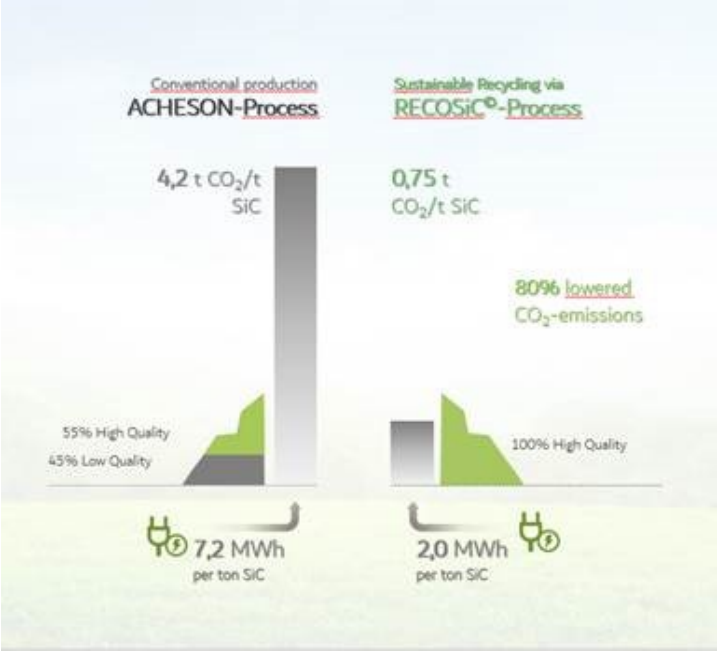
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ESK-SiC GmbH

A recent discussion with management at ESK-SiC GmbH proved to be both interesting and informative as ***SiC & More*** and the rest of the world continue to learn more about their RECOSIC technology. As mentioned in issue #93, Guido Mueller of ESK-SiC stated, "This process will change the game in SiC!" In addition, "We see an environmentally friendly process, which gives silicon carbide the chance to step in the future, where a low carbon footprint and the saving of resources is key to be successful."

In issue #93, ***SiC & More*** published two charts provided by Mueller that gave the reader a rudimentary description of the Acheson process and how it compares to the new recycling process developed by ESK-SiC and Fraunhofer.

The following graph, provided by Mueller, further depicts the incredible advantages of the RECOSIC process over the traditional Acheson production method.



To compliment the new graph, Mueller said, "We are proud to launch our RECOSIC process in big steps over the next three years. This process gives us 100% crystalline material and reduces the CO2 output with up to 80% compared to the state-of-the-art Acheson process."

Mueller added, "ESK is quite sure that we can replace step by step the Acheson process and enter into a circular economy for silicon carbide-based materials, especially refractory and ceramic materials."

ESK is currently running at full capacity and continues to concentrate sales efforts on refractory and specialty markets. Mueller elaborates, "This focus has brought us more and more opportunities to the high-end markets over the past two years."
ESK-SiC GmbH continues to be a world leader in pursuing value added markets and even more importantly, the company is being environmentally friendly at the same time. There exists a sincere effort to be environmentally friendly and doing more than their fair share to make things better.

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Fiven Group



Pictured above is the Fiven team preparing to tackle the challenging project of planting 100,000 trees on the Fiven property in Barbacena, Brazil

Over the past few years, ***SiC & More*** has received numerous inquiries regarding the status of Fiven's Puerto Ordaz, Venezuela silicon carbide (SiC) furnace plants. That interest has only increased since the global shortage of SiC fell upon the globe during Q4 2021 and prices reached historically high levels. Unfortunately, the status of said furnace plants cannot be confirmed, however, recent correspondence with one of Fiven's strategic managers was truly enlightening as we discover the company's commitment to the environment goes far beyond what one would normally expect in the SiC industry. Consider the following excerpt from recent correspondence:

On the subject of sustainability, I can gladly give you some additional facts:

In 2021, the Fiven Group has received the Ecovadis sustainability certification in silver. The certification evaluates environmental, social, and ethical performance. The silver rating places Fiven in the top 25% of all companies assessed by Ecovadis. The rating underscores our ambition to improve our sustainability program. We have received a lot of interest and positive feedback from our customers and believe this type of third-party review is a valuable tool to provide unbiased feedback on our actions.

Concerning our environmental efforts, I would like to highlight the following in particular: Fiven has pledged to reach net-zero emissions by 2050. As far as we know, we are the first silicon carbide producer worldwide to make this commitment.

We realize that a promise alone will not change anything, so we have drawn up an environmental roadmap focusing on three key areas: emissions to air, water withdrawal, and waste.

The issuance of a sustainability-linked bond in June 2021 further proves our commitment, as it integrates sustainability into our financing. In the corresponding framework, we define clear targets and actions for further improving our environmental footprint. We are going to reduce CO2 emissions by 9%, SO2 emissions by 15%, and water withdrawal by 10% by 2025 (compared to 2019 levels).

One project contributing to this goal is planting 100,000 trees on our property in Barbacena, Brazil. The trees planted are native to their environment and contribute to the biodiversity of Fiven's forest, which already has 400,000 trees. It is one of the most ambitious environmental projects in the state of Minas Gerais.

Our mission of shaping industries can only be achieved through continued commitment to delivering sustainable, high-quality products for our global customer base. As a worldwide leader within our industry, we aim to utilize our global reach and manufacturing experience to drive change across our value chain.



Pictured above are some of the Fiven team members installing guide stakes for some of the 100,000 trees.

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Metals Industry Update

RIVIAN

Southern California-based Rivian Automotive Inc. plan to add a second shift at the production facility in Normal, Illinois. Rivian beat revenue expectations in Q2 2022 with sales of $364 million being led by the delivery of nearly 4,500 R1 SUVs and electric delivery vehicles. The Normal plant has an annual capacity of 150,000 units.

INFLATION

The U.S. year-over-year inflation rate was 8.5% with the initial report for July. July represented the first flat inflation month of 2022. By comparison, the U.S. inflation rate for 2021 was 4.7%. In Argentina, interest rates were increased to an exorbitant 69.5% in order to curb inflation that is over 70%. Mexico raised its interest rate to 8.5%, which is the highest since 2008.

ALGOMA

Algoma Steel announced that its $545 million project to replace the existing blast furnace and basic oxygen steelmaking process with two electric arc furnaces (EAFs) is on schedule as well as on budget. Algoma is expected to have an annual raw steel production capacity of about 3.7 million tons.

MACHINE TOOL ORDERS

U.S. machine tool orders slipped during each month of Q2 2022 with much of the erosion attributed to continued supply chain issues. U.S. machining and other manufacturers' new capital-equipment orders fell to $417.5 million during June, which was down 5.1% from the May number. The good news, however, is that the $2.84 billion in 2022 year-to-date new orders is an improvement of 13.1% over the same period in 2021.

STEEL PRODUCTION

The AISI reported that through August 6, 2022, U.S. raw steel production was 54.47 million tons, which is down 3.1% compared to the 56.22 million tons produced for the same period in 2021. The U.S. is not the exception but rather the norm as the World Steel Association reported that through 1H 2022, nine of the 10 largest steelmaking nations produced less steel than in the same period in 2021 with only India showing improvement. During 1H 2022, China is down 6.5% by volume compared to same period in 2021.

GERDAU SA

Gerdau recently announced that the company would invest about $55 million to expand capacity at its Midlothian, Texas bar mill bringing the capacity of the mill to two million tons per year. The company reported earnings that showed the North American division reported its best quarter in history with EBITDA of $542 million.

EUROPEAN STEEL

Several European steel producers cut production by idling blast furnaces during the summer months as steel demand softened. This is being attributed mainly to lower car production, which has been caused primarily by a parts shortage. The cut in production will, to some degree, support price stability for steel producers.

INGERSOLL RAND

IR recently announced that the company had net income of $139 million in Q2 2022 based on $1.4 billion in sales. IR also completed three acquisitions worth about $34 million by buying businesses in Missouri, China, and India.

CATERPILLAR

During Q2 2022, Caterpillar's profits rose 18% to $1.7 billion on revenues of $14.2 billion. CEO Umpleby said that Caterpillar had seen no appreciable improvement in the supply chain and the status and delivery of key materials and components remain unpredictable.

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ZAPOROZHABRASIV CONTINUES TO MOVE FORWARD



BFA furnace under power at Zaporozhabrasive in Ukraine

Zaporozhabrasiv, The Ukrainian producer of brown fused alumina and silicon carbide, had suspended its work on February 24 due to the outbreak of hostilities in Ukraine, however, already in March the company had begun a gradual resumption of production.

As issue #94 of ***SiC & More*** goes to print, the brave employees of Zaporozhabrasiv continue to work their jobs and supply customers with value added products. The resilience of the people is unquestioned.

As one manager at Zaporozhabrasiv put it, "The situation in Ukraine remains hard, but we believe in our victory."

The same manager said, "I can say that today we have enough electricity to produce both SiC and BFA though the price of kWh also increased a lot." Virtually every global producer of SiC and BFA will attest to the daily struggle of rationalizing the cost of kWh to end-use market selling prices. Can you imagine the daily difficulties making those decisions while in the middle of a war zone?

SiC & More will continue to make efforts to communicate with colleagues at Zaporozhabrasiv and provide readers with information regarding the struggle and of the company's commitment to their employees and customers.

Brown Fused Aluminum Oxide

Although the price of BFA crude ordered in early August dropped by $25-30 ton, the most expensive material in recent history will be arriving at U.S. and European ports during mid to late August.

Negotiations are currently taking place for parcels expected to depart China in October 2022 and that tonnage is expected to be $30-35 ton less than the material ordered in early August.

The material that was ordered in early August, however, won't show up in the respective end-use markets until mid to late 1Q 2023 and the material ordered in October won't get processed and moved to end-users until late 2Q 2023. As a result, most refractory and abrasive end-users shouldn't expect a softening of BFA prices for at least another six months. A processor did comment, "Prices should probably increase during the fourth quarter and level off during the first quarter of 2023. Of course, that depends on processors' different strategies when it comes to inventory and sales management."

It's believed that China supplies about 85% of the world's BFA markets. There are a few other options for BFA consumers including The Curimbaba Group, which is a major player out of Brazil. Curimbaba's ELFUSA group is said to be operating at full capacity and is resolving many of the logistics issues that plagued most exporters for the past several years.

The cost of bauxite, environmental issues, cost of energy, COVID, capacity utilization, and logistics remain hurdles for most Chinese producers and their trading partners.

In issue #93 of ***SiC & More,*** a trader made some interesting comments about the Chinese steel industry. ***SiC & More*** revisited with the same trader that for an update and his suggestion was for a direct reprint of his comments from early June. "I expect to see some softening in Chinese FOB pricing as we progress through summer and into autumn. Beyond that, however, I will be keeping an eye on China's steel industry. I believe China's steel capacity utilization will have a profound effect on BFA supply and demand and pricing as we enter Q4 and another New Year."

Whether readers are dealing in BFA, SiC, ferroalloys, MgO, graphite, pig iron, bonded or loose abrasives, fluorspar, etc., keeping an eye on China's steel industry, as well as China's metals and minerals business as a whole, is vitally important.

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WHAT HAPPENS IN BRAZIL DOESN'T STAY IN BRAZIL

Brazil remains a global powerhouse when it comes to metals and minerals-related businesses. Brazil contains rich mineral reserves including iron ore, copper, tin, bauxite, granite, manganese, quartz, not to mention gold, gemstones, etc. Brazil's manufacturing sector is the third largest in the Americas with significant participation in automotive, oil & gas, iron & steel (think pig iron, ferroalloys, SiC, Al2O3, etc.), machinery and equipment, and agriculture. Depending on the source, Brazil's natural resource value is about $22 trillion. In addition, Brazil's yearly GDP runs neck and neck with the likes of Russia, South Korea, and Canada. Brazil has both the largest population and economy in all Latin America. In other words, if you are in the metals and minerals business, staying current on Brazilian activities is a must.

Updates from Francisco Batista:

a) Energy: Not much has changed since issue #93 of ***SiC & More***. The weather forecasts indicate rainfall within average for next rainy season (November-April), which will make average energy spot price for 2023 to be under $40/MWh. Grid costs, on the other hand, are inflated for the upcoming four years as a consequence of the inexplainable thermal dispatch during 4Q21 - 2Q22. There is a structural excess of energy for the foreseeable future in Brazil, however, it is all about the raw material water. As hydros are still the largest backup generation assets in Brazil, their reservoirs are being exhaustively used by the System Operator meaning they can't go through two years of below average rainfall levels without compromising the energy balance of the country.

b) Macroeconomics: The Brazilian Central Bank has increased interest rate again this month to 13.75%. Another hike of 50bps is expected for next month. Some economists say BCB will need to go higher than that to fight current inflation of 11.9% (accumulated in the last 12 months) although July's inflation index was announced today as -0.68% (mostly as a consequence of the recent tax reduction over fuel and energy). The overall outlook is surprisingly positive for the 2022 GDP (+2%) but no one has a clue what will happen to BR economy if the U.S. and Europe enter an economic recession in 2023.

c) Commodities: The exchange rate is still very favorable for exporters in Brazil along with improving logistics and stable market prices. We are starting to see heavier investments from commodity producers to increase their output specially for manganese and Sslicon-derived products.

d) Major Elections 2022: There have been few changes since the last report in issue #93. The far-right (Bolsonaro) vs far-left (Lula) battle is only getting tougher and shall be decided in a runoff and, according to the polls, with a clear advantage for Lula.



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DIGGING THROUGH THE ARCHIVES



Archeological dig. Stock photo

No doubt, it's an adventure locating old documents in your library and the process can often to be enlightening. This is the fourteenth segment from the dusty but irreplaceable ***SiC & More*** archives. Most of the previous segments have been related to abrasive and refractory topics. The literature that has been pulled from the archives makes it apparent that the evolution of the business often goes unnoticed. These segments are also great reminders of the many years of tedious research done by those that came before us in this astonishing industry. The following excerpt does not bear the name of the author.

Property facts about Silicon Carbide:

♦Appearance: When removed from the furnace, the silicon carbide is a mass of interlocking iridescent crystals, the crystals themselves being largely twinned and often coalescent. Single crystals of any size are rare. Their iridescence is due to a thin surface layer of silica resulting from superficial oxidation of the carbide. Washing in hydrochloric acid will remove this layer. The crystals vary in color from very pale green to black depending on the amount of included impurities.

♦Crystal Structure: There are two crystallographic species, one of which exists in a number of forms. The low temperature form, beta SiC, is cubic and has been produced in small crystals. The high temperature or alpha form, which is the major constituent of commercial abrasive grain, crystallizes in the hexagonal system, in which it occurs in several forms in both the hexagonal and rhombohedral classes. As these forms began to be identified they were designated Type I, II, or III, in the order of their discovery, but further investigation has shown a definite relationship between them, and proposed a new nomenclature which shows this relationship. There are a limited number of possible arrangements of atoms in a layer of the silicon carbide crystal. All types have these same layer arrangements but differ in the position of the layers with respect to each other and each type may be distinguished by the number of layers before the succession repeats itself.

♦Optical Properties: Silicon carbide has a high index of refraction, strong birefringence, strong dispersion, and is uniaxially positive. The mean indices of refraction for the alpha type in sodium light are as follows:

No = 2.648 Ne = 2.691

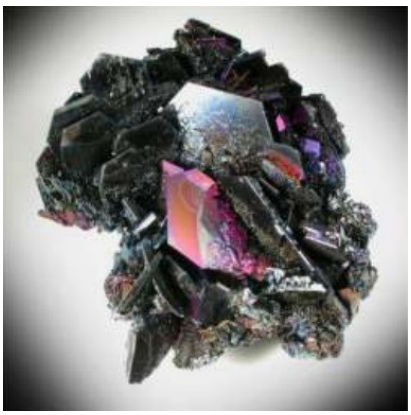
It was found that the unusually large dispersion in the range 4360-6,000A to be 0.0918 for the o-ray and 0.1028 for the e-ray. Beta silicon carbide, being cubic, is isotropic and it was found that its index of refraction in lithium light is close to 2.63, which is about the same as that for the o-ray of alpha in the same wave length.

♦Thermodynamic Properties: Probably the best and latest values of thermodynamic properties will be found in the U.S. National Bureau of Standards publication, "Selected Values of Chemical Thermodynamic Properties".

♦Specific Gravity: Specific gravity as calculated and as determined experimentally, does not vary greatly between the different crystallographic types. Experts calculated the values 3.210 for beta silicon carbide and 3.208 for the 6H type of alpha silicon carbide from the lattice parameters. The greatest factor in causing conflicting data to be found in the literature as to the specific gravity of silicon carbide, is its varying impurity content introduced from the raw materials used in its manufacture. The figure most commonly used for calculations involving the commercial product is 3.2, which is sufficiently accurate for most purposes.

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SiC Pricing Holding Mostly Firm



In issue #93 of ***SiC & More***, a SiC producer commented, "In the past you fixed a price for the product at the start of the year and that was it. Now, everyday you have new inputs, things are not as usual and you have to cope with every new."

Not much has changed since issue #93, although global prices have softened just a bit. As a refresher, prices dropped in early May by about $30 ton then increased by nearly $50 ton in early June, which represented what many considered – along with early March – the highest prices in history. By the beginning of July there was a $30-35 ton drop then another $20 in late July. During early August price quotes reflected $20-25 ton decrease. In other words, after this short roller coaster ride, the market is $20-25 ton lower in August than it was when ***SiC & More*** last reported pricing. Keep in mind, the above decreases reflect mostly SiC crude destined for lower grade refractory and metallurgical products.

Much of the most expensive SiC in history that was under contract in June has yet to hit a processors door let alone make its way to end-use markets. In short, end-use market pricing will, more than likely, increase again in Q4 2022.

There are several legitimate reasons for SiC pricing remaining at near record levels. First and foremost is the price of kWh. A recent conversation with a producer led to this comment, "Electricity went from 25 cents per kWh in June to 30 cents for every day in July." When kWh prices hit that level, SiC furnaces are generally put on hold. After all, this is not a liquid process and SiC producers are accustomed to shutting down with as little as an hour notice during peak energy demand. A second reason for the continued strong pricing is the inflated price being paid for petroleum coke and/or anthracite – both of which remain at record or near record levels.

Another reason for firm pricing is Russia's invasion of the Ukraine. The supply lines from Ukraine are somewhat disrupted whereas Russian SiC is not flowing into the EU, which puts upward price pressure on the EU producers and causes supply dislocation.

The energy issue is essentially a worldwide crisis. To put just the unstable kWh pricing in perspective, consider SiC furnace operations that were accustomed to paying 5-8 cents per kWh have been paying a firm 10-15 cents with spot purchases of 25-30 cents with some prices even higher than 30 cents. It takes approximately 7000 kWh to produce a ton of SiC and kWh represent 40-60% of the cost to produce a ton of SiC crude. In other words, depending on the region, energy alone has contributed anywhere from $350 to over $2,000 per ton to the production cost.

In issue #92 of ***SiC & More***, a trader commented, "Generally, what goes up must come down. Many producers of commodities are suffering from bizarre costs and finding it almost impossible to operate their factories. When kWh prices are this high, operating at off-peak hours is the only avenue for survival. I cannot fathom this continuing into 2023, but I would have never imagined this is where we would be in 2022." When asked about SiC pricing during May and June, this same trader said, "There has been about a $30 ton softening but I attribute that to currency exchange rates."

So where do we go from here? As far as SiC furnacing is concerned, the supply and price of kWh are the keys along with the price of pet coke. Going forward, most producers do not seem optimistic about the price of kWh. If energy is not abundantly available, SiC prices will remain bloated. A trader said, "There is not going to be a sharp decrease in the price of commodities. There is too much uncertainty when it comes to the price of kWh, raw materials, and transportation. I suspect the first quarter of 2023 will represent the beginning of a long and slow erosion of prices. I also don't expect most commodities to return to their pre-COVID prices. I personally believe those days are in the rear-view mirror."

Another trader shared this perspective. "Global prices have remained relatively firm even though SiC demand in China is soft. If the Chinese steel industry picks up steam, the demand for SiC for refractory, metallurgy, and abrasives will certainly increase putting pressure on supply and pricing. In my opinion, we are not out of the woods when it comes to price increase."

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RHOMBUS ENERGY SOLUTIONS TO LEVERAGE WOLFSPEED'S SILICON CARBIDE DEVICES FOR FASTER EV CHARGING INFRASTRUCTURE

Press Release May 09, 2022

Durham, N.C., and San Diego, Calif., May 9, 2022 — Rhombus Energy Solutions, a leader in electric vehicle (EV) charging and power conversion technology, today announced that Wolfspeed, Inc., (NYSE: WOLF), the global leader in Silicon Carbide technology, will supply its EV2flex™ line of charging infrastructure products with Silicon Carbide MOSFETs, which will offer the products greater efficiency, higher power density and faster charging times.
Rhombus' EV2flex™ infrastructure includes a family of products that enables fast, bi-directional charging and efficient energy storage. Vehicle-to-grid (V2G) charging supports power flow between the grid and the car, allowing a charged vehicle to become a power source when needed and ultimately enhancing the stability of the power grid.

"Wolfspeed has unequivocally demonstrated the high value of their Silicon Carbide MOSFETs and we are pleased to partner on advanced technology products," said Deanne Davidson, senior vice president and general manager of Rhombus Energy Solutions. "As Rhombus continues to be the leading provider for V2G charging systems, Wolfspeed's Silicon Carbide MOSFETs are a critical component for Rhombus to meet the demands in the growing DC fast-charging market for EVs."

"Wolfspeed is excited to work with Rhombus, as we believe bi-directional charging is a game-changing technology for the stability of the power grid and our Silicon Carbide solutions will help accelerate that transformation," said Jay Cameron, senior vice president and general manager of Wolfspeed Power. "Silicon Carbide increases both power system efficiency and power density to create a faster, more reliable transfer of power. Wolfspeed is leading the industry-wide transition from silicon to Silicon Carbide, which is critical as we look for more efficient and innovative ways to support the power grid, such as bi-directional EV charging."

Wolfspeed is the preferred Silicon Carbide provider for Rhombus due to its unmatched, 30+ year history and expertise working with Silicon Carbide power devices. Wolfspeed's 1200V Silicon Carbide MOSFETs will power Rhombus' EV2flex-120™ charging infrastructure. Wolfspeed's third generation MOSFETs deliver the performance and reliability required to meet a wide variety of industrial, energy and automotive applications.
Rhombus' latest product in the EV2flex™ portfolio; the EV2flex-120™ dual channel will be on display at the 2022 Advanced Clean Transportation (ACT) Expo in Long Beach, CA.

About Rhombus Energy Solutions
Rhombus develops and manufactures bi-directional electric vehicle charging systems including the EV2flex™ line of charging infrastructure, high-efficiency power conversion systems and energy management system (EMS) software for vehicle-to-grid (V2G) capable electric vehicle fleet charging, energy storage and microgrid applications. The high reliability of our solutions is the result of decades of experience developing high-power systems for a variety of applications and deployment scenarios, including UL-1741-SA system-to-grid solutions. For more information, please visit www.RhombusEnergy.com.

EV2flex™ and EV2flex-120™ are trademarks of Rhombus Energy Solutions.

Wolfspeed (NYSE: WOLF) leads the market in the worldwide adoption of Silicon Carbide and GaN technologies. We provide industry-leading solutions for efficient energy consumption and a sustainable future. Wolfspeed's product families include Silicon Carbide materials, power-switching devices and RF devices targeted for various applications such as electric vehicles, fast charging, 5G, renewable energy and storage, and aerospace and defense. We unleash the power of possibilities through hard work, collaboration and a passion for innovation. Learn more at www.wolfspeed.com.

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Continued from previous page:

Forward Looking Statements:
This press release contains forward-looking statements by Wolfspeed involving risks and uncertainties, both known and unknown, that may cause Wolfspeed's actual results to differ materially from those indicated. Actual results may differ materially due to a number of factors, including the risk we may be unable to manufacture these new products with sufficiently low cost to offer them at competitive prices or with acceptable margins; the risk we may encounter delays or other difficulties in ramping up production of our new products; customer acceptance of our new products; the rapid development of new technology and competing products that may impair demand or render Wolfspeed's products obsolete; and other factors discussed in Wolfspeed's filings with the Securities and Exchange Commission, including its report on Form 10-K for the year ended June 27, 2021, and subsequent filings. For additional product and company information, please refer to www.wolfspeed.com.

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