expenditures	% of Total
Direct	R\$ 7 million (US \$ 3.4 million)	24%
First-Use	R\$ 11 million (US \$ 5.1 million)	36%
End-Use	R\$ 12 million (US \$ 5.5 million)	39%

*Source: PwC calculations*

It is estimated that the nickel value chain is responsible for approximately \$30 million (US \$ 14 million) of research and development expenditures in Brazil.

## 7 Opportunities and Challenges for the Industry

As a component of our research for this socio-economic impact analysis, we reviewed the social factors that influence the operations of the Brazilian nickel mining and stainless steel industries. Our analysis indicates that a variety of economic, social, and legal factors influence the operations of nickel mining and stainless steel companies within Brazil, creating opportunities and challenges for the industry. These factors originate both domestically and internationally, impacting the nickel value chain in Brazil.

Industry influencing factors were identified by reviewing relevant company annual reports, corporate websites, material from industry associations, and other research. This section focuses primarily on the mining components and stainless steel production of the nickel value chain, as these activities have the greatest socio-economic impact within Brazil.

### 7.1 Opportunities & Challenges

#### Opportunities

**High Demand for Stainless Steel:** Overall long term growth in global stainless steel demand has provided significant opportunities for the Brazilian stainless steel industry. Increased demand for stainless steel increases demand for nickel, even as nickel prices have been increasing. However, short term declines in nickel and stainless steel demand due to the current economic slowdown will present a significant challenge for the near future.

**Industry Consolidation:** Both the Brazilian mining and stainless steel sectors have undergone considerable consolidation over the last two decades. Since the late 1980s, the broader domestic steel sector shrunk from over thirty companies to just nine, with four accounting for the majority of the market share; this has occurred even as gross output and profitability have increased. Similarly, the international nickel mining industry has consolidated significantly, with one Brazilian mining company emerging as a world leader with significant global market share. Consolidation has enabled these industries to prosper and benefit from economies of scale, greater market control, and international prominence.

**Investment in Research and Development:** Brazilian stainless steel companies have invested heavily in research and development within Brazil, focusing on production chain re-engineering, product development, and specialty alloys development. Companies report research on tension retention for high strength springs, ultra smooth alloys for bearings and other applications, and micro-alloys research.

## **Challenges**

**Competition with Emerging Markets:** Other emerging markets (particularly China) have seen rapid increases in their stainless steel production capacity, thereby creating competition with Brazilian producers.

**Energy Prices:** Stainless steel production and nickel mining are high energy-intensive industries and rising energy prices are creating significant production cost challenges worldwide. Energy efficiency and waste minimization have become central issues for Brazilian companies operating in this sector. While declining energy prices due to the global recession are providing some energy cost relief, energy prices will likely rebound over the long term.

**Environmental Issues and Climate Change:** Environmental issues, and particularly acid rain/greenhouse gas emissions, are a major problem for the mining and stainless steel industries in Brazil. Companies in these industries continue to be among the largest emitters of airborne pollutants in Brazil. Habitat destruction and biodiversity loss is also a high profile issue that affects mining companies operating within Brazil, while some small low quality stainless steel producers have been involved in controversies involving the use of charcoal derived from rainforest slash-and-burn practices.

**High Ore Prices:** Overall long term increases in base ore/metal prices for iron, chrome, nickel, and other inputs presents an ongoing challenge to the global stainless steel industry. Price declines over the last few months (due to the economic slowdown) are providing some price relief, however, metal prices will likely increase in the long term.

**Securing Stable Inputs:** Most stainless steel mills operate continuously and require consistent inputs to maintain profitability. Ensuring a stable and low cost supply of metal inputs has been difficult in some cases due to growing global demand. Price fluctuations (particularly rapid price increases) are often associated with supply shortages.

**Infrastructure and Transportation:** Underdeveloped infrastructure and transportation networks represent a significant challenge for Brazilian nickel mining companies. Due to poor infrastructure in remote and underdeveloped areas of the country, significant nickel deposits are not accessible without large up-front infrastructure investment. In many cases Brazilian mining companies are responsible for developing infrastructure related to mining activity, adding significantly to the cost of mining development.

## 8 Industry Contribution to Social Development

Over the last two decades there has been increasing pressure on corporations from the public, government, consumers, investors, and activists to respond to demands for improved social performance. As a result, mining and stainless steel companies have implemented policies that ensure employee health and wellness, protect the environment, and maximize benefits for communities and Brazilian society. In recent years, nickel mining and stainless steel companies operating in Brazil have implemented Corporate Responsibility (CR) policies to address these issues.

In the following sections we describe the contributions that nickel mining and stainless steel companies have made to social development through their employee, community, and cultural support activities. Common social impact management strategies are listed below and discussed in more detail in the following sections.

Social impact and accountability practices for Brazilian nickel mining and stainless steel companies, with regard to employees:

- Anti-smoking and AIDS prevention campaigns
- Competitive wages and benefits
- Employee training
- Improved environmental conditions on the operating site and in surrounding community
- Occupational health and safety
- Work-life balance programs

Social impact and accountability practices for nickel mining and stainless steel companies, with regard to communities:

- Employee volunteering
- Environmental protection
- Long-term community relations
- Philanthropic support for social welfare (e.g. education, health, etc.)

### 8.1 Company initiatives for employees and contractors

**Employee Wages and Benefits:** Brazilian nickel and stainless steel producers provide high paying jobs and comprehensive health/insurance benefits for domestic workers. Workers in these sectors are among the highest average paid in Brazilian industry.

**Occupational Health and Safety:** All nickel mining and stainless steel companies make Occupational Health and Safety (OH&S) a priority and they undertake management, training, and safety programs that are effective at protecting worker health and safety.

This is demonstrated by the improvement in the health and safety record of stainless steel and mining companies in Brazil.

**OH&S Reporting:** All companies regularly measure and report on key performance indicators related to their OH&S management and in many cases senior managers are responsible for OH&S performance. Under Brazilian laws companies are required to report any major OH&S related accidents or infractions.

**OH&S Training:** All companies provide OH&S training to their workers in order to protect their staff and to ensure that they have the necessary skills and knowledge to meet OH&S goals.

**Promoting a Healthy Workplace and Workers:** Nickel mining and stainless steel companies in Brazil are committed to protecting employee physical and mental health, and they encourage workers to pursue a healthy work-life balance. Companies provide onsite health facilities and adhere to strict health and safety codes. Many companies provide competitive health/dental insurance benefits in order to protect employee health and welfare. Employee exercise and wellness programs are common in Brazil, and several companies reported internal anti-smoking and AIDS prevention campaigns. These campaigns were implemented following the realization that Brazilian industry workers had high rates of smoking and AIDS in the early 1990s. One Brazilian stainless steel company has succeeded in reducing employee smoking rates from 34% in 1992 to just 4.2% in 2006.

**Providing Employee Training:** Training of current and prospective employees is a priority for nickel mining and stainless steel companies, which provide ongoing education to employees focusing on skill development, higher level skill acquisition, and specialization.

## 8.2 Company initiatives for communities

Nickel mining and stainless steel companies in Brazil report being actively involved in their local communities through a variety of community outreach programs and policies. Through these initiatives and the economic opportunities created by these industries, companies are able to support Brazilian communities, economic development, cultural programs, and the environment. Common approaches undertaken by companies in these sectors include the following:

- **Business and Employment Opportunities:** Large nickel mining and stainless steel companies are major employers in Brazil, providing high paying jobs that are firmly rooted in the domestic economy. These companies also provide considerable opportunities for other Brazilian businesses, forming active economic relationships with goods and service firms in the technical, legal, financial, accounting, environmental, and other sectors.

- **Community Support Programs and Philanthropy:** Brazilian nickel mining and stainless steel companies are actively involved in local communities, supporting local charities by providing funding, staff, equipment, and logistics resources. Companies support health, environmental initiatives, education, community welfare, sports, arts, and development charities. Most large companies support a diverse assemblage of these charities. Funding for human welfare and development initiatives are particularly important in Brazil. As an example, one major mining company has invested more than \$140 million USD from 2005-2007 on infrastructure projects that are of great benefit to local communities. These projects include road infrastructure construction and repair, the creation and maintenance of basic sanitation services, construction of training centers, and the recovery of historic monuments. By budget allocation, 12% of this work was conducted 'pro bono' benefiting local communities and the broader Brazilian economy.
- **Education Programs:** Brazilian nickel mining and stainless steel companies make significant investments in education at all levels of the education system. Encouraging the development of quality primary education for all Brazilians is a philanthropic priority for stainless steel and nickel mining companies and these industries support a variety of large scale apprenticeship, ecological education, literacy, elementary schooling, and arts education projects. For example, one company has supported a project for several years that promotes citizenship and education through theater workshops, environmental awareness programs, primary education support, and IT lessons held at the operating facility. These programs focus on underprivileged children and adolescents who would not otherwise have access to quality schooling. The company supports this project by offering funding, allowing access to facilities and equipment, and encouraging staff to contribute through volunteering initiatives. The company has also supported local school authorities in efforts aimed at increasing the quality and availability of education for squatters in urban slums.
- **Employee Volunteering:** Many Brazilian nickel mining and stainless steel companies encourage employees to volunteer in their local communities, supporting community sports, education, health, fundraising, and environmental initiatives. Typically employee volunteering is supported by providing paid leave and company funding for philanthropic endeavors.
- **Environmental Stewardship:** Environmental protection and stewardship is a priority for nickel mining and stainless steel companies and new technological developments/management approaches have enabled these companies to drastically improve their environmental performance over the last few decades. Top priorities include water quality protection, recycling and waste disposal, energy efficiency, habitat protection, and acid rain/climate change emissions. In recent years Brazil's environmental regulations have become considerably more stringent and regulators insist that the stainless steel industry meets the same environmental standards as comparable firms operating in Germany or Japan. The

large nickel mining companies that dominate the Brazilian nickel sector are also regulated by much stricter environmental regulations than their peers in other emerging markets. Most nickel mining and stainless steel companies in Brazil have sophisticated environmental management regimes dealing with each of the issues mentioned. One stainless steel producing company, for example, has management systems in place for waste, energy efficiency, greenhouse gas emissions, and water quality. In addition, the company conducts environmental education programs and has voluntarily placed 2,500 hectares of company land in legal reserves. The company owns an additional 8,200 hectares of native vegetation that are informally protected. As another example, a major mining company has worked with local municipalities and other organizations to conserve 8,000 km<sup>2</sup> of forest in the Carajas Mosaic region.

- **Stakeholder Involvement:** Many nickel mining and stainless steel companies employ stakeholder involvement and consultation practices as part of the planning, development, and operation of their facilities. Stakeholder and community consultation helps to optimize the social benefits of development and is pursued in order to aid companies with planning community outreach, business, and environmental activities. One major mining company, for example, conducts bi-annual ‘community interchange forums’ in order to assess the needs of stakeholders and how the company is impacting local communities. These forums allow stakeholders and company officials to communicate directly, fostering cooperation and the resolution of contentious issues.

## 9 Conclusions

The analysis presented in this study has demonstrated that the nickel industry produces widespread and significant economic and social benefits for the Brazilian economy.

Economic impacts across the entire nickel value chain are estimated to be R\$ 16.5 billion (US\$ 7.6 billion) in value-added, which corresponds to 0.7% of the Brazilian GDP. The economic activities of the nickel value chain were also responsible for the employment of approximately 189,000 persons, earning R\$ 3 billion (US\$ 1.4 billion) in annual salaries and wages.

Member companies of Brazil's nickel value chain experience many of the same opportunities and challenges as their counterparts in other countries. Increased global demand for stainless steel and specialty alloys benefits the local industry through increased productivity and profits. Similarly when nickel prices increase, nickel mining companies generate higher profits and can consider the development of formerly marginal producing mines. As demand and prices decline, however, the reverse is true and the entire industry experiences a reduction in growth.

In addition to recent market opportunities, Brazil's nickel value chain has experienced industry integration and consolidation, which has strengthened its ability to be the primary supplier domestically and a cost competitor internationally.

Challenges for the industry continue to be the increasing cost of inputs such as energy and metals, as well as the stability and consistency of supply.

Firms in the nickel mining industry invest in the Brazilian economy through contributions they provide to the communities in which mines and mills are located. Support is provided on many fronts including health and welfare, education (from primary to jobs skill training) and infrastructure development. Companies also encourage employee participation in these initiatives. Importantly, in addition to optimizing social benefits for communities, companies engage in consultation with stakeholders and communities as part of the planning, development and operation of their facilities

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