

# GridStar Flow for Long Duration Energy Storage

Richard Brody | March 10, 2021



# GridStar Flow

FLEXIBLE. DURABLE. SAFE.

Pioneering utility-scale flow battery  
utilizing proprietary metal ligand  
coordination chemistry.



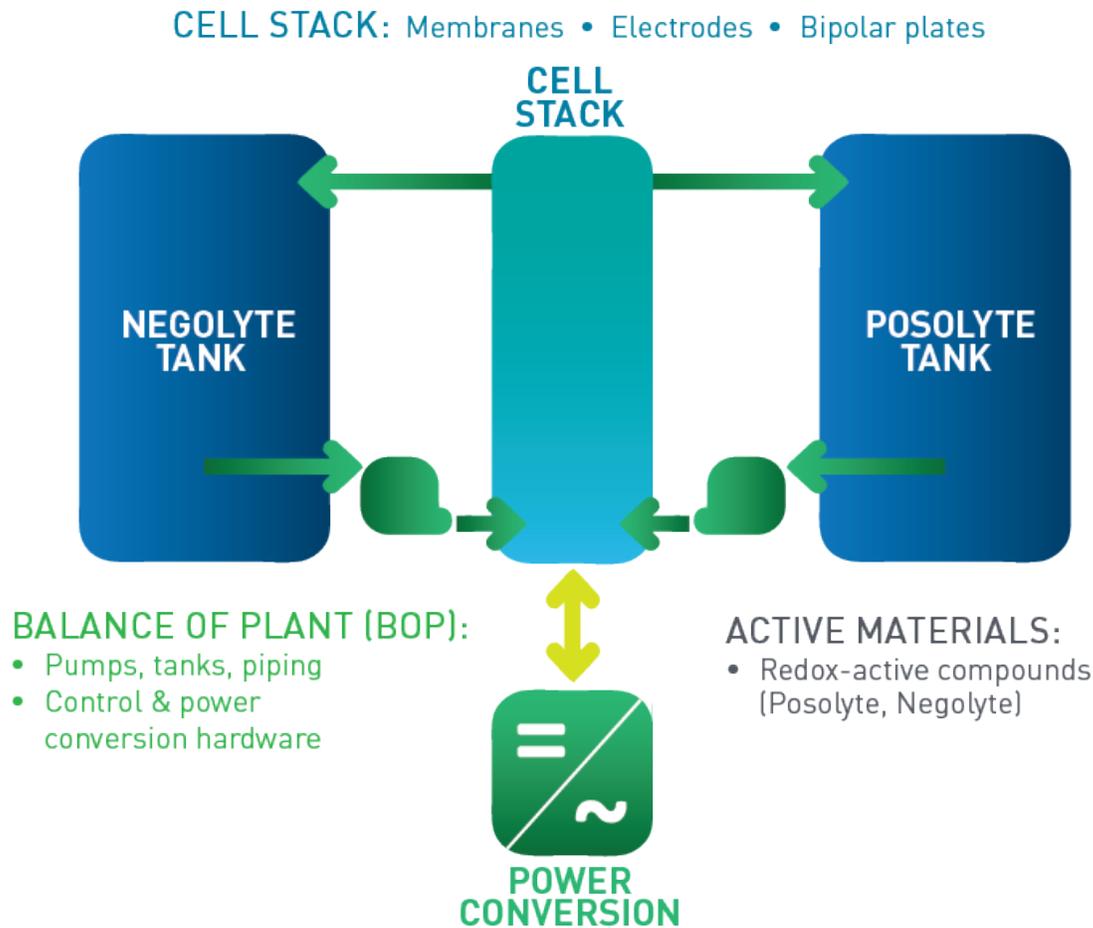
# Traditional technologies are unable to meet expanding long duration requirements



- Degradation and shortened lifespan caused by frequent cycling, holding at high state-of-charge and calendar aging
- Degradation requires oversizing or augmentation leading to increased TCO
- Sealed batteries are not project-configurable, resulting in costly oversizing of power capacity for longer duration needs
- Thermal runaway presents potential safety hazard
- Durability and duration limitations increasingly impact Li-ion project economics at longer durations – best suited for applications of four hours or less

**Li-ion value proposition breaks down for long-duration, high-cycling projects**

# Flow Battery Architecture and Opportunity



## Architectural advantages

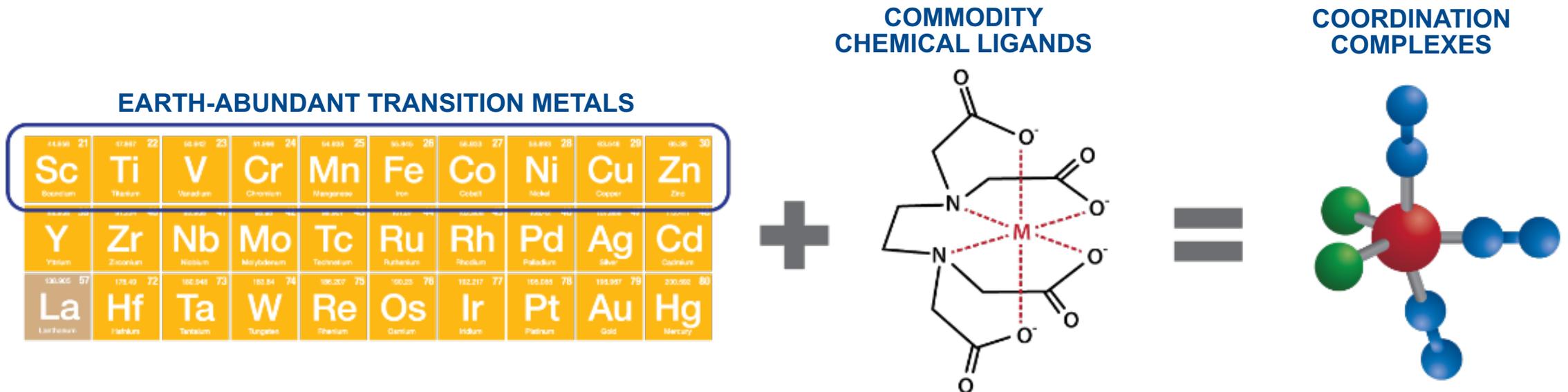
- Decoupling of power and energy enables low cost long-duration storage
- Energy capacity insensitivity to duty-cycle affords operational flexibility (e.g., deep or frequent cycling, storage at high states-of-charge)
- Straightforward augmentation
- Safety (e.g., aqueous electrolytes)

## Incumbent technologies have failed

- High cost, corrosivity, and/or toxicity of electrolytes
- Low current density (e.g., zinc plating systems)
- Active material cross-over

# Coordination Chemistry Advantages

- Enhanced performance due to larger molecule size & negative charge of complex
- Enhanced safety due to non flammable and modest pH electrolytes
- Enhanced efficiency by using molecular design to tune potential
- Established supply chain allowing procurement of raw materials from reliable partners



Our proprietary GridStar Flow technology optimizes energy storage performance, flexibility, and safety for long-duration applications.

# Advantages of GridStar Flow

## Long-Duration

- 6 to >12 hours duration

## Durable

- Able to do multiple daily deep-discharge cycles
- Long useful life

## Flexible

- Freedom to operate in future differently than originally planned
- Energy and power can be sized independently
- Can add additional energy in future, as required
- Switch between products over any time period to maximize revenue
- Able to address shorter duration applications

## Cost Competitive

- Competitive total cost of ownership

## Safe

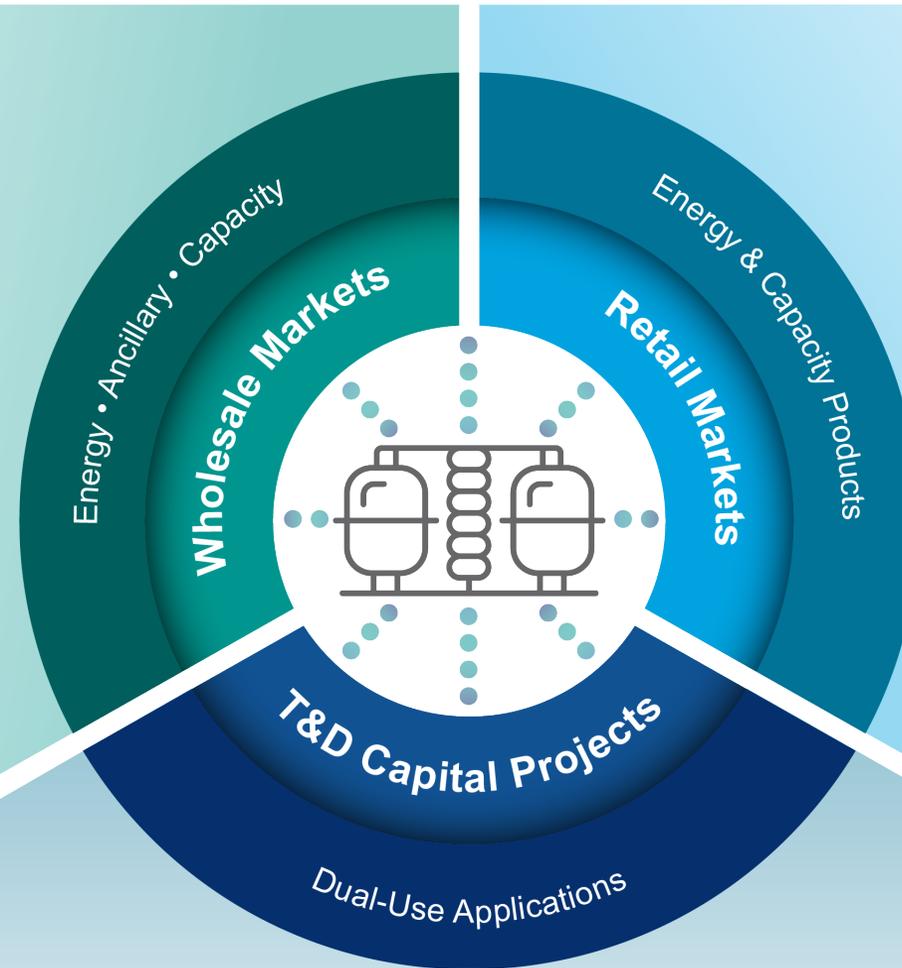
- Designed for system-level safety and site-ability
- Non-flammable battery chemistry

## Lockheed Martin Reputation

- History of pioneering innovation and technology commercialization
- Fortune 500 company

# GridStar Flow Applications

- Regulation / Real-Time Balancing
- Reserves – Imbalance & Contingency
- Subhourly Price Arbitrage
- Bulk Renewables Integration
- Intraday & Multiday Optimization



- BTM Generation Integration
- Microgrids
- Resilience (Diesel/GT Replacement)
- Retail Rate Management
- Access to Wholesale Market Value Streams
- Distribution Deferral

- Deferral/Elimination (20 year design life)
- Transportation Electrification
- Voltage Support
- Access to Wholesale Market Value Streams

\* See appendix for full list of applications

# First Commercial Version of GridStar Flow

## GridStar Flow S/N01

- Located at 95,000 square foot Andover, Mass. facility
- 250 - 500 kW<sub>AC</sub>, 2.5 MWh (5 -10 hr) system
- S/N01 will be tested to validate system performance
- S/N01 will form the design basis for customer-sited projects.



# GridStar Flow

10 MW<sub>AC</sub> / 100 MWh Configuration



THANK YOU

[lockheedmartin.com/energystorage](https://lockheedmartin.com/energystorage)

Inquiries to [energy.info@lmco.com](mailto:energy.info@lmco.com)

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