



## **Research and Policy Planning Department**

**MINING INVESTMENT IN CHILE**

**PROJECT PORTFOLIO**

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## Contents

<b>Foreword</b> .....	<b>1</b>
<b>I. Introduction</b> .....	<b>2</b>
<b>II. Mining Project Portfolio</b> .....	<b>2</b>
2.1 Copper, Gold, and Silver Mining Projects.....	2
2.2 Other Relevant Mining Projects .....	3
<b>III. Projected Investments</b> .....	<b>5</b>
3.1 Investments Profiles.....	5
3.2 Regional Distribution of Projected Mining Investment .....	6
3.3 Copper Mining Investment Allocations, by Degree of Certainty.....	6
<b>IV. Projected Copper Production in Chile</b> .....	<b>8</b>
4.1 Mine Copper Output (2010-2020) .....	8
4.2 Mine Copper Output by Region (2010-2020) .....	9
4.3 Estimate Review .....	10
<b>V. Estimated Production of Other Minerals</b> .....	<b>13</b>
5.1 Gold and Molybdenum .....	13
5.2 Iron .....	14
5.3 Industrial Minerals .....	14
<b>Annex A: Methodology</b> .....	<b>15</b>
<b>Annex B: Copper, Gold and Silver Investment Projects</b> .....	<b>19</b>
<b>Annex C: Leading Industrial Mineral and Iron Mining Projects</b> .....	<b>29</b>



## **MINING INVESTMENT IN CHILE**

### **Project Portfolio**

#### **Foreword**

This updated report issued by the Cochilco Research and Policy Planning Department reviews projects under construction or expected to start construction in 2011-2015.

In addition to investment in copper, gold and silver projects, as of this report we also include iron and industrial minerals (iodine, nitrates, potassium salts). The overall portfolio is valued at US\$66.9 billion, including US\$44 billion to be spent in 2011-2015 –a new mining investment record for Chile.

The report estimates copper production through the year 2020 based on both current and planned operations. It also provides a projection of gold, iron, and molybdenum production.

Investments through 2020 are expected to result in production of 7.75 million TPY of refined copper, 110 TPY of gold, 60 kTPY of fine molybdenum, and 15 million TPY of iron.

Our review shows that most of Codelco's investment is allocated to structural projects designed to ensure long-term sustainability. Major private miners are also expanding operations to prolong their lifespan and/or implementing new projects.

A significant new development is the role of new entrants accounting for significant investment amounts, notably Japan's Pan Pacific Copper, Canada's Quadra FNX Mining, Far West Mining and GoldCorp, and Australia's PanAust.

Santiago, Chile

July 2011



## **I. Introduction**

This report provides an estimate of expected investment in the Chilean copper, gold and silver, iron, and industrial minerals (e.g., iodine, nitrates, potassium salts) mining sectors. It also estimates production through the year 2020 as a result of these investments.

Methodology notes are contained in Annex A.

This report has three parts:

- A review of the existing portfolio, including projects under construction or expected to do so by 2015. Copper, gold and silver projects are shown in Annex B. Iron and industrial minerals mining projects (iodine, nitrates, potassium salts) are shown in Annex C.
- Estimated investments by Codelco and private copper, gold and silver, iron and industrial minerals miners.
- Estimated mine copper output (e.g., concentrate and SX-EW cathodes) through the year 2020, including a review of projected performance and a global estimate of gold, iron, and molybdenum production.

## **II. Mining Project Portfolio**

Chile has a robust mining investment project portfolio valued at US\$66.8 billion, including US\$54.3 earmarked for copper, US\$9.8 billion for gold and silver, and US\$2.1 billion for iron and industrial minerals.

### **2.1 Copper, Gold, and Silver Mining Projects**

The project portfolio includes investments by Codelco and private copper and gold miners both underway (start date prior to 2011) and expected to start in 2011-2015, regardless of intended on-stream date.

Table 1 below shows investment projects by intended startup date, region, sector, status, and project amount.

**Table 1: Copper and Gold Mining Project Portfolio**

Startup	Company Name	Project Name	Region	Sector	Type	Status	Investment (US\$ Mn)
2011	ANGLO AMERICAN	Los Bronces Exp. to 160 kTPD	Santiago	Large	Expansion	Construction	2.500
	FREEPORT MC MORAN	El Abra Sulfolix	Antofag.	Large	Replacement	Construction	725
	BHP BILLITON	Escondida New Bioleach	Antofag.	Large	Replacement	Construction	384
2012	COLLAHUASI	Expansion Phase I	Tarapacá	Large	Expansion	Construction	750
	BHP BILLITON	Escondida Crusher Reloc.	Antofag.	Large	Replacement	Construction	554
	XSTRATA	Lomas Bayas II Extension	Antofag.	Large	Replacement	Construction	293
2013	BARRICK	Pascua	Atacama	Gold	New	Construction	1.500
	BHP BILLITON	Escondida New Ox. Heap Leaching	Antofag.	Large	Replacement	Probable	426
	CAN-CAN	Diego de Almagro- Leach	Atacama	Midsize	New	Possible	107
2014	PAN PACIFIC COPPER	Caserones	Atacama	Large	New	Construction	2.000
	CODELCO (MH Div.)	Mina Ministro Hales	Antofag.	State	New	Construction	2.515
	ANTOFAGASTA MIN.	Antucoya	Antofag.	Large	New	Possible	950
	FAR WEST	Santo Domingo	Atacama	Large	New	Possible	941
	PANAUST	Inca de Oro	Atacama	Midsize	New	Possible	600
	KINROSS	Lobo - Marte	Atacama	Gold	New	Possible	575
	CODELCO (Salv. Div.)	San Antonio Oxides	Atacama	State	New	Possible	317
	CAN-CAN	Diego de Almagro- Conc.	Atacama	Midsize	New	Possible	120
2015	GOLDCORP	El Morro	Atacama	Gold	New	Probable	2.500
	QUADRA FXN MINING	Sierra Gorda	Antofag.	Large	New	Possible	2.500
	CODELCO (Chuqui. Div.)	Quetena	Antofag.	State	New	Possible	620
2015 and Beyond	TECK	Quebrada Blanca Hypogenic	Tarapacá	Large	New	Probable	3.000
	CODELCO (Ten. Div.)	New Mine Level	O'Higgins	State	Replacement	Probable	2.790
	BHP BILLITON	Escondida Phase V	Antofag.	Large	Expansion	Probable	2.514
	CODELCO (Chuqui. Div.)	Chuquicamata Underground	Antofag.	State	Replacement	Probable	2.200
	CODELCO (Andina Div.)	Expansion to 244 Ktpd (Phase II)	Valparaíso	State	Expansion	Possible	6.400
	ANTOFAGASTA MIN.	Sierra Gorda District	Antofag.	Large	New	Possible	6.000
	BARRICK	Cerro Casale	Atacama	Gold	New	Possible	5.250
	TECK	Relincho	Atacama	Large	New	Possible	3.000
	COLLAHUASI	Expansion Phase II	Tarapacá	Large	Expansion	Possible	2.450
	CODELCO (RT Div.)	Sulfides Phase II	Antofag.	State	New	Possible	1.946
<b>Subtotal</b>							<b>56.427</b>
<b>Other Codelco Projects</b>							<b>7.744</b>
<b>Total Investment in Copper, Gold and Silver</b>							<b>64.171</b>

Source: Cochilco, based on published reports.

Project details are shown in Annex B.

The "Other Codelco Projects" category includes other non-major projects also requiring an Investment Project Authorization (API),<sup>1</sup> e.g., equipment replacement, facility repair, exploration, research and development, feasibility studies, cleanup, workplace safety, and welfare projects.

## 2.2 Other Relevant Mining Projects

In addition to copper and gold, the Chilean mining industry also attracts significant investments in other minerals, notably iron and industrial minerals.

<sup>1</sup> A review conducted jointly by Cochilco and the Ministry of Planning (MIDEPLAN).



**Table 2: Iron and Industrial Minerals Mining**

Company Name	Project Name	Region	Sector	Type	Status	Investment (US\$ Mn)
CAP	Cerro Negro Norte	Atacama	Iron	New	Construction	574
CAP	Los Colorados Expansion	Atacama	Iron	Expansion	Construction	342
MINERA SANTA FÉ	Bellavista	Atacama	Iron	New	Possible	143
<b>Subtotal Iron</b>						<b>1.059</b>
SQM	Pampa Hermosa	Tarapacá	Nitrate	Expansion	Construction	1.033
SQM SALAR	Expanded KCl Production	Antofagasta	Potassium	Expansion	Construction	527
SQM SALAR	SOP Plant Expansion	Antofagasta	Potassium	Expansion	Construction	100
<b>Subtotal Industrial Minerals</b>						<b>1.660</b>
<b>Grand Total</b>						<b>2.719</b>

Source: Cochilco, based on published reports.

All projects are expected on stream by 2013 save for Pampa Hermosa, to be phased in over the course of the next six years. Project details are shown in Annex C.



### III. Projected Investments

#### 3.1 Investments Profiles

The overall project portfolio is worth an estimated US\$66.8 billion. This amount includes projects under construction and projects slated to begin construction in 2011-2015, plus portions to be invested from 2015 to startup.

Investments slated for 2011-2015 stand at US\$44.1 billion, 66 percent of the project portfolio.

Planned investment in copper mining stands at US\$54.3 billion or 81.2 percent of the total. The balance goes to gold and silver mining with US\$9.82 billion or 14.7 percent and to iron and industrial minerals mining with US\$2.71 billion or 4.1 percent. Details on Table 3 below.

**Table 3: Projected Mining Investments (US\$ Mn)**

SECTOR	Before	2011	2012	2013	2014	2015	After	Total	% Share
<b>1) Copper (1.1 + 1.2 + 1.3)</b>	<b>3.331</b>	<b>5.721</b>	<b>6.012</b>	<b>7.951</b>	<b>7.064</b>	<b>7.312</b>	<b>16.955</b>	<b>54.346</b>	<b>81,2%</b>
1.1) CODELCO	369	2.674	3.447	3.883	2.599	2.487	9.005	24.464	36,6%
1.2) Large Private Miners	2.932	3.010	2.355	3.718	4.300	4.790	7.950	29.055	43,4%
1.3) Midsize Miners	30	37	210	350	165	35	0	827	1,2%
<b>2) Gold and Silver</b>	<b>715</b>	<b>675</b>	<b>1.150</b>	<b>2.010</b>	<b>1.975</b>	<b>2.150</b>	<b>1.150</b>	<b>9.825</b>	<b>14,7%</b>
<b>3) Iron and Industrial Minerals</b>	<b>316</b>	<b>740</b>	<b>900</b>	<b>245</b>	<b>138</b>	<b>120</b>	<b>260</b>	<b>2.719</b>	<b>4,1%</b>
<b>Total (1+2+3)</b>	<b>4.362</b>	<b>7.136</b>	<b>8.062</b>	<b>10.206</b>	<b>9.177</b>	<b>9.582</b>	<b>18.365</b>	<b>66.890</b>	<b>100,0%</b>

Source: Cochilco, based on published reports.

Codelco accounts for 45 percent and major private miners for 53.5 percent of copper mining investment. Medium-scale copper miners account for the balance.

To provide as accurate an overview of Codelco's investment potential as possible, information is derived primarily from the Codelco 2011 Business and Development Plan (2011 PND) and other reports available to Cochilco.

Information on private mining projects is assembled from official announcements, press reports and trade publications providing an overview of stage of development and company plans. Gold as well as combined gold/copper mining projects are reported.

The iron mining review reports on key projects undertaken by CAP Minería and Minera Santa Fe. Leading projects by SQM account for most investment in industrial minerals (potassium chloride, nitrates, iodine).



### 3.2 Regional Distribution of Projected Mining Investment

Table 4 shows the regional distribution of projected mining investment.

**Table 4: Regional Distribution of Projected Mining Investment (US\$ Mn)**

Region	Before	2011	2012	2013	2014	2015	After	Total	% Share
Tarapacá	273	670	450	620	1.270	2.040	1.910	7.233	10,8%
Antofagasta	1.257	3.097	3.282	3.634	3.620	2.939	7.565	25.392	38,0%
Atacama	1.045	1.367	2.865	4.043	2.995	2.889	3.150	18.353	27,4%
Valparaíso	85	358	337	548	522	945	5.140	7.935	11,9%
Santiago	1.600	936	121	106	67	54	0	2.884	4,3%
O'Higgins	103	708	1.007	1.255	703	716	600	5.093	7,6%
<b>Total</b>	<b>4.362</b>	<b>7.136</b>	<b>8.062</b>	<b>10.206</b>	<b>9.177</b>	<b>9.582</b>	<b>18.365</b>	<b>66.890</b>	<b>100,0%</b>

**N.B.:** Other CODELCO investment is earmarked for Antofagasta (40%), Atacama (5%), Valparaíso (20%), Santiago (5%)  
Source: Cochilco, based on published reports and own estimates.

Table 4 shows that project amounts for Atacama closely resemble those for Antofagasta.

### 3.3 Copper Mining Investment Allocations, by Degree of Certainty

Table 5 shows projects under construction, projects whose feasibility and other studies are well underway and are therefore likely to begin construction soon, and those deemed possible based on company statements.

Least certain are projects in the "Possible" category. These are still under review and/or awaiting permits before a final decision is made. As these account for US\$30.1 billion or 45.1 percent of the US\$66.7 billion value of the overall portfolio, they warrant close watching.

In the "Possible" category, Codelco accounts for US\$9.3 billion or 37.9 percent of overall investment, major private copper miners for US\$14.9 billion or 51.3 percent, and gold mining for US\$5.8 billion or 59.3 percent.

**Table 5: Mining Investment Distribution by Degree of Certainty (US\$ Mn)**

Sector	Project	Before	2011	2012	2013	2014	2015	After	Total	% Share
Mining Total	Under Construction	3.679	4.391	3.470	2.004	837	175	260	14.815	22,1%
	Probable	373	2.301	3.261	5.060	3.976	3.513	3.330	21.813	32,6%
	Possible	310	445	1.331	3.142	4.365	5.894	14.775	30.262	45,2%
	<b>Total</b>	<b>4.362</b>	<b>7.136</b>	<b>8.062</b>	<b>10.206</b>	<b>9.177</b>	<b>9.582</b>	<b>18.365</b>	<b>66.890</b>	<b>100,0%</b>
CODELCO	Under Construction	157	681	1.095	481	67	35	0	2.515	10,3%
	Probable	123	1.949	2.276	2.925	1.801	1.563	2.030	12.666	51,8%
	Possible	89	45	76	477	732	889	6.975	9.283	37,9%
	<b>Total</b>	<b>369</b>	<b>2.674</b>	<b>3.447</b>	<b>3.883</b>	<b>2.599</b>	<b>2.487</b>	<b>9.005</b>	<b>24.464</b>	<b>100,0%</b>
Large Private Miners	Under Construction	2.691	2.420	1.175	1.268	650	20	0	8.224	28,3%
	Probable	145	265	480	800	1.350	1.600	1.300	5.940	20,4%
	Possible	96	325	700	1.650	2.300	3.170	6.650	14.891	51,3%
	<b>Total</b>	<b>2.932</b>	<b>3.010</b>	<b>2.355</b>	<b>3.718</b>	<b>4.300</b>	<b>4.790</b>	<b>7.950</b>	<b>29.055</b>	<b>100,0%</b>
Medium-Scale Private Miners	Under Construction	0	0	0	0	0	0	0	0	0,0%
	Probable	30	37	205	335	100	0	0	707	85,5%
	Possible	0	0	5	15	65	35	0	120	14,5%
	<b>Total</b>	<b>30</b>	<b>37</b>	<b>210</b>	<b>350</b>	<b>165</b>	<b>35</b>	<b>0</b>	<b>827</b>	<b>100,0%</b>
Gold	Under Construction	515	550	350	85	0	0	0	1.500	15,3%
	Probable	75	50	300	1.000	725	350	0	2.500	25,4%
	Possible	125	75	500	925	1.250	1.800	1.150	5.825	59,3%
	<b>Total</b>	<b>715</b>	<b>675</b>	<b>1.150</b>	<b>2.010</b>	<b>1.975</b>	<b>2.150</b>	<b>1.150</b>	<b>9.825</b>	<b>100,0%</b>
Iron and Industrial Minerals	Under Construction	316	740	850	170	120	120	260	2.576	94,7%
	Probable	0	0	0	0	0	0	0	0	0,0%
	Possible	0	0	50	75	18	0	0	143	5,3%
	<b>Total</b>	<b>316</b>	<b>740</b>	<b>900</b>	<b>245</b>	<b>138</b>	<b>120</b>	<b>260</b>	<b>2.719</b>	<b>100,0%</b>

Source: Cochilco, based on published reports and own estimates.

## IV. Projected Copper Production in Chile

### 4.1 Mine Copper Output<sup>2</sup> (2010-2020)

Shown below is mine copper output through 2020, with 2010 as baseline year.

**Table 6: Potential Mine Copper Output in Chile Through 2020 (kMTF)**

	Status	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
		<b>Total Mine (kMTF)</b>	Operating	5.419	5.691	5.750	5.814	5.706	5.546	5.329	5.076	4.853
	Construction	0	0	220	297	486	564	615	595	549	556	604
	<b>Baseline Total</b>	<b>5.419</b>	<b>5.691</b>	<b>5.971</b>	<b>6.111</b>	<b>6.192</b>	<b>6.110</b>	<b>5.943</b>	<b>5.671</b>	<b>5.403</b>	<b>5.340</b>	<b>5.078</b>
	Probable	0	0	0	0	41	246	394	572	649	673	
	Possible	0	0	0	5	95	317	448	1.013	1.506	1.829	2.000
	<b>Project Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>95</b>	<b>358</b>	<b>694</b>	<b>1.407</b>	<b>2.079</b>	<b>2.478</b>	<b>2.673</b>
	<b>TOTAL MINE</b>	<b>5.419</b>	<b>5.691</b>	<b>5.971</b>	<b>6.116</b>	<b>6.288</b>	<b>6.468</b>	<b>6.637</b>	<b>7.078</b>	<b>7.481</b>	<b>7.819</b>	<b>7.751</b>
<b>Total Concentrate (kMTF)</b>	Operating	3.330	3.577	3.638	3.750	3.701	3.670	3.589	3.405	3.309	3.306	3.075
	Construction	0	0	213	284	465	543	591	578	529	538	577
	<b>Baseline Total</b>	<b>3.330</b>	<b>3.577</b>	<b>3.851</b>	<b>4.034</b>	<b>4.165</b>	<b>4.213</b>	<b>4.179</b>	<b>3.983</b>	<b>3.839</b>	<b>3.844</b>	<b>3.651</b>
	Probable	0	0	0	0	41	246	394	572	649	673	
	Possible	0	0	0	0	23	153	243	808	1.297	1.607	1.755
	<b>Project Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>23</b>	<b>194</b>	<b>489</b>	<b>1.202</b>	<b>1.870</b>	<b>2.256</b>	<b>2.428</b>
	<b>TOTAL CONCENTRATE</b>	<b>3.330</b>	<b>3.577</b>	<b>3.851</b>	<b>4.034</b>	<b>4.188</b>	<b>4.407</b>	<b>4.668</b>	<b>5.185</b>	<b>5.708</b>	<b>6.100</b>	<b>6.079</b>
<b>Total SX-EW Cathodes (kMTF)</b>	Operating	2.089	2.114	2.113	2.064	2.005	1.875	1.740	1.670	1.544	1.478	1.399
	Construction	0	0	8	13	22	21	24	17	20	18	27
	<b>Baseline Total</b>	<b>2.089</b>	<b>2.114</b>	<b>2.120</b>	<b>2.077</b>	<b>2.027</b>	<b>1.897</b>	<b>1.764</b>	<b>1.687</b>	<b>1.564</b>	<b>1.496</b>	<b>1.426</b>
	Probable	0	0	0	0	0	0	0	0	0	0	0
	Possible	0	0	0	5	72	164	205	205	209	222	245
	<b>Project Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>72</b>	<b>164</b>	<b>205</b>	<b>205</b>	<b>209</b>	<b>222</b>	<b>245</b>
	<b>TOTAL SX-EW</b>	<b>2.089</b>	<b>2.114</b>	<b>2.120</b>	<b>2.083</b>	<b>2.100</b>	<b>2.061</b>	<b>1.969</b>	<b>1.893</b>	<b>1.773</b>	<b>1.718</b>	<b>1.671</b>

N.B.:  
 Baseline = Operating + Under Construction  
 Probable = Advanced studies plus EIA approval  
 Possible = Advanced (from prefeasibility underway on)

Source: Cochilco estimates.

Table 6 provides a summary of potential mine copper output through the year 2020. It allows for the fact that the certainty of production potential profiles varies and projects may materialize under conditions and at times that differ from those originally contemplated.

Estimates are based on existing output profiles, new flows from projects under construction, and additional flows from probable or possible projects coming on stream through 2015 as noted in Section III.

<sup>2</sup> Including both copper concentrate and SX-EW cathodes.

## 4.2 Mine Copper Output by Region (2010-2020)

Planned investment translates into operations in specific regions. Tables 7, 8 and 9 below show mine copper, copper concentrate and SX-EW cathode output profiles by region, respectively, using 2010 as baseline year.

**Table 7: Mine Copper Output Through 2020, Shown by Region (kMTF)**

I. Tarapacá	Baseline	695	712	759	765	738	725	680	648	641	631	631
	Projects	0	0	0	0	0	0	50	245	416	588	636
	<b>Subtotal</b>	<b>695</b>	<b>712</b>	<b>759</b>	<b>765</b>	<b>738</b>	<b>725</b>	<b>730</b>	<b>893</b>	<b>1.057</b>	<b>1.219</b>	<b>1.268</b>
II. Antofagasta	Baseline	2.931	3.021	3.051	3.121	3.194	3.102	3.074	2.995	2.826	2.780	2.496
	Projects	0	0	0	0	56	169	357	741	977	1.106	1.203
	<b>Subtotal</b>	<b>2.931</b>	<b>3.021</b>	<b>3.051</b>	<b>3.121</b>	<b>3.250</b>	<b>3.271</b>	<b>3.431</b>	<b>3.736</b>	<b>3.803</b>	<b>3.886</b>	<b>3.698</b>
III. Atacama	Baseline	421	409	400	397	470	505	490	445	436	449	503
	Projects	0	0	0	5	40	189	287	421	485	502	491
	<b>Subtotal</b>	<b>421</b>	<b>409</b>	<b>400</b>	<b>402</b>	<b>510</b>	<b>694</b>	<b>777</b>	<b>866</b>	<b>921</b>	<b>951</b>	<b>994</b>
IV. Coquimbo	Baseline	486	576	602	598	593	590	578	578	578	577	572
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>486</b>	<b>576</b>	<b>602</b>	<b>598</b>	<b>593</b>	<b>590</b>	<b>578</b>	<b>578</b>	<b>578</b>	<b>577</b>	<b>572</b>
V. Valparaíso	Baseline	265	330	340	323	318	321	301	300	283	269	247
	Projects	0	0	0	0	0	0	0	0	171	239	284
	<b>Subtotal</b>	<b>265</b>	<b>330</b>	<b>340</b>	<b>323</b>	<b>318</b>	<b>321</b>	<b>301</b>	<b>300</b>	<b>455</b>	<b>508</b>	<b>530</b>
Santiago	Baseline	217	235	421	492	461	442	417	417	392	392	392
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>217</b>	<b>235</b>	<b>421</b>	<b>492</b>	<b>461</b>	<b>442</b>	<b>417</b>	<b>417</b>	<b>392</b>	<b>392</b>	<b>392</b>
VI. O'Higgins	Baseline	404	408	399	414	419	425	404	288	246	241	236
	Projects	0	0	0	0	0	0	0	0	29	44	59
	<b>Subtotal</b>	<b>404</b>	<b>408</b>	<b>399</b>	<b>414</b>	<b>419</b>	<b>425</b>	<b>404</b>	<b>288</b>	<b>275</b>	<b>285</b>	<b>296</b>
Total	Baseline	5.419	5.691	5.971	6.111	6.192	6.110	5.943	5.671	5.403	5.340	5.078
	Projects	0	0	0	5	95	358	694	1.407	2.079	2.478	2.673
	<b>TOTAL</b>	<b>5.419</b>	<b>5.691</b>	<b>5.971</b>	<b>6.116</b>	<b>6.288</b>	<b>6.468</b>	<b>6.637</b>	<b>7.078</b>	<b>7.481</b>	<b>7.819</b>	<b>7.751</b>

Source: Cochilco estimates.

**Table 8: Concentrate Output Through 2020, Shown by Region (kMTF)**

Region	Status	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I. Tarapacá	Baseline	465	488	551	570	544	544	544	518	518	518	518
	Projects	0	0	0	0	0	0	50	245	416	588	636
	<b>Subtotal</b>	<b>465</b>	<b>488</b>	<b>551</b>	<b>570</b>	<b>544</b>	<b>544</b>	<b>594</b>	<b>764</b>	<b>935</b>	<b>1.106</b>	<b>1.155</b>
II. Antofagasta	Baseline	1.277	1.353	1.360	1.459	1.566	1.573	1.604	1.555	1.515	1.525	1.315
	Projects	0	0	0	0	0	40	193	577	809	924	998
	<b>Subtotal</b>	<b>1.277</b>	<b>1.353</b>	<b>1.360</b>	<b>1.459</b>	<b>1.566</b>	<b>1.613</b>	<b>1.797</b>	<b>2.132</b>	<b>2.324</b>	<b>2.450</b>	<b>2.314</b>
III. Atacama	Baseline	291	282	277	271	344	379	390	386	364	380	424
	Projects	0	0	0	0	23	154	246	380	444	461	450
	<b>Subtotal</b>	<b>291</b>	<b>282</b>	<b>277</b>	<b>271</b>	<b>367</b>	<b>533</b>	<b>637</b>	<b>766</b>	<b>809</b>	<b>841</b>	<b>874</b>
IV. Coquimbo	Baseline	472	551	571	571	571	568	557	557	557	557	557
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>472</b>	<b>551</b>	<b>571</b>	<b>571</b>	<b>571</b>	<b>568</b>	<b>557</b>	<b>557</b>	<b>557</b>	<b>557</b>	<b>557</b>
V. Valparaíso	Baseline	250	314	325	310	308	311	291	290	273	259	237
	Projects	0	0	0	0	0	0	0	0	171	239	284
	<b>Subtotal</b>	<b>250</b>	<b>314</b>	<b>325</b>	<b>310</b>	<b>308</b>	<b>311</b>	<b>291</b>	<b>290</b>	<b>445</b>	<b>498</b>	<b>520</b>
Metropolitana	Baseline	175	183	370	441	416	416	392	392	367	367	367
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>175</b>	<b>183</b>	<b>370</b>	<b>441</b>	<b>416</b>	<b>416</b>	<b>392</b>	<b>392</b>	<b>367</b>	<b>367</b>	<b>367</b>
VI. O'Higgins	Baseline	402	406	397	412	417	422	401	285	243	238	233
	Projects	0	0	0	0	0	0	0	0	29	44	59
	<b>Subtotal</b>	<b>402</b>	<b>406</b>	<b>397</b>	<b>412</b>	<b>417</b>	<b>422</b>	<b>401</b>	<b>285</b>	<b>272</b>	<b>282</b>	<b>293</b>
Total Nacional	Baseline	3.330	3.577	3.851	4.034	4.165	4.213	4.179	3.983	3.839	3.844	3.651
	Projects	0	0	0	0	23	194	489	1.202	1.870	2.256	2.428
	<b>TOTAL</b>	<b>3.330</b>	<b>3.577</b>	<b>3.851</b>	<b>4.034</b>	<b>4.188</b>	<b>4.407</b>	<b>4.668</b>	<b>5.185</b>	<b>5.708</b>	<b>6.100</b>	<b>6.079</b>

Source: Cochilco estimates.

**Table 9: SX-EW Cathode Output Through 2020, Shown by Region (kMTF)**

Region	Status	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I. Tarapacá	Baseline	230	224	207	195	193	180	136	130	123	113	113
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>230</b>	<b>224</b>	<b>207</b>	<b>195</b>	<b>193</b>	<b>180</b>	<b>136</b>	<b>130</b>	<b>123</b>	<b>113</b>	<b>113</b>
II. Antofagasta	Baseline	1.654	1.668	1.691	1.662	1.629	1.528	1.470	1.440	1.310	1.255	1.181
	Projects	0	0	0	0	56	130	164	164	168	181	204
	<b>Subtotal</b>	<b>1.654</b>	<b>1.668</b>	<b>1.691</b>	<b>1.662</b>	<b>1.684</b>	<b>1.658</b>	<b>1.634</b>	<b>1.604</b>	<b>1.479</b>	<b>1.436</b>	<b>1.385</b>
III. Atacama	Baseline	130	127	123	126	126	126	100	59	71	69	79
	Projects	0	0	0	5	17	35	41	41	41	41	41
	<b>Subtotal</b>	<b>130</b>	<b>127</b>	<b>123</b>	<b>132</b>	<b>143</b>	<b>161</b>	<b>140</b>	<b>100</b>	<b>112</b>	<b>110</b>	<b>120</b>
IV. Coquimbo	Baseline	14	25	30	27	23	22	21	21	21	21	16
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>14</b>	<b>25</b>	<b>30</b>	<b>27</b>	<b>23</b>	<b>22</b>	<b>21</b>	<b>21</b>	<b>21</b>	<b>21</b>	<b>16</b>
V. Valparaíso	Baseline	16	16	16	13	10	10	10	10	10	10	10
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>13</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>
Metropolitana	Baseline	42	52	51	51	45	26	25	25	25	25	25
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>42</b>	<b>52</b>	<b>51</b>	<b>51</b>	<b>45</b>	<b>26</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>
VI. O'Higgins	Baseline	2	2	2	2	2	3	3	3	3	3	3
	Projects	0	0	0	0	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
Total Nacional	Baseline	2.089	2.114	2.120	2.077	2.027	1.897	1.764	1.687	1.564	1.496	1.426
	Projects	0	0	0	5	72	164	205	205	209	222	245
	<b>TOTAL</b>	<b>2.089</b>	<b>2.114</b>	<b>2.120</b>	<b>2.083</b>	<b>2.100</b>	<b>2.061</b>	<b>1.969</b>	<b>1.893</b>	<b>1.773</b>	<b>1.718</b>	<b>1.671</b>

Source: Cochilco estimates.

### 4.3 Estimate Review

By helping offset depletion, the investment process reviewed here has a strong impact on overall copper production in Chile.

As such, by 2020 potential mine copper production in Chile should stand at 7.41 million tons, a 36.8 percent increase for the period under review and a 3.2 percent rise from the 5.42 million tons produced in 2010.

Most expected growth is in concentrate, expected to rise from 3.33 million tons in 2010 to 5.74 million in 2020, a 72.3 percent increase for the period or a 5.6 percent annual growth rate.

The trend reverses for SX-EW cathodes, expected to stay above 2 million tons through the year 2015, then decline to 1.67 million tons by 2020, a 20 percent slide over the 2.09 million tons produced in 2010. Natural depletion of surface leachable oxides and sulfides is making new leaching projects few and far between.

While overall production is expected to expand 36.8 percent in 2010-2020, growth will not be evenly shared across regions.

Expected to exceed the country average are Atacama with 136 percent (Caserones, El Morro, Cerro Casale, Santo Domingo and other mid-size operations), Valparaíso with 100 percent (Nueva Andina), Tarapacá with 82 percent (Quebrada Blanca Hypogenic, Collahuasi Expansion), and Santiago with 81 percent (Los Bronces Expansion). Antofagasta will grow 15 percent as leading projects are replacements and hydrometallurgical operations have declined significantly. Development of the



New Teniente Mine Level will make copper production in O'Higgins drop briefly, then recover early in the next decade.

An overview of copper mining in each segment is shown below.

#### **4.3.1 Short Term (2011-2013)**

Mine copper output in 2011 should come in at 5.69 million tons of refined copper, a 267,000-ton or 5.0 percent annual increase. The trend should stand over the short term, with production in 2013 expected to reach a record 6.12 million tons.

Hydrometallurgical production is expected to come in at some 2.1 million tons of SX-EW cathodes, the highest ever.

Concentrate production is expected to rise by 700,000 over the 3.33 million tons produced in 2010, with contributions from the new Esperanza and Andacollo Hypogenic operations and the Los Pelambres, Andina Phase I, Los Bronces and Collahuasi Phase I expansions.

This is the result of recent investments expected to come on stream in this period.

#### **4.3.2 Medium Term (2014-2016)**

Baseline refined copper production in this period is expected to stand at 6.0 to 6.2 million tons. New projects should add an extra 694,000 tons, leading to a new record of 6.64 million tons by 2016.

Leaching operations start to decline in 2015 as leachable resources become depleted and operations at Codelco's Mina Sur begin to wind down. As a result, SX-EW cathode production is expected to drop by 310,000 tons over 2013, partly offset by possible projects contributing an additional 200,000 tons. Overall, hydrometallurgical production should stand at 2 million tons by 2016.

Hydrometallurgical projects reviewed include Codelco's Quetena and San Antonio, Antofagasta Minerals' Antucoya, and the leachable stage of projects Diego de Almagro and Sierra Gorda.

Clearly, most of the momentum will come from concentrate as current operations reach capacity to produce over 4.2 million tons. New projects coming on stream in this period should contribute 489,000 tons, placing concentrate production expected for 2016 at 4.67 million tons.

Large-scale projects reviewed include Codelco's Ministro Hales, Pan Pacific Copper's Caserones, Quadra FNX's Sierra Gorda, GoldCorp's El Morro, Far West's Santo Domingo, and the Escondida Phase V Expansion. Mid-size Diego de Almagro (Copec) and Inca de Oro (PanAust) were also reviewed.



Interestingly, other than the Escondida expansion (designed to regain lost capacity), these are all greenfield projects, most undertaken by new entrants.

#### **4.3.3 Long Term (2017-2020)**

This is when copper production reaches a high point. While production from existing operations should decline by some 850,000 tons, new projects should contribute an additional 1.63 million tons, reaching the expected 7.41 million tons by 2020.

Concentrate production in 2020 should stand at 5.74 million tons, a 2.41 million increase from 2010. Concentrate production's overall share should grow from 61.5 percent in 2010 to 77.5 percent in 2020.

Hydrometallurgical production is expected to drop from 38.5 percent in 2010 to 22.5 percent or an estimated 400,000 tons. Key mines, including Radomiro Tomic Oxides and Mantoverde, will cease operations in this period.

While uncertainty increases as the timeline progresses, planned long-term projects are expected to be contributing a significant 31.4 percent by the end of the decade.

Key projects expected to come on stream in this period include Codelco's Chuquicamata Underground, Nueva Andina Phase II, New Teniente Mine Level, and RT Sulfides Phase II, Collahuasi's Phase II expansion, Barrick's Cerro Casale copper and gold project, and Teck's Relincho. Although all hold significant potential, Chuquicamata Underground and the New Teniente Mine Level will not be in full production until the next decade.

Not contemplated in the current portfolio are several projects that might materialize in this period, including expansions to Antofagasta Minerals and Quadra FNX's Sierra Gorda operations, a Phase VI Escondida expansion, new deposits owned by Anglo American in the vicinity of Los Bronces, and various operations whose life will be increased through development of sulfide ores exposed as oxidized ores are mined.

## V. Estimated Production of Other Minerals

Gold, silver and molybdenum production is not estimated, as it is contingent on the concurrent production of copper and there is no direct link between main product and byproduct production. Below we estimate medium-term production levels achievable as a result of the investments noted.

### 5.1 Gold and Molybdenum

Gold projects included in this report are expected to produce some 70 TPY when in full operation by the end of the decade. Greenfield copper projects with a significant gold content should contribute an additional 9.4 TPY.

**Table 10: Expected Gold Production by Project**

Project	Controller	Start	Capacity Production (MT)
<b>Primary</b>			
Pascua <sup>3</sup>	Barrick	2013	18.6
Lobo-Marte	Kinross	2014	10.9
El Morro	GoldCorp	2015	9.4
Cerro Casale	Barrick	2017	31.1
<b>Secondary</b>			
Esperanza	Antofagasta Minerals	Late 2010	6.9
Inca de Oro	PanAust 66% Codelco 34%	2014	1.3
Sierra Gorda	Quadra FNX Mining	2015	1.2

Source: Cochilco.

New production is in addition to the 40 TPY produced in the past decade. Overall production should grow to between 110 and 120 TPY of gold and a significant although as yet indeterminate amount of silver.

Some new copper concentrate projects (Quebrada Blanca Hypogenic, Relincho, Sierra Gorda, Caserones) contemplate recovery of molybdenum at the rate of some 20-25 kTPY in concentrate form. Overall production should stand at some 60 kTPY of fine molybdenum content.

<sup>3</sup> Pascua is the Chilean portion of the binational Pascua-Lama project. Once operating at capacity, production is expected to stand at 25 MT, including 75 percent sourced from Chile.



## **5.2 Iron**

In 2010, iron production stood at 9.13 million tons of ores or 5.54 million tons of refined iron. Projects undertaken by CAP and Minera Santa Fe, plus coproduction from Far West Mining's Santo Domingo copper project, are expected to contribute some 16.5 million tons of ores or 9.7 million tons of refined iron.

As such, in the second half of this decade Chile should be producing some 25 million tons of iron ores<sup>4</sup> or in excess of 15 million tons of refined iron.

## **5.3 Industrial Minerals**

New nitrate projects to be gradually implemented promise to increase production of sodium and/or potassium nitrate by 1.2 million TPY, plus 6,500 TPY of iodine and 1.55 million tons of potassium chloride.

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<sup>4</sup> Iron content ranging from 58 to 63 percent.



## **Annex A: Methodology**

The methodology used to draft this report is explained below.

### **1. Scope**

This report covers current and planned investments in 2011-2015 by both Codelco and medium- and large-scale private miners.

Investment estimates are allocated on a per-annum basis. Also shown are actual investments made through 2010 in connection with ongoing projects with a start date prior to 2011.

Investments in connection with projects with an estimated start date beyond 2015 are identified as such.

Project particulars are complemented by estimations on additional copper output contributed, if any, plus notes on current status.

Information is provided on a best-guess basis, based on data current at the time of writing. Where no such data is available, annual investment allocations are estimates not necessarily supported in sources.

Companies are not in any way responsible for the forecasts made in this report.

### **2. Investment Likelihood**

Investment information is qualified by degree of certainty. Projects are ranked from most to least likely as either under construction, probable –i.e., feasibility and environmental impact assessment reviews in an advanced stage- or deemed possible based on prefeasibility results and company statements of intent, even if no formal commitment has yet been made.

### **3. Codelco Investment Plans: Sources of Information**

#### **3.1 Methodology**

While most Codelco investments involve projects yielding a return, the company also invests in equipment replacement, facility upgrades, mining exploration, R&D, feasibility studies, environmental cleanup, workplace safety, and employee benefits.



Investment estimates are based solely on Codelco submissions to the Investment Project Authorization (API) process.<sup>5</sup>

Investment projections are based on public reports provided by company officials or on the Codelco web site, complemented by information contained in Codelco's 2011 Business and Development Plan (2011 PND) and other official reports submitted on a regular basis to the Cochilco Strategic Management Assessment Division.

As such, the information herein should be construed as a strategic planning tool rather than as binding on the agencies reviewing investment projects. Its value resides in reflecting Codelco's long-term vision after recent corporate governance changes.

The key points considered in presenting Codelco data are as follows:

- a) API-authorized annual investments in 2011-2015 are as shown on the 2011 PND.
- b) This report considers only major investments (four structural projects and three other large projects). Investment materialized before 2011 and after 2015 is noted as such.
- c) The "Other Investments" category is the difference between annual amounts in the 2011 PND and the aggregate of the above major investment projects. This amount includes investments made in support of existing Codelco operations and other API outlays known to Codelco head office.
- d) Smelter and refinery investments were excluded as Codelco policy in this regard remains under review.

#### **4. Private Mining Investment: Sources of Information**

Sources include public reports and announcements culled from company web sites, the news media, trade publications, and the like. Exploration-related and routine investments were not included.

Often only a global amount and intended start year are known. In such cases, annual estimates are based on tentative completion timeframes reported to the environmental impact assessment system, if available.

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<sup>5</sup> A review conducted jointly by Cochilco and the Ministry of Planning (MIDEPLAN). Disbursements considered as investments by Codelco (i.e., deferred expenses and the like) which require no authorization are not included.



#### **4.1 Large Copper Mining**

Includes all projects under construction. Projects under consideration were brought up to date based on a review of current status, investment forecasts, estimated startup and output profiles.

Entry of projects Antucoya (Antofagasta Minerals, Antofagasta) and Refugio (Teck, Atacama) is noted.

Far West Mining's Santo Domingo copper concentrate project was upgraded from mid-size to large-scale based on new data revising expected production from 65 kTPY to 115 kTPY.

#### **4.2 Medium-Scale Copper Mining**

The report notes the change in ownership in project Diego de Almagro, bought by Copec from Cerro Dominador through its Can-Can mining affiliate. Leaching and concentration project data is based on preliminary announcements by Copec.

Project Inca de Oro remains a going concern following ratification of a partnership agreement between Codelco and PanAust under Law 19317.

#### **4.3 Gold and Silver Mining**

Ongoing construction at Barrick's binational Pascua Lama project is noted, including recognition that investment will be evenly divided among Chile and Argentina. Based on availability of ores, Chile will account for 75 percent of the output and Argentina for the balance.

The Cerro Casale project (75% Barrick, 25% Kinross) was updated to reflect a budget increase to US\$5.2 billion and postponement of startup to 2017 or later.

#### **4.4 Iron and Industrial Minerals Mining**

Project data was assembled from submissions to the environmental impact assessment system and status reports noted on company web sites.

### **5. Copper Output**

Information shown is based on concentrate and SX-EW cathode output from mine sources through the year 2020. This includes estimated output profiles for both existing operations and projects in paragraph 2 above.

Smelter and refinery output is not included, as no formal investment projects currently exist in these sectors.



All figures are shown as refined copper content relative to 2010, based on the most recent data available to the Cochilco Research and Policy Planning Department.

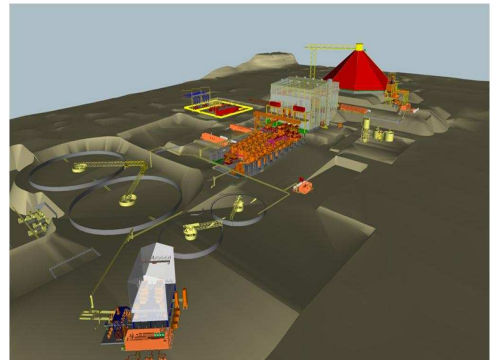
Ranking projects as under construction, probable or possible helps determine the likelihood of output profiles for each category. The sum total equals the mine copper output potential existing in Chile based on the project portfolio reviewed in this report.

## Annex B: Copper, Gold and Silver Investment Projects

### I) Codelco ([www.codelco.cl](http://www.codelco.cl))

#### ***MINISTRO HALES MINE DEVELOPMENT (Ministro Hales Division)***

Codelco recently created the Ministro Hales Division to develop and operate the Ministro Hales mine, 5 km north of Calama. Ministro Hales is a copper sulfide deposit holding estimated reserves of 219 million tons with 1.13 percent average grades and a high silver content. Once operational, the facility is expected to process up to 50 kTPD in a concentrating plant adjacent to the open pit.



High arsenic levels will require fluidized bed roasting (up to 350 kTPY concentrate) yielding high-grade (37% refined copper content) concentrates for sale and/or use as smelter feed. Roasting plant gases will be abated by a sulfuric acid plant. Recovery of smaller amounts of copper oxide through leaching is being considered.

**Est. Investment Amount:** US\$2.51 Bn

**Status:** Under construction. Expected operational in late 2013.

#### ***QUETENA (Chuquicamata Division)***

Development of a leading leachable resource deposit in the Toki Cluster, near both Calama and the Ministro Hales mine. Leaching solutions will be transported to hydrometallurgical plants in the Sur Mine, current facing depletion.

**Est. Investment Amount:** US\$620 Mn

**Status:** Prefeasibility review underway. Expected operational by 2015.

#### ***RADOMIRO TOMIC SULFIDES, Phase II (Radomiro Tomic Division)***

Stage II involves mining sulfides surfacing at the Radomiro Tomic Mine as overlying oxides become depleted. Reserves are an estimated 1.46 billion tons with 0.53 percent average copper grades.

The project, which calls for extraction and concentration of 100 kTPD of ores, includes a thickened tailings dam and the infrastructure required to treat and pump desalted water to the plant.





The Division is also considering leveraging the available hydrometallurgical infrastructure to bioleach low-grade sulfides.

**Est. Investment Amount:** US\$1.9 Bn

**Status:** A possible project currently undergoing a feasibility review. Startup expected no earlier than 2017.

### ***CHUQUICAMATA UNDERGROUND (Chuquicamata Division)***

Chuquicamata holds reserves estimated at 1.7 billion tons with 0.7 percent copper grades. High-productivity block caving methods will be used on four 30- to 40-kTPD mining faces to recover up to 340 kTPY refined copper. Startup would coincide with the end of open pit economic life, with ores feeding existing concentrators.



**Est. Investment Amount:** US\$2.2 Bn

**Status:** Probable project, environmental impact assessment completed. Feasibility review underway. Gradual development is expected, with production start slated for 2018.

### ***SAN ANTONIO OXIDES (Salvador Division)***

Project involves processing of oxidized ores left over from underground development of the old Potrerillos Mine. Located 8 km SE of the Potrerillos Smelter at 3,200 m altitude, reserves stand at an estimated 111 million tons.

Plans include a new crushing plant on the old mine site and construction of a conveyor-fed hydrometallurgical (SX-EW) plant in the Potrerillos area. Capacity is an estimated 30 kTPY SX-EW cathodes over 17 years. As part of its operating continuity policy, the Division is also looking into processing sulfide ores from the old mine site.



**Est. Investment Amount:** US\$317 Mn

**Status:** Possible project. Prefeasibility review underway, submitted for EIA review. Mining and production expected to start in 2012 and late 2014, respectively.

### ***NUEVA ANDINA 244 kTPD PHASE II EXPANSION (Andina Division)***

Phase II of Andina Division's plans to harness its full potential calls for upgrading mining and processing capacity from 94 to 244 kTPD. Project includes a new open pit, continuing underground mining, and relocating processing plants to a lower altitude. Phase II should contribute an additional 330 kTPY, for an overall output of 540 kTPY refined copper in concentrate form.

Phase III, calling for expanding capacity to 290 kTPD, is under profile review. Also being considered is underground development of the Sur Sur Mine once the third panel is shut down. Given the vast amount of low-grade sulfides generated by massive mining operations, forced leaching is being considered. This would help mitigate the environmental impact of acid water. Phase III, however, is not considered in this report.



**Est. Investment Amount:** US\$6.4 Bn (Phase II)

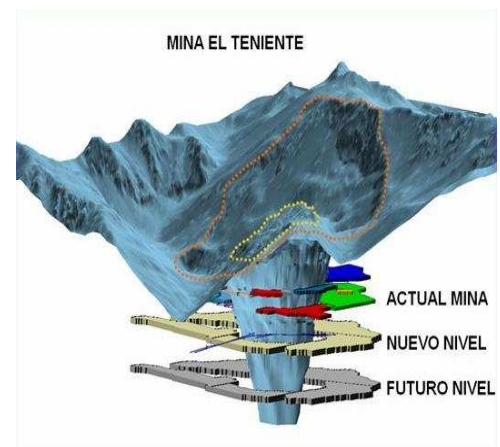
**Status:** A possible project currently undergoing a feasibility review. Startup expected in 2018.

### ***NEW TENIENTE MINE LEVEL (Teniente Division)***

Project involves mining a new sector at altitude 1,880 m, 100 m below the current mine level. The plan is designed to increase reserves by 2.5 billion tons with 0.82 percent average grades and ensure the long-term 137-kTPD divisional target.

**Est. Investment Amount:** US\$2.79 Bn

**Status:** Probable project, EIA completed. Feasibility review underway. Gradual startup expected in H2 2017.



## II) Major Private Copper Miners

### 2.1 Anglo American ([www.anglochile.cl](http://www.anglochile.cl))

#### ***Los Bronces Development (Anglo American Sur)***

Project involves increasing processing capacity from 57 to 160 kTPD, thereby adding some 200 kTPD to the Los Bronces concentrate output.

Includes a new crushing and milling line plus a slurry pipeline for transportation of ores to higher-capacity copper and molybdenum concentrating plants in the valley.

**Est. Investment Amount:** US\$2.5 Bn

**Status:** Under construction. Startup expected in late 2011.



### 2.2 Antofagasta Minerals ([www.antofagasta.co.uk](http://www.antofagasta.co.uk))

#### ***ANTUCOYA (Minera Antucoya Ltda.)***

A deposit located 125 km NE of Antofagasta and 45 km from the coast with estimated 900 million tons copper reserves. Low grades (0.29 percent) could support production of 80 kTPY SX-EW cathodes through some 23 years. A major innovation is the ability to use seawater, to be pumped from the Esperanza facility nearby, for all processing purposes.

**Est. Investment Amount:** US\$950 Mn

**Status:** Possible project. Feasibility study underway, submitted for EIA review.

#### ***SIERRA GORDA DISTRICT (Antofagasta Minerals)***

Two deposits of interest (Telégrafo and Caracoles) have been discovered near the current Tesoro and Esperanza operations as part of a wide-ranging exploration program in the Sierra Gorda district.

**Est. Investment Amount:** US\$6 Bn

**Status:** Possible project. Prefeasibility review underway. Development expected to start by 2014 and operations no earlier than 2016.

## 2.3 BHP Billiton ([www.bhpbilliton.com](http://www.bhpbilliton.com))

### **HEAP LEACHING CONSTRUCTION (Minera Escondida)**

To support its SX-EW cathode production plan, Escondida is planning to implement additional sulfide bioleaching and oxide leaching areas, complete with the required equipment and facilities.

**Est. Investment Amount:** US\$384 Mn (bioleaching); US\$426 Mn (oxides)

**Status:** Construction of bioleaching area underway; expected on stream in H2 2011. The oxides project is in the feasibility stage and should be operational in late 2013.

### **PHASE V EXPANSION (Minera Escondida)**

The original Laguna Seca Plant project was complemented by a new mill and concentrating plant replacing the Los Colorados facility, to be relocated in order to clear the area for new mining. These plans are designed to retain current concentrate output in spite of declining grades.

A new phase to be defined may consider construction of a third concentrating plant plus a desalination plant supplying water to the new operations.

**Est. Investment Amount:** US\$2.5 Bn

**Status:** Probable project. Phase I involves relocating crushing and ore transportation facilities to allow access to higher-grade mineralization areas. (EOA Project, US\$554 Mn). The new facilities are expected on stream in H2 2012 (mill) and late 2015 (plant).



## 2.4 Doña Inés de Collahuasi ([www.collahuasi.com](http://www.collahuasi.com))

### **COLLAHUASI EXPANSION (SCM Doña Inés de Collahuasi)**

A project designed to boost Collahuasi's overall output by 170 kTPD based on increasing sulfide ore processing while retaining leachable ore capacities. Phase II will seek a further 260 kTPD increase to bring the overall refined copper output to 1 million tons.

**Est. Investment Amount:** Phase I: US\$750 Mn / Phase II: US\$2.4 Bn



**Status:** Phase I under construction; expected on stream in 2012. A possible Phase II requires a feasibility review; phase-in expected after 2016.

## 2.5 Far West Mining ([www.farwestmining.com](http://www.farwestmining.com))

### **SANTO DOMINGO**

Santo Domingo is the largest of four IOCG deposits explored by FWM in the Diego de Almagro district. Available information suggests possible development of sulfide resources to produce over 100 kTPY copper concentrate and some gold plus 4 million TPY iron ores (magnetite and hematite).

**Est. Investment Amount:** US\$941 Mn

**Status:** A possible project currently undergoing a prefeasibility review. Might come on stream in late 2014.

## 2.6 Freeport McMoRan ([www.fcx.com](http://www.fcx.com))

### **SULFOLIX (Cía. Contractual Minera El Abra)**

El Abra's Sulfolix project ensures operational continuity through copper sulfide leaching. The project, which should yield some 115 kTPD for overall production of some 160 kTPY SX-EW cathodes, leverages existing mining and hydrometallurgical capacities. The project addresses declining oxides production and should extend the life of mine by at least 10 years.

**Est. Investment Amount:** US\$725 Mn

**Status:** Under construction. Gradual startup in H2 2011, on stream in 2015.

## 2.7 Pan Pacific Copper ([www.ppcu.co.jp](http://www.ppcu.co.jp))

### **CASERONES (Minera Lumina Copper Chile)**

Caserones stands at 4,200 m altitude, 115 km southeast of Copiapó, Atacama. The project entails mining sulfides for their copper, gold and molybdenum content and leaching lower-grade resources. Plans call for expanding concentration capacity to 160 kTPY and 3 kTPY molybdenum and leaching capacity to 30 kTPY SX-EW cathodes. Includes construction of a seawater desalination plant.

**Est. Investment Amount:** US\$2 Bn

**Status:** Under construction. Expanded concentrating expected in 2014, followed by the leaching stage.



## 2.8 Quadra FNX Mining ([www.quadramining.com](http://www.quadramining.com))

### ***Sierra Gorda (Minera Quadra Chile)***

A deposit located in the vicinity of Spence and Tesoro, 140 km east of Antofagasta. Exploration suggests the presence of major copper, gold and molybdenum reserves that could be processed at a rate of 110 kTPD to produce some 130 TPY copper concentrate, 36,000 ounces of gold and 7 kTPD of molybdenum over 25 years. Oxides might also be mined.

**Est. Investment Amount:** US\$2.5 Bn

**Status:** A possible project currently undergoing a feasibility review, expected on stream in 2015. A recent agreement between Quadra FNX and Sumitomo could move up the timeline.

## 2.9 Teck ([www.teck.com](http://www.teck.com))

### ***Quebrada Blanca Hypogenic (Minera Quebrada Blanca)***

A hypogenic primary sulfide deposit underlying secondary supergenic sulfide ores currently yielding 85 kTPY SX-EW cathodes through leaching. Development is slated to coincide with depletion of economic leachable reserves. Once operating at capacity, the project -which contemplates a 120 kTPD concentrating plant- should yield about 200 kTPD copper concentrate and 4 kTPD refined molybdenum.

**Est. Investment Amount:** US\$3 Bn

**Status:** A possible project currently undergoing a feasibility review. Expected on stream in 2016, as leachable ore mining concludes.

### ***RELINCHO (Minera Relincho)***

A copper and molybdenum deposit 50 km north of Vallenar, bought by Teck in 2008 and kept in reserve until now. Preliminary exploration suggests a processing capacity of 120 kTPD yielding up to 190 kTPY copper concentrate, plus an undefined amount of molybdenum.

**Est. Investment Amount:** US\$3 Bn

**Status:** A possible project currently undergoing a prefeasibility review. Final exploration results available in 2012, estimated startup in 2018.



## 2.10 Xstrata ([www.xstrata.com](http://www.xstrata.com))

### **LOMAS BAYAS II (Minera Lomas Bayas)**

Following a 75 kTPY cathode expansion and given initial deposit depletion, plans now call for mining a new pit 3 km from the current site and construction of a new heap leaching facility in order to extend the life of mine through 2020. The existing plant infrastructure is expected to maintain production levels despite lower grades.

Xstrata plans to mine sulfide resources underneath surface oxidized resources.

**Est. Investment Amount:** US\$293 Mn

**Status:** Under construction. Startup expected in 2012.

## III) Medium-Scale Copper Mining

### 3.1 Copec ([www.cancan.cl](http://www.cancan.cl))

#### **DIEGO DE ALMAGRO (Minera Can-Can S.A.)**

An IOCG (iron oxide-copper-gold) deposit 10 km from Diego de Almagro, Atacama, holding reserves estimated at 300,000 tons copper and 27,000 oz. gold. This project was recently acquired from Cerro Dominador by Minera Can-Can, a mining affiliate of the Copec Group.

Original plans included leaching oxides and concentrating sulfides to produce 11 kTPY SX-EW cathodes and 22 kTPY copper concentrate. Iron recovery is not contemplated. However, based on investment announcements, the new owners are expected to expand the original project scope.

**Est. Investment Amount:** US\$107 Mn (oxide leaching), US\$120 Mn (sulfide concentration).

**Status:** A possible project now being redefined. Phase I expected on stream no earlier than 2013.

### 3.2 PanAust ([www.panaust.com.au](http://www.panaust.com.au))

#### **INCA DE ORO (Cía. Minera Inca de Oro)**

A project launched by Codelco following exploration in the Diego de Almagro district. The prefeasibility review contemplates production of some 50 kTPY copper concentrate and 40,000 ounces of gold per year. Since this is a minor project for Codelco's scales of operation, a 66 percent share was sold to Australia's PanAust



under Law 19137, with Codelco retaining 34 percent ownership. The agreement includes an additional net smelter return (NSR) payment to Codelco.

**Est. Investment Amount:** US\$600 Mn

**Status:** A possible project currently undergoing a feasibility review. Expected on stream in 2014.

## **IV) Gold and Silver Mining**

### **4.1 Barrick Gold ([www.barrick.com](http://www.barrick.com))**

#### ***PASCUA (Cía. Minera Nevada S.A.)***

Pascua, a gold deposit at 4,600 m altitude 53 km north of the old El Indio Mine, forms a single unit with the Lama deposit on the Argentine side of the border. Global reserves are estimated at 17.1 million oz. gold and 560 million oz. silver, mostly oxides. Three-fourths of reserves lie in Chile (Pascua) and the remainder in Argentina (Lama). Ores will be crushed on-site in Chile, then trucked to plants across the border. These include a cyanide leaching plant processing free-milling ores (83%) to produce doré<sup>6</sup> and a concentrating plant processing refractory ores (17%) to obtain gold- and silver-rich copper concentrate. Expected annual output stands at 800,000 oz. gold and 35 million oz. silver, about 75 percent from the Chilean side. Information on marginal copper content not available.

**Est. Investment Amount:** US\$1.5 Bn (portion to be invested in Chile; US\$3 Bn total).

**Status:** Construction underway; expected operational in 2013.

#### ***CERRO CASALE (Minera Estrella de Oro Ltda.)***

This orebody, located in Aldebaran, on the southern tip of the Maricunga gold belt 100 km due east of Copiapó, is among Chile's largest undeveloped gold deposits. The project contemplates production of gold, silver, and copper. A 75 kTPD cyanide leaching plant will process free-milling ores to obtain metal doré while a 150 kTPD concentrating plant will process sulfide ores to obtain gold- and silver-rich copper concentrate. Global production is estimated at 1 million ounces of gold and 100 kTPY copper concentrate.

**Est. Investment Amount:** US\$5.2 Bn

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<sup>6</sup> A gold and silver alloy in bar form. It is a common commercial gold ore form. Doré is further refined to separate gold and silver.



**Status:** The original investment budget has been upgraded while numerous changes to the original project have required a new Environmental Impact Assessment Review. Startup not expected before 2016.

#### **4.2 Kinross ([www.kinross.com](http://www.kinross.com))**

##### ***LOBO-MARTE (SCM Santa Rosa)***

A deposit in the Maricunga gold belt, 160 km east of Copiapó at 4,200 altitude. The prefeasibility review calls for open-pit mining at a rate of 47 kTPD and leaching ores to obtain an estimated 350,000 ounces per year (about 9 TPY) of gold in doré form.

**Est. Investment Amount:** US\$575 Mn

**Status:** A possible project undergoing EIA review. Construction could start in 2013, once feasibility is completed. Not expected on stream before 2015.

#### **4.3 GoldCorp ([www.goldcorp.com](http://www.goldcorp.com))**

##### ***EL MORRO (Minera El Morro)***

Project spans two deposits (El Morro and Fortuna, the latter holding the largest potential) 80 km east of Vallenar, in Alto del Carmen, Atacama. Reserves are an estimated 6.7 million oz. of gold and 2.56 million tons of copper. The estimated 90 kTPD processing capacity should result in 150 kTPY copper concentrate with a high (353,000 oz.) gold content over 15 years. The project contemplates a 740 l/s desalination plant and pumping infrastructure supplying most water requirements.

**Est. Investment Amount:** US\$2.5 Bn

**Status:** A probable project with an approved EIA review. Construction could start in 2012, with startup not expected before 2015.



## **Annex C: Leading Industrial Mineral and Iron Mining Projects**

### **I. Iron Mining**

#### **1.1 CAP S.A. ([www.cap.cl](http://www.cap.cl))**

##### ***CERRO NEGRO NORTE (Cía. Minera del Pacífico)***

Project involves open-pit development of the Cerro Negro Norte iron mine with a view to producing on the order of 4 million TPY of iron ore concentrate. Project facilities include:

- Cerro Negro Norte, comprising the mine proper, waste rock dumpsites, ore stockpiles, primary crushing facilities, ore processing plant, concentrating plant, thickened tailings dam, and a pipeline pumping water from wells in Toledo, in the Copiapó River Valley.
- Water/slurry pipeline, comprising a pipeline pumping water from the port to Cerro Negro Norte and a slurry pipeline transporting iron ore concentrate from the concentrating plant to existing port facilities.
- Punta Totalillo, comprising expansion and/or modification of the filtration plant, emergency pond and stockpile areas based on the existing shipping infrastructure. While existing port facilities are cleared for use by the authorities, additional demand from the project will require an expansion. This area will include facilities pumping water reclaimed from iron ore concentrate filtration back to Cerro Negro Norte.

**Est. Investment Amount:** US\$574 Mn

**Status:** Construction underway; startup expected in the first quarter of 2013.

##### ***LOS COLORADOS EXPANSION (Cía. Minera del Pacífico)***

The project involves building a new plant to complement the existing 3.35 million TPY plant and expand production of iron ore preconcentrate to 9.15 million TPY. The new facilities would serve the needs of the Huasco iron pellet plant.

**Est. Investment Amount:** US\$342 Mn

**Status:** Construction underway; startup expected in the first quarter of 2013.



## 1.2 Minera Santa Fe ([www.minerasantafe.cl](http://www.minerasantafe.cl))

### **BELLAVISTA**

The project stands in Llanos de Chamonate, Copiapó, 2.7 km from the Cerro Imán site. The project site stands 10 km from Copiapó and 65 km from the port of Caldera. Ores will be loaded at Punta Totoralillo.

The project intends to optimize iron content recovery by adding a magnetic washing (wet concentration) phase helping guarantee the company's 2.5 million TPY production target over 25 years.

**Est. Investment Amount:** US\$143 Mn

**Status:** Undergoing environmental review. Construction should take 2 years.

## II. Industrial Minerals

### 2.1 SQM S.A. ([www.sqm.cl](http://www.sqm.cl))

#### **PAMPA HERMOSA**

The project stands south of Pozo Almonte, in the new Nueva Victoria Industrial Zone, where SQM intends to set up long-term iodine and nitrate production facilities. The project, designed to increase prilled iodine production from 4.5 kTPY to 11 kTPY, also calls for a new 1.2-million TPY sodium/potassium nitrate plant.

Some 37 million TPY of nitrates will be mined in five areas. After leaching, solutions will be transported to iodine plants and then to solar ponds for crystallization of salts, which are then purified in the nitrate plant.

**Est. Investment Amount:** US\$1 Bn

**Status:** Environmental approval received. Construction underway, with initial phase expected to take some 15 months. Investment will proceed through the next six years. Expected project life is 31 years.

#### **POTASSIUM CHLORIDE PRODUCTION EXPANSION (SQM Salar)**

Project entails upgrading existing potassium chloride facilities in the Atacama salt flats from 650 kTPY to 2 million TPY, with 70 percent of the new capacity being added in the first four years. The project also contemplates new equipment, improved processing, and modifications to solar pond and stockpile areas, leaving salt water and water extraction unchanged.



**Est. Investment Amount:** US\$527 Mn

**Status:** Construction underway; initial phase expected to take some 15 months. Investment will proceed through the next six years. Expected project life is 31 years.

***SOP PLANT EXPANSION (SQM Salar)***

The project involves modifying the existing wet potassium sulfate plant facilities and support infrastructure and processes in order to produce potassium chloride only or both potassium sulfate and potassium chloride concurrently. A new salt feed will be added to the existing line in order to feed sylvite salts for production of potassium chloride (KCl), enabling dual production of both potassium sulfate and potassium chloride or only potassium chloride.

**Est. Investment Amount:** US\$100 Mn

**Status:** Construction underway, expected on stream in 2012.



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