RBC Capital Markets

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The world needs more copper, a look at which projects can deliver it

We forecast a need for 5Mt of new copper mine supply by 2028 (25% of current production) as existing production declines and demand continues to grow steadily. Several companies are nearing sanction decisions on new projects and this note compares and contrasts these projects. We also expect M&A activity to pick up as copper prices continue to rise over the next several years. We provide a look at some of the options for buying production or development projects.

There's lots of copper projects available, but at what price?

- We have compiled a project database through our own models and the Wood Mackenzie project database which contains potential for 8Mt of incremental annual copper production. While some of these projects may get the greenlight in the near term, others could take several years, and likely require higher copper prices, to resolve technical and/or permitting challenges.
- We believe an incentive copper price of $3.50/lb would be required to develop adequate supply over the next 10 years and this price could be higher as cost inflation returns (see our February note).
- Several companies are contemplating project sanction decisions in the near term, notably **Teck** with QB2, and **Hudbay** at Rosemont. See page 3 for how these projects fit globally.

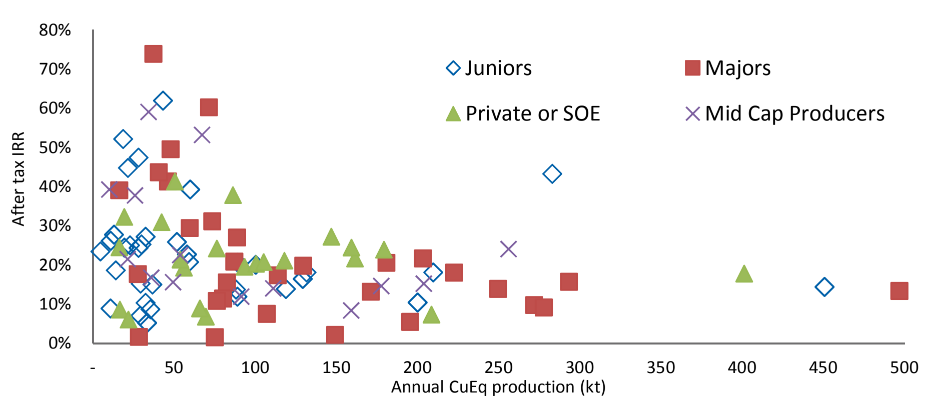
Potential for increased M&A

We believe M&A could pick up in the copper space alongside rising prices. The copper producers in our coverage universe are trading at $14,260 per tonne of annual copper production while the cost to build is estimated to be $14,444/t on average suggesting it may make sense to buy production to get immediate cash flow and avoid execution risk of building a new project. Junior copper explorers have received renewed attention and the base metals juniors we track are now trading at $0.03/lb (EV/lb CuEq M&I+I) which remains below the average transaction price since 2010 of $0.07/lb (Exhibit 10).

Larger projects often come with lower returns

The larger copper projects tend to have lower grades and high capital costs resulting in lower returns. There are some smaller high return projects such as **Nevsun's** Timok and **Teck's** San Nicolas. **Ivanhoe's** Kamoa-Kakula project is truly an outlier due to its scale and grade and potential for a very large, high return project, albeit with heightened geopolitical risk in the DRC.

Exhibit 1: Majors control 41% of the potential copper projects



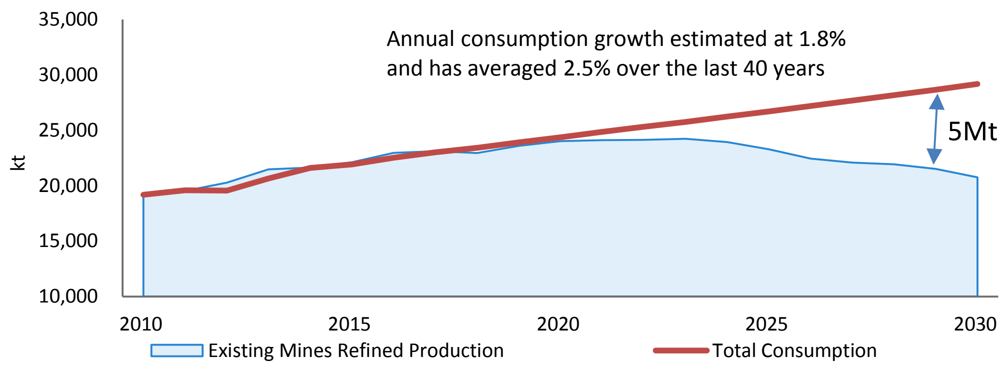
Source: RBC Capital Markets estimates, Wood Mackenzie

The world needs more copper as we enter a structural deficit

If you are reading this note, you have probably seen some version of the chart below showing the potential for a large copper supply deficit to form within a few years as existing mine supply declines and demand continues on its steady rise. We estimate 5Mt of new copper supply is required by 2028, in a market with consumption of 28Mt (Exhibit 2).

The purpose of this report is to compare potential copper projects as several companies are contemplating sanction decisions in the near term, notably **Teck at QB2** and **Hudbay at Rosemon**t, while others like **Lundin Mining** are actively looking for projects to acquire.

Exhibit 2: The world needs more copper with potential for large deficits in coming years

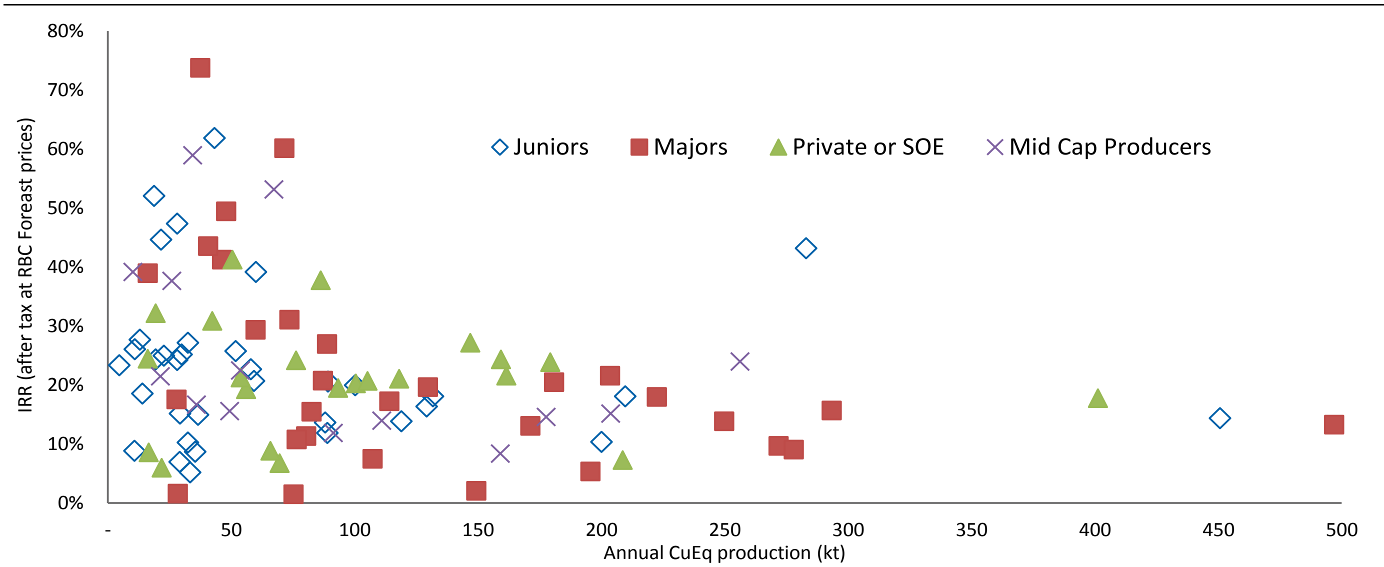


Source: RBC Capital Markets estimates, Wood Mackenzie

Where is all that copper going to come from?

Through a combination of our own models and Wood Mackenzie's copper project data, there appears to be roughly 8Mt/year of identifiable projects at various stages of development. The chart below shows that Major producers own 41% of the project, small and mid-tier copper producers 13%, pre-production juniors 24%, and private companies and state owned entities which own 22%.

Exhibit 3: Majors own 41% of potential copper projects



Source: RBC Capital Markets estimates | RBC copper forecasts: $3.25/lb for 2018/19, $3.50/lb in 2020, $3.75/lb in 2021/22, $3.00/lb long term

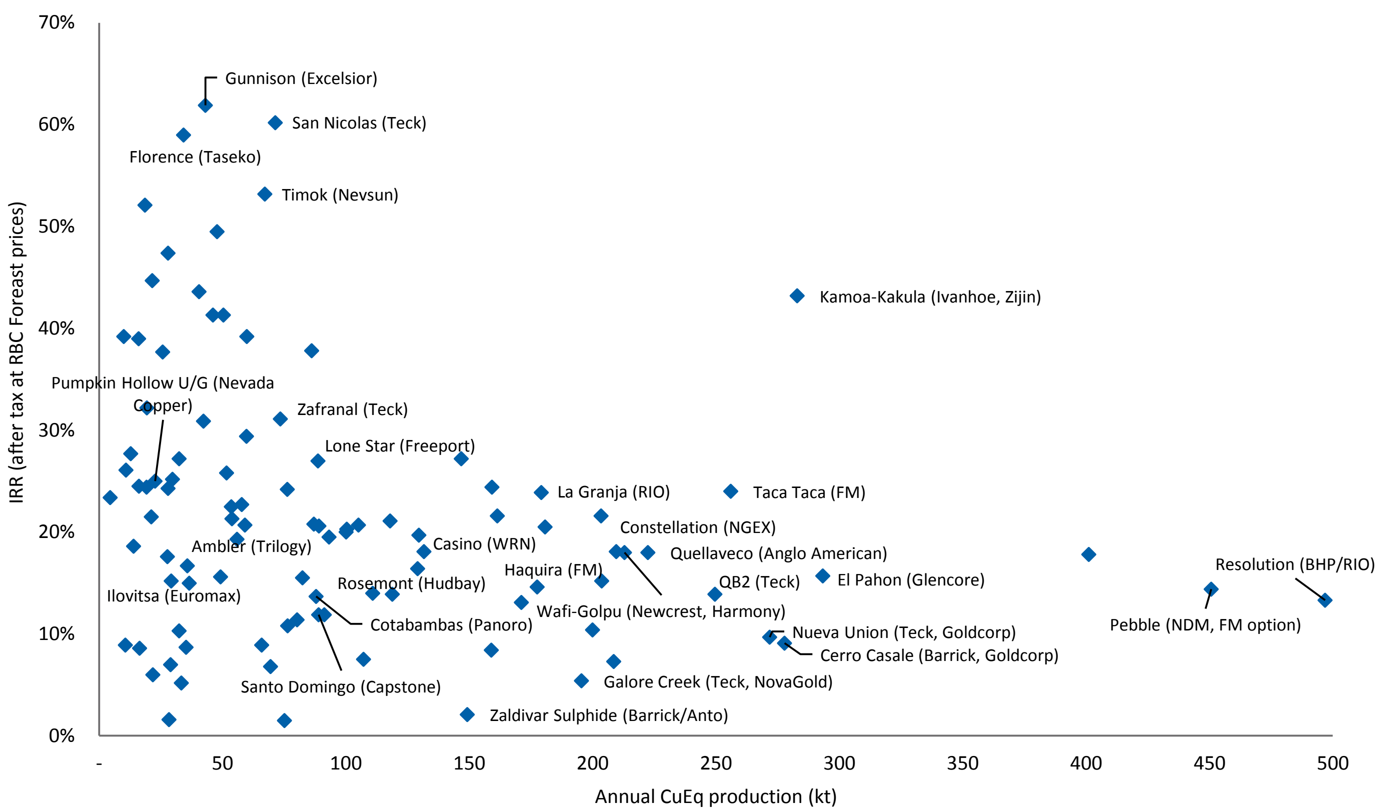
Larger projects tend to come with lower IRRs

Comparing projects by average annual copper equivalent production and IRR shows most of the larger projects tend to have lower IRRs, unless they have above average grades or significant by-product credits. We believe this is due to the larger capital costs and more drawn out construction periods. Nevertheless, it is interesting to highlight where some notable projects screen on this basis. **Nevsun's** Timok project stands out in terms of IRR, while **Ivanhoe's** Kamoa-Kakula project is truly an outlier due to scale and grades. **Hudbay's** Rosemont and **Teck's** QB2 are below average in terms of IRR but both have potential for a meaningful production impact for their respective companies and long mine lives to benefit from multiple metal price cycles.

The other way to think about this is incentive price and we believe a $3.50/lb copper price would be required to generate a 15% return to meet the required copper production levels. This could be higher if there is a rush to build projects and capital cost inflation comes back in a meaningful way. See our note from February on the challenge in generating returns in a rising commodity price environment (here)

We acknowledge that these projects are at various stages of development and some project estimates may be more up to date and/or realistic than others. There are also ways to improve these projects through exploration success and other optimizations.

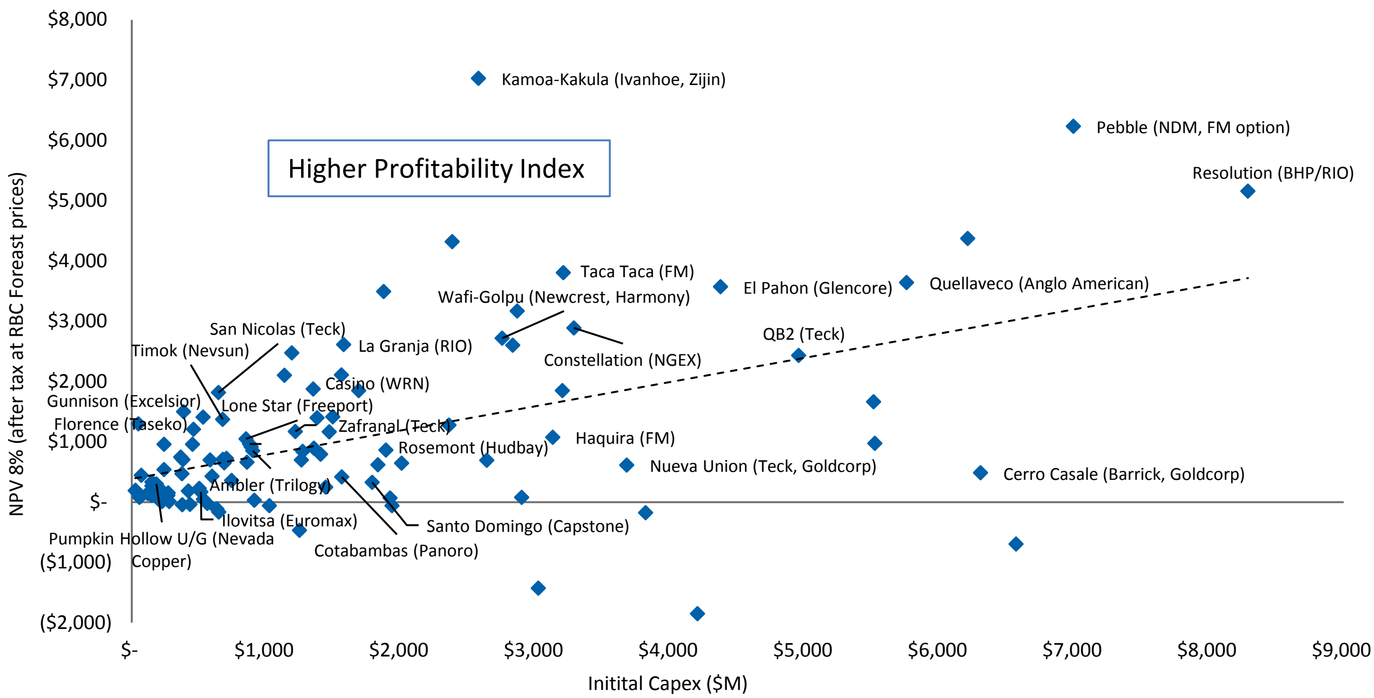
Exhibit 4: Bigger production usually comes with larger capex, longer schedule at the expense of IRR



RBC copper forecasts: $3.25/lb for 2018/19, $3.50/lb in 2020, $3.75/lb in 2021/22, $3.00/lb long term
Source: RBC Capital Markets estimates, Wood Mackenzie, Company Reports

Bang for the buck: Comparing NPV and initial capex, the average profitability index (NPV/initial capex) in this database is 1.3x at our forecast prices (Exhibit 5).

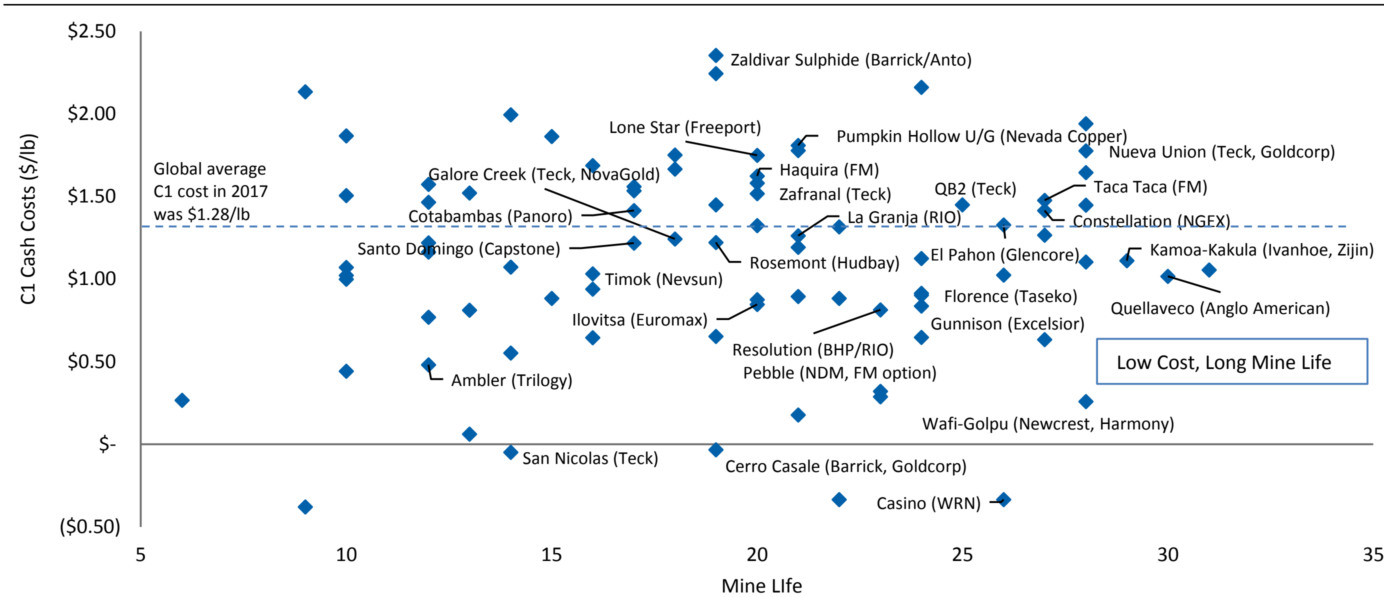
Exhibit 5: The average profitability index (NPV over initial capex) for copper projects is 1.3x



Source: RBC Capital Markets estimates, Wood Mackenzie, Company Reportsm | RBC copper forecasts: $3.25/lb for 2018/19, $3.50/lb in 2020, $3.75/lb in 2021/22, $3.00/lb long term

Long mine life assets can benefit from multiple copper cycles: There are some long mine life projects with potential to generate strong margins for 20+ years (Exhibit 6).

Exhibit 6: There are several projects with potential to generate strong margins for 20+ years

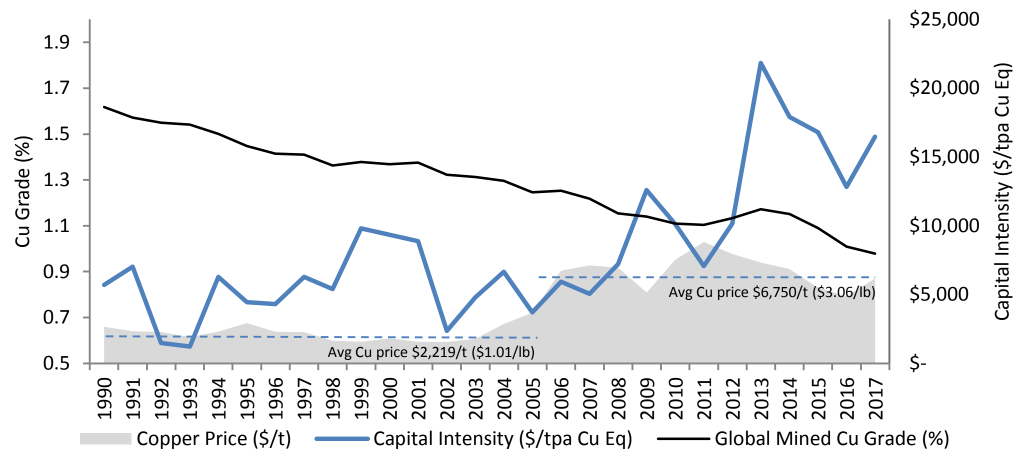


Source: RBC Capital Markets estimates, Wood Mackenzie, Company Reports

Capital Intensity Trends

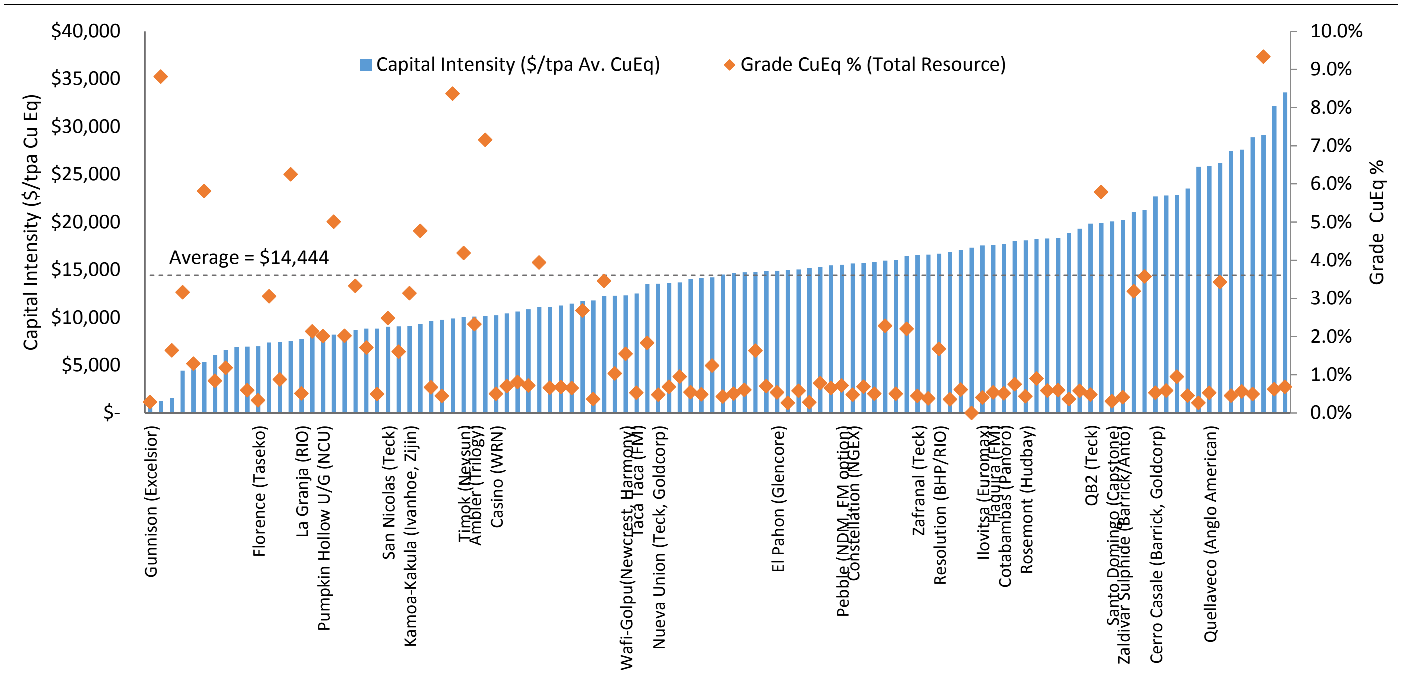
Capital intensity has risen alongside the decline in mined copper grades and projects completed over the last few years cost roughly $15,000/t of annual copper equivalent production, nearly triple the average from 1990-2005 of $5,500/t when the copper price averaged $1.01/lb (Exhibit 7). This is similar to the average within the copper project database which is $14,444/t (Exhibit 8).

Exhibit 7: Capital intensity has risen alongside declining copper grades



Source: RBC Capital Markets estimates, Bloomberg, Wood Mackenzie

Exhibit 8: Smaller higher grade projects tend to have lower capital intensity

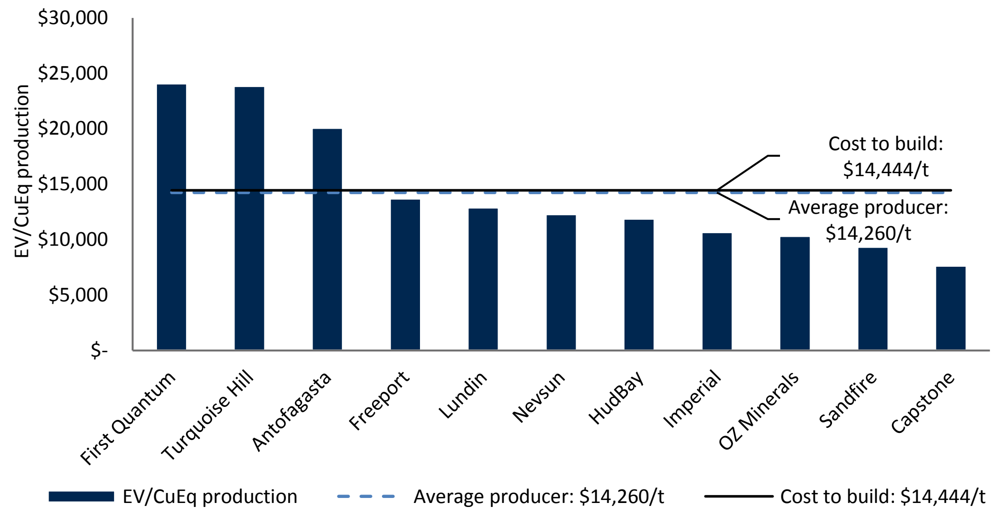


RBC copper forecasts: $3.25/lb for 2018/19, $3.50/lb in 2020, $3.75/lb in 2021/22, $3.00/lb long term
Source: RBC Capital Markets estimates, Wood Mackenzie

Potential for increased M&A if cycle heats up

We believe M&A activity could increase if copper prices remain strong and companies look to restock project pipelines. **Lundin Mining** and **Capstone** have expressed a desire to pursue M&A. Options include acquiring a producing asset or a development stage project. Currently the copper companies in our coverage universe are trading at $14,260 per tonne of copper equivalent annual production, which is right at the average cost to build green field projects at $14,444/t (Exhibit 9).

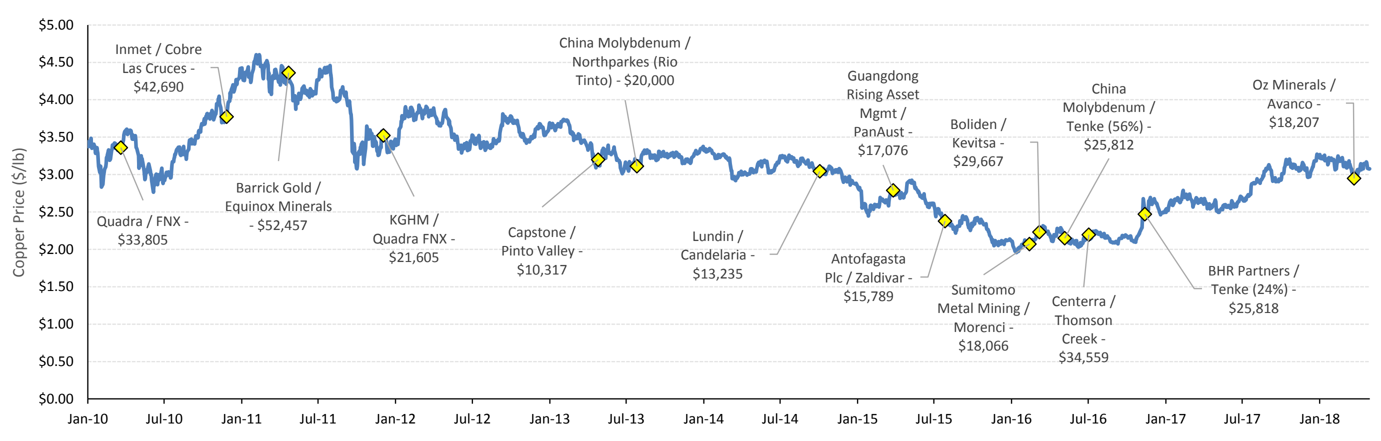
Exhibit 9: The cost to buy production is comparable to the cost to build production



Source: RBC Capital Markets estimates, ThomsonONE, Wood Mackenzie

The median transaction for producing assets since 2010 was completed at $22,000/t, which would be a 50% premium to the current trading range noted above (Exhibit 10).

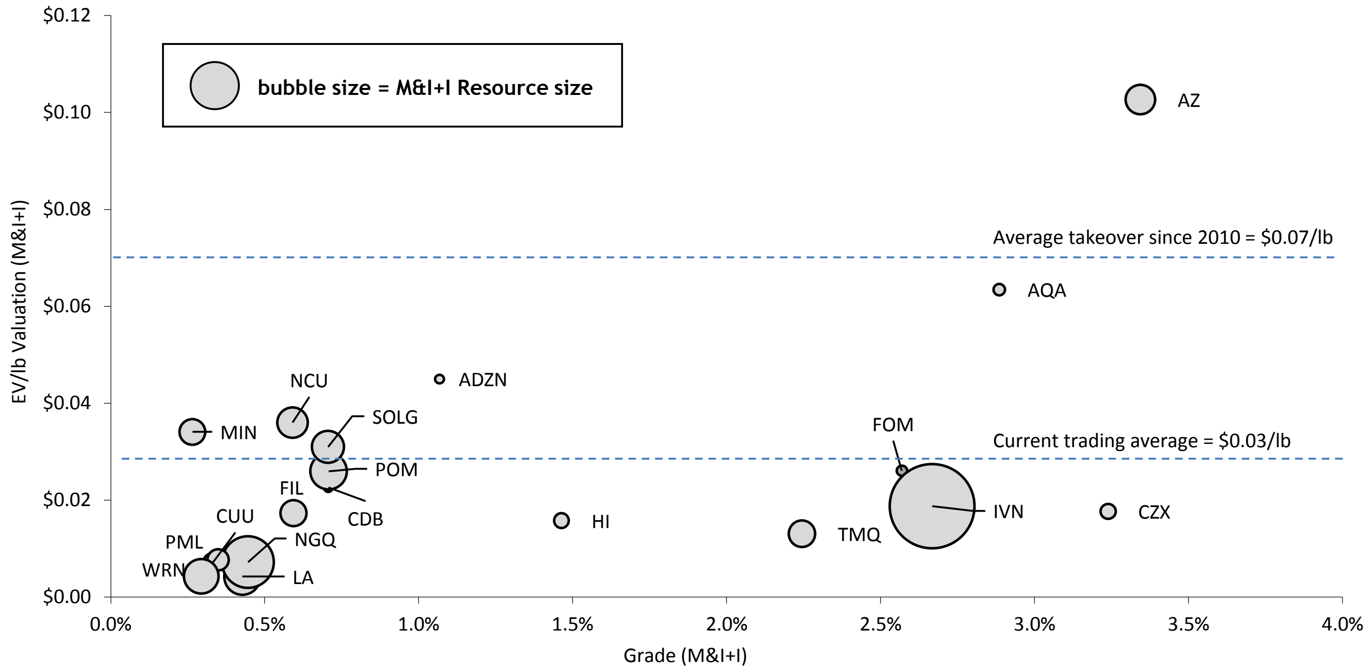
Exhibit 10: Producing assets have transacted at median price of $22,000/t since 2010



Source: RBC Capital Markets, Bloomberg, Company Reports

For junior base metals companies, including copper and zinc, the current trading range on an EV/pound basis (M&I+I, CuEq) is $0.03/lb, which is below the average takeover since 2010 of $0.07/lb (Exhibit 11).

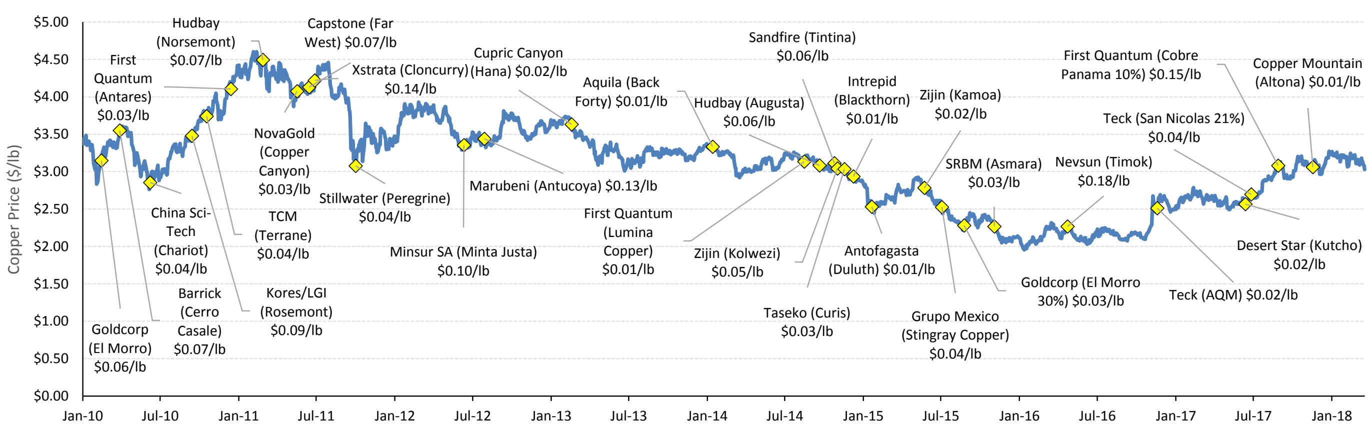
Exhibit 11: Junior base metals companies (includes copper and zinc) trade a discount to the historic takeover price



Source: RBC Capital Markets, Company Reports, ThomsonONE

The average takeover since 2010 was completed at $0.07/lb EV/lb (CuEq, M&I+I) (Exhibit 12).

Exhibit 12: Base metals precedent transactions for pre-production assets since 2010



Source: RBC Capital Markets, Company Reports, Bloomberg

Appendix – RBCCM pre-production base metals comps

Company	Ticker - Exch	Price ($/sh)	YTD Perf.	Shares O/S (MM)	Mkt. Cap US$M	EV US$M	Contained (MM lbs) - CuEq		Grade (%)	Valuation (EV/lb)		Wkg Cap (US$M)	Area of Major Exploration
							M&I	M&I+I	M&I+I - CuEq	M&I	M&I+I		
Aquila Resources	AQA-T	C$0.27	2%	331.0	$64	$70	971	1,111	2.9%	7.3¢	**6.3¢**	$13	Michigan
Arizona Mining (Taylor only)	AZ-T	C$4.15	20%	313.0	$990	$970	6,587	9,670	3.3%	14.7¢	**10.0¢**	$70	Arizona
Adventus Zinc Corporation	ADZN-V	C$0.85	12%	57.0	$38	$29	562	652	1.1%	5.2¢	**4.5¢**	$8	Newfoundland
Canada Zinc Metals	CZX-V	C$0.31	$0.15	167.0	$40	$37	1,689	2,157	3.2%	2.2¢	**1.7¢**	$6	British Columbia
Copper Fox	CUU-V	C$0.10	(27%)	437.0	$32	$34	2,679	5,249	0.3%	1.3¢	**0.6¢**	$0	BC / Arizona
Cordoba Minerals	CDB-V	C$0.16	(63%)	207.0	$27	$25	584	1,057	0.7%	4.2¢	**2.3¢**	$3	Colombia
Excelsior Mining Corp	MIN-T	C$1.47	11%	206.0	$227	$196	4,990	5,620	0.3%	3.9¢	**3.5¢**	$36	Arizona
Filo Mining	FIL-V	C$2.26	297%	72.0	$140	$139	5,128	8,008	0.6%	2.7¢	**1.7¢**	$1	Chile / Argentina
Foran Mining Corporation	FOM-V	C$0.40	(4%)	111.0	$36	$32	803	1,483	2.7%	4.0¢	**2.2¢**	$3	Saskatchewan
Highland Copper	HI-V	C$0.11	(24%)	473.0	$42	$43	1,632	2,853	1.5%	2.6¢	**1.5¢**	$6	Michigan
Ivanhoe Mines	IVN-T	C$2.65	(38%)	791.0	$1,696	$1,527	53,821	78,538	2.7%	2.8¢	**1.9¢**	$179	DRC / South Africa
Los Andes Copper	LA-V	C$0.30	(18%)	245.0	$56	$56	9,932	12,771	0.4%	0.6¢	**0.4¢**	$0	Chile
NGEX Resources	NGQ-T	C$1.04	(1%)	226.0	$178	$173	20,117	26,193	0.4%	0.9¢	**0.7¢**	($1)	Chile / Argentina
Nevada Copper	NCU-T	C$0.66	(12%)	445.0	$222	$258	6,985	7,758	0.6%	3.7¢	**3.3¢**	$47	Nevada
Panora Minerals	PML-V	C$0.35	(8%)	261.0	$71	$68	3,432	8,488	0.3%	2.0¢	**0.8¢**	($2)	Peru
Polymet	POM-T	C$1.06	(1%)	320.0	$264	$334	10,026	12,393	0.7%	3.3¢	**2.7¢**	$16	Minnesota
SolGold	SOLG-T	C$0.47	(8%)	1,696.0	$614	$506	7,671	16,794	0.7%	6.6¢	**3.0¢**	$99	Ecuador
Tinka Resources	TK-V	C$0.46	(37%)	246.0	$90	$85	-	2,034	2.2%	n.a.	**4.2¢**	$4	Peru
Trilogy Metals	TMQ-T	C$1.56	12%	131.0	$154	$148	5,279	10,981	2.2%	2.8¢	**1.3¢**	$5	Alaska
Western Copper and Gold	WRN-T	C$1.04	(17%)	100.0	$82	$79	8,969	18,503	0.3%	0.9¢	**0.4¢**	$3	Yukon

	M&I	M&I+I
Median	2.8¢	**2.1¢**
Average	3.8¢	**2.7¢**

Priced as of May 3, 2018
Source: Bloomberg, ThomsonONE, Company Reports

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