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# 2010 DOE, Li-Ion Battery Cell Manufacturing

Kee Eun

LG Chem Ltd./Compact Power Inc.

Jun 8<sup>th</sup> 2010

Project ID # **ARRAVT001**

# Overview

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## Timeline

- Start: Sep 01<sup>st</sup>, 2009
- End: May 31<sup>st</sup>, 2013
- Percent complete: 0.58%

## Budget

- Total project funding
  - DOE share: \$151,387,000
  - LGC/CPI Share: \$151,403,339

## Barriers

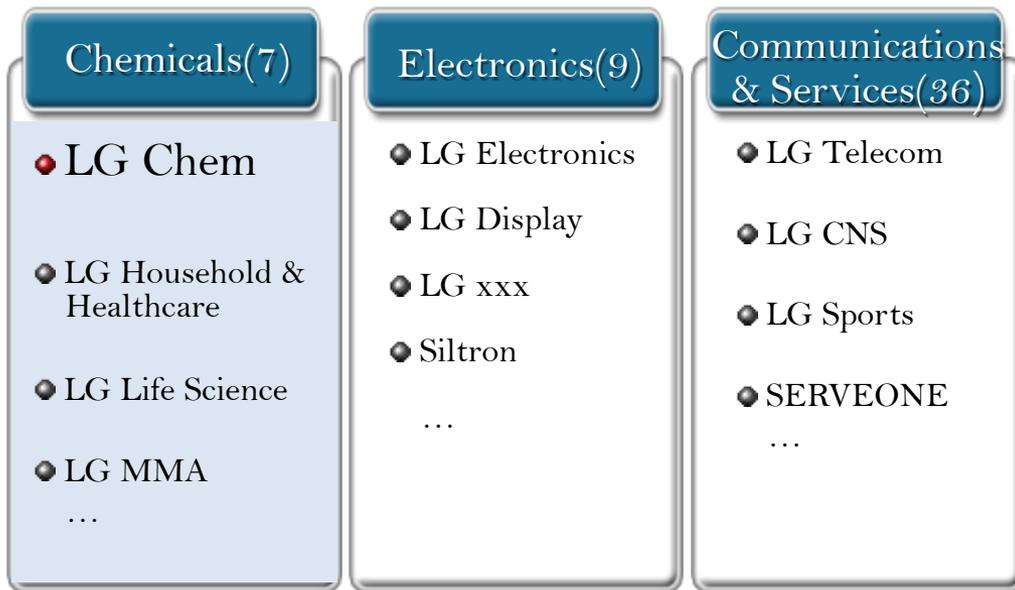
- Environmental permission
- Construction/Building permission
- DCAA Audit

## Partners

- DOE/NETL
- LG Chem Korea team.
- Architect & Engineering Firm
- Design Builder

# Company: LG, LG Chem

## Business Area

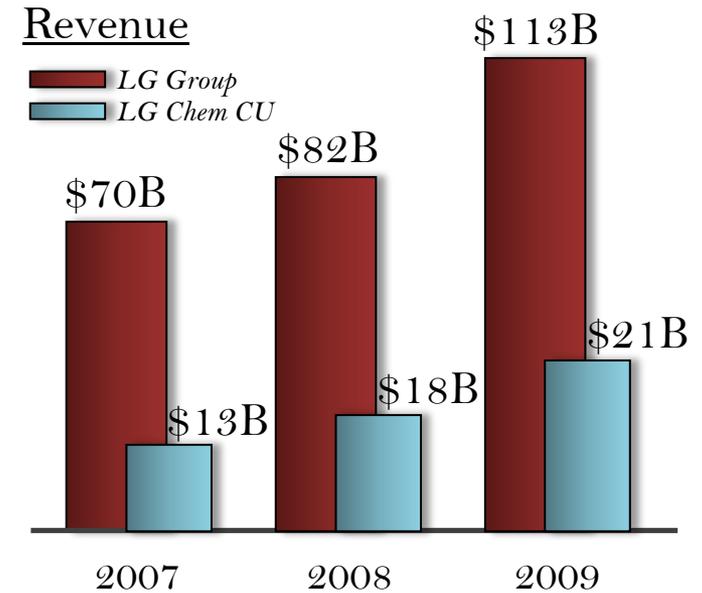


- Established in 1947
- LG Chem: mother company of LG
- 52 subsidiaries in LG

## Business Performance



## Revenue



[Assumed/Fixed] Exch. rate: KRW1,100/USD

# Company: Compact Power Inc.

## Overview

- LG Chem owns 100%
- Foundation: Colorado (Oct, 2000)
- Location: Troy, MI (Mar, 2005)
- Business
  - Marketing & development of Li-ion battery pack
- Employees
  - 11 ('00) → over 110 ('10)

## Key achievements

- Secured DOE Grant (\$151M)
- Secured Michigan Tax Credits for construction of cell manufacturing facility
- USABC Program
- GM Volt Pack development Program
- To develop & manufacture
  - Electronics
  - Pack systemsfor (Hybrid) Electric Vehicles

# Relevance

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The objective of this project is to design, construct, start-up and test a production facility for Li-ion Polymer Batteries in Holland, Allegan County, Michigan (Cell Manufacturing Facility).

After starting assembly operations in 2012, an expansion of production capability will continue through 2013 with the addition of a high volume electrode manufacturing line and more assembly lines.

When it reaches full scale operation in 2013, more than 400 direct employees (Operators, Engineers, Administration staff) will be working on site.

# Approach

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To achieve the goal, this project will be performed in 3 phases.

✓ **Phase 1: Program Management and Planning (~ June 30, 2010)**

Establish and maintain plans to ensure program performance to requirements, and ensure proper reporting and accountability to meet Award requirements.

✓ **Phase 2: Construction of Cell Manufacturing Facility (~ Nov 30, 2011)**

Construct buildings to create a domestic US based Advanced Lithium Ion Battery Cell Manufacturing capability.

✓ **Phase 3: Equipment Installations and Validation of Production Processes (~ Mar 31<sup>st</sup> 2012)**

Assure integration with other interfacing processes and systems to minimize production disruptions.

# Approach

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LG Chem's cells using laminated packaging with mixed cathode chemistry and Safety Reinforced Separator (SRS™) offer a number of advantages, including:

✓ **Unique Design (Stacking of Plates & Folding)**

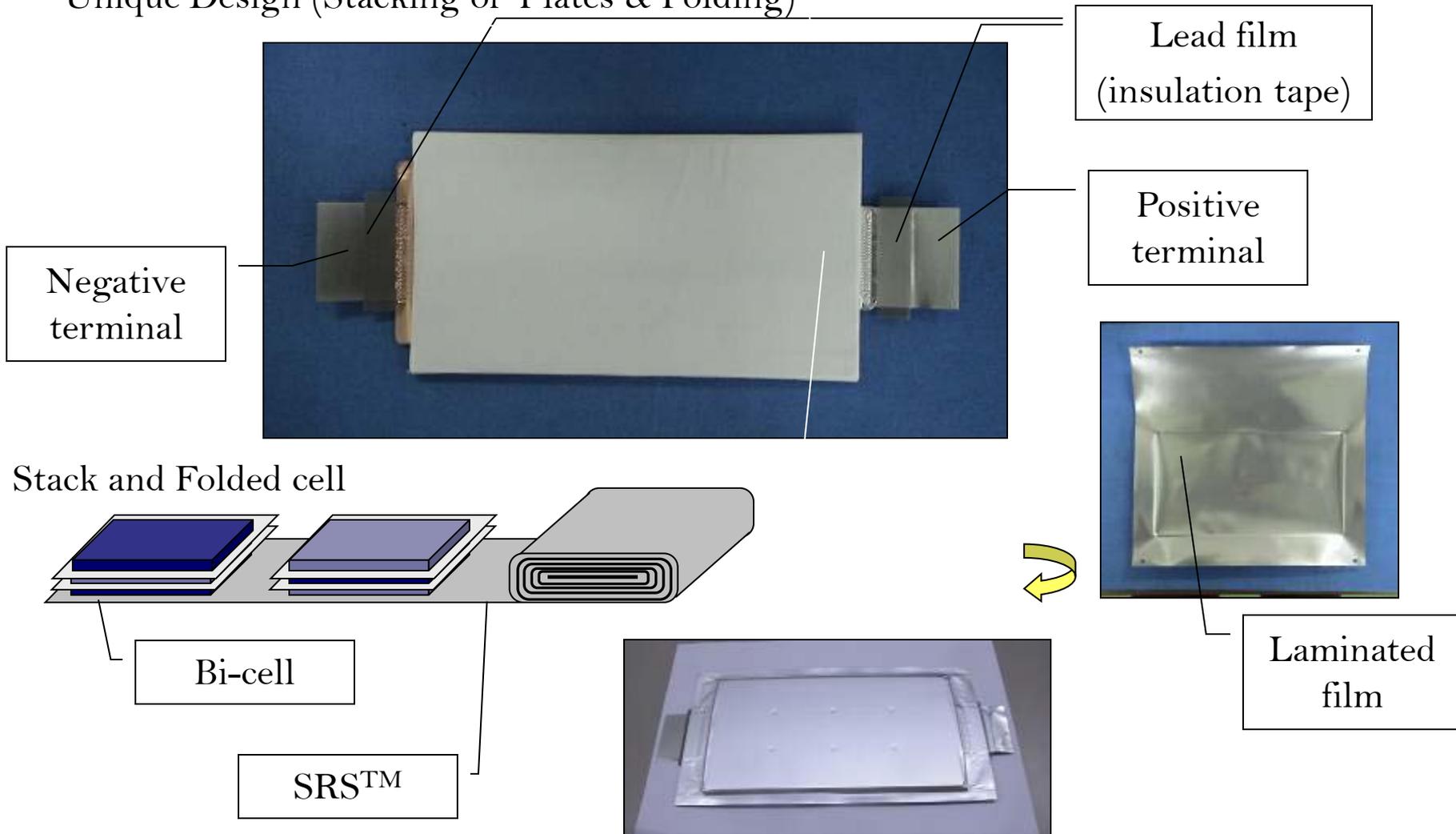
- High Rate Capability (easy current collection)
- More suitable for scaling-up (handling of long electrodes not required)
- Maintains dimensional stability during cycling
- Proven technology in mass production through manufacturing of cells for consumer applications

✓ **Robust laminated packaging design**

- Simple, more liable and less expensive manufacturing
- Simpler to change cell footprint

# Approach

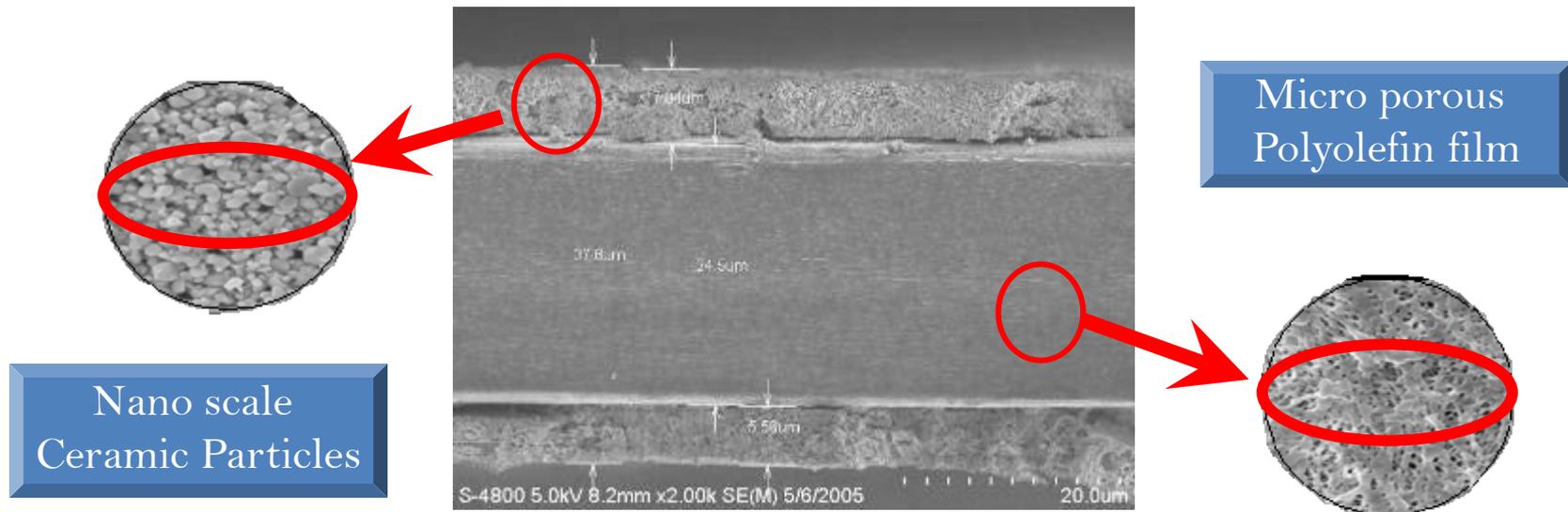
- Unique Design (Stacking of Plates & Folding)



# Approach

SRS™ provides superior abuse-tolerance

1. By preventing internal short circuit
2. By improved thermal and mechanical strength



- Has ~6x the puncture strength of conventional separator

# Approach

Components	Materials
Cathode	Mn-Spinel based
Anode	Graphite or Amorphous-carbon
Separator	SRS™
Electrolyte	LiPF <sub>6</sub> in Organic solvents (Gel type)
Packaging	Laminated

# Accomplishments & Progress

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Through Due Diligence and numerous meetings with local officials we can report on the current status as follows:

✓ **1<sup>st</sup> Round Due Diligence (15 Sites in Michigan)/ Apr ~ May 2009**

- Evaluation criteria: Access, Workforce, Infrastructure, Surroundings

✓ **2<sup>nd</sup> Round Due Diligence (5 Sites)/ Aug 2009**

- LG Chem executive tour
- Phase I environmental survey

✓ **Phase II environmental survey and decision/Oct 2009**

- Notified City of Holland in Nov 2009
- Signed Purchase Agreement in Feb 2010
- Required Annexation and Rezoning in progress

✓ **Project Announcement on Mar 12, 2010 in City of Holland**

# Accomplishments & Progress

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U.S. and Korean Construction teams have been working with the Architectural & Engineering firms to accomplish the following;

✓ **Appoint A&E firm/ Oct 2009**

- 14 firms were evaluated and appointed a joint team of  
: R Company (Architect), G Company (Engineering), A Company (Civil)

✓ **Preliminary design/ Oct 2009~ Mar 2010**

- Over 260 drawings
- Bid package to select a Design Builder

✓ **Design Builder Bidding/Selection**

- 5 General Contractors invited
- Bid package release/Mar 12, 2010
- Technical/Cost Bid Analysis conducted/Apr 11, 2010
- Final selection/Apr 12, 2010

# Accomplishments & Progress

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Michigan Department of Environmental Quality and City of Holland have worked closely with the LGC/CPI Team to achieve:

## ✓ **Wetland Permit**

- Application submitted (MDEQ)/Jan 10, 2010
- Public notice period completed/ Mar 10, 2010
- Currently under review at MDEQ field office
- Approval due May 30-2010

## ✓ **Air Permit**

- Reviewed all chemical material, quality, quantity/Jan ~ Mar,2010
- Application submitted (MDEQ)/Mar 17, 2010
- Approval due May 30-2010

## ✓ **Site Plan**

- Site plan submission/Feb 2, 2010
- Site plan approved by City Commission/Mar 25, 2010

# Accomplishments & Progress

All necessary steps to DOE requirements were followed

- ✓ **Notification from DOE of nomination toward Grant/** Oct 18, 2009
- ✓ **Award negotiation/** Sep 2009 ~ Feb 2010
  - Statement of Project Objective
  - Cost Justification (PMC 123)
- ✓ **Environmental Assessment Report per NEPA/** Dec 14, 2009
  - Awaiting DOE approval
- ✓ **Grant awarded/**Feb 17, 2010
- ✓ **Defense Contract Audit Agency on site Audit/** Mar 16, 2010
  - Report to DOE by Apr 15, 2010
- ✓ **Project Kick-off Meeting/** Mar 31, 2010
- ✓ **Definitization period/** ~ June 16, 2010

# Accomplishments & Progress

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LGC/CPI will subsequently complete the remaining tasks to ensure on-track schedule.

- ✓ **DCAA Audit (Report to DOE on Apr 19<sup>th</sup>, 2010)**
- ✓ **Definitization (~ 16<sup>th</sup> Jul, 2010)**
  - Cost structure review and adjustment  
(Allowable vs. unallowable)
  - Rationalize costs based on actual bid from GC
  - Financing Plan (LGC Investment Committee approved)
- ✓ **NEPA Report**
- ✓ **Merit Review Presentation (Jun 8<sup>th</sup> 2010)**

# Collaborations/Partnerships

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Federal, State and Municipality are extremely supportive.  
All partners from the private sector are also well aligned.

## ✓ **DOE/NETL**

- Clear guidelines for billing/reporting
- Quick responses to inquires

## ✓ **Michigan State**

- Financial incentives to LGC/CPI and local communities
- Coordination with municipal agencies (ie: permitting)

## ✓ **City of Holland**

- Support for permitting/relocation/training of workers/land purchase
- Incentives for infrastructure

## ✓ **Private sector partnership**

- A&E firms – timely co-work for facility design
- Design builder – commitment to the success of Project

# Future work

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1<sup>st</sup> Phase construction will be completed by Oct 31<sup>st</sup> 2011 and Start of Production is expected to be on Mar 1<sup>st</sup> 2012.

- ✓ **Select Design Builder (Apr 20 2010)**
- ✓ **Purchase land (May 31<sup>st</sup> 2010)**
- ✓ **Complete design for 1<sup>st</sup> phase construction (Jun 30, 2010)**
- ✓ **Obtain necessary permits before Ground-breaking (Jun 30, 2010)**
- ✓ **Ground breaking (Jul 5<sup>th</sup> 2010)**
- ✓ **Building construction phase 1 (~ Oct 31<sup>st</sup> 2011)**

# Summary

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- ✓ No significant issues have been found.
- ✓ Supports from Federal/State/Municipal authorities are tremendous.
- ✓ LGC/CPI is trying to accelerate construction timeline in order to ensure sufficient time for equipment installation and validation. In turn, this will enable us to start hiring operators in earlier timeframe.
- ✓ LGC/CPI's battery cell technology has been proven through: track record experiences in manufacturing for last 10 years in Korea and numerous in-house and customers' validation.
- ✓ LGC/CPI is confident that the success of this project will contribute to recovery of economy through job creation and building a strong technical basis in US.
- ✓ Ultimately, this will reduce US dependence on foreign oil.