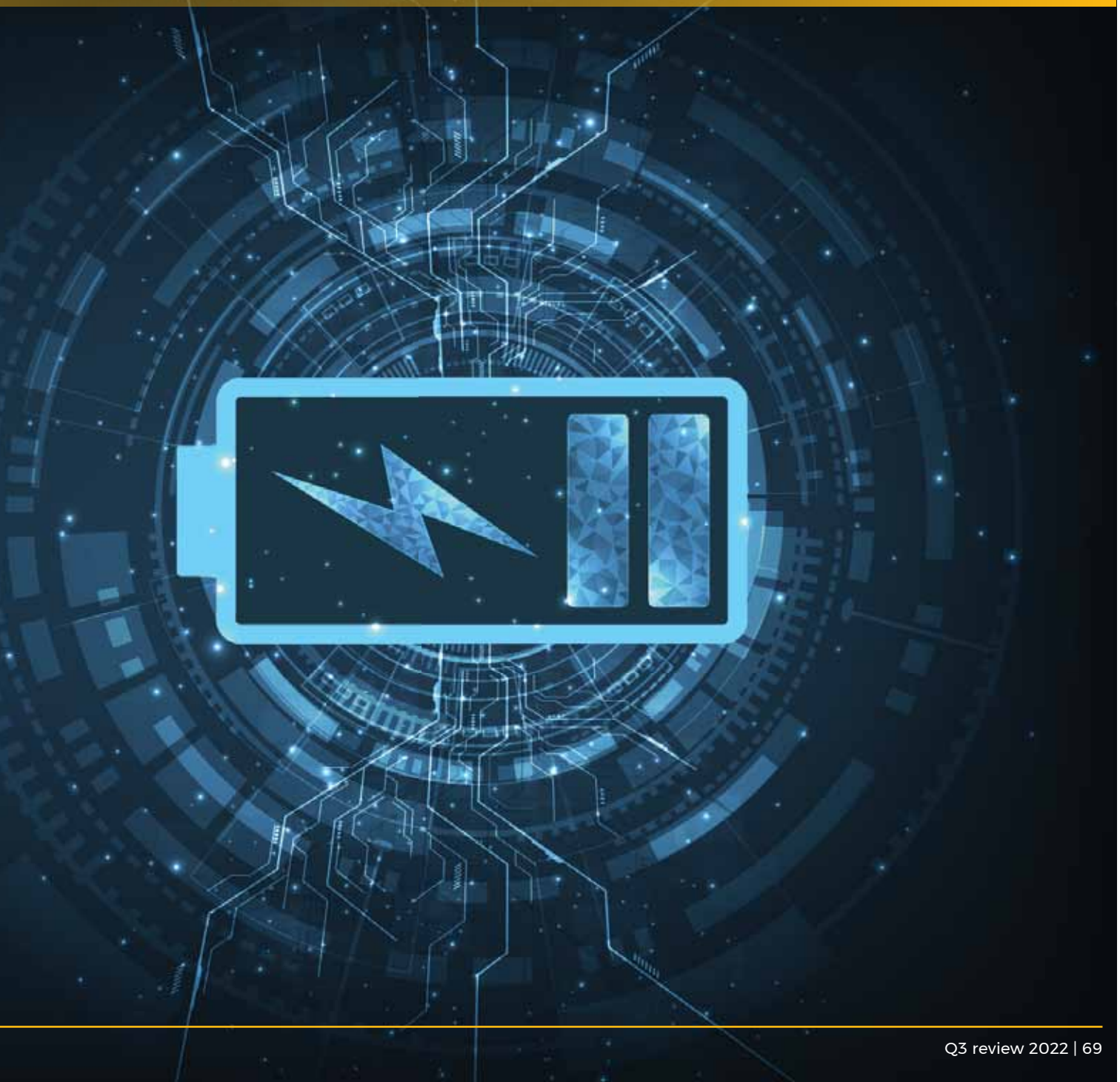
What chance does anode production have outside of China?

China holds dominance over much of the anode supply chain but developments outside of China are set to be vital to battery supply chain localisation in europe and north America. Rachit Vats explores the story of anode production outside of China.



In early September Norwegian graphite maker Vianode said it would set up a full battery value chain in the country for the European market, a move though a drop in the battery anode ocean where China has a stronghold but is nevertheless a crucial step that comes at a time as the global race for securing electric vehicle raw material locally gathers pace.

Vianode, which is owned by Elkem, Hydro and Altor Equity Partners, said it would invest $193.5 million in a battery plant in Herøya, Norway, to have an annual anode graphite production capacity of about 20,000 electric vehicles by 2024 and ramp it up further to provide anode materials for two million EVs annually by the end of this decade.

The sustainable synthetic graphite making firm is however not alone as more companies begin to look outside China to build anode supply chain capabilities, an area where the dragon nation has a towering dominance and other nations have major catching up to do.

"The global demand for batteries is growing rapidly, driven by the green transition, but there is not sufficient ramp-up of battery materials production," said Vianode general manager Stian Madshus.

"Europe is facing a significant shortfall of graphite materials towards 2030, which Vianode aims to address with our high-performance offerings," Madshus said, adding that Vianode's graphite materials are produced with up to 90% lower CO_2 emissions compared to standard materials.

Following Vianode's announcement, Australia's battery anode and advanced material company Talga Group said it has signed an early-stage offtake agreement with Automotive Cells Company (ACC) for the former's flagship Talnode-C battery anode product.
The non-binding deal will see Talga supply ACC, a company co-owned by Mercedes-Benz and Stellantis, with 60,000 tonnes of Talnode-C over five years. Talga's battery anode product is made from high-grade natural graphite and will be sourced from its Vittangi anode project in Sweden, which aims to supply the lithium-ion battery market.

New entrants seek share of the anode pie

New entrants are increasingly looking to capture a foothold in the anode market and strengthen their anode capacity pipeline with ambitious capacity targets. The Benchmark Anode Market Assessment anticipates that the global market share of Tier 2 and Tier 3 Chinese production will overtake Tier 1 market share by 2026, increasing further to reach 64% by 2030.

Further, Benchmark anticipates that the global market share of Tier 3 Chinese anode capacity will surpass that of Tier 1 producer market share before the end of the decade, growing to over 40% by 2030, set to drive legacy Tier 1 producers to increase investment efforts and expansion plans in order to maintain their current sizeable anode market share.

The definitive agreement is expected to include supply of ramp up volumes over 2023 - 2025, prior to the 60,000 tonne offtake supply commencing in 2026.

The announcement also follow another Australian-listed graphite project developer Black Rock Mining's (Black Rock) offtake agreement with the US-based anode aspirant, Urbix, for the sole offtake of -100 (95% C) natural flake graphite produced from the second phase of the former's planned Mahenge project in Tanzania.

The collaboration is aimed at establishing an anode supply chain which fulfils the supply localisation as well as the ESG demands of the US and European battery industries. Urbix also aims to leverage the opportunity to meet with domestic content stipulations in the US Inflation Reduction Act (IRA).

The agreement would see Black Rock Mining's Mahenge project build a production capacity of 83,000 tonnes annually of graphite concentrate and is targeting first production in late 2023. In the next stage the plant's production capacity is set to double to 167,000 tonnes annually by 2026 and followed by a further ramp to 250,000 tonnes a year in the final phase.
UK cell maker BritishVolt in late July announced that it had signed a MOU with Tier 1 Chinese anode major, BTR, for the supply of synthetic graphite and silicon oxide anode materials. BritishVolt said it aims to build a 38 GWh battery Gigafactory in Northumberland, England, planned to begin production in 2024 with an initial capacity of 10 GWh, and reach nameplate production capacity by the end of the decade.

The deals follow the first public graphite supply deal between Tesla and Syrah Resources last year that is aimed at lowering the Elon Musk-led EV maker's reliance on Chinese supply of the battery anode material.

Syrah Resources also announced that the first advance from a $107 million loan under the US Department of Energy's (DOE) Advanced Technology Vehicles Manufacturing loan program had been finalised and is expected in the fourth quarter this year.

Vertical integration strategy

Syrah Resources' loan from the US DOE will be used to fund its Vidalia Active Anode Material Facility in Louisiana, USA. Syrah is one of several graphite companies looking to capture more downstream value.

For natural anode developers outside of China many are following a vertical integration strategy whereby they are developing both natural flake graphite

In May Porsche led a $400 million dollar investment in silicon anode developer Group14 Technologies
Credit: josefkubes

mining capacity and downstream spherical anode production.

Westwater Resources is also vertically integrated operations with both flake graphite and spherical graphite production located in the USA. The company is developing its downstream capacity first and will source feedstock externally, with operations due to come online in 2023, with its mined supply set to enter production in 2028.

Elsewhere in North America, Canada's Nouveau Monde is also building out a vertically integrated natural flake graphite to anode supply chain. Its natural flake Matawinie Mine in Quebec Canada is due to enter production this year. Its downstream operations are located in Becancour, which is also host to other lithium ion cathode developments.

In Europe Talga Resources and Mineral Commodities are both following vertically integrated strategies.

Next Source Materials, which is developing the Molo graphite mine in Madagascar due to enter phase 1 production this year, also set out plans last year to develop its own spherical graphite production through an agreement with Japanese and Chinese anode producers.

Chinese anode squeeze

While the anode action outside China is plenty, it is still not enough to challenge the dragon nation's dominance. In fact, China is set to maintain its anode production dominance over the coming decades and beyond unless the global electric vehicle supply chain leverages the incoming changes in policies aimed at developing indigenous sourcing, ranging from mining to production.

As of now, nearly all anode material is made in China and that volume is expected to grow significantly in the coming decade even as new projects come online in the rest of Asia, Europe and North America.

Total anode production from China is expected to exceed 600,000 tonnes by the end of 2022, or about 90% of the total global production, according to the **Benchmark Anode Forecast**.

That volume is forecast to grow by more than double to almost 1.5 million tonnes between now and the end of 2030 as electric vehicle and battery makers secure more supplies of key anode material such as synthetic and natural graphite and silicon.

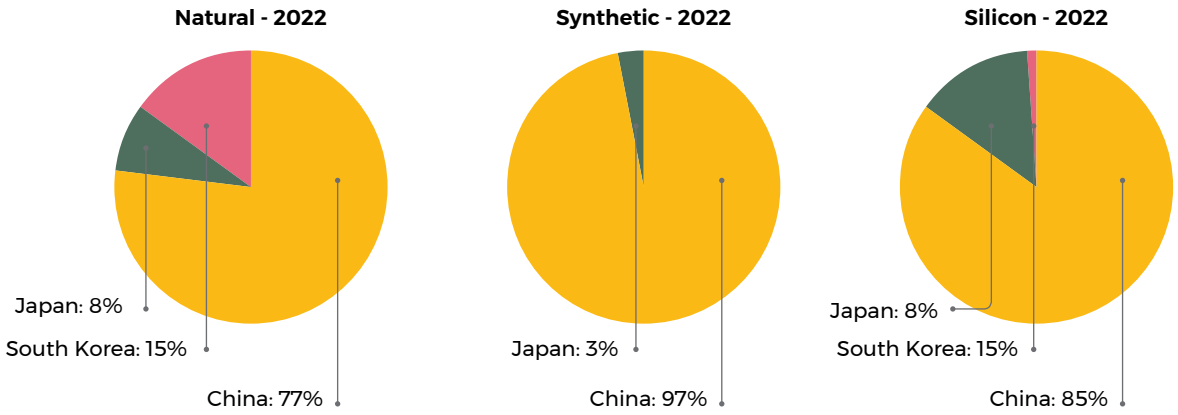
Interestingly, China's share would have increased to nearly 92% by the end of the decade, a mix that the region is expected to maintain till 2035 even as the rest of Asia, Europe and North America adds more capacities.

"China can do it much cheaper when compared with the rest of the world," said George Miller, analyst at **Benchmark Mineral Intelligence**.

The average cost of producing per

The anode state of play today

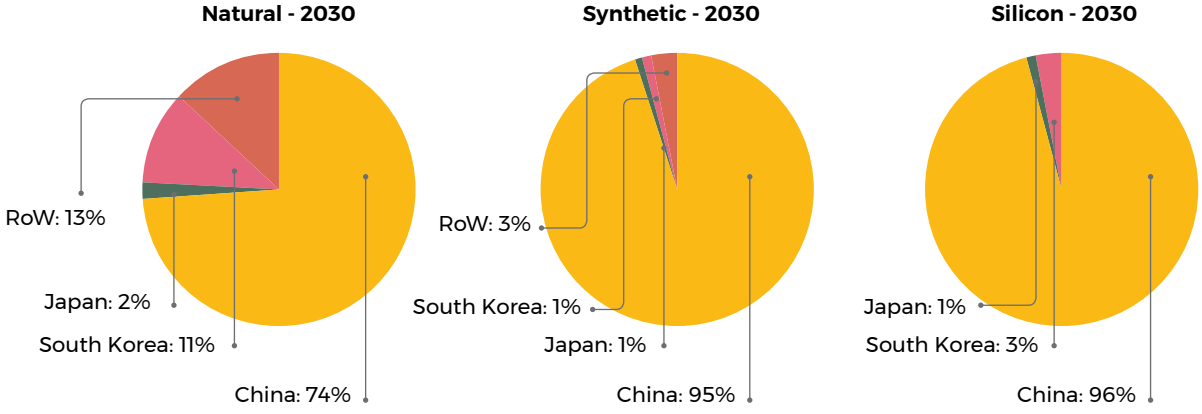
Data from Benchmark's Anode Forecast shows the global production split by anode type and region. China's dominance differs across anode types



Source: Benchmark's Anode Forecast

Anodes tomorrow

China is set to continue to dominate the anode scene by the end of the decade but in absolute terms other regions will see huge growth despite a small market share



Source: Benchmark's Anode Forecast

10,000 tonnes of graphite in China is $50 million. In the rest of Asia it is about $100 million per 10,000 tonnes and $150 million in Norway," Miller said.

Experts also point out that while anode production volume outside of China is much smaller, it is still quite crucial as the recently passed IRA in the US and Europe's proposal of the Critical Raw Material Act, are aimed at ensuring more resilient supply chains locally and and lowering reliance on China for the production of battery raw materials.

Still, expansion in Europe and North America could likely be driven by China, even if indirectly.

"I think the majority of the large expansions, even in Europe and North America, are probably going to be from Chinese and manufacturers over the next decade. That's because they've got the expertise in it with commercial scale and manufacturing. I don't think much is going to change," said Robert Burell, analyst with **Benchmark**.

the big anode makers

While the anode market is a crowded space in terms of the number of companies operating in the category and across the different kind of anode materials, it is still quite top heavy.

Only nine 'Tier One' Chinese companies currently control the bulk of the global anode capacity, according to the **Benchmark Anode Capacity Index** which tracks a total of 165 companies including capacity

from 'Tier Two' and 'Tier Three' suppliers.

Tier One suppliers are defined as those with more than 5 GWh of annual cumulative production capacity who are also qualified to supply more than one multinational electric vehicle producer outside of China.

Approximately 58% is from the top nine Tier One suppliers alone. Of this, China's BTR New Energy and Shanshan control half of that capacity with their synthetic graphite chemistry.

BTR New Energy and Shanshan also have 270,000 tonnes and 290,000 tonnes of capacity under construction and are planning to add 610,000 tonnes and 240,000 tonnes of new capacity, according to the **Benchmark Anode Capacity Index**.

Both BTR and Shanshan focus on artificial graphite manufacturing. In fact, artificial or synthetic graphite is currently the dominant choice for anode feedstock than the natural graphite. The former is commonly made using petroleum feedstock and coal-fired electricity, which has higher consistency and is far more expensive than the natural version.

Though as per **Benchmark** the demand for natural graphite used in electric vehicle anodes is forecast to overtake that of synthetic graphite by 2027.

falling market share

Interestingly, Japan and South Korea's anode production share has fallen in recent years despite a good head start, even as China's dominance has gained strength.

While South Korea's three major electric vehicle (EV) battery makers -- LG Chem, Samsung SDI and SK Innovation -- and Japan's Panasonic are established battery suppliers for world's top automakers including Tesla, Ford, General Motors and others, they still lag behind China when it comes to anode raw material supplies.

South Korea and Japan's share in anode material is expected to end 4% and 5% by the end of this year and shrink to 2% each by 2026, as per the **Benchmark Anode Forecast**.

"South Korea and Japan first started with commercial scale manufacturing. But they are not very large end markets for electric vehicles. China, which is a large end market for electric vehicles, quickly gained market share as it developed a low cost method for manufacturing anode material," Miller said.

Japan currently has a strong presence in active anode material (AAM), particularly with higher quality production as 80% of AAM from Japan is manufactured by Tier 1 producers including Showa Denko, accounting for 48%.

South Korea, which is home to Posco Chemical, has significant AAM production output, particularly for natural graphite which accounts for 15% of global supply in 2022, as per **Benchmark Anode Forecast**. Although both synthetic graphite and silicon capacity is expected to rise in South Korea by 2030 and natural graphite will remain the dominant production chemistry.

Posco Chemical is responsible for over 99% of AAM production in South Korea in 2022 and is expected to continue ramping up capacity extensively. The chemical conglomerate is also setting its sights on silicon anode, a next-generation material for lithium-ion batteries, amid growing demand from electric-vehicle battery manufacturers.

Other than China, Japan and South Korea, only Taiwan, India and the U.S. are currently producing AAM and together enjoy less than a 10% of global share.

A flurry of North American anode developments have been announced in 2022 in a bid to expand the region's grasp on the lithium-ion battery anode market. Despite the developments in the region, current North American production of anode material is essentially zero and is forecast to account for 0.1% of global anode supply in 2022 and 0.6% by 2030. Natural graphite remains the dominant chemistry in the region's current plans, followed by synthetic graphite and silicon, respectively.

Anode types in play

The anode is key because depending upon the choice of material — natural or synthetic graphite, silicon and other — it helps determine the safety, charging speed, capacity and life cycle of a battery.

Graphite can be produced by natural or artificial means and both production routes differ in process and final product. Natural flake graphite concentrates are produced by graphite mines while the artificial ones are manufactured by graphitisation of amorphous carbon.

Both routes require post-processing of the graphite to achieve the desired properties for use as anode active materials in lithium-ion batteries. Natural graphite is often mixed with synthetic graphite in lithium ion battery anodes to achieve a good balance of performance and cost.

While lithium ion demand for synthetic graphite currently exceeds flake, that mix is set to change in the coming years, as per **Benchmark**'s forecast, which also shows that Africa will overtake China as the largest, low-cost producer of flake graphite by the end of the decade. This would be made possible as numerous projects in Mozambique, Madagascar, and Tanzania are expected to play a major role in global supply by the mid-2020s.

While graphite continues to dominate the anode market, electric vehicle makers are also increasingly looking towards next-generation, silicon-

GM invested in OneD Battery Sciences at the end of the quarter
Credit: OneD Battery Sciences

based anode technologies as they look to improve performance and range.

Total demand for silicon in 2022 is up 72% y-o-y, with 82% arising from the transport sector. By 2030, the transport sector is forecast to account for 87% of total silicon demand owing to the requirement for higher energy density figures and EV ranges.

Silicon anode production currently occupies a 1% share of the global anode market by tonne (3% by MWh). **Benchmark** forecasts this to increase by around 300% by 2030 even though graphite is on course to maintain more than 90% market share until the mid-2030s.

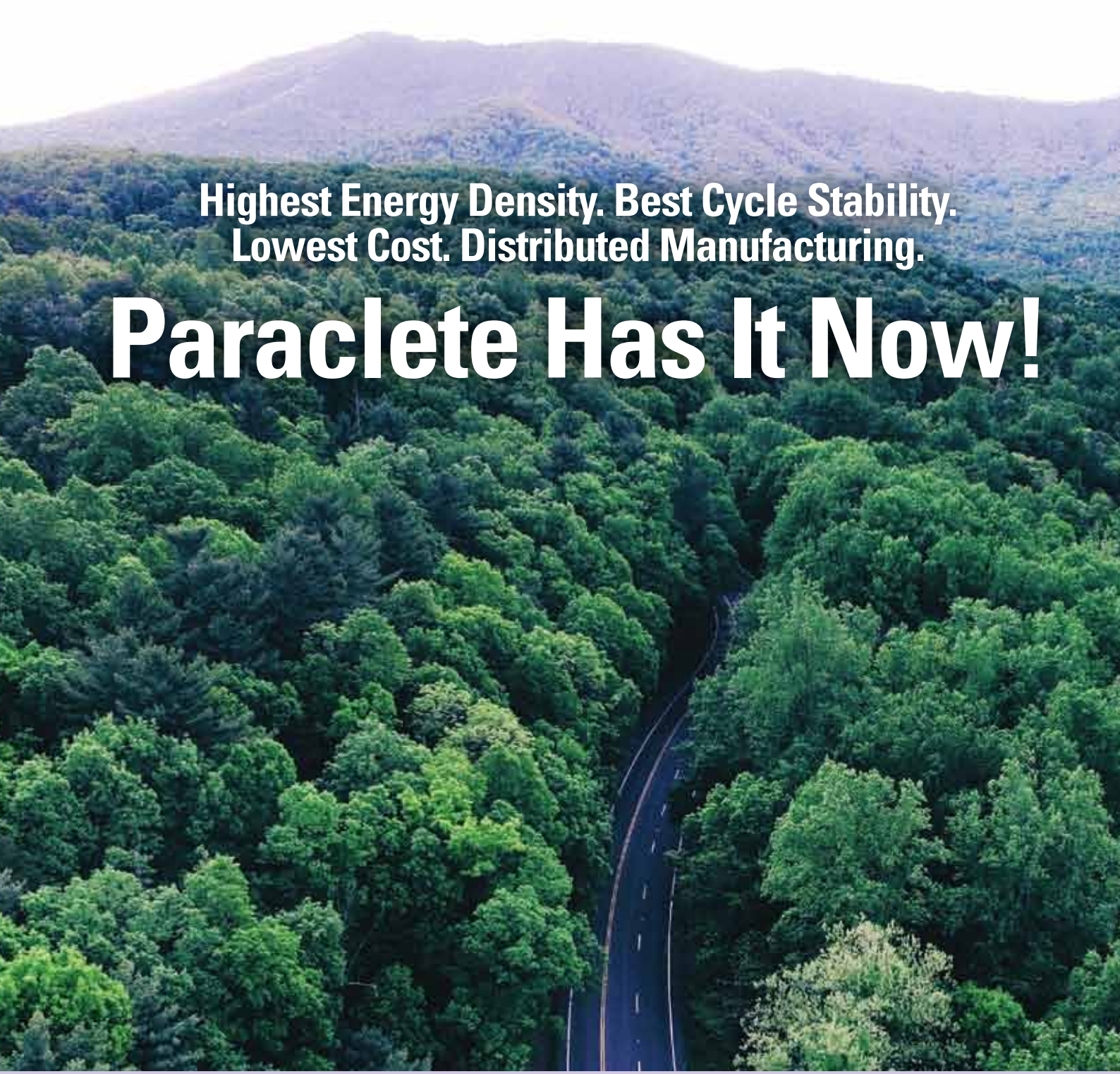
Benchmark analysis shows it could take anywhere from a year and a half to two years and a half for a synthetic graphite anode facility to go from commissioning to first production. While the foray from producers into new silicon-based chemistries could see this extend out to 3-4 years as they simultaneously undergo product development and qualification.

This, coupled with the high CAPEX intensity, which **Benchmark** estimates to be approximately 85% greater for silicon-based anode projects than that of synthetic graphite-based facilities.

Despite these costs, the performance benefits offered by silicon anodes see continued investment and research into the technology.

At end of September, General Motors invested $25 million in US silicon anode developer OneD Battery Sciences. This follows other recent investments from automakers including a Porsche-led $400 million investment in silicon-anode producer Group14 Technologies in May. This year we also saw Mercedes-Benz's partnership with battery material company Sila for deploying silicon anode technology in upcoming EV models.

In China, companies such as BTR, Guangdong Dowstone Tech, Tianmu Lake, Hebei Kuntian and Shida Shenghua all announced major plans for silicon- dominant anode capacity.



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