

Nickel Institute

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

February 2009



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1 Executive Summary

In this report we have examined the economic impact of the Mexican nickel industry, (“the nickel industry”) and its associated value chain. Because Mexico is not a producer of nickel ore, the results of the analysis emphasize the importance of stainless steel production over other aspects of the value chain such as mining.

1.1 Economic impact of the Mexican 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 economic impacts of this value chain in Mexico.

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 Mexico is estimated to be Mex\$ 24.6 billion (US \$ 2.3 billion). It is estimated that the nickel value chain generates employment of 131,573, with associated salaries and wages of Mex\$ 9.8 billion (US \$ 896 million).

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 work¹ 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 one 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.² 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.

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 Mexican nickel industry and associated value chain. The country-specific analysis includes the following subject areas:

1 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.

2 The Nickel Institute, About the Nickel Institute, http://www.nickelinstitute.org/index.cfm/ci_id/2/1a_id/1.htm, accessed September 25, 2007

- 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 three tiers: direct nickel industry, first-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 separately from the “broad” value chain would require not only industry, but product specific data. Unfortunately, industry data collected by the Mexican Institute of Statistics & Geography (INEGI) does not provide this level of detail. Our estimates, therefore, 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
- 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 Mexican nickel industry from published sources as well as PwC published and internal documents
- Developed an economic impact model for the Mexican nickel industry
- 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 OECD and the Mexican Institute of Statistics & Geography (INEGI).

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.”

As it is our mandate to cover a diverse value chain that spans several industries, it is also necessary to use a consistent time series of data. In this study, therefore, we have used 2006 as our base year for measuring the economic impact of the nickel value chain as all required data for that year has been reported. Unfortunately, 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, however, 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 Mexican economy, rather than as specific to a single 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 Mexican nickel industry and provides information on the size and characteristics of the industry.

Section 5 outlines Mexico'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, and salaries and wages for part of the nickel value chain. Also discussed are estimates for capital expenditures, capital employed, and estimated research and development spending generated by the industry.

2.6 Report Limitations

This Report is not intended for general circulation, nor is it to be published in whole or in part, without prior written consent from PricewaterhouseCoopers LLP ("PwC"). 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, opinions 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 that 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.³

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 ductility strength at high temperatures, increased corrosion resistance 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 finishing (plating), 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, corrosive atmospheres and shape-memory applications.

3.1 The Nickel Value Chain

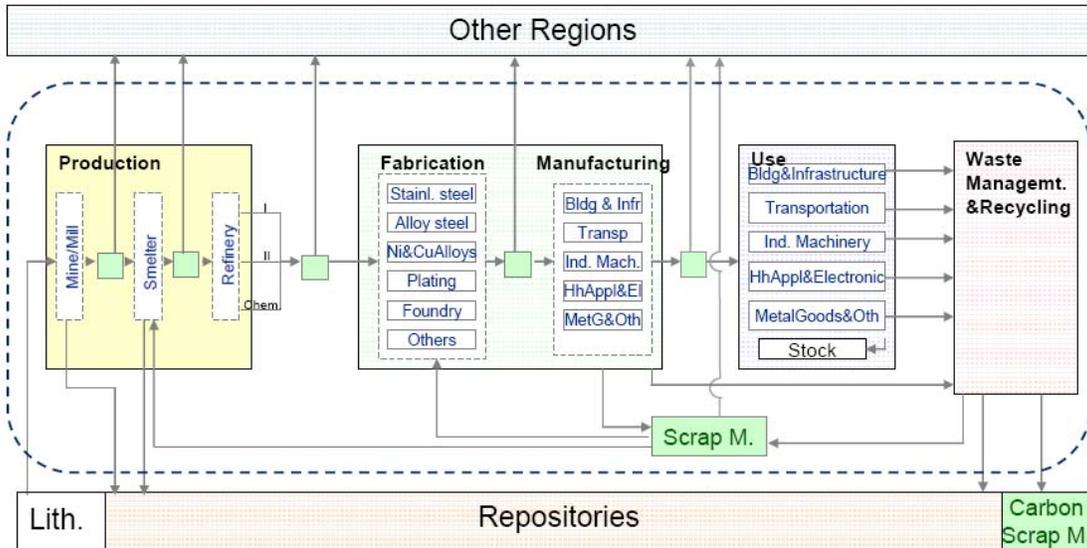
Value chains are used to describe and analyze the range of activities required to bring products or services from inception, through production, to final use and disposal. Extended value chain frameworks are often used to provide a more holistic understanding of the socio-economic environment in which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

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 Mexican nickel value chain.

3 The Nickel Institute, Nickel and Its Uses, http://www.nickelinstitute.org/index.cfm/ci_id/16/la_id/1.htm, accessed September 25, 2007.

4 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)

The value chain for nickel can be thought of as including three distinct tiers. These are the “Direct Nickel Industry”, “First-Use Sectors”, and “End-Use Applications”. Each is described below.

Direct Nickel Industry – Comprised of nickel mines, smelters and refineries. It 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 direct nickel industry also includes all activities associated with the recycling of nickel-containing products.

First-Use Sectors – Comprised of nickel that is used as a plating material and to produce special chemical products for batteries and catalysts. 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 that undertake specialist services such as metal shaping, forming and sub-assembly.

End-Use Applications – Comprised of 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.

3.2 Overview of the World Nickel Industry

As of 2006, the European Union (with Germany as the largest EU user) was the world’s largest user of nickel. China was the world’s largest single user of nickel, with Japan and the United States placing second and third respectively. Mexico placed as the 21st largest user of nickel.

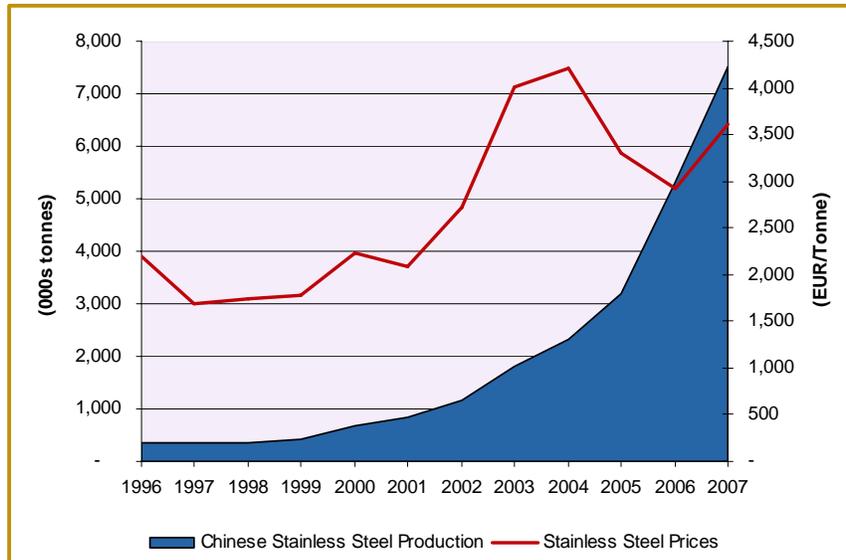
Table 3.1: Worlds Largest First-Users of Nickel in 2006

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%
21	Mexico	0.19%

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 3.1.

Figure 3.2: World and Chinese Stainless Steel Production



Source: Vale-Inco (2007)

3.3 World Nickel Industry Outlook

As 2008 draws to a close, it has become clear that the US economy is mired in what could be a protracted recession, induced by a collapsing housing market and turmoil in credit and financial 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



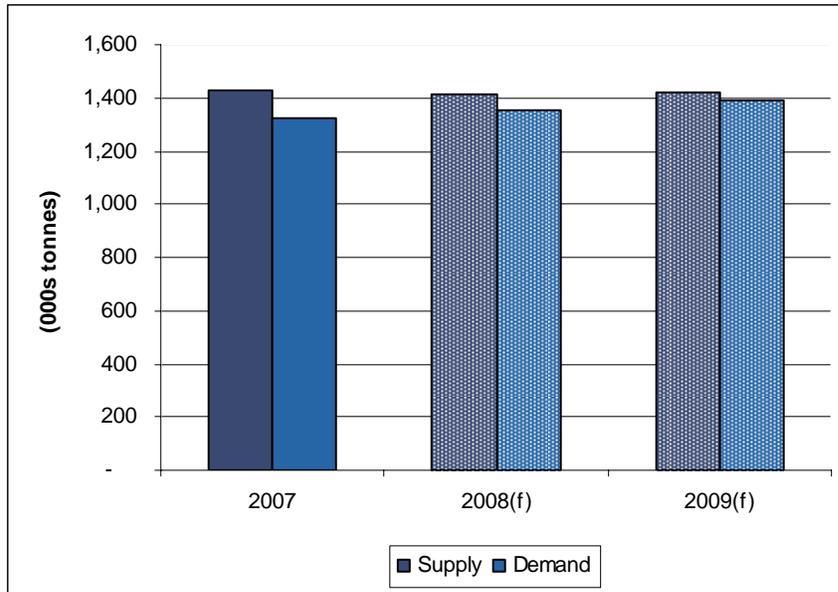
Source; Metalprices.com, London Metal Exchange Cash Price

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.

Figure 3.4: Global Nickel Supply & Demand Outlook



Source: ABARE

4 Country-Specific Analysis - Mexico



Annual Data ⁵	2006	% Share of World
Estimated Value-Added of Nickel Value Chain (Mex\$ m)	\$24.6 billion	n/a
Mine Production (tonnes)	0	n/a
Nickel Reserves (tonnes)	0	n/a
Nickel Use (tonnes)	2,600	0.19%
Exports of Nickel (tonnes)	4	n/a

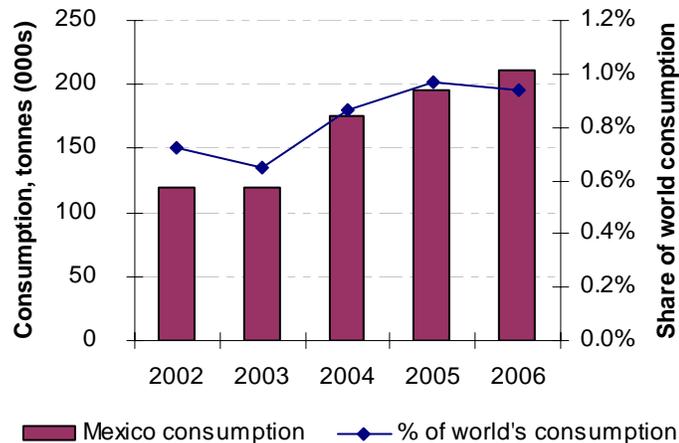
Source: Heinz Pariser, PwC Calculations.

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

4.1 Overview of the Mexican Nickel Industry

There are no mining, smelting, or refining of nickel in Mexico. Mexico has a stainless steel industry, however, and according to the *Annual Stainless Steel Statistics* published by the World Bureau of Metal Statistics, in 2006 Mexico used 211,000 tonnes of stainless steel, which represents 0.94% of the world's use. Between 2002 and 2006, stainless steel use in Mexico grew 76%, while the world stainless steel use grew 35%.

Figure 4.1: Stainless Steel Consumption in Mexico



Source: World Bureau of Metal Statistics

In 2006, Mexico exported 221,129 tonnes of stainless steel, mainly to the United States (88.7%) and China (6.7%). In the same year, Mexico imported 419,975 tonnes of stainless steel from Italy (57.6%), the U.S. (17.5%), Germany (6.2%), South Africa (5.2%), and China (4.5%).

⁵ Nickel production, trade and use numbers may not balance due to data revisions, data confidentiality or other irregularities in reporting.

5 The Nickel Value Chain in Mexico

5.1 Methodology

At each stage of the value chain described in Section 3.1, economic transactions take place. These transactions produce an array of economic impacts for the Mexican 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 used or consumed by industry Y for use in its own production of goods and services, which are then used or 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

There are no nickel mines, smelters, or refineries in Mexico. The Mexican direct nickel industry involves only activities related to importing of nickel-containing products. In 2006, Mexico imported 2,083 tonnes of unwrought nickel, however the economic impacts of direct nickel industry in Mexico are immaterial and will not be included in this report.

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 Mexico 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 sourced from the Mexican input-output accounts.

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 needed to be made for nickel-based goods. This was done using the ratio of purchases of nickel-based goods to all industry intermediate inputs. Values for economic variables were then assigned to broad industry categories using relevant industry ratios.

We have 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 Mexican Gross Domestic Product (GDP).

Our estimate of value-added attributable to the nickel industry is produced using value-added statistics compiled by INEGI (*Instituto Nacional de Estadística y Geografía*) as well as multipliers calculated from the Mexican input-output accounts.

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 OECD data, and rely principally on published employment and value-added data by industry. 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 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 conglomerates that make their capital structure decisions based on their aggregate business. To estimate the capital employed that is attributable to nickel, therefore, 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.

5.2.7 Taxes

Our estimates of taxes generated by the nickel industry include corporate income taxes and payroll deductions.

5.2.8 Currency

All economic impact estimates are in Mexican Pesos (Mex\$).

6 Economic Impact of the Nickel Industry in Mexico

6.1 Economic Impact of the Direct Nickel Industry Mexico

There are no nickel mines, smelters, or refineries in Mexico. There are, therefore, no direct impacts to report.

6.2 Economic Impact of the First-Use Nickel Industry Mexico

Due the high number of “*maquiladoras*”⁶ in Mexico, nickel usage is mostly related to stainless steel. In 2006, Mexico imported 420,000 tonnes and exported 221,000 tonnes of stainless steel.

Total use of nickel in the traditional first-use industries in Mexico in 2006 was approximately 2,600 tonnes⁷. Table 6.1 compares Mexico’s first-use of nickel to the major nickel users around the world.

Table 6.1: Worlds Largest First-Users of Nickel in 2006

Rank	Country	% of World Nickel Use in 2006
1	China ¹	19%
2	Japan	13%
3	United States	11%
4	Germany	9%
5	South Korea	7%
21	Mexico	0.19%

1. Includes Hong Kong

Source: Pariser (2007)

To estimate the value of nickel use in the key areas of first-use we have utilized Pariser use data.

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

⁶ A maquiladora is a factory that imports materials and equipment on a duty-free and tariff-free basis for assembly or manufacturing and then re-exports the assembled product.

⁷ Heinz Pariser, “The End Uses of Nickel 1996-2006”, 2007

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 6.2 below.

Table 6.2: Economic Impact of the First-Use Nickel Industry in 2006

	First-Use Industry	Support Industries (Multiplier Effects)	Total
Output (\$ million)	Mex\$ 6,710 (US\$ 616)	Mex\$ 7,386 (US\$ 678)	Mex\$ 14,096 (US\$ 1,294)
Value-added (\$ million)	Mex\$ 3,491 (US\$ 321)	Mex\$ 3,218 (US\$295)	Mex\$ 6,709 (US\$ 616)
Employment	13,185	20,264	33,449
Salaries & Wages (\$ million)	Mex\$ 891 (US\$82)	Mex\$ 1,397 (US\$ 128)	Mex\$ 2,288 (US\$ 210)

6.2.1 Output (Sales)

Direct output in the Mexican first-use industry amounted to Mex\$ 6,710 million (US \$ 616 million) in 2006, with an additional Mex\$7,386 million (US \$ 678 million) in support industry impacts. The total output from the first-use industry is estimated at Mex\$ 14,096 million (US \$ 1,294 million).

6.2.2 Value-added

The first-use industry contributed Mex\$ 3,491 million (US \$ 321 million) directly in GDP or value-added to the Mexican economy and stimulated a further Mex\$ 3,218 million (US \$ 295 million). Total contribution to GDP was Mex\$ 6,709 million (US \$ 616 million).

6.2.3 Employment

Activities in the Mexican first-use industry are estimated to employ 13,185 persons directly, and 20,264 persons indirectly through multiplier effects. Total employment generated by first-use industries is estimated at 33,449 people.

6.2.4 Salaries & Wages

The employment generated by the first-use industry has associated salaries and wages equal to Mex\$ 2,288 million (US \$ 210 million). Approximately 39% or Mex\$ 891 million (US \$ 82 million) of wages and salaries are generated directly and a further Mex\$ 1,397 million (US \$ 128 million) are generated through multiplier effects.

6.3 Economic Impact of the End-Use Nickel Industry Mexico

Our analysis of the end-use industry in Mexico follows the categorization used by Pariser. The major nickel using industries in Mexico 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.⁸ Value-added and other measures of interest are then allocated according to industry ratios.

The results of this analysis are presented in Table 6.3.

⁸ The average industry mark-up is calculated as Sales/Cost of Goods & Services.

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

	End-Use Industries	Support Industries (Multiplier Effects)*	Total
Output (\$ million)	Mex\$ 23,379 (US \$2,147)	Mex\$ 20,389 (US \$1,872)	Mex\$ 43,768 (US \$4,019)
Value-added (\$ million)	Mex\$ 8,906 (US \$818)	Mex\$ 8,997 (US \$826)	Mex\$ 17,903 (US \$1,644)
Employment	35,423	62,614	98,037
Salaries & Wages (\$ million)	Mex\$ 3,152 (US \$289)	Mex\$ 4,317 (US \$396)	Mex\$ 7,469 (US \$685)

*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 Mexico is equal to Mex\$ 43.7 billion (US \$ 4 billion). Approximately Mex\$ 23.4 billion (US \$ 2.2 billion) or 53% of end-use output is contributed directly, while Mex\$ 20.4 billion (US \$ 1.9 billion) is stimulated through multiplier effects.

6.3.2 Value-added

The total value-added contribution from end-use industries is over Mex\$ 17.9 billion (US \$ 1.6 billion). End-use activities generate Mex\$8.9 billion (US \$ 818 million) in Mexican GDP and stimulate a further Mex\$ 9.0 billion (US \$ 826 million) 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 98,037 workers with approximately 35,423 persons employed directly by the end-use industry and a further 62,614 employed in support industries.

6.3.4 Salaries & Wages

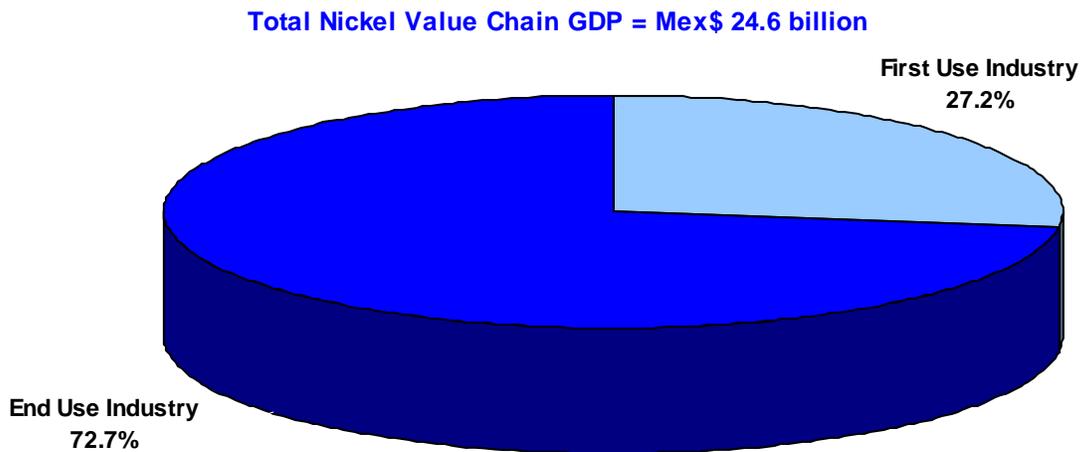
The employment generated by the end-use industry has associated salaries and wages of approximately Mex\$ 7.5 billion (US \$ 685 million). The end-use industry is estimated to contribute Mex\$ 3.2 billion (US \$ 289 million) directly while support industries are estimated to contribute Mex\$ 4.3 billion (US \$ 396 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 Mexican economy by nickel is Mex\$ 24.6 billion (US \$ 2.3 billion), based on total output of Mex\$ 57.9 billion (US \$ 5.3 billion). The value-added produced by the nickel value chain in Mexico corresponds to approximately 0.24% of Mexican GDP. The economic activities of the nickel value chain were responsible for the employment of approximately 131,573 individuals, earning Mex\$ 9.8 billion (US \$ 895 million) in annual salaries and wages.

The impact of the nickel value chain is skewed towards the end-use nickel industry, which accounted for 72.7% of the value-added generated by the nickel value chain. The distribution of GDP impacts is shown in Figure 6.1

Figure 6.1: Distribution of Value-Added across the Nickel Value Chain



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

6.5 Human Resources

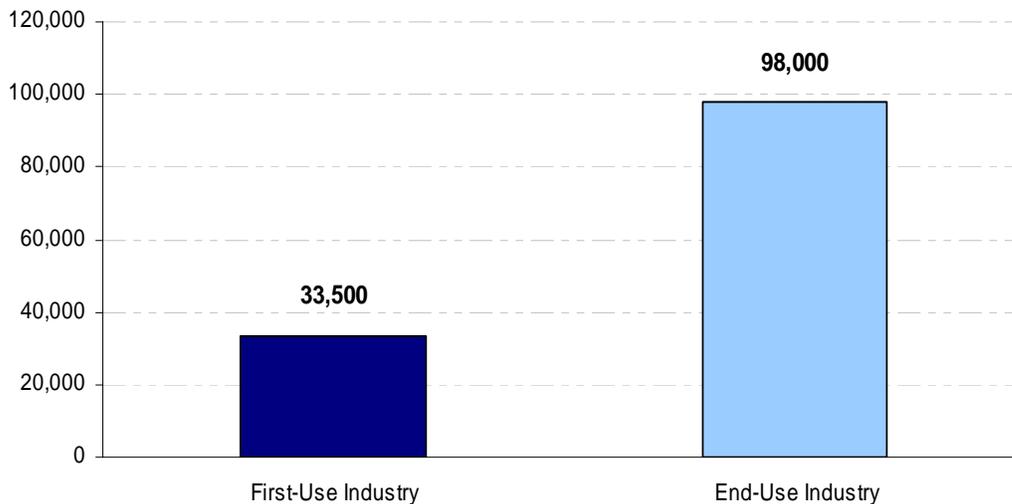
The following section provides a profile of employment in the first-use and end-use nickel industries with a focus on the following categories:

- Number of employees
- Average wages

Number of Employees

Figure 6.2 illustrates the estimated employment attributable to the Mexican nickel industry. Included is the number of employees estimated to be employed in the first-use and end-use industries, as well as employment created indirectly through multiplier effects. The end-use nickel industry is by far the largest employer, with estimated employment of 98,000 people. The employment attributable to nickel in the first-use industry is approximately 33,500 jobs. These numbers reflect the high use of stainless steel by the manufacturing industry in Mexico. Total employment attributable to the nickel value chain is estimated to be close to 131,500 jobs.

Figure 6.2: Employment across the Nickel Value Chain, 2006

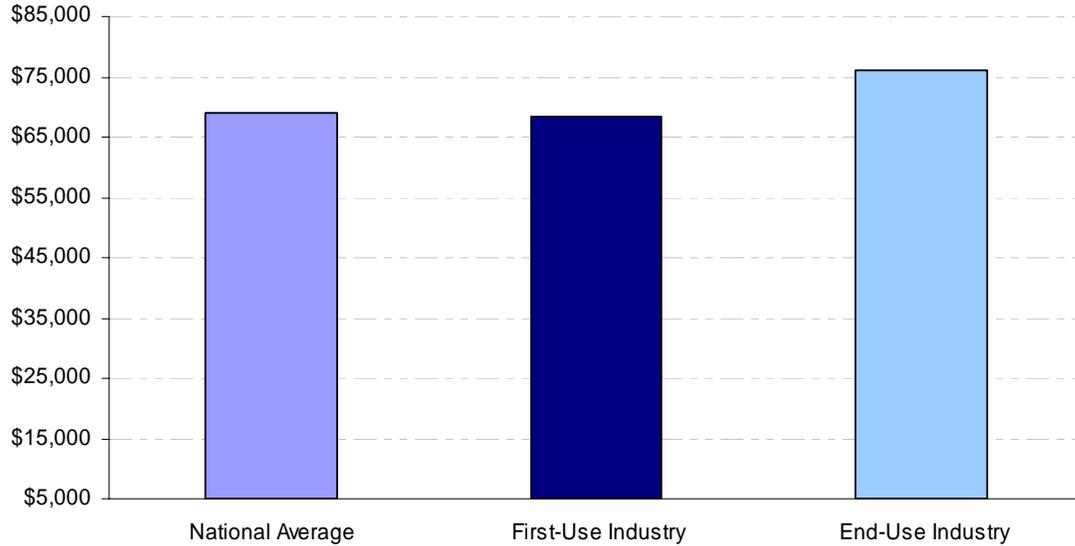


Source: PwC calculations

Salaries and Wages

Figure 6.3 provides a salary comparison of first-use and end-use nickel industries (including multiplier effects) against the national average salary in Mexico.

Figure 6.3: Average Annual Salaries across the Nickel Value Chain



Source: PwC calculations

The average salary for workers in the first-use nickel industries was Mex\$ 68,402 (US \$ 6,281) per year, which is below the national average of Mex\$ 68,948 (US \$ 6,331). Average salary in the end-use nickel industries was Mex\$ 76,185 (US \$ 6,996), above the national average.

Taxes

In Mexico, the primary taxes incurred by firms in the nickel industry are corporate income taxes. Corporations in Mexico also pay payroll taxes, making employer contributions towards the *Intituto Mexicano del Seguro Social* (Mexican social security). Employee contributions towards Mexico social security are deducted from their pay cheques.

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 6.4.

Table 6.4 Taxes in the Mexican Nickel Industry

Tax Type	Description
Corporate Income Tax	The average corporate income tax rate in Mexico in 2006 was approximately 29%.
Payroll Taxes/Deductions	Mexican payroll tax rate is 2% and 6.9% for social security contributions.

The largest contributor to tax revenues in the nickel value chain is the end-use nickel industry, which paid approximately Mex\$ 2.3 billion in taxes in 2006. First-use industries are estimated to have contributed a further Mex\$ 914 million for a total of Mex\$ 3.2 billion 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 Mexican 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 6.5: Capital Expenditures, 2006

Industry	Capital Expenditures	% of Total
First-Use	Mex\$ 563 million (US \$ 52 million)	10%
End-Use	Mex\$ 4,803 million (US \$ 441 million)	90%

Source: PwC calculations

The end-use industry accounts for an overwhelming majority of capital expenditures in the nickel value chain at Mex\$ 4,803 million or 90% of total estimated capital expenditures in the nickel value chain. While the industries that comprise the first-use industries may also be capital intensive, the minimal nickel use in these industries translates to a low value of capital expenditure attributable to the nickel value chain. It is estimated that approximately Mex\$ 563 million can be attributed to the first-use industries in Mexico. Total capital expenditures in the nickel value chain are estimated to be Mex\$ 5,366 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 in one jurisdiction with any precision as it relates to their global nickel operations. The estimates provided, therefore, 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 6.6: Capital Employed, 2006

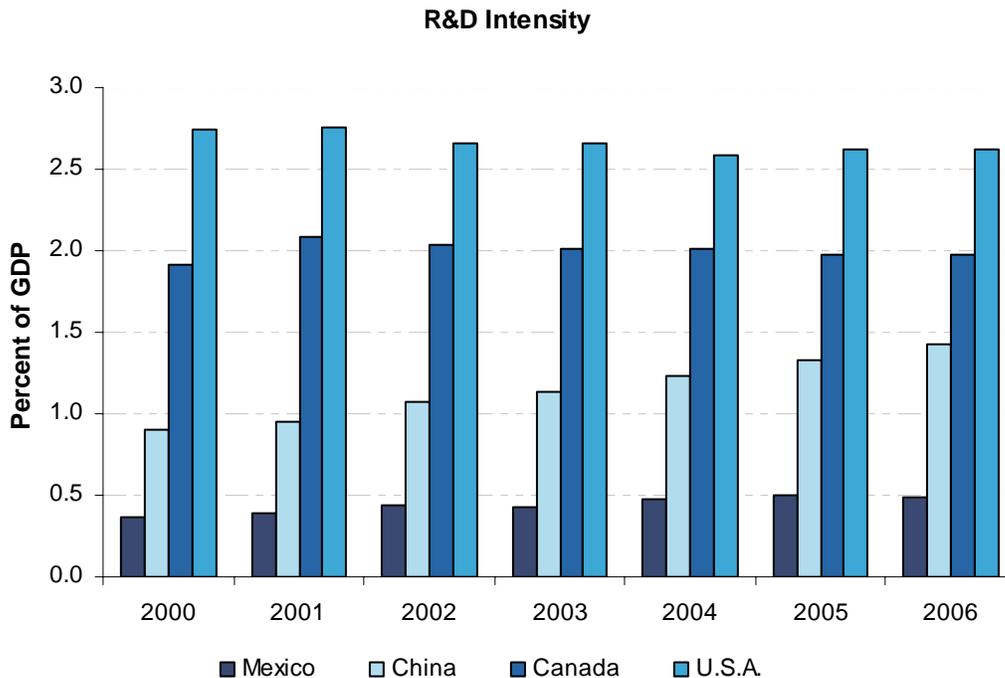
Industry	Capital Employed	% of Total
First-Use	Mex\$ 2.0 billion (US \$ 188 million)	4%
End-Use	Mex\$ 26.8 billion (US \$ 2.5 billion)	96%

Source: PwC calculations

Total capital employed in the nickel chain is estimated to be Mex\$ 28.8 billion.

6.7 Research and Development

Figure 6.4: Total R&D Expenditure Share of GDP, 2000-2006



Source: OECD

The “*OECD Factbook 2008: Economic, Environmental and Social Statistics*” mentions that in 2006, Mexico’s R&D intensity accounted for about 0.5% of GDP, which is low relative to OECD countries. Mexico R&D intensity is lower than countries with similar levels of development, such as Brazil, China, Russia, and South Africa.

R&D expenditure in the nickel value chain has been estimated using industry ratios of R&D expenditure to GDP from OECD. These estimates are meant to represent the average R&D contribution of the nickel value chain with the understanding that actual spending will fluctuate year to year. Table 6.7 displays the composition of R&D spending in the nickel value chain. These estimates do not include multiplier effects.

Table 6.7: Estimated R&D Spending in the Nickel Value Chain

Industry	R&D Expenditures	% of Total
First-Use	Mex\$ 1 million (US \$ 92 thousand)	1%
End-Use	Mex\$ 87 million (US \$ 8 million)	99%

Source: PwC calculations

It is estimated that the nickel value chain is responsible for approximately Mex\$ 88 million (US \$ 8 million) of research and development expenditures in Mexico.

7 Conclusions

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

Economic impacts across the entire nickel value chain are estimated to be Mex\$ 24.6 billion (US \$ 2.3 billion) in value-added, which corresponds to 0.24% of the Mexican GDP. The economic activities of the nickel value chain were also responsible for the employment of approximately 132,000 persons, earning Mex\$ 9.8 billion (US \$ 896 million) in annual salaries and wages.

Appendix A. List of Sources

Economic Statistics and Research Reports

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