

# Mine to Anode

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**SYRAH** RESOURCES

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## Company Overview



Photo: Balama Graphite Operation

# Syrah's Value Proposition



## Electric Vehicles require graphite

- Electric Vehicle (“EV”) adoption is gaining momentum
- Anodes in lithium-ion batteries used in EVs are made of graphite



## Graphite is a strategic critical mineral

- Global anode supply chain is currently 100% reliant on China
- Graphite is designated as a strategic critical mineral in USA, EU, Japan & Australia



## Balama Graphite Operation: A Tier 1 asset

- Long life (>50 years<sup>1</sup>) and high grade (16% TGC<sup>2</sup>)
- Largest integrated natural graphite mine and processing operation globally
- Significant vanadium resource at Balama is a valuable option<sup>3</sup>



## Vertical Integration in USA

- Balama vertically integrated with AAM<sup>4</sup> facility at Vidalia, USA
- Large scale ex-Asia AAM supply option that is ESG verifiable

Syrah's vision is to be the world's leading supplier of superior quality graphite and anode material products, working closely with customers and the supply chain to add value in battery and industrial markets

1. Life of mine based on current 107Mt Graphite Ore Reserves being depleted at 2Mt throughput per annum. Refer to 2021 Annual Report released to ASX 24 March 2022 for Reserves as at 31 December 2021. All material assumptions underpinning the Reserves and Resource statement in this presentation continue to apply, other than as updated in subsequent ASX releases.

2. TGC = Total graphitic carbon.

3. Scoping study on potential to refine vanadium as per ASX release 30 July 2014.

4. AAM = Active anode material.

# Syrah's Positive ESG Profile



## Leading ESG standards

- ✓ ISO:45001 and ISO:14001 certification at Balama
- ✓ Vidalia expansion project being developed in line with best practice health, safety and environmental standards
- ✓ Critical Risk Management Framework embedded across the Group



## Best practice sustainability frameworks

- ✓ Sustainability frameworks guided by:
  - Global Reporting Initiative (GRI)
  - United Nations Sustainable Development Goals (SDGs)
  - International Council on Mining and Metals (ICMM)
  - Initiative for Responsible Mining Assurance (IRMA)
- ✓ Robust Community Development and Stakeholder Engagement Strategy



## Low carbon footprint

- ✓ Lower carbon emissions footprint (life cycle) of natural versus synthetic graphite
- ✓ Independent life cycle assessment (LCA) completed
- ✓ Implementing initiatives to lower carbon footprint further



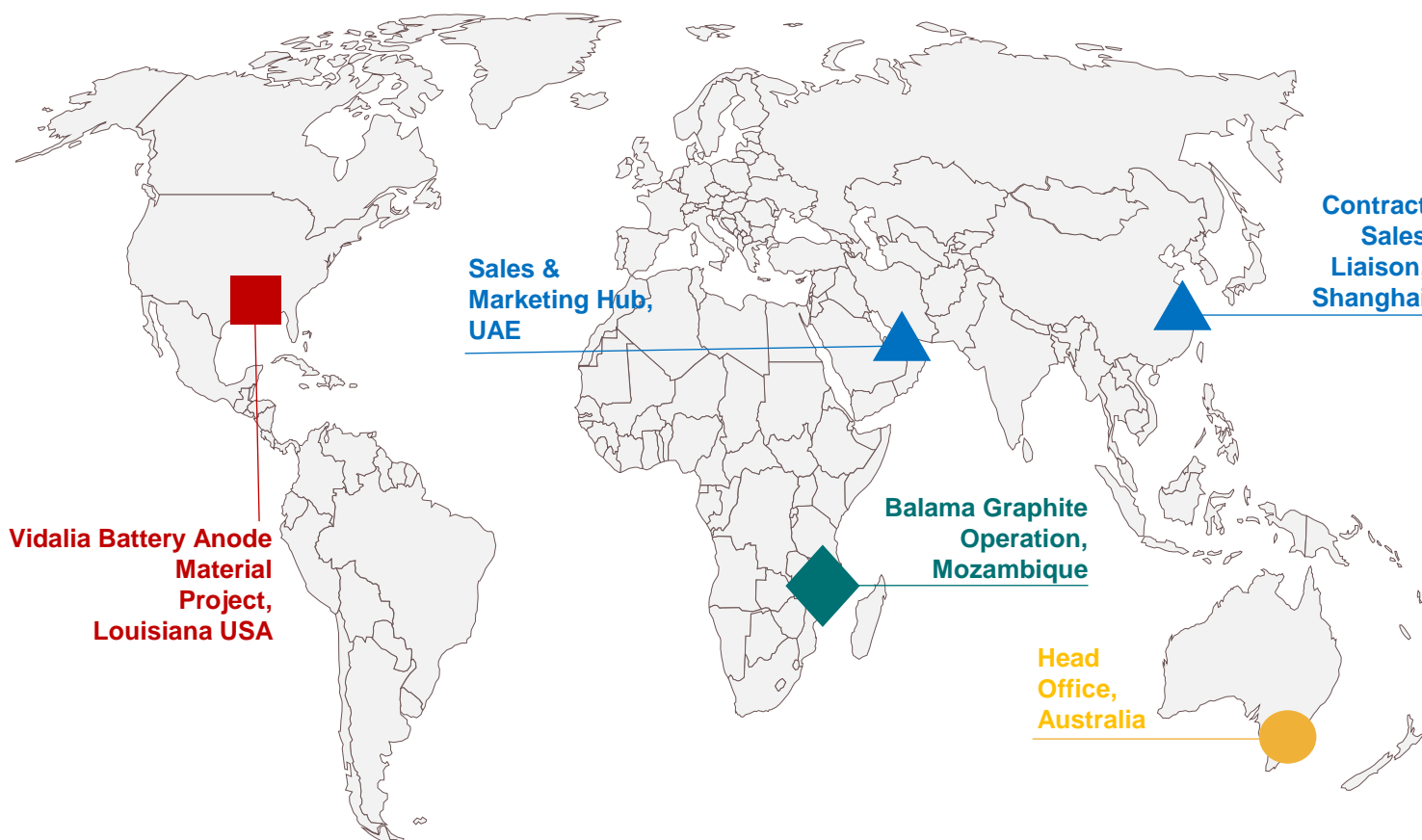
## Auditable back to source

- ✓ Fully integrated by Syrah from mine to customer
- ✓ Vidalia products will have a single chain of custody back to the source



# Syrah is a globally integrated natural graphite producer

A global business to service the growing demand for natural flake graphite and processed graphite-based products



## ◆ : Balama Graphite Operation

- Ore Reserves 107Mt at 16% TGC<sup>1</sup> (17Mt of contained graphite) underpinning a 50+ year mine life<sup>2</sup>
- Simple open pit operation, low stripping ratio, design production capability 350kt flake graphite per annum
- Balama graphite product mix and specifications are suited for use in the lithium-ion battery and traditional markets

## ■ : Vidalia Active Anode Material Facility

- Capability to produce coated purified spherical graphite for product qualification in the lithium ion battery supply chain
- Existing facility under construction to 11.5ktpa production capacity

## ▲ : Sales & Marketing

- Global sales and marketing functions led from UAE
- Sales and marketing support provided by contract sales liaison in China

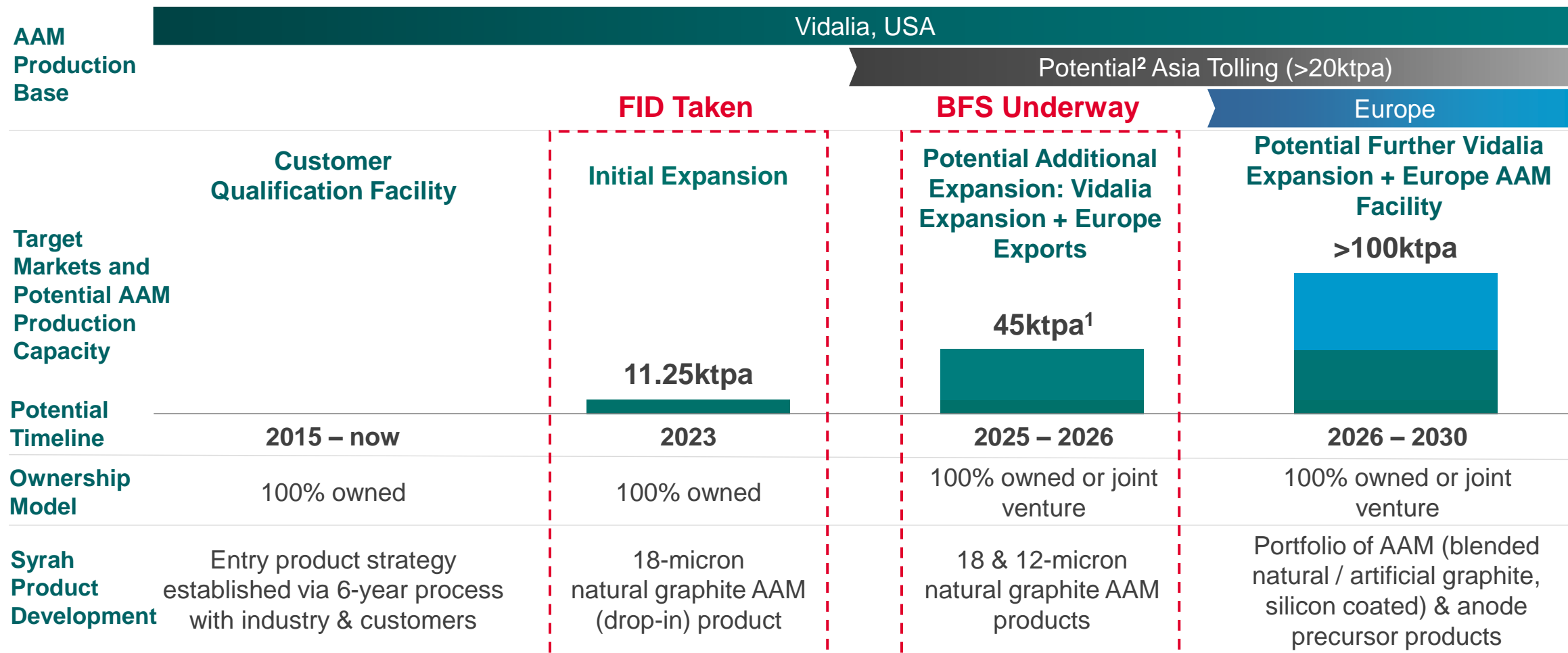
## ● : Corporate Office

- Finance, Legal, Human Resources, Investor Relations

1. TGC = Total Graphitic Carbon.

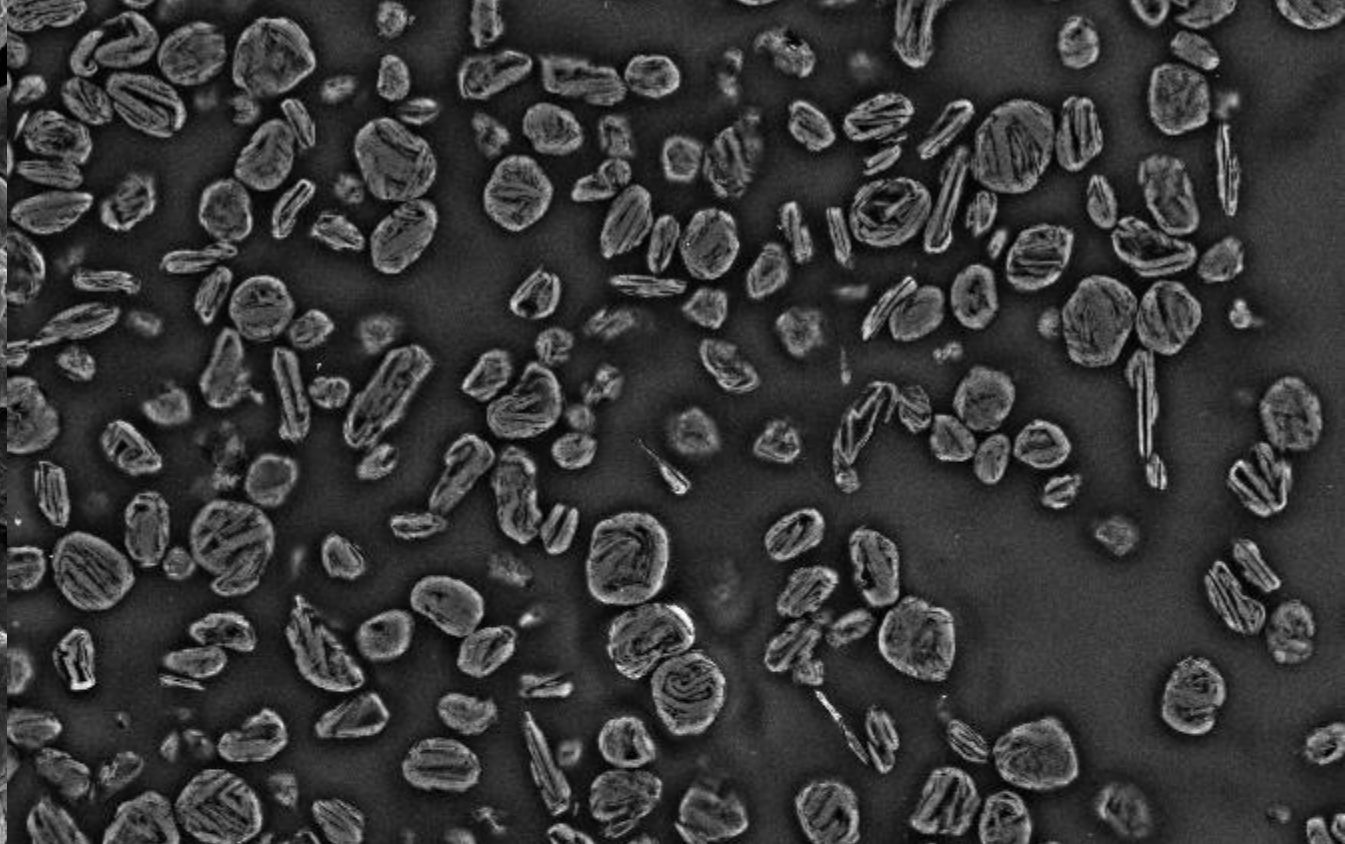
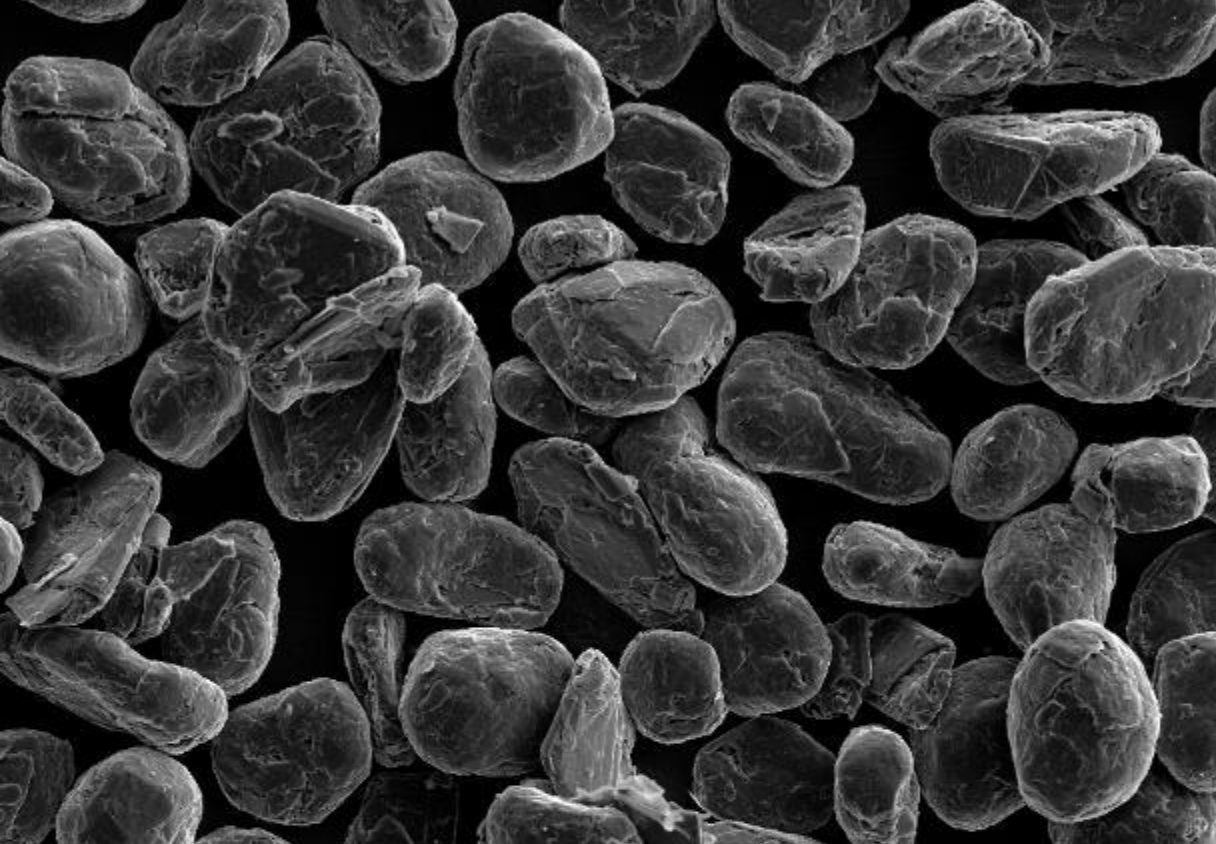
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# Syrah's vision is to become a leading supplier of anode products

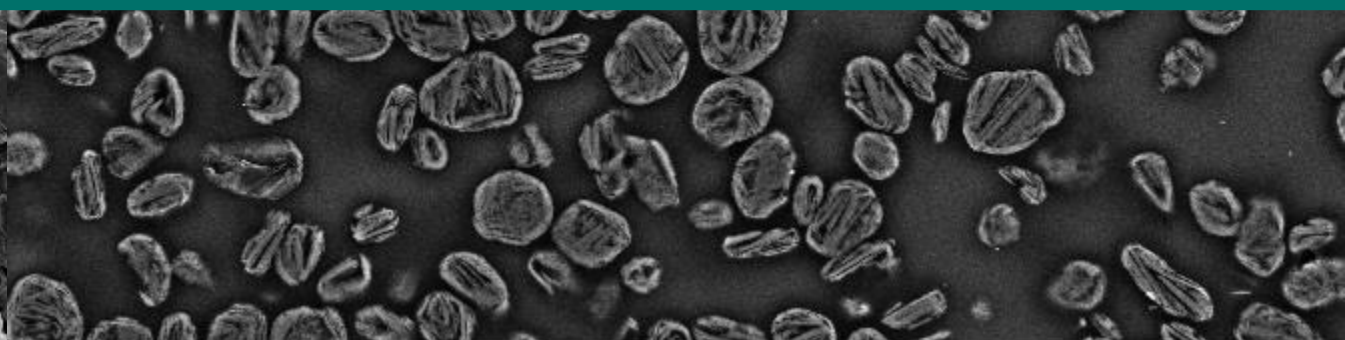
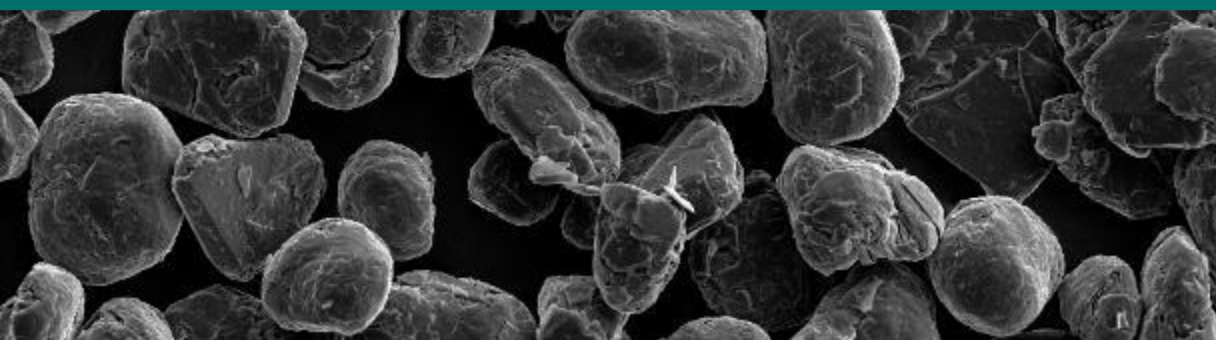


**Syrah's downstream expansion strategy is underpinned by integration with a scalable mining/processing operation and world-class graphite resource at Balama**

1. BFS on potential Vidalia expansion to at least 45ktpa AAM production capacity due in 2022.



## Product Overview



FoV  
140  $\mu\text{m}$

WD  
9.92 mm

Speed  
5

20  $\mu\text{m}$



FoV  
279  $\mu\text{m}$

WD  
15.03 mm

Speed

Photo: SEM CLP16



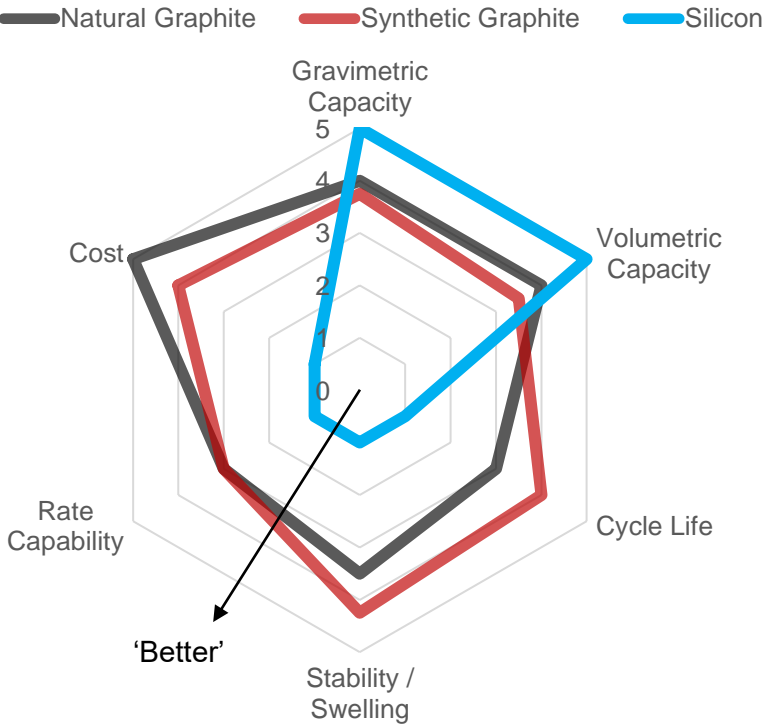
# Anode Material KPIs

## Internal (Vendor) Benchmark Results (Current)

### Powder Properties (Carbon)

Characteristic	Typical Ranges
Purity (LOI Carbon%)	>99.9% (Min) - > 99.99%
Particle Size Distribution	5 - 25 um (D50)
Crystal Structure (d002 interlayer spacing)	0.335 – 0.4nm (hard carbon)
Density (Tapped)	>0.9 g/cc
Surface Area (BET)	1 – 5 m2/g
Morphology	Spherical, Isotropic preference
Pellet Density (>2T)	>1.5 (Ag), >1.7 (Ng)
Moisture	0.1 -> 0.5%

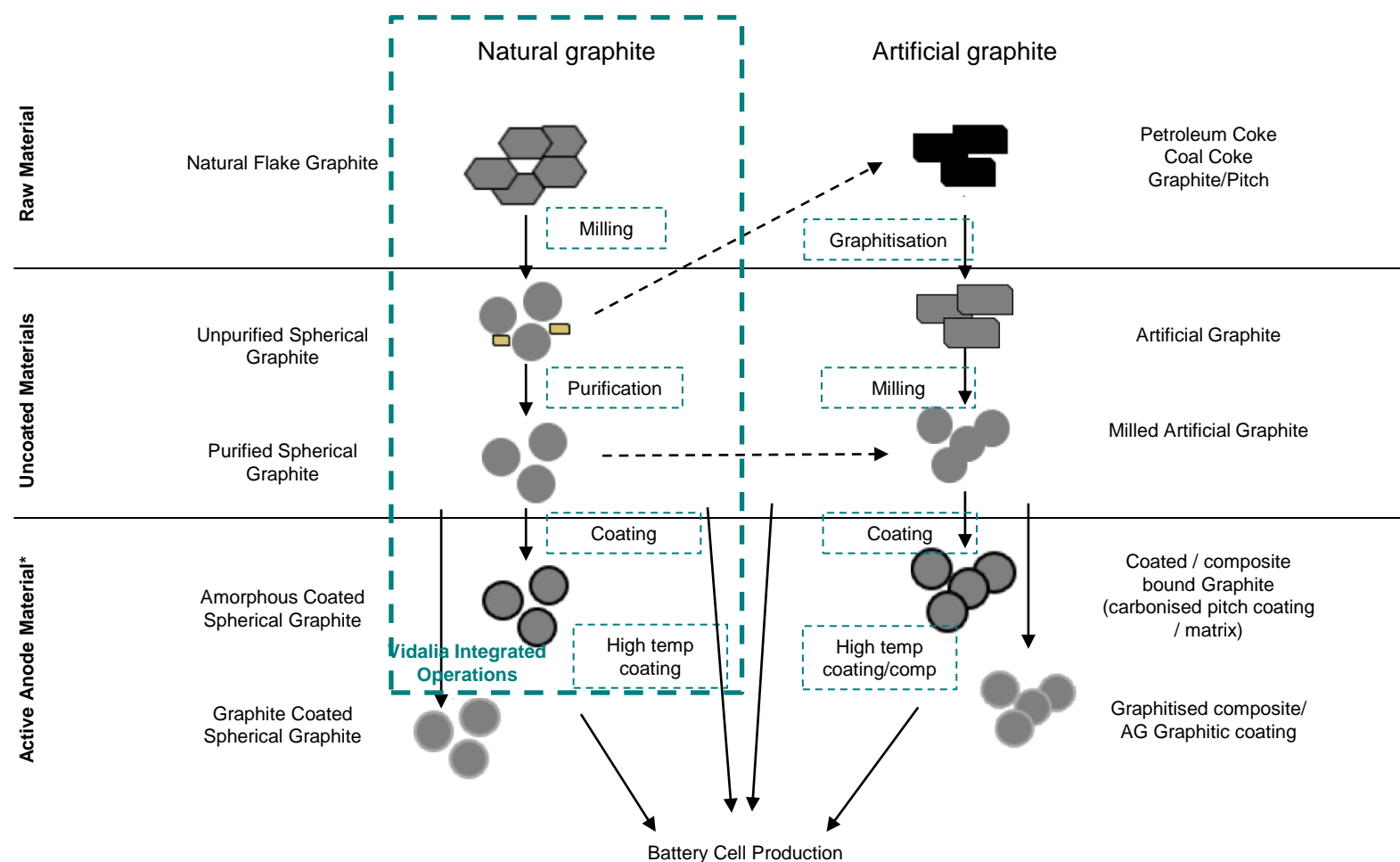
### Battery Performance



# Syrah progressing to be a vertically integrated natural graphite anode supplier

The Vidalia facility is fully integrated to complete all steps in the process for production of AAM using Balama natural graphite

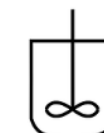
## Typical Production Tree for Natural Graphite and Artificial Graphite AAM



### Balama Natural Graphite Operation



MINING



CONCENTRATION



MILLING/  
SHAPING



PURIFICATION

### Vidalia Active Anode Material Project



CARBON  
COATING



THERMAL  
TREATMENT



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# CLP Product Line

## Natural Graphite Anode Active Material



Morphology			Standard	CLP-18	CLP-12
Particle Diameter	μm	Dmin	ASTM E2651	-	
		D10		10.0 ± 2.0	7.0 ± 2.0
		D50		18.0 ± 2.0	12.0 ± 2.0
		D90		27.0 ± 3.0	24.0 ± 3.0
		D99		≤ 50	≤ 50
BET Specific Surface Area (SSA)	m²/g		ISO 9277	2.5 ± 0.5	< 4.0
Tap Density (Td)	g/cc		ASTM D7481 (3000 taps)	> 1.0	> 0.95
Chemical					
Moisture	%		ASTM C562	≤ 0.1	≤ 0.1
Ash	%		ASTM C561	≤ 0.04	≤ 0.04
Total Carbon (TC = 100 – LOI)	%		Dry basis	≥ 99.96	≥ 99.96
Trace Impurities					
Iron (Fe)	ppm		ICP-OES	≤ 30	≤ 30
Electrochemical					
Specific Capacity	mAh/g		Half Cell (C/10)	358	355
First Cycle efficiency	%		Half Cell (C/10)	94	93
Discharge Rate	%		Coin Cell (1C:C/20)	94	95

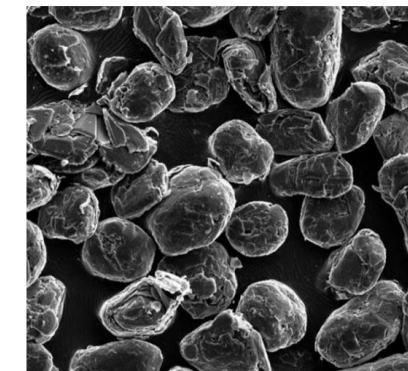
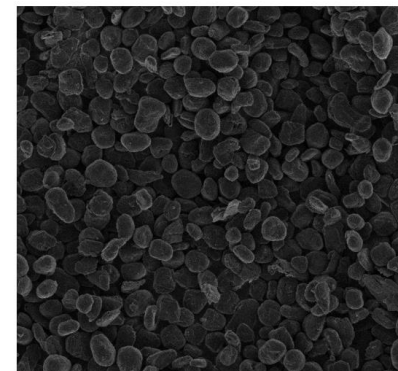
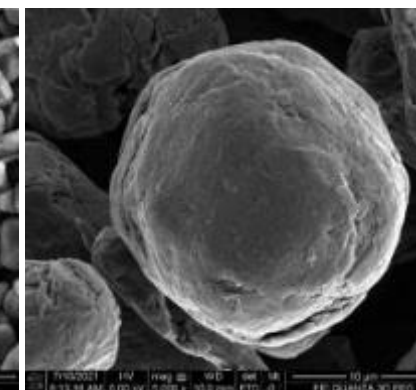
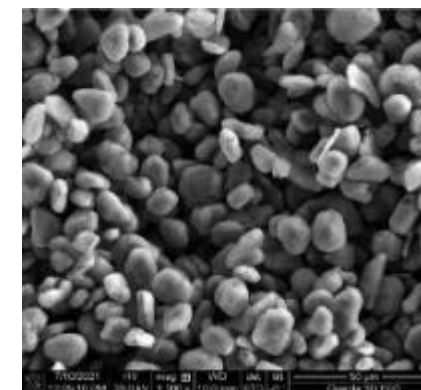


Figure 1: Scanning Electron Microscope (SEM) images of Vidalia AAM from furnace.



CLP-12, Natural Graphite Active Anode Material- SEM Images





## Technical Performance



Photo: Syrah Lab

# Committed to measuring and mapping material characteristics to performance

Electrochemical expertise developed internally through external cell testing and customer interaction – supplementary consultancy as required

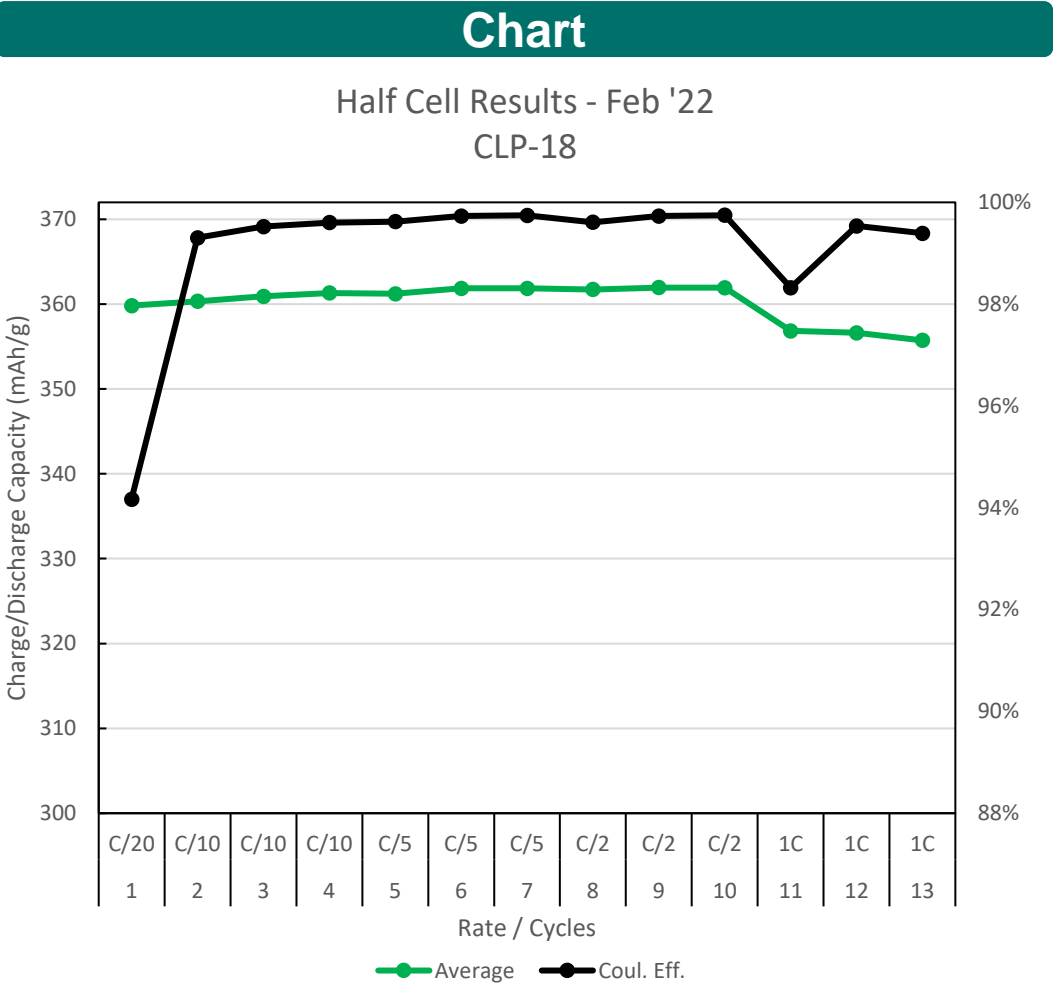
## Measuring and Mapping Interdependencies

Atomic Structure	Powder Properties	Electrode Properties	Electrochemistry	Cell Properties
<u>Inputs</u>  Interlayer Spacing (D002)  Crystallite Domain (Lc length)  Rhombic Phase (ABAB/ABC Ratio)  Crystallite thickness (Edge plane exposure)	<u>Processing</u>  Particle Size Distribution  Surface Area  Surface porosity  Surface impedance  Shape  Purity  Tap Density  Energy Density  Internal porosity & permeability	  Porosity  Wettability  Compressed density  SEI homogeneity  Spring-back  Expansion  Conductivity  Peel Strength  Slurry mixing/viscosity	  Tortuosity  Impedance  Current density  Activation energy	  Cycle performance  Shelf life  Rate Capability  Discharge performance  Charge performance  Swelling  Safety

Highly dependent on cell design

# CLP18: Half Cell Performance

## Internal (Vendor) Benchmark Results (Current)



KPIs & Method

Specific Capacity (mAh/g)	First Cycle Efficiency (%)	Rate (Delithiation)-1C:C/20 (%)
359.8	94.17	362.9/359.8 99.2%

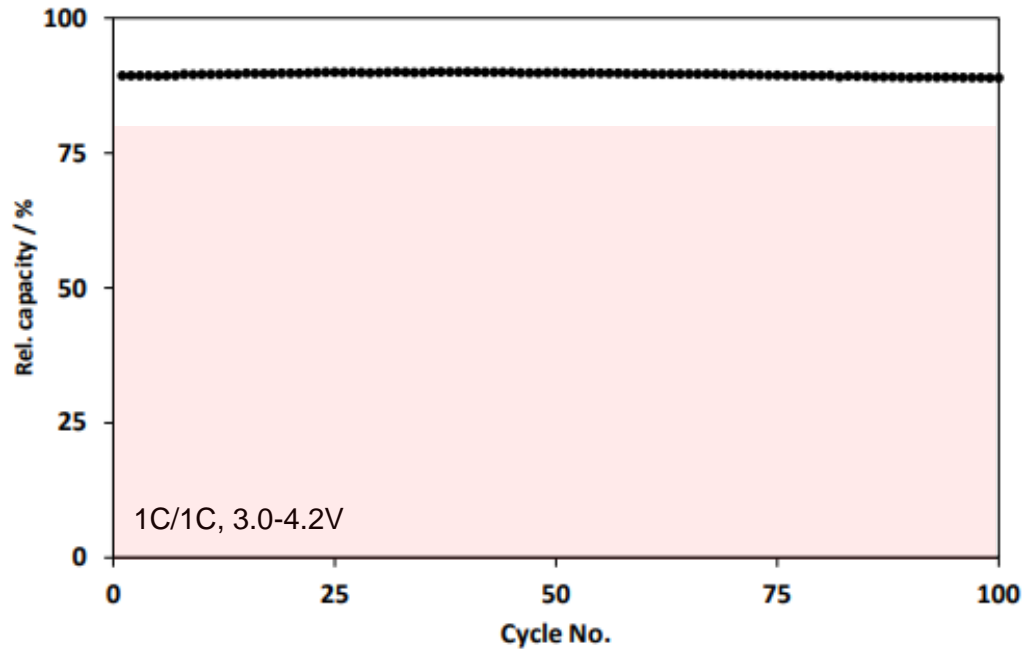
Half Cell Methodology / Design	
Cell Type	2032
Cell Components	Cell can, spring, SS spacer (1mm), Li foil, separator, glass fibre separator (300um), Anode, Cu collector (10um)
Electrode Comp.	Graphite:CB:CMC:SBR (94.5:1.5:1.5:2.5)
Electrolyte	12.7% LiPF6, 26.2% EC, 61.1% EMC (%w/w)
Calendared Thickness	85um
Loading	12.8mg/cm2
Pressed Density	1.5g/cc
Porosity	30%
Temperature	22.5 °C



# Cycle Life and Particle morphology

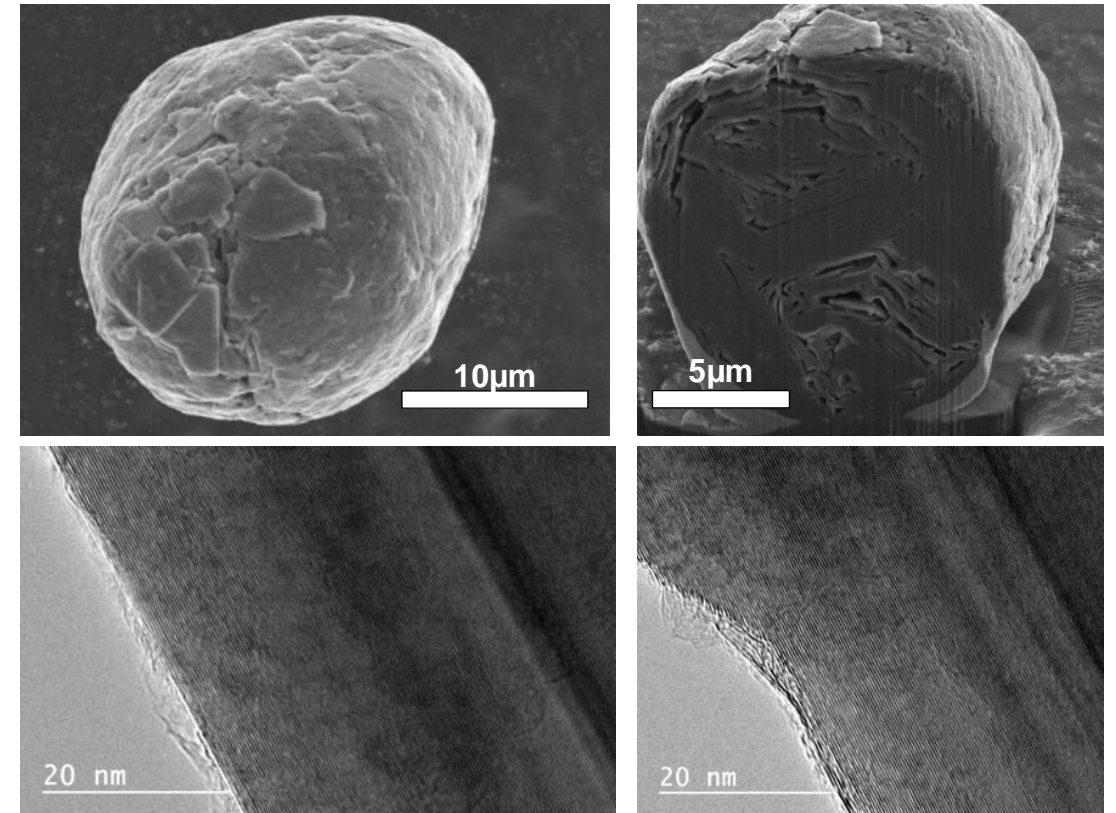
Syrah's CLP Product cycle life is enhanced through particle engineering

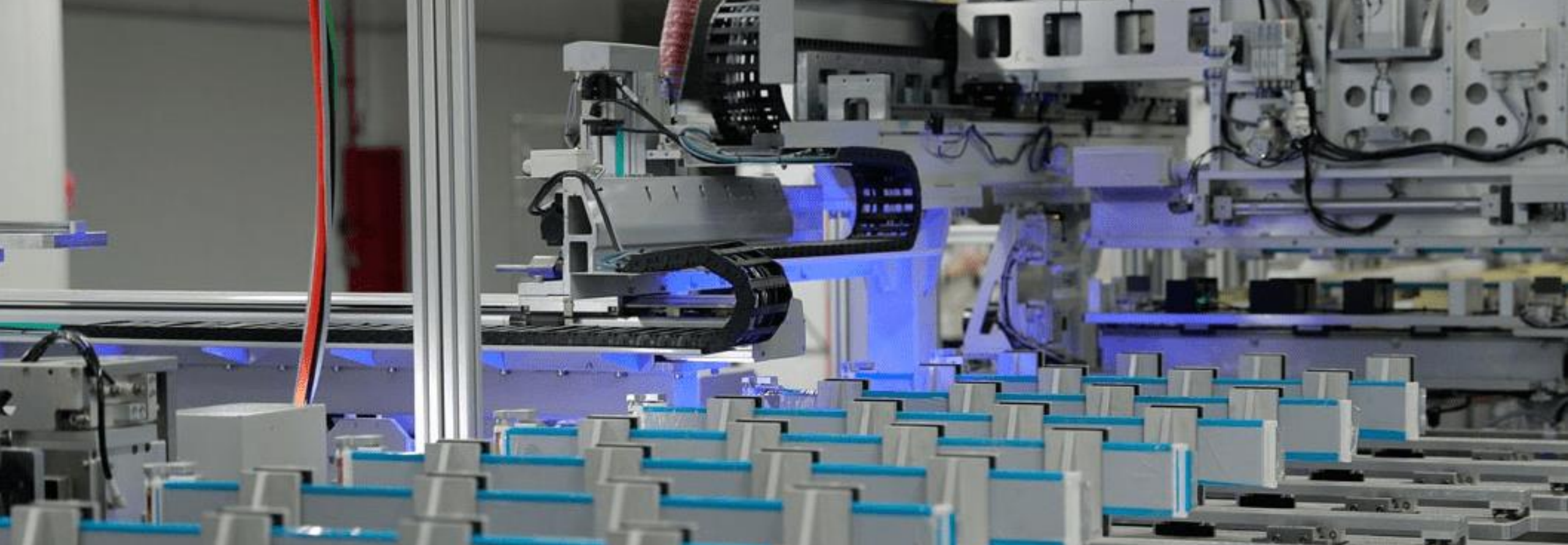
## 25°C – Full coin-cell, Ni(622) Cathode



100% = first charge capacity

## Cross-section and Carbon Coating





## Market Update

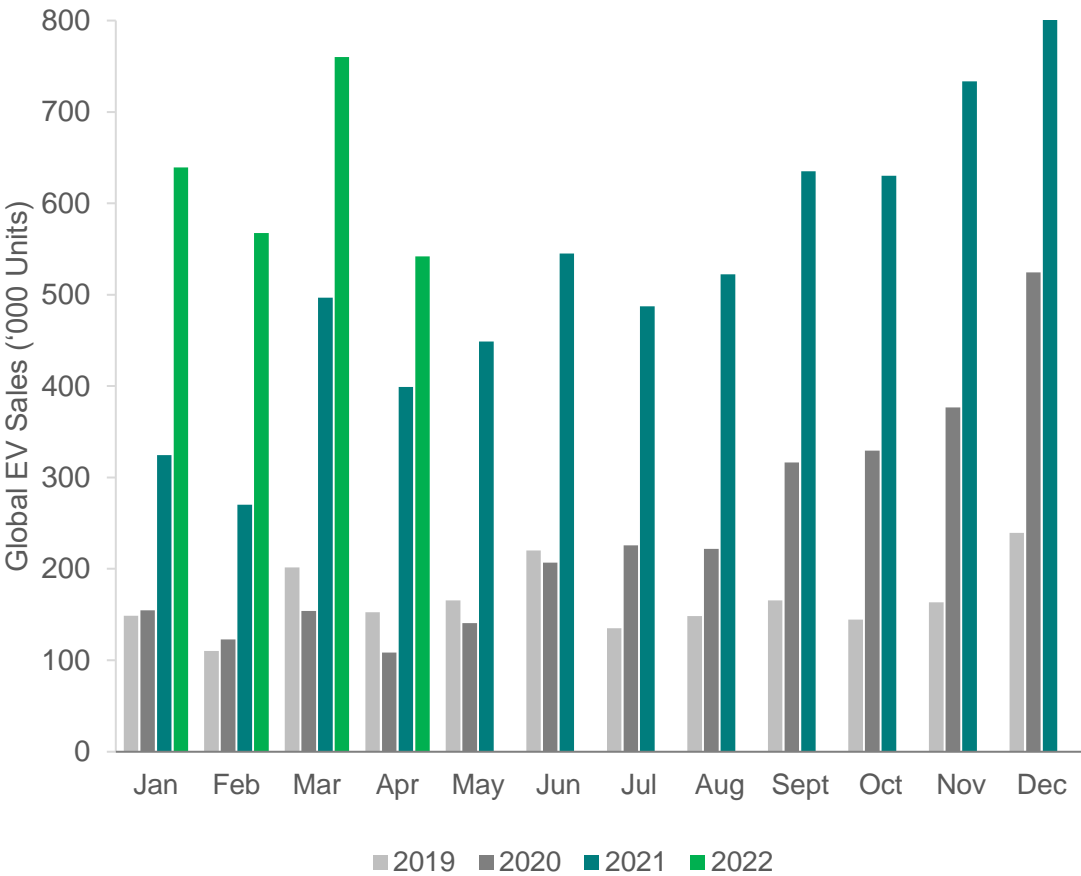


Photo: Li-ion Cell Production

# xEV adoption requires significant lithium-ion battery supply

Growth has been incredibly strong, market share has increased to ~24% in China for April

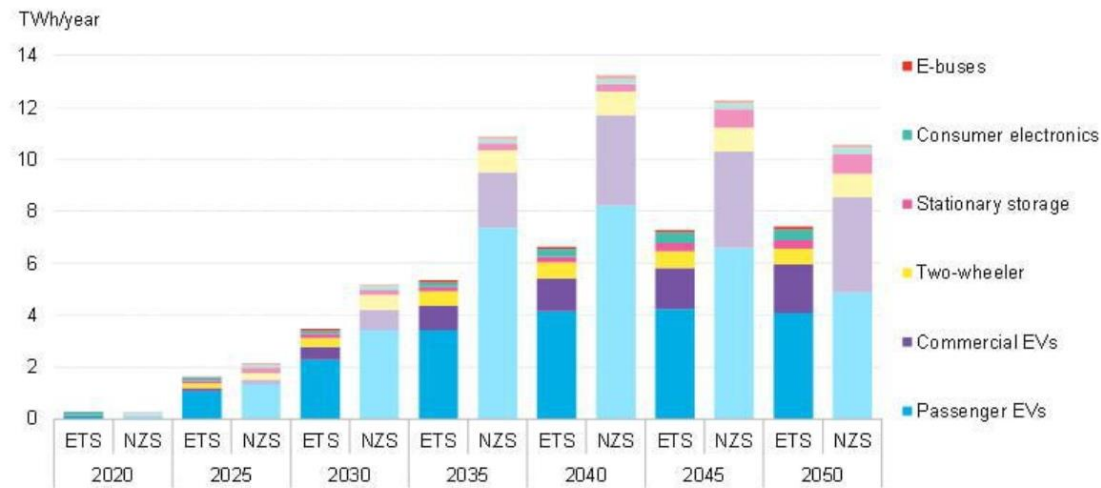
## xEV (BEV + PHEV)



Source: Marklines

## Li-ion Battery

Battery demand outlook under BNEF's Economic Transition Scenario and Net Zero Scenario



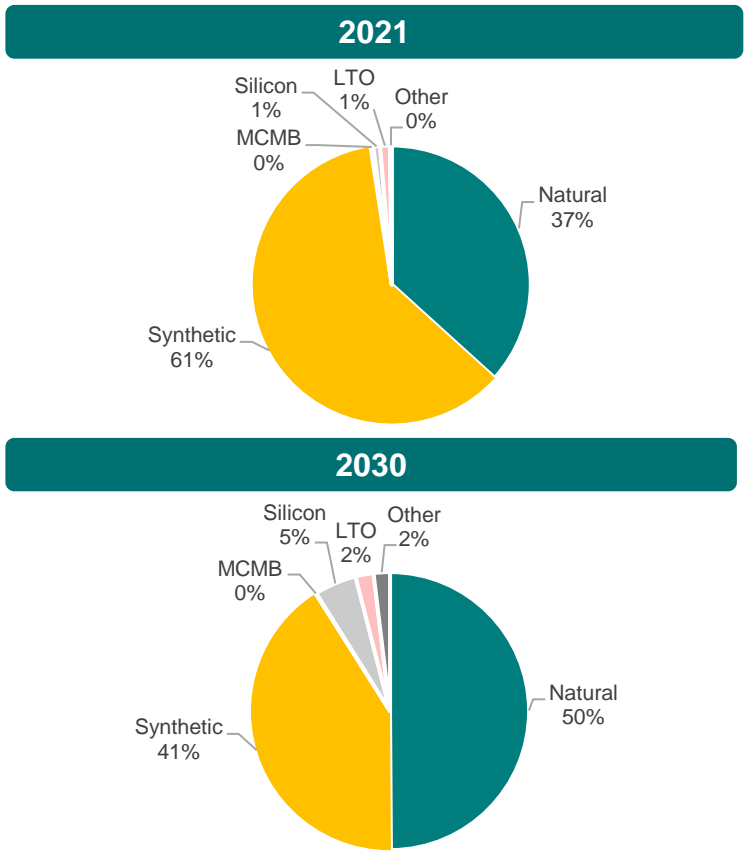
Source: BNEF. Note: Consumer electronics and stationary storage demand are assumed to be the same under both scenarios. ETS is the "Economic Transition Scenario" and NZS is the "Net Zero Scenario".

Source: BNEF



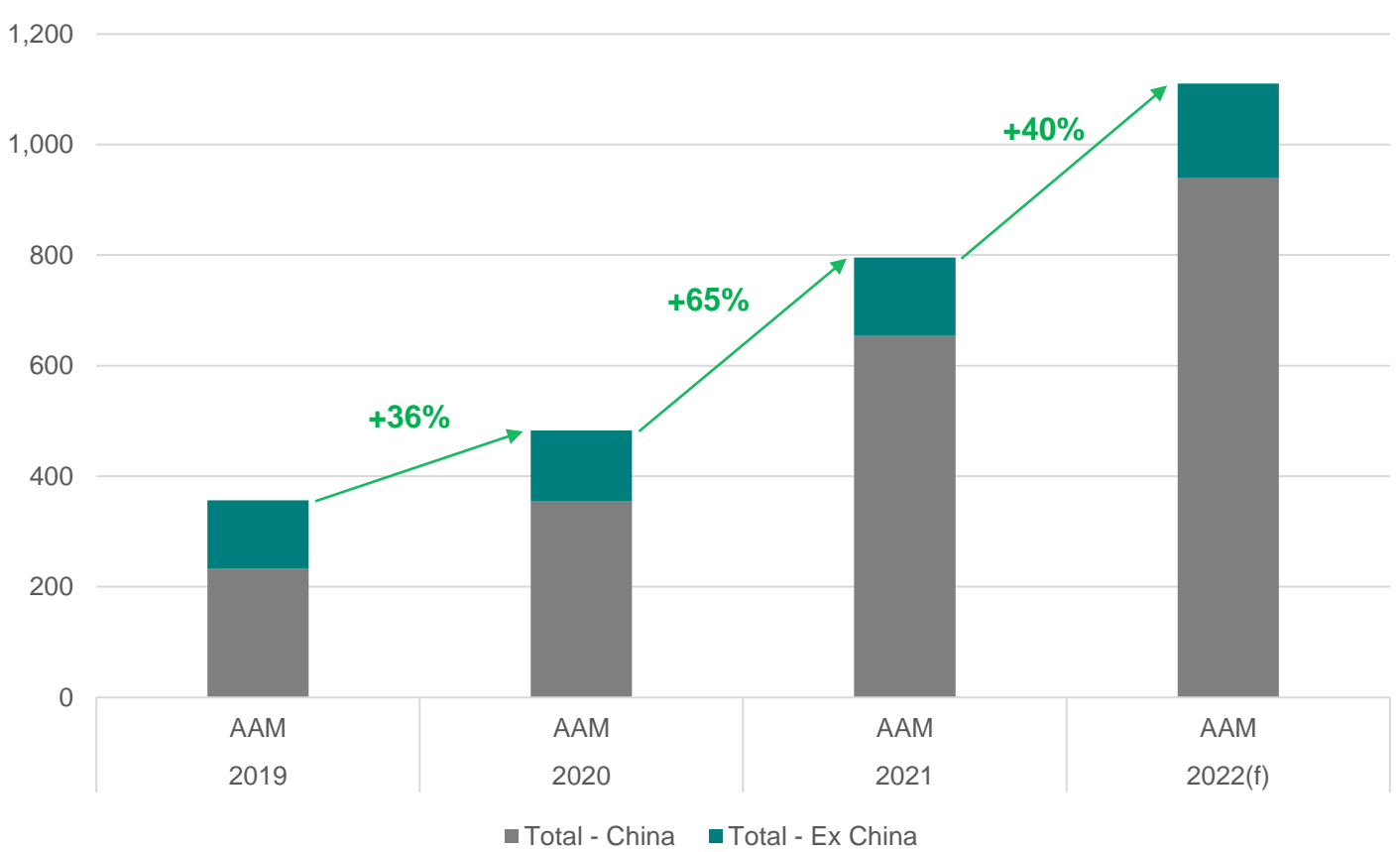
# Significant Active Anode Material is required for the lithium-ion battery market

Anode Market Share



Source: Benchmark Mineral Intelligence Flake Graphite Forecast, Q1 2022

Global Anode Material Production (kt)

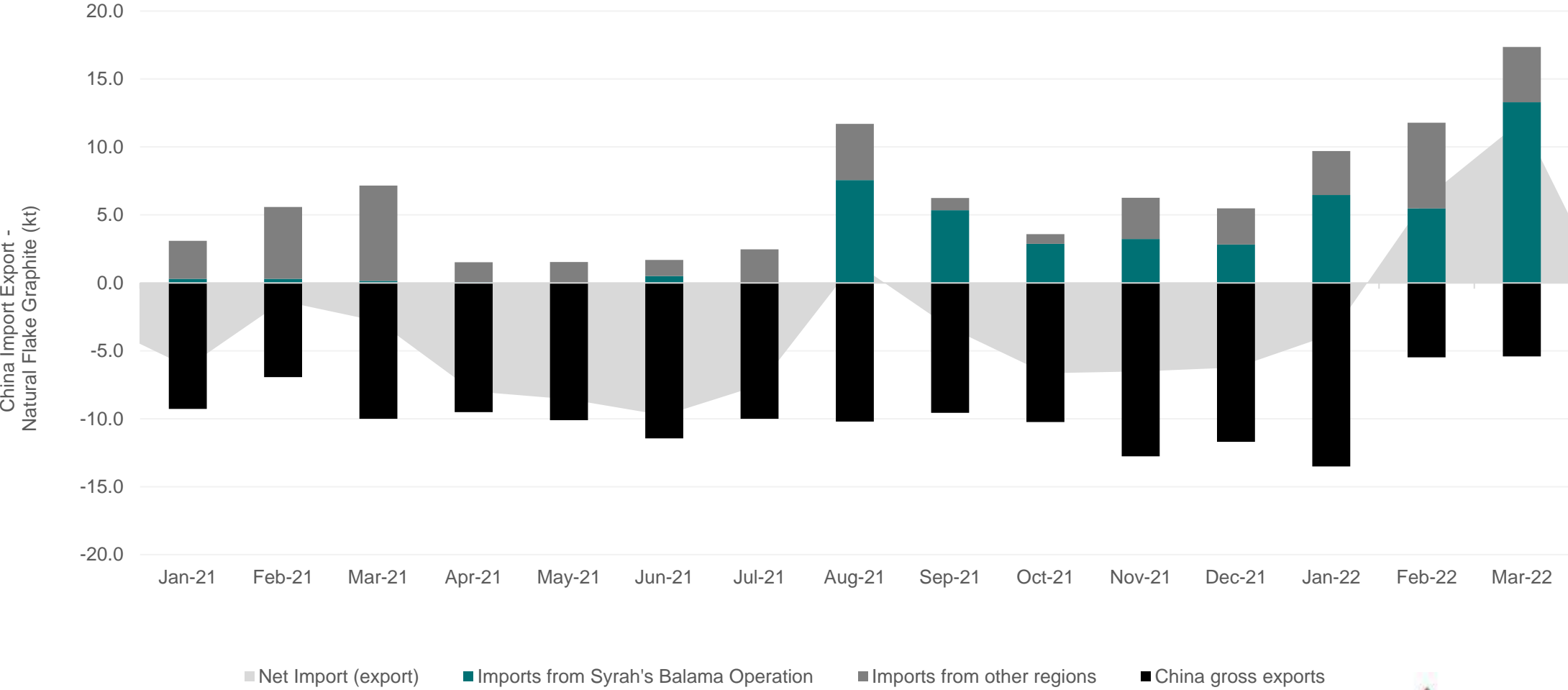


Source: ICCSino (excludes 'Other'), Company reports, Syrah analysis

# Natural flake graphite is the key feedstock for Active Anode Material

Not all natural graphite is suitable for consumption as Active Anode Material, major industrial markets are steel and foundry

## China back to net importer



Source: Asian Metals