

# Hitachi's Initiatives on Lithium-ion Battery Business —Aiming to Create a Green Society—

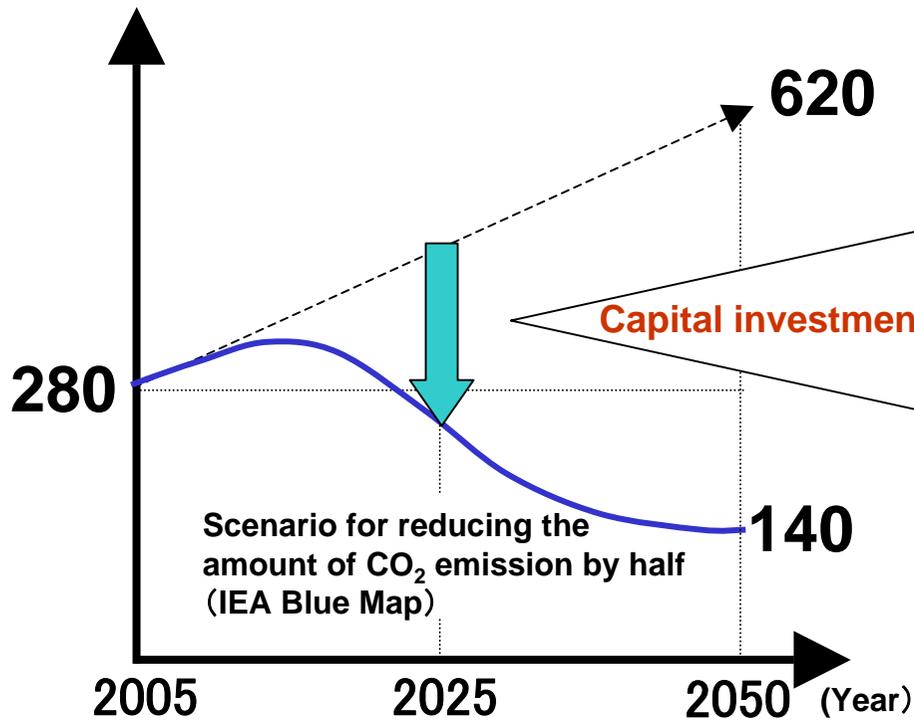
**April 17, 2009**

**Hitachi, Ltd.**

High expectations for batteries in the areas of green mobility and new energy

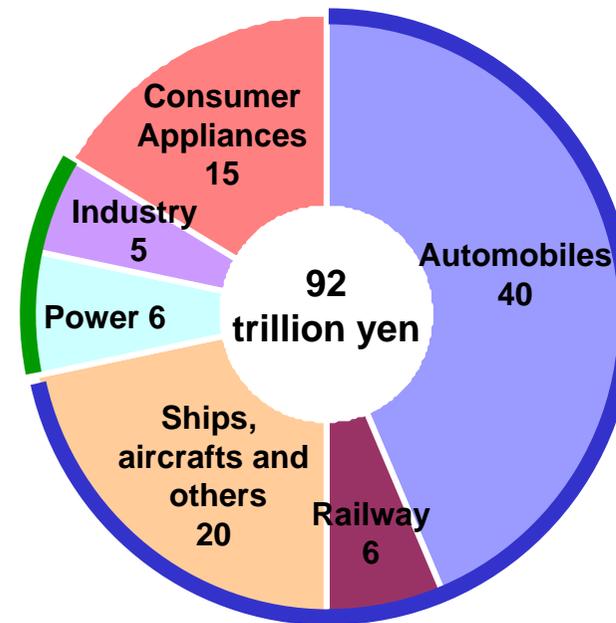
Amount of CO<sub>2</sub> emission in the world

(100 million tons per year)



IEA: International Energy Agency

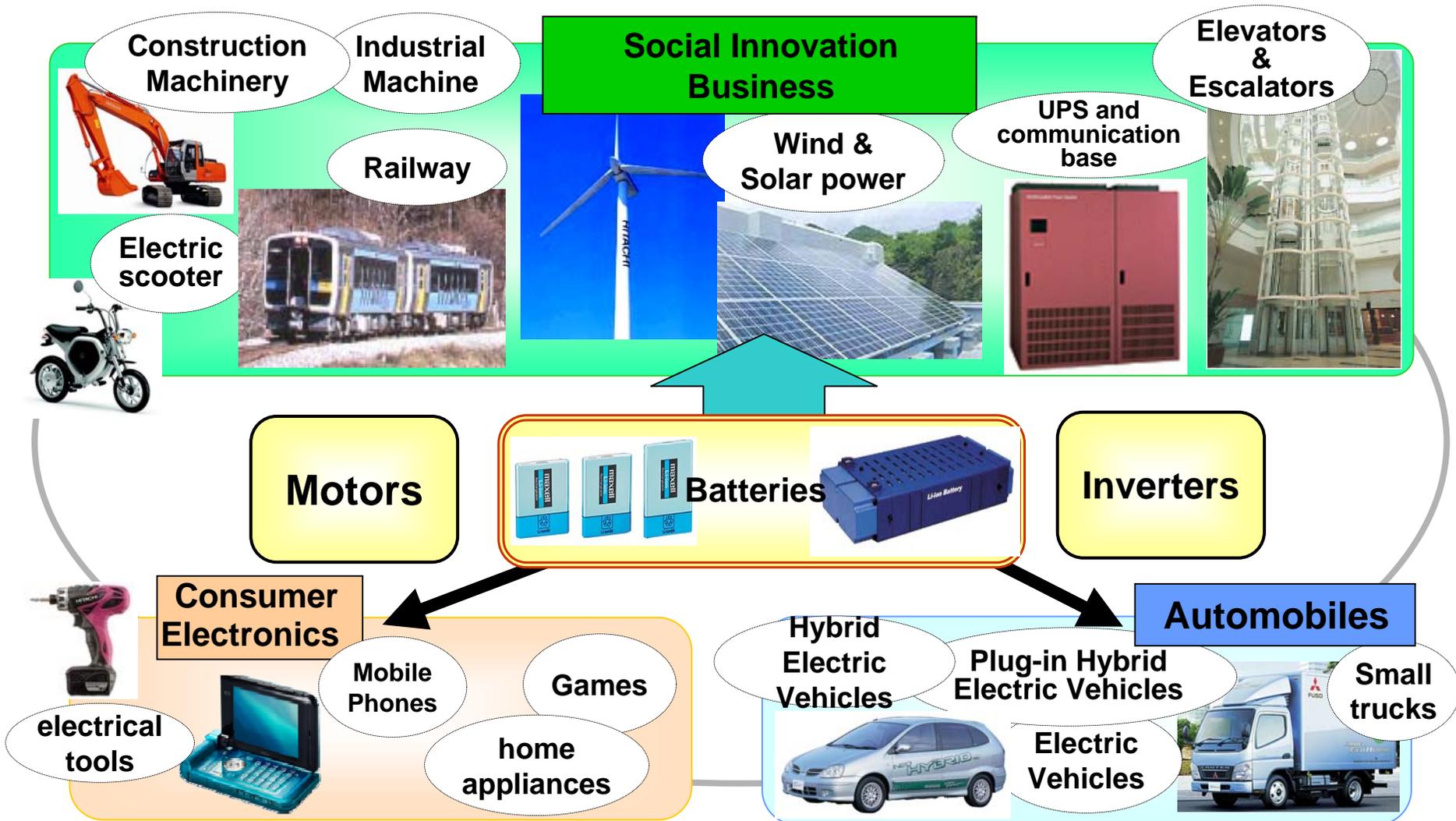
- █ Developing electrical vehicles  
66 trillion yen (Green Mobility)
- █ Equalization allowance of new energy  
11 trillion yen



Expected increase of business by 2025

Source: Hitachi Research Institute

Batteries are the core devices as well as motors and inverters



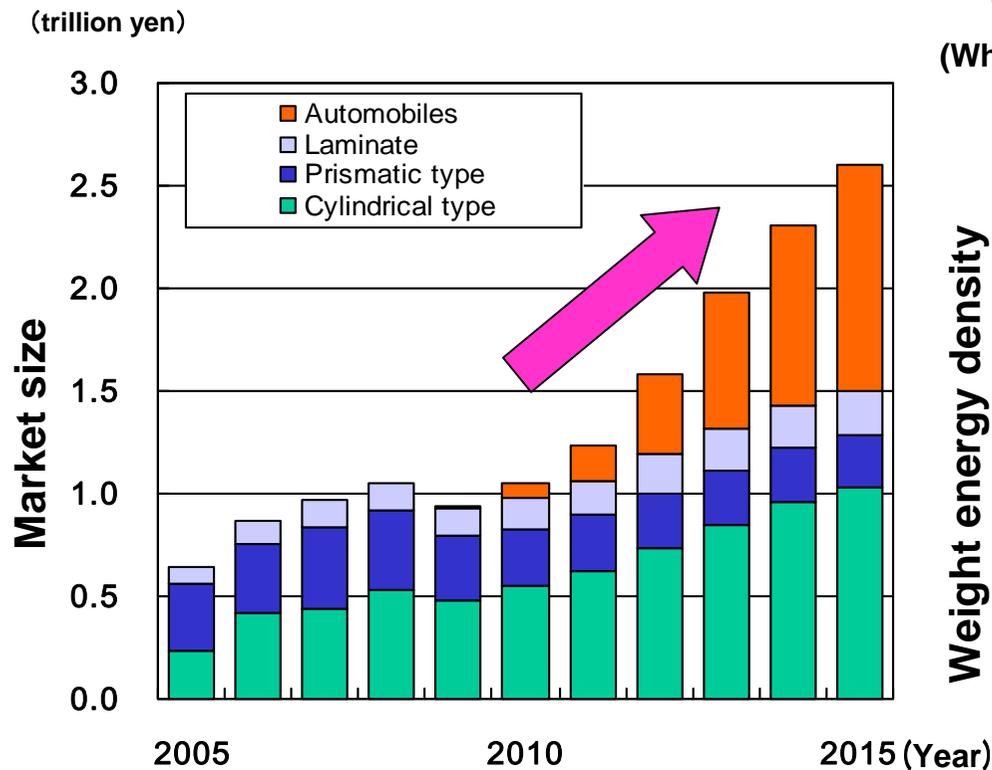
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## Expectations and challenges of lithium-ion batteries

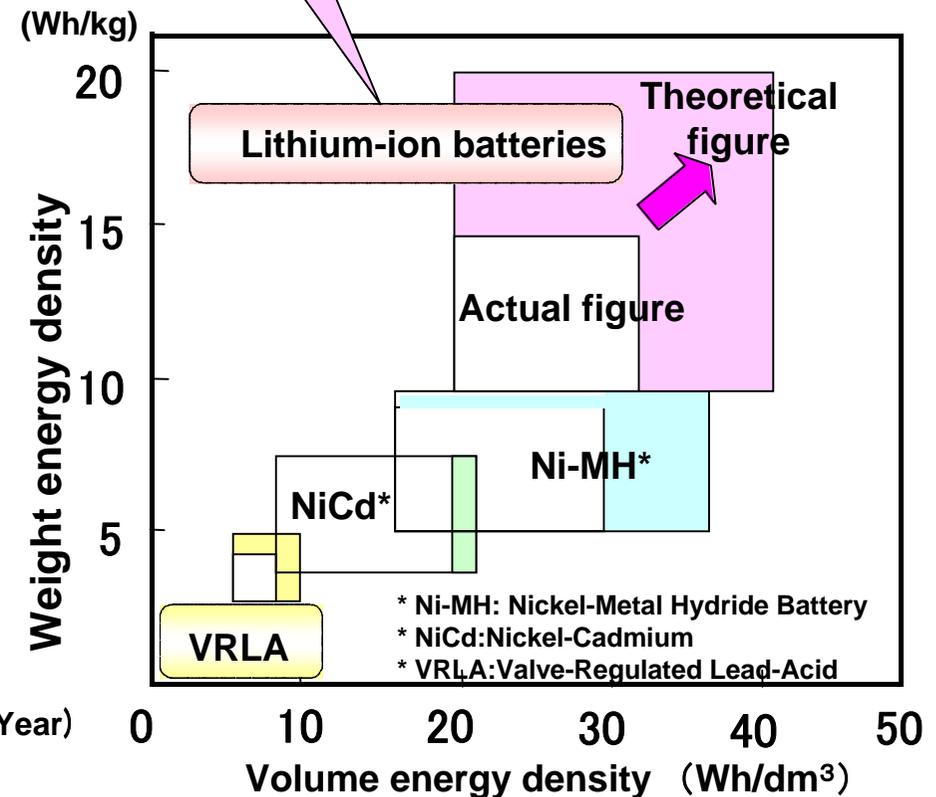
- Light in weight and high-energy density are the traits, this enables to broaden applications from consumer to middle/large scale
- High reliability and cost are the challenges need to be overcome for the diffusion

Volume and weight of the lithium-ion batteries:

- Approximately 1/2 of a nickel-metal hydride batteries
- Approximately 1/3 of a lead acid batteries

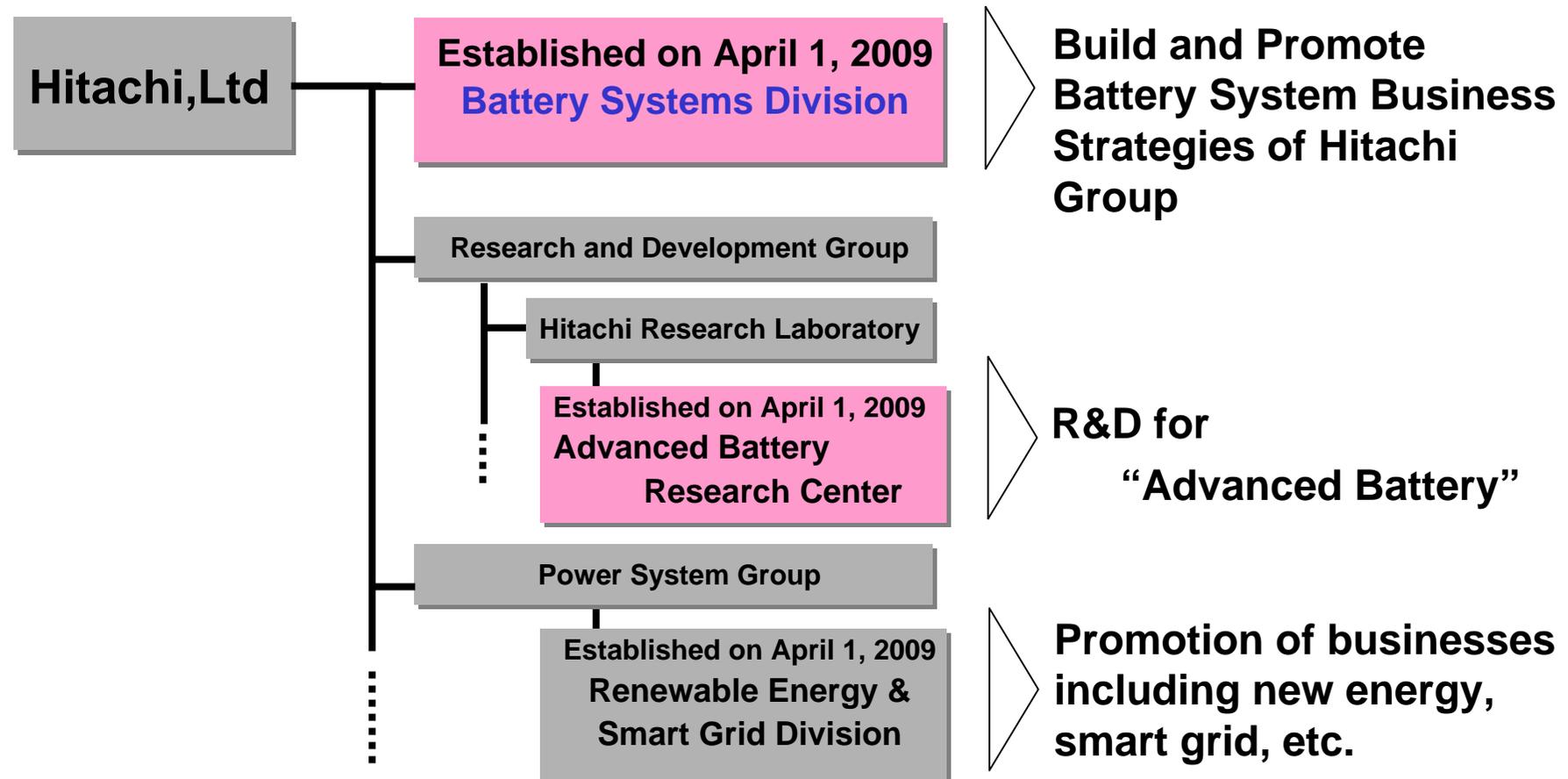


(Source: Institute of Information Technology, Ltd.)



**Mission**

1. To strengthen collaborative creation within the Hitachi Group on battery businesses
2. Cultivation of new applications for lithium-ion batteries



## 1. Originally developed electrodes (materials, dispersion, coating technology)

- No recalls on lithium-ion batteries for consumer products use  
(600 million cells were shipped since 1996)
- Pioneering product development of lithium-ion batteries for automobile use  
(600 thousand cells were shipped since 2000)

## 2. Full engagement in batteries, from cells to surrounding businesses related to batteries

- Lithium-ion battery is an electric device, which requires control system -
- Manufacturing equipment, materials, cell, module(control),  
electricity storage system

## 3. Developing system businesses centered on batteries

- Using lithium-ion batteries, which were developed for automobile use in  
Hitachi's competitive fields, including rolling stocks.
- Developing new usages of lithium-ion batteries to meet the needs of the society  
such as new energy and smart grid

**High speed and high quality production of electrodes through usage of dispersion and coating technologies developed in house by Maxell**

◆ **The new factory for electrodes utilizing cutting edge technologies**

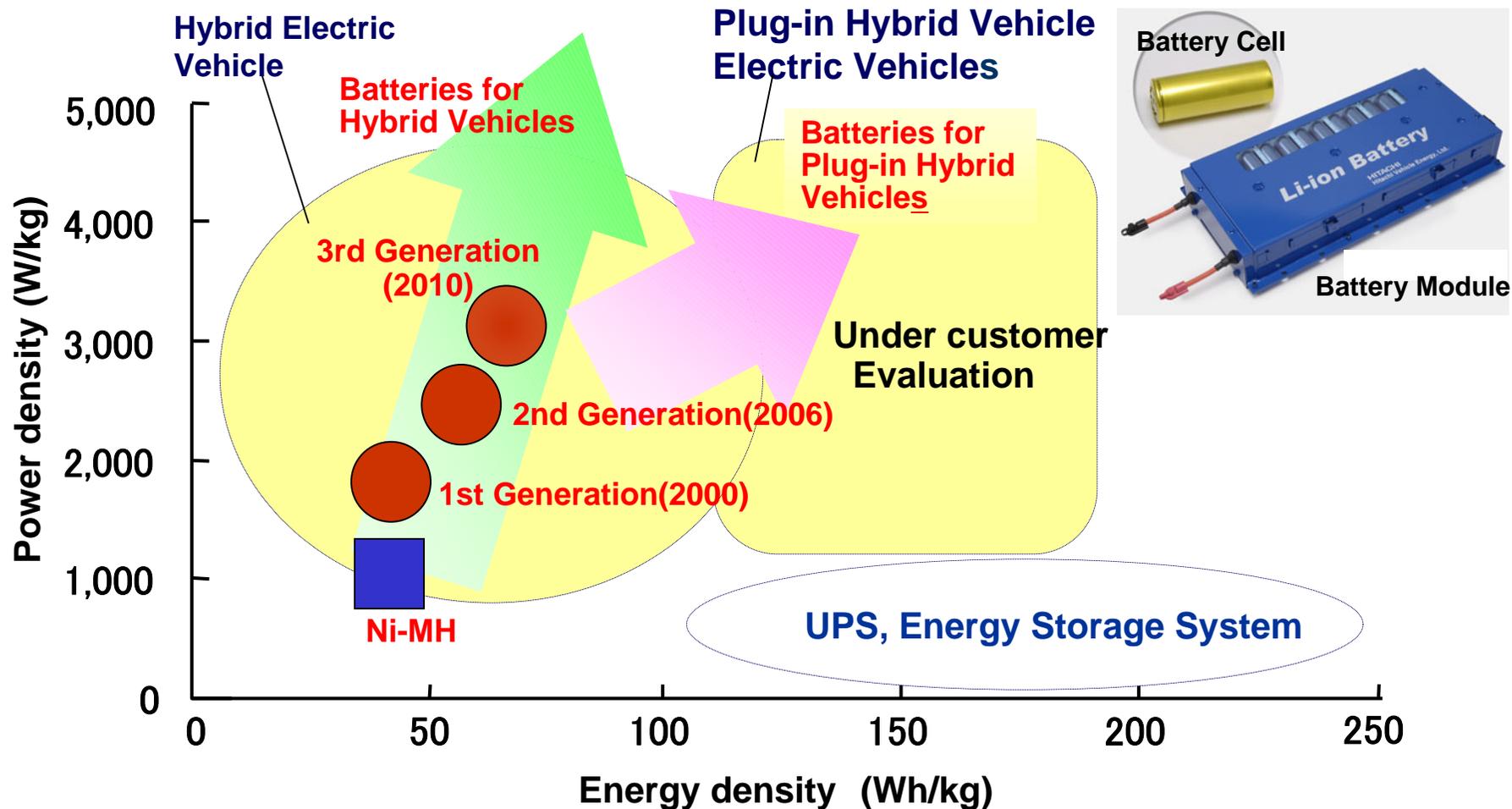
- Dispersion and coating technology, developed through the production of electromagnetic tape
- Production capacity of 40 million electrodes per month (converted in batteries for consumer product applications)
- Manufacture of electrodes for batteries applied to hybrid electric vehicles

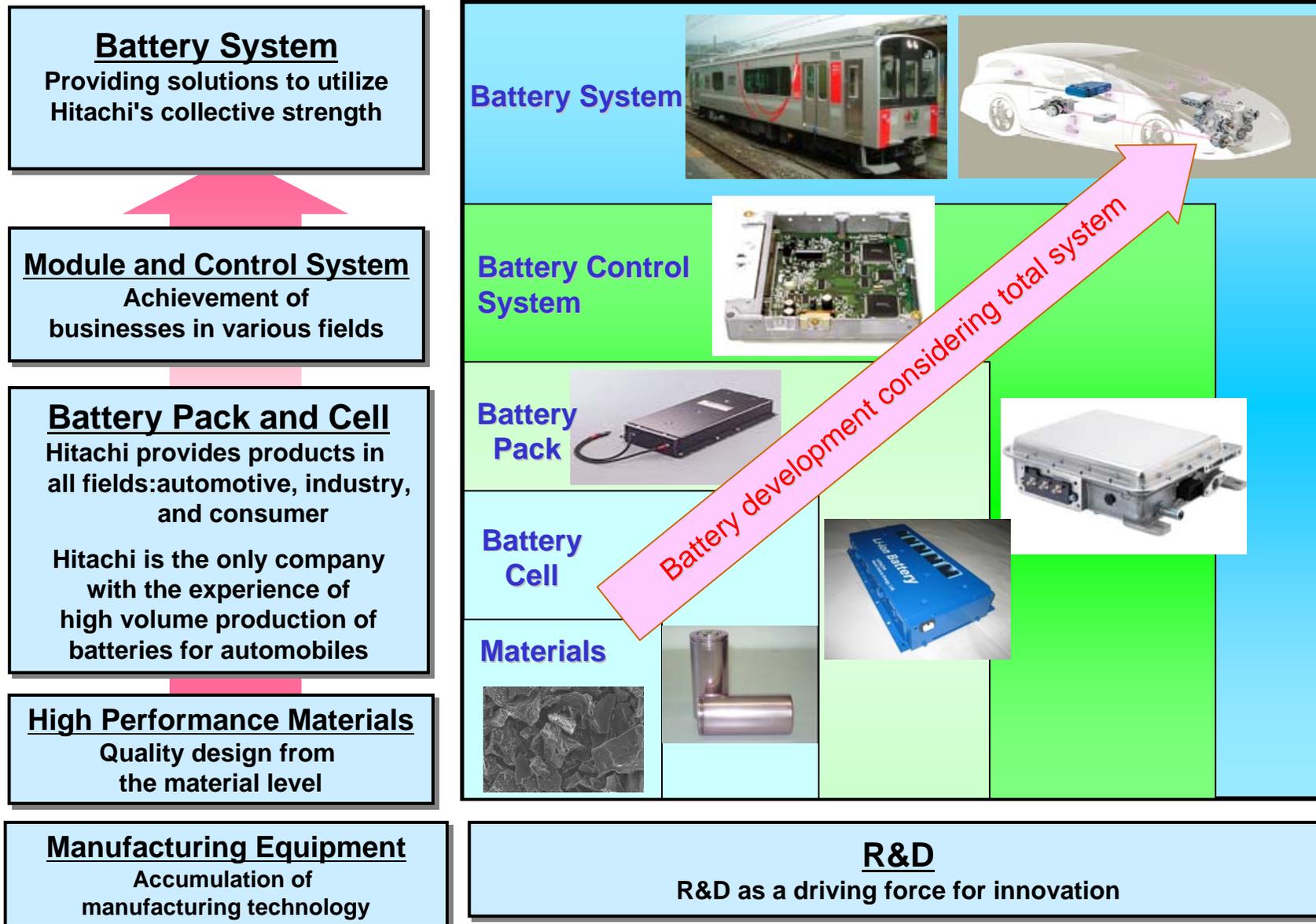


**Construction completed on  
February 13, 2009  
Hitachi Maxell**

**The new factory (Kyoto Works)  
A two story building with total floor space  
of 15,000 m<sup>2</sup> due to come online in 2009**

- Improving energy density by using manganese based original material for electrodes
- Competitive material cost (versus cobalt), high reliability (material, designing of batteries)





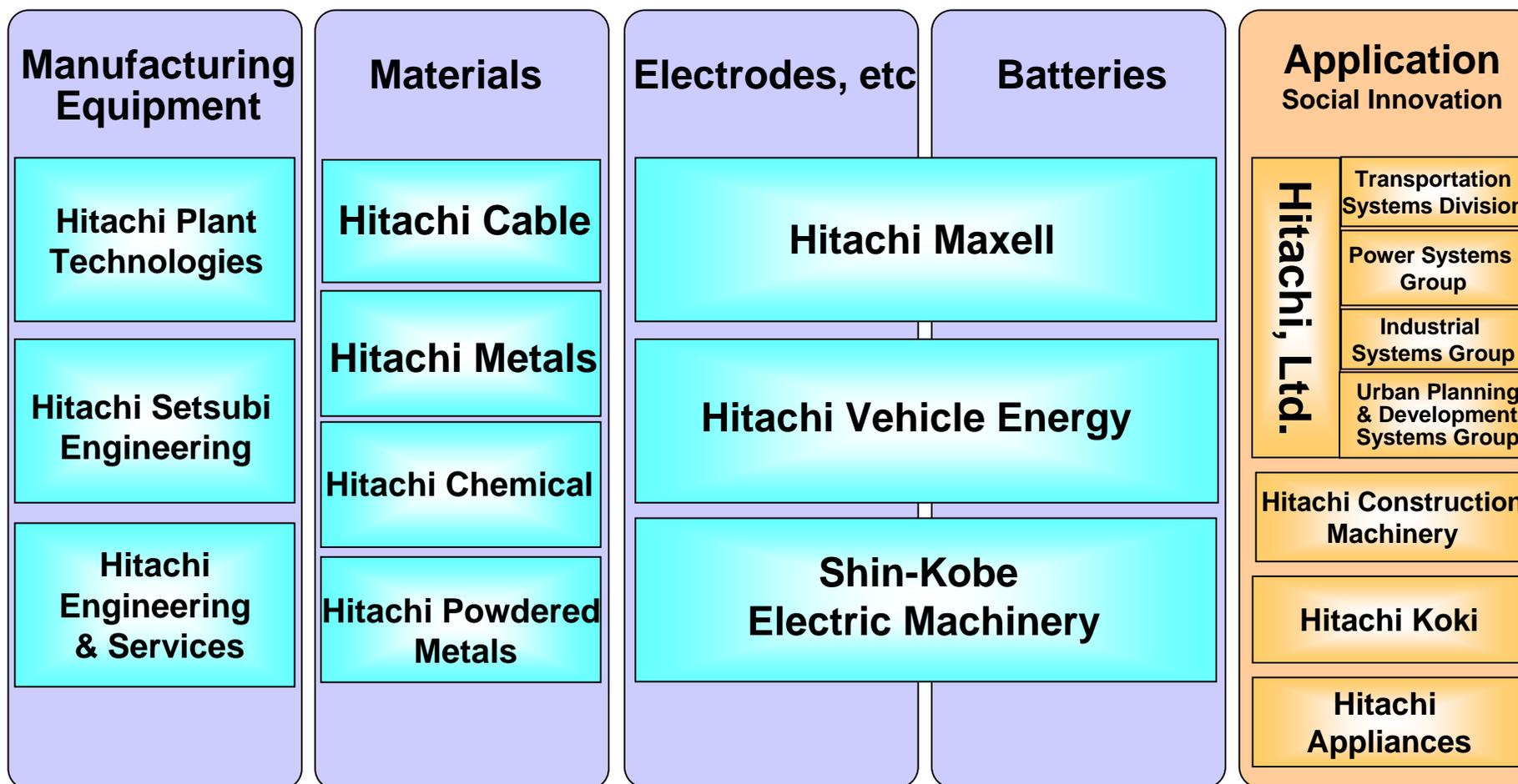


# Overview of Batteries' Businesses



# Business Map of Hitachi's Lithium-ion Batteries

With the collective strength of the Hitachi Group,  
we are aiming to develop the world No.1 lithium-ion batteries



# Main Manufacturing Sites for Lithium-ion batteries



Investment for  
New facility:  
6.0 Billion Yen

Total Amount of  
Investment:  
23.0 Billion Yen\*



Shin-Kobe  
Electric Machinery  
Saitama Works



Hitachi Vehicle Energy  
Tokai Works

Total Amount of Investment:  
15.0 Billion Yen

Hitachi Maxell  
Kyoto Works



Shin-Kobe  
Electric Machinery  
&  
Hitachi Vehicle Energy  
Hikone Works

Total Amount of Investment:  
3.0 Billion Yen



\*Included Investment  
for Overseas Works

- Batteries for mobile phones entered the stage of maturation (split into high function and commodity types)
- Battery Demand for digital cameras, game machines and PND are brisk

PND: Personal Navigation Device

**Sales: 30.0 Billion yen (FY 2007)**



**50.0 Billion yen (FY 2011)**

### ◆ Prismatic lithium-ion batteries

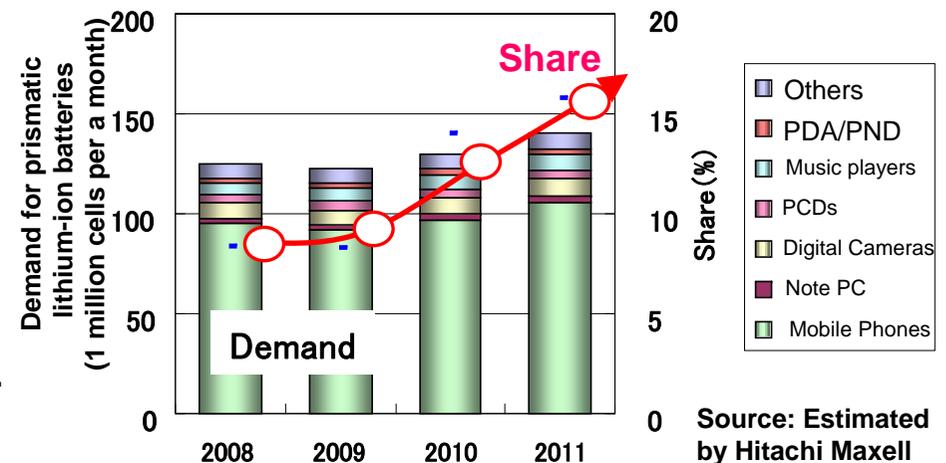


Number of recalls: 0

### Flat, high capacity and safety

- Development of high-capacity positive-electrode material without using cobalt.
- Development of high-capacity hybrid negative-electrode.
- Adopting originally developed heat-resistant separator.
- Development of thin 1.5 Ah cell (4mm).

### <Market and Share>



Application	Status	Company
Mobile phones	Mass Production	Hitachi Maxell
Portable gaming devices	Mass Production	Hitachi Maxell

Application	Status	Company
Digital cameras	Mass Production	Hitachi Maxell
PND	Mass Production	Hitachi Maxell

- **Electrical tools: Shift from NiCad and Nickel-metal hydride batteries to lithium-ion batteries.**
- **Shift to automotive applications owing to small and light lithium-ion batteries.**

**Sales: 10 million yen (FY 2007)**



**15.0 Billion yen (FY 2011)**

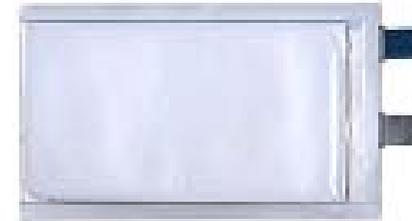
◆ High power, cylindrical form batteries



### High power and safety

- Adaptation of high dispersion, low resistance electrode.
- Active material, which excels at heat stability

◆ 10Ah class laminated batteries



### High capacity, High power and safety

- Safety design achieved by the adaptation of originally developed layered structure.
- Appropriate selection of active materials depending on its use.

Application	Status	Company	Application	Status	Company
Cordless power tools	Mass Production	Hitachi Maxell	Portable measuring instruments	Under development	Hitachi Maxell
Cordless gardening tools	Mass Production	Hitachi Maxell	Electric bicycle	Under development	Hitachi Maxell

- Market of lithium-ion batteries for hybrid electric vehicles will expand.
- Batteries used for HEV may shift to mainly lithium-ion batteries by 2015.

**Revenues (business goal): approximately 100 billion yen (FY 2015)**

### ◆ Batteries for Hybrid Electric Vehicles

- Launched In 2000;  
adopted for commercial vehicles
- Developed the 2<sup>nd</sup> generation battery in 2006;  
1.5 times higher output compared to  
the previous model.



1st Generation Battery



2nd Generation Battery

### ◆ Batteries for Electric Vehicles

Sales started in 2000

### ◆ Batteries for Plug-in Hybrid Electric Vehicles

Under customer evaluation

- Delivered 600,000 cells
- Accumulated investment of 15 billion yen
- Production line of 300,000 cells capacity per month:  
nearly completed.

Application	Status	Company
Hybrid Electric Vehicles	Mass Production	Hitachi Vehicle Energy
Plug-in Hybrid Electric Vehicles	Under evaluation by customer	Hitachi Vehicle Energy

Application	Status	Company
Electric Vehicles	Production Experience	Hitachi Vehicle Energy

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## Track record of Lithium-ion Battery Sales for Automobiles

### Hybrid Electric Vehicles

2000: Nissan  
Tino Hybrid



### Electric Vehicles

2000: Nissan  
AltraEV

2000: Nissan  
Hypermini



### Hybrid Commercial Trucks

2005: ISUZU  
ELF HYBRID



2006: Mitsubishi Fuso Truck  
and Bus CANTER Eco Hybrid



2007: Eaton Corporation HEV Trucks



2007: Mitsubishi Fuso Truck  
and Bus AEROSTAR  
Eco Hybrid



● **Bring the latest environmental technologies to the global marketplace**

- Delivered motors and inverters for GM Hybrid cars
- Received large order for lithium-ion batteries (Delivery for 100,000 cars/year from 2010)



Lithium-ion batteries are expected to replace lead acid batteries in large capacity, high energy output applications (such as rolling stock, construction machines etc.)

Revenues (forecast) : 13 billion Yen in 2015

Including battery systems and maintenance services

### ◆ Batteries for Backup Power



Announced on March 4, 2009

- Power Supply System for IT system (Collaboration with NTT Facilities Inc.)
- Flame retardant :Equivalent to UL94-V0
- 10 years life in floating charging condition
- 60% reduction in volume and weight from lead-acid batteries

### ◆ Batteries for Energy Storage



Prototype

Application		Status	Company
Railway	Diesel Hybrid Train	Mass production	Shin-Kobe
	Regenerative Energy Storage System (B-CHOP)	Mass production	Shin-Kobe
Telecom & IT	Backup Power	Development completed	Shin-Kobe

Application		Status	Company
Construction Machinery		Under development	Shin-Kobe
Renewable Energy Generation System (Wind/Solar Power)		Under development	Shin-Kobe

### Build bases for green society using electric and storage technologies



**Batteries**

**Information & Telecommunications**



**-UPS**

UPS: Uninterruptible Power System

**Industrial Systems**



- Rolling Stock
- Forklift truck
- Construction machinery

**Energy Storage**



- Wind & Solar power
- Smart grid

## ○ Hybrid Train

- First commercial hybrid train in the world
- 10% reduction in fuel consumption
- Noise reduction by 30dB  
(The engine stops when the train stops)
- 60% reduction in diesel emission

- \* The hybrid system was developed under collaboration with JR East Japan.
- \* Above figures are compared to conventional diesel train of JR East Japan.



Hybrid train received eco product award in 2007



Battery module



## ○ Nominated the preferred bidder for British Department for Transport for UK “Intercity Express Program”

News release on February 12, 2009

- The total fleet of up to 1,400 coaches is planned to be in service from 2013 by the end of 2018.
- The hybrid system facilitates changes in the traction power source.



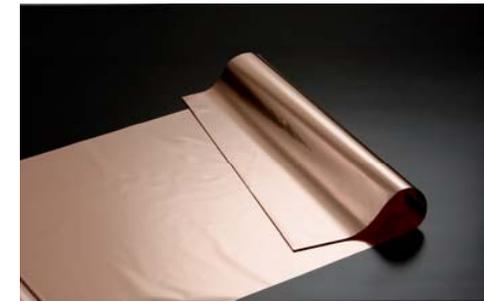
# Materials and Equipments that Support the Battery Manufacturing

## Battery Materials Business

We contribute to achieve high performance and safety at the material level.

### ◆ Carbon anode materials

- Launched sales in 1998
- World's No.1 Market Share
- Artificial Natural Graphite Series



### ◆ Rolled copper foil for electrodes

## Battery Manufacturing Equipment

The technologies for battery manufacturing equipment are possessed within Hitachi Group

### ◆ High-speed Automatic Assembly Cell Impregnation Laser Welding

We have many sales achievement both home and abroad.



### ◆ Roll press line for high accuracy rolling of electrode materials

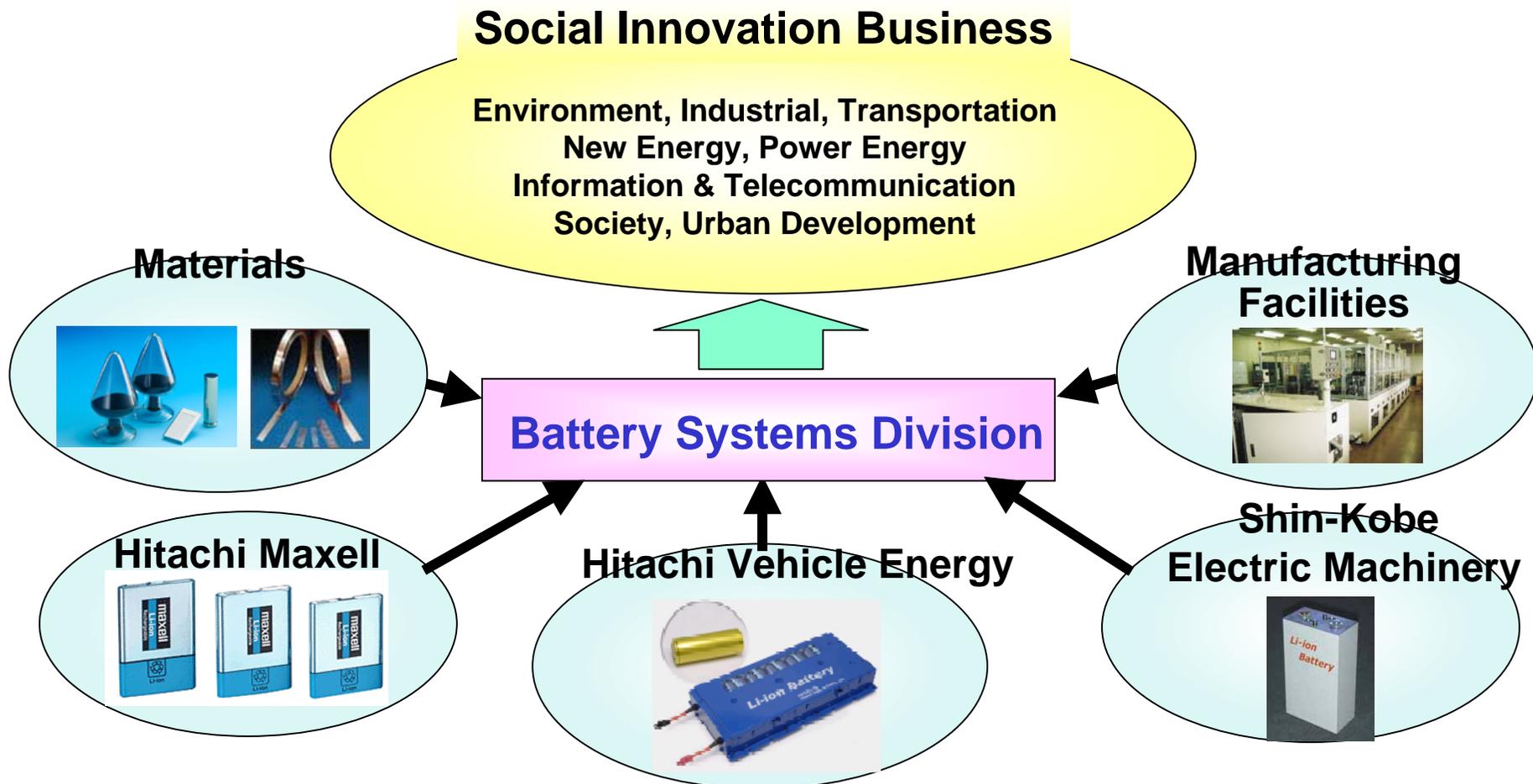




# Summary



- With the collaborative creation within the Hitachi Group, we will challenge the advancement of batteries.
- We will contribute to the creation of the green society, with batteries as a core product.



**HITACHI**  
Inspire the Next