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ECONOMIC UPDATE

Number 12 • MAY 2021

EXECUTIVE SUMMARY

AMERICAS: U.S. FIRST QUARTER GDP grew at a 6.4% annual rate, bringing the world's largest economy within 1% of its peak, reached just before COVID struck. **Industrial production** rose 1.4% in March, and the capacity utilization rate gained a point to 74.4%. Manufacturing production was up 2.7%. **The U.S. trade deficit** jumped 5.6% to an all-time high of \$74.4 billion in March amid roaring domestic demand. There were large gains in imports of motor vehicles. American goods exported vaulted 8.9%, boosted by shipments of motor vehicles, industrial supplies, consumer and capital goods and food. **Factory orders** grew at a slower pace in April, likely constrained by shortages of inputs amid pent-up demand. **U.S. retail sales** climbed 9.8% in March after falling 3.5% in the prior month. The broad-based rebound was led by motor vehicles, with receipts at auto dealerships surging 15.1%. **U.S. employers added a modest 266,000 jobs in April** and unemployment rose to 6.1% as more people entered the workforce. **Consumer confidence** reached a 14-month high in April as increased vaccination against COVID-19 and additional fiscal stimulus allowed for more service-oriented businesses to reopen.

OVERSEAS: THE GLOBAL SHORTAGE OF SEMICONDUCTORS CUT AUTO PRODUCTION IN EUROPE AND CHINA. The **eurozone economy** contracted by 0.6% in the 1stQtr, reflecting restrained stimulus spending and a botched effort to secure vaccines that has left many major economies contending with restrictions on daily life. **China's economy** grew a record 18.3% in the 1stQtr from last year's pandemic low point, but economists estimate that underlying YOY GDP growth was about 5.4 percent.

STEEL: U.S. STEEL CANCELLED A \$1 BILLION CAPITAL INVESTMENT PROJECT slated for its Mon Valley Works. USS said the decision was based on the company's expanded focus on sustainability. **Allegheny Technologies** reported a \$7.9 million loss in the 1stQtr but anticipates improved demand for its jet engine products. The USW struck ATI's Specialty Rolled Products locations March 30, a day before the end of the quarter. The strike is continuing after the union rejected ATI's latest four-year contract proposal.

MEDICAL: 'SWEAT STICKER' DIAGNOSES CYSTIC FIBROSIS WITHIN MINUTES. A Northwestern University-led research team has developed a novel skin-mounted sticker that absorbs sweat and then changes color to provide **an accurate, easy-to-read diagnosis of cystic fibrosis within minutes.** The soft, flexible, skin-like "sweat sticker" offers a stark contrast to current diagnostic technologies, which require a rigid, bulky, wrist-strapped device to collect sweat. **Pfizer** expects its COVID-19 vaccine to generate about \$26 billion in sales this year, reflecting the shot's growing role in the global vaccination campaign.

AEROSPACE: CONTRACT AWARDED TO DEVELOP NUCLEAR REACTOR TO POWER MISSIONS TO THE MOON. The Defense Advanced Research Projects Agency awarded a \$22 million contract to General Atomics to **design a small nuclear reactor for space propulsion.** The project will attempt to demonstrate a nuclear thermal propulsion system in orbit. A nuclear reactor will heat propellant to extreme temperatures before expelling the hot propellant through a nozzle to produce thrust.

AUTOMOTIVE: GM IS TESTING NEW TECHNOLOGY FOR ALUMINUM-BASED EV BATTERIES, including increasing the use of aluminum and aluminum alloys. GM continues to explore various technology solutions for its upcoming Ultium batteries. The batteries are expected to have a cell cost of at least \$50/kW below current prevailing market prices with an operational life of at least one million miles and last up to 600 miles between charges. **U.S. auto sales** for April were expected to be the highest ever recorded for the month.

STEEL: STAINLESS STEEL SCULPTURE DROPPED IN MARIANA TRENCH WILL STORE DNA FOR 10,000 YEARS. A Danish artist worked with a team of engineers to create a unique, free-standing steel sculpture that acts as a time capsule and withstands the pressure of deep-sea conditions. **The nano-engineered stainless steel outer surface** does not interact with or contaminate the natural environment, while guaranteeing the integrity of the structure that protects its DNA cargo. The corrosion-resistant stainless steel structure will contain a sealed chest of hair and blood samples, and it will maintain its shining finish for millennia.

METALS: AA CALLS FOR CHANGES TO SECTION 232 TARIFFS, OTHER TRADE POLICY. The Aluminum Association (AA), representing U.S. companies that make 70% of the aluminum and aluminum-fabricated products shipped in North America, urged the administration to **implement immediate and urgent reforms to Section 232 exclusion process.** The AA claims that the current process has inadvertently made the U.S. a magnet for imports and actively incentivizes companies to turn first to imported aluminum products. Aluminum is a key component in making vehicles more efficient, medical devices lighter and packaging more recyclable.

ENERGY: FRENCH RAIL COMPANY ORDERS 12 HYDROGEN-POWERED TRAINS. French national railway SNCF has ordered 12 hydrogen-powered trains to begin tests in four regions in 2023 as it eyes a zero-emissions future with the nascent technology. They are designed to **combine onboard hydrogen with outside oxygen via a fuel cell** mounted in the roof that powers the motors. A fuel cell produces electricity from fuel (on the anode side) and an oxidant (on the cathode side), which react in the presence of an electrolyte.

THE AMERICAS

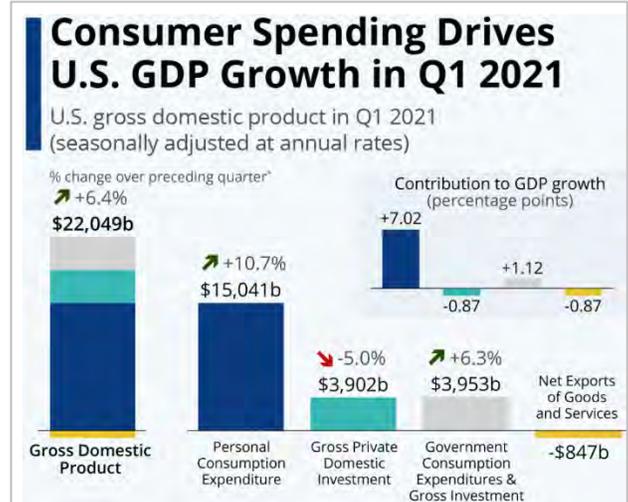
- U.S. consumer confidence** jumped to a 14-month high in April as increased vaccination against COVID-19 and additional fiscal stimulus allowed for more service-oriented businesses to reopen, boosting demand and hiring by companies. The Conference Board's consumer confidence index raced to a reading of 121.7 vs. 109.0 in March.
- U.S. employers** added a modest 266,000 jobs in April and unemployment rose to 6.1% as more people entered the workforce. The slowdown in hiring signaled a potential loss of economic momentum, as some businesses struggled to find workers and faced supply-chain issues. Manufacturing employment was down 18,000—predominantly in motor vehicles where chip shortages idled some factories.
- Consumer prices** increased 0.6% in March as the economic recovery gained momentum, marking the start of an expected months-long pickup in inflation pressures. The acceleration in the CPI came mainly from energy prices, particularly gasoline prices, which climbed 9.1%. The CPI jumped 2.6% in the year ended March.

***Key Update:** For a better sense of true inflation trends, it helps to look at percent change in prices since February 2020, adjusted to reflect an annual rate instead of a 13-month rate. For example, gasoline prices are up an annualized 12.3% since February 2020, not as dramatic as the 22.5% YOY price rise reported in March. Overall consumer price inflation is running at 2.2% using this measure — a few tenths of a percent higher than the inflation index preferred by the Fed.*
- Durable goods orders** rose 0.5% in March after falling 0.9% in February. March orders were restrained by a 1.7% decline in orders for transportation equipment. Orders for civilian aircraft tumbled 46.9% despite Boeing reporting it had received 196 aircraft orders (compared to 85 in February), including 185 737 MAX jets. Orders for motor vehicles and parts shot up 5.5% after plunging 9.1% in February. Motor vehicle production has been hit by a global semiconductor chip shortage.
- U.S. factory activity** grew at a slower pace in April, likely constrained by shortages of inputs amid pent-up demand unleashed by rising vaccinations and massive fiscal stimulus. The ISM index of national factory activity fell to a reading of 60.7 in April after surging to 64.7 in March, which was the highest level since December 1983. The ISM survey's measure of prices paid by manufacturers in April rose to the highest reading since July of 2008.



- U.S. 1stQtr GDP** grew at a 6.4% annual rate and left the world's largest economy within 1% of its peak, reached in late 2019 just before the coronavirus pandemic appeared.

***Key Update:** The economy has grown robustly for three consecutive quarters. The unemployment rate has fallen to 6.1% as hiring accelerated. Worker filings for jobless benefits also have fallen to pre-COVID lows in recent weeks.*



- The U.S. trade deficit** jumped 5.6% to an all-time high of \$74.4 billion in March amid roaring domestic demand. Imports soared 6.3% to a record high \$274.5 billion. Total exports surged 6.6% to \$200 billion, as goods vaulted 8.9% to \$142.9 billion, boosted by shipments of motor vehicles, industrial supplies, consumer and capital goods, and food. There were large gains in imports of motor vehicles.
- U.S. import prices** rose 1.2% in March and 6.9% on an annual basis. March price indexes for petroleum and natural gas on a 12-month basis were up 9.1%. Export prices increased 2.1% and 9.1%, on a monthly and yearly basis.
- Factory orders** increased 1.1% in March, boosted by strong demand for machinery, motor vehicles, and fabricated and primary metal products. However, momentum could slow because of bottlenecks in the supply chain.
- U.S. industrial production** rose 1.4% in March and the capacity utilization rate gained a point to 74.4%. Manufacturing production was up 2.7%. Utility output fell 11.4% as the weather warmed and Americans turned down the heat. Mining output rose 5.7%, pulled higher by oil and gas extraction. Production of motor vehicles and parts rose 2.8% after sinking 10% in February, as semiconductor shortages stalled vehicle output in both months.
- U.S. service sector activity** grew at a slightly slower pace in April. "There was slowing growth in the services sector in April; however, the rate of expansion is still strong," said the chairman of the ISM Services Business Survey Committee.



- **U.S. producer prices** jumped 1.0% in March and 4.2% for the 12 months through March. The YOY PPI was boosted as last spring's weak readings dropped out of the calculation. Wholesale energy prices increased 5.9%, accounting for 60% of the broad-based rise in prices for goods in March.
- **U.S. retail sales** climbed 9.8% in March as Americans received additional pandemic relief checks from the government and the level of COVID-19 vaccinations increased. The broad-based rebound was led by motor vehicles, with receipts at auto dealerships surging 15.1% after falling 3.5% in February. Sales at clothing stores soared 18.3%. Consumers also boosted spending at restaurants and bars, leading to a 13.4% jump in receipts.
- **The U.S. budget deficit** in March grew to a record \$1.7 trillion in the six months since October, as the federal government continued to pump huge sums of money into the economy to help workers and businesses cope with the pandemic. Federal spending is far outpacing revenue — the Treasury is expending twice as much money as it takes in, having spent a record \$3.4 trillion so far this fiscal year.
- **The U.S. Leading Economic Index** rose 1.3% in March after a 0.1% drop in February. The Conference Board said the improvement in the U.S. leading economic index with all ten components contributing positively, suggests economic momentum is increasing in the near term and now projects YOY growth could reach 6.0% in 2021.
- **Existing home sales** in March dropped 3.7% to an annual rate of 6.01 million units, up 12.3% YOY and well above their pre-pandemic level. At March's sales pace, it would take only 2.1 months to exhaust the current inventory, down from 3.3 months a year ago. New home sales climbed 20.7%, likely boosted by an acute shortage of previously owned houses on the market. Housing starts surged 19.4%, the highest level since June 2006.
- **U.S. consumer spending** rebounded in March, rising 4.2% as households received additional COVID-19 pandemic relief money that boosted personal income 21.1%. Consumers shelled out more money on big-ticket items such as autos and furniture. The saving rate soared to 27.6%. Households have amassed \$2.2 trillion in excess savings, which could provide a powerful tailwind for consumer spending this year and beyond.
- **U.S. construction spending** rebounded 0.2% in March as strength in housing was offset by continued weakness in outlays on nonresidential structures and public projects. Spending on residential projects rose 1.7%, but private nonresidential construction such as gas and oil well drilling fell 0.9%. Federal government spending declined 2.1%.

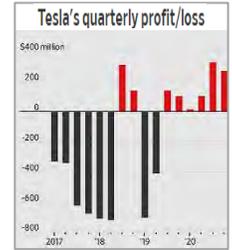
- **Steel mills** in the U.S. shipped 6.735 million tons of steel in February, a 9.2% drop from the previous month. Shipments year-to-date were 14.155 million tons, a 13.2% decrease vs. the same period in 2020. (See **Appendix: Steel**, page 13)
- **Steel imports into the U.S.** were 2.292 million tons in March, including 1.774 million tons of finished steel, higher by 20.7% and 23.6% respectively vs. March 2020. Total steel imports in the first quarter increased 7.5%, while finished steel imports declined 1.4% vs. last year's 1stQtr. Finished steel import market share in the U.S. was estimated at 18% over the first three months of 2021.
- **U.S. Steel** set a goal to achieve net-zero carbon emissions by 2050, building on its existing goal to cut greenhouse gas emissions' intensity by 20% across the company's global footprint by 2030. The emissions goal is the most aggressive by an American steelmaker and includes Scope 1 (direct emissions) and Scope 2 (direct emissions and those from the power consumed) but not the emissions from its supply chain. The company intends to leverage its growing fleet of electric arc furnaces coupled with other technologies such as direct reduced iron, carbon-free energy sources and carbon capture, sequestration and utilization.
Key Update: Electric arc furnace production is considered the simplest way to decarbonize, but this type of output only accounts for about 25% of U.S. Steel's production, with integrated mills accounting for the rest.
- **U.S. Steel** cancelled a \$1 billion capital investment project slated for its Mon Valley Works. USS said the decision was based on the company's expanded focus on sustainability. The steelmaker also announced plans to permanently idle three coke batteries at its Clairton plant—representing 17% of coke production—by early 2023. USS issued its 1stQtr results a day before the Mon Valley Works announcement. The company reported net earnings of \$91 million, compared with a net loss of \$391 million a year ago.
- **The quick recovery in stainless steel demand** is leaving manufacturers in the automotive, white goods and agricultural segments short of material and parts to maintain their production schedules. Scrap and iron ore continue to point upwards in terms of demand and price trends. After the Chinese holidays, nickel prices are rising again. EU lead times for steel and stainless steel continue to lengthen and now appear to have reached January 2022, affecting small and medium-sized stainless steel consumers from the downstream industry and distributors.





- **Allegheny Technologies Inc.** reported a \$7.9 million loss in the 1stQtr but anticipates improved demand for its jet engine products. The USW struck ATI’s Specialty Rolled Products locations March 30, a day before the end of the quarter. The strike is continuing after the union rejected ATI’s latest four-year contract proposal at the end of April.
- **Ford and BMW** are leading a \$130 million funding round in a solid-state battery startup, Solid Power, as carmakers push to lower the cost of electric vehicles by investing in the development of affordable but powerful rechargeable batteries. Ford is pushing to electrify key models in its lineup, including the Transit van, F-150 pickup and already sells the all-electric Mustang Mach-E SUV. By the end of 2021, BMW aims to have five fully electric models available across the BMW and MINI brands.
Key Update: Solid-state battery technology involves a high-capacity energy storage device that improves on lithium-ion batteries, replacing the liquid or gel-form electrolyte with a solid, conductive material. The new technology offers more energy density and better safety due to a lack of flammable components. Solid Power has said its technology can deliver 50% more energy density than current lithium-ion batteries.
- **Ford Motors** expects the chip shortage to cut \$2.5 billion from adjusted pretax profit this year. Lack of semiconductors will force it to cut 2ndQtr production in half, but it expects the situation to improve after June. The full recovery of the semiconductor supply chain for auto makers could stretch into 2022. Meanwhile, Intel is investing \$3.5 billion in its manufacturing facility in New Mexico to boost advanced chip packaging technologies.
- **U.S. auto sales** for April were expected to be the highest ever recorded for the month, helped by strong consumer demand and tighter dealer inventories. April new vehicles sales are forecast to reach 1.5 million units, up 110% compared to a year ago. Average transaction prices are expected to rise 6.8% to \$37,572 and average incentive spending per unit to fall by 36% to \$3,191 vs. last year.
- **Caterpillar** logged a 1stQtr profit of \$1.53 billion, up 40% from the year-ago period. Revenue increased 12% to \$11.89 billion. Construction sales climbed 27%. Resource-industries sales grew by 6%, boosted by greater demand from the mining industry. Improved demand from the power-generation and oil-and-gas industries helped energy-and-transportation sales grow by 4 percent.
- **Toyota** will invest \$803 million in its Princeton, IN, plant and hire 1400 new employees to build two new SUVs there. The new SUVs will be “electrified”, but Toyota didn’t specify if they would be battery-operated or hybrid models.

- **Tesla** posted a record quarterly profit despite supply disruptions, fueled by rising deliveries and increasingly broad-based demand for EVs. Tesla’s revenue in the 1stQtr jumped 74% vs. a year earlier to \$10.4 billion. Tesla generated a \$438 million net profit, up from \$16 million a year ago, and delivered 184,877 vehicles, more than double the 1stQtr 2020.



- *Key Update: Tesla didn't earn its record profit from selling cars. It sold some of the \$1.5 billion worth of bitcoin that it purchased in February, contributing \$101 million or nearly 25% of its total profit. Sales of regulatory credits to other auto makers to help them meet emissions mandates reached \$518 million, accounting for nearly 100% of Tesla's \$533 million in pretax income. Both actions helped avert red ink.*
- **Rio Tinto** has started production of battery-grade lithium from waste rock at the Boron mine site in California. The lithium is being produced from a lithium demonstration plant at the mine which is equipped to recover the critical mineral from the 90-year-old waste piles at the Boron borate operation. Following an initial small-scale trial in 2019, Rio Tinto validated the process of roasting and leaching waste rock to recover high grades of lithium. The plant will run throughout this year to optimise the process. Production capacity is planned to be ramped up to 5,000 tons/year, enough to develop batteries for nearly 70,000 electric vehicles. (See [Appendix: Automotive](#), page 11)
- **NASA's Mars Ingenuity helicopter** made history and became the first powered craft to fly on the planet. Overcoming extreme cold, dangerously thin air and flawed flight software, the autonomous copter spun its twin carbon-fiber rotor blades to rise 10 feet into the thin Martian air. It hovered briefly in the breeze before safely landing back on the ground. Ingenuity combines high-speed rotors and featherweight carbon-fiber materials with inexpensive electronics hardware used in smartphones—off the shelf but 150 times more powerful than the computer microprocessors NASA has used previously in space.
- **Boeing** reported a 1stQtr operating loss of \$353 million, its sixth-straight quarterly loss, compared with a \$1.7 billion loss a year earlier. Increased 737 MAX jet deliveries reflected a cautious rebound in air travel. Boeing completed a hot-fire engine test on NASA's SLS rocket in the quarter and still expects to deliver the first 777X mini-jumbo in late 2023, despite certification and design challenges.



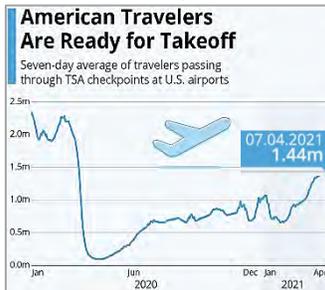
- **SpaceX** was awarded a contract to build a capsule to land astronauts on the moon, the latest in a string of lunar-related wins for Elon Musk's company. SpaceX beat out two rivals for the moon taxi that will carry astronauts to and from the moon's surface from an orbiting capsule as early as 2024. The NASA contract is part of a larger



Artemis program to explore and develop deep space. That program relies more heavily on the private sector and commercial funding than previous efforts. SpaceX already flies astronauts to and from the International Space Station and is developing a large new rocket called the Super Heavy to launch the Starship vehicle on which its lunar lander is based. (See **Appendix: Aerospace**, page 8)

- **SpaceX** launched its third crewed rocket for NASA, sending four astronauts into orbit and marking the first time the company achieved the takeoff with both a pre-used capsule and rocket. It was the first time that two of the company's Crew Dragon capsules will be simultaneously docked at the ISS. Later, a SpaceX capsule with four astronauts returning from the ISS splashed down safely in the Gulf of Mexico, the first such nighttime return to Earth for NASA in decades. Another mission, dubbed Crew-3, is set to take place in the fall, sending another team of astronauts aloft.

- **United Airlines** reported a \$2.4 billion adjusted net loss for the 1stQtr, as fuel costs rose and the airline operated fewer flights amid continued weak demand due to the pandemic. Average fuel cost climbed nearly 30% in the quarter; passenger traffic fell 52% compared to the same period in 2020. The airline forecasts a return to profitability later this year and expects to restore some capacity cuts as more people are willing to travel.



- **The maritime industry**, is coming to a consensus that liquefied natural gas will provide an intermediate solution toward finding cleaner fuel to power ships. Two of the world's biggest container lines ordered vessels that operate with LNG, while Royal Dutch Shell and Australian miner BHP have been offering long-term charters to shipowners willing to build natural gas-fueled tankers and bulk carriers. The focus on new fuel sources marks the biggest change in ship power since the switch from coal to oil.

- **Exxon Mobil** scored its first profit in five quarters in the first quarter of 2021. Net income was \$2.73 billion vs. a loss of \$610 million a year earlier. Earnings for Exxon and rivals have been rising with crude oil prices, which are up by a third this year, as a global oil surplus from the pandemic drains and fuel demand recovers. Exxon floated a public-private initiative that would collect and sequester CO² emissions from petrochemical plants along the Houston Ship Channel. Exxon said it would cost at least \$100 billion to finance a project that could store 50 million tonnes of CO² by 2030 and double that amount by 2040.

A group of U.S. electricity companies offered to work with the Administration and Congress to design a broad set of policies to reach a near-term goal of slashing the sector's carbon emissions by 2030. The group of 13 power interests, including Exelon, PSEG and Talen Energy Corp, said that Washington should implement policies, including a clean energy standard (CES), to ensure the industry cuts carbon emissions 80% below 2005 levels by 2030. In November, Talen Energy said it will eliminate the use of coal at all of its facilities as a direct reflection of its "No Harm" culture. Talen is developing renewable energy and battery storage projects at strategic locations across its facilities.

Key Update: *The 2030 goal of the group of 13 is consistent with Evergreen Action, an advocacy group that proposed a CES in February, saying utilities should worry less about the 2035 goal and focus on early wins because the last portion of emissions cuts is the hardest to achieve.*

- **Pfizer** expects its COVID-19 vaccine to generate \$26 billion in sales this year, reflecting the shot's growing role in the global vaccination campaign. The two-dose shot contributed \$3.5 billion to the company's \$14.6 billion overall 1stQtr sales. Pfizer has begun studying an updated version of the vaccine for the dangerous variant first identified in South Africa and is working on making the two-dose shot easier for vaccinators to administer and store.

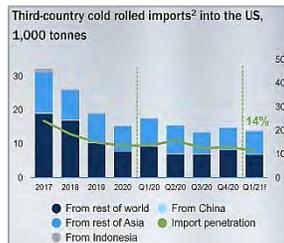
- **Medtronic** said the U.S. FDA granted breakthrough-device designation to its Emprint ablation catheter kit. The medical-technology company said the device, if approved, would be used in conjunction with its Emprint microwave generator and its lung-navigation platform to provide a minimally invasive, localized treatment of malignant lesions in the lung. (See **Appendix: Medical**, page 12)



EUROPE, AFRICA & THE MIDDLE EAST

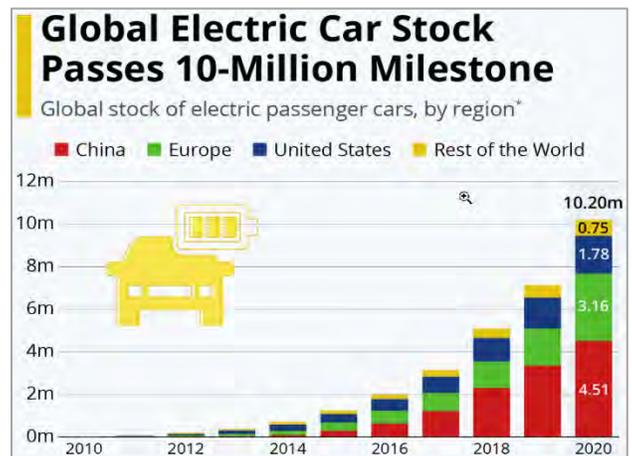
- **The eurozone economy** contracted by 0.6% in the 1stQtr, reflecting restrained stimulus spending and a botched effort to secure vaccines that has left many major economies dealing with continued restrictions on daily life. German's economy diminished by a sharp 1.7%. Italy and Spain slipped by much smaller magnitudes — 0.4% in Italy and 0.5% in Spain. France grew by a modest 0.4%, but its prospects face a fresh challenge in the form of new pandemic restrictions imposed in April.
- **Outokumpu stainless steel deliveries** increased 16% in the first quarter, as EBITDA rose to €177 million and all business areas improved performance compared to the previous quarter. It was the strongest quarter in history for the Americas unit due to higher demand and positive raw material impacts. The Americas adjusted EBITDA was €54 million compared to €20 million a year ago.

Key Update: *Outokumpu expects stainless steel deliveries in the 2ndQtr to increase by 0–5% vs. the 1stQtr. European ferrochrome benchmark price was increased to US\$1.56/lb. (See Appendix: Steel, page 13)*
- **ArcelorMittal** posted 1stQtr net income of US\$2.285 billion vs. a net loss of \$1.120 billion a year ago. It was the company's best quarter in a decade. Sales were \$16.193 billion, up 9% on the year-ago quarter. Divestitures resulted in lower steel shipments of 16.5 million tonnes, 15% lower than a year ago. ArcelorMittal reiterated its forecast for steel demand growth of 4.5% to 5.5% this year.
- **The European Union** aims to cut its dependency on Chinese and other foreign suppliers in six strategic areas including raw materials, pharmaceutical ingredients and semiconductors, under a new industrial action plan. Europe relies on China for about half of 137 products used in sensitive ecosystems, key to the bloc's green and digital goals. The EC will conduct an in-depth review of the six areas, which also include batteries, hydrogen and cloud and edge technologies and decide on appropriate measures.
- **Saudi Aramco** reported a 30% increase in 1stQtr profits YOY, earning \$21.7 billion after a rocky year in which the market was flooded with crude oil just as COVID-19 dried up demand. The state oil company's good fortune, part of an industry-wide recovery, is the result of recovering demand and a decision by OPEC to limit supply.



- **Airbus** launched the biggest shake-up of its manufacturing network in a decade, combining aerospace assembly in France. Its Premium Aerotec unit will be split: part combined with manufacturing plants in Stade, some elements with the Hamburg factory, with the rest folded into a new business specializing in small, mass-produced "detail" parts. Airbus reported income of €362 million vs. a loss of €481 million a year earlier. Sales dipped slightly to €10.5 billion. Airbus is planning to ramp up production in anticipation of greater demand for its planes.
- **Auto makers in Europe**, eager to boost sales of their electric vehicles, have a new strategy: Demanding higher taxes on conventional vehicles that burn gas and diesel fuel. Top automotive executives are calling on European governments to introduce the new taxes on CO² emissions from gasoline and diesel-powered cars and trucks to help their EVs better compete. They say the levies should take the form of highway tolls or higher fuel taxes. "We need to tax carbon at the pump," Markus Duesmann, Audi CEO, said. (See Appendix: Automotive, page 11)

Key Update: *Traditional auto makers face a dilemma. The bulk of their business is still selling cars with internal-combustion engines, including family cars, big SUVs and sports cars. Raising fuel taxes could hurt sales of those vehicles, but unless EVs can compete on price with conventional cars, it will be hard for auto makers to lure customers to them and recoup the vast investments manufacturers have made in the technology.*



- **Stellantis**, the combination of Fiat Chrysler and Peugeot-maker PSA Group, slashed planned production by 11% or 190,000 vehicles in the 1stQtr due to the global chip shortage and warned of additional cuts in the weeks ahead as the crisis lingers. The chip problem will force it to cut 2ndQtr production even more, but the company expects the situation to improve after June.

ASIA/PACIFIC, JAPAN, AUSTRALIA & INDIA

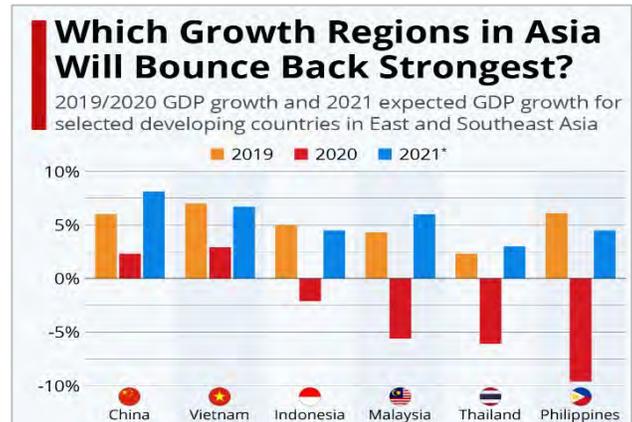
- China's economy** grew a record 18.3% in the 1stQtr from last year's pandemic low, but stripping out the statistical distortion from last year's low base of comparison, economists estimate that underlying YOY GDP growth was about 5.4%, lower than the pre-coronavirus trend of roughly 6% growth. China's factory activity in April expanded at the fastest pace in four months on stronger demand, but concerns over surging raw materials and input costs clouded the outlook. Both output and new orders increased at the fastest pace this year, while overseas demand improved. Manufacturers also increased their staffing levels for the first time in five months.


- China's Wenchang space port** will build a US\$3 billion supercomputing center by year-end to analyze data obtained from space. The center will provide big data services for industries, including the aerospace and marine sectors. In the next decade, China envisions massive constellations of commercial satellites that can offer services ranging from high-speed internet for aircraft to tracking coal shipments. To meet the demand for satellite launches, China will have to build bigger rockets that can carry more satellites or build more launch sites, or both.
- Japan's manufacturing sector** registered the strongest improvement in operating conditions in three years in April. Firms reported fast expansions in production and incoming business, as demand and confidence continued to recover from multiple waves of COVID-19 infections.

Key Update: IHS Markit forecasts Japanese industrial production will grow 7.7% in 2021, although this would not fully recover the output lost to the pandemic in 2020.
- Global crude steel production** was 169 million tonnes (MT) in March, a 15.2% increase compared to a year ago. China produced 94 MT of crude steel, an increase of 19.1% vs. March 2020. The United States cast 7.1 MT of crude steel, a 1.0% gain vs. the year prior. India's production was 10 MT, up 23.9%. Japan produced 8.3 MT, up 8.3%. South Korea made 5.5 MT, up 1.2%. (See [Appendix: Steel](#), page 14)
- Hyundai Motors** posted 1stQtr profit that nearly tripled to its highest in four years but warned it would have to adjust production again in May because of a chip shortage. Unlike its rivals, the company staved off production halts in the 1stQtr due to a healthy chip inventory, but the shortage, exacerbated by a fire at a chip factory in Japan and storms in Texas, is now catching up with Hyundai.

- China's auto sales** recovered to pre-pandemic levels in the 1stQtr and electric vehicle sales surged, with 437,000 units sold—a nearly 8% market share. Passenger vehicle sales increased 69% YOY to 5.09 million, putting sales back where they were two years ago, still down significantly compared with 2018's record 1stQtr, when 5.67 million cars were sold.

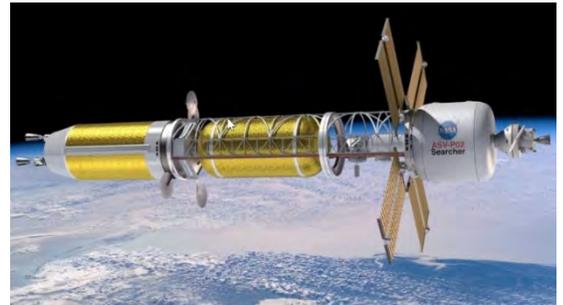
Key Update: The global shortage of semiconductors is hitting auto production in China. VW, China's biggest foreign automaker which hopes to sell over four million vehicles in the country, said the situation had not improved in the 2ndQtr. Over 25 million vehicles were sold last year in China.
- Taiwan chipmaker United Microelectronics Corp** will spend US\$3.59 billion over the next three years to expand capacity and will guarantee supplies and prices to its clients as part of the plan, amid the global chip shortage.
- A new survey by Ipsos** paints a bleak picture of the return to normal after the COVID-19 pandemic. Fewer than 25% of respondents across 30 countries believed that a return to normal was possible within six months. An average of 34% across all countries believed that pandemic restrictions would still be in place for longer than 12 months. China was one of the most optimistic countries in the survey but only 17% said that life was already back to normal even for them. In the U.S., 31% thought that the pandemic would only last 6 more months or that life had already normalized.



- Iron ore prices** continued their climb in April to 10-year highs despite China's environmental restrictions, with benchmark ore fines imported into Northern China trading for \$178.43/mt and Brazilian fines a record \$211.10/mt. Steel margins in China are very attractive at the moment, so even with the restrictions in the Tangshan region, other producers have every incentive to try to increase operating rates. (See [Appendix: Commodities](#), page 15)
- Copper prices** posted a record high in early May, rising to \$10,361 a tonne. Infrastructure plans and the green-energy push provide a bullish backdrop for all industrial metals.

ECONOMIC UPDATE: APPENDIX TO THE MAY 2021 ISSUE**AEROSPACE: CONTRACT AWARDED TO DEVELOP NUCLEAR REACTOR TO POWER MISSIONS TO THE MOON**

The Defense Advanced Research Projects Agency (DARPA) awarded a \$22 million contract to General Atomics to design a small nuclear reactor for space propulsion. General Atomics, based in San Diego, was selected for the first phase of a program known as a DRACO, short for demonstration rocket for agile cislunar (the volume of space between the Earth and the moon) operations. **The project is to demonstrate nuclear thermal propulsion — the use of a nuclear reactor to heat up rocket fuel to generate thrust.** In May, DARPA’s Tactical Technology Office solicited proposals in a broad agency announcement. The stated goal was to test a nuclear thermal propulsion system in orbit by 2025. Space propulsion systems in use today include electric and chemical propulsion, but other options might be needed for future exploration beyond Earth’s orbit. The DRACO program intends to develop novel nuclear thermal propulsion technology (NTP). Unlike propulsion technologies in use today,



NTP can achieve high thrust-to-weights similar to chemical propulsion but with two to five times the efficiency. The ability to monitor cislunar space will require a breakthrough in propulsion technology. The DRACO program will attempt to demonstrate a nuclear thermal propulsion system in orbit. A nuclear reactor will heat propellant to extreme temperatures before expelling the hot propellant through a nozzle to produce thrust. Christina Back, vice president of nuclear technologies and materials at General Atomics Electromagnetic Systems, said, “Nuclear thermal propulsion is a leap ahead of conventional propulsion technology and will enable spacecraft to travel immense distances quickly.” However, a study by the National Academies said that both nuclear thermal propulsion (NTP) and nuclear electric propulsion (NEP) approaches must overcome significant hurdles for their use in a notional 2039 human mission to Mars. NTP is a process where a nuclear reactor heats up a fuel such as liquid hydrogen to generate thrust but that technology faces several challenges beyond the nuclear reactor itself. They include being able to heat up the propellant to the required temperature of 2,700 kelvins and bringing the system up to operating temperature within one minute. Other challenges include a lack of ground-based testing facilities for NTP systems and difficulties storing liquid hydrogen for the duration of a mission. NEP, where a nuclear reactor generates power for electric thrusters, needs to scale up its power and thermal management systems to levels far beyond what’s been demonstrated to date in order to work with megawatt-class reactors. Of the two technologies, the report was more optimistic about NTP, concluding, “An aggressive program could develop an NTP system capable of executing the baseline mission in 2039.”

AEROSPACE: ASTROBOTIC SELECTS FALCON HEAVY TOLAUNCH NASA’S VIPER LUNAR ROVER

Astrobotic announced in April that it selected SpaceX’s Falcon Heavy for its Griffin Mission 1 lunar lander mission, which will deliver VIPER spacecraft to the south pole of the moon in late 2023. Astrobotic won a NASA competition last year to transport VIPER on its Griffin lunar

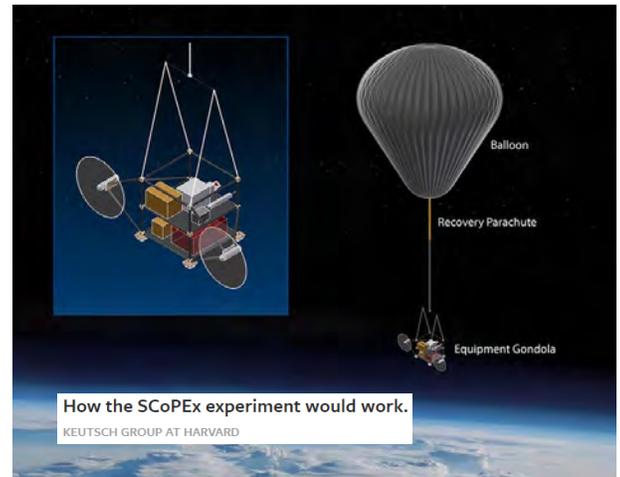


lander. “Getting to the moon isn’t just about building a spacecraft, but having a complete mission solution. SpaceX’s Falcon Heavy completes our Griffin Mission 1 solution by providing a proven launch vehicle to carry us on our trajectory to the moon,” Daniel Gillies, director of Griffin Mission 1 at Astrobotic, said. **VIPER is a NASA mission to investigate permanently shadowed regions of craters at the lunar south pole that may contain deposits of water ice that could serve as resources for future crewed missions. It is designed to operate for 100 days after landing.** VIPER is the biggest mission that is part of a NASA initiative to purchase payload accommodations on commercial lunar landers. Astrobotic won a \$199.5 million task order in June 2020 to deliver VIPER to the lunar surface on its Griffin lander.

Astrobotic will launch its first mission, a smaller lunar lander called Peregrine, on the inaugural launch of United Launch Alliance’s Vulcan Centaur currently scheduled for late this year. The Astrobotic contract adds to a growing backlog for the Falcon Heavy, which has not flown since the Space Test Program (STP) 2 mission in June 2019. The next Falcon Heavy launch is expected no earlier than July, carrying a classified payload for the U.S. Space Force. Another Falcon Heavy launch for the Space Force is scheduled for late this year. SpaceX has won NASA contracts for Falcon Heavy, including the launch of the Psyche mission to the metallic asteroid of the same name in 2022 and in February, the first two elements of the lunar Gateway in 2024. Falcon Heavy is also the front-runner for the ongoing competition to launch the Europa Clipper mission after NASA concluded that mission could not launch on the Space Launch System as originally planned.

SOLAR GEOENGINEERING: BILL GATES WILL HAVE TO WAIT A WHILE TO BLOCK THE SUN

Just as quickly as it was announced, a controversial solar geoengineering experiment backed by Bill Gates has been postponed until at least 2022. **Gates and other private donors are supporting Harvard University's Solar Geoengineering Research Program, which had planned to launch a new study based in Sweden in June researching the efficacy of blocking sunlight from reaching Earth's surface.** The Stratospheric Controlled Perturbation Experiment (SCoPEX) aimed to see how a tiny amount of aerosol in a trial would influence the immediate surroundings. Now, Harvard is delaying the study to examine the impact on Sweden itself, as well as the indigenous Sami people who live in the region. **Geoengineering is the term for technologies that try to alter Earth's physical qualities on the largest scale possible.** One example is cloud seeding, where airplanes flush clouds with particulate matter in order to coalesce into rain. Carbon capture, where emissions are taken and sequestered beneath Earth's surface, is another major form of geoengineering. Scientists have devised multiple ways to block sunlight from reaching Earth's atmosphere or surface. These are gathered under the umbrella term "solar geoengineering". The most common and studied method is to reflect sunlight away from Earth using aerosol particles in the atmosphere but until now, this has been seen as more of a fringe idea. SCoPEX planned a small pilot experiment, with the rationale that we need to scrutinize and consider the idea of solar geoengineering today so we don't end up relying on a totally untested technology in the future. The SCoPEX experiment sought to release just a small amount of aerosol material into the sky in a specific location, but now Harvard says even this must be considered in more detail and with ethical implications in mind. **The Harvard scientists had planned to launch a high-altitude balloon from Esrange Space Station in Kiruna, Sweden, to test whether it could in the future carry equipment to release solar radiation-reflecting particles into the Earth's atmosphere.** However, a Harvard advisory committee that was set up to study the project's ethical implications recommended pushing back the test "until a more thorough societal engagement process can be conducted to address issues related to solar geoengineering research in Sweden". This will likely postpone the platform launch until 2022, the committee said. The same factors that make solar geoengineering a radical idea make it almost impossible to test, even on the small scale. Hopefully, the different groups involved can come to an understanding and develop a pilot experiment that more people feel is ethically sound. With everyone from investors to indigenous groups involved in the process, SCoPEX will never get off the ground without a lot of diplomacy.



ENERGY: FRENCH RAIL COMPANY ORDERS 12 HYDROGEN-POWERED TRAINS

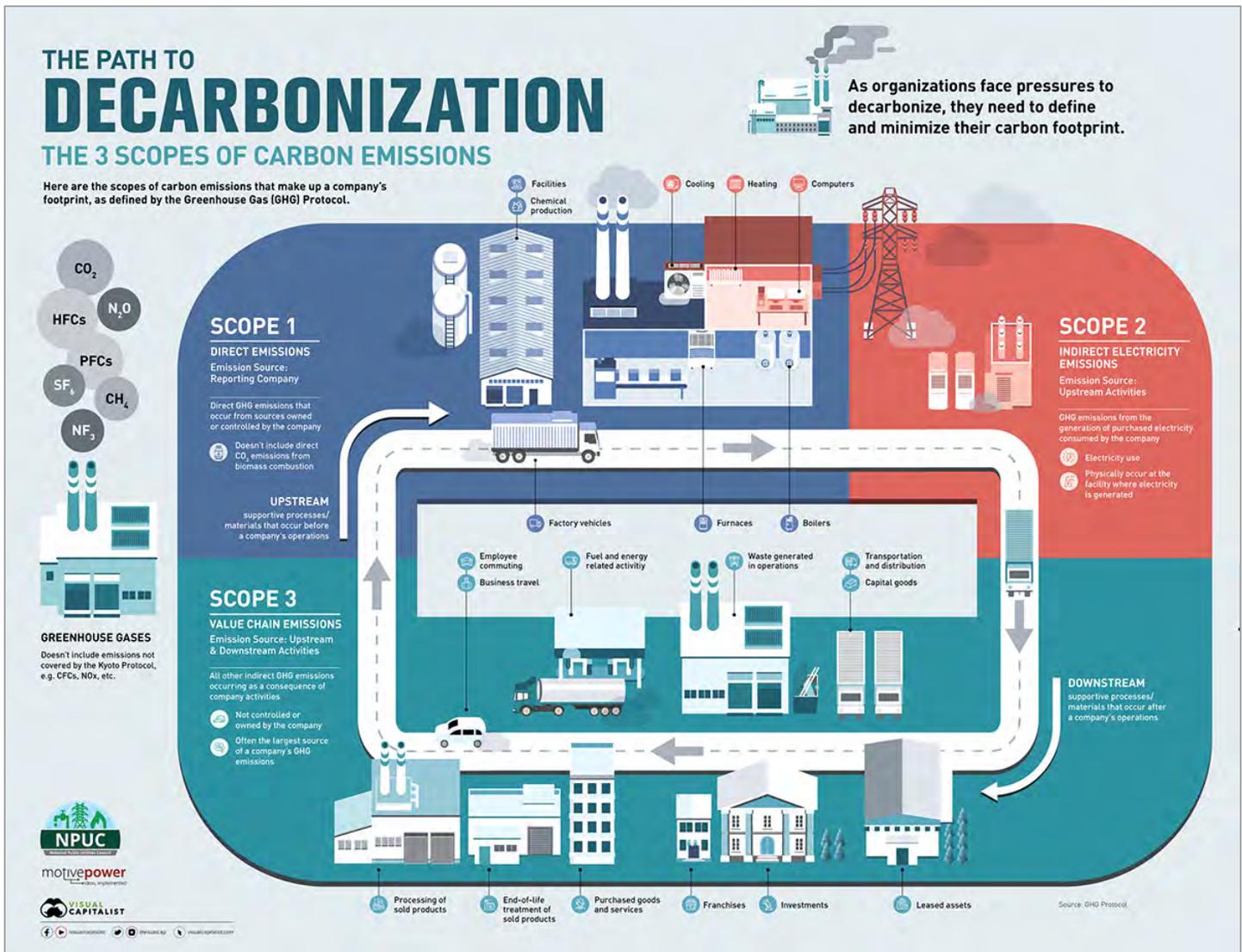
French national railway SNCF has ordered 12 hydrogen-powered trains to begin tests in four regions in 2023 as it eyes a zero-emissions future with the nascent technology. The trains will be built by the French industrial group Alstom and operate on either hydrogen or



electricity when overhead catenary wires are available. They are designed to run up to 600 kilometres (375 miles) on each hydrogen charge and should begin service in 2025. The contract is worth \$225 million for the first 12 trains, which will seat 218 passengers and be divided evenly among the four regions in eastern and southern France. Alstom first tested prototypes in Germany three years ago and has now begun a commercial phase with 41 orders for the 72-meter-long trains. **They are designed to combine onboard hydrogen with outside oxygen via a fuel cell mounted in the roof that powers the motors.** A fuel cell is an electrochemical conversion device. It produces electricity from fuel (on the anode side) and an oxidant (on the cathode side), which react in the presence of an electrolyte. The reactants flow into the cell, and the reaction products flow out of it, while the electrolyte remains within it. Fuel cells can operate virtually continuously as long as the necessary flows are maintained. "This is another step towards zero emissions in public rail transport," Christophe Fanichet, head of SNCF's Voyageurs unit, said. SNCF currently operates 1,100 regional express trains that use diesel fuel, which it plans to phase out by 2035. It is also testing alternative technologies based on batteries and a "green" fuel made from colza or rapeseed. Hydrogen is considered a leader in the race to develop sustainable energy sources and slash carbon emissions, but it is expensive to produce and the electricity needed generates a lot of carbon dioxide emissions or other pollutants.



ENERGY: DECARBONIZATION 101: WHAT CARBON EMISSIONS ARE PART OF YOUR FOOTPRINT?



What Carbon Emissions Are Part Of Your Footprint? With many countries and companies formalizing commitments to meeting the Paris Agreement carbon emissions reduction goals, the pressure is on to decarbonize. A common commitment from organizations is a “net-zero” pledge to both reduce and balance carbon emissions with carbon offsets. As organizations face mounting pressure from governments and consumers to decarbonize, they need to define the carbon emissions that make up their carbon footprints in order to measure and minimize them. **This infographic highlights the three scopes of carbon emissions that make up a company’s carbon footprint.** The most commonly used breakdown of a company’s carbon emissions are the three scopes defined by the Greenhouse Gas Protocol, a partnership between the World Resources Institute and Business Council for Sustainable Development. The GHG Protocol separates carbon emissions into three buckets: emissions caused directly by the company, emissions caused by the company’s consumption of electricity and emissions caused by activities in a company’s value chain. **Scope 1 Direct Emissions:** These emissions are direct GHG emissions that occur from sources owned or controlled by the company and are generally the easiest to track and change. **Scope 2 Indirect Electricity Emissions:** These emissions are indirect GHG emissions from the generation of purchased electricity consumed by the company, which requires tracking both the company’s energy consumption and the relevant electrical output type and emissions from the supplying utility. **Scope 3 Value Chain Emissions:** These emissions include all other indirect GHG emissions occurring as a consequence of a company’s activities both upstream and downstream. GHG emissions aren’t controlled or owned by the company, and many reporting bodies consider them optional to track, but they are often the largest source of a company’s carbon footprint.



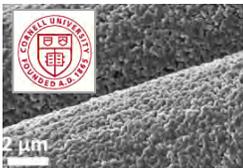
AUTOMOTIVE: GM IS TESTING NEW TECHNOLOGY FOR ALUMINUM-BASED EV BATTERIES

General Motors is testing a variety of new technologies to cut the cost of electric vehicles, including increasing the use of aluminum and aluminum alloys. In April, GM President Mark Reuss said the auto maker continues to explore various technology solutions for its upcoming Ultium batteries, which it expects to introduce in about four years. The new batteries are the result of a \$2.3 billion joint venture with LG Energy Solution of the Republic of Korea. **The batteries are expected to have a cell cost of at least \$50/kW below current prevailing market prices, have an operational life of at least one million miles and last up to 600 miles between charges.** Among the directions GM is taking with its research include silicon-rich and lithium metal anodes, dry processing electrodes and solid state and high voltage electrodes. Current plans have the battery utilizing graphite-based anodes, nickel-cobalt-manganese-aluminum (NCMA) cathodes and a liquid electrolyte. GM says it will use the battery in several models including the Hummer EV and the Cadillac Lyriq (pictured). In order to meet the expected demand of 1 million electric vehicles per year by 2025, GM and LG are expected to announce soon plans for a second EV battery plant in Tennessee. Reuss said that his company continues to be open to new technologies and partnerships with different firms on EV batteries. He predicted a sharp rise in demand for various metals necessary for the production of such batteries, but **GM continues to look for breakthroughs that would lessen its dependency on metals like cobalt and nickel.**



AUTOMOTIVE: ALUMINUM ANODE BATTERY CAPABLE OF 10,000 ERROR-FREE CHARGING CYCLES

Cornell University researchers have developed a new method for incorporating aluminum in zinc-anode batteries that will produce rechargeable batteries that can be used for up to 10 thousand error-free cycles. An engineering team designed a web of interwoven carbon fibers that bonds more strongly with aluminum than ever before. One researcher elaborated upon the importance of this breakthrough, **“A very interesting feature of this battery is that only two elements are used for the anode and the cathode, aluminum and carbon, which are inexpensive and environmentally friendly.** They also have a very long cycle life. When calculating the cost of energy storage, we need to amortize it over the overall energy throughput, meaning that the battery is rechargeable, so we can use it many, many times. If we have a longer service life, this cost will be further reduced. Basically, we use a chemical driving force to promote a uniform deposition of aluminum into the pores of the architecture.” (Pictured: This magnified image shows aluminum deposited on carbon fibers in a battery electrode.) The chemical bond makes the electrode thicker and its kinetics faster, resulting in a rechargeable battery that is safer, less expensive and more sustainable than lithium-ion batteries. When utilizing this new method, researchers determined that the aluminum-anode batteries could be charged and discharged at least one order of magnitude more times than other aluminum anode batteries. Although superficially different from earlier innovations for stabilizing zinc and lithium metal electrodes in batteries, the principle is the same: to design substrates that provide a large thermodynamic driving force that promotes nucleation, while preventing runaway, unsafe growth of the metal electrode by forces such as surface tension which can be massive at small scales. Among the financial backers of this research is the U.S. Department of Energy Basic Energy Sciences Program.



AUTOMOTIVE: TOP NATIONS FOR MINING RAW MATERIALS IN THE EV LITHIUM BATTERY SUPPLY CHAIN



TOP 25 NATIONS FOR MINING IN THE EV BATTERY SUPPLY CHAIN

Here are the top 25 countries for raw materials in the lithium-ion battery supply chain in 2020 and 2025p based on BloombergNEF's rankings. Countries are ranked according to resource availability, mining capacity, and refining capacity.

Five critical minerals required for lithium-ion batteries:

- Lithium
- Cobalt
- Manganese
- Graphite
- Nickel



The Role of Mining in the EV Battery Supply Chain

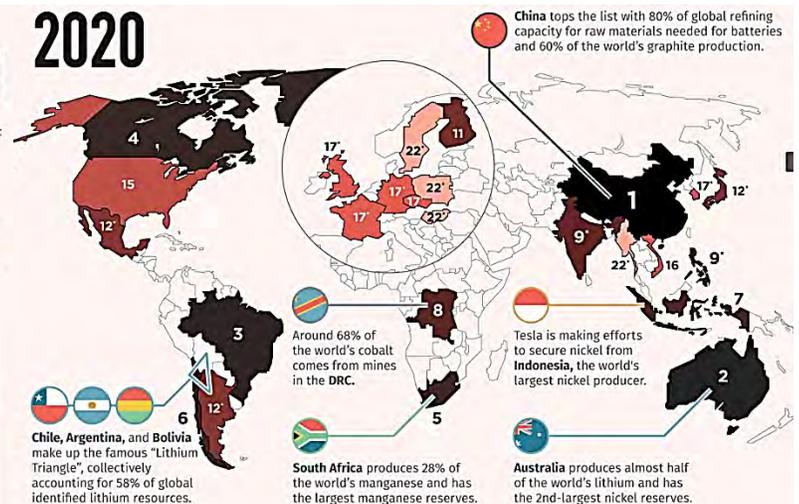
Batteries are one of the most important and expensive components of electric vehicles (EVs). The vast majority of EVs use lithium-ion (Li-ion) batteries, which harness the properties of minerals and elements to power the vehicles. But batteries do not grow on trees—the raw materials for them, known as “battery metals”, have to be mined and refined.

Battery Metals: The Critical Raw Materials for EV Batteries

The raw materials that batteries use can differ depending on their chemical compositions. However, there are five battery minerals that are considered critical for Li-ion batteries:

- Cobalt
- Graphite
- Lithium
- Manganese
- Nickel

2020



MEDICAL: 'SWEAT STICKER' DIAGNOSES CYSTIC FIBROSIS WITHIN MINUTES

A Northwestern University-led research team has developed a novel skin-mounted sticker that absorbs sweat and then changes color to provide an accurate, easy-to-read diagnosis of cystic fibrosis within minutes. While measuring chloride levels in sweat to diagnose cystic fibrosis is standard, the soft, flexible, skin-like “sweat sticker” offers a stark contrast to current diagnostic technologies, which require a rigid, bulky, wrist-strapped device to collect sweat. After developing the sweat sticker at Northwestern, the researchers validated it in clinical pilot studies involving cystic fibrosis patients and healthy volunteers. The sticker showed enhanced performance in collected sweat volume and equivalent accuracy to traditional platforms. **The most-common life-shortening genetic disease, cystic fibrosis affects one in every 3,300 births in the U.S. and 70,000 people worldwide. Promising outcomes wholly depend upon early diagnosis.**



Because the disease attacks the digestive system, patients can become severely malnourished if they do not receive treatment soon after birth. By softly adhering to the body, the millimeter-thick sticker makes direct but gentle contact with the skin without harsh adhesives. Not only does this make the sticker more comfortable and imperceptible to the wearer, this intimate coupling also enables the sticker to collect 33% more sweat than current clinical methods. The high collection rate ensures that one test will consistently collect a large enough sample to provide an accurate result. The sticker also has built-in colorimetric sensors that detect,



measure and analyze chloride concentration in real time using a smartphone camera, bypassing the need for expensive laboratory equipment and excruciating wait times. This opens possibilities for testing outside of hospitals in the home setting, which could provide relief to parents in rural or low-resource areas without access to clinical centers with specialized diagnostic tools. All newborns are screened for cystic fibrosis within the first few days of life through a heel prick. If that screen is abnormal, then pediatricians order a sweat test to confirm the diagnosis. During the sweat test, the baby must wear the hard, wrist-strapped device for up to 30 minutes. Sometimes smaller babies have trouble producing enough sweat for the test or the loose, ill-fitting sweat-collection device is unable to collect a large enough sample.

In these instances, the baby must repeat the test at a later date, inducing anxiety and delaying treatment. Building sensing capabilities into the sticker offers potential for a speedier diagnosis. **Users can simply snap a photo of the sweat-filled sticker and wirelessly transmit it to a clinic for quick analysis, alleviating diagnostic delays and allowing patients to start treatment as soon as possible.** The device uses a network of microfluidic channels to collect sweat directly from the skin and route it to chambers to react with chemical reagents. Those reagents cause a change in color that correlates to the chloride concentration level. Collecting and analyzing sweat at the point of collection enables an earlier diagnosis, crucial for preventing severe complications and improving long-term patient outcomes. The sweat sticker may be used to routinely track cystic fibrosis patients' long-term health and gauge how they respond to treatment. If the sticker detects a change in chloride levels, for example, that could inform a physician's treatment plan. While running the clinical trials, doctors noticed how much older children loved the sweat stickers, especially compared to the traditional sweat tests. “Children love stickers,” a doctor said. “They smile and giggle. It's a much easier, comfortable and even fun device to wear.”

TECHNOLOGY HARDWARE: NEW SUPERCOMPUTER IN WYOMING TO RANK AMONG WORLD'S FASTEST

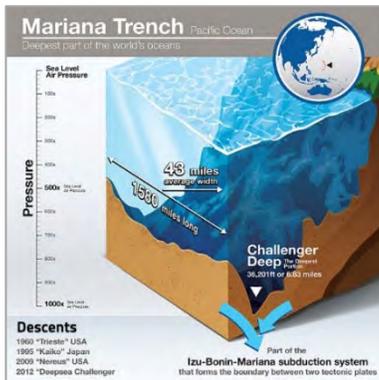
A new supercomputer in Wyoming will rank among the world's fastest and help study phenomena including climate change, severe weather, wildfires and solar flares. Hewlett Packard Enterprise won a bid to provide the \$40 million machine for a supercomputing center in Cheyenne, the National Center for Atmospheric Research in Boulder announced. The HPE-Cray EX supercomputer will theoretically be able to perform almost 20 quadrillion calculations per second—3.5 times faster than the existing machine at the NCAR-Wyoming Supercomputing Center. **The new machine's maximum speed per second will be roughly equivalent to each person on Earth completing a math equation every second for an entire month.** That power will enable some of the most sophisticated simulations yet of large-scale natural and human-influenced events. The supercomputer should rank among the world's 25 fastest after it's installed this year and goes into operation in early 2022, according to the National Center for Atmospheric Research. “It will support basic research in ways that will lead to more detailed and useful predictions of the world around us, thereby helping to make our society more resilient to increasingly costly disasters and contributing to improved human health and well-being,” center Director Everette Joseph said. More than 4,000 people from hundreds of universities and other institutions worldwide have used the supercomputing center since it opened in 2012. The facility's current supercomputer, named Cheyenne, is over three times faster than its predecessor, which was named Yellowstone. A contest among Wyoming school children will decide the new supercomputer's name.





STEEL: STAINLESS STEEL SCULPTURE DROPPED IN MARIANA TRENCH WILL STORE DNA FOR 10,000 YEARS

A Danish artist worked with a team of engineers to create a unique, free-standing steel sculpture that acts as a time capsule and withstands the pressure of deep-sea conditions. Kristian von Hornsleth's work, *the Star of Vejle*, is one of a pair of 10 cubic meter sculptures. One sits in the town of Vejle, Denmark, and the other stands 6.83 miles below sea level off the coast of Guam. **The deep-sea sculpture was designed to act as a DNA storage unit that will function for at least 10,000 years.** Hornsleth secured DNA contributions from more than 3,000 people worldwide that will be kept safely within the structure of the deep-sea sculpture. The corrosion-resistant stainless steel structure will contain a sealed chest of hair and blood samples and it will maintain its shining finish for millennia. The extreme longevity required of the project forced Hornsleth to consult with a team of engineers, as the artist was insistent that the DNA contents remain useable for potential cloning purposes in some distant future. "I want to monumentalize our fear of dying to give people hope. You'll know that there's a piece of you in the ocean that will be there after you're gone," he said. This combination of artistic and practical scientific considerations presented a unique set of challenges. The sculpture's electro polished stainless steel pipe structure makes it immune to corrosion for at least 10,000 years. Almost 7 miles down, the conditions at the bottom of the Mariana Trench are extreme. The water pressure is 1,000 times greater than at sea level, but life can still be found, with microbial life forms and even some species of fish discovered on the trench floor. This surprising abundance of life formed a key part of the discussions between Hornsleth's engineering



team and the University of Guam's Geology Department, as it was vital that the Deep Storage Project does not cause any damage to the natural environment of the Mariana Trench. The team eventually settled on a hermetically sealed, electro polished stainless steel pipe structure that would guarantee no rust or erosion in the oxygen void of the trench floor, leaving no impact on the local environment. **Electro polishing removes the outer layer of the stainless steel using an electrochemical solution that strips away any embedded contaminants, micro cracks or other surface imperfections that can impact longevity and performance.** This nano-engineered stainless steel outer surface means that the sculpture surface does not interact with or contaminate the natural environment and guarantees the integrity of the structure that protects its DNA cargo. The perfectly smooth finished will prevent any organic life from finding purchase and dulling its finish, allowing the sculpture and its contents to be easily discovered and returned to the surface

even after millennia in the depths. **The future may be uncertain, but one thing can be relied upon: the enduring power of stainless steel that made possible this unique monument to human ingenuity.**

STEEL: THE GLOBAL STEEL INDUSTRY ASSOCIATION DEFINES 'LOW-CARBON STEEL'

The steel industry's history reflects the societies in which it operates, and since the industrial revolution, iron and steel production has been powered by coal. This is now changing and the steel industry is transforming to provide products and services in a future in which the emission of carbon dioxide and other greenhouse gases is severely curtailed. The steel industry association *Worldsteel* is putting in place some definitions that will provide clarity on what is meant when these topics are discussed. The industry is working to develop and launch a new family of steel products produced with a much lower carbon burden than in the past. This low-carbon steel is manufactured using technologies and practices that result in the emission of significantly lower emissions than conventional production. **Worldsteel will use 'low-carbon steel' as the phrase 'low-carbon electricity' is used, asserting that it is intuitively easier to understand and its meaning is clear. Ultimately steel needs to contain some carbon, as this is what differentiates it from pure iron.** While this essential alloying carbon can be sourced from non-fossil sources, its presence makes 'zero-carbon' steel something of a misnomer. If a balance can be achieved between the greenhouse gases put into the atmosphere when producing steel and emissions taken out of the atmosphere by sinks, the resulting steel can be referred to as 'net-zero', or 'carbon-neutral steel'. The production of 'net-zero steel' may require offsets in other sectors to achieve true neutrality, and it is important that if claims of carbon neutrality are made, producers are transparent about boundaries, their accounting methodologies and the quality and credibility of any offsets used. Many promising breakthrough technologies will still use carbon as a chemical reducing agent but prevent harmful GHGs from being released into the atmosphere. The emissions from the steel industry will ultimately be decarbonized, the ironmaking process itself may not be.





METALS: ALUMINUM ASSOCIATION CALLS FOR CHANGES TO SECTION 232 TARIFFS, OTHER TRADE POLICY

The Aluminum Association (AA), representing companies that make 70% of the aluminum and aluminum products shipped in North America, released a new policy brief in April. The document highlights key priorities to ensure that U.S. aluminum can compete on a fair and level global playing field. The U.S. aluminum industry supports nearly 660,000 total jobs (166,000 direct) and nearly \$172 billion in total economic output (\$70 billion direct). **Aluminum is a key element of any comprehensive strategy to enhance the nation’s infrastructure, while conserving energy, improving environmental quality and mitigating climate change. Aluminum is a key component in making vehicles more efficient, medical devices lighter and packaging more recyclable.** The federal government has also recognized strong domestic aluminum supply chains as vital to national security, especially in an unexpected or extended conflict or national emergency. “Three years after the implementation of the Section 232 tariffs on most aluminum imports into the U.S., it is time to take a fresh look at trade policy to support a robust domestic aluminum industry,” said Tom Dobbins, president & CEO of the AA. He added that the Administration and the new Congress have an opportunity to harness the growth potential for aluminum as a sustainable solution for the 21st century and capitalize on the more than \$3 billion of private U.S. aluminum investment over the past decade. “The federal government can take action immediately to put American aluminum on an equal footing with overseas competitors.” Among other recommendations in the document, the AA urges the Administration to: **(1) Implement immediate and urgent reforms to Section 232 exclusion process:** The current Section 232 product exclusion process has inadvertently made the U.S. a magnet for imports and actively incentivizes companies to turn first to import aluminum products like sheet, plate and foil that are manufactured in abundance in the U.S. **(2) Carefully consider country-wide exemptions to the Section 232 aluminum tariffs for countries committed to market-based trade:** The U.S. Trade Representative should consider negotiating the removal of Section 232 aluminum tariffs with countries that trade fairly and have taken action to address unfairly subsidized imports that destabilize their domestic markets. **(3) Continue robust trade enforcement and maintain Section 301 tariffs on aluminum imports:** The government should fully enforce existing trade rules, including anti-dumping and countervailing duty (AD/CVD), maintain Section 301 tariffs on imports of aluminum from China and ramp up evasion and circumvention efforts until harmful structural subsidies that drive overcapacity are addressed.



Aluminum Flat Wires for N95/FFP2 Mask Production

STEEL: WORLD STEEL ASSOCIATION SHORT-RANGE OUTLOOK FOR STEEL DEMAND IN 2021 AND 2022

The World Steel Association’s Short-Range Outlook (SRO) for 2021 and 2022 forecasts that steel demand will grow by 5.8% in 2021 to reach 1,874.0 million tonnes (Mt) after declining by 0.2% in 2020. In 2022, steel demand will see further growth of 2.7% to reach 1,924.6 Mt. The current forecast assumes that the ongoing second or third waves of infections will stabilize in the 2ndQtr and steady progress on vaccinations will continue, allowing for a gradual return to normality in major steel-using countries. Commenting on the future, it expects structural changes in a post-pandemic world will bring about shifts in steel demand shape. The steel industry will see exciting opportunities from rapid developments through digitization and automation, infrastructure initiatives, reorganization of urban centers and energy transformation, while the industry is responding to the need to produce low-carbon steel. **Despite high infection levels, the U.S. economy was able to rebound strongly from the first wave of COVID due to the substantial fiscal stimulus that supported consumption.** This helped durable goods manufacturing, but overall U.S. steel demand fell by 18% in 2020. The Biden Administration recently announced a large fiscal proposal containing provisions for substantial infrastructure investment over a multi-year period. The plan is expected to be considered by Congress in the 2ndH of 2021 and, depending on its final form, may have upside potential for steel demand in the longer term. However, steel demand recovery will be constrained in the short term by a weak rebound in the non-residential construction and energy sectors. The automotive sector is expected to recover strongly. **Globally, the automotive sectors saw the most profound decline among the steel-using sectors, with a nosedive in the 2ndQtr of 2020. While post-lockdown recovery was somewhat more robust than expected, the decline in the automotive industry in 2020 was of a double-digit scale in most countries.** However, the automotive sector is expected to recover strongly in 2021. The recovery will be driven by pent-up demand, increased use of personal transportation due to safety concerns and increased household cash savings. The recovery is expected to be particularly strong in the U.S., where the production level in 2021 will exceed the 2019 level. **The global automotive industry is expected to return to the 2019 level in 2022.** Despite a faster than expected recovery in demand, the sector is encountering another supply chain bottleneck in early 2021 with a shortage of semiconductors and other parts, which could constrain the recovery potential.



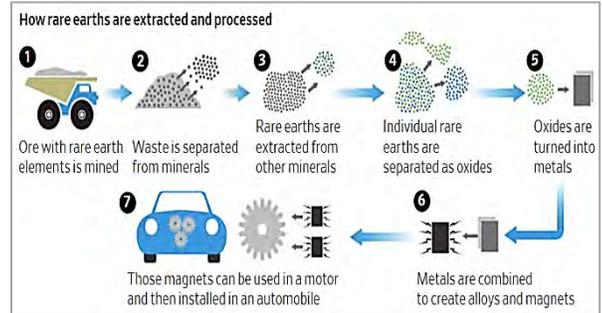
COMMODITIES: U.S. MOVES TO EASE CHINA'S MONOPOLY ON RARE EARTHS

Rare-earth metals are used to make just about everything, from smartphones and display panels to speakers and televisions. While China currently dominates the market for these commodities, the U.S. has taken an interest. These rare-earth elements haven't spent much time in the investor spotlight, but COVID has been a wake-up call for secure supply chains for strategic metals needed for our most advanced critical technologies.

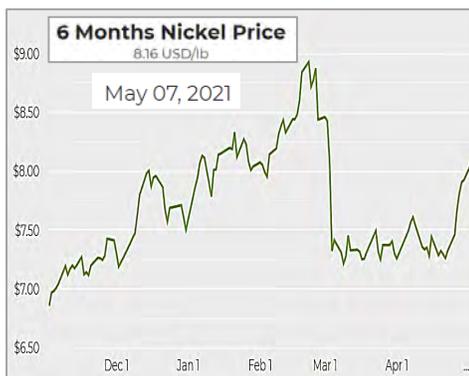
Rare earths refer to a group of 17 elements that have a variety of uses, including lanthanum used in oil refining, praseodymium for aircraft engines and neodymium used to create permanent magnets that have many applications. Among the most highly prized are the "magnet feed" rare earths, neodymium and praseodymium. Businesses and governments across the West are gearing up to counter China's dominance in that key component of modern technology, the magnet. But the dozens of companies jostling for

government support will struggle to establish a supply chain to rival China's rare-earth magnet industry, which has a decades-long head start and steadfast state support. China recognized rare earths as the strategic commodity over the next generation similar to oil.

Powerful magnets made of rare-earth minerals are essential components in electric-vehicle motors, wind turbines and other technology. China mines over 70% of the world's rare earths and is responsible for 90% of the complex process of turning them into magnets, analysts say. That dominance gives Beijing sway over makers of various fast-growing technologies. Demand for these powerful magnets is poised to see sharp growth in the next decade. Rare-earth magnet applications are forecast to account for roughly 40% of total rare earth demand by 2030, compared with an estimated 29% in 2020. China has about 70% of the world's known rare-earth reserves, the most in the world. Even rare earths that are mined in the U.S. must be sent to China for processing. China has announced that it will boost its mining quotas in the 1stQtr of this year by nearly 30%, which indicates strong and rising demand. With its tight grip on the world market for rare earths, it's no wonder that China in the past has taken advantage of its dominance, including by considering restricting exports in its trade disputes. The World Trade Organization found in 2014 that China had set limits and duties on rare earth exports that breached the group's rules. Analysts expect a huge jump in prices coming as China uses rare earths as a weapon. In November, the DOD announced agreements with several rare earth producers in a move to strengthen the market's domestic-supply chain. The U.S. government is investing tens of millions of dollars in efforts to mine and process rare earths. President Biden in February signed an executive order directing a review of supply chains for critical materials, including rare earths. His recent infrastructure plan also pledged investment in rare-earth separation projects. Officials in Europe, Canada, Japan and Australia are getting their checkbooks out as well.



METAL/COMMODITIES: SIX MONTH PRICE INDEX TRENDS TO MAY 2021



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