



**NATRION**

**Powering America's Warfighters**

# 30,890

Number of U.S. casualties in Iraq and Afghanistan that occurred during transport of diesel fuel.

That is **52%** of all sustained casualties.



# 700

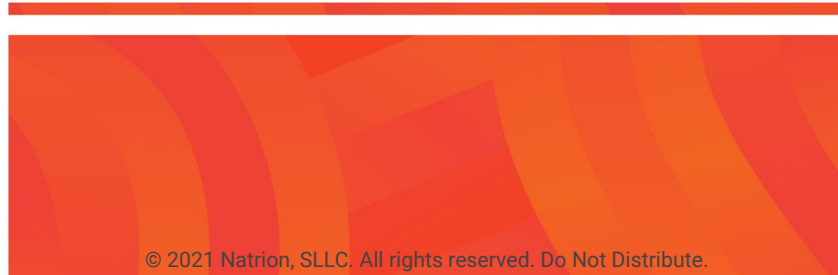
Total number of forward operating bases (FOBs) in Iraq and Afghanistan

# 22

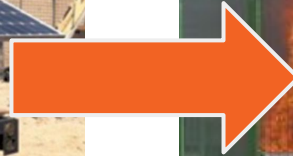
Number of **daily** truckloads of diesel needed by each FOB for generators

# \$20MM

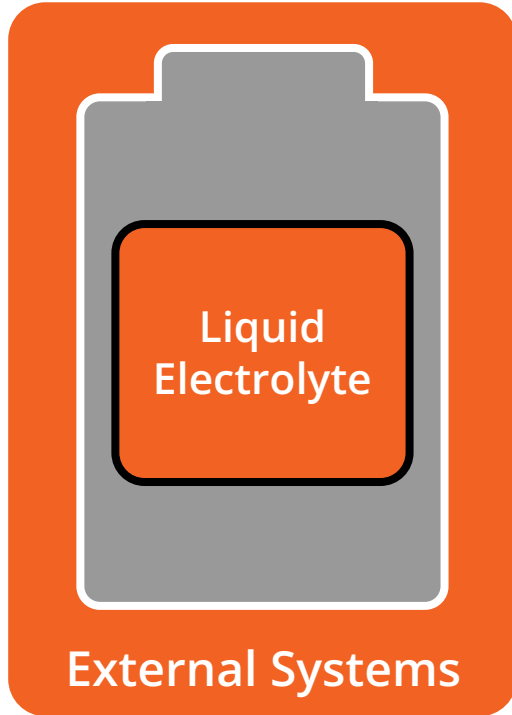
Average amount spent each year on fuel for each FOB (**\$14 billion total**)



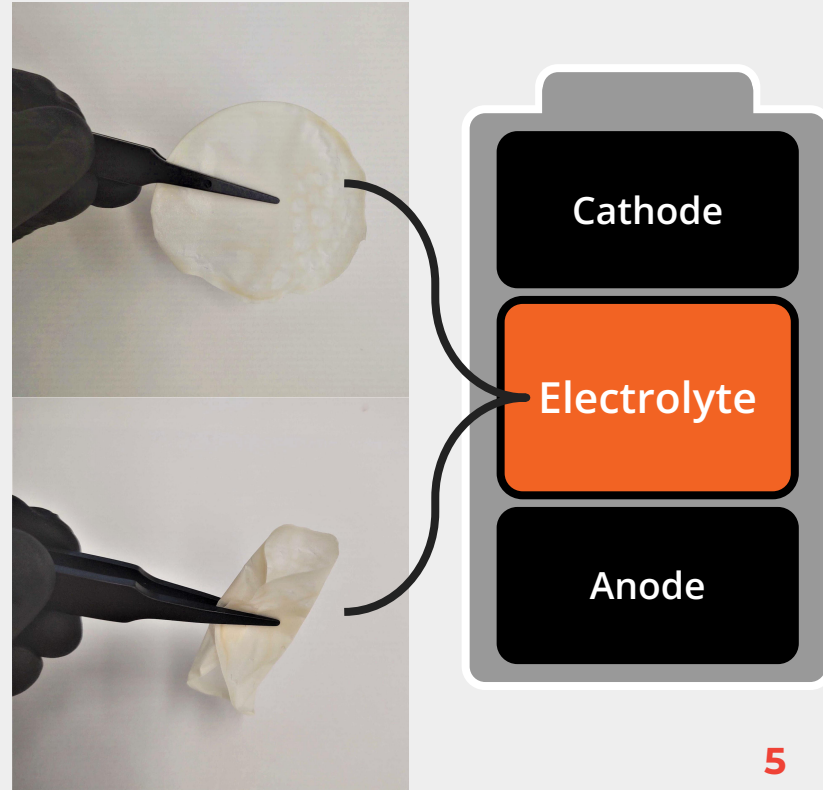
# Replacing Diesel with Solar + ESSs



# The Current State-of-the-Art



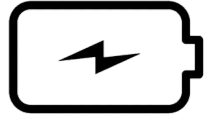
# NATRION



# The Current State-of-the-Art



**-5°F to 140°F**



**700 Wh / L**



**30% efficiency loss**

# NATRION



**-60°F to 600°F**



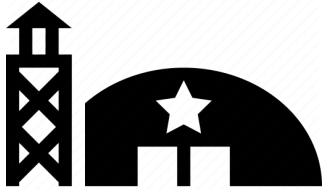
**1000 Wh / L**



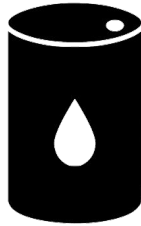
**15% efficiency loss**



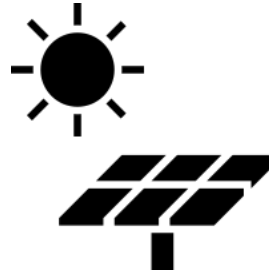
# Initial Hypothesis



US Army is an expeditionary force operating FOBs in contested territories



In order to power these FOBs, the Army uses diesel generators, which put our soldiers at risk



Solar arrays also have the potential to meet these power needs, but only provide intermittent power



Pairing solar power with trailer-mounted battery packs will eliminate our dependency on diesel



# Pivot Analysis

## Generator-Centric Microgrid

- Difficult to transport
- Centralized
- Indivisible
- Impedes expeditionary capabilities

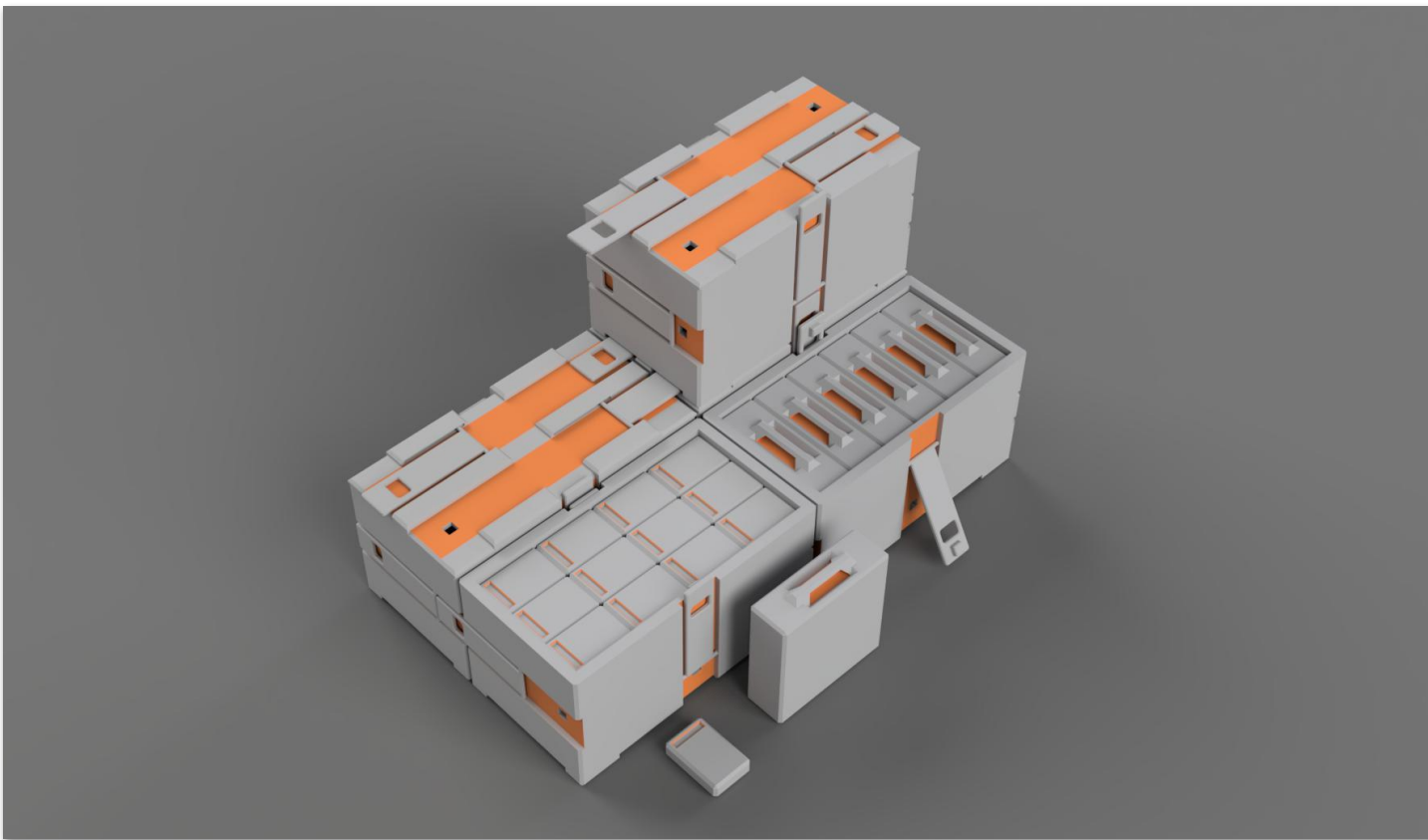
Battery  
Suite  
System

## Post-Generator Metagrid

- Hypermobile
- Decentralized
- Infinitely subdivisible
- Enhances expeditionary capabilities







*The entirety of the battery suite.*

# R&D Cycle

**LISIC Chemistry  
Finalized**

May  
2021



**Scale-Up + Cell-Level  
Validated**

Dec.  
2021



**Battery Pack  
Validated + POs**

Aug.  
2022



# Use Case Demonstration



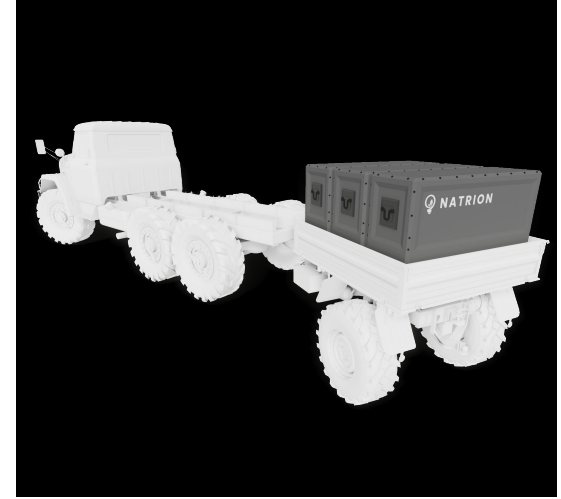
**Stationary Energy Storage**

100V / 150A / 30kWh  
modules for Adaptive  
Carbon Systems



**Marine Propulsion Systems**

Request-for-proposal for  
100kWh unit from  
Dynamiq Yachts



**Defense Power Systems**

Air Force SBIR & collab.  
with Army CERL



# Management



**Alex Kosyakov**  
*CEO*



**Tom Rouffiac**  
*COO*



**Duke Shih, Ph.D.**  
*Senior Engineer*



# R&D



**Ritin Joseph**  
*Materials Analysis*



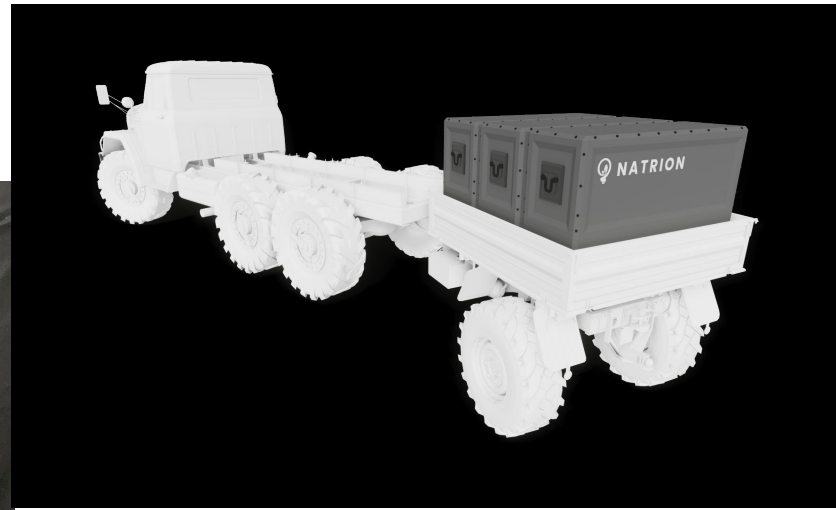
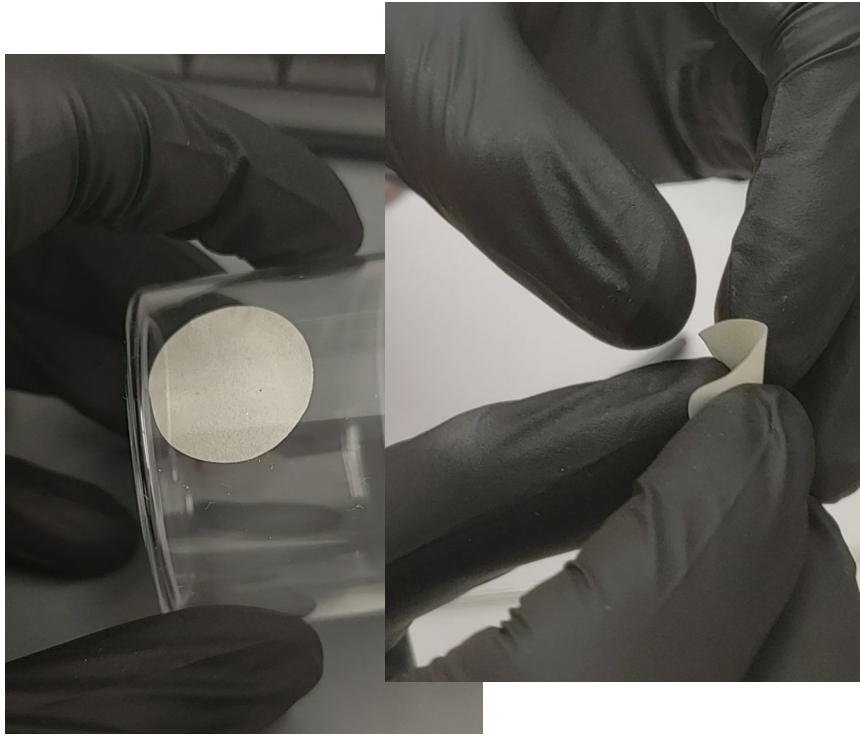
**Henry Markarian**  
*Systems Integration*



**Jake McFarland**  
*Defense Business Dev.*



# MVP (Week 5)



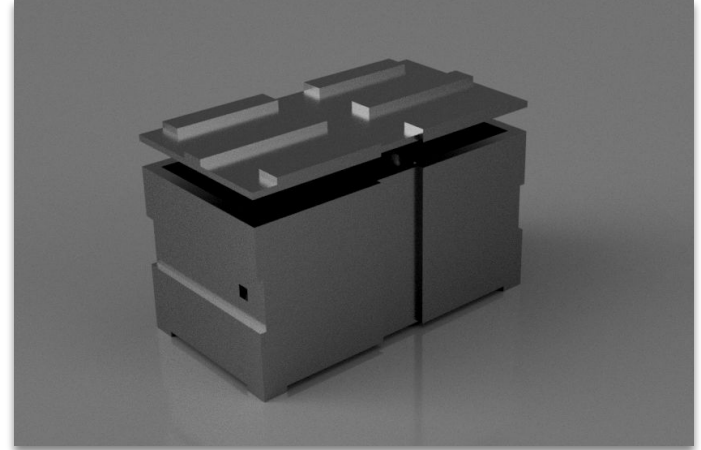
- Using polyethylene oxide
- Thermal resilience not substantially improved (300° F)
- Trailer-mounted



# MVP (Week 7)



Prototype #1



Prototype #2



# Potential Pilots



# Looking Forward

## Finalize LISIC Chemistry

Now → May 2021  
(3 mo)

R&D at MRL and Binghamton Lab

Demonstrate standalone LISIC component viability

Complete \$1.5MM seed raise



## Scale-Up + Cell-Level Validation

May → Dec. 2021  
(6 mo)

Move into new larger lab at Research Park

Build out pilot production line in NY

Pilot in AMTE/IM3's commercial cells

DoD Phase II



## Deliver MVP and Product

Dec. → Aug. 2022  
(9 mo)

Develop LISIC battery pack with AMTE and MEP Technologies

Deliver units for USAF/CERL pilots → first POs

Potential Series A





## Asks:

MOU  
(memorandum of  
understanding)

Funding

Strategic Partners  
(in scaling/  
manufacturing)

**More Urgent**

**Less Urgent**

## Purposes:

Sponsor Phase II  
USAF SBIR

Financing a  
CRADA for pilot  
with Army CERL

Scale validation,  
meeting pilot  
capacity





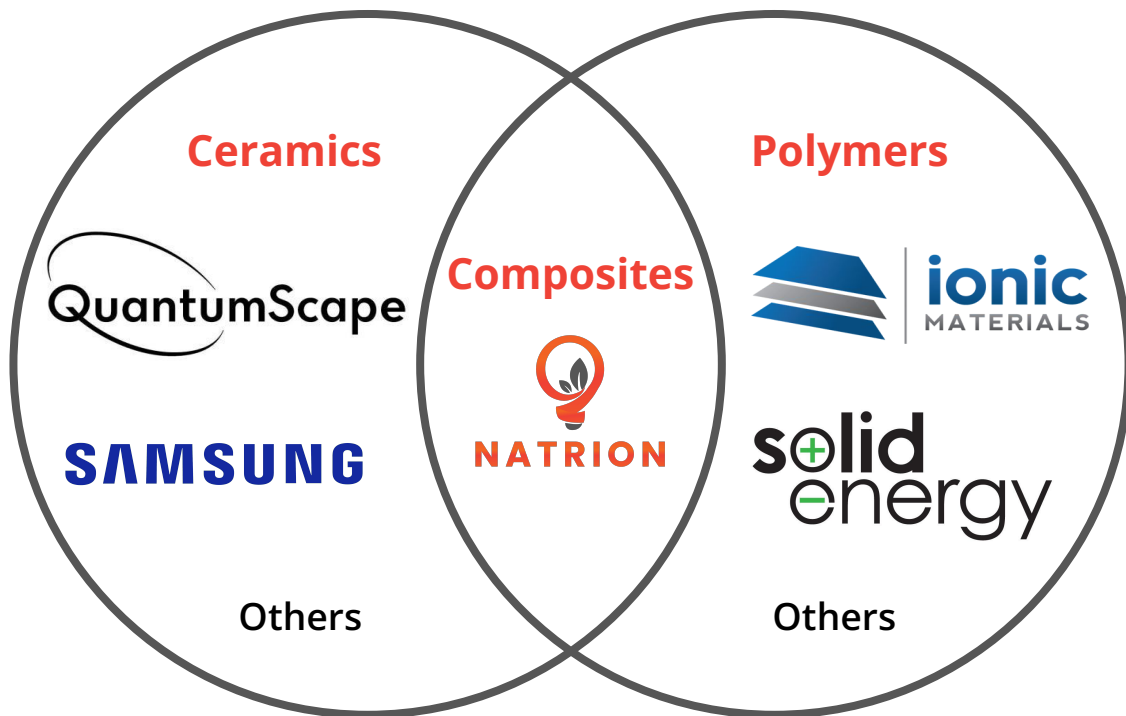
# Appendix



# Technological Landscape

Solid electrolytes are a hot technology but, while the whole world is taking a binary approach by pursuing either pure polymer or pure ceramic solutions, Natrion's new composite uses both types of materials to combine their best properties.

*Ceramics have high performance but are brittle. They can crack inside batteries, killing cell lifespan. They are also cost-prohibitive and relatively thick.*

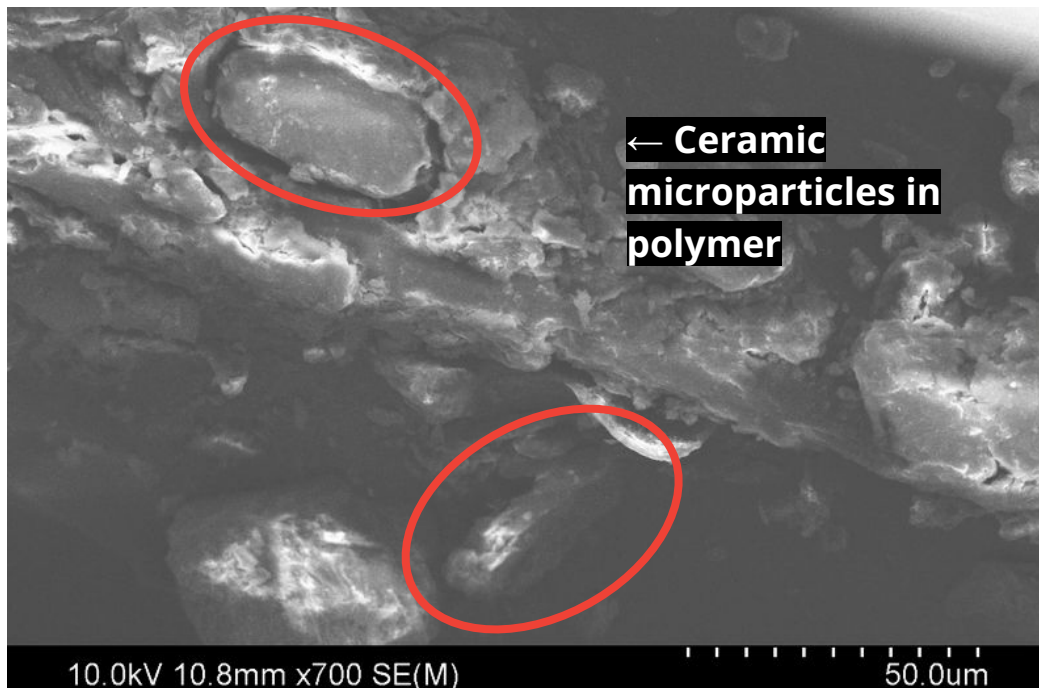


*Polymers are cost-efficient, durable, thin and flexible. However, they suffer from insufficient performance and diminished thermal resilience.*



# The Holy Grail of Composites

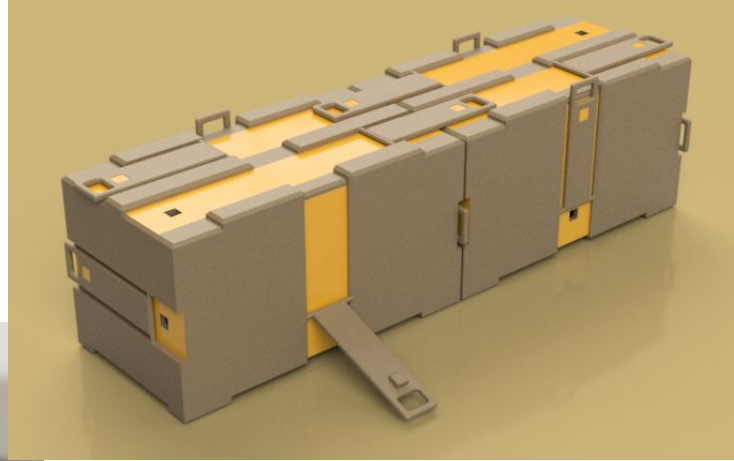
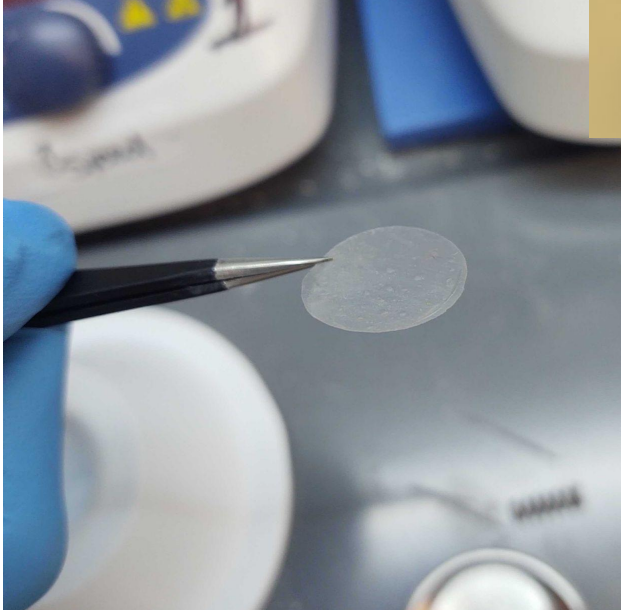
Companies such as Ampcera and NEI have attempted to create similar composite solutions, but have only done so using polyethylene oxide (PEO). PEO, however, affords minimal improvements in thermal resilience as compared to conventional liquid electrolytes. Furthermore, ion transport in the battery electrodes is still a challenge, and liquid electrolyte is often still added to form what are effectively gel-polymers (GPEs).



Natron is the first to implement a composite with PVDF — a long sought holy grail of polymers due to its extreme thermal stability. Natron has resolved the polarizability issues that have stifled PVDF innovation in the past. In addition, the company has pioneered its own new layered aluminosilicate ceramic intercalated with plasticizer that frees the PVDF chains while softening LISIC's surface for excellent adhesion and interfacial transport with battery electrodes and improved ion transport properties.



# MVP (Now)



- 600°F
- Non-toxic solvent
- Enables highest performance batteries
- Ready for scale-up into battery suite prototypes



# Monetization

Manufacturers who have voiced their interest in offering third-party validation of LISIC towards future contracts for LISIC component purchasing include:

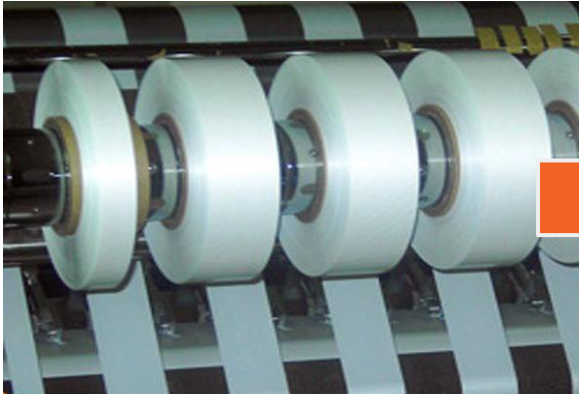
- **AMTE Power:** AMTE will be piloting LISIC in its 10Ah pouch cells this summer as it works towards completing the company's new 5GWh plant in Scotland
- **Imperium3:** IM3 will be piloting LISIC in its 4Ah cylindrical cells this summer as it works towards completing the company's new 15GWh plant in Endicott, NY
- **Tesla:** Tesla is particularly interested in implementing LISIC in its Gigafactory 3 facility in Shanghai, China once Natrion's initial pilots are complete
- **SimpliPhi Power:** A California producer of residential energy storage solutions, SimpliPhi Power wants to validate LISIC in their proving lab



# Market Size

Contract B2B sales:  
\$0.12 - \$0.14 / sqft  
(30%-50% margin)

\$30MM / yr / GWh avg. →  
250GWh in 2025 →  
**SOM: \$7.5B**





**Mic Vittadello**

*Electrolyte R&D Lead*

Ph.D., Chemistry



UNIVERSITÀ  
DEGLI STUDI  
DI PADOVA



**Hao Liu**

*Cell Testing Lead*

Ph.D., Materials Engineering



UNIVERSITY OF  
CAMBRIDGE



**Jon Tuck**

*Commercialization & IP*

Ph.D., Materials Engineering



UNIVERSITY OF  
OXFORD



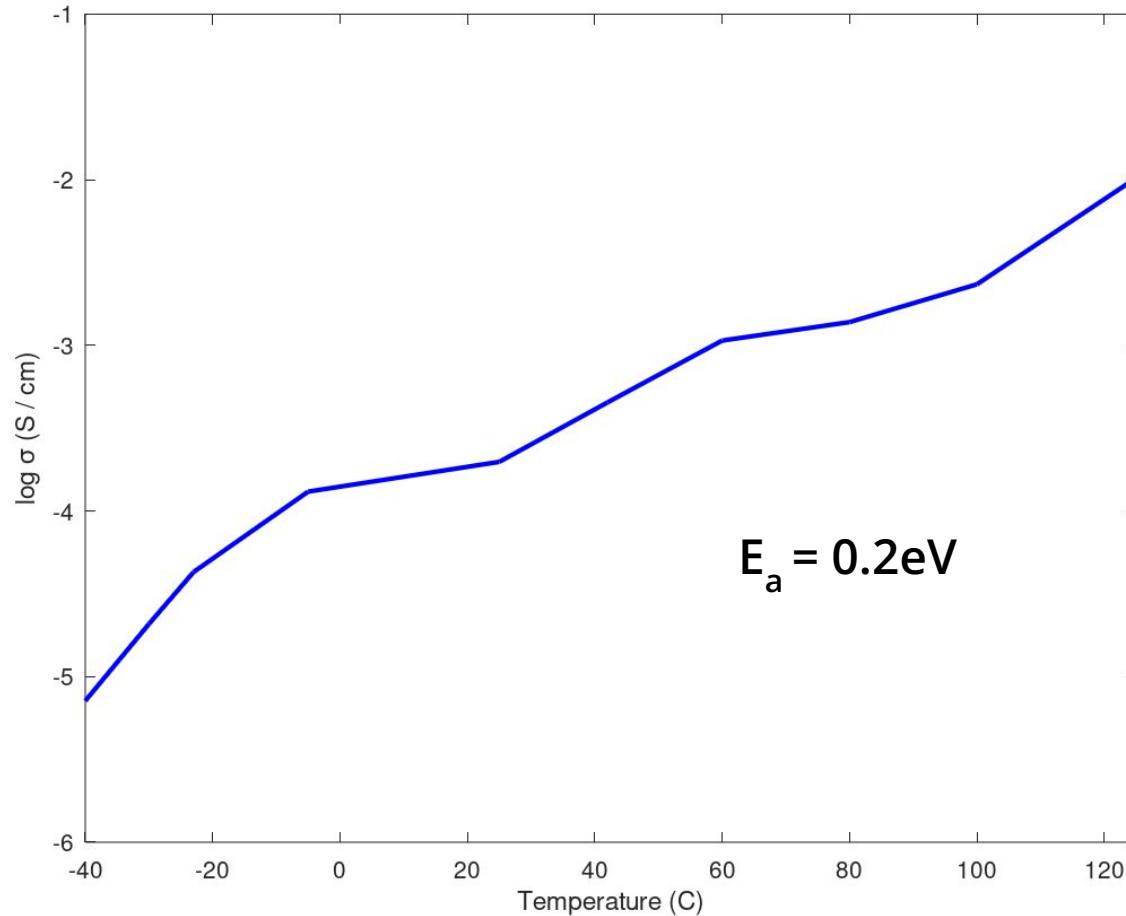
**CU  
NY** THE CITY  
UNIVERSITY  
OF  
NEW YORK

**BINGHAMTON**  
UNIVERSITY  
STATE UNIVERSITY OF NEW YORK

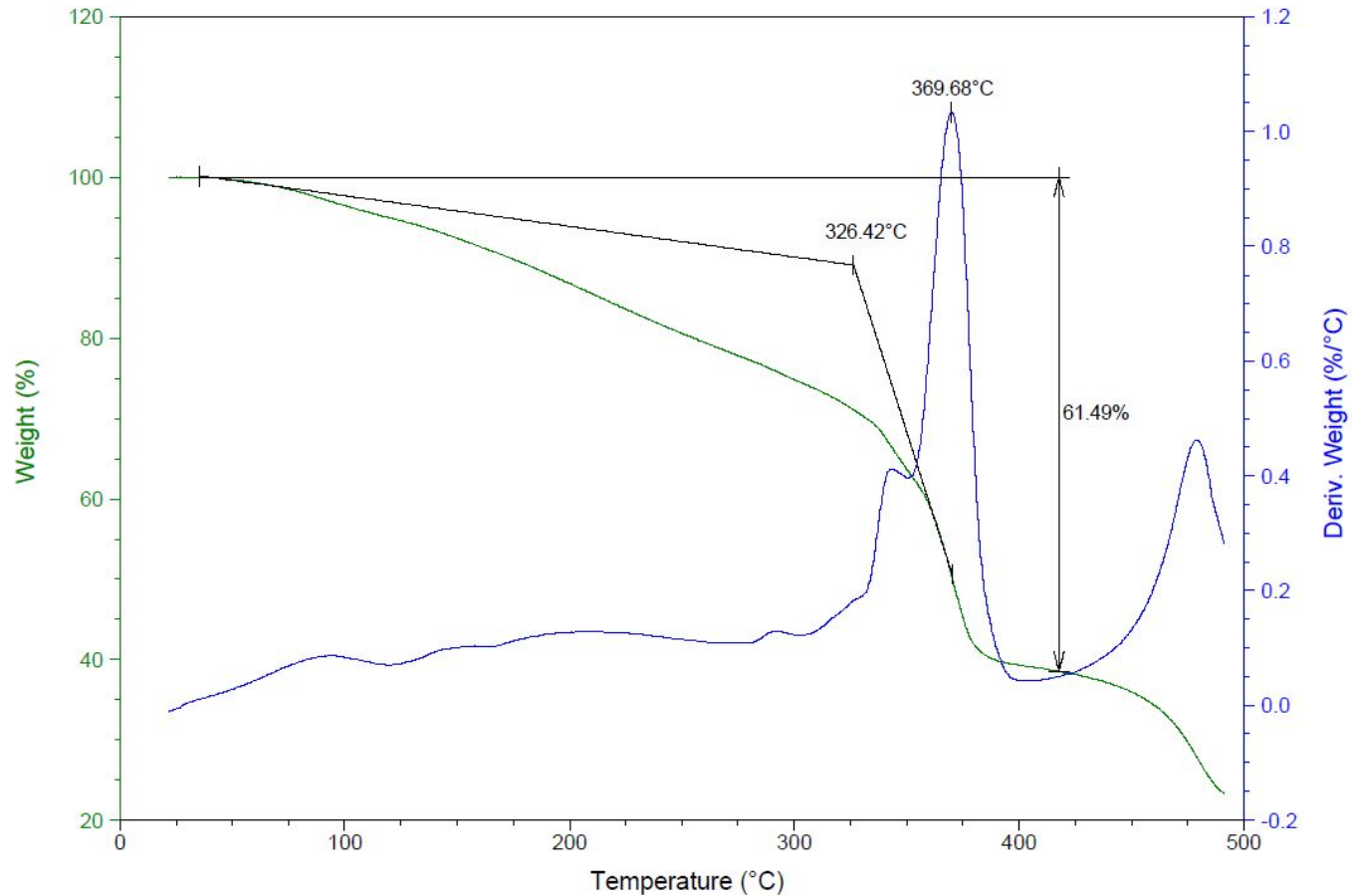
**amt**  
power



# Ionic Conductivity



# Thermal Stability



# Financial Summary

	2019	2020	2021	2022	2023	2024
Revenue from Sales	\$ -	\$ -	\$ -	\$ 1,980,000.00	\$ 10,200,000.00	\$ 52,800,000.00
COGS (Cost of Goods Sold)	\$ -	\$ -	\$ -	\$ 840,000.00	\$ 6,800,000.00	\$ 35,200,000.00
<b>Gross Margin %</b>				57.58%	33.33%	33.33%
OPEX (Operating Expense)	\$ 10,000.00	\$ 18,600.00	\$ 188,600.00	\$ 226,800.00	\$ 1,836,000.00	\$ 9,504,000.00
CAPEX (Capital Expense)	\$ 12,500.00	\$ 60,000.00	\$ 410,800.00	\$ 350,000.00	\$ 583,000.00	\$ 2,915,000.00
<b>EBITDA (Operating Income Before Depreciation)</b>	\$ (10,000.00)	\$ (18,600.00)	\$ (188,600.00)	\$ 913,200.00	\$ 1,564,000.00	\$ 8,096,000.00
Funding Required	\$ 65,000.00	\$ 250,000.00	\$ 1,500,000.00	\$ 7,000,000.00	-	-
Employee Headcount	3	8	15	20	30	50



# Budget

	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	September 2021	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022	May 2022	June 2022	July 2022	August 2022	
<b>Binghamton, NY Lab</b>																			
Rent	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	\$650.00	
Supplies	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	\$4,100.00	
Insurance	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	\$50.00	
<b>Total</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	<b>\$4,800.00</b>	
<b>MRL, Illinois Lab</b>																			
Rent	\$4,580.00	\$4,580.00	\$4,580.00	\$9,800.00	\$9,800.00	\$9,800.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	\$4,580.00	
Testing																			
Personnel	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	
<b>Total</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$9,880.00</b>	<b>\$9,880.00</b>	<b>\$9,880.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	<b>\$4,640.00</b>	
<b>New Illinois Lab</b>																			
Rent			\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	\$8,400.00	
Supplies			\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	\$4,240.00	
Waste			\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	\$800.00	
Prototyping Line					\$190,000.00														
Personnel			\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	\$80.00	
<b>Total</b>			<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$201,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	<b>\$11,520.00</b>	
<b>Salaries</b>																			
Senior Battery Engineer (SBE)	\$1,500.00	\$1,500.00	\$1,500.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	\$8,333.00	
SBE Benefits				\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	\$1,298.00	
Development Salaries	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00	
Contract Employees	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	\$2,000.00	
<b>Total</b>	<b>\$9,500.00</b>	<b>\$9,500.00</b>	<b>\$9,500.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	<b>\$17,631.00</b>	
<b>Manufacturing</b>																			
Pilot Line			\$11,000.00	\$50,000.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	\$38,625.00	
<b>Total</b>			<b>\$11,000.00</b>	<b>\$50,000.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	<b>\$38,625.00</b>	
<b>Monthly Total</b>	<b>\$18,940.00</b>	<b>\$18,940.00</b>	<b>\$41,460.00</b>	<b>\$93,631.00</b>	<b>\$272,256.00</b>	<b>\$82,256.00</b>	<b>\$77,216.00</b>	<b>\$77,216.00</b>	<b>\$77,216.00</b>	<b>\$77,216.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$67,776.00</b>	<b>\$29,151.00</b>

<b>Average Monthly Burn Rate</b>	
	\$74,440.56

<b>Seed Raise</b>	\$1,500,000.00
<b>Total Budgeted</b>	\$1,336,930.00



# Intellectual Property

(12) **United States Patent**  
**Kosyakov**

(10) **Patent No.:** US 10,957,914 B2  
(45) **Date of Patent:** Mar. 23, 2021

(54) **METAKOALIN SOLID IONIC CONDUCTOR AND A SODIUM-ION BATTERY USING THE SAME**

*H01M 4/38* (2006.01)  
*H01M 4/02* (2006.01)  
(52) **U.S. CL.**  
CPC ..... *H01M 4/9016* (2013.01); *H01M 4/38* (2013.01); *H01M 10/3945* (2013.01); *H01M 2004/027* (2013.01); *H01M 2004/028* (2013.01)

(71) Applicant: **Natron LLC**, Albany, NY (US)

(72) Inventor: **Alexander Sergeevich Kosyakov**, Greenwich, CT (US)

(73) Assignee: **Natron LLC**, Albany, NY (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 47 days.

(58) **Field of Classification Search**  
CPC .. *H01M 4/1391*; *H01M 4/131*; *H01M 4/0404*; *H01M 2004/028*; *H01M 4/523*; *H01M 4/661*; *Y02E 60/50*  
See application file for complete search history.

(21) Appl. No.: **16/378,111**

(22) Filed: **Apr. 8, 2019**

(65) **Prior Publication Data**

US 2019/0319275 A1 Oct. 17, 2019

**Related U.S. Application Data**

(60) Provisional application No. 62/657,679, filed on Apr. 13, 2018.

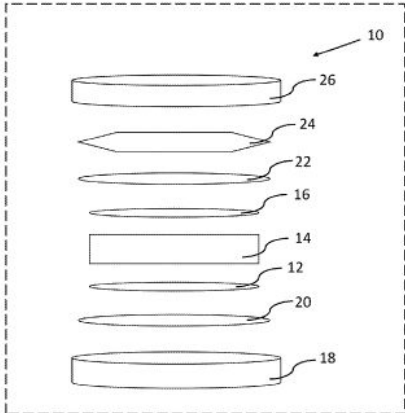
(51) **Int. Cl.**  
*H01M 4/00* (2006.01)  
*H01M 4/50* (2006.01)  
*H01M 10/39* (2006.01)

(56) **References Cited**  
U.S. PATENT DOCUMENTS  
2017/0110259 A1\* 4/2017 Mdia ..... H01G 11/36  
\* cited by examiner

*Primary Examiner* — Cynthia H Kelly  
*Assistant Examiner* — Monique M Wills  
(74) *Attorney, Agent, or Firm* — Whitmyer IP Group LLC

(57) **ABSTRACT**  
A sodium-ion battery comprising a biochar-based anode layer, on NaNiO<sub>2</sub>, cathode layer, and a metakolin solid electrolyte pellets layer.

**8 Claims, 7 Drawing Sheets**



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Website: www.whipgroup.com

March 18, 2021

VIA EMAIL ONLY  
[akosyakov@natron.co](mailto:akosyakov@natron.co)

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Natron LLC  
120 Hawley St. Ste. 211  
Binghamton, NY 13901

Re: WHIP File 07549-P0004A  
US Provisional Patent Appl. No. 63/161,496 - Filed March 16, 2021  
A Composite Solid Electrolyte

Dear Alexander:

Enclosed are copies of the Application Data Sheet and Provisional Patent Application electronically filed March 16, 2021 with the US Patent Office.

Also enclosed is the Electronic Filing Acknowledgment dated March 16, 2021 and assigning Application No. 63/161,496. The official filing receipt confirming this information will follow.

Further, enclosed is an Assignment for signature by you, the inventor. The USPTO will accept digital or electronic signatures (e.g., /John Smith/). Such signatures can be inserted in the signature block by the signatory and emailed back to our office. A witness is not required if the Assignment document is signed and dated.

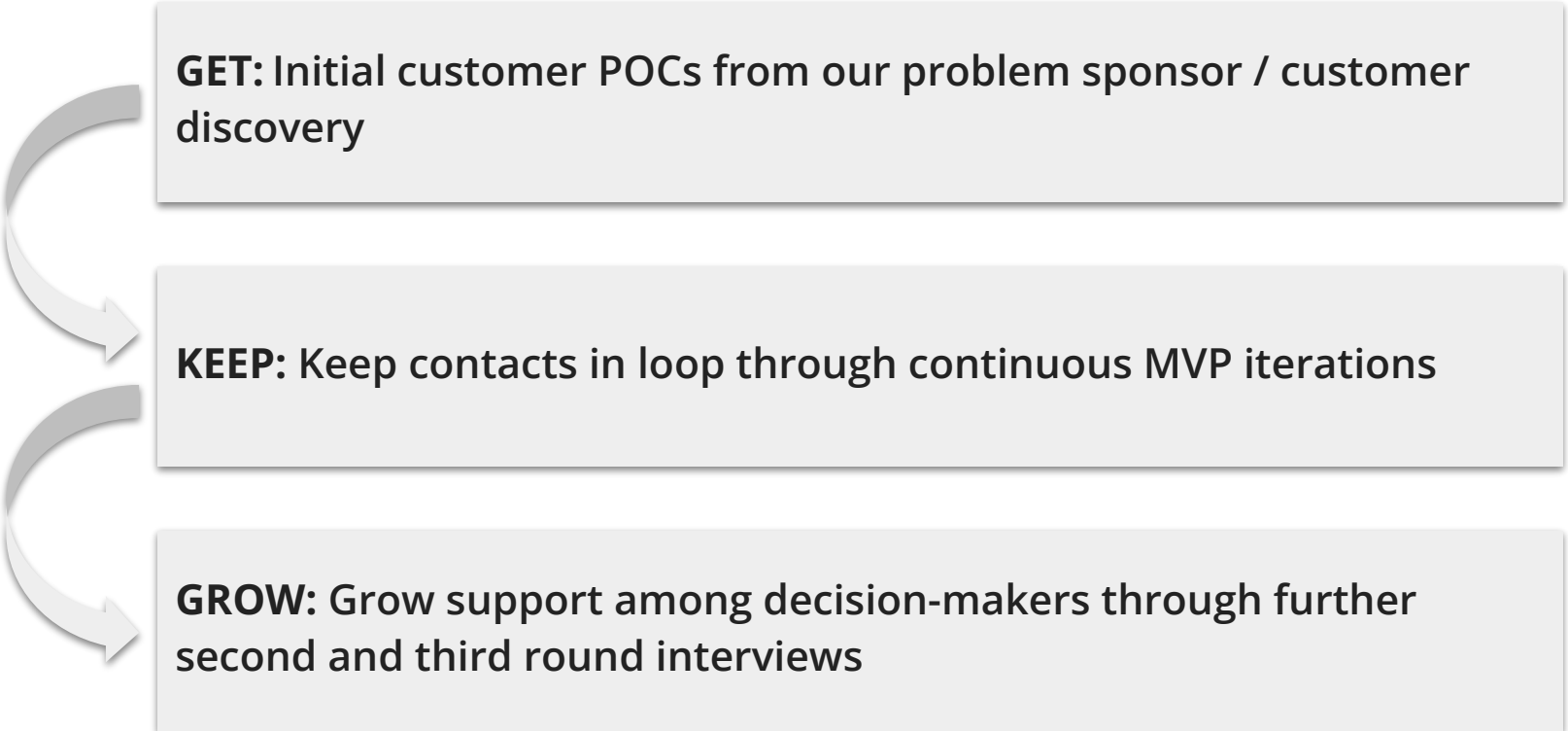
Patent applicants and their attorneys have an ongoing obligation to disclose all known documents relevant to the patentability of any application filed with the US Patent Office. Non-disclosure of a material document can result in the forfeiture of any patent rights stemming from an application. Please send us copies of any such documents (e.g., international search reports, written opinions, references cited in counterpart foreign applications) so that we may comply with this requirement. If relevant documents known to the applicant are not submitted within three months of the filing date of the application, additional fees may be required in order for the US Patent Office to consider the relevant documents.

We will keep you advised of all further developments.

Sincerely,  
  
Benjamin N. Luehrs  
[trademark@whipgroup.com](mailto:trademark@whipgroup.com)



# Get-Keep-Grow Diagram:



**GET:** Initial customer POCs from our problem sponsor / customer discovery

**KEEP:** Keep contacts in loop through continuous MVP iterations

**GROW:** Grow support among decision-makers through further second and third round interviews



# Interviewee Archetypes

## LTCs:

Scott Hallman – Plans Officer,  
21st TSC

Harlan Kefalas – 1SG and  
Base Mayor

## Truckmasters:

Andrew Gregory – 1SG, 51st  
CTC

Joseph Hull – Senior  
Truckmaster

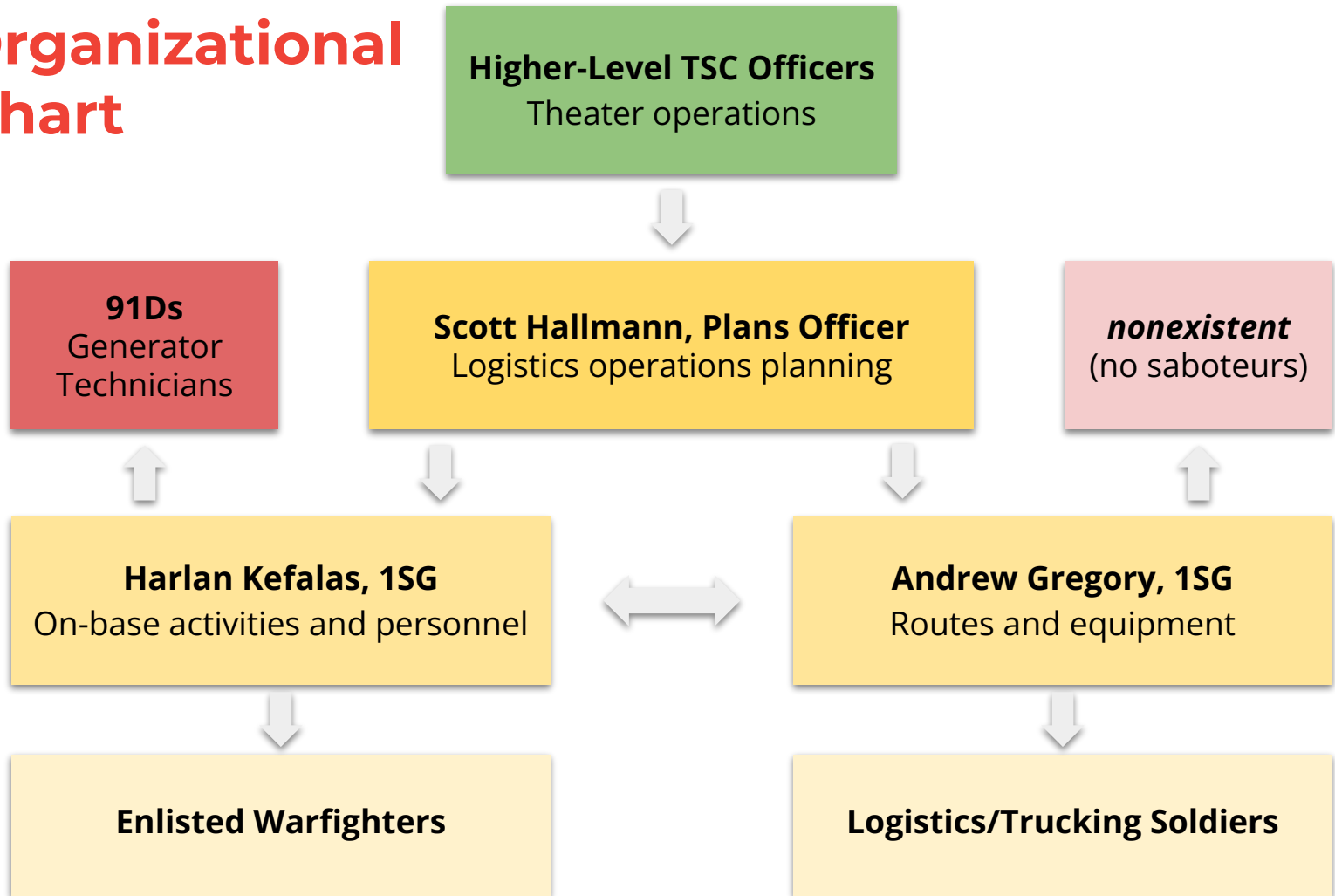
## Platoon Sergeants:

Jose Barada – Infantry Division, Fort Carson

Brian Bell – Distribution Level Platoon Sergeant



# Organizational Chart

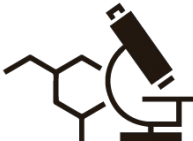





## KEY PARTNERS:



## KEY ACTIVITIES:

- R&D  

- Scale-up  


## VALUE PROPOSITION:

Battery suite of energy storage:

- Safe
- Efficient
- Scalable

## BUY-IN & SUPPORT:

- LOSs / MOUs
- DoD SBIRs
- Small-scale deployment and validation

## BENEFICIARIES:

- MSCs
- TSCs
- Scout units
- USACE

**MISSION BUDGET:**  
\$50,000

## KEY RESOURCES:



AFWERX

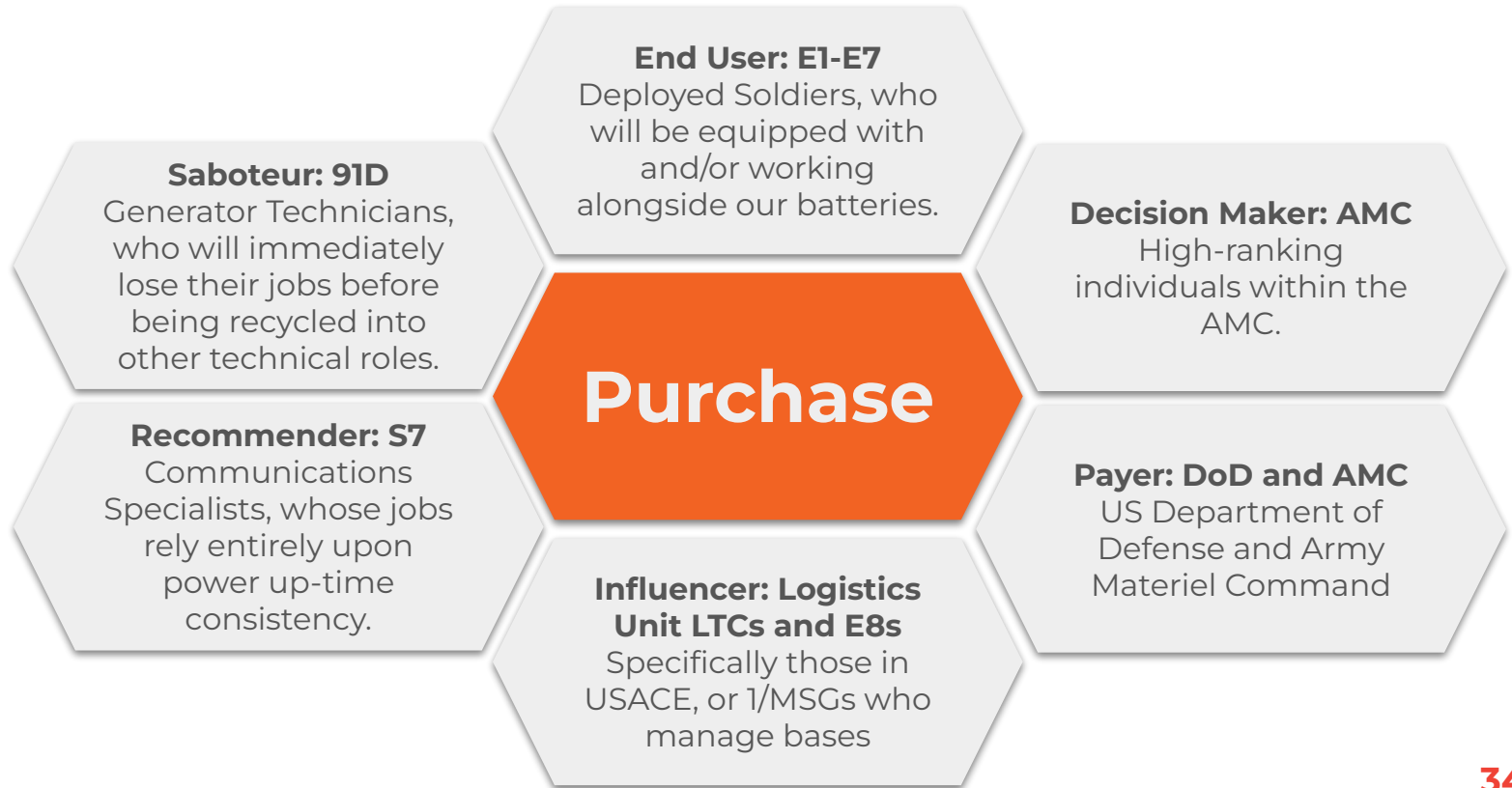


## DEPLOYMENT:



**MISSION ACHIEVEMENT:**  
Adoption of batteries

# Petal Diagram



# Rough Order of Magnitude

