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October 24-26, 2012

Nice, FRANCE

CONTACT

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The worldwide battery market 2011-2025

Christophe PILLOT

Director, AVICENNE ENERGY

Presentation Outline

- The rechargeable battery market in 2011
- The Li-ion battery value chain
- Li-ion battery material market
- Forecasts & conclusions



The worldwide Battery
market 2011-2025

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The International Energy & Power Supply Conference and Exhibition

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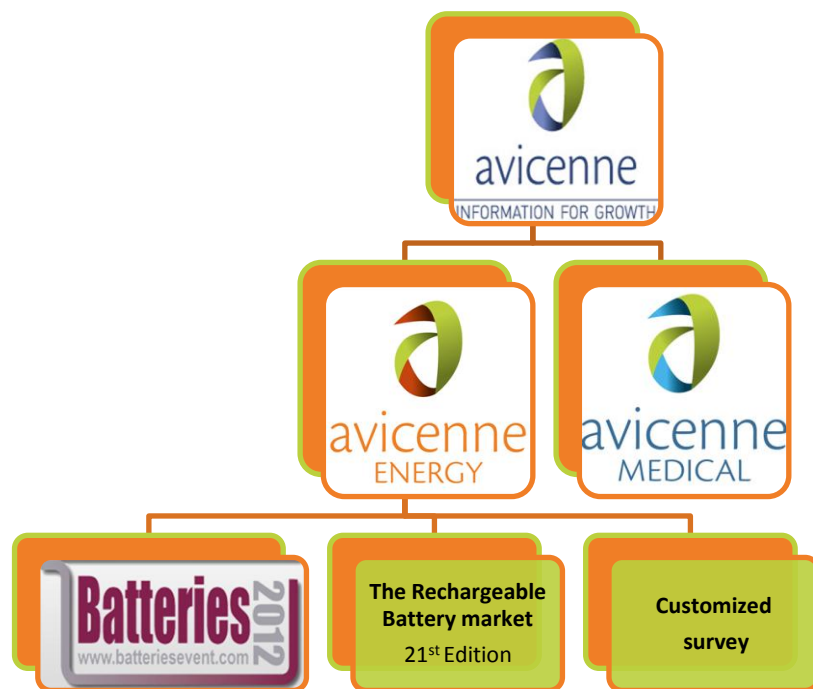
80 SPEAKERS

24 th october		25 th october		26 th october		
Keynotes AVICENNE HP TOYOTA SB LIMOTIVE BAR ILAN UNIV. GTAI J. PETERSEN		Car Makers FORD PSA RENAULT DAIMLER TOSHIBA		Safety SAE CELGARD MIJOBIL A&D	Battery NATUREO FINANCES GS YUASA SAFT LECLANCHE	
		Raw Mat. UMICORE PRAYON BASF CLARIANT TODA KOGYO QINGDAO	Manu- facturing MEGTEC POLYTYPE EIRICH SOVEMA	Safety ETTEPLAN INERIS RECHARGE EUROBAT	Battery BASF-OVONIC POWERGENIX IKERLAN ILZRO-ALABC	
		R&D TOYOTA FRAUNHOFER INST. US DOE R. BRODD IFP CEA SHMUEL DE-LEON SWEL	Portable TI INTEL ST ERICSSON CALL2RECYCLE	Automotive Energy Storage LG CHEM A123 ALTAIRNANO EDF IMTECH		
		Raw Mat. FMC HITACHI ARKEMA JSR ENTEGRIS	Future ROLANDBERGER ELEMENT ENERGY MANZ TUBINGEN BUHLER	 www.batteriesevent.com The International Energy & Power Supply Conference and Exhibition		
		Battery Managmt. CHE EV INTERTEK RWTH AACHEN HEL LITHIUM BALANCE				

AVICENNE PROFILE

Information for Growth - Powering your company's market strategy
with in-depth research

- Creation: 1992
- Headquarter: Paris
- Liaison Office: Japan, USA
- AVICENNE Energy Director:
Christophe Pillot
- 4 consultants in Paris



METHODOLOGY: EXTENSIVE FIELD RESEARCH TO RETRIEVE & CROSS CHECK INFORMATION

Top management contacts network > 17 000 contacts



Conferences & Exhibitions



2nd Int'l Rechargeable Battery Expo
BATTERY JAPAN



In Depth analysis Of applications



Cross Check Analysis





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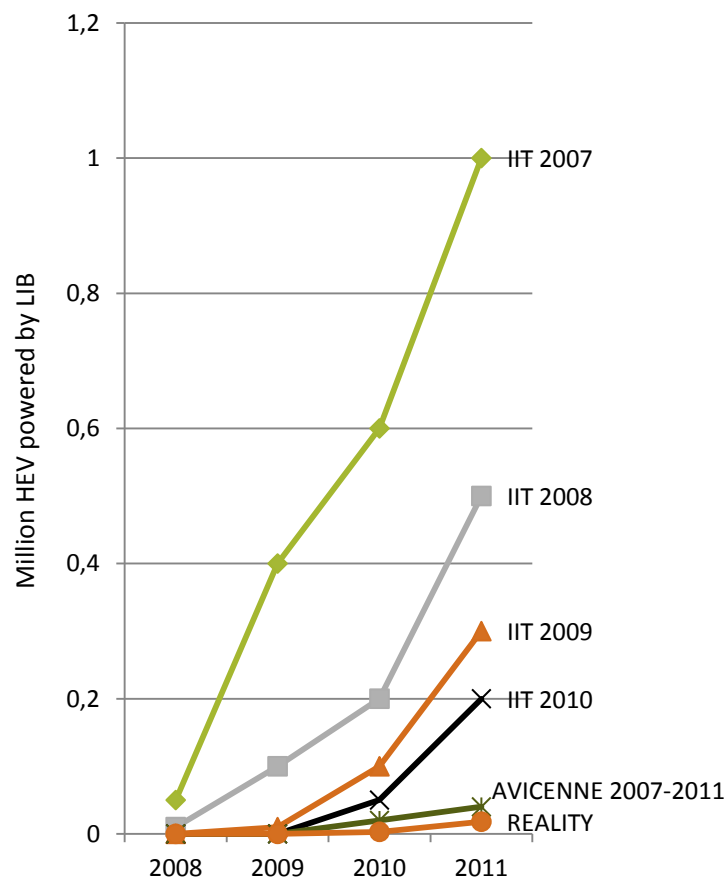
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MORE THAN 180 REFERENCES WORLDWIDE

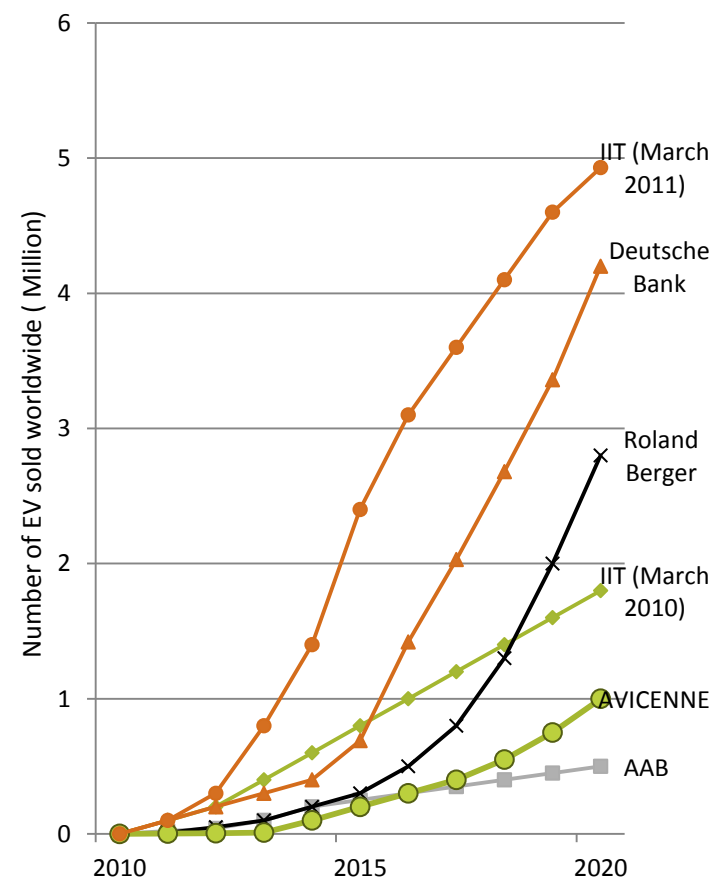
✦ A123	✦ DIALOG SEMICONDUCTOR	✦ JBC	✦ SAGENTIA
✦ AIR LIQUIDE	✦ DOW CHEMICAL	✦ JETRO	✦ SAINT GOBAIN
✦ AIR PRODUCT	✦ DOW CORNING	✦ JOHNSON CONTROLS	✦ SAKTI
✦ AHLSTROM	✦ DUPONT	✦ KODAK	✦ SAMSUNG SDI
✦ ALCATEL	✦ DURACELL	✦ KRUGER	✦ SANIK
✦ AMPEREX (ATL)	✦ EDF	✦ LAZARD	✦ SCHRODER VENTURE
✦ APPLIED MATERIALS	✦ ELECTRO ENERGY	✦ LECLANCHÉ	✦ SCOTENT ENTREPRISE
✦ AROS SECURITIES	✦ ENER 1	✦ LEGRAND	✦ SFPZ
✦ ARC	✦ ENERGIZER	✦ LG CHEMICAL	✦ SHENZHEN HIGH POWER TECHNOLOGY
✦ ASHLAND	✦ EOLITE	✦ LION CELLS	✦ SCHOTT AG
✦ ATOFINA - ARKEMA	✦ EPCOS OHG	✦ LITTLE FUSE	✦ SKC
✦ AT KEARNEY	✦ ERAMET	✦ LILIPUCIAN	✦ SVE - DASSAULT
✦ AXEON	✦ ETC AB	✦ LYNAS CORP	✦ SOLVAY
✦ BAIN	✦ FACOM	✦ MATSUSHITA	✦ SONY
✦ BASF	✦ FALCON BRIDGE	✦ MICROSOFT	✦ STIBAT
✦ BATTERY R&D ASSOCIATION OF KOREA	✦ FAIRSHILD SEMICONDUCTOR	✦ MTI MICRO FUEL CELLS	✦ STORCK
✦ B&D	✦ FAMEART	✦ MOLTECH	✦ STRATEGY ANALYSIS
✦ BHP BILLITON	✦ FIST	✦ MOLYCORP	✦ TERRAROSSA CAPITAL
✦ BRAND LICENCING PARTNERS (BLP)	✦ FLORIDIENNE DE CHIMIE	✦ MOMENTIVE	✦ TIGER GLOBAL
✦ BOURNS	✦ FMC	✦ MOTOROLA	✦ TODA KOGYO
✦ BOSCH	✦ FORTU POWER CELL	✦ MUNSTER UNIVERSITY	✦ TOTAL
✦ BUHLER GMBH	✦ FRANCE TELECOM	✦ NANOCYL	✦ TOTAL WIRELESS SOLUTION
✦ BYD	✦ FULTON INNOVATION	✦ NCCP - RUSSIA	✦ TOYO
✦ CAP X	✦ GAIA	✦ NITECH	✦ TOYOTA
✦ CATELLA	✦ GIL IMPORT BATTERIES LTD.	✦ NKKPC	✦ TYCO
✦ CARBONE LORRAINE	✦ GS MELCOTEC	✦ NORILSK NICKEL	✦ UMICORE
✦ CARLYLE	✦ HC STARCK (BAYER)	✦ NOVALED	✦ UNIROSS
✦ CATELLA	✦ HILTI	✦ NTK POWERDEX	✦ URALEMENT
✦ CATERPILLAR INC.	✦ HITACHI MAXELL	✦ OMG INC	✦ US NAVY
✦ CDN COBALT	✦ HOLLINGSWORTH & VOSE CIE	✦ PANASONIC	✦ VARTA
✦ CEA/LITEN	✦ HONEYWELL	✦ PHILIPS	✦ VOLTRACK
✦ CELGARD	✦ HPL (HIGH POWER LITHIUM)	✦ PHOTON	✦ WARBURGPINCUS
✦ CHEMETALL	✦ HUTCHINSON	✦ PK & WISE	✦ WORLD INDUSTRIAL INFORMATION CENTER
✦ CHEMISHE FABRIK BUDENHEIM	✦ IER	✦ POWER GENIX	✦ WR GRACE & CIE
✦ CIBA	✦ IGL EXPORT.	✦ PRAYON	✦ YASLAMEN
✦ CIAPS CHINA	✦ INTERNATIONAL COMPONENT CORP.	✦ PRISMARK	✦ ZEBRA
✦ COGEMA	✦ INTERNATIONAL RECTIFIER	✦ PSA	✦ ZPOWER
✦ CONOCO PHILIPS	✦ INTEK	✦ RAYOVAC	
✦ CRU GROUP	✦ INTEL	✦ RECHARGE	
✦ CSC CHALLENGE STRATEGY CHANGE	✦ INTERSIL	✦ RENAULT	
✦ DCN	✦ INCO	✦ RHODIA	
✦ DELTA	✦ ITRI	✦ ROLAND BERGER	
✦ DGA	✦ ITS	✦ SAFT	

AVICENNE ENERGY: RENOWNED TO HAVE REALISTIC FORECASTS

HEV powered by Lithium ion battery
forecasts from 2008 to 2011



EV sold, in million units, worldwide,
2010 - 2020



Source : International Battery Conference, Fort Lauderdale 2007, 2008, 2009, 2010 & 2011

The worldwide Battery
market 2011-2025

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OUTLINE

➤ THE RECHARGEABLE BATTERY MARKET IN 2011/2012

➤ LIB VALUE CHAIN

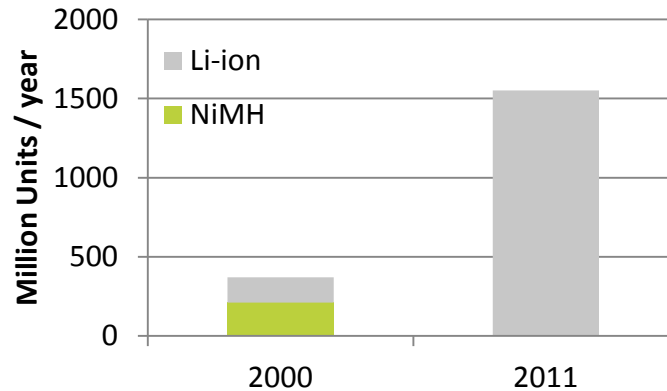
➤ LIB RAW MATERIAL MARKET

➤ 2020 & 2025 FORECASTS

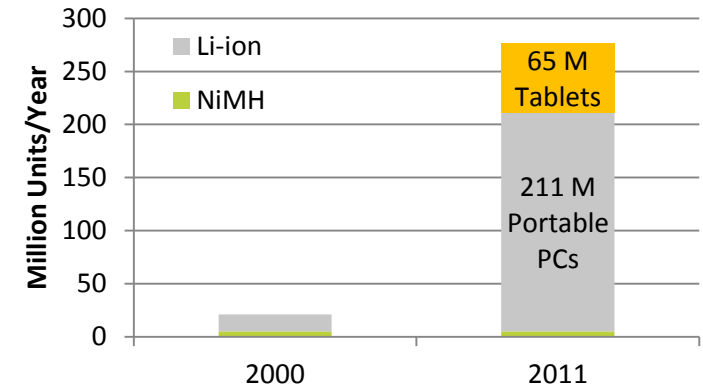
➤ CONCLUSIONS

THE BATTERY MARKET IS REALLY DYNAMIC

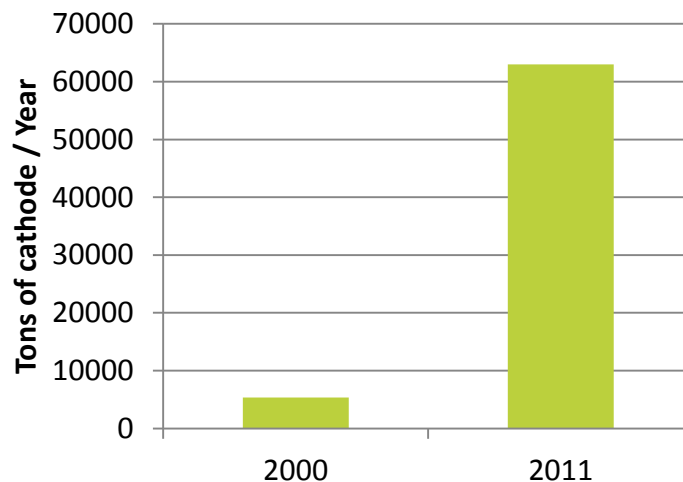
Cellular Phones sold per Year (Million)



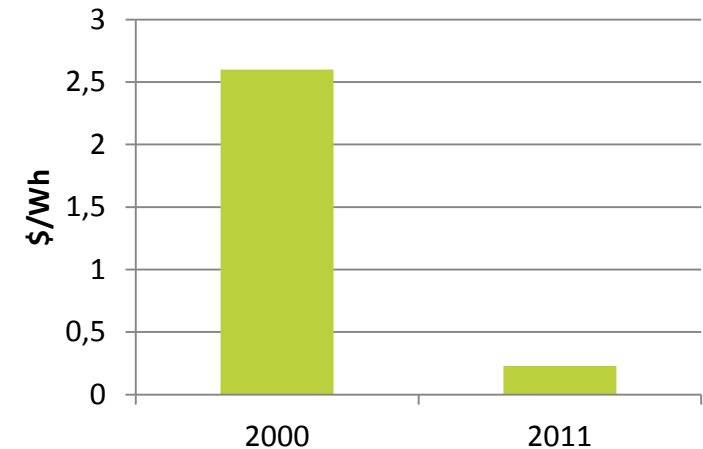
Portable PC sold per Year (Million)



Tons of Li-ion Cathode per year

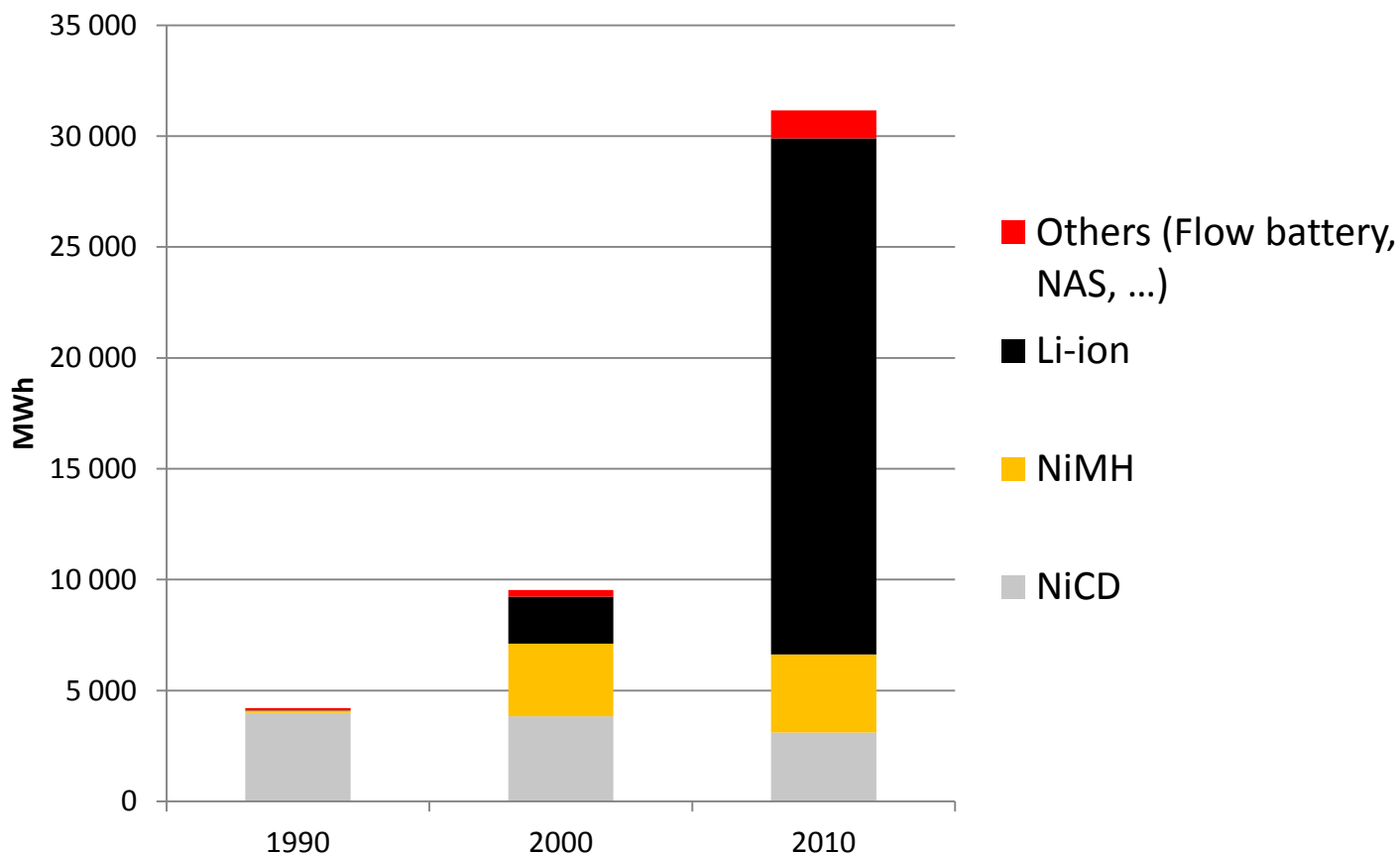


Li-ion 18650 cell price (\$/Wh)



THE WORLDWIDE BATTERY MARKET 1990-2010

Lithium Ion Battery: Highest growth & major part of the investments





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LI-ION IN 2011

MAIN APPLICATIONS: CELLULAR, NOTEBOOK

>4 200 M cells – 28 000 MWh
9 700 M\$

CAGR 2006/2011
+21% per year in Volume
+13% per year in value

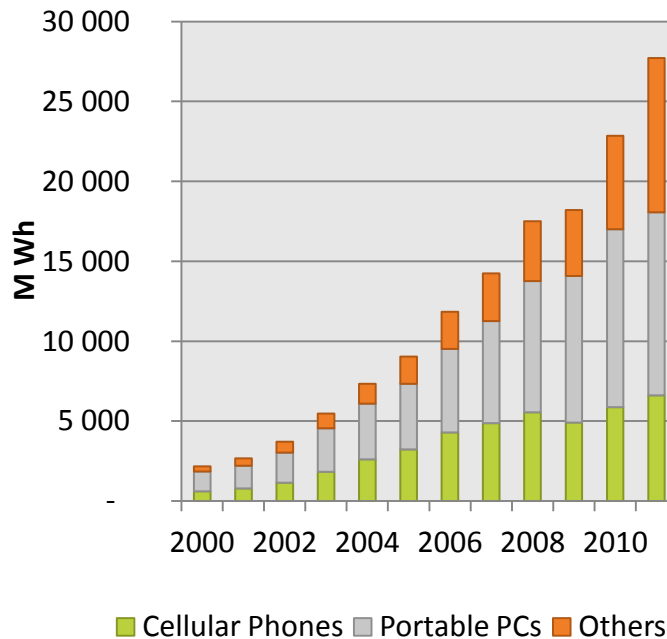
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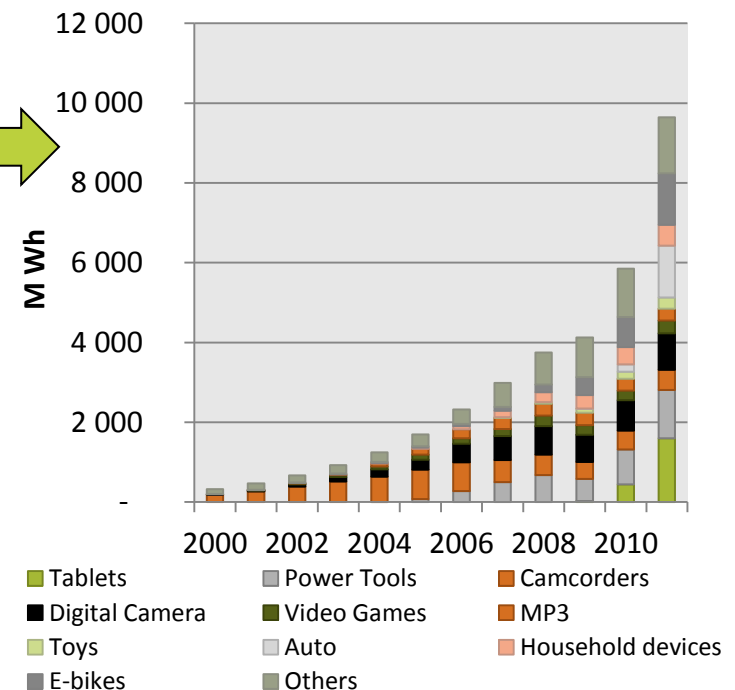
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Li-ion Battery sales,
MWh, Worldwide, 2000-2011



Li-ion Battery sales,
MWh, Worldwide, 2000-2011





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LI-ION IN 2011

MAIN APPLICATIONS: CELLULAR, NOTEBOOK

> 4 200M cells – 28 000 MWh
9 700 M\$

CAGR 2006/2011
+21% per year in Volume
+13% per year in value

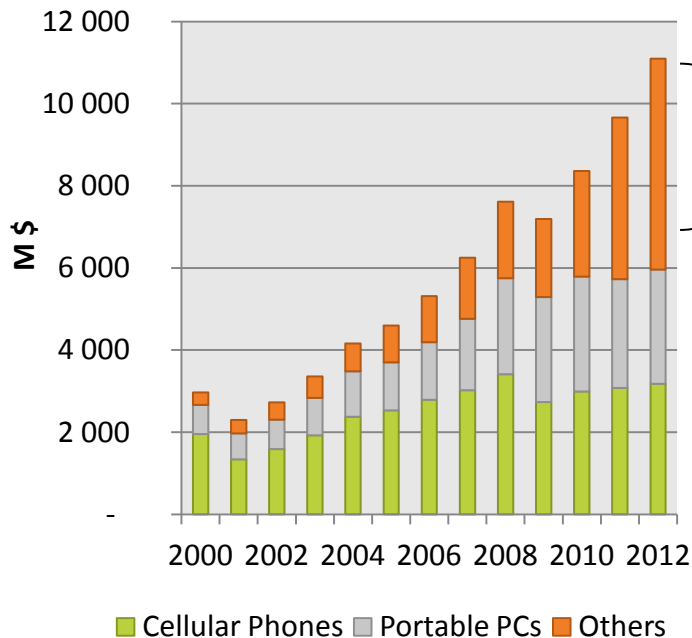
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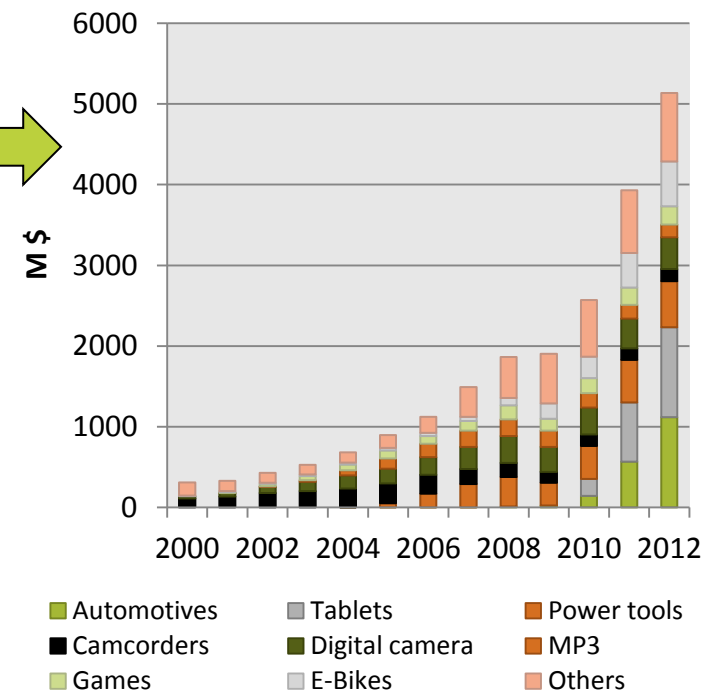
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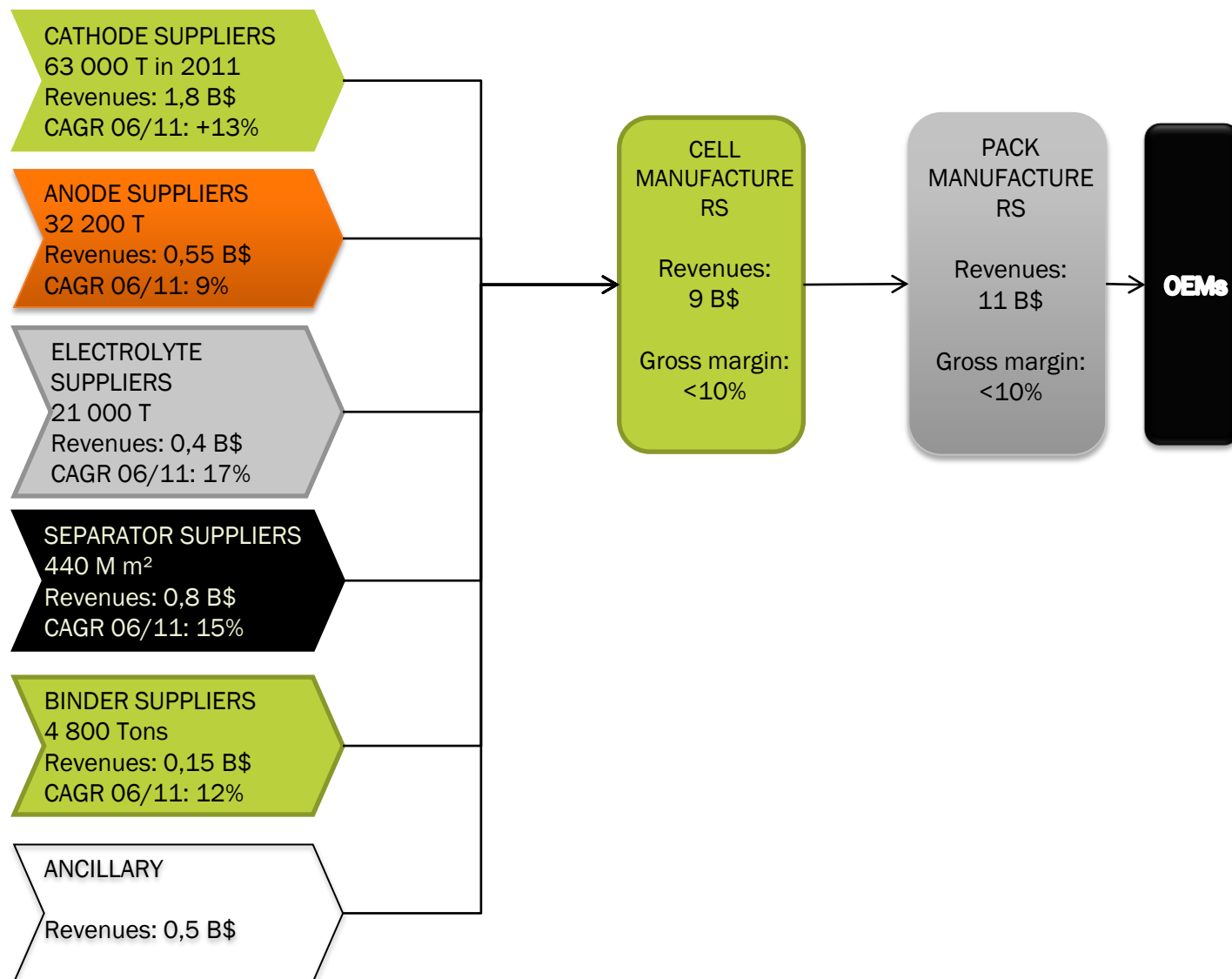
Li-ion Battery sales,
M\$, Worldwide, 2000-2011



Li-ion Battery sales,
M\$, Worldwide, 2000-2011

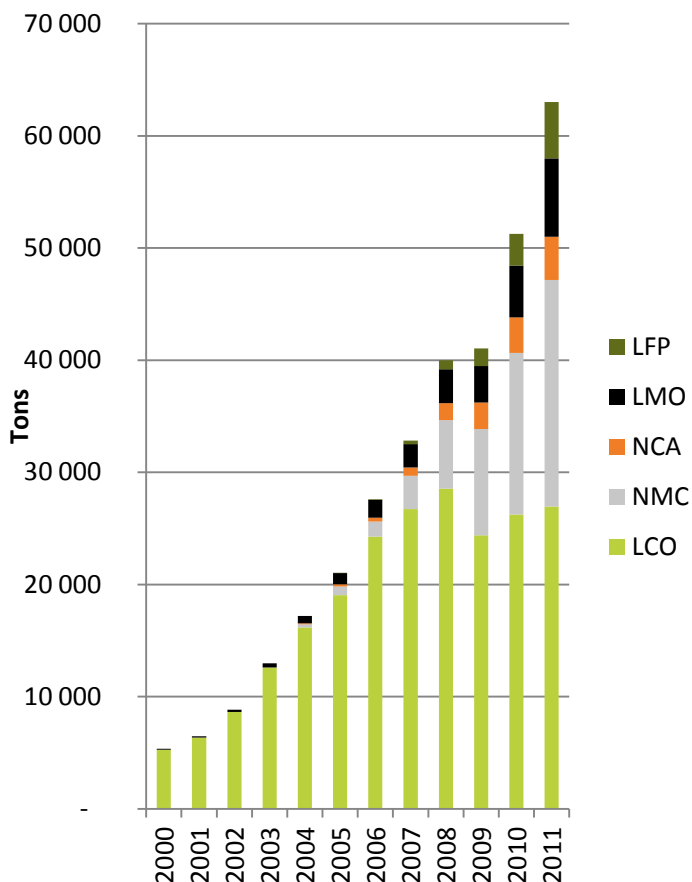


LI-ION VALUE CHAIN

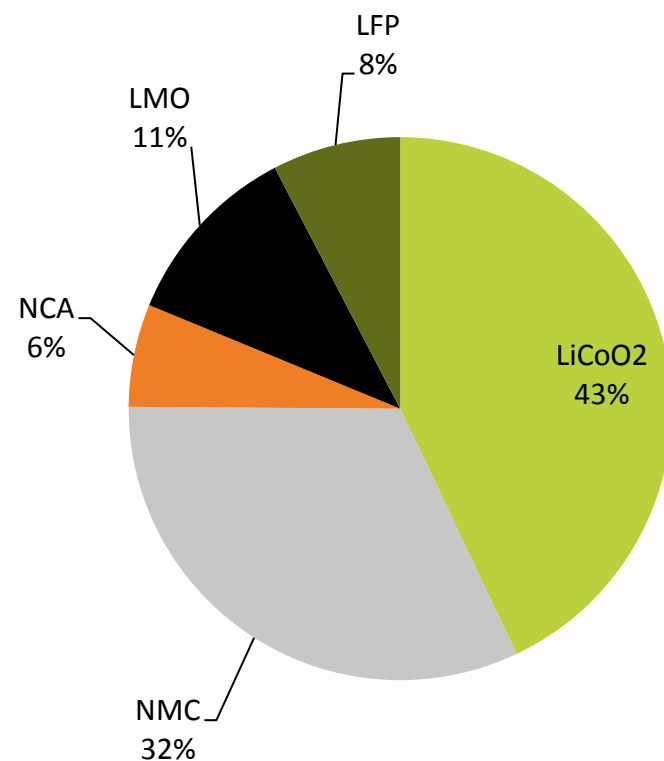


CATHODE ACTIVE MATERIALS NEEDS BY CHEMISTRY

Cathode active materials for LIB
in Tons, 2000-2011

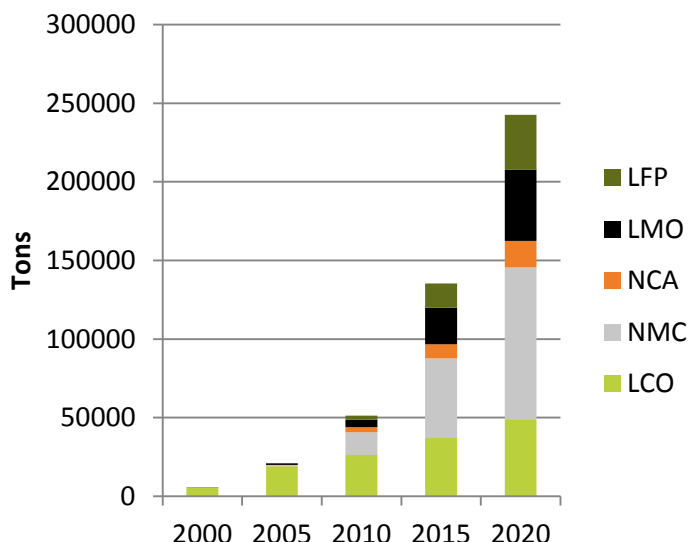


Cathode active materials for LIB,
% of volume, 2011



CATHODE ACTIVE MATERIAL FORECASTS 2000-2020

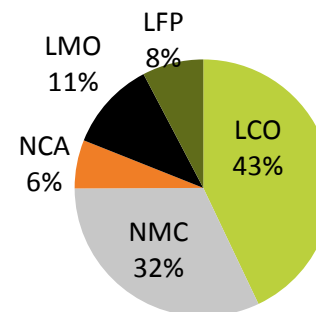
Cathode active materials 2000-2020 - Tons



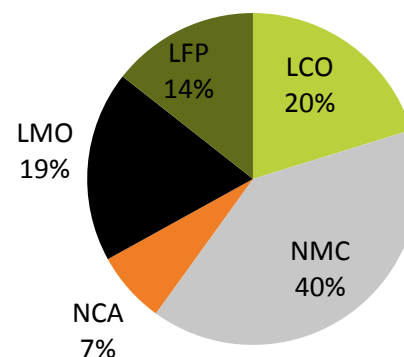
ASSUMPTIONS:

- 🔋 Portable devices:
2010-2020: +11% per year in volume
- 🔋 HEV
3,7 M HEV/year in 2020
35% LIB
- 🔋 P-HEV
0,4 M P-HEV/year in 2020
100% LIB
- 🔋 EV
1M EV/year in 2020
100% LIB

Cathode active materials in 2011: 63 000 Tons



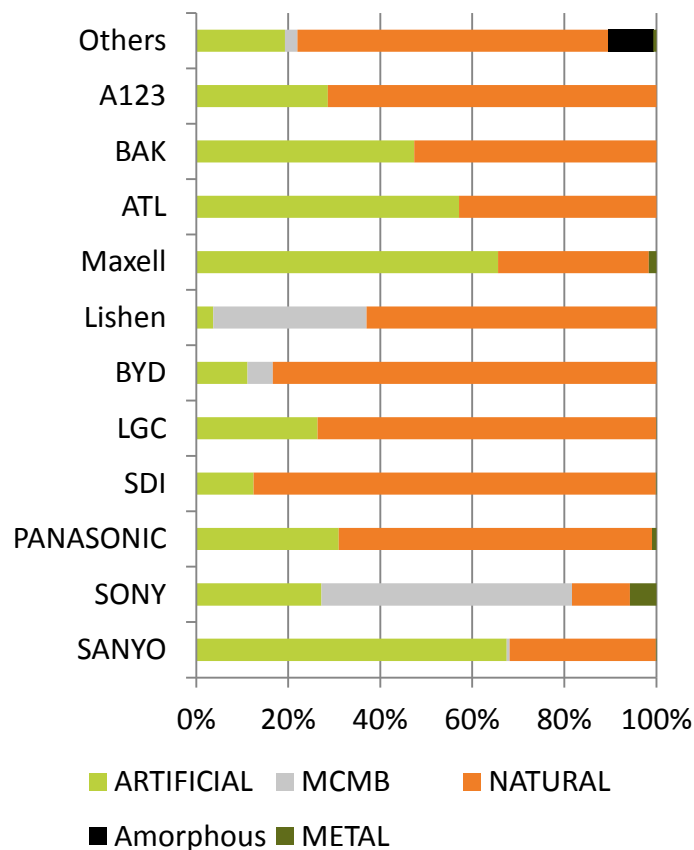
Cathode active materials in 2020: 250 000 Tons



ANODE FOR LIB IN 2011

Natural graphite is more & more used

The worldwide Battery market 2011-2025



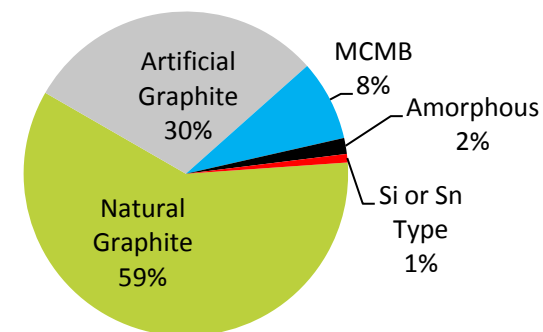
Note:

MCMB: Mesocarbon Microbeads

Material	Energy	Life	Power	Safety	Cost
Artificial Graphite	++	+	0	+	0
Natural Graphite *	++	0	0	0	++
Meso Phase Artificial Graphite	0	++	++	++	0
Hard Carbon	0	++	++	++	0
Soft Carbon	0	+	++	++	+

Source: Hitachi Chemical

Carbon for LIB anodes by type (2011)



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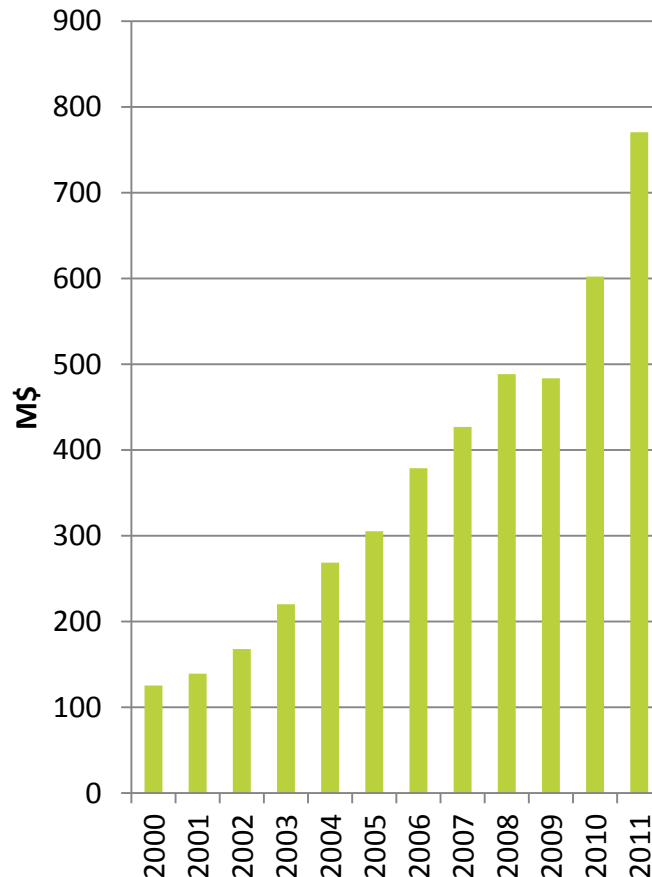
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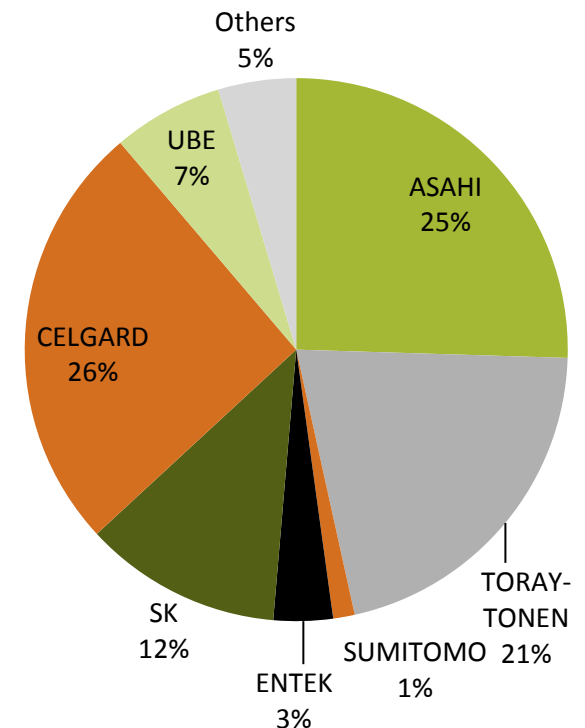
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LIB SEPARATOR MARKET 2011

LIB separator market, M\$,
CAGR 2001/2011: +19%



LIB Separator supplier, market
share in 2011

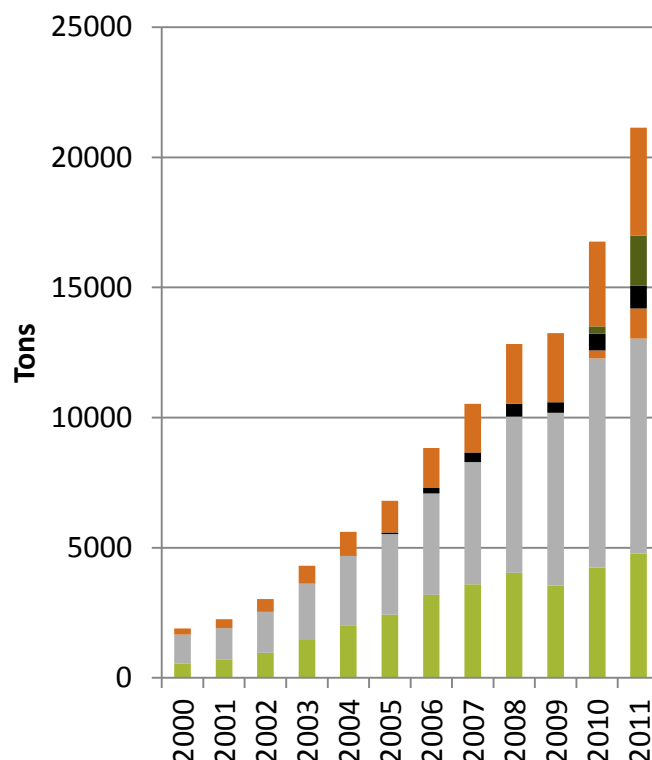


Others: TDK/Nitto Denko, Foshan Jinhui Hi-Tech, Shenzhen Senior Technology Material, Xinxiang Green next Energy, Dupont,...

ELECTROLYTE SUPPLIERS/CUSTOMERS

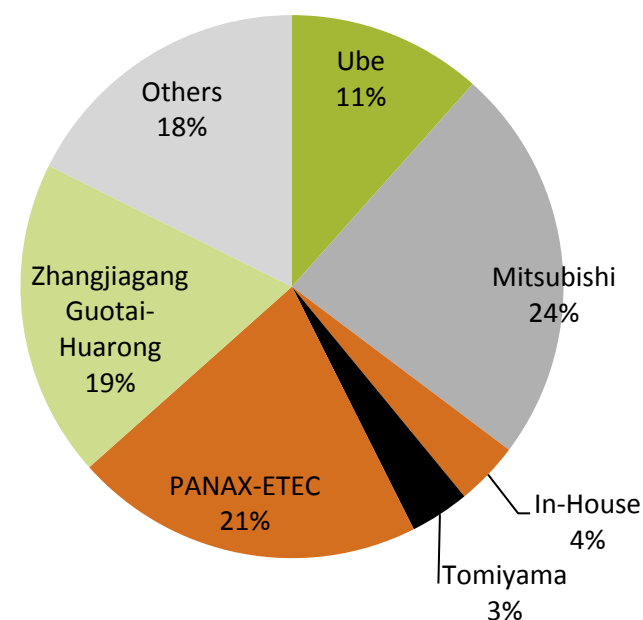
21 200 TONS IN 2011

LIB electrolyte market, Tons,
CAGR 2001/2011: +19%



■ Cellular ■ Portable PC ■ Tablets
 ■ Power tools ■ Auto ■ Others

LIB electrolyte supplier, market share in 2011



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TIME TO MARKET FOR NEW MATERIALS IN LIB INDUSTRY



The worldwide Battery
market 2011-2025

- The research and development in this industry is very long and time consuming.
- Time to market to commercialize a new material is long. Remember that the first Li-ion battery was launch by Sony in 1991 with LCO cathode, graphite, LiPF6 electrolyte & polyolefin membrane. It was 20 years ago.
- LTO was invented by Matsushita in 1993 (19 years ago)
- Lithium iron phosphate was invented in 1995 (15 years ago).
- So, it take between 10 & 20 years to commercialized a new material in the battery industry.

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BATTERY MARKET FORECASTS 2011-2025

Applications covered

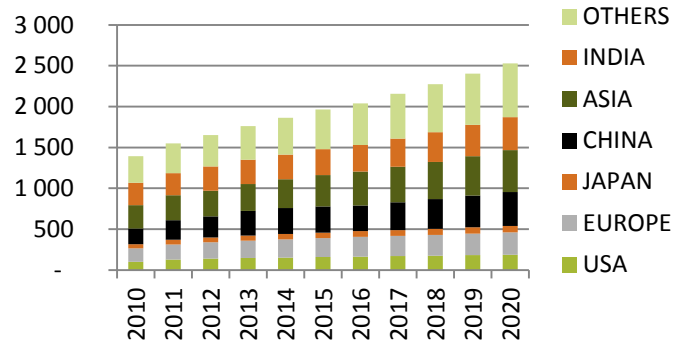
- 🔋 Portable PCs, net-book
- 🔋 Cellular Phones, Smartphones
- 🔋 Tablets
- 🔋 Camcorders
- 🔋 Cordless Tools, Gardening tools
- 🔋 Digital Camera
- 🔋 Games, MP3
- 🔋 Cordless Phones
- 🔋 Shavers, Toothbrush,
- 🔋 RC Cars
- 🔋 E-bikes
- 🔋 Security lighting
- 🔋 Vehicles: HEV, P-HEV, EV
- 🔋 Energy Storage
- 🔋 Others

Parameters analysis

- 🔋 Main segment trends
- 🔋 Power need trends (volume, weight, capacity, running time)
- 🔋 Penetration rate for each Chemistry, each form factor
- 🔋 2011 -2020 Forecasts
- 🔋 OEM strategies and positions
- 🔋 Main drivers & limiters

PORTABLE ELECTRONIC DEVICE FORECASTS 2011-2020

Cellular phone demand (M Units)
CAGR 2010-2020: +6%



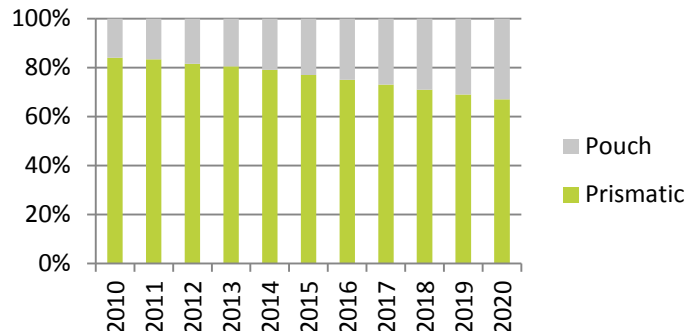
Cellular Phone market Drivers

- Emergent market
- Renewal ratio increase
- Smartphone penetration increase



LIB cells demand 2010-2020

Polymer penetration: 16% -> 33%



LIB cells for cellular phone trends

- Pouch cell ratio increase
- Increase of Thickness
- Increase of >1400 mAh capacity

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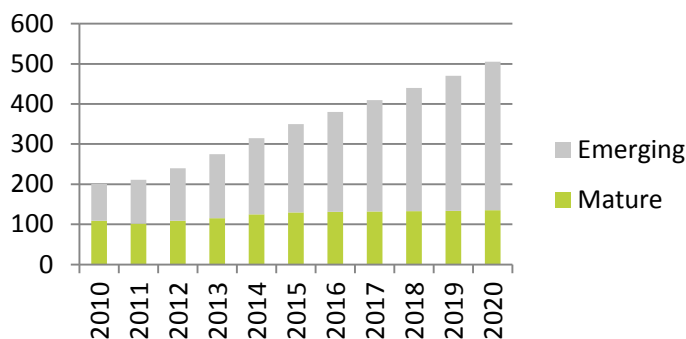
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PORTABLE ELECTRONIC DEVICES FORECASTS 2011-2020

Portable PC demand (M Units)

2010-2020 CAGR: +10%



Source: IDC, Gartner, AVICENNE Energy

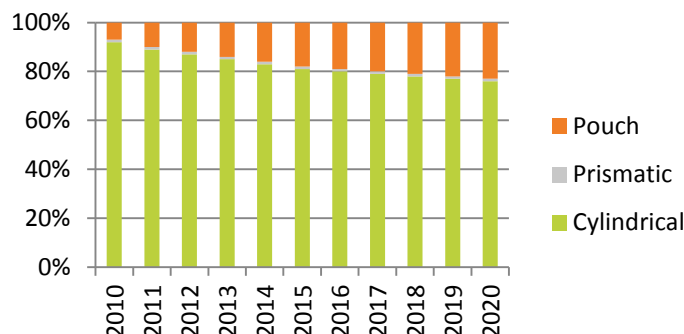
Portable PC market trends

- Mature market stable or decreasing
- Growth driven by Emerging market
- Ultrabook is increasing (20⁽¹⁾ to 60% in 2013⁽²⁾)
- ASP decreasing (<499\$ Portable PCs increase from 25% in 2010 to 33% in 2012)

(1) Samsung & AVICENNE (2) Intel

LIB cell demand 2010-2020

Polymer penetration: 7% -> 23%



LIB cells for portable PC trends

- Thinner cells
- Pouch cells penetration increasing from 7% in 2010 to 23% in 2020
- > 2800 mAh for Premium/corporate
- 2.2 Ah for consumer, emerging market



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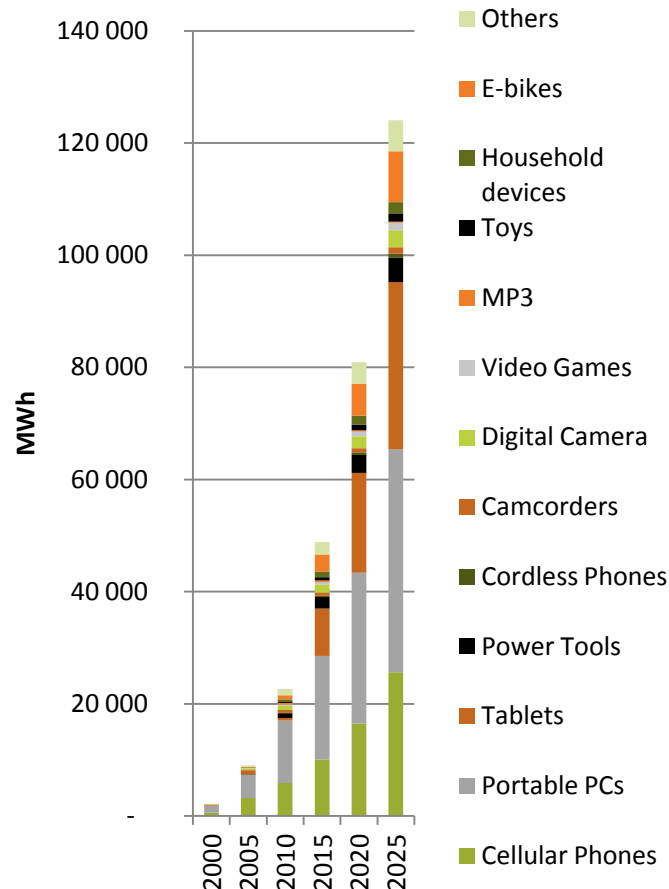
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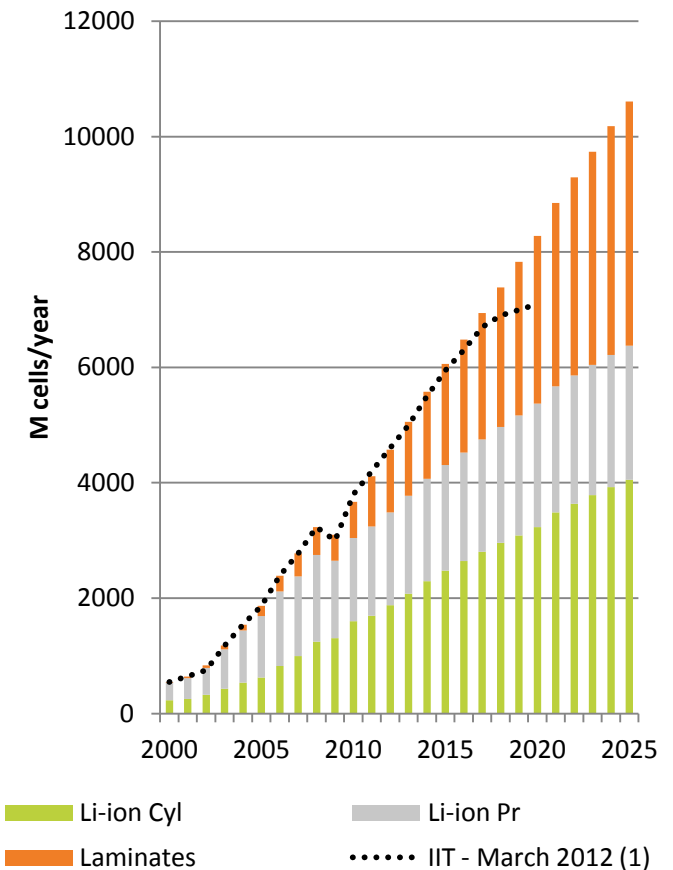
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2025 LIB FORECASTS EXCEPT AUTOMOBILE

2000-2025 LIB market, MWh, by
application (except Auto)



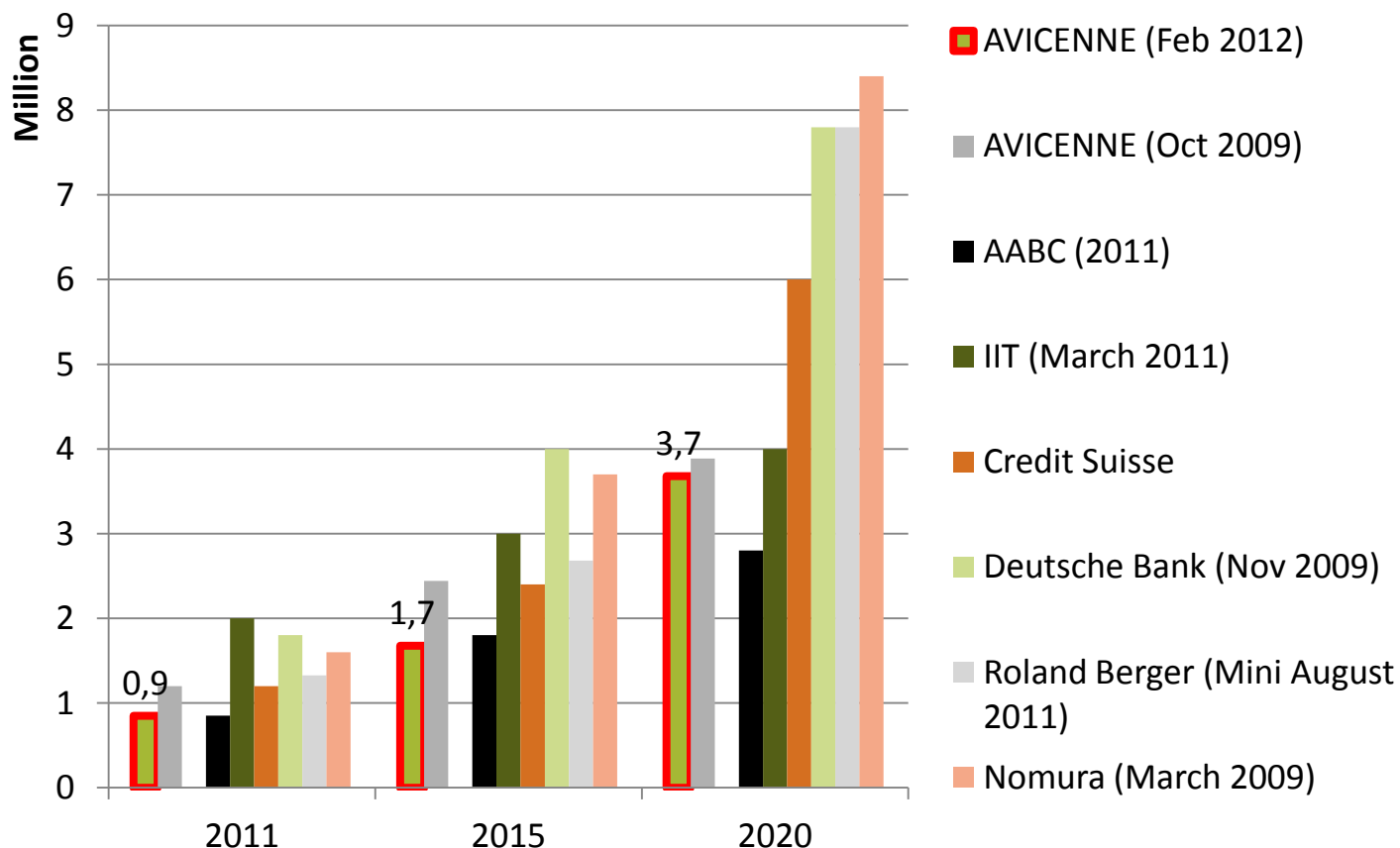
2000-2025 LIB market, M cells,
by form factor (Except Auto)



(1) Source: Battery Japan 2012 BJ-1 conference – Slide p 10

LONG TERM HEV FORECAST FROM 3 TO 8 M HEV IN 2020

AVICENNE ENERGY FORECASTS ARE REALISTIC COMPARE TO OTHER ANALYSTS



Source: AVICENNE ENERGY Compilation, February 2012

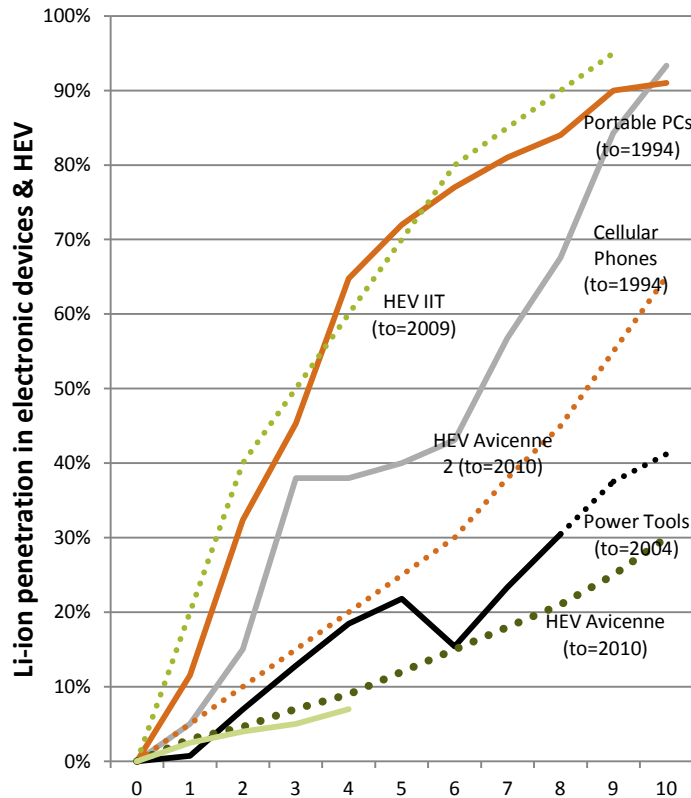


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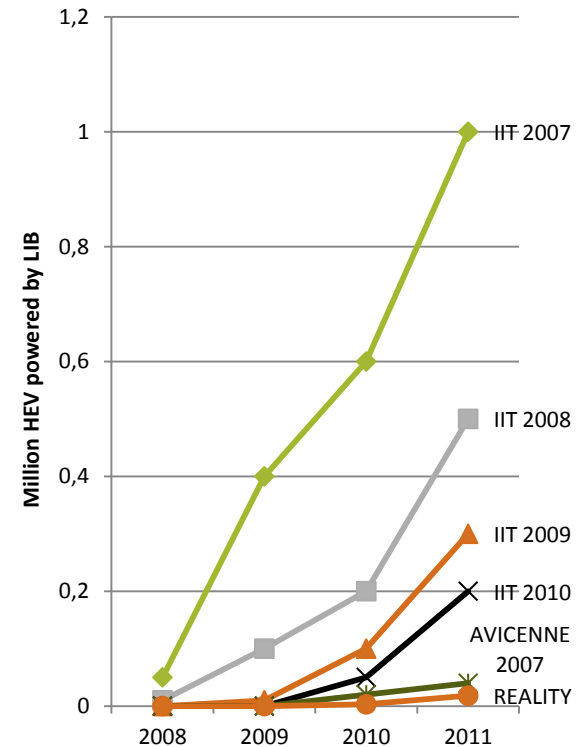
LI-ION PENETRATION IN VARIOUS DEVICES: AVICENNE & OTHER ANALYSTS FORECAST

Li-ion penetration in electronic devices & HEV



- (1)AVICENNE HEV Forecasts, march 09, Relevant scenario
 (2)AVICENNE HEV Forecasts, march 09, Li-ion Optimistic scenario
 (3)IIT, TAKESHITA, March 08, THE 25th INTERNATIONAL BATTERY SEMINAR & EXHIBIT, Slide 8 & March 2009, 26th Battery Seminar,
 (4)AAB, Menahem ANDERMAN, Ph.D, Tampa, Florida, May 2009

HEV powered by LIB forecasts from 2008 to 2011



Source : International Battery Conference, Fort Lauderdale 2007, 2008, 2009, 2010 & 2011

The worldwide Battery market 2011-2025

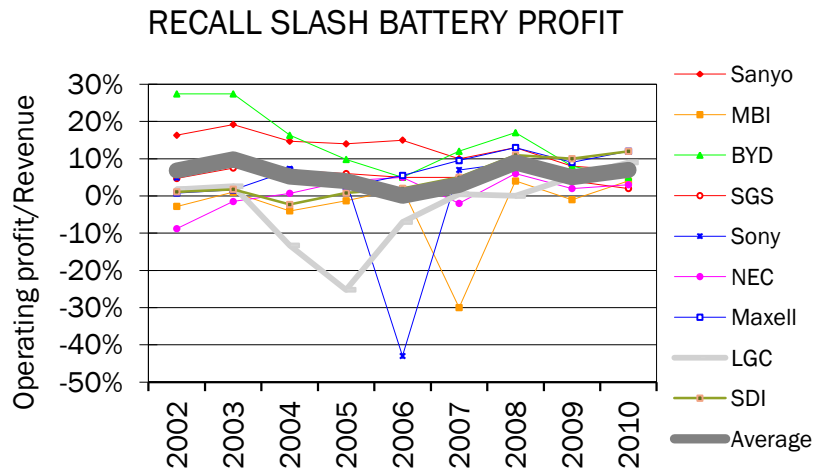
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LIB BUSINESS RECALL SLASH BATTERY PROFIT

- More & more incidents & accidents
- All the battery makers and the OEM are concerned
- Recall cost impact drastically the battery business and the profitability



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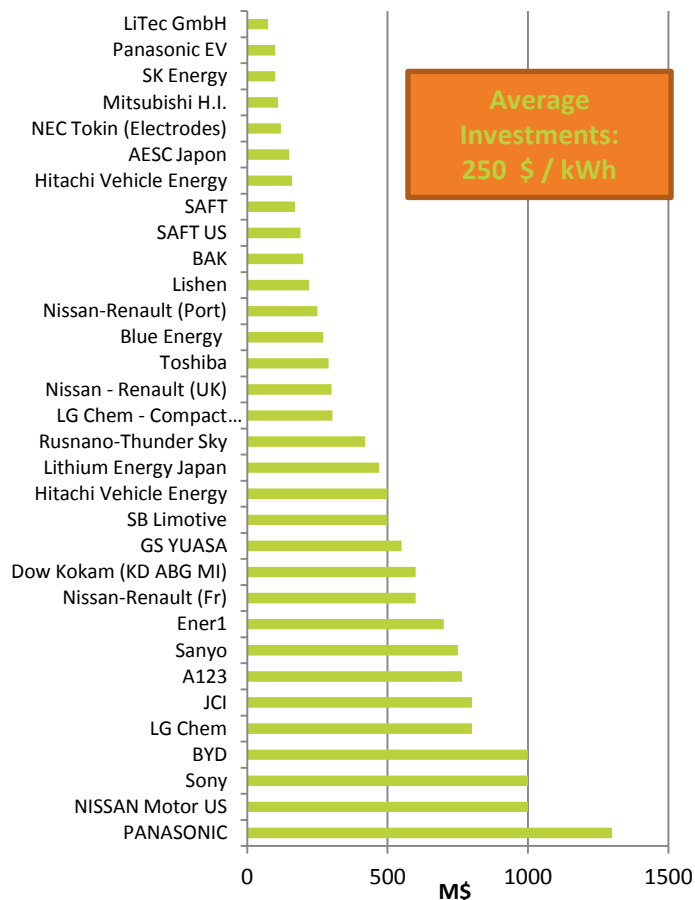
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LIB MANUFACTURING INVESTMENTS 2009-2015

10-12 B\$ WORLDWIDE
>50 GWh in 2015

Total Investment (M\$) made for LIB manufacturing



The worldwide Battery
market 2011-2025

BATTERIES 2012
October 24-26, 2012
Nice, FRANCE

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A123 Michigan Plant - Photo courtesy of A123 Systems



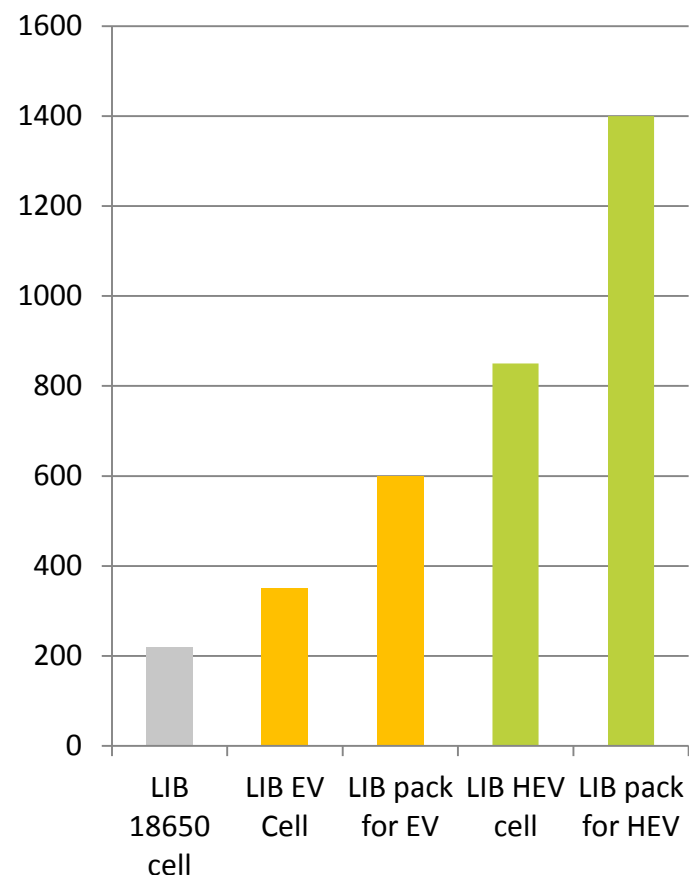
Liotech Plant, Novosibirsk – 1,5 GWh production capacity

LIB BATTERY COST

Costs analysis

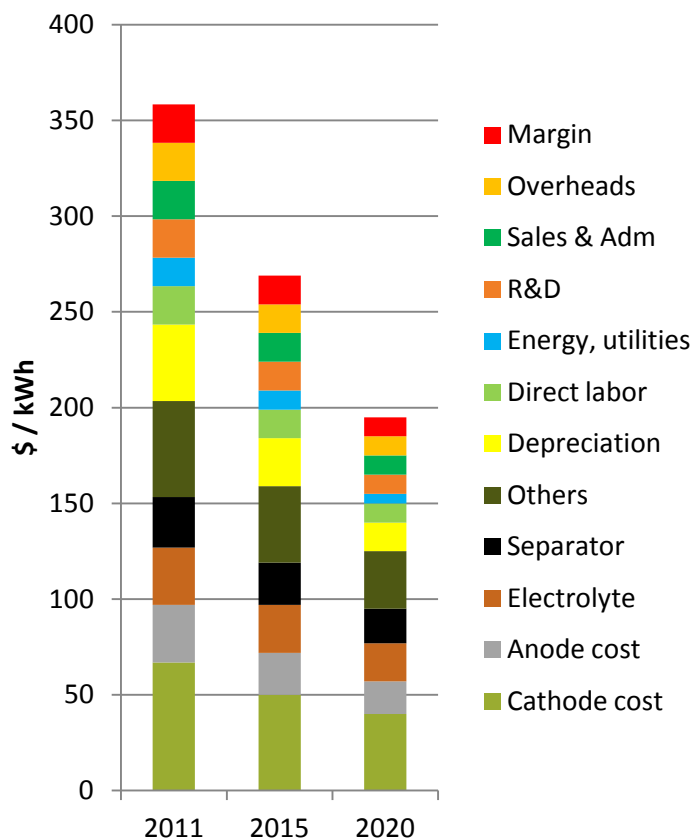
- 🔦 Raw material cost (Co, Mn, Ni, Al, Cu, ...)
- 🔦 Anode, cathode, Electrolyte, separator, binders, Cu & Al foil, etc... cost structure :
 - 🔦 CAPEX,
 - 🔦 labor cost,
 - 🔦 R&D
 - 🔦 Marketing, Adm, Overhead, margin)
- 🔦 Raw material needs / mAh
- 🔦 Electrode process Yield
- 🔦 Assembly Process Yield
- 🔦 Cell manufacturing cost
- 🔦 Module manufacturing cost
- 🔦 Pack assembly cost
- 🔦 ...

Battery price in 2011 \$/kWh

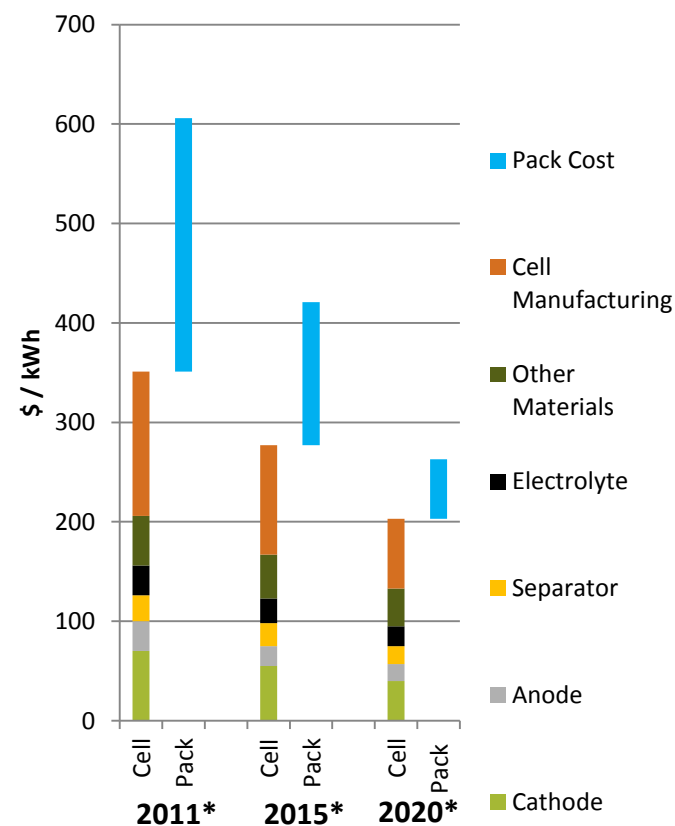


LI-ION BATTERY COST 2011-2020

LIB cell average cost (EV design ; NMC cathode)



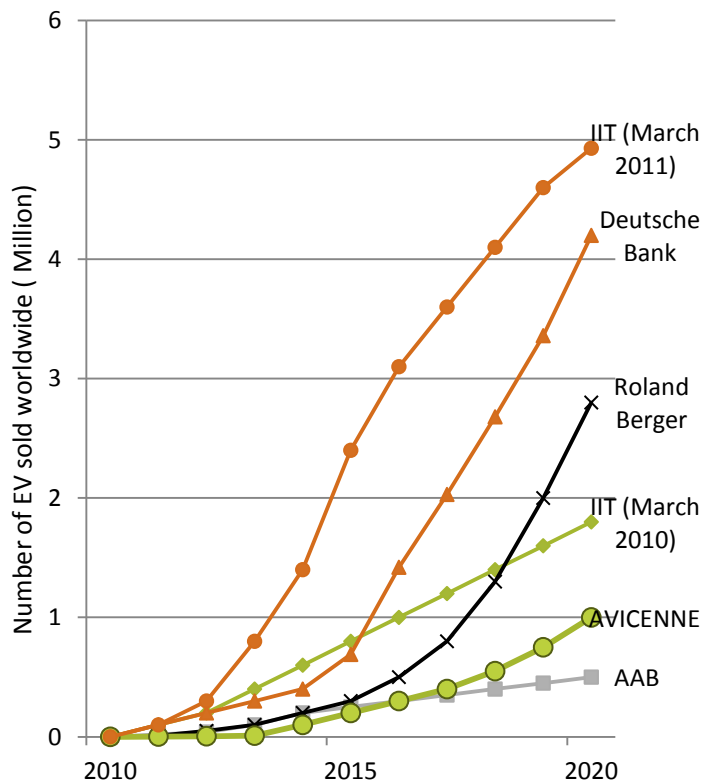
LI-ION BATTERY PACK COST FOR EV



* For Production > 100 000 packs/year

EV FORECASTS 2011-2020

EV sold, in million units,
worldwide, 2010 - 2020



IIT, March 2011 Fort Lauderdale

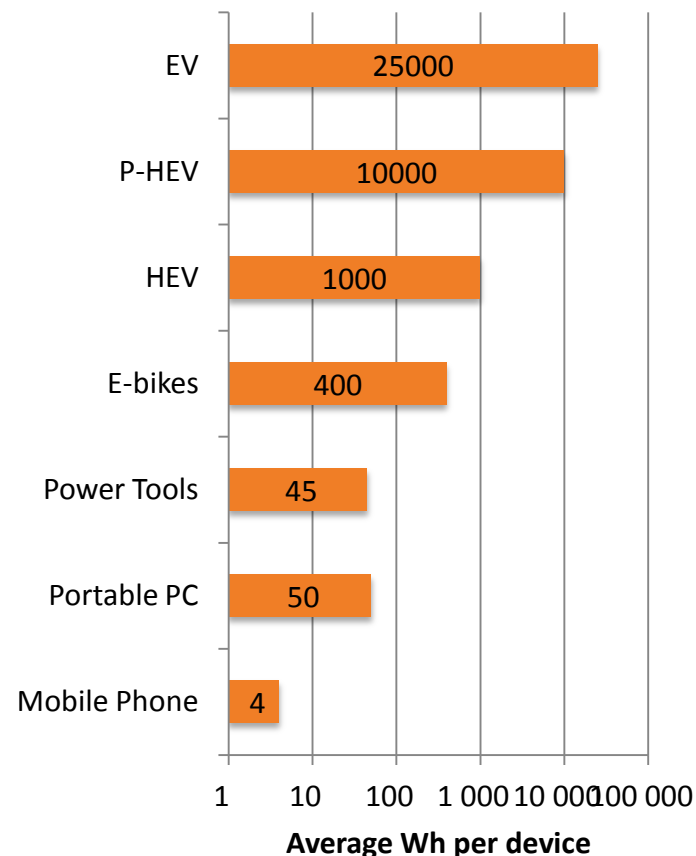
IIT, March 2010 Fort Lauderdale

Deutsche Bank, Electric Cars: Plugged In 2 – Nov 2009

Roland BERGER, Oct 2011, Batteries 2011 Cannes

AAB, AABC Europe, Mainz, June 2011

EV impact on the LIB & raw
material market is HUGE



The worldwide Battery
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The worldwide Battery
market 2011-2025

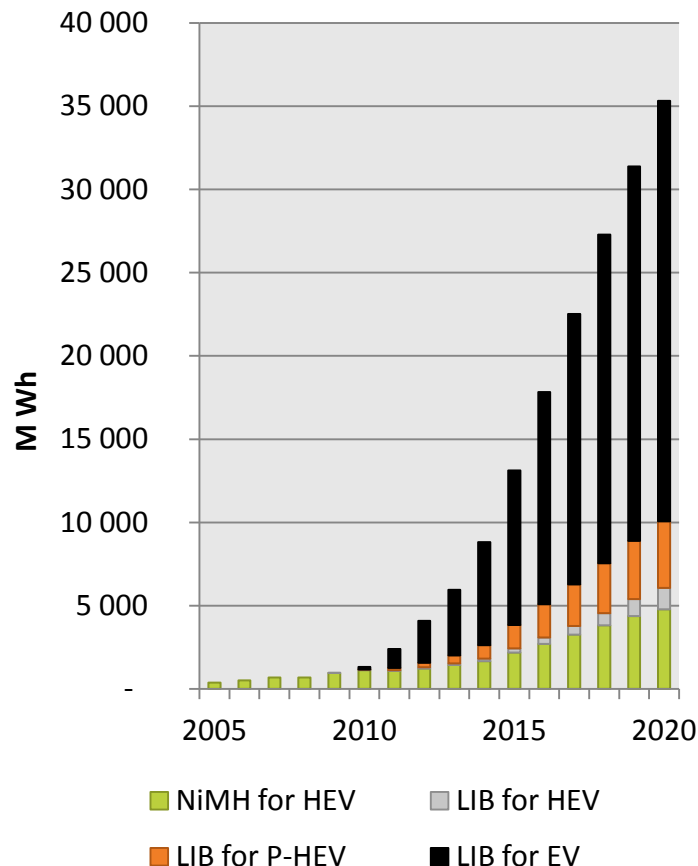
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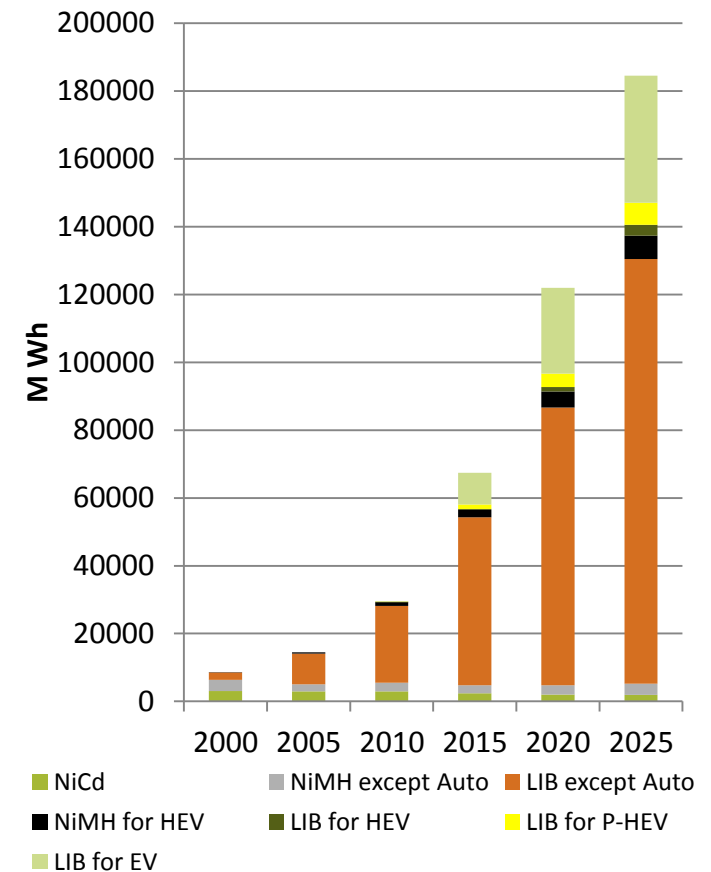
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TOTAL BATTERY DEMAND 2011-2020

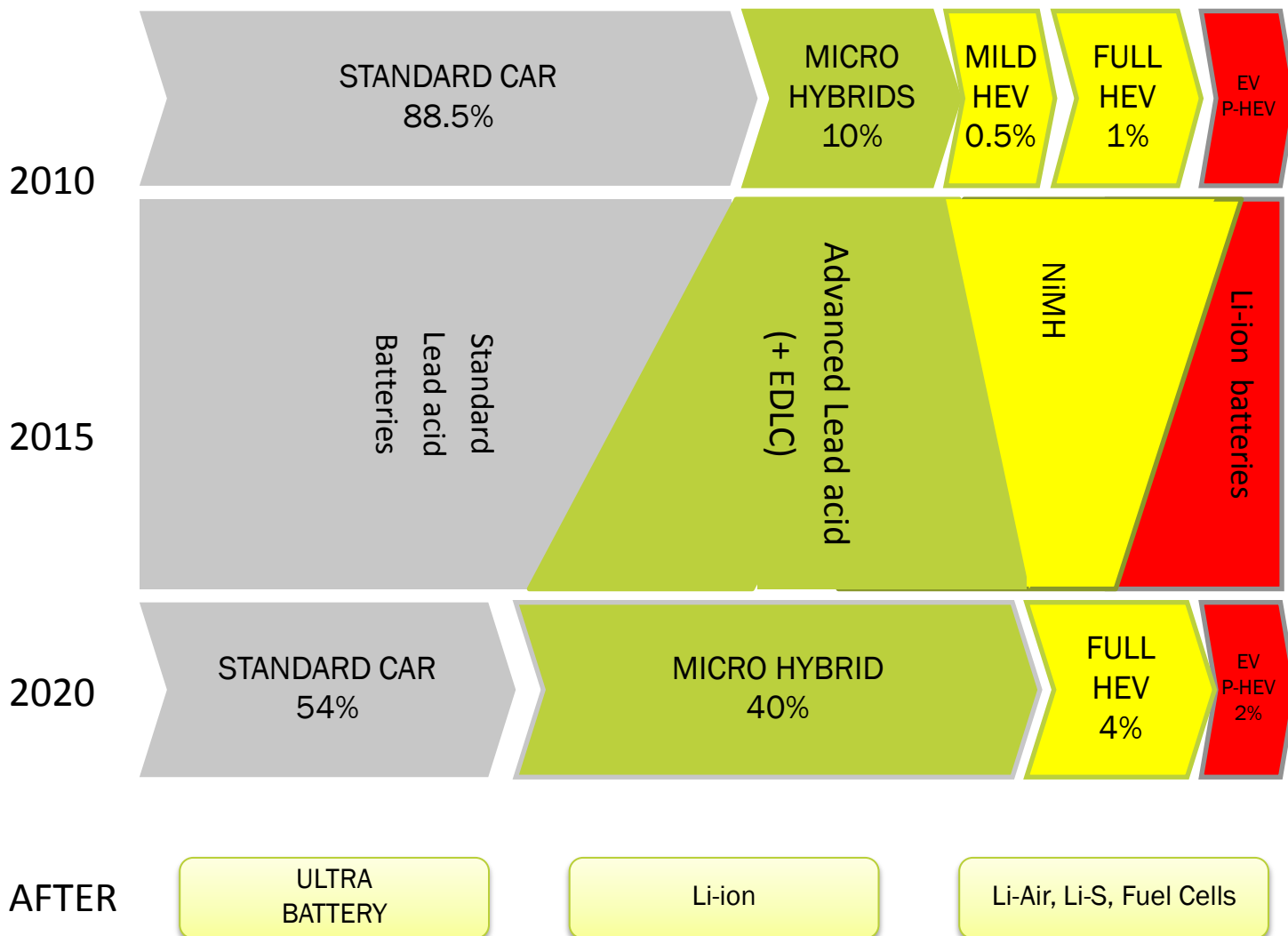
EV, HEV & P-HEV Battery
needs (M Wh) 2005 – 2020



Total battery demand (MWh)
2000 – 2025



HEV, P-HEV AND EV REALITY OF THE MARKET WILL BOOST MICRO HYBRID AND ADVANCED LEAD ACID BATTERIES



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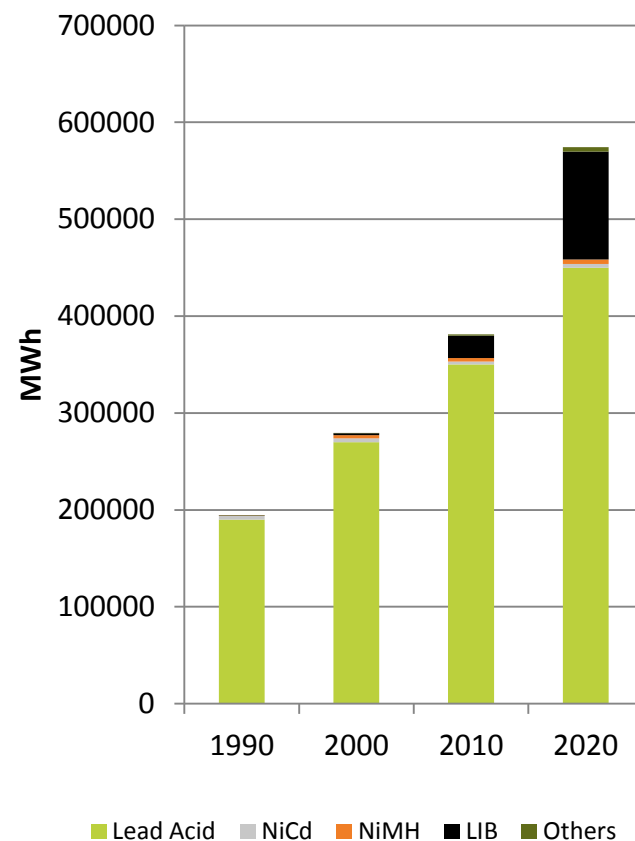
TAKEAWAYS

Battery Market 2010-2020

CAGR = +8%

- 🕒 Li-ion battery is driven today by Portable PCs & electronic devices
- 🕒 For HEV, the battery technology is today the NiMH
- 🕒 LIB begin really to compete in 2012
- 🕒 P-HEV & EV will be powered by Li-ion: 5 B\$ market in 2015 & 9 B\$ in 2020
- 🕒 EV expectations attract large Chemical companies
- 🕒 New materials are needed to meet Automotive standards
- 🕒 HEV will account for less than 5% of the automotive sales in 2020
- 🕒 P-HEV & EV < 2% by 2020
- 🕒 Micro-hybrid will achieve 40%
- 🕒 Lead acid battery will be the first market in 2020 in volume & value

RECHARGEABLE BATTERY MARKET WORLDWIDE 2000-2020



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THANK YOU



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