Hitachi’s Battery Business

Combining Hitachi’s strengths with a focus on industrial applications

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President & CEO,
Battery Systems Company
Hitachi, Ltd.
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Contents
1. Market Environment
2. Activities at the Battery Systems Company
3. Business Strategies
1-1. Market Environments

- High expectations for batteries in the areas of green mobility and new energy
- Batteries are key devices in the formation of Smart Communities and other new industrial fields

Worldwide CO₂ Emissions

(billion tons per year)

Developing electric vehicles: 66 trillion yen (Green Mobility)
New energy equalization allowance: 11 trillion yen

Capital investment

Expected increase in business by 2025

Source: Hitachi Research Institute

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1-2. Lithium-ion Battery Market Trends

- Lithium-ion batteries have global growth potential on a scale of 4 trillion yen
- There is an increasing demand for power storage as a means of reducing CO₂ emissions, and growth is expected in industrial and automotive applications, with government measures (e.g., the Green New Deal) spurring this growth

![Graph showing lithium-ion battery market trends from 2008 to 2020](Image)

Source: Hitachi Survey
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Contents

1. Market Environment
2. Activities at the Battery Systems Company
3. Business Strategies
2-1. Targets of Hitachi’s Battery Business

Strengthen the expansion of battery business from devices to battery solutions for power sources, with a focus on industrial applications, and create new business based on collaborations throughout the Hitachi Group.

<table>
<thead>
<tr>
<th>Direction targeted by Hitachi’s battery business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products using batteries</td>
</tr>
<tr>
<td><strong>Battery Solutions</strong></td>
</tr>
<tr>
<td><strong>Battery Cells/Packs</strong></td>
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<tr>
<td>Advanced Materials</td>
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<tr>
<td>Manufacturing facilities</td>
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<tr>
<td>Products using batteries</td>
</tr>
<tr>
<td>Power Source Solutions</td>
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<tr>
<td>Battery Control</td>
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<tr>
<td>Packs</td>
</tr>
<tr>
<td>Cells</td>
</tr>
<tr>
<td>Materials</td>
</tr>
<tr>
<td>Battery Systems Company</td>
</tr>
<tr>
<td>R&amp;D (Innovation Engine)</td>
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</tbody>
</table>

Propose batteries that take the entire system into consideration.
2-2. Platform Technologies that Support Hitachi’s Battery Business

The Battery Systems Company combines:
(1) “Monozukuri” capabilities in consumer and automotive batteries;
(2) Advanced material technologies from Research Divisions; and
(3) System applications based on Hitachi Group collaborations

Battery Systems Company
Combining Hitachi’s strengths with a focus on industrial applications

Dispersion coating / electrode production
(Hitachi Maxell)

Automotive Production Lines
(Hitachi Vehicle Energy)

Long-lasting electrode materials*
(Advanced Battery Research Center, Hitachi Research Laboratory)

Hitachi Group’s Materials Products

Control technologies and products using batteries

Monozukuri Capabilities

Advanced materials technologies

*Results of research contracted by NEDO

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2-3. “Monozukuri” Capabilities

- Hitachi’s “Monozukuri” pursues outstanding safety, power, and capacity.
- Electrode manufacturing is at the core of batteries, and Hitachi’s battery manufacturing achieves high reliability.

**Electrode production**

- High-precision dispersion/coating technologies

**Hitachi’s Lithium-ion Batteries**

- High power and high capacity
  - Computer tape manufacturing technologies
    - Dispersion technologies
    - Coating technologies
    - Slit technologies
  - 1965: Production of Maxell's magnetic tape begins

**Battery Production**

- High reliability
  - Micro-battery manufacturing technologies
    - Volume production of automotive batteries for commercial vehicles
  - Welding technologies
  - Sealing technologies
  - 1961: Production of Maxell’s battery (cell) begins “Maximum Capacity Dry Cell”

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2-4. Advanced Materials Technologies

Develop technologies in a comprehensive process, from material-synthesis to battery prototype evaluations

Challenges towards advances materials technologies

- Material-synthesis
- Electrochemical evaluation
- Battery evaluation

Platform for integrated analysis of electrode surface response and internal degradation

- Crystallinity analysis
- Electrode surface response analysis
- Electrolyte decomposition reaction analysis

- Technology for doubling the life of industrial lithium-ion batteries with manganese cathodes

- Compound cathode material (reduced cobalt content)
- Silicon anode material (increased capacity)

[Research contracted by NEDO]

- Spinel Manganese: 5yrs. 8yrs. 15yrs. Estimated life
- Newly developed materials: Life
- Decrease of space
- Crystallized materials
- Nano-sized silicon crystallite
- Ceramic coating
- Crystallized carbon
- Amorphous silicon oxide

Cycles $^{1/2}$
- Control technologies to maximize battery cell performance
- The Hitachi Group’s product capabilities enable comprehensive

**Information and Telecommunications**
- UPS: Uninterruptible Power Supply

**Industrial machinery**
- Railway / Construction machinery

**Power systems**
- Wind power / Solar power / Smart grids

- Cell controllers
- Battery controllers
- "HiGT" chip
- Power module

Battery Control
Low loss / high voltage resistance inverters
High efficiency motors

**Battery**

**Inverter**

**Motors**

* HiGT: High Conductivity IGBT, IGBT: Insulated Gate Bipolar Transistor
2-6. Configuration of the Battery Systems Company

Battery Systems Company

1. Business Management Division:
   Overall supervision of operations; Creation of large-scale industrial solutions business

2. Hitachi Maxell:
   Consumer battery and small- to medium-sized industrial lithium-ion battery business

3. Hitachi Vehicle Energy:
   Automotive lithium-ion battery business

Revenues

FY2009 : 142.1 billion yen  (Including non-battery business at Hitachi Maxell)
2-7. Promoting Optimization of Battery Business

Promote overall optimization of a broad range of battery business fields, from small consumer products to large-scale industrial applications, and improve investment efficiency by breaking away from the "separate vertically integrated" model.
### Unique Features of Hitachi’s Battery Business

- Battery business base covers a wide range of applications, from consumer products to industrial applications.
- Proposes solutions based on collaborations between Business Divisions and other Hitachi Group companies.
- Adopts advanced technologies through R&D (Innovation Engine).

<table>
<thead>
<tr>
<th></th>
<th>Consumer applications</th>
<th>Automotive applications</th>
<th>Industrial applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Small to medium-sized packs</td>
</tr>
<tr>
<td>Co. A (Korea)</td>
<td>○</td>
<td>○</td>
<td>—</td>
</tr>
<tr>
<td>Co. B (Japan)</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Co. C (U.S.)</td>
<td>—</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Hitachi</td>
<td>○</td>
<td>○</td>
<td>○</td>
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</tbody>
</table>

- ○ Currently rolling out business
- ○○ Planning on rolling out Business in the future

System collaboration proposals
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3-1. Hitachi Maxell’s Strategy and Products

- Increase business in consumer product aiming for high-end smart phones
- Expand business in growth fields with cylindrical, laminated, and micro batteries
- Develop new industrial market with high-power cylindrical and laminated batteries

### Product lineup

<table>
<thead>
<tr>
<th>Micro batteries</th>
<th>Mobile batteries</th>
<th>Cylindrical batteries</th>
<th>Laminated batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coin-type rechargeable batteries</td>
<td>High capacity batteries by using Si anode</td>
<td>Expanding applications (power tools, etc.) with high-power type, and developing a high capacity type</td>
<td>Thin, high-capacity batteries Sample size variation</td>
</tr>
<tr>
<td>About 20mm in diameter; capable of high rate discharge at 140mA</td>
<td>Mobile phones, smart phones, digital cameras, portable game devices, electronic dictionaries, etc.</td>
<td>Power tools, gardening tools, pedelecs, wireless radios, etc.</td>
<td>Electric scooters, UPS, floor cleaners, portable power supply, etc.</td>
</tr>
</tbody>
</table>

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3-2. Investments in Laminated Batteries

Total investment: 2 billion yen
Production of laminated batteries to begin in fiscal 2011

- Selected as recipient of METI subsidy for the program
- Assembly facilities installed in the Toyama Works and electrode production facilities installed at the Kyoto Works
- Achieves both small-lot production and high-efficiency production
- Laminated batteries contribute to the expansion of the Battery Solution Business at the Battery Systems Company as a core device in industrial applications (electric scooters, etc.)

Toyama Works
Kyoto Works
New electrode plant
3-3. Hitachi Vehicle Energy’s Strategy and Products

- Strengthen marketing targeting commercial buses and trucks (in March 2010, achieved cumulative shipments of one million cells)
- Fiscal 2010: Began operation of a new production line, and began delivery in passenger vehicles
- Develop large, high-capacity batteries for PHEVs and strengthen rollout to industrial fields

Product lineup

<table>
<thead>
<tr>
<th>Cylindrical batteries/packs for HEVs</th>
<th>Prismatic batteries for HEVs</th>
<th>Prismatic batteries for PHEVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery cell</td>
<td>4,500W/kg high output type; 1.7x the output of former Hitachi models</td>
<td>25Ah high capacity type; motor running distance: approx. 20 km</td>
</tr>
<tr>
<td>Battery pack</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

High-quality, high-reliability battery cells and packs based on extensive track record in the automotive market

Hybrid commercial vehicles (buses, trucks), hybrid electric vehicles (HEV), rolling stocks, cargo-handling machinery systems, stationary energy storage systems for regenerative power absorption, etc.

Plug-in hybrid electric vehicles (PHEVs), stationary industrial applications, etc.
3-4. Battery Solution Business

- Seek out new applications, mainly in the industrial application (e.g., Smart communities)
- Target for orders in related fields: 1 billion yen (FY2012); 10 billion yen (FY2014)

Applications in existing systems business

Seeking out new applications in Smart communities, etc.

Rolling out business in power systems and new energy applications

- Design rechargeable battery controls/interfaces for system power sources
- Integrate peripheral hardware (PCS, etc.)
- Maintenance, service

PCS: Power Conditioning System

Lithium-ion battery cells/packs

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3-5. Collaborations with Shin-Kobe Electric Machinery

- Shin-Kobe Electric Machinery promotes lead acid battery business, and Battery Systems Company supports expansion of the long-life lead acid battery business targeting new energy applications.
- Shin-Kobe and Battery Systems Company collaborate in seeking out new applications for large-scale industrial lithium-ion batteries.

**Product lineup**

<table>
<thead>
<tr>
<th>Long-life lead acid rechargeable batteries</th>
<th>Prismatic lithium-ion batteries</th>
<th>Cylindrical lithium-ion batteries</th>
<th>Lithium-ion capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>For wind power generators; expected life: 17 yrs. (LL-W type); For storage: 10-15 yrs.</td>
<td>200Ah high-capacity batteries(^*1) (Float life: 10 yrs.)</td>
<td>Industrial cycle applications based on EV batteries (50Ah, 90Ah)</td>
<td>Greater output than EDLC (^*2), and more than 3x the energy density</td>
</tr>
<tr>
<td>Wind power generator output variance control, power storage, etc.</td>
<td>Backup applications (UPS, etc.)</td>
<td>Construction equipment, electric forklifts, wind/solar power generators, etc.</td>
<td>Energy regeneration, compensation power sources, etc.</td>
</tr>
</tbody>
</table>

\(^*1\) Joint development with NTT Facilities, Inc.  \(^*2\) Electric Double Layer Capacitor
3-6. Development of Innovative Battery Technologies

- Started up Group-wide development project targeting large-scale industrial applications (May 2010)
- Developing “standard cells” and “battery control platforms”

3 year plan; 5 billion yen

Targets for industrial use lithium-ion batteries

![Graph showing energy density vs. output density for different types of batteries and their applications.]

- Lithium-ion Batteries
- Large capacity Industrial batteries
- Capacitors
- Power tools
- PHEV
- EVs
- Electric scooters
- Small consumer products
- Lead acid rechargeable batteries
- Nickel metal-hydride batteries
- Nickel-cadmium batteries
- HEV
3-7. Summary of Battery Systems Company’s Strategies

**Product Strategies**
- Combine the comprehensive strengths of the Hitachi Group, and expand into the Battery Solution Business

**Development Strategies**
- Continually strengthen innovative battery technologies, in collaboration with R&D Group

**Cost Strategies**
- Increase investment efficiency by promoting overall optimization (unification of production and procurement activities)
- Increase cost competitiveness through the Group-wide development project

**Finance/Alliance Strategies**
- Secure global intellectual property rights for innovative battery technologies
- Actively build partnerships (alliances) with outside companies
Baterry Systems Company’s Revenue (FY2014Target) 250 billion yen

The Battery Systems Company will support the new Social Innovation Business in various fields, including Green Mobility and New Energy Applications.
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