June 2019

Metal Market Magazine

COPPER CLUB 75TH ANNIVERSARY

Diego Hernandez and other leaders on copper's past, present and future

Metals technologies

Top steelmakers 2019 edition

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PRIMETALS TECHNOLOGIES

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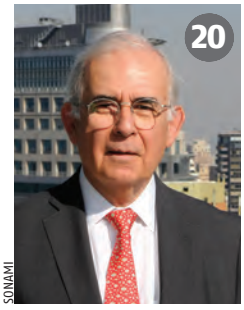

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Comment

Ferrous and non-ferrous

It would be interesting to know how many of the influential people in the US copper supply chain who met at the birth of what became today's Copper Club thought then that the club would still be going strong 75 years later.

As the Copper Club now celebrates its 75th anniversary, a major section of this June 2019 issue of *Metal Market Magazine* looks back at the organization's purpose and activities. The club has increasingly broadened its international outlook, launched scholarships to support promising new members of a group that encompasses all aspects of copper production and trade, and honours leading people who have been particularly active in the cause of copper.

One such individual, Diego Hernandez, president of the Chilean mining association Sonami, is our cover interviewee this month. He recalls a career that has spanned important international roles in some of the best known mining companies and projects, including Codelco, Anglo American, Rio Tinto, BHP Billiton and Vale.

Other leading lights and award winners in the sector recounting distinguished careers within the Copper Club anniversary section include Art Miele, Richard Adkerson and Apurv Bagri. Their views on the outlook for copper – together with those contributed by many others in the supply chain and market – give a rounded picture of the future for the red metal.

This issue also includes Fastmarkets' annual ranking by output of the world's largest steel producers – a glance at which list highlights the still growing ascendancy of Asian steelmakers. Regional reports from Fastmarkets' global team of steel reporters reveal a checkered pattern, albeit with a continuous thread of the positive and negative impacts of the international trade protection measures deployed by many countries over the past year.

We include a separate feature section focused on the Turkish steel industry, which as a major scrap-based steel producing nation, in addition to integrated works, has been affected by both global and domestic developments over the past 12 months.

Our metals technologies section encompasses a list of new plant orders placed in recent months. It shines a spotlight on some of the latest technologies deployed internationally and a pointer to where the most capital investment is being made – for steel production in particular. Despite the often-reported cooling in China's rate of growth, projects there are still plentiful.

Meanwhile, the resurgent US steel sector is ploughing some of its earnings back into boosting both the capabilities and capacities of an industry for which President Trump's trade measures delivered a bumper year for many mills.

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"Influential stakeholders' views on the outlook for copper give a rounded picture of the future for the red metal"

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News review: non-ferrous

5G phones not likely to hike cobalt demand

Some mobile phone producers have started to develop devices that support the fifth generation (5G) network, but long-term support for cobalt demand from 5G phones will be limited, Fastmarkets heard on the sidelines of a cobalt conference in Hong Kong this week.

There was likely to be an instant boost for cobalt demand, however, when many consumers replaced their 4G mobile phones with those enabled for 5G, market sources told Fastmarkets at the Cobalt Institute Conference in Hong Kong, May 15-16.

But this support for cobalt demand was likely to be short-lived because the total consumption of cobalt for mobile phone manufacture was not expected to rise significantly, they added.

SHUTTERSTOCK

5G smart mobile telephone radio network antenna base station on telecommunication masts

Rusal seeks market share after 21% earns fall

Russian aluminium producer Rusal said it will focus on restoring its market position after its first-quarter revenues plunged by 20.9% year on year in a period "challenged by the past year's events."

Rusal reported revenue in the first quarter of 2019 of $2.17 billion, a fall of 20.9% year on year from $2.744 billion. The company said the fall in revenue was due to the decrease in the London Metal Exchange aluminium price, which fell by 13.9% to $1,859 per tonne in the first three months of 2019, compared with $2,159 per tonne in 2018.

Alexandria to grow Minn extrusion capacity by 30%

Alexandria Industries is expanding its Alexandria, Minnesota, aluminium extrusion facility, with extrusion capacity expected to increase by 30% once a newly purchased press is installed.

The company declined to disclose the facility's current or projected annual capacity, but told Fastmarkets AMM via email that the facility will consume 70 million lbs of aluminium with the new press.

Jiangxi Copper builds scrap facility in Malaysia

Jiangxi Copper has become the first Chinese company to receive the green light to set up a large-scale copper scrap processing facility in Malaysia after China's clamp down on copper scrap imports led to mass scrap diversion to Southeast Asia, two company officials directly involved in the matter told Fastmarkets.

The major project, including the process of scrap dismantling, was approved despite opposition from the Malaysian market arguing that the country should avoid being a "dumping ground" for scrap unwanted by China.

The facility will be able to process up to 150,000 tonnes per year of copper scrap and should be complete in one year's time, the first company source said.

Bushveld to acquire Duferco vanadium assets

Vanadium producer Bushveld Minerals has agreed to buy multiple South African production assets for $68 million, it said on May 1.

The South Africa-based miner will acquire Duferco Vanadium Investment Holding's Vanchem plant, the ferro-vanadium business of its subsidiary South African Japan Vanadium (SAJV), and all the shares in subsidiary Ivanti Resources.

The Vanchem plant is a primary vanadium producing facility. It produces vanadium oxides, ferro-vanadium and vanadium chemicals.

Glencore's cobalt production up 56% in Q1

Glencore produced 10,900 tonnes of cobalt in the first quarter of 2019, up 56% from 7,000 tonnes produced during the same period a year ago.

The increase was largely due to the ramp-up at the Katanga mine in the Democratic Republic of Congo. A total of 3,500 tonnes of cobalt in hydroxide was produced at the mine in the first quarter compared with 500 tonnes in the January to March quarter of 2018.

Trafigura reshuffles its non-ferrous metals team

Trafigura has consolidated its leadership team in the non-ferrous refined and concentrates metal division headed by Amin Zahir in a management reshuffle, Fastmarkets learned on May 15.

In the reshuffle, which was announced in the first week of May, new heads have been appointed for each global metal to lead both the refined and raw materials businesses.

Zinc TCs to remain high through 2019: Nexa CEO

Zinc spot treatment charges (TCs) could remain at their current high levels through the rest of 2019 because additional Chinese smelting capacity will only come online next year, Nexa Resources' chief executive officer Tito Martins told investors on May 2.

But the price on the London Metal Exchange could rise in the second half of the year amid a global deficit of the metal, he added. The company has forecast that consumption will exceed production during 2019.

Falling prices hit Southern Copper earnings

Southern Copper Corp (SCC) saw its earnings drop in the first quarter of 2019, with falling global metals prices offsetting an increase in shipments as the company ramped up output at its copper concentrator at the Toquepala mine in Peru.

SCC posted net revenues of $1.75 billion in the first quarter of 2019, down by 4.8% from $1.84 billion in the same period of 2018, hit by lower global base metals prices. ▶

Deal ends strike at Minsur tin mine in Peru

Peruvian tin producer Minsur resumed normal operations at its San Rafael mine in the southern province of Melgar on May 1 following the end of a workers' strike that was announced on April 30.

"An agreement was made with our workers' trade union at San Rafael to finish the strike," Minsur said in a filing with the Peruvian stock exchange. "Work at the unit was immediately resumed."

The union had demanded a bonus for employees, since the workers did not agree with the share of profits distributed by the mining company, Minsur stated on April 30.

Mineral Resources' Mount Marion lithium output dips

Australian lithium spodumene concentrate producer Mineral Resources has announced lower first-quarter spodumene production at its Mount Marion mine in Western Australia.

It produced 106,683 tonnes of lithium spodumene concentrate, at the Mount Marion operation in the south-central region of the state, in the January-March quarter, down by 7.23% from the 115,000 tonnes produced in the previous quarter, Mineral Resources said.

Hernic Ferrochrome expected to scale down its smelting ops

Hernic Ferrochrome expects to scale down its smelting operations between June and August amid challenging market conditions, the company announced last week.

The South African ferro-chrome producer went into business rescue in September 2017. Rival Samancor Chrome was expected to buy it after being named the preferred bidder in 2017.

Hydro CEO eyes Al business CO_2 footprint

Norsk Hydro will aim to create a more sustainable footprint through the life cycle of its low-carbon aluminium products and solutions, the company's new president and chief executive officer, Hilde Merete Aasheim, said this week.

Aasheim took up her new position at the Norwegian aluminium producer on May 8, replacing Svein Richard Brandtzæg whose departure was announced in March.

NORSK HYDRO

Norsk Hydro aims to create a sustainable footprint for its low-carbon aluminium products

Novelis sales jump 8% on higher Al prices

Downstream aluminium product maker Novelis announced an 8% jump in sales, which it attributed to higher aluminium prices in its 2019 earnings report on May 8.

The Atlanta-based company reported net sales of $12.3 billion in the fiscal year ended March 31, 2019.

"The increase was driven by a higher average aluminium price," the company said in the report.

A 3% increase in shipments of flat-rolled products to 3,274,000 tonnes also helped boost the sales figure.

Braidy-Rusal JV scores BMW Al sheet contract

BMW Group has chosen Braidy Atlas – the joint-venture project between Russian aluminium producer UC Rusal and US holding company Braidy Industries – to supply aluminium sheet for North American manufacturing, due to the venture's focus on a low-carbon footprint and using "green" inputs, Braidy Industries' top executive told Fastmarkets AMM.

Once the greenfield aluminium rolling mill begins production, starting from 2021, it will supply the automaker's South Carolina plant with 5000- and 6000-series aluminium sheet, Braidy Industries chief executive officer Craig Bouchard said.

GrafTech unfazed by Chinese electrode competition

GrafTech International is unfazed by increased competition from China's ultra-high-powered graphite electrode market thanks to growing steel capacity in the United States, according to the graphite electrode manufacturer's top executive.

"How much of it actually reports to the market, and how long will it take for them to get to a place where they do actually build these [graphite electrode facilities] and get them up and running?" president and chief executive officer David J. Rintoul said on May 1 during the Ohio-based company's earnings conference call. "How long will it be before they can practically be considered viable competition? We think it's some time."

AMG Ebitda boosted by strong V, Cr prices

AMG Advanced Metallurgical Group recorded a modest increase in earnings before interest, tax, depreciation and amortization (Ebitda) at its Critical Materials division for the first quarter of 2019, helped by strong performances in vanadium, chrome and antimony.

The division generated Ebitda of $31.2 million, up 1% compared with the first quarter of 2018, the Amsterdam-listed group said on May 1.

Silicon refineries in southern China delay restarts on rising costs

A decision by some silicon metal producers in southern China not to resume operations immediately after the start of the region's rainy season could signal the development of a wider trend across the region, Fastmarkets MB understands.

Increasing costs arising from China's anti-pollution drive and a persistently weak market has caused some silicon metal producers in the southern Chinese provinces of Yunnan and Sichuan to delay the restart of their refining operations.

News review: steel

GM expects 232 headwinds

The Section 232 tariffs on aluminium and steel imports into the United States – combined with higher commodities prices – will cost General Motors $1 billion this year, company executives said during a conference call to discuss the automaker's first-quarter earnings.

For the full-year 2019, GM expects "headwinds from commodities and tariffs to the tune of about $1 billion," chief financial officer Dhivya Suryadevara told analysts during the conference call, echoing sentiments the automaker had expressed last summer. After the 232 tariffs were implemented last year, GM noted in its second-quarter 2018 results that its largest exposure to volatility in the metals market came from steel, followed by aluminium.

Scrap challenges drive ISA to post Q1 loss

Industrial Services of America Inc swung to a loss in the first quarter, citing the challenging business environment.

"Recent and ongoing market conditions had a dramatic impact on first-quarter 2019 results. Although we are disappointed in first-quarter 2019 results, we continue to work to mitigate the impact of these market conditions," chief executive officer, president and chief financial officer Todd Phillips said in a statement on the company's earnings results on May 14.

British Steel enters compulsory liquidation

Troubled UK long steel producer British Steel has been placed into compulsory liquidation following an order from the UK high court, the UK official receiver, part of the UK's Insolvency Service, said on May 22.

GENERAL MOTORS

Headwinds from higher commodities prices and Section 232 tariffs hit General Motors first quarter results

"The company in liquidation is continuing to trade and supply its customers while I consider options for the business. Staff have been paid and will continue to be employed," a statement from the official receiver said.

"The [UK high] court also appointed special managers to assist me with my work and they are engaging with staff and their representatives to keep them informed, as well as contacting British Steel's customers," the statement continued.

The UK high court has appointed Hunter Kelly, Sam Woodward and Alan Hudson of global professional services firm EY to act as special managers to assist the official receiver with his duties as liquidator.

Salzgitter excels in Q1, warns of headwinds

German steelmaker Salzgitter showed a year-on-year increase of 31% in pre-tax earnings for the first quarter of 2019, attributed to the "very satisfactory" results from its steel strip business and other units, the company said on May 15.

Salzgitter's total external sales for the first quarter were €2.3 million ($2.6 million), unchanged from the corresponding period in 2018. Total sales in the first quarter from the strip mill business, which produces such materials as hot-rolled coil, were €598.8 million ($672 million), down from €609.4 million the year before.

The €125.9 million ($141.29 million) of pre-tax earnings for the first quarter of 2019 compared with €95.9 million a year earlier. It was also the best first quarter for the company since 2008 and confirmed preliminary expectations announced on April 29.

In spite of the increased earnings, the steelmaker warned of emerging economic headwinds and an uncertain political environment. But it did affirm its expectation for pre-tax profit in the 2019 financial year of €125-175 million.

PSC Metals swings to quarterly loss

PSC Metals LLC swung to a loss in the first quarter of 2019 as fewer shipments and lower average selling prices negatively impacted its revenues.

The Mayfield Heights, Ohio-based metal recycler posted a $3-million loss on $93 million in revenues in the three months ended March 31, in contrast to a $4 million profit on $118 million in income over the same period in 2018.

The company pointed out that non-ferrous residue material such as zorba was especially hurt by lower prices during the period.

The company did increase its capital expenditures to $5 million in the quarter, up from $1 million in the first quarter of 2018.

Strong prices boost 2018 earnings, Ezz Steel says

Egypt's use of selective anti-dumping duties helped the country's biggest steelmaker, Ezz Steel, to report a 23% increase in earnings in 2018, the company said last week.

Ezz Steel enjoyed strong demand for long and flat steel products in both the domestic and export markets, it said. This enabled it to show consolidated earnings before interest, taxes, depreciation and amortization (Ebitda) of E£5.44 billion ($317.53 million) for 2018, compared with E£4.42 billion for 2017.

But the company's net earnings, after tax and minority interests, showed a loss of E£1.64 billion in 2018. This compared with a loss of E£1.58 billion in 2017.

Weak Turkish lira hurts long steel mart

The long steel markets in Turkey have been more seriously affected by the consequences of the recent country-wide mayoral elections than the flat steel markets because of the increased weakness of the country's lira.

The decline in the exchange-rate value of the Turkish lira hurts the long steel market because that is the currency used for trading in such commodities. The flat steel market, meanwhile, conducts its trades in US dollars.

The mayoral elections were held on March 31, with some unexpected results.

China slaps 25% tariff on American steel

China will impose tariffs of up to 25% on carbon and stainless steel imports from the United

States beginning in June amid escalating trade tensions between the two countries.

These form part of $60 billion worth of US products that China imports.

The bulk of steel products, listed by China's Ministry of Finance, face the heftiest tariffs of 20-25% from June 1. These include billet, hot-rolled coil, cold-rolled coil, hot-dipped galvanized flat steel, color-coated steel, hot-rolled bar and rod, and structural steel, as well as various types of stainless steel products.

Other steel products will incur a 10% tariff.

Currently, China has a 5-10% tariff on US steel products.

Former ArcelorMittal plant has new owner

Three years after it was shuttered and put into liquidation, the former ArcelorMittal steel mill in Point Lisas, Trinidad and Tobago, has a new owner.

Aeternus Steel Holdings Ltd, a joint venture between local company Integritus Group and Dubai investors Cassia Group was announced May 1 as the winner of a bid round initiated by the liquidator, Trinidadian attorney Christopher Kelshall. The bid round, the second for the plant, began in January and ended in March.

The company, which appears to be newly incorporated, was created "with the intention to provide world-class, high-end quality steel products to the domestic market, the wider Caribbean and the international community," according to its website. It will now have access to one of the biggest direct-reduced iron plants in the world.

India is rising star of Asian steel market

India is likely to be the rising star of the Asian steel markets longer term due to the expected growth in its steel demand, delegates at the Singapore Iron Ore Forum – the anchor event of Iron Ore Week – said on May 9.

SHUTTERSTOCK

The Indian government's big investment into housing schemes will fuel steel demand growth

"India's steel demand is expected to increase by 200 million tonnes in 20 years, with domestic production capacity likely to rise to match it," Wood Mackenzie bulks researcher Ming He said.

The Indian government has made huge investments into housing schemes and infrastructural projects, which could lead to sustained growth in the steel markets in coming years, according to National Mineral Development Corporation chairman N. Baijendra Kumar.

Gerdau Q1 sales fall on 2018 divestments

Brazilian steelmaker Gerdau saw its sales volumes go down by 22.9% year on year during the first quarter of 2019 after divesting operations in Chile, India and the United States throughout 2018, the company said in an earnings report published on May 8.

The report showed sales volumes of 2.99 million tonnes for January-March, compared with 3.87 million tonnes in the first quarter of 2018. Crude steel output also fell to 3.34 million tonnes, against 4.17 million tonnes in the same comparison.

Gerdau completed the sales of its Chilean and Indian businesses, as well as rebar and wire rod units in the US, last year. Although the move reduced overall revenue, the remaining divisions reported higher margins for the company.

Vale to invest $2.5bln in iron ore dry processing

Vale plans to invest around $2.5 billion in iron ore dry processing during the next five years in a move that is estimated to switch 70% of output to this method, the Brazilian mining company said on May 13.

Over the past 10 years, capital expenditures in Brazil aimed at reaching this goal have totaled $17.5 billion, Vale said. Roughly 60% of the miner's production is currently dry, using only natural moisture, it added.

The company expects to invest $390 million solely in the Brazilian southeastern state of Minas Gerais for the implementation of dry stacking, the miner said.

The Brazilian diversified miner reported a net loss of $1.64 billion in the first quarter of 2019 due to provisions made after a disaster at a tailings dam at Brumadinho, in the country's southeastern state of Minas Gerais.

THYSSENKRUPP

ThyssenKrupp remains open to consolidation opportunities for its European steel business amid rationalization news

ThyssenKrupp to cut 2,000 EU steel jobs

German industrial conglomerate ThyssenKrupp is planning to cut 6,000 jobs over the next three years, including 2,000 jobs in its steel business, chief executive officer Guido Kerkhoff said in a conference call on May 10.

ThyssenKrupp remains open to consolidation opportunities for its European steel business, which will be reintegrated into the parent company, following news of the European Commission's expected non-approval of the proposed European flat steel joint venture with Indian steelmaker Tata Steel.

The company also plans to hold an initial public offering for its profitable elevator business and is open to consolidation opportunities for its material services business, which includes Italian flat stainless steel mill Acciai Speciali Terni.

Liberty promotes GM, eyes US market share

In a move to better enable its expansion within the United States, Liberty Steel USA has appointed Revansidha "Rohit" Gulve general manager of recently acquired long products mill Liberty Steel Peoria in Illinois.

Gulve had been general manager of the smaller

News review: steel

Liberty Steel Georgetown. Liberty Steel USA, a subsidiary of parent company GFG Alliance, has credited Gulve with leading the restart of the long-idled long products mill in South Carolina.

"We have made substantial progress since we entered the US market last year, and Rohit's skills and commitment have played a vital part in that," Liberty Steel USA chief executive Michael Setterdahl said. "We're confident he will now bring continued success and growth to Peoria and give added momentum to Liberty's drive forward in the American steel sector."

Burns Harbor coke battery repairs under way

Roof repairs are under way for ArcelorMittal USA's No2 coke battery at its Burns Harbor facility, a company spokesperson confirmed to Fastmarkets AMM via email on May 7.

The $19.25-million project, which will not add to the company's coke or steelmaking capacity, is scheduled to be finished in 2022.

The facility's No2 battery is designed to produce 950,000 tons of coke per year for ArcelorMittal's Burns Harbor steelmaking operations, according to the company spokesperson.

Zekelman to build $150mln ERW tube mill

Zekelman Industries will build the "world's largest continuous ERW [electric-resistance-welded] tube mill" to increase the domestic availability of hollow structural sections and target the non-residential construction market, the company announced on May 7.

The location and capacity of the mill were not disclosed.

The $150-million facility is scheduled for start-up in September 2021, according to the Chicago-based tubing mill. It represents the largest private investment in the US steel industry in the last decade, the company said.

Zekelman has tapped SMS as supplier for the mill, Kusakabe for the milling cut-off and Mair for the material handling and packaging line, according to the announcement.

LME

Gay Huey Evans will replace Sir Brian Bender as chairperson of the London Metal Exchange when he retires

Irvin hot-strip mill to close after USS project

U.S. Steel (USS) plans to close the hot-strip mill at its Irvin Plant near Pittsburgh once a $1.2 billion continuous casting and rolling facility is constructed nearby, company executives said on May 7.

The state-of-the-art "endless" casting and rolling operation will be located at U.S. Steel's Edgar Thomson Plant in Braddock, Pennsylvania, where the company's blast furnace and slab casting operations are situated.

"Irvin will continue to run production. And then we'll have a transition to the Edgar Thomson facility," U.S. Steel president and chief executive officer David Burritt said at the annual Association for Iron and Steel Technology conference in Pittsburgh. He noted that the Irvin Plant hot-strip mill, which was built in 1938, is dated.

The first coil from the new line at Edgar Thomson is expected to be rolled in 2022. Once that line is rolling, the hot-strip mill at Irvin will not be needed.

The cold-rolling and coating facilities at Irvin will continue to operate, Richard Fruehauf, vice president of strategic planning at U.S. Steel, told Fastmarkets AMM.

Revised duties new hurdle for Mexico tube ops

The United States Commerce Department ordered higher anti-dumping duties on most imports of light-walled rectangular tubing from Mexico, erecting an additional barrier to the Mexican producers who still face Section 232 tariffs.

Three of four Mexican providers of light-walled rectangular pipe and tube had their dumping margins increased in Commerce's administrative review, according to the final results last month. The new range is 8.32-17.65% versus 4.48-16.23% preliminary results in August 2018.

Huey Evans to be first female LME chairperson

Gay Huey Evans will be the first female chairperson of the London Metal Exchange, replacing Sir Brian Bender when he retires at end of the year, Fastmarkets understands.

Huey Evans has spent over 30 years working within the financial services industry. She is a non-executive director of Itau BBA International Ltd, deputy chairman of The Financial Reporting Council and a member of the board of Standard Chartered.

In 2016, she received an OBE for services to financial services and diversity.

China encourages mills to set up scrap centers

China's National Development & Reform Commission is encouraging steelmakers in the country to set up their own scrap recycling and processing centers in its latest guidelines to the steel industry.

"Steel mills are encouraged to build their own large-scale ferrous scrap collection and processing centers and increase the rate at which ferrous scrap is utilized," the commission, China's economic planning agency, said in a policy document posted late last week.

Steel mills should consider the demand and supply fundamentals of the scrap market, as well as other transportation and logistical factors, as "strict" precursors to replace some of their blast furnace capacity with electric-arc furnace technology, it said.

Global long steel outlook worsening: Irepas

The global long steel market was mostly unstable despite a balance between supply and demand, the International Rebar Producers and Exporters Association (Irepas) said in its most recent short-range outlook document for the long steel sector.

This was a change of sentiment from the positive outlook Irepas offered in March.

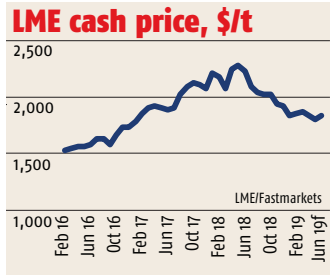
Although the balance of supply and demand has been maintained in the global long steel market, business remains difficult to transact on a global scale, Irepas said in its outlook report on May 3, leading to the forecast of instability. But shorter-distance regional business was mostly good, it added.

Market analysis

Aluminium

Prices poised to rebound

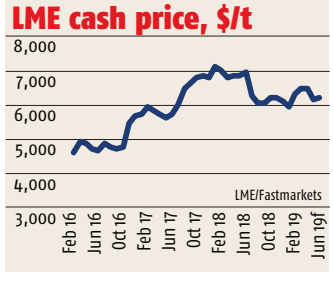
The re-escalation of tensions in the US-China trade dispute over the past month, coupled with soft Chinese economic data, has sapped global risk appetite and pressured base metal prices lower. After last year's strong sell-off, LME aluminium's price action so far in 2019 is looking more like base-building and consolidation. It has traded within a range of $1,785-1,950 per tonne and has set a triple-bottom. In holding it down, speculative funds have built their bearish exposure to a record high level. That leaves this market at risk of short-covering rallies if bullish triggers emerge. As for premiums, we expect some action in the US market after it reached an agreement to remove Section 232 tariffs from Canada and Mexico. Prior to the implementation of 232 tariffs, the US Midwest premium was around $175 per tonne, but it skyrocketed to almost $500 per tonne in April 2018 and has continued to trade above $400 per tonne. It should now retreat from this elevated level.



Copper

Bearish risks dominate short-term view

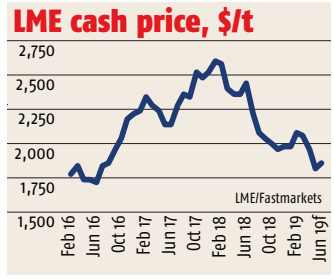
We have a bearish short-term view on copper prices for the coming month or so due to the absence of tightening in the fundamental picture (evident in weak premiums) and the deterioration in the forward fundamental picture (due to US-China trade tensions and perceptions of softer economic growth in China). This could translate into speculative selling until a recovery in Q2. Regarding Chinese copper demand indicators, although the home appliance sector (15% of domestic copper demand) has been solid, expanding by 12.5% year on year in January-April, the transport sector (9% of Chinese copper demand) continued to deteriorate. Automobile production has contracted by 11.8% in the year to date amid a global automotive recession. However, we expect a re-acceleration in Chinese copper consumption in H2 2019 stemming from stronger demand from the power sector (52% of Chinese domestic demand). We estimate Chinese real refined copper demand growth at 3% and 4% in Q3 and Q4, respectively. This should underpin a strong rebound in copper prices in H2.



Lead

Low stocks, but little else to be bullish about yet

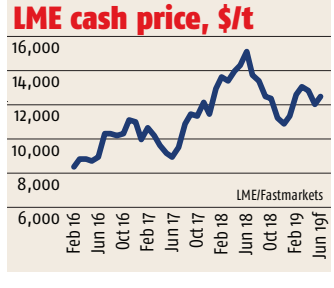
LME lead prices have rebounded well after slipping to a three-year low of $1,773 per tonne on May 13, which is a sign of good dip-buying appetite. Lead has been one of the biggest losers from global trade tensions as the automotive industry has been a hard hit sector. Some good news was that US President Donald Trump delayed for six months his decision on whether to impose tariffs against imported vehicles and vehicle parts from Japan and Europe. But China's auto industry remains in the doldrums. Since it has been contracting for ten months, and US-China tensions have only escalated, Beijing may step in to intervene and provide a boost. That could lead to a pick-up in interest and perhaps some restocking along supply chains, which would have a bullish knock-on effect given still low visible inventories of refined lead. Overall, after suffering more than most in the trade war fall-out, lead may be a big gainer when a deal gets done and sentiment recovers.



Nickel

More fundamental positives than negatives

For nickel, although a weak stainless steel market is compounding broader macro/geopolitical risk-off sentiment, we believe there are still more fundamental positives than negatives for the nickel market. Some of the positives include still-strong growth in Chinese EV sales of 28% year on year in April, despite a reduction in government subsidies; the resumption of environmental inspections in China that may disrupt NPI production in the short term; and exchange stocks remaining on a downtrend. In addition, the Q1 reporting season has revealed generally lower year-on-year production by many nickel miners (Nornickel -0.4%, Glencore -10%, Vale -6.1%, BHP -9%, South32 -12.1%, Eramet -5.4%, Lundin -18.1%, among others), with cumulative production among these seven down 11,600 tonnes versus Q1 2018. And Vale has lowered its 2019 guidance by 28,000 tonnes relative to our previous reference point. These positive fundamentals are helping to support the downside for nickel prices during this soft patch by attracting bargain hunting, and laying the foundation for a recovery in prices when risk-appetite recovers.



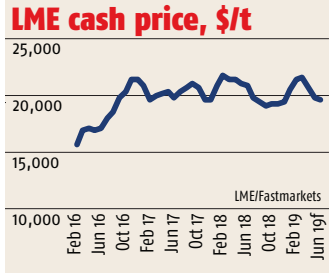
Fastmarkets MB

In this regular section, Fastmarkets MB's research team summarize their in-depth reports to highlight key factors driving the markets and their short-term price forecasts. The weekly service, Base Metals Market Tracker, provides independent analysis and forecasts for base metal markets and prices.

Tin

Resilient price may not last

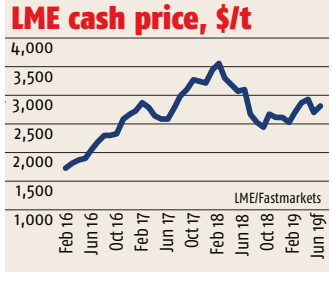
LME tin has proven more resilient than other base metals with the re-escalation in the US-China trade spat. We continue to be mildly bearish on tin prices in the short term due to continuing weak physical demand, expectations for a recovery in Indonesian tin exports, and looser refined tin market conditions proxied by rising exchange inventories since the start of Q2. The negative macro backdrop could also impact tin prices to some extent. We expect a rebound in tin prices from late June, however, as the SHFE/LME tin ratio seems to signal. Solder accounts for about half of global refined tin demand, especially in the US (8% of global demand) and China (50% of global demand). According to the Semiconductor Industry Association (SIA), semiconductor sales in Q1 tumbled 29% quarter on quarter in the US and dropped 15% in China. In China, semiconductor production dropped 2.1% year on year in April, marking an 8th straight month of year-on-year decline, and has contracted by 6.7% in the year to date.



Zinc

Tightness still prevails

Despite macroeconomic headwinds and surging concentrate production, falling SHFE zinc stocks remain a barometer for the underlying fundamentals in China, backing up the notion that smelters have yet to raise their utilization rates. Even though around 500,000 tonnes per year of updated smelting capacity is due to enter production this year, China's environmental watchdog will conduct further rounds of inspections, maintaining pressure on smelters. It appears unlikely we will see any major step up in utilization rates until H2 and our forecast for annual output growth of 1.9% may need downgrading. Elsewhere, the lack of deliveries into the LME warehouse system despite the biggest backwardation in 13 years suggests the ex-China market remains tight. But price sentiment is being driven by macro factors – namely US-China trade tensions – and the risks remain to the downside or until the fundamentals can reassert themselves. When they do, the key will be whether the concentrate surplus is filtering into the refined market or whether the smelting bottleneck continues to hold it back.



Analysis by **Andy Cole**, Fastmarkets MB

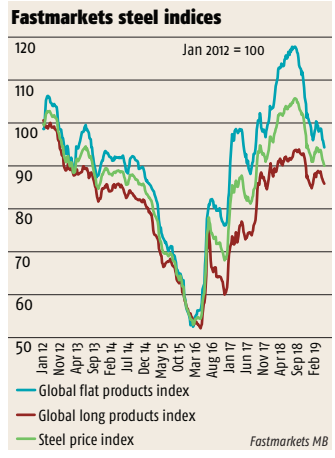
Steel

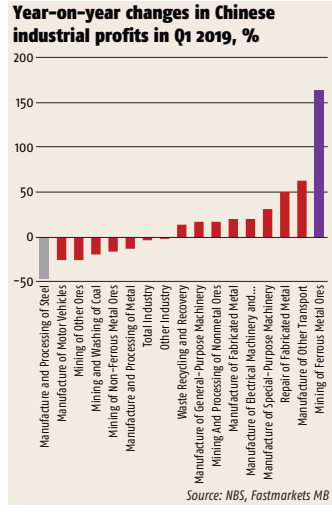
Production cuts beckon, but more in the "west" than in China

Increasingly positive sentiment and the strong price rises we recorded in March led to a large revival in margins at China's steel producers. From a profit margin of just 2% in the January-February period we detailed one month ago, steel producers moved up to 3% for the first quarter. This, however, is just half of China's industrial average. As the chart shows, from a profitability perspective, the steel industry was the worst performing industry in China during Q1, worse even than the automotive industry; profits fell more than 40% year on year. At the top end of the scale – no surprises here – were the profits of China's iron ore miners who benefited hugely from a combination of rising demand – otherwise known as excessive BFI production in China – and supply constraints among their lower-cost rivals in Brazil and Australia. Together these factors pushed and pulled the MBIOI62 to a Q1 average of $82.41 per tonne, up 11% year on year.

China's Manufacturing PMI remained positive in April, just, though the relevant indicators for the steel industry were again comparatively strong: Manufacturing production hit a score of 52.1; New Orders 51.4; and the so-called Purchase Quantity Index, which refers to manufacturers' key raw material hit 51.1. These readings were all comfortably above the headline number. In the circumstances saleable (finished) steel production continued to surge in April rising by 11.5% among the CISA-member mills, pushing the growth rate for the first four months to 11.1%. In a further sign that the steel industry has overcome the environmental constraints that Chinese authorities imposed, Hebei province, the state at the epicenter of "blue sky" targets, recorded a 16.5% rise in steel production and a 17.8% rise in crude steel effectively increasing their share of the national total to 24%, double their nearest rival Jiangsu.

While the characterization of a booming China has ▶





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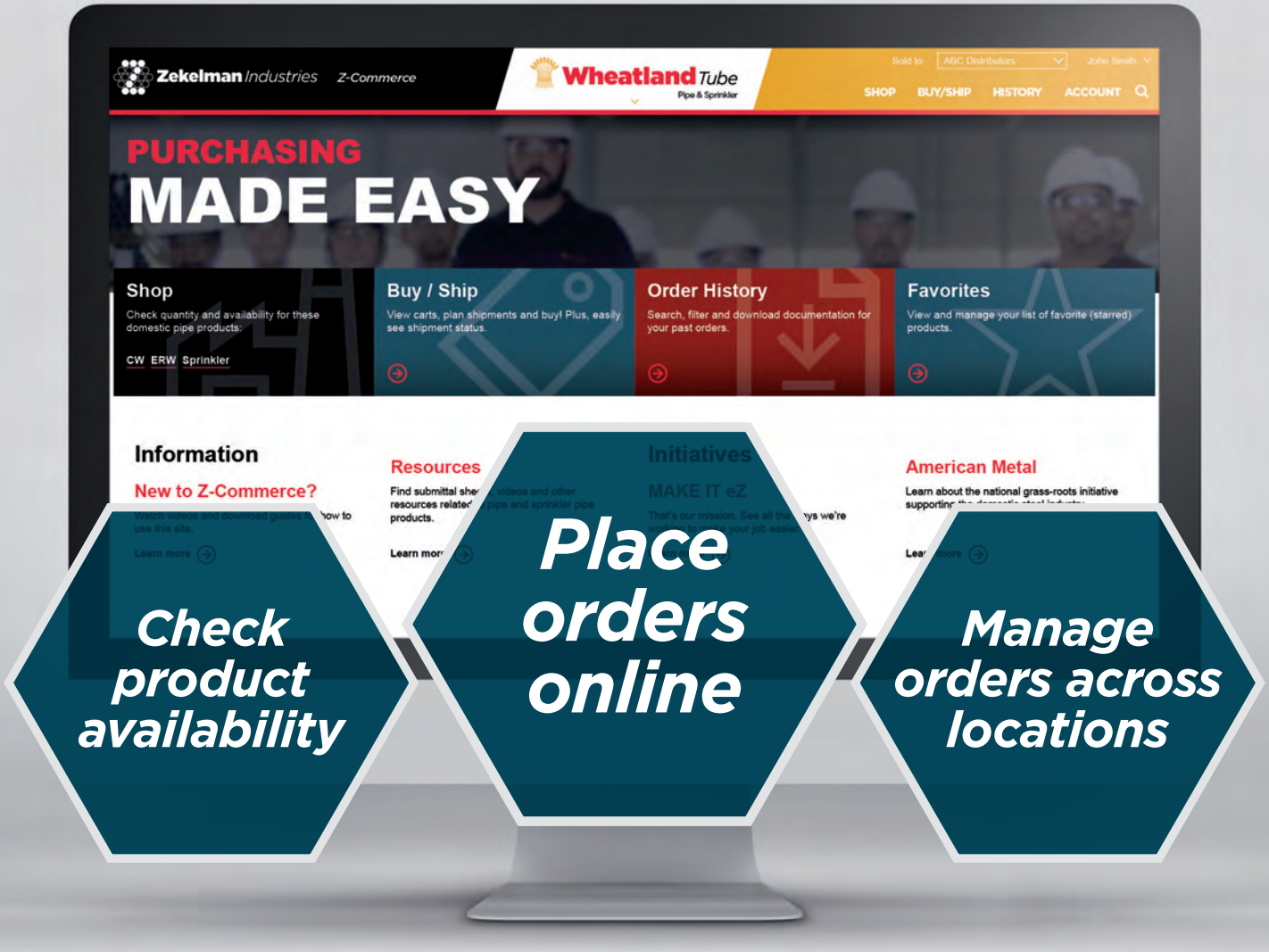

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clearly returned, the associated benefits of high prices and profits everywhere else, is yet to materialize. Nowhere is this the case more clearly demonstrated than in the US where mill prices for the HRC benchmark fell below $700 per metric tonne in May for the first time since before section 232 (December 2017). In the southern EU market, prices have fallen to an average of €450 per tonne ($500) for the first time since November 2016. Back then, US prices were struggling to revive above $550 per tonne and US mills will be hoping that Section 232 will continue to protect them from any cheap, lossmaking EU or other foreign steels that would otherwise force them back to lossmaking levels below $600 per tonne. At present, the average south European mill base price at the port of export to the USA would be no less than $628 per tonne FOB when including the 25% tax, giving the supplier no more than an unpalatable $62 per tonne to deliver material into the US Midwest. If as we suspect, US prices only have farther to fall in the short term as Canadian and Mexican supplies compete duty free, US and not just European mills – ArcelorMittal has already announced pending cuts – are going to be contemplating some significant downtime.

Unable to blame China, whose trade to both markets is a fraction of what it was, the solutions will have to be found closer to home. EU mills overall have continued to cut production this year, if only by 2% on average, whereas US mills were going the other way up 7% in the first quarter.

Analysis by **Alistair Ramsay**, Fastmarkets MB

Steel raw materials

Global scrap prices hinge on Turkey's return to health

At a roundtable discussion this January at the Material Recycling Association of India (MRAI) in Kochi, Southern India, we presented to delegates the view held by the Fastmarkets MB research team that ferrous scrap prices this year will be higher than 2017 but underperform since last year. As one might expect, this view did not receive universal approval from a room packed with scrap merchants, but so far our theory has been correct. Prices for Northern Europe-origin HMS 1&2 (80:20) scrap imported to Turkey looked likely to average around $300 per tonne cfr in the first five months of 2019. That compares with $351 per tonne last year and $267 per tonne in 2017. Similar price patterns have also been seen in other key ferrous scrap import markets such as India and Taiwan.

The key reason for lower scrap prices this year has been Turkey – the world's largest scrap importer and leader for global scrap prices – has caught a cold. With the weak lira and a shrinking local construction sector reducing margins, Turkey's long steel mills have this year cut back on production and reduced scrap purchases. Turkey's crude steel output fell 13.9% year on year in January-March, according to the World Steel Association. The country imported 3.89 million tonnes of ferrous scrap in January-March, the Turkish Steel Producers Association said, lower than both 2018's 5.37 million tonnes and 2017's 4.25 million tonnes.

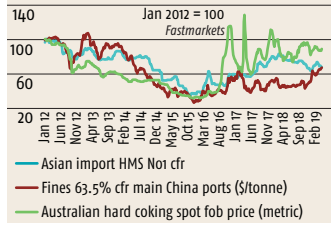
The high correlation between movements in US scrap markets and export prices has been negative for US domestic tags. Although local factors such as bloated supply contributed to the downturn in the US domestic scrap market in April and May, the drop came after two consecutive monthly declines in Turkey. Our research shows that the monthly change in the Philadelphia HMS 1 scrap price has only diverged from the direction of the Turkish HMS 1&2 import price one month per year since 2014. As the chart shows, changes in the Chicago domestic shredded scrap price since the start of 2012 have correlated more closely with export volumes (with a one-month lead time) and export prices than local hot rolled coil (HRC) prices and local demand with a one-month lead time.

The US market's continued exposure to the Turkish import price comes despite the US being less dependent on Turkey as a buyer of their scrap. US ferrous scrap exports rose 15.7% year on year in 2018 to 17.33 million tonnes, according to US Census Bureau data, but the share occupied by Turkey – its single largest buyer – fell. Turkey's export share for 2018 was 19.8%, down strongly from the 24.3% share seen in 2017, with volumes to Turkey actually falling 5.5% in 2018 to 3.43 million tonnes. Instead, Asian countries gained share, with exports to South Korea, Vietnam and Taiwan making up an average of 22.4% of all US exports in 2018 compared with 17.1% in 2017.

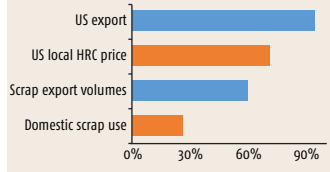
Despite the tough year so far, Turkey's import scrap market could be partially healed by the recent halving of US import tariffs on Turkish steel back to 25% from the previous 50%. With the tariff reduction, Turkey's export rebar prices (including freight) can now undercut local US prices by over $100 per tonne, likely raising Turkey's rebar sales and supporting scrap demand. But unhealthy downside risks persist as EU quotas mean Turkey will no longer have access to European long steel markets in the second half of 2018, while Oxford Economics forecasts Turkey's construction output will fall 1.7% this year. So despite any near-term boost from the tariff reduction, we see Turkish import scrap prices underperforming last year overall, and thus we maintain that unpopular view given at MRAI Kochi.

Analysis by **Lee Allen**, Fastmarkets MB

Fastmarkets MB steelmaking raw materials indices



Export markets are key factors for US local scrap prices



Note: US scrap exports and scrap demand calculated with one-month lead time

Source: Fastmarkets AMM, Fastmarkets MB

SONAMI

Diego Hernandez

'Copper has a great future'

With an international career that has spanned senior positions with some of the biggest companies and mines for non-ferrous metal production, Sonami president Diego Hernandez tells Andrea Hotter about the multiple roles that led him to the pinnacle of copper mining

Diego Hernandez was in his mid-20s when he learnt a very important lesson about negotiating. The young mining executive, who would go on to become the chief executive officer of both Collahuasi and Codelco – as well as hold senior positions in BHP Billiton, Anglo American and Rio Tinto – was working in Minas Gerais state in Brazil.

It was his first on-the-ground role in mining, and he was general manager of a tin and tantalum operation in an area surrounded by farmland. Naturally, this meant lengthy discussions with local farmers over land access, which was something Hernandez quickly discovered the villagers were very good at.

One farmer came to him and offered to sell Hernandez land that he did not need or want, so he politely declined. But the man persevered and it became clear that he was not going to take no for an answer. "I said I didn't have the money just to stop the farmer from offering me the piece of land, so he said, 'ok, I'll take your car.' That was probably half the price of the piece of land, which I didn't even want," Hernandez says.

Hernandez ended up buying the land using his car and some extra personal money as payment, learning in the process some key takeaways about negotiating, including that creativity and persistence pays.

The young Hernandez had come to Brazil from Santiago, Chile, where he was born and raised. His parents, both of whom were professors, wanted Hernandez to speak a foreign language fluently and sent him to the French school in Santiago, where he learnt to read and write in French even before mastering his native tongue, Spanish.

Excelling in mathematics, Hernandez was in the top five nationally in exams and ended up at the Engineering School at the University of Chile, where his older brother was studying chemical engineering. When it came to pick an engineering discipline to specialize in during his third year, "then I wondered why I was there!" Hernandez laughs.

He eventually settled on mining engineering, "an area where you need to know a little of everything because mines are isolated – so you need to understand electricity, mechanics, geology,

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manage different resources like people, financial, technical. I think that was what attracted me," Hernandez says.

In 1969, his fourth year, Hernandez went to live in France for a scholarship at the prestigious École des mines de Paris. He stayed nearly a further four years, finishing his degree in Paris and later validating it in Chile and Brazil. It was also where he built on his love of cooking, mastering paellas and empanadas while seeking something different from the food served at the university cafeteria.

"Paris was great – it was one of the places to be at that time," he reminisces. "It was also very hard work because the academic standard was high. But I survived and graduated there in mid-1973," he says.

Mining move

Hernandez, by this time married in France to his Brazilian wife, took his first job in Sao Paulo with an engineering firm, working on mining projects and perfecting his Portuguese language skills. It was the time of an economic boom in Brazil and his services were in demand. Hernandez moved after a year to the tin-tantalum mine, then owned by investment bank Banque de l'Indochine.

"I liked tin and tantalum very much. Even as a medium-size mine, we produced 15% of world tantalum production and prices went from around $10 per pound to more than $100 per lb at the time, so we had a very good couple of years enjoying great prices," he says. "In that job I worked on all aspects, including technical, people, taxes and accounting – it was really good training. I was quite young with a big responsibility and learnt a lot, in a very nice place," he adds.

After four years the mine was sold to a European metallurgical group. Hernandez stayed on for another two years, and then decided to return to Chile.

His next role was as assistant general manager at the Mantos Blancos copper mine in Chile's Antofagasta region. Initially owned by the Hochschild Group, before its sale during Hernandez' time there to Anglo American, the mine was then the country's largest private copper producer.

"It is at Mantos Blancos that I learned a lot about operations because the mine was underground and open pit with an oxide plant and a concentrator – it was like two mines in one," Hernandez says. He spent over four years there, living in the port city of Antofagasta and traveling 30 miles to the mine every day, six days a week. "There wasn't too much time to spend outside the mine!" he notes.

'Working for a business association is a little like a public service because you have to work for the country, the industry'

Eventually the opportunity to move back to Brazil and develop a project presented itself. Hernandez left Anglo American and joined Rio Tinto at the Morro do Ouro gold operation in Paracatu, Minas Gerais state, just as its feasibility study was approved. "I was number two for the project – firstly working as the counterpart for the engineering firm doing the project and then the rest of the time organizing and preparing the company for production. That's where I learned how to manage projects," Hernandez says.

The mine, now owned by Kinross, was commissioned by Rio Tinto in 1987 and produced about 50 tonnes of gold through 1999, equivalent to about 9% of Brazil's total gold production in its lifetime.

"Once I had completed my work at that project, I was appointed in charge of the development of new projects at Rio Tinto Brazil. However, I then received an offer to return to Chile with Anglo to take over a gold project it was just starting," Hernandez recalls. He took the job. Based in Santiago, the Marte gold project was in Copiapó, Atacama region, Chile, where Hernandez travelled weekly.

But the role, he willingly admits, was a "very tough experience, because we built, commissioned and shut the project down within three years."

"Everything went against us – the exchange rate, gold prices, plus the gold recovery was not what had been expected from the feasibility study. It was very tough, probably the hardest job I ever had – very good training, but very expensive training," he adds. It was the personal low point of his career, he says, but notes that Anglo American was incredibly supportive throughout the experience.

Mantos Blancos

After the difficult time with the Marte gold project, Hernandez continued to work with Anglo American in Chile as development manager. "We had to recover our credibility," he acknowledges.

The company did, in spectacular fashion, with two new copper projects – Manto Verde in the Atacama region and an ambitious plan to develop one pit on top of all the underground mines and open pits of the existing Mantos Blancos operation. The idea of an enlarged mega-pit was something that had initially been conceived when Hernandez was working at Mantos Blancos over a decade earlier, but had been considered too risky by former management.

"When I came back to Mantos Blancos I thought it was too late for the project, but the country manager asked me, 'why don't you look into it again?'" Hernandez says. "So we did, and that's why Mantos Blancos is still alive today. Both projects were very interesting and successful."

Anglo American asked Hernandez to be the general manager of Mantos Blancos Company, its main company in Chile at that time. His remit included everything but management of Compañía Minera Doña Inés de Collahuasi, a joint venture in which Anglo American was a major shareholder. Collahuasi was nonetheless very familiar to him because Hernandez had previously led the team to evaluate Anglo American's acquisition of a stake in the copper operation.

Collahuasi

When the Collahuasi CEO left unexpectedly, Hernandez was offered the role on a temporary basis while the search for a full-time executive took place. Seconded to the operation from June 1995 until November that year, he must have done something right because the joint venture partners offered Hernandez the role on a permanent basis.

"I wasn't a candidate originally, but they were satisfied with what I had done during this six-month period," Hernandez says. "Taking the Collahuasi role was a big decision for me because one of the conditions was to leave Anglo American – it was a joint venture firm and they wanted an independent management," he adds.

He joined Collahuasi in 1996, as the project secured its financing package and began construction, spending nearly five years at the project including through the mine's first year of commercial production. All his previous knowledge came together, creating the biggest project worldwide in copper at the time.

It also gave him experience in working for a company with several shareholders, although the downside was the room ▶

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Total Lubricants, a leading player in the global lubricants market, announces the launch of FOLIA, a revolutionary development in the field of metalworking. FOLIA is a biosourced, water-based fluid free of mineral oils and emulsifiers. Offering outstanding cooling and lubricating properties, it provides users a unique solution for a variety of machining operations.
FOLIA delivers substantial productivity gains, longer tool life and lower operating costs and can also reduce the number of processing steps.
FOLIA's excellent cooling power and lubricity extend the tool lifetime and allow operators to manufacture more parts at a higher rate, reducing tooling costs which are a significant expense.

for promotion was limited since he was already at the top of the venture's management structure. To get around this, once construction was complete Hernandez was authorized to spend some time working for business associations, including as president of Chilean mining trade association Consejo Minero and the board of the Chilean mining society Sociedad Nacional de Minería (Sonami).

Hernandez' next move was a return to Brazil, this time to work with recently privatized mining firm Vale. It was 2001, and he was in charge of non-ferrous metals, which included two gold mines, two kaolin mines, an underground potash mine and then Vale's first copper project, Sossego in Carajás.

He speaks fondly of Vale's former ceo, Roger Agnelli, a Brazilian banker, entrepreneur, and corporate leader who was appointed to the role in 2001 while in his early 40s. "I spent two-and-a-half years with Vale under Agnelli, who was a real character! It was the first time where my boss was younger than me," he adds, crediting him with transforming the formerly bloated company into one of Brazil's top global groups.

BHP Billiton

Although enjoying his role at Vale, opportunity came knocking again when Hernandez was offered the role of head base metals for BHP Billiton. "I thought that was a unique opportunity because it was an international job, but based in Santiago. There are not too many jobs like that," he says.

So he joined BHP Billiton and spent six years with the mining giant, running a global portfolio that included the Cannington silver-lead mine in Australia, the Antamina copper-zinc joint venture in Peru, plus the Escondida and Cerro Colorado copper operations in Chile. During his tenure, BHP Billiton also built the Spence copper mine in the Atacama region of Chile.

"That was great – BHP Billiton was a big company, and I learnt a lot there. When I joined Chip Goodyear was the CEO and extremely interesting to work for," he notes.

It was during his time at BHP Billiton that Hernandez was nominated for a Copper Club Ankh Award*, an honour that he says was "very important" for him. But by the time of the award ceremony in June 2010, he had left BHP Billiton, having been offered the position of CEO of Chile's state-owned copper producer, Codelco. A strong sense of national calling swung the tough choice for him.

'Mining is a great opportunity to work in an international business for people that would like to manage large resources, including human and financial'

"I left a very enjoyable role with BHP Billiton to go to Codelco, firstly because I had the opportunity to once again be a CEO, and secondly because I love my country and its mining industry, and I wanted to give back what I had received," Hernandez says.

Once there, Hernandez spearheaded Codelco's move to exercise a long-standing option to buy a minority stake in the coveted Anglo American Sur properties, including the flagship Los Bronces mine. Before it could, however, Anglo American surprised the mining industry with the sale of a stake to Mitsubishi, a move that Codelco argued violated the Chilean legal principle of "good faith" by selling the stake preemptively. An increasingly acrimonious dispute ended up in the courts; before it was resolved, Hernandez resigned, citing personal reasons.

"It was a challenging time, but I think we did a lot of good things. Among others, we exercised the option to buy back Los Bronces from Anglo American Sur – Codelco eventually succeeded with that," he says. "It was most unexpected for many people who didn't believe Codelco could make that kind of move," Hernandez adds.

It was the first time in his career that he didn't have a role to go to, but not for long: within a couple of months he became CEO of UK-listed miner Antofagasta Minerals, a role he stayed in until 2017, when he decided to leave executive management positions.

Sonami and present day

He is now back at Sonami, this time as its president, and he has two other roles: as board director of zinc-focused miner Nexa Resources, controlled by Votorantim, and as adviser to the president of the Penoles-Fresnillo group in Mexico, which focuses on zinc, lead, silver and gold. "Working for a business association is a little like a public service because you have to work for the country, the industry," Hernandez reflects.

"My approach has been I take a job, and I enjoy it while I am learning. But there is a moment when the contribution starts to be flat and then it's time to move. If you don't have another opportunity in your organization then you don't need to be ashamed to look somewhere else," he says.

"I've been lucky – I think all my moves have been at the right time and, except between Codelco and Antofagasta, I ended a job one day and started a new role the next day. I always knew what I would be doing," he adds.

Stepping down from executive roles has not eased his workload however, because his three roles have him traveling continually, something he enjoys and recognizes was not common among his generation. When he does get some spare time, he reads and also cooks, although "I want to be on my own in the kitchen – not with other people around!" he laughs.

Hernandez also enjoys his family. He has one son – a mining engineer – and three daughters, as well as seven grandsons, and is aware how critical their support has been. "To be able to work in this business you need to have a wife and family that supports you – we have moved I don't know how many times, living in different houses, new countries and places," he adds.

What would his advice be for a twenty-something version of himself starting in mining today?

"Mining is a great opportunity to work in an international business for people that would like to manage large resources, including human and financial. Of course, there is a price to pay – you have to move a lot, work in operations to understand how the business operates, and that can be challenging and different," he says. "You need a long-term perspective for the business or it won't work, but have to achieve short-term results for shareholders or there is no long term!" he notes.

"Irrespective of the sometimes negative reputation that mining has, copper has a great future. It's very important and will be grow increasingly more important amid all the challenges of climate change and the move to electromobility. It's very important that we keep producing copper because it's part of the future," he concludes.

***Copper Club 75th anniversary**

See the special section on following pages for further Ankh Award winner profiles and more on the history and activities of the Copper Club.

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The dilemma of unplanned events

Digital transformation implies transformation by technology. But the true value of digital transformation is not in the technology – rather it is in the ability to react fast and mitigate value losses. Shortening the time between an event and the correct action makes all the difference in a competitive market.

Successful metals production today already represents the leading edge of knowledge, application, imagination and intuition in various fields. MES systems as well as advanced planning tools are a vital element within the automation pyramid of every highly sophisticated steel or aluminium producer.

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- No paper
- Fast closing

These are the long-term goals of digital transformation – and as the term 'transformation' indicates, this is an ongoing process, not a single task. A production management solution is fundamental for this process – the reliable enabler on a challenging journey!

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2. EASY IMPLEMENTATION & NON-DISRUPTIVE UPGRADES
Only a stable and reliable product with a broad installation base is able to meet current and future industry requirements.

3. REAL-TIME RESPONSIVENESS & OPTIMIZATION
Manage process exceptions by having the right choice available – in real time. Smart assistance systems will guide operation experts through the uncertainties of production.

4. DATA ANALYSIS & PREDICTIVE SERVICES
The availability of new mass data technologies provides a golden opportunity to maximize the potential of every producer's IT environment.

5. QUALITY & RELIABILITY
Reliable processes which are robust towards disruptions are the basis for high-quality products. Therefore expert know-how and seamless process traceability must be reflected by the IT system responsible.

6. MULTI-SITE SOLUTIONS AND DATA CENTERS
A stable and flexible IT infrastructure that follows the ever-changing demands of global production is the right backbone to realize the business of the future.

PSI, the #1 strategic partner for steel and aluminium producers, with its leading production management software PSImetals, will start a new journey into the future of production management in June 2019. We invite all our current and future customers to join us. Departure is at Metec 2019 in Düsseldorf.

ON THE ROAD TO THE FUTURE. TOGETHER.
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PSI Metals
Raffael Binder
Director Marketing
info@psimetals.com
www.psimetals.com

How the club began

In this 75th anniversary year of the Copper Club, Fastmarkets special correspondent Andrea Hotter has compiled a comprehensive account of the club's history, its scholarship and award programs, profiled some of its leading members, and obtained multiple viewpoints on copper trends and outlook

COPPER CLUB

The Copper Club's inaugural dinner in 1944

A group of men met for dinner in Washington DC. It was December 1944, and the world was at war. Little did they imagine that the occasion would be the start of an annual gathering that is still going strong during this 75th anniversary year.

The participants were representatives of the copper industry and part of President Franklin D. Roosevelt's War Production Board (WPB), set up to two years earlier to help the US government serve the needs of World War II. Its work included converting industries from peacetime to wartime needs, allocating scarce materials and prioritizing the distribution of materials and services. Copper was key.

"Silver is needed in the war effort: we have an acute shortage of copper, and since silver conducts electricity as well as copper, we can substitute silver for copper in many cases and use the copper thus saved for vital military applications," said Harvey Anderson, chief of the WPB's conservation and substitution branch in November 1942.

As they worked together over the months, the various WPB copper delegates formed strong friendships, which strengthened over lunches at the Union Terminal, the city's key transportation hub.

Calling themselves the Copper Club of World War II, the group – including representatives from mining, smelting, refining and manufacturing – decided to have a dinner to mark the winding down of its work as the end of the war approached. That meal, held in a Washington hotel, was the first for what was later to become known as the Copper Club.

A resounding success, the men decided at the dinner to bring the industry together once a year and look for ways to work together on common causes in the meantime. And so was born the organization that exists today.

Future dinners were held in New York, where a number of major copper companies were headquartered. Although the organization started as a relatively small, US-focused effort, the dinner grew to attract people from around the world, including clients, and became an ultimate opportunity for the industry to come together.

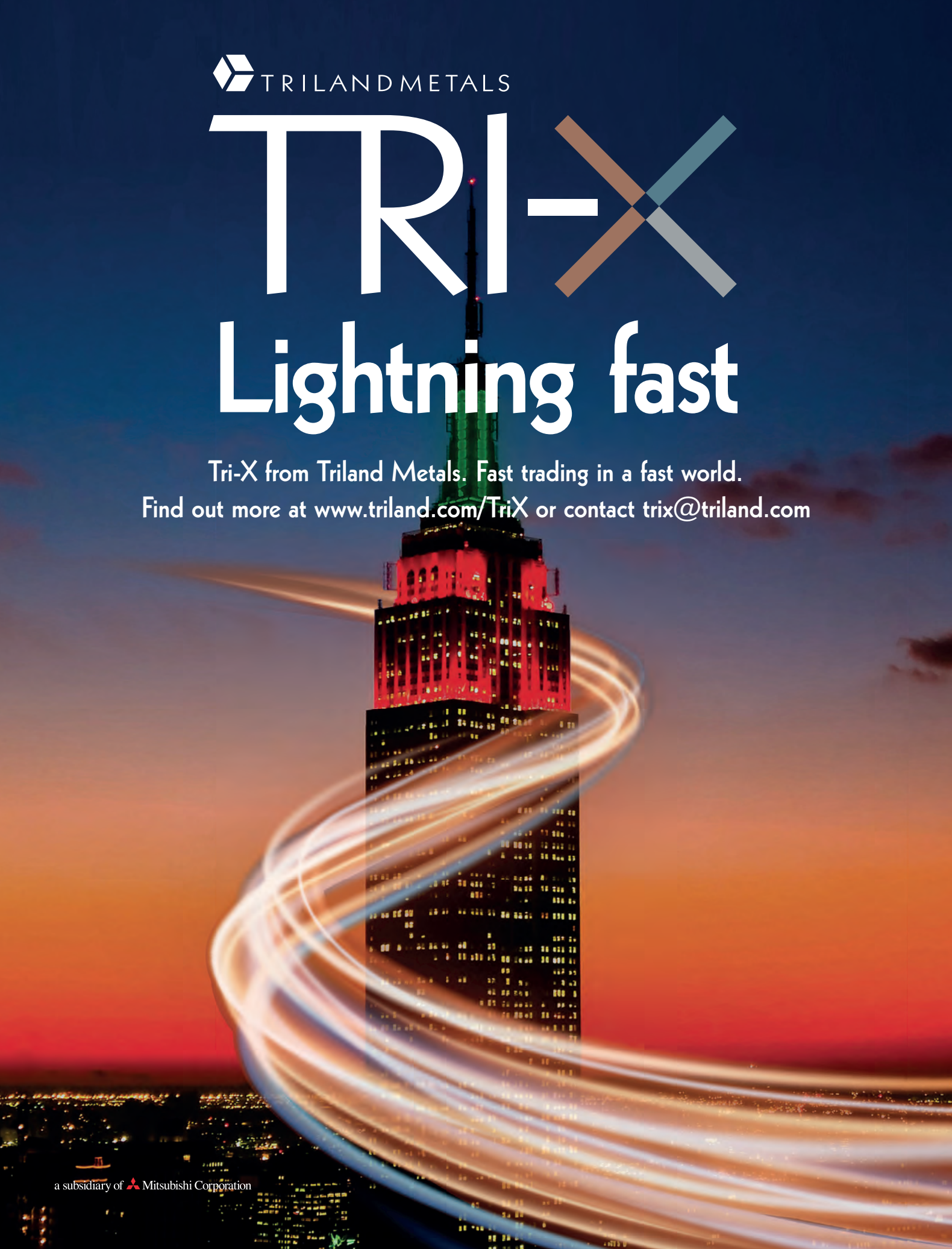
Initially there was an official membership process to join the Copper Club, but it was eventually decided that anyone working in the industry was a member of the club automatically. Just as globalization has changed the dynamics of the copper industry, so too has the membership of the Copper Club changed to reflect that trend.

Two decades after its inception, the Copper Club created the Ankh Award to honor those that had made extraordinary efforts on behalf of the industry. This was followed in 1994, the Copper Club's 50th anniversary year, by the launch of a scholarship award program with the goal of developing students to play a positive role in leading the industry's future.

In an industry that has gradually moved away from integration to the separation of production activities, the Copper Club has become all the more important in its 75th year as a means of bringing copper participants together to promote and protect their businesses.

COPPER CLUB

The Copper Cub's 25th anniversary dinner in 1969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Scholarship program

The 25th anniversary of scholarships

Set up in 1994 during the 50th anniversary year of the organization, the Copper Club Educational Fund has awarded over 150 individual scholarships and two special grants, worth more than $1.2 million dollars in total. That includes eight scholarships this year to students from different universities across the United States.

Recipients are selected by the organization's scholarship committee, currently operating under its third chair, Joseph Robertson.

The first chair was former Phelps Dodge executive and current Copper Club chairman Art Miele, who was succeeded by Fred Demler, who is now global head of metals at brokerage firm ED&F Man. Michael Lockwood, principal of The Metals Risk Team, will take over the role this year.

The grants are funded by companies with which many of the organization's members are associated. They include the Lord Bagri scholarship, sponsored by the Bagri family, and the Barry Feldman Memorial scholarship, sponsored by Oskar Lewnowski via the Langdale Foundation, Michael Farmer and David Lilley.

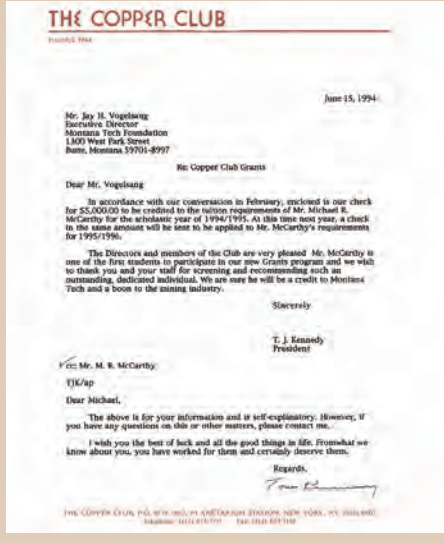
The Colorado School of Mines also distributes scholarship money from funds it invested as part of an endowment after being given a one-time grant by the Copper Club. Other scholarships are granted directly by the Copper Club.

This year's recipient of the Lord Bagri Scholarship is Curtis Johnson of the University of Nevada, Reno, while the Barry Feldman Memorial Scholarship has been awarded to Dirk-Philip Van Den Berg, from the University of Kentucky. Scholarships have also been awarded to Chris Osterhout of Virginia Tech, Kerst Kingsbury of the University of Arizona, and Maria Pineda of the New Mexico Institute of Technology.

Under the Colorado School of Mines endowment, scholarships have also been awarded to Timothy MacInyre, Kaitlyn Nagel and Jack Dombrowski.

A first recipient

When Michael McCarthy opened a letter from the Copper Club, he was taken aback. He had recently been told he was one of three first recipients of the association's inaugural grants program and that he had won a scholarship towards the next two years of his



THE COPPER CLUB

June 15, 1994

Mr. Jay H. Vogelsang
Executive Director
Montana Tech Foundation
1300 West Park Street
Butte, Montana 59701-8997

Re: Copper Club Grants

Dear Mr. Vogelsang

In accordance with our conversation in February, enclosed is our check for $5,000.00 to be credited to the tuition requirements of Mr. Michael R. McCarthy for the scholastic year of 1994/1995. At this time next year, a check in the same amount will be sent to be applied to Mr. McCarthy's requirements for 1995/1996.

The Directors and members of the Club are very pleased Mr. McCarthy is one of the first students to participate in our new Grants program and we wish to thank you and your staff for screening and recommending such an outstanding, dedicated individual. We are sure he will be a credit to Montana Tech and a boon to the mining industry.

Sincerely

T. J. Kennedy
President

cc: Mr. M. R. McCarthy

TJK/ap

Dear Michael,

The above is for your information and is self-explanatory. However, if you have any questions on this or other matters, please contact me.

I wish you the best of luck and all the good things in life. From what we know about you, you have worked for them and certainly deserve them.

Regards,

tuition at Montana Tech. What he was not prepared for was the size of the check.

"I didn't know the amount – $5,000 a year – until I got the letter. To my knowledge, at the time at Tech there was no single scholarship that was even close to this amount. It was a great feeling," says McCarthy, who was studying mining engineering at the Butte, Montana-based university.

The grant enabled McCarthy to go to summer school instead of getting a temporary job, taking extra credits to both ease his senior year and enhance his knowledge base. It also allowed him to graduate from Tech without any student debt, with the financial cost of education being "a huge issue that's only bigger now. I always appreciated that."

Emerging in 1995 from Tech as valedictorian, McCarthy started as an engineer for Placer Dome at its Golden Sunlight mine in Montana, now owned by Barrick. It was a mine in transition, undergoing a complex permitting process that left McCarthy a little baffled.

Mike McCarthy is Copper Club Choice

Mike McCarthy

Sept. 94

"One of the frustrating things to a naïve young engineer was that we would come up with engineering solutions to issues and then be told 'no', because it didn't fit the permitting regime. That to me was a black box that I couldn't understand," he says.

From Golden Sunlight he went to work for the mining division of Montana Power, then the main power provider for the region. McCarthy ran into similar frustrations there. Trying to understand how the legal process worked, he spent vast amounts of time talking to lawyers. "Everything I was doing was being dictated by lawyers. I decided I either had to get past this frustration and accept it, or take action to understand it," he adds.

He opted for the latter, enrolling in a three-year graduate degree course in law at the University of Utah, focusing on natural resources law. The move into law was initially unsettling – mining had been in his blood from birth. McCarthy's great-grandfathers and grandfathers were all underground miners, and one grandfather in particular was a huge influence on him growing up.

"There were obviously thoughts of 'did I do the right thing?' because I truly loved engineering and the nitty gritty of solving tough engineering problems, and I knew I would miss that," he says. "So, while I was driven and focused and fairly certain I was doing the right thing, there were always those thoughts that, 'Boy I'm going to miss engineering.' And I do," he adds.

The combination of engineering and law, however, proved to be a winning ticket. In 2000, McCarthy started work at the law firm of Parsons Behle and Latimer, a natural fit because of its century-long mining clientele like Rio Tinto Kennecott and Barrick. By around 2008, mining had largely taken over his practice as commodity prices boomed.

Then in 2016, a role opened up that McCarthy says was like going home as he knew the company well. That role was at Barrick, where McCarthy is now the Assistant General Counsel US, based in Salt Lake City, Utah.

He remains extremely grateful to the Copper Club for giving him a head start. "It's a wonderful and telling reflection of the Copper Club that the scholarship program is still in place. Every once in a while organizations come to a decision that impacts the lives of many, many people in a very positive way, not to mention the benefit it has for the industry," McCarthy says. "It's a reflection on the people in the organization that they would do something like this. It's an outstanding scheme." ▶

Happy 75th anniversary from the London Metal Exchange

LME
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From one venerable metals institution to another, we'd like to wish the Copper Club a very happy 75th anniversary.

We are proud to have worked with the world's copper community since 1877 when copper became the first metal to be traded on our market.

We send our best wishes to the Copper Club for the next 75 years!

SETTING THE GLOBAL STANDARD

Copper Club 75th anniversary

Copper Club scholarship winners

2019–2020

The Lord Bagri Scholarship Recipient
Curtis Johnson, University of Nevada
Barry Feldman Memorial Scholarship Recipient
Dirk-Philip Van Den Berg, University of Kentucky
Chris Osterhout, Virginia Tech
Kerst Kingsbury, University of Arizona
Maria Pineda, New Mexico Institute of Technology
Timothy MacInyre, Colorado School of Mines
Kaitlyn Nagel, Colorado School of Mines
Jack Dombrowski, Colorado School of Mines

2018–2019

The Lord Bagri Scholarship Recipient
Cayley Brooks, University of Arizona
Barry Feldman Memorial Scholarship Recipient
Christopher Hareland, Rice University
Cameron Baker, Colorado School of Mines
Bon Durica, New Mexico Institute of Mining & Technology
Seth Edelen, Colorado School of Mines
Byron Hurtubia, Pontificia Universidad Católica de Chile
Luke McCulloch, Montana Tech
Alex Norris Virginia Tech
Monica Paul, University of Illinois at Urbana-Champaign
Emily Perry, Colorado School of Mines

2017–18

The Lord Bagri Scholarship Recipient
Andrei Romascanu, McGill University
Barry Feldman Memorial Scholarship Recipient
Kristopher Schaff, Montana Tech
Emma Baker, University of Nevada, Reno
William Behre, Colorado School of Mines
Javier Cejas, Pontificia Universidad Católica de Chile
Rachel English, Colorado School of Mines
Sean Klasen, University of Arizona
Evan McCombs, Colorado School of Mines
Bethany Witter, Virginia Tech

2016–17

Barry Feldman Memorial Scholarship recipient
Jennifer Jorgensen, University of Nevada, Reno
Ian Brummel, Colorado School of Mines
Cory Burkwald, Michigan Tech
Wesley Hall, Colorado School of Mines
Bridger Hurley, Montana Tech
Jing Liu, The University of Arizona
Tim MacIntyre, Colorado School of Mines
Zarifa McIntosh, Colorado School of Mines
Daniel Rowles, Virginia Tech

2015–16

Katherine Burke, Missouri University of Science & Technology
George Chapin, University of Utah
Maureen Chorney, Montana Tech
Taylor Dawn, The University of Arizona
Madison Lytle, Colorado School of Mines
Hannah Steadman, Colorado School of Mines
Joe Waite, Colorado School of Mines
Jiaxuan Zhang, University of New South Wales

2014–15

Ilse Alacantara, The University of Texas at El Paso
Ryan Burton, University of Utah
Elliot Britvec, Colorado School of Mines
Mara Erhard, University of Arizona
Wesley Hall, Colorado School of Mines
Steven Piippo, Montana Tech of the University of Montana
Myriah Santistevan, South Dakota School of Mines & Technology
Felip Sarovic Allende, Pontificia Universidad Católica de Chile
Jillian Trickey, Virginia Tech
Joe Waite, Colorado School of Mines

2013–14

Anjelica Campos, New Mexico State University
Douglas "Ty" Conner, Colorado School of Mines
Tyler Faulkner, Virginia Tech
Deanna Fitzgerald, Missouri University of Technology & Science
Timothy Gort, Colorado School of Mines
Jamie Lynn Mills, University of Arizona
Jordan Oxborrow, Colorado School of Mines
Jonathan Spring, McGill University
Krysten Whearley, Northern Arizona University
William Yin, Queen's University

2012–13

Andrew Carey, University of Utah
Sebastián Garrido Ortega, Pontificia Universidad Católica de Chile
Lynn Kern, Virginia Tech
Kyle Lindahl, Colorado School of Mines
Michael MacArthur, Queen's University
Scott McCue, Montana Tech
Tiffany Oney, Colorado School of Mines
Kimberlin Schnittker, University of Texas at El Paso
Danielle Taran, University of Arizona
La Fon Weston, Colorado School of Mines
Copper Club Mine to Mill Grant – *Bestowed to the University of Arizona, Department of Mining and Geological Engineering*

2011–2012

Nolan Black, University of Utah
Andrea Brickley, Colorado School of Mines
Valeria Contreras, Franklin High School
Kalli Dinger, South Dakota School of Mines & Technology
Liz Hunter, Colorado School of Mines
Ernesto Ignacio Santibanez Borda, Pontifica Universidad Católica de Chile
Jordan Rutledge, Colorado School of Mines
Rebekah Simon, Colorado School of Mines
Jason Solomon, University of Arizona
Zachary Wappes, Virginia Tech
Jordan Zampini, McGill University
Tohoku University*
**Grant awarded for student aid due to the devastating earthquake*

2010–11

Ariane Erickson, Montana Tech, University of Montana
Julian Gastelum, Arizona State University
David Haviland, Queen's University
Emma Janisch, Colorado School of Mines, Major: Metallurgical and Material
George Jennings, New Mexico State University
Joshua Morris, Virginia Tech
Dana Specht, University of Arizona Arizona
Christopher Storaker, Pontificia Universidad Católica De Chile
Crystal Twenter, Missouri University of Science and Technology
Sarah Williamson, New Mexico State University
William MacIntyre, Colorado School of Mines
Conor Pesicka, Colorado School of Mines
Kimberly Conner, Colorado School of Mines
Taylor Christenson, Morenci Jr. Sr. High School
Cody Clark, Franklin High School
Kyle Edwards, Silver High School

2009–10

Domingo Gustavo Lama Astaburuaga, Pontificia Universidad Católica De Chile
Andrew Mountford, Queen's University, Kingston Ontario
Nicole Loehr, Montana Tech, University of Montana
Scott Shields, University of Arizona

2008–09

Jack Stratton, Montana Tech, University of Montana
Liane Sandula, Queen's University, Kingston Ontario
Skylar Cobb, Colorado School of Mines
Andrew Storey, Virginia Polytechnic Institute

2007–08

Meghan C. McGrath, University of Missouri-Rolla
Philippe Tetreault-Pinard, McGill
Christopher J. Roos, Montana Tech
Juan Carlos Cortés Campos, Catholic University of Chile

2005–06

Filepe Nicolás Bernal Rebolledo, Catholic University of Chile
James Joseph Martin, Virginia Tech
Dustin Meisburger, University of Arizona
Kelly Ann Murphey, Montana Tech

2004–05

Brady Butler, University of Utah
Kara Smith, Virginia Tech
Jennifer Nekuda, Colorado School of Mines

2003–04

Emily Bracken, University of Missouri
Lisa Schlink, South Dakata School of Mines
Tim Casins, Colorado School of Mines
Steven Shipley, University of Arizona

2002–03

Laure Pate, Colorado School of Mines
Andre Gagne, McGill University
Steve Bundrock, Montana Tech
Nathan Switzer, University of Missouri-Rolla

2001–02

Elizabeth A. Niemi, Montana Tech
Jorge Peter, University of Missouri
Emily A. Sarver, Virginia Tech
Joseph D.White, Colorado School of Mines

2000–01

Grant Kaiser, McGill University
Jennifer Conning, Montana Tech
Bert Cantu, South Dakota School of Mines
David Harding, University of Utah

1999–2000

Brian R. Buckham, University of Idaho
Bradley J. Estes, Montana Tech
David D. Michel, Queen's University
David A. Neal, Virginia Tech

1998–99

Peter Collins, University of Missouri
Joclyn Hunt, Montana Tech
Richard D. Murdock, Queen's University
Roy T. Oommen, McGill University

1997–98

Michelle Langmaid, University of Arizona
Christopher Misterek, South Dakota
Mindy Settles, University of Missouri
Susanne Wilson, Queen's University

1996–97

Lauren Cockhill, Montana Tech
Kevin Kidd, Colorado School of Mines
Zvonka Nickolich, University of Missouri
Gordi Wong, McGill University

1995–96

Stephen Antenucci, McGill University
Renee Balison, Montana Tech
Chris Allen, University of Arizona

1994–95

Michael Holme, University of Missouri
Kristi Linn Kelly, University of Arizona
Michael R. McCarthy, Montana Tech

FREEPORT-McMoRan

Congratulations Copper Club on your 75th Anniversary!

For the past 75 years, the Copper Club has been instrumental in promoting the accomplishments of the copper mining industry and the people who make it great! Freeport-McMoRan is proud of our long history with the club and our many leaders who have been recognized by its prestigious Ankh Award. We look forward to continuing to support the club's great work in promoting copper and the important role it plays in our society.

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Ankh Awards

In most of the past 57 years, the Copper Club has named an Ankh Award winner, presented during its annual dinner to honour outstanding individual achievements in and contributions to the industry

The first Ankh Award was given in 1962 to Clyde Weed, chairman of Anaconda Company, where he had worked for almost 50 years; the last award was in 2018, to Harry (Red) Conger, President and Chief Operating Officer-Americas at Freeport-McMoRan. There is no Ankh Award this year, with the organization instead celebrating its 75th anniversary with a special 1940s-themed dinner at the Pierre Hotel in New York.

Named after the ancient Egyptian hieroglyphic symbol the ankh, the winner receives a trophy reproducing Auguste Rodin's famous bronze sculpture, the Thinker, often used as an image to represent philosophy. Recent statues have been made of resin with a brass patina.

The Ankh Award was given to the copper-dominated Statue of Liberty on the robed goddess sculpture's 100th anniversary in 1986.

The organization has also presented lifetime achievement awards on three occasions. In 2007, a lifetime achievement award was given to Tom Kennedy, president of the Copper Club for over 25 years and a participant in most of the years since the organization's inception.

A lifetime achievement award was also given in 2012, to Jürgen Leibbrandt, Codelco's Executive VP, Commercial Development, and in 2014, to Andrew G. Kireta, Sr., President & CEO of the Copper Development Association.

Nominees are nominated by the copper industry and the winner selected by the Ankh Award committee. The cover profile section of this issue of *Metal Market Magazine*, and the following pages, profile several Ankh Award winners.

COPPER CLUB

Some of the past Ankh Award Winners at the Copper Club Dinner in 2016. Front Row: Diego Hernandez, Oscar Gonzalez Rocha, Art Miele, Andrew Kireta Sr. Back Row: Brian O'Shaughnessy, Dan Jones, Stephen Higgins.

Past Ankh Award recipients

2018: Harry M. (Red) Conger, President and Chief Operating Officer-Americas, Freeport-McMoRan Inc.

2017: Apurv Bagri, President & CEO, Metdist Ltd, and Gregory Christopher, Chairman & CEO, Mueller Industries, Inc.

2016: Stephen T. Higgins, VP Marketing & Sales, Freeport-McMoRan, and Daniel L. Jones, Chairman, President and CEO, Encore Wire

2015: Oscar Gonzalez Rocha, President & CEO, Southern Copper Corporation

2014: Andrew G. Kireta, Sr., President & CEO, Copper Development Association Inc, and Stuart Thorn, President & CEO, Southwire

2013: C. M. Koo, Chairman, LS-Nikko and Jim Vann, Chairman, Rea Magnet Wire

2012: Jürgen Leibbrandt, Executive Vice President, Commercial Development, Codelco, and The Men and Women, Past and Present, of the Arizona Copper Industry

2011: Masayoshi Matsumoto, President & CEO, Sumitomo Electric Industries, and Laurence Golborne, Chile's Minister of Mines

2010: Diego Hernandez, President of BHP Billiton Base Metals

2009: Richard Adkerson, President & CEO, Freeport-McMoRan

2008: The International Copper Association Health and Environment Team

2007: J. Steven Whisler, Chairman and CEO, Phelps Dodge Corp

2007: Tom Kennedy, a lifetime achievement award

2006: Brian O'Shaughnessy, President and CEO, Revere Copper Products, and Juan Villarzu Rohde, CEO, Codelco

2005: Takashi Sakamoto, recently retired, Chairman, Nippon Mining & Holdings, Inc.

2003: Arthur Miele, Senior VP of Marketing, Phelps Dodge Corp. and President, Phelps Dodge Sales Co., and Andronico Luksic, Chairman, Antofagasta PLC

2002: The Lord Bagri CBE, Chairman of the Metdist Group

2001: William O'Hagan, President & CEO, Mueller Industries Inc, and Robert Payne, President & CEO, Copper Development Association

2000: Marcos Lima, President & CEO, Codelco

1999: Christopher Green, former Chairman, London Metal Exchange, and Norbert Brodersen, spokesman for the executive board, KME

1998: Charles Preble, President & CEO, Southern Peru Copper Corporation

1997: Richard de J. Osborne, Chairman, President & CEO, Asarco

1996: Stanley Craft, President & CEO, Essex Group Inc., and Lennart Gustafsson, retired President of the International Copper Association and former CEO, Outokumpu Copper

1995: Milton Ward, Chairman, President & CEO, Cyprus Amax Minerals Co

1994: The Copper Club marked its 50th anniversary with a banquet and historical review in lieu of an annual Ankh Award

1993: Douglas Yearley, Chairman & CEO, Phelps Dodge Corporation

1992: J. Burgess Winter, President & CEO, Magma Copper Co

1991: Keith Hendrick, former Chairman, Noranda Minerals Inc.

1990: Sir Alistair Frame, former Chairman of RTZ Corp

1989: G. Frank Joklik, CEO, Kennecott Corp.

1988: G. Robert Durham, former Chairman, Phelps Dodge, retired President & CEO, Walter Industries

1987: Bryon Halstead, CEO, Halstead Tube

1986: Statue of Liberty, on her 100th anniversary

1985: Frank Archibald, CEO, Southern Peru Copper

1984: Roy Richards, Founder and former CEO, Southwire Co.

1983: George Atwood, Advisory Director for Pennzoil Co., Chairman & CEO, Duval Corp

1982: Harold Lewin; Louis Schwab; Joseph Zimmerman – these awards were bestowed on three industry veterans, though they were not technically designated as Ankh awards

1981: George Munroe, former Chairman, President & CEO, Phelps Dodge Corporation

1980: James Santini, US Representative for Nevada

1979: Maxie Anderson, President, Ranchers Exploration

1978: Charles Barber, Chairman & CEO, Asarco Inc

1977: Plato Malozemoff, Chairman & CEO, Newmont Mining Corp

1976: Alfred Powis, Chairman, Noranda Inc

1975: Sir Ian MacGregor, President & CEO, Amax Inc

1973: Frank Milliken, CEO, Kennecott Corp

1972: William Meissner Jr., Head of the Copper Division, the U.S. Department of Commerce

1970: John Eikenberg, Chairman & CEO, Revere Copper and Brass Inc

1968: Robert G. Page, Chairman, Phelps Dodge Corporation

1965: James Boyd, CEO, Copper Range

1964: Sir Ronald Prain, Chairman, the Rhodesian Selection Trust

1963: Simon Strauss, Director, Magma Copper Co, former Vice-Chairman, Asarco Inc

1962: Clyde Weed, Chairman, Anaconda Company

Ankh Award winner 2003

Art Miele

There are not many mining executives who can say that they took on the Iranian authorities headed by Iran's first Supreme Leader, Ayatollah Ruhollah Khomeini, and won. Art Miele, who spent his career at former US manufacturing and mining firm Phelps Dodge, is one that can.

It was the 1970s and Miele – as manager, business development for Phelps Dodge International Corp. – led the effort to establish a presence in Iran. The joint venture company SICAB began manufacturing and selling a variety of wire and cable products in Iran in 1974.

Everything had run smoothly until the 1979 Iranian Revolution, which saw the overthrow of the country's last Shah and the end of 2,500 years of Persian monarchy. "We had 26 expats involved in SICAB, who were initially sent to India for what we thought was a temporary period when we first saw the potential dangers approaching in Iran," Miele recalls.

The company's workers never returned. Phelps Dodge lost control of SICAB and Miele was involved in the team that sued the Republic of Iran in the Hague. "Just as we were getting very close to the final resolution I received a communication from Iran saying they would love to talk to us about coming back. We said 'thank you, but no thank you!'" he says.

Phelps Dodge won the case before the tribunal in 1986, receiving its original investment of over $2.4 million plus interest in the deposition.

International businessman

Miele began his career with Phelps Dodge in 1967, following receipt of a masters' degree in International Business from George Washington University, where he majored in finance and marketing.

Choosing a job in which he could travel and develop an international perspective had been central to Miele's career choice from the start. "My interest was in a world that was starting to move towards globalization. It took a good 15 years before that trend became evident, but my interest was from the start in the international side of the business," he says.

At that time, Phelps Dodge was predominantly a US mining company with a few international operations, but also a very diverse manufacturing company active in 21 countries in all aspects of the downstream metals industry. Moreover, the president and chief executive officer of the international division was Danish, the chief operating officer was from the USA, one of its senior vice presidents was Egyptian, and another was from Cuba.

Miele was quickly sold. "I said, 'if they offer me that job, then I'm in.' They offered me the job, as manager of business development," he says.

Based in corporate headquarters in New York City, Miele's first project was a Chilean manufacturing company, which later formed the basis for Phelps Dodge's involvement in Chile's mining sector. He was also involved in preparations for buying and growing a company in Brazil.

Miele's new job also began a lifelong affair with the Waldorf Astoria hotel in New York City. Located directly opposite the former Phelps Dodge headquarters on Park Avenue, the Waldorf became a second home to Miele and his family over the years, having himself first stayed there in 1967 when he joined the international group.

COPPER CLUB

Art Miele at the 2018 Copper Club dinner

He was planning a big celebration to mark his 50th consecutive year of staying there, but the hotel closed in March 2017 for renovations after being sold to China's Anbang Insurance Group. "We would typically arrive and they would say, 'Welcome home.' I was really very disappointed!" he says.

Roles overseas

During his interview for his role at Phelps Dodge, Miele had told the international unit's CEO of his belief in globalization and his ambition to live abroad. "He said, 'if you're any good we'll get you overseas in five years.' Well, it took a little over six years to send me, so I might have been good but I wasn't that good!" Miele laughs.

His first overseas posting was in Puerto Rico, where Phelps Dodge had two major downstream manufacturing operations – one copper/aluminium, the other steel. After this he moved to Caracas, Venezuela, where he ran the company's South American operations, including four units in Venezuela itself.

To Miele, living in Venezuela was also like going home. He had spent a significant portion of his courtship of his Florida-born wife – whose grandparents had been diplomats at the country's US Embassy – in Caracas during the 1960s. Living at the home of her aunt and uncle, the latter an international lawyer, Miele had written his thesis in the Venezuelan capital, where foreign oil companies were still the main game in town despite nationalization.

"My wife, Susan, and I got engaged in Venezuela; we knew the country well and didn't expect to return to live there, but ten years later we were back. We had a network of friends so it was an easy transition," Miele says.

"During the 1960s I had decided I wanted to be a country manager, because those guys had it made! The problem was Phelps Dodge wouldn't just let me manage a country – after a while they tacked on a region, which added complexity to my life. But that was a great time," he quips.

It also worked wonders for Miele's Spanish language skills, which were ▶

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minimal before moving to Puerto Rico – he had instead studied Latin and French.

"I took a Berlitz course for two weeks and went off to San Juan speaking Spanglish, then got to Venezuela where they didn't recognize Spanglish, so I had to become a little more proficient in Spanish," he says. "By the time we left Venezuela I was fairly comfortable in the language. If you're forced to read Julius Caesar in Latin then I guess you can make your way through any romance language," he adds.

Running Phelps Dodge's South American operations took Miele all over the region at a time of political upheaval, with military dictatorships and conflicts common. Miele himself got inadvertently caught up in a student protest in Bolivia, where he had been visiting a tin mine – "These little things happen to you when you travel" – after being dropped in the square near his hotel by the head of the operation.

Miele was questioned by the police before being escorted to his hotel. Several years later he came across the same mine manager at a board meeting in Manila for Phelps Dodge's Philippines Energy Products Corporation. "Small world!" Miele says.

After eleven years outside the USA, Miele was, in 1982, offered a role in either Bangkok, Thailand, or at international headquarters in Coral Gables, Florida, adding Phelps Dodge's Asian operations to his South American role. "My children had never lived on the US mainland, so we decided it would be a good time to bring the kids back," he says.

He had just spent three months in Lausanne, Switzerland, as part of the Harvard Senior Executive program, which took 40 professionals from across the globe. Juggling his work at Phelps Dodge with the study, Miele says the company was getting him ready to move into the senior C-suite of the corporation.

It did not take long. In 1987, Phelps Dodge – which was slowly divesting its manufacturing businesses – decided to move its headquarters to Phoenix to be closer to its mining operations in Arizona, and asked Miele to follow as vice president, commercial.

"There were a number of very well-qualified candidates for that position, but finally after a number of years, the forecast of my expectations that the world would move towards globalization was becoming a fact, and my experience supervising companies around the world made it a pretty natural fit to move into that role," he says. "The mining side of Phelps Dodge was really gearing up to become global."

Board roles

The divestment of its manufacturing business highlighted an issue that still concerns Miele today – the potentially negative impacts that a non-integrated industry could have on copper. In particular, he was worried about the mining sector becoming divorced from the ultimate consumer, and concerned that the industry was not working collectively to protect its market from substitution.

It led to the birth in 1989 of the International Copper Association, spurred by Miele and six other executives from various industry corporates. Spending on international activities rapidly rose from $3 million a year to between $40 million and $50 million. "Those of us involved understood you could be operationally not integrated, but you had better have strong downstream relationships," he notes.

He also became deeply involved in the London Metal Exchange when he was invited by its then-chairman, Lord Raj Bagri, to join the board. At that time, the LME was in the midst of a scandal, when Yasuo Hamanaka, chief copper trader at Sumitomo Corp, was found in 1996 to have accrued unauthorized losses of billions of dollars.

Miele stayed on the board for the maximum ten-year limit, and was a central part of the LME's drive for increased transparency, a move to electronic trading, and demutualization of the exchange. He became great friends with Lord Bagri, who he describes as a "mover and shaker, one of the real icons of the industry."

He has also been on the board of the Copper Club for more than 25 years and has served as its chairman for the last 12 years, although he is stepping down this year.

"It's time to hand the role over to the next generation. I am very confident that under the leadership of Steve Higgins and the new board of directors, the Copper Club is in good hands," he says. "I've been proud to be on the board and to have had the opportunity to work with so many people in the industry that have made a significant difference."

In addition to Lord Bagri, Miele says that over the years those people include former Phelps Dodge CEO Douglas Yearley, ex-ICA chairman Lennart Gustafsson, former Magma Copper CEO J. Burgess Winters, past Codelco CEO Marcos Lima, ex-Mueller Industries CEO William O'Hagan, and former Nippon Mining chairman Takashi Sakamoto, all of whom are prior winners of Copper Club's Ankh Award.

That honor was bestowed on Miele in 2003, the same year as his great friend, Antofagasta founder Androniko Luksic – "We went to Africa together to visit copper mines and then we went on a photo safari together. He was one of my favourite people."

"The biggest blessing of the Copper Club and the industry has been the people I've met over the years. Many were Ankh Award winners, as they were iconic to the industry," Miele adds.

Miele finished his career at Phelps Dodge in Arizona, where he still lives today. In addition to the commercial business, he also ran refining and copper products operations, as well as the Climax molybdenum business in Colorado. He retired at the end of 2006 when he reached 65, but stayed in the copper industry, joining Rea Magnet Wire and becoming its non-executive chairman five years ago.

Future

As he steps down from the Copper Club board, Miele is optimistic about the future of the industry due to its role as a key building block in everyday lives, but he reiterates the need for it to be vigilant and to work collaboratively.

"When I began my career in copper the industry was far more integrated than it is today. This provided me with the opportunity to gain first-hand experience with all sectors from mining, smelting, refining through manufacturing to the end users," he says.

"For that reason, I have a strong appreciation for the need for all sectors of the copper industry to come together and defend its products from substitution and promote current and new product applications. Organizations such as The Copper Club, ICA, Copper Development Association, International Wrought Copper Council and others are important vehicles for achieving this objective," he concludes.

Ankh Award winner 2009

Richard Adkerson

Richard Adkerson, chief executive officer of the world's largest listed copper producer, Freeport-McMoRan, was going to be an engineer until a bad experience changed his mind.

He had a summer job at a school-bus assembly plant following high school in Kosciusko, Mississippi. It was good work, but the working conditions then were poor – clay floors, no air-conditioning and inadequate safety procedures. "I saw two people get pieces of their hands cut off. One day I came to work and there was a thumb on my machine!" Adkerson recalled. It pushed a math-minded student towards business and made a lasting impression about the importance of workforce safety that Adkerson took with him when he joined the mining industry 25 years later.

Adkerson grew up in small towns in the US Deep South. He was more interested in playing football and baseball than anything else until he aced his college entrance test and became a National Merit Scholar, something Adkerson said "surprised everybody."

He ended up going to Mississippi State University, where, after the experience at the bus factory, he asked the Associate Dean at the College of Business for academic advice. "He told me that accounting is the language of business, so I majored in accounting," Adkerson said. "Accounting is one of those light-switch deals – you either get it or you don't. I got it, and I also liked it," he added.

With a degree, an MBA and Certified Public Accounting qualification under his belt, he joined Arthur Andersen in New Orleans. In December 1970, he was assigned his first principal client: McMoRan Exploration Co.

Working with McMoRan

The path to create Freeport-McMoRan was complex, but Adkerson was there from almost the start. McMoRan had just been founded when Adkerson walked into its offices. There were 16 people with the company at that time, including the three founders, Ken McWilliams (the 'Mc' of McMoRan), Jim Bob Moffett ('Mo'), both geologists, and Mack Rankin ('Ran'), a petroleum land man and business executive.

FREEPORT-MCMORAN

The path to create Freeport-McMoRan was complex, but Adkerson was there from almost the start

Adkerson spent the next five years working closely with McMoRan in New Orleans as the company grew, until another opportunity came his way – an accounting fellowship with the Securities & Exchange Commission (SEC) in Washington, DC.

When his term at the SEC ended in 1978, Adkerson moved to the heart of the oil and gas industry in Houston and became one of Arthur Andersen's youngest ever partners, age 31. An expert in SEC matters, within a year he became head of Arthur Andersen's worldwide oil and gas practice during the tumultuous 1980s and he resumed his working relationship with McMoRan.

While all this was happening, a mining company with its roots in the sulphur business was quietly developing what – unbeknown to it – would become one of the industry's greatest mines. Established in 1912, Freeport Sulphur became Freeport Minerals, having added other resources to its portfolio. In 1981, Freeport merged with McMoRan. Adkerson became an adviser on the newly merged company's transactions.

The company moved its headquarters to New Orleans from New York in the mid-1980s and in 1988 completed an initial public offering for its Indonesian subsidiary. The year prior, 40-year-old Adkerson moved to Chicago to become head of Arthur Andersen's global public company audit practice. It was then that internal bickering between the firm's consulting arm and the traditional accounting/audit firm caused his devotion to the firm to wane. Adkerson made the decision to move back to Houston after completing the Advance Management Program at the Harvard Business School.

Word got out that he was not entirely happy and, after some competing offers, he joined Freeport as a financial dealmaker in 1989. It was the same year that Chip Goodyear, the future head of BHP Billiton, joined Freeport; the pair formed an "exceptional partnership," Adkerson said.

Mining the moon

Freeport quickly determined that its Grasberg discovery was a game-changer. A long-lost geology paper on the highest mountain on the Island of New Guinea resurfaced, leading Freeport to visit the site in 1960. Recognizing its potential, Freeport negotiated and signed its first Indonesian contract in 1966, developed the small high-grade deposit and started production in 1972.

It took until 1988 – the year before Adkerson joined Freeport – for the firm to drill a grassy ridge named 'Grasberg', located three kilometers from the original mine. That same year, Adkerson made his first trip to Freeport's operations in Indonesia and snapped a Polaroid photo of the Grasberg exploration shack that is framed on the wall of his office today. The rest is history.

After a series of assets sales and innovative financings, in 1992 Adkerson was made CFO and Goodyear was Chief Development Officer of Freeport. In the mid-1990s, Freeport spun-off its copper business as well as its oil and gas unit, leaving the agricultural minerals business

with the parent. Adkerson moved with the former, and Goodyear became CFO of the latter, which was ultimately merged into what is now Mosaic.

During this time, Grasberg was being developed "in an extraordinarily rapid fashion," said Adkerson. After the company faced liquidity issues during the mid-1990s, in part because of the parent's dividend policy, another miner, Rio Tinto, made an investment to help finance Grasberg and it became a partner in the project in 1995. Within a couple of years, the major development of Grasberg was completed.

Freeport was widely viewed as a relatively small but interesting company, and things were going well. Adkerson was now Freeport's president, with Moffett the chairman and CEO. But in May 1998, Indonesian President Suharto stepped down. It was in the midst of the Asian financial crisis, and the contagion spread globally.

"Grasberg took all our focus: everybody rolled up their sleeves and thought about how to develop it for the long-haul," Adkerson said. Yet times were difficult: copper and share prices slumped, and the company repurchased a third of its stock when its value fell, in anticipation of a revival that was not quickly forthcoming, which created another liquidity crisis.

Adkerson started working closely with company treasurer Kathleen Quirk, and the pair set about working towards restructuring the company's balance sheet. "It was boot-camp training for what we had to deal with just a few years later," Adkerson said.

Then, in 2003, China emerged as a major developing economy, and the world came out of recession. "Grasberg was fully developed and we started making money hand over fist. We paid off all of our debt and were distributing large amounts to shareholders," Adkerson added.

Phelps Dodge deal

At the end of 2003, Adkerson became CEO and Quirk became CFO; Moffett was chairman, largely focused on the separate oil and gas business. Adkerson's attention turned to the future of Freeport – a single-asset company, which was not sustainable. "We talked with a number of bankers and companies about strategic ideas – in the back of our minds, we always thought someone would come in and buy us," Adkerson admitted.

But they could not find the right deal. Grasberg was an unusual orebody – roughly two-thirds of the value was in copper and the rest was in gold, so it did not naturally fit with other mining or pure gold companies; plus it was in Indonesia, which had lingering political risk implications.

FREEPORT–MCMORAN

Ringing the closing bell on the NYSE on the day of Freeport–McMoRan's merger with Phelps Dodge in 2007

One company that Adkerson had his eye on, starting in the 1990s, was Phelps Dodge, a major copper producer with large low-grade deposits. A deal was elusive until 2006, when Phelps Dodge was under pressure by an activist investor and responded by attempting a complicated three-way transaction in which it would acquire Inco and Falconbridge. It failed, losing out to Vale and Xstrata, respectively.

Freeport's bankers suggested the miner purchase Phelps Dodge, something that initially amazed Adkerson. "I recall thinking, a short-time earlier we'd been really financially stretched, and now we were being told we could do the largest merger ever done in the mining business," he added.

Given the green light by the Freeport board, in August Adkerson called Phelps Dodge CEO Steve Whisler with an offer to pay a market premium. The deal was announced at the end of November, and was received with shock. "Nobody thought Freeport could do it," Adkerson laughed.

The acquisition was a high point in Adkerson's career. "It was a big decision for me to take on the Phelps Dodge challenge in 2006 when I was 60, a time when many consider doing something different and I have a lot interests away from work. But it was a dream come true for us to acquire a company more than twice our size and have a global focus, something I targeted all my career," he said.

Having initially planned to pay off $10 billion of debt in four years, Freeport did so in nine months. But the new unit was quickly tested by the 2008 financial crisis; "That's when our organization really came together," Adkerson added. Freeport immediately shut down its expansion projects while it watched the price of copper collapse from $4 to $1.20 per lb by the end of the year, with expectations of further declines. It also cut costs, improved productivity and reduced output.

The company developed plans to operate its mines in the US and South America at break-even, and to use the cash flows from Indonesia to fund debt servicing and G&A. Fortunately, the macroeconomic backdrop turned positive much more quickly than expected, and, aided by the company's actions, by 2011 the company was debt free, its share price was at record highs, and Adkerson thought the company was set up for large cash returns of shareholders and long-term success.

Unfortunately, that situation did not last for long. Freeport was hit by a double whammy of Indonesian contract renegotiations and an ill-advised investment in oil and gas, which Adkerson said he adamantly opposed.

Oil & gas

The oil and gas investment was first proposed in early 2012, by Moffett and ▶

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FREEPORT-MCMORAN

Signing ceremony in Jakarta for divestment agreement

some Freeport board members. The idea was to diversify the company into an area in which its management had experience at a time when its mining expansion projects were coming together and the company was generating strong cash flow from then-high copper prices. Adkerson was not supportive, aware that Freeport shareholders wanted exposure to copper and China, not oil and gas.

But the notion carried the day at the Freeport board level, with Freeport going on to acquire Houston-based Plains Exploration & Production Company, as well as McMoRan Exploration Company, of which Adkerson was co-chairman, a situation that meant he was conflicted and precluded from voting on the deal.

He said that he almost quit over it. "It was a tough decision for me – I came close to leaving," he admitted. But he stayed, feeling a responsibility to the company's employees, shareholders and the communities where Freeport operated.

In mid-2014 oil prices started collapsing, followed by copper prices later that year. By the fall of 2015, things had really deteriorated and the severity of the situation had become very clear. The board started the process of restructuring, a situation hastened when activist shareholder Carl Icahn took an 8.5% stake in Freeport. Moffett left at year-end, replaced by current chairman Gerald Ford.

The year ahead was a "tough, tough, tough time," Adkerson said, noting that the company had gone from being cash rich to having $20 billion of debt. "Commodity prices were terrible. There was a lot of speculation that we just weren't going to make it. We started trying to sell oil and gas assets in the fourth quarter of 2015 and there were no buyers."

Freeport changed the oil and gas management in early 2016 and then set about trying to unwind its related capital expenditure commitments, including restructuring drill contracts. Sumitomo, a long-time joint venture partner of Freeport's copper business, bought an additional stake in Morenci; the company was forced to sell Tenke Fungurume to China Molybdenum, something that Adkerson says he would not have done under different circumstances.

In early 2016, the company set a goal of cutting its debt by $5-10 billion within two years; by the end of that year it had already cut it by $10 billion, and continued reducing it in 2017 and 2018.

Indonesia

While all this was taking place, Freeport was fighting a battle on another front – over the fate of its Indonesian investment. Things had been running relatively smoothly there until the country passed a new mining law in 2009. Early indications were that it would not apply to Freeport because of its established contract. It was not until 2011, when the new regulations were adopted, that Freeport's contract started to be undermined.

By 2013, Freeport thought its contractual issues were resolved, but a last-minute decision in January 2014 effectively banned the company's exports – "a total surprise" to Adkerson and his team. Efforts continued over the next couple of years, with various twists and turns, until new regulations were announced at the end of 2016 that the government believed resolved the situation. They did not.

"It was very difficult. I remember landing in Jakarta as these regulations came out and my email was lighting up with people congratulating me for having solved the problem. I hadn't even seen the regulations," Adkerson recalled. "When I read them, I called the government and said, 'This just doesn't work, we can't accept this.'"

Negotiations hit an impasse, and Freeport filed a notice of arbitration in February 2017, with Adkerson conducting a press conference in Jakarta to highlight the company's stance. The approach worked: talks resumed, a temporary extension for exports was provided, and extended again to allow for discussions, leading to a broad-terms framework for an agreement later that year.

Freeport agreed to meet the government's aspirations to own a 51% stake in Grasberg and said that it would build a smelter the government wanted; in return, the company would be granted an extension of its operations through 2041 with legal and fiscal certainty, with any divestments to be at fair market value and Freeport continuing to manage the operations.

In the midst of this, Rio Tinto made it clear that it was interested in selling its 40% stake in Grasberg, something Adkerson described as creating an opportunity for "an elegant solution" in which everyone would win. Rio Tinto would get to exit Grasberg at an acceptable valuation; the government would get its desired stake and a commitment to a new smelter; Freeport would sell a far smaller stake than initially envisaged and receive an extension of its rights to operate Grasberg with legal and fiscal certainty. A definitive agreement was signed in September 2018, marking another professional high for Adkerson.

The company's focus for the next two years is now on completing the transition from open-pit to underground mining at Grasberg, ensuring the new partnership for its smelter is a positive one for all stakeholders, and running the rest of its business to ensure that it maximizes production and controls costs in a safe way, Adkerson says.

"Our intention is not to look to make major investments or engage in M&A activity. We're going to continue to study potential future investments, but we're not going to pull any triggers on big projects in the next two years until we get some clarity on the global markets, which are very unclear right now," he added.

When he is not traveling, attending events associated with his former university, or working with the US National World War II Museum in New Orleans, Adkerson's great love is the outdoors, and particularly the mountains, where he rides horses, hikes, fishes and hunts. He said that his best pals are his labrador retriever, Carly, and his German shorthair pointer, Sis – Adkerson describes himself as their "emotional support human."

He also loves spending time with his three sons – Ryan, Tyler and Clark – and two granddaughters – Reese, aged five, and Cora, two; Adkerson's eyes light up whenever they're mentioned.

This profile is based on a cover profile interview first published in the November-December 2018 issue of Metal Market Magazine.

Ankh Award Winners 2002 and 2017

Apurv Bagri

METDIST

Metdist's Apurv Bagri

There are few names that are synonymous with copper, the London Metal Exchange (LME), and the global metals industry, but Bagri is indisputably one. Both Lord Bagri, CBE, the longest serving chairman of the LME and founder of The Metdist Group, and his son, Apurv Bagri, have been honoured with the Ankh Award, in 2002 and 2017 respectively – the only father and son to have achieved this honour.

With a career that commenced at just 15 and went on to span eight decades, Lord Bagri oversaw some of the most significant moments in the LME's history. He championed demutualisation in September 2000, transferring the market from a cooperative-structure to a private shareholder-owned exchange, which in turn facilitated the market's modernization and ensured its continued growth.

He oversaw the introduction of an electronic trading platform, launching LME Select in February 2001, convinced that the exchange could not let technology move ahead without it. His hands-on guidance, unwavering belief in the exchange and dedication to the metals world that he loved is credited to the LME emerging unscathed and, remarkably, a stronger market, following the 1996 Sumitomo Crisis.

He never forgot his roots in the trade and industry and was a strong proponent of the need to protect the LME's unique trading methodologies of open outcry and the inter-office telephone market. His link to the trading floor was intensely personal. Lord Bagri created Metdist Trading, which in February 1970 became one of the first two overseas members of the exchange, something he described as one of the highs of his career.

Rather fittingly, a portrait of Lord Bagri, who died in April 2017, age 86, is etched into a copper cathode hanging in the mezzanine gallery of the LME, overlooking the trading floor.

When his son Apurv Bagri joined the business in 1980, Metdist represented a very different operation to the group today: its core activities centered on LME brokerage and an India-focused merchanting business. But things were starting to change. That same year, the group established its manufacturing arm in the form of a copper rod business in Malaysia, initially with a 10,000 tonnes per year capacity.

From father to son

With his passion being the LME, Lord Bagri handed over the day-to-day running of the physical merchanting business to his son – a separation that Apurv Bagri believes was highly beneficial for both and that enabled him to become involved with its trading from an early stage.

At that point the LME brokerage was never focused on being a significant commercial entity; instead it was "part and parcel of what we saw as our involvement in the global metals business," Apurv Bagri says.

"At its simplest level the LME brokerage was an important part of being a member of the community, and on another level, we always believed that it gave us insight and a seat at an important table around which we could understand, learn and grow within the non-ferrous metals arena," he notes. "The LME brokerage business survived in that capacity for decades," he adds.

The rest of the group grew significantly as the years progressed, but Metdist Trading was left to operate as a value-added component. By 2014, it became clear that it was time to develop a long-term strategy for the unit; as Apurv Bagri says, "a suboptimal size LME brokerage business was no longer necessary from the point of view of the group's global involvement in metals."

"By that time the group had begun to flex its financial arms and invest in other non-metals businesses, and we wanted to convert our LME brokerage arm to a substantial independent operation," he notes.

The problem was that to achieve this would have required very significant capital, including sizeable credit facilities for clients, Apurv Bagri acknowledges. "The view we formed was that very honestly we could do more with that money than give it to someone else via a credit line; which realistically was a business better suited to financial institutions and banks," he adds.

Enter Nigel Dentoom, a long-term associate of the Bagri family, fresh from his role as chairman of LN Metals, with a diverse career in both LME brokerage and the physical metals industry. Tasked with exploring and implementing ways to develop and expand Metdist's LME operations, Dentoom set about delivering the criteria set by the group for the brokerage's future.

"We wanted to maintain a shareholding and to be part of the exchange, not just for historical reasons but by being associated with a very large substantial financial group," Apurv Bagri says.

With the immediate benefit of brand, history, and a passage to its Indian roots, Metdist Trading was a very attractive acquisition. Presented with several alternative partners, the brokerage eventually partnered with China Construction Bank Corp (CCB), completing a deal in April 2016 to sell it a 75% stake in the firm and handing over responsibility for running the business to CCBI.

The new entity was renamed CCBI Metdist Global Commodities (UK) Ltd, becoming the first company majority-owned by a Chinese bank with Category 1 membership of the LME. "It brought together CCB's expertise in China and our interest and involvement with India. The sense was that, combined, we'd have the capacity to serve customers and clients across two of the most populous and potentially fastest growing economic giants of the century," Apurv Bagri says.

Meanwhile, the group's copper fabricating business had grown. Over the years, Metdist added an air conditioning and tube plant to its Malaysian operations, and almost 40 years on has a combined rod, wire and tube capacity of 350,000 tonnes per year. "It's been quite a journey for that business, and it's a very important part of what we do," says Apurv Bagri. "There probably isn't a house or building in Malaysia that hasn't been touched in some way by one of our products," he adds.

METDIST

Apurv Bagri with his daughters, Amisha and Aditi

Malaysia's Prime Minister Tun Mahathir bin Mohamad was recently guest of honour to inaugurate an expansion at the group's rod plant, an unusual move for the now 93-year-old and testament to Metdist's decades-long presence in the country. The completion of the expansion marked a poignant moment for Apurv Bagri as it is the final deal that he worked on with his father.

"The last set of conversations my father and I had were around the expansion and reorganization of the metal fabricating businesses – these are the last transactions that he really signed off on and said that we should do," Apurv Bagri says.

A new era

The other central players driving the expansion were Apurv Bagri's two daughters, Amisha and Aditi. "At the end of the day, the fundamental question for the family is around what do we do for the next generation. We are committed to a very substantial presence in the copper fabricating business and it is now of a scale and size that is quite important," Apurv Bagri adds.

His daughters were present when Apurv Bagri received the Ankh Award in 2017; as he recalls, "Their public statement at the time was, can you explain to us why there has been no Copper Woman of the Year in the history of the award?" The award was a bitter-sweet moment for Apurv Bagri, coming 15 years after Lord Bagri's own Ankh Award, and two months after his father's death. "I told him when he was in hospital that I had received the Ankh Award, and to this day I don't really know if he understood me, though I pray that he did," Apurv Bagri says.

He remains amused by a ritual established by his father and Art Miele, former Phelps Dodge executive and 2003 Ankh Award winner, who were close friends. Miele was on the LME board during Lord Bagri's tenure as its chairman, and for years after each meeting the pair would have tea at London's Inn on the Park hotel.

"I used to go and pick up my father on the way from the office. Sometimes I sat there for a few minutes, sometimes I didn't, but 100% of the times that I came, I was the one that paid the bill for the two of them," Apurv Bagri laughs.

"I always used to complain to both that the tea was theirs and I was only the delivery and pick-up boy, and yet I got saddled with the bill. Art and my father had almost made it a tradition that they would have that tea knowing I would turn up and settle the account," he adds.

Apurv Bagri is himself on the board of Hong Kong Exchanges & Clearing, owner of the LME since 2012, something he regards as a "great privilege." He sits on numerous other boards, including the Dubai Financial Services Authority, of which he has been deputy chairman since June 2017, and the International Wrought Copper Council, which he also previously chaired.

His great passion, meanwhile, is education and mentoring. Apurv Bagri is a member of the Corporation of University College School and honorary rector and former pro-chancellor and chair of Council of City University, London.

He is also a visiting professor at Cass Business School, of which he is an alumnus, and is a past chairman of TiE Inc., a global non-profit organization that promotes entrepreneurship and wealth creation.

Apurv Bagri also holds the highly prestigious position of chair of the governing body of the London Business School, a constituent college of the federal University of London. He has been involved with the school for over 18 years, holding an honorary fellowship and having overseen its recent highly successful fund-raising campaign.

"The biggest thing in my life is education," Apurv Bagri says. "My girls say I am involved with education all the time; I say I do it in my spare time," he adds.

Bank of America Merrill Lynch

The exit may just be the beginning

Generational transfer of ownership and the alternatives

Change is a constant force in today's global business environment. Most companies grapple with natural lifecycles driven by both internal and external factors. Large companies are not immune to these factors, with 52% of Fortune 500 companies disappearing over the last 15 years. For family-owned businesses, survival and succession is even more challenging. Less than one-third of family businesses survive into the second generation, and only about 13% make it into the third generation. In the metals industry, the players, large and small, must constantly adapt to the cyclical ups and downs, based on supply, demand and competition.

Aside from the mills, the metals industry remains fragmented, including metal recyclers, metal service centers, fabricated metal manufacturers and makers of metal end-use products. Many of these are family-owned businesses that face a decision regarding a generational transfer of ownership or a sale to a strategic or financial buyer or the employees. In metals distribution, although there has been some significant consolidation in the recent past, including Union Partners' acquisition of Contractors Steel and Olympic Steel's acquisition of Berlin Metals, there remain significant consolidation and ownership transition opportunities. In the fall of 2018, the Metal Service Center Institute reported that the revenue of the top five North American service centers (Reliance, Ryerson, Kloeckner, Samuel and Russel) account for only slightly more than 20% of the sales of the top 50 service centers.

Today's market environment provides an excellent opportunity in which to recapitalize a business to facilitate the generational transfer of ownership or for a change of control transaction. The attractiveness of the business to prospective buyers, valuation and legacy issues are key considerations. Senior debt, mezzanine financing and equity capital are available to facilitate these transactions. However, it is important to have a capital structure that helps ensure the continuity of the business and enables the company to navigate through industry conditions.

Ira J. Kreft

Global research on the "Resilience of 100-Year Family Enterprises," supported by Merrill Lynch's Center for Family Wealth Dynamics and Governance®, Merrill Lynch's Family Office Services, and U.S. Trust, Bank of America Private Wealth Management, has identified key factors underlying the success of generative families' efforts to sustain and reinvent themselves over generations.

For privately-held companies that don't have a viable succession plan, an outright sale may be the best option; and they will have to consider whether they want to sell to a strategic investor or private equity. Private equity may be executing a buy-and-build strategy in an industry and resemble a strategic buyer except in terms of investment horizon. In metals distribution, acquirers may be looking to expand their geography. For example, with the increased capacity being added in the southern United States, metal service centers are actively seeking opportunities to acquire existing distributors in the region, which can make a privately-held business attractive to potential acquirers. In other cases, an acquisition can provide opportunities to cross-sell products across entities, consolidate purchasing and bring value-added products and services to the existing customer base.

The global presence and experience base of Bank of America Merrill Lynch can provide a world view of best-in-class practices to move a business forward. We employ our PeerProfiler™ software, which leverages Bank of America's proprietary database of financial data to assist our clients in evaluating their performance relative to peers and industry benchmark and help identify opportunities to improve operating performance and working capital management that can drive increased business value. And, the debt capacity analysis can be utilized to support strategic priorities and available financing sources.

We advise our clients on their alternatives in light of their goals and objectives. For some privately held companies, as noted previously, it could be how to execute and finance a generational transfer of ownership. However, it could also include selling the business to the senior management team or to an Employee Stock Ownership Plan. For some companies, an Initial Public Offering may be an alternative.

If the decision is an outright sale of a firm, Bank of America Merrill Lynch's investment banking group can advise on the sale of the business. We have extensive experience in the global metals and mining sector and relationships with many firms seeking to acquire complementary companies to expand their reach into new geographic or product markets.

The path forward for a privately held company is a very personal journey; no two situations are the same. Based on the global presence and depth of experience of Bank of America Merrill Lynch, we can identify customized solutions tailored to the needs and strengths of each firm and its ownership that can make the exit just the beginning.

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Ankh Award winner 2003

Andrónico Luksic

Andrónico Luksic Abaroa grew up in the town that he would eventually name his London-listed copper producer after: Antofagasta, in the north of Chile.

But mining was not part of the career he initially envisaged. The son of a Croatian immigrant, a young Luksic studied law in Santiago and attended the Sorbonne in Paris, returning eventually to his home town to work for a local law firm. Frustrated at the lack of career advancement, Luksic left the firm for a career in business.

He first turned his attention to a Ford auto dealership in which he had a small stake purchased from money earned during his student days. At that time, the Antofagasta area was booming as the copper industry developed, and the dealership was supplying the local mining community.

It did not take long for a move into copper – Luksic was approached to buy a 25% interest in a nearby mine. A keen amateur geologist, Luksic jumped at the chance. He struck a deal to buy the stake in monthly installments spread over 25 years, but very quickly managed to buy out the remaining shareholders to own the mine himself.

The purchase proved to be a boon. A couple of years later Luksic sold it to Japanese firm Nippon Mining Company for $500,000, a sizeable fortune at the time. It allowed him in 1954 to create Luksic Group, which would eventually become a vast Chilean conglomerate comprising operations in not just mining but also fishing, manufacturing, electricity, food processing and forestry.

The group expanded during the 1970s outside Chile, adding businesses across Latin America while navigating the intricacies of Chilean politics at the time. His acumen paid off – in 1979 the group added the Antofagasta & Bolivia Railway Company to its investments.

Antofagasta and copper

Using Antofagasta as a vehicle, the group increased its mining interests through a series of acquisitions and expansions. In 1996, Antofagasta consolidated all its non-core banking and industrial interests into the Luksic family conglomerate, Quiñenco, in order to focus on mining and transportation.

The Antofagasta that the copper industry knows today really grew after that. Located in Chile's Coquimbo region, 240 km north-east of Santiago, Los Pelambres started production in 1999 and is now undergoing an expansion to take it to 400,000 tonnes per year, up from 350,000-355,000 tpy.

The group also owns Centinela, located in the Antofagasta region and formed in 2014 from the merger of the Esperanza and El Tesoro mining companies, which had been producing since 2001. Also in the region, the group owns Antucoya, which has been mining and leaching oxide ore to produce copper cathodes since 2016, and Zaldivar, a joint venture with Barrick that Antofagasta operates.

Last year, Antofagasta produced 725,300 tonnes of copper, up by 3% on 2017 levels.

When the time came for him to retire, Luksic divided the running of the various businesses within his group among his children. His oldest son, also named Andrónico, now manages the family's banking interests; his middle son, Guillermo, ran the Quiñenco companies until his sad passing in 2013; his youngest son, Jean-Paul, is chairman of the mining operations and took over the Quiñenco companies after his brother died. Luksic's daughters, Paola and María Gabriela, oversee the family's charitable foundations.

Luksic, who was awarded the Ankh Award in 2003, died two years later in Chile at the age of 78.

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Antofagasta's Los Pelambres mine is undergoing expansion to take it to output of 400,000 tonnes per year

One hundred words on copper

Andrea Hotter asks leaders in the world of copper production, trading and application to sum up their views on the outlook for the metal in about 100 words

Danny Malchuk, president operations, BHP Minerals Americas

The outlook for copper is undeniably positive, but there are significant challenges to achieving its potential. The world needs more high-quality copper, but finding, accessing and extracting it – economically and sustainably – is becoming more complex. New deposits will require ever-increasing water and energy intensity, in a world where access to these is becoming increasingly constrained and politically sensitive. Economies will continue to decarbonise and electrification and renewables will drive demand. At the same time, end consumers of copper-intensive products are more ethically minded, and care about how and with what those products are made. 'Green' copper is the key to unlocking our future. The industry must work along the supply chain so that copper is discovered, mined, sold and used sustainably for generations to come.

Arnaud Soirat, CEO, Rio Tinto Copper & Diamonds

Rio Tinto continues to see significant opportunity in copper, with the world expected to need the same amount in the next 25 years that it produced in the last 500 years. This is being driven by fundamental changes in society: urbanization, industrialization and renewable energy. Copper plays a key role in electrification and power production; for example, a wind turbine capable of generating a megawatt of power – enough to supply several hundred homes – needs more than three tonnes of copper. We are well positioned to meet this demand with tier one operating mines on three continents and outstanding growth options.

Mark Hansen, CEO, Concord Resources Limited

Copper is now the most interesting metal market. The evolution of demand applications is an exciting positive for the market over the next decade. Many

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market participants focus on the sustainability of demand that has driven the copper market for the last decade: construction, China, automotive; but the market now must look to growing electrification trends, smart grids, biological applications and so on. Those trends are accelerating and the upside is potentially significant. It is well known that to meet those demand upsides, finding the medium-term supply will be challenging, requiring new incentive prices to engineer the necessary results.

Tom Albanese, lead independent director, Nevada Copper

Copper markets stand to benefit from both supply and demand drivers. On the demand side, the shift toward E-Vehicles and the conversion of our hydrocarbon-based economy toward a more sustainable renewables-based economy will lead to improvements in copper consumption. Copper supply growth will meanwhile be constrained by declines in some of the world's largest copper mines, further pressured by the effects of both reduced capital spending and increased stakeholder pressure delaying major new projects. Short term, these positive forces are being tempered by trade tensions and GDP concerns, but they will become more evident as metal balances tighten.

Michael Lion, CEO, Everwell Resources Ltd and Lion Consulting Asia Ltd

I can't say how often I overpaid for bright shiny copper scrap from Hong Kong to LA, but it didn't matter – someone always needs copper! That's particularly the case now, with lower ore-yield bodies and the metal's increasing use in electric vehicles, plus for IT and medical purposes, as the recurrent theme of "sustainable copper" continues to drive demand. Scrap – ignorant regulators please note, it's a recyclable raw material, not "waste" – champions the ever-enduring, constantly glowing, future for the red metal that glisters as much as gold, but in much greater profusion – copper!

Bernie Schilberg, CEO, Prime Materials Recovery

The only certainty over the next two decades in the copper industry is that market dynamics will change significantly more than has happened during the past two centuries. Copper resources presently are not sufficient to satisfy projected future demand. Policy and technology will lead to innovation in mining, refining, recycling, fabrication and trading, impacting the downstream markets. It will be critical for industry participants to heavily support training in human development and make significant investments in capital projects to compete in this global economy. The future and opportunity has never been so evident.

Paul Crone, head of metals proprietary trading, Engelhart Commodities Trading Partners

Why is copper so interesting? Betting on the price of copper is a very popular way to express a macro view on the world given its industrial importance. The future of the copper market, one of the top three metals consumed globally, remains structurally sound given the easy access to trade futures and options via the three major exchanges as well as physically. The level of global participation continues to increase as copper remains extremely sensitive to China, the largest consumer and one of the largest producers of the metal. The key drivers of price being consumption, production, the US dollar and oil, along with unforeseen events such as strikes, earthquakes and geopolitical instability, ensure that speculative interest will remain abundant.

Jürgen Schachler, CEO, Aurubis AG

We expect a constant, good supply of concentrates in 2019 – the higher copper price remains a strong incentive for the mines to boost their output and force supply from new mines and extensions. However, there are some clouds on the


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horizon, with lower supply from Grasberg and more smelter capacity coming online in China. But the healthy concentrate market fundamentals as well as maintenance of multiple smelters will reduce smelter demand and keep the market in balance. Furthermore, with our ability to process more complex concentrates, we are not as dependent on the benchmark as most of our competitors. So for 2019, we are still confident.

Kathleen Quirk, executive vice president and chief financial officer, Freeport-McMoRan

We are optimistic about the near- and long-term outlook for copper. In addition to supply-side constraints, the fundamentals are underpinned by copper's important role in the global economy, including favorable trends in urbanization, copper intensity in renewable energy, and low-carbon electrification. As a leading copper producer, we remain focused on providing this essential metal in a safe, cost-efficient and environmentally responsible manner.

David Lilley, chief investment officer, Drakewood Capital Management

Over half the world's population is living in middle-class households or above, and forecast to grow to 5.5 billion by 2030. The aspiration of this middle class is to be connected, clean consumers. All parts of these ambitions are copper intensive. Power infrastructures need to transform to deal with green generation; its diffusion and variability. Vehicles, products and machinery trend to clean electric power from internal combustion. Data proliferates exponentially and the cloud needs protection and power. At the same time there have never been greater political, social and environmental challenges to building new mine supply. Something's gotta give!

Kostas Bintas, head of copper trading, Trafigura

Copper remains an essential raw material for the sustainable development of our modern lives and societies. Its superior conductivity and durability properties will continue to enable strong growth. Vehicle electrification and renewable energy sources are expected to grow exponentially in the coming years, and these 'industries of the future' tend to be more copper intensive, which will support demand and paint a bright outlook for the copper market.

Brandon Koo, senior executive vice president, head of business group, LS-Nikko

The copper smelting industry is facing challenges from the increasing uncertainty


RIO TINTO

of the concentrates market, a decline in copper demand due to the global recession, a tightening of global environmental and safety regulations, and the increasing cost of energy and continuous production. In this environment, LS-Nikko Copper is striving to define its key competitiveness through investment in environmental/safety facilities and establishment of proactive management systems, the stable procurement of raw materials, and stabilized operations with strengthened productivity and efficiency. Through digitalization, LS-Nikko Copper will establish a smart factory, optimized for its smelting business, to execute these key competitiveness factors and to become the global no.1 smelter. Based on this vision, LS-Nikko Copper will continuously strengthen its cooperation with suppliers and customers to acquire sales and stable raw material procurements.

Oskar Lewnowski, founder and chief investment officer, Orion Resource Partners

Economic revolutions require feedstock, usually a commodity, to transform lives. The first revolution – the agricultural one – was based on grain and water. The second and third revolutions – industrial and transportation – required iron ore and oil to advance mankind. The fourth one, currently underway – the technology revolution – will require its own commodities. As technology advances and scaled networks prevail globally, energy and communication infrastructure will become central to new economic and political realities. The servers and switches that underpin and connect the worldwide web would not exist without mining to provide a key input – copper. Get ready! From 2022 on, it's going to be a wild ride on the supply side.

Paul Akroyd, CEO, IXM

Disruptions to blister and cathode production and more restrictive Chinese scrap import regulations have tightened the cathode market over the last twelve months. The Chinese government has reacted to the slowdown of the economy through measures that should stimulate metals consumption growth. Going forward, accumulating concentrate deficits due to increases in Chinese smelting capacity and an inadequate mine project pipeline will constrain the raw material supply for cathode production. Copper prices will need to provide an incentive ▶

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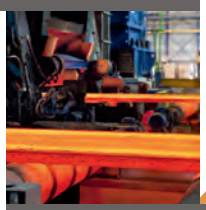

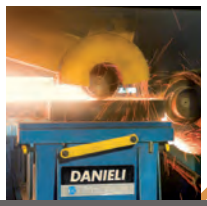

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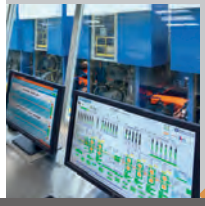

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for miners to approve the projects required to meet future demand, which suggests limited downside risk given the recent rise in cost inflation.

Ruben Fernandes, CEO, Base Metals, Anglo American

Copper is one of the most essential metals in our modern lives. Its role in enabling an ever more clean, green and connected world is expected to further increase an already growing forward demand curve. Even at modest projections, the world will need the equivalent of 22 new Collahuasi-size mines in the next 12 years. As we all know, sufficient new supply is unlikely. That is unless we find new ways to more efficiently mine, process and extract the precious metal, using a fraction of the water and energy, more precisely targeting the metal and leaving the waste rock behind. This is Anglo American's FutureSmart Mining approach that we believe holds the answer to a sustainable future for mining and our planet.

Mark Loveitt, president, International Wrought Copper Council (IWCC)

Copper has a bright future. Well – I hear you say – he would say that, wouldn't he? But, yes, it's true. Copper is at the forefront of new technologies: sustainable energy, electric vehicles, autonomous vehicles, artificial intelligence, and the required infrastructure for all of these applications. The list isn't endless, but not only are these applications driving demand for copper over and above traditional applications, they also help reduce overall carbon emissions. And copper's recyclability means that what we use today will be available for reuse in decades to come. So yes, it's true: copper has a bright future!

Yasunobu Suzuki, director & senior managing executive officer, president, Advanced Products Company, Mitsubishi Materials Corporation

We are experiencing a game-challenging revolution at a phenomenal speed as the world has never seen before, especially in electrification, electric control and autonomous driving of vehicles, AI, IoT, 5G and sustainable energy generation. There is an ever-increasing demand for lighter and leading-edge performance copper alloys. The total volume increase is more than offsetting unit weight reduction through miniaturization. Copper is also contributing to the environmentally friendly future and growth is phenomenal, particularly in antimicrobial, drinking water applications and sustainable aquaculture wire-mesh applications.

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Xie Shicai, chairman, Powerway Group Co., Ltd.

From H2-2018 to Q1-2019, China's copper semis production was slow overall, mainly due to a slowdown in the end-use markets. Trade friction between China and the USA had an adverse effect on exports, as did the weaker economic situation in Europe and the USA. After the Spring Festival, the semis-fabricating industry began to strengthen. China's macro-economic performance is improving. The government has increased support for the manufacturing industry, reduced taxes, expanded domestic demand and lowered the VAT rate. The government will actively promote and develop the transportation industry, new-energy vehicles plus the industrialization of information technology, and accelerate the roll-out of the 5G network. All of these are expected to have positive effects on the copper industry.

Oriol Guixà, CEO & president, La Farga

Copper demand in the 1980s was 10 million tonnes a year. Today, annual demand is 30 million tonnes and might be 40 million tonnes by 2028. Copper comes from mines (20.7 million tpy) and the circular economy (8.9 million tpy). Copper from the circular economy is influenced by three factors. First is the copper price. Secondly, while 14 million tpy of secondary material is generated, only 8.9 million tpy is recovered; 5.1 million tpy might be 'lost'. Improved recovery should see this 'lost' material entering the supply chain. Thirdly, copper has a useful life of 20 years. China became a major copper consumer in the 2000s, which means by the 2020s China's copper will start to be recycled. There is more than enough copper to guarantee supply, so that copper can contribute to a more sustainable, transparent, healthier, and greener world.

SHUTTERSTOCK

Osamu Inoue, president & COO, Sumitomo Electric Industries, Ltd

Copper is an excellent conductor of electricity and as such is essential for the manufacture of wires and cables for a wide variety of applications. Looking to the future, there will be growing demand for electricity to power our cities. And that energy will be required to be generated and distributed in an ever more environmentally friendly way. Sumitomo Electric Industries has 120 years of experience in manufacturing and developing various types of electric wires and cables. Therefore, SEI's advanced technologies enables us to continue to meet future social requirements.

Don Lindsay, president & CEO, Teck Resources Limited

We remain very positive on the long-term outlook for copper. The global trends of decarbonisation and increasing electrification will drive strong demand for copper well into the future. This bodes well for Teck as we look to double or even triple our copper production with Quebrada Blanca Phase 2 and potential future expansions.

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Top steelmakers 2019 edition

International trade protection measures have continued to loom large over global steel markets over the past year – to the benefit of some producers and the detriment of others. Alongside Fastmarkets' annual ranking of steelmakers by output, our correspondents around the world review developments in their regional steel sectors

NORTH AMERICA

It took time and a substantial toll on players up, down and across the worldwide steel supply chain. For almost a year, the uncertainty, anticipation and speculation accompanying the possibility of a sweeping US trade action impacted the international steel arena.

But the global guessing game came to an end on March 3, 2018, when President Donald Trump signed a proclamation imposing tariffs of 25% on steel imported into the United States. And, with the sweep of a pen, that set the stage for an unprecedented rebound in the fortunes of North America's top steelmakers.

"The best way to sum up 2018 is this – it was a record year for Nucor," John Ferriola, chairman, CEO and president of the Charlotte, North Carolina-based steelmaker said in a statement accompanying the release of the company's 2018 financial results. "We posted record earnings per share and record revenues. And we shipped a record amount of steel," he added.

For Nucor, the highest ranked US steel producer listed in this year's compilation of Top Steelmakers, and the five other North American steelmakers cited, 2018 was an exceptionally good year.

All five American mills in the list – Nucor Corp., United States Steel, Steel Dynamics, Inc. (SDI), AK Steel and Commercial Metals Co. (CMC) – not only charted improved financial results but, emboldened by the Section 232 action, announced a series of facility restarts, revamps, upgrades, acquisitions and stock buybacks – not to mention the construction of at least two billion-dollar-plus, new-generation greenfield mills.

Last year SDI completed the acquisition of "substantially all" the assets of Kentucky Electric Steel, Ashland, Kentucky, 75% of United Steel Supply LLC, an Austin, Texas-based distributor of painted Galvalume® flat-rolled steel, and Companhia Siderugica Nacional LLC's Heartland Steel Processing LLC unit, which produces various higher-margin, flat-rolled steels through further processing.

In late November and in a display of confidence in the future of American steelmaking, Fort Wayne, Indiana-based SDI announced plans to invest $1.7-1.8-billion in the construction of a three-million-ton-per-year greenfield, "organic" flat-rolled mill capable of producing latest-generation advanced high-strength (AHSS) steels.

Equally, if not more bullish, Nucor announced plans only days after the Section 232 tariffs were signed into law to build a $240-million rebar micro-mill in Frostproof, Florida. Estimated annual capacity is 350,000 tons with construction expected to take two years pending permit and regulatory permitting.

Six months later, in early September, Nucor's board of directors approved a $650 million investment to expand production at Nucor Steel Gallatin's flat-rolled sheet mill in Ghent, Kentucky. Capacity there will climb from 1.6 million tons to approximately 3.0 million tons annually.

And earlier this year, North America's top-ranked steel producer pulled out all the stops and disclosed plans to build a $1.35-billion, state-of-the-art steel plate mill in Brandenburg, Kentucky. The facility will be capable of producing 1.2-million tons of steel plate annually.

Meanwhile, CMC spent much of 2018 laying the groundwork to integrate 33 rebar fabrication facilities and four steel mills (with a combined annual mill rolling capacity of 2.5-million tons) into its Irving, Texas-based family. CMC acquired the assets from Gerdau S.A. for a cash price of $600-million. CMC also completed the construction ▶

Top steelmakers in 2018

Ranking 2018	Ranking 2017	Company	Country of origin/ Main domicile	2017 Output	2018 Output
● 1	1	**ArcelorMittal SA** Luxembourg		93,100	92,500
● 2	2	Baowu Iron & Steel	China	65,390	67,429
● 3	3	Nippon Steel Corp (i)	Japan	46,820	47,840
● 4	4	Hesteel Group Co Ltd	China	44,063	44,894
● 5	5	POSCO	Korea (South)	42,200	42,900
● 6	6	Jiangsu Shagang Group Co Ltd	China	38,347	40,660
● 7	7	Anshan Iron & Steel (Group) Corp	China	34,220	37,359
● 8	8	JFE Steel (ii)	Japan	33,095	32,310
▲ 9	10	Tata Steel Ltd	India	25,390	29,190
▲ 10	14	Jianlong Group	China	20,260	27,885
▲ 11	9	Shougang Group	China	27,629	27,342
▼ 12	11	Shandong Iron & Steel Group	China	21,679	23,209
▲ 13	15	Valin Group	China	20,146	23,012
▼ 14	12	Nucor Corp (iii)	United States	21,478	22,456
▼ 15	13	Hyundai Steel Co	Korea (South)	21,010	21,481
● 16	16	Maanshan Iron & Steel Co Ltd	China	19,714	19,642
● 17	17	Novolipetsk Steel (NLMK)	Russia	16,850	17,285
▲ 18	20	JSW – Jindal South West Steel Ltd	India	16,060	16,690
▼ 19	18	SAIL – Steel Authority of India Ltd	India	16,420	16,300
▲ 20	21	Benxi Iron & Steel (Group) Special Steel Co Ltd	China	15,769	15,897
▲ 21	22	Fangda Group	China	15,111	15,512
▲ 22	25	United States Steel Corp (US Steel Corp)	United States	14,434	15,346
▼ 23	19	Gerdau SA	Brazil	16,120	15,340
▲ 24	26	Baotou Iron and Steel (Group) Co Ltd	China	14,200	15,245
▼ 25	24	China Steel Corp (iv)	Taiwan	14,660	15,180
▼ 26	23	Rizhao Steel Group	China	14,982	14,951
▲ 27	31	Liuzhou Iron & Steel Co	China	12,299	13,529
▼ 28	27	Evraz plc	Russia	14,033	13,019
▲ 29	34	Techint Group (Ternium SA) (v)	Luxembourg	11,597	12,951
● 30	30	Magnitogorsk Iron & Steel Works – MMK	Russia	12,860	12,664
▼ 31	29	ThyssenKrupp AG	Germany	13,216	12,580
▲ 32	47	CITIC Pacific	China	8,771	12,551
● 33	33	Severstal	Russia	11,651	12,000
▲ 34	36	Fujian Sansteel (Group) Co Ltd	China	11,194	11,682
▲ 35	40	Shaanxi Iron & Steel (Group) Co Ltd	China	10,238	11,381
▼ 36	35	Pingxiang Iron & Steel Co Ltd	China	11,465	11,309
▲ 37	38	Hebei Jingye Group	China	10,406	11,245
▲ 38	41	Anyang Iron & Steel Group Co Ltd (AISCO)	China	10,057	10,972
▼ 39	37	TISCO – Taiyuan Iron & Steel (Group) Co Ltd	China	10,503	10,704
▼ 40	32	Jinxi Iron & Steel Group Co Ltd	China	11,719	10,331
▲ 41	42	Nanjing Iron & Steel United Co Ltd (NISCO)	China	9,849	10,050
▲ 42	45	Steel Dynamics Inc	United States	9,067	9,900
● 43	43	Panzhihua Iron & Steel Group	China	9,242	9,523
▲ 44	46	Xinyu Iron & Steel Co Ltd	China	8,902	9,364
▲ 45	52	Tsingshan Holding Group	China	7,480	9,290
▼ 46	44	Erdemir	Turkey	9,203	9,145
▲ 47	53	Esfahan's Mobarakeh Steel Co (vi)	Iran	8,659	9,020
▼ 48	39	Zenith Steel Group	China	10,360	8,700
▲ 49	50	SSAB AB	Sweden	7,995	8,028
▲ 50	55	Tianjin Steel	China	7,125	7,770
– 51	New	Tangshan Donghai Iron & Steel Group Co Ltd	China	7,427	7,609
▼ 52	51	Metinvest Holding LLC	Ukraine	7,630	7,323
▲ 53	60	Kunming Steel	China	6,364	7,272
▲ 54	56	Celsa Group	Spain	7,021	7,098
▲ 55	58	Salzgitter AG	Germany	6,955	7,039
▲ 56	66	Jiuquan Iron & Steel (Group) Co Ltd (JISCO)	China	5,175	7,018
▲ 57	59	Riva Forni Elettrici	Italy	6,930	6,977
▲ 58	65	Jindal Steel & Power Ltd	India	5,690	6,960
▼ 59	49	voestalpine Group	Austria	8,150	6,940
▼ 60	53	Kobe Steel Ltd	Japan	7,460	6,875
▲ 61	82	Chongqing Iron & Steel (Group) Co Ltd	China	4,114	6,382
▼ 62	61	Minmetals Yingkou Medium Plate Co Ltd	China	6,088	6,362
▼ 63	62	Jiangsu Binxin Special Steel Material Co Ltd	China	5,981	5,985
● 64	64	BlueScope Steel Ltd	Australia	5,864	5,971
▼ 65	63	Tangshan Ruifeng Steel	China	5,969	5,735
▲ 66	69	Lingyuan Iron & Steel (Group) Co Ltd	China	5,052	5,530
▲ 67	74	Rashtriya Ispat Nigam Ltd, Visakhapatnam Steel Plant (Vizag Steel)	India	4,731	5,520
▲ 68	100	Tangshan Ganglu Iron & Steel Co Ltd	China	3,066	5,389
▼ 69	67	AK Steel Corp (vii)	United States	5,077	5,156
▲ 70	72	Saudi Iron Steel Co (Hadeed)	Saudi Arabia	4,770	5,124
▲ 71	73	Metalloinvest Holding Co	Russia	4,758	5,100
▲ 72	75	Quzhou Yuanli Metal Co Ltd	China	4,665	4,915
▲ 73	77	Ezz Steel Co	Egypt	4,515	4,882
▼ 74	57	Tangshan Guofeng Iron & Steel	China	6,958	4,864

Ranking 2018	2017	Company	Country of origin/ Main domicile	2017 Output	2018 Output
▲ 75	78	Wu'an Yuhua Steel	China	4,497	4,797
– 76	New	Ningbo Iron & Steel Co Ltd	China	4,573	4,553
▼ 77	70	Tianjin Metallurgical Group	China	4,854	4,547
▲ 78	79	Ahmsa – Altos Hornos de Mexico SA de CV	Mexico	4,390	4,523
▲ 79	84	Zaporizhstal Integrated Iron & Steel Works JSC	Ukraine	3,926	4,106
▲ 80	87	Commercial Metals Co (viii)	United States	3,690	4,050
▲ 81	89	Hebei Tianzhu Iron & Steel (Group) Co Ltd	China	3,505	4,027
▼ 82	68	CSN – Companhia Siderurgica Nacional	Brazil	5,062	4,000
▲ 83	111	Yunnan Yuxi Steel	China	2,693	3,992
▲ 84	109	OAO TMK (ix)	Russia	3,784	3,989
▼ 85	76	Xinxing Ductile Iron Pipes Co	China	4,577	3,888
▼ 86	80	Mechel PAO (Mechel)	Russia	4,274	3,881
▼ 87	85	Henan Jiyuan Iron & Steel Group Co Ltd	China	3,823	3,851
● 88	88	Khouzestan Steel Co (KSC)	Iran	3,676	3,820
▼ 89	86	Dongkuk Steel Mill Co Ltd	Korea (South)	3,727	3,767
▲ 90	92	Shandong Shiheng Special Steel Group Co Ltd	China	3,410	3,745
▲ 91	104	Icdas Celik Enerji Tersane ve Ulasim San AS (x)	Turkey	3,700	3,700
▼ 92	90	Tianjin Rockcheck Steel Group Co Ltd	China	3,475	3,686
● 93	93	Shandong Taishan Iron & Steel Co Ltd	China	3,334	3,601
– 94	New	Fujian Sanbao Special Steel Co Ltd	China	3,299	3,534
– 95	New	Liberty House Group	UK	–	3,500
▼ 96	91	Nippon Steel Nisshin Co Ltd (xi)	Japan	3,440	3,360
▼ 97	96	Acciaieria Arvedi SpA	Italy	3,188	3,352
● 98	98	Lengshuijiang Iron & Steel Group Co	China	3,081	3,274
▲ 99	115	Delong Holdings Ltd	China	2,595	3,180
▲ 100	107	Shanxi Zhongyang Iron and Steel Co Ltd	China	2,792	3,127
▼ 101	97	Emirates Steel Industries PJSC	United Arab Emirates	3,149	3,100
▼ 102	94	Yancheng Lianxin Iron & Steel Co Ltd	China	3,228	3,094
▼ 103	101	Usiminas – Usinas Siderurgicas de Minas Gerais SA	Brazil	3,013	3,087
▼ 104	102	Changshu Longteng Special Steel Co Ltd	China	3,009	3,002
▼ 105	95	Diler Group	Turkey	3,200	3,000
● 106	106	Shanxi Jianbang Group	China	2,810	2,987
▲ 107	110	Dazhou Iron & Steel Co	China	2,733	2,961
▼ 108	105	Trinecké Železárny as	Czech Republic	2,885	2,923
– 109	New	Xilin Iron & Steel Group	China	2,402	2,891
▲ 110	116	Tokyo Steel Manufacturing Co Ltd	Japan	2,580	2,860
▼ 111	108	Saarstahl AG	Germany	2,785	2,782
– 112	New	British Steel Ltd (xii)	United Kingdom	2,700	2,700
– 113	New	Tianjin Tiantie Metallurgical Group	China	2,867	2,628
▼ 114	112	Weifang Special Steel Group Co Ltd	China	2,678	2,612
▲ 115	119	Colakoglu Metalurji AS	Turkey	2,500	2,600
▼ 116	114	Qatar Steel Co	Qatar	2,645	2,575
▲ 117	120	Feralpi Group	Italy	2,448	2,504
▲ 118	123	Belorussian Steel Works (BMZ)	Belarus	2,345	2,474
– 119	New	Shanxi Xintai Iron & Steel Co Ltd	China	2,151	2,447
▼ 120	118	Acerinox SA	Spain	2,519	2,440
▼ 121	120	Outokumpu Oyj (xiii)	Finland	2,448	2,428
▲ 122	126	Vallourec (xiv)	France	2,256	2,364
▼ 123	113	Tangshan Donghua Steel Enterprise Group	China	2,673	2,342
– 124	New	Dongbei Special Steel Group Co Ltd	China	1,608	2,338
▼ 125	117	AG der Dillinger Huttenwerke	Germany	2,521	2,334
▼ 126	125	ESCO – Esfahan Steel Co	Iran	2,300	2,263
▼ 127	103	Hebei Wenfeng Iron and Steel Co Ltd	China	2,973	2,228
● 127	127	Tangshan Wenfengshanchuan Wheel Co Ltd	China	2,253	2,228
▼ 129	99	Industrias CH SA de CV (xv)	Mexico	2,091	2,128
▼ 130	128	Badische Stahlwerke GmbH	Germany	2,240	2,126

All figures in thousand tonnes

(i) In last year's ranking Nippon Steel Corp was listed as Nippon Steel & Sumitomo Metal Corp

(ii) JFE's figure includes subsidiary company outputs calculated by percentage

(iii) Nucor's figure is converted from reported figures in US tons to metric tonnes

(iv) China Steel Corp's ranking last year was based on 2016 production figures as 2017 was not available at the time of going to press. This year's ranking shows updated figures for 2017 and 2018 but represent sales tonnages rather than output

(v) Ternium's figures are shipped steel

(vi) Mobarakeh's ranking last year was based on 2016 production figures as 2017 was not available at the time of going to press. This year's ranking shows an updated figure for 2017 production.

(vii) AK Steel Corp's figure represents volume of shipments rather than crude steel production – converted from reported figures in US tons to metric tonnes

(viii) Commercial Metals Co's figure converted from reported figures in US tons to metric tonnes

(ix) OAO TMK's ranking last year was based on 2016 production figures as 2017 was not available at the time of going to press. This year's ranking shows updated figures for 2017 and 2018 but represent sales tonnages rather than production

(x) Icdas production figure for 2017 has been repeated as 2018 not avalible at time of going to press

(xi) Nippon Steel Nisshin Co Ltd was listed as Nisshin Steel Co Ltd last year

(xii) British steel Ltd 2018 production unavailable at time of going to press, so 2017 production figure has been repeated

(xiii) Outokumpu figure is for delivered tonnages rather than production

(xiv) Vallourec figures relate to tonnes sold

(xv) Industrias CH SA de CV ranking last year was based on 2016 production figures as 2017 was not available at the time of going to press. This year's ranking shows updated figures for 2017 and 2018 but represent sales tonnages rather than output

Ranking movement: ▲ Up ▼ Down ● Unchanged – New entries this year

Top steelmakers in 2018

BIG RIVER STEEL

and commissioning of a second micro-mill in Durant, Oklahoma.

"If you don't have steel, you don't have a country," President Trump told an audience of hard-hats, politicians and local and state officials and representatives gathered at US Steel's Granite City Works in late July to mark the restart of the mill's 'A' and 'B' blast furnaces and the recall of some 800 workers. Both ironmakers were idled in December 2015.

Plans to bring 'B' furnace back on line were announced on March 7, 2018 and were spurred, US Steel executives said, by the pending action announced by President Trump on March 1, 2018 as a result of the Section 232 national security investigation.

Less than a month later, Pittsburgh-based US Steel unveiled plans to invest a minimum of $750 million – as part of a $2-billion asset revitalization initiative – to modernize its flagship, Gary, Indiana operation.

The upbeat momentum continued into the New Year. In February 2019, US Steel announced plans, which had been suspended in December 2015, to restart construction of an electric arc furnace (EAF) at its Tubular Operations in Fairfield, Alabama. And in early May, North America's second-largest steelmaker said it would invest $1-billion plus to build a new sustainable endless casting and rolling facility at its Edgar Thomson plant in Braddock, Pennsylvania, and a cogeneration facility at its Clairton cokemaking plant in Clairton, Pennsylvania.

By virtually any measure and after decades of costly trade litigation, bankruptcies, consolidation and a seemingly futile search for a "fair playing field," 2018 marked a true turning point for North American mills.

Pivoting on the implementation of the Section 232 tariffs, the real-world results for US steelmakers are clear. In recent months, capacity utilization, as measured by the American Iron and Steel Institute, increased to more than 80% – levels not seen in more than a decade – and steel shipments weighed-in 5% higher in 2018 than 2017. Finally, steel imports plummeted 35% from the time the Section 232 steel tariffs took effect in April, 2018 through February, 2019.

Jo Isenberg-O'Loughlin

It has been a busy year for US steel mills, many of which, like Big River Steel, are expanding capacities and capabilities

CIS

In 2018, steel consumption growth in the Commonwealth of Independent States (CIS) has slowed down after the strong increase a year before. That has forced higher exports, mainly from Russia.

Steel consumption in the CIS reached 56.2 million tonnes in 2018, according to World Steel Association (Worldsteel) data. Steel usage increased by 3.5% year on year, while the rise between 2016 and 2017 was 6.5%. In 2019, the growth is expected to be lower – just 1.4%.

In 2018, steel use in Russia went up to 41.2 million tonnes, an increase of 0.7% year-on-year. The expected increase in 2019 is 1%.

Slower steel demand growth domestically, a weaker rouble and stronger prices in external markets led to a 4% increase of steel product exports from Russia. In 2018, they were 26.05 million tonnes, according to the International Steel Statistics Bureau (ISSB).

The growth was mainly related to higher semi-finished steel products shipments, which were 13.35 million tonnes in 2018, compared with 12.44 million tonnes in 2017, according to ISSB.

Novolipetsk Steel exported 10.91 million tonnes from Russia in 2018. That was an increase of 9.1% year-on-year. From this tonnage, more than 7 million tonnes was slabs. About 2.78 million tonnes were shipped to third parties. The rest was sent to NLMK's foreign subsidiaries and affiliates in the United States and Europe.

NLMK's billet sales to third parties surged by 12% in 2018, to 770,000 tonnes, against 686,000 tonnes in 2017. NLMK cut domestic sales in Russia by 4% year on year, to 5.8 million tonnes in 2018.

Other major steelmakers in Russia cut, or remained relatively flat in, export sales.

Evraz shipped to external customers 10.98 million tonnes of steel products in 2018, which was a decline by 7.6% year-on-year. From this tonnage, 4.7 million tonnes was related to semi-finished product sales. Meanwhile Evraz has increased

local sales in Russia to 5.04 million tonnes in 2018, from 4.34 million tonnes a year before.

Magnitogorsk Iron & Steel Works (MMK) cut exports by 15% year-on-year, to 2.38 million tonnes in 2018, while shipments to the local market increased by 5.9%, to 9.03 million tonnes on higher sales of high-value-added products.

Severstal's steel product sales totaled 11.22 million tonnes in 2018, up by 2% year-on-year. Within this, exports remained almost unchanged at 4.41 million tonnes.

Export growth from Russia was partly related to sales from Donetskstal (DMZ), Yenakiieve Iron & Steel Works (Yenakiieve Steel) and the Makiivka unit, and Industrial Union of Donbass's (ISD) Alchevsk Iron & Steel Works – assets based in Eastern Ukraine which now export steel products and pig iron from Russian Black Sea ports.

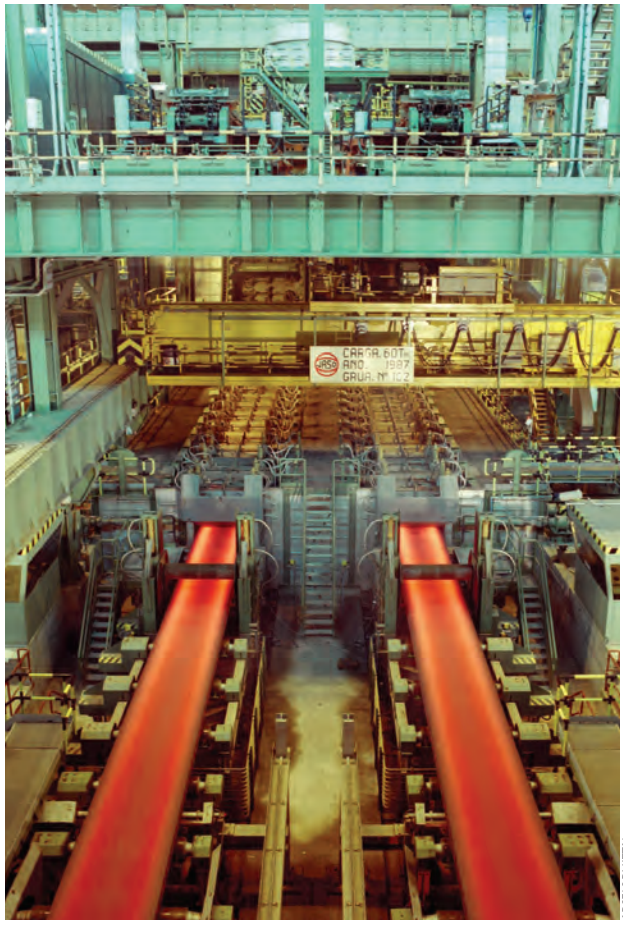
Ukraine exported around 12.74 million tonnes of finished steel and semis in 2018, according to ISSB data, slightly down from 13.18 million tonnes in 2017. Metinvest shipped around 12 million tonnes of semis and steel products including resales – that was an almost 15% increase year-on-year.

From this volume, about 4.1 million tonnes was shipped to the Ukrainian domestic market, which was 1 million tonnes, or 32% higher, than in 2017. Domestic sales have increased as steel consumption continued to grow in Ukraine, reaching 5.7 million tonnes, against 5.5 million tonnes a year before, according to Metinvest.

Steel production

In 2018, the steel output in the region was almost unchanged at 101 million tonnes, according to Worldsteel, with Russian and Ukrainian output at 71.68 million tonnes and 21.1 million tonnes, respectively.

Steel output in Russia may increase further on the start-up of a new mill – Tula Steel, a subsidiary of Industrial Metallurgical Holding (IMH) – in May.



ARCELORMITTAL

ArcelorMittal remains the world's largest steelmaking company

The steelmaking equipment at Tula Steel includes a 1.6-1.9 million tpy basic oxygen furnace and a 1.5 million tpy continuous casting machine. The other 40% of products will be exported, mostly to other CIS countries, but also to countries across Europe.

Ukraine's Metinvest plans to increase steel production as well. The company's new 2.5 million tpy continuous casting machine (CCM), which started up last November at its Ilyich Iron and Steel Works in Mariupol, was operating at design capacity during the first quarter of 2019. This will boost the company's steel output by 800,000 tonnes in 2019, with all additional volumes sold in slabs and HRC on export.

"Large slab suppliers, Novolipetsk Steel in particular, have planned maintenance this year. That is why we expect the shortage in our usual outlets – in European, Black Sea and Mediterranean markets. That is why we are planning to ship additional tonnages of slabs to re-rolling assets in our traditional markets," Metinvest's chief executive officer Yuriy Ryzhenkov said.

In the longer term, two major Russian steelmakers are planning to increase steelmaking as well. NLMK is going to boost steel output above 14 million tonnes at its Russia Flat Steel division, from 13.3 million tonnes in 2018. Severstal is planning to increase steel production to 12.7 million tonnes, up from 12 million tonnes in 2018.

Marina Shulga

EUROPE

Despite the implementation of the EU's safeguard import quota, continued tough competition from imports and slow trading led to a weakening in domestic EU prices over the second half of 2018 and in the first half of 2019.

The European Commission (EC) imposed definitive safeguard measures on 26 imported steel products in February 2019, replacing the provisional measures that have been in place since July 2018.

The amount of import volumes per product permitted into the EU will increase by 5% against their respective 2015-2017 import average volumes on July 1, when the new annual safeguard quota comes into force, raising concerns of imports gaining an increased market share in the region, according to regional steel association Eurofer.

European steelmakers are currently in discussions with the EC to request that the safeguards be strengthened to protect domestic steelmakers from greater import competition, while the EC began a review into the current safeguard on May 17.

While the EU's apparent steel consumption rose by 2.6% year-on-year to 163 million tonnes in 2018, according to Eurofer, steel imports into the region increased by 12.3% year-on-year, meaning that European mills did not fully benefit from the rise in consumption.

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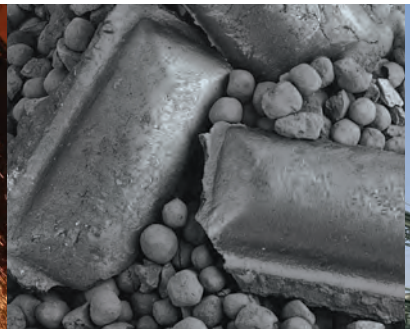

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MIDREX

Top steelmakers in 2018

European producers' shipments to the domestic market picked up by only 0.6% year-on-year in 2018, with domestic prices falling amid weak automotive demand and low competing import prices – particularly from Turkey.

The United States has given the EU and Japan a 180 day-window to reduce imports of automobiles and certain automobile parts, essentially delaying potential Section 232 tariffs on imports of these products, it said on May 17. The delay is a temporary reprieve for European flat steelmakers, who have been hit by weaker automotive sector demand.

Fastmarkets' weekly price assessment for domestic hot-rolled coil (HRC) in northern Europe was €480-490 per tonne ex-works on May 15, down sharply year-on-year from €570-590 per tonne ex-works on September 2018, its highest level over the past year. Fastmarkets' weekly domestic price assessment for rebar in Northern Europe also weakened over the past year, albeit more moderately.

ArcelorMittal retained its position as the world's largest steelmaker in 2018. The Luxembourg-headquartered producer reported an operating income of $1.63 billion for its European operations in 2018, down sharply from $2.36 billion in 2017.

On May 6, the company reacted to the situation of low demand and rising imports by deciding to temporarily reduce annualized European flat steel production by 3 million tonnes. This includes slowing down the planned production increase at ArcelorMittal Italia to 6 million tonnes per year. ArcelorMittal Italia includes Italian steel producer Ilva, which ArcelorMittal finally acquired in November 2018.

International metals group Liberty House acquired a number of ArcelorMittal's European flat steel operations in April 2019, following an EC requirement for ArcelorMittal to reduce its market share and preserve effective competition in the European steel market, following its purchase of Ilva.

Elsewhere, the proposed flat steel merger between Germany's ThyssenKrupp and the European subsidiary of India's Tata Steel faced continued competition concerns from the EC.

Following news of the potential failure of the merger, ThyssenKrupp unveiled a new commercial strategy, involving a plan to cut 6,000 jobs over the next three years, including 2,000 jobs in its steel business. However, the company remains open to EU steel consolidation opportunities, it said.

Looking ahead to the second half of 2019, growth in apparent steel consumption in the EU is forecast to contract by 0.4% in 2019, according to Eurofer, while ArcelorMittal is more bearish, expecting it to contract by up to 1% year-on-year in 2019.

UK and European steel market participants have renewed calls for the European Union and the United Kingdom to reach an agreement and avoid continued market uncertainty, after the UK was granted a six-month extension to delay Brexit until October 31, and temporarily avert the prospect of the UK having to leave the EU without a deal.

UK long steel producer British Steel has faced a number of Brexit-related difficulties in recent months. The company received a UK government loan worth £120 million to cover its 2018 annual bill from the EU for the company's carbon emissions. Requests for further government financial support were not forthcoming and the company entered into administration.

While the overall EU market outlook does not appear so optimistic as ArcelorMittal,the largest steelmaker did announce higher offer prices for HRC across Europe on May 10, following its decision to reduce production. This was followed by Italian re-roller Marcegaglia also raising offer prices for hollow sections, coil and plate products.

Viral Shah

'UK and European steel market participants have renewed calls for the EU and the UK to reach an agreement and avoid continued market uncertainty'

LATIN AMERICA

The Brazilian steel industry started 2019 with optimism after signs of recovery in the steel market in 2018, when demand increased after two weak years of 2016 and 2017. But the expectation was not confirmed in the early months of 2019 and the sector is still waiting for an improvement to occur in the months to come.

The Brazilian steel institute, Aço Brasil, expects steel consumption in the country to rise by 4.60% this year, to 22.06 million tonnes, after an increase of 7.30% in 2018, with 20.57 million tonnes. Despite the positive figures for consumption last year, steel demand showed signs of weakness at the end of 2018 and a full recovery was expected for this year.

The growth for 2019 is expected to be driven by a stronger domestic market, with a higher level of domestic sales offsetting lower exports. But the signs of a market rebound are not clear yet and this year's expectation was revised downwards after performance in the first quarter was weaker than expected.

The Brazilian economy has underperformed and ongoing political issues after a change of government last year has created uncertainty and led investments to a halt. "There are 4,500 infrastructure works halted in the country, and everybody is waiting for approval to reforms [to the Brazilian pension system] to resume investments," Aço Brasil executive president Marco Polo de Mello Lopes said late in April.

Gerdau, ranked 23rd in the Top Steelmakers list, has recently said there is a chance of steel prices increasing in the second quarter, amid lower competition from imported material. It saw its sales volumes to the Brazilian domestic market increase by 5.90% in the first quarter, compared with the previous quarter, to 939,000 tonnes.

The results exceeded analysts' expectations. "We expect [Gerdau's] margins to continue ▶

rebounding ahead, as steel demand [in Brazil] picks up," analyst Leonardo Correa from BTG Pactual said in a report in May. The company, which has operations in Brazil and the US, is also benefiting from increased prices and lower imports after duties imposed following the US Section 232 investigation.

Other Brazilian steel producers, such as Companhia Siderúrgica Nacional (CSN), are planning price increases for the months ahead, as currency moves and higher international steel prices have made imports less attractive.

Gerdau and CSN have been purchasing semi-finished steel material from third-parties and are planning a revamp of blast furnaces in mid-2019. Maintenance works are expected to last until August or September, and the companies have said they expect no effect on sales.

After the maintenance is over, the companies' blast furnaces are expected to see an increase in productivity. CSN is studying building a new galvanizing facility in Brazil, to be supplied with increased productivity generated by the blast furnace maintenance.

The Mexican steel industry increased steel output by 0.90% in 2018, to 20.10 million tonnes, according to figures from the World Steel Association. Last year, producers benefited from measures to protect the steel industry from low-priced imports.

The country's steel sector had a stable outlook until mid-May, when US president Donald Trump decided to exempt Mexico and Canada from a 25% tariff over steel imports resulting from the Section 232 investigation. While some volumes of exports of steel materials were being made to the US despite the tariff, market sentiment improved after the announcement.

"We believe this is a firm and very positive step to the industry in all regions and a huge improvement towards the signing of the USMCA," Mexican steel association Canacero said after President Trump's announcement. Unlike other countries, such as Brazil and South Korea, Mexican producers will not be subject to a quota for steel imports in order to avoid the tariffs.

Finished steel use in Mexico was expected to grow by 1.60% in 2019, to 25.80 million tonnes, after having decreased by 3.90% in 2018, to 25.40 million tonnes, according to Worldsteel's April forecast.

According to the Latin American steel association, Alacero, Mexico used to export around 2.50 million tonnes per year of steel products to the US before Section 232 tariffs, and such volumes were under threat when the duties were imposed in June 2018. The country's largest integrated steelmaker, Altos Hornos de México (Ahmsa), reported in February that Section 232 tariffs cost the company around $250 million in reduced exports to the United States.

Besides an improved outlook after the exemption of Section 232 measures, most Latin American governments have continued to take measures to protect their steel industry from low-priced steel imports. The Mexican government renewed late in March a 15% safeguarding duty against imports of several steel goods. The safeguarding duty, which expired in January 2019, was one of the main reasons behind the positive performance of the country's steel sector last year.

"Mexico has advanced a bit more than other countries in Latin America in trade defense measures," Máximo Vedoya, president of Alacero and Canacero, said in May. "To some extent, all countries are taking actions against low-priced imports, which come mainly from China, but such measures take time to be applied," he said.

In March, Colombia imposed an 8.50% additional safeguarding duty to imports of rebar from countries with which it does not have free trade agreements, for a period of two years.

Felipe Peroni

'Most Latin American governments have continued to take measures to protect their steel industry from low-priced steel imports'

MIDDLE EAST

Middle East crude steel production increased by 12.6% in 2018, with a total output of 36.062 million tonnes, compared with 32.020 million tonnes in 2017, according to Worldsteel data. The countries in the total include the United Arab Emirates (UAE), Iran, Saudi Arabia and Qatar.

Middle East steel production is largely focused on long steel products, given that demand in the region primarily stems from construction projects, and with construction demand having decreased from its peak a few years ago, the region is now self-sufficient in long products.

The region still has to import flat steel though because there is only one producer of hot-rolled coil in the Middle East – Saudi Arabia's Hadeed Sabic. However, other producers are now looking at diversifying into flat steel products, particularly given the threat to margins from global protectionism and increased imports, with at least two companies rumored to be planning such investments.

Steel demand in the Middle East is currently moderate because of a low number of big projects.

UAE-based Emirates Steel CEO Saeed Al-Romaithi said on February 26, 2019 that Emirates Steel is expecting a slowdown in the Middle East construction sector that will persist throughout 2019. He said that he expected the slowdown in the regional construction industry this year because of increases in iron ore prices, a drop in sales prices, market volatility, and protectionist actions by some nations.

He had made an earlier prediction in October 2018 of a decline in global steel demand of 1.4% in 2019, in his capacity as chairman of the economics committee of the World Steel Association.

In May 2018, Al-Romaithi, said that Gulf Cooperation Council (GCC) countries were acutely aware of trade issues and are keen to limit the impact of steel being redirected to countries outside the US. ▶

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"It's a bit slow because the whole GCC is linked together [in terms of anti-dumping legislation] but something is definitely happening – the region is lacking the rules and regulations that we need to give us freedom to compete fairly in the market," he said.

"From our point of view, the demand outlook for rebar [for] 2018-2019 looks stable – we have the 2020 Dubai Expo and related infrastructure construction currently going on in the UAE," Al Romaithi said.

Abu Bucker Husain, CEO of UAE-based Al Ghurair Iron and Steel (AGIS) believed 2017 had been the worst year for contracts being awarded in the Middle East since 2012, but now that investment in construction, infrastructure projects and the oil and gas sector has returned, this could all change, he said at Fastmarkets MB's Middle East Iron and Steel Conference in December 2018.

Participants and speakers at the conference agreed that the Middle East region needs more protective measures because low-priced steel, which cannot be exported to the US because of 25% Section 232 duty, is being redirected to Middle East due to the lack of efficient protective trade measures.

GCC countries, which are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE, did increase the import duty on rebar and wire rod to 10% from the previous 5% in effect from January 16, 2019.

The region is currently self-sufficient for long products, and trade is mostly between the GCC member countries for long products.

In addition, the Saudi National Committee for Steel Industry (NCSI) was formed in 2018 in order to avoid low-quality steel imports entering Saudi Arabia and the Middle East region, and to support local production. The Saudi Arabian Standards, Metrology & Quality Organisation (SASO) banned the trading of pre-painted galvanized coil products which do not comply with its regulations. Nevertheless, some low-quality imports still continue, according to Nouf Bahamdan, coated flat steel director of NCSI.

Investments

Oman's Jindal Shadeed, part of India's Jindal Steel & Power (JSPL), has successfully commissioned a new billet caster with a capacity of 2 million tonnes per year at its mill in Sohar in northern Oman in April 2019.

UAE-based United Iron & Steel Co (UISC) started producing its own cold-rolled coil at its plant in Abu Dhabi for processing into hot-dipped galvanized coil in March 2019. The new 250,000 tonnes-per-year cold-rolled coil (CRC) facility consists of an in-line push-pull pickling line, a single-stand cold-rolling mill and a continuous galvanizing line to process both hot- and cold-rolled coil.

Dubai-based multinational Dana Group has completed the construction of new mills for the manufacture of CRC and hot-dipped galvanized coil (HDG) in the UAE in February 2019. Installation and commissioning of the necessary machinery is under way. The company did not give a date for the start of production, but it expects to produce 250,000 tonnes per year of HDG and Aluzinc coils. It will also produce 150,000 tpy of pre-painted galvanized iron (PPGI), or color-coated coil, at the unit in the Dubai Industrial Park, 35 km from the Jebel Ali sea port.

Bahraini rebar producer Unirol increased its rebar production capacity to 275,000 tonnes per year from 175,000 tpy with the launch of a new unit in March 2019.

UAE

Crude steel production in the UAE totaled 3.247 million tonnes in 2018, down by 1.9% on an annual basis from 3.309 million tonnes in 2017. Production in the country is expected to improve because of better demand for local products in 2019.

The UAE produced 805,000 tonnes of crude steel in January-March 2019, 10% more than the 732,000 tonnes produced in the same period of 2018.

'Middle East steel production is largely focused on long steel products, given that demand in the region primarily stems from construction projects'

Iran

Iran recorded the highest crude steel output in the region, with 25 million tonnes of output, up by 17.7% from 21.236 million tonnes in 2017. The country ranked as the tenth largest steel producing nation in 2018, up from being 13th biggest in 2017.

However, US President Donald Trump announced his country's withdrawal from the nuclear deal on May 8, 2018 and the sanctions on Iran were reinstated in 2019, with further sanctions on Iranian metals – including steel, aluminium and copper.

The country's steel exports may decrease because sanctions on Iran mean that payments cannot be made to Iranian banks in US dollars or gold, therefore limiting the country's international trade.

Iran produced 6.223 million tonnes of crude steel in January-March 2019, 7.1% more than the 5.811 million tonnes compared year-on-year.

Saudi Arabia and Qatar

Saudi Arabia produced 5.240 million tonnes of crude steel in 2018, which was an 8.4% increase compared with 4.831 million tonnes a year earlier, according to Worldsteel data.

Current demand for steel is stronger compared with late 2018, and earlier 2019, and if it continues to be strong, production may move higher, sources believe. However, the country's economy depends directly on oil prices, so any fall in oil price will have a negative effect on steel market. Saudi Arabia produced 1.412 million tonnes of crude steel in January-March 2019, 18.4% more than the 1.193 million tonnes produced in the same period of 2018.

Qatar produced 2.575 million tonnes of crude steel in 2018, a fall of 2.6% from 2.644 million tonnes a year earlier. The country's crude steel production in the first three months of 2019 reached 632,000 tonnes, 1.2% more than the 624,000 tonnes produced in January- March 2018.

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Tariffs trouble Turkish steel

As a major scrap-based steel-producing nation with multiple export markets, Turkey is bound to be affected by international trade quotas and tariffs. The past year is a case in point, explain Şerife Durmuş and Cem Türken

International trade barriers and a volatile exchange rate for the Turkish lira have had ramifications for both flat steel and long product markets over the past year.

FLAT PRODUCTS

Demand for flat steel in Turkey's domestic market has been slow since August 2018, when the country's lira lost significant ground against the dollar and the United States doubled the tariffs applied to steel entering the country from Turkey.

The lira was trading at TRY100 to $16.5811 on May 21. This compared with $17.25 on April 14, $19.00 on March 14, $18.22 on November 14 last year, and $23.12 on May 14, 2018.

US duties on Turkish steel were reduced back to 25% in May 2019, so sentiment in the Turkish steel market has improved a little.

Political uncertainties have also affected the Turkish steel sector in 2019. Mayoral elections were held on March 31, with some unexpected results. The ruling Justice & Development Party (AKP) won the majority of votes for mayors across the country, but lost out in the key cities of Ankara, Istanbul, Adana and Antalya, where the opposition Republican People's Party (CHP) triumphed.

After a dispute, members of the country's Supreme Election Council (YSK) accepted the objection put forward by the AKP to the Istanbul poll, and scrapped that result on May 6. The Istanbul election will now be re-run on June 23.

SHUTTERSTOCK

Rates of vehicle production have declined in Turkey this year

Production

Slab production in Turkey was 4,346,000 tonnes in January-April 2019, 7.65% more than the 4,037,000 tonnes produced in the first 4 months of 2018. The country's total crude steel production reached 11,233,000 tonnes in January-March 2019, a 10.5% decrease year-on-year.

Flat steel production increased in Turkey, while long steel production fell because of shrinking export markets for long steel. The European Commission (EC) imposed definitive safeguard duties on imports of a range of steel products on February 1, 2019.

The import safeguard quota for wire rod from Turkey allows for 121,331 tonnes of material from the country to be brought in over the first quota period, which will run until July this year. For rebar, the Turkish quota is 117,232 tonnes over the same period.

As a result of these restrictions, some Turkish mills have reduced their capacity utilization, while others that can produce either slab or billet have focused on slab production due to stronger demand for flat steel in the export markets.

Even though current sentiment is more positive in the country after the reduction of US duties, production is unlikely to improve in 2019 compared with 2018 in Turkey because of weak domestic demand and a slow market for long steel products.

Turkey produced 37.3 million tonnes of crude steel in 2018, a 0.56% decrease compared with 2017, according to the Turkish Steel Producers Association (TÇÜD).

Imports

Turkey increased the hot-rolled coil (HRC) import duty to 6% for re-rollers, up from 3.5% previously, effective from January 1, 2019.

Additionally, the duty for cold-rolled coil (CRC) imports, including for hot-dipped galvanized coil (HDG), pre-painted galvanized coil (PPGI) and white goods was changed to 7%, effective from January 1, 2019. It was 7% for HDG producers and 5% for PPGI producers previously, while white goods producers did not get a duty discount until 2019. Turkey had previously imposed a 10% import duty on CRC imports.

Turkey terminated an investigation into the effects of steel product imports on the country's domestic steelmaking industry, the Official Gazette announced on May 7. No additional duties or other measures will be imposed after the conclusion of the investigation.

The probe began in April 2018, and considered imports from all origins of flat, long and stainless steel, along with steel tube & pipe products. Turkey's ministry of trade announced in the Official Gazette that import volumes of the products under investigation did not increase significantly during the period under scrutiny, and that the ▶


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imports did not cause any harm to local production.

Exports

The quotas introduced by the European Commission (EC) did not have an effect on hot-rolled coil because the EC did not announce country-specific quotas for hot-rolled coil, but the quota for coated coils under HS codes 7210 70 80, 7212 40 80 is 21,834 tonnes until June 30.

Turkey exported 1,263,804 tonnes of coated coil under customs code 7210 in 2018, with 711,543 tonnes going to EU member countries. So Turkey's exports to Europe for colour-coated coil are limited. However, hot-dipped galvanized coil exports are strong to the region.

Turkey exported 1,713,822 tonnes of flat steel in January-March 2019. This volume was up by 41.08% from the 1,214,777 tonnes exported in the same period of 2018, according to the Turkish Statistical Institute (TÜIK).

The country's export volumes are expected to increase after the US decreased the import duty on Turkish steel to 25% from the previous 50% on May 17, 2019. Turkey exports of hot-rolled coil under HS code 7208 to the US in January-March 2019 were very small. In the same period, Turkey exported 18,227 tonnes of rebar under HS code 7214 to US shores, according to the TÜIK.

This compares with Turkey-origin shipments of HRC and rebar to the US that totalled 233,304 tonnes and 181,115 tonnes respectively in the first three months of 2018, according to TÜIK. Turkish market participants believe the reduction of the duty will allow for the resumption of shipments to the US and will help domestic steel production grow in Turkey.

Morocco imposed a permanent 11% anti-dumping duty on Turkish HRC in August 2014, which was challenged by Turkey in October 2016. A World Trade Organization panel made its ruling in late October 2018, noting that the Moroccan government had violated the trade body's regulations when it established dumping margins on Turkish steelmakers Çolakoglu Metalurji and Erdemir.

Morocco asked the WTO Appellate Body to review its decision. Turkey exported 13,908 tonnes of hot-rolled flat steel classified under customs code 7208 to Morocco in 2013, but exports of the product had fallen to 8,721 tonnes in 2017.

Automotive industry

The automotive industry is one of the biggest steel-consuming sectors for Turkey's steelmakers, but it has been shrinking since 2018. Turkey's vehicle output totalled 1,550,150 units in 2018, down by 8.59% from 1,695,731 vehicles the previous year, the Turkish Automotive Manufacturers Association (OSD) reported.

In January-March 2019, Turkey produced 361,516 vehicles, 14.98% fewer than the 425,195 vehicles produced in the first three months of 2018, according to the OSD.

In 2018, domestic vehicle sales were 641,541 units, down by 35% from 986,829 vehicles in 2017. The country imported 397,266 vehicles in 2018, a decline of 36.38% from 624,487 vehicles the previous year, while exports fell by 1.04% to 1,318,869 units from 1,332,794 units in the same comparison, the OSD data show.

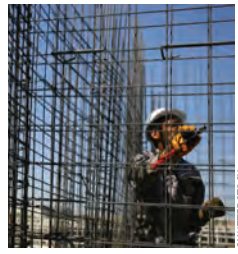
Some automotive producers in Turkey have reduced production because of weak demand.

Export volumes

Turkey's flat steel exports had been increasing, especially since early 2017, thanks to strong demand in Europe. Demand for Turkish flat steel is strong in Europe.

Turkey exported 1,713,822 tonnes of flat steel in January-March 2019. This volume was up by 41.1% from the 1,214,777 tonnes exported in January-March 2018, according to the TÜIK.

Hot-rolled flat steel exports were 1,067,299 tonnes in the period, a 33% increase year-on-year, compared with 802,4945 tonnes exported in January-March 2018. Cold-rolled flat steel exports were 146,037 tonnes in the first quarter of 2019, a 131.29% increase compared with 63,139 tonnes exported in the same period of 2018.



SHUTTERSTOCK

Some construction projects have stopped due to financial and political uncertainties in Turkey

Turkey exported 412,160 tonnes of coated coil in January-March 2019, 57% more than the 262,348 tonnes exported in January-March 2018. The country's narrow flat steel exports reached 34,709 tonnes in the first three months of 2019, just a 7% increase compared with 32,454 tonnes exported in January-March 2018. And alloy flat steel exports were 53,617 tonnes in the first quarter of 2019, not much less than the 54,342 tonnes exported in January-March 2018, according to TÜIK.

Investments

New Turkish flat steel producer Yildiz Iron & Steel started production of CRC in early December 2018. The mill's capacity is 1.5 million tonnes per year of CRC at its facility in Kocaeli, close to Istanbul. Yildiz started production of HDG at the facility in July 2018.

Turkish trader and steel service center Galva Metal started production of CRC at its facility in Kartepe, in the north-western Turkish province of Kocaeli in January 2019. The unit's capacity is 60,000 tonnes per year, in coils 850-2,000 mm wide and a gauge of 0.25-6.00 mm.

Turkish steelmaker Erdemir's second HDG line started commercial production in April 2019. This line has capacity for 350,000 tpy and will increase Erdemir's total HDG capacity to 650,000 tpy. It will produce 0.4-2.0 mm thick coil in widths of 700-1,900 mm. Erdemir Group will also build two new blast furnaces, although full details have yet to be announced.

LONG PRODUCTS

The Turkish long steel market suffered heavily from weak demand in the country's export and domestic markets in the past year. Turkey's long steel export markets were hit by the trade barriers erected in the country's principal outlet markets, while its domestic market was badly affected by the weakening lira due to internal political and economic problems. ▶

The sentiment for long steel exports out of Turkey was negative until mid-May, with no recovery expected, but the halved import duties in the United States brought some glimmer of hope to the market. The US lowered its tariffs on steel imports from Turkey to 25%, from the previous 50%, effective May 17.

The move reversed a decision by US President Donald Trump in August last year to impose higher tariffs on US imports of Turkish aluminium and steel amid an escalation in tensions between the two countries. Turkish market participants believe the reduction of the duty will allow for the resumption of shipments to the US and will help domestic steel production grow in Turkey.

Overall demand in the country's export markets were sluggish until mid-May, owing to doubled Section 232 tariffs in the US, safeguarding quotas in Europe and additional duties imposed by Egypt. This affected steel production in the first four months of the year. Turkey produced 11.2 million tonnes of crude steel in January-April 2019, a decrease of 10.50% year on year, according to the Turkish Iron & Steel Producers Association (TÇÜD). It exported a combined total of 21.40 million tonnes of steel products in the full year of 2018 – a 20.80% increase year-on-year.

The country is unlikely to match that export level in 2019 because of several challenges. Ugur Dalbeler, chief executive officer of Turkish steelmaker Çolakoglu Metalurji, who is also a member of the board of directors of TÇÜD, said that domestic steel consumption shrank by 39% year on year in the first two months of 2019. TÇÜD has reported that consumption fell to 3.4 million tonnes in January-February, against 5.6 million tonnes in the first two months of 2018. Exports, meanwhile, increased by 18%.

But Dalbeler believes that exports will fail to increase through the rest of 2019 because of the import quotas set by the EU, one of Turkey's major export markets.

The EU has set a range of quotas for steel product imports, with some supplier countries, such as Turkey, being allotted specific amounts. These have already been filled for long steel for the current quota period, and mostly filled for flat steel.

'Overall demand in the country's export markets were sluggish until mid-May, owing to doubled Section 232 tariffs in the US, safeguarding quotas in Europe and additional duties imposed by Egypt'

Dalbeler noted that Turkish flat and long steel exporters were now looking in Asia for new export markets, because high prices for steel from China allow competition from Turkish steel. But the Asian market will not provide a long-term solution, in the way that the US and the EU have done in previous years, because of the volatility of prices in the region.

Long steel exports into the EU were also limited by that region's safeguarding quotas. The European Commission (EC) imposed its definitive safeguard duties on February 1.

The import quota for wire rod from Turkey allowed for 121,331 tonnes of material from the country to be brought in over the first quota period, which will run until July this year. For rebar, the Turkish quota was 117,232 tonnes over the same period. Both quotas were filled almost immediately from material that had been shipped earlier.

The EU quotas for Turkey-origin rebar exports have been set at 301,537 tonnes for July 2019 to June 2020, and 316,614 tonnes for July 2020 to June 2021. To put that in context, in 2018 alone, Turkey's rebar exports to the EU totalled 821,178 tonnes.

The US market has been effectively closed to Turkish exporters because the doubled import tariffs that were applied under that country's Section 232 trade legislation since August 2018.

Another barrier for Turkish exporters was created when Egypt imposed additional import duties of 25% for rebar imports, and between 3% and 15% for billet imports on April 15. Egypt had already imposed a permanent anti-dumping duty on rebar from Turkey at 7.0-22.8% in 2017.

As a result of these developments in the export markets, a number of Turkish long steel producers have reduced their capacity utilization. Turkey's steel billet output was 6.89 million tonnes in January-April 2019, down year-on-year from 8.51 million tonnes, according to the TÇÜD.

Domestic demand

In Turkey's domestic long steel market, political and economic problems and the weakening lira continued to put pressure on demand and prices. The unexpected results from the mayoral elections held on March 31, 2019, and the decision to re-run the Istanbul election on June 23, have more seriously affected long steel product markets than the flat steel markets because of the increased weakness of the country's lira.

The decline in the exchange-rate value of the Turkish lira hurts the long steel market because the local currency is used for trading in such commodities domestically, while the mills buy most of their raw material needs in US dollars.

The news of the re-run of Istanbul elections led to the lira losing more ground against the dollar, because of international fears about the rule of democracy in Turkey. This added to the problems already affecting the lira. The currency originally began to lose value against the dollar as a consequence of a political dispute between Turkey and the US, after Turkey detained a US citizen on suspicion of links to a proscribed political group.

"Market players were not expecting the [result of the] mayoral election [in Istanbul] to be cancelled," a source in the country said. "Most mills which sell finished goods for lira have closed their sales, because they cannot predict where the lira is going."

"The domestic long steel market is suffering from weak demand. Nobody wants to buy rebar at such high prices. All customers are keeping their bookings at the lowest possible volumes," another Turkish source said.

"Construction projects have already stopped due to financial and political uncertainties. The major cities changed hands at the elections, so construction licenses might need to be renewed," a third Turkish source added.

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Customer	Supplier	Order details	Start-up
Australia			
GFG Alliance	Danieli	Design and construction of new 750,000 tpy rail and heavy section mill at Whyalla Steelworks to be equipped with RH2 system	H2 2020
Bolivia			
Empresa Siderurgica del Mutun	Tenova HYL/Sinosteel Equipment and Engineering	250,000 tpy Energiron DRI facility, 650,000 tpy conc. plant, 400,000 tpy pelletizing, 190,000 tpy long product mill	Mid-2021
Brazil			
Usiminas	Danieli	Replacement of converter No. 4 at Ipatinga integrated steelworks BOF plant No. 2 by a new 180-tonne converter with Q-Temp monitoring system	Early 2020
China			
Angang Iron & Steel	Primetals Technologies	Slab caster modernization to replace CCM 1 in steelworks No.1 to improve slab quality for plate mill and increase max slab thickness from 300 to 360 mm	Q3 2019
Baoshan Iron & Steel	Fives	Bronx 6-roll hot pipe straightener for seamless tube & pipe up to 197 mm dia	November 2019
Chengde Jianlong Special Steel	Danieli	Q3-Intelligence advanced business analytics solution suite for plant performance	Fall 2020
Chengdu Changfeng Steel	Primetals Technologies	New Quantum EAF and ladle furnace	Early 2020
Daye Special Steel	SMS group	Upgrade of 75 ton DC EAF in Xinyegang with new pin-type bottom electrodes	2019
Daye Special Steel	SMS group	Hydraulic 50/60 MN open-die forging press	May 2020
Dongfeng Forging	SMS group	MP 5000 eccentric forging press for plant in Shiyan, Hubei Province, to make light-truck crankshafts with a maximum finished weight of 21.5 kg	Q2 2020
HBIS Laoting Steel	Primetals Technologies	New 2 million tonne per year two-strand continuous slab caster to add to two other slab casters due to start up in 2019	February 2020
Henan Tongren Aluminium	Tenova	Continuous annealing and pretreatment line for processing 100,000 tpy of aluminium strip for automotive and aerospace	Early 2021
Jiangsu ChangBao Precision Steel Tube Co, Ltd	SMS group	Premium quality finishing (PQF®) 300,000 tpy seamless tube plant and automation to produce tubes up to 6.625 inches dia and 4-20 mm wall thickness for OCTG	Q1 2020
Nanjing Iron & Steel	SMS group	EAF upgrade with ConSo R6 injector technology for EAF No. 3 in Luhe, Nanjing. Upgrade for 4-strand CCM4 at Nanjing plant No. 2 for production of more than 800,000 tpy of blooms (250 x 300 and 320 x 420 mm)	2019
Ningbo Powerway Alloy Material Co	Danieli	New 20-high cold finishing mills for a range of copper alloys from soft pure copper to hard phosphor bronze (1.2 mm entry thickness, min. 0.03 mm finish thickness, max. width 650 mm)	Last quarter of 2020
Shougang Jingtang United Iron & Steel	Primetals Technologies	1.5 million tonne per year continuous pickling line for UHSS grades of hot rolled strip for transportation and heavy industrial applications	Late 2019

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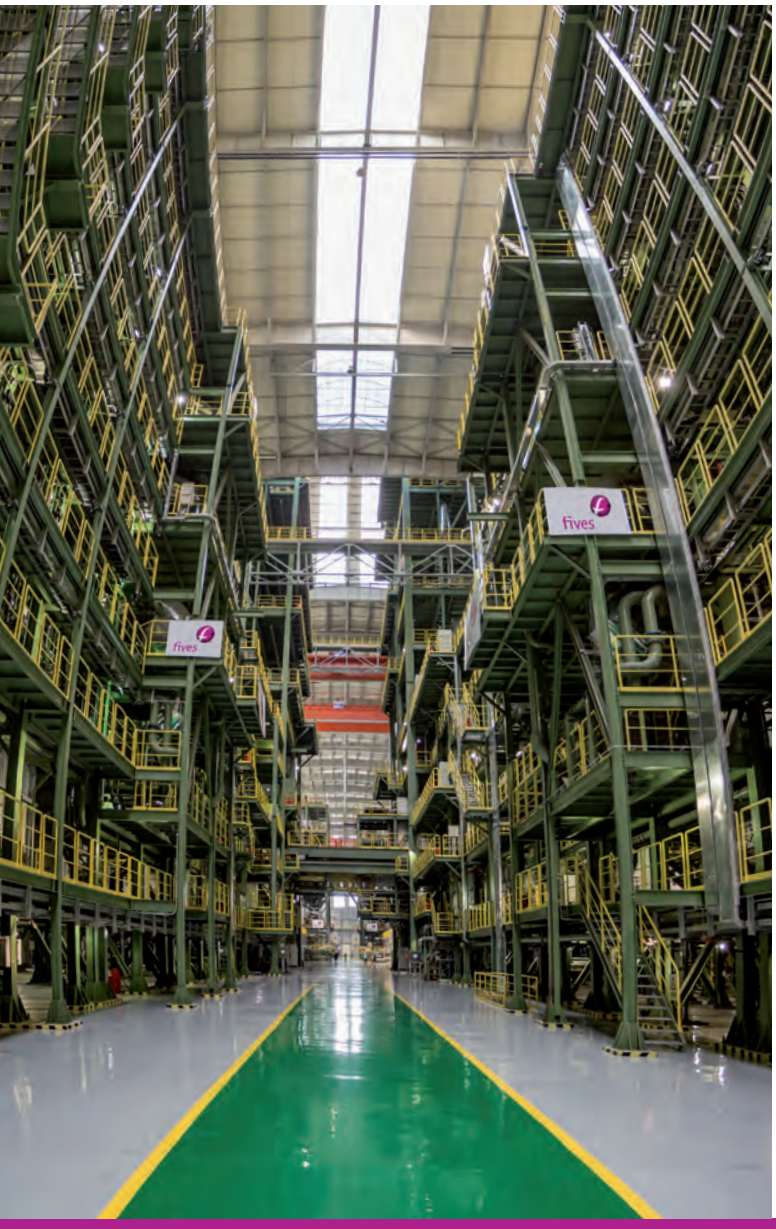

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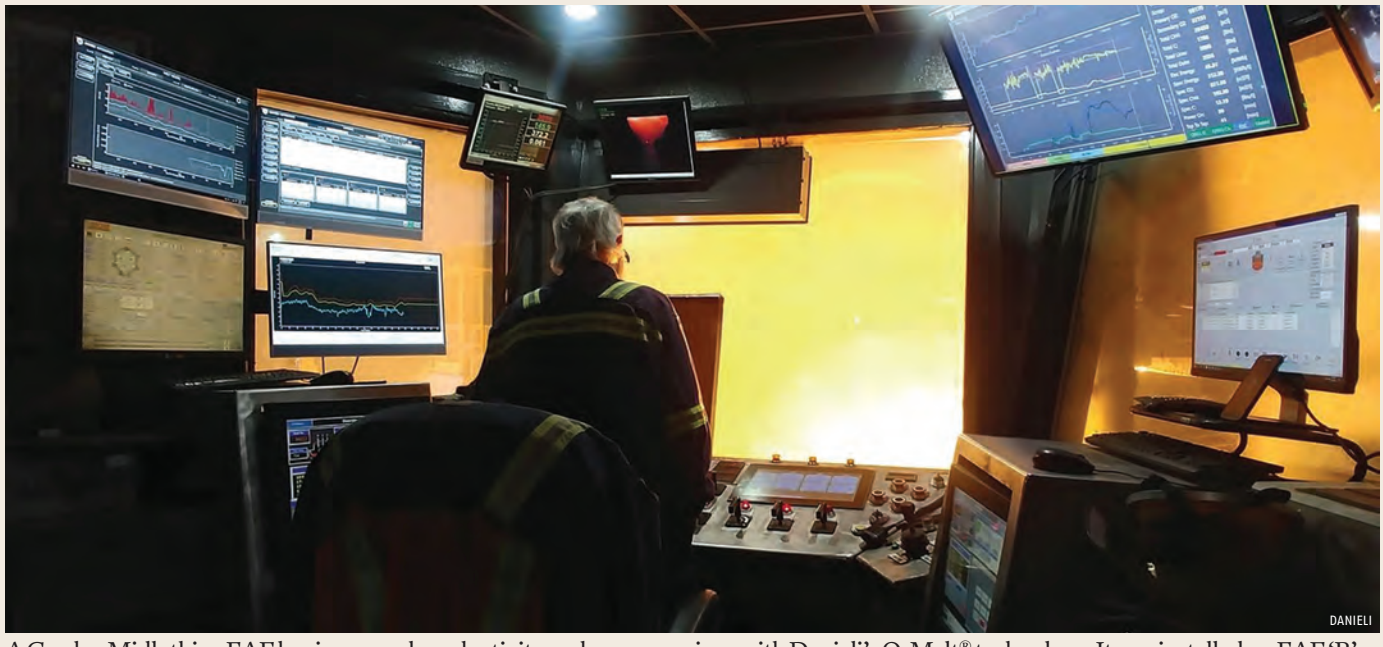

A Gerdau Midlothian EAF has improved productivity and energy savings with Danieli's Q-Melt® technology. It was installed on EAF 'B' at the Midlothian plant in Texas, USA, and started up in January 2019. Gerdau Midlothian released the final acceptance certificate after 15 days of operation, notes Danieli, recording savings for power-on (14%), electric energy (9%) and electrodes (24%).

Customer	Supplier	Order details	Start-up
Sichuan Liuhe Forging	SMS group	High-speed 50/55 MN open-die forging presss with X-Forging Box radial forging tool for aerospace and large steam turbine components	Q4 2019
Wuzhou Yongda Special Steel	Primetals Technologies	New scrap-fed Quantum EAF and twin-ladle furnace	Early 2020
Colombia			
SIDOC	Danieli	Q-Smartec EAF electrode-saving system through dynamic water cooling	March 2019
Ternium Barranquilla	SMS group	Vertical compact coiler (VCC®) for 120 tph bar mill (8-16 mm dia rebar) in Palmar de Varela	–
France			
Laminoirs des Landes	Danieli	Hydraulic dividing shear for plate mill (range of thickness up to 50 mm max, and width up to 3,500 mm max)	Early 2020
Germany			
Musashi Europe	SMS group	5,000 ton closed-die eccentric forging press (MT 5000) to produce large forgings for cars and trucks	Q4 2019
Stahlwerk Thueringen	SMS group	New CCS® stand to replace existing U1 stand for heavier and larger sections	August 2019
Italy			
Feralpi Siderurgica	SMS group	EBROS billet (up to 150 mm square and 12 meters long) welding system for endless rolling into wire rod	Q1 2020
Fonderie Pandolfo	Tenova LOI Thermprocess	65,000 tpy Twin-chamber melting furnace TCF® for aluminium extrusion billet	End-2019
Marcegaglia Ravenna	SMS group	Two-stand 550,000 tpy reversing cold mill (CCM®) for steel strip 750-1,570 mm wide and entry thickness 0.60-5.00 mm. Minimum final thickness of 0.23 mm	April 2020
South Korea			
Posco	SMS group	Modernization of gas cleaning systems for 3 BOFs in Gwangyang	End of 2019
Morocco			
Riva Industries	Danieli	Meltshop, with EAF Q-Melt suite with Melt Model system, and caster to produce 800,000 tpy of 130x130 to 200x200 mm billets	Mid-2020
Peru			
Aceros Arequipa	SMS group	1.2 million tpy steel mill and continuous six-strand billet caster (130, 160 and 180 mm), including 120 ton AC EAF	Early 2020
Poland			
Cognor SA	Fives	Renovation of pusher reheat furnace using AdvanTek® technology	Q2 2020

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Sumitomo Metal 1.2 Mt Coking Oven, Japan

Mining and Mineral Processing

3Mt Cudeco Copper Mine Concentrating Mill, Australia

Iron Making

ISDEMIR 3050m3 Blast Furnace(2 Mta) General Contract Project, Turkey

Pellet

MSPL 1.2mtpa Pellet Plant, India

Steel Rolling

TOSYALI 950mm Hot Continuous Rolling(1.1 Mta) General Contract Project, Turkey

Sintering

ISDEMIR 300m2 Sinter Plant, Turkey

Steel Making

TOSYALI 240t EAF, Algeria

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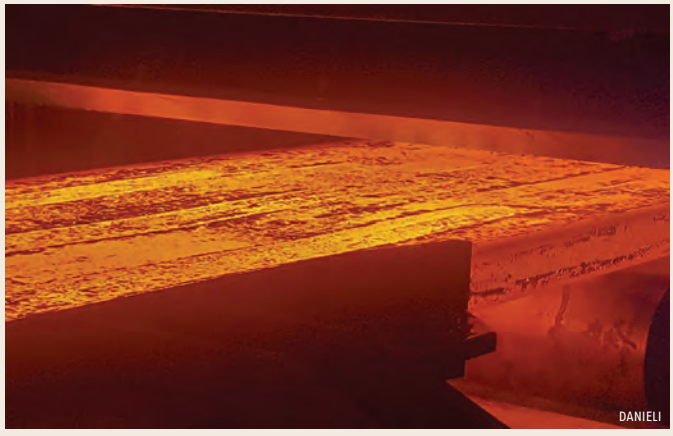
DANIELI

Hot tests are proceeding for the innovative Danieli Universal Endless (DUE®) plant of Shougang Jingtang United Iron & Steel Co. Ltd, in Caofeidian, China. It will provide coil-to-coil and endless, thermo-mechanical and multi-phase, ultra-thin and thick products in a single production line, making both value-added niche products as well as commercial-grade products.

Shougang Jingtang's DUE® plant will produce 2.1 million tpy in a wide mix of steel grades and strip dimensions from 0.8 to 12.7 mm thickness and widths from 900 to 1,600 mm. In mid-April the hot test of the caster area started as per schedule, and within a few days several heats of LC and MC grades had been cast. Targets were achieved, producing 110 mm thick, 1,420 mm wide slabs. The mill has also started rolling tests. Danieli says that its DUE® layout configuration, together with effective and optimized energy consumption, now represents the most extensive application of Danieli's concept of production flexibility.


PRIMETALS

A newly introduced DynaJet® Flex spray cooling system from Primetals Technologies has been started up at Hyundai Steel's 2.8 million tpy two-strand continuous slab casting machine CC2 in Dangjin, South Korea. The technology allows for pulse width modulated cooling, thus enabling high discretization of cooling zones in the width direction (800-1,650 mm on slabs 250 mm thick) and widening the operation window with higher turn down ratios compared with cooling systems currently in use. This minimizes the appearance of corner cracks, especially for advanced high-strength steels (AHSS). Scarfing losses and air consumption are consequently reduced. This is the first industrial application of DynaJet Flex technology, notes Primetals Technologies.

Customer	Supplier	Order details	Start-up
Portugal			
Megasa group	SMS group	New walking beam furnace (160 tph cold charged; 210 tph hot charged) for 120–160 mm billets up to 14.5 meters long for existing bar mill	End summer 2020
SN Seixal	Danieli	Rolling mill modernization, including new K-welder for EWR and intermediate and finishing stands for wirerod and spooled bar in coil production	Summer 2020
Russia			
Abinsk Electric Steel Works	Danieli	600,000 tpy H3 wirerod line (5.5 to 16 mm dia smooth rounds; 6 to 12 mm dia quenched and microalloyed rebar)	–
Evraz NTMK	Primetals Technologies	Automation and electrical equipment for BF No.6 reconstruction	Mid-2020
MMK	SMS group	Product Quality Analyzer (PQA®) system for on-line analysis of process, production and quality data	–
MMK	Paul Wurth	BF No. 2 cooling system modernisation	2020
MMK-Metiz	Tenova LOI Thermprocess	Expansion of HPH® bell-type furnace plant for wire coils	Early 2020
Novorossiysk Rolling Plant	Danieli	500,000 tpy H3 wirerod mill (to roll 150x150 mm billet into 5.5 to 16 mm dia wire rod and deformed wirerod in coils weighing up to 2.1 tons)	–
NTMK	Paul Wurth	Technical upgrade of BF No.6 to increase capacity to 2.5 million tpy	October 2020
OMK	Danieli	New seamless pipe complex for 500,000 tpy of OCTG (casing and tubing), linepipe and industrial pipe from 2.875 to 10.75 inches, using FQT technology	2021
Serbia			
HBIS Serbia Iron & Steel	Primetals Technologies	BOF converter No.2 replacement with tapping weight of 105 tonnes, including a Vaicon Link 2.0 suspension system and new tilting drive	Q2 2020
Spain			
Sidenor Basauri	SMS group	Stage 2 upgrade of walking beam furnace to increase capacity from 85 tph to 130 tph of specia steel blooms 185–240 mm square	H2 2020

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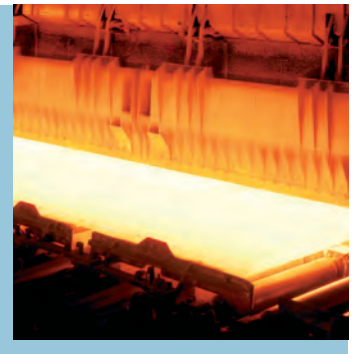

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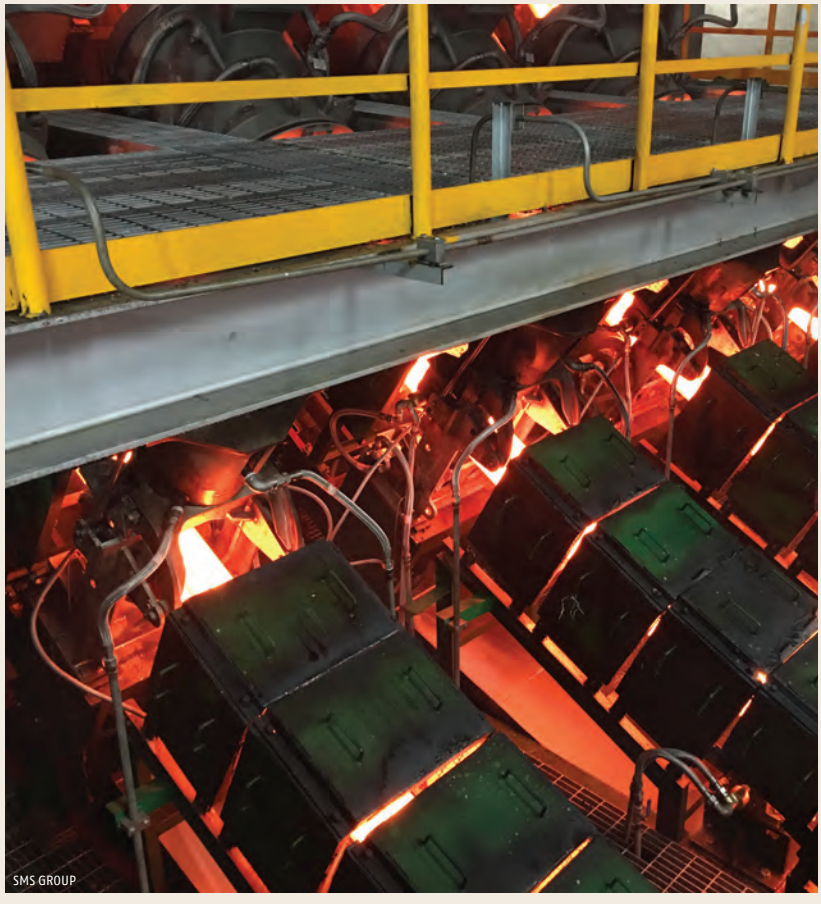
SMS GROUP

Jiangsu Yonggang Group Co., Ltd., in Jiangsu Province, China, has granted SMS group company SMS Concast the final acceptance certificate for the modernization of a new four-strand SBQ billet caster, replacing an old caster at Yonggang in Zhangjiagang, China. Jiangsu Yonggang´s SBQ steel grades portfolio now includes high-quality bearing and other engineering steel grades.

The new billet caster, with a capacity of 540,000 tpy, produces square billets from 150 to 220 mm. It was redesigned for the flying tundish production concept, a method to increase the operation time and yield of the caster. The tundishes were equipped with the Conflow stopper control to assure a precise and stable steel flow for reliable casting requiring minimal maintenance. In addition to the standard mold electromagnetic stirrer Constir-MEMS, a final stirrer Constir-FEMS helps achieve the required product quality in terms of center segregation and center porosity. The spray cooling system is equipped with SMS Concast's Airmist spray nozzles, enabling a uniform and softer cooling at lower water consumption. Provision has been made for the future application of Dynamic Mechanical Soft Reduction (DMSR) for bigger sections. A further technology is heat tracking as part of the level-2 system. This module allows the quality of each heat to be meticulously traced down to single billet slices and thus enables the operator to predict quality events and improve the production yield by cut optimization.

Customer	Supplier	Order details	Start-up
Turkey			
Diler Demir Celik	Danieli	Vacuum degassing station with Q-AFS technology providing automatic control of slag foaming	–
Oyak Mining & Metallurgy (Erdemir)	Danieli	Inspection and conditioning plant to process 300,000 tpy (min.) slabs in ultra-low, low- and medium-carbon and alloy steel grades	–
Erdemir	Paul Wurth	New BF2 at Eregli to produce 5,000 tpd of hot metal. New BF1 at Isdemir to produce 7,900 tpd	March 2021 (Erdemir); May 2021 (Isdemir)
USA			
American SpiralWeld Pipe Co	SMS group	New online spiral pipe mill in Paris, Texas, to produce pipes over 16 meters long, OD of 610-3,658 mm and max wall thickness of 25.4 mm in material grades up to X-70	2020
Big River Steel	SMS group	Expansion to 3 million tpy of steel production with two EAFs and two twin-ladle furnaces, plus a second strand, tunnel furnace and another downcoiler for CSP® plant	–
California Steel Industries	Primetals Technologies	Upgrade of main drives and motors on 86 inch HSM; upgrade of CGL line drives and automation system	Mid-2020; mid-2022
JSW Steel	Danieli	Replacement of primary descaler, hot plate leveler and plate shearing line No. 1 at Baytown, Texas, to improve plant yield	Fall 2019
Nucor	Danieli	Two new water-treatment plants for MI.DA. minimill projects for Nucor Sedalia (Missouri) and Nucor Frostproof (Florida)	Late-2019 (Sedalia); Early-2020 (Frostproof)
Nucor Tuscaloosa	Primetals Technologies	Plate mill upgrade,including new power coiler downcoiler to produce heavier line pipe gauges for energy industry	Q1 2020
Nucor-Yamato	SMS group	Upgrade of heavy section mill (Mill 2) for wide flange and H-pile sections in Blytheville, Arkansas. Replacement of UR-E and UF stands by tandem-reversing mill type CCS 1500	H2 2020
U.S. Steel	Primetals Technologies	New 2.5 million tonne per year Arvedi ESP endless-casting rolling plant for high-quality, ultra-thin (0.08-6 mm) strip with max..strip width of 1,956 mm (77 inches) to include AHSS grades	–
Zekelman Industries	SMS group	New 400,000 tpy, 28 inch ERW tube welding line for Atlas Tube structural tube division (10.75-28 inch dia up to 1 inch thick; plus square and rectangular hollow sections from 8 x 8 inch to 22 x 22 inch; or 34 x 10 inch)	–

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The latest cold mill technology

The new cold mill complex built for Yıldız Demir Çelik in Turkey is a case study in state-of-the-art technology, supplied by Danieli

Favorable market conditions in Turkey led Yıldız Entegre Holding to enter the cold strip processing sector, adding to its long experience in forestry products, fertilizers, chemistry, port operations, energy generation and insurance sectors.

It decided in 2015 to enter the steel business through its subsidiary company Yıldız Demir Çelik, selecting Danieli as technology partner and supplier of its first steel processing plant: a new, complete cold-mill complex to transform black coils purchased from the market into added-value cold-rolled, tempered and coated coils.

The cold-mill complex is in Kocaeli, an industrial area in northern Turkey. The installation comprises a pickling line coupled to a six-high tandem cold mill, a galvanizing line, a temper mill and annealing line. It started operating in sequence at the beginning of 2018 and now is producing in excess of the contractual rate, up to 1.5 million tpy.

Advanced technologies

Danieli notes that one of the strong points of the continuous pickling line coupled with five-stand, six-high tandem mill is the entry area, designed for high reliability and with an "any-coil-feed" concept to avoid production losses due to coil preparation and joining.

The pickling section is based on Danieli patented Turboflo® technology. It is preceded by a powerful scale breaker, operated at up to 500 kN of tension, to improve the shape of incoming strip and to increase the effectiveness of the further pickling process. Turboflo's advanced turbulent channel concept achieves the highest energy savings and pickling condition flexibility regardless of the strip grade and speed, according to Danieli.

The plantmaker adds that the tandem mill section includes five six-high mill stands with 25,000 kN separating force to produce high-strength quality grades with superior flatness correction capabilities through advanced mechanical equipment and new, accurate and sophisticated models.

Operational flexibility is ensured by the installation of positive/negative work-roll and intermediate-roll bending and intermediate-roll shifting system on each stand, with the possibility of using tapered or shaped rolls.

Additionally, final strip shape is controlled by an in-line shapemeter, providing feedback on bending, tilting and selective cooling headers on mill stand No5.

Ultra-low hysteresis hydraulic automatic gauge control (HAGC) with a 45% faster response time ensures precise control of strip thickness.

As a result, strip thickness tolerance will decrease down to ±0.6%, head/tail off-gauge length will be lower than four meters, and strip flatness will be less than 6IU.

A new system has been developed by Danieli to accurately control roll-bite lubrication, thus changing its effect if and when required to stabilize the friction coefficient of the roll bite in any mill conditions.

To ensure high product quality and surface appearance, an innovative strip-drying system called confined jet dryer is installed, in addition to the equipment used to seal the exit strip gap of a rolling stand. This effectively removes any droplets from the strip surface thanks to a 20% larger shearing effect than standard solutions.

DANIELI

Danieli Automation supplied all of the electrical and control systems

The heavy-duty exit flying shear that, together with the carousel reel, ensures flying gauge change and an endless rolling process can cut all material grades and sizes at a speed of up to 300 meters per minute, minimizing mill slowdowns that could cause poorer strip quality in terms of shape, thickness and surface.

The commercial production of the tandem mill started within 22 months from order placement, and the throughput capacity hit more than 50% of nominal quality within 30 days, Danieli reports.

Optimized shaped rolls

The tandem mill is designed to cover the whole potential product mix for automotive markets, from ultra-soft material (IF, ULC steel) to ultra-hard material (DP1000-DP1200).

Consequently, mainly to maintain a wide area for shape control while operating the mill at highest rolling force the mill stand can use, optimized shaped rolls (OSR) have been selected to obtain an equivalent crown in relation to the shifting stroke of the intermediate roll.

The OSR has a special roll barrel contour. The OSR for the Yıldız mill can be applied to the IR roll, keeping the taper zone in place, thus minimizing the disturbance to the roll shop and at the same time allowing the intermediate roll to be utilized with straight or with shaped roll contour.

Flexible HDG

The 400,000 tpy line will process LC, MC, and HSS grades. Strip thickness will range from 0.2 to 3.0 mm and width from 700 to 1,300 mm, respectively.

The line will run at speeds of up to 200 meters per min, processing incoming coils of over 30 tonnes. The finishing section has the flexibility to produce coils down to a minimum size of 5 tonnes, suitable for steel service centres.

Its vertical annealing furnace from Danieli Centro Combustion includes a recuperative room to heat the ▶

Metalloinvest

How Metalloinvest delivers high product quality in the digital age

Metalloinvest embraces Industry 4.0 to power production and sustainable development

In the metals and mining sector, as in all major industries, the focus on climate change and environmental considerations has never been stronger. Governments, public and private investors and key stakeholders of major companies recognize the urgency and are pressuring the industry to respond. As a result, there is a new trend in the steelmaking process to make production more environmentally friendly. Steelmakers have started to shift from blast furnace production to direct reduced iron and electric arc furnace production methods, which generate 70% fewer emissions than older processes. With newly introduced carbon dioxide emission allowances in the European Union and steadily increasing costs for carbon dioxide certificates, steelmakers have to adapt quickly in order to mitigate the growing production cost base.

Companies like Metalloinvest, a leading global iron ore and merchant HBI producer and supplier, and one of the leading producers of high-quality steel in Russia and the CIS region, are increasingly opting for more environmentally friendly electric and cokeless production methods, and using higher-grade iron ore raw materials in steelmaking to address these challenges.

Metalloinvest began to implement initiatives improving the efficiency of its operations and quality of products a long time ago, shifting more towards production of higher value-added (HVA) products. The company's development strategy, which was first adopted in 2015 and renewed this year, centres on increasing the production of HVA products – high-grade iron ore, high-grade pellets, and HVA billets and SBQ (special bar quality), and hot briquetted iron (HBI) and direct reduced iron (DRI). To this end, over the last three years the company has invested about $1.6 billion to upgrade its production facilities.

HBI-3 Plant at Lebedinsky GOK

The state-of-the-art HBI production facility (HBI-3 Plant) at Lebedinsky GOK (part of Metalloinvest) was launched in 2017. It is the largest HBI production facility in Russia and one of the biggest in the world with a production capacity of 1.8 million tonnes per year. The technology for the direct reduction of iron used in HBI production is the most environmentally friendly technology available for steel production from iron ore. During the DRI process, there are no emissions associated with the production of coke, sintering ore and pig iron, as well as solid waste in the form of slag.

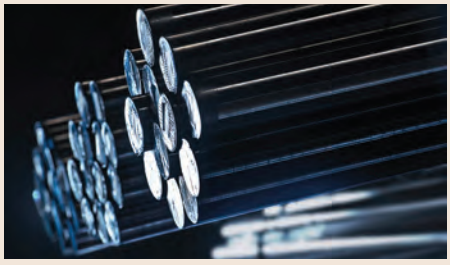
Similarly, high-grade pellet production benefitted from the modernization of Metalloinvest's Pellet Plant #3 at Mikhailovsky GOK, boosting the plant's productivity by 5%. Modernization is also under way at the electric arc furnace shop at Ural Steel, which is making the transition to using flexible modular furnace (FMF) technology. To increase the efficiency of the transportation of iron ore, Metalloinvest continues the construction of conveyor systems for transporting iron ore using cyclical and continuous transportation technology and the crushing and conveyor facility.

Production is not the only area being targeted by Metalloinvest's strategy – increasing efficiency lies at the heart of the company's digital transformation. Metalloinvest has centralized its IT and digital business systems, increasing efficiency and reducing operational costs. It recently opened a Centre for Innovation at Stary Oskol in collaboration with SAP and Accenture, who will assist the company in developing solutions based on the newest technologies, including artificial intelligence, the internet of things and big data. Furthermore, SAP and Accenture are helping Metalloinvest consolidate its digital competencies on a single platform.

Stary Oskol, a small town in Russia and home to Metalloinvest's OEMK, is also the location of the company's data centre, the heart of the SAP S4HANA business suite system. SAP S4HANA unifies all users on one system and demonstrates that Metalloinvest is using this Industry 4.0 to its best advantage.

What's more, an increased focus on health and safety is in all the industry's interest, when considering the importance of boosting efficiency and streamlining companies. That's why a central objective of Metalloinvest's new strategy is to become a "zero incident" company, leading other Russian metals and mining companies in its compliance with international standards in industrial health and safety culture.

As Metalloinvest heads towards 2023, the company will continue focus on increasing the quality of its HVA products, maximizing its efforts to reduce environmental impact of its operations, improving health and safety standards and using the power of digital transformation for the benefit of the company, its employees and other stakeholders, as well as the whole industry.



Rolled steel products

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strip up temperature; a direct-fired section with a multi-burner doors zone to completely clean the strip surface (avoiding the installation of the cleaning section); a radiant tubes zone equipped with 2P gas-fired tubes for superior temperature uniformity along the strip width; a jet cooling section; and an equalizing zone for HSS grades production.

The Danieli Kohler X-Jet wiping system allows very accurate control of final zinc coating thickness down to 40 g per sq meter on each side (at 180 meters per minute), giving excellent coating uniformity along the strip and consequent line operational expenditure reduction by 5% per year.

Since the beginning of operations, the HDG Line has been running at the nominal productivity rate, with high quality standards that allowed Yildız to enter the market at a very high level.

Batch annealing furnaces

The annealing facility, with a nominal production capacity of 300,000 tpy, includes twelve working bases, six heating furnaces and six cooling bells.

The equipment, fully supplied by Danieli Olivotto Ferrè, is state-of-the-art technology for high-convection coil annealing in 100% hydrogen atmosphere, to ensure optimal heat transfer along coil width and perfect strip surface cleanliness.

The high convection provided by the base high-flow fan guarantees the absence of spot overheating on coil turns and uniform heating for the whole mass of the coil. Consequently, the structure and the mechanical properties of the annealed product will be the same on all the parts of the coil, especially regarding tensile strength and elongation. During the subsequent cooling cycle, finally, the coil turns will not stick to each other, even with thin product. Decarburization is completely avoided in the all-metal working chamber.

Danieli Olivotto Ferrè will also supply an innovative set of nine double final cooling units (DFCUs), which perform an additional cooling (from 160° to approximately 60°C) of the charge after the "standard" annealing cycle. This shortens the waiting time between annealing treatment and temper mill rolling, reducing intermediate stocking areas.

Temper finishing mill

The 450,000 tpy four-high mill stand processes annealed coils with a 1,000-ton separating force and at a speed of up to 630 meters per minute.

The mill stand can operate with double work rolls diameter to broaden the range of steel grades processed (from HSS to EDDQ). The mill can operate in dry and wet mode and is equipped with a dedicated dust and fume exhaust system to guarantee safe operating conditions.

The mill is designed with an entry bridle for perfect rolling of thin material, an in-line inspection section to check surface appearance, and an electrostatic oiling machine to serve market requirements.

Danieli Automation supplied all of the electrical equipment and control systems for the entire complex, providing an integrated and optimized system configuration up to Level 3. The single-source automation system and the experience of Danieli Automation provides a smoother project execution, a quicker start-up, and an easier know-how transfer to result in high plant efficiency and yield, notes the company.

Products and applications

The cold complex is designed to produce high-quality steel products to enter both the local and international markets at the highest level, satisfying the most demanding end users. The product range includes white goods applications, commercial, structural and construction grades, IF, HSS, HSLA and DP material.

Danieli notes that close coordination with the customer on schedule, project details and project execution delivered successful results. The plantmaker adds that the tandem mill start-up has delivered zero waste from day one, followed by a daily increase in throughput and quality, looking forward to completing all performance guarantees.

Flatness results

Danieli reports that the tandem cold mill has achieved excellent results for the strip shape. It can impart a flat, positive bow or negative bow shape profile in an easy and repetitive way, depending on the downstream processing requirements.

DANIELI

The product range includes multiple grades of material

The main actuators for shape control are: positive and negative WR bending; positive and negative IR bending; IR shifting with flat tapered roll or with shaped (OSR) tapered roll; differential IR shifting in case of shape asymmetry localized at the strip edges; HAGC tilting; selective cooling to control the WR thermal crown.

A team effort

"Yıldız had the courage and vision to build the most complete cold-rolling complex in the region. The Danieli and Yildız teams related closely, working as one flexible, dynamic, lean team to create a plant designed and constructed for easy and flexible operations and maintenance; on-time and with consistent performance," said Danieli division manager Tommaso Settimo. "In such a spirit of partnership, we can find together with our customers the optimal solutions for long-lasting success, which is a powerful driving force that unites us all."

Dmitriy Voitekhovskiy of Danieli's technical team for the project said: "Our target was to implement the most advanced technological features, allowing a fast start-up of the plant with high quality levels from the beginning. Field results were really surprising and even better than expected. Performance levels were reached just a few days after commercial production."

With its investment, Yildiz will meet the need for high-quality flat-sheet metal products for the white goods and automotive industry. It will offer its products to the market as Yıldız Demir Çelik, which will be a replacement for imports in such industries.

Yıldız Demir Çelik noted that, having completed the first phase of its investment, in 2020 it will complete a second-phase investment of $350 million. The Yıldız Demir Çelik factory, where 450 people are employed, will reach 750 people with the completion of its second phase investment.


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Extracting value from Indian iron ore

Divisions over the best ways to exploit India's extensive iron ore resources continue. Kunal Bose outlines the debate between steelmakers, iron ore miners and the government

SHUTTERSTOCK

During his time as mines minister in the Indian government led by the Bharatiya Janata Party (2014-19), Piyus Goyal said the mining industry's contribution to gross domestic product could be raised to about 3.5% from the then-prevailing 2.4% in the next few years, by annually raising minerals output. The idea was that rapid development of the sector by stepping up private and government investment in exploration, prospecting and mining would be a sure way of creating more wealth for the nation and economic opportunities in relatively remote rural areas.

It was not lost on the government that prosperity and welfare of the country's large population are an effective tool to fight extremism, which has taken root in parts of the minerals-rich countryside. There have been instances of extremist groups sabotaging efforts to open iron ore mines in Chattisgarh and bauxite mines in Andhra Pradesh, for example.

The Indian mining industry's share of national GDP was actually down to 2.1% in the year ended March 2018. Next only to coal, in which India's production is well over 600 million tonnes per year, iron ore makes the largest contribution to the country's minerals basket. And after years of setback in the production of iron ore, since it hit a peak of 218.55 million tonnes in 2009-10 as exports to China boomed then, output once again exceeded 210 million tonnes in 2017-18 (*see table*).

Indian iron ore production will need significant expansion to fulfil the nation's ambitions in steelmaking

The country's iron ore production and exports fell to a low of 156 million tonnes and 4.50 million tonnes, respectively, in 2015-16, impacted in part by the government's decision to impose a punitive export duty and further by restrictions on mining in some areas because of environmental concerns. Other difficulties included land acquisition and the complexities involved in satisfying both environmental and forest regulations.

India, which remains the world's fastest growing economy with the IMF anticipating GDP growth at 7.3% in 2019-20 and 7.5% next year, was a hot destination for foreign direct investment in 2018, amounting to over $37.76 billion in 235 deals. Nevertheless, though a precise figure for the mining sector is not available, industry officials say the mining sector, including iron ore, has not attracted any significant foreign investment in recent years. Foreign groups generally do not seem to find the ground reality inspiring to put their money into Indian mining.

Domestic demand

The steel policy announced in 2017 says the country will be making 255 million tonnes of crude steel in 2030-31, based on a capacity to be enhanced to 300 million tonnes per year from the present annual level of around 140 million tonnes. Steel production ▶

of that order will require iron ore output of 437 million tonnes, which calls for an additional 227 million tonnes of output. Industry officials are, however, doubtful about the ore production target being achieved in the current policy and regulatory environment, with long delays in even routine permission for mining coming through.

A steel industry official says: "What is true of iron ore is also going to be the fate of the steel policy target of 161 million tonnes of coking coal supply. The 2030-31 coking coal requirement is based on projection that the blast-furnace/basic-oxygen-furnace route will have its share of steel production raised up to 65% from the present 40%. The policy says coking coal import dependence is to be brought down to 65% from 85% now. But the slow progress in opening new mines and setting up washeries to make unusually high-ash-bearing domestic coal BF-use compliant make it doubtful if the targeted reduction in import dependence will be achievable." RK Sharma, director general of Federation of Indian Mineral Industries (FIMI), does not find any reason to disagree.

Since mining is a highly capital intensive business, its progress in India will call for the "use of high-end technology and equipment for scaling up productivity, ensuring safety of mine workers and protecting the environment of areas surrounding mines," says a spokesperson for the Confederation of Indian Industry. That India will need an investment of around $6 billion to meet 2030-31 iron ore requirements not only gives an idea of capital intensiveness of new mines development, but also of the urgency of FDI.

Sharma says: "Exploration is the lifeline of mining. Intensity of exploration will have a bearing on the level of mining in a country." Following the promulgation of Mineral (Non-exclusive Reconnaissance Permits) Rules, 2015, the central government assigned exploration rights to most public sector undertakings (PSUs) in the mining and metals sectors.

India's iron ore production and trade*

Year	Production	Export	Import
2009-10	218.55	117.37	0.89
2015-16	155.91	4.50	7.09
2016-17	192.08	30.48	4.60
2017-18	210.47	20.99	8.70
2018-19	(full year) 210.00	(11 months) 14.15	(11 months) 12.64

**In millions of tonnes*

Source: Indian Bureau of Mines and Ministry of Mines

This is in addition to the Geological Survey of India and Mineral Exploration Corporation Limited, which for decades have been engaged in bridging the gap between initial discovery of a prospect and its eventual exploitation. According to Sharma, "most of the PSUs given this responsibility do not, however, have the expertise and required infrastructure to undertake exploration of up to G2 and G3 levels."

The government, which promotes reforms to attract foreign capital, does not want to be seen to have virtually nationalized the exploration part of the mining business. This and the realization that the public sector will not be able to deliver results – and as a result sufficient quantities of iron ore will not be available locally to feed the expanding steel industry – prompted the government to bring out a new National Mineral Exploration Policy to make room for private sector participation in exploration.

According to BK Bhatia, spokesperson for FIMI, private-sector participation, especially by foreign groups, will remain elusive until the Mines and Minerals (Development and Regulation) Amendment Act, 2015 is suitably amended for seamless transition from the reconnaissance permit (RP) stage to the next stage of prospecting-licence/mining-lease. The present regime requires that a RP holder hand over on successful exploration the explored block to the concerned state government for it to subsequently put it up for auction. Exploration is a high-risk business and private parties do not find what is on offer attractive. Bhatia says: "If exploration stays at a low level, then you will hardly find any greenfield mines being put on auction. Since 2015-16, of the 19 iron ore mines auctioned, as many as 14 'C' category mines in Karnataka were already in existence. Only five new blocks came under the hammer."

Steel industry officials from groups owning mills close to the coast are keeping their options open to step up imports in case there is tightening of domestic supply as new steel capacity growth picks up momentum. Sharma, however, believes "whatever the constraints, iron ore miners will not be found wanting in doing their best to meet steelmakers' growing demand. Why should a nation with iron ore resource of 33.276 billion tonnes, including 22.487 billion tonnes of hematite and 10.789 billion tonnes of magnetite, be an importer of the mineral at any point? Give a push to exploration, iron ore resource base will only expand. This we have seen happening in many countries, including Australia, Canada and Brazil."

Miners in India tell the government that the resource base of iron ore and other minerals will continue to expand provided the country steps up investment in exploration by involving the private sector alongside public enterprises. An industry official, quoting an S&P Global Market Intelligence report, says: "India's total spending of $15 million in exploration in2017 compares poorly with $1.11 billion by Canada, $1.08 billion by Australia and $560 million by Brazil. This needs quick correction."

An immediate concern of steelmakers based inland in particular is the expiry of 232 non-captive iron ore mining leases, including 24 working and 208 non-working mines on March 31, 2020. These must be put up for auction by state governments before new leases are granted. Preparation for auction is a time-consuming process and then the successful bidders will have to secure a whole host of clearances from regulatory authorities before actually starting iron ore excavation. Steelmakers are facing the prospect of ore supply from the country's two leading producing ▶

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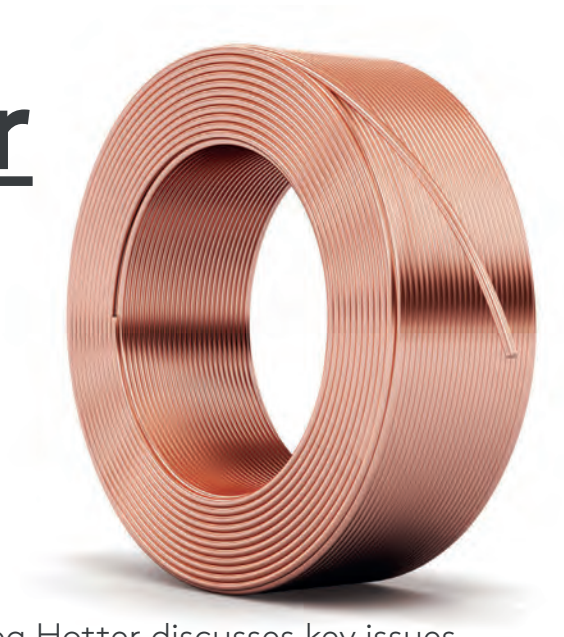

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states, Orissa and Jharkhand, shrinking by up to 60 million tonnes per year on expiry of the present leases.

The MMDR Act 2015 says that while the "leases granted before January 12, 2015" to non-captive mines will expire in March 2020, those for captive mines will have their validity till March 2030. Bhatia says one way to avoid "production disruption on a large scale would be by giving lease extension to merchant mines to March 2030."

Captive versus merchant mining

In the meantime, pressure is building on the government that, in pursuit of the objective of the national mineral policy of "rationalising reserved areas" held by PSUs, Steel Authority of India Limited (SAIL) and the country's biggest iron ore producer NMDC should be made to surrender the "undeveloped iron ore blocks in their possession." Contesting the demand, both SAIL and NMDC maintain that, although their present ore production may not be in alignment with their mining capacity and reserves, they have ambitious plans for the future.

For example, NMDC has a target to produce 100 million tonnes of ore by 2030-31 by comparison with 35.5 million tonnes in 2018-19. NMDC chairman Baijendra Kumar says "people, however, believe we are capable of producing 150 to 200 million tonnes of ore." JSW Steel managing director Sajjan Jindal, for example, believes that NMDC has technical and financial prowess to achieve production capacity of 200 million tonnes in the course of time.

SAIL is aware that the ministries of steel and mines are under pressure from merchant miners and standalone steel mills that there should be a "detailed study of iron ore reserves of PSUs and their utilization leading to release of the surplus for auction." But SAIL, which wants to lift crude steel capacity from 21 million tonnes to 50 million tonnes by taking advantage of surplus land at its disposal is very possessive of all its

'New Delhi continues to use high duties to discourage exports'

reserves. To remain self-reliant in iron ore at this level of steelmaking input, SAIL will be required to step up ore production to close to 100 million tonnes per year by 2030-31, from 27 million tonnes in 2017-18.

However possessive SAIL and a few private sector groups, particularly Tata Steel, may be of their iron ore assets, Bhatia says: "Steelmakers having captive mines are a uniquely Indian phenomenon which has its origin over a century ago when Tata Steel began operation at Jamshedpur." Some years later, IISCO, taken over by SAIL, got leases over large tracts of iron-ore-bearing areas when it was run privately.

Bhatia believes that mining and metal making require altogether different skill sets: "A miner is unlikely to be a great steelmaker. Conversely, the latter will not have anything great to show as a miner." Nevertheless, in India many steelmakers want to have their own mines. Similarly, NMDC and Vedanta, which was the biggest iron ore producer in Goa before all mining leases in the state were cancelled by the Supreme Court in February 2018 and is the largest mining entity in Karnataka, have forayed into steelmaking. NMDC is in the last lap of commissioning a 3 million tonne per year steel mill at Nagarnar in Chattisgarh. Vedanta recently acquired a 2.5 million tonne per year steel plant in Jharkhand and wants to raise its capacity to 5 million tonnes per year.

Export–import

Advised by steelmakers that India should conserve all its iron ore resource despite its gigantic size and huge potential for new discoveries for local value addition, New Delhi continues to use high duties to discourage exports. Iron ore producers find no merit in the government continuing to charge an export duty as high as 30% on lump and fine ore with iron content of 58% and more. The mining industry argues that since the local steelmakers and producers of sponge iron have a distinct preference for high grades of ore, the government should waive export duty on ore with up to 62% iron content. As the government has not obliged, iron ore mines have built up pithead stocks of around 150 million tonnes – mostly fines with potential to do harm to the surrounding environment. The two major steel groups owning captive mines undertake selective mining to extract only very high grades of ore to get the best blast furnace productivity.

"The country has missed an opportunity to monetise pithead stocks by not removing export tax. Moreover, as most of our mines are small, mounds of stocks are interfering with their production," says Sharma. An Orissa-based merchant miner says: "The 30% duty that robs Indian ore of price competitiveness in the global market has not allowed us to reap benefits from the January tailings dam disaster at Brazil's Vale and production disruptions in Australia due to March cyclonic storms." Beside export tax, under court order the mines in Karnataka are not allowed to export iron ore. In addition, pellets made in the state using local ore cannot be sold in the world market.

It is no wonder then that, between April 2018 and February 2019, India could export only 14.15 million tonnes, by contrast with 20.99 million tonnes in 2017-18. In the first 11 months of 2018-19, strong demand from coastal mills, particularly in Karnataka, led imports to rise to 12.64 million tonnes, against 8.70 million tonnes in the full year of 2017-18.

Karnataka-based mines complain that the state's coastal mills are importing iron ore with the "sole objective" of keeping the prices of local ore down. High imports are hurting Karnataka miners since the court order restrains them from selling iron ore in other parts of the country. India's ore production in 2018-19 is estimated at 210 million tonnes, more or less the same as the 210.47 million tonnes in 2017-18. Unfettered exports will help the industry to clear pithead stocks and lift production at the same time, says Sharma.

Pushing performance materials ever higher

Ever more demanding applications for metals continue to push greater efforts to increase their performance. Myra Pinkham reviews recent progress

Recent technological innovations – particularly those related to the materials used in such high-end markets as the automotive, aerospace, defense and medical industries – have been very supportive of demand for a variety of high-performance metals. That has driven companies and research organizations alike to develop new alloys and production processes to fulfill this growing need.

Top on the list of the objectives in recent high-performance metals innovations is to develop metals that help original equipment manufacturers (OEMs) to cost-effectively lighten the weight of their products – including through higher strength metals that also have other benefits – and to find materials that work in increasingly high temperature and other challenging environments without compromising performance.

Another big push has been made in efforts to develop powders for 3D printing, or additive manufacturing, and other metal products that could help to limit scrap generation, and in equipment for more efficient production and testing of newly developed high-performance metal alloys for various end-use applications.

Many industry players point out that much of this could be described as more of an evolution than a revolution, being accomplished by tweaking the chemical composition and properties of existing alloys to create innovative new products, resulting in some real benefits for end-use customers.

CONSTELLIUM

Freeform bending of aluminium extrusions at the Constellium University Technology Center

Spurred on

"Much of the development work is being spurred by a pull from end-use customers, who want products that are environmentally sound and can reduce fuel consumption," Christine Keener, vice president of commercial and strategy for Alcoa Corp.'s aluminium business unit, points out. She also notes that governmental pressures, including more stringent fuel economy and emissions standards to go into effect in 2025-2030 in the United States and Europe, and increased electric vehicle sales, continue to push automakers worldwide to find ways to achieve greater efficiencies.

Using lighter weight metals and metal components for anything that moves people and/or goods just makes a lot of sense, says Alan Taub, senior technical advisor for Lightweight Innovations for Tomorrow (LIFT), which is operated by the American Lightweight Materials Manufacturing Innovation Institute, explaining that such lightweighting helps to either increase the fuel economy or the ability to increase the payload for various types of transportation. He notes that for automobiles there is, on average, $5 of fuel cost savings per kilogram of lightweighting, while for commercial aircraft that fuel saving is about $500 per kilogram.

He says that one technology that has recently been seeing broader use in both the aerospace and automotive applications is super-vacuum high-pressure aluminium die casting – a process that is already in use in Europe, but is now starting to also be implemented in North America. Utilizing integrated computational materials engineering (ICME), this technology allows companies to achieve lower levels of microporosity in their castings, which, in turn, lets them achieve better fatigue performance and to make thinner walled castings, and therefore lighter weight components.

Taub says that the greatest benefit is achieved when using this type of casting with heat-treatable

aluminium alloys as, due to the low porosity, those alloys can be heat treated without blistering. However, he adds that the ability to produce thin-wall castings with this casting method is generally applicable to a wide array of aluminium alloys.

Automotive demand

There have been several high-performance aluminium casting alloys that have been recently introduced aimed at the auto market. For example, late last year Alcoa introduced its EZCast-NHT™ non-heat treatable alloy, which Keener says has good mechanical properties for both automotive structural parts and for battery trays for electric vehicles, which tend to be prone to larger distortion during heat treatment.

Several aluminium producers have also recently introduced, or plan to shortly introduce, high-strength aluminium alloys for the automotive market, both for lightweighting and certain other purposes, including greater damage tolerance when a vehicle is involved in an accident. Another factor, Abe Vadhavka, director of materials and manufacturing technology for the Center for Automotive Research (CAR), says is the "tug of war" between aluminium and advanced high-strength steels, including newly developed third-generation AHSS, for automotive applications.

Martin Jarrett, technical director for Constellium's automotive structures and industry business unit says that his company has been at the forefront of the development of such high-strength alloy development with the 2017 introduction of its HSA6 alloy, which he maintains is still the highest strength 6000-series aluminium alloy currently available to the automotive market. It has a tensile strength of more than 400 MPa, generally replacing alloys with only about 300 MPa tensile strength. Jarrett says that such high-tensile strength was previously only possible with 7000-series alloys, which are more difficult to produce and are not recyclable to more standard 5000- and 6000-series automotive alloys.

CONSTELLIUM

Testing an aluminium crash management system

In 2017 Constellium introduced its HCA6 high-strength (280 MPa), high-crush 6000-series alloy, enabling the production of fully crushable extrusions with no cracking. Jarrett says that several major automakers, including Ford, BMW and Audi have been using these alloys, which, when used together in already intensive crash management systems could lighten their weight by as much as 25-30%.

Novelis Inc. is in the midst of developing 6000- and 7000-series high-strength aluminium alloys for the automotive market, which are expected to see their first commercialization later this year with introductions ramping up over the next two years. Pierre Labat, the company's vice president of global automotive, says that this summer Novelis expects to commercialize a 6000-series alloy with a tensile strength greater than 350 MPa, which it plans to follow a couple months later with a 7000-series alloy with a tensile strength of greater than 500 MPa.

Labat says that its new 6000-series alloy is designed to remain ductile and can be formed by typical cold forming at OEMs and Tier 1 parts suppliers. However, he says that the new 7000-series will require hot stamping as an additional process step for customers to achieve the ductility and elongation that they require.

This follows Novelis' recent introduction of its Advanz 6HF-e200™ heat treatable aluminium casting alloy and Fusion technology, first in Europe and last year in North America, also for automotive and motorcycle applications. Labat says that while Advanz 6HF-e200 is quite an improvement over the previous generation in terms of formability, Fusion goes an extra mile in formability given that it allows simultaneous casting of multiple alloys into one product. For example, a product with a very highly formable core that also has a very high quality surface could be achieved. Labat says that these two products, which are both already commercially available, tend to be used for exteriors of vehicles when OEMs are looking for stiffness and sharp design traits without the weight of steel.

Rio Tinto Aluminum has recently introduced its high-strength Revolution-Al auto wheel alloy, which it says could reduce wheel weight by 7% while offering similar ductility to A356, with its higher magnesium content allowing for higher strength and with the addition of manganese helping to reduce elongation. Revolution-Al is said to have 20% greater yield strength than A356 while being less impacted by cooling rate variations. "This allows our customers to make a better wheel, which in the end makes cars that are safer, more fuel efficient and appealing to end consumers," Alf Barrios, Rio Tinto Aluminum's CEO, says.

Aerospace demand

Meanwhile, for aerospace applications, Magnesium Elektron's Elektron 43 magnesium alloy was recently certified for use for certain commercial aircraft interior components. It provides a way to lower the weight of the aircraft if it is used instead of aluminium alloys for such interior components as seats.

Titanium continues to make gains too, especially in several critical aerospace and defense applications, helped by the fact that it is not just lightweight but its alloys can operate at higher temperatures. Greg Himstead, vice president, sales and marketing for titanium distributor Titanium Industries, notes that most new titanium alloys derive from the evolution of existing alloys.

One significant new alloy is the ARCONIC-THOR titanium alloy, which was introduced last year by ▶

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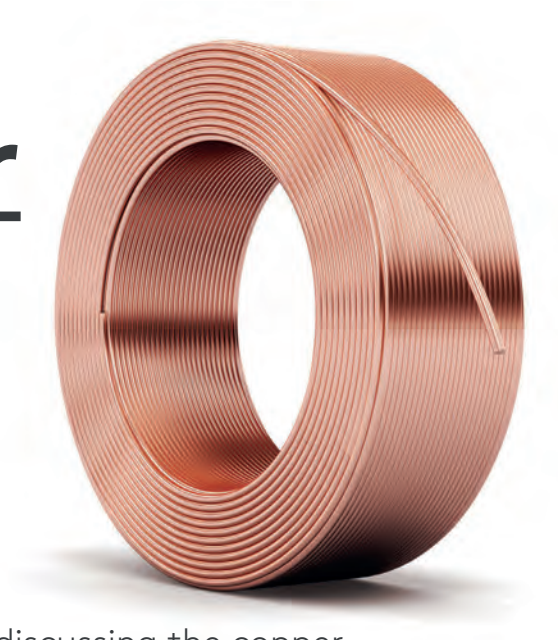

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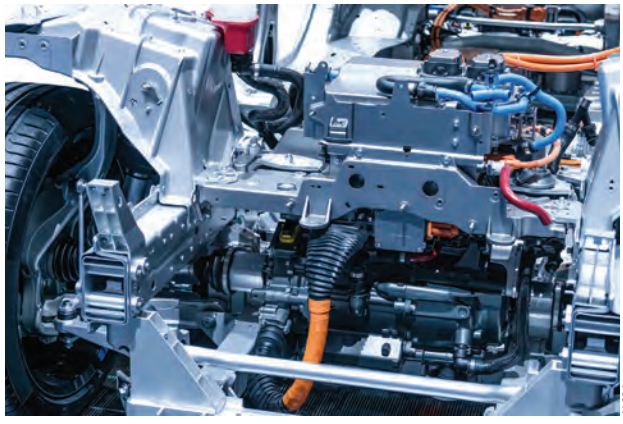
Arconic Inc. for use in the hotter sections of jet engines. Arconic states that it is nearly 50% lighter than incumbent nickel-based superalloys and has three times better oxidation resistance than conventional titanium alloys – advantages that translate into cost savings and greater fuel efficiencies. Available in sheet, plate, foil, billet, rolled rings, forgings and extrusions, it is formable, heat treatable, forgeable and weldable and has acceptable oxidation resistance, even at temperatures that are as much as 200 degrees Fahrenheit higher than those suggested for previously available high-temperature titanium alloys.

There has also been some development of new titanium aluminide alloys. Christopher Jackson, director of new business development and sales for Retech Systems LLC, says that while some of the interest is in titanium aluminide powder, these alloys are being introduced by various titanium producers in cast and wrought form as well, given the alloys' lower density and high strength.

While one driving force for titanium aluminides has been in jet engines, given higher operating temperatures, Jackson says another popular use is for automotive turbocharger wheels. He says that in both applications aluminides offer great benefits over nickel alloys, particularly given the ability to reduce rotational inertia in components using these alloys.

Gary Coates, manager of market development and technology for the Nickel Institute, says that much of the development of new nickel alloys recently has been geared towards military and space exploration, including rocket engine applications. He points out that there has also been some modification of existing nickel alloys, making them higher strength and more corrosion resistant so they could be used in certain downhole oil and gas applications in fields with high hydrogen sulfide content. He says there is some similar development work for nickel alloys for high-temperature applications for advanced ultra-supercritical steam generation in coal-fired power plants, which he says is just around the corner.



ALCOA

EV powertrain with a number of structural components where Alcoa's EZCast-NHT™ can be applied

3D printing

There has also been some movement in alloy development and certain processes aimed at the growing interest in 3D printing or additive manufacturing, which LIFT's Taub says is beginning to be deployed for the production of complex aerospace parts made from such high-performance metals as titanium, nickel-based alloys and aluminium, and is likely to be used further as the speed of 3D printing increases.

While there has yet to be any commercial production of 3D printed rotating jet engine parts, but rather only printing of less critical aerospace parts where there is less of a dynamic load, Jackson says that there has been some testing to also enable that to be done in the coming years. Meanwhile, 3D printed parts are also finding applications in the automotive and medical sectors.

This demand has supported both powder-based and wire-based technologies and the metals they use. For example, Charles "Chet" Fuller, chief commercial officer of Norsk Titanium, says that there is a tremendous need for his company's Rapid Plasma Deposition (RPD™) wire-based additive manufacturing technology, in which wire is melted precisely in an inert, argon-gas environment to reduce the cost of titanium components and forgings. He says this occurs as this technology – like powder technologies that are being used for smaller, more intricate components – reduces the aerospace buy-to-fly ratio, relating to the amount of material needed to make the part and the amount of material that is required to be machined away. Fuller says this is very important for titanium as it relatively expensive compared with other aerospace metals used in structures, and is expensive to machine. He points out that another benefit of additive manufacturing in general is that it dramatically reduces lead times and the capital cost of forging dies.

NORSK TITANIUM

Completed commercial aerostructure titanium part next to its near-net RPD™ form

Retech's Jackson says that additive manufacturing has stimulated atomized metal powder production and development, which until recently exhibited relatively slow growth. There is certainly more activity now. For example, Carpenter Technology Corp. has recently developed a set of alloys specifically for 3D printing and in mid-May formed an additive manufacturing business unit.

Jackson says that for titanium two areas where there has been a lot of development work and higher-volume production has been for 6Al-4V (6-4), commercially pure (CP) and titanium aluminide powders, with 6-4 and CP powders taking the lead for the time being. "But I think that the aluminides will catch up as companies continue to specify the material," he says.

Recent alloy development work has also supported development of new testing technology and equipment, Malini Hoover, CEO of Advanced Optical Technologies (AOT), points out. She says that her company has developed a new type of crystallographic imaging sensor for use in its patented polarization grain-orientation imaging nondestructive testing technique that is currently in the process of being commercialized for the testing of titanium alloys. She says this technique is less labor intensive and time consuming than current more destructive testing techniques, such as electron backscattering diffraction (EBSD) and spatially resolved acoustic spectroscopy (SRAS). Hoover says that AOT has testing solutions for such other metals too, including beryllium, magnesium, zinc, tin, zirconium and uranium.

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WHEN OUTCOMES MATTER™

Material choices for EV production

Material choices for electric vehicle production are widening as the growing number of new EV models accelerates. Seema Chaudhary reviews recent developments

The relative merits of steel versus aluminium for stakeholders in the automotive industry have always elicited hot debate, which continues with the steady movement of manufacturing towards electric vehicles. Whichever material tops the wish list among engineers and designers on the back of fuel economy and emissions standards by 2025, manufacturers are clear that safety and sustainability will feature strongly.

The trend towards lightweight construction has facilitated the growing popularity of aluminium and plastics in automotive manufacturing. But a recent study commissioned by Voestalpine from the German Handelsblatt Research Institute (HRI) highlights that the "development of innovative high- and ultra-high tensile steel grades also secures the long-term future of steel in the automotive industry, because not only is the material both lightweight and tough, it is also easy to process, can be recycled, and is cost-efficient."

The use of advanced high-strength steel (AHSS), however, is already a material of choice for the chassis, or body in white (BIW), and main closures, such as hoods and trunk lids, of smaller and lighter cars. In addition to its use in some models of car, aluminium has found widespread use in bigger vehicles, such as SUVs and lightweight trucks for components such as bumpers, crash boxes and wheels.

New steel grades

To meet demand, steelmaker U.S. Steel is introducing several new grades of AHSS and generation 3 (Gen3) grade steels in 2019 and thereafter for future vehicle platforms. Components made from its advanced steels are designed with durability, crash energy management, appearance, formability and cost in mind. U.S. Steel notes that its steel is "formable, weldable, strong and has state-of-the-art coating that will help resist corrosion," (*see table*). It adds that the load paths on the evolving battery electric-vehicle (EV) body structure are ideally suited for AHSS and Gen3 steels, for increased safety, lower mass and lower manufacturing carbon-dioxide emissions.

New steel grades have 3-4 times the tensile strength of conventional steel, making them of great value for safety, while also extending the electric vehicle range by reducing weight.

VOLKSWAGEN

Volkswagen's ID. Buggy concept car features its MEB toolkit

U.S. Steel generation 3 and martensitic steels

780XG3™	800 MPa	Generation 3 steel
980XG3™	1,000 MPa	Generation 3 steel
1180SHF	1,200 MPa	SHF
Mart-Ten™	1,500 MPa	Ultra high-strength martensitic steel
Mart-Ten™	1,700 MPa	Ultra high-strength martensitic steel

Source: U.S. Steel

New applications

New applications for aluminium include the EV battery housing made from aluminium by Novelis (*see box*). Volkswagen Group too has been highlighting its modular electric toolkit (MEB) platform, based on an extruded aluminium spaceframe. The carmaker is rolling this out to third parties to be showcased in small-series cars such as the ID. Buggy, Audi e-tron GT, Skoda Vision iV and Seat Urban. The e.Go, based in Aachen, Germany, has been the first partner to use Volkswagen's MEB e-mobility platform.

Meanwhile, Tesla has said that it will be reducing aluminium and titanium in its Model 3 chassis in favour of a "mix of materials". Tesla's steel-intensive Model 3 is the smallest and cheapest model by Tesla to date and geared towards the mass market – further marked by the company's breaking ground on a 'Gigafactory 3' plant in Shanghai, China, to begin production by the end of the year.

Jaguar has also entered the EV market with its aluminium-intensive I-Pace. The Chinese population are a good model to look at for the EV revolution, with nearly half of EV cars sold in 2025 expected to be from that country, according to Bloomberg's Electric Vehicle Outlook 2017.

BMW will be constructing the i5 in steel and light alloys from 2021, rather than using carbon fiber, which dominated in the i3.

Barriers to entry faced in traditional car manufacturing are opening up, with new market entrants such as vacuum cleaner manufacturer Dyson recently filing its patent for a premium aluminium-based model of EV.

According to Al Bedwell, director of global powertrains at LMC Automotive, steel has some clear cost advantages: "My feeling is that steel will dominate in the mass market EV segment, mostly for cost reasons. Premium and exotic EVs are more likely to use aluminium. But with advances in steel specification and construction techniques, the weight saving of aluminium over steel may not be that great." Composite construction is another option, but this carries a significant cost penalty, Bedwell notes.

Abe Vadhavkar, director of materials and manufacturing technology at the Center for ▶

Automotive Research (CAR), says: "My thoughts are that the automobile industry is highly cost driven, which will continue to be a limiting driver. The base cost of steel is lower along with the legacy equipment cost of welding being lower as well." Vadhavkar highlights that "technology is mature when using existing machinery and this will make it more difficult to move to exotic materials."

"Moreover when we go into the area of automated vehicles, which reduces the need for driver involvement and requires sensors, mass reduction will be a critical factor in the cost equation, which is a consideration that always drives high-volume manufacturing," Vadhavkar says.

Manoj Madhaven, principal and registered investment advisor at Oxford Chase Advisor, comments: "Electric vehicle makers are focused on increasing range and one of the key factors is weight. Manufacturers will move away from steel in the long term and this could be towards alloys or could be carbon. Although now carbon fiber is very expensive, over time we will see a drastic reduction in cost. There is a lot of promise with carbon composites as you don't have to mine it and it can be manufactured in the lab." Low-cost carbon fiber Zoltek PX35 is featured in the Uniti electric car in Sweden, for example.

Vadhavkar notes that composite recyclability has its down side, saying that "while there are more and more applications of composites, this will be hampered because of recyclability issues. Aluminium can be 100% recycled when separated by grade."

Moreover, says Vadhavkar: "Aluminium usage will grow in the future as we go towards lightweighting because the electric vehicle range sensitivity means you have to take weight out."

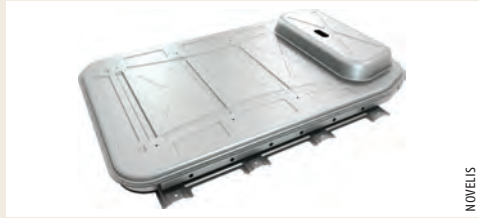
Novelis makes strides

The price of vehicles for the mass market and methods for lightweighting them are constant considerations for the automotive sector. For electric vehicles, range between charging is a key factor. Ganesh Panneer – vice president and general manager automotive at Novelis North America which is a member of the Aluminium Transportation Group (ATG) – says that while there is a lot of talk surrounding the popularity of steel versus aluminium in the main body of electric vehicles, range is a key consideration for consumers. "Having a lighter vehicle body is one way to save weight and aluminium is well-suited to this," says Panneer.

Novelis has developed an aluminium-sheet battery enclosure utilizing Advanz™, providing a sustainable battery solution for a market that is expected to triple by 2025, according to the company. Being 50% lighter than the steel equivalent is a boon for mass production of the battery enclosure, and the design is more cost-effective than aluminium extrusion and casting-intense designs.

"Novelis is working on new grades with higher strength and greater formability as we increase strength and reduce thickness and improve formability to stamp complex shapes," says Panneer.

Panneer cites start-up manufacturers that have been at the forefront of sustainable electric vehicle design using aluminium body parts. This has been seen at US automakers Rivian and Faraday Futures. China's EV manufacturer Nio recently launched the ES8 using Novelis' high formability Advanz™, which delivers greater bending and weight savings to automakers.


NOVELIS

Novelis utilizes Advanz™ in its EV battery enclosure

Panneer notes that there are a number of factors when OEMs select materials, for which safety and sustainability make aluminium a good choice. Aluminium-intensive vehicles have received five-star accreditation from the National Highway Traffic Safety Administration (NHTSA), which tests the safety of cars. The Ford F150 pick-up is one such model five-star rated for safety, says Panneer. The current Ford F150 model is also considerably lighter than its predecessor.

Mixed materials and the joinability of aluminium is a key consideration. New joining technology can effectively connect through riveting, welding and structural welding.

Panneer cites the forecast commissioned by ATG from Ducker Worldwide 2017 on key trends and factors to consider for aluminium's continued popularity (*see table*).

Aluminium penetration forecast for hoods, doors and BIW

Aluminum hood penetration
Will increase from 50% in 2015 to 71% in 2020. Hoods will account for 25% of the of the total 2020 closure weight, and doors will be 43%

Aluminium door penetration
Will increase from less than 5% in 2015 to slightly over 25% 2020; Prior to 2014, there were virtually no aluminium doors in North American-produced vehicles, save for the Tesla Model S

BIW (in some cases complete BIW)
Nearly 25% of 2028 vehicles will have partial aluminum; 2.1 million of those vehicles will be pickup trucks; 400,000 will have PHEV/ZEV powertrains

Source: Ducker Worldwide

Bonding and forming

In future, manufacturers will differentiate by their expertise in bonding, joining and forming technologies. Innovation in special alloys with a higher silicon and aluminium content can alleviate the loss of heat in an EV motor during magnetic reversal by up to 30%, according to the HRI study.

"Third-generation advanced high-strength steel is cold stamped as opposed to hot stamped. Cold-stamped high-strength steel has issues like springback, which we don't have with press-hardened hot-stamped steel," says Vadhavkar.

He notes that in terms of materials usage, innovative additive manufacturing techniques will play a part, with the use of combined manufacturing processes, such as combining stamping with additive manufacturing in steel. This would mean taking the part and adding material only where needed, which you could not possibly make with traditional methods, and this will play a part in lightweighting.

In a pointer to the future, CAR in collaboration with Lightweight Innovations for Tomorrow (LIFT), operated by the American Lightweight Materials Manufacturing Innovation Institute (ALMMII), is implementing a project to test and evaluate mixed-material joining technologies to save on weight and production costs.

ArcelorMittal project to look at 'green' hydrogen for Hamburg DRI plant

ArcelorMittal is earmarking €65 million ($73 million) for a project to use hydrogen on an industrial scale for the direct reduction of iron ore in steelmaking to greatly lower CO_2 emissions.

The plant in Hamburg is already efficient in using natural gas in a direct reduction plant (DRI) production process. In the coming years a pilot plant will follow there to target not only the use of alternative raw materials but also the direct avoidance of carbon (CDA).

It is planned that the University of Freiberg will collaborate on the project which will initially take place on a demonstration scale producing 100,000 tonnes per year. In the future the plant should also be able to run on green hydrogen from renewable sources.

"Our Hamburg site offers optimum conditions for this innovative project: an electric arc furnace with DRI system and iron ore pellets stockyard as well as decades of know-how in this area. The use of hydrogen as a reducing agent shall now be tested in a new shaft furnace," Frank Schulz, chief executive officer of ArcelorMittal Germany, said.

ArcelorMittal has invested €250 million in various carbon emissions reduction technologies, such as in Ghent where waste carbon gases will be used for the production of alternative fuels or in chemical products. It is also testing methods such as biocoal from waste wood as an alternative to coking coal as a reducing agent in blast furnaces.

ARCELORMITTAL

ArcelorMittal's Hamburg plant is already one of the most energy-efficient in the Group

NASA makes new 3D printed copper alloy for aero components

NASA has developed a new copper-chromium-nobium alloy for use in rocket propulsion components within propulsion engines and which, according to NASA researchers, can potentially "equal to or exceed their traditionally manufactured predecessors."

NASA Marshall Space Flight Center (MSFC) and NASA Glenn Research Center (CRC) in the US went on to successfully print the near-fully dense and functional alloy GRCop-42 using powder-bed fusion, with 50% thicker layers (0.045mm) than its predecessor GRCop-84.

Researchers have demonstrated that the alloy is readily printable and can be additively manufactured into fully dense components with consistent properties at higher throughput rates than the alloy GRCop-84, which was hot fire tested in 2016 and 2017.

They produced printed parts such as combustion chamber liners and fuel injector faceplates using Concept Laser's M2 3D printer. GE Additive has a 75% share of Concept Laser. The machine was used because "it had proven to be 'copper friendly' with its inert glovebox and build chamber, and the 400W laser could achieve the high-energy density needed to fully melt the '42'".

It was developed for use in rocket propulsion components that needed high thermal conductivity, excellent creep resistance, low-cycle fatigue life, and strength at elevated temperatures such as combustion chamber liners and fuel injection face plates.

Initial parameter tests using average porosity and pore size showed good technique for predicting mechanical properties, particularly in elongation values.

The lower '42' Cr and Nb content has made it easier for powder vendors to process but was not easily available before.

Hydro upgrades casting operations to meet advanced automobile needs

Hydro Husnes in Norway will revamp its casting operations with new technology to produce more advanced semi-products for the automobile aluminium forging market.

The company will invest NOK150 million ($17 million) with operations expected to commence in 2020.

The new in-house low-pressure casting (LPC) technology, once upgraded, will strengthen Hydro's offering for materials in niche segments like forging stock, thus enabling efficiencies in cost and quality.

"The key for us is the flexibility to be able to cast both extrusion ingots and forging materials according to customer demand in a flexible and efficient way," Johan Berg, plant manager at Hydro Husnes, said.

Customers will be able to produce forge stock in a large casthouse from liquid metal from electrolysis compared to the traditional smaller scale casthouses typically based on melting ingots and horizontal casting methods.

The demand for aluminium forge stock is high, said the company. Forge stock can be used for car suspension arms and knuckles in the automotive industry – an area which is demanding more of the metal to fill its lightweighting for energy efficiency along with performance and safety requirements.

"The investment is timed well with the ongoing upgrade of Hydro Husnes' second electrolysis line that is due to start operations in 2020, with an annual planned output of 210,000 million tonnes of aluminium semi-products," Berg said.

HYDRO HUSNES

Hydro Husnes will produce more aluminium for forging

Tokyo 2020 Olympic torch created using Al extrusion technology

The Tokyo 2020 Olympic relay torch housing has been manufactured from a seamless sheet of part-recycled metal using traditional and contemporary aluminium extrusion manufacturing know-how from UACJ Extrusion Corporation.

The technology was also used in the making of the Shinkansen bullet train, according to Japan's official Tokyo2020.org website.

The gold-coloured torch is made from approximately 30% recycled material originally from the temporary prefabricated housing used after the 2011 earthquake and tsunami disaster that hit Japan's Tohoku region.

The torch design by Tokujin Yoshioka Inc communicates the steps taken in building a sustainable future from sustainable materials, in its design as a single flame with five separate flames emerging from a flower petal shape.

The torch relay will be held for 121 days. To keep the flame burning bright, the torch features two combustion mechanisms; a high calorific blue flame and catalytic reaction which supports the red flame of the torch.

The continuous-flame 71 cm length torch weighs around 1.2kg and will tour the entire length and breadth of Japan.

The central symbolic light and Sakura cherry blossom shape when viewed from above represents the concept of 'hope lights our way' to coincide with the cherry blossom season in Japan in March 2020, when the Tokyo 2020 Olympic relay will begin.

TOKYO2020.ORG

The Olympic 2020 relay torch production process uses both old and new aluminium extrusion know-how

Hydro and Sowitec mull floating solar power project for Pará operations

Hydro and Germany-based renewable energy company Sowitec are collaborating on potentially installing a large-scale floating solar power plant on Lake Tucurui in Brazil, which could reduce emissions at Hydro's operations in Pará, including the alumina refinery Alunorte and primary aluminium plant Albras.

"Hydro has a clear strategy to further reduce emissions from our operations. Increasing our use of clean energy is an important contributor to achieving that target," Arvid Moss, executive vice president of Hydro's energy business area, said.

Brazilian antitrust authorities approved the joint venture on May 6, along with several authority permits necessary for the project to get under way.

Details of the plant size or cost were not yet available given that the project is currently at an early planning phase. Hydro and Sowitec think it will be around two years to know if the renewable electricity project can be profitable.

"If we succeed in realizing this project, it will be an important milestone for floating solar development in Brazil," Frank Hummel, chief executive officer of Sowitec, said.

SHUTTERSTOCK

Hydro venture looks at floating solar power solutions for Pará operations

Thyssenkrupp Schulte's structural steel supply

Thyssenkrupp Schulte, part of the Materials Services Business Area, has proven to be a reliable partner for Germany's construction industry by providing special structural steel for "solid and durable equipment for difficult subsoil," such as drilling rig masts and crane booms, said the company.

The company offers tailor-made services for its 70,000 customers providing around 50,000 tonnes of structural steel per year of which 90% is from both the XAR® portfolio and Thyssenkrupp Steel Europe's high-strength N-AXTRA®.

Thyssenkrupp Schulte has provided one such customer – Bauer Maschinen GmbH – with 350 tonnes of special structural steel, just-in-time and tailored to its needs for foundation engineering parts used in extreme conditions. Proximity to its customers is an important consideration says Thyssenkrupp.

"We ensure that our partners receive only the finest materials. Special structural steel is particularly remarkable for its wear resistance, which makes the equipment extremely resilient and tough," Christoph Hartmann, regional coordinator for special structural steel at Thyssenkrupp Schulte in Munich, said.

A key consideration says Thyssenkrupp is the strength of materials the industry requires where the wall thickness of steel can be reduced without losing load-bearing capacity – an important consideration also for the movement of heavy vehicles in extreme environments.

Thyssenkrupp Schulte is part of Thyssenkrupp Materials Services which has 480 locations in 40 countries.

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