



INTERNATIONAL NICKEL STUDY GROUP

WORLD DIRECTORY OF
NICKEL PRODUCTION
FACILITIES

2019

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WORLD DIRECTORY OF NICKEL PRODUCTION FACILITIES

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INTRODUCTION

THE INTERNATIONAL NICKEL STUDY GROUP

The International Nickel Study Group (INSG) is an autonomous, intergovernmental organization aimed at enhancing the world nickel market transparency. Membership comprises nickel producing, consuming and trading countries. Its operations began in The Hague, Netherlands, early in 1991, and since 2006 it has been based in Lisbon, Portugal. The INSG has no provision for market stabilization activities or market intervention of any kind.

Objectives

The INSG has proven to be an efficient mechanism:

- to collect and publish statistics on nickel markets;
- to publish other information on nickel, such as this directory of industry facilities;
- to provide a forum for discussions on nickel issues of interest to nickel producing and consuming countries and their industries;
- to collect information on environment, health and safety issues related to nickel and its compounds;
- to undertake forecasts and economic analysis of nickel markets and related topics for the information of member countries and for sale;
- to contribute to the promotion of sustainable development principles within the nickel industry.

Members

The following are members of the INSG:

Australia	Brazil	Cuba
European Union	Finland	France
Germany	Greece	Italy
Japan	Norway	Portugal
Russian Federation	Sweden	
United Kingdom		

These members together account for a significant share of world nickel mine production, primary nickel trade and nickel usage. The Group seeks to broaden its membership to include all countries with an interest in nickel production, usage (consumption) or trade so as to be fully representative of the international nickel economy.

Committee Structure and Meetings

The highest authority of the INSG is its General Session. Consideration of the work program takes place in the Standing Committee, Statistics Committee and the Environmental and Economics Committee. An Industry

Advisory Panel (IAP) was established in 1995. The Standing Committee oversees the financial and administrative matters of the Study Group. The Statistics Committee oversees the statistical work of the INSG, such as deciding on statistics to be collected and studies or other work on statistics to be undertaken. The Environmental and Economics Committee (established in 1998) initially dealt with environment, health and safety issues related to nickel and its compounds. More recently it became involved in activities related to sustainable development and also on economic studies of relevance for the nickel industry. Representatives of nickel producing and consuming companies and industry associations play an important role in the work of these "operating" committees, as advisers to government delegations. The Industry Advisory Panel has an important role in advising on technical questions and the work program.

The INSG as a whole meets in General Session once a year (in October) and meetings of all committees and the IAP are held immediately ahead of the Session. The IAP, Standing Committee, Statistics Committee and Environmental and Economics Committee also meet in October.

Products

The Group publishes a Monthly Bulletin on World Primary Nickel Statistics. The introduction of the Environmental and Economics Committee broadened its scope to environmental and economic issues related to the nickel market on one hand, and to sustainable development and related initiatives on the other. This resulted in the introduction of data collection on trade and use of secondary nickel units (nickel recycling).

Other outputs include:

- a World Directory of Nickel Production Facilities, including periodical updates of new nickel industry developments;
- a biannual, internal short-term forecast of nickel production, usage and market balance;
- a compendium of legislation and other initiatives affecting nickel;
- economic studies on nickel markets.

All enquiries relating to this directory should be addressed to Mr. Ricardo Ferreira, Director of Market Research and Statistics.

THE NICKEL INDUSTRY

Nickel Production

Nickel occurs in nature in combination with oxygen, sulphur, silica and other elements. Economically workable deposits are of two main types. *Nickel sulphides* (e.g., pentlandite, a nickel-iron sulphide) are of igneous origin associated with ultra-basic rock types, and often occur together with economically recoverable amounts of copper, cobalt, gold, platinum group metals and several other metals. *Nickel laterites* are weathering products in a tropical environment of ultra-basic rocks that originally contained very small amounts of nickel. The nickel becomes concentrated in near-surface layers and occurs in the form of oxides and silicates. Cobalt and iron are commonly associated with nickel but laterites do not contain other valuable constituents in economically recoverable amounts.

Nickel deposits occur widely throughout the world. The most important sulphide deposits are in the Russian Federation, Canada, Australia, China, the Nordic countries and Africa. Laterites most commonly occur in tropical countries such as New Caledonia (France), Indonesia, the Philippines, Cuba, Dominican Republic and several Latin American countries, but also in more temperate countries such as Albania, Greece, Kazakhstan and the Ukraine Republic. Both ore types occur in the Russian Federation, Australia, Brazil and the United States.

Several different technologies are used in the treatment of nickel ores. The nickel content of sulphide ores usually can be concentrated several times by relatively economical ore dressing techniques before the "concentrate" is smelted and refined to produce usable nickel products. Laterite ores, in contrast, are amenable to only limited concentration by screening and drying, and therefore almost the entire volume of ore must go to the metallurgical plants. Laterite processing tended to be much more energy intensive, but this is likely to change by the introduction of the Pressure Acid Leach (PAL) technology in the late 1990s. Mining costs of laterites are usually much lower than for sulphide ores. These differences, plus the availability of byproduct values, can have an important influence on the viability of specific deposits.

The minimum economically treatable nickel content in ore is generally about one percent (ten kilograms per tonne of ore), but lower grades can be viable under favourable circumstances, especially if there are byproducts. Nickel is also produced as a byproduct of other metals, the most notable example being the platinum group metals (PGM) in southern Africa. Some other non-ferrous metal refineries also recover small quantities of byproduct nickel.

Nickel processing techniques are of two types: pyrometallurgical whereby ores or concentrates are melted in furnaces and the contained metals separated from slag and further refined; and hydrometallurgical whereby the valuable metals are leached from the surrounding waste rock and then further refined. Both

processing techniques are applied to sulphide and laterite ores.

Nickel Products

Finished nickel products usable by consuming industries are placed into two classes plus chemicals, and defined by the International Nickel Study Group as follows:

Refined Nickel (Class I) - products with a nickel content of 99% or more:

- Electrolytic nickel (whole and cut cathodes)
- Pellets
- Granules
- Briquettes
- Powder/flakes
- Rondelles

Charge nickel (Class II) - products with a nickel content of less than 99%:

- Ferro-nickel
- Nickel oxides/oxide sinter
- Utility (China P.R., Japan, Korea Rep., Taiwan)
- Nickel pig iron (China P.R. and Indonesia)

Chemicals

- Chemical nickel oxide
- Nickel sulphate
- Nickel chloride
- Nickel carbonate
- Nickel acetate
- Nickel hydroxide
- Other salts and chemicals

This directory provides information on the producers of Class I and Class II products but not of chemicals, although some of the listed producers also make nickel chemicals. In addition, there are a number of "intermediate" nickel products, which may be traded before final processing. These intermediates include nickel sulphide matte and impure nickel hydroxides, oxides and sulphates. Producers of these are also listed in the directory (see also the notes to the table on page v). Please note that additional capacity from planned or proposed expansions of existing facilities is also listed with those facilities in Sections B and C of this directory.

Current capacities for finished nickel are summarized by country and company in the table on page v, together with actual production of finished nickel by country in the previous year. Capacities of new industry developments are listed on page vi-x in accordance with the project qualifications as defined in Section D.

Contact details of most of the nickel producers are listed in Section A.

Nickel Production Capacity

Section B of this directory lists capacities for mines, where available, in terms of tonnes of ore mined or milled and

also in terms of nickel content of production, particularly where the product is shipped elsewhere for processing.

Section C lists rated or estimated annual smelter and refinery capacities for each plant in terms of nickel content. Only facilities actually operating in 2018 are included. Most of the figures are considered to be reasonable measures of what the facilities can produce under "normal" conditions but actual annual production is often less than rated capacity for many reasons, e.g. shortage of inputs, breakdowns or technical problems, natural disasters, strikes, market-related closures, or disruptions due to renovations. Alternatively, production can exceed rated capacity under favourable conditions or due to a switch from lower to higher grade ore. Thus, "capacity" is an imprecise concept and can change upwards or downwards for many reasons. However, realization of rated capacities listed for the Russian Federation is believed to be conditional on investment in mining and/or processing facilities.

Flowcharts of the smelters/refineries listed in this section are reproduced in Annex when indicated.

Section D New Nickel Industry Developments consists of 3 different sections. The first section **D1 Committed Developments** comprises new production facilities as well as expansions of existing ones, confirmed for completion in the next four to five years, which meet specific criteria (among other feasibility study completed and financing secured). **D2 Likely Project Developments** is a group of projects which are likely to come to fruition, but have not come as far as meeting the criteria as in D1. **D3 Potential Project Developments** lists projects which are being considered, but far more work is required to be defined as likely. The INSG Secretariat surveys the above-mentioned developments and projects regularly.

Section E lists nickel mines, smelters and refineries that currently are not operating but potentially could be reopened in the future. This Section is also regularly updated.

Nickel Usage

Nickel is a lustrous white metal with a melting point of 1453° C and relatively low electrical and thermal conductivity, and is capable of being magnetized. The properties, which characterize most nickel-containing alloys and steels, are high resistance to corrosion and oxidation and excellent strength and toughness at elevated temperatures.

Today, the major use for nickel is in the production of stainless and heat resisting steels, which accounts for about 65% of total usage (consumption). Other uses comprise a wide range of other steel alloys including castings (10% of use), non-ferrous alloys (about 12%), electroplating (8%) and others including chemicals (5%). Nickel use in stainless steel is increasing in proportion to total usage (consumption), as its growth exceeds that of other uses.

Usage (consumption) categories used by the International Nickel Study Group are as follows:

Stainless steels (other than castings) containing by weight 1.2% or less of carbon and 10.5% or more of chromium, with or without other elements.

Other alloy steels (excluding castings).

Steel castings, alloyed (including cast iron).

Non-ferrous products (including castings) are products of pure nickel (98-100% nickel content), nickel base alloys (50-97% nickel), iron-nickel-chrome) alloys (30-49% nickel), copper base alloys (1-49% nickel) and clad materials.

Plating: nickel metal used for plating (nickel used to manufacture chemicals and nickel chemicals used for plating is included under "Other uses").

Other uses: catalysts, batteries and chemicals.

These nickel-containing products are mainly used for the production of capital goods, consumer goods as well as intermediate products in the following industries:

- transport equipment
- mechanical engineering
- building and construction
- electrical and electronic engineering
- metal products
- chemical industry.

Some 300 000 end-use applications of nickel are known. In more than three-quarters of these, nickel alloys are used for their heat- and corrosion-resistance. Pure nickel metal or nickel alloyed with another metal, mainly copper, is used in coinage. This is the oldest known use for nickel.

Examples of products that feature nickel or nickel-containing alloys and steels include:

- pipelines, valves, seawater systems and topside cladding used in the offshore oil and gas industry;
- vessels, ducts and flue liners for coal-fired power stations and waste incinerators;
- containers for long-term storage of nuclear waste;
- heat-exchangers, pipes and valves for water desalination plants and for waste water treatment;
- cooking vessels and work surfaces for commercial food processing;
- kitchen and table ware;
- processing, storage and transportation vessels for milk, wine, beer and other beverages;
- curtain wall cladding for modern city centre buildings;
- combination zinc-nickel coatings for corrosion protection of steel car body panels;
- rechargeable batteries for cordless electrical appliances;
- turbine blades and other vital components of aero engines.

INFORMATION SOURCES FOR THE DIRECTORY

Compilation of this revised edition of the directory of nickel production facilities began with information solicited by the INSG from member and non-member countries. Information (in some cases partially) was received officially from or on behalf of:

Australia	Finland	Philippines
Austria	France	Russian Federation
Brazil	Germany	South Africa, Rep. of
Canada	Greece	United Kingdom
China, P.R.	Japan	United States
Colombia	Korea Rep.	Zimbabwe
Cuba	New Caledonia	
Dominican Rep.	Norway	

Additional data were obtained from companies concerned or from recent corporate and government publications.

The INSG is grateful to the above sources. Corrections for a subsequent update edition would be welcomed.

EXPLANATORY NOTES

All weights are in tonnes (metric tons of 2204.6 pounds).

Symbols and Abbreviations:

M	million	res.	reserves	Ag	silver	N	North
d	day	avg.	average	Au	gold	E	East
m	month	cap.	capacity	Co	cobalt	S	South
y	year	conc.	concentrate	Cu	copper	W	West
g/t	gram per tonne	est.	estimate(d)	Fe	iron	FYROM	Former Yugoslav Republic of Macedonia
t	tonne	ind.	indicated	Ni	nickel		
t/d	tonnes per day	inf.	inferred	NPI	nickel pig iron		
t/m	tonnes per month	meas.	measured	Pd	palladium		
t/y	tonnes per year	prob.	Probable	Pt	platinum		
wmt	wet metric	prov.	Proven	PGE	platinum group		
t/y	tonnes per year	prob.	Probable	Pt	platinum		
wmt	wet metric	prov.	Proven	PGE	platinum group		
	tonne	prodn.	production		elements		
dmt	dry metric	AL	Atmospheric	PGM	platinum group		
	tonne		leaching		metals		
wMt	million wet	BFS	bank feasibility				
	metric tonnes		study				
dMt	million dry	DFS	definitive				
	metric tonnes		feasibility study				
		HPAL	high pressure				
			acid leaching				
		LOM	life of mine				
		OP/OC	open pit or open				
			cast (mine)				
		PAL	pressure acid				
			leaching				
		PFS	pre-feasibility				
			study				
		SP	stockpile				
		UG	underground				
			(mine)				

WORLD FINISHED NICKEL PRODUCTION AND CAPACITY

<u>Country</u>	<u>Notes</u>	<u>Nickel Production 2018*</u>	<u>Nickel Capacity 2018**</u>	<u>Notes to the table</u>
		(000 t)	(000 t/y)	
Australia	1	xxx	xxx	<p>1. Reported production for Australia is finished nickel but it also exports concentrate and matte for processing elsewhere, and imports ore for processing.</p> <p>2. Austria's production is from secondary feed.</p> <p>3. Reported production for Brazil is finished nickel but it also exports matte for processing elsewhere.</p> <p>4. Reported production for Canada is finished nickel but it also imports and exports ore and intermediate feed. Vale includes the Sudbury, Thompson and Long Harbour refineries.</p> <p>5. Reported production for China P. R. includes nickel pig iron production.</p> <p>6. Reported production for Cuba is finished oxide sinter but it also exports Ni-Co sulphides for refining elsewhere.</p> <p>7. Finland's production is based largely on imported feed.</p> <p>8. Reported French production is refined nickel and salts from New Caledonian matte.</p> <p>9. Reported production for Indonesia includes ferro-nickel and nickel pig iron production. For comparison purposes, capacity includes a similar volume of nickel pig iron production.</p> <p>10. Japan produces finished nickel from imported ore and intermediate materials.</p> <p>11. Reported production for New Caledonia is ferro-nickel and nickel oxide, it also shipped matte to France for refining until 2016, and exports ore for processing elsewhere.</p> <p>12. Norway's mine production is exported for processing. Reported production is refined nickel from imported intermediate feed.</p> <p>13. Reported production for the Russian Federation is finished nickel, but it also imports some feed and exports matte. Production may include some nickel toll refined from imported feed.</p> <p>14. Reported production for South Africa is refined nickel, but it also exports intermediate products.</p> <p>15. The UK produces refined nickel from imported intermediate materials.</p> <p>16. Production reported for Zimbabwe is refined nickel from domestic feed plus imported matte and sulphate, and ore also exported for processing elsewhere.</p> <p>17. The Total may not be equal to the sum of the countries due to some nickel oxide sinter produced in one country being processed to class I nickel in another country.</p> <p>In addition to the above notes, Botswana exports matte for refining elsewhere, the Philippines exports a mixed nickel sulphate and also ore, Papua New Guinea exports nickel hydroxide, Spain, Turkey and Zambia export ore and have no operational processing facilities.</p> <p>* Reported 2018 production data are partly estimated. ** Some production facilities could produce over quoted capacities.</p>
Murrin Murrin			(xxx)	
Kwinana			(xxx)	
Yabulu			(xxx)	
Austria (Treibacher)	2	xxx	xxx	
Brazil	3	xxx	xxx	
Barro Alto			(xxx)	
Codemin			(xxx)	
Tocantins			(xxx)	
Onça Puma			(xxx)	
Canada	4	xxx	xxx	
Vale			(xxx)	
Sherritt			(xxx)	
China, P.R.	5	xxx	xxx	
Jinchuan			(xxx)	
Other			(xxx)	
Colombia (Cer. Matoso)		xxx	xxx	
Cuba	6	xxx	xxx	
Nicaró			(xxx)	
Punta Gorda			(xxx)	
Dom. Rep.		xxx	xxx	
Finland (Norilsk)	7	xxx	xxx	
France (Eramet)	8	xxx	xxx	
Greece (Larco)		xxx	xxx	
Guatemala (Solway)		xxx	xxx	
India (Nicomet)		xxx	xxx	
Indonesia	9	xxx	xxx	
PT Antam			(xxx)	
Japan	10	xxx	xxx	
Hyuga			(xxx)	
Nippon Yakin			(xxx)	
Pacific Metals			(xxx)	
Sumitomo			(xxx)	
Vale Japan			(xxx)	
Korea, Rep. (Posco)		xxx	xxx	
Madagascar (Ambatovy)		xxx	xxx	
Myanmar (Tagaung)		xxx	xxx	
New Caledonia (Fr.)	11	xxx	xxx	
Doniambo			(xxx)	
Koniambo			(xxx)	
Vale New Caledonia			(xxx)	
N. Maced. (Feni Industries)		xxx	xxx	
Norway (Glencore)	12	xxx	xxx	
Russian Federation	13	xxx	xxx	
Severonikel			(xxx)	
Ufaleynikel			(xxx)	
Yuzhuralnikel			(xxx)	
Serbia (Kosovo) (Ferronikeli)		xxx	xxx	
South Africa, Rep. of	14	xxx	xxx	
Implats			(xxx)	
Anglo Platinum			(xxx)	
Ukraine Republic (Pobuzhski)		xxx	xxx	
UK (Vale)	15	xxx	xxx	
Zimbabwe	16	xxx	xxx	
Bindura			(xxx)	
Empress			(xxx)	
TOTAL	17	xxx	xxx	

NEW NICKEL INDUSTRY DEVELOPMENTS

COMMITTED DEVELOPMENTS (D1)

<u>Project</u>	<u>Company</u>		<u>Capacity (Ni content, t/y)</u>		
			<u>Ore & Conc</u>	<u>Intermediate</u>	<u>Primary</u>
Australia					
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
Brazil		xxx			
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
Canada		xxx			
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
China P.R.					
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
Cuba					
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
Finland					
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
Indonesia		xxx			
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
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xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx
Philippines					
xxx	xxx		xxx	xxx	xxx
Solomon Islands					
xxx	xxx		xxx	xxx	xxx
xxx	xxx		xxx	xxx	xxx

NEW NICKEL INDUSTRY DEVELOPMENTS

COMMITTED DEVELOPMENTS (D1)

<u>Project</u>	<u>Company</u>	<u>Capacity (Ni content, t/y)</u>		
		<u>Ore & Conc</u>	<u>Intermediate</u>	<u>Primary</u>
Turkey	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
United States	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Zambia	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
TOTAL (D1):		xxx	xxx	xxx

SAMPLE
please do not quote

NEW NICKEL INDUSTRY DEVELOPMENTS

LIKELY PROJECT DEVELOPMENTS (D2)

<u>Project</u>	<u>Company</u>	<u>Capacity (Ni content, t/y)</u>		
		<u>Ore & Conc</u>	<u>Intermediate</u>	<u>Primary</u>
Australia		xxx	xxx	xxx
xxx	xxx		xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Brazil	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Canada		xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
China P.R.		xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Colombia		xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Cuba	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Greenland	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Indonesia		xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
Russian Federation	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
South Africa	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx
TOTAL (D2):		xxx	xxx	xxx

NEW NICKEL INDUSTRY DEVELOPMENTS

POTENTIAL PROJECT DEVELOPMENTS (D3)

<u>Project</u>	<u>Company</u>	<u>Capacity (Ni content, t/y)</u>		
		<u>Ore & Conc</u>	<u>Intermediate</u>	<u>Primary</u>
Australia				
XXX	XXX		XXX	XXX
XXX	XXX		XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX		XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Brazil		XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Cameroon				
XXX	XXX	XXX	XXX	XXX
Canada				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
China P.R.		XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Cuba				
XXX	XXX	XXX	XXX	XXX
Guinea				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Indonesia		XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Kazakhstan				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Papua New Guinea				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Russian Federation				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
Sweden				
XXX	XXX	XXX	XXX	XXX
Tanzania				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
United States				
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
XXX	XXX	XXX	XXX	XXX
TOTAL (D3):		XXX	XXX	XXX

A - CONTACT DETAILS

The section contains contact information on most nickel producing companies, including individual mines, smelters and refineries around the world.

COMPANY NAME AND ADDRESS	CONTACT DETAILS
ALBANIA	
Balfin Group St. 'Papa Gjon Pali II', ABA Business Center 11th Floor Tirana	Contact: Title: Phone: Fax: Email: info@balfin.al Website: www.balfin.al
Cunico Resources N. V. Jan Luijkenstraat 8 1071 CM Amsterdam The Netherlands	Contact: Title: Phone: +31 (0) 20 71 83 555/6 Fax: Email: info@cunicoresources.com Website: www.cunicoresources.com
AUSTRALIA	
A-Cap Energy Limited Perth Office: Level 1, 136 Stirling Hwy Nedlands, Perth WA 6009 Australia PO Box 291 Nedlands WA 6909 Registered address: Level 38, 123 Eagle St Riverside Centre Brisbane QLD 4000 Australia Botswana Office: Plot 374 Moffat Rd, Francistown, Botswana	Contact: Title: Phone: +61 8 9467 2612 Fax: +61 8 7200 7612 Email: Website: https://acap.com.au/
Ardea Resources Limited Suite 2, 45 Ord Dstreet West Perth WA 6005	Contact: Title: Phone: +61 8 6244 5136 Fax: Email: ardea@ardearesources.com.au Website: https://ardearesources.com.au/
Artemis Resources Ltd. Level 3, IBM Building, 1060 Hay Street, West Perth, WA Australia, 6006 PO Box R933 Royal Exchange NSW Australia, 1225	Contact: David Lenigas Title: Executive Chairman Phone: +61 2 9078 7670 Fax: +61 2 9078 7661 Email: info@artemisresources.com.au Website: artemisresources.com.au

B - NICKEL MINES

ALBANIA

COMPANY AND MINE	ORE TYPE, RESERVES	MINING METHOD AND CAPACITY	MILLING METHOD AND CAPACITY	REMARKS
Cunico Resources Bitincka mine Southern Albania near Korca and Kapstica	Reserves of Fe-Ni 21 Mt @ 1.03% Ni, 40% Fe, 9.61% SiO ₂ Reserves of Ni-Si 15.3 Mt @ 1.21% Ni, 17.5% Fe, 36.8% SiO ₂ , 0.03% Co	OP mine		Mine located about 200km from FeNi smelter.
Cunico Resources Guri – I – Kuq mine Central Albania near the town of Pogradec	Reserves of Fe-Ni 53.Mt @ 0.97% Ni, 42% Fe, 17% SiO ₂ , 0.075% Co	OP mine		Mine located about 200km from FeNi smelter.
Cunico Resources Nome mine Northern Albania, Kukës area	Reserves of Fe-Ni 2.3 Mt @ 0,85% Ni, 43% Fe, 13% SiO ₂ , 0,047% Co Reserves of Ni-Si 4 Mt @ 1.198% Ni, 22% Fe, 41% SiO ₂ , 0,046% Co	OP mine		Mine located about 200km from FeNi smelter.

C - NICKEL SMELTERS AND REFINERIES

AUSTRALIA

COMPANY AND PLANT	FEED	PROCESS TECHNOLOGY	CAPACITY AND PRODUCTS	REFINED CAPACITY (Ni content)	REMARKS
BHP Billiton Nickel West Kalgoorlie Smelter Kalgoorlie, Western Australia	Ni sulphide conc. from Mt Keith and Leinster (own) and Kambalda (3rd party - from Mincor, under offtake agreement) mine feed.	Outokumpu flash furnace, Pierce-Smith converters, matte granulation.	Up to 110,000 t/y nickel in granulated matte (about 65% Ni).		Matte refined at company's Kwinana refinery or exported. Flowchart in Annex.
BHP Billiton Nickel West Kwinana Refinery Kwinana, Western Australia	Matte from Kalgoorlie Smelter.	Sherritt process: ammoniacal leach, hydrogen reduction.	Refined nickel in briquettes and powder.	65000 t/y	Plant debottlenecking on course to achieve 84,000 t/y capacity. Development of Ni sulphate plant on site, with capacity for 100,000 t/y Ni sulphate (ca. 22,000 t/y contained Ni, expected to be concluded in 2019), with possible second phase to reach 200,000 t/y (ca. 45,000 t/y contained Ni) being studied. Mini sulphate plant operating as of mid 2018 to deliver samples. Flowchart in Annex.
Glencore Nickel (through wholly owned subsidiary Minara Resources) Murrin Murrin Refinery 60 km E of Leonora, Western Australia	Feed from own mine.	Sherritt pressure acid leach process (HPAL), sulphide precipitation and hydrogen reduction process.	LME Grade Ni briquettes and powders (40,000 t/y) and Co metal (5,000 t/y).	40000 t/y	Commissioned in 1999. Flowchart in Annex.

D - NEW NICKEL INDUSTRY DEVELOPMENTS

D1 - COMMITTED DEVELOPMENTS

AUSTRALIA

PROJECT	COMPANY	PROJECT DESCRIPTION	PRODUCTS	CAPACITY (Ni Content, t/y)			REMARKS
				Ore / Conc.	Intermediate	Primary	
Black Swan Project Laverton Western Australia	Poseidon Nickel	Black Swan (OP): Total Resources: 30,700 kt @ 0.58% Ni, 179 kt Ni metal; 0.01% Co, 4.2 kt Co metal (Jul 2014). Silver Swan (UG): Total Resources: 168 Kt @ 9.5% Ni, 16.03 kt Ni metal; 0.19% Co, 316 t Co metal (Aug 2019). Total Reserves: 57 Kt @ 5.79% Ni, 3.3 kt Ni metal; 0.11% Co, 600 t Co metal (May 2017).	Concentrate				Black Swan has been on care and maintenance since 2009. Project acquired from Norilsk in late 2014. The project comprises the Silver Swan underground mine, the Black Swan open pit and the Black Swan 2.2Mtpa Concentrator with 191,400t of nickel metal in resource. On going drilling. Restart planning and Study subject to ongoing optimisation.
Lake Johnston Project Laverton Western Australia	Poseidon Nickel	Maggie Hays: Resources (inclusive of Reserves): Ind.: 2.6 Mt @ 1.6% Ni; Inf.: 0.9 Mt @ 1.17% Ni; Total 3.5 Mt @ 1.49% Ni, 0.05% Co (Mar 2015).	Concentrate, 1.5 Mtpa Concentrator				Confirmation of intrusive nickel-copper style model not traditional komatiite hosted model leading to Abi Rose discovery. Drilling program at Abi Rose released in Nov 2018. Planning has commenced for a geochemical exploration campaign to the south of Maggie Hays.

D - NEW NICKEL INDUSTRY DEVELOPMENTS

D3 - POTENTIAL PROJECT DEVELOPMENTS

AUSTRALIA

PROJECT	COMPANY	PROJECT DESCRIPTION	PRODUCTS	CAPACITY (Ni Content, t/y)			REMARKS
				Ore / Conc.	Intermediate	Primary	
Bell Creek Nickel-Cobalt Project Greenvale, Queensland	Australian Mines Ltd	Mine. Resource: Measured 11.4Mt @ 0.84% Ni, 0.05% Co; Indicated 12.7Mt @ 0.64% Ni, 0.03% Co, Inferred 1.7Mt @ 0.55% Ni, 0.03% Co (Abril 2019)	On-site beneficiation plant capable of producing a concentrated feed for trucking is currently being considered.				Assessing low-cost satellite nickel-cobalt operation potential.
Big Red Big Red	JV Independence Group, Rumble Resources	Nickel sulphide. Ni-Cu deposit.	Concentrate				Part of Fraser Range Projects Joint Venture - IGO 70%, RTR 30%. Work completed: aircore drilling; ground gravity survey. Plan to review geochemical results.
Broken Hill Project Southeast of Broken Hill Region, New South Wales	Impact Minerals	Nickel sulphide. Ni-Cu-Co-PGE mineralisation associated with ultramafic rocks; Zn-Pb-Ag mineralisation hosted by metasedimentary rocks and amphibolite; and pyrite-cobalt deposits.					Exploration is underway. In July 2018 Impact announced a JV with BlueBird Battery Metals Inc to farm in to Broken Hill Project but terminated during the 2018Q4. Impact reported several significant high grade drill results from at least three prospects: Red Hill, Platinum Springs and Dora East.
Collurabbie Nickel 500 km N of Kalgoorile, Western Australia	Rox Resources	Ni-Au sulphide mine. Mineral Resource: 573,000t @ 1.63% Ni, 1.19% Cu, 0.082% Co, 1.49 g/t Pd, 0.85 g/t Pt.	Ore.				The project has potential to add value to the Fisher East Project, being only 70 km to the east. If both projects are brought into production, there is potential for ore from both sites to be treated at the same plant.

E - CLOSURES

AUSTRALIA

COMPANY AND PROJECT	TYPE OF FACILITY	DESCRIPTION	REMARKS
McMahon Holdings Blair Mine 20 km S.E. Of Kalgoorlie, WA	Nickel sulphide ores and concentrates.		Closed 12 October 2001. Re-opened by Australian mines in December 2003.
Mincor Resources NL Redross Mine Kambalda, WA	Ni sulphide. Resources: Meas.: 0.04 Mt @ 4.9% Ni, Ind.: 0.14 Mt @ 2.9% Ni, Meas. and Ind.: 0.18 Mt @ 3.34% Ni, Inf.: 0.07 Mt @ 2.90% Ni (March 2019)	UG mine.	Toll treated at Kambalda Mill. Concentrate sold to BHP Billiton. Re-opening of former 1970's mine via new decline. Production commenced mid-2004. Production terminated in May 2009 as mine exhausted. There are other unexplored underground resources. Timing of the explorations is not known. Mincor reported resources for Redross in 2019.
Norilsk Nickel Australia Waterloo Nickel Operation NNW of Kalgoorlie, WA	Ni sulphide	UG mine.	Ore was sold to Nickel West Leinster Operation (BHP Billiton). Production suspended for indefinite period of time. Note: Norilsk Nickel report all Australian Reserves and Resources under Norilsk Nickel Cawse.
Tectonic Resources RAV 8 Project 25 Km E of Ravensthorpe, WA	UG mine, produced 15,430 tonnes of contained nickel.	Nickel sulphide concentrate plant. OP commenced February 2000, then UG in October 2001.	Plant closed in December 2001. UG operations closed in September 2005 due to depletion of reserves. Re-opened in January 2007. Mining likely to cease by August 2007. Exploration JV entered into with Mincor in January 2007.