



# ASX Announcement

1 April 2022

## Presentation to International Battery Seminar

AnteoTech Ltd (ASX: ADO) ("AnteoTech" or "the Company") provides the attached presentation, which is being presented by Mr Manuel Wieser, AnteoTech, Head of Energy, at the International Battery Seminar, in Orlando, Florida, on Thursday 31 March at 2.25 pm (Eastern Daylight Time).

The International Battery Seminar is an industry event bringing together leading OEM's and cell manufacturers, showcasing the state of the art of worldwide energy storage technology developments for consumer, automotive, military, and industrial applications.

AnteoTech's presentation titled "*Binder Networking Made Easy: Drop-In Cross-Linker Additives for High Silicon Content Anodes*" focuses on the Energy division's work in developing the cross-linker additive AnteoX™ for pairing with water-based binders. The presentation showcases the versatility of AnteoX as it is applied to various binder chemistries and the electrochemical test results, which form the culmination of the most recent work in the binder program. The data has, of necessity, been kept confidential and can now be made public.

Of particular note are the positive results obtained from in-house testing of cycling capacity retention when using AnteoX in a silicon-rich anode that delivers more than 1000mAh/g of anode coating capacity in a full cell battery. The inclusion of AnteoX in the binder formulation improves the cycle life of the battery by up to 100%, maintaining 70% capacity retention at 200 cycles.<sup>1</sup>

The presentation also highlights results recently received from Collaborator 8's testing, demonstrating AnteoX achieves a substantial improvement in mechanical strength when paired with a commercial PAA co-polymer binder product. The samples containing AnteoX showed an up to 56% increase in ultimate tensile strength when compared to a control, along with an increase in the elastic modulus of the binder. The increase in strength is evidence of the strong cross-linking effect facilitated by AnteoX and the increase in the elastic modulus of the binder material has been shown to be an important factor in managing the volume expansion of silicon-containing anodes, thereby improving their electrochemical performance and longevity.

The team is very encouraged by Collaborator 8's test results as they provide yet another technical proof point of AnteoX's benefit with the Collaborator's existing binder product. The results are planned to be communicated to Collaborator 8's customers, while AnteoTech will continue to work closely with Collaborator 8 to firm up a range of business opportunities.

In parallel, AnteoTech is targeting to replicate these results with other Collaborators in the binder space that offer different binder chemistries to the industry. Mr Wieser is being accompanied to the

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<sup>1</sup> Result is representative for use of ANTEO X in a >1000mAh/g m -silicon anode design of the composition used.

conference by Ms Glenda McLoughlin, AnteoTech non-executive director and the newly appointed Chief Commercial Officer-Energy, Mr Conor Marley, to both support Manuel and familiarise themselves with the most recent industry developments.

Mr Marley joins AnteoTech's Energy division as an interim appointee coming from a long career in the energy sector which has included Global Vice President roles with Chevron covering Downstream Energy & Chemicals in sales and marketing and more recently Asia Pacific Sector Lead for Advisian (a division of Worley Parsons) having responsibility for the Downstream Energy and Chemicals business that delivered business improvement breakthroughs for their clients across the Asia Pacific.

This announcement has been authorised for release by the Board.

**For more information, please contact:**

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**About AnteoTech - (ASX:ADO)**

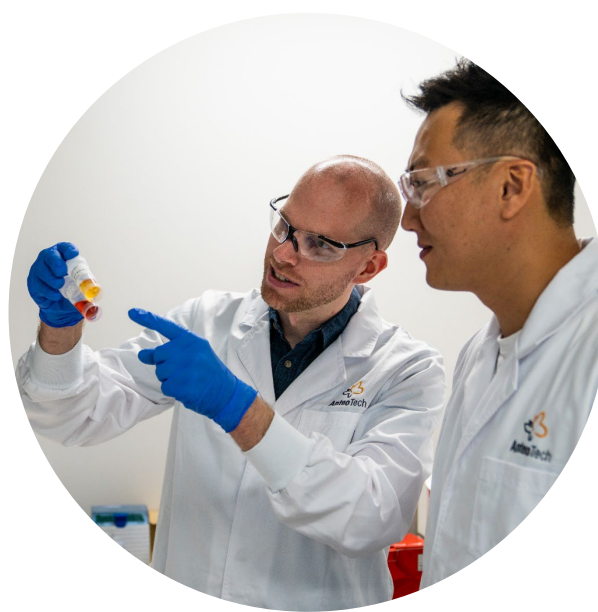
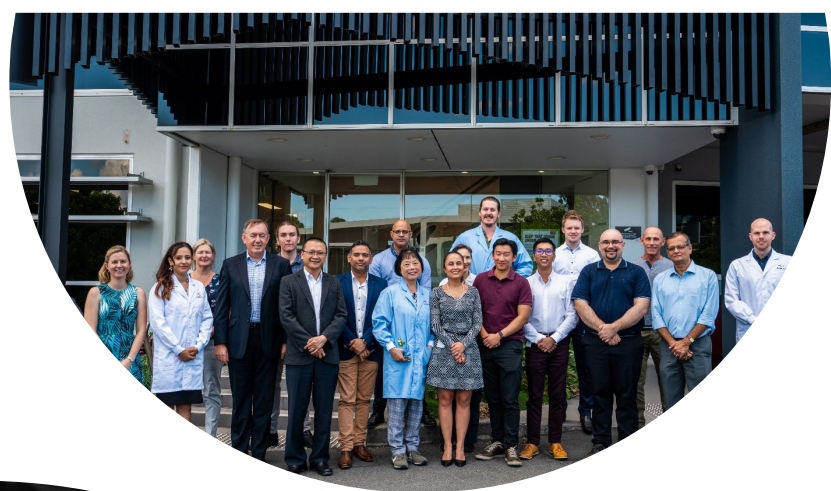
AnteoTech is a surface chemistry company with Intellectual Property ("IP") in its core technology product groups AnteoCoat™, AnteoBind™ and AnteoRelease™. The Company's purpose is to create shareholder value by identifying and solving important global industry problems by providing unique value-add solutions for its customers. Customers operate in the life sciences, diagnostics, energy and medical devices markets.

**AnteoTech - Social Media Policy**

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# AnteoTech – Silicon anode program

**Binder networking made easy: Drop-in crosslinker additives for high silicon content anodes**

**Presented by Manuel Wieser, Head of Energy Business**

**International Battery Seminar – Orlando Florida  
31<sup>st</sup> March 2022**



# Disclaimer



## **Important Information**

The purpose of the presentation is to provide an update of the business of AnteoTech Ltd (ASX:ADO) (AnteoTech). These slides have been prepared as a presentation aid only and the information they contain may require further explanation and/or clarification. Accordingly, these slides and the information they contain should be read in conjunction with past and future announcements made by AnteoTech and should not be relied upon as an independent source of information. Please contact AnteoTech and/or refer to the Company's website for further information.

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## **Forward-looking statements**

The presentation may contain certain "forward-looking statements". Forward-looking statements can generally be identified by the use of forward-looking words such as "may", "will", "would", "could", "expect", "intend", "plan", "aim", "estimate", "target", "anticipate", "believe", "continue", "objectives", "outlook", "guidance" or other similar words, and include statements regarding AnteoTech's intent, belief or current expectations with respect to AnteoTech's business and operations, market conditions, results of operations and financial condition, capital adequacy and risk management. These forward looking statements should not be relied upon as a representation or warranty, express or implied, as to future matters. Prospective financial information has been based on current expectations about future events and is, however, subject to risks, uncertainties, contingencies and assumptions that could cause actual results to differ materially from the expectations described in such prospective information. AnteoTech disclaims any obligation to update any forward looking statement to reflect events or circumstances after the date of the presentation, subject to the disclosure requirements applicable to the Group.

## **Not an offer of securities**

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# AnteoTech - Today

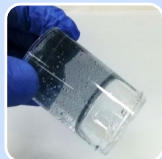
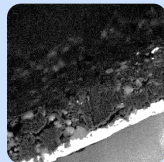
AnteoTech is commercializing innovative patented nano-technology  
Active in two growth sectors: Lithium-ion battery market and Point of Care (PoC) diagnostics



## ENERGY BUSINESS – Silicon enabling products

- Cross-linker additives (AnteoX™)
- Advanced binder solutions (AnteoLink™)
- Silicon dominant anode designs

  
ANTEOX







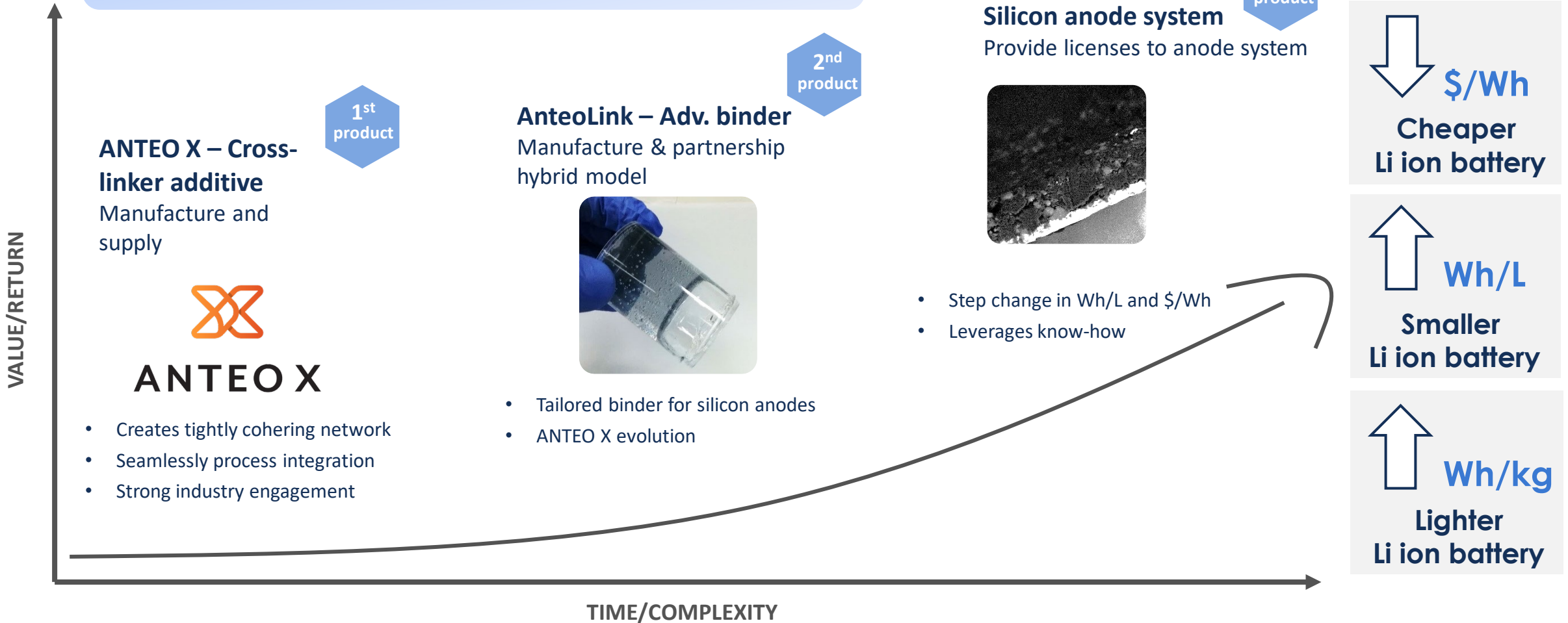
## POC DIAGNOSTIC BUSINESS – Reagents, rapid tests and services

- Improving PoC testing & assay development in diagnostics, drug development
- Proven product in market – AnteoBind™
- Rapid Diagnostic PoC Platform EuGeni™



# Technology development roadmap

Silicon enabling products + anode design know-how =  
**Pathway to smaller, lighter and cheaper batteries**



# ANTEO X™

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Cross-Linker Additives (CLAs) for water-based anode binders



# The silicon challenge from a binder perspective

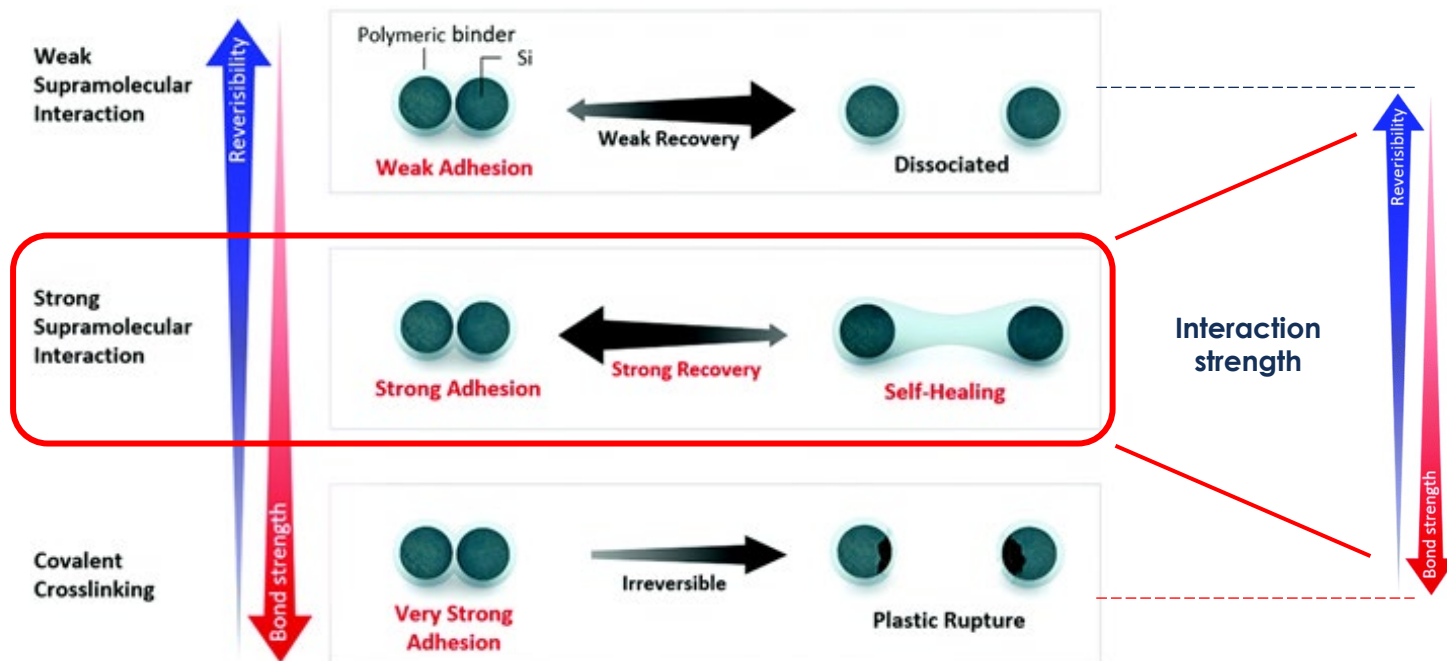


- Binders are an integral part of electrodes of lithium-ion batteries and act by facilitating
  - 1) Particle dispersion
  - 2) Electrode homogeneity
  - 3) Structural integrity
  - 4) Conductive network structure
- With increasing levels of silicon incorporated into the anode repeated expansion and contraction causes stress on the electrode structure
  - This stress largely falls onto to the binder to compensate
- To advance silicon anode technology **we need advanced binders!**



# Binders and interaction mechanisms

- Conventional binders are typically linear synthetic organic or natural polymers providing weak physical attractive forces
- Advanced-type binders are utilising chemical cross-linking to create binder networks and to strengthen the binding forces



Developed IP position on a suite of compounds covering supramolecular interactions from weak to strong



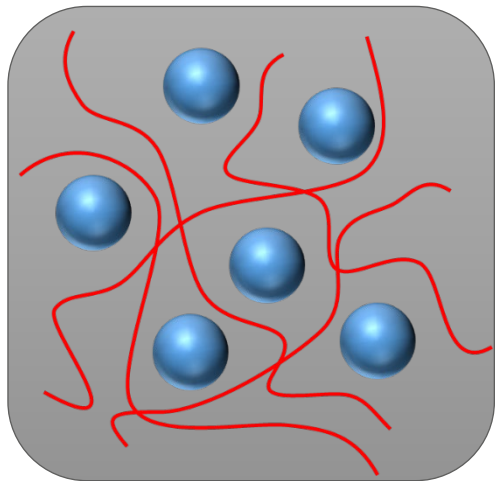
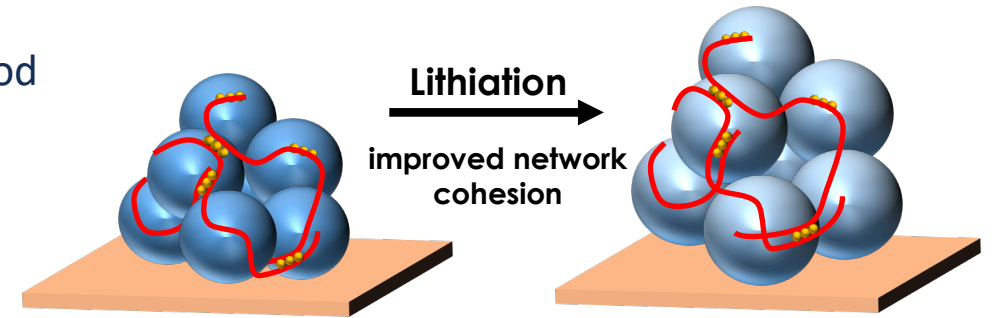
Can we combine the benefits of all three interaction mechanisms into one binder system?

Source: Kwon et al. The emerging era of supramolecular polymeric binders in silicon anodes *Chem. Soc. Rev.*, 2018, **47**, 2145-2164

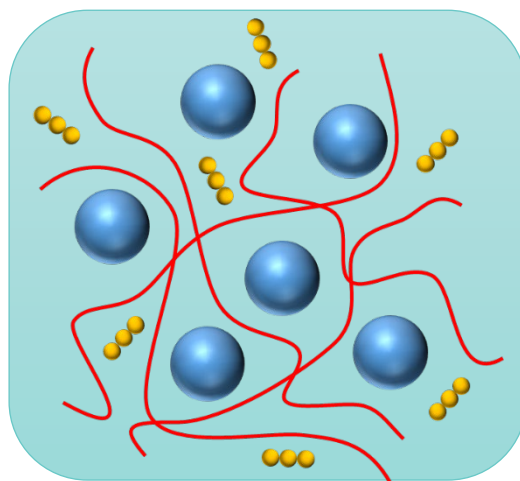
# ANTEO X/advanced binder for anode cohesion

## Benefits of AnteoTech's CLA compounds

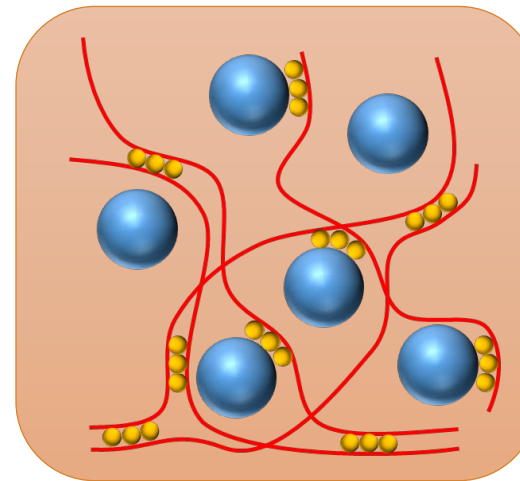
- Water-based cross-linker compound classified as non-dangerous good
- Added as final component to the slurry fabrication process
- Potentially low-cost alternative to complex binder synthesis
- Creates tightly cohering network structure within the anode
- Applied to off-the shelf as well as proprietary binders
- Stable across a wide pH range



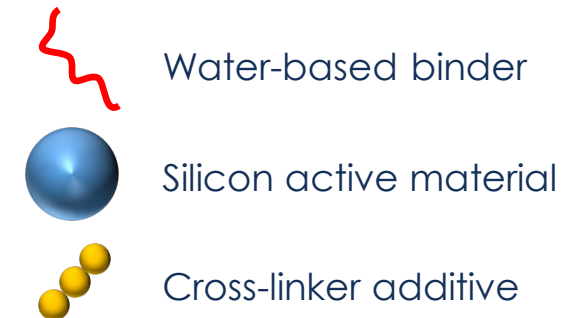
Conventional anode slurry with water-based binder



Addition of water-based Cross-Linker Additive



Electrode coating and curing resulting in cross-linked silicon electrode



# ANTEO X cross-links a range of binder chemistries

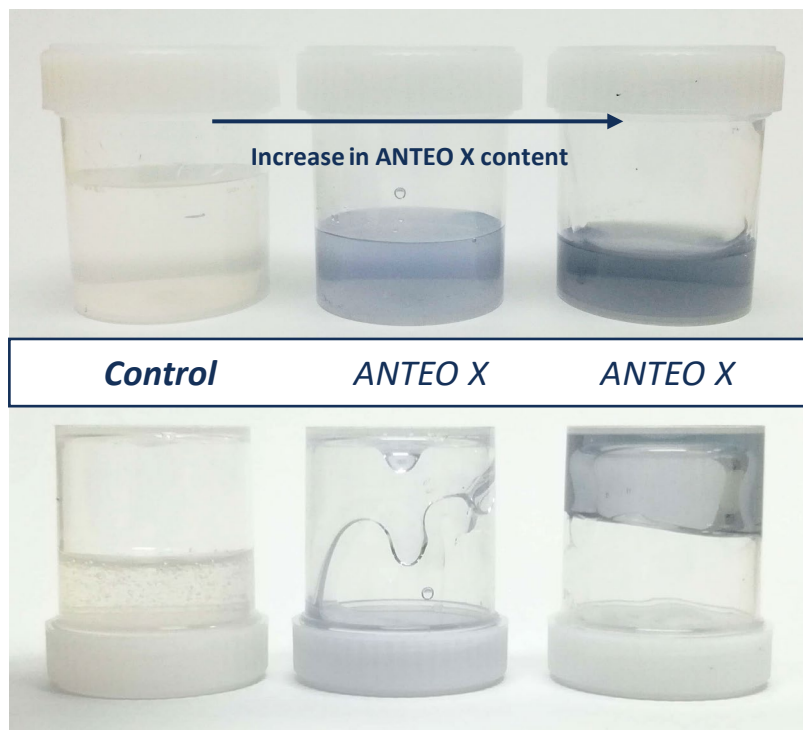


➤ **Demonstrated cross-linking effect with**

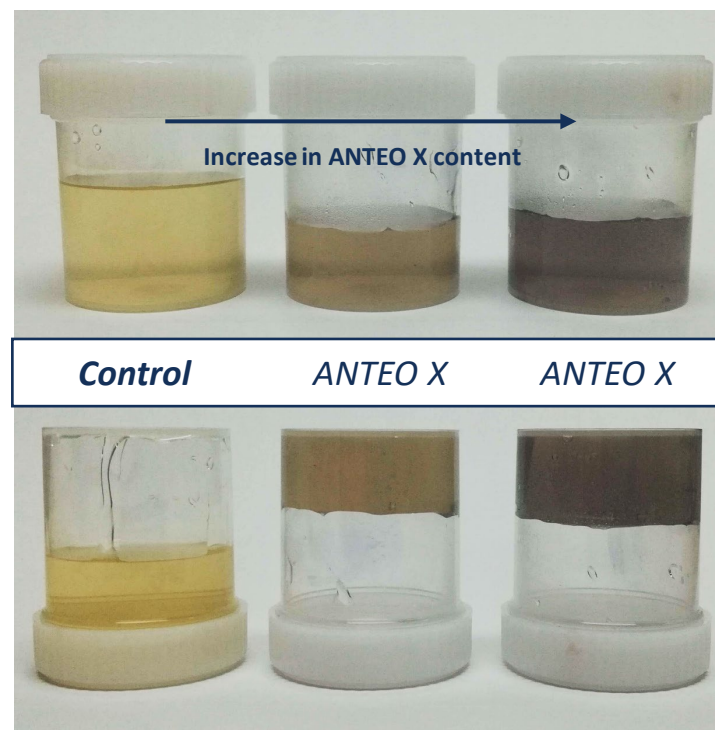
- 1) a wide range of conventional binder types (CMC, PAA, Alginate, etc.)
- 2) proprietary binder chemistries (PAA co-polymers)
- 3) demonstrated compatibility with SBR binder chemistries

➤ **The higher the ANTEO X concentration the stronger the cross-linking effect**

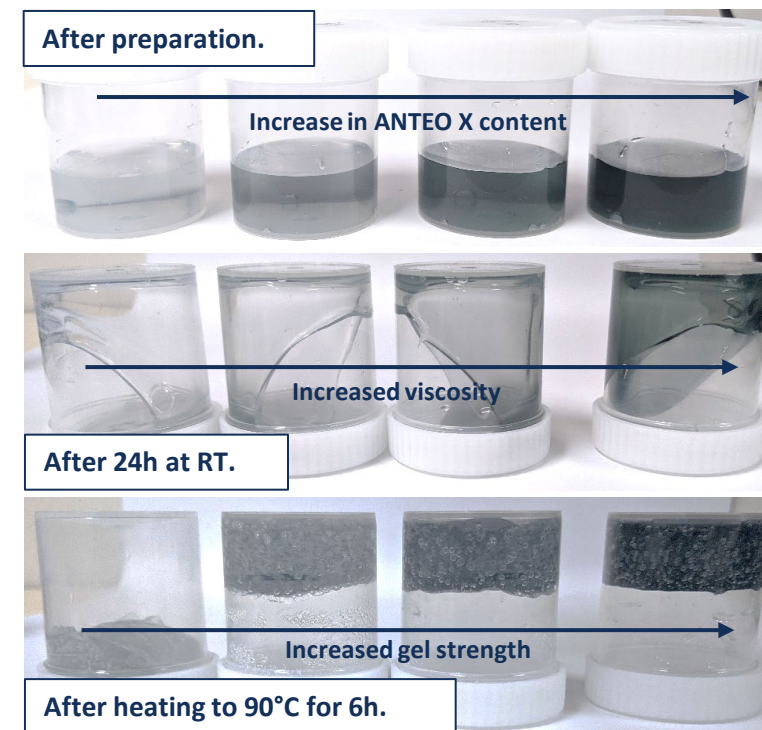
## LiPAA (1,250kDa)\*



## NaAlginate\*



## NaCMC\*



\* sourced from Sigma Aldrich – 6wt.% in H<sub>2</sub>O, 80% neutr. with LiOH

\*sourced from Sigma Aldrich – ≥2,000 cP, 2 % (25 °C), 2 wt.% in H<sub>2</sub>O

\* sourced from MTI – 400,000 g/mol, 1.5 wt.% in H<sub>2</sub>O

# ANTEO X compatibility with SBR binder emulsions

- **Prevalent binder system in the near-term will continue to be CMC/SBR**
  - ANTEO X is compatible with SBR binders by maintaining a stable emulsion
  - CMC/SBR/ANTEO X mixtures demonstrate comparable cross-linking and heat curing effect in hydrogel studies (compared to CMC/ANTEO X blends)
- **Evaluation of performance enhancing effects of ANTEO X on anodes using CMC/SBR binder system currently in progress**

## CMC/SBR hydrogels with ANTEO X

After preparation.



Increase in ANTEO X content

After curing.



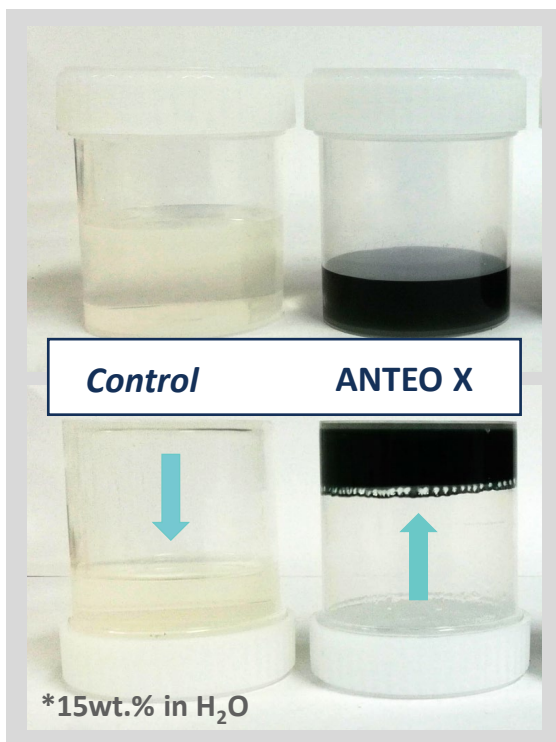
Increase in cross-linking strength

# ANTEO X cross-links a range of binder chemistries

- *The cross-linking effect can be controlled via curing mechanism to ensure slurry processability*
- *Pot life stability of up to 24h, subject to slurry specifications and target properties*

- *Note: Hydrogel/slurry studies are only meant as visual aid to explain cross-linking effect.*
- *Electrode coatings can be dried under standard manufacturing conditions.*

LiPAA (250k g/mol)\*



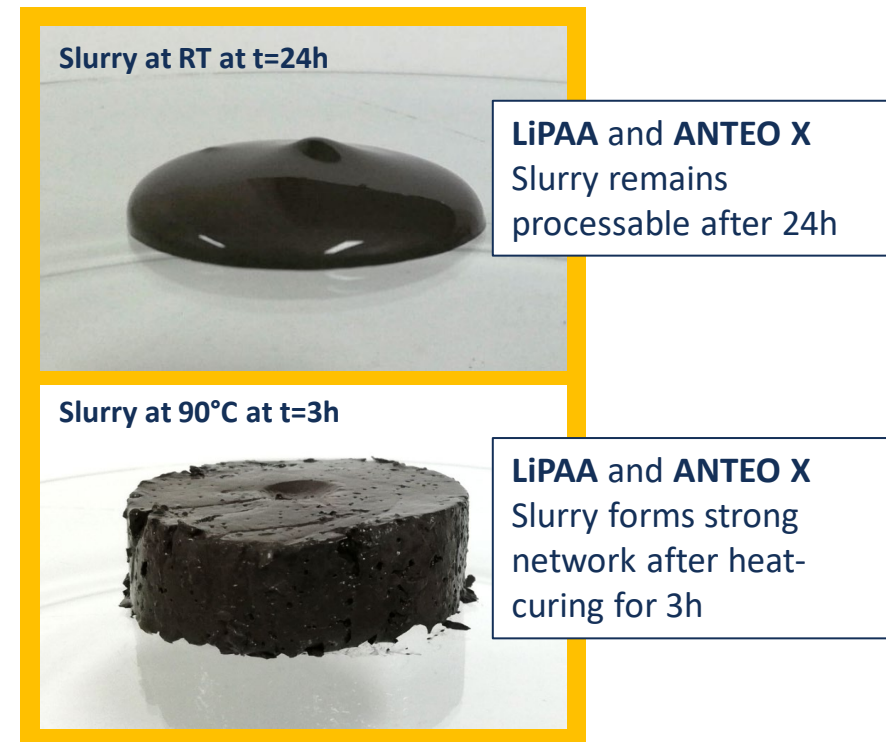
CONVENTIONAL  
SLURRY PROCESS

m-silicon  
LiPAA  
Carbon

Control slurry



Slurry with ANTEO X

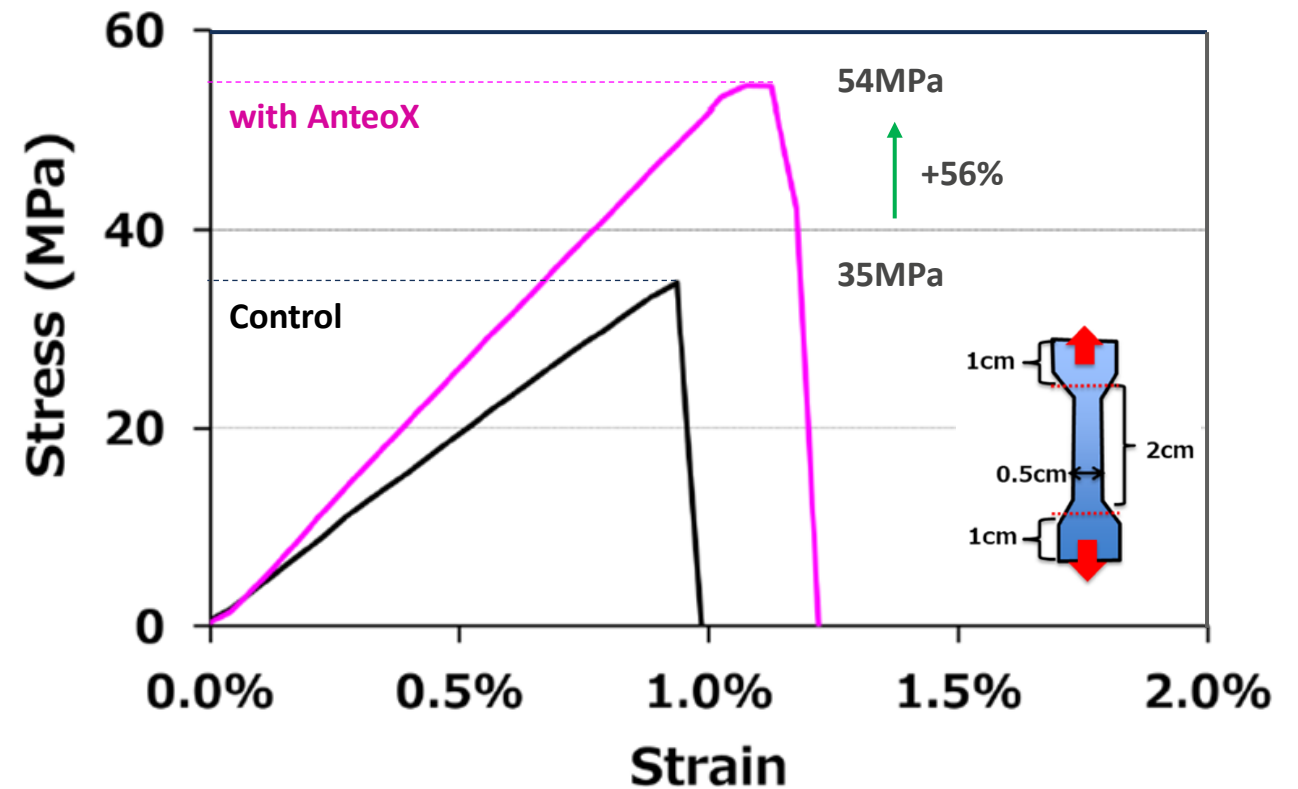


# ANTEO X achieves improvement in mechanical strength when paired with PAA co-polymer

- Effective cross-linking of a commercial PAA co-polymer binder demonstrated via use of ANTEO X
- Addition of ANTEO X resulted in
  - Increase in ultimate strength
  - Increase in elastic modulus
- Previously demonstrated correlation between
  - elastic modulus, reduced expansion and battery performance

**ANTEO X potentially offers simple way to enhance performance of most binders without chemical synthesis**

Tensile strength test



※CLA3 : Cross-linker Additive 3 (Anteo X)

- Sample thickness: 0.08 ~ 0.13 mm
- Tensile Speed: 5 mm/min

# Electrochemical performance

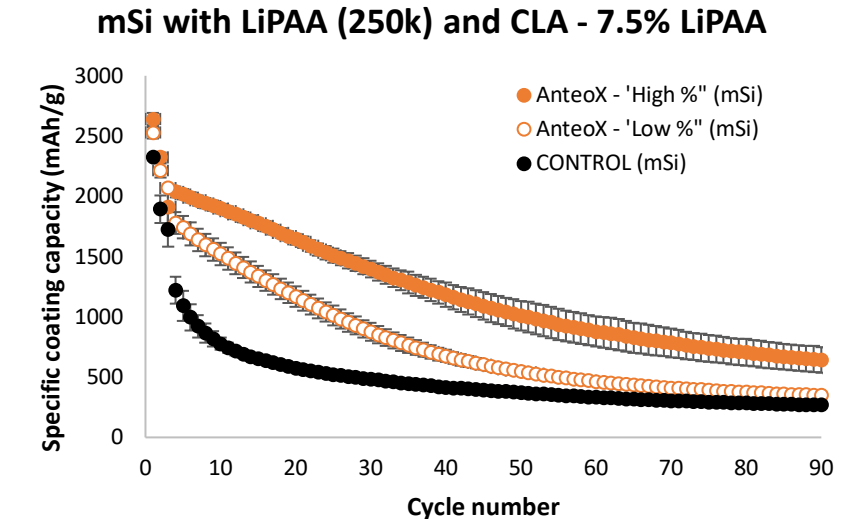
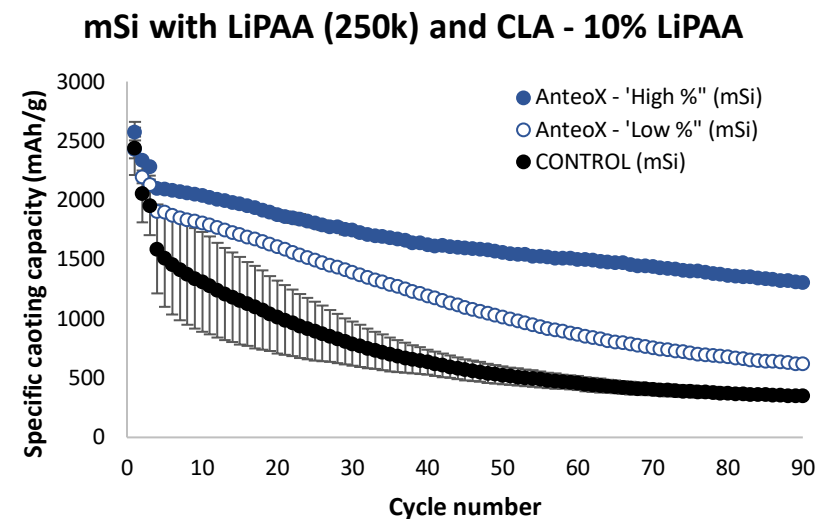
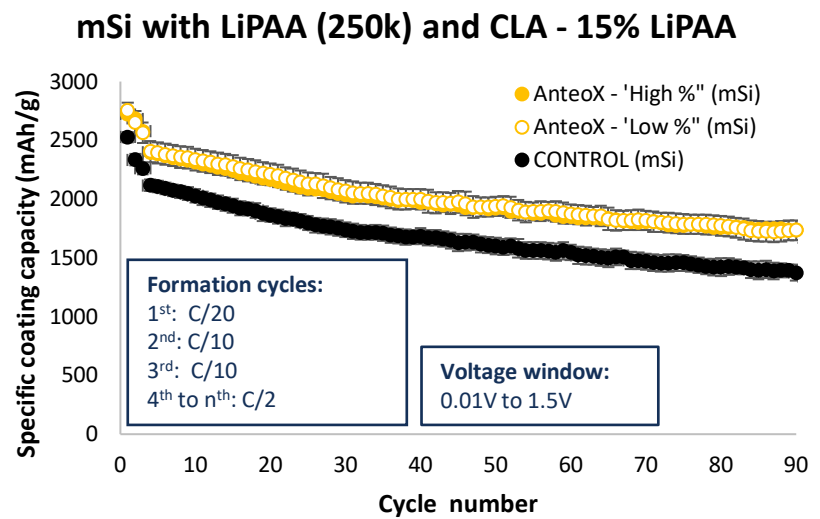
Results and outlook



# ANTEO X stabilizes 70% micro-silicon anode – Half cell



*Cross-linker additive paired with 70% micro-silicon anodes shows substantial improvements in cycling stability by increasing silicon utilization and by stabilizing the anode coating at high as well as low binder content*



**70% mSi electrode target specifications**  
Areal capacity: ~4.0 mAh/cm<sup>2</sup>  
LiPAA is PAA 25% neutr. with LiOH

**Results have been validated in full cells using high silicon content anodes of >1000mAh/g coating capacity at binder levels in between 4% to 8%**

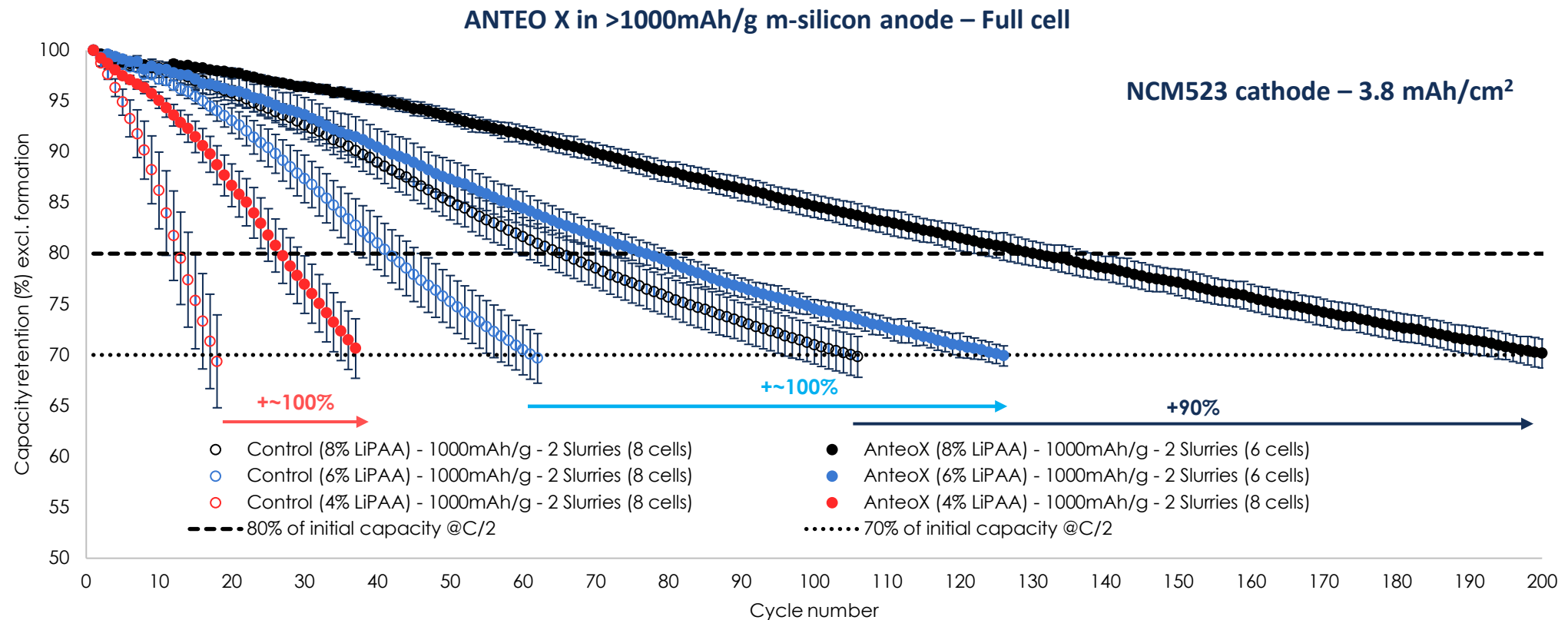


# ANTEO X in >1000mAh/g m-silicon anode – Full cell



## ANTEO X achieves substantial improvements in cycle life for very high-capacity silicon anodes

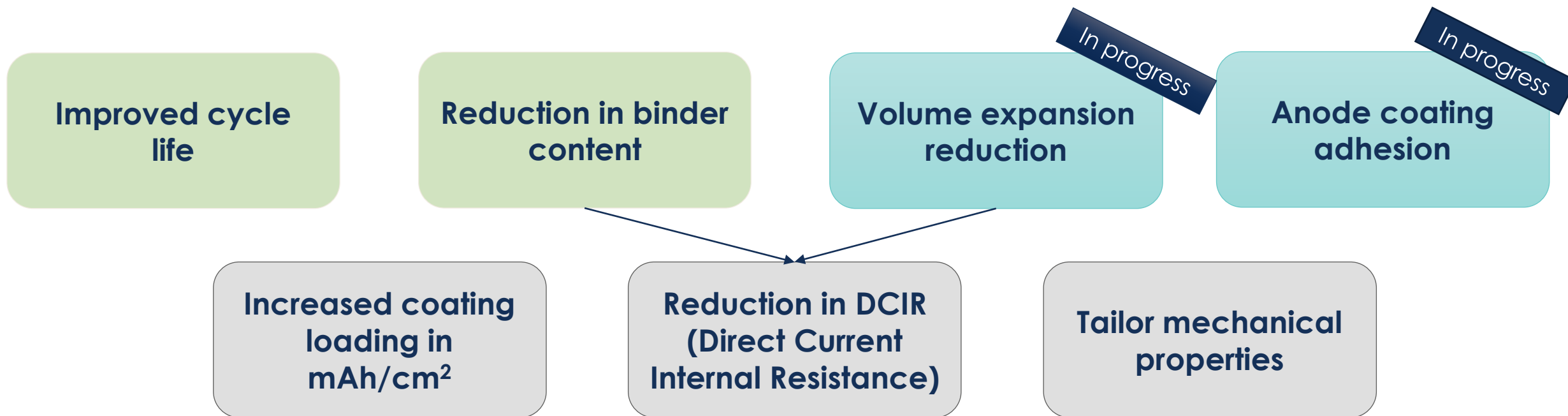
- The lower the binder content the lower the performance
- AnteoX improves performance of electrode at every tested binder level in between 4% to 8%



# Target value propositions for ANTEO X

**ANTEO X can deliver performance improvements along several dimensions with demonstrated improvements in cycle life and reduction in binder content**

- Additional performance enhancing effects are currently under investigation



# Enabling high energy and cost-effect batteries

- **AnteoTech and partners - VISION**

- Roadmap to **>1000mAh/g** and **>800mAh/cm<sup>3</sup>** of coating capacity based on joint product offering
- Extremely cost competitive active material with established ton-scale production
- Silicon enabling solutions that improve cycling performance
- Know-how in silicon anode design

- Anode design that directly replaces graphite

- **Micro-silicon anode** that achieves **300+ cycles at 80%** capacity retention in full cells
- Next development milestones are targeting up to **>500 cycles**
- Demonstrated results with adoption ready materials
- No changes to electrode processing methods
- High silicon content in anode 70%+
- Low structural expansion

- Portfolio of performance improvement projects

- Technology refinement that targets mass markets (**>500 cycles**)
- Existing pipeline of performance enhancing projects
- Opportunities for collaboration





**Our mission is to help the industry extract the best performance out of binder chemistries currently in the market**



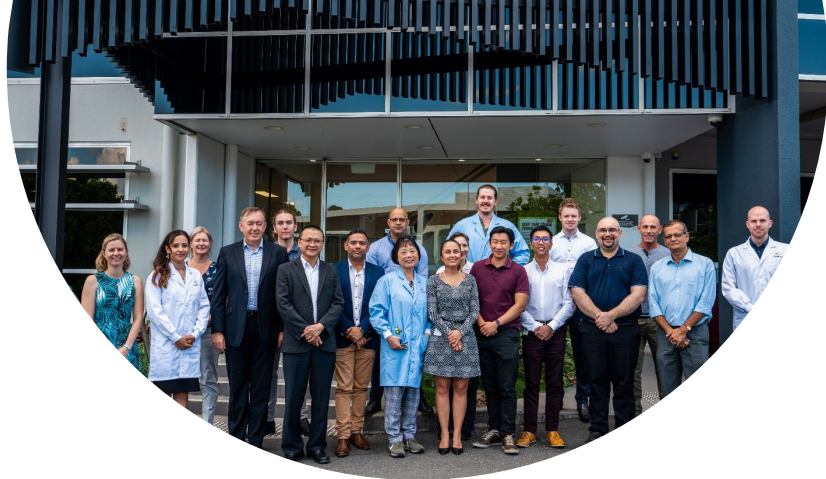
**ANTEO X is being evaluated by several industry partners in Europe and Northern Asia**

- ANTEO X samples are available for evaluation
- ANTEO X scale-up and pilot production plant targeted for 2023/2024



**Looking to establish partnerships to deliver outstanding results and products to the industry**

- Seeking active engagement to develop commercial battery solutions within the ANTEO X binder project as well as silicon anode program



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