About UEP

• Develops and manufactures rechargeable zinc-manganese dioxide batteries for stationary energy storage systems

• Spun out of the City University of New York (CUNY) in 2013

• Battery manufacturing and testing facility in Pearl River, NY (outside NYC)
Rechargeable Alkaline Batteries

UEP revolutionizes the familiar alkaline battery (e.g., double AA) into a rechargeable alkaline battery to enable **decarbonization goals worldwide**.

- **Recyclable**
- **Non-toxic**
- **Modular solution** residential to grid
- **Low fire risk**
  - UL 1973/9540A
Supply Chain

Alkaline batteries use some of the most widely available elements on planet earth.

**Zinc**
- 12,000,000 metric tons in production annually
- 250,000,000 metric tons in reserve

**Lithium**
- 85,000 metric tons in production annually
- 18,000,000 metric tons in reserve
UEP has a **joint venture** with the Godrej Group in India. Godrej has 1.1bn consumers, USD $4.1bn in annual revenue.

**Manufacturing Scale and Growth**

- **2021**
  - 10MWh pilot manufacturing plant in Pearl River, New York.

- **2022**
  - Scaled manufacturing plant in Mumbai, India.
Roadmap to Reduce Cell Costs

2021 Gen 1 Battery

- Currently Available for Commercial Installations
- Safe, no thermal runaway risk.
- Competitive solution for early adopters.
- Recyclable technology.

2022 Gen 1+ Battery

- Volume Procurement Costs
- $100/kWh manufactured cost
- 1 Electron Access

2023 Gen 2 Battery

- Technology Advancements
- 2 Electron Access
- $50/kWh manufactured cost

- Competitive solution for early adopters.
## UEP Product Applications

### COMMERCIAL & INDUSTRIAL

**Applications**
- Critical power backup
- Peak shifting
- Distributed storage
- Demand charge reduction

**Existing Customers/Partners**

![SDSC](image1.png)  ![CUNY](image2.png)

### RENEWABLES

**Applications**
- Align solar generation with demand
- Reduce solar curtailment
  - Grid support
- Regulate and smooth power quality and quantity

**Existing Customers/Partners**

![NP](image3.png)  ![Sandia National Laboratories](image4.png)

### UTILITY

**Applications**
- Transmission and distribution deferral
- Aggregated behind-the-meter customer use
- System resilience and reliability

**Existing Customers/Partners**

![EPRI](image5.png)
Product Family

Battery Cell  Residential  Commercial  Large Containerized

2020  2021  2022
Installation Portfolio

2019
- Peak Shaving Container 120kWh

2020
- U.S Navy Support Backup 15kWh

2021
- Residential Power Backup 32kWh

2022
- San Diego Supercomputer Center 2MWh
- Navajo Nation Solar Microgrid 15kWh
System Developmental Testing at SolarTAC Facility and UEP

- Installed energy storage systems
- Additional testing based on utility use cases, including substation power backup

Emerging Energy Storage Technology Testing and Demonstration

- Deep dives on technology readiness of pre-commercial energy storage technologies
- Testing, demonstration, and data analysis of hosted and government-funded energy storage projects, leveraging advanced data infrastructure and methods
- Collaborative forum to obtain data, status updates, and lessons learned from emerging energy storage technology experiences
Project objective

This project is designed to characterize the UEP energy storage system (ESS) and demonstrate its performance in use cases selected with interested utilities.

Project milestones included:

- Battery manufacture and ESS assembly
- Shipment to SolarTAC
- System installation and commissioning
- ESS characterization testing
- ESS select use case testing

With completion of testing, UEP would look to deploy additional ESS in collaboration with partner utilities.
Manufacturing and shipping

Battery cells awaiting filling and sealing. Cells will be wired together in 12V modules.

Battery system being loaded into truck for shipping to Solar TAC. Entire system was built and shipped within two months of contract award.
System delivery and commissioning at SolarTAC

System components upon arrival at SolarTAC.

Batteries assembled within battery racks, housed in testing container.
Characterization testing

Initial characterization testing as defined Energy Storage Integration Council (ESIC) protocols. Specific tests to be performed:

- **6.1.1 Available Energy Capacity**
- **6.1.2 Charge Duration**
- **6.1.3 Rated Continuous Power**
- **6.1.5 Round trip efficiency**
- **6.2.1 Self Discharge**

Available energy capacity testing of the UEP system. Approximately 47.5 kWh was discharged during the first cycle.
Parallel system test at UEP

- Characterization testing also underway at UEP following the same ESIC protocols.
- System has been charged/discharged for seven cycles to establish nameplate power and capacity.

- System characteristics:
  - Rated power: 10kW Max power: 20kW
  - Rated energy: 40 kWh Max energy: 60 kWh
  - Operating voltage range: 600-350 VDC
System electronics and controls

Inverter controller used to schedule, monitor, and record system charging and discharging data. Ideal Power/CET 30kW bidirectional multiport inverter used for testing at UEP.
Completed test data from system installed at UEP

<table>
<thead>
<tr>
<th>EPRI TESTS</th>
<th>Cycle No</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Charge Rate (kW)</td>
<td>2.5</td>
</tr>
<tr>
<td>Discharge Rate (kW)</td>
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<tr>
<td>Charge Energy (kWh)</td>
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<tr>
<td>Rest Period Chg End -&gt; Dis (hr)</td>
<td>10.2</td>
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<tr>
<td>Discharge Energy (kWh)</td>
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<tr>
<td>Discharge Period (hr)</td>
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<tr>
<td>Rest Period Dis End -&gt; Chg (hr)</td>
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<tr>
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<tr>
<td>Charge End Voltage (V)</td>
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<tr>
<td>Discharge Start Voltage (V)</td>
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<tr>
<td>Did Cell Start Voltage (V)</td>
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<tr>
<td>Max Cell Charge Voltage (V)</td>
<td>1.765</td>
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</table>
Test results through seven cycles for system installed at UEP
**UL 9540A Safety Testing**

- UL 9540A testing demonstrated UEP batteries do not reach thermal runaway when subjected to abuse tests.
- Abuse testing performed by DNV-GL produced similar results and determined that "*Unlike lithium-ion batteries, UEP’s cell is essentially nonflammable*"
- UL 1973 granted; FDNY Certificate of Approval and CE marking efforts currently in process.

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Thermal Runaway Time</th>
<th>Thermal Runaway Time</th>
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<tbody>
<tr>
<td>1</td>
<td>Film Heater</td>
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<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Pipe Heater</td>
<td>Not observed</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>Nail Penetration</td>
<td>Not observed</td>
<td>N/A</td>
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<tr>
<td>4</td>
<td>Overcharge</td>
<td>Not observed</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>Overdischarge</td>
<td>Not observed</td>
<td>N/A</td>
</tr>
</tbody>
</table>

UEP batteries after 9540A testing (above) and temperature data captured during the test (below).
Reliable Power For All

Gabriel Cowles
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