

LG Chem Batteries for Automotive Applications

2010. 11

LG화학

Trend of Li-ion Battery (LIB) Market

The market of LIB is expected to be rapidly expanding from IT based application to Electric Vehicle (EV) and Energy Storage System (ESS).

Application		 	  
Market Scale	**$9.4 bn ⇨ $22.0 bn** (′ 10 yr) (′ 20 yr)	**$2.8 bn ⇨ $30.2 bn** (′ 10 yr) (′ 20 yr)	**$0.2 bn ⇨ $25.7 bn** (′ 10 yr) (′ 20 yr)

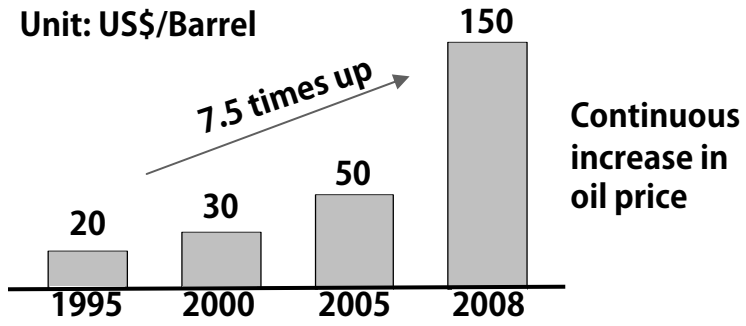
*The 8th Committee of Green Growth Korea (2010.7.13)

LG Chem

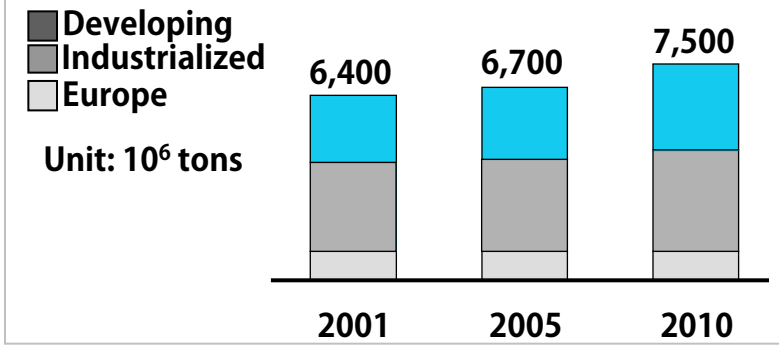
Why Electric Vehicle ?

Up rising of oil price and the needs of eco-friendly clean energy make big growth in electric vehicle market.

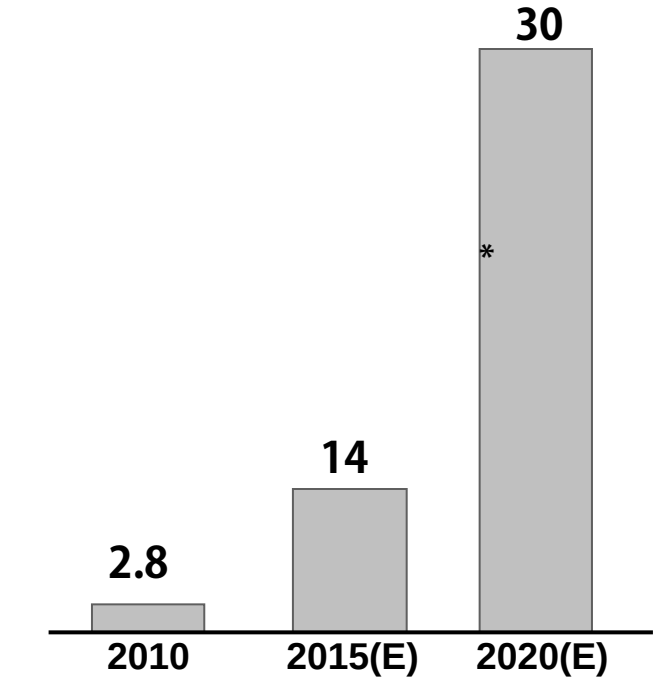
Oil Price[1]



CO_2 gas exhausted[2]



Market of for EV application[3]



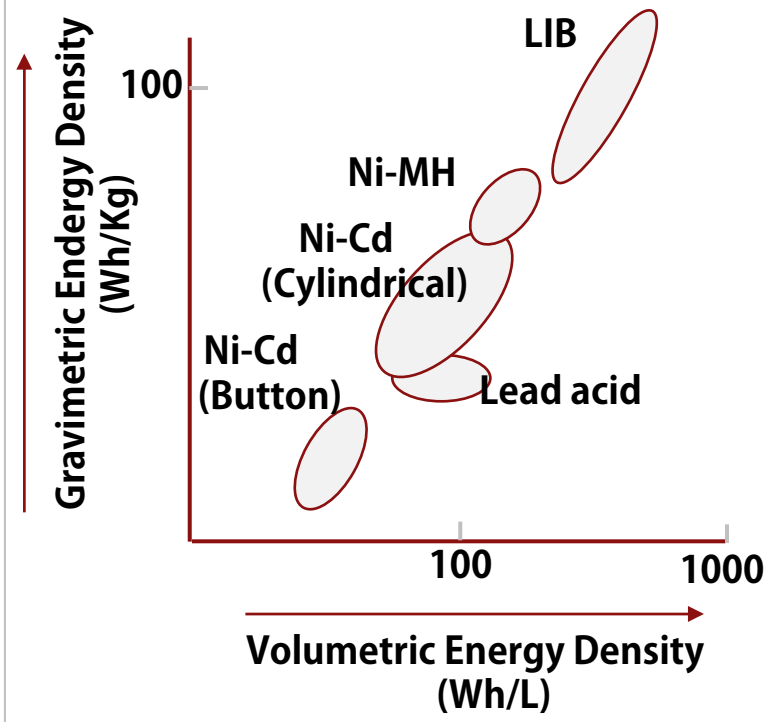
1. NYMEX Crude Oil Price:WTI 2. Energy Information Administration, *International Energy Outlook*, 2003 (Washington, DC)
3. The 8th Committee of Green Growth Korea (2010.7.13)

LG Chem

Lithium Ion Battery (LIB)

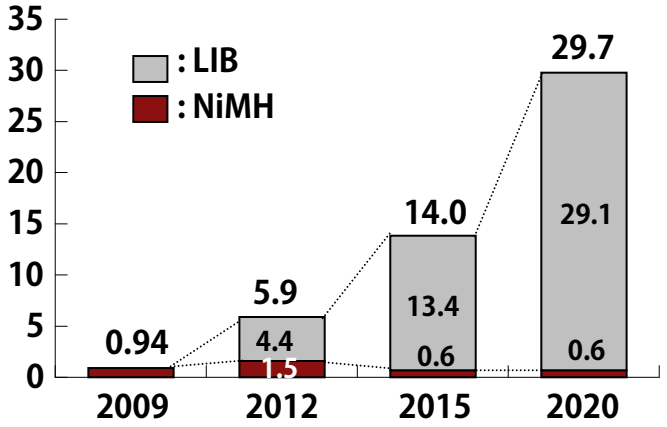
Lighter, smaller, and longer life than other battery …..

Secondary battery and its performance



LIB vs NiMH battery[1]

Unit: US$ bn



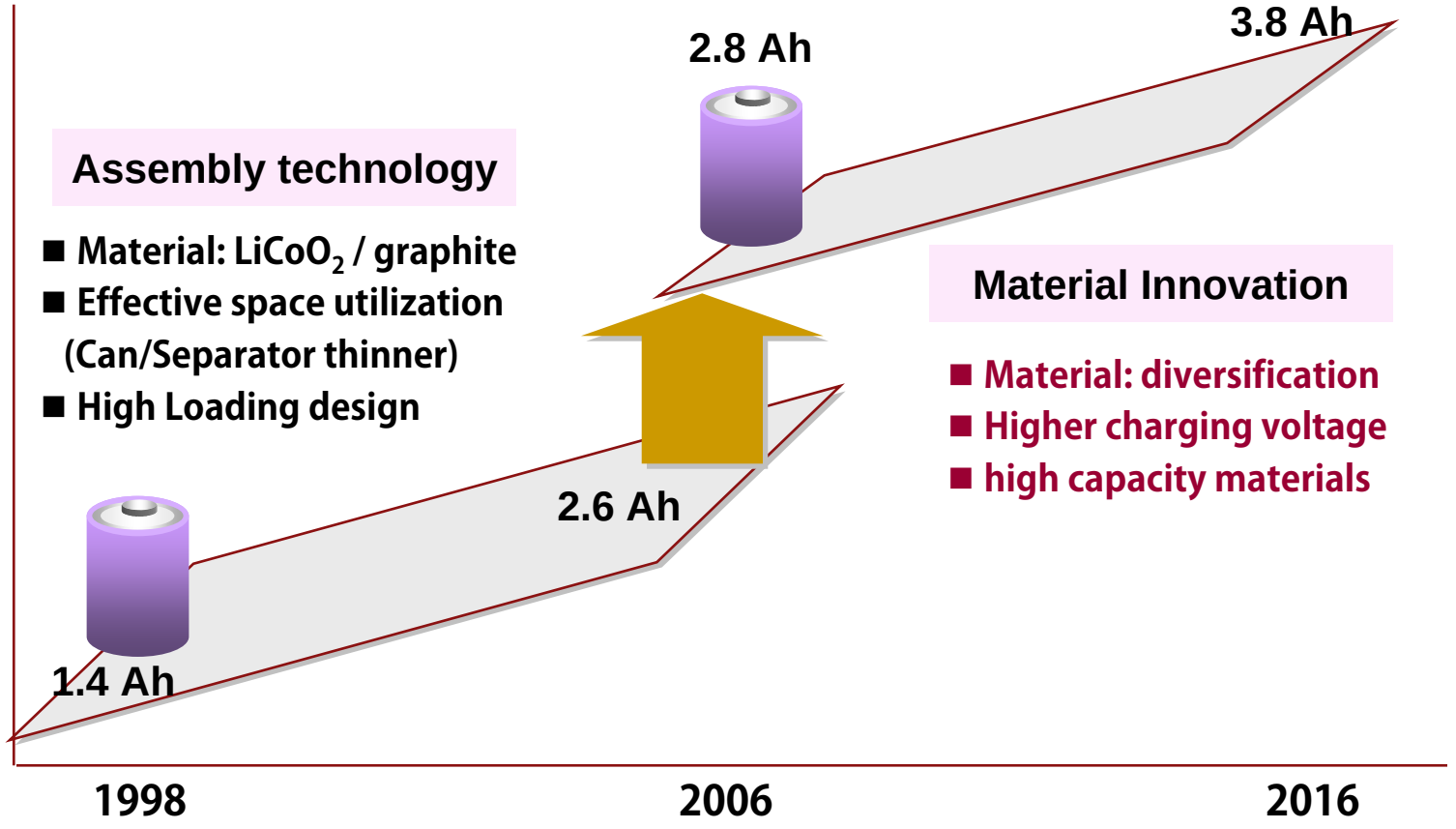
■ High performance of LIB promotes the replacement of NiMH market.

' 09. Q4)

LG Chem

Technology Trend of LIB

The core technology of LIB has been focused on the assembly of cell in early state. But the performance and capacity is improved with the battery material innovation.

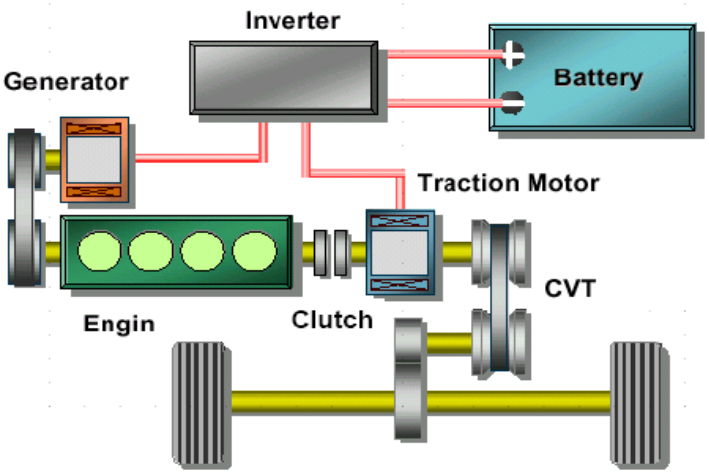


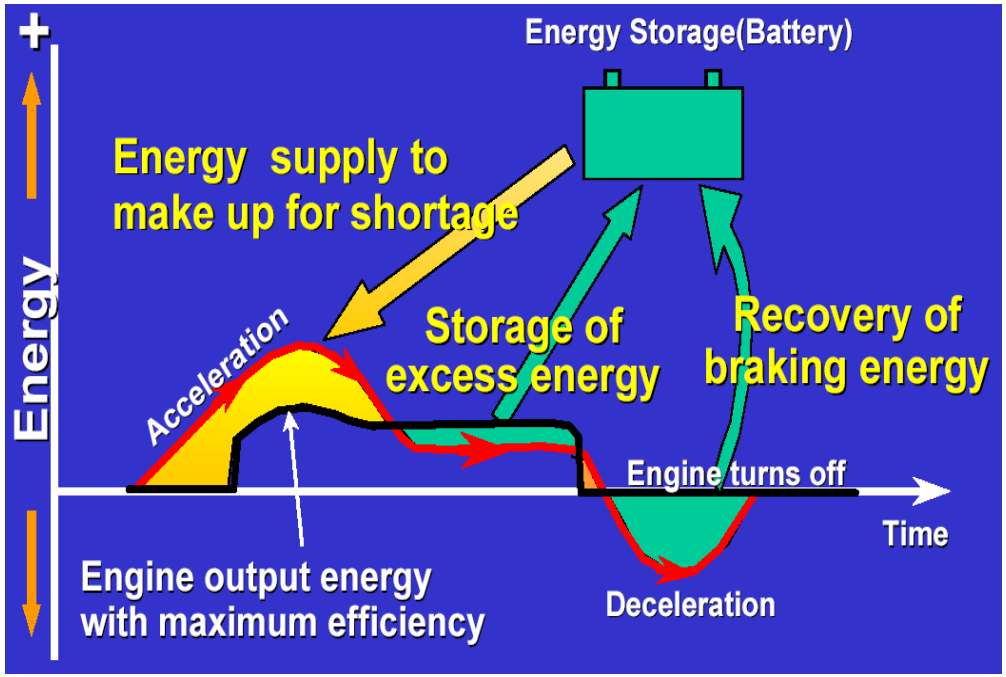
LG Chem

Battery and Electric Vehicle

10 mile driving by motor ➔ PHEV10, 20 mile driving by motor ➔ PHEV20

Schematic showing of Electric vehicle





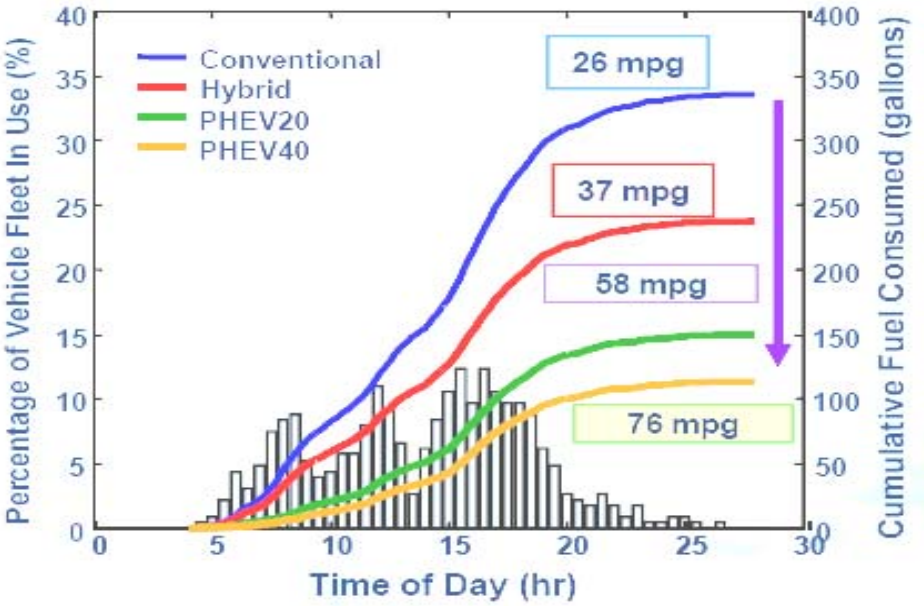
HEV	Engine + Motor driving
PHEV	Motor
FCEV BEV	Motor driving only

LG Chem

Necessity of PHEV

♦ Daily average driving mileage
- More than 50% : Driving under 30km
- PHEV 20 : 50% off in gasoline

♦ Introduction of PHEV
- Highly economical feasibility
- Reduce the dependency of gas



	Average Daily Costs		
	Gas.	Elec.	¢/mile
CV	$5.13	--	11.35
HEV	$3.60	--	9.45
PHEV20	$2.30	$0.48	7.29
PHEV40	$1.75	$0.72	6.48

Tony Market(NREL), Clean Cities Congress and Expo (2006.05)

LG Chem

PHEV Development Program : America

Fundamental Research Project

Funded by Office of electricity Delivery and energy Reliability

Energy Storage for Utility Applications

Battery pack system (Minimum 50% industry cost share)

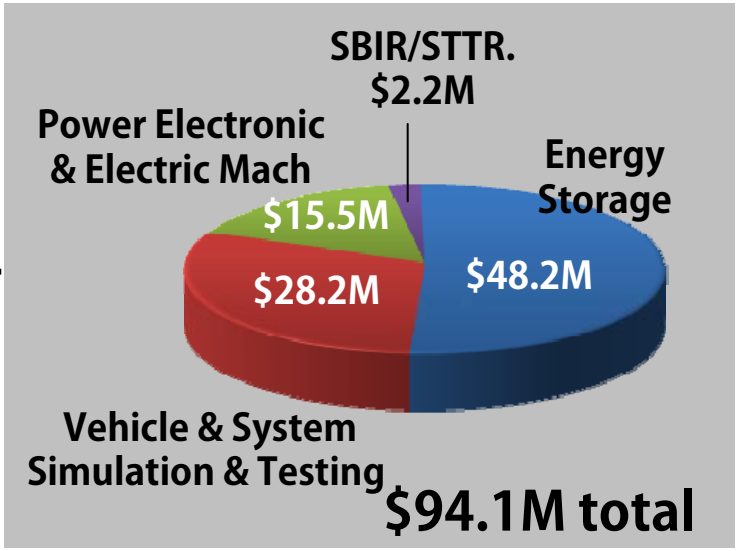
Battery Development (USABC)

Study on cell behavior for higher performance

Applied Research (DOE, National Lab)

New material (Power, energy)

(DOE, National Lab, Univ)

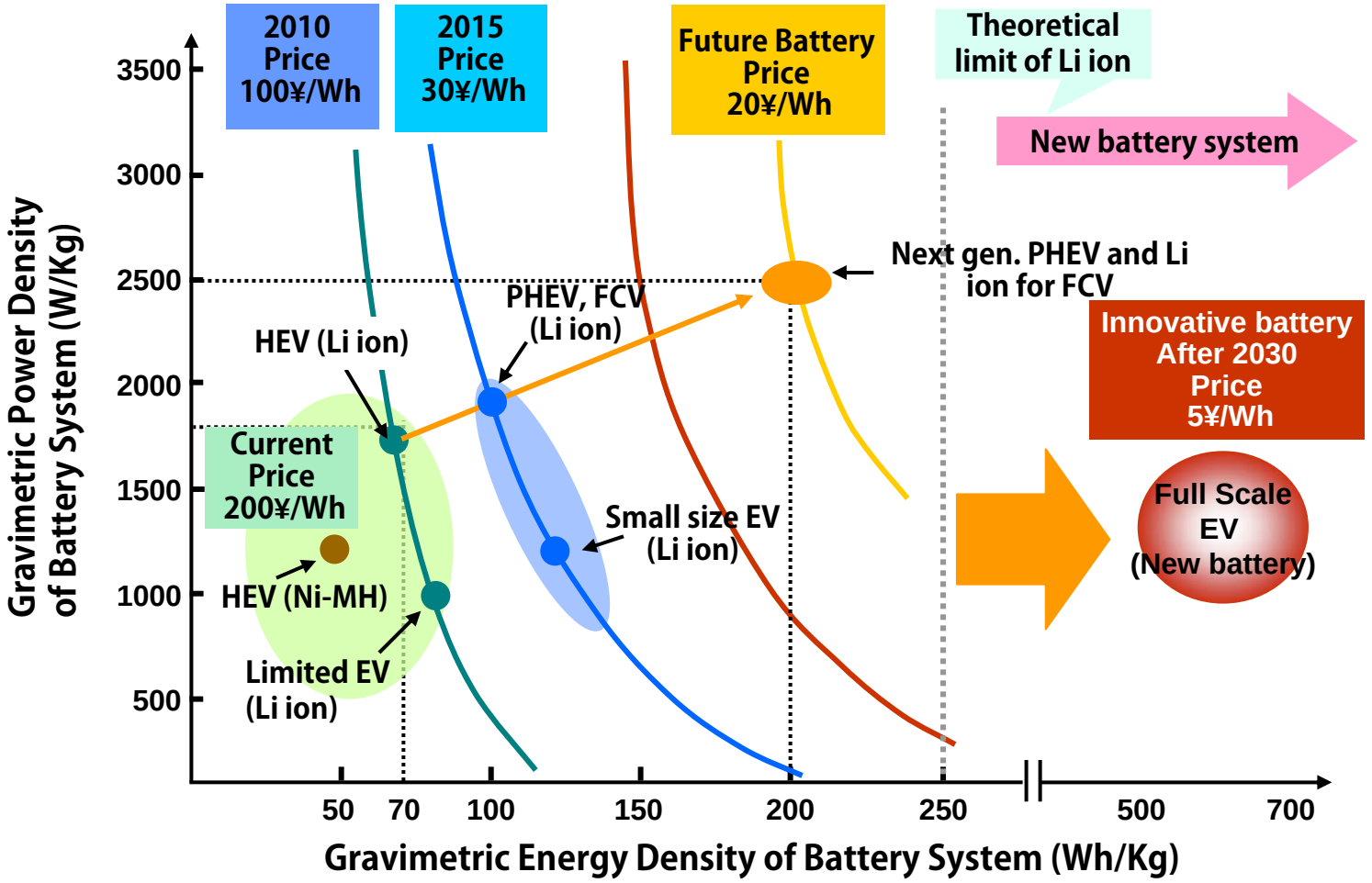


Funded by Vehicle Technologies Programs

Source : IMLB 2008

LG Chem

Japan Battery Program for EV Application



NIKKEI ELECTRONICS 2006. 11. 6

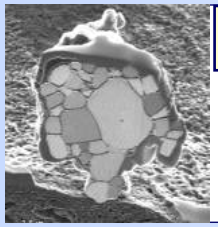
LG Chem

Why LG Chem?

LG Chem is the only one chemical company producing Lithium Ion Battery in the world.

- ✓ Strong chemistry background
  - New materials development
  - Analysis & evaluation of materials
- ✓ More than 10 yrs of mass production experience (Batery for IT application)
- ✓ Synergy within LG group
  - LG Electronics
  - LG Innotek
  - LG V-ENS

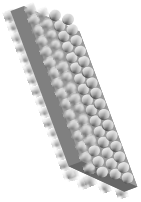
Battery related material developed



Cathode

New composition
New process

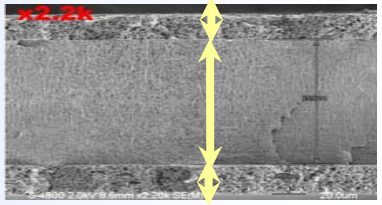
- 3 component (NMC)
  - Mass production since ' 07 yr (350 ton/month)
  - High capacity/stability
- $LiFePO_4$ Olivine material

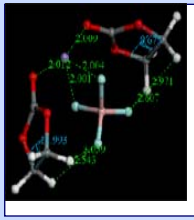


Separator

SRS™
- Safety reinforced separator

- SRS™ : Prevent Internal Short





Electrolyte

In-house prodction

- High voltage
- Functional additives
- Nonflammable electrolyte

LG Chem

Values LG Chem Brings to Customers

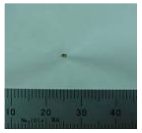
Safety and Cost

- SRS™ Separator: Prevent internal shortage
- Mn-spinel: durability at high temperature
- Laminate Package: excellent thermal performance
- $LiFePO_4$: excellent safety and low cost by new process

Performance

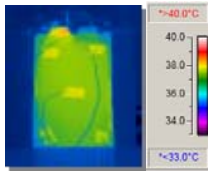
- Product Life : 10 yrs / 150,000 miles
- High Power, High Energy
  ⇒ suitable for Plug-in HEV/EV
- Future materials?

Safety of SRS™

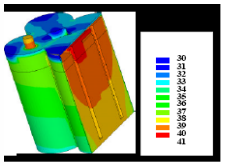
	LGC SRS	PE
Hot Plate test (150 ℃/1hr)		
Hot nail test (450 ℃/10sec)		

Temperature at high discharge

Laminated Package



Cylindrical



LG Chem

EV

CT&T

Ford

VOLVO

GM

(2010. 7. 15, USA)

长安汽车

HYUNDAI

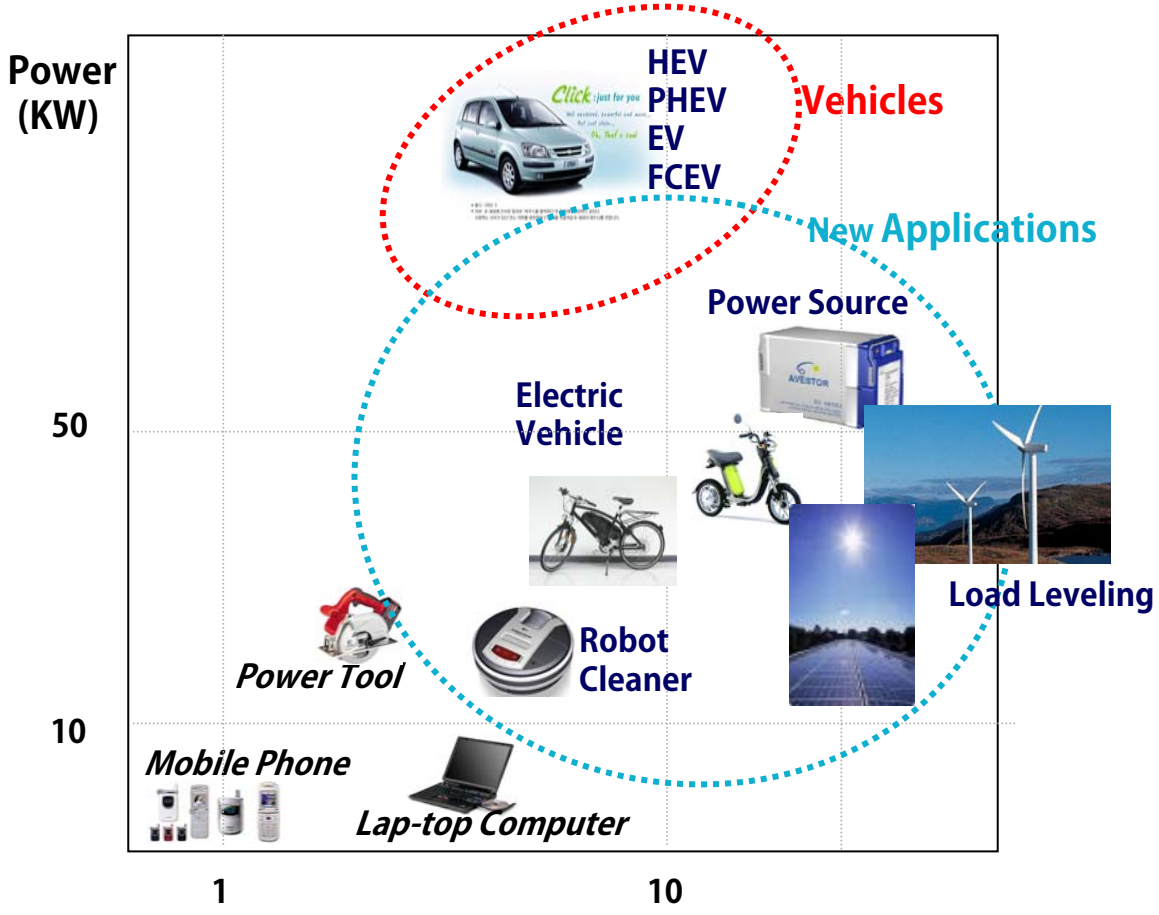
KIA
기아자동차

EATON

AES

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

LG Chem



Clean & Efficient

Energy Storage System

to save

Energy & Environment

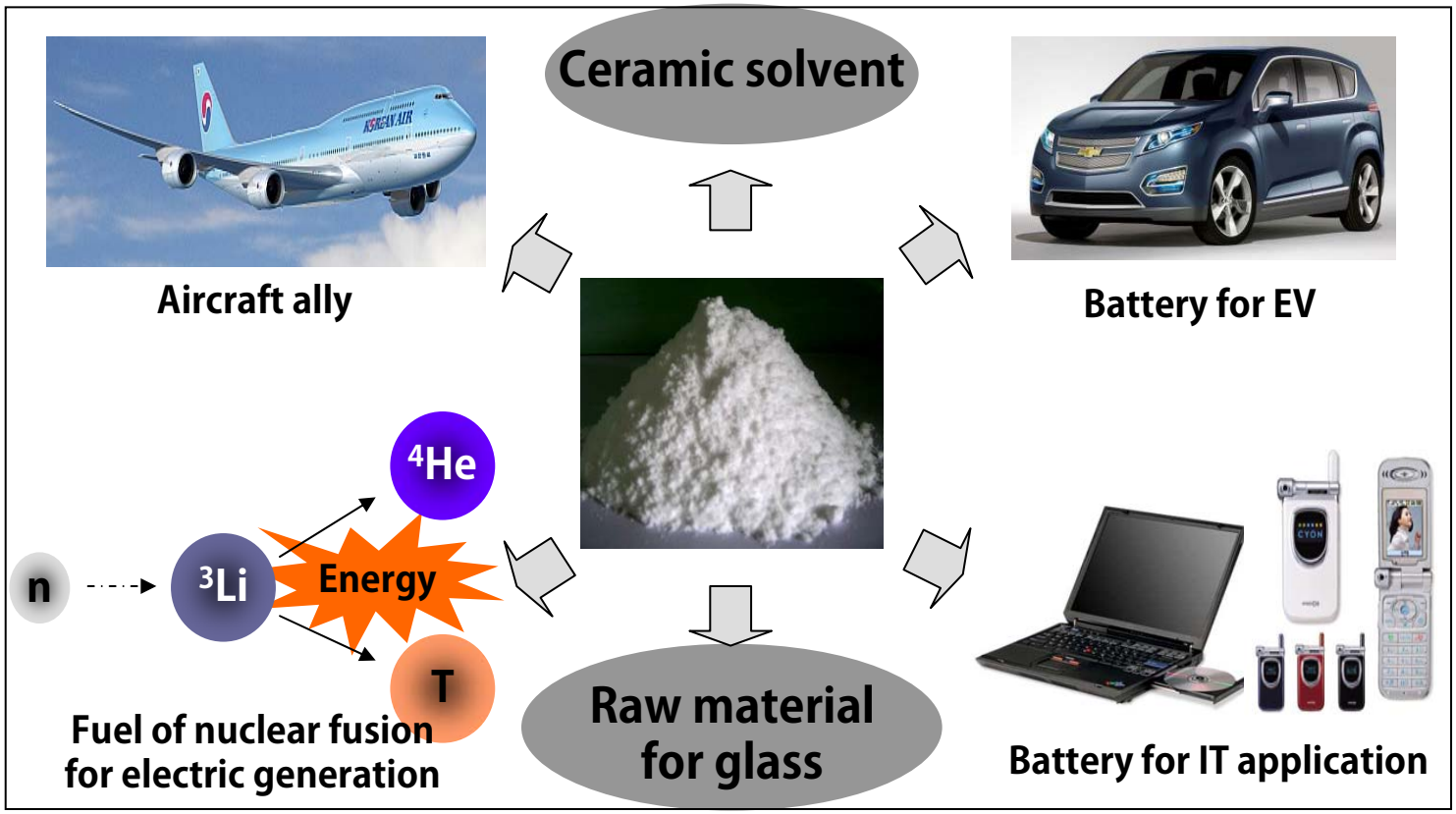
LG Chem

Main Application of Lithium

Properties of Lithium

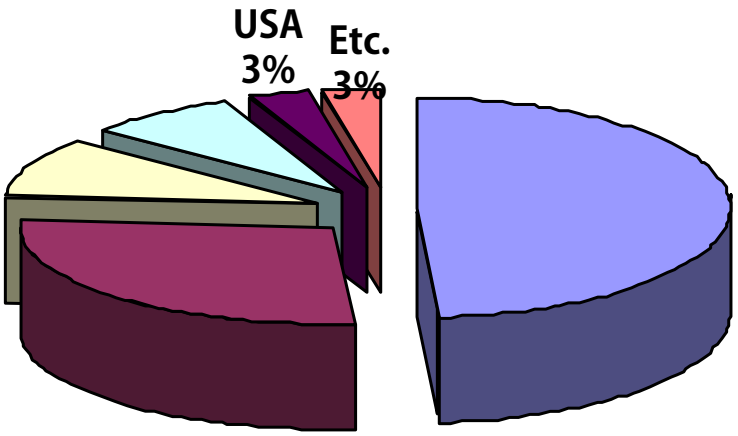
- ❑ Atomic number 3, the lightest element in Alkali metals
- ❑ Density : 0.534g/cm^3 (Half of H_2O)
- ❑ High reactivity but stable lithium oganic or inorganic compound
- ❑ Natural form : Li_2CO_3(contains some impurities)

Major Application

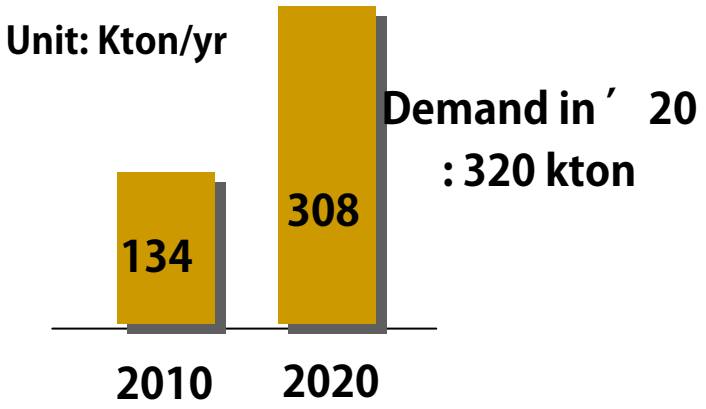


LG Chem

Global deposit of Li



Annual Production of Li_2CO_3

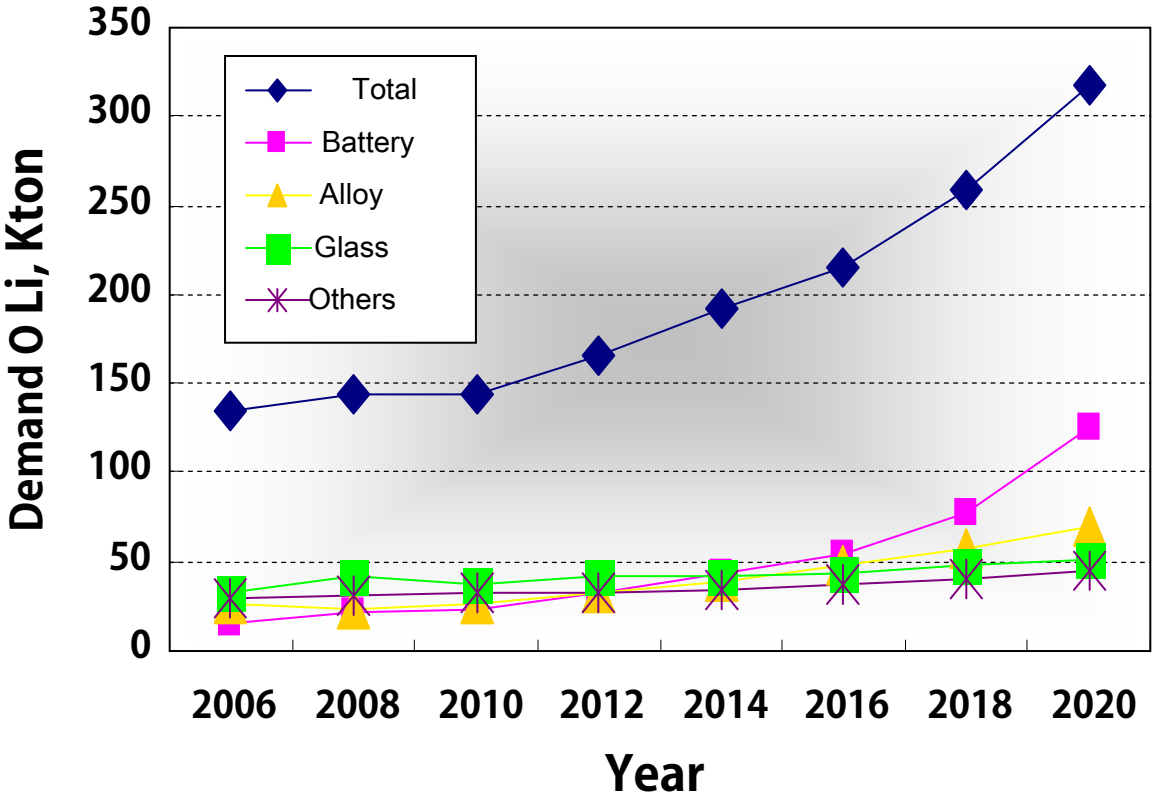


❑ Major supplier of lithium carbonate (Li_2CO_3)
SQM (MS 40%), Chemetall (MS 30%), FMC (MS 20%), China (MS 10%)

LG Chem

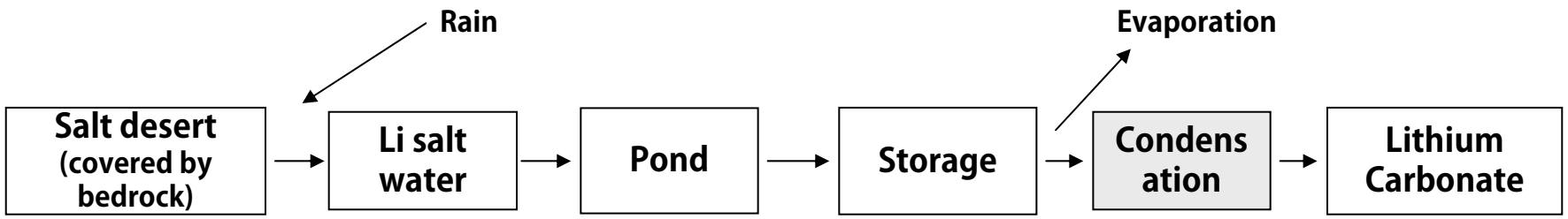
Demand of Lithium Carbonate

Demand will be rapidly increased with the base of battery for IT and electric vehicle application since 2013.



LG Chem

Synthesis Process of Lithium Carbonate



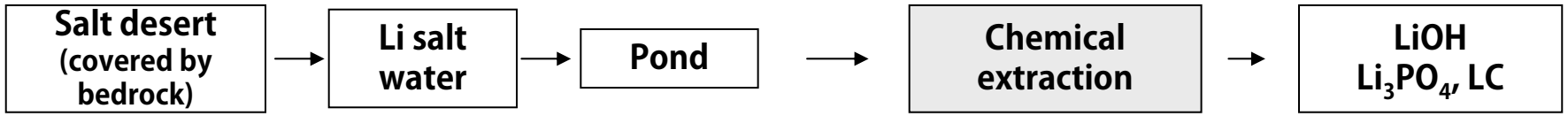
Yield: 25%

Concentration of Li: 0.03~0.1%
Uyuni: 0.005~0.01%
Sea water: 0.17ppm

▪ Size: 4kmx9km

Climate: Dry and high temperature is preferred (Chile)

New Process: Chemical Process



High purity and low cost process

Yield: 86%
High purity: 99.99%

LG Chem

Thank you !