OFFICE OF CLEAN ENERGY DEMONSTRATIONS

FLOW BATTERY BASED LONG DURATION ENERGY STORAGE DEMONSTRATION (CMBlu Energy)

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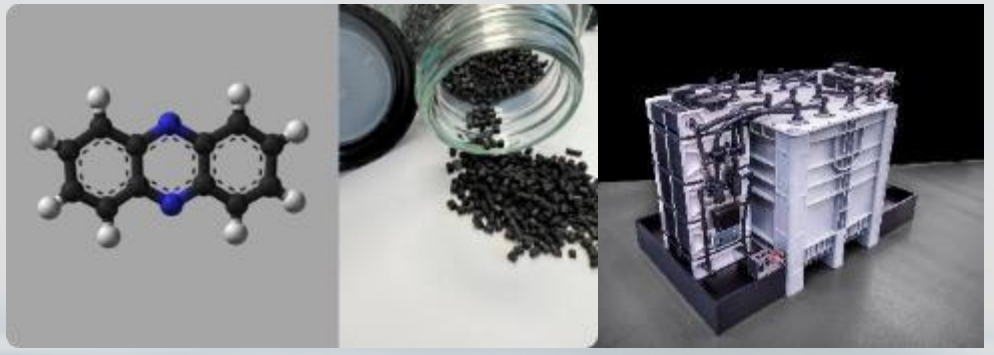
CMBlu Energy

We empower the world with unlimited energy storage inspired by nature.

Organic SolidFlow batteries

Utilize carbon-based molecules and combine elements of solid-state and flow battery technologies to enable a first-of-a-kind energy storage solution.



Safe

No Fire or Explosion Risk

No Toxic Fumes

Moderate pH

Sustainable

No Rare or Conflict Materials

Recyclable and Reusable

Small Modular Footprint

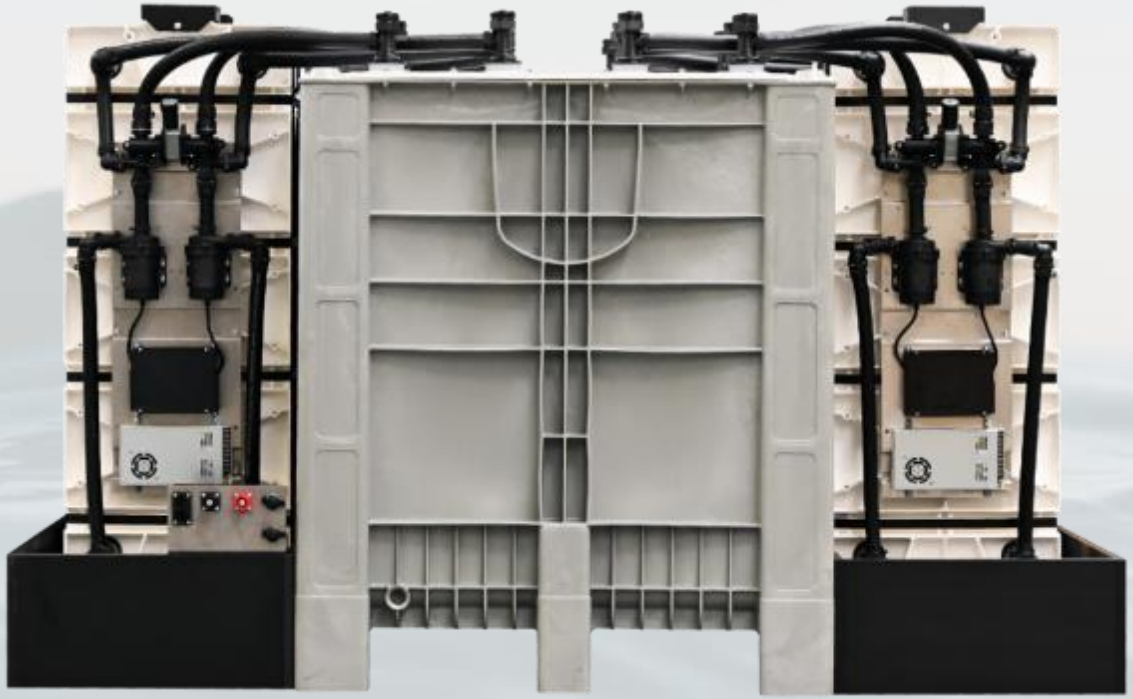
Secure

Reliable and Robust Supply Chain

Local, Abundant Materials

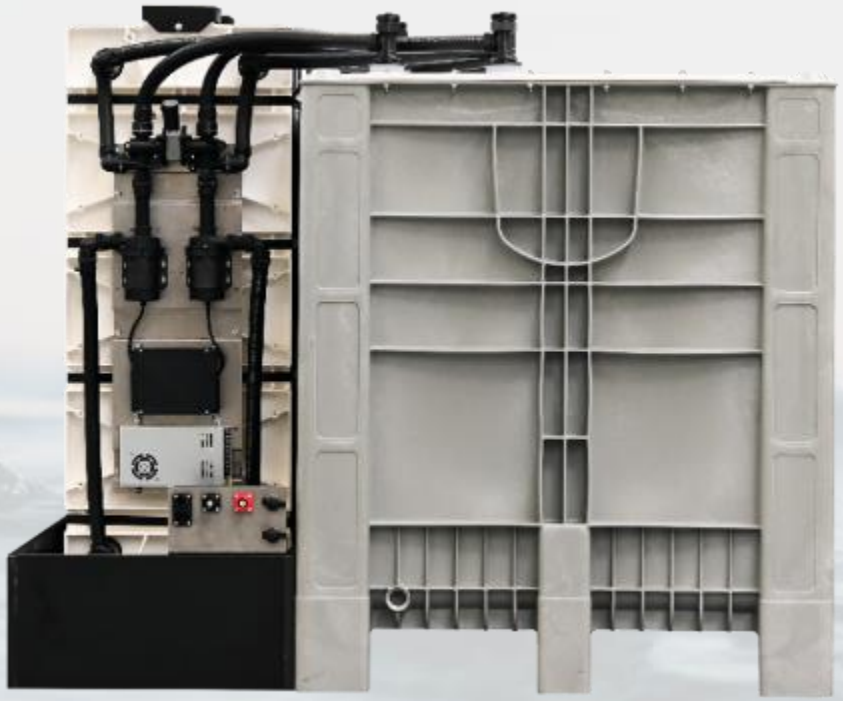
Standard Components found in Automotive Industry

5 – 10+ Hour System



- 40 kW, 200 kWh
- Plug & Play
- UL 1973
- CE-marked
- Footprint 27ft²
- Stackable =>27ft²/MWh*
  (Tesla 42ft²/MWh)

10 – 24+ Hour System



- 20 kW, 200 kWh
- Plug & Play
- UL 1973
- CE-marked
- Footprint 22ft²
- Stackable =>22ft²/MWh*
  (Tesla 42ft²/MWh)

cmblu

* 5 modules stacked

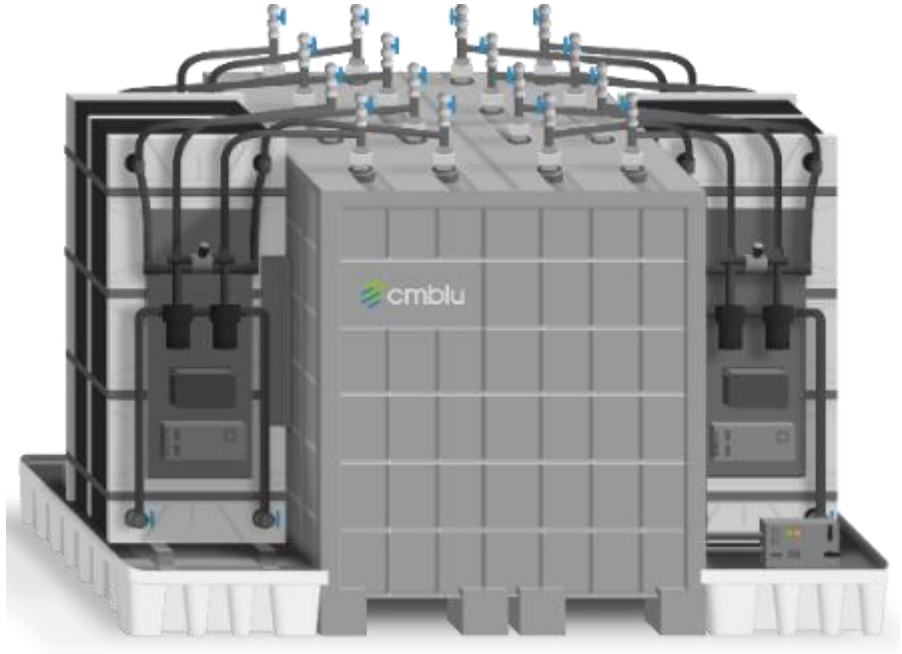
Energy Storage Warehouse

System Overview: Multi-String Configuration

Cycle Life	> 20,000(1)
Scalability	Modular & Stackable
Energy Density	200 Wh/kg
Storage Time	Multi-hour to days
Efficiency	Up to ~90%
Max Capacity	Up to GWh range
Footprint	27 ft^2/MWh
Commercial Readiness	Q4 2024

Source: Company estimate, CMBlu Energy company model and TÜV SÜD.
(1) CMBlu project life reflects 20 years and 3 cycles per day or 21,000 cycles. Li-ion project life reflects 7,000 cycles and 2 cycles per day / 1 cycle per day over the life of the project for a project life of 10 and 20 years.

DESCRIPTION OF MODULE TESTING MATRIX (INL)



Product specification: CMBlu BESS		
Product Version: prototype		
Project Specifications (8 modules per string)		
Rated Power	120 kW	
Rated Energy Capacity	1200 kWh	
Surge Power	280 kW	
Number of Strings	2 (2 parallel inverters)	
Electrical data per string		
Maximum DC voltage	1150 VDC	
Minimum DC voltage	720 VDC	
Nominal DC voltage	730 - 1130 VDC	
Rated power	60 kW	
Grid connection	480 VAC, +/- 10% @ 60Hz	
Inverter product name/type	PowerBRIC GEN 2	LS Energy Solutions Final inverter TBD
Total energy capacity	600 kWh	
Efficiencies per string		
Round-trip efficiency (full cycle) AC-AC	70 %	

Our analyses will be supported by our **DeepLynx Digital Twin** architecture and a **techno-economic analysis** on grid stability.

Testing Summary:

- LDES Performance validation at RT
- LDES Performance evaluation from 10 to 40 °C.
- Cold start vs Warm Standby modes, 10 to 40 °C.
- Simulated field conditions (per EPRI recommendations).

What we Hope to Learn: *Mission Readiness*

- Startup time per mode (cold start versus warm standby),
- Energy delivery and efficiency vs Temperature (10-40°C),
- Energy delivery and efficiency vs Discharge Power.
- Critical Gains: operational envelopes over T, power load, duration etc. that will match capabilities to applications.

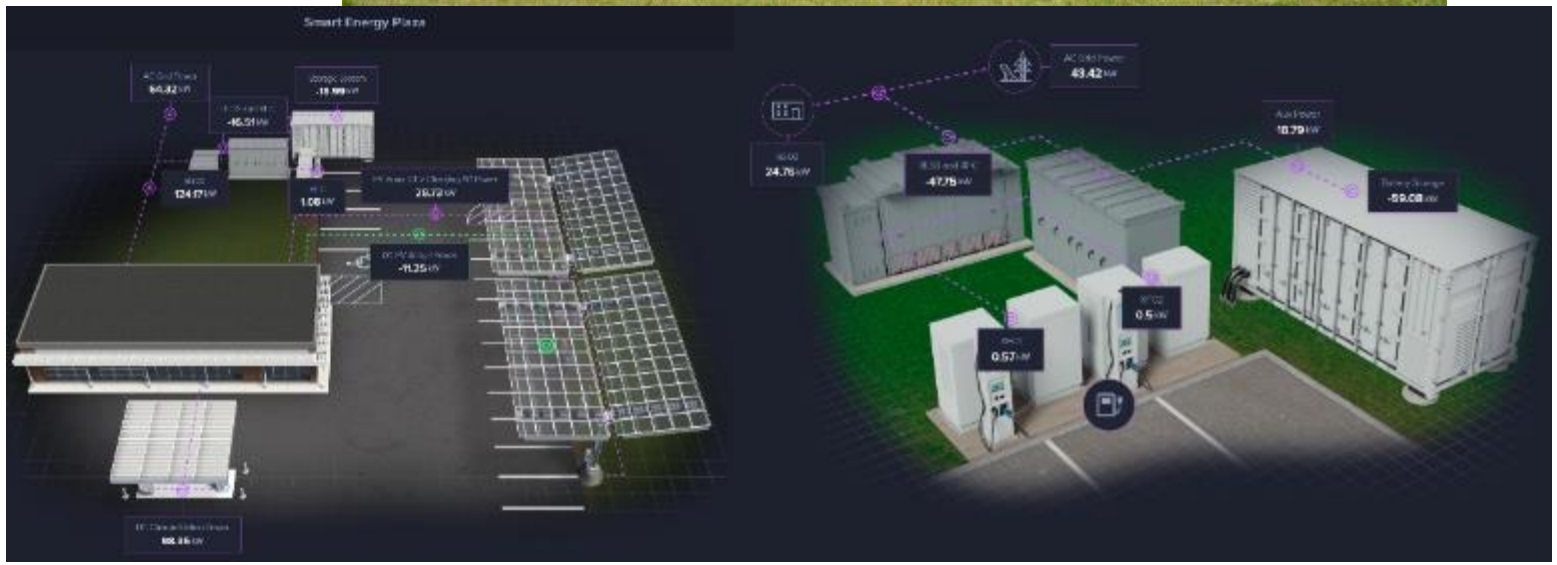
We will help advance TRL from 6 to 7-8 and identify candidate field applications.

CMBIu ENERGY LDES INSTALLATION SITE (ANL)

FULL-SCALE UNIT

Smart Energy Plaza

- EV Charging and DER Research Testbed
  - (12) AC Level 2 & (4) DC Chargers
  - (2) DC 350kW Chargers
  - 600kWh BESS – to be decommissioned
  - (2) 40kW PV Arrays
- CIP.io – Custom open-source IOT backend
- OPAL RT Simulation Platform for HIL experiments



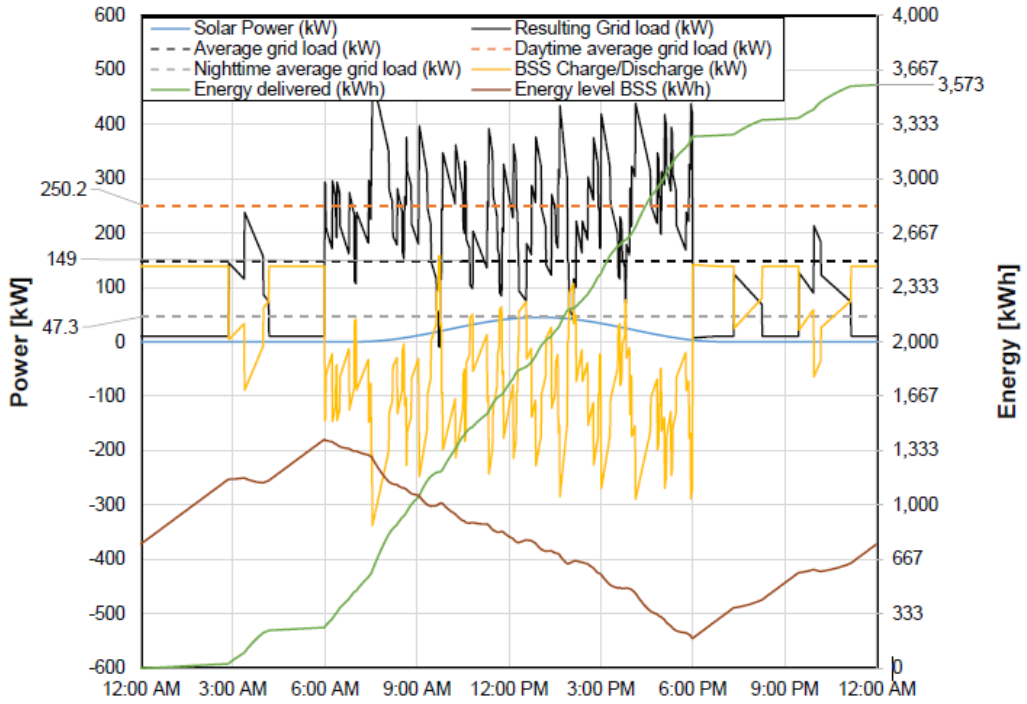
LDES OPERATIONAL EVALUATION (ANL)

General Performance

- **Use-case independent** performance benchmarking
  - Rated Discharge Power(Sustained/Peak)
  - Rated Charge Power (Sustained/Peak)
  - Charge/Discharge Durations
  - Roundtrip efficiency
  - Start-up/Response times, Ramp Rates

Application and Use-case Testing

- Primary Use-case – **Enabling EV Fast Charge Site**
  - Net Load Limiting – defer interconnection upgrade
  - Net Load Peak Limiting – demand charge reduction
  - Net Load Energy Shifting – Time-of-use cost reduction
- Secondary Use-case #1 – **EV Fast Charge Resilience**
  - Load pickup – response to outage
  - Load Following – Manage on-site supply/demand balance
    - PV DER and EV Charging



- Secondary Use-case #2 – **Wholesale Markets**
  - Day-ahead energy time-shift
  - Real-time energy time-shift
  - Spinning Reserve
  - Frequency Regulation

To be supported by LCA/TEA tools.

Closing Thoughts……Community Outreach

Engaging our communities as early as possible

- **Identify Stakeholders and Community Partners**
  - Illinois Alliance for Clean Transportation
  - Drive Clean Indiana
  - ANL's Applied Research, Education & Deployment Group
  - ANL's Office of Community Engagement
  - Idaho agricultural, rural, tribal and utility stakeholders
- **Collaborative Efforts**
  - Understand barriers/concerns for technology adoption/liftoff
  - Work together to identify tangible benefits metrics
    - Environmental considerations
    - Enabling EV charging access
    - Grid Resiliency
    - Workforce development opportunities
- **Host Demo Days**
  - Host on-site demonstrations – community members, local industries, organizations, and stakeholders
  - Technology showcase, potential impacts, start the conversation - **mechanisms for adoption**

Thank you for your Attention!