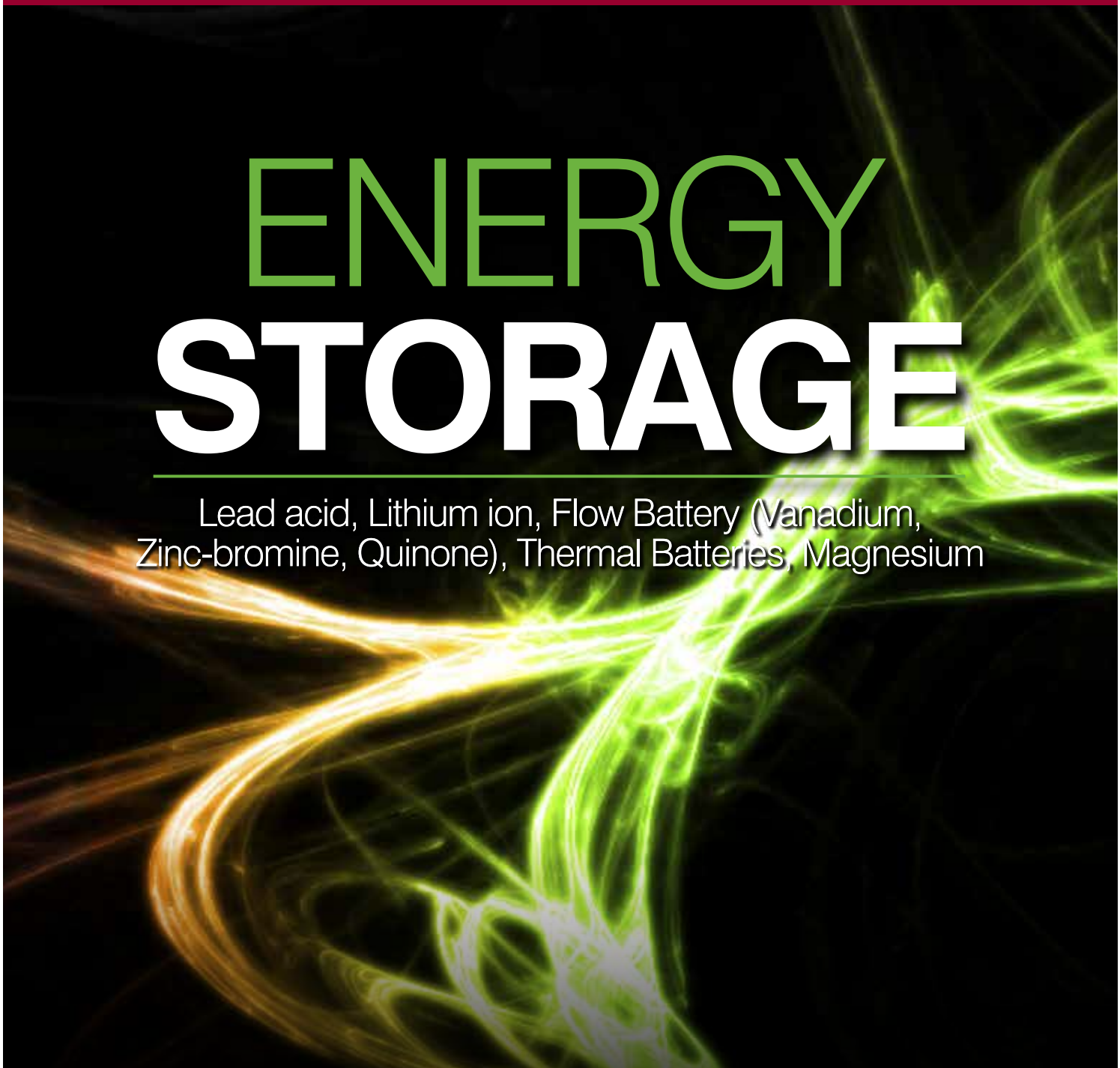
CTC Concurrent Technologies Corporation



# ENERGY STORAGE

Lead acid, Lithium ion, Flow Battery (Vanadium, Zinc-bromine, Quinone), Thermal Batteries, Magnesium

**From man-portable to grid-scale applications, Concurrent Technologies Corporation supports the full life cycle of energy storage development.**

*Research, development, engineering, design, implementation, test and validation.*

CTC Concurrent Technologies Corporation

# ENERGY STORAGE

## Lead acid, Lithium ion, Flow Battery (Vanadium, Zinc-bromine, Quinone), Thermal Batteries, Magnesium

Concurrent Technologies Corporation (CTC) is an independent, nonprofit, applied scientific research and development organization focused on developing solutions that address current barriers and challenges related to cost competitive energy storage technologies, validated reliability and safety, equitable regulatory environment, and industry acceptance.

We have more than 18 years of experience integrating and testing various energy storage technologies for a host of applications. Our most recent research and development activities focus on the improvement of flow battery components, stack design, and electrolyte.

As a member of the Energy Storage Association (ESA) and an affiliate-level member of the Joint Center for Energy Storage Research (JCESR), CTC is working with other national leaders in science and engineering to help enable next-generation energy storage solutions.

## Flow Batteries

### Component Level Optimization

***Electrolyte***

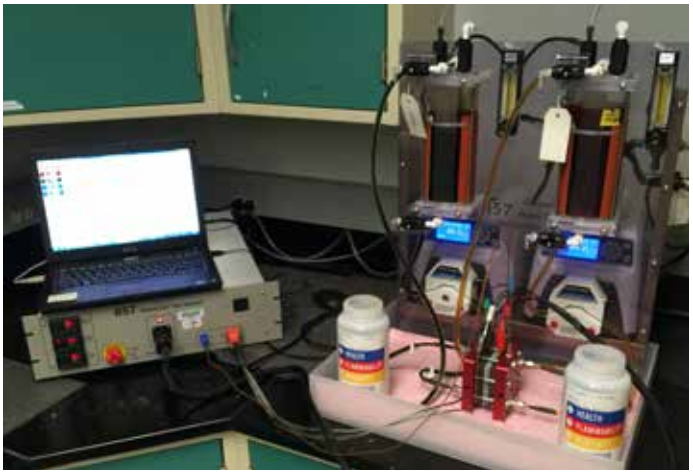
Quinone, vanadium, metal-acetylacetonate-based non-aqueous, imidazolium-based ionic liquids, deep eutectic-based ionic liquids/solvents, all-organic non-aqueous, conductive particles effects on electrolytes

***Electrode***

Unique design features that provide a pressure drop reduction of 27%, slight hit on energy efficiency 2% that is being addressed

***Membrane***

Characterize permeability, selectivity, chemical and thermal stability, and mechanical flexibility/tear-resistance; also, investigating membrane-electrode interface.



## Single Cell Testing

- Charge, discharge, electrolyte flow control, temperature control, and data acquisition
- Three current range potentiostat for charge and discharge operation in constant-current or constant-voltage mode
- EIS and HFR during charge or discharge
- Voltage scanning for CV and LSV experiments
- Integrated constant-voltage, scan voltage, constant-current, and scan current, open circuit, voltage EIS, and current EIS experiments in software with battery/fuel cell polarity conventions for automated charge/discharge cycling, testing and diagnostics
- User-defined experiment termination/reversal, e.g., voltage or current limit
- Inputs for anolyte and catholyte state-of-charge electrodes
- Safety features: shutdown on E-stop or potentiostat over voltage/current fault

## Multi-scale Stack Testing

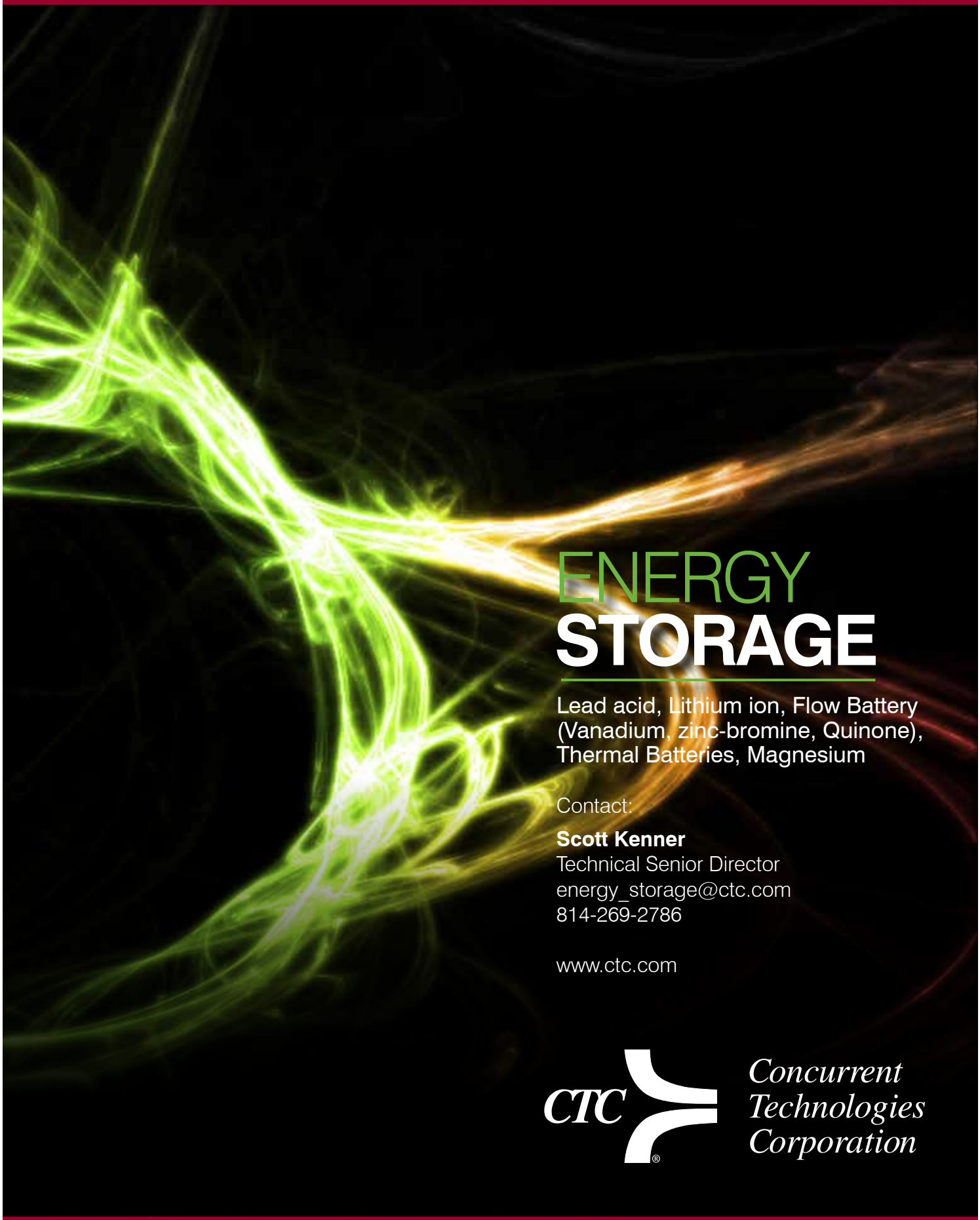
- Test Sequencer and control software (PLC controlled, data collection)
- Balance of plant control algorithm development
- Pressure sensors, flow meters, voltage and current monitoring, H2 monitoring, cover gas capability
- Individual cell voltage monitoring
- Electrolyte temperature control (50 – 150 F°)
- Programmable bi-directional power cycling
  - Independent (2 channels)
    - 8 to 420 VDC, - 320 to +265 ADC (-640 to +530 ADC, parallel), - 170 kW to +125 kW
  - Independent (3 channels)
    - 0 to 40 VDC, up to 600 ADC (per module), 8 kW source / 12 kW discharge per channel
- Safety features: E-stop, over voltage/current fault, temperature, flow, and pressure shutdown

## Flow Battery Scale Up

- Stack design and scale up from a single cell working area
  - 2.75” X 2.75” to a 10 cell stack with a 24” X 24” working area
- Tested with 10-cell stack with all-vanadium
- Patented seal design and patented composite electrode

## Additional Capabilities:

- Computational fluid dynamics and finite element analysis
- Post-mortem component analysis
- Stack assembly fixtures

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