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Aluminum Industry:
Resilience Amidst Shifting Sands

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Rising demand for aluminum is spurring growth opportunities for ambitious Gulf operators, but a shortage and high market prices for gas have many on the backfoot. Efficiency and sustainability of power supplies and operational excellence are two cornerstones of resilience – a much-needed ingredient in today's rapidly changing market.

The global aluminum market is predicted to display a compound annual growth rate of 6.4% between 2017 and 2025, according to Transparency Market Research. If realized, market value will climb more than 70% from the $143.87 billion in 2016 to $249.29 billion by the end of 2025. Year-on-year demand for aluminum in the Middle East alone neared 6% in the first quarter of 2017 – the highest among different geographies across the world – with the region accounting for around 10% of global production at around 5.6 million tons. Of the total production, the Gulf Aluminum Council (GAC) estimates that approximately 40% is utilized by downstream industries in the Gulf and 60% is exported to different parts of the world.

Demand in the Gulf is largely being driven by the construction sector, as well as budding appetite for lighter and more environmentally friendly motor cars. For the latter, just one kilogram of aluminum used to replace heavier materials in a car or light truck has the potential to eliminate 20kg of CO_2 over the lifetime of the vehicle, according to the GAC. The International Energy Agency (IEA) reports that the sale of electric cars worldwide hit a record high last year at more than 750,000. Such 'green savings' are particularly coveted as global political momentum for the Paris Agreement builds, with Gulf countries also pursuing greener energy roadmaps. The impact of increasingly environmentally aware nations is well illustrated by China, the world's biggest aluminum market. Plans to cut 3-4 million tons of production capacity this year – around a tenth of the country's total – from mostly coal-fired plants are underway in large part to ease the dangerous levels of smog clogging up the industrial cities of the world's second largest economy. Hit-and-miss transparency means the full impact of Beijing's efforts remains to be seen.

There is a stumbling block to the Gulf's bullish narrative and the region's ability to sharpen its competitive edge. Securing power supply accounts for approximately 30% – 40% of the production cost of aluminum – and the Gulf has a gas shortage and high market prices. The Gulf historically enjoyed the competitive advantage of cheap power, but rising populations, industrial expansion and a lagging portfolio of new power infrastructure projects means the region is now playing catch up. Domestic power demand is expected to rise at an annual average pace of 8% between 2016 and 2020, according to Saudi Arabia's Apicorp, with the region needing an additional 100GW of power capacity over the next decade.

"The global aluminum market has many faces. It has very old smelters in some traditional regions versus new and innovative production in other regions, such as the Gulf. You also have a range of different power sources, from coal-fired to hydropower. Such a fragmented industry makes it very difficult to come together with singular solutions. Collaboration and integration of the value chain – from mine to market – is vital."

A busy world

Growing populations are one of the key drivers behind rising demand for aluminum.

9.7
The world's population is expected to climb by nearly a third by 2050 from today's 7.6 billion to 9.7 billion people.

1950
Saudi Arabia and the UAE have experienced rapid growth from the 3.1 million and 70,000 people, respectively, reported in the mid-1900s.

2050
Saudi Arabia's population could grow by 37% to 45 million and the UAE's by 39% to 13.1 million in just over three decades.

Source: Comprised using UN data

"We need to keep things simple for all so that concepts and ideas can be implemented with a great deal of efficiency. If a concept is understood by all, it can be implemented efficiently."

Efficiency is king

Therein lies the importance of pinning down solutions to increase the efficiency of smelters while reducing power consumption and cost – a very challenging nexus to master. GE estimates that globally, a 1% increase in real efficiency of aluminum smelters can lead to a saving of $970 million on the cost of production, $936 million in output increase and a saving of $464 million in operating and maintenance costs. In the Gulf alone, a 1% increase in efficiency would lead to a staggering $28 million in savings on operations and maintenance. GE's 9HA gas turbine is a prime example of how prioritizing efficiency pays off. After investing $2 billion into research and development (R&D) and three years of intensive development by an 1,800-strong team, the Bouchain gas turbine in France achieved a 62.22% rate of efficiency – earning the technology a spot in the Guinness World Records in June 2016 as the world's most efficient combined-cycle power plant. Bouchain is as large as a house, has more than a 99% reliability rating and can reach full capacity in approximately the time it takes to drink a coffee – just 28 minutes.

A single turbine weighs as much as an Airbus A380 aircraft, the tip of the last blade moves at 1.5x the speed of sound and a single 9HA can power up to 680,000 homes.

Reviewing operating variables to streamline upmost efficiency in a market where the majority of influences are uncontrollable makes sense. Generally, only 20% of operating expenses (Opex) fall under the direct control of any given smelter. Smelters can bolster their efficiency by optimizing the use of their resources and exploring alternative measures for labour, management overheads, marketing and sales, for example. The remaining 80% of Opex is largely driven by the market; the flow of energy and raw materials like electrolytes, coke and pitch, for example. While trickier to mitigate, these costs could be optimized by putting the spotlight on improving economies of scale, deepening understanding of market forces and dynamics and leveraging digital tools that promote efficiency.

Digital tools that fall under the umbrella term the '4th Industrial Revolution' are rapidly making the

A Quick History

1825
Hans Christian Oersted, a Danish chemist, was the first to produce tiny amounts of aluminum in 1825.

30
Oersted's work was continued by Friedrich Woehler, a German chemist, who set about working from 30 grams of aluminum powder in October 22, 1827.

18
It took nearly another two decades of continuous experimentation for Woehler to create small balls of solidified molten aluminum in 1845.

1886
Aluminum's development changed with the discovery of a more cost-efficient electrolytic production method in 1886 – but the excellent results required an enormous amount of electric power.

1903
Widespread use followed, including light aluminum engine parts that helped propel Orville Wright's aircraft for 12 airborne seconds in 1903 – the world's first sustained human flight.

Source: Comprised using information from Aluminum Leader, Gulf Aluminum Council

GCC: Let's talk

The theme of how to compete rather than collaborate often weaves its way through conversations amongst Gulf operators – a habit that stymies greater dividends. Lee Iacocca, the American automobile executive, summarises the value of knowledge sharing well: "You can have brilliant ideas, but if you can't get them across, your ideas won't get anywhere." More proactive conversations that lead to quantifiable progress between key stakeholders is key to finding common synergies and leveraging the region's competitive edge. Industry, government and academia must all be engaged.

Greater cooperation between Gulf smelters in areas such as the treatment of Spent Pot Lining (SPL), Alumina and raw materials would improve economies of scale and subsequently, efficiency and resilience. Treatment of SPL would be less costly if it was all treated in one place, with the UAE potentially being a good location due to the existing high production capacity. Building one Alumina refinery to supply alumina to all Gulf smelters would also bolster efficiency. Oman is perhaps the most viable location due to its port facilities aiding marine transportation logistics for imports of bauxite from elsewhere, such as Australia and Africa. Collectively leveraging the market's purchasing power to negotiate better terms for raw materials, including freight and other transportation costs, would also benefit all Gulf smelters.

The region's transmission network needs urgent attention and could benefit from following the European model, where 25% of all energy produced is traded on long-term contracts, bilateral and intraday trades. A more robust transmission architecture could also encourage the growth of arbitrage opportunities. All stakeholders must understand that reaching the upmost levels of efficiency means the capacity and output of the smelter are accurately aligned to the market demand. What sounds like a simple and obvious mission statement is often lost in translation due to poor and slow communication.

Working together will enable the Gulf to counter the rising competition driven by the US' cheaper shale gas. Without quick action in the Gulf, the region's shortage of gas and high market prices could lead to Gulf-based investors funnelling cash into US-based smelters – a win for US President Trump's 'America First' policy. But it could mark a triple blow to the Gulf's energy market; the region's energy producers are already trying to adjust to the growing market share of the US' shale oil and LNG markets.

Widening the region's talent pool and R&D expertise through a cross-border approach between industry and academia would also pay intellectual dividends and support Gulf countries' bid to create knowledge-based economies that reduce their reliance on imported human capital. The region is not short of budding millennial talent. The World Economic Forum (WEF) estimated in 2014 that the Middle East and North Africa (MENA) have the highest youth unemployment rate in the world; 27.2% in the Middle East and more than 29% in North Africa.

aforementioned nexus more viable. The concept of digitalization is not entirely new, but the industry's ability to harness and digest far greater volumes of data is. In this new world, asset performance management (APM) takes on new dimensions, bringing together multiple technologies that include the industrial internet of things, smart meters, sensors, data analytics, and even virtual models of products or processes. When APM is applied effectively, it can expand flexibility by reducing start-up time, lowering the turndown limit, increasing peak power capacity, and reducing emissions. It can also reduce fuel costs by increasing efficiency, extending maintenance intervals, and reducing or eliminating unplanned outages. Plant operations optimization (OO) can improve fuel supply management, financial planning, and regulatory compliance and business optimization (BO) can enhance market intelligence and forecasting, portfolio optimization and fuel procurement.

Digital transformation has been a financial lifeboat for archaic operators trying to match the pace of operators with modern infrastructure and for market frontrunners, such as China, keen to continually sharpen their competitive edge. Operators' digital toolboxes differ around the world, but all could benefit from improvements. China has robust and plentiful hardware, Europe has good software but aged hardware, while ambitious Gulf countries must quicken their exploration of new technologies to help compensate for gas supply woes.

"Having more data is great, but it is not everything. We need people who understand what it means. My smartphone may have more processing power than Nasa's 1960s computers, but I only use three applications on it. The value in the rest of the data is not used. So, how can we squeeze every inch of value from the tools we already have?"

Rapid change risks confusion and an education process for those in industry, finance and politics would lift the veil on any ambiguity. A simple guidebook that can be understood by all is required to break down the complex concepts behind new digital tools that can do predictive maintenance and performance analytics. Digital pioneers in the aluminium and power markets must communicate regularly and in simple language; complex terminology only dulls listeners' appetite to learn.

"Five years ago, having data analysts sitting in a smelter control room was unthinkable. Now, it's increasingly the norm – the positive change is happening very quickly."

Hedging danger

With great digital opportunities, come great challenges; welcome to cybercrime, the new global mafia. Skilled hackers taking control of an aluminium or power plant – be it to halt or manipulate operations – is a very real threat that must be hedged against. Recent examples where hackers have exploited loopholes in existing safeguards include reports by the International Atomic Energy Agency (IAEA) of an attack on a nuclear plant a few years ago, computer viruses infecting a German nuclear power plant and most recently, cyberattacks on US power plants this year.

The aluminum industry is not alone. Cybersecurity Ventures predicted that cybercrime will cost the world $6 trillion annually by 2021 – up from $3 trillion in 2015. If realized, this market will be more profitable than the global trade of all major illegal drugs combined. Unsurprisingly, spending on information security is expected to exceed $1 trillion cumulatively from 2017 to 2021.

While not directly connected to the aluminum industry, a handful of recent events have illustrated how we – including energy stakeholders – cannot risk being left in the intellectual dark. The Turing Test proposed by Alan Turing in 1950 aimed to determine whether a machine can demonstrate our level of cognitive ability in words, actions and concepts. The Test was passed for the first time in 2014 when a computer algorithm convinced 33% of the human judges that it was a 13-year-old boy called Eugene Goostman during a thirty-minute typed conversation online. And in July this year, two programs organized by Facebook to trade against each other changed the rules of dialogue and developed their own language – one that was indecipherable to humans. Looking ahead, a collaborative ethos to ensure a steady power supply and leveraging the growing list of commercially-viable digital tools will help the Gulf keep one step ahead in a market where competition will only intensify.

**White Paper is based on a roundtable event hosted by GE during the Arab International Aluminum Conference (ARABAL) in Muscat, Oman on November 6, 2017.*

Financial appetite

Loosening investors' purse strings requires borrowers to tick off a demanding checklist: upmost efficiency, robust output, reliability and an ability to flex with shifting market dynamics. The good news for borrowers is that investors are gradually emerging from a quiet spell; Thomson Reuters' LPC data shows that the region's overall borrowing of $28.25 billion in the first three quarters of this year in the Middle East marked the lowest level in six years. Successful innovations, such as GE's Bouchain plant, are helping whet investors' appetite. The more fluid the flow of funds, the greater potential for local patent registration, digital fluency and the growth of grassroots intellectual property (IP) – each a key ingredient to attracting yet more investors.

Investors' growing appetite is fortuitous timing for in the MENA power market alone, Apicorp estimates that $302 billion must be invested between 2017 and 2021. Of this, $179 billion will be needed to add 138GW of generating capacity, with the rest earmarked for transmission and distribution (T&D). While Gulf governments are proactively pursuing green energy agendas and supporting the Paris Agreement, the lack of storage facilities means the financial bankability of a smelter cannot be justified based on renewable energy alone. Solar, wind and hydro are all increasingly popular but intermittent forms of power supply. However, investors are open and keen to invest in aluminium projects that have a 'green face'; renewable energy being used as a complementary power supply, or used to support non-essential on-site operations.