

COPPER INDUSTRY - - HIGHER DEMAND AND SUPPLY ESTIMATES FOR 2020;
PRICE FORECASTS KEPT AT MARCH 24TH REDUCTIONS; RATINGS CUT

- We raised our 2020 global demand forecasts to a 5.5% from a 10% decline, raising China to +3% from -5% after robust second-quarter data, raising the U.S. to -9% from -11% and raising ROW to -15.4% from -15.7%.
- This estimates a 1.1 mmt higher 2020 estimated world copper demand, or a 2021 new demand record at 24.4 mmt.
- We raised our estimate of world copper supply for 2020 to -1.5% from -4.4% or by $\frac{3}{4}$ mmt due to (1) 6.2% April YTD refined output gains, (2) a 1.9% April YTD world mine output gain, (3) a 35% WBMS estimated Chinese April YTD 2020 mine output gain that we watered down to a +12.5% from +5% in our models and our estimate of a 1% of world demand reduction to off-exchange copper-in-concentrate inventories rather than a more typical 1.75% refined output loss.
- We are skeptical of the copper price rally to \$2.77/lb today as (1) virus cases spread for the total world and U.S. although not for China, (2) China's soft export profile and 21% May YTD vehicle sales declines suggest China is less ebullient than some recent data, (3) we estimate Chinese entities hoarded 3 to 4 mmt of nonferrous metals in the 2020 first-half and (4) some copper miners or observers may exaggerate risks of output mishaps.
- After all, copper miners achieve their highest rates of return on mine output mishap warnings.
- For these reasons we view the recent very strong stocks markets, Nasdaq records, S&P 500 rebound to down 6% on July 6th from down 33% on March 23rd and \$2.77/lb copper price rebound as an opportunity to raise cash balances, take profits or thin positions. In our own portfolios, we have raised about 20% cash and taken profits on early stage mines, gold or other rebounding sectors.
- We have kept our copper price estimates at \$2.40/lb for 2020, \$2.70 for 2021, \$3.00 for 2022, \$3.25 for 2023 and \$3.50/lb for 2024 onwards. We acknowledge a \$2.546/lb first-quarter and \$2.425/lb second-quarter average and the current \$2.77/lb spot price on July 6th.
- Cap ex postponements, delays to underground development, deferrals of waste stripping and project rescheduling by SCCO, FCX, RIO, Teck, ANTO, Anglo American, Codelco and others suggest a better 2022 to 2027 long-term outlook.
- We estimate that typical copper shares anticipate already \$3.50/lb long-term copper based on valuations near our NPV-based price targets.
- Over the past month we reduced our copper Overweight ratings to 5 from 9, where we kept Grupo Mexico, Teck, First Quantum, ANTO and Glencore at reduced price targets of \$4 for Grupo Mexico, \$23 Teck, \$14 First Quantum, \$13 ANTO and \$3 per ordinary for Glencore.
- On June 17th we cut HudBay Minerals and Southern Copper both to Neutral from Overweight, and FCX to Underweight from Overweight due to combinations of lower price targets at lower estimated future copper prices and second-quarter

share rebounds. On May30th we cut BHP to Neutral Weight from Overweight due to price appreciation.

- In mid-2020 there are certain favorable dynamics in some copper mine income statements, including (1) cheaper diesel fuel, (2) fast weakening resource currencies, (3) higher gold byproduct prices, (4) firm iron ore prices for certain diversified mines that mine iron ore and (5) discretionary cost cuts. In the March financials the direct cash production costs for Teck fell \$0.28 and ANTO fell \$0.14/lb even with smaller moly byproduct credits.

APRIL CHINESE COPPER DEMAND HIGHER THAN EXPECTED, WHERE WE RAISE OUR GLOBAL COPPER DEMAND ESTIMATES

We are impressed that China's vehicle sales rose in April and May 2020 for the first times in two years, and that the full year vehicle sales total may fall < 5% after the 80% plunge in February. Further, Chinese apparent demand rose 0.2 mmt in April, where copper hoarding perhaps due to growth or perhaps due to hoarding at low prices continues in June 2020.

We raised our estimate of 2020 copper demand growth in China to +3% from a 5% decline, and raised our estimate for 2021 Chinese demand growth to 4% atop the 3% 2020 rise up from a 6% prior estimated 2020 rise previously following a 5% estimated 2020 fall. The net impact on 2021 raises our estimate in China to 13.71 mmt from 12.89 mmt for 2021, or a 0.8 mmt higher level.

We also raised our USA 2020 estimate estimate to a 9% from an 11% fall, and left ROW the same as global virus data are prolific and suppress economic growth. We raised our ROW demand estimate to a 15.4% from a 15.7% fall with the stronger USA rebound. The resulting calculations increase our global demand estimate for 2020 to a 5.5% from a 10% fall to 22.6 up from 21.5 mmt and an 8.5% 2021 rise to 24.5 up from 23.6 mmt. The firmness in China suggests that 2021 will rebound to be a record global demand year, and supply surpluses remain large but not as monumentally huge as we previously expected.

GLOBAL MINE OUTPUT OUTLOOK GOING FORWARD

We are skeptical of some sensational news about copper supply disruptions. The mining companies have **every incentive to exaggerate supply outages**, because such news makes spot **copper prices rise**. In effect, the copper companies have an **infinite rate of return from press releases about worker layoffs or mine outages**.

In fact, 7 of the 10 nations with the largest virus case numbers mine copper two. Only India, UK and Italy have no copper output among the 10 most infected nations. USA, Brazil, Russia, and Spain do not appear to have notable copper mine disruptions. We call attention to Peru, Chile and Mexico, where nearly all outputs are open pti except for Codelco in Chile.

Chile's copper mine output rose 3.8% April 2020 YTD. However, we call attention to the unionized and politicized state miner Codelco, which operates 3 underground mines. In the March quarter it reported 387,000 t of attributable copper output up 4.2% from 371,000 t last year. Its underground mines El Teniente produced 102,000 t, Andina 45,000 t, and Salvador 11,000 to total 158,000 t in the March 2020 quarter versus 147,000 t last year. We consider El Teniente the riskiest mine in the world as the workers take a 20 to 30 minute tram or subway ride into the mountain, and then travel to their mine faces underground. These Codelco underground mines are about 10% of Chilean or 3% of world copper supply.

We note that June quarter mine output losses for gold miners have been much less than feared. KL lost < 5%, WPM 15%, PAAS about 20% or AEM 30%-40% of their outputs. These companies each had the majority of their mines interrupted.

APRIL GLOBAL COPPER MINE OUTPUT LOWEST IN SIX YEARS, BUT GAINS IN CHILE AND CHINA ENCOURAGE US TO RAISE OUR COPPER MINE OUTPUT ESTIMATES

April world copper mine output fell to 1.531 mmt from 1.874 mmt in December 2019 or 1.722 mmt in January 2020, where January has peak summer holidays in Chile. April 2020 was the lowest month in over 5 years since February 2015 at 1.473 mmt or September 2014 at 1.525 mmt. The WBMS reported its principal mine output declines in April versus January 2020 in Peru at 69,000 t, Mexico 34,700 t, Canada at 16,200 t, and DRC Congo at 62,600 t. However, the WBMS did not report a decline in Panama, where First Quantum idled fully on April 7th going to "care and maintenance" after reporting virus cases in its work force on May 24th perhaps to lose almost its full near 20,000 t outputs in April and May. FCX cut its work force at Grasberg on May 17th after three virus deaths, and announced a 400 mm lb or 0.18 mmt output cut on April 24th in Peru, New Mexico and AZ. Vale's continued output in Brazil may have fallen in May and June, as virus grew worse there. In May 2020 workers returned in Peru, Mexico and Canada, but outputs likely fell in U.S., Panama and Indonesia. On April 27th Southern Copper stated its April single month output would decline by 7,000 to 10,000 t, which suggests the WBMS 34,700 t shortfall in Mexico in April was exaggerated if SCCO was correct.

Chile, China, the U.S., Australia, Zambia, Poland, Russia, Mongolia and other nations had no discernible virus damages through April according to WBMS. Chile achieved a 3.8% or 69,300 t gain in mine output April YTD led by Escondida, Collahuasi and Codelco. China at 161,000 t, DRC at 29,900 t, Panama at 64,600 t, USA at 32,100 t, Spain at 10,000 t and PNG at 8,500 t were other April YTD world copper output gains driving the 1.9% or 124,200 t April YTD global gain.

We previously estimated a 4% fall in 2020 world output to 19.8 mmt last March 24th driven by a 6% up from 3% allowance for mine interruptions at 1.26 mmt and a planned 2% mine output gain to 21.02 mmt. While April fell short by 0.2 mmt and May 2020 looks to be similarly bad, the strong outputs in Chile and China suggest our 6% full year

world mine outage allowance could be too much unless the same disruptions follow consecutively each month to September. Further, China's mine output gains suggest a more than 2% gain to world copper mine output simply from China for 2020 if they continue above the 80,000 t gain we originally estimated. Further, Chile's trends to a 200,000 t gain rather than the 112,000 t fall we had estimated, which adds another 1.5% to the base level of global copper mine output aside from pandemic outages.

Thus, we are raising our estimate of world copper mine output for 2020 to 20.5 mmt from 19.8 mmt on March 24th, which is less than a 1% rather than a 4% full year decline.

Table 32: Revised July 6, 2020
Global Copper Supply and Demand Summary (000 metric tonnes)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E
Total Global Consumption	19,566	20,291	21,133	22,750	22,902	23,185	23,332	23,925	23,882	22,563	24,486	25,126	25,788	26,472
% Change	1.2%	3.7%	4.1%	7.7%	0.7%	1.2%	0.6%	2.5%	-0.2%	-5.5%	8.5%	2.6%	2.6%	2.7%
Total Mine Output	16,293	16,981	18,247	18,594	19,405	20,370	20,094	20,300	20,474	20,927	21,822	22,752	23,728	24,183
% Change	1.1%	4.2%	7.5%	1.9%	4.4%	5.0%	-1.4%	1.0%	0.9%	2.2%	4.3%	4.3%	4.3%	1.9%
Secondary Scrap Recycling	3,553	3,662	3,857	3,860	3,878	3,199	3,826	3,730	3,808	3,608	3,680	3,753	3,866	3,982
Mine Interruptions 3% Normal	0	0	0	0	0	0	0	0	0	-1,046	-655	-683	-712	-725
Refined Output Adjust. 1.75%	-228	-206	-988	299	-213	-466	-778	-168	-214	209	-382	-398	-415	-423
Total Copper Supply	19,585	20,437	21,116	22,753	23,070	23,102	23,142	23,862	24,067	23,697	24,465	25,424	26,467	27,016
% Change	2.3%	4.4%	3.3%	7.8%	1.4%	0.1%	0.2%	3.1%	0.9%	-1.5%	3.2%	3.9%	4.1%	2.1%
Supply Surplus (Deficit)	52	147	-16	3	167	-82	-190	-63	185	1,134	-20	298	679	543
Reported Inventory Change	19	147	-16	3	167	71	-190	-63	185	1,134	-20	298	679	543
Total Refined Cu Inventories	1,205	1,352	1,336	1,339	1,506	1,577	1,387	1,324	1,509	2,644	2,623	2,921	3,600	4,144
Copper Price (\$/lb.)	3.86	3.63	3.34	3.12	2.51	2.20	2.80	2.92	2.72	2.40	2.70	3.00	3.25	3.50

Source: World Bureau of Metal Statistics; JTVIR, LLC Estimates

INCREASE TO ESTIMATED MINE OUTPUTS IN CHINA BY 120,000 TONNES FOR 2020 ONWARDS

China's April YTD 2020 estimated copper mine output from WBMS is up 161,000 t or up 35%. For this reason raised our estimate of China's 2020 copper mine output by 120,000 t or 7.5% to a 12.5% from a 5% gain. There may be more increases, where in effect we only gave credit for the WBMS estimated January-to-April 2020 output gain, and we did not estimate it continues over the final eight months of 2020.

China reports refined copper output, and imports of refined copper, copper-in-concentrates and scrap. The WBMS estimates the mine output from the refined output and import and export data. We are concerned that Chinese smelters liquidated concentrate inventories, for example, causing WBMS to over estimate China's copper mine output.

April YTD also saw large increases in copper mine output in Spain, DRC, Chile, Panama, USA and PNG. We had already estimated Panama's gains in our First Quantum model.

Due to pandemic, we suspect that subsequent months may interrupt such outputs. We have not increased estimated outputs for any of those nations in a conservative manner.

MINE INTERRUPTION ALLOWANCE CUT TO 5% FROM 6%

Normally in our global copper demand-supply models we allow for a 3% future mine output loss due to strikes, pit wall failures, mechanical issues, weather or other mine interruptions. On March 24th we raised our 2020 mine interruption allowance to 6% from 3%, which caused us to estimate a 4.4% decline in global copper supply net of the mine interruption and smelter refined output adjustments after a 2.1% gain in mine output.

In this report we have cut the mine output loss allowance to 5% from 6% because the year is half over, and we have more knowledge of mine interruptions. Canada, Mexico and Peru have resumed most mine operations, and the unionized underground copper mines of state miner Codelco in Chile appear to be the most vulnerable to shutdown. In fact, on July 6th FCX issued a press release stating that its Lone Star heap leach product was substantially complete, and would produce copper in the 2020 second-half.

WE DO NOT ATTEMPT TO ESTIMATE COPPER, GOLD OR OTHER MINE INTERRUPTIONS IN OUR INDIVIDUAL COMPANY MODELS

In general, we do not focus on “one-time items” or “short-term issues” in our time allocation and research focus strategies. Except for revisions to our SCCO and Grupo Mexico models, we have not attempted to estimate the degree of mine output loss for mines in Peru, Chile, Mexico, Canada or other copper mines. We address these in one catchall “5% mine interruption” estimate.

We will update individual mine output models one-by-one AFTER companies disclose June quarter output, June quarter earnings and/or revise or restore guidances. We will use our time when we believe we can meaningfully update our spreadsheets and defer during periods of uncertainty.

We estimate the largest world copper output losses include:

- * First Quantum idlings of Cobre Panama near 20,000 tonnes/month.
- FCX voluntary cuts to high cost U.S. heap leach mines due to lower prices and 20,000 t June quarter loss at Cerro Verde
- June quarter reductions to SCCO in Peru and Mexico of up to 50,000 t.
- June quarter reductions to Las Bambas, Antamina, Constancia and other mines in Peru.
- September quarter reductions to Codelco’s 3 underground mines in Chile of up to 25,000 tonnes per month if they run at 50% of normal output.
- Postponements or delays to underground mine development, waste stripping or formal cap ex projects likely to hurt 2022 or later mine outputs.

In most cases the disruptions to gold or copper miners appears to be 5% to 20% of June quarter outputs. However, the spread of pandemic in North and South America suggests

some companies will have delays in the September or December quarters. We believe outages may occur to underground mines, such as 3 of Codelco's mines that total 0.6 mmt, and that open pit mines may practice social distancing in open pit trucks, shovels, crushers or concentrators. The greater risk are social interactions during bus rides to sites or when "off duty" or in cafeterias in "mine camps."

The net effect of our revisions to mine output by nation, 1% drop in mine interruption allowance and change to a 1.0% upwards rather than a 1.75% deduction for "refined output allowance" is to increase our estimate of the 2020 change in refined copper supply to a 1.5% decrease from a 4.4% fall, or a 2.9% increase.

TIME LAGS BETWEEN MINE CRUSHER AND REFINED OUTPUT UP TO SIX MONTHS

We estimate time lags of up to six months between lower mine operations and lower refined output. The principal explanations of such delays are (1) ore stockpiles, (2) heap leach percolation cycles, (3) up to 2 month transportation cycles from mines to smelters often in Asia and (4) work-in-process inventory delays at smelters and refineries.

In 2019 the startup of Cobre Panama, the mid-July blockade of Peru's Matarani primary export port and multiple blockades of Chinalco's Las Bambas copper mine also in Peru caused at least a 0.5 mmt buildup of copper-in-concentrate inventories in transit or in smelters. These extra stockpiles probably will offset the first two months of pandemic related mine output outages for April, May and perhaps June. We estimate by July, or the fourth month, such stockpiles will be significantly reduced or depleted.

REVISED OUTPUT ADJUSTMENT FACTOR CHANGES IN DIRECTION FOR APRIL 2020

For these reasons the we changed the 1.75% "refined output adjustment" in our demand-supply model, where we deduct 1.75% from mine output each year for concentrate losses in handling, smelter slag losses or changes in inventory. Normally refined output is less than mine output plus scrap supply by several hundred thousand tonnes or up to 1 mmt. For 2020 we revise it to a 1% addition rather than 1.75% deduction, where we expect about a 225,000 tonne drawdown. **This is a large roughly 600,000 t swing factor.**

REFINED OUTPUT UP 6.2% WORLDWIDE APRIL 2020 YTD AS COPPER-IN-CONCENTRATE INVENTORIES BUILT UP IN 2019 FILL THE SUPPLY GAP FROM MINE OUTAGES DUE TO VIRUS

The World Bureau of Metals Statistics reported world mine output up 1.92%, world refined output up 6.2% 8.1% and world copper apparent demand up 1.5%. We believe the refined output gain is accurate, and driven by surprising large mine output gains in China and DRC as well as good productivity in Chile, Peru, Panama or the USA. We question whether the 1.5% gain in apparent demand is accurate, where we think large

volumes of unsold vehicles, other manufactured goods or recently arrived but unused copper sit in various supply chains.

Our detailed models below estimate a 2.2% gain in 2020 world mine output prior to a 5% allowance almost twice normal for mine outages, a 1% supply benefit from drawdown of copper-in-concentrate inventories and a 2.9% fall in refined supply. We also estimate a 5.5% fall in global demand with a 3% rise in China and 15.4% in ROW. **Refined supply trends 9% ahead of our estimates**, and the gains in China's second-quarter vehicle sales improves to a 21% May YTD 2020 decline to suggest China may sidestep our estimate of a demand decline.

We have not raised our 2020 copper price estimate, despite July 6th prices near \$2.77/lb, because there are many evidences of continued record virus infections in the U.S., Latin America and Asia. We are pessimistic about second-half 2020 demand rebounds, where the health crisis continues. We cut our copper price estimate on March 24th to \$2.40 from \$2.90/lb for 2020, to \$2.70 from \$3.25 for 2021, \$3.00 from \$3.50 for 2022, \$3.25 from \$3.75 for 2023 and to \$3.50 from \$4.00/lb for 2024 thereafter. We expect stern measures to contain the coronavirus in Asia and North America, but for it to continue for over a year in Europe, Latin America, Africa and Third World nations without strong health systems. Copper prices average \$2.5460/lb for the first-quarter of 2020 and \$2.425/lb in the second-quarter after a \$2.72 average in 2019.

Because of buildups of ½ to ¾ mmt of copper-in-concentrate inventories in 2019, we doubt that the March-to-May pandemic-related copper mine closures mostly in Panama, Mexico, Peru and Chile will make any dent in global refined copper output unless they continue into July or the 2020 second-half

OUR REVISED ESTIMATE OF A **1.5% DECLINE** UP FROM 4.4% REFINED OUTPUT FALL IN 2020 APPEARS VERY CONSERVATIVE IN VIEW OF 6.2% APRIL YTD 2020 **RISE**

The 455,500 t or 6.2% April YTD 2020 refined output rise stems from large gains of 325,500 t or 11.7% in China and 130,000 t in ROW. Large increases include 80,400 t Chile, 14,800 t Mexico, 20,900 t Peru, 75,300 t USA, 10,800 t Finland, 27,700 t Indonesia, 26,800 t Japan, 14,900 t Kazakhstan, 12,600 t Laos, and 25,600 t South Korea. We suspect that the large gains in four nations in the Americas could be disrupted by virus, and that China, Japan or South Korea may not be able to import as much copper-in-concentrate from Latin America as they had expected. Only Finland, Indonesia, Kazakhstan and Laos appear secure.

It is notable that several nations already posted declines in refined output April YTD 2020. These include Belgium 39,700 t, Germany 23,000 t, DRC 35,100 t, South Africa 5,900 t, India 48,100 t, Brazil 16,400 t, and Australia 12,500 t. South Africa, India and Brazil have had terrible virus statistics in recent weeks, where their declines could worsen. DRC has little testing, and its situation may or may not worsen. Belgium and

Germany probably will see fewer copper-in-concentrate imports from Latin America. Australia appears to be the only stable nation among the seven declining nations.

Stockpiles or hoarding further complicate demand estimates. Shanghai Futures Exchange weekly inventories fell 15 straight weeks by 660,242 t in the past 15 reports including 277,276 t CU until a July 3rd reversal. Further, China's State Reserve Bureau, Yunnan province at 800,000 t and Gansu province at 436,000 t have established stockpile procurement funds. Yunnan and Gansu are expected to buy AL and ZN to subsidize local producers.

On March 24th we cut our 2020 scrap supply estimate by 0.2 mmt. We provided for a disruption to the scrap recycling industry, a disruption to world trade in scrap and lower scrap collections after lower consumption. We may be too cautious, but this remains our best judgment.

Large 215,500 t FCX in Indonesia and 88,200 t mine output declines in Zambia in 2019 have been offset by mine output gains in Panama, DRC, China, Kazakhstan, Poland and Australia that are much larger. World mine output had been strong in the six months leading up to March-April 2020 Latin American mine outages to combat virus. *We are not impressed at the March-April Latin American copper mine closures in view of (1) 6 mm units or 1/4 fall in 1Q world auto sales, (2) our estimate of a 5.5% up from 10% global copper demand fall in 2020 and (3) the 0.5 to 0.8 mmt copper-in-concentrate inventory buildup we estimate since January 2019 to February 2020.*

PANDEMIC CLOSURES MOST BULLISH FOR 2022 TO 2027 TIME FRAMES

Southern Copper postponed four large projects to 2027-2028 from 2024-26 timetables. Southern Copper also delayed 3 small projects in Mexico to 2022-23 from 2020-21. It had been the most rapidly growing copper miner in the world prior to these delays, and had nearly doubled its output since 2013. We exclude the 120,000 t Tia Maria project among these delays. Continued infill drilling, more detailed engineering, technical and tradeoff studies, community relations, land purchases and more cautious permit timetables explain these delays. None of these SCCO delays stem from virus, and they were described in early 2020 SEC filings, the December 31 earnings call and the March 31 earnings call in late April.

Longer term, large projects have been delayed or postponed. Codelco delayed underground mine expansions at El Teniente and Chuquicamata Subteranea. First Quantum's next phase expansions in Panama suffer with the second-quarter output delays. Rio Tinto's Mongolian underground 22 to 29 month delay is notable. Regulatory delays block HBM at Rosemont in Arizona or SCCO at Tia Maria in Peru. Copper prices averaged \$2.72/lb in 2019 too low to encourage marginal large capital projects. Teck, for example, delayed Quebrada Blanca sulfides but farmed out 30% to Sumitomo Corp and soft prices do not encourage the next phase QB expansion. Teck's 50%-owned NuevaUnion (renamed from Relincho) JV with NEM also in Chile, its 70%-owned Schaft Creek in B.C., or 50%-owned Galore Creek JV also with NEM in B.C. are

similar examples of projects needing higher than \$3.00/lb copper prices to move ahead. Similarly, FCX is in no rush to build the 240,000 mtpd sulfide mill at 51%-owned El Abra or sulfide mills at Lone Star, Bagdad, Sierrita, Morenci, etc. until prices well exceed \$3/lb.

STOCK RECOMMENDATION CHANGES TURN CAUTIOUS

Our NPV models for copper miners were much less favorable after our March 24, 2020 cut in our long-term copper price estimate for 2024 onwards to \$3.50 from \$4.00/lb. In fact, it appears that consensus expectations for copper prices are optimistic, and already anticipate \$3.50/lb copper. This reduces our optimism towards the copper sector.

Separately, we are concerned that the 1.5% April YTD 2020 WBMS reported copper demand gain will be revised down, as WBMS warns. Further, we are skeptical of higher Chinese apparent copper demand in the second-quarter, where we raised our 2020 estimated full year demand growth to +3% from -5%.

Over the past month we reduced our copper Overweight ratings to 5 from 9, where we kept Grupo Mexico, Teck, First Quantum, ANTO and Glencore at reduced price targets of \$4 for Grupo Mexico, \$23 Teck, \$14 First Quantum, \$13 ANTO and \$3 per ordinary for Glencore.

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Iron ore, gold or in the case of Norilsk Nickel palladium continue as robust byproduct or diversified earnings, while molybdenum, silver or cobalt prices offer disappointing byproduct revenues. One year ago higher iron ore earnings and gold, nickel or palladium byproduct earnings helped certain companies. In August 2019 we updated our earnings estimates and price targets for **Anglo American, BHP, Glencore, Grupo Mexico** and **Norilsk Nickel** in a “housekeeping manner” as we had not written standalone reports on each of them since we trimmed copper price estimates on May 27th, January 20th or previously since at least December 2018. We cut our earnings estimates for Glencore and Grupo Mexico, but raised estimates for Anglo American and BHP due to much larger iron ore earnings and for Norilsk Nickel due to higher palladium and nickel prices and lower unit costs.

COPPER EXCHANGE INVENTORIES FALL IN SHANGHAI

On July 3rd total combined exchange inventories of copper were 401,514 t down from May 15th at 531,332 t down from April 24th combined copper exchange inventories fell to 559,753 t and a March 20th combined copper exchange inventory peak to 630,521 t from only 291,545 t up about 339,000 t since January 19, 2020. LME inventories on July 3rd were 210,700 tonnes, Nymex 84,320 short tons and Shanghai inventories 114,318 t as only the Nymex inventories rose consistently in recent months. Shangahi exchange inventories fell 277,276 t in the 15 weeks ended June 26th to account for most of the declines. **The four week moving average at July 3rd is a 6,705 t fall for copper inventories.**

The State Reserve Bureau in China normally operates “below the radar” and may release stockpiles into the Chinese market if its economy needs supplies. We suspect it bought copper inventories aggressively in 2Q taking advantage of lower prices.

Copper exchange inventories made a five year high on March 30, 2018 at 910,507 t and came within 21,000 t of a fifteen year high, where most of the runup from 527,144 t on December 17, 2017 came on Shanghai Futures Exchange or Asian locations in the LME system. We were relieved that copper exchange inventories did not rise another 21,000 t to make a 15 year high at 922,000 t, where the all-time record at 1.35 mmt was in October 2002. Thus, Shangahi Futures Exchange warehouse inventories see wide swings among extremes.

Our demand-supply model below is hyper-sensitive to small changes in demand or supply. The prospect of a global demand decline in 2020 threatens to add more than 1 mmt per year in excess inventories to push our copper-demand supply model into a large supply surplus until multiple copper mine projects are closed or delayed for economic, permit or engineering reasons.

REFINED CU OUTPUT LAGS IN 2019 TO A 0.13% FALL IN 2019 AFTER UP 1.6% IN 2018, UP 1.4% 2017, 0.2% 2016 AND 2.5% 2015

The reported 2019 world refined copper output down 0.13% or 31,000 improved each month as “copper-in-concentrates” in transport arrive at smelters to get refined. Some copper concentrates had been “trapped” or unable to reach the market, such as the roughly two months of Las Bambas mine output near 67,000 t due to the two month Fuerbamba blockade in February-to-April, the July blockade of a southern port in Tia Maria protests blocking ½ to ¾ of Peru exports exceeding 200,000 t/month and now another blockade of kilometers 50 to 250 of the Las Bambas road. First Quantum’s Cobre Panama shipments from the second-quarter now have been refined and sold too. Smelter maintenance outages have passed. We estimate in Table 35 below that 425,000 to 625,000 t of copper-in-concentrates have built up in 2019 thus far.

WBMS reports a 0.17% in 2019 global demand largely due to the 0.3% meager gain in refined output, as the unrefined copper-in-concentrate cannot get consumed as wires,

tubes, etc. We estimate about 0.5 mmt of copper-in-concentrate inventory built up in 2019, which manifests itself as a 15.8% gain in January 2020 world refined output even though mine output rose only 9.5% in January 2020 according to WBMS.

There were 11 notable refined output **gains** in 2019, where the larger gains were Poland 65,400 t, China 497,500 t, Zambia 71,000 t, Australia 19,000 t, Kazakhstan 28,300 t, Iran 26,100 t, Mexico 30,100 t and Brazil 32,900 t. The smaller gains were 21,000 t Austria, 16,200 t Serbia, 21,000 t DRC, and Myanmar 6,300 t. These aggregate gains more offset various large declines.

The larger 2019 refined output **declines** were from India 127,800 t, Chile 192,100 t, USA 53,800 t, Indonesia 15,000 t, Japan 98,200 t, Laos 6,300 t, Oman 6,000 t, South Korea 26,500 t, South Africa 8,200 t, Belgium 29,200 t, Bulgaria 21,900 t, Finland 18,700 t, Germany 69,800 t, Spain 46,000 t, Sweden 23,100 t, and Peru 28,600 t. The gains in Poland, DRC, Kazakhstan or Brazil reflect “captive smelters” or SXEW to local mines.

In 2018 refined output grew 1.6% or 369,800 t, where refined output data tends to be accurate. For example, China discloses refined output for each nonferrous metal, but not mine outputs, where China is the largest smelter nation. The gains larger than 40,000 t were Zambia 96,700 t, DRC 124,800 t, China 60,000 t, Iran 70,700 t, Japan 106,400 t, Myanmar 45,000 t and Philippines 79,100 t. Smaller gains were Chile 31,300 t, USA 27,900 t, Australia 16,600 t, Indonesia 28,100 t, Kazakhstan 13,400 t, South Korea 16,300 t, Spain 12,800 t and Finland 10,400 t.

Large 2018 declines were in India 289,700 t where Vedanta had environmental objections, and also Poland 20,100 t, South Korea 29,300 t, and South Africa 22,300 t. Smaller declines were Belgium 14,000 t, Germany 16,900 t, Poland 20,100 t, Mexico 10,000 t and Myanmar 13,100 t.

WORLD COPPER MINE OUTPUT UP 1.6% IN 2019, 1.0% 2018 AFTER 1.4% 2017 FALL SLOWING FROM 5.5% 2016 AND 4.5% 2015 GLOBAL OUTPUT GAINS

In April 2019 First Quantum started up and by September 2019 had declared “commercial” a large copper mine in Panama that will be about 1.5% of world copper output to produce 147,500 t in 2019 and almost double in 2021. It accounts for almost ½ of the 329,000 t or 1.6% global output gain in 2019.

Chilean copper output fell in 44,100 t in 2019 after it had after it had rebounded after mid-year to fall only 8,800 t October YTD. Social unrest in November and December included the burning of 60 WalMart stores following a \$0.04 public transportation fare hike to \$1.16 from \$1.12.

In 2019 and 2018 global copper mine output gains were small, but avoided declines like 2017. In 2017 world copper mine output had its first decline since 2002 and 1982. In 2015 and 2016 world output gains were large due to new mine projects such as Las

Bambas in Peru, the Cerro Verde mine tripling in Peru, expansions in Kazakhstan and others.

Recent significant mine supply events include RIO's July 16th 16 to 30 month delay at Oyu Tolgoi, Codelco and Escondida's large declines in Chile in the 2019 first-half, FCX's Grasberg planned declines, Glencore's 200,000 t output cut to the Mutanda copper mine in DRC, Hudbay's judicial challenges to the 127,000 t Rosemont mine, SCCO's delays to the 120,000 t Tia Maria heap leach mine in Peru, various Zambian regulatory changes or our estimate of up to a 13,000 t output cut at MMG Minmetals Las Bambas mine due to the Fuerbamba village road blockade. We budgeted initially a 2% or 415,000 t allowance for 2019 and a 3% or 638,000 t allowance for 2020 copper mine outages (Tables 27 and 32). It is notable that many of these supply misses stem from regulatory delays or engineering challenges rather than near-term copper prices.

Table 33: Chinese and ROW Monthly Cu Demand (000 tonnes); ROW 2019 = 2009 Cycle Trough												
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CHINA												
Jan	467.3	539.2	611.4	731.4	709.6	877.2	856.7	850.4	879.7	989.4	976.7	949.0
Feb	604.1	462.4	476.2	689.9	666.8	742.3	739.9	895.3	800.2	883.4	761.9	927.1
Mar	620.9	769.7	582.5	782.7	678.8	908.0	943.5	1028.7	991.4	951.3	914.7	981.1
April	665.1	636.9	594.2	760.6	741.6	1019.2	986.0	1111.3	985.8	1,259.4	1040.4	1,198.3
May	673.7	688.4	607.5	706.8	823.5	883.3	912.1	955.7	1,008.1	903.6	983.8	
June	656.1	640.7	636.7	721.2	823.7	948.5	945.9	1011.1	1,035.6	1,075.1	993.4	
July	625.7	626.2	609.9	690.7	824.3	826.1	852.5	883.9	1,002.2	1,046.6	1066.6	
Aug	537.5	644.4	748.9	732.2	812.0	961.6	936.5	926.3	960.3	1,077.7	1075.3	
Sept	636.7	648.0	734.9	771.9	962.1	988.0	1021.5	998.6	1,121.8	1,125.1	1141.5	
Oct	517.5	523.9	702.4	700.1	898.6	1009.4	1016.5	908.9	942.0	990.4	1167.3	
Nov	530.5	627.2	778.7	770.8	968.9	1063.6	1135.5	945.8	902.0	1,092.4	1248.2	
Dec	627.8	629.0	831.5	765.7	926.1	1103.8	1111.1	1049.3	1,167.0	1,171.2	1264.1	
Total	7 085.8	7 385.4	7 880.8	8 895.6	9830.1	11302.7	11353.1	11642.2	11,790.5	12,482.3	12799.5	
t/month	590.5	615.4	656.7	741.3	819.2	941.9	946.1	970.2	982.5	1040.2	1066.6	
Pct.Chg.	37.6%	4.2%	6.7%	12.9%	10.5%	15.0%	0.4%	2.5%	1.3%	5.9%	2.5%	
ROW												
Jan					958.8	950.0	984.6	939.2	960.1	960.7	917.2	959.9
Feb					952.5	922.1	879.7	981.4	985.1	923.4	858.1	938.8
Mar					1026.7	972.8	938.3	977.5	1,042.3	919.1	933.9	982.2
April					934.5	1107.3	998.5	1004.0	1,023.6	954.6	965.5	917.9
May					935.8	992.8	990.9	1003.3	1,022.1	950.1	944.1	
June					989.4	1013.5	966.7	1065.1	988.4	926.1	958.5	
July					991.7	1036.7	987.8	993.0	983.0	911.2	976.2	
Aug					900.5	899.5	946.2	971.9	927.9	861.9	855.8	
Sept					905.3	945.8	923.8	1001.6	969.9	907.3	901.8	
Oct					941.7	970.0	954.2	1002.6	1,010.2	967.5	895.6	
Nov					935.3	944.2	913.5	1004.0	958.2	967.6	901.9	
Dec					909.3	874.8	898.9	846.7	862.2	851.0	846.3	
Total	11,043	11,923	11,664	11,163	11324.2	11399.0	11549.5	11711.7	11,560.8	11,442.7	11086.9	
t/month	920.3	993.6	972.0	930.2	943.7	949.9	962.5	976.0	963.4	953.6	912.9	
Pct.Chg.		8.0%	-2.2%	-4.3%	1.4%	0.7%	1.3%	1.4%	-1.3%	-1.0%	-4.3%	
Source: WBMS and John Tumazos Very. Ind. Res., LLC estimates												

Table 36										
World Refined Copper Consumption										
(000 Metric Tonnes)										
	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E	Growth %
Germany	1,243	1,180	1,200	1,017	763	935	953	972	992	2.0%
U.K.	22	19	18	18	16	16	16	16	16	0.0%
France	196	210	201	199	150	179	181	183	185	1.0%
Italy	596	633	552	555	388	447	451	456	460	1.0%
Belgium	251	190	243	242	194	233	233	233	233	0.0%
Spain	312	346	367	361	271	325	331	338	345	2.0%
Sweden	128	134	122	131	111	125	125	125	125	0.0%
Poland	284	274	296	284	255	281	286	292	298	2.0%
Other East Eu	104	108	108	108	97	105	110	116	121	5.0%
Other West Eu	253	260	243	238	190	219	219	219	219	0.0%
Africa	140	119	136	130	123	129	131	133	135	0.0%
Japan	973	998	1,039	1,011	834	980	990	999	1,009	1.0%
S.Korea	759	767	717	633	538	632	638	645	651	1.0%
Taiwan	507	498	382	371	334	367	371	374	378	1.0%
Thailand	342	363	361	356	325	364	386	409	434	6.0%
Indonesia	203	220	231	181	136	150	153	156	159	2.0%
Malaysia	242	261	205	179	143	157	163	170	177	4.0%
India	499	486	512	527	474	550	572	595	619	4.0%
Iran	95	114	122	122	98	104	110	117	124	6.0%
Saudi Arabia	177	132	90	70	63	66	66	67	68	1.0%
Turkey	464	446	482	464	394	453	474	495	517	4.5%
Other Asia	227	362	285	276	234	269	277	286	294	3.0%
U.S.A	1,811	1,771	1,814	1,850	1,684	1,936	1,946	1,955	1,965	0.5%
Canada	170	178	198	195	166	195	196	197	198	0.5%
Brazil	293	282	291	304	274	307	310	313	316	3.0%
Mexico	423	361	407	451	406	467	490	515	540	5.0%
Other Americas	161	135	121	116	104	114	113	112	111	-1.0%
Australia	23	31	51	52	49	49	49	49	49	0.0%
C.I.S.	445	470	453	442	364	410	406	402	398	-1.0%
China	11,642	11,790	12,482	12,800	13,184	13,711	14,156	14,617	15,092	3.3%
Vietnam,N Korea	199	197	194	201	201	211	222	233	245	5.0%
World Total	23,185	23,332	23,925	23,882	22,563	24,486	25,126	25,788	26,472	
Pct. Change	1.2%	0.64%	2.54%	-0.18%	-5.52%	8.52%	2.62%	2.63%	2.65%	
Pct. Change ex-China	-0.1%	0.0%	-0.9%	-3.1%	-15.4%	14.9%	1.8%	1.8%	1.9%	
Pct. Change China	2.5%	1.27%	5.87%	2.54%	3.00%	4.00%	3.25%	3.25%	3.25%	
ROW	11,543	11,542	11,443	11,083	9,380	10,775	10,970	11,172	11,381	

Source: WBMS; John Tumazos Very Independent Research, LLC estimates

	Table 37: World Copper Supply Estimated to 2024 (000 met. t)								
	(Includes Firm Projects Without Geology Successes Inferred)								
	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E
Swe,Fin,Sp,Port=Europe	343	379	389	344	344	344	344	344	344
S. Africa	65	66	47	51	51	51	51	51	51
DR Congo	1,024	1,095	1,225	1,433	1,417	1,472	1,577	1,848	1,933
Zambia	738	803	857	759	785	835	835	835	860
Other Africa	135	101	103	106	106	106	106	106	106
Philippines	84	68	71	76	76	75	75	75	75
Indonesia	696	666	651	336	374	668	804	804	759
Pakistan	14	10	10	10	10	10	10	10	10
Iran	279	292	311	307	313	320	326	333	339
Laos	168	153	149	130	130	130	130	130	130
Turkey	100	83	80	108	110	127	130	134	137
Other Asia	172	181	251	268	268	268	268	268	268
U.S.A.	1,431	1,258	1,216	1,285	1,368	1,443	1,456	1,545	1,584
Canada	696	597	543	573	584	596	608	620	632
Chile	5,553	5,504	5,832	5,787	5,665	5,741	6,083	6,255	6,316
Peru	2,354	2,446	2,399	2,334	2,384	2,409	2,512	2,511	2,505
Mexico	766	742	751	770	735	771	771	867	913
Brazil	338	385	377	362	362	462	462	442	422
Argentina	82	33	17	0	0				
Panama			0	148	285	300	325	350	350
Other Americas	29	34	30	27	27	27	75	125	125
Olympic Dam	169	142	147	181	220	250	275	300	300
Other Australia	778	714	773	748	748	755	766	778	789
Papua New Guinea	80	105	96	106	90	80	70	70	70
C.I.S.	1,482	1,667	1,576	1,662	1,712	1,742	1,774	1,807	1,841
Poland	425	420	402	449	444	444	444	444	444
Mongolia	353	320	320	307	307	307	307	432	557
China	1,851	1,656	1,507	1,601	1,801	1,828	1,856	1,884	1,912
Eastern Europe	169	173	169	210	212	262	312	362	412
Total Mine Output	20,370	20,094	20,300	20,474	20,927	21,822	22,752	23,728	24,183
Scrap Recycling	3,199	3,826	3,730	3,808	3,608	3,680	3,753	3,866	3,982
Mine Interruptions 3%	0	0	0	0	1,046	655	683	712	725
Refined Output Adj.1.75%	-466	-778	-168	-214	209	-382	-398	-415	-423
Total Cu Refined Supply	23,102	23,142	23,862	24,067	23,697	24,465	25,424	26,467	27,016
Percentage Change	0.1%	0.2%	3.1%	0.9%	-1.5%	3.2%	3.9%	4.1%	2.1%

Source: WBMS; John Tumazos Very Independent Research, LLC estimates

Table 34: Monthly Trend of Global Copper Mine Output (000 Tonnes)										%Change yr/yr		
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2018	2019	2020
Dec	1,562	1,613	1,612	1,741	1,792	1,821	1,828	1,844		0.4%	0.9%	
Nov	1,464	1,587	1,558	1,676	1,778	1,664	1,797	1,783		8.0%	-0.8%	
Oct	1,512	1,613	1,589	1,691	1,770	1,708	1,745	1,764		2.1%	1.1%	
Sept	1,474	1,572	1,525	1,608	1,740	1,706	1,728	1,744		1.3%	0.9%	
Aug	1,452	1,560	1,557	1,586	1,743	1,759	1,724	1,776		-2.0%	3.1%	
July	1,381	1,544	1,529	1,607	1,718	1,778	1,721	1,741		-3.2%	1.1%	
June	1,408	1,504	1,551	1,627	1,730	1,705	1,739	1,719		2.0%	-1.2%	
May	1,414	1,491	1,526	1,605	1	1,701	1,751	1,761		2.9%	0.6%	
April	1,390	1,434	1,516	1,568	1,678	1,718	1,675	1,645	1,531	-2.5%	-1.8%	-6.9%
Mar	1,409	1,466	1,547	1,574	1,666	1,605	1,717	1,720	1,705	7.0%	0.1%	-0.9%
Feb	1,294	1,352	1,511	1,473	1,559	1,548	1,624	1,582	1,650	4.9%	-2.6%	4.3%
Jan	1,336	1,474	1,531	1,579	1,597	1,678	1,672	1,669	1,722	-0.4%	-0.2%	3.2%
Annualize	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Dec	18,389	18,992	18,984	20,495	21,105	21,440	21,520	21,714				
Nov	17,807	19,307	18,953	20,397	21,629	20,244	21,868	21,693				
Oct	17,799	18,988	18,707	19,906	20,838	20,115	20,545	20,774				
Sept	17,935	19,122	18,551	19,564	21,168	20,753	21,020	21,216				
Aug	17,101	18,363	18,330	18,676	20,520	20,714	20,293	20,913				
July	16,258	18,183	18,006	18,923	20,229	20,937	20,264	20,497				
June	17,126	18,301	18,870	19,791	21,051	20,739	21,159	20,914				
May	16,653	17,554	17,968	18,894	10	20,030	20,613	20,729				
April	16,913	17,442	18,445	19,074	20,421	20,899	20,376	20,016				
Mar	16,588	17,263	18,212	18,529	19,610	18,896	20,222	20,247	20,070			
Feb	16,288	17,626	19,697	19,203	19,621	20,181	21,167	20,618	20,770			
Jan	15,734	17,355	18,026	18,593	18,798	19,762	19,689	19,655	20,279			
Dec/Jan	16.9%	9.4%	5.3%	10.2%	12.3%	8.5%	9.3%	10.5%				
World	000 mt	Gain	World Mine Output									
2020	19,824	-847	April annualized gains China, DRC, Chile, Panama & Zambia, Mexico and Peru down									
2019	20,672	345	DRC, Panama, Kazakh, China, Aussies up and Indonesia & Zambia fell									
2018	20,327	211	new record world mine output									
2017	20,116	-255	First decline since 1982 and 1977									
2016	20,370	994	2nd Largest gain ever after 2013									
2015	19,377	752	4th largest ever after 1996, 2013 & 2016									
2014	18,625	509										
2013	18,115	1,153	Largest gain ever									
2012	16,962	699	5th largest ever after 1996, 2013, 2015, 2016									
2011	16,263	148										
2010	16,115	250										
2009	15,865	194										
2008	15,671	123										
2007	15,548	367										
1996	11,145	889	2nd largest ever after 2013									

Source: WBMS and JTVIR, LLC estimates

Table 35 - - Copper Concentrates interact with scrap and leached Cu (000 t)												
Approach #1: Rates of Change in mine and refined output												
			Apr 20	2019	2018	2017	2016	2015	2014	2013	2012	2011
Mine Output Gain			124	345	206	(255)	1,047	817	477	1,313	750	147
SXEW heap leach gain			3	(6)	152	(92)	(138)	60	51	137	189	127
Scrap gain			23	69	(96)	627	(679)	18	3	195	109	200
Virgin Concentrate Gain			121	351	54	(163)	1,185	757	426	1,177	561	20
Refined output gain			456	(31)	186	243	219	538	1,510	598	537	603
Derived Concentrate Buildup			(311)	451	(228)	221	286	238	(1,081)	774	133	(382)
Approach #2: Absolute mine output versus refined output												
			Apr 20	2019	2018	2017	2016	2015	2014	2013	2012	2011
Total Refined Output			7,852	23,619	23,650	23,464	23,220	23,001	22,463	20,953	20,355	19,818
Less Scrap			1,295	3,799	3,730	3,826	3,199	3,878	3,860	3,857	3,662	3,553
Less Heap Leach SXEW			1,248	3,825	3,831	3,678	3,770	3,908	3,848	3,797	3,660	3,472
=Virgin Conv. Refined Output			5,309	15,995	16,089	15,960	16,251	15,215	14,755	13,299	13,033	12,793
Mine Output -Leach SXEW			5,360	16,845	16,500	16,465	16,654	15,469	14,776	14,318	13,302	12,791
Raw Concentrate Buildup			51	851	411	505	402	254	21	1,019	269	(3)
Adjusted Buildup 1% Losses			(3)	682	246	340	236	99	(126)	876	136	(130)
Source: JTVIR, LLC estimates starting from WBMS copper data												

The 2019 global copper mine output rise of 1.6% or 329,000 enjoyed large gains like 147,500 t in Panama in line with expectations. The large 208,200 t gain in DRC is a surprise, as Glencore cuts back, where Chinese-owned companies must be leading the gain or else the DRC gain could be a false report. **Gains** also include China 94,700 t, Kazakhstan 90,200 t, Peru 18,500 t, Mexico 18,600 t, Canada 29,800 t, USA 68,800 t, Australia 15,200 t, Papua New Guinea 9,300 t, Myanmar 5,600 t, Philippines 4,900 t, Saudi Arabia 10,000 t, Turkey 20,200 t, Armenia 17,900 t, Serbia 35,500 t, and Poland 47,700 t. Large **decliners** were Indonesia as expected at 250,900 t, Chile 45,500t, Brazil 15,400 t, Zambia 98,500 t, Iran 4,100 t, Laos 19,000 t, Mongolia 11,700 t, Uzbekistan 14,800 t, Finland 14,200 t, Georgia 7,200 t, Portugal 3,300 t, Spain 20,000 t, Sweden 8,300 t and Argentina 17,400 t as expected with Alumbra declining.

STATE MINERS GENERALLY WEAKER PLAYERS

Codelco had cutbacks in 2015, 2016 and 2017 to its proposed capital spending, which has been about $\frac{3}{4}$ of the original plans. These cutbacks may reduce outputs in 2019 or 2020 or delay developments of new zones. It had stable output in 2018 at 1.678 mmt, 2017 at 1,734 mmt, 2016 at 1.7075 mmt, 2015 1.7317 mmt and 2014 1.6718 mmt at the mines it manages excluding its 49% of El Abra or 49% of Anglo American Sur. The Chilean, Polish and PNG state miners actually operate mines, while Gecamines in DRC and Zambian Consolidated Copper Mines (ZCCM) own minority carried stakes in private miners. These 5 companies total over 3 mmt of supply, which lack adequate investment to be sustained, are overstaffed and in the cases of KGHM among have the highest costs in the world.

COPPER SCRAP VOLUMES

We estimate copper scrap supplies fall 200,000 t in 2020 with lower copper prices and lower industrial production. However, March 2020 quarterly output rose 9,800 t to 964,100 t reflecting favorable business conditions in many regions in January and February. A 31,000 t reported gain in Bulgaria was the only notable increase.

Copper scrap supplies rose 69,300 t in 2019 to 3,799,400 from 3,730,100 t in 2018. They were in the 2019 first-quarter 954,300 t, 934,900 t in the second-quarter, 953,500 t in the third-quarter and 956,700 t in the final quarter. The softening price over the course of 2019 appeared to erode recoveries slightly. Chinese scrap rose 40,900 t, where its efforts to increase domestic collections appear successful as it closed out imports. USA grew 3,200 t, Belgium grew 11,100 t, Bulgaria grew 57,300 t, Slovakia 11,100 t, Spain 5,600 t, and Austria 21,000 t. Japan **fell** 27,300 t, Germany 23,800 t, Serbia 17,600 t, Sweden 1,800 t and Ukraine 2,900 t.

In 2018 scrap supplies fell 99,000 t globally to 3,855,000 t. China fell 101,200 t, Belgium fell 37,500 t, Bulgaria fell 14,500 t, Germany 10,300 t, Slovakia 9,700 t, Spain 1,700 t, Sweden 4,800 t, Ukraine 2,100 t and Turkey fell 21,550 t. Japan rose 49,300 t, Canada rose 2,200 t, Austria rose 41,300 t and Finland 7,700 t.

Scrap supplies rose 748,800 t in 2017 to a new record 3,947,300 t up 23.4%. China led the recovery up 481,200 t, despite its restrictions on imports of low grade copper or mixed nonferrous scraps cause no declines though may have prevented bigger gains. This is a larger rebound in scrap collections in 2017 than we had estimated. There must have been Chinese stockpiles melted down as copper prices rebounded in 2017. The doubling in iron ore and met coal prices helped drive the doubling in steel scrap, and more copper gets collected as obsolete autos or appliances are shredded.

The WBMS estimated 3,856,600 t for 2013, 3,859,900 t for 2014 and 3,877,700 t for a much reduced 2015 record, which fell to 3,198,500 t down 679,200 t in 2016 led by a 678,300 t fall in China and “virtually no change” where ROW fell 900 t.

We estimate Chinese restrictions on scrap imports have little or no market impact, where those volumes go to India or Southeast Asian low wage markets instead. It is possible those redirected volumes are not tabulated, however, as China, South Korea, Japan, Iran and Turkey are the only Asian destinations in WBMS data.

We estimate that copper smelters operated near 70% of capacity worldwide, and have room for more concentrates. Chinese new rules requiring 99% sulphur dioxide recapture in 2016 and Chilean 95% sulfur and arsenic capture in December 2014 are an obstacle to copper supply. Chilean Environmental Superintendent Juan Carlos Monckeberg twice attempted to close the Ventanas copper smelter of Codelco near the 400,000 t El Teniente mine without success. Serbia modernizes the 3,000 tonne per month output Bor smelter to join the EU.

CHINESE DEMAND SURGES IN APRIL-MAY, WHERE WE ANTICIPATE STRONGER COPPER DEMAND FROM CHINA IN NEXT TWO WBMS REPORTS

Record May 2020 Chinese steel output, a 21% gain in May 2020 Chinese vehicle sales, an uptick in May 2020 Chinese aluminum output and apparent hoarding of large amounts of nonferrous metals all suggest that May and June of 2020 Chinese apparent copper demand data will be strong. Full industrial outputs and low new virus data bode well for the 2020 second-half. China boomed to 62% of world steel output and 57% of world aluminum output in May 2020.

The WBMS reported a strong 1,198,300 t April 2020 single month Chinese copper demand level, or 158,000 t more than April 2020 and more than 11 of the 12 individual months of 2020. It reported a 3.6% April YTD 2020 Chinese demand gain with the first-quarter at 2.857 mmt. However, the March 2019 quarter was the weakest period since 2013 in China for copper demand averaging under 885,000 t/month, where the 2019 nine months remainder of the averaged 1.128 mmt/month. Thus, the March 2020 quarter average of 952,000 t/month is better than last year but not “strong.”

We increased our 2020 copper demand estimate for China to +3% from -5%. We estimate a 6% Chinese and 15% ROW demand rebound in 2021 for a 10% global demand gain in 2021, which will leave world demand about 5.2% lower in 2021 than our prior estimates based on 2.6% smooth growth. For 2022 onwards we estimate a 2.6% global demand growth rate with 3.25% in China and 1.8% in ROW. However, ROW demand in 2019 fell to 2009 levels, and in 2020 will fall far below 2020 where the case for a 1.8% ROW demand growth rate depends on global reshoring out of China.

ROW COPPER DEMAND IN APRIL YTD 2020

The WBMS reported a 0.8% fall in April YTD 2020 ROW copper demand after a 1.5% gain for ROW copper demand in March 2020 YTD, and a 1.5% April YTD global gain down from a March 4.5% global demand gain including the Chinese gain.

April YTD 2020 demand **gain** nations were China 142,100 t and a plethora of nations gaining < 45,000 t. These included Poland 8,200 t, Russia 27,000 t, Spain 3,900 t, Egypt 6,000 t, Indonesia 6,000 t, Kazakhstan 17,900 t, South Korea 17,400 t, Taiwan 44,900 t, Brazil 7,000 t, Mexico 29,500 t and USA 4,000 t. Most of those demand gaining nations had severe lockdowns and virus death totals, and we continue to estimate a 15.4% ROW demand fall for 2020 even though the WBMS reports a only a 0.8% fall April YTD for ROW.

We expect future downward revisions to April YTD 2020 data. The June 16th WBMS report for April YTD reversed Bulgaria, Sweden, Turkey to a YTD decline from a notable gain and reduced the reported gain for Spain and Brazil each by nearly 75%, for example.

Some of the nations for which WBMS reported demand **declines** for April YTD 2020 demand may be revised to larger declines. Virtually the entire world had large

lockdowns, supply chain disruptions and declines in the first 5 months of 2020 due to virus. We expect **EVERY** region to have demand declines for 2020.

April 2020 YTD demand **decliner** nations were Belgium 8,700 t, Finland 1,600 t, Germany 53,300 t, Italy 23,800 t, Sweden 13,300 t, India 28,900 t, Japan 22,200 t, Canada 8,200 t, Peru 7,600 t, Kuwait 6,800 t, Thailand 2,800 t, Turkey 2,700 t, and Vietnam 9,400 t. Clearly Germany and Japan's declines were consistent with their December and March quarterly GDP declines. Kuwait and other oil exporters suffer with the collapse of crude oil prices.

Table 1: Summary Cash Flow Table for Metals Coverage (\$ mm)															
Ticker	Stock Price	Mkt Cap	Mkt cap to Free 2020E CF	2018 EBITDA	2019 EBITDA	2020 EBITDA	2018 After Tax CF	2019 After Tax CF	2020 After Tax CF	2018 CAP EX	2019 CAP EX	2020 CAP EX	2018 Free CF	2019 Free CF	2020 Free CF
Steel															
	7/2/20														
X	7.07	1,400	(1.0)	1,576	646	(268)	1,888	555	(372)	1,001	950	1,000	887	(395)	(1,372)
NUE	41.40	12,452	41.7	3,088	2,160	1,500	2,509	1,802	1,298	1,000	1,800	1,000	1,509	2	298
ATI	10.19	1,492	8.1	505	492	220	519	430	324	139	139	139	379	290	185
WOR	35.61	1,820	9.5	351	340	235	351	293	287	76	85	96	275	209	191
Gold Mining															
NEM	60.96	48,402	233.3	185	200	243	186	214	229	33	44	22	153	170	207
GOLD	26.27	46,705	48.9	526	962	1,414	522	938	1,360	275	456	405	247	482	955
PVG	8.17	1,520	1.8	391	1,131	1,399	727	952	1,209	1,089	800	361	(362)	152	848
KL	41.68	11,166	10.8	1,069	1,748	2,482	725	1,244	1,810	652	950	775	73	294	1,035
AEM	62.83	14,873	5.3	2,149	5,925	4,669	1,326	2,775	4,025	1,032	1,393	1,231	294	1,383	2,794
AAU	28.98	12,039	11.6	1,069	1,748	2,482	725	1,244	1,810	652	950	775	73	294	1,035
PAAS	29.24	6,129	24.6	247	451	625	106	350	538	144	293	288	(38)	57	249
Royalty Companies															
RGLD	121.05	7,928	20.9	76	297	383	340	281	380	12	1	-	328	280	380
FNV	136.78	25,783	45.0	438	676	840	484	616	773	1,015	121	200	(532)	495	573
WPM	43.29	19,215	32.8	736	396	601	494	562	767	1,126	315	182	(631)	247	585
SAND	9.50	1,968	44.9	39	59	64	47	61	69	48	65	26	(1)	(4)	44
OR	9.95	1,447	(195.8)	(62)	(225)	84	(103)	(262)	48	256	148	55	(359)	(410)	(7)
Copper/Nickel/Diversified															
BHP	50.07	126,927	16.9	22,284	21,942	22,546	10,647	14,808	15,903	5,212	7,926	8,400	5,435	6,882	7,503
RIO	56.29	91,404	17.7	23,263	18,197	16,357	13,230	16,273	12,160	5,430	5,500	7,000	7,800	10,773	5,160
VALE	10.41	54,121	6.6	15,306	15,841	17,014	12,907	10,668	13,210	3,807	5,950	5,000	9,100	4,718	8,210
GLCNF	2.10	29,933	5.3	15,767	13,571	12,726	11,570	9,930	9,848	8,730	4,200	4,250	2,840	5,730	5,598
NGLOY	11.74	30,524	13.6	9,542	9,964	10,134	6,495	6,647	6,796	3,400	4,521	4,546	3,095	2,126	2,250
NILSY	26.45	40,416	8.3	6,181	7,496	8,066	5,114	7,411	6,502	1,657	1,657	1,657	3,457	5,754	4,845
SCCO	38.91	30,077	25.2	3,556	3,518	3,017	2,366	2,461	1,943	1,121	708	750	1,245	1,753	1,193
GMBXF	2.32	18,022	15.1	4,892	4,948	4,162	3,422	3,702	2,742	1,687	1,123	1,550	1,736	2,579	1,192
FCX	11.50	16,687	(44.7)	6,599	2,351	1,582	4,932	738	1,727	1,971	2,650	2,100	2,961	(1,912)	(373)
FSUMF	9.68	30,224	4.6	3,222	6,032	9,342	2,805	6,342	8,672	901	1,048	2,100	1,904	5,294	6,572
SOUHY	7.13	7,236	5.4	2,892	3,829	2,795	1,793	2,766	1,992	436	840	650	1,357	1,926	1,342
TECK	10.47	6,095	(7.7)	6,104	4,728	2,932	4,567	3,777	2,405	2,897	3,081	3,200	1,670	696	(795)
ANFGF	11.60	11,436	16.8	1,880	1,702	1,131	2,007	1,987	1,681	873	1,000	1,000	1,134	987	681
FQVLF	7.91	5,432	14.4	1,888	1,861	1,618	1,508	1,527	1,378	2,584	893	1,000	(1,076)	634	378
CCJ	10.12	4,005	13.4	624	501	712	810	310	448	55	100	150	754	210	298
LUNMF	5.40	3,961	117.4	671	773	798	595	572	654	752	665	620	(156)	(93)	34
HBM	2.97	776	(3.8)	624	354	263	383	266	158	206	304	360	177	(38)	(202)
Aluminum															
AWCMY	4.41	3,174	(17)	642	133	(190)	636	130	(187)	94	60	60	636	130	(187)
CENX	6.96	614	(10.2)	27	(64)	(50)	150	(26)	(10)	83	45	50	67	(71)	(60)
HWM	15.31	6,660	5.4	2,125	2,015	2,159	1,728	2,071	1,750	768	586	510	960	1,485	1,240
AA	10.97	2,036	5.0	3,234	1,560	758	2,301	1,309	754	399	379	350	1,902	930	404

Sources: Company reports and John Tumazos Very Independent Research, LLC estimates.

Ticker	Stock Price	Mkt Cap	Mkt cap to Free 2020E CF	2018 EBITDA	2019 EBITDA	2020 EBITDA	2018 After Tax CF	2019 After Tax CF	2020 After Tax CF	2018 CAP EX	2019 CAP EX	2020 CAP EX	2018 Free CF	2019 Free CF	2020 Free CF
	7/2/20														
Forest Products and Paper Companies															
IP	35.35	13,787	7.0	3,647	4,121	3,351	3,543	3,959	3,180	1,572	1,300	1,200	1,971	2,659	1,980
LPX	25.48	2,879	15.5	652	196	290	499	232	256	214	163	70	285	69	186
OSB	23.44	1,887	15.2	724	138	226	550	140	199	211	150	75	339	(10)	124
PKG	99.65	9,410	13.0	1,487	1,442	1,282	1,294	1,242	1,102	551	400	375	742	842	727
WRK	28.20	7,276	3.9	2,942	3,261	3,405	2,799	2,715	2,966	1,000	1,400	1,100	1,799	1,315	1,866
GPK	14.09	3,951	8.3	893	979	1,008	716	743	794	395	340	320	321	403	474
WY	22.24	16,602	15.9	1,880	1,161	1,400	1,640	419	1,313	427	384	270	1,213	35	1,043
UFS	20.55	1,168	4.0	4	694	456	658	529	518	195	255	225	463	274	293

Sources: Company reports and John Tumazos Very Independent Research, LLC estimates.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E	2021E	2022E	2023E	2024E
U.S. steel (mm Tons)	91.9	95.9	95.4	98.2	86.5	86.5	91.2	95.7	96.2	86.5	97.5	103.5	106.0	106.0
Gold Price (\$/oz)	1,585	1,662	1,406	1,267	1,160	1,249	1,258	1,269	1,392	1,625	1,500	1,500	1,575	1,600
Silver Price (\$/oz)	\$35.63	\$31.16	\$23.72	\$19.05	\$15.69	17.10	17.01	15.66	16.12	16.50	18.00	20.00	20.00	20.00
Copper Price (\$/lb)	\$4.00	\$3.63	\$3.34	\$3.12	\$2.51	\$2.20	\$2.81	\$2.92	\$2.72	\$2.40	\$2.70	\$3.00	\$3.25	\$3.50
Nickel Price (\$/lb)	\$10.42	\$7.93	\$6.83	\$7.66	\$5.37	\$4.35	\$4.71	\$5.95	\$6.33	\$5.50	\$6.00	\$7.00	\$8.00	\$8.00
Alum Ingot (\$/lb)	\$1.09	\$0.914	\$0.837	\$0.847	\$0.76	\$0.73	\$0.89	\$0.96	\$0.81	\$0.74	\$0.80	\$0.87	\$0.87	\$0.87
Lead (\$/lb)	\$1.09	\$0.99	\$0.97	\$0.95	\$0.81	\$0.85	\$1.05	\$1.02	\$0.91	\$0.90	\$1.00	\$1.10	\$1.10	\$1.10
Zinc (\$/lb)	\$0.99	\$0.88	\$0.87	\$0.98	\$0.88	\$0.95	\$1.31	\$1.32	\$1.15	\$0.95	\$1.05	\$1.20	\$1.20	\$1.20
Iron Ore benchmk \$/t	\$168	\$129	\$135	\$97	\$56	\$53	\$71	\$67	\$93	\$92	\$85	\$80	\$80	\$80
Met Coal \$/t	\$257	\$193	\$149	\$115	\$95	\$100	\$150	\$175	\$175	\$135	\$145	\$160	\$160	\$160

Sources: Company reports, AISI, Comex, LME and JTVIR, LLC estimates.

Underlying Dynamics	2012	2013	2014	2015	2016	2017	2018	2019E	2020E
Uncoated Free Sheet (offset 50-lb rolls \$/t)	918	863	901	879	883	845	933	933	925
NAm UFS Industry Volume (mm tons)	8.76	8.51	8.46	8.12	7.91	7.53	7.47	6.80	6.67
Containerboard Price Realizaation (\$/t)	871	976	997	975	940	1,043	1,150	1,139	1,095
NAm Containerboard Ind Volume (mm tons)	30.1	31.1	31.7	31.9	32.7	33.3	33.2	33.5	34.3
Board Lumber (WY \$ per 000 sq ft)	347	423	426	379	389	442	482	389	400
Plywood (WY \$ per 000 sq ft)	338	357	362	339	362	389	436	363	348
Oriented-Strand Board (Norbord prices \$/000 sq)	225	267	196	192	231	304	311	203	228

Source: Company reports, Am. Forest and Paper Assn, Pulp & Paper Week, Random Lengths, JTVIR, LLC estimates

Universe Table 5: John Tumazos Very Independent Research, LLC Metals and Mining Coverage Universe

			Price	Target	Mkt Cap	Shares	Gross Cash Flows				
							2020E	2021E	2021E	2020E	2020E
	Steel	Rating	7/2/20	Price	(\$ mm)		EPS	EPS	P/E	CF/Share	P/CF
X	US Steel	O	7.07	18	1,400	198.0	(6.92)	-4.52	NM	(2.91)	-2.4
NUE	Nucor	N	41.40	27	12,452	300.8	1.82	1.72	24.0	4.34	9.5
ATI	Allegheny Technologies	N	10.19	22	1,492	146.4	(0.24)	0.68	14.9	0.83	12.3
WOR	Worthington Ind.(May FY)	O	35.61	65	1,820	51.1	\$2.07	3.27	10.9	\$5.25	6.8
	Gold Mining										20 P/CF
NEM	Newmont Mining	N	60.96	43.99	48,402	794.0	1.88	1.38	44.3	4.63	13.2
GOLD	Barrick Gold	U	26.27	14.42	46,705	1777.9	0.69	1.85	14.2	1.85	14.2
PVG	Pretium	N	8.17	6.11	1,520	186.0	0.41	0.31	26.1	1.21	6.8
KL	Kirkland Lake Gold	N	41.68	37.03	11,166	267.9	2.66	2.38	17.5	4.49	9.3
AEM	Agnico Eagle	N	62.83	58.58	14,873	236.7	1.81	1.72	36.6	4.92	12.8
AU	AngloGold	N	28.98	20.60	12,039	415.4	2.52	1.67	17.4	2.50	11.6
PAAS	Pan American Silver	O	29.24	32.93	6,129	209.6	0.94	0.57	51.7	2.17	13.5
	Royalty Companies				Mkt Cap						
RGLD	Royal Gold	U	121.05	79.48	7,928	65.5	2.90	2.83	42.8	5.22	23.2
FNV	Franco Nevada	N	136.78	93.80	25,783	188.5	2.07	2.05	66.8	3.95	34.6
WPM	Wheaton Precious Metals	N	43.29	33.25	19,215	443.9	0.68	0.70	61.7	1.65	26.2
SAND	Sandstorm Gold	N	9.50	8.61	1,968	207.2	0.07	0.10	99.0	0.30	31.2
OR	Osisko Gold Royalties	N	9.95	8.10	1,447	145.4	0.22	0.57	17.6	0.57	17.6
	Copper/Nickel/Diversified				Mkt CAP						20 P/CF
BHP	BHP Billiton ADR	N	50.07	44	126,927	2535.0	3.85	3.86	13.0	8.64	5.8
RIO	Rio Tinto ADR	N	56.29	45	91,404	1623.8	4.26	4.05	13.9	7.50	7.5
VALE	Vale	N	10.41	11	54,121	5198.9	1.25	2.17	4.8	2.32	4.5
GLCNF	Glencore	O	2.10	3	29,933	14254	0.14	0.16	13.1	0.67	3.1
NGLOY	Anglo American ADR	N	11.74	11	30,524	2600.0	1.41	1.23	9.6	5.04	2.3
NILSY	Norilsk Nickel ADR	N	26.45	24	40,416	1528.0	3.11	2.54	10.4	5.28	5.0
SCCO	Southern Copper	N	38.91	39	30,077	773.0	1.18	2.02	19.3	2.28	17.0
GMBXF	Grupo Mexico	O	2.32	4	18,022	7785.0	0.16	0.22	10.5	0.53	4.3
FCX	Freeport-McMoRan	U	11.50	7	16,687	1451.0	(0.21)	0.45	25.8	0.86	13.4
FSUMF	Fortescue Metals	O	9.68	14	30,224	3122.3	1.74	1.66	5.8	2.10	4.6
SOUHY	South32	O	7.13	15	7,236	1014.8	0.23	0.11	67.6	0.39	18.1
TECK	Teck Resources Ltd	O	10.47	23	6,095	582.1	0.84	1.46	7.2	4.46	2.3
ANFGF	Antofagasta PLC	O	11.60	13	11,436	985.9	0.11	0.50	23.4	0.74	15.7
FQVLF	First Quantum	O	7.91	14	5,432	686.7	(0.13)	0.62	12.7	1.71	4.6
CCJ	Cameco	N	10.12	10	4,005	395.8	0.29	(0.39)	NM	1.09	9.3
LUNMF	Lundin Mining	N	5.40	4	3,961	733.6	0.10	0.18	30.7	0.48	11.4
HBM	HudBay Minerals	N	2.97	3	776	261.3	(0.62)	0.11	26.0	0.60	4.9
	Aluminum										20 P/CF
AWCMY	Alumina Ltd	N	4.41	1	3,174	719.7	(0.27)	-0.18	NM	(0.07)	NM
CENX	Century Aluminum	N	6.96	12	614	88.2	(1.43)	-0.43	NM	(0.14)	NM
HWM	Howmet Aerospace	N	15.31	15	6,660	435	2.19	3.61	4.2	3.58	4.3
AA	Alcoa	O	10.97	15	2,036	185.6	(0.61)	-0.53	NM	3.91	2.8

Sources: Company reports, AISI, Comex, LME and JTVIR, LLC estimates.

Universe Table 6: John Tumazos Very Independent Research, LLC Metals and Mining Universe Cont'

		Tang	Est. Tang				2020		
		Book	BV/share	Price/	2020	2020	EV/		
	Steel	Value	2020	Tang. BV	EV	EBITDA	EBITDA	Div.	Yield
X	US Steel	1,602	\$8.09	0.87	6,851	(268)	NM	\$ 0.04	0.57%
NUE	Nucor	6,784	\$21.24	1.95	14,161	1,500	9.4	\$ 1.61	3.89%
ATI	Allegheny Technologies	1,573	\$10.75	0.95	2,179	220	9.9	\$ -	0.00%
WOR	Worthington Ind. (May fiscal)	268	\$5.25	6.78	2,617	347	7.5	\$0.96	2.70%
	Gold Mining		20 TBVPS					Div.	Yld
NEM	Newmont Mining	22,118	27.86	2.19	51,232	4,437	11.5	\$1.00	1.64%
GOLD	Barrick Gold	16,677	9.38	2.80	48,861	3,836	12.7	\$ 0.28	1.07%
PVG	Pretium	1,014	\$ 5.45	1.50	1,762	242	7.3	\$ -	0.00%
KL	Kirkland Lake Gold	3,487	\$ 15.38	2.71	10,530	1,257	8.4	\$ 0.50	1.20%
AEM	Agnico Eagle	4,415	20.37	3.08	15,680	1,399	11.2	\$ 0.70	1.11%
AU	AngloGold	2,525	\$6.08	4.77	14,077	2,482	5.7	\$0.08	0.26%
PAAS	Pan American Silver	2,661	12.70	2.30	6,165	625	9.9	\$ 0.14	0.48%
RGLD	Royal Gold	2,269	32.20	3.76	7,782	353	22.0	\$ 1.12	0.93%
FNV	Franco Nevada	4,897	25.98	5.26	25,530	808	31.6	\$ 1.00	0.73%
WPM	Wheaton Precious Metals	5,748	11.65	3.72	19,786	1,422	13.9	\$ 0.40	0.92%
SAND	Sandstorm Gold	718	3.46	2.74	1,844	58	31.6	\$ -	0.00%
OR	Osisko Gold Royalties	1,672	11.50	0.87	1,634	113	14.4	\$ 0.15	1.51%
	Copper/Nickel/Diversified		20 TBVPS					Div.	Yld
BHP	BHP Billiton ADR	54,917	19.21	2.61	143,272	22,546	6.4	\$ 2.66	5.31%
RIO	Rio Tinto ADR	40,792	\$25.12	2.24	104,787	16,357	6.4	\$ 2.35	4.17%
VALE	Vale	48,759	\$9.47	1.10	57,088	17,014	3.4	\$ -	0.00%
GLCNF	Glencore	38,320	\$ 2.74	0.77	58,643	12,726	4.6	\$ -	0.00%
NGLOY	Anglo American ADR	25,555	19.15	0.61	37,462	10,134	3.7	\$ 1.00	8.52%
NILSY	Norilsk Nickel ADR	6,199	\$ 4.06	6.52	44,702	8,066	5.5	\$ 2.17	8.19%
SCCO	Southern Copper	6,805	\$ 8.80	4.42	35,150	3,017	11.7	\$ 0.80	2.06%
GMBXF	Grupo Mexico	12,704	\$ 1.48	1.57	26,564	4,162	6.4	\$ 0.07	3.00%
FCX	Freeport-McMoRan	11,175	\$ 7.70	1.49	33,263	1,582	21.0	\$0.00	0.00%
FSUMF	Fortescue Metals	12,667	\$ 4.10	2.36	31,653	9,342	3.4	\$ 1.13	11.70%
SOUHY	South32	11,197	\$ 2.21	3.23	4,483	2,892	1.6	\$ 0.21	2.96%
TECK	Teck Resources Ltd	25,096	\$ 45.22	0.23	9,676	2,932	3.3	\$ 0.15	1.45%
ANFGF	Antofagasta PLC	8,013	\$ 8.13	1.43	14,225	1,131	12.6	\$ 0.07	0.64%
FOVLF	First Quantum	9,500	\$ 13.83	0.57	12,065	1,618	7.5	\$0.008	0.10%
CCJ	Cameco	4,928	\$ 12.60	0.80	4,512	712	6.3	\$ 0.18	1.78%
LUNMF	Lundin Mining	3,836	\$ 5.23	1.03	4,017	798	5.0	\$ 0.12	2.22%
HBM	HudBay Minerals	1,480	\$5.66	0.52	1,674	263	6.4	\$0.015	0.52%
	Aluminum		20 TBVPS					Div.	Yld
AWC	Alumina Ltd	1,365	\$1.90	2.32	3,434	(190)	NM	\$ 0.06	1.36%
CENX	Century Aluminum	762	\$ 8.70	0.80	952	(64)	NM	\$ -	0.00%
ARNC	Howmet Aerospace	409	\$0.94	16.27	9,332	2,159	4.3	\$ -	0.00%
AA	Alcoa	3,972	\$21.40	0.51	4,695	3,234	1.5	\$0.00	0.00%

Sources: Company reports, AISI, Comex, LME and JTVIR, LLC estimates.

Universe Table 7: John Tumazos Very Ind. Research, LLC Fertilizer, Paper & Forest Products Universe															
Ticker	Company	Rating	Share Price 7/2/20	Target Price	Market Cap. (\$ mill.)	Shares Outstg. (mills)	EPS 2020E	EPS 2021E	P/E 2020E	CF/PS/CF	Est. Tan BVPS Dec-20	Price-to-Tangible BVPS	Div.	Yield	
Forest Products and Paper Companies															
IP	Int'l Paper	O	35.35	\$ 48	13,787	390.0	\$3.71	\$3.66	9.5	7.1	5.0	12.54	2.82	2.05	5.8%
LPX	Louisiana-Pacific	O	25.48	\$ 27	2,879	113.0	1.05	\$1.37	24.4	2.2	11.8	10.78	2.36	\$0.58	2.3%
OSB	Norbord Inc.	O	23.44	\$ -	1,887	80.5	0.36	0.82	64.7	2.1	11.3	11.79	1.99	0.15	0.6%
PKG	Packaging Corp.	N	99.65	\$ 94	9,410	94.4	6.31	7.16	15.8	11.0	9.1	9.49	10.50	3.16	3.2%
WRK	WestRock	O	28.20	\$ 58	7,276	258.0	3.78	3.83	7.5	8.1	3.5	5.92	4.76	1.86	6.6%
GPK	Graphic Packagin	O	14.09	\$ 18	3,951	280.4	0.94	1.03	14.9	2.8	5.0	0.44	32.04	0.30	2.1%
WY	Weyerhaeuser	O	22.24	\$ 31	16,602	746.5	0.66	0.72	33.6	1.5	15.3	11.71	1.90	1.36	6.1%
UFS	Domtar	O	20.55	\$ 40	1,168	56.9	2.42	2.99	8.5	7.8	2.6	32.44	0.63	42.52	206.9%

Source: Company Reports and John Tumazos Very Independent Research LLC Estimates

CERTIFICATION OF OUR RESEARCH OPINIONS

I, John Tumazos, certify that the opinions written in all research reports are my own. I believe what we write, and from time to time I may buy or sell the shares we recommend after a 48 hour delay after publishing our reports following the advice we give. Further, I personally proofread and “click the pdf button” on virtually every report we publish except sometimes when I am abroad.

Our team or employees is encouraged to disagree with me at any time. We have active and vigorous internal debates concerning appropriate discount rates or long-term terminal growth rates to use in net present value valuations or other analytical issues. My team realizes that customers want to pay for my 30+ years of experience, but I encourage them to disagree, correct or provoke debate to improve our work.

DEFINITION OF A RESEARCH OPINION

We have target prices, investment ratings, earnings estimates and financial models for 47 companies upon which we maintain regular research coverage.

The legal or regulatory definition of research, however, is more broad. Regulators consider any written or editorial commentary about a stock or publicly traded company to be “research.” However, a “recommendation” or “opinion” is not rendered unless there is a price target and specific buy or sell recommendation.

From time-to-time we visit very large, important global companies outside our research coverage. Our objective may be to be well informed about industry events, predict future mine output or “supply” in a particular market or to begin to learn about a complex company to begin future full research. We may need to learn and become familiar to provide inputs to our financial models. In May 2008 we published a partial report on Xstrata after visiting two of its mines in South America. In November 2008 we published a partial report summarizing our visits to the London headquarters of Xstrata and Anglo-American outside our coverage as well as Rio Tinto and Antofagasta PLC within our full coverage. In August 2009 we published two research reports on Severstal after visiting its Columbus, MS newest steel plant a second time. These “partial” reports

contained no price target, investment rating, earnings estimates or financial models. Instead, they provided detailed descriptions of the important locations we visited or meetings in headquarters.

We provide research about commodities markets in general, “seminar highlights” on up to another 75 or more companies we host annually at our conferences outside our regular full research coverage and “partial reports.” We have no price target, written investment opinion, earnings estimates or financial models (production, incomes statement, cash flow or balance sheet simulations) of such companies outside our coverage that speak at our March or November conferences. Any viewpoint we have without complete financial models or careful financial analysis is “winging it.”

Our intent in writing Seminar Highlights is to provide a one page written summary of each seminar participant company’s presentation. We provide live open, public, unrestricted webcasts of each such corporate presentation at our conferences as a courtesy to each participating company, and archive each webcast under the “conferences” tab of www.veryindependentresearch.com.

Our clients should not automatically consider our invitation of a company to speak at our future conferences as a “Buy Recommendation” or complete endorsement. We may not have visited the mines or assets of some of these companies. Occasionally we invite a company to speak to learn more about them as a stage in our learning process.

ORGANIZATION OF JTVIR

John Tumazos Very Independent Research, LLC (JTVIR) is organized as an investment advisor in the State of New Jersey and regulated by the NJ Bureau of Securities. We publish about 20 research reports each month covering about 40 to 50 stocks in the metals commodities markets, forest products, aluminum, steel, gold, copper and other mining sectors. We travel abroad or domestically typically each month visiting companies. We host Conferences each year in which companies make presentations, which are archived for roughly one year at www.veryindependentresearch.com under the “conferences” tab.

Currently we have over 30 paid clients in the U.S., Canada, Switzerland and U.K. Three of our clients have engaged us to write “custom studies” on pre-production mining stocks without any U.S. or global research coverage, including Skye Resources (an 11 bil lb nickel resource in Guatemala), Mercator Minerals (a copper-moly restart in Arizona) and JSW Steel’s 70%-owned Minera Santa Fe (48 sq km undrilled magnetic anomaly and associated iron ore properties in 3rd Region of Chile).

JTVIR DISCLOSURES

“John Tumazos Very Independent Research, LLC” (JTVIR) is a Delaware Corporation formed July 6, 2007 with registration effective on August 27, 2007 as an investment advisor in the state of New Jersey owing to our place of business in New Jersey.

JTVIR is not a broker-dealer, and conducts no trades. Its primary business is to provide “unbundled” metals, paper and fertilizer industry securities and market research to institutions or corporations in a zero commission, electronic execution, electronic dissemination, unbundled format for a specified annual fee structure.

Our investment rating system for securities recommendations is Overweight, Neutral Weight or Underweight. Overweight or Underweight recommendations are estimated to vary from the relative performance of the S&P 500 by more than 10% annually, and the intended time horizon is up to 24 months. Our securities research is intended for institutional investors that might buy up to 10% of a given company, and as such focuses more towards longer-term dynamics impacting the net present value of future cash flows rather than “day trading” sorts of near-term issues.

Except for WestRock, International Paper, Graphic Packaging, Domtar, Norbord, South32, Alcoa, Teck, U.S. Steel, Glencore, First Quantum, Grupo Mexico, Southern Copper, HudBay Minerals, Worthington Industries, Pan American Silver, Centerra Gold, Paramount Gold Nevada, Vale, Fortescue Metals, Allegheny Technologies, Pan American Silver Escobal mine contingent value right, Sandstorm Gold, Premier Gold, Kirkland Lake Gold, Appia Energy, Texas Minerals Resources Corp., McEwen Mining, Galway Gold, or Galway Metals neither JTVIR, its members or its employees own or have a financial interest in any securities discussed in this report or any reports we have published recently. Our policy is full disclosure.

As of mid-2018, my son Charles Tumazos took full control of accounts in his name after age 30. He elected to become a paid subscriber to my research, where he controls his accounts and makes his own decisions. Going forward, we will disclose John Tumazos’ personal holdings and exclude “family accounts.” Our positions will be a little smaller.

Our policy permits personal trading in the metals or paper industries. Our policy is that any personal trading must be consistent with our recommendation, made two business days or more AFTER a recommendation or change in recommendation and held for a minimum of 30 days or one month. We believe it is virtuous for a securities analyst to “put his or her money where his mouth is” to invest consistent with the recommendation to clients after such recommendation has been made, and we disagree with some restrictions made upon broker-dealer employees after 2000 era scandals.

However, our policy permits up to one directorships and up to five consulting projects, advisory assignments or financial advice to corporations. Our policy is full disclosure of any advisory relationship or conflict going back three years.

Numerous prior investment banking relationships existed prior to three years history to the pre-1997 time frame under the employment of Donaldson, Lufkin and Jenrette or Oppenheimer & Co., Inc. Some of these we can recollect included 14 different gold mine valuations or sales for Barrick Gold, LAC Minerals (later acquired by Barrick), Addington Resources (gold assets in Montana acquired by Canyon Resources),

Westworld Industries (Bolivian assets acquired by Battle Mountain Gold later acquired by Newmont Mining), Coeur d'Alene Mines, Crown Resources (acquired by Kinross Gold), Freeport-McMoRan Gold (acquired by Minorco later AngloGold later Queenstake Resources), FMC Gold (later renamed Meridian Gold) and others. Sole managed initial public offerings included Reliance Steel & Aluminum and Huntco. Lead-managed initial public offerings included American Steel & Wire (later acquired by Birmingham Steel) and lead-managed underwritings included Quanex. Co-managed underwritings included the IPO of Century Aluminum and Grupo Imsa and offerings for AK Steel, Kaiser Aluminum, Agnico-Eagle Mines, Cameco and others. Asset sales or purchase advisories, fairness opinion or trusteeships were done for Thypin Steel (sold to Ryerson Tull), Cyclops Corp. (sold to Armco later sold to AK Steel), Allegheny Corp., Bethlehem Steel, the U.S. Dept. of Justice pursuant to the June 1984 merger of LTV and Republic Steel to sell the Gadsden, AL integrated flat-rolled mill, Cobre Copper, and others. Some examples we can recall of incomplete transactions for which a prospectus was either drafted or partly drafted indicating much work included stock underwritings not completed for Wheeling-Pittsburgh Steel, Steel Dynamics, Atlas Corp., Webco, Sharon Steel, IPSCO, Co-Steel Inc., and others.

ANALYST UNIVERSE COVERAGE:

John C. Tumazos, CFA as of June 2007: Rio Tinto, Louisiana-Pacific, Nucor Corp., Newmont Mining, U.S. Steel, International Paper, BHP Billiton, MeadWestvaco Corp., Antofagasta PLC, Allegheny Technologies, Alcoa Inc., Inco Limited, Bowater, Temple-Inland, Barrick Gold, Abitibi-Consolidated, Weyerhaeuser Co., Alcan Inc., Smurfit-Stone Container, Plum Creek Timber, Worthington Industries, Goldcorp Inc., AngloGold Ashanti, Freeport-McMoRan Copper & Gold, and FNX Mining. Dynatec, Alcan and Bowater are companies not continued in the research coverage of JTVIR, LLC that was previously included in the prior June 6, 2007 Prudential Equities Group universe owing to takeovers. Smurfit-Stone Container and AbitibiBowater were dropped from JTVIR research coverage after they entered bankruptcy. Skye Resources, FNX Mining, QuadraFNX Mining, Duluth Metals, Xstrata, MeadWestvaco, Smurfit-Stone Container (new) were dropped after full coverage initiation due to takeover.

Subsequently, since September 2007 JTVIR, LLC has initiated regular coverage of new companies not previously covered in the former universe at the former Prudential Equities Group. These new companies include CF Industries, Mosaic, Franco-Nevada, Silver Wheaton, Royal Gold, Osisko Gold Royalties, Sandstorm Gold, South32, Teck, Agnico-Eagle Mines, Mercator Minerals, Skye Resources, General Moly, Inc., Thompson Creek Metals, Duluth Metals, Polymet Mining, Greystar Resources, Vale, GlencoreXstrata, Glencore, Xstraa, Anglo American, Packaging Corp. of America, Norbord, Rock Tenn, HudBay Minerals, Alumina Ltd., Fortescue Metals, and Century Aluminum.

In accordance with applicable rules and regulations, we note above parenthetically that our stock ratings of "Overweight," "Neutral Weight," and "Underweight" most closely correspond with the more traditional ratings of "Buy," "Hold," and "Sell," respectively; however, please note that their meanings are not the same. (See the definitions above.) We believe that an investor's decision to buy or sell a security should always take into account, among other things, that the investor's particular investment objectives and experience, risk tolerance, and financial circumstances. Rather than being based on an expected deviation from a given benchmark (as

buy, hold and sell recommendations often are), our stock ratings are determined on a relative basis (see the foregoing definitions).

There is no intention to “balance” the number of Overweight or Underweight ratings, as instances of broad over- or under-performance among basic industrials may occur. JTVIR makes each investment judgment in a “bottoms up” manner based on the assets of each individual company.

Price Target – Methods/Risks

The methods used to determine the price target generally are based on future earning estimates, product performance expectations, cash flow methodology, historical and/or relative valuation multiples. The risks associated with achieving the price target generally include customer spending, industry competition and overall market conditions.

Additional risk factors as they pertain to the analyst's specific investment thesis can be found within the report.

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Additional information on the securities discussed herein is available upon request. The applicable disclosures can be obtained by writing to: John Tumazos Very Independent Research, LLC, 11 Yellow Brook Road, Holmdel, NJ 07733 Attn: John C. Tumazos.

BOARD OF TRER AUGUST 6, 2012 TO MAY 27, 2013

On August 6, 2012 we joined the board of Texas Rare Earth Resources, and were elected Non-Executive Chairman. We made an early stage investment in the company after it obtained its core property in the fourth-quarter of 2010, and we and other activist shareholders believed there was room for improvement in its business plan and performance in 2012. We did not expect our participation in TRER to be indefinite, and believed that it will seek a larger mining company to help it complete its projects.

On May 27, 2013 we resigned from the Board of Texas Rare Earth Resources. We were pleased that metallurgical research into sulphuric acid heap leach processes made advances, which determined an alternative process requiring 10% to 20% of the cap ex proposed in the prior June 15, 2012 NI 43-101 study. The 2010 identification and possession of the property and the 2013 metallurgical advances added value, and we thought a larger organization would better develop the production plant.

We declined all other invitation to join Boards of Directors. We do not want distractions or other activities to weaken JTVIR, LLC. Further, we have a "team psychology" and a large commitment to one another within JTVIR, LLC.

JTVIO

John Tumazos Very Independent Opinions, LLC (JTVIO) is a separate company providing various services "other than" investment research sold to institutions in JTVIR. Counsel advised any other activities be organized separately. Such other activities have involved < 5% of our time. Since 2008 we have done such advisories for 18 companies, or 1 or 2 assignments per year typically.

In general, we may provide investment banking or advisory services mostly to sub-\$100 mm mining companies that have defined a "deposit," but need more capital after a discovery for infill drilling, bulk metallurgical testing, definitive feasibility study or the capital outlays to build a mine. JTVIO envisions merger advisory, "second opinion" critiques of investment banking advice, strategic consulting, valuation opinions, fairness opinions, mine technical services such as "Third Party Reviews" of technical studies or other corporate services. The "research coverage" of JTVIR largely involves very large companies with completed steel, aluminum, forest products or mine plants with market capitalizations usually between \$1 and \$250 billion. Historic companies often over one

century old, such as Alcoa or U.S. Steel or BHP Billiton, will use top ten commercial or investment banks for advisory services and we make no attempt to be engaged by them owing to their long historic relationships.

We prefer to advise companies without revenues, which large investment banks like Goldman Sachs, JP Morgan, Morgan Stanley or BMO often avoid. Such mining companies without revenues are not as competitively over-banked, and many of the geologists are quite gifted and have extremely promising projects.

We undertook some platinum market studies for Platinum Group Metals in the past year.

We have accepted compensation from Texas Rare Earth Resources and Appia Energy, a private concern, related to introducing investors to them.

In August 2011 we advised the Board of Directors of Augen Gold that a hostile tender offer from Trelawney Mining. On October 9, 2010 we were engaged by Tara Gold Resources to evaluate the fairness of their September 13, 2010 proposed merger to amalgamate with Tara Minerals, which it terminated on March 7, 2011. We delivered a “structure opinion” to Tara Gold Resources and Tara Minerals on May 20, 2011 that the cancellation of the announced September 13, 2011 merger was “fair.” On June 24, 2010 we delivered a Fairness Opinion to the board of directors of Paramount Gold and Silver for compensation in their acquisition of X-Cal Resources, Ltd concerning the Sleeper gold mine near Winnemucca, NV formerly operated in 1986-1996 by Amax Gold and having past output of 1.66 mm oz gold and 2.3 mm oz silver plus 26,000 oz of placer gold almost one century ago.

On October 6, 2010 we were engaged by Dorado Ocean Resources Limited, a privately held company. That assignment has concluded without success or compensation.

On June 3, 2008 Galway Resources engaged JTVIO to commercialize its Victorio, New Mexico molybdenum-tungsten deposit containing over 200 mm pounds of each mineral in situ, which is JTVIO’s first activity (see www.galwayresources.com June 3, 2008 press release). We have received compensation from Galway Resources.

These past engagements pose no “conflict of interest” with JTVIR research coverage as long as JTVIR does not cover or write on Paramount Gold and Silver, Galway Resources, or other sub-\$250 mm market cap emerging companies. However, subsequently Galway Resources has documented gold occurrences on Galway grounds and begun drilling. After our November 6-12, 2009 trip to the California gold district of Colombia, we published research reports on Greystar Resources and NOT Galway Resources to avoid conflicted research. We omitted Galway Resources from our “Conference Highlights” report even though it spoke at our November 19, 2009 conference in a similar vein to avoid conflicted research.

JTACR

John Tumazos Advisory and Compensated Research, LLC (JTACR) is a separate investment advisor registered with the State of New Jersey Bureau of Securities on June 27, 2011 as CRD # 157,606. **Under no circumstances will JTACR be commissioned by a mining or other publicly traded company simply to write a “paid” research report.** Its purpose is to include research reports after separate compensation has been received for an advisory service such as a fairness opinion, mergers & acquisitions advice, introductions of investors in a capital raising or other advisory services. Regulators presume that any “compensation” or potential compensation biases research reports, however small, and outside counsel advises us that we should not write about a company as “John Tumazos Very Independent Research, LLC” if compensated or seeking compensation.

We have created a separate web site, www.advisoryandcompensatedresearch.com to support JTACR. It is separate from our normal research investment advisor site, www.veryindependentresearch.com. Since the second half of 2011 JTACR has published research reports on Texas Rare Earth Resources, Paramount Gold and Silver, Galway Resources, Galway Gold, Galway Metals and Platinum Group Metals. These represent < 10% of our company research and < 5% of our written research report output.

POTENTIAL MONEY MANAGEMENT ACTIVITIES

We manage my own money and one client account. Our trades conform to our published research and follow publication by a minimum of two business days. Client recommendations have first priority.

In November 2011 we accepted our first customer money management account, and we are beginning to set up an account and legal agreement to manage money for him. We are in the process of completing such paperwork.

Money Management for clients could be another line of business. “Mine Development Fund” is a “current” project to establish a small fund to invest in post-discovery, large resource companies (over \$2 billion in situ mineral value already defined) requiring financing to “build the mine” and grow. The target market cap of the companies in which it would invest would be \$0.1 to \$10 billion. Our detailed studies of emerging mines may prove synergistic across several applications. We have also considered creating sector ETFs, but determined there is more value-added in fund management.

Our published over 2,500 research reports to Since July 7, 2007 has concentrated on the metals commodities themselves, steel, aluminum, forest products and larger capitalization mines like Rio Tinto, BHP, Freeport-McMoRan Copper, Barrick Gold, etc. Only 7%-10% of our written research involves the “sub-\$2 billion mine” size range that would be the focus of either JTVIO or Mine Development Fund. Thus, compliance issues or conflicts of interest would occur in a smaller subset of JTVIR coverage as JTVIR coverage involves larger caps, “established processing companies” or commodities. JTVIO or the buy-side investing may focus on much smaller companies

POTENTIAL MINE SERVICES ACTIVITIES

We delivered a written critique for two NI 43-101 compliant studies of copper deposits in Argentina and Chile for publicly traded companies based in Toronto. One was a second preliminary economic assessment for a deposit with approximately 30 billion pounds of copper and 5 mm oz of gold. The other was a definitive feasibility study to expand a small copper mine with an established production history.

As a substantial user of mine feasibility study reports or other technical reports prepared at early stages after first discovery, sometimes we are very dissatisfied. We may from time-to-time provide “Third Party Review,” critique such mine scoping study or prefeasibility study reports. We do not seek to “second guess” scientific issues of mine engineering or metallurgy. However, we may differ with the mathematics of reserve determination, capital cost estimates, “simultaneity” of price and cost assumptions, various business planning issues, the opportunity to “phase” or subcontract to reduce initial capital costs or other financial issues. The “custom studies” we have provided to several buy-side JTVIR customers may resemble “Mine Services” future products presented as “Third Party Review” of mine technical studies.