ALCHEMY INDUSTRIAL

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THE SUN COMPANY

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NAATBatt Sodium-Zinc Battery Workshop

R&D Activity in Zinc Battery Technology

Houston | November 30 - December 1, 2023

Presenters

Andrew Malek

VP of Engineering and Manufacturing

Andrew leads Alchemy development for The Sun Company and other clients including including Urban Electric Power (ZnMn battery technology)

Kevin Meagher

Chief Science Officer

Kevin has 20 years pioneering energy modeling and analytics solutions with over 20 patents awarded. Previously, Kevin was President and CTO of Power Analytics, industry leader in Digital Twin software.

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TSC Flow Battery Development History

Combining superior energy density & power density for REDOX flow

2018

- The Sun Company (TSC) initiated its quest to accelerate renewable energy adoption
- Exclusive license secured from PNNL for Zinc Iodide electrolyte

COLLABORATIVE BREAKTHROUGHS

- Electrolyte Chemistry
- Battery Longevity
- Cell Stack Design
- Manufacturing

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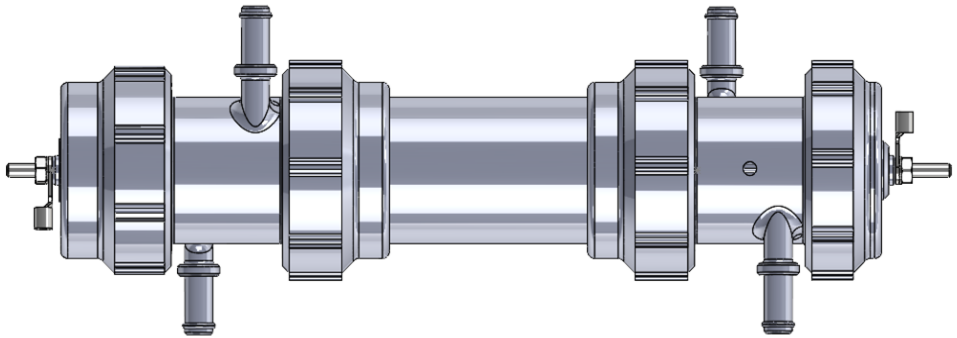
Definition of Terms

- **Cells** - The “cell” is the lowest level of the hardware design. The cell is where the electron transfer occurs for discharging
and charging of electricity.

- **Reactor** - The “reactor” houses the “cells” and provides the path for the flow of the anolyte and catholyte through the cells.

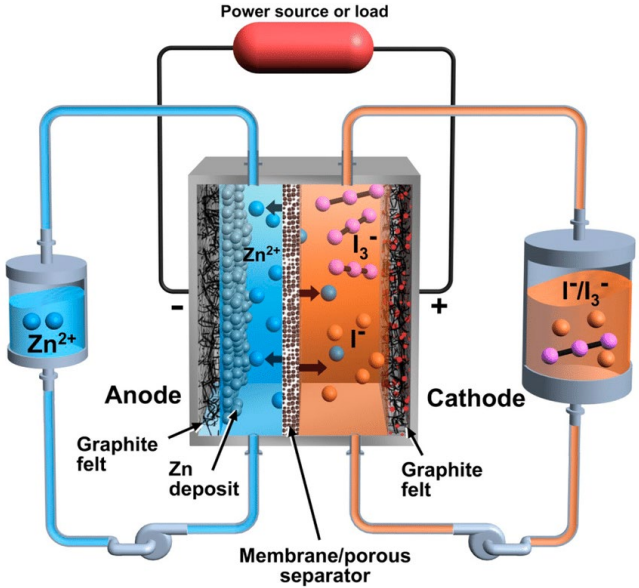
- **Stack** - The “stack” houses the reactors and the required electrical and plumbing connections to form a working unit. The TSC stack design will likely be between 2.3 and 2.6kW per stack.



Design Objectives of TSC REDOX

SUPPLY CHAIN SECURITY

- Abundant (critical electrolyte chemistry, Zinc Iodide)
  - Both Zinc and Iodine reserves far exceed global Lithium reserves
- Geopolitically Friendly Reserves
  - 43% of Zinc ore is mined in the U.S
  - 85% of global Iodine reserves are found in the U.S., Japan, and South America
- Commoditized and Multi-source Off-the-Shelf Componentry
  - TSC batteries will utilize domestically sourced power electronics, pumps, sensors, and other key components
- Domestic Manufacturing and Assembly
  - TSC batteries will be built and assembled in the U.S.



EARTH-FRIENDLY DESIGN

- Earth-friendly (low carbon, non-toxic) manufacturing
  - The creation of ZnI2 (Zinc Iodide) utilizes a simple, low-cost, low-heat, and non-toxic chemical reaction
- Complete End of Life Recycling
  - The battery electrolyte never wears out.
  - TSC batteries can undergo ‘refurbishing’ at 30 years to replace minor components such as pumps and electronics and extend its operation life by decades

Design Objectives of TSC REDOX

ROBUST

- Proven Redox Flow Architecture
  - The redox flow battery architecture has been used by industry for over 50 years
- 30 year Lifecycle
  - Each reactor is guaranteed for 20 years with an expected lifetime of over 30 years
- Wide operating temperature range (-4 to 131degree F)

HIGH DENSITY

- Energy Density
  - TSC batteries utilizes TSC's exclusive Zinc Polyiodide electrolyte chemistry providing up to 7x the energy storage of any alternative within a given space
- Power Density
  - TSC batteries use a radically new cell stack design providing up to 20x the power delivery capacity within a given space

SAFE

- Electrolyte Chemistry
  - The TSC battery electrolyte is Non-toxic, Non-flammable, and Non-explosive

Design Objectives of TSC REDOX

PERFORMANT

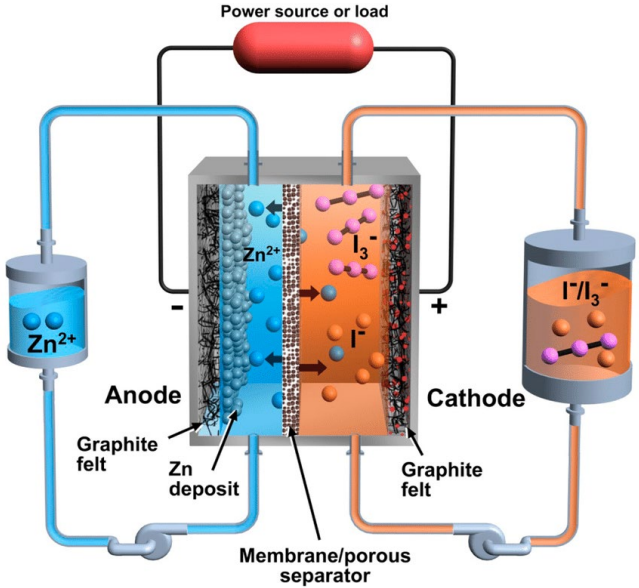
- Duty Cycle
  - TSC batteries support 2 full charge/discharge cycles / day making them ideal for residential and industrial use cases including market participation, dynamic load management, EV charging, and other applications
- Efficiency
  - Round trip energy efficiency is over 85%

COST EFFECTIVE

- Levelized Cost of Storage (LCOS)
  - The TSC battery high duty cycle, low price and long lifetime make it highly competitive

SCALABLE

- Scalable Energy
  - The TSC1000 supports custom electrolyte storage tanks sizing allowing the battery to support hours, days, or weeks of off-grid operation
- Scalable Power
  - The TSC1000 uses a scalable design with pluggable 'reactors' that can be added to flexibly increase battery power delivery within a monitored and managed rack-based framework



Zinc Additives (Chemistry & Geometry)

- Octet Scientific (Z6)
- Suppress unwanted side reactions such as dendrite growth and gas generation
- Enhance desired electronic effects such as low surface polarization and increased conductivity
- Improve electrolyte physical properties such as viscosity and stability

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Design for Manufacturing

- To scale using contract manufacturing and hybrid “Maker Labs”
- Fast prototyping
- Agile Manufacturing
- Workforce Development

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Thank You

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