



# Leveraging Enovix Architecture to Accelerate Battery Performance

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# The Enovix Advantage



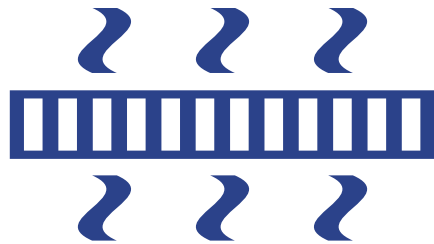
Patented Battery  
Architecture and  
Process Technology



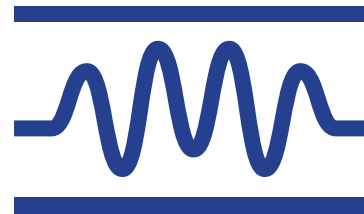
Enables 100%  
Active Silicon  
Anode



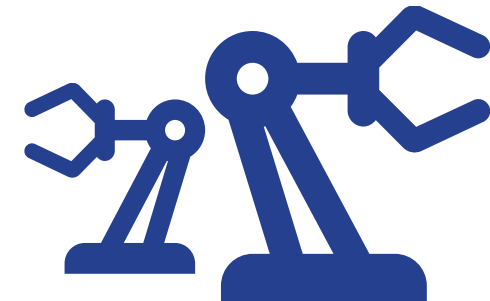
Step-Change  
Increase in Energy  
Density



Exceptional thermal  
performance



BrakeFlow Technology –  
Significantly Increases  
Tolerance to Internal Shorts



Scaling up commercial  
production in 2022 with  
multiple facilities planned

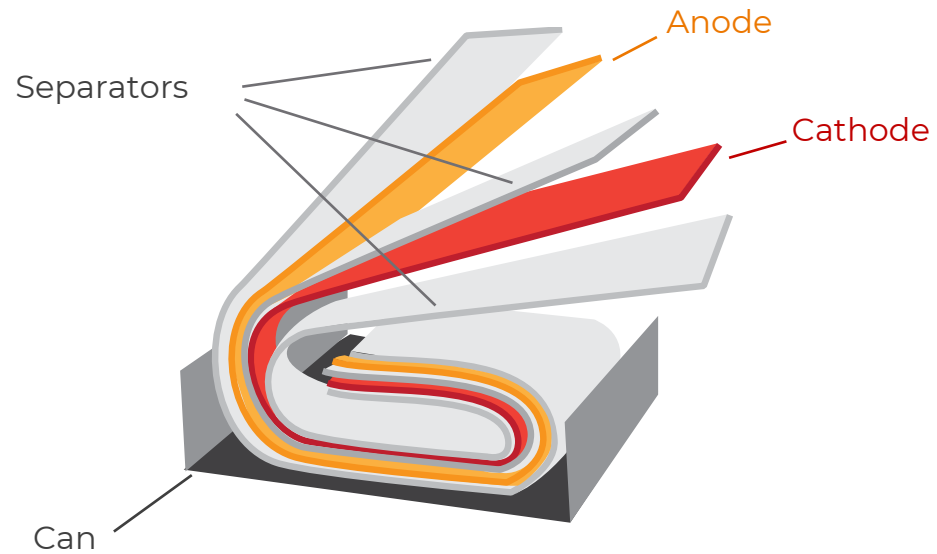


# Fab-1: Fremont, CA

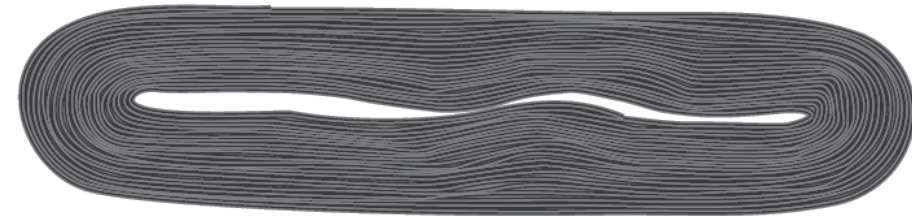


# Conventional Cell Architecture

Conventional **Wound** Lithium-ion Cell

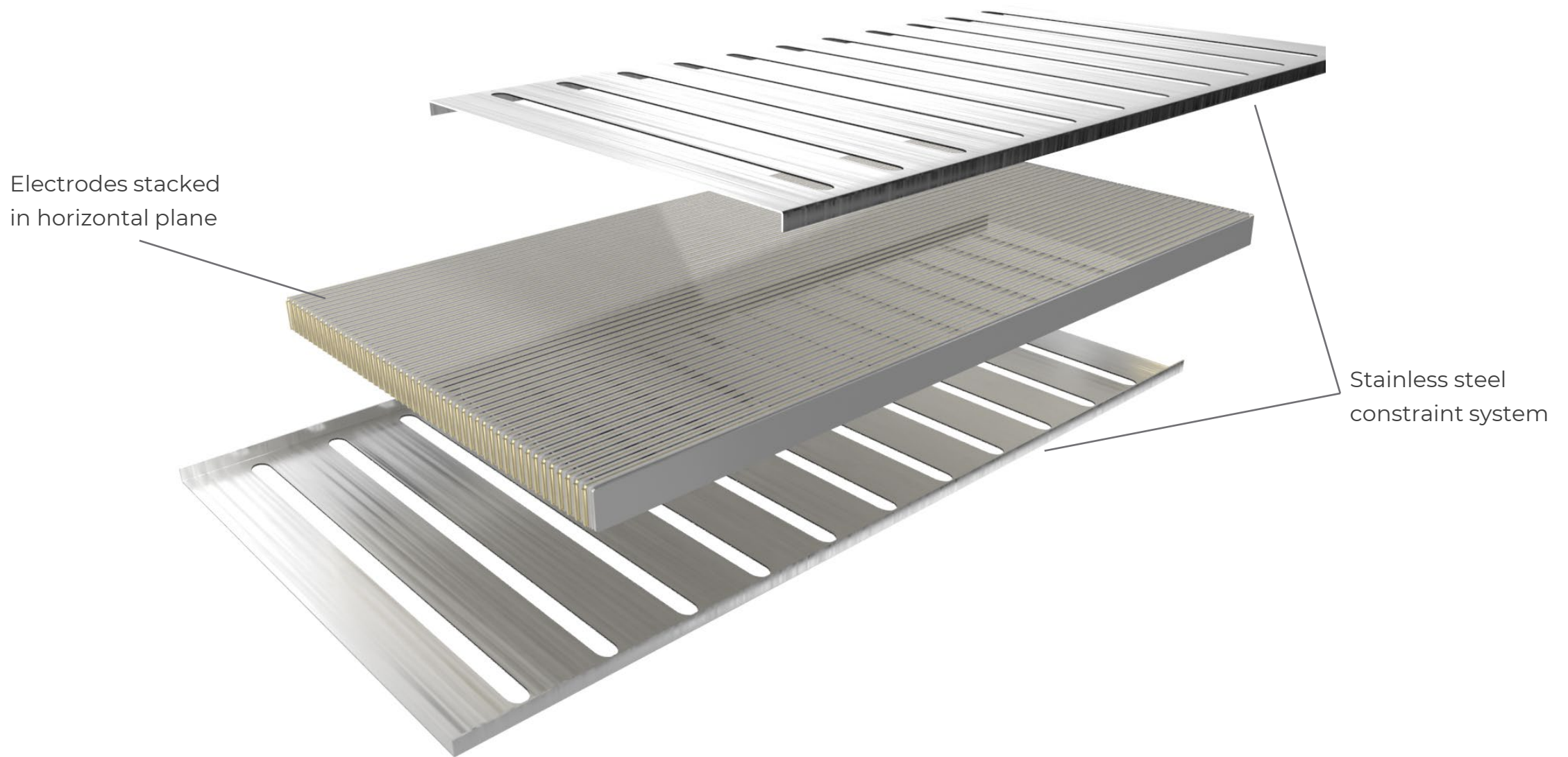


**Illustrated Cross-Section**





# Enovix Cell Architecture



# Enovix Architecture

- | High Energy Density
- | High Cycle and Calendar Life
- | Fast Charge
- | Safety



# Enovix Architecture

## High Energy Density

| High Cycle and Calendar Life

| Fast Charge

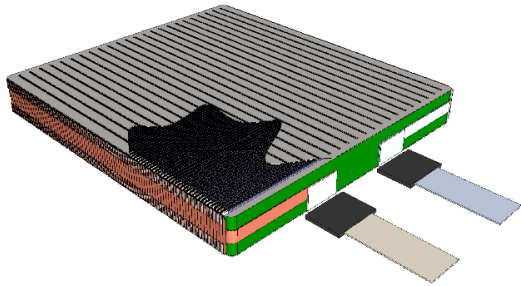
| Safety



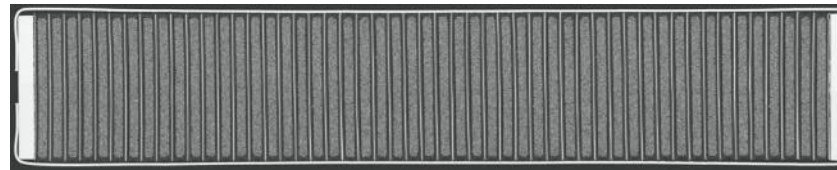


# Enovix 3D Silicon™ Cell Architecture

Enovix 3D Silicon Lithium-ion Cell



Photomicrograph Cross-Section<sup>1</sup>



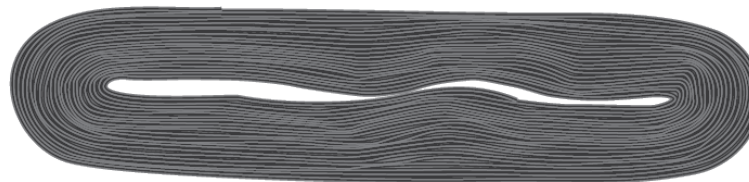
Silicon Anode Material Capacity

**1800 mAh/cc<sup>2</sup>**

Conventional **Wound** Lithium-ion Cell



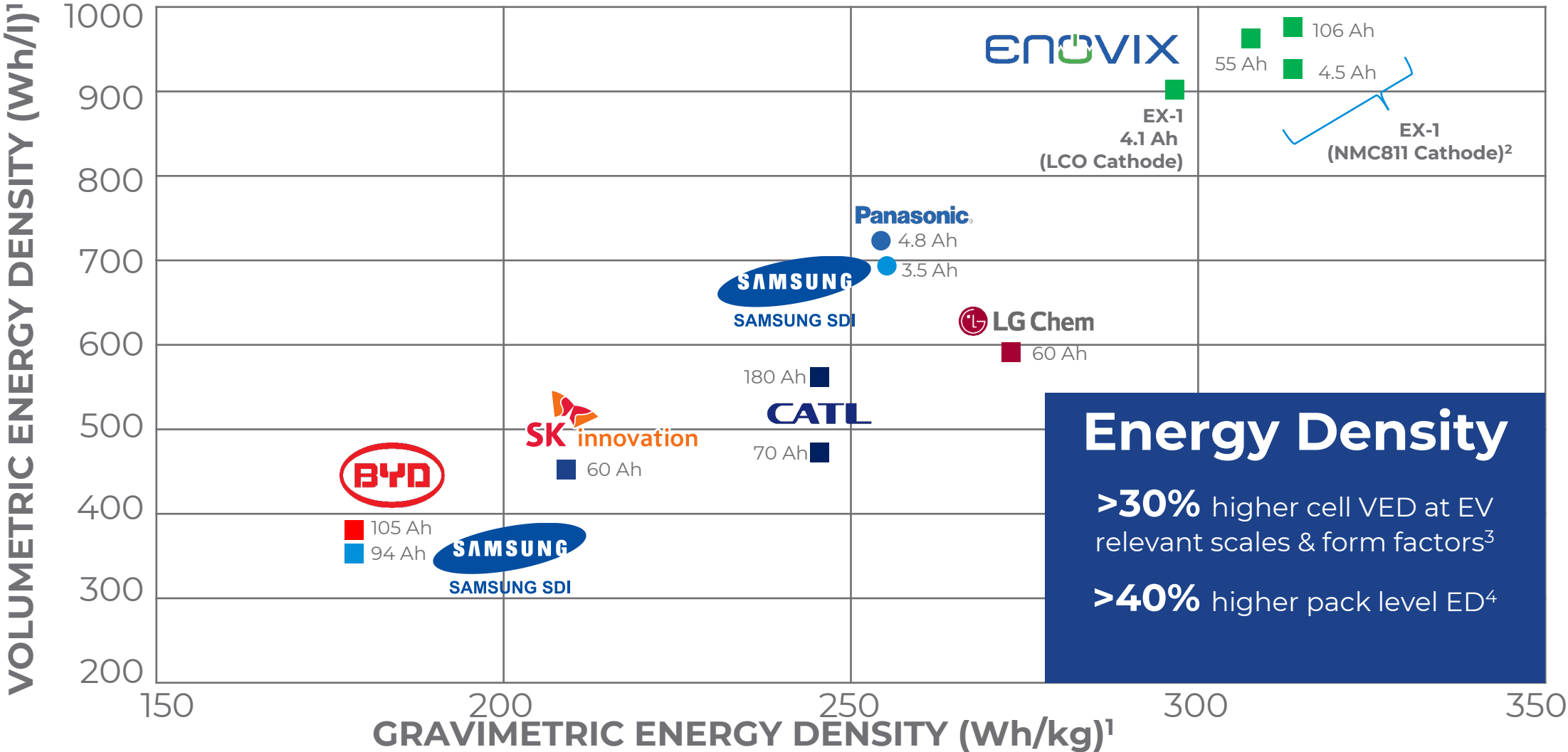
Illustrated Cross-Section



Graphite Anode Material Capacity

**800 mAh/cc<sup>3</sup>**

# High Energy Density



<sup>1</sup> Sources for competitor data: UBS Global Research, October 2020 and Samsung data sheet (Model INR18650-35E). Competitors include Li-ion batteries that meet specifications for EVs

<sup>2</sup> Design Targets

<sup>3</sup> Enovix 55.2 Ah cell design vs 5 Ah, 730Wh/l, 21700 cell

<sup>4</sup> Assumed 100% packing efficiency for pouch or prismatic vs 90.7% packing efficiency for cylindrical form factor

# Enovix Architecture

| High Energy Density

**High Cycle and Calendar Life**

| Fast Charge

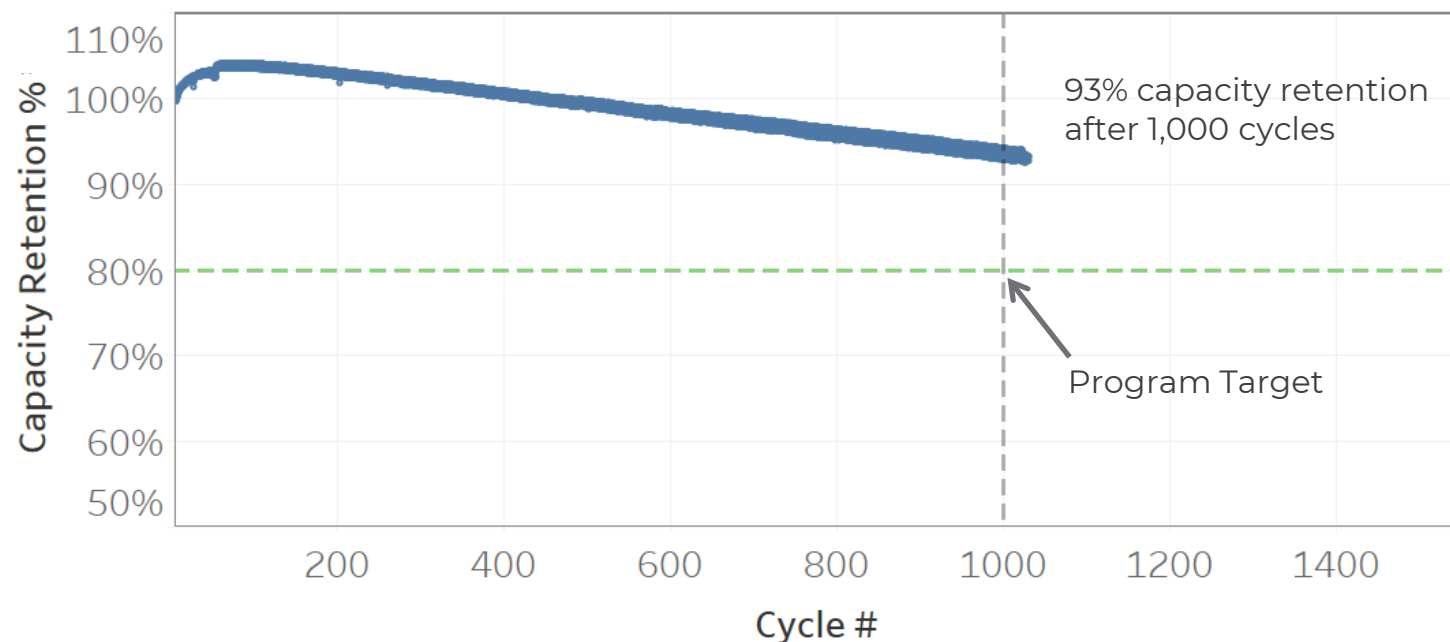
| Safety





# High Cycle and Calendar Life

Successfully Exceeded 1,000 Cycles Achieving DOE Program Cycle Life Objectives



## NMC-622 CELL DATA

267 mAh (29 mm x 17 mm x 3.4 mm)  
541 Wh/l packaged energy density (889 Wh/l core)  
695 Wh/l modeled packaged energy density for 55Ah cell  
4.2 – 2.5V Cell Voltage @ 30 deg. C  
0.33C CCCV Charge – 0.33C Discharge with periodic multi-rate diagnostic discharge steps

## DOE Program Objectives:<sup>1</sup>

Demonstrate Si-rich anode and electrolyte capable of:

- (i) 350 Wh/kg
- (ii) 750 Wh/l
- (iii) <20% Energy Fade after 1000 cycles
- (iv) 10-year calendar life

## Collaborators:



Multi-component model predicting Si integrity

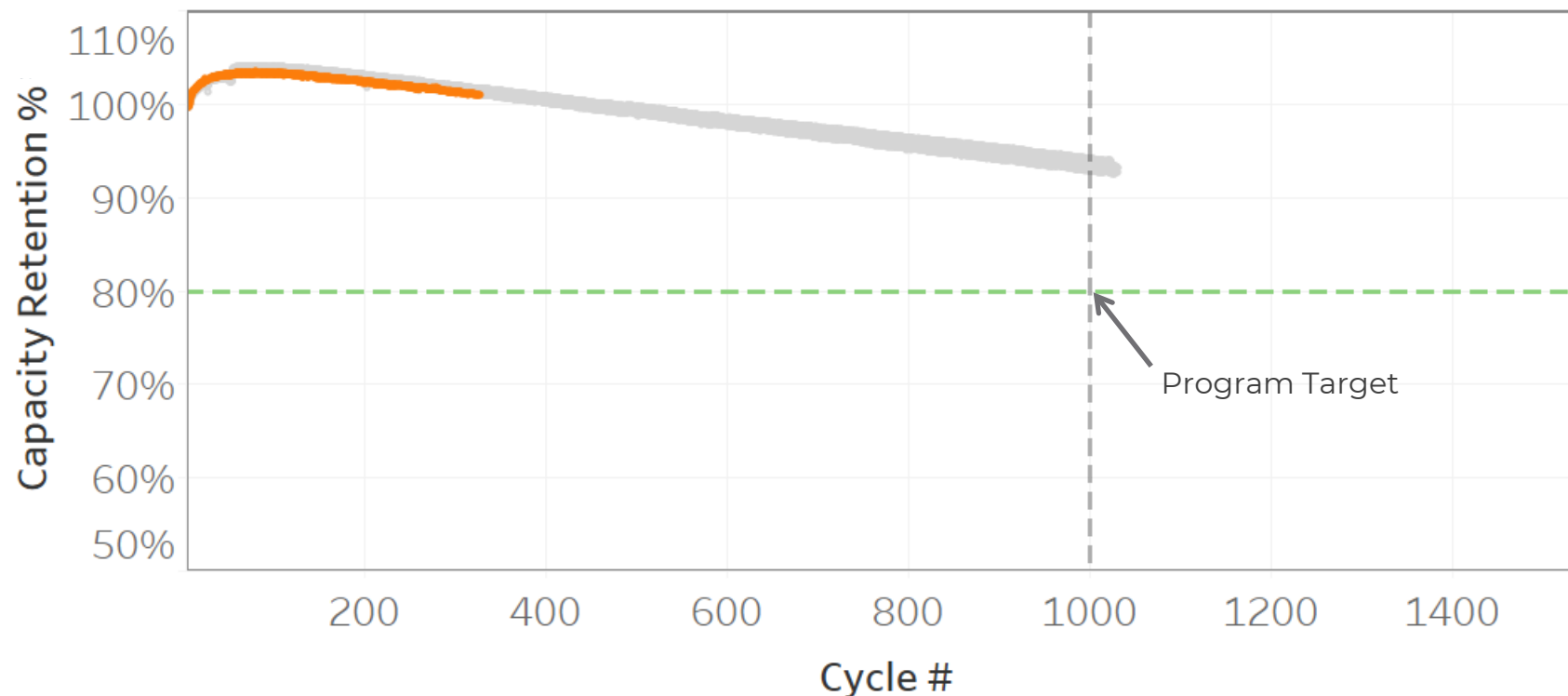
**Mitsubishi Chemical**

Optimized electrolytes for Si anodes

<sup>1</sup>When scaled to an automotive size cell (40 Ah or greater)

# High Cycle and Calendar Life

Cycle life testing of >2.5 Ah cells tracking 0.27 Ah cell performance



## NMC-622 CELL DATA

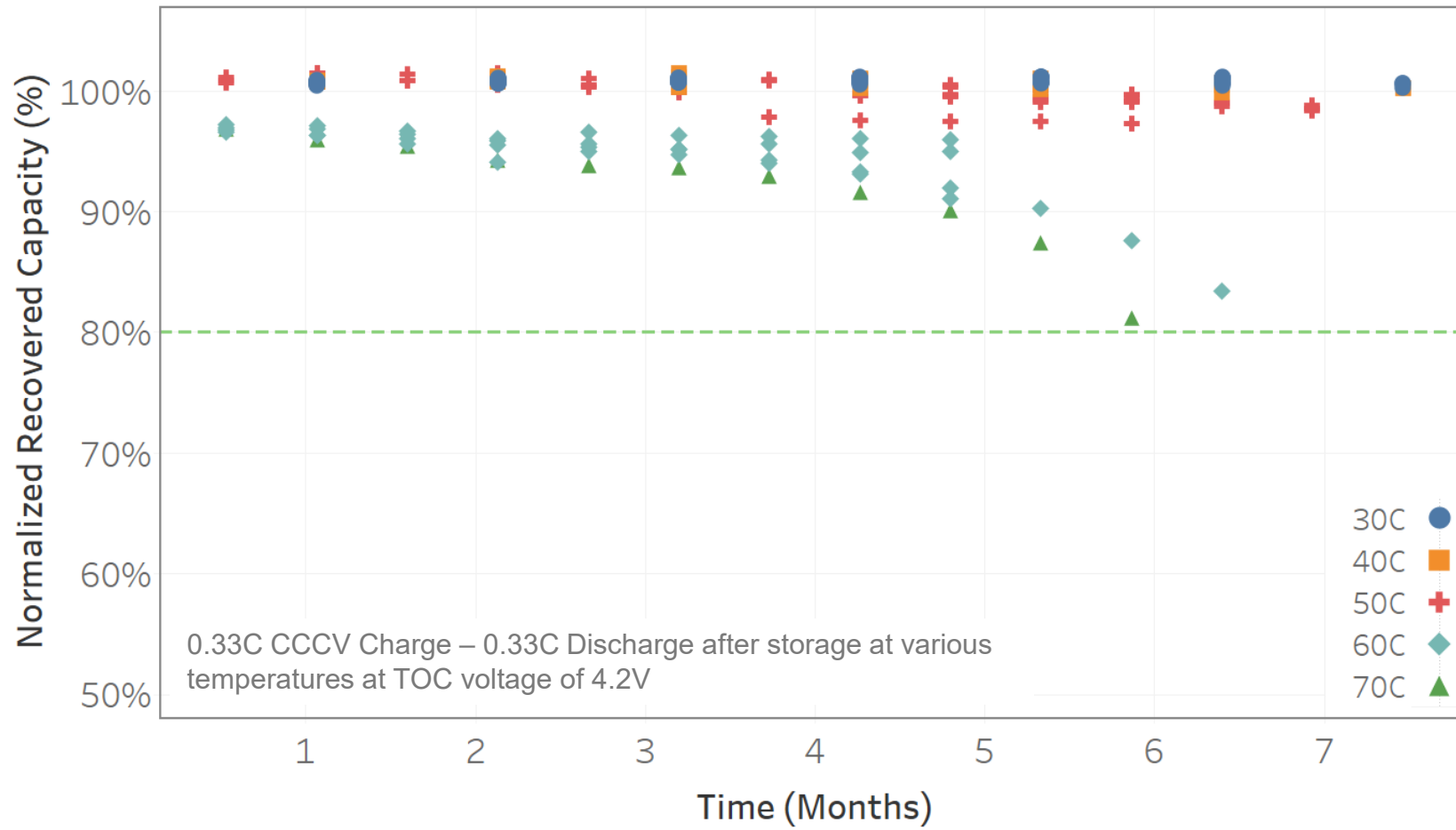
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695 Wh/l modeled packaged energy density for 55Ah cell  
4.2 – 2.5V Cell Voltage @ 30 deg. C  
0.33C CCCV Charge – 0.33C Discharge with periodic multi-rate diagnostic discharge steps

## 2.7Ah NMC-622 CELL DATA

2.72 Ah (71.4 mm x 38.7 mm x 5.3 mm)  
644 Wh/L packaged energy density (886 Wh/L core)  
695 Wh/L modeled packaged energy density for 55 Ah cell  
4.2-2.5 V cell voltage @ 30 deg. C  
0.33C CCCV Charge – 0.33C Discharge with periodic multi-rate diagnostic discharge steps

# High Calendar Life

0.27 Ah cells projecting calendar life of >10 years



- Minimal capacity loss seen after 6+ months TOC storage at 30, 40, and 50°C
- Calendar Life projections to be made after >9 months of capacity retention data



# Enovix Architecture

| High Energy Density

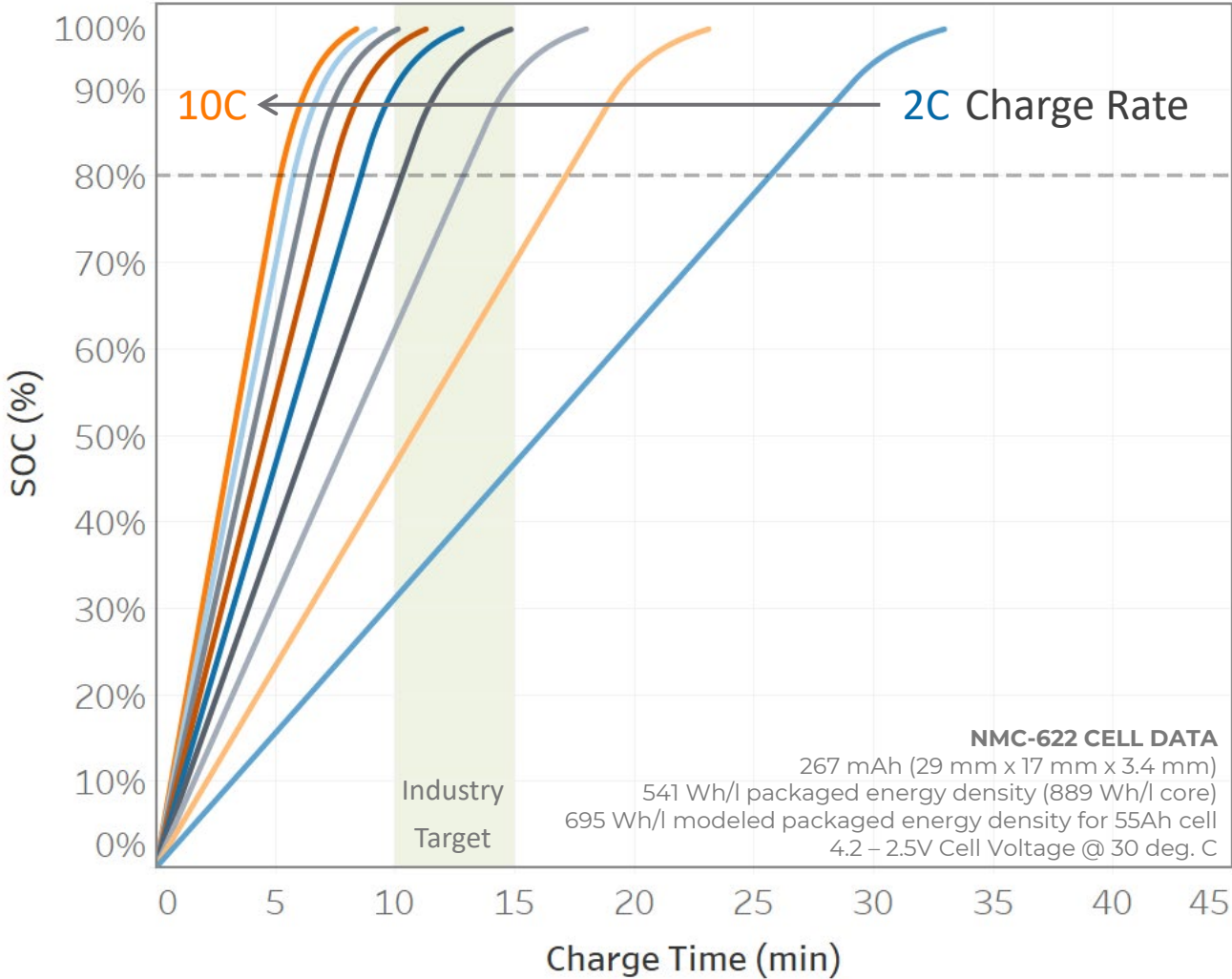
| High Cycle and Calendar Life

**Fast Charge**

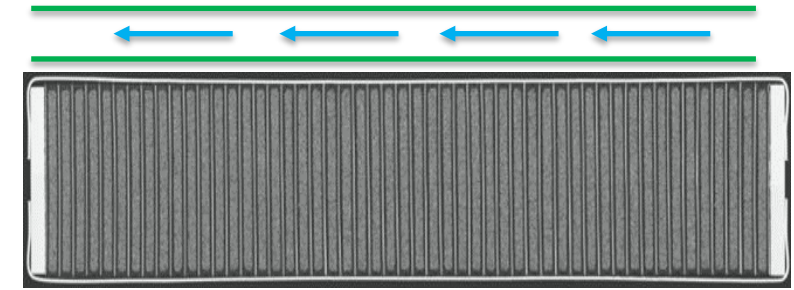
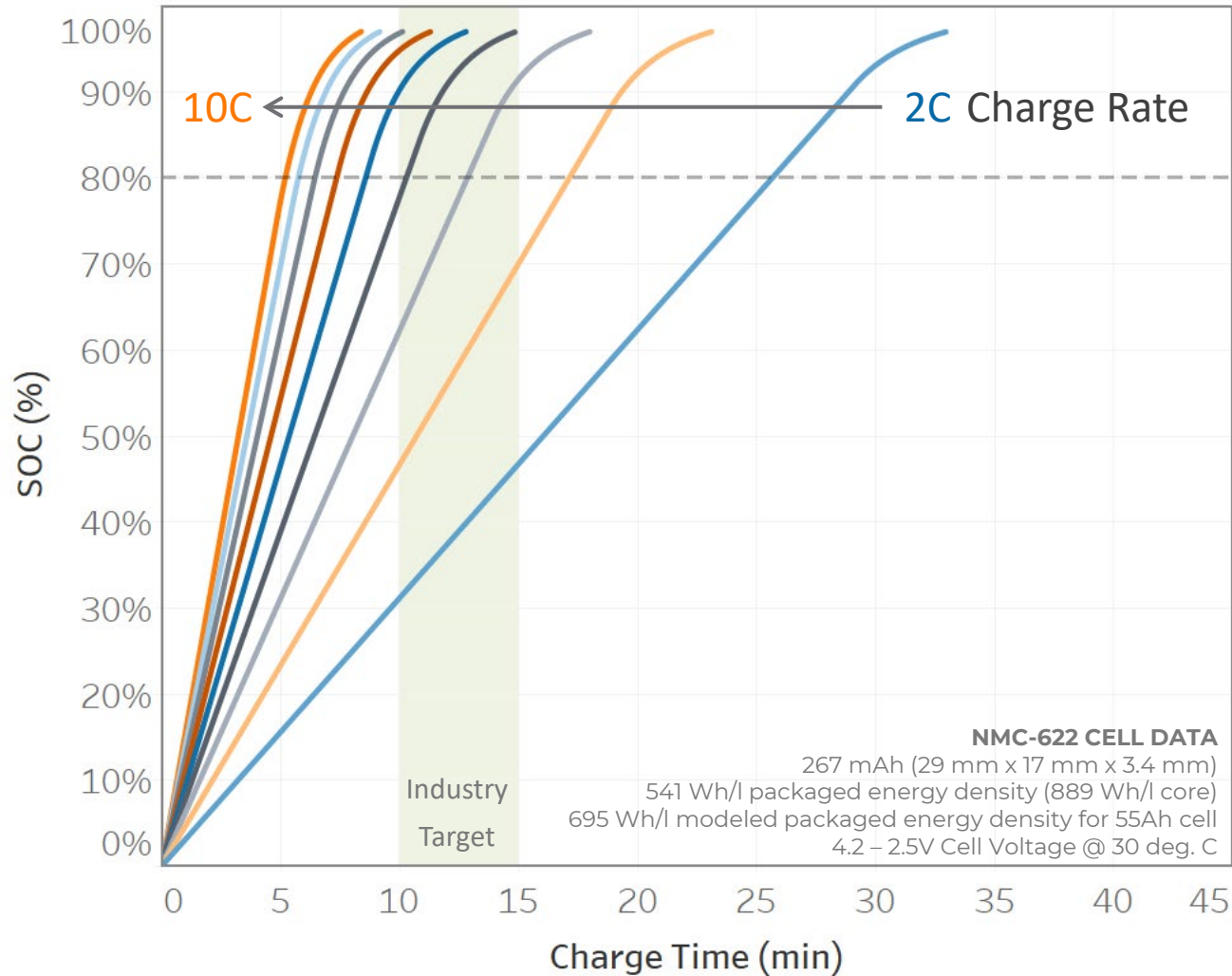
| Safety



# Architecture & Chemistry Built for Fast Charge



# Architecture & Chemistry Built for Fast Charge



## Fast Charge

~**4.6x** cell thermal conductivity for equivalent pouch cells<sup>1</sup>

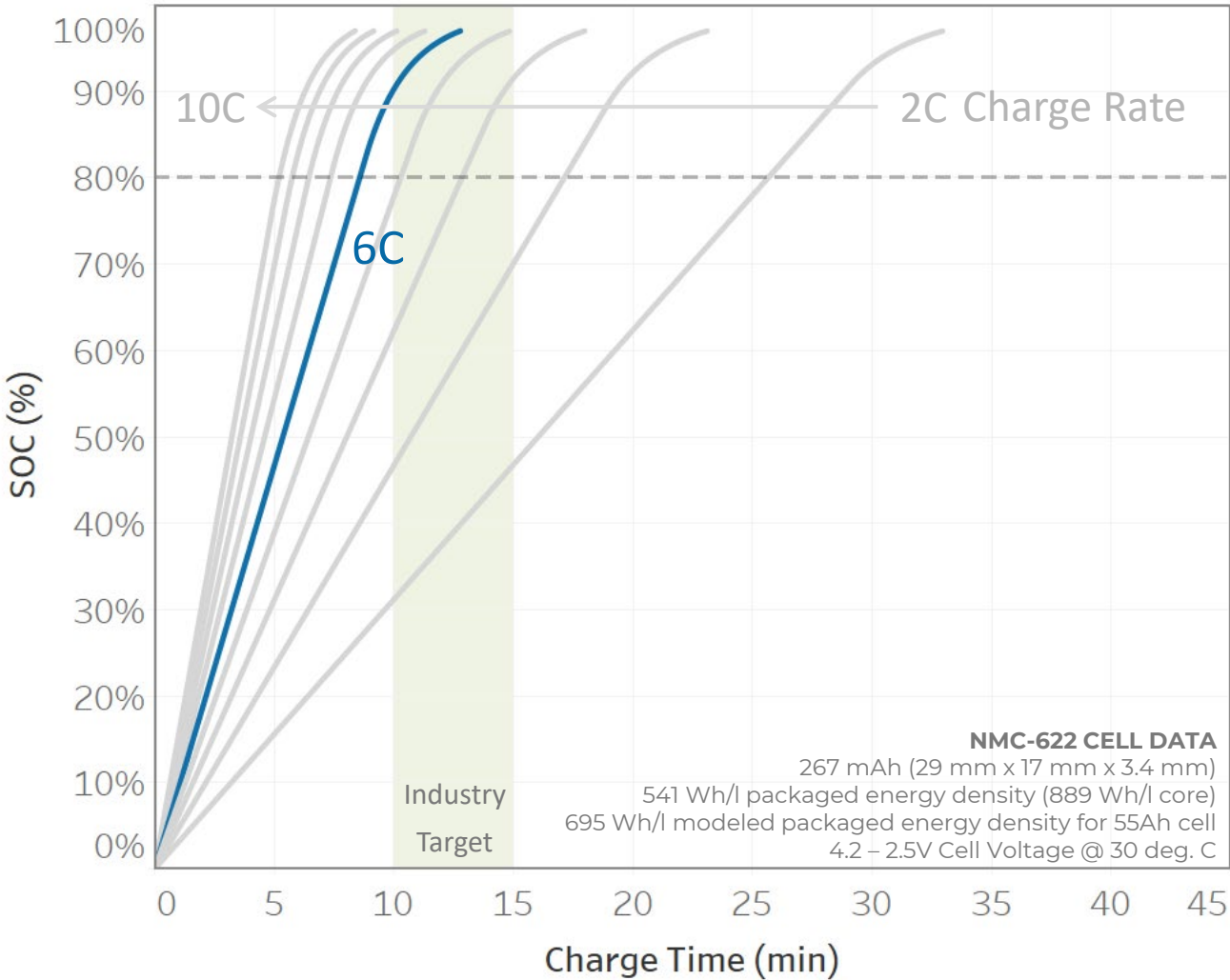
~ **56%** thinner anode than graphite<sup>2</sup>

~ **140mV** higher lithiation potential<sup>3</sup>

<sup>1</sup>Through-plane conductivity; Enovix 3.4Ah cell, 5.3mm thick, LCO cathode (3.3 W/m-K) vs 6.0Ah pouch cell, 6.7mm thick NMC cathode (0.732 W/m-K); verified by 3<sup>rd</sup> engineering pack analysis  
<sup>2</sup>100% active elemental Si anode de-rated from a fully-lithiated theoretical capacity of 2194 mAh/cc to account for Li-trapping and pre-lithiation  
<sup>3</sup>0.22V vs Li/Li+ for Si; 0.08V vs Li/Li+ for Graphite



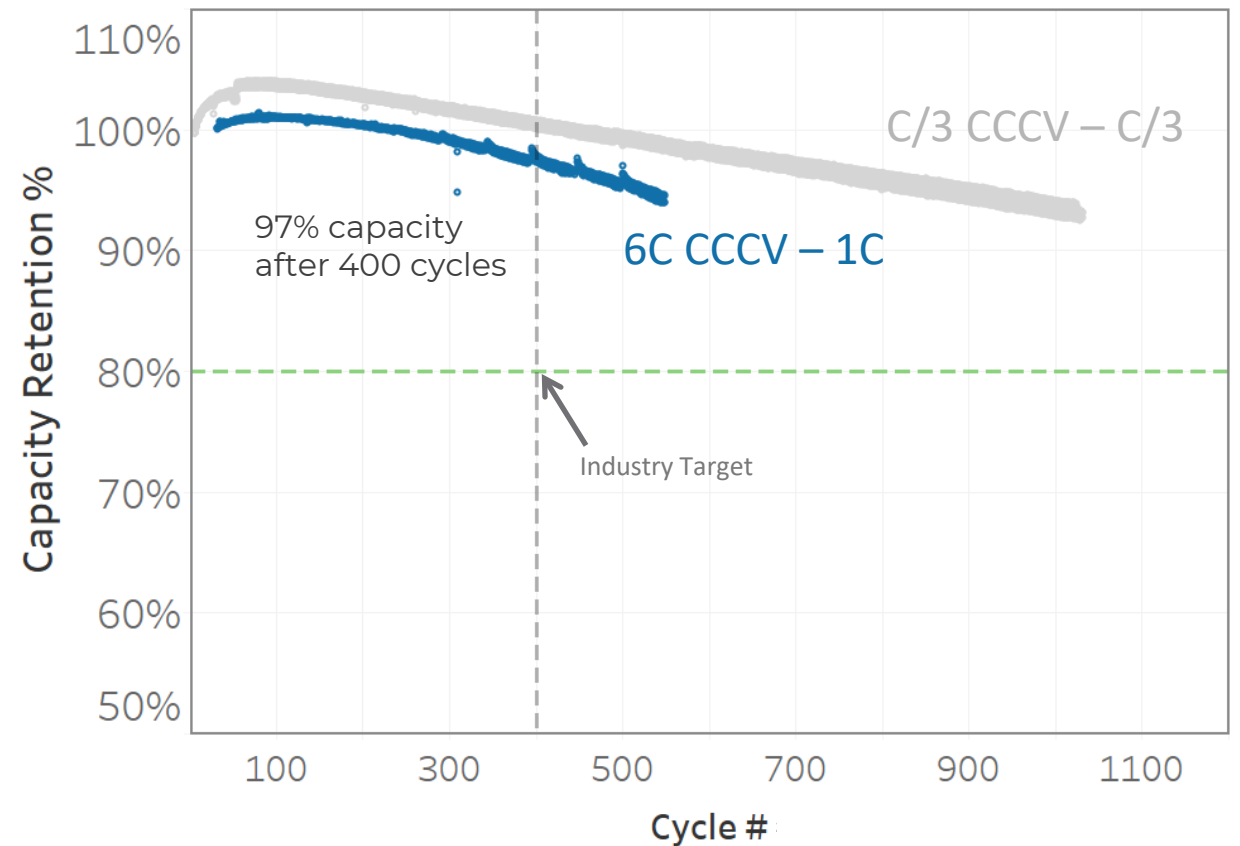
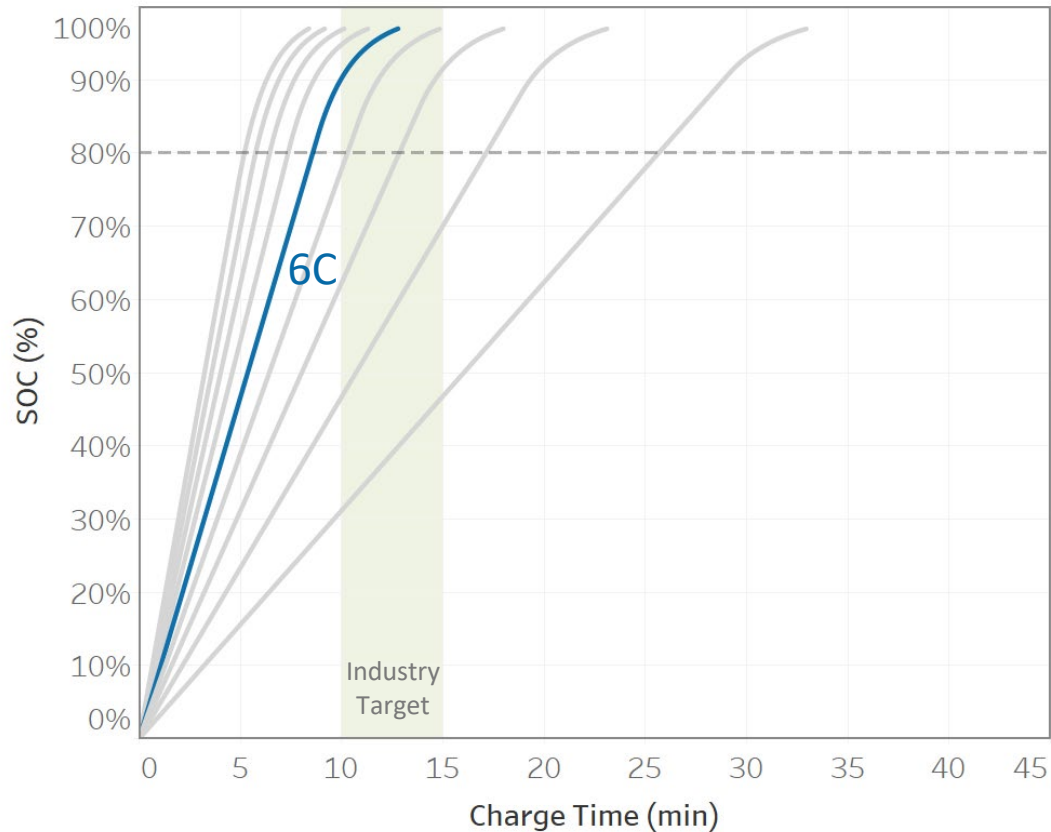
# Architecture & Chemistry Built for Fast Charge



| Charge Rate | 0→80% SOC (min) | 0→90% SOC (min) | 0→99% SOC (min) |
|-------------|-----------------|-----------------|-----------------|
| 6C          | 8.6             | 9.9             | 14.9            |

# Architecture & Chemistry Built for Fast Charge

>600 cycles are achieved with minimal capacity loss



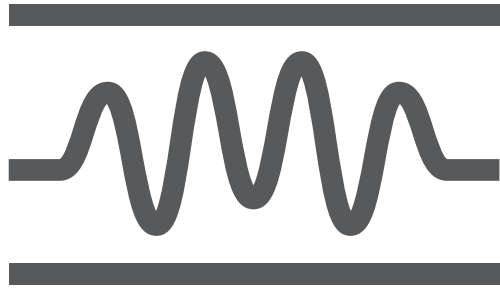
# Enovix Architecture

- | High Energy Density
- | High Cycle and Calendar Life
- | Fast Charge

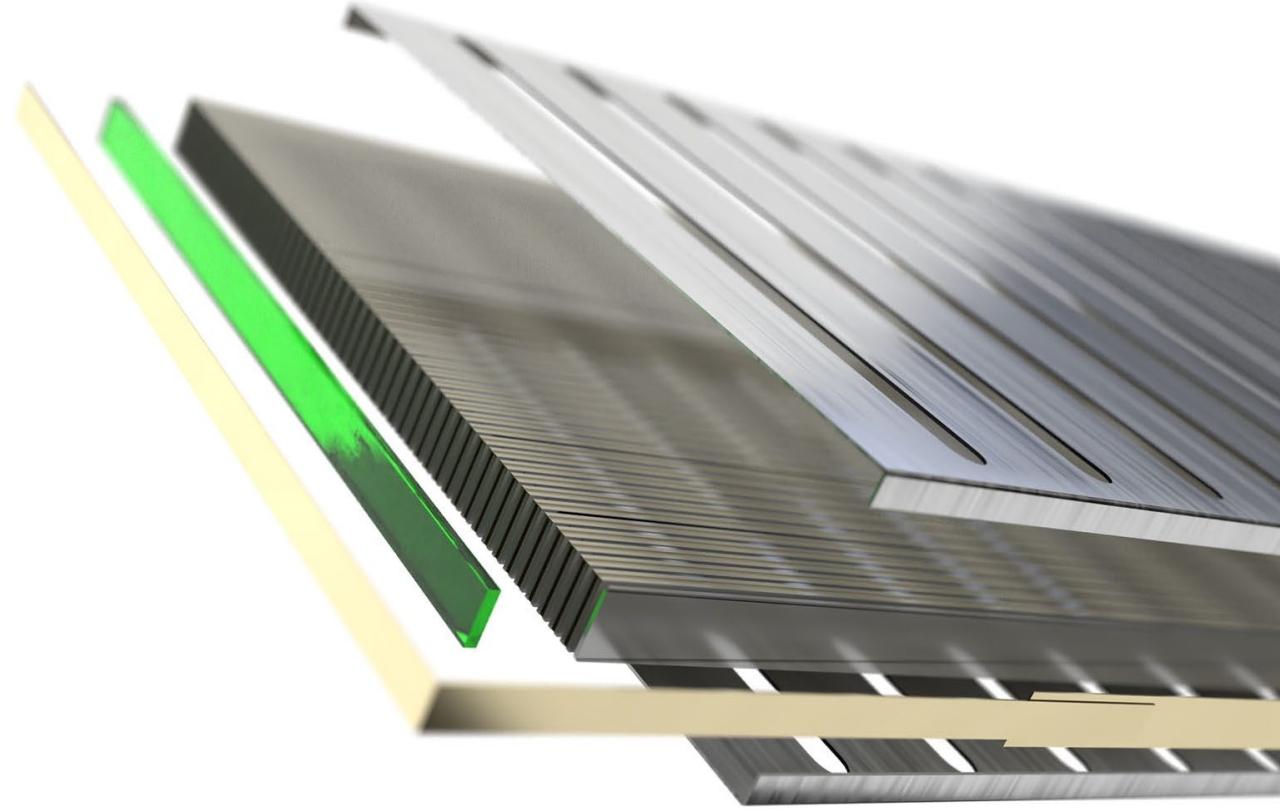
**Safety**







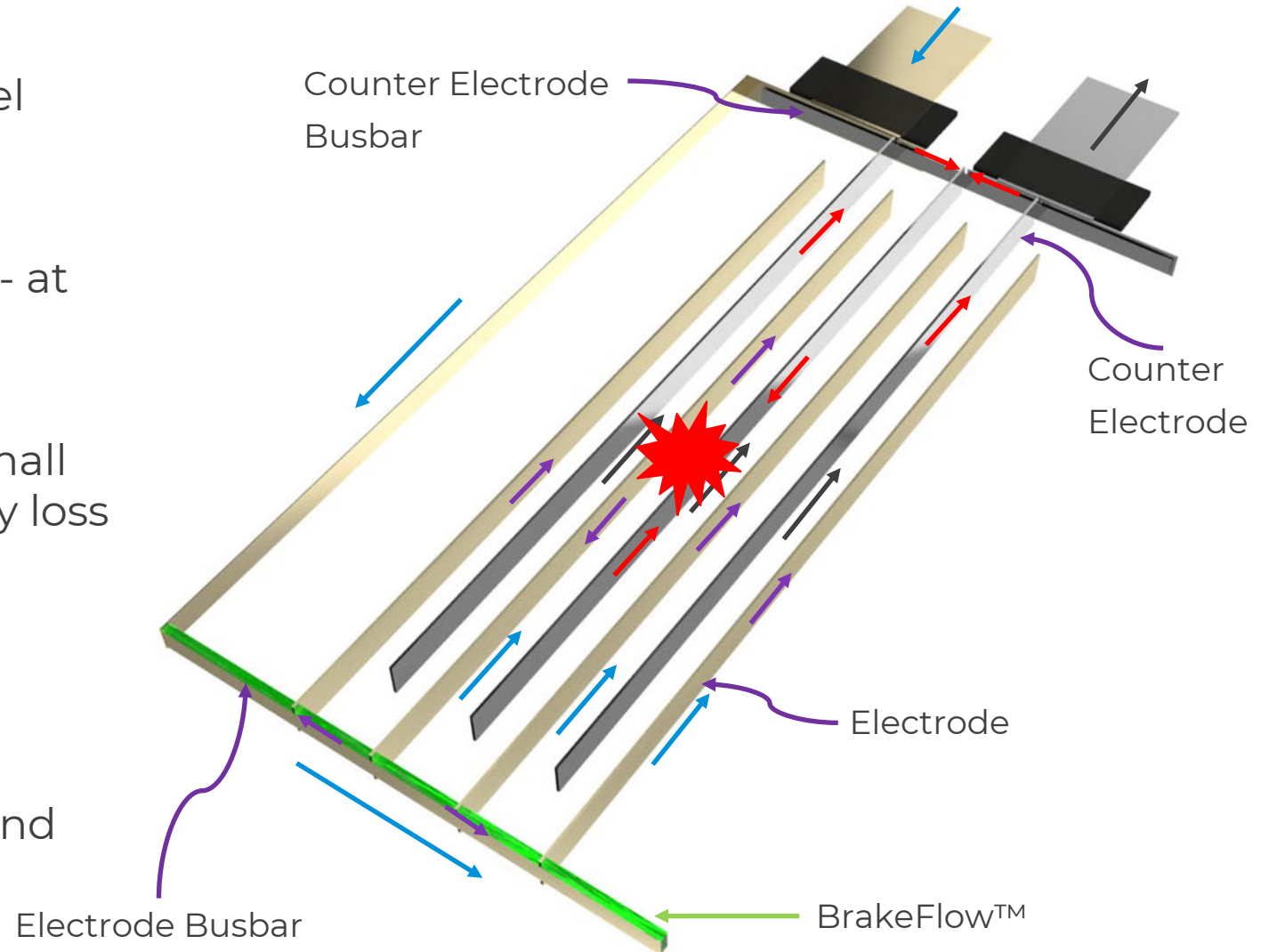
# Enovix **BrakeFlow™** Technology



# Introducing Enovix BrakeFlow™ Technology

Breakthrough in advanced Li-ion battery abuse tolerance

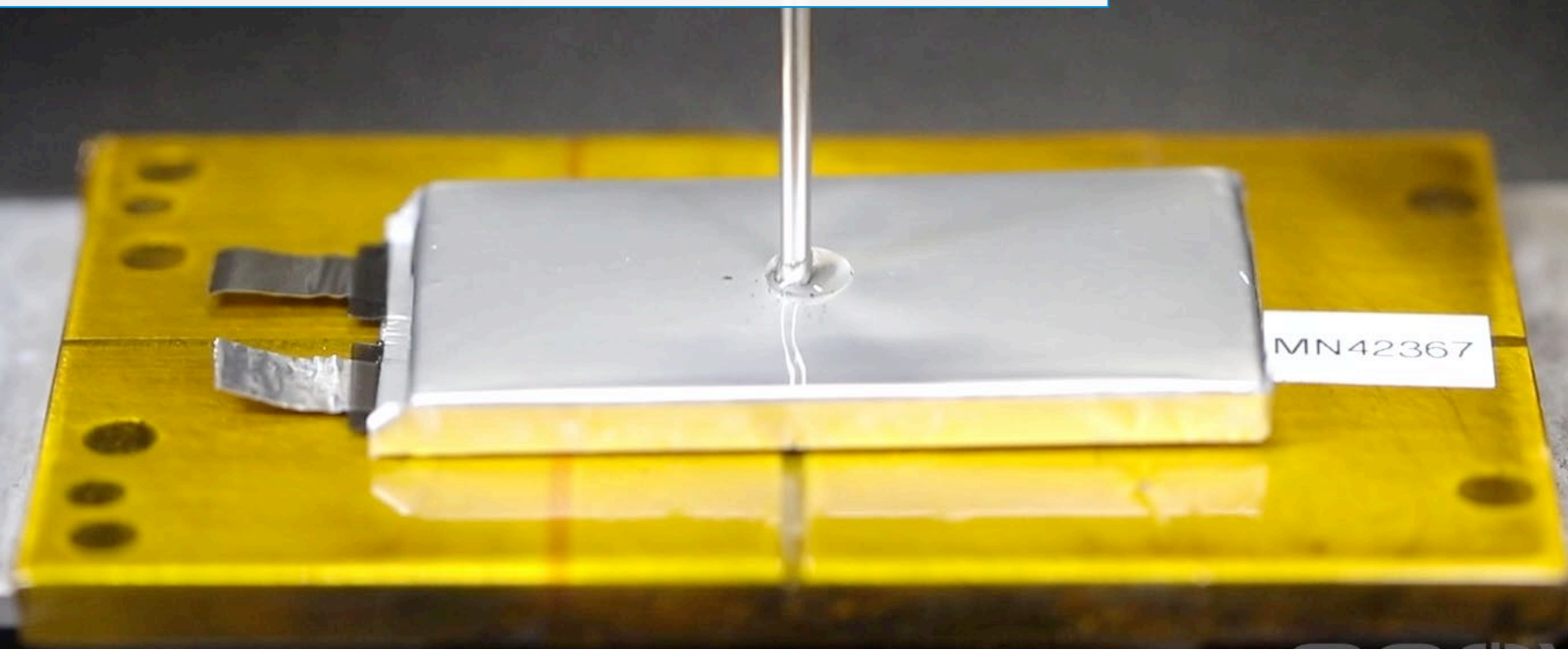
- Architecture enables multiple parallel cell-to-busbar connections
- BrakeFlow - a resistor with set value - at busbar junction
- Normally, each electrode carries a small current resulting in negligible energy loss
- In event of internal short, BrakeFlow regulates current flux to the short
- Limits short area from overheating and inhibits thermal runaway



## CELL DETAILS

3.4 Ah; 12.3 Wh (71.6 mm x 38.6 mm x 5.5 mm)  
804 Wh/l packaged energy density (1167 Wh/l core)  
4.35V TOC cell voltage  
LCO cathode, 100% active Si anode  
97% C:0.2C rate capability

Learn more at [www.Enovix.com/BrakeFlow](http://www.Enovix.com/BrakeFlow)



ENOVIX

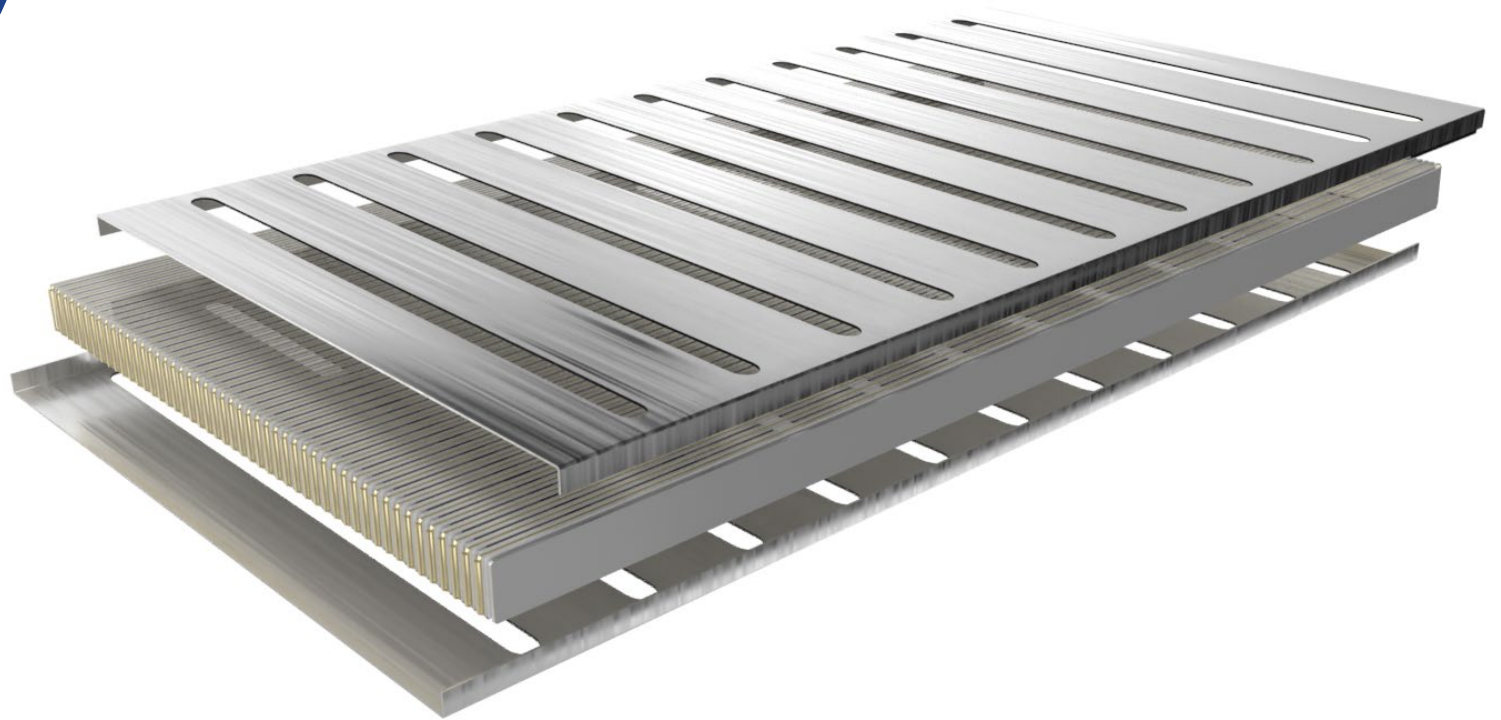
# Enovix Architecture Accelerates the Industry

High Energy Density

High Cycle and  
Calendar Life

Fast Charge

Safety





# Enovix Architecture Accelerates the Industry

**Materials  
Agnostic**

**Any cathode**

**Any anode**

**Standard  
separators &  
electrolytes**

**Form Factor  
Agnostic**

**Scalable from  
wearable to EV**

**Pouch**

**Prismatic**

**Simplifies/  
Optimizes  
Pack<sup>1</sup>**

**Low swell**, tight  
tolerance cells

**Simplified**  
interconnect and  
thermal design

**Eliminates** pack  
level constraints

**Reduces cell  
counts**  
weight & volume  
savings

**Enables  
Next-Gen  
Chemistries**

(Solid State, Li-Metal,  
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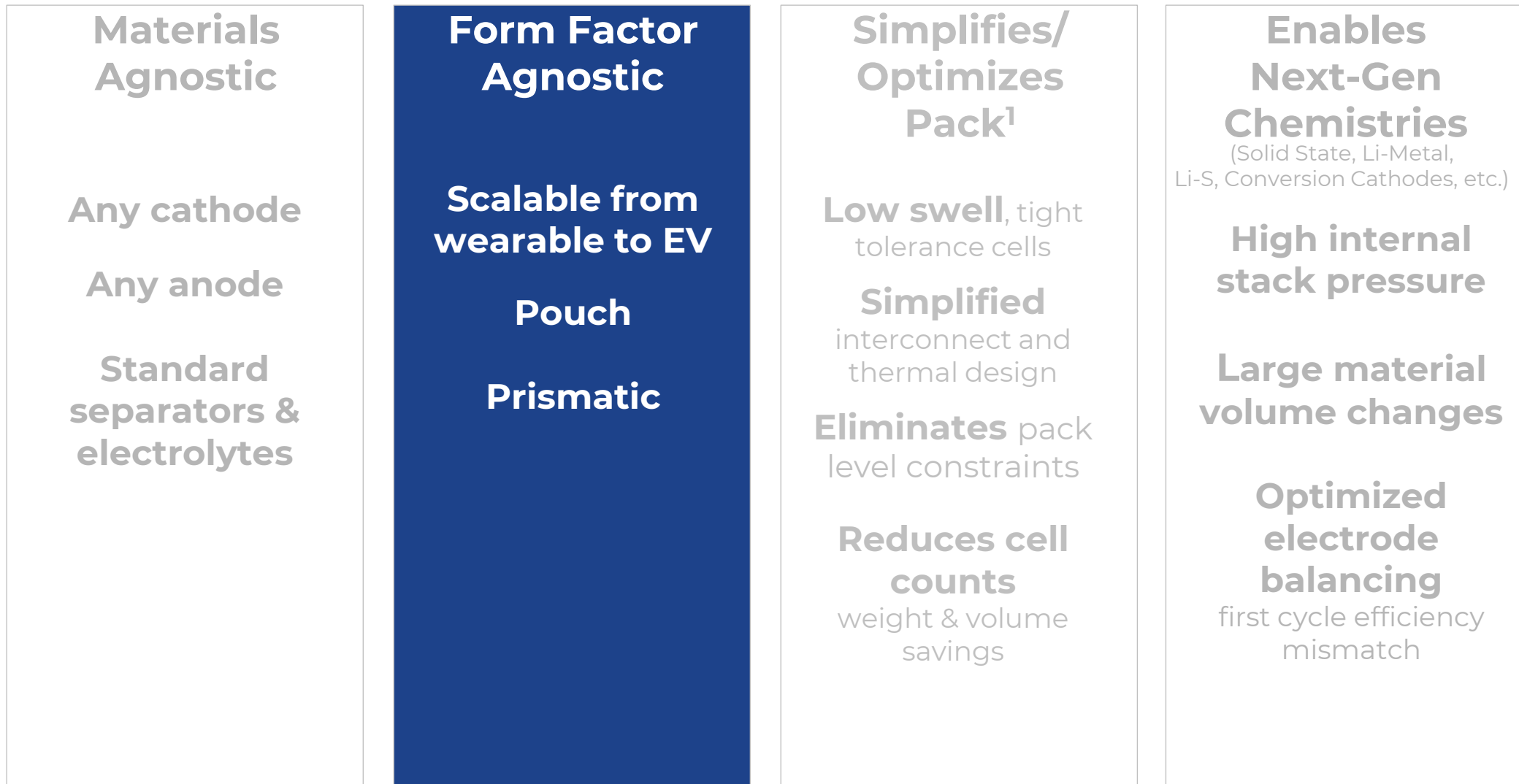
**High internal  
stack pressure**

**Large material  
volume changes**

**Optimized  
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first cycle efficiency  
mismatch



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- High Energy Density
- High Cycle and Calendar Life
- Fast Charge
- Safety
- Materials Agnostic
- Form Factor Agnostic
- Simplifies/Optimizes Pack
- Enables Next-Gen Chemistries



# Enovix Architecture Accelerates the Industry

- Going to market this year in consumer electronics with 100% active silicon anodes
- Excellent results in EV chemistry
- Experienced EV team
- Actively engaging with partners
- Contact us: [Mobility@Enovix.com](mailto:Mobility@Enovix.com)



ENOVIX | mobility





# Thank You

Learn more at [Enovix.com](https://www.enovix.com)