

**BLACK DIAMOND
STRUCTURES™**

Process and Performance Improvements Enabled by MOLECULAR REBAR® Products

Dr. Paul Everill – Chief Technology Officer

ELBC 2024

Black Diamond Structures, LLC

Integral to the Industry

- Celebrating our 10th year providing worldclass products and service to dozens of global manufacturers
- Leveraging advanced materials science and battery testing capabilities to solve our customer's challenges
- Active participants in global technical debates (ex. AUX applications, 2 V cell development, ESS)

Approachable Products

- Optimized for materials efficiency, delivering benefits at ultra low loading levels (<0.06% wrt PbO)
- Cost offset by reduced warranty claims, material/waste reductions, and increased factory output

Certified and Dependable

- ISO 9001:2015
- REACH certified
- "Non-hazardous" by US Environmental Protection Agency / Department of Transportation
- Certified logistics team with global reach



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Innovation Across the Energy Storage Landscape

Lead-Acid Batteries

Charge Acceptance
>25%



Cycle Life
>25-300%



Enables Partial State
of Charge Operation



Improved Thermal
Operations Range



Energy Dense Lithium Anodes

Higher Energy Density
>20-45%



Longer Cycle Life
>20-100%



Increased Electrode
Strength >30-100%



NMC/LFP Lithium Cathodes

>15 min Fast Charging
Enablement (4C Rate)



Enhanced High-Power
Discharge Capability

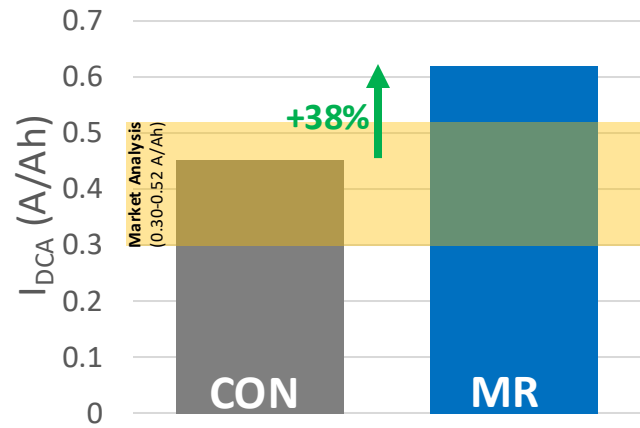


>5-10% Longer Cycle
Life



Our tailor-made MOLECULAR REBAR[®]-based formulations provide solutions for today's energy storage challenges

Selected Customer Highlights



Enhanced Flooded Batteries

- MOLECULAR REBAR[®] provides market-leading performance to EFB
- 38% increased DCA
- Improved CCA (>10%)
- No water loss issues



Advanced Traction Design

- Batteries containing MOLECULAR REBAR[®] operate in Heathrow
- Reliable fast charge
- Improved thermal operation
- Reinforced active material



eRickshaw

- Thousands of eRickshaw drivers use MOLECULAR REBAR[®] batteries daily
- Enabled >15-month warranty
- Resists sulfation, vibration
- Lower maintenance



....Let's grow together



Deep Cycle + Renewables

- Unparalleled reliability under deep discharge
- Superior operation under renewable workloads
- Optimizable formation efficiency



BATTERY ENGINEERING

Product Series by Application

Need	Application		NAM Product	PAM Product
Performance	Automotive	SLI – Conventional Flooded	Pb1100N	PbAC
		Start/Stop – Enhanced Flooded	Pb1200N	
		Advanced Auto – VRLA	Pb1300N	
		Motorcycle – VRLA	Pb1400N	
	Motive	eRickshaw – Flooded (Tubular)	Pb2100N	
		eRickshaw – Flooded (Flat Plate)	Pb2200N	
		eVehicles – VRLA	Pb2300N	
		Golf Cart – Flooded	Pb3200N	
		Forklift/ Lift Trucks – Flooded	Pb4100N	
	Stationary	Inverter – Flooded	Pb3100N	
		Solar – Flooded	Pb3200N	
		Solar – VRLA	Pb3300N	
		Advanced Renewables + Utilities – VRLA	Pb3400N	
Process	All	Improved Process, Plate Output, Less Waste	PbLite™	

PbLite™: Our First Process Additive

Early Adopters Use PbLite™ to:

- Increase manufacturing output
- Reduce waste / recycling costs
- Stabilize weight / thickness “Cpk” values
- Increase pasting rate (plates/min)

Zero, or Negative, Implementation Cost

- MOLECULAR REBAR® investment returned during production
- *\$30-50 returned per batch in extra plates and reduced waste*
- Fast validation process with zero risk

Innovative Formulation

- Improves paste rheology or “spread-ability”
- Increases paste, plate, and battery uniformity
- Highly efficient at only 2.5 L / 1000 kg



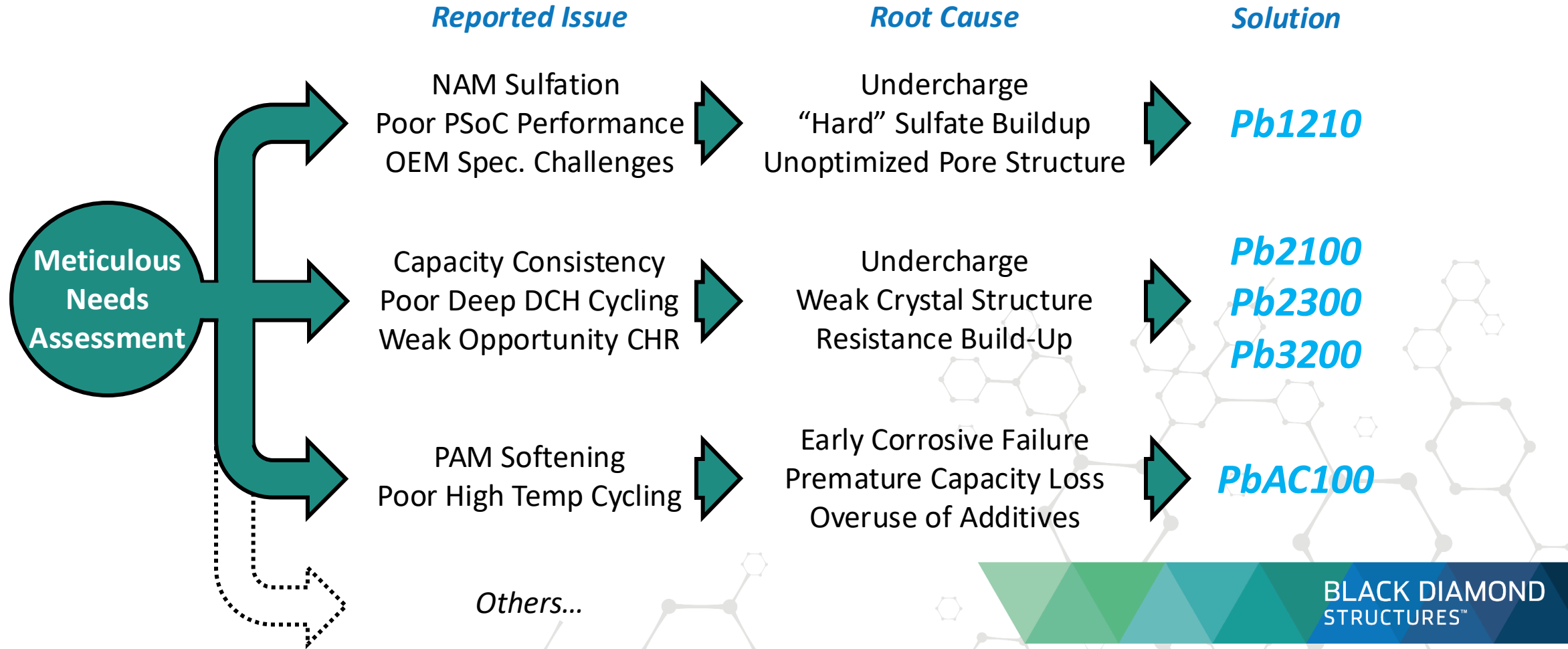
Reported Metric	Range
Extra Plates Produced (#)	50-200 (Auto)
Extra Plates Produced (%)	0.2 - 2.0
Waste Reduction (%)	25-75
Battery-to-Battery Variation	~2X Reduction
Battery Capacity	No Negative Effect
CCA	No Negative Effect
Cycling (Room Temp)	No Negative Effect
Cycling (High Temp)	No Negative Effect

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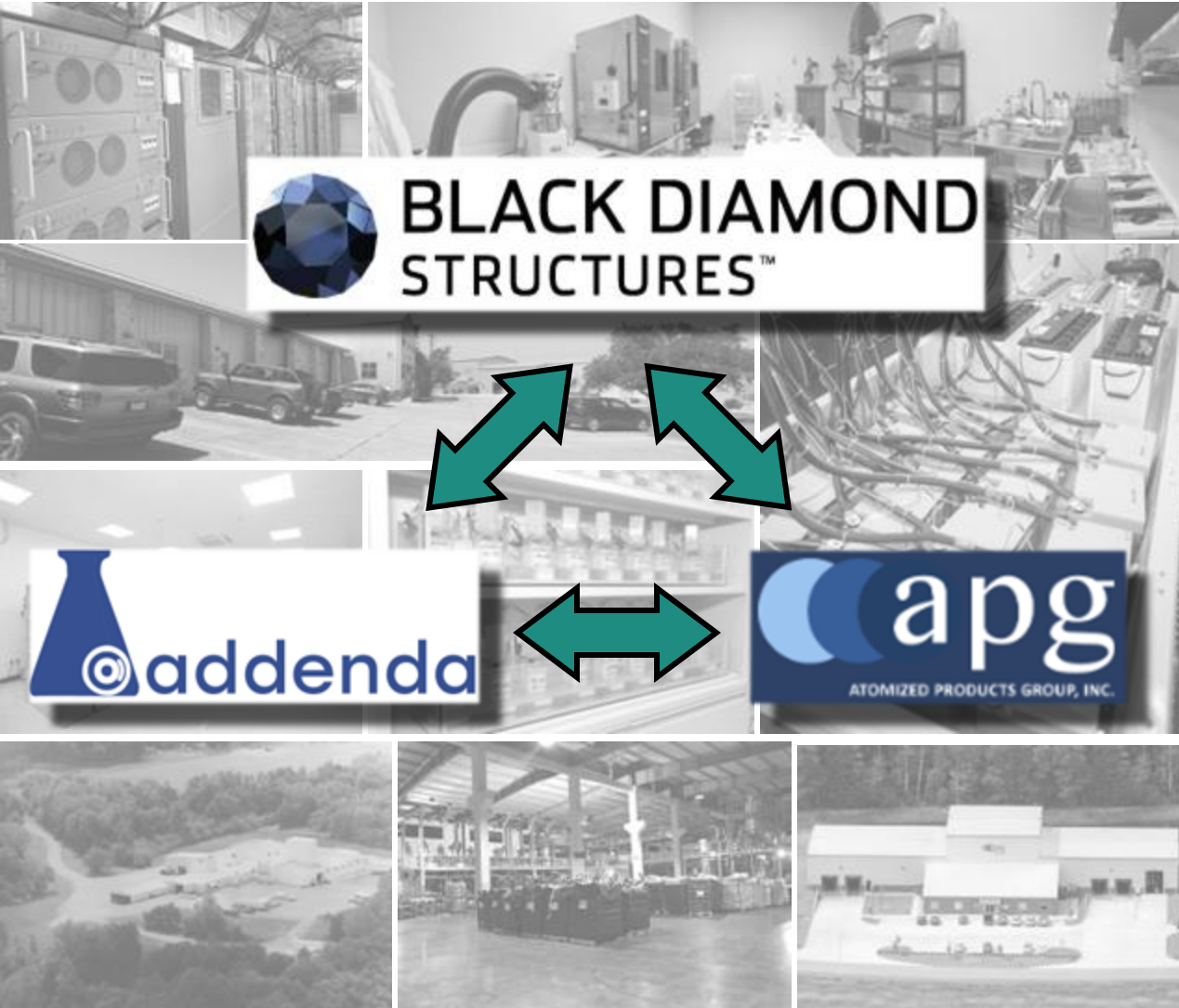
Solutions-Based Approach to Improve Performance

Black Diamond Structures believes in strong cause/effect-based prescriptions of our products

- Customers leverage our materials analysis tools, electrical testing capability, and >100 years of experience



An Advanced Additive Alliance



Black Diamond Structures, Atomized Products Group (APG), and Addenda announce an Alliance

- Formed to better serve our customers
 - Improves customer access to bespoke products
 - Bolsters customer technical support network
 - Aims to decrease customer development time
- Integrates
 - Product portfolios
 - Commercial teams
 - Research facilities (2 V, 12 V, Materials Testing)
 - Global manufacturing capability
 - Decades of application knowledge

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Visit the Alliance at **Booth #88**

www.blackdiamond-structures.com
www.addendallc.com
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Thank You for Your Time!!

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