Overview of the Office of Electricity’s Energy Storage Science & Technology Activities

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OE Peer Review
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Overview of OE ESS Program Management Structure

- **Dr. Imre Gyuk**
  Program Manager, Department of Energy
  Office of Electricity Delivery and Reliability (OE)

- **Sandia National Laboratories**
  Ross Guttromson, Program Manager

- **Pacific Northwest National Laboratory**
  Dr. Landis Kannberg, Program Manager
  Dr. Z. Gary Yang, Laboratory Fellow

- **Oak Ridge National Laboratory**
OE Energy Storage Program Focus Areas

Applied R&D
- Electrochemical Batteries
- Mechanical (CAES, Flywheels)
- Power Electronics

Energy Storage Program

Policy, Education, and Outreach

Analysis & Demos
Overview of Development Activities at Sandia

Advanced Development
- Storage Technologies R&D
- N2/O2: High temp Room temp

Early Stage Technology
- Flow batteries:
  - MetILs
  - Membranes
  - Mechanical
  - Mechanical Engineering
  - Mechanical Models
  - Thermo-electro-chemical
  - Ceramic Capacitors

Nearer Term Development
- Ambient Sodium Battery
- Flywheel Nano-composites
- CAES

Industrial Collaborations
- Lead Carbon CRADA
  - 3rd party independent testing
  - Cell Module
  - Large Scale

Power Electronics
- Materials R&D Bulk GaN Gate Oxides
- Semiconductor Devices SiC GaN
- Power Modules
- Power Conditioning System (PCS)
- Grid-Scale Applications
# Highlights of ESS Program

**Coordinated Sub-Programs on Flow and Sodium Batteries**

<table>
<thead>
<tr>
<th>Flow Batteries</th>
<th>Early Stage</th>
<th>Nearer Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electroactive Electrolytes “MetILs”</td>
<td>Improving VRB Electrolytes</td>
<td></td>
</tr>
<tr>
<td>Membrane Development</td>
<td>Component Modification</td>
<td></td>
</tr>
<tr>
<td>Mechanical Modeling</td>
<td>Testing Facility—Standards Development</td>
<td></td>
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</tbody>
</table>

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<thead>
<tr>
<th>Sodium Battery</th>
<th>Room Temperature</th>
<th>High Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaSICON based efforts</td>
<td>β&quot;-Al$_2$O$_3$ based efforts</td>
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<tr>
<td>Family of cathodes</td>
<td>Reduced temperature</td>
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</tbody>
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OE University Solicitation for ESS Technologies

$2.4M awarded in 2-stage national proposal selection process

Peer Review panel consisted of industry, academic, and government energy storage experts

Requirement to demonstrate a bench-scale prototype of technology

<table>
<thead>
<tr>
<th>PI</th>
<th>University</th>
<th>Co-PI</th>
<th>Technology Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esther S. Takeuchi</td>
<td>University at Buffalo NY</td>
<td>Ken Takeuchi</td>
<td>Multivalent ion cathodes</td>
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<tr>
<td>Austen Angell</td>
<td>Arizona State University</td>
<td>S. W. Martin, Iowa State University</td>
<td>Ambient Temperature Sodium Batteries</td>
</tr>
<tr>
<td>Jesse S. Wainright</td>
<td>Case Western Reserve University</td>
<td>U. Landau, CWRU R. Savinell, CWRU</td>
<td>All-Iron Flow Battery</td>
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<tr>
<td>Bruce Dunn</td>
<td>UCLA</td>
<td>Y. Gogotsi, Drexel University</td>
<td>Electrochemical Capacitors</td>
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