ADENA POWER

Sustainable Energy Storage
For Our Net Zero Future

Low-cost Metal-Supported Metal Halide Energy Storage Technology

DE-SC0021566

Neil Kidner

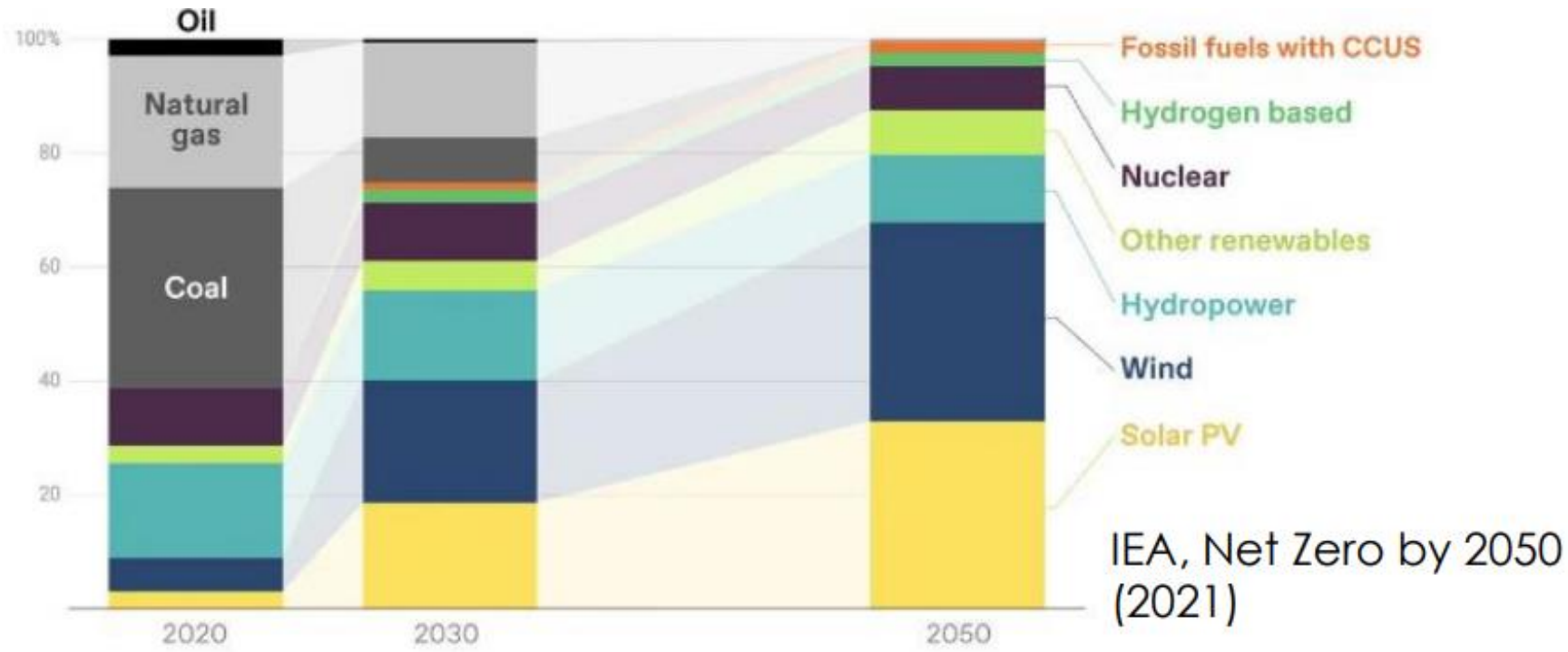
A Nexceris Company

Agenda

- Motivation
- Adena's sodium solid-state energy storage solution
- Highlights
  - Technical advancements
  - Manufacturing readiness and cost analysis
  - 1 kWh MVPRO module
  - Upcoming utility demonstrations
- Product Evolution and Go to Market Strategy

Motivation

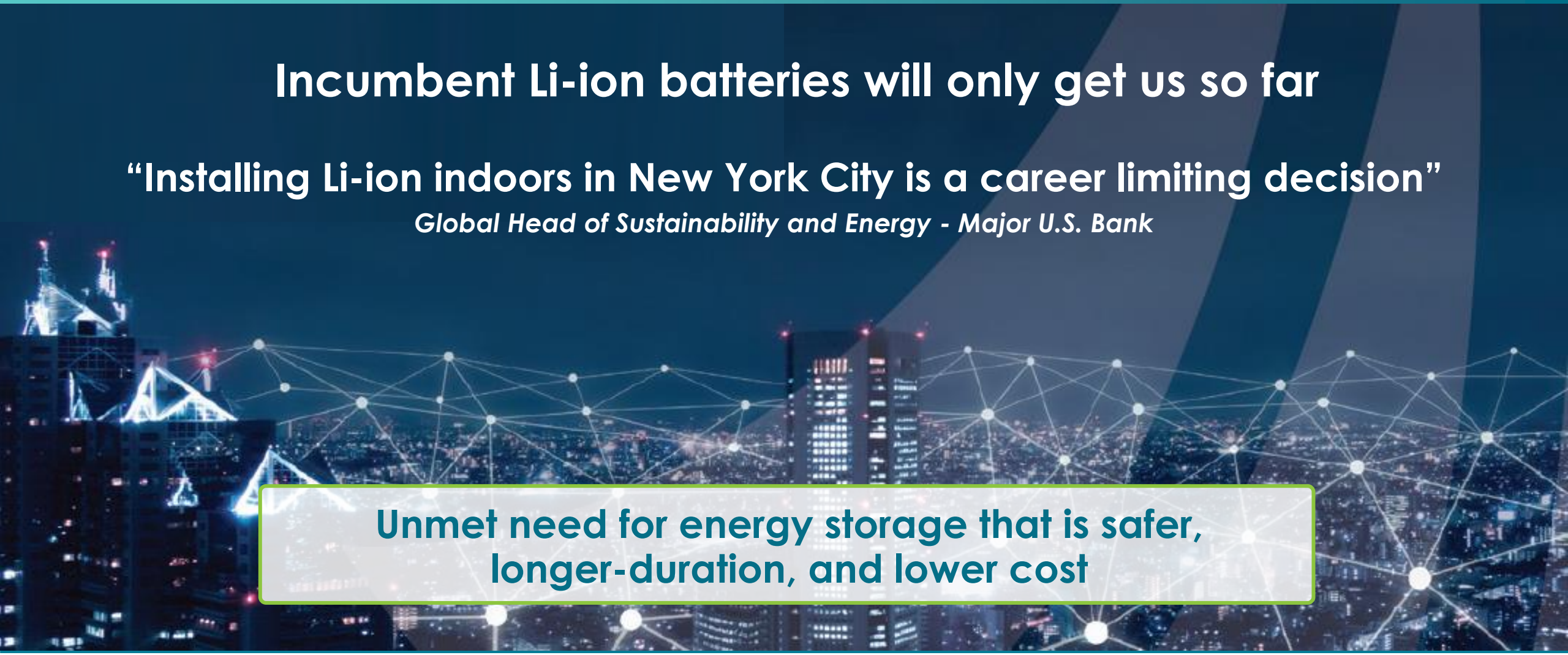
Restructuring of Gen stack needed for net zero



IEA, Net Zero by 2050 (2021)

For renewable energy to be considered just energy need viable energy storage

The Problem



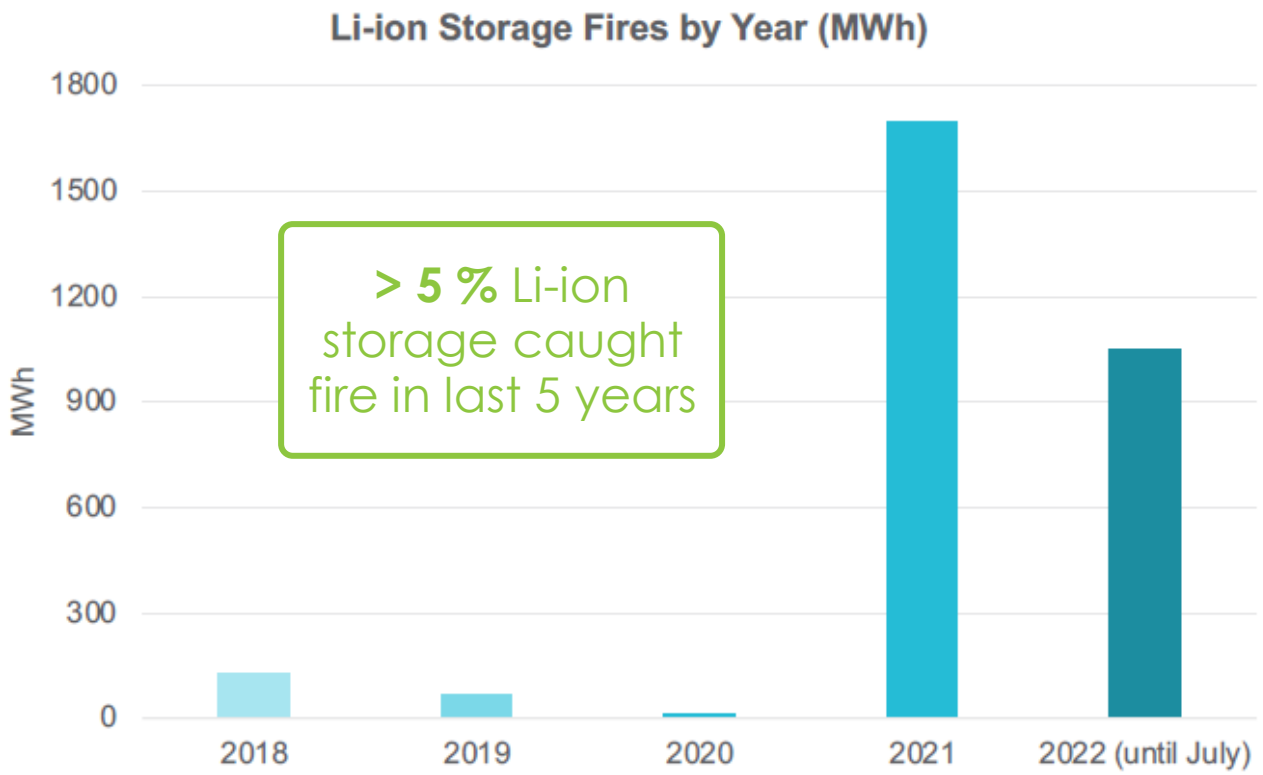
Incumbent Li-ion batteries will only get us so far

“Installing Li-ion indoors in New York City is a career limiting decision”

Global Head of Sustainability and Energy - Major U.S. Bank

Unmet need for energy storage that is safer, longer-duration, and lower cost

Safety

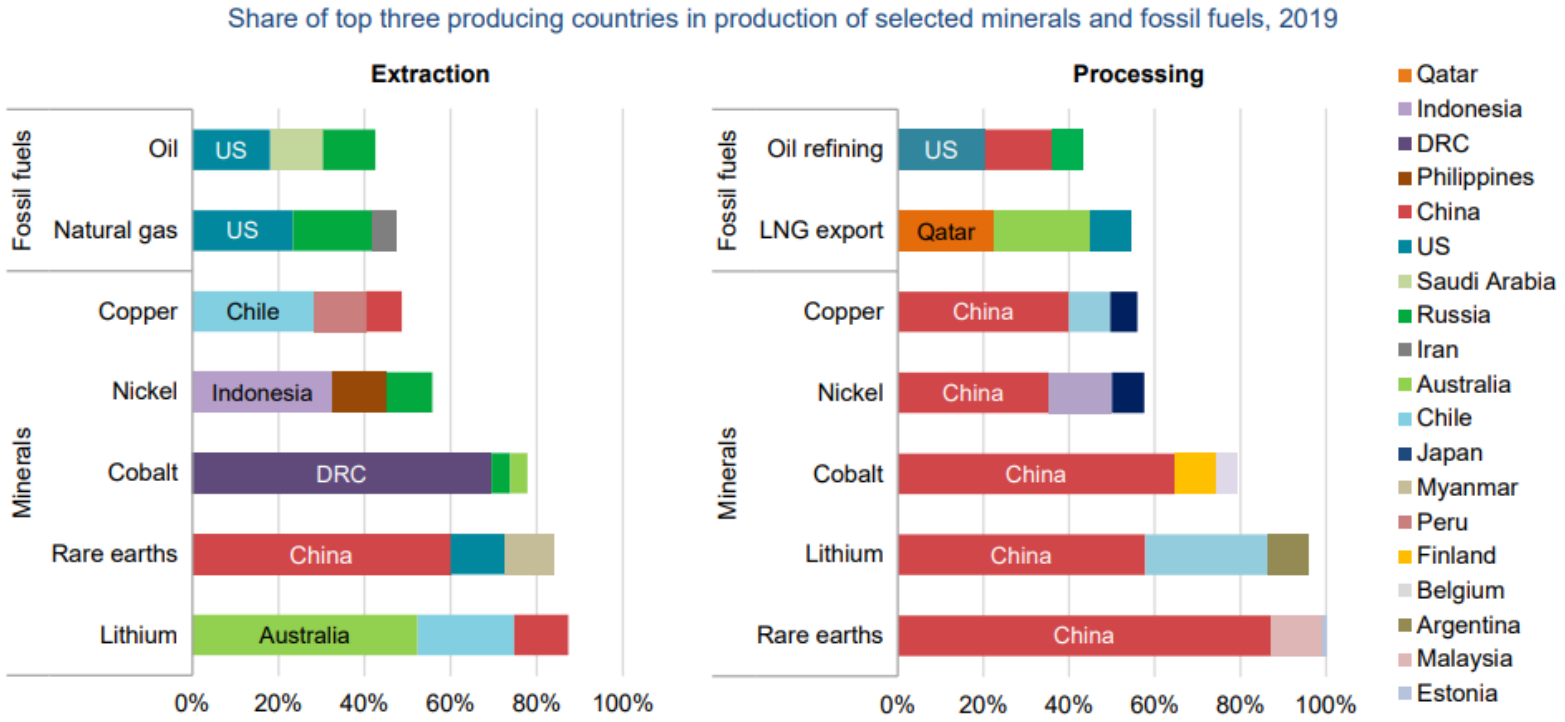


EPRI BESS Failure Event Database

Nexceris has addressed Li-ion safety with industry leading Li-ion Tamer system

- Market access
- How to get tech deployed

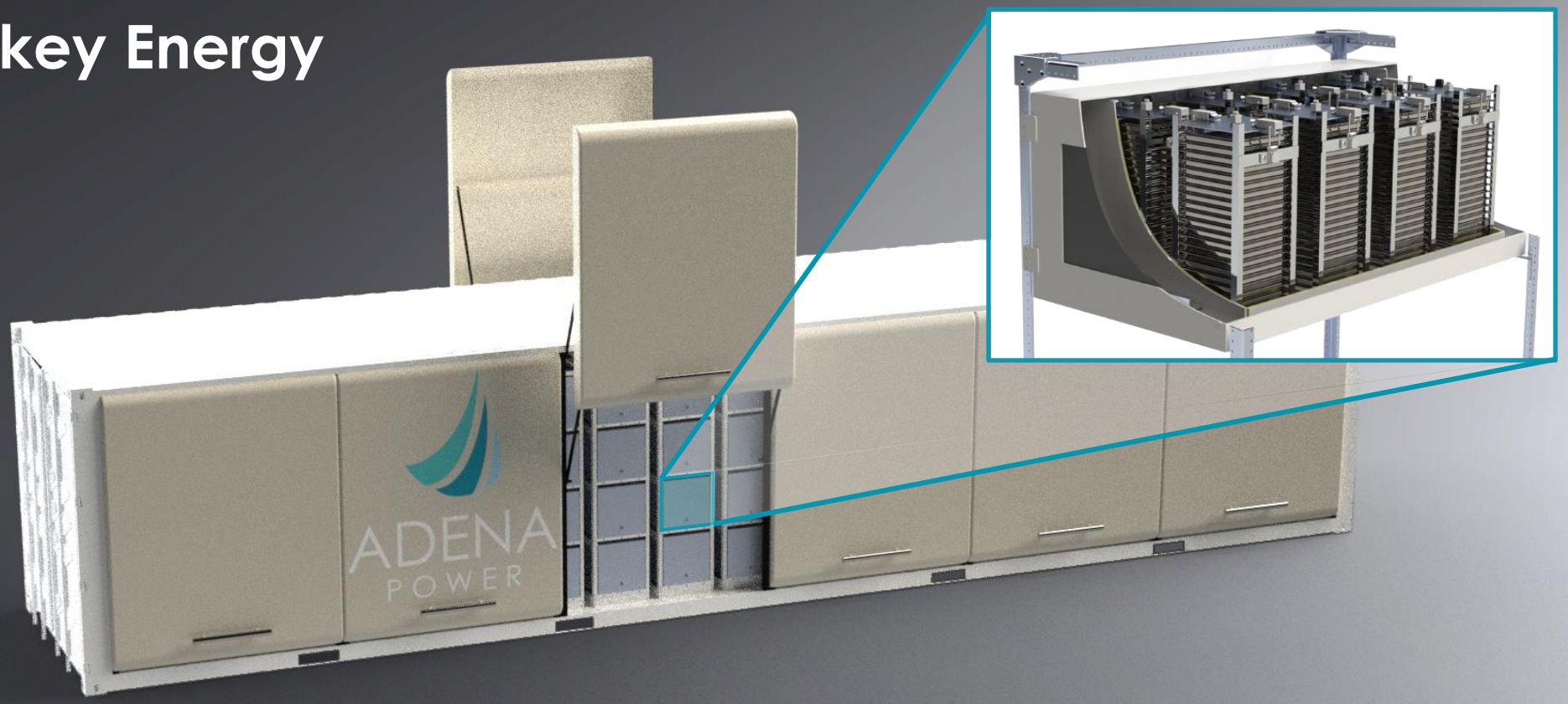
Energy transition - unprecedented demand for critical raw materials



IEA World Energy Outlook Special Report – The Role of Critical Minerals in Clean Energy Technologies (Feb. 2022)

Breakthrough Sodium Based Energy Storage Product

0.25-1.5 MWh Turnkey Energy Storage System



30 % lower cost than Li

Safe

Sustainable domestic materials

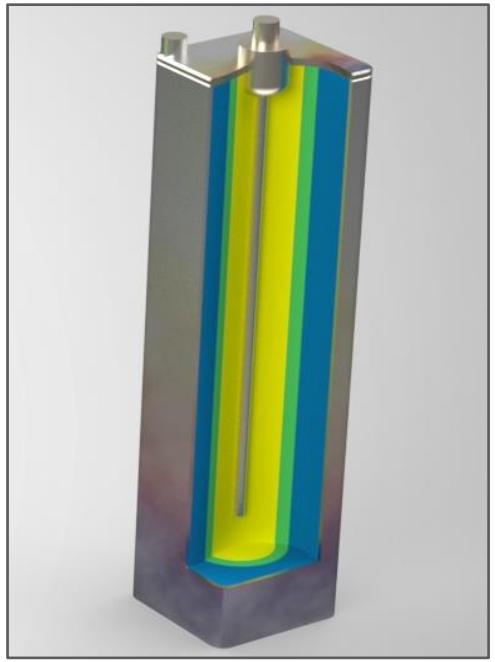
Customer Value Proposition

Provide target C&I market with differentiating energy storage solution

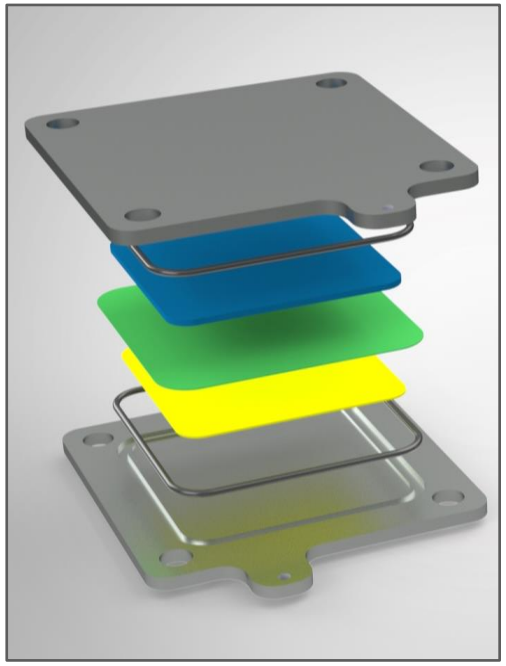
Product Feature	Key Customer Benefit
Low Cost	$350/kWh installed
Intrinsically Safe	Faster deployment, opens new markets
Secure domestic supply chains and manufacturing	Turnkey ESS in the ground earlier
Flexible duration (1-18 hours)	Firm renewable assets and access multiple value streams
Reliable, minimal maintenance	Lower O&M costs, eliminate need for HVAC
Sustainable	Fully recyclable – Better cradle to grave cost

Sodium Metal Halide Battery Chemistry

Conventional



Adena Cell



Lower temperature

Lower cost materials

Scalable manufacturing

Anode (blue): Na anode compartment and current collector
Cathode (yellow): Ni-NaCl (standard), Fe-NaCl (Adena) and $NaAlCl_4$ secondary electrolyte
Electrolyte (green): β″ -alumina (standard), Na-conducting NASICON membrane (Adena)

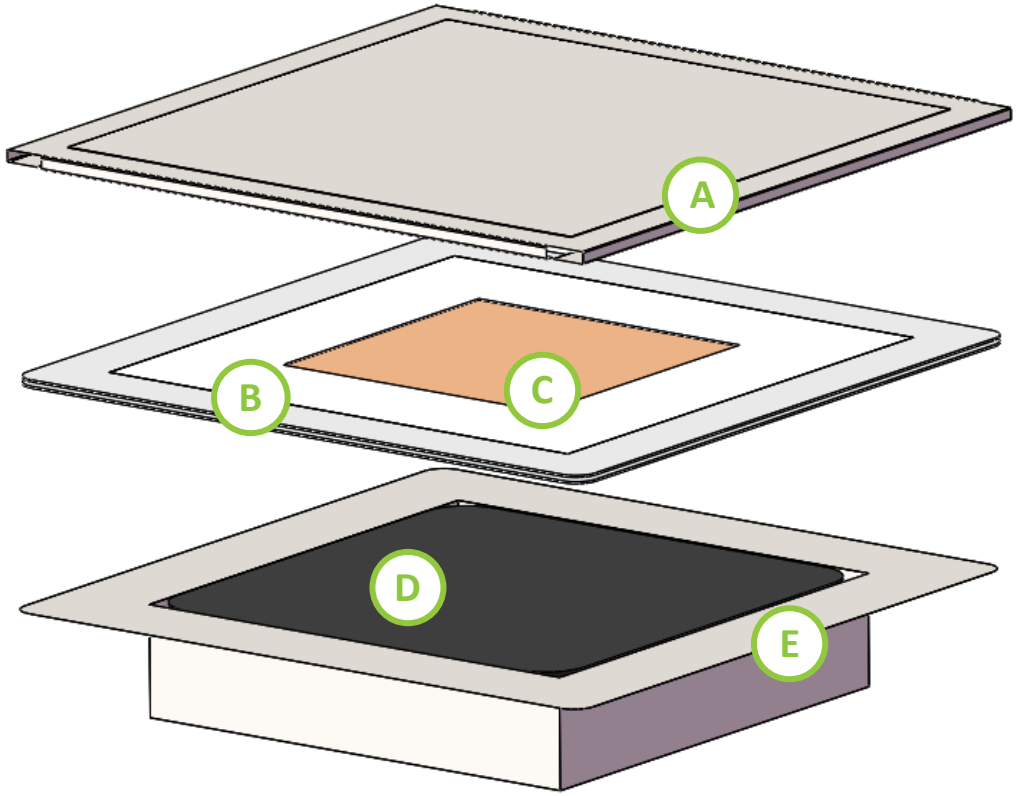
Competitive Analysis

Most energy dense and efficient Li-ion alternative

	Adena Power	Li-ion	Na-Metal Halide	Flow	Zn-hybrid cathode	Pb-Acid	Na-Sulfur
Total Cost	●	●	○	◑	●	◑	○
Roundtrip Efficiency	●	●	●	○	◑	○	◑
Energy Density	●	●	◑	○	◑	○	◑
Lifetime	●	◑	◑	●	◑	○	◑
Sustainable Materials	●	○	◑	◑	●	◑	◑
Safety	●	○	●	●	●	◑	◑

● Excellent
◑ Average
○ Poor

Adena's Cell Technology



A Anode

- Discharged - no active anode

B Polymer Sealing

- Low-cost
- Simplified cell assembly

C Polymer-supported NASICON electrolyte

- Thin, highly conductive NASICON substrate
- Mechanically robust

D Iron based cathode chemistry

- Energy capacity controlled by cathode depth

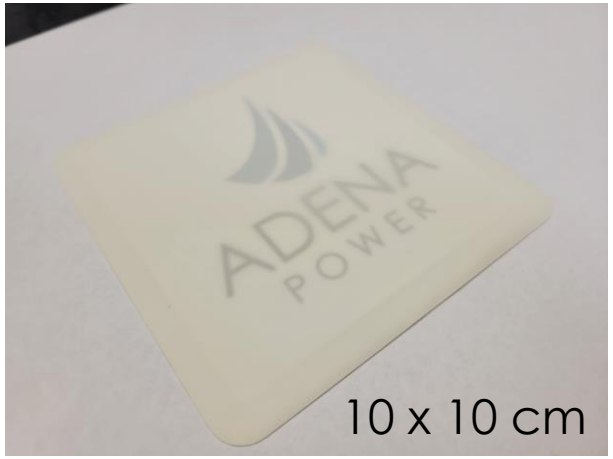
E Stamped cell-housing

- Low-cost mild steel
- Scalable manufacturing process

Technology Development Overview

Powder-to-system development

Ceramic membrane



8 Ah Cell

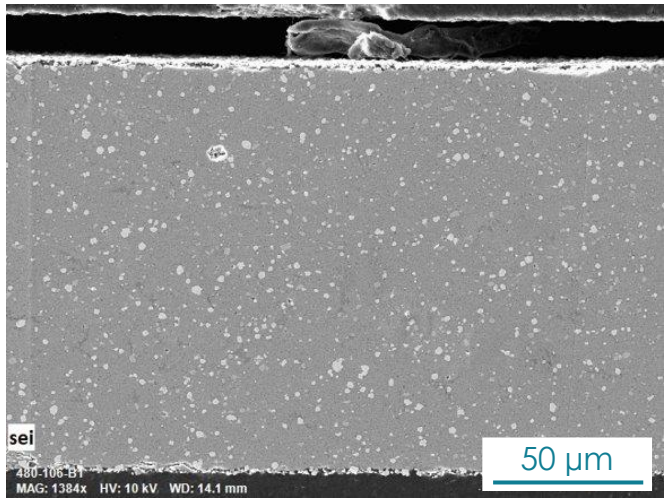
Cartridge

1 kWh MVPRO module

- Materials synthesis & processing know-how
- Vertical Integration
- Strong defensible IP position

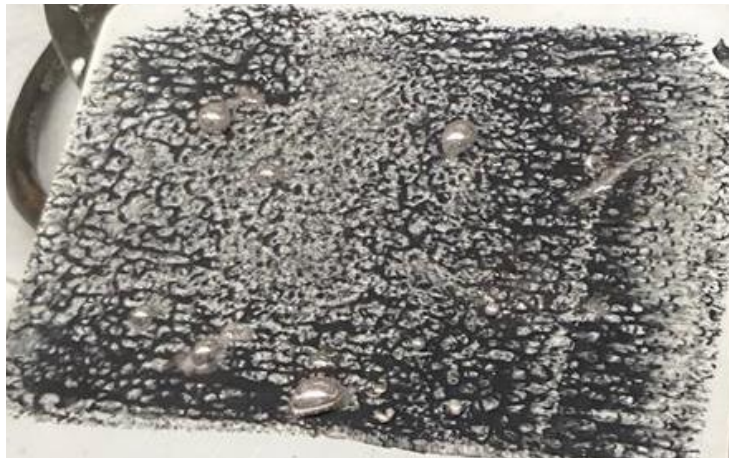
NASICON Powder and Membrane Development

NASICON Membrane	Result
Size	10 cm x 10 cm (w/ 15 cm x 15 cm proof-of-concept)
Membrane Density	Fully Dense (> 95 %)
Flatness	Flat – no wrinkles/camber
Compositional Homogeneity	No center-to-edge variation (minimal Na/P volatility)
Membrane defects	Defect free (pass leak check)
Conductivity	Highly conductive



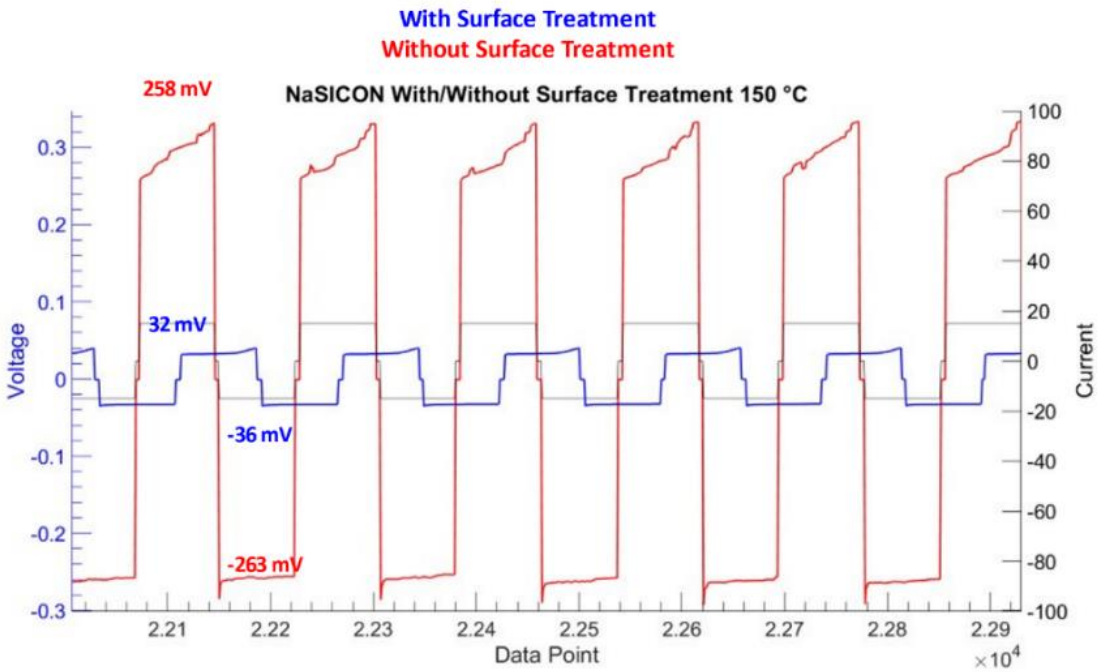
NASICON surface treatment – sodium wetting

Initial Attempt



Optimized spin-coat process

Alternative wetting approach



Manufacturing Readiness

Cell Development

Gen. 1 Gen. 2

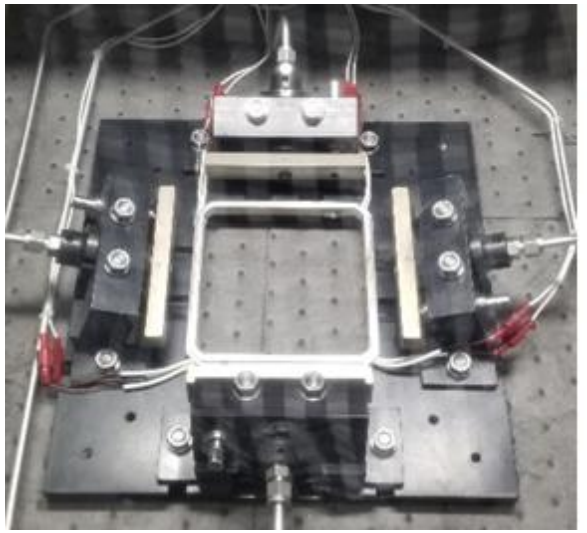
90 % weight reduction

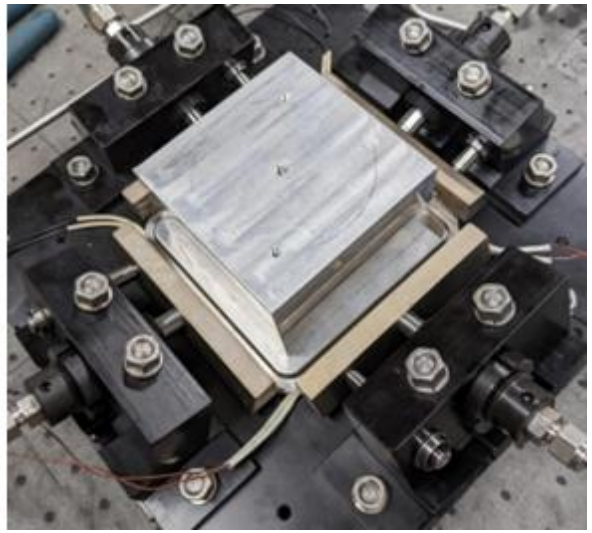
+95 % cost reduction

80 % assembly time reduction

Cell Assembly

Hydraulic crimping tool

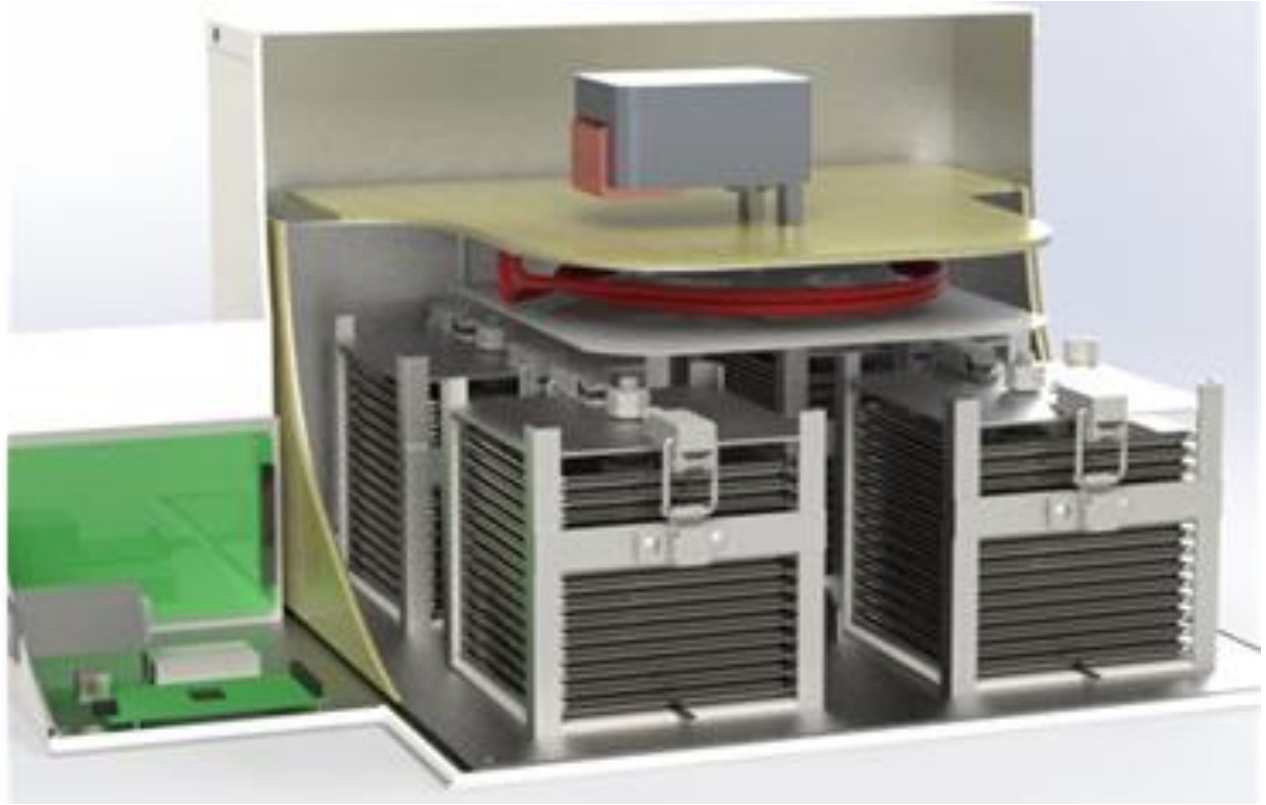




Module Design & Development

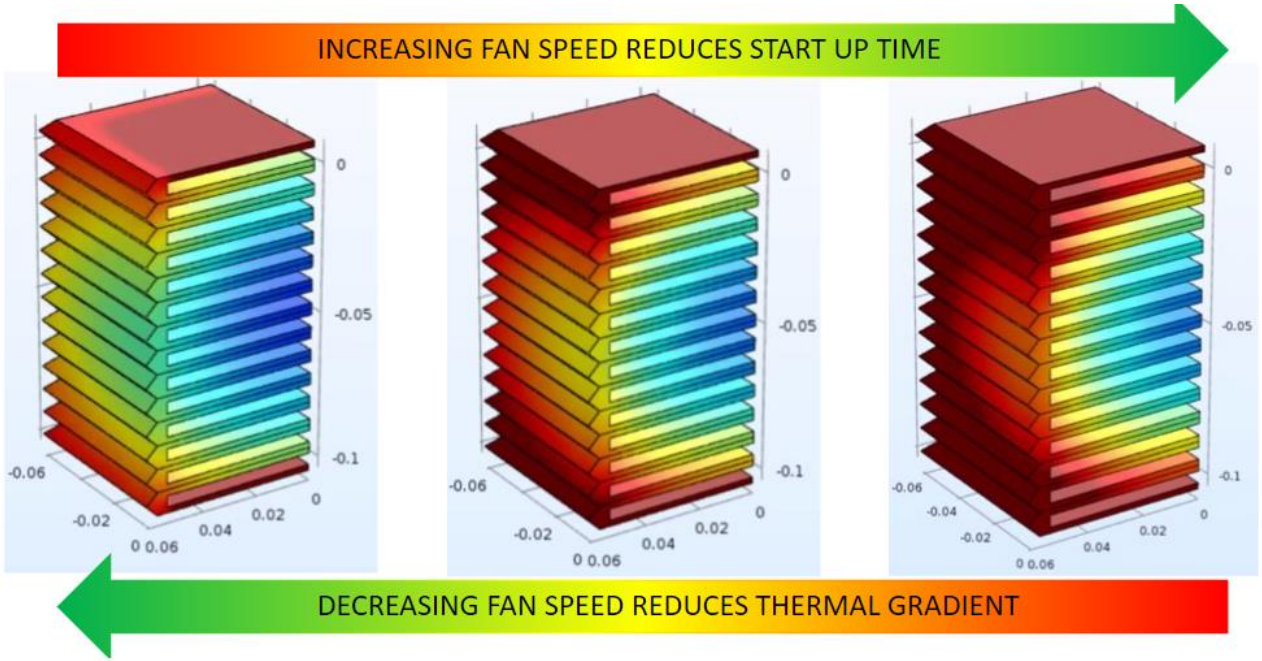
Cell Cartridge

1 kWh module design

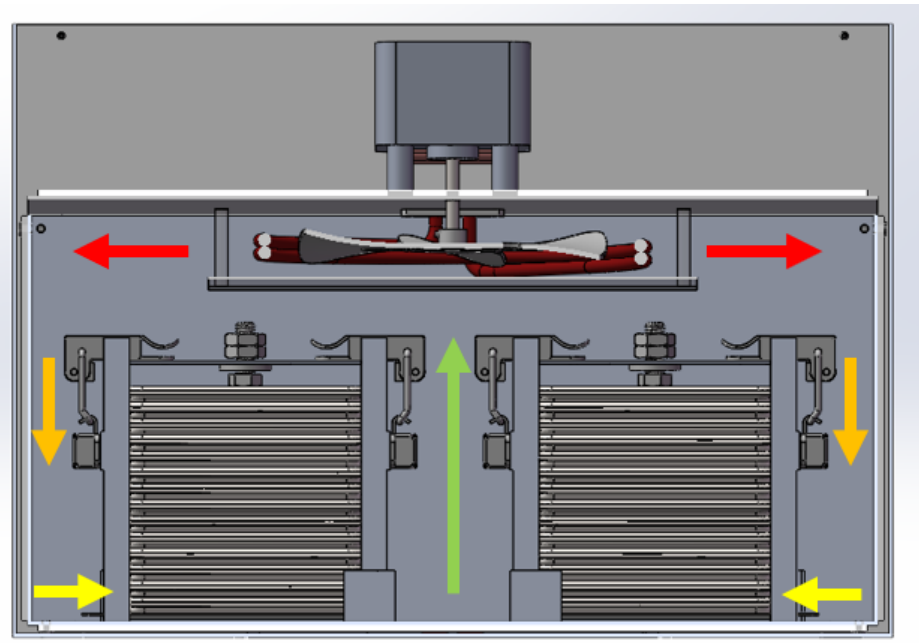


1 kWh Module Thermal Modeling

Cartridge T distribution vs. fan speed



1 kWh thermal management



1 kWh module demonstration

Successful 1 kWh module at end of 2022

Integrated Thermal Management

4 cartridges of 11 cells in parallel

Off-the-shelf BMS

2023 Field Demonstrations

Multiple scaled demonstrations with utility partners in 2023

DUKE ENERGY® 15 kWh system demonstration

incubateenergy labs multiple utilities (Summer 2023)

Proven Technology at Product Scale

External demonstrations creates springboard for target market

Product Evolution

Product Roadmap

2023

MVPRO module
1 kWh

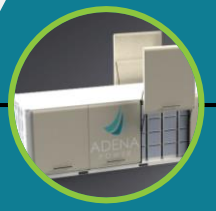
Duke Demo
15 kWh system

Series A Investment

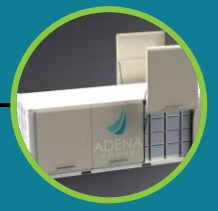
2024

incubate:energy labs
Demonstration

Product Launch



1st production intent
250 kWh system MVPRO



250 kWh system production

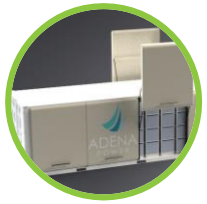
2025

Manufacturing Roadmap

Industrialization Partner	Under-utilized assets create a 52-week head start and reduce capital
NEXCERIS where energy meets environment	Leverage current infrastructure and cross-functional resources

Spring 2023 → **Fall 2024**

50X



0.1 MWh/year → **5 MWh/year**

Go to Market Strategy

Launch with C&I turnkey ESS, scale with utilities

Phase I

Sell turnkey ESS to 3-5 C&I customers

EV Fleet Electrification

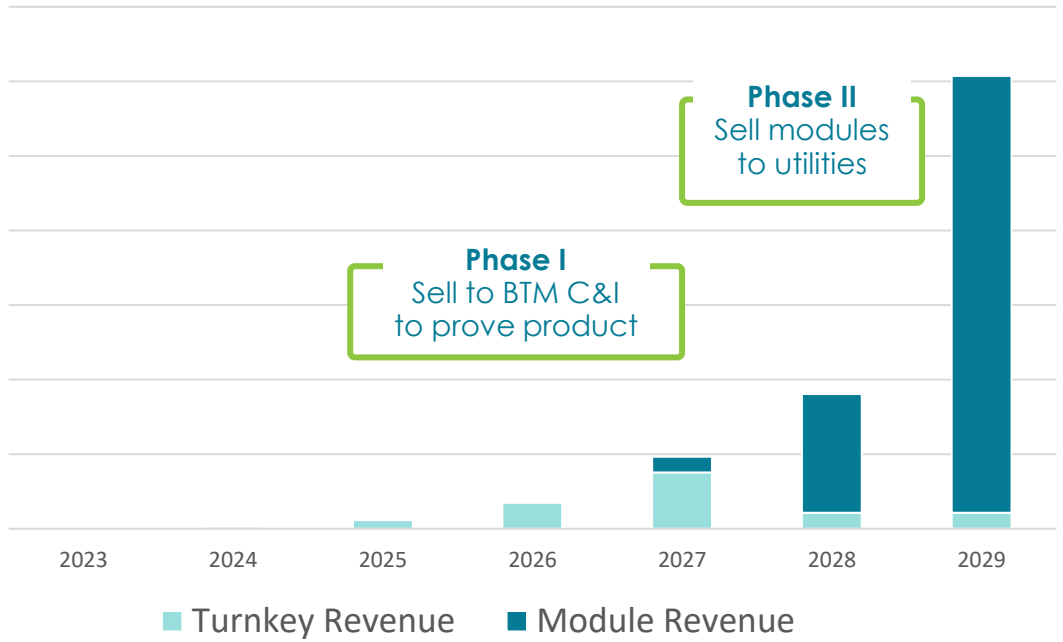
Hospitals

Indoor Farming

Demonstrate value-stream stacking

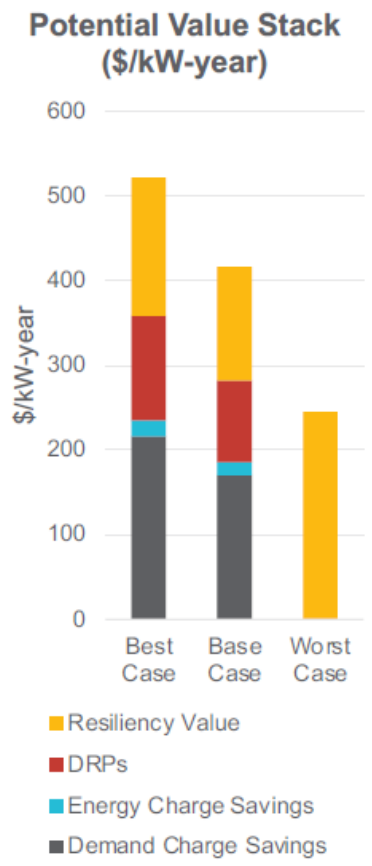
Setup for the next phase of growth

Adena Power Revenue Growth



Energy Storage Value Stacking Example

	Analysis	Estimated Average Annual Value $/kW		
		Best	Base	Worst
Summary	The value proposition for LDS for industrial customers in North Carolina is moderate to good. There are moderate revenues available from non-resiliency value streams: ▪ Base case: The storage is only valued for resiliency for that portion it provides for outages caused by major events. We assume that participation in other value streams causes a trade-off with providing resiliency against everyday outages. ▪ Best case: In this scenario, the storage is monetized in all available value streams, and there are few trade-offs with performing resiliency and other functions. ▪ Worse case: In this case, the only use case for the storage is resiliency (150% of the state average).	**521**	**416**	**245**
Demand charges	Duke's TOU tariff schedule is ideal for a customer with a flat load curve (benefitting from load shifting). A 12-hour peak period is a duration that only LDS could serve.	216	**170**	0
Energy charges	There are limited opportunities from energy arbitrage with this tariff.	19	**15**	0
DRPs	Retail DRPs are available in North Carolina through Duke Energy. There are no wholesale DRPs.	123	**97**	0
Wholesale markets	North Carolina is in a regulated market. Wholesale ancillary services and resource adequacy markets do not exist.	0	**0**	0
Resiliency	High resiliency values exist in North Carolina which suffers from 11 hours of outages per year from major events. It is unlikely that LDS can be sized to cover the total critical load of the customer, especially if duration of some major events exceeds LDS's capacity. It is expected that LDS is cited with FFGs.	163	**134**	245

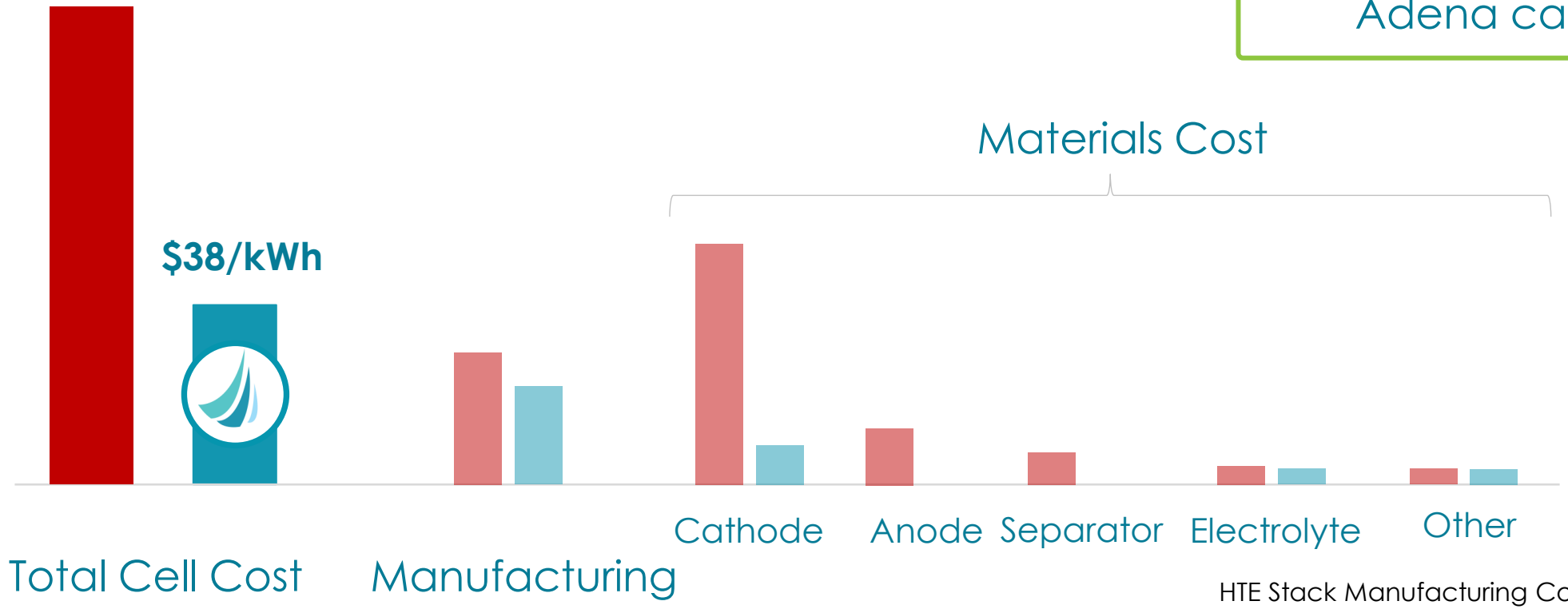


High Volume Cost Analysis

Low material cost enable aggressive cost targets

$101/kWh Li-ion Av. Cell cost (2021)

At volumes of 4M cell/year
Adena can surpass Li-ion



BloombergNEF
HTE Stack Manufacturing Cost Analysis, Strategic Analysis 2022

Adena Power Team

Devoted to bringing sustainable energy storage to market

Neil Kidner Ph.D.
Co-Founder & President
15 years experience in product development & manufacturing scale-up

Nathan Cooley
Co-Founder & Chief Financial Officer
15 years experience in emerging energy commercialization space

Dedicated Adena Power team with a wealth of clean tech experience

Advisory Board and Support

Industry leaders moving Adena forward

Pacific Northwest National Laboratory
COX Enterprises, Inc.
Burns McDonnell
Current
Duke Energy
The Ohio State University

Nexceris to deploy experts when necessary

Long history of successful commercialization

Backup Information

Neil Kidner Ph.D.
President and Co-Founder

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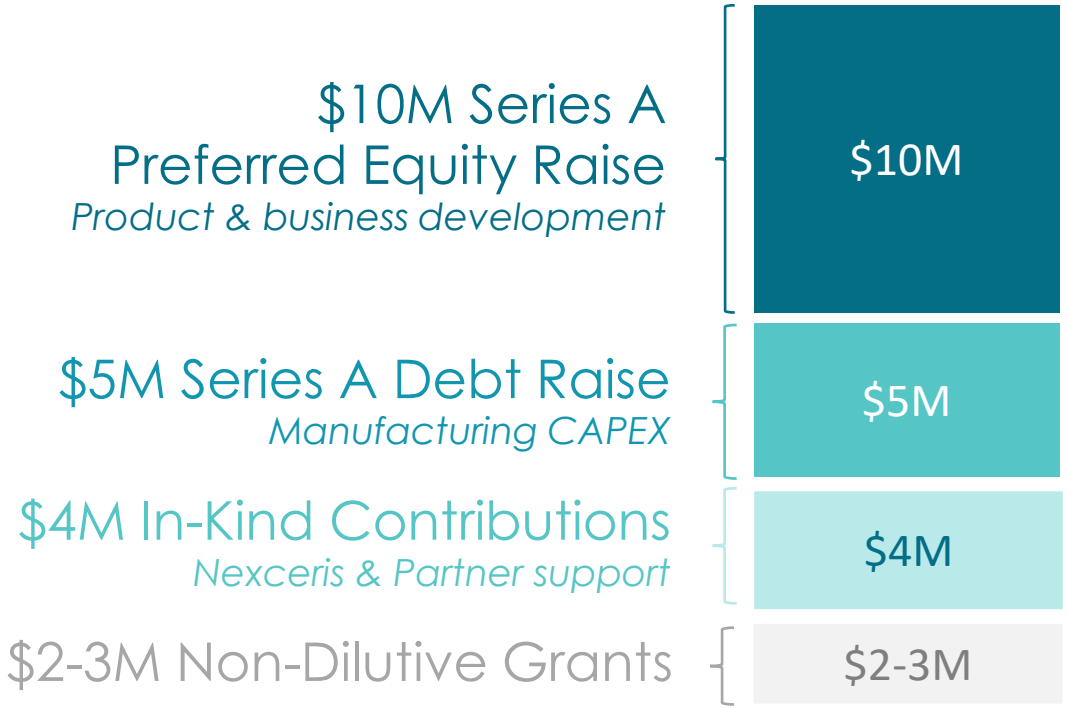
First Phase of Investment

Series A funding allows Adena to launch products

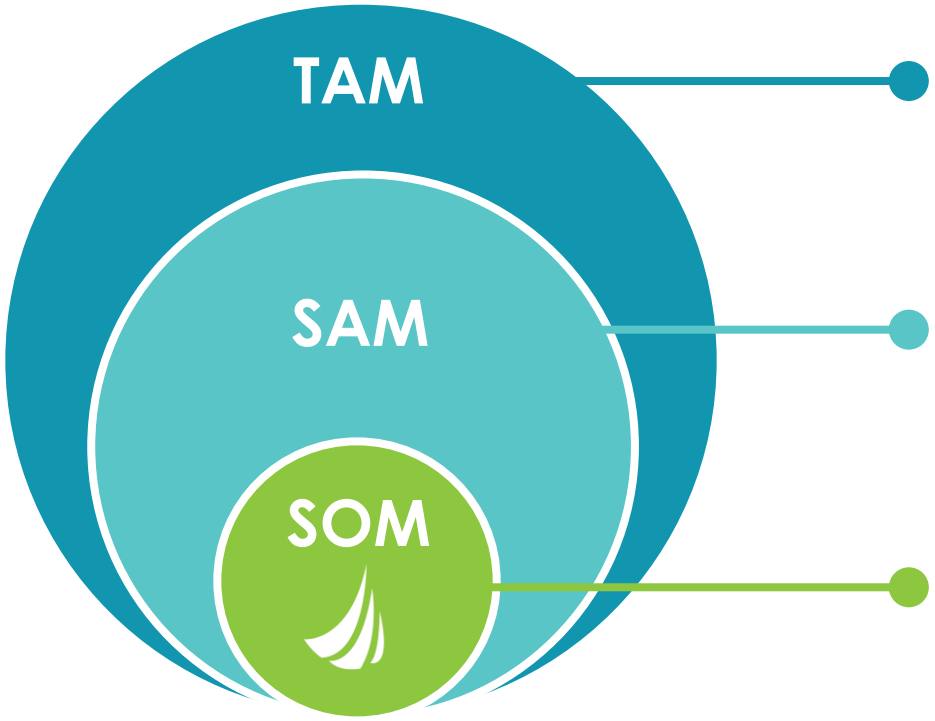


Milestones Achieved from Funds

Build out additional facilities at Nexceris and Partner	Mid 2024
Turnkey ESS MVPRO	Mid 2024
Manufacturing scaled to 5 MWh annual capacity	End 2024
0.25-1.5 MWh turnkey ESS delivered to customers	End 2024

Addressable Market Opportunity

Stationary energy storage market is large & growing



$42 Billion/year
Total Addressable Market
Stationary Energy Storage

$1-2 Billion/year
Service Addressable Market
U.S. Urban C/I Energy Storage

Up to $1 Billion/year
Service Obtainable Market
50 % market share

NYSERDA 2019 Energy Storage Market Evaluation Nov. 2019
Metal Halide Energy Storage Commercialization Assistance Report (2022)