Toxco Inc, is a global battery recycling company that specializes in the recycling of multiple battery chemistries. Toxco has specialized knowledge in the field of recycling high energy battery systems such as primary and secondary lithium batteries.

Toxco has been recycling lithium batteries for over 18 years.

Toxco was selected as a DOE funding recipient to construct a dedicated facility in Ohio to recycle large format high energy batteries used in hybrid and electric vehicles.

Toxco is expanding existing battery recycling operations in Ohio with the DOE expansion facility being built adjacent to Toxco’s existing operations.

Toxco has developed enhance recycling and recovery technologies to recover battery components to return to the manufacturing sector.
<table>
<thead>
<tr>
<th>DOE Merit Review</th>
<th>Timeline</th>
<th>Barriers</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>April 1, 2010</td>
<td>End of Life Vehicle Batteries Timeline</td>
<td>Sustainability in Processing Materials</td>
</tr>
<tr>
<td>Finish Date</td>
<td>December 2013</td>
<td>U.S. Battery Production Timeline</td>
<td>Managing Materials Through Pre-Production</td>
</tr>
<tr>
<td><strong>Budget</strong></td>
<td></td>
<td>Cell Chemistry Identification</td>
<td>Working Groups within Industry (i.e., USABC)</td>
</tr>
<tr>
<td>DOE Project Funding</td>
<td>$ 9,553,652</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor Project Funding</td>
<td>$ 9,553,607</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Received 2009</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Received 2010</td>
<td>$ 223,988.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Received 2011 (to date)</td>
<td>$ 72,123.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RISKS**
- Consumer Confidence in New Technology
- Unsuccessful Deployment of Technology
- New Battery Technology Developments

**Partners**
- Electri-Core

**Collaboration / Resources**
Objectives / Relevance

- There are approximately 1.9 million hybrid electric vehicles in North America today.
- HEV/EV’s sales are expected to reach 20% by 2020.
- Toxco Inc.’s objective is to construct a battery recycling facility dedicated to the recycling of large format high energy batteries used in hybrid and electric vehicles.
- Toxco’s prime objective is to solve for various chemistries used in OEM vehicle and grid application platforms.
- Provide batteries for secondary life through repurposing and reconditioning.

DOE Merit Review 2011

Facility Sizing

Construction

Recycle / Repurpose
Objectives / Relevance

- Construct a fully integrated facility utilizing best developed technology.
- Install proven systems to recover battery materials that are reutilized for battery manufacturing.
- Create “New Resource” for battery materials and supply side logistics.
- Provide safe practices for management of large high energy battery systems.
- Ability to manage multiple battery chemistry systems within a developed technological infrastructure.
Approach

Toxco has taken a multidisciplinary approach in determining the Strengths, Weaknesses, Opportunities and Threats with respect to this program. Some of these areas are:

• Enhanced technology development in battery recycling.
• Recovery of materials as integral component of closed loop system.
• In depth meetings and discussions with potential customers to define short, medium, and long term needs.
• Continued research into market developments related to battery development.
• Involvement with Trade Associations that have vested interest in national electrification infrastructure.
• Participation in industry meetings and discussions related to end of life management of HEV/EV Batteries.
Facility Siting in Lancaster Ohio.
- 60% of Population within 650 miles.
- Close proximity to ARRA funding recipients
- Close to automotive manufacturing hub.
Approach

Facility design, layout, construction, and processing

- Define Customer Requirements
- Identify Battery Chemistries per Application
- Analytical/Battery Materials
- Identify Secondary Applications
- Determine Customer Timeline
- Determine Market Size
- Define Customers
- Identify Partner
- Designate Appropriate Process Lines
- Designate Capacities of Process
- Define Partner Criteria

Battery Materials
Secondary Batteries
Approach

DOE Merit Review 2011

To better understand the entire framework of required demands that a dedicated resource facility Toxco has reviewed:

- Comprehensive life cycle approach to all facets of hybrid battery systems:
  - Recycling and recovery.
  - Transportation and handling.
  - Identification of components at manufacturer level.
    - Labeling of Cathode Materials

- Packaging and logistics across multiple industrial platforms.
  - Front end users of batteries.
  - End users of batteries.
Toxco has achieved successful isolation and recovery of cathode materials from lithium ion batteries in recycling system.

Successful isolation and recover of high purity $\text{Ab}_5$ Rare Earth misch metal alloy from EV nickel metal hydride batteries.

Conducted successful recycling studies on multiple battery systems from automotive OEM’s, and battery manufacturers.

Successfully constructed lithium ion batteries utilizing recovered cathode materials from recycled batteries.
Technical Accomplishments and Progress

DOE Merit Review 2011

Hydrogen potential in Toxco recovered Ab₅ Rare Earth anode (NiMH Battery)
Recycling agreements in place with multiple Automotive OEM’s.
Environmental Assessment of facility location completed.
Site survey work completed
Civil and Storm Water Engineering completed
Architectural plans and facility design work on schedule.
Storm water permits approved.
Retention pond work to begin April/May.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Collaboration / Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricore</td>
<td>Liaison between Toxco and DOE, Project Management, Reporting, Outreach.</td>
</tr>
<tr>
<td>United States Advanced Battery Consortium</td>
<td>Consortium on Battery EOL Identification of material components, identification on battery management issues</td>
</tr>
<tr>
<td>Portable Rechargeable Battery Association</td>
<td>Trade Association on identifying underlying regulatory issues with EOL</td>
</tr>
<tr>
<td>Society Automotive Engineers</td>
<td>Battery Recycling Task Force identifying challenges in managing large format high energy batteries, establishing recycling standards for U.S. battery recyclers.</td>
</tr>
<tr>
<td>Automobile Recyclers Association</td>
<td>Addressing solutions on recovering and recycling large format batteries at end of life.</td>
</tr>
</tbody>
</table>
Future Work - 2011

- Complete Architectural and Design Work – April/May 2011
- Begin facility permitting – May 2011
- Process material flow diagrams completed – May 2011
- Begin facility construction - May/June 2011
- Begin initial equipment orders – June/July 2011
- Complete Facility Construction – Dec 2011
Begin installation of 1st battery line – January 2012
Begin installation of battery refurbishing /reconditioning processing - February 2012
Complete installation of 1st battery recycling line – May 2012
Ordering of equipment for 2nd battery processing line – May/June 2012
Complete installation of battery refurbishing processing – May 2012
Complete installation of 2nd battery recycling line Oct/Nov 2012
Location of Toxco’s planned expansion