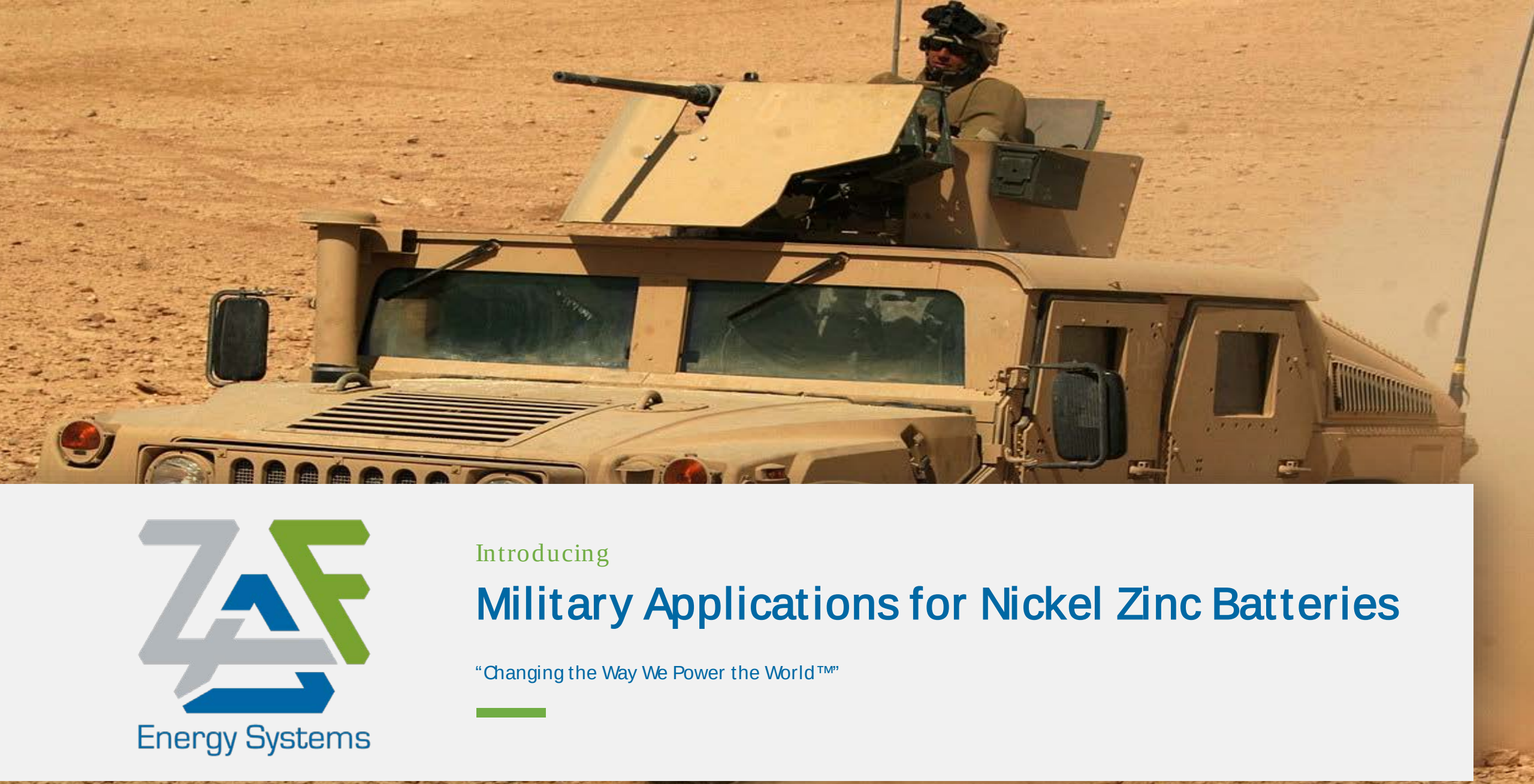


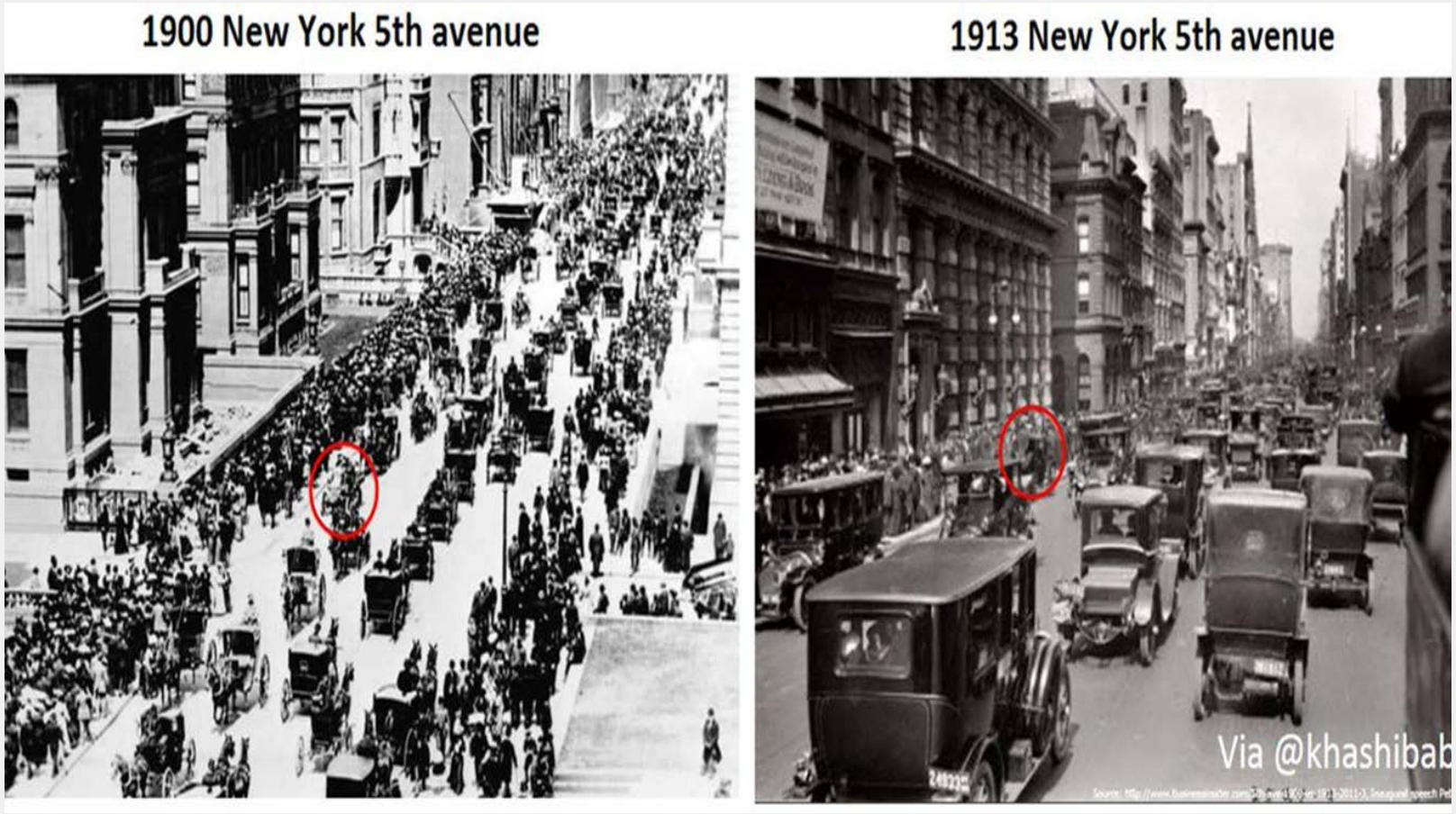
ZAF Energy Systems

Introducing

Military Applications for Nickel Zinc Batteries

"Changing the Way We Power the World™"

Disruption is Inevitable



New Option for old Problems

The Dilemma

"Performance Gaps" exposed as technology evolves

Lead-acid Shortcomings

Capacity
Seeking longer run times in smaller packages

Power
More power required for commercial and industrial users

Life
Demand for longer cycle life and shelf life

Lithium-ion Problems

Safety
Customers in key markets place a premium on safety

Complexity
Operations require advanced electronics (BMS)

Cost
Widespread deployment of storage requires < $200/ kWh

Market expected to exceed

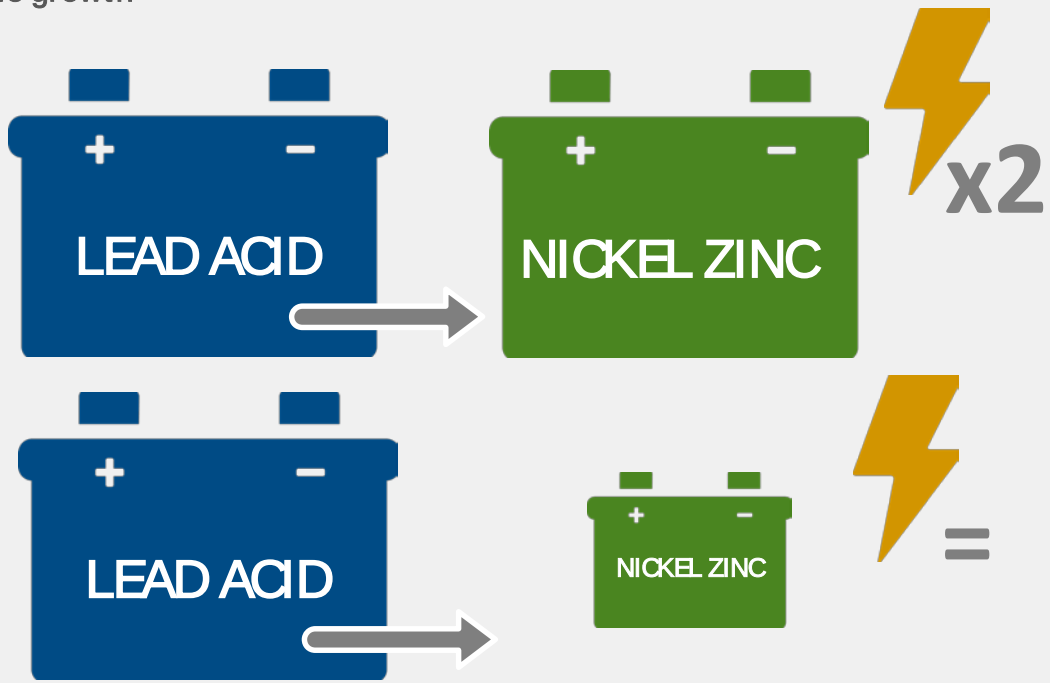
1 TWh by 2025

Why Nickel Zinc Batteries?

Why ZAF?

ZAF's nickel-zinc battery design solves historic problems.

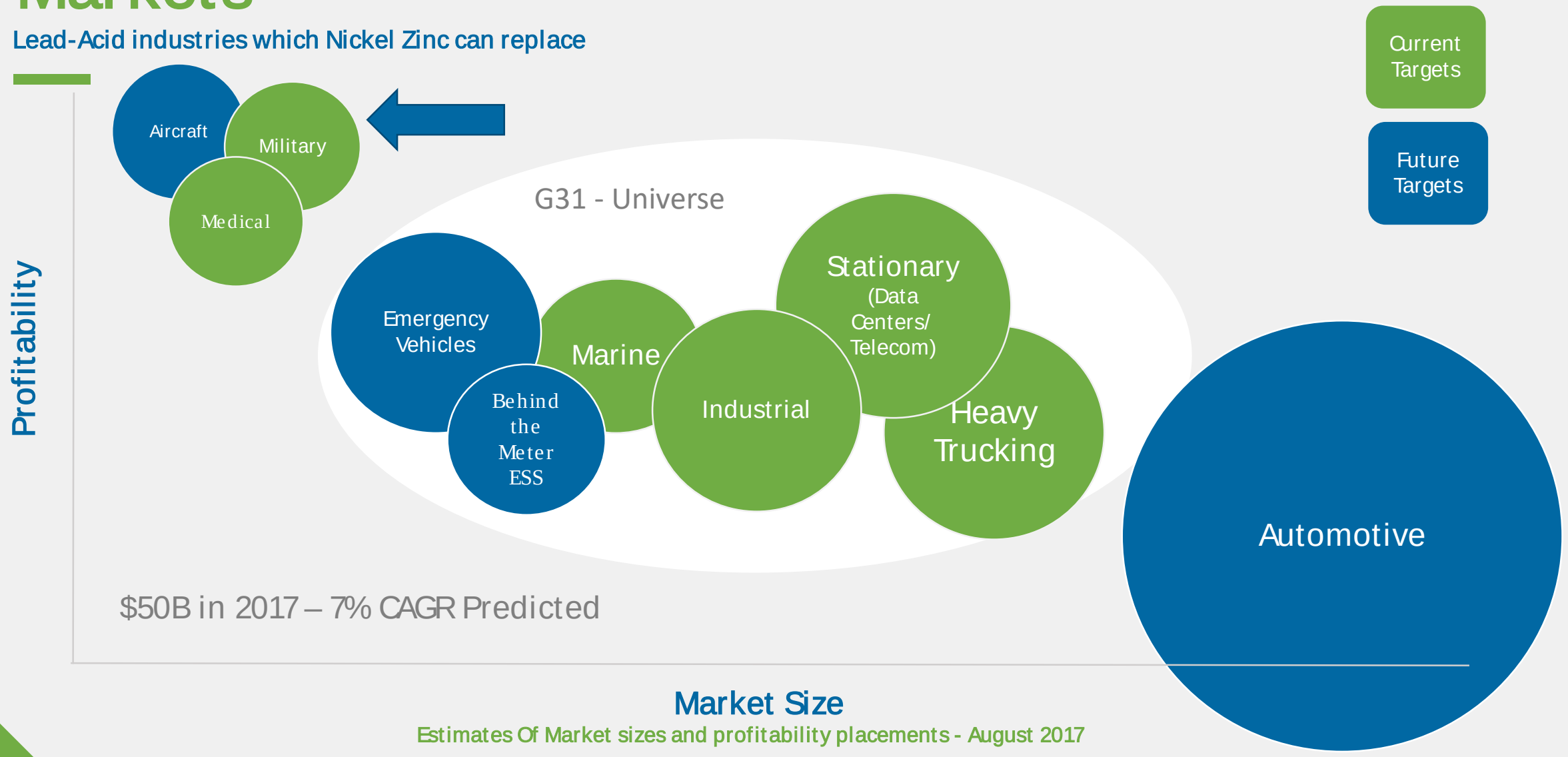
- ✓ Electrolyte dry out
- ✓ Zinc migration
- ✓ Dendrite growth



A Nickel Zinc (NiZn) battery can give 2x performance in the same size or the same performance as a Lead Acid battery in half the footprint.

Markets

Lead-Acid industries which Nickel Zinc can replace



Estimates Of Market sizes and profitability placements - August 2017

Military Applications for NiZn

- Mobile Communications
- UPS Back Up
- Energy Storage for remote operations
- Power Equipment for modern solider
- Laser devices
- Replacement for 6T (700,000+ purchased yearly)
- Aircraft

Nickel Zinc Group 31

Capacity and Power Comparison versus Equivalent Lead Acid

Battery Data	ZAF G31 NiZn Capacity	Odyssey G31 AGM – Lead Acid	ZAF G31 NiZn Power	Unit
Capacity (C/20)	172	100	152	Ah
Capacity (C/3)	**165**	**84**	**147**	**Ah**
Mass	27	35.3	27	kg
Cycle Life (80% DOD)	700	400	700	Cycles
CCA Current (30s)	650	1150	1000	A
Specific Energy (C/3)	71	27.4	63	Wh/kg
Energy Density	131	70.9	117	Wh/L

Military-Government Entity Applications

Military Sector Breakdown

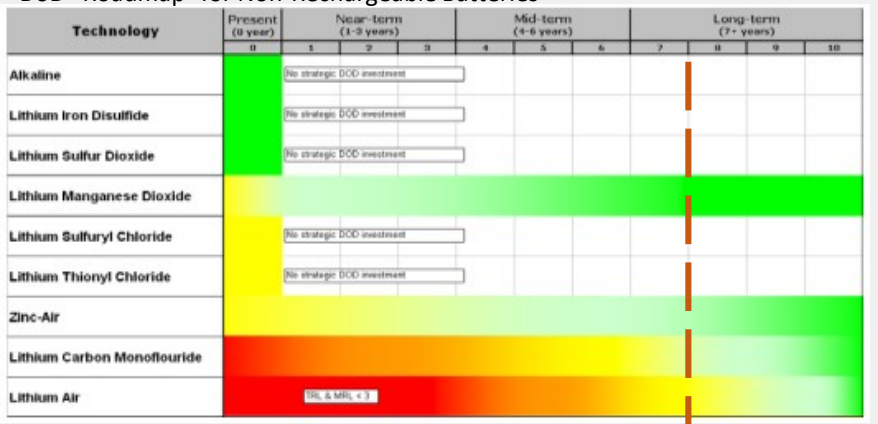
Application	Current Chemistries	Alternative Chemistry	Advantages of Alternative Chemistry	Potential Customer/Sponsor
Submarine	PbA	NiZn	Energy density & longer life (cost & uptime)	US Navy NAVSEA
6T Current Vehicles	PbA	NiZn	Weight, life-cycle cost	Us Army TARDEC
6T Stop-Start Future Vehicles	PbA	NiZn	Weight, life-cycle cost	General Atomics
Critical information infrastructure	PbA	NiZn	Life-cycle cost, capacity	General Dynamics/DIA
Future Pursuit Opportunities				
Critical infrastructure backup	PbA	NiZn	Weight, life-cycle cost	Homeland Security
Diver propulsion device	AgZn/Li-ion	NiZn/ZnO2	AgZn: performance; Li-ion: cost and safety	Navy, Marines
Emergency backup/telco (COW)	PbA	NiZn	Weight, life-cycle cost	FEMA
GREENS/FOB microgrids	Li-ion/PbA	NiZn	Li-ion: safety; PbA: weight & energy; Both: cost	Army, USMC
ICBM-Silo backup systems	PbA	NiZn	Energy density & longer life	Air Force
Launch batteries	AgZn	NiZn/ZnO2	Performance and Cost	Air Force, Navy
Legged squad support system	Li-ion	NiZn/ZnO2	Safety and cost	Army
Manned underwater delivery vehicles	AgZn/Li-ion	NiZn	AgZn: performance; Li-ion: cost and safety	Navy
Most military aircraft	NiCd/PbA	NiZn	NiCd: reduced maintenance; PbA: weight & energy; Both: cost	Air Force, Navy
Rib boats	PbA	NiZn	Weight, life-cycle cost	USMC
SEAL delivery vehicles	AgZn	NiZn	Cost (Considering Li-ion, safety is preventing)	Navy
Shipboard backup power (UPS)	Li-ion	NiZn	Cost and safety	Navy
Tactical Assault Light Operator Suit	Li-ion	ZnO2	2x Performance, Cost, and Safety	SOCOM
Unmanned air systems	Li-ion/PbA	ZnO2	2x Performance, Cost, and Safety	Air Force
Unmanned surface vehicle systems	Li-ion/PbA	NiZn/ZnO2	Li-ion: safety; PbA: weight & energy; Both: cost	Navy
Unmanned underwater vehicle systems	Li-ion	ZnO2	2x Performance, Cost, and Safety	Navy

Defense Portable Power Market

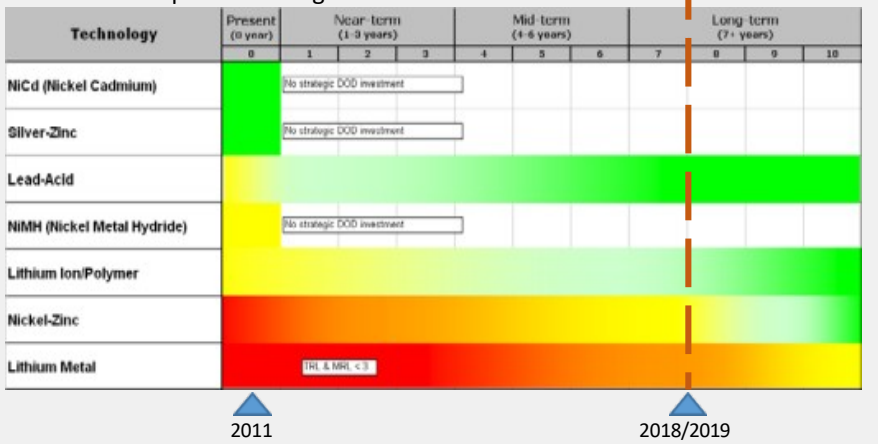
DoD to spend $6.1B on portable power for forward deployed bases by 2030.

- Changes in chemistry promoting increase in utilization for portable power (DoD Roadmap supports nickel-zinc).
- New vehicles, and transports require lighter, more powerful batteries. 6T batteries in approximately 700,000 vehicles.
- Increasing deployment of mobile microgrids driving.
- Migration paths are seen as “evolutional” for this market segment. 6T “stop-start” vehicles in development.

DoD “Roadmap” for Non-Rechargeable Batteries



DoD “Roadmap” for Rechargeable Batteries

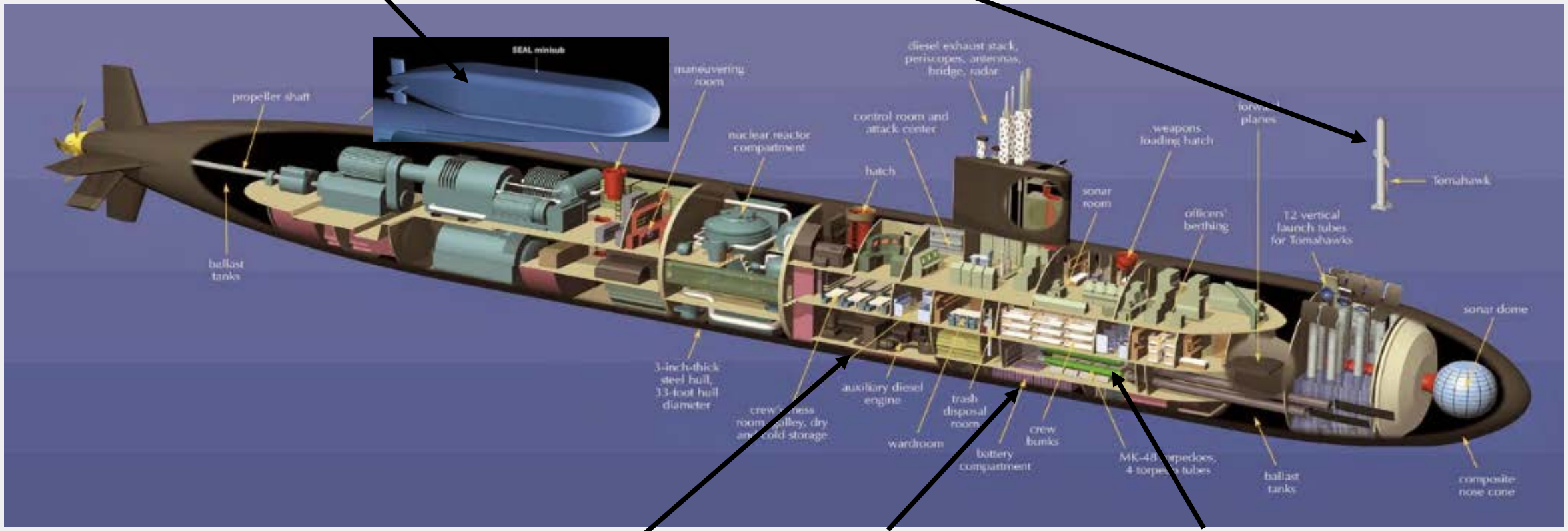


Battery Specification	PbA Spec	Generation NiZn	Armasafe Plus	Deka US 6TL	Li-Ion
Nominal Voltage (V)	12	12	12	12	12
Volume (L)	17.4*	17.23	15.6	18.4	17.42
Weight (kg)	34 (40.75)	28 (61.7lbs)	40 (88 lbs)	33 (73 lbs)	22 (48lbs)
Rated Capacity (C/3) (Ah)	120	165	120 (C/20)	120 (C/20)	120
Cold Cranking Amps (-18°C) (A)	1100	900	1225	750-825	1000-1100
Specific Energy (Wh/kg)	42	69	36	43	65
Energy Density (Wh/L)	83	112	92	78	82

Batteries are in:

SEAL Delivery Vehicle (Battery TBD: Li-ion Possible)

Missiles ($LiFeS_2$ & AgZn)



Black Start System (VRLA)

Submarine Itself (VRLA)

Torpedoes (AgZn)

Naval

Underwater power

Naval underwater batteries
are a $50M+/ yr market

- **Submarines have on-going battery issues**
  - Formerly flooded lead acid batteries lasted 7 years
  - Now VRLA lead acid batteries last 3-4 years
  - New Columbia-Class submarine's systems too much load for lead acid

- **NAVSEA worked with major lead-acid company**
  - NAVSEA approached ZAF, Development Contract now in place.

ZAF currently meets or exceeds current specifications

NiCd to NiZn Comparison

Saft ULM®: Designed to keep you flying for the lowest Total Cost of Ownership (TCO)

Reduced maintenance

Plastic bonded electrodes (PBE), first developed by Saft, reduce maintenance intervals by over 50%

One example: A330 operators choosing the Airbus approved Saft ULM® batteries have extended their maintenance intervals from 1000 oph to 3000 oph and, as a result, have significantly reduced their operating cost.

Long service life

High quality proprietary separator systems extend life duration by up to 10 years

The longer the life the lower the TCO.

Less weight

The use of lightweight plastic bonded electrodes reduces weight

The decrease in weight means less fuel burn resulting in a reduction in aircraft operating costs.

Travel anywhere

Combination of Saft plastic bonded electrodes and superior separator systems reduce overcharge current

The decrease in overcharge current results in a longer life even under the most difficult climates both hot and cold. Temperature range from -40°C to +70°C (-40°F to +158°F).

Exceptional storage life

Long-term storage of up to 10 years without any intervention ever required

Zero maintenance cost during storage.

Easily replaceable spare parts

Designed for individual cell replacement

Instead of buying an entire battery, opt to easily replace cells for a low cost.

For new installations or retrofit solutions

Form, Fit & Function interchangeable with standard high-performance products

No aircraft modification necessary, which allows for commonality between interchangeable components resulting in cost-effective inventory solutions.

- ZAF NiZn Comparison
  - Zero Maintenance
  - Same Service Life
  - Similar Weight
  - Same Operating Environments
  - Form, Fit and Function Interchangeability by Design
  - Longer Storage Life
  - Same Capability for Cell Replacement
  - Form, Fit and Function Interchangeability by Design

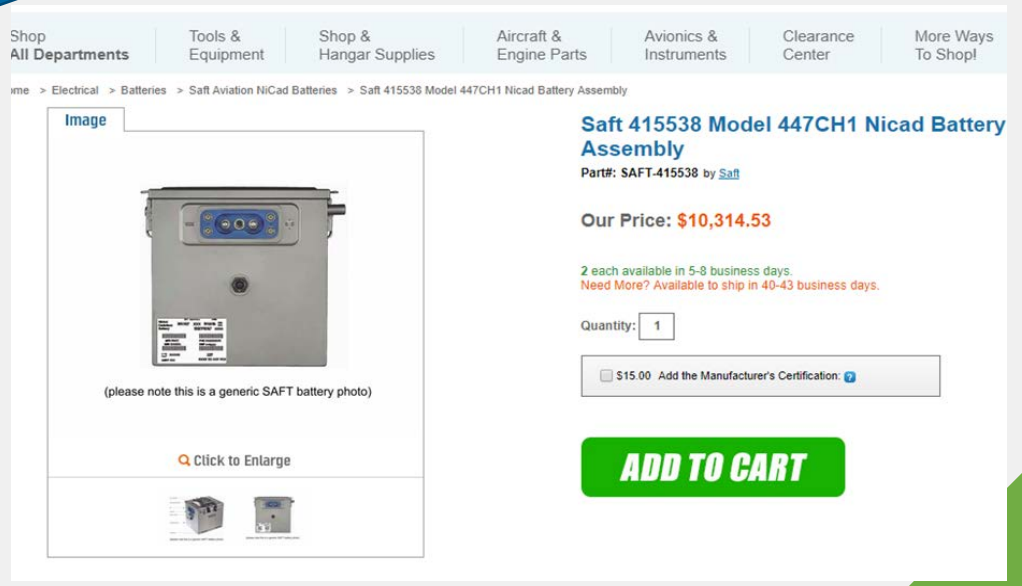
Cost Comparisons

PbA
$2k-$4k x2

NiZn
$5k-$8k x 2

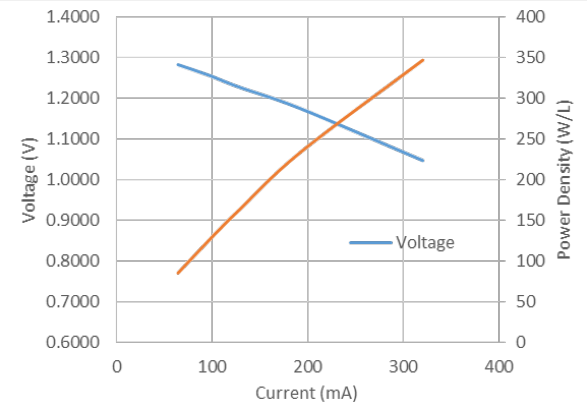
NiCd
$7k-$10k x *

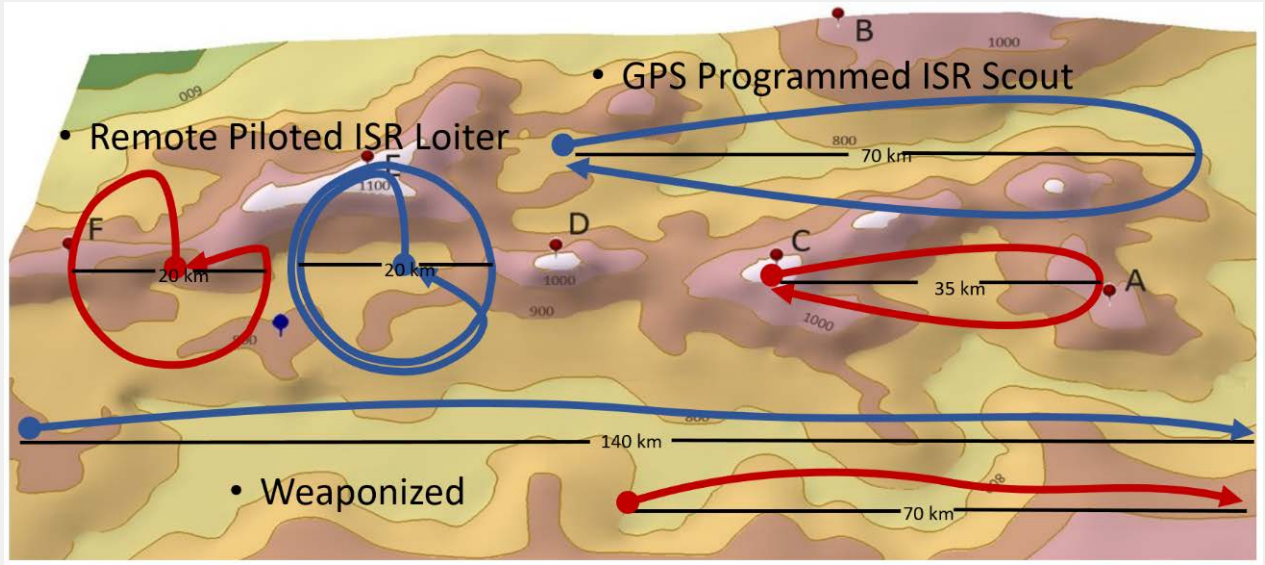
Li-Ion
$15k-$20k x 2



* Times 3-4 because of hot-swap operational needs due to maintenance requirements.

Zn-Air vs. Li-Ion Example – Raven UAS

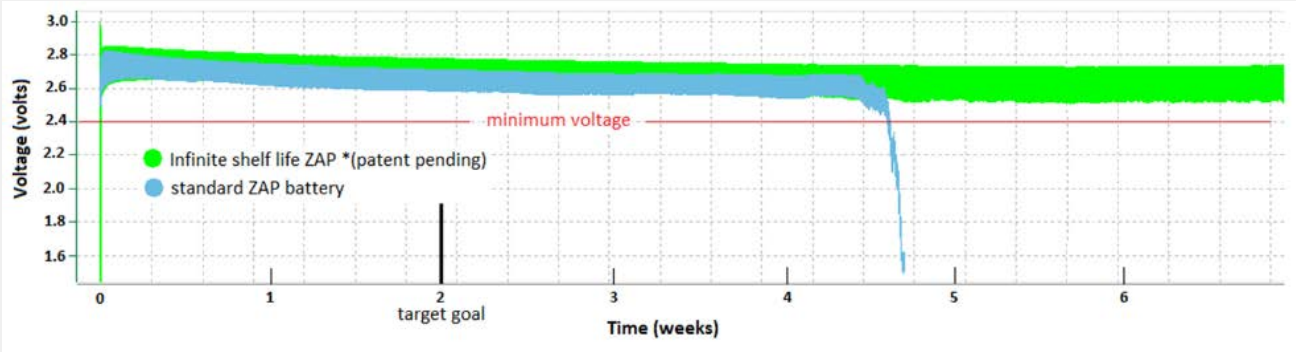




- Zn-Air has twice the energy density as Li-ion.
- Up to now, a primary battery. ZAF has achieved operational 50-cycle life.
- Note: This particular cell is not currently optimized for high power applications. A Zinc-Air cell optimized for power density projects to have 2X the power density of our tested pouch cell.

The mission effect of twice the endurance.

(Average Speed 30.5 knots, Average Endurance Li-ion 75 minutes)



Testing Specifications: 125mA for 400mS at 10 minute intervals for 2 weeks (2048 cycles)

Economics

Comparison Against Lithium

- Lithium $100 per battery and 200 cycles = $.50 per mission and 35km per cycle = $1.42/ mission
- Zn $50 per battery and 50 cycles=$1.00 and 70km per mission=$1.42

RQ-11B Raven is the most widely used unmanned aircraft system in the military today.

Contract Award

Minuteman III, ICBM Silo Ground-Station Backup Power

- In 2018 ZAF Proposed to the Rapid Innovation Fund (RIF) Broad Agency Announcement (BAA) titled “ICBM battery: ZAF Ni-Zn replacement batteries for ICBM ground facility battery”.
- ZAF was notified by the Air Force proposal review team that our proposal had been selected for contract award.
- Contract Value: $1.4M

U.S. AIR FORCE

ZAF Energy Systems

Summary

- We have the ideal technology and a compelling value proposition to displace lead-acid.
- We address a huge and growing market.
- We have a formula for sustainable energy storage unlike any other competing product.
- We have the strategic partnerships and business strategy to scale production to meet demand.
- We have the plan and the team to execute.

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