



NAVIGATING THE SILICON CHALLENGE

Manuel Wieser
Chief Technology Officer

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DISCLAIMER

Florida IBS 2024 – Orlando, Florida

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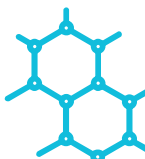
ANTEOTECH – CLEAN ENERGY TECHNOLOGY DIVISION

Commercializing technologies that enhance the storage and management of energy across multiple sectors

Established and growing business



Proprietary technology platform



Developing solutions for high impact sectors



Publicly listed company (ASX)

- Highly experienced leadership team delivering commercial outcomes
- Based in Brisbane, Australia

CET - Lithium-ion battery technologies

- Anteo X™ binder additive
- Silicon anode formulation know-how
- Ultra high silicon anode technology

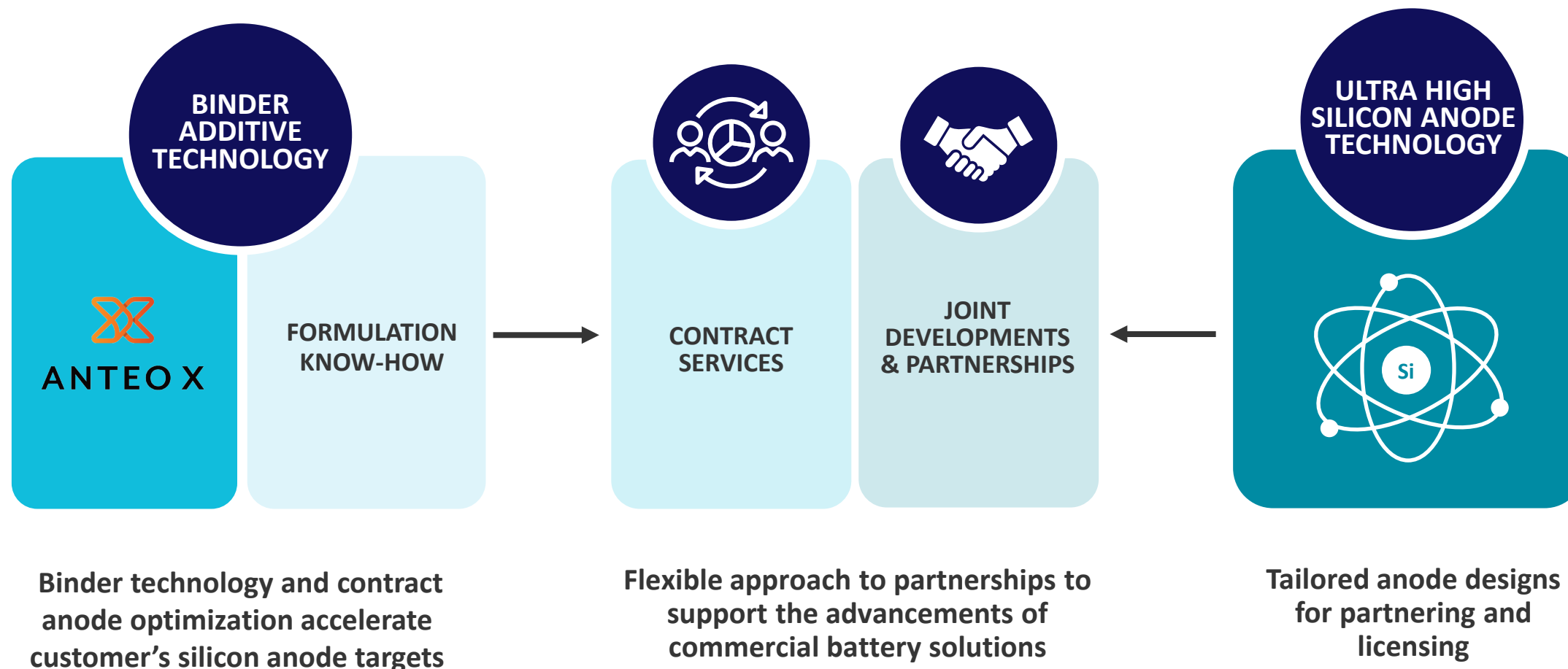
CET - Capabilities

- Deep experience in developing silicon anode designs of >20wt% silicon active material
- Performance optimization of silicon anode designs
- Anteo X production facility (early 2024)



TECHNOLOGY PLATFORMS AND PARTNERSHIPS

Combining AnteoTech's silicon enabling products and anode design know-how to create pathways to smaller, lighter and cheaper lithium-ion batteries



Anteo X™

Binder additive for high silicon anodes

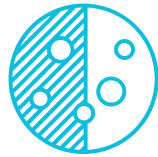


THE SILICON CHALLENGE FROM A BINDER PERSPECTIVE

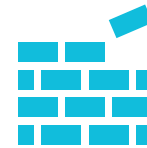
Binders form an integral part of electrodes, and act by facilitating



Particle dispersion



Electrode homogeneity



Structural integrity



Conductive network

(1) More silicon in the anode generally means more expansion and contraction of electrode structure

(2) This stress largely falls on the binder to compensate

➤ **To advance silicon anode technology we also need advanced binders!**

➤ **We also need advanced anode formulation know-how to optimize performance and cost!**

ANTEO X™ BINDER ADDITIVE TECHNOLOGY

Anteo X cross-links the battery binder and creates a uniform 3D network structure in the electrode improving electrochemical and mechanical performance



Cycle life

Extended cycle life for high silicon content anodes
Can reduce structural expansion of the anode



Ease of use

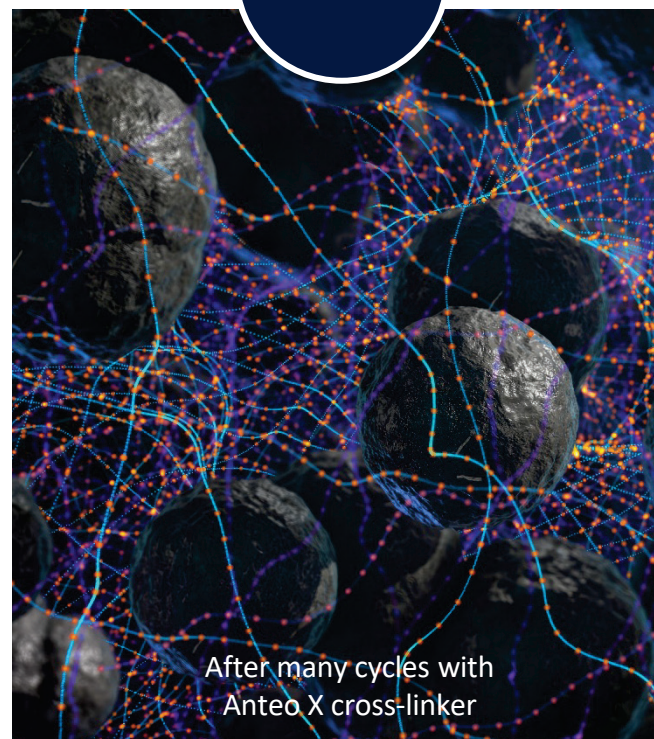
Aqueous solution (non-hazardous)
Easily transported & stored
Broad binder compatibility
Integrates into electrode manufacturing process



Cost optimization

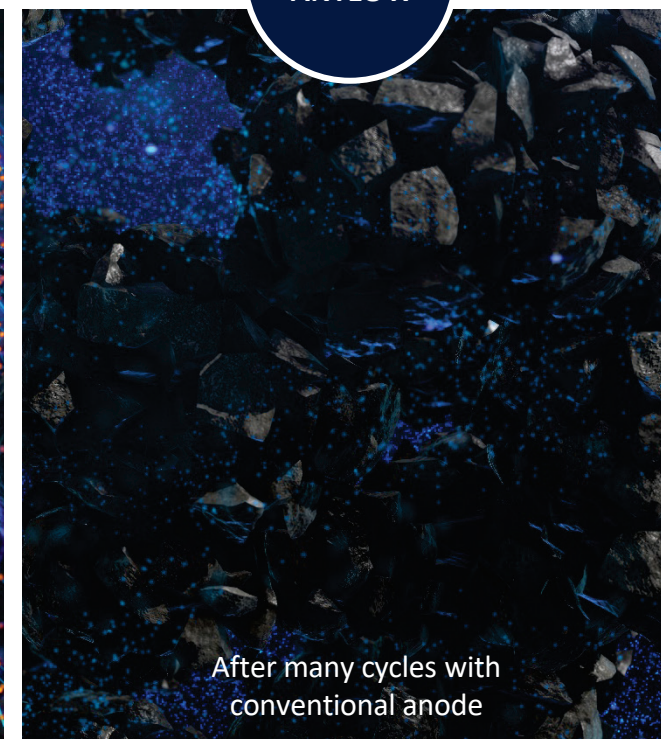
Can help to optimize inactive material fraction
Optimize CNT content (impacts \$/Wh)
Reduce binder content (impacts \$/Wh)

WITH ANTEO X



After many cycles with Anteo X cross-linker

WITHOUT ANTEO X



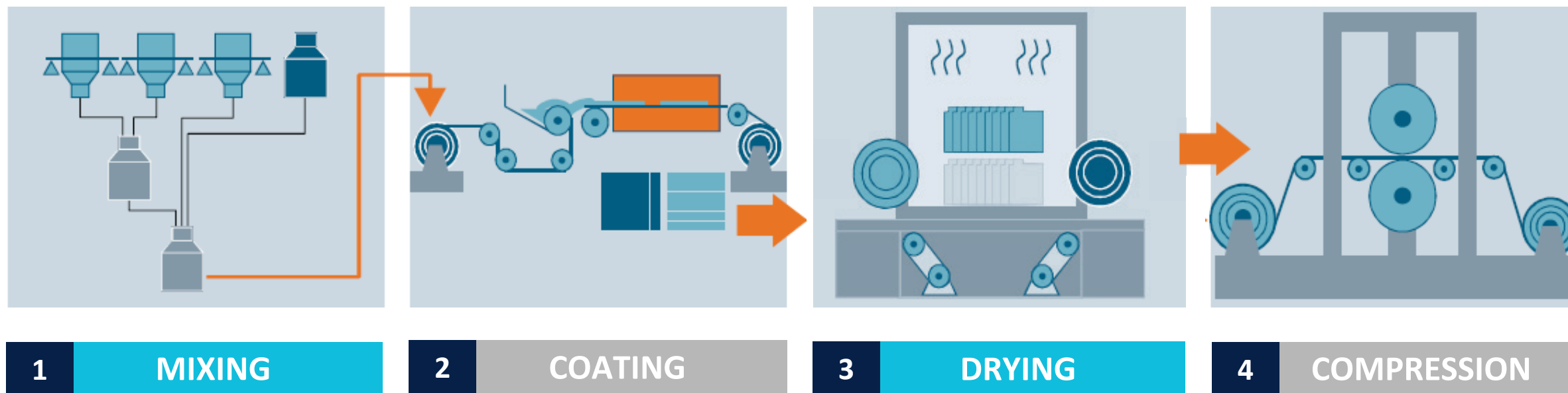
After many cycles with conventional anode

ANTEO X™ BINDER ADDITIVE TECHNOLOGY

Anteo X designed with the intent to not change any parameters on existing manufacturing processes

- (1) Integrates seamlessly with Mixing Step (1) and activates during Drying Step (3)
- (2) Added to the process as the final component

ADDITION of 

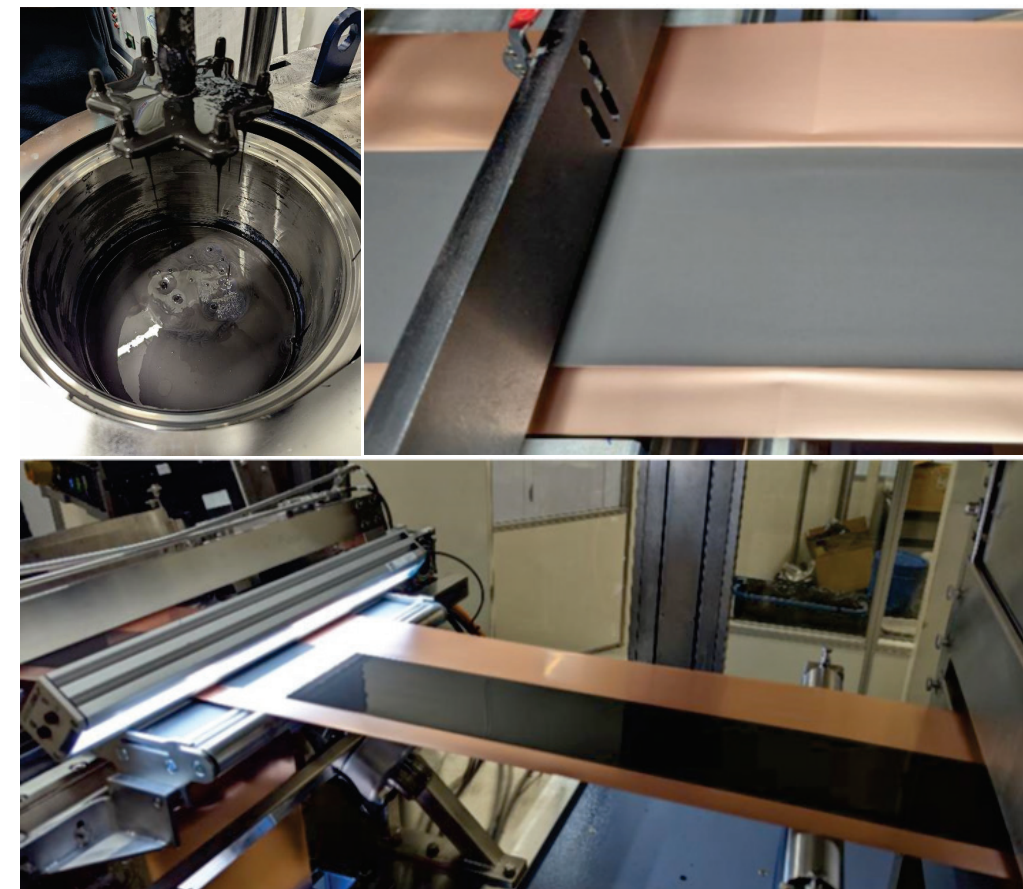
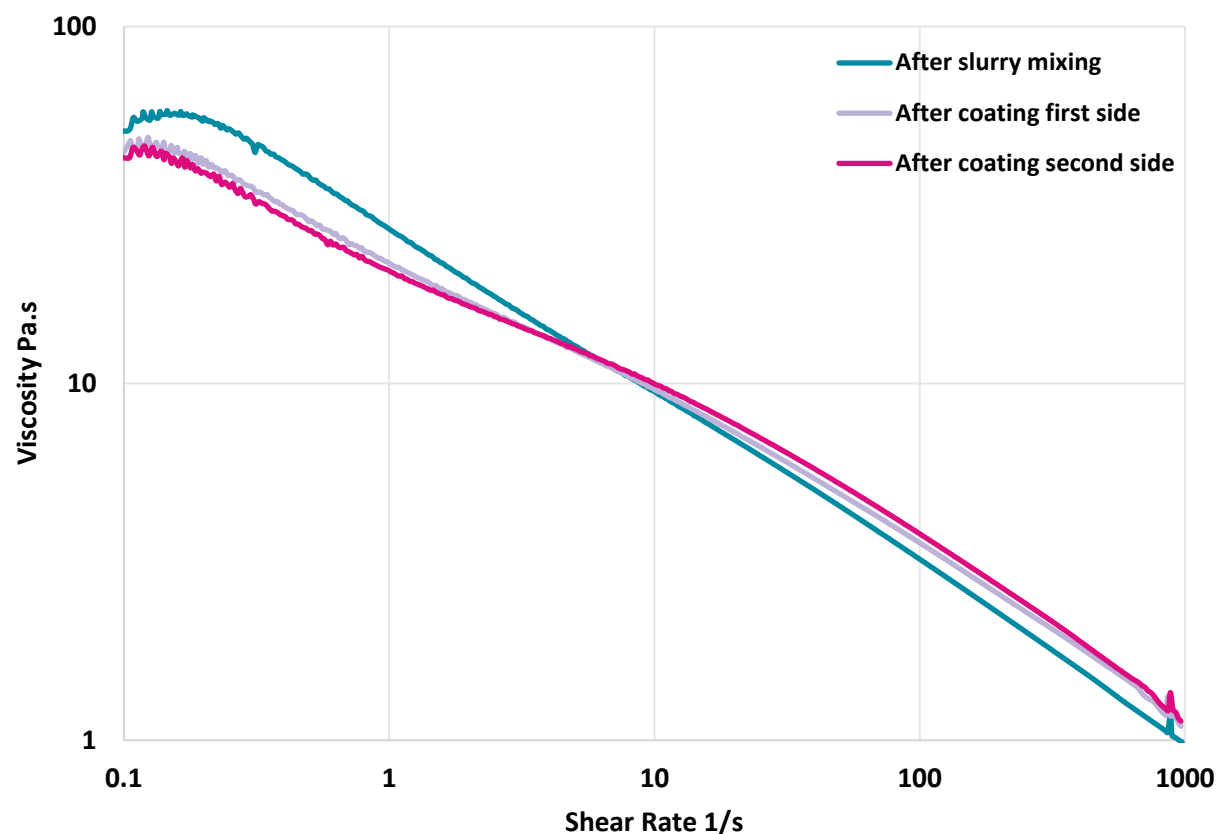


Source: Siemens AG

ANTEO X™ BINDER ADDITIVE TECHNOLOGY

Anteo X designed for ease of integration into existing manufacturing processes

- (1) Confirmed scalability of Anteo X use in larger-scale manufacturing process
- (2) Stable pot-life and slurry rheology throughout process duration



Silicon-carbon composite and Graphite anode optimization

Case study

SILICON ANODE — ACTIVE % VS. INACTIVE %

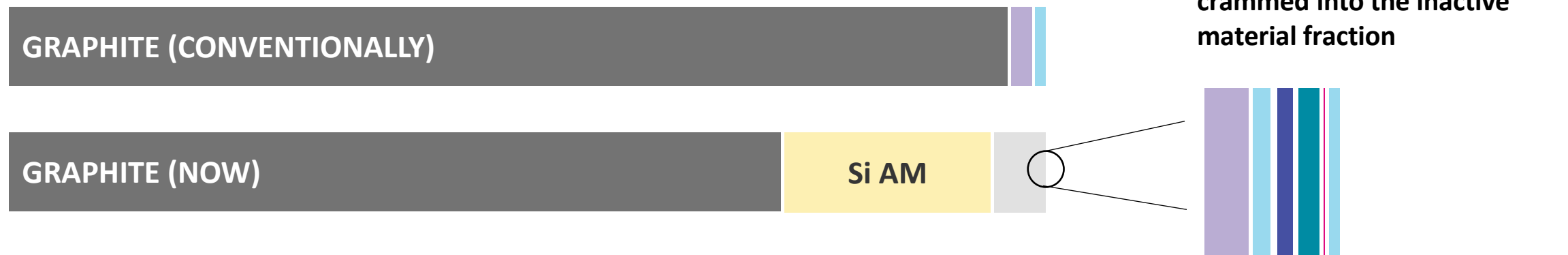
Deep experience and capabilities in silicon anode development and designs

Optimising the inactive material fraction matters

- Optimisation of <5wt.% of the anode composition can create substantial performance and cost advantages
- Incorporation of silicon AMs into anodes triggered the uptake of advanced components for the inactive material fraction
- Provides companies with more levers to improve performance but also makes formulation development more time-consuming

Partnering for acceleration

- Expertise in formulation development across range of binders and conductive/structural additives
- Anteo X binder additive technology improves silicon integration and stabilisation
- Flexible approach to partnerships to support the advancements of commercial battery solutions

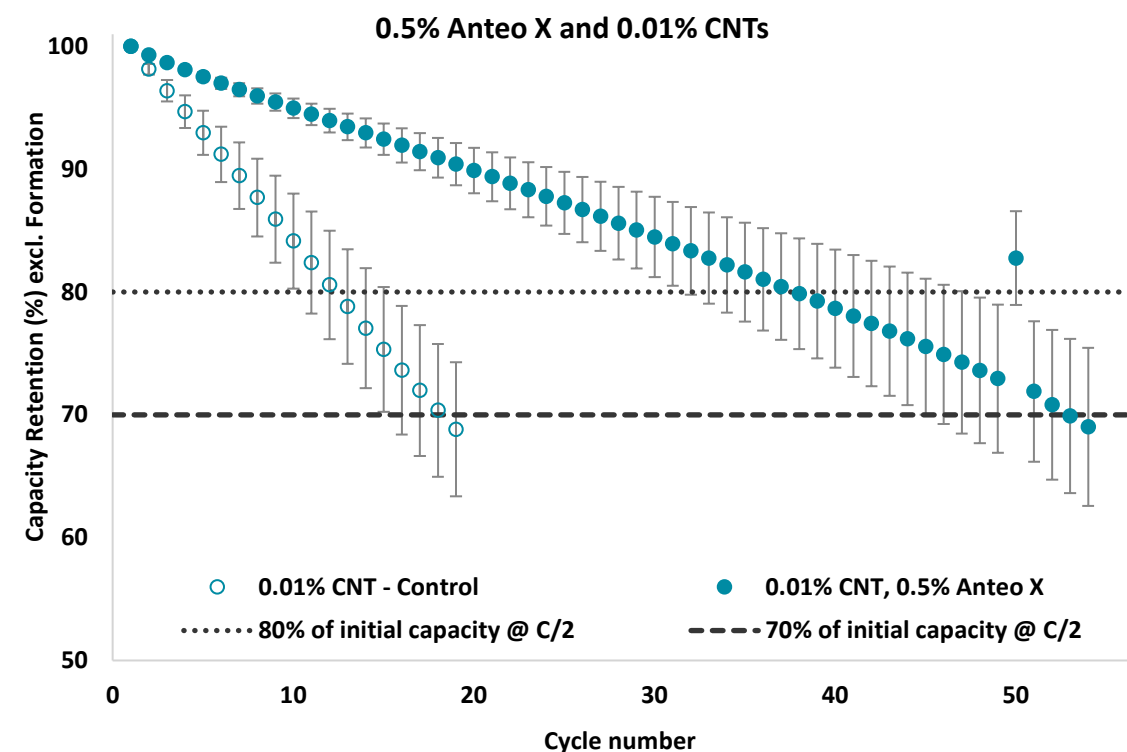
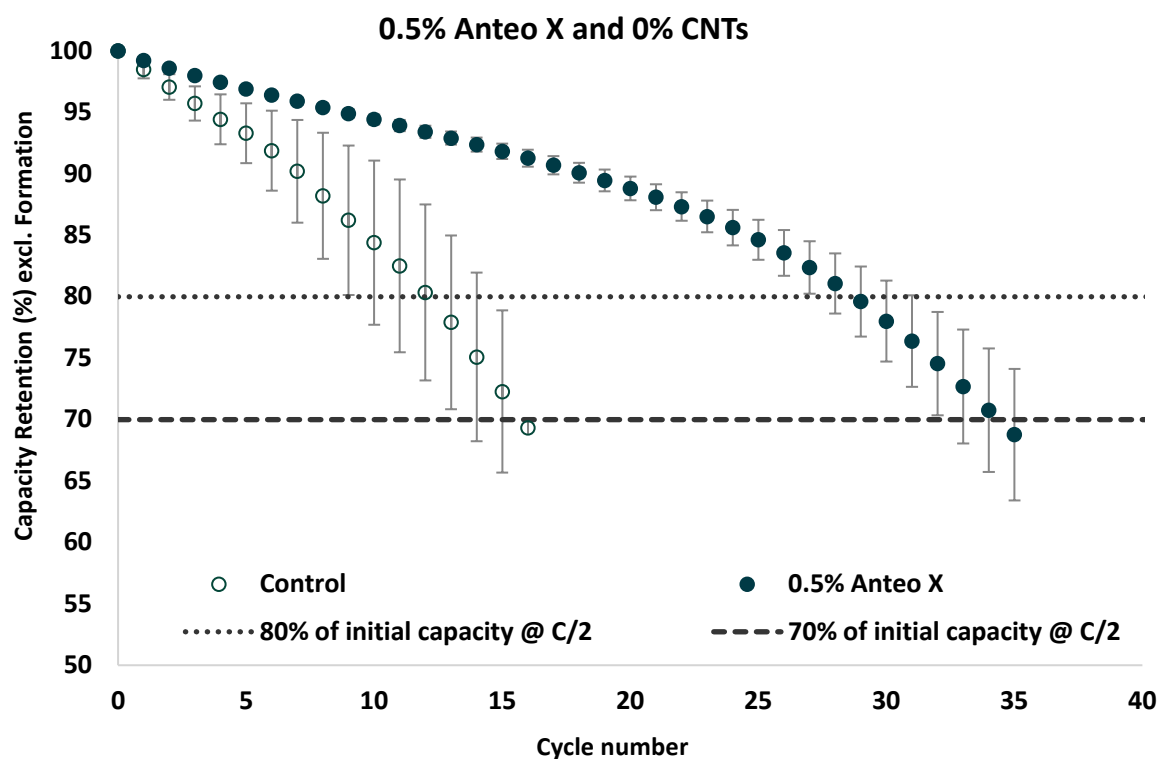


SILICON CARBON COMPOSITE ANODE

Clear impact of Anteo X addition on silicon anode performance

(1) Baseline experiment to evaluate response of anode system to the change in one parameter

- Anode coating capacity at C/2: ~620 mAh/g paired with NCM532 cathode: 3.8 mAh/cm²
- Binder type: CMC/SBR
- Total binder: 3%



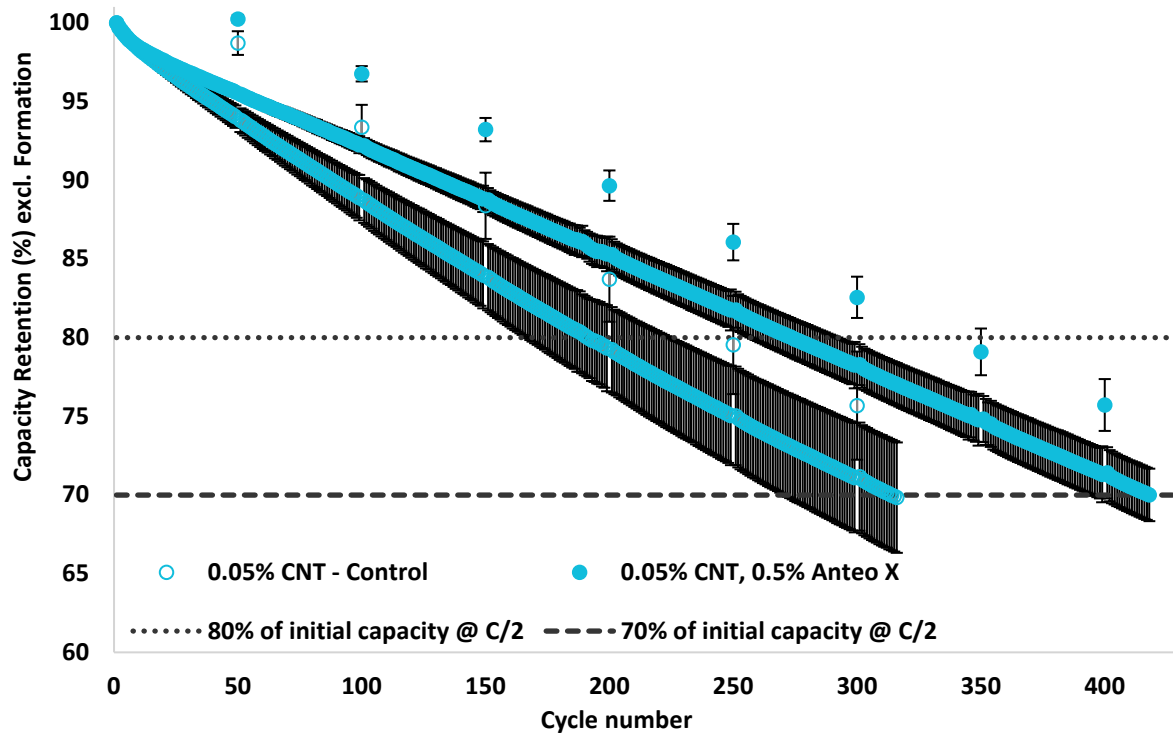
SILICON CARBON COMPOSITE ANODE

Clear impact of Anteo X addition on silicon anode performance

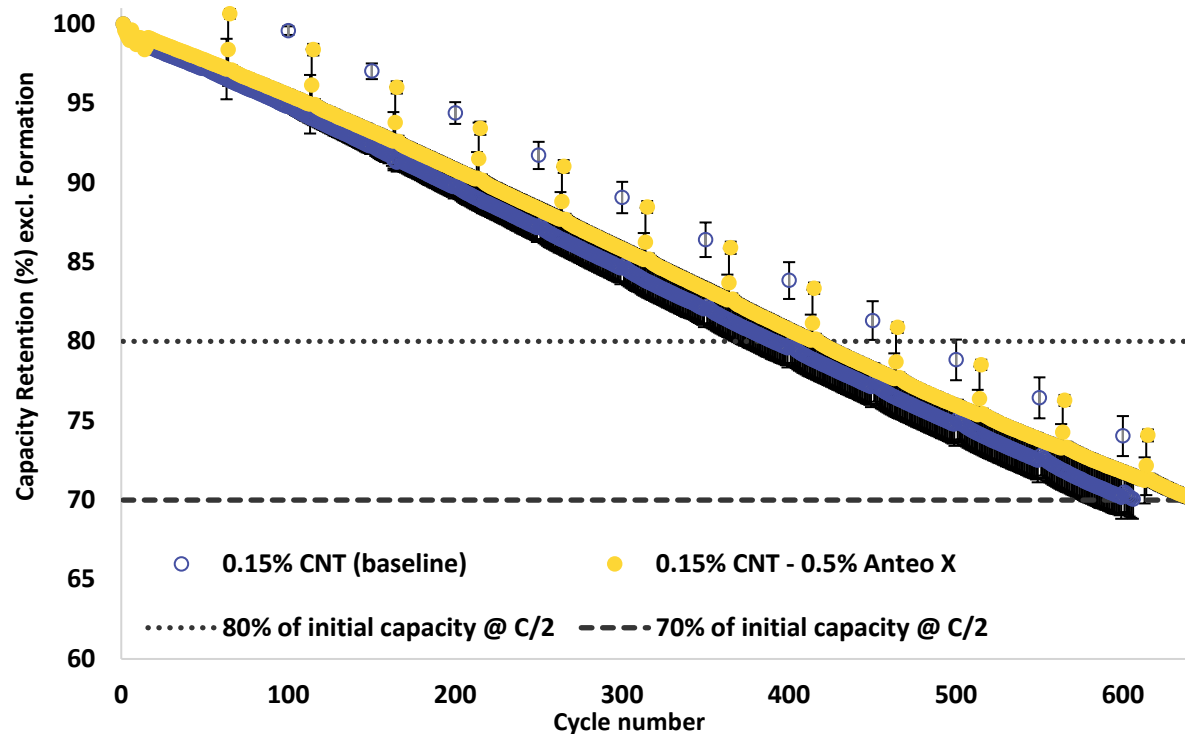
(1) For the same anode configuration, the CNT content was increased to 0.05% and 0.15%

- 0.05% CNT: Addition of Anteo X increased capacity retention by **35%** at 80% capacity retention
- 0.15% CNT: Addition of Anteo X increased capacity retention by **7%** at 80% capacity retention

0.5% Anteo X and 0.05wt% CNTs



0.5% Anteo X and 0.15wt% CNTs

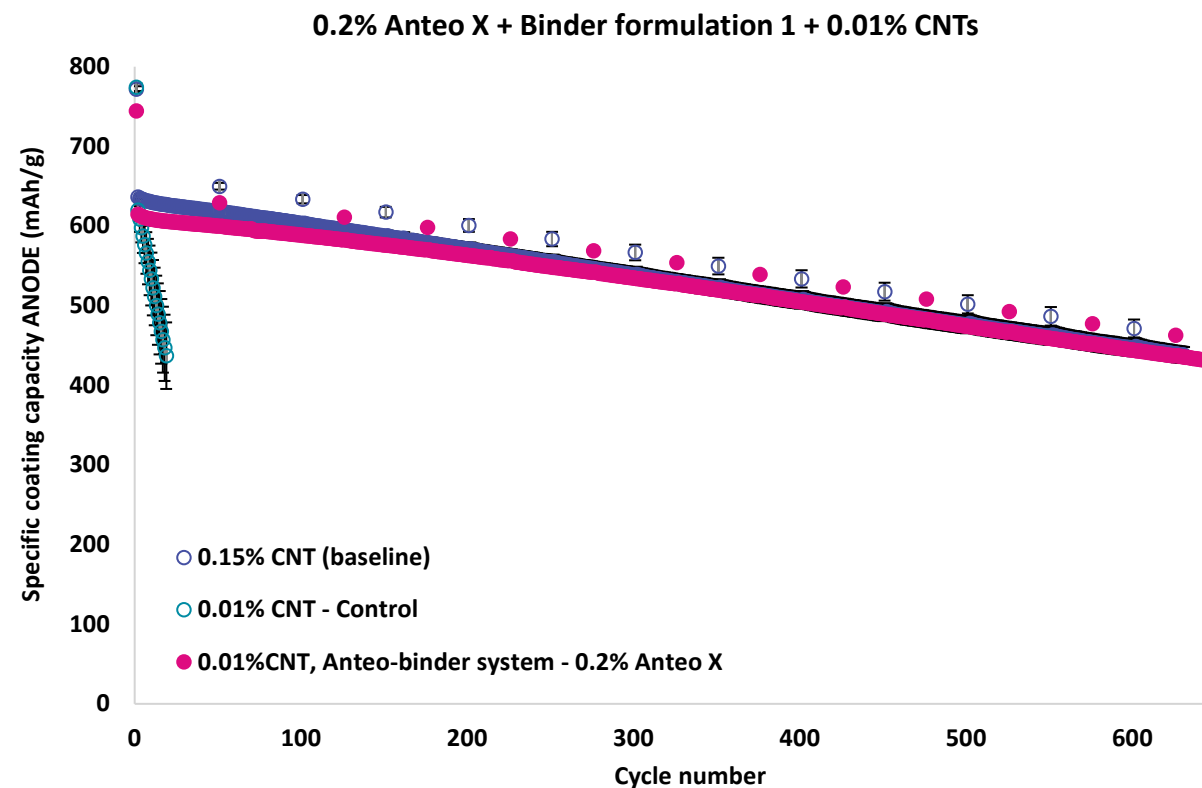
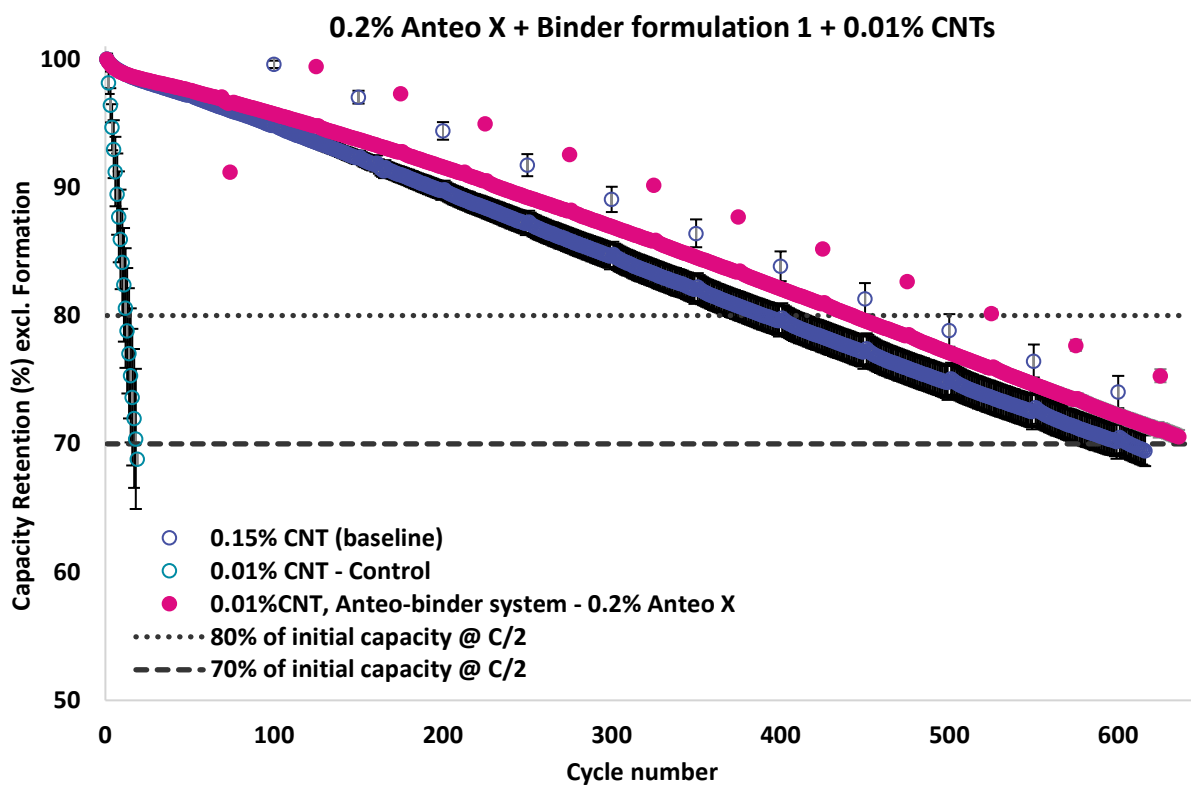


SILICON CARBON COMPOSITE ANODE

Clear impact of Anteo X addition on silicon anode performance

(1) Maximum performance plus potential cost savings enabled by balanced binder composition paired with Anteo X

- **10%** difference in capacity retention at cycle 440
- **15-fold** reduction in CNT content while increasing anode performance



ECONOMICS OF THE INACTIVE MATERIAL FRACTION (IAF)

Potential cost savings by optimizing the inactive material fraction of the anode

Starting position

0.15% CNTs

0% Anteo X

BASELINE

+ % Binder/Carbon

New position

0.01% CNTs

0.20% Anteo X

OPTIMISED

+ % Binder/Carbon

Estimate of impact on EV battery cost

80 kWh battery pack

993 \$US of IAF cost per car (starting position)

404 \$US of IAF cost per car (new position)




Potential savings TOTAL per car: **+589 \$US**

- 59% in costs

- 93% of CNTs

ANTEO X™ – SUMMARY

Binders, Anteo X and CNTs work together to achieve superior performance and cost metrics

-  Binders as well as structural additives play critical roles in enabling silicon anode performance
-  Anteo X and CNTs both work as structural additive by forming networks and providing connectivity
-  Anteo X can be used to optimize the amount of CNTs in the anode formulation

Ultra High Silicon Anode

Pure silicon particle-based anode

THE MARKET IS DEMANDING RAPID COST REDUCTION

Market demands for cost reductions yet simultaneous desire for increased energy density is creating a challenging scenario

- To increase the energy density of anodes the role of silicon needs to evolve from additive to main component
- But the increase in silicon content often comes at significant additional cost



Low cost



Stable performance



Managed expansion



Existing supply chains

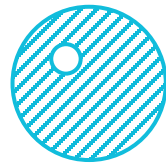


EXTRACTING PERFORMANCE FROM SILICON ANODES IS A MULTI-FACETED PROBLEM

AnteoTech's silicon anode leverages multiple avenues for technological advancement, enabling next-generation battery capabilities



**Anode formulation optimization
and material synergies**



**Advanced surface
coatings on particles**



**Electrode post
treatment**



**Cell design
and components**

- **Combining know-how and complementary technologies, AnteoTech's Si anode design is targeting a step change in battery performance at reduced cost**

ANTEOTECH'S ULTRA HIGH Si ANODE DESIGN

AnteoTech's approach utilizes low grade, unrefined silicon, combined with company IP and complementary technologies to deliver a step change in battery performance



650 charge / discharge cycles

demonstrated whilst retaining 80% of the initial capacity with ICEs of >90% possible



Low grade, unrefined silicon

competitors use super refined silicon - expensive, limited and carbon intensive



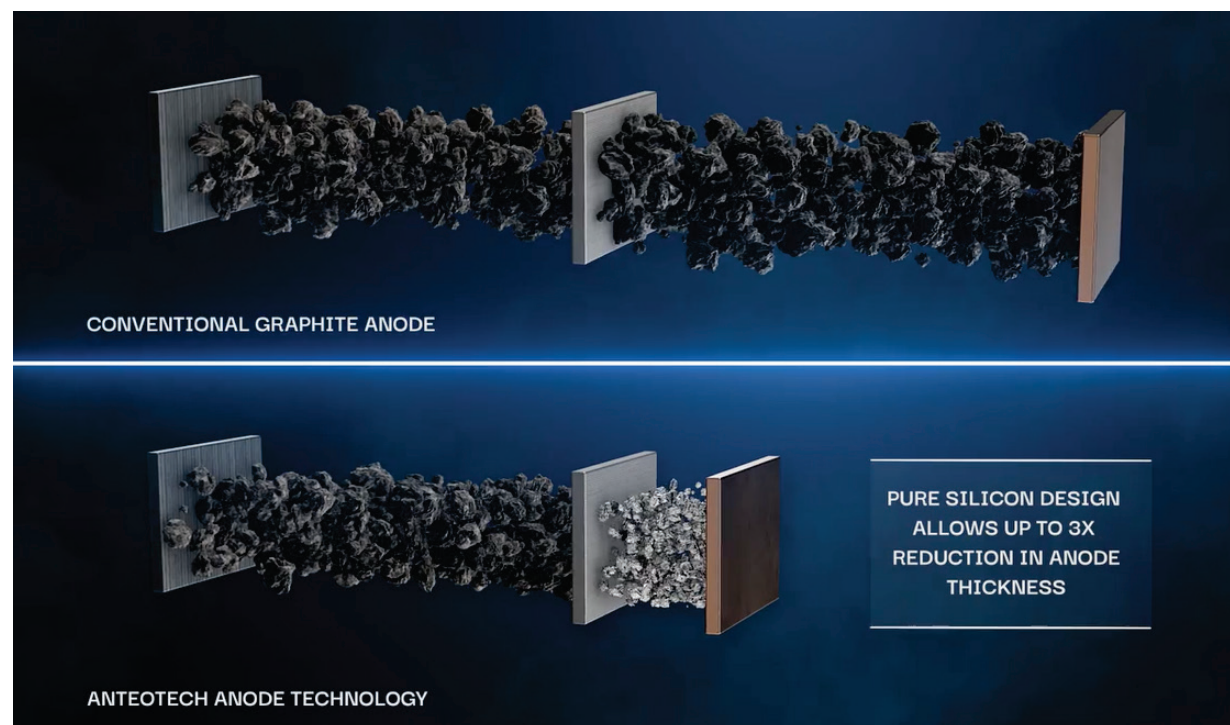
8.5x cheaper

active material on a \$/kWh basis



35% improvement target

in energy capacity



ULTRA HIGH Si ANODE DESIGN – Targeting >1000 mAh/g

Combining know how and complementary technologies to provide a step change in battery performance

2021 DESIGN: 625mAh/g @ C/2

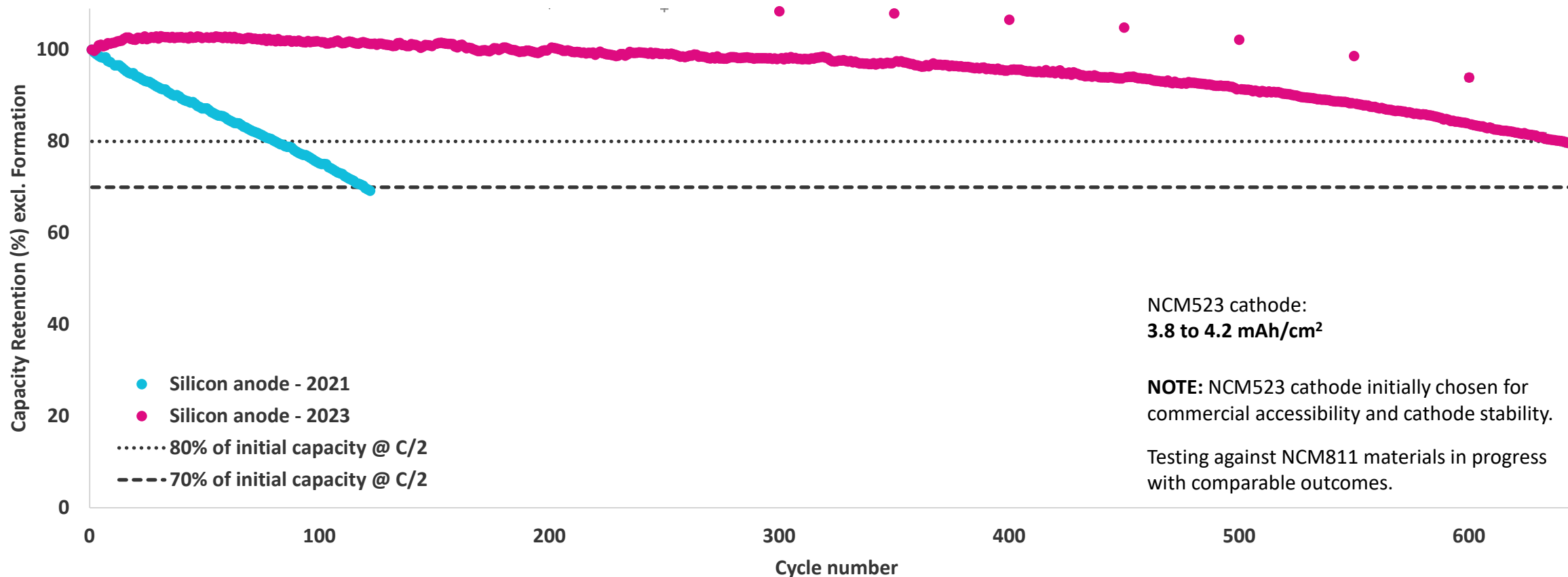
NCM523 full cell

80 cycles @ 80% capacity retention

2023 DESIGN: 725mAh/g @ C/2

NCM523 full cell

650 cycles @ 80% capacity retention



ANTEOTECH – CLEAN ENERGY TECHNOLOGY DIVISION

Commercializing technologies that enhance the storage and management of energy across multiple sectors

Anteo X™



Product development completed

Successfully trialled in R2R manufacturing runs
Stable slurry rheology
ISO9001 conforming product development

First Anteo X Revenues



Anteo X paired with optimised anode

Anteo X in tailored anode sold to major EV manufacturer
Evaluations underway for Anteo X to be a performance enhancer in their next gen battery

Contract Services – Si Anode



Optimisation of inactive material fraction

Delivery of improved performance and cost reductions for silicon anodes
Customer projects completed

Anteo X Production Facility



Located at Brisbane, Australia HQ

Facility completed February 2024
20,000 litre annual capacity
Scale-up to 80,000 litres at nominal cost

Ultra-High Silicon Anode



650 cycles @ 80 % capacity retention

AnteoTech proprietary Ultra-High Silicon Anode development program, utilising low grade unrefined silicon

First scaled-up production - Ultra High silicon anode



Production of proprietary double sided Ultra-High Silicon Anode
Testing indicates that anode performance is easily reproduced at scale



MANUEL WIESER

Chief Technology Officer

manuel.wieser@anteotech.com

anteotech.com

 https://twitter.com/AnteoTech_