

Expected forward production per copper miner

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Beyond 2025 and relatively sure – SCCO =0.7MT – Newcrest to add 0.16MT from Wafi one day. KAZ Baimskaya – 0.2MT

Codelco – 1.7MT steady – sum 1.7MT 2020 – GROWTH 1.7MT

Codelco is producing 1.7MT but the open pit Chuquicamata needs to go underground and \$20 billion have to be spent to keep production at current levels long-term and then another \$20 billion.



[Codelco investor presentation](#)

However, project dates are constantly postponed and it is not a guarantee that the company will produce 1.7MT steadily over time.

PROJECT	INITIAL CAPEX	CURRENT CAPEX	INITIAL START DATE	CURRENT START DATE
Chuquicamata Underground	\$3.7 bn	\$5.5 bn	2018	2019
Teniente New Level	\$3.1 bn	\$5.5 bn	2017	2023
Andina Future Development	\$6.4 bn	\$2.7 bn	2020	2025
Radomiro Tomic Phase II	\$4.7-\$5 bn	Under review	2016	Under review

Codelco investments and production – Source: Bloomberg

Without issues, Codelco should be able to maintain 1.7MT production up till 2044, but it is not expected it adds much production.

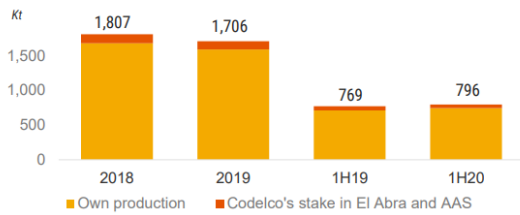


Codelco’s cash costs are \$1.4 per pound, which means that for investments to be profitable, it needs a higher copper price because when you add the \$1.4 to the \$20 billion you need to invest, you are barely profitable at lower copper prices.

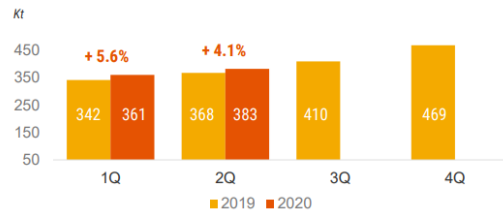
Production in 2020 is aligned with our original plan



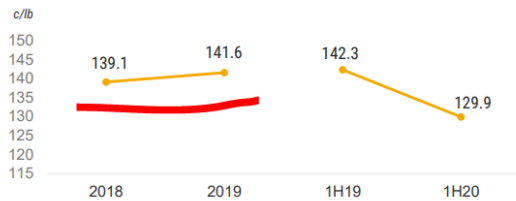
Copper Production (Full-year & First Half)



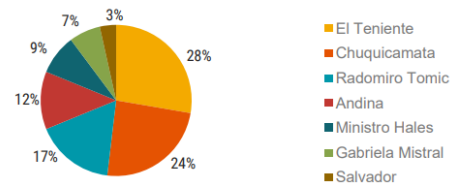
Quarterly Production (Own production 2019 and 1H20)



C1 Cash Cost (Full-year & First Half)



2020 Half-year own production by operation



Codelco production costs

Codelco also has \$16 billion of debt, which is high but in agreement with the government but still at 4 times EBITDA.

BHP – 1.7MT – 3.4 MT – growth 3.4MT

Mines: Escondida, Olympic Dam, Spence, Antamina.

Potential forward – Resolution and Olympic Dam – unlikely given the low return at current copper levels.

Project	Description	Timeline	Reserve	Stage	Life	Status	Key Risks/Notes
Olympic Dam BFX ¹⁷ Copper	Development into the Southern Mine Area, debottlenecking of existing surface infrastructure to increase production capacity to 240-300 ktpa	<5 years	Up to ~2,500	Pre-feasibility	12-25	**	- Access to additional resource in Southern Mine Area - Accelerated additional production - Continued resource definition - Power network instability
Resolution Copper	Underground block cave with attractive grade profile and competitive cost curve position	>5 years	<3,000	Concept	~15	Non Operated	- High copper grades - Resilient to price - Non-operated JV - Technical risk due to caving at the resource depth and tailings options - Permitting requirements

BHP strategy presentation

Rio Tinto – 0.4MT = 3.8MT – growth 3.8MT

Growth from Oyu Tolgoi, Winu (permitting and feasibility) and Resolution (permitting and feasibility) - I don't think that there will be much growth over the next 5 to 7 years except for Oyu Tolgoi.

Oyu Tolgoi will go under Turquoise, while what remains is Rio's share, thus 0.4. [Resolution](#) is 50% owned with BHP, unlikely to see production in this decade, or there should be much higher copper prices, but then we already made our money. Underground operations are risky and Rio knows it after the mumbo jumbo with Turquoise. Possible production 0.45 MT.

Glencore – 1.4MT down to 1.3 MT long term – 2020=5.2MT, 2024=5.1MT

FCX – 1.5MT – growing to 1.9 2022 = 6.7 MT later 7.1 MT

Higher production on Grasberg underground ramp up

Anglo American 0.8 – +0.45MT by 2023 – 7.5MT – later 8.35MT

Production 0.65 bu5 0.8MT, add 0.3MT for Quellaveco and 0.15 for Los Bronces. Collahuasi stable and owned by Glencore in part, add 0.1 MT for Japanese ownership

Quellaveco (Copper)

ATTRACTIVE GREENFIELD AND BROWNFIELD OPTIONS

Long life greenfields and fast returning brownfields						
Quellaveco (Copper)	APPROVED	Our share: \$2.5bn to \$2.7bn ¹	+180ktpa	From: 2022	~4 year payback	>15% IRR >50% margin
Marine Namibia (Diamonds)	APPROVED	~\$0.2bn	+0.5Mctpa	2022	~3 year payback	>25% IRR >60% margin
Moranbah-Grosvenor (Met Coal)	~2020	\$0.3bn to \$0.4bn	+4-6Mtpa ²	2021/22	~3-4 year payback	>30% IRR >50% margin
Collahuasi (Copper)	~2021	\$0.9bn to \$1.1bn	+80ktpa	2024	~4 year payback	>20% IRR >50% margin
Mogalakwena expansion (PGMs)		significant expansion potential – studies under way				
Sishen & Kolomela (Kumba)		infrastructure dependent				
Technology & Innovation	ONGOING	\$0.1bn to \$0.5bn pa	multiple options - rapid payback, low capex			

1. Attributable share post syndication proceeds.
2. Initial stage of upgrade work completed in 2019, increasing capacity by ~1Mtpa, remaining capacity increase 3-5Mtpa.

Source: [Anglo American](#)

Los Bronces, going up to 0.5MT from 0.3.

Antofagasta – 0.7MT, going to 1MT 2025 – 8.3MT later 9.35 MT

Norilsk 0.5 – stable – 8.8 MT – 9.85 MT

First quantum 0.7MT – 0.7MT – 9.5MT later 10.55MT

Southern copper 1MT – 2025 1 MT – 2027 1.7MT – 10.5MT – 11.55 MT by 2025. 2027 12.35 MT

Teck 0.3 MT + 0.3 by 2023 – 10.8MT – 2023 12.15 MT

Diverse Pipeline of Growth Options

	In Construction	Medium-Term Growth Options	Future Options
Copper Strong platform with substantial growth options	QB2	QB3	Galore Creek
		Zafranal	Schaft Creek
		HVC Brownfield	Mesaba
		NuevaUnión	
		San Nicolás (Cu-Zn)	

QB2 delay 6 months

Nueva Union – possible 0.2 MT, Zafranal (protests, for sale) QB3 has earliest decision in 2024.

Galore Creek – huge project, but not feasible at current prices, sold 50% to Newmont by [Novagold](#) in 2018 for \$275 million.

Too expensive to develop.

TABLE 2

	2004 PEA	2006 FS	2011 PFS
CAPEX			
Accuracy	+/- 25%	+15%/-10%	+25%/-20%
Contingency	20%	13.30%	18%
Mine	\$153 M	\$457 M	\$357 M OR \$582 OR \$939M
Plant	\$170 M	\$410 M	\$835 M
Infrastructure	\$236 M	\$330 M (w/ tunnel, 2 yrs)	\$697 M
Tunnel	\$165 M (3 yrs)	Included above	\$580 M (4 yrs)
Sum Direct	\$560.4 M	\$1.44 B	\$2.47 B
Sum Indirect	\$131 M	\$446 M	\$1.30 B
Total CAPEX	\$828 M	\$2.23 B	\$5.16 B
Economic Analysis			
After tax NPV	\$23M (5% discount)	\$599 M (5% discount)	\$137 M (7% discount)
After tax payback	4 yrs	4 yrs	7.8 yrs
After tax IRR	5.70%	10.60%	7.40%

Note: The 2011 mine capital cost estimates are subject to inconsistencies within the report. The true value may be one of those stated in the report (shown) or a different value altogether. All dollars are Canadian.

Source: Canadian Mining Journal

Source: [Mining](#)

Barrick Gold – 0.15 rest included with Zaldivar for Antofagasta – 0.15 = 10.95/12.3 MT

Newcrest mining – 0.1 growth Wafi Golpu – 11.05/12.4 MT

Wafi Golpu – discussing mining permits with NPG government. Adding 0.16MT of copper per year – gold project, likely to go onward because of high prices when permitting is done. Long, long term add 0.16MT.

Seabridge gold KSM project – 0.1MT copper – gold project, probably profitable at gold \$2k, but a hustle. Unlikely

Konkola copper mines – Zambia – 0.1MT – 11.15/12.5MT

Zijin Mining – 0.4MT - +0.1MT from Timok 2023 – 11.55/13MT

MMG – 0.45MT – no growth = 11.9/13.45mt

Kaz Minerals – 0.3MT Aktogay +0.05 = 12.2/13.8MT

Long-term Baimskaya – 0.2MT long long long term.

Boliden – 0.15 = 12.35/13.95

Lundin Mining – 0.25 growth to 0.3 – 12.6/14.25

KGHM 0.7mt stable – 13.3/14.95

IVANHOE 0.25 growth – 13.3/15.2

Long term another 0.25 but beyond 2025

OZ MINERALS 0.1 mt = 13.4/15.3

Hudbay – 0.15 – stable – 13.55/15.45

Rosemont project not permitted and unlikely 0 0.15 if go

Jinagxi – 0.35 China 1.5 stable – 1.5 = 15.05/16.95

ATALYA – 0.05 – 15.1/17

BUENAVENTURA 0.05 – stable 15.15/17.05

Capstone Mining 0.05 – 0.08 – 15.2/17.13

They have some projects, but unlikely until copper is higher.

CENTRAL ASIA METALS PLC – 0.01/0.01

Copper Mountain Mining 0.03/0.06 – 15.24/17.2

ENTRÉE – no production – Oyu Tolgoi stake

TURQUOISE 0.2/0.5 2026 – 15.44/17.7

ERO copper 0.04/0.04 – possible growth but – 15.48/17.74

Excelsior mining 0.01/0.05 if it works 15.49/17.79

Fortune minerals 0

Vale 0.4/ 0.5 – 15.89/18.29

METALS X LTD – small projects tin and cobalt+copper

NITTETSU MINING CO LTD – 0.05, 0.05 = 15.94/18.34

NORTHERN DYNASTY MINERALS – Pebble – no permitting 0.3kt

SANDFIRE RESOURCES NL 0.07

SIERRA METALS – small mixed

SOLGOLD PLC – possible 0.3MT later than 2025 and more

TASEKO MINES LTD 0.06 – 0.08 = 16/18.42

TRILOGY 0.05 after 2025 for sure

Western Copper possible 0.08

McEwen – Los azules – possible 0.2MT

China Moly 0.2MT – 16.2/18.62

Many private small miners around Africa and the globe, up to 0,1 MT production likely add for the 5mt missing. Also in shares not accounted in the above discussed production. Plus, production alongside other metals like gold etc. For example, Iran is producing 0.35MT, Laos 0,2 MT et.c etc. I don't think I have also accounted for all the 5.6MT produced in chile but I think it covers the 3.8MT that I am missing from the total production of 20MT!

Total mine production is 20 MT

TOTAL COPPER MINE PRODUCTION WORLDWIDE

20m mt

TOTAL REFINERY PRODUCTION OF COPPER WORLDWIDE

24,045k t

CHILE'S COPPER MINE PRODUCTION

5,600k t

ALPALA DELIVERS MANY OF THE WORLD'S BEST PORPHYRY COPPER-GOLD INTERSECTIONS

High grades at Alpala to deliver fast payback
(drill hole sections listed below)

Rank	Operator	Property	Location	Interval (m)	Cu (%)	Au (g/t)	Cu:Eq (%)	m% Cu:Eq
1	Anglo American	Los Sulphatos	Central Chile	717.0	3.60	0.00	3.60	2581
2	Codelco	Chilean Giants	Northern Chile	unknown	unknown	unknown	unknown	unknown
3	Kennecott	Bingham Canyon	Utah, USA	unknown	unknown	unknown	unknown	unknown
4	Newcrest Mining	Wafi-Golpu	Papua New Guinea	1421.5	1.14	0.64	1.54	2195
5	Newcrest Mining	Wafi-Golpu	Papua New Guinea	943.5	1.44	1.28	2.25	2122
6	Imperial Metals	Red Chris	BC, Canada	1024.0	1.01	1.26	1.81	1850
7	Anglo Gold Ashanti	Nuevo Chaquiri	Colombia	810.0	1.65	0.78	2.14	1736
8	Freeport McMoran	Grasberg	Irian Jaya	591.0	1.70	1.80	2.84	1677
9	Ivanhoe Mines	Oyu Tolgoi	Southern Mongolia	326.0	3.77	1.23	4.55	1482
10	SolGold Plc	Cascabel - Hole 12	Ecuador	1560.0	0.59	0.54	0.93	1455
11	SolGold Plc	Cascabel - Hole 9	Ecuador	1197.4	0.63	0.83	1.16	1385
12	Exeter Resources	Caspiche	Northern Chile	1214.0	0.90	0.33	1.11	1346
13	SolGold Plc	Cascabel - Hole 67	Ecuador	1028.0	0.71	0.91	1.29	1326
14	SolGold Plc	Cascabel - Hole 5	Ecuador	1358.0	0.61	0.53	0.94	1279
15	Metallica	El Morro, La Fortuna	Chile	780.0	0.84	1.24	1.62	1266
16	SolGold Plc	Cascabel - Hole 16	Ecuador	936.0	0.75	0.95	1.35	1266
17	Anglo American	Los Sulphatos	Central Chile	990.0	1.26	0.00	1.26	1247
18	Ivanhoe Mines	Oyu Tolgoi	Southern Mongolia	476.0	2.16	0.67	2.58	1230
19	SolGold Plc	Cascabel - Hole 57	Ecuador	978.0	0.64	0.95	1.24	1213
20	SolGold Plc	Cascabel - Hole 71R	Ecuador	882.0	0.74	1.00	1.37	1208
21	SolGold Plc	Cascabel - Hole 23R	Ecuador	1030.0	0.59	0.90	1.16	1195
22	Metallica	El Morro, La Fortuna	Chile	754.0	0.93	0.99	1.56	1179
23	Newcrest	Cadia Ridgeway	NSW, Australia	341.0	0.93	3.86	3.37	1149
24	Ivanhoe Mines	Hugo Dummet	Southern Mongolia	302.0	3.11	0.98	3.73	1126
25	Ivanhoe Mines	Oyu Tolgoi	Southern Mongolia	422.0	2.48	0.21	2.61	1103
26	SolGold Plc	Cascabel - Hole 55R	Ecuador	1062.0	0.69	0.52	1.02	1083
27	SolGold Plc	Cascabel - Hole 58-D1	Ecuador	983.9	0.73	0.56	1.08	1063
28	SolGold Plc	Cascabel - Hole 75	Ecuador	1918.4	0.41	0.19	0.53	1017
29	SolGold Plc	Cascabel - Hole 68	Ecuador	664.0	0.88	1.03	1.53	1016
30	Imperial Metals	Red Chris	Canada	1135.0	0.50	0.59	0.87	991
31	Exeter Resources	Caspiche	Northern Chile	1058.0	0.70	0.35	0.92	975
32	SolGold Plc	Cascabel - Hole 15R2	Ecuador	1402.0	0.48	0.34	0.69	974
33	Exeter Resources	Caspiche	Northern Chile	792.5	0.96	0.40	1.21	961
34	Imperial Metals	Red Chris	BC, Canada	716.3	0.79	0.74	1.26	901
35	Nevsun	Timok	Serbia	798.0	0.80	0.22	1.11	886
36	SolGold Plc	Cascabel - Hole 17	Ecuador	954.0	0.60	0.52	0.93	884
37	SolGold Plc	Cascabel - Hole 21	Ecuador	946.0	0.67	0.39	0.92	872
38	Metallica	El Morro, La Fortuna	Chile	820.0	0.59	0.73	1.05	862
39	SolGold Plc	Cascabel - Hole 19	Ecuador	1344.0	0.44	0.28	0.62	829
40	SolGold Plc	Cascabel - Hole 18	Ecuador	864.0	0.57	0.61	0.96	825
41	Seabridge Gold Inc.	KSM	Canada	1023.4	0.24	0.77	0.73	744

NOTES: *Gold Conversion Factor of 0.63 calculated from a copper price of US\$3.00/lb and a gold price US\$1300/oz. True widths of downhole interval lengths are estimated to be approximately 25% to 60%. Sources: peer review, snl.com, various company releases & broker reports, infomine.com, infomine.com.

*Mineral samples collected at depth listed



CSD-18-055R: 1344m
2.14 % Cu, 3.46 g/t Au*



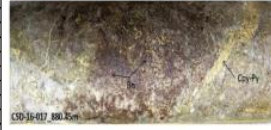
CSD-17-025: 821.9m
18.03% Cu, 0.98 g/t Au*



CSD-16-009: 1300m
1.287% Cu, 3.73g/t Au*



CSD-16-009: 1209.3m
2.97% Cu, 4.09g/t Au*



CSD-16-017: 880.5m
2.37% Cu, 2.00g/t Au*

AN EMERGING COPPER GOLD MAJOR /16

Galore Creek vs. Global Copper

Size of the Prize (Resources)



- One of 30 Undeveloped Deposits with significant contained copper in Resources
- One of few with development permit, reserves, and completed PFS/FS studies
- Strong Tahltan relationship, significant remaining exploration potential

