Lab Embedded Entrepreneurship Programs

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Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Long Duration Storage Shot Summit:

Lab-Embedded Entrepreneurship Program Session

manufacturing.energy.gov

Lab-Embedded Entrepreneurship Program

Empower innovators to mature their ideas from concept to first product, positioning them to align with the most suitable commercial path to bring their technology to scale.

① **Recruit** the best energy technology innovators

CHAIN REACTION INNOVATIONS

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Argonne NATIONAL LABORATORY

BERKELEY LAB

OAK RIDGE National Laboratory

INNOVATION CROSSROADS

② **Leverage** expert mentorship and world-class facilities at the national labs on a win-win basis

Accelerate access to follow-on funding

③ **Position** people and technology for market

https://www.energy.gov/eere/amo/lab-embedded-entrepreneurship-programs

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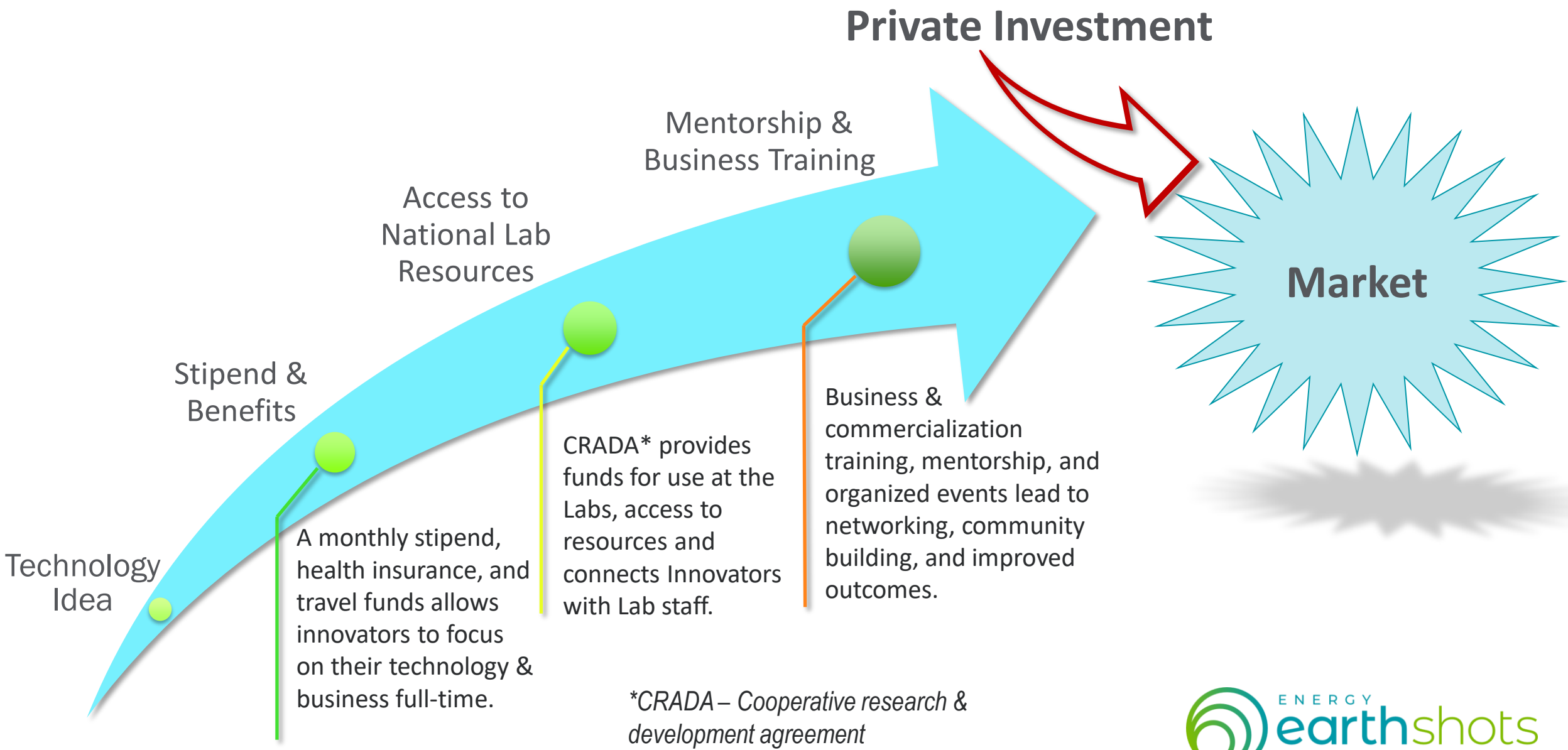
Accelerate Progress to Market



CRADA – Cooperative research & development agreement

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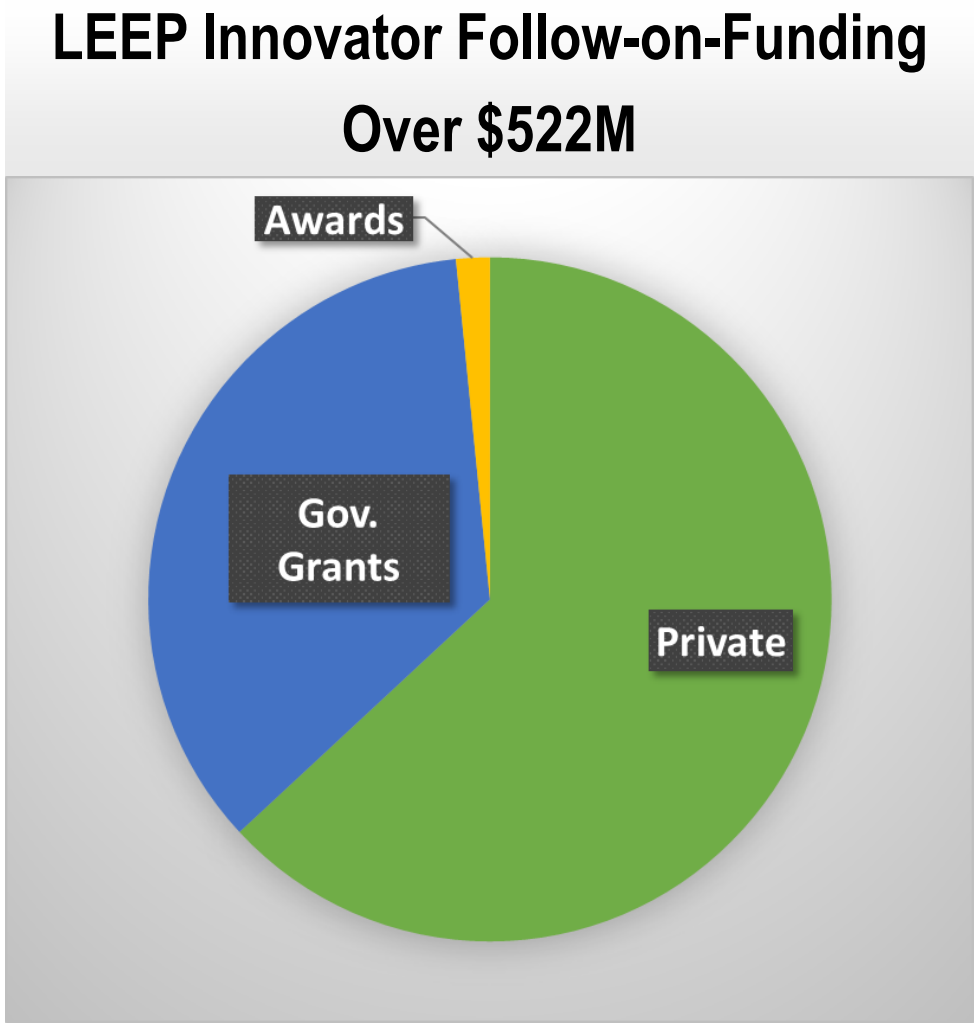
Program Success



- 96% success rate for companies continuing to operate after the program
- 12 Innovators have been recognized in Forbes' 30 under 30
- 11+ companies are selling commercial products

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Today's Panel

LEEP Managers, Advanced Manufacturing Office, DOE

Joe Cresko
(Chief Engineer)

Paul Syers
(Technology Manager)

CHAIN REACTION INNOVATIONS
Entrepreneurship at Argonne

John Carlisle
(Director)

JOLT

Tom Guarr
(Founder Jolt Energy)

INNOVATION CROSSROADS

EONIX

Dan Miller
(Director)

Don DeRosa
(Co-Founder Eonix Energy)

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Rachel Slaybaugh
(Director)

Antora Energy

David Bierman
(Co-Founder Antora Energy)

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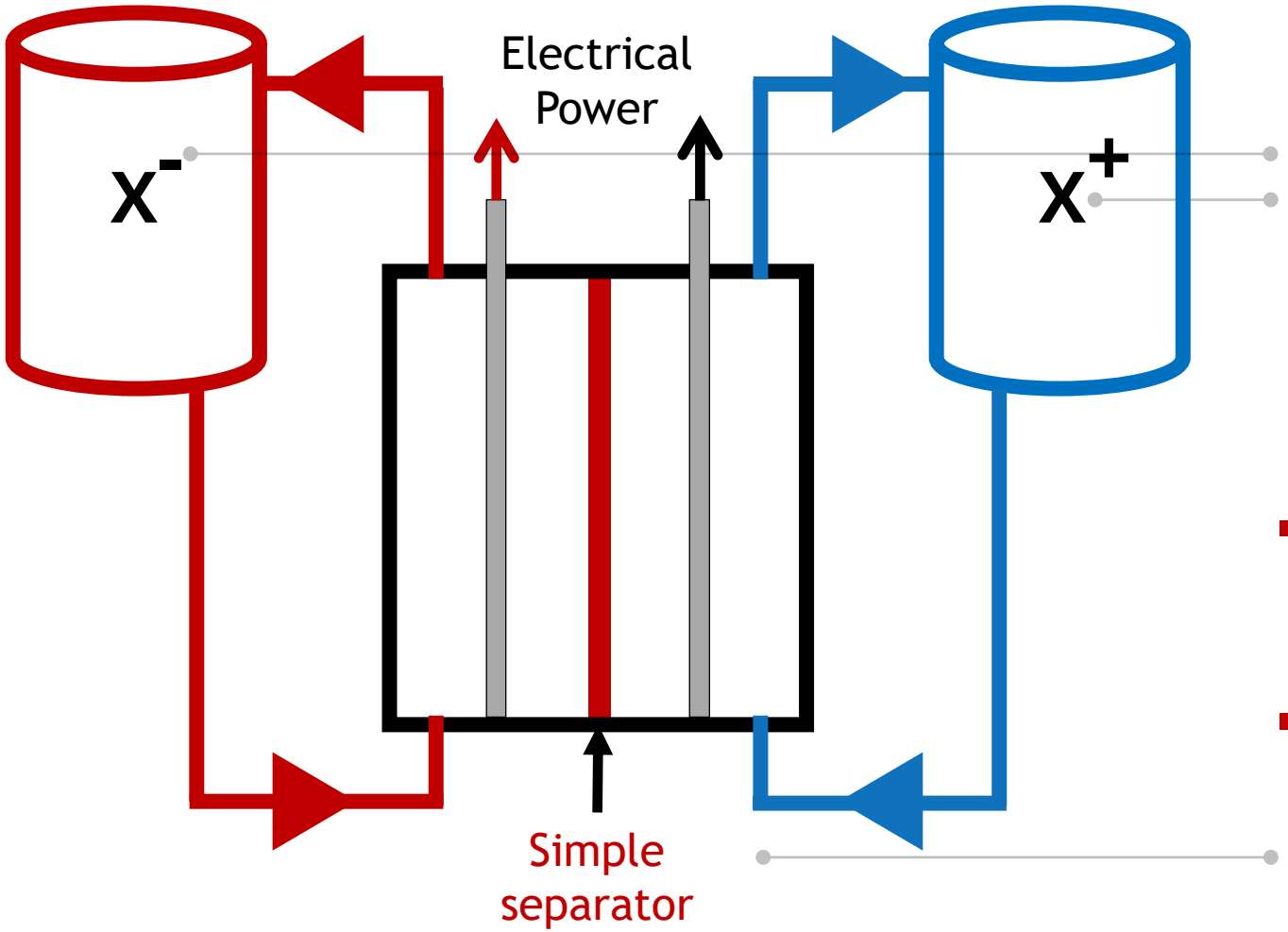
ORGANIC BATTERIES
POWERING A RENEWABLE GRID

ENERGY STORAGE TECHNOLOGIES

The Jolt Organic Redox Flow Battery



Vanadium replaced by a simple organic compound that functions as ***BOTH*** the negative fuel and positive electrolyte.

- Higher Voltage (2X)
- Multielectron capability (2X)

NET RESULT:

More energy at lower cost

Expensive selective membrane replaced by a simple porous separator

Milestones and Progress

ACTIVITIES

Launch

- Initial concept
- Lab data
- IP license

Technical Progress

- Lab space
- Material screening
- Modeling
- RFB prototype

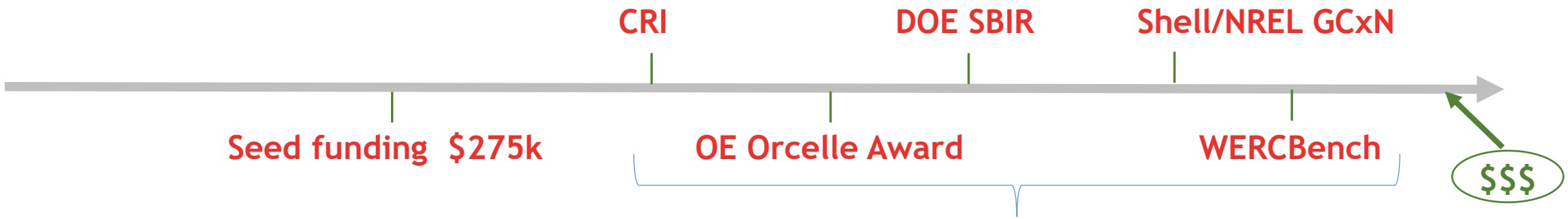
Business Development

- CRI Program
- I-Corps
- Tech validation
- Build team

Commercialization

- Larger prototype
- Scale-up
- Field Trial
- Extended testing

FUNDING



$1.1 M in non dilutive funding to date

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Rapidly Designing Electrolytes

INNOVATION CROSSROADS
OAK RIDGE NATIONAL LABORATORY

Before Innovation Crossroads 2018		After Innovation Crossroads 2021
High Voltage Electrolytes for ultracapacitors	Tech	**Rapid & Auto Electrolyte Screening** for ultracaps & lithium-ion batteries
Reduce Cost & Size of ultracapacitors	Value	**Reduce Time & Cost** To develop application specific products
$400M Direct Electrolyte Sales	Market	**$5B+** Initial Cell Market
$550k Non-Dilutive Grants	Funding	**$3.7M** Non-Dilutive Grants
150+ Initial Prototypes	Progress	**3** Products Under Development

High Voltage Ultracapacitors 2021

Non-Flammable Lithium Ion Batteries 2023

29 Cu

Energy Dense Anode Free 2026

Innovation Crossroads provided us with:

Extensive Technical Resources

Commercialization Guidance

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1 TWh Annually

By 2025

$100 Billion in Batteries

Market Drivers

RENEWABLES & GRID ESS

COST
Global Deployment needed will cost trillions

SAFETY
Permitting barriers due to flammability

AUTOMOTIVE

COST
65% of EV cost derived from battery pack

SIZE
Low Range & Slow Charging

DEFENSE

SIZE
Weight limitations & Low Range

SAFETY
Flammability is a vulnerability

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ATLAS-System: Rapid Material Design

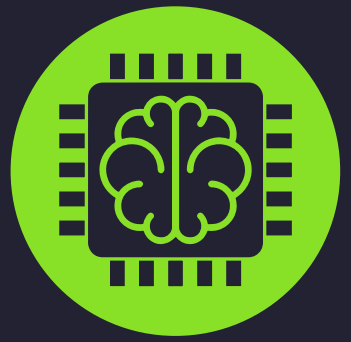
Problem: Cost, Time, & Risk
Solution: ATLAS-SYSTEM

Atlas-Cells

Embedded Sensor

- Spectator Material does not change behavior
- High Reproducibility
- Explicitly measure everything in a battery

Data Processing



Automated Analysis

- Calculates performance metrics
- Identifies point of failure

Pilot System Operating at Joint Institute for Advanced Materials

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RAPID MATERIALS DEVELOPMENT

Advantages from Eonix ATLAS System

Time & Cost To Understand
A NOVEL CHEMISTRY

STATE OF THE ART	VS	ATLAS
3M BASF TESLA		EONIX
10 MONTHS		**8 DAYS**
• Long Term Cycling • Post-Mortem Characterization • PhD Labor		• Short Term Cycling • In-Situ EC • Semi-Auto
1 Chemistry $125,000		1 Chemistry $7,500

RESULT: Eonix can rapidly develop **new material products** that address the **differentiated** needs of the energy storage market **37X faster** than competitors.

ATLAS is a *productivity multiplier* for energy storage materials research

Pilot System developed at Oak Ridge National Lab
Scaled System at the Joint Institute for Advanced Materials

EONIX

WHAT HAVE WE DONE WITH ATLAS?

Non-flammable Lithium Ion Battery

Opportunity

Grid storage deployment is expected to grow from 12 GWh (2018) to 158 GWh (2024) in six years.

$14B
2024

Problem

FDNY requires fire suppression system

AZ Temp ban on LiB after grid explosions

SK has had 23 grid fires

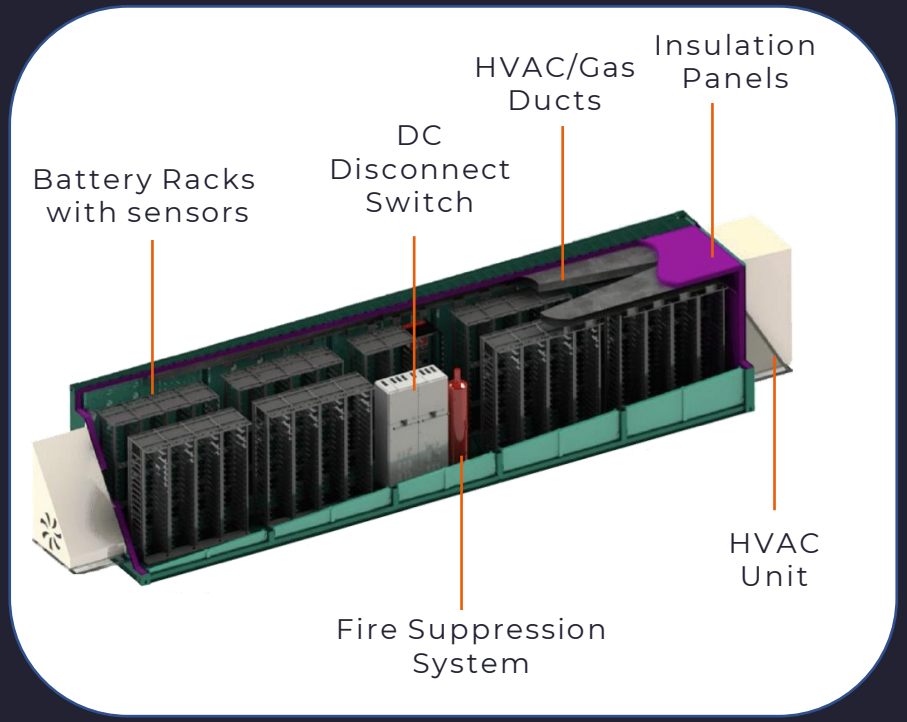
Solution: Carbonate Free Electrolyte

Plug & Play non-flammable electrolyte

Carbonates are required for longevity

Selected candidate has Melting point of 25 C

Value



25% Of Cost

- Fire Suppression System
  - **Increases CapEx**
- Emergency Explosive Gas Ventilation System* (APS)
  - **Increases CapEx**
- HVAC or Liquid* Cooling System (APS)
  - **Increases CapEx, OpEx, & LCOE**

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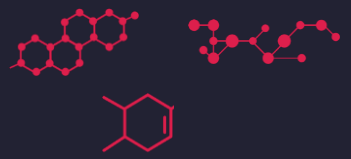
TIMELINE

2020

Electrolyte Screening

21

Chemistries



2021

1Ah Cells

Non-Flammable
(F.P. >160°C, 10x higher)

> 70° C Operation

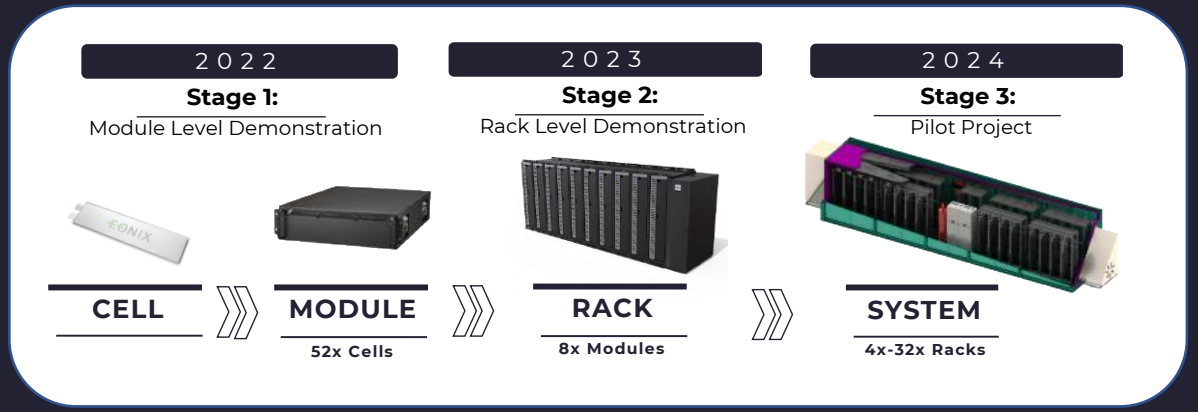
Plug n' Play with existing Electrodes & Form Factors

2022

Production Prototypes

18650 & 10Ah

Cells



2024

Grid Storage Pilot

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Rapidly Designing Electrolytes

EONIXENERGY.COM

Contact at dderosa@eonixenergy.com

Collaborators - Strategic Partners - Chemical Suppliers – Battery Manufacturers

Any Questions?

Thank you!

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