avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

Batteries EVENT

www.batteriesevent.com

The International Energy & Power Supply Conference and Exhibition

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015

Nice, France,
October 6, 2015

Christophe PILLOT

Director, AVICENNE ENERGY

Presentation Outline

- The rechargeable battery market in 2014
- The Li-ion battery value chain
- Li-ion battery material market
- Forecasts & conclusions

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

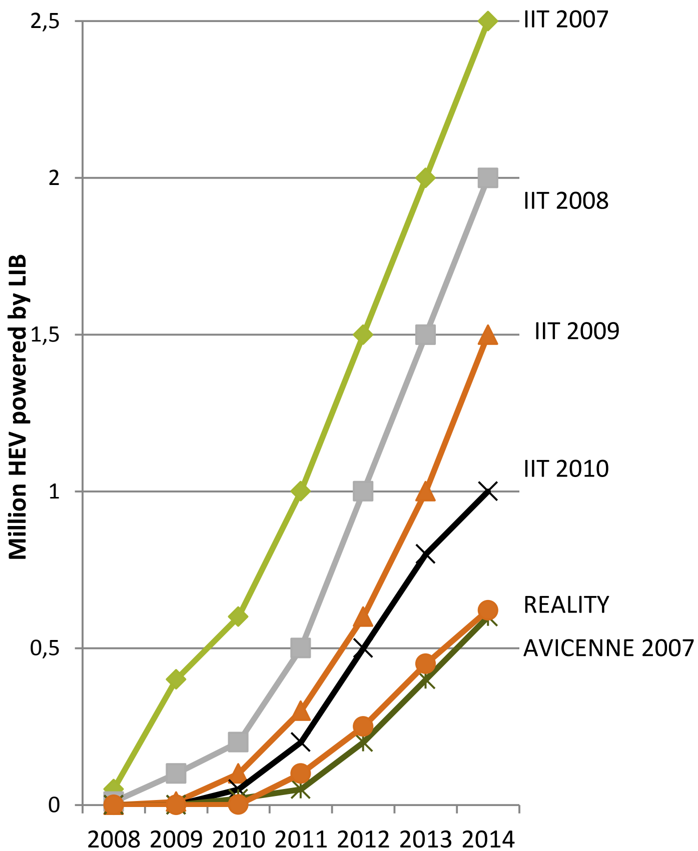
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

AGENDA

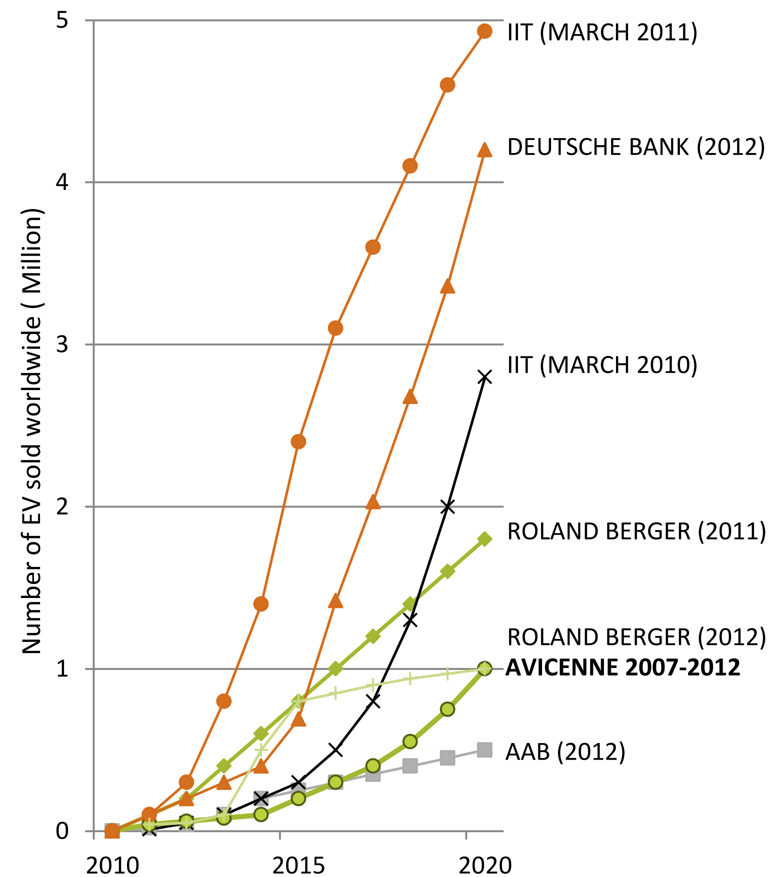
- The market in 2014 by technology, applications & battery suppliers
- Li-ion battery value chain
  - Raw materials market
  - Supplier / customer relationship
  - Raw material cost
  - New entrants strategy
  - Raw material road map 2000-2030
- xEV market in 2014
- xEV forecasts up to 2025
- Could Lithium ion replace lead acid for industrial applications?
- Rechargeable battery market forecasts up to 2025

AVICENNE ENERGY: RENOWNED TO HAVE REALISTIC FORECASTS

HEV powered by Lithium ion battery forecasts from 2008 to 2014



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



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

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

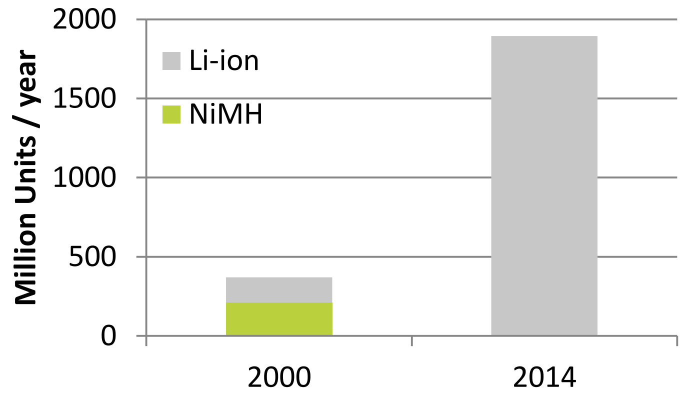
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

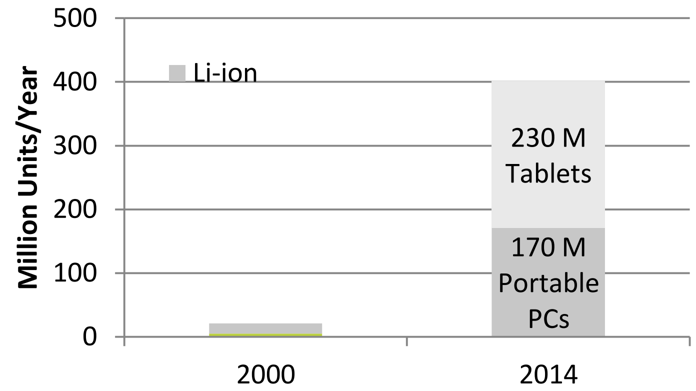
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THE BATTERY MARKET IS REALLY DYNAMIC

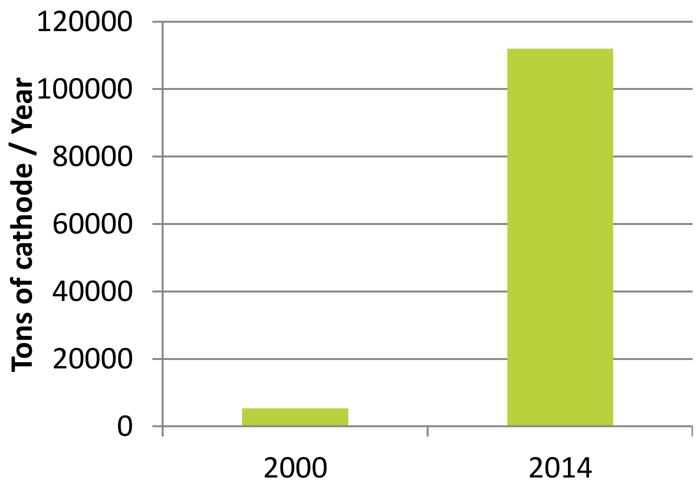
Cellular Phones sold per Year (Million)



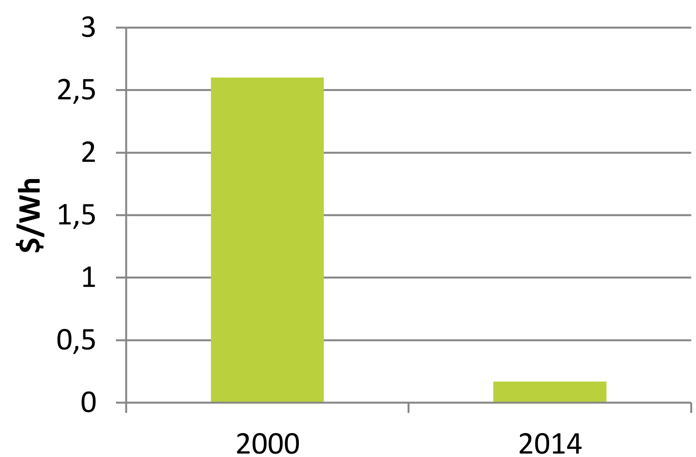
Portable PC sold per Year (Million)



Tons of Li-ion Cathode per year



Li-ion 18650 cell price ($/Wh)



Source: AVICENNE ENERGY Analyses 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

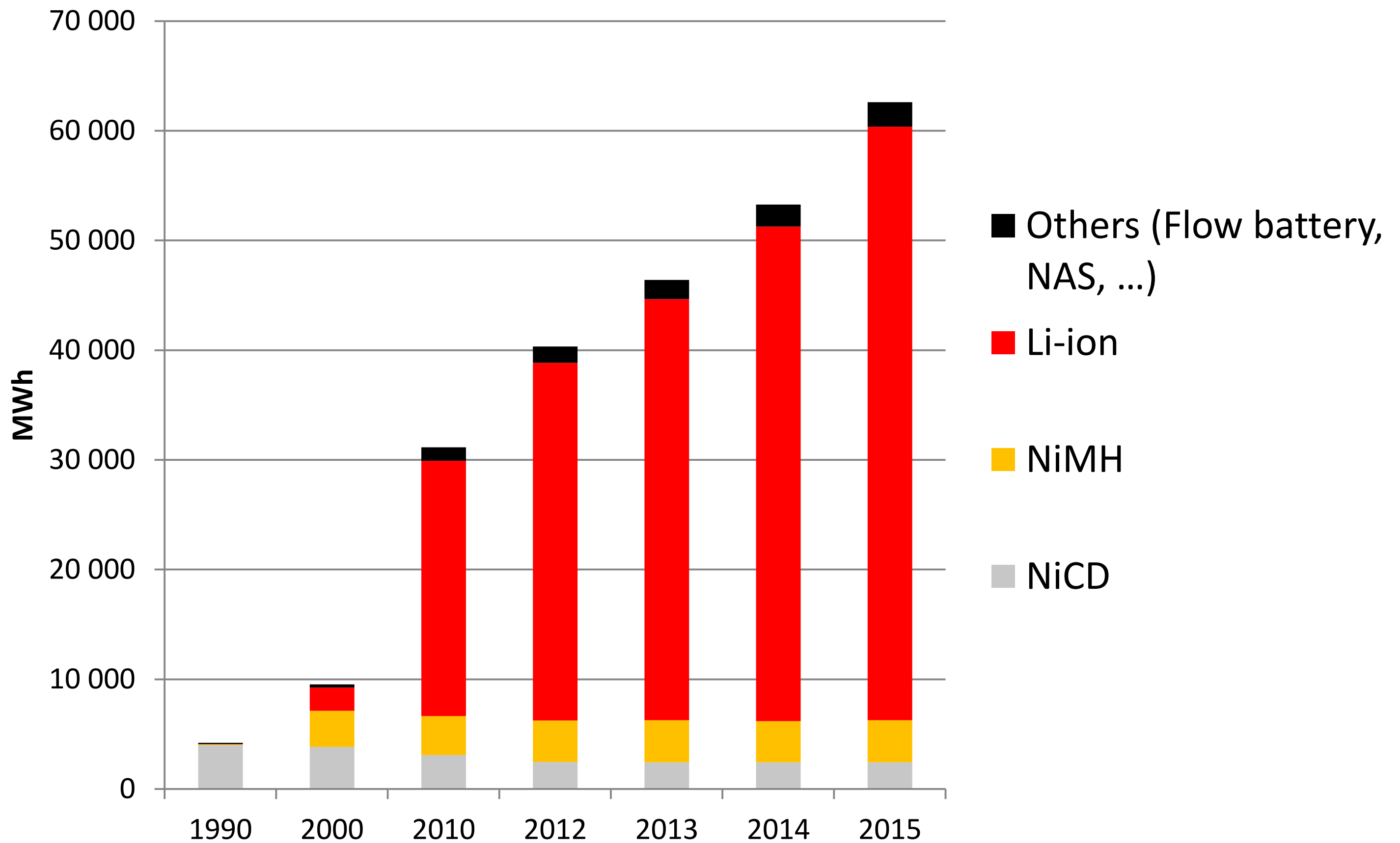
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THE WORLDWIDE BATTERY MARKET 1990-2015

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



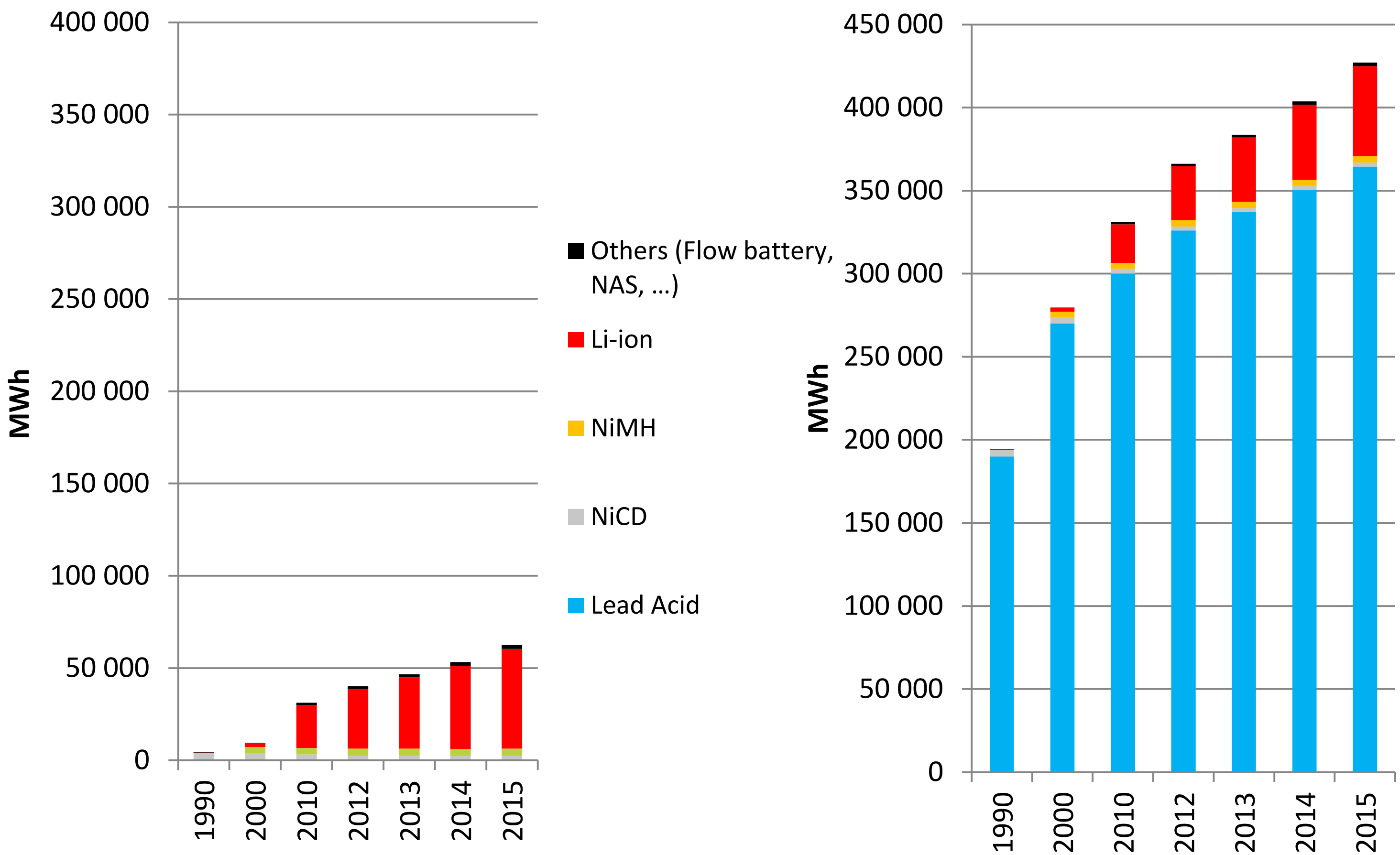
Source: AVICENNE ENERGY, 2015 *2015: Estimations*

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

THE WORLDWIDE BATTERY MARKET 1990-2015

The Rechargeable Battery Market and Main Trends 2014-2025

Lithium Ion Battery: Highest growth & major part of the investments
Lead acid batteries: By far the most important market (90% market share)



BATTERIES 2015
October 6, 2015
Nice, FRANCE

Source: AVICENNE ENERGY, 2015

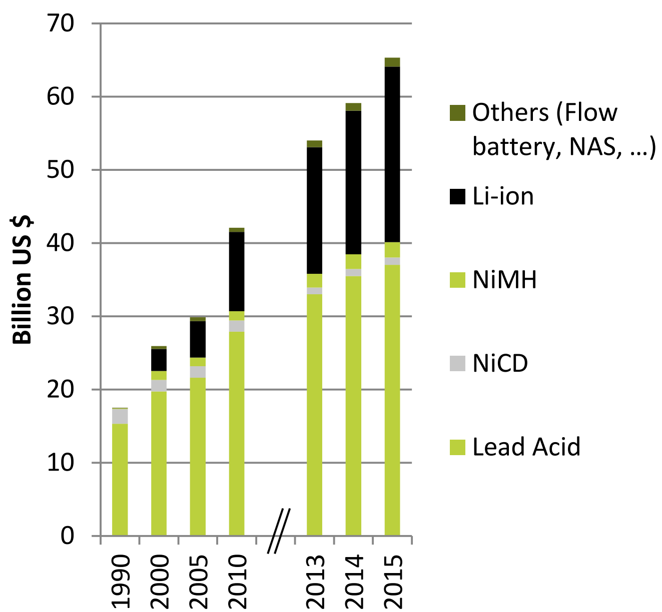
2015: Estimations

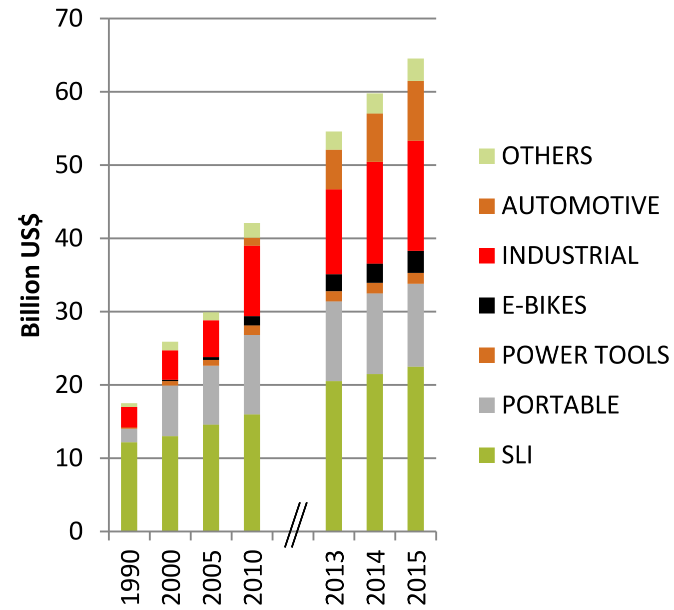
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

THE WORLDWIDE BATTERY MARKET 1990-2015

60 BILLION US$ in 2014 – Pack level[1]
5% AVERAGE GROWTH PER YEAR (1990-2014)





SLI: Start light and ignition batteries for cars, truck, moto, boat etc…

PORTABLE: concumer electronics (cellular, portable PCs, tablests, Camera, …), data collection & handy terminals,

POWER Tools: power tools but also gardening tools

INDUSTRIAL

- *MOTIVE: Forklift (95%), others*
- *STATIONARY: Telecom, UPS, Energy Storage System, Medical, Others (Emergency Lighting, Security, Railroad Signaling,, Diesel Generator Starting, Control & Switchgear,*

AUTOMOTIVE: HEV, P-HEV, EV

OTHERS: Medical: wheelchairs, medical carts, medical devices (surgical power tools, mobile instrumentation (x-ray, ultrasound, EKG/ECG, large oxygen concentrators

1- Pack: cell, cell assembly, BMS, connectors – Power electronics (DC DC converters, invertors…) not included

Source: AVICENNE ENERGY, 2015

2015: Estimations

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT www.batteriesevent.com The International Energy & Power Supply Conference and Exhibition

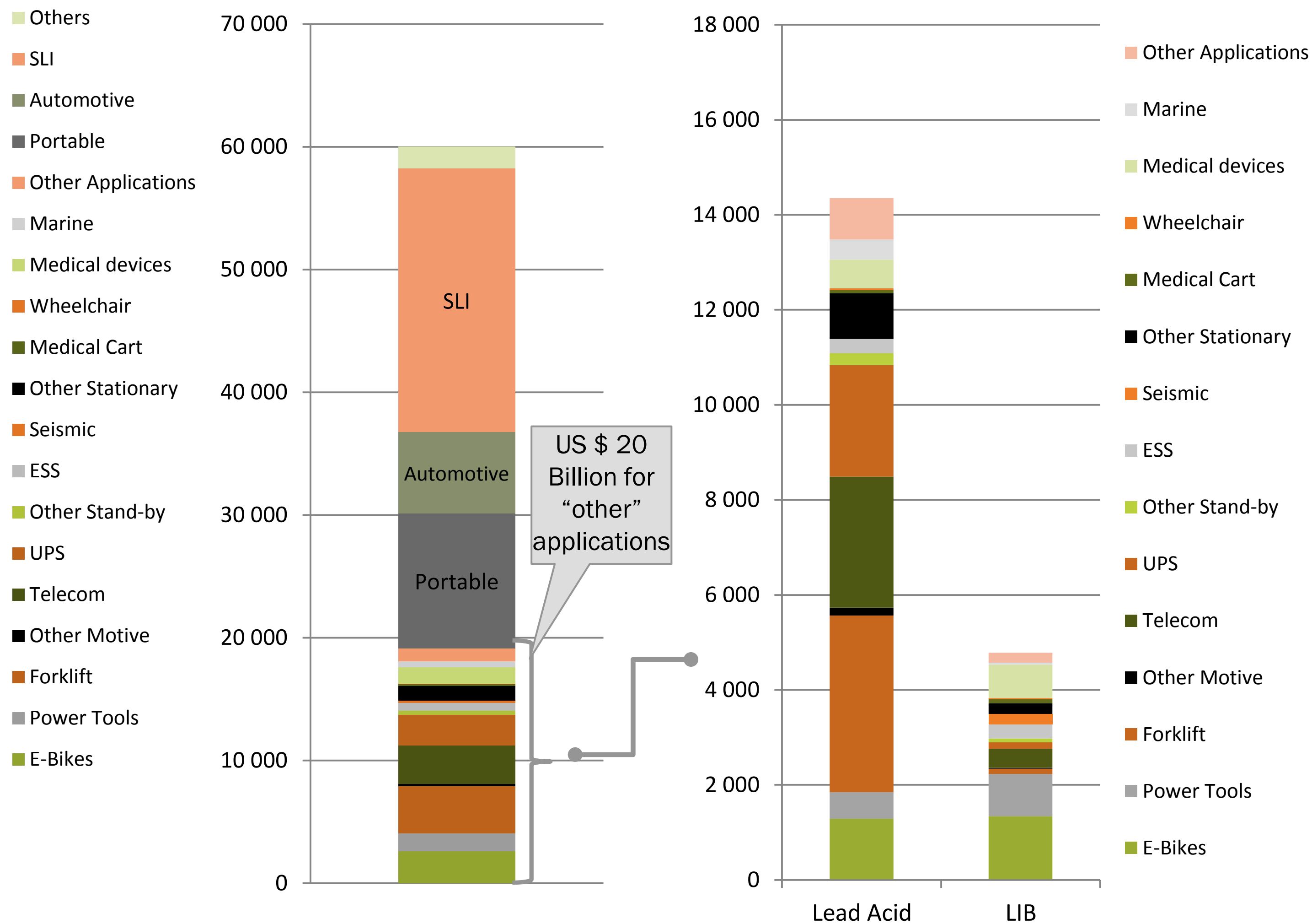
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THE WORLDWIDE BATTERY MARKET IN 2014: US $ 60 BILLION

Battery market in 2014 (M$)



1- Pack level: Pack including cells, cells assembly, BMS, connectors – Power electronics (DC DC converters, invertors…) not included

Source: AVICENNE ENERGY, 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

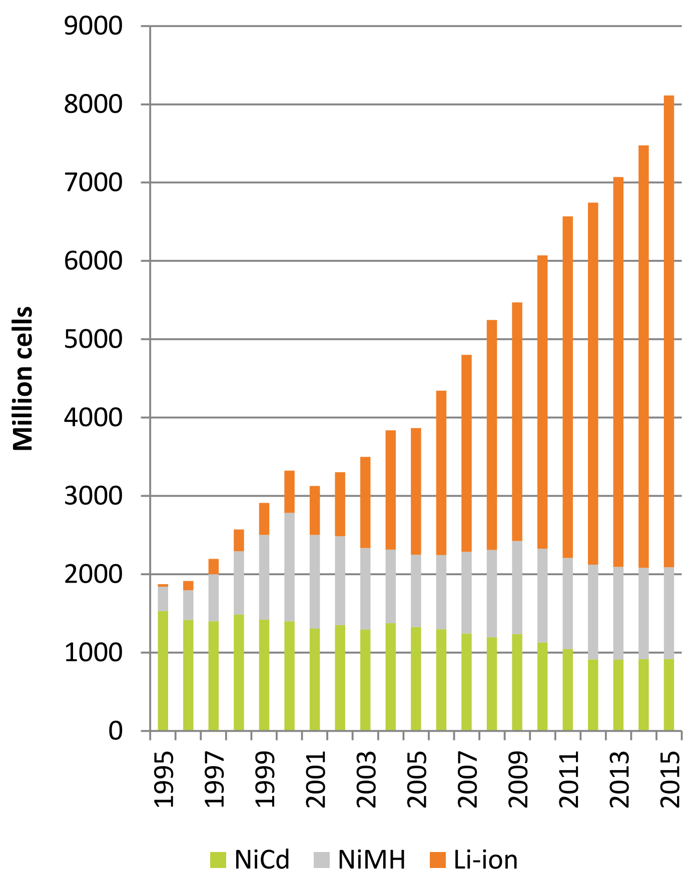
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

WORLDWIDE BATTERY SALES BY CHEMISTRY, UNITS, 1995-2015

The worldwide rechargeable battery market, Million cells, 1995-2015



2015: estimation data

Which cell are we talking about?

Front Edge Technology, Inc

GS Yuasa International / Lithium Energy Japan

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

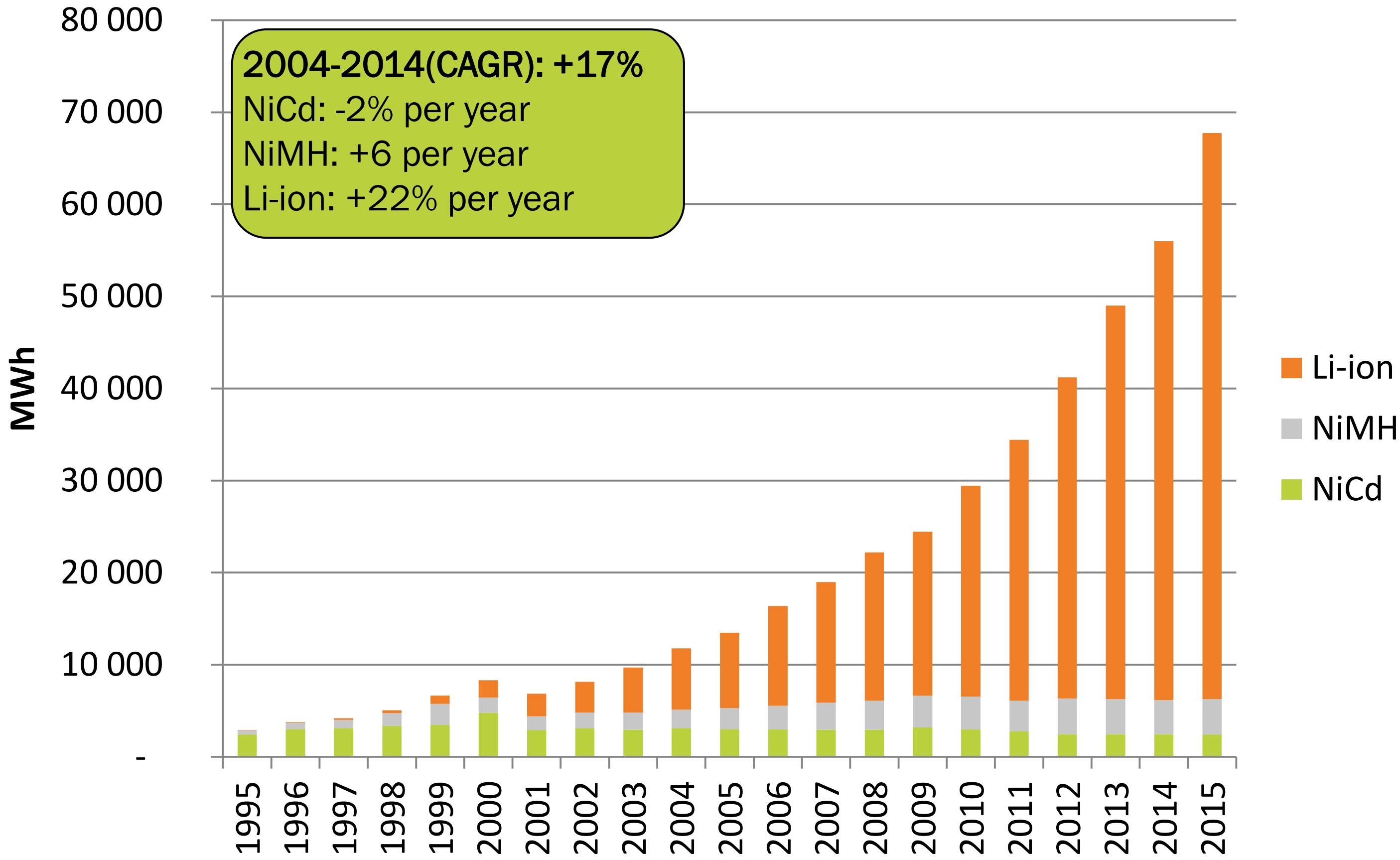
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

WORLDWIDE BATTERY SALES BY CHEMISTRY, MWH, 1995-2015

The worldwide rechargeable battery market, in volume, MWh, 1995-2015



2015: estimation data

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

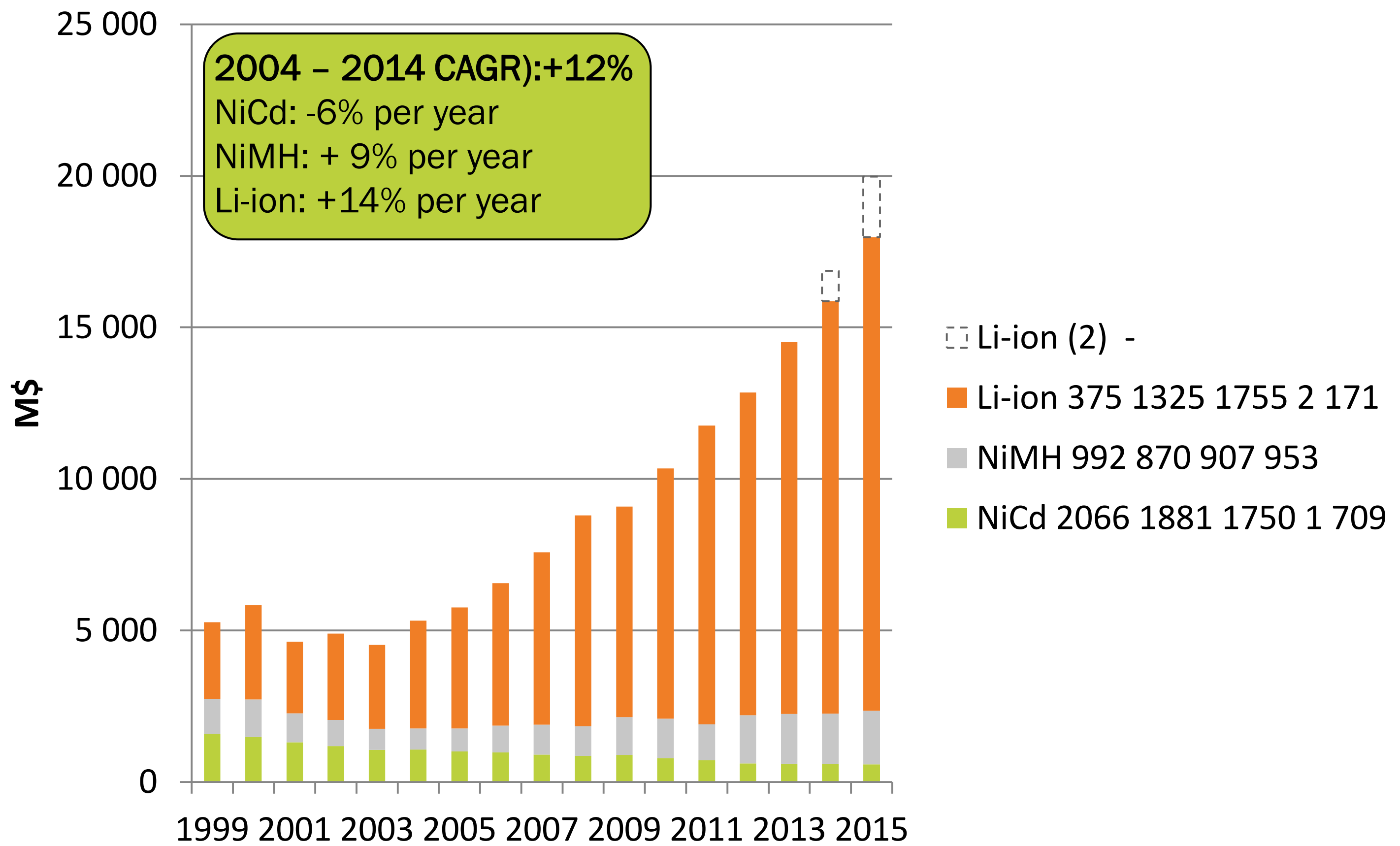
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

WORLDWIDE BATTERY SALES BY CHEMISTRY, M$, 1995-2015

The worldwide rechargeable battery market, in value, M$, 1995-2015 (1)



(1) *Cell level*

(2) *New Lithium ion battery market detected: e-bus, x-ev, others in China*

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

EACH BATTERY TECHNOLOGY HAS ITS SPECIFIC ABSOLUTE ADVANTAGES

Advantage of ... / ...On	Lead Acid	Nickel Cadmium NiCd	Nickel Metal Hydride NiMH	Lithium-Ion: Conventional	Lithium-Ion: Laminate
Lead Acid		• Gravimetric energy density • Volumetric energy density • Operating temperature range • Self discharge rate • Reliability (progressive extinction)	• Gravimetric energy density • Volumetric energy density • Self discharge rate	• Gravimetric energy density • Volumetric energy density • Voltage output • Self discharge rate	• Gravimetric energy density • Volumetric energy density • Self discharge rate • Design characteristics
Nickel Cadmium NiCd	• Higher cyclability • Voltage output • Price		• Gravimetric energy density • Volumetric energy density	• Gravimetric energy density • Volumetric energy density • Voltage output • Self discharge rate	• Gravimetric energy density • Volumetric energy density • Self discharge rate • Design characteristics
Nickel Metal Hydride NiMH	• Higher cyclability • Voltage output • Price	• Operating temperature range • Higher cyclability • Self discharge rate • Price		• Gravimetric energy density • Volumetric energy density • Operating temperature range • Higher cyclability • Voltage output • Self discharge rate	• Gravimetric energy density • Volumetric energy density • Operating temperature range • Self discharge rate • Design characteristics
Lithium-Ion: Conventional	• Higher cyclability • Price • Safety • Recyclability	• Operating temperature range • Higher cyclability • Price • Safety • Recyclability	• Price • Safety • Discharge rate • Recyclability		• Gravimetric energy density • Volumetric energy density (potentially) • Design characteristics • Safety • Price
Lithium-Ion: Laminate	• Higher cyclability • Price	• Operating temperature range • Higher cyclability • Price	• Volumetric energy density • Higher cyclability • Price	• Operating temperature range • Higher cyclability	
Absolute advantages	• Higher cyclability • Price	• Operating temperature range • Price	• Volumetric energy density	• Gravimetric energy density • Volumetric energy density • Self discharge rate • Voltage output	• Gravimetric energy density • Volumetric energy density • Self discharge rate • Voltage output • Design characteristics

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

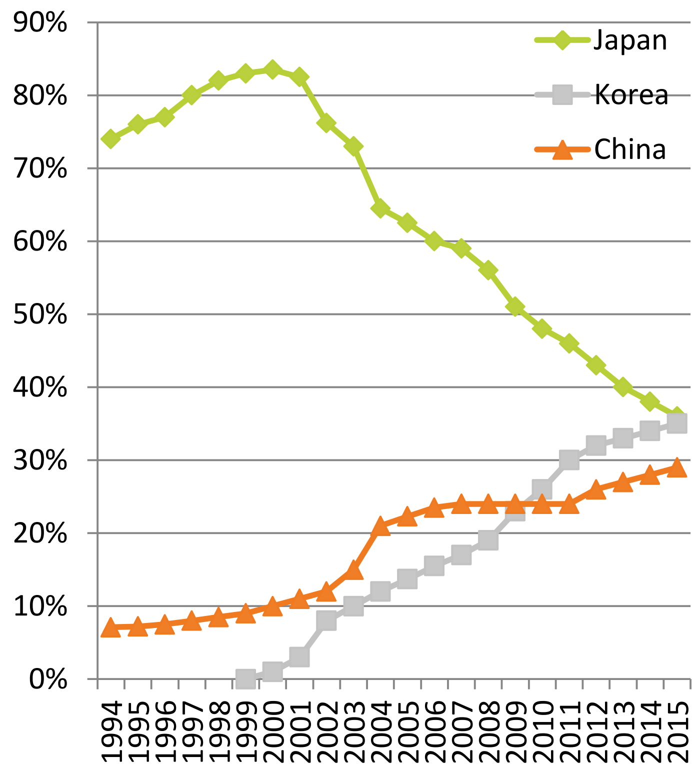
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

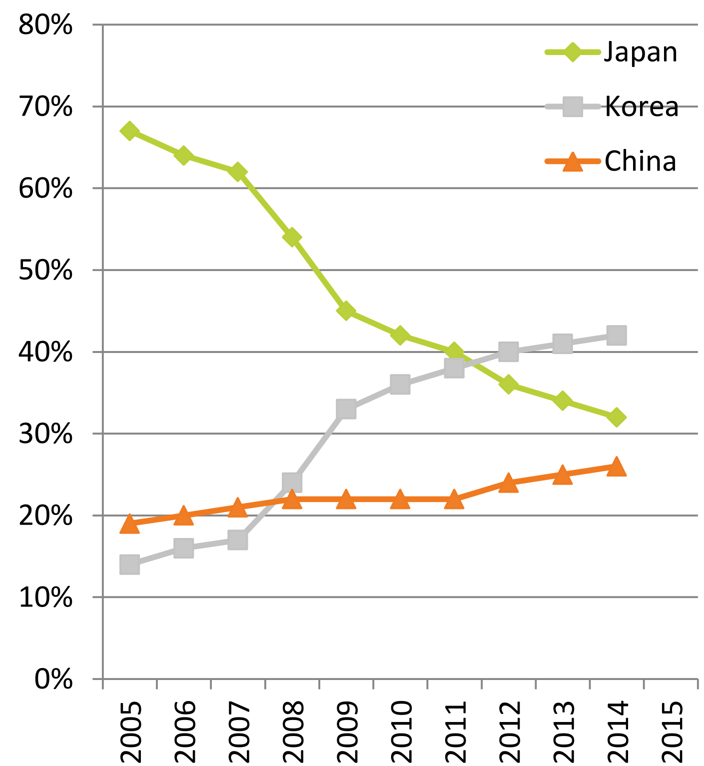
JAPANESE, CHINESE & KOREAN MARKET SHARE

Japanese market share (value) decreasing: from 82 % of the market in 2001 to < 40% in 2014

Rechargeable battery[(1)] market by country



LIB market by country



(1) Excluding lead acid batteries

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

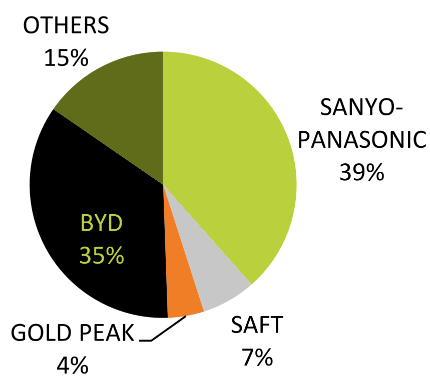
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

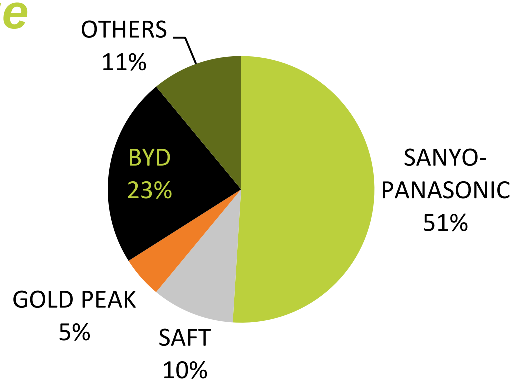
NICD BATTERY: MARKET SHARE IN 2014 IN VOLUME WORLDWIDE

The worldwide NiCd battery market Company market share in 2014 in volume – 920 M cells

In volume



In value



SANYO-PANASONIC is leading the market

Companies	Million cells
SANYO-PANASONIC	350
SAFT	60
GOLD PEAK	40
BYD	320
OTHERS	150
TOTAL	910

Fumio Ohtsubo (Panasonic) & Seiichiro Sano (Sanyo) January 8th, 2012

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

NICD IN 2014
MAIN APPLICATION: POWER TOOLS

920 M cells – 2450 MWh

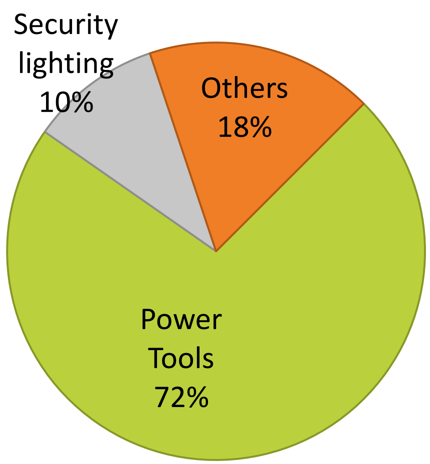
600 M$[1]

CAGR 2004/2014

-2% per year in volume

-6% per year in value

NiCd by application worldwide, % in value, 2014



- All the applications are decreasing
- Competition with NiMH & Li-ion

- New application (?)
  - Energy storage

ABB Inc., Fairbanks, Alaska, 27 MW/15 minutes

Note:

[1] Portable applications, power tools and emergency lighting only: industrial application as well as energy storage are excluded

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

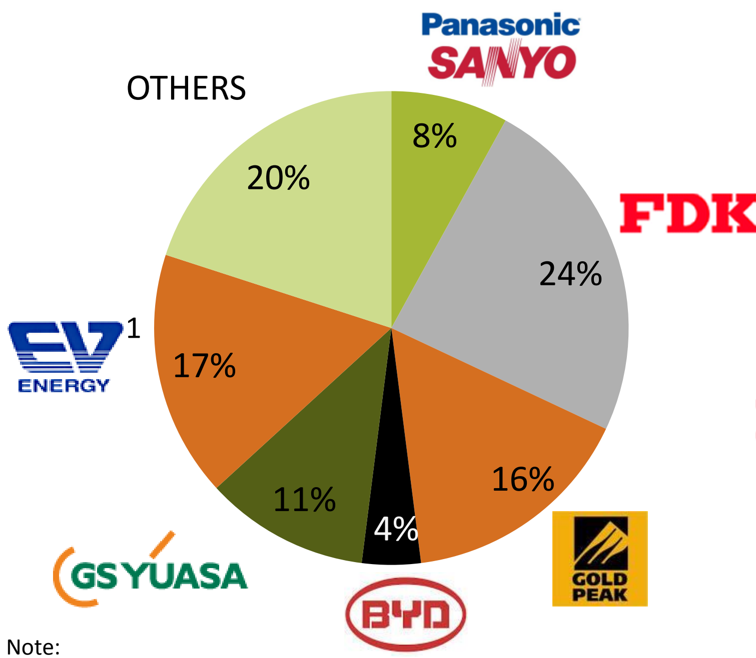
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

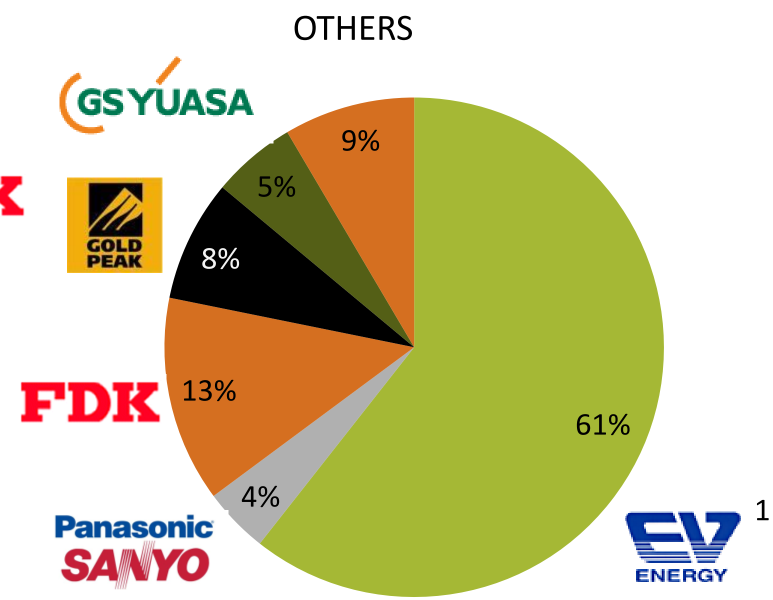
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

NIMH BATTERY: MARKET SHARE IN 2014 WORLDWIDE

The worldwide NiMH battery market Company market share in 2014 in volume – 1200 M cells



The worldwide NiMH battery market Company market share in 2014 in value – 1670 M$



Note:

[1] PEVE: Primearth EV Energy (PEVE) The company was known as Panasonic EV Energy Co until 2 June 2010. The company was formed in 1996 as a joint venture between Toyota and Panasonic, with Panasonic holding 60% of the capital. Panasonic sold 40.5% of the company to Toyota. PEVE is the supplier of the NiMH battery packs for Toyota's hybrids, as well as for Honda (Civic hybrid and first generation Insight) hybrids. The company also provides the NiMH prismatic battery modules for the General Motors

[2] Japan's Sanyo Electric Co sold part of its battery operations to FDK Corp a Fujitsu Ltd unit, for 6.4 billion yen ($70 million) to satisfy antitrust regulators ahead of its planned takeover by Panasonic Corp at the end of 2009.

Source: AVICENNE ENERGY Analyses

Note: Market in value at the cell level – 1,9 B$ at the pack level

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

NIMH IN 2014
MAIN APPLICATION: HYBRID VEHICLES

1 165 M cells – 3 700 MWh

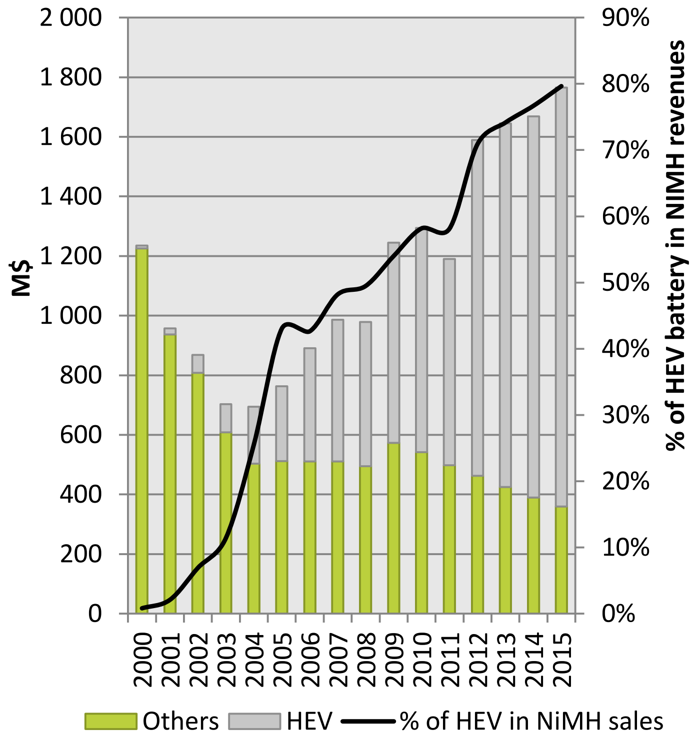
1.65 B$[(1)]

CAGR 2004/2014

+9% per year in Volume

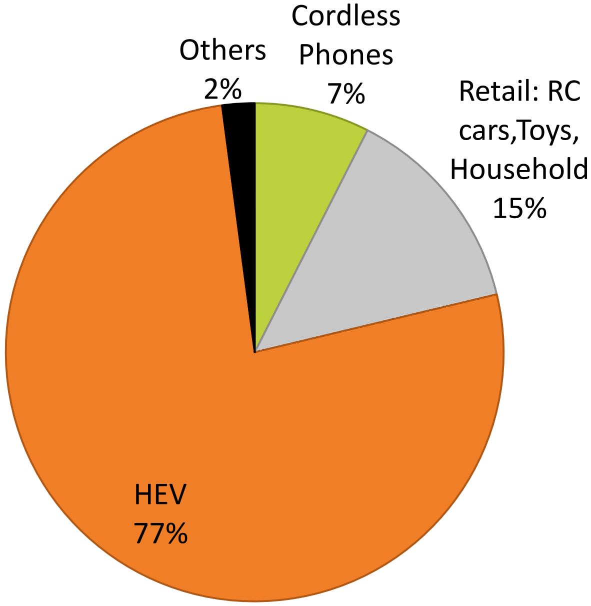
+8% per year in value

NiMH battery market worldwide in value
% for HEV application



(1) Cell based market – 1,9 B$ at the pack level

NiMH battery by applications, worldwide, % in value, 2014



The Rechargeable Battery Market and Main Trends 2014-2025

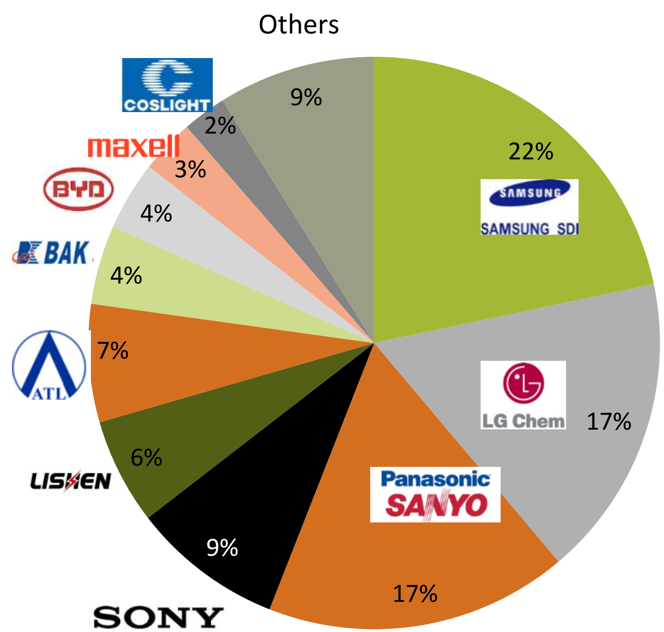
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

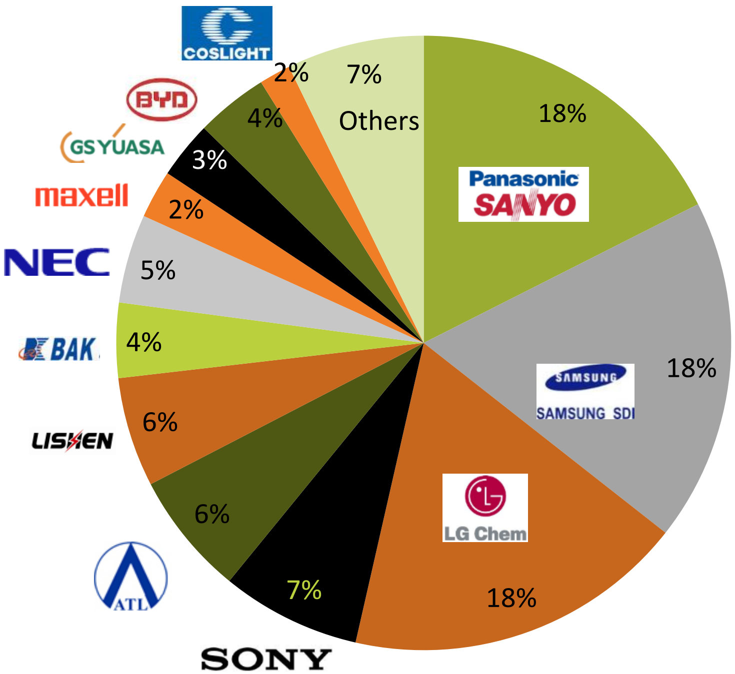
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LI-ION BATTERY: MARKET SHARE IN 2014 WORLDWIDE

The worldwide Li-ion battery market Company market share in 2014 in volume: 5400 M cells



The worldwide Li-ion battery market Company market share in 2014 in value(1) – 13,6 B$



Source: AVICENNE ENERGY Analyses 2015

(1) Cell level. LIB battery pack market: >16,7 B$

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

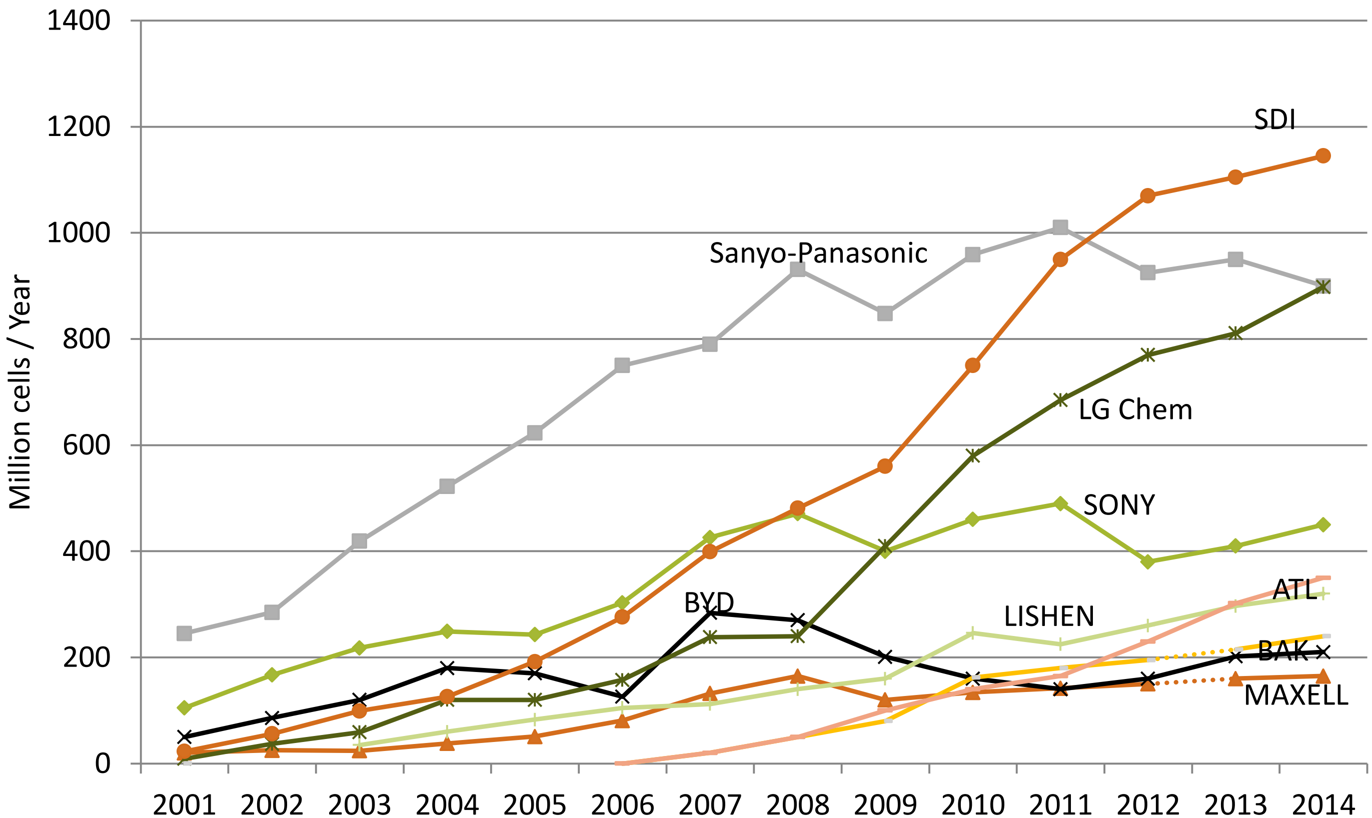
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

MAJOR LI-ION MANUFACTURERS YEARLY PRODUCTION 2001-2014

Samsung SDI & LG Chem are growing very fast



Panasonic acquired Sanyo in Dec 2009

Source: AVICENNE ENERGY Analyses 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

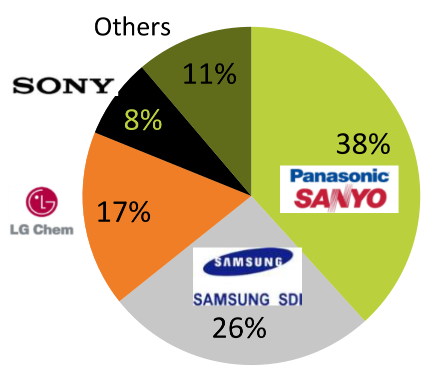
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

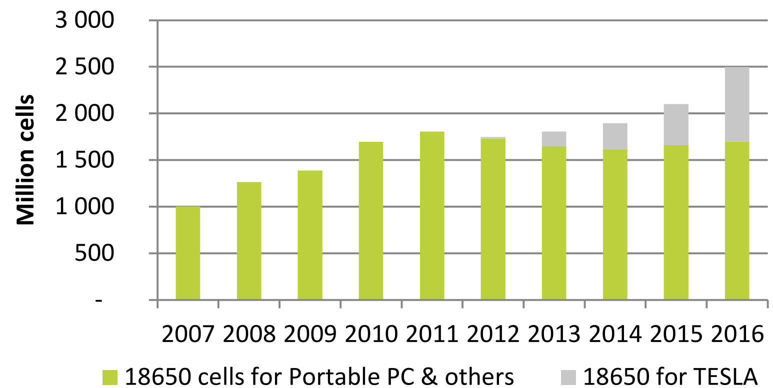
CYLINDRICAL LI-ION BATTERY

In 2014, TESLA demand represent roughly 15% of the Cylindrical cells demand

Cylindrical LIB market Company market share in 2014 in volume: 1960 Million cells (+6%)



SANYO-PANASONIC, SDI & LG will share the market

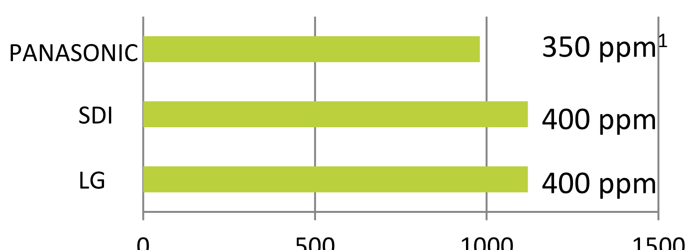


Assumptions: TESLA sold 35 kEV in 2014, 55 kEV in 2015 and 100 kEV in 2016

Key success factor

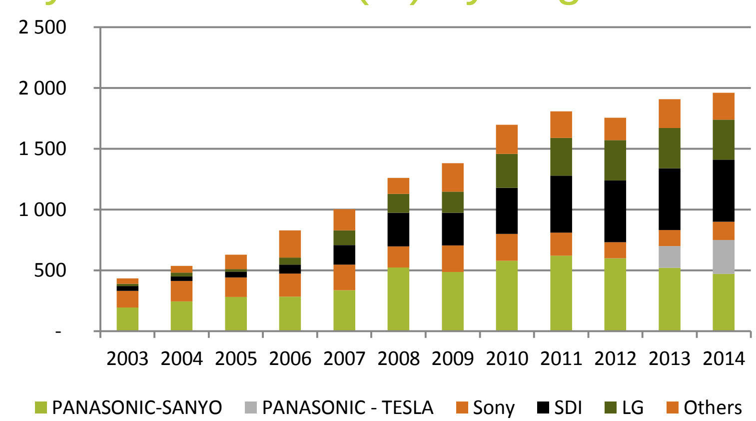
- Production speed (-> cost)
- Performances
- Customer (Portable PCs) access

Production Speed: 18650 – 2,8Ah cells



Note: [1] ppm: piece per minutes

Cylindrical cells (M) by mfg.



Source: Interviews with LG, SAMSUNG, SANYO-PANASONIC

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

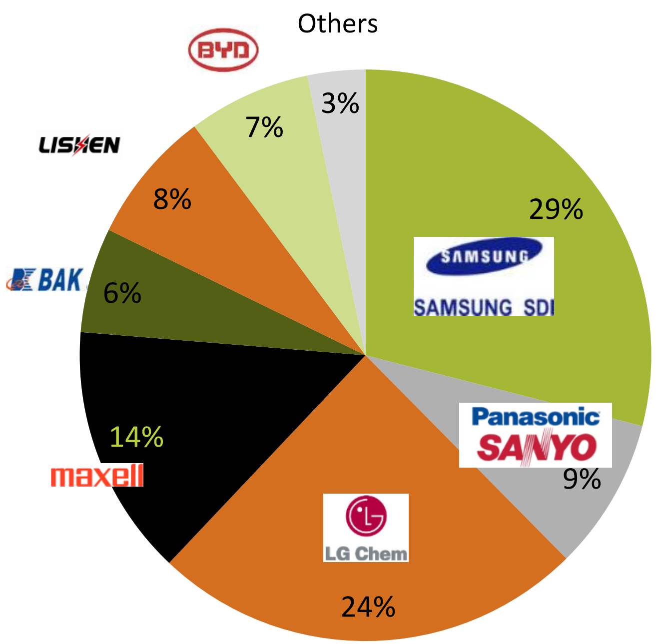
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

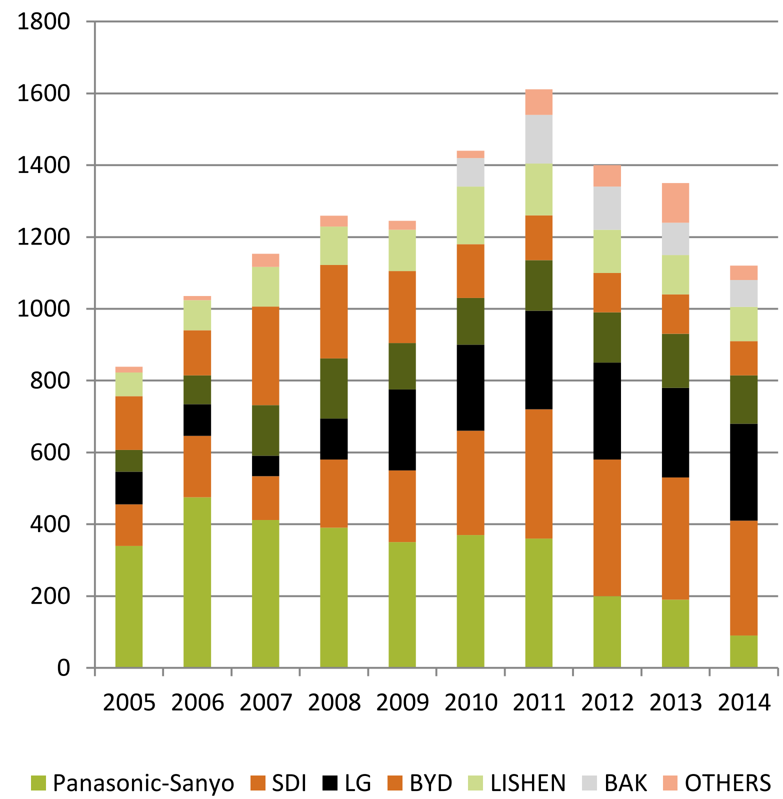
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

PRISMATIC LI-ION BATTERY

Prismatic LIB market Company market share in 2014 in volume: 1120 Million cells (-10%)



Prismatic cells (M) by Mfg. : SAMSUNG is leading



Source: AVICENNE ENERGY Analyses 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

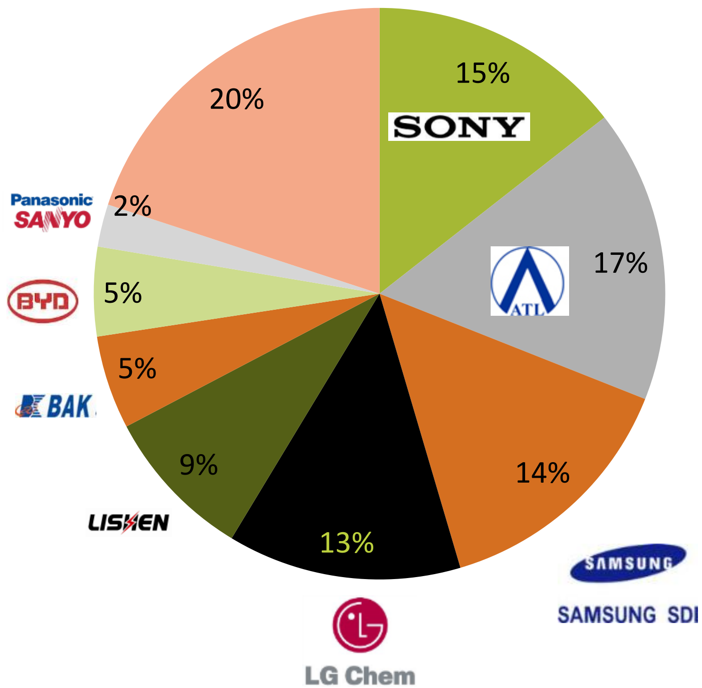
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

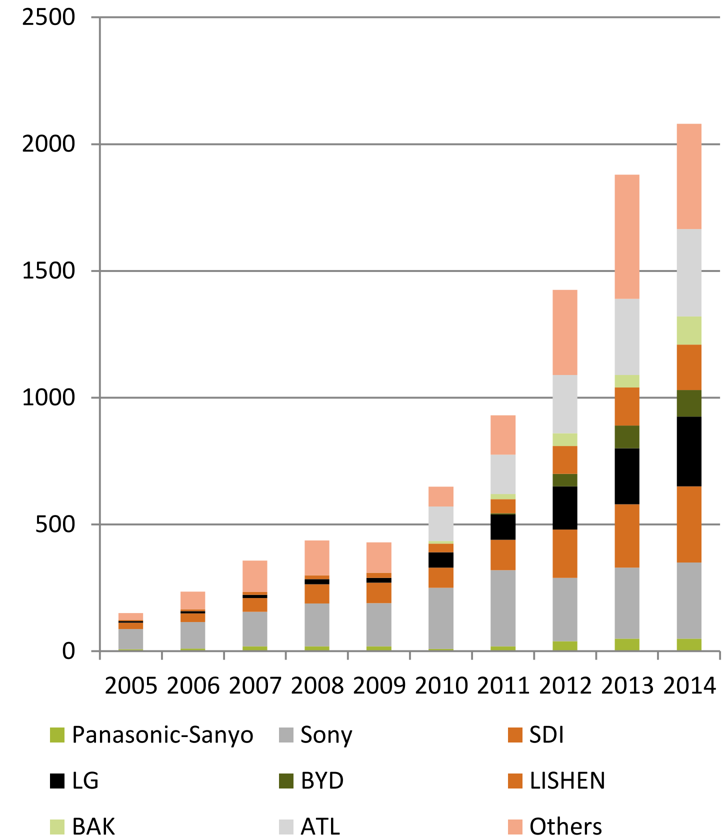
LI-LAMINATE BATTERY

Laminate battery market Company market share in 2014 in volume: 2 080 Million cells (+15%)



Source: AVICENNE ENERGY Analyses 2015

Pouch cells (M) by Mfg. SONY, ATL and SAMSUNG are leading this market



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

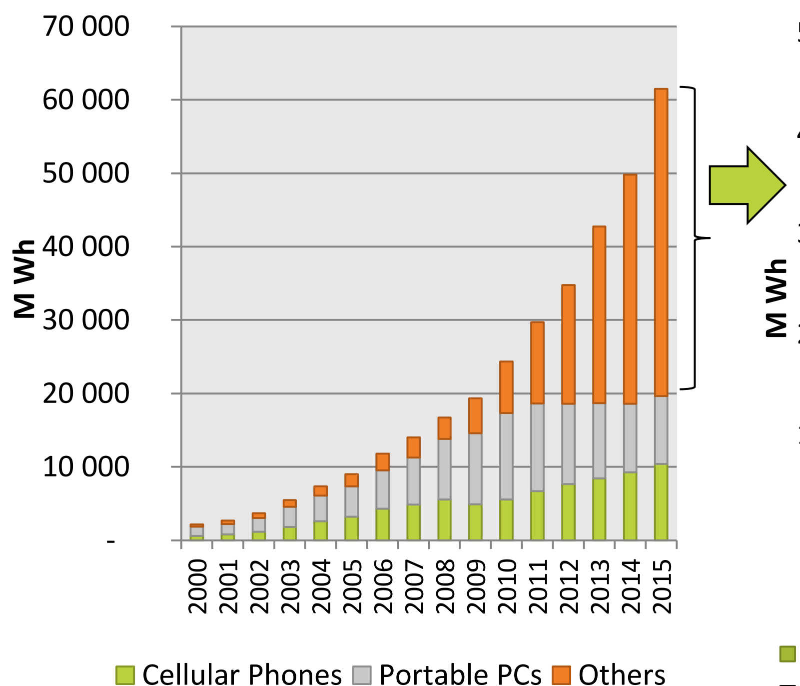
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LI-ION IN 2014
MAIN APPLICATIONS

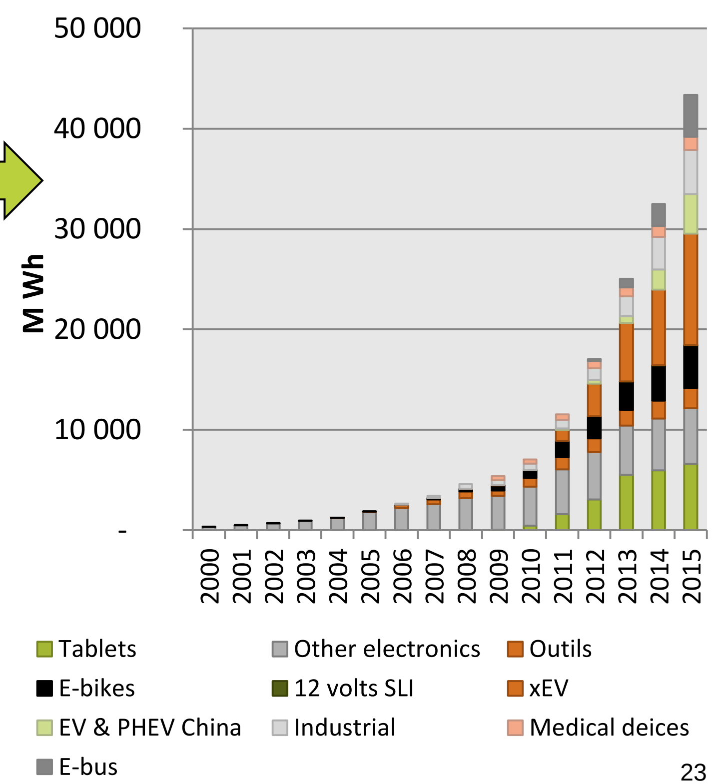
5 250 M cells – 50 000 MWh
13 600 M$ (2)

CAGR 2004/2014
+20 % per year in Volume
+14% per year in value

Li-ion Battery sales, MWh, Worldwide, 2000-2015 (1)



Li-ion Battery sales, MWh, Worldwide, 2000-2015



(1) *2015 estimation data*
(2) *Cell level*

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

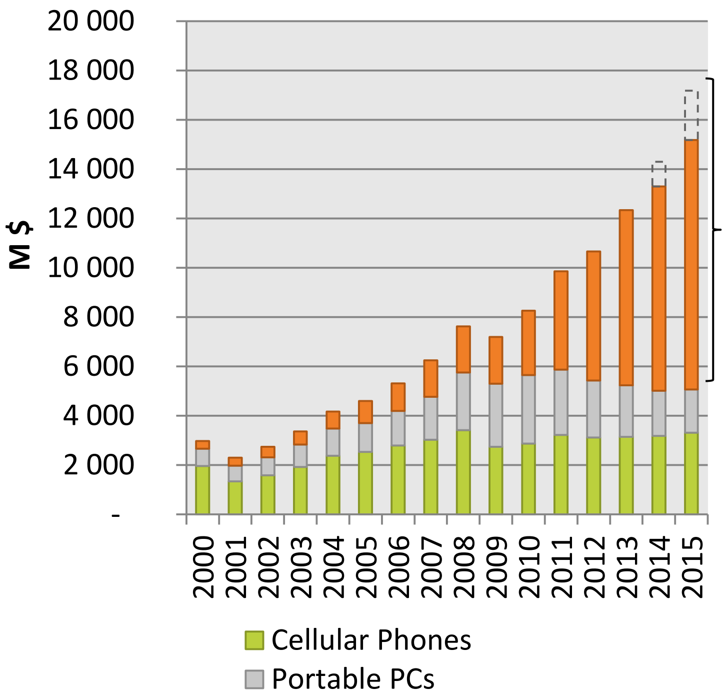
LI-ION IN 2014
MAIN APPLICATIONS

5 250 M cells – 50 000 MWh

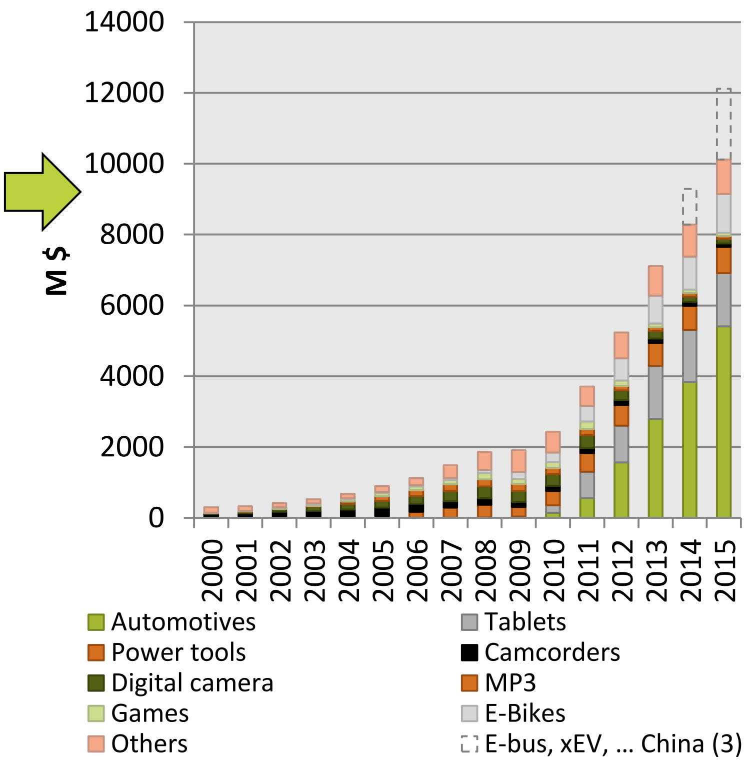
13 600 M$ (2)

CAGR 2004/2014
+20 % per year in Volume
+14% per year in value

Li-ion Battery sales, M$, Worldwide, 2000-2015 (1)



Li-ion Battery sales, M$, Worldwide, 2000-2015 (1)



(1) 2015: Avicenne Forecasts

(2) Cell level

3) New market detected in China – 30 000 E-bus sold in 2014

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

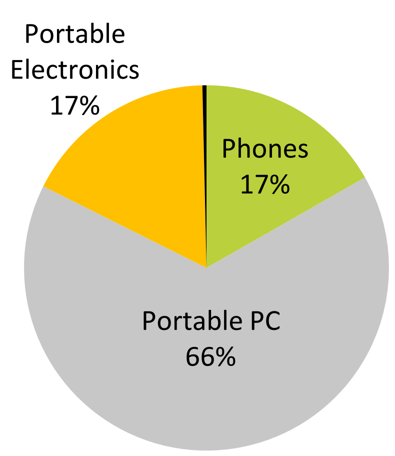
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB MAIN APPLICATIONS

From Portable devices to Automotive & industrial batteries

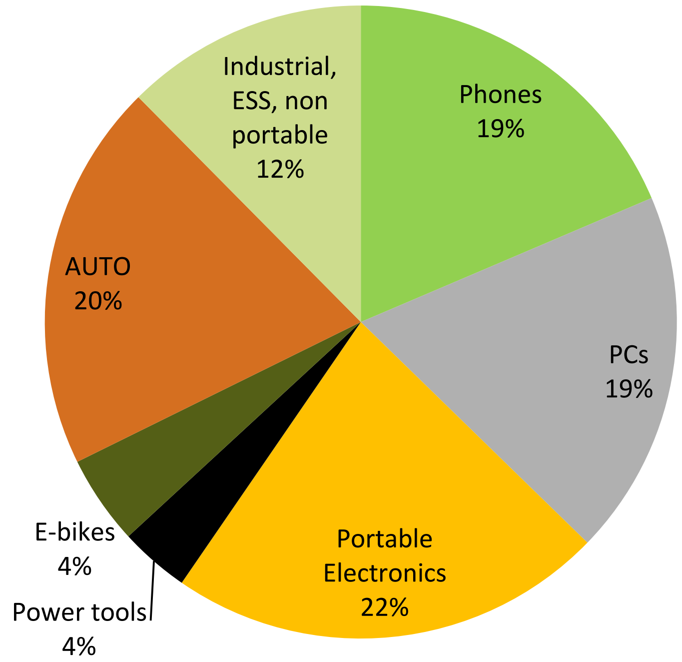
Li-ion battery market worldwide by application in volume, **2000**

(< 2 GWh)



Li-ion battery market worldwide by application in volume, **2014**

(50 GWh)



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

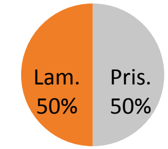
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

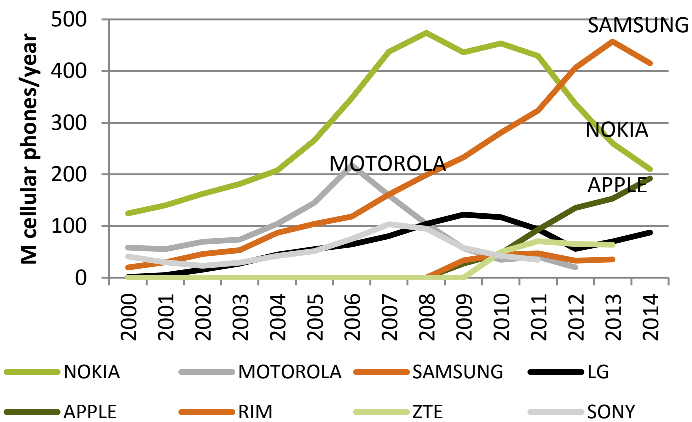
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

CELLULAR PHONES MARKET > 1980 M LIB CELLS IN 2014

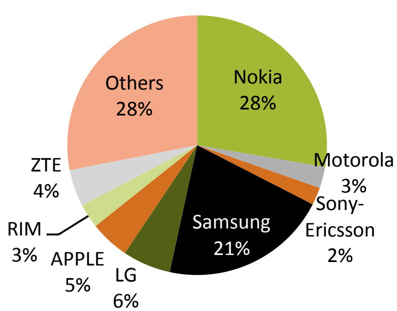


LIB cell format (Volume) 2014

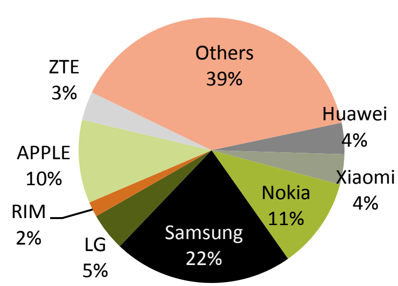
+1800 M cell phones sold in 2013 (+7% CAGR)



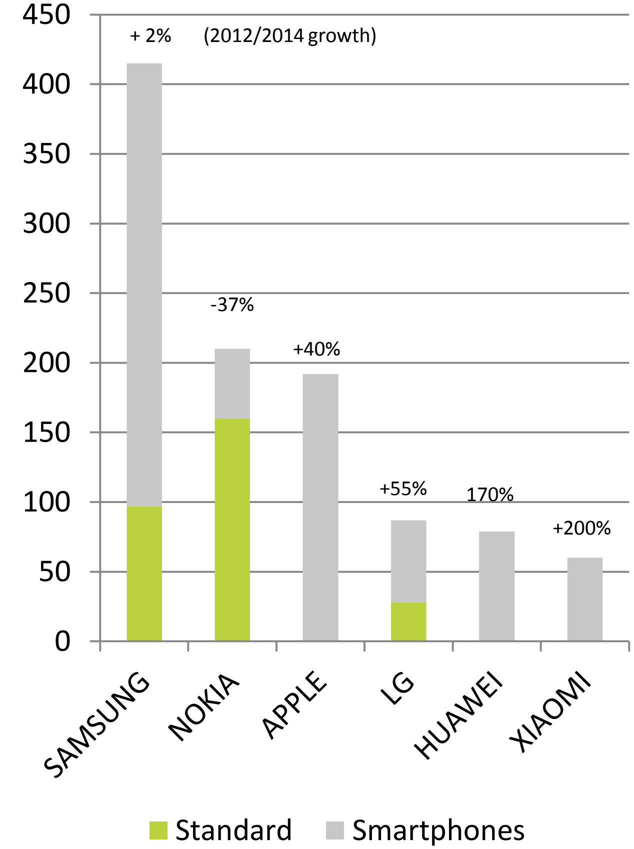
2012
1630 M Phones



2014
1900 M Phones



Samsung Galaxy & I-phone change the game



The Rechargeable Battery Market and Main Trends 2014-2025

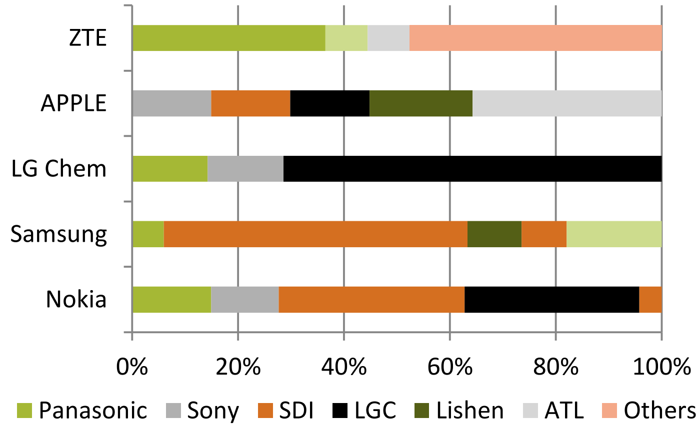
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

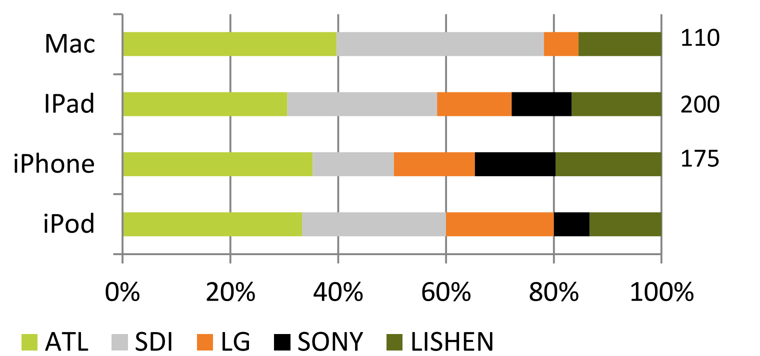
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

CELLULAR PHONES/LIB SUPPLIERS RELATIONSHIPS

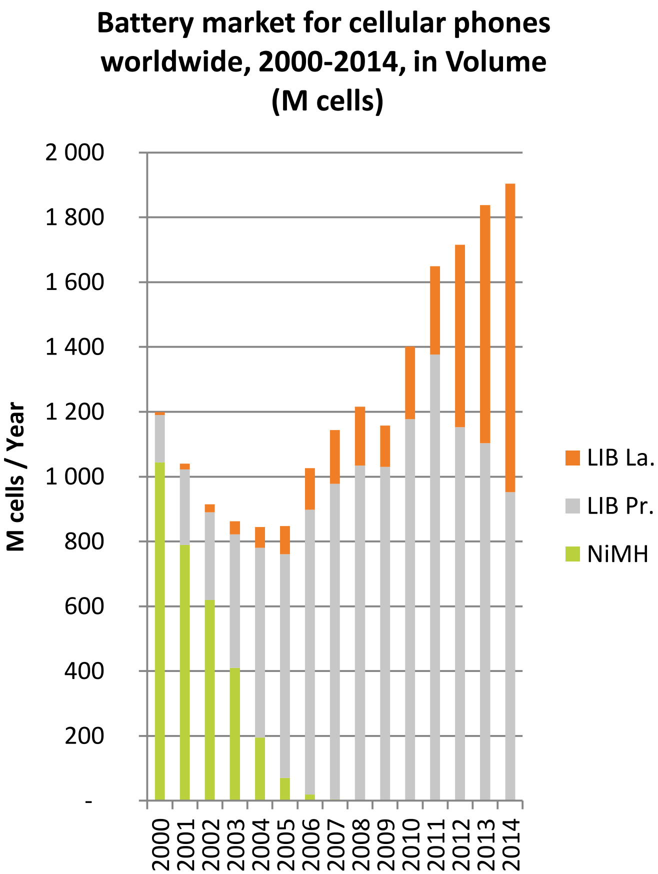
2014 Cellular Phone makers / battery suppliers relation



APPLE needs in 2014



Smartphones *ie* laminate LIB increasing



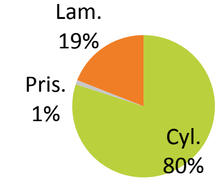
avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

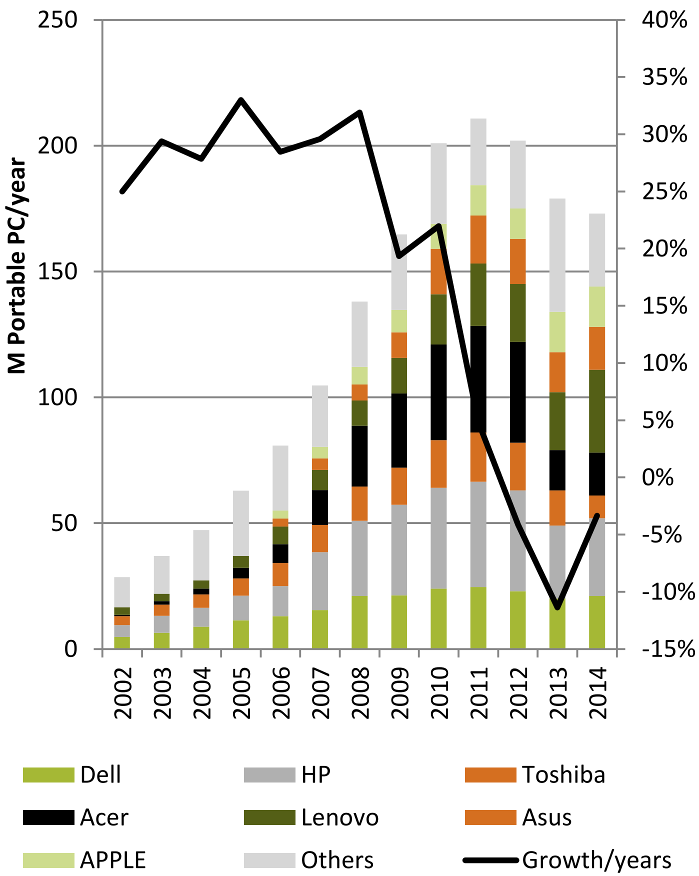
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

PORTABLE PC MARKET 990 M LIB CELLS IN 2014



LIB cell format (Volume) 2014

173 M portable PCs sold 2013/2014: -4%

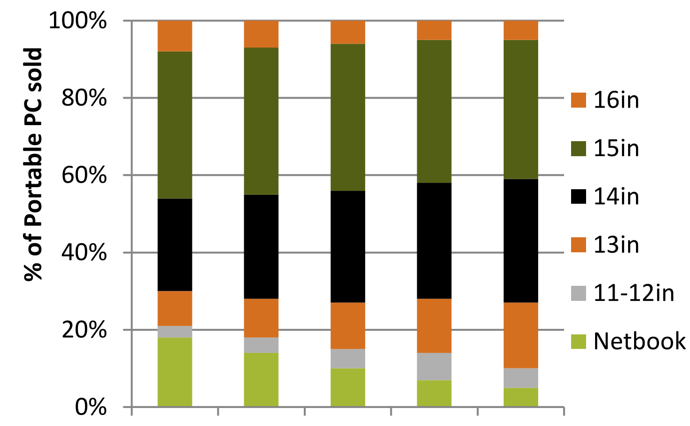


Note: Excluding Tablets

Market outlook 2014

- Uncertain macro & weakness in both consumer & commercial growth
- No sign for end-customer demand recovery
- Decrease due to cannibalization by tablets
- Small overall decrease only thanks to Emerging market growth

Increase of Ultra-thin Portable PCs



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

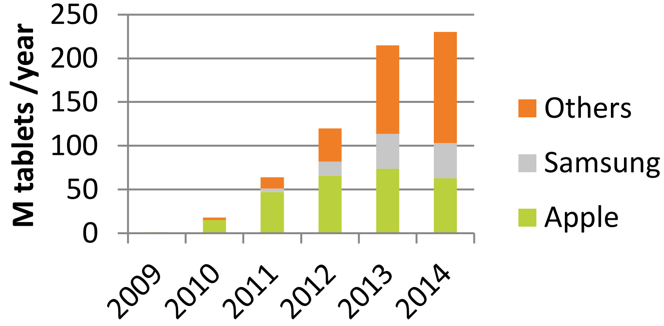
TABLET MARKET > 550 M CELLS IN 2014

Lam. 100%

LIB cell format (Volume) 2014

Tablets sold (Million)

Apple leadership



Source: Gartner, IDC, Display search – 2013: AVICENNE Estimation

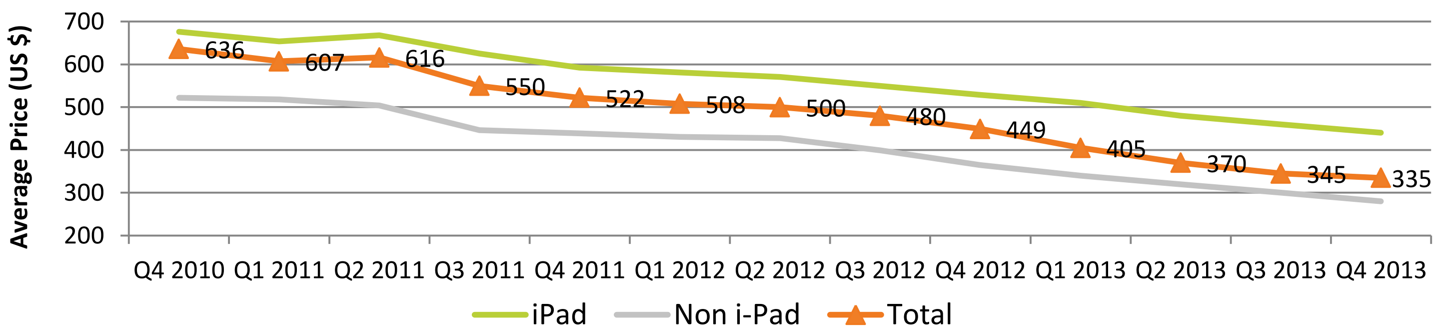
Others 2014: Asus 11,5 M, Lenovo 11,2 M, Amazon 3,3 M…

Market Outlook 2014

- Lower growth (7% only).
- Growth driven by
  - mature market (77%)
  - consumer market (95%)
- Apple (27%), Samsung (17%), Asus (5%), Acer, Lenovo, Amazon are the key competitors

ASP tablets drop

From \$636 in Q4 2010 to \$335 in Q4 2013: - 47% in 36 months



avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

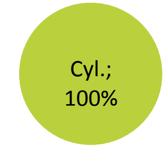
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

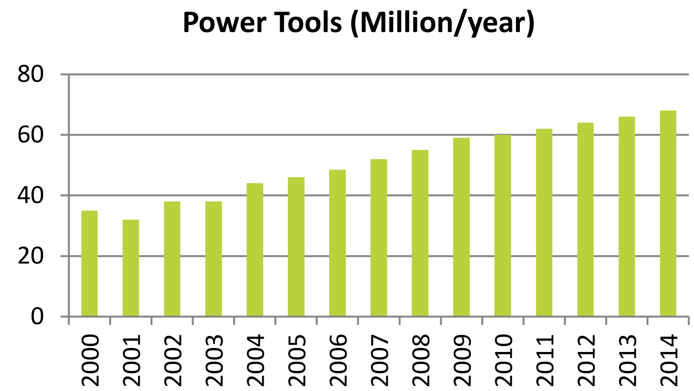
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

POWER TOOL MARKET LIB DEMAND IS GROWING

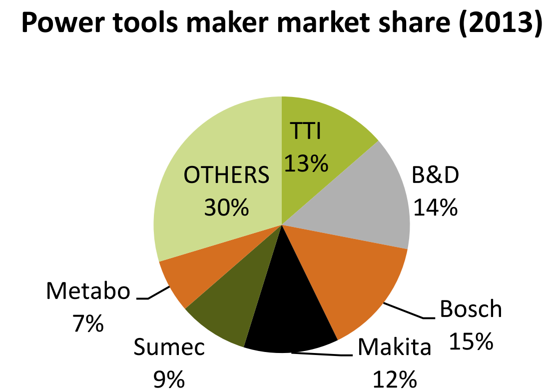


LIB cell format (Volume) 2014

Power tools market is growing

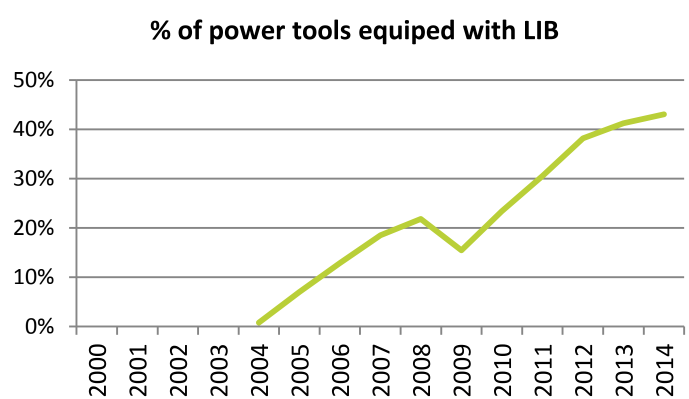


Power tools suppliers

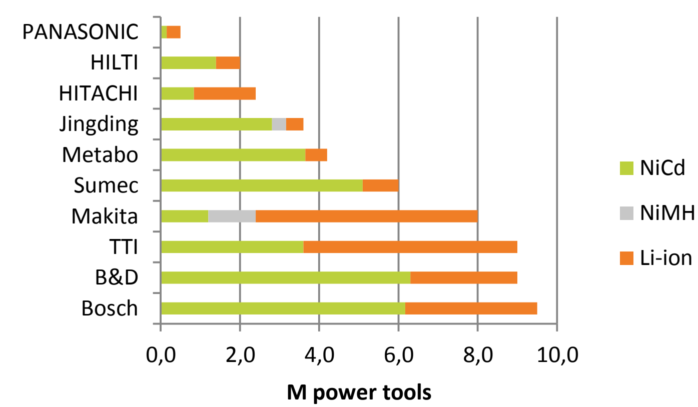


Others: Jingding (3.6 M), Panasonic (0.5 M), Hitachi (2.4 M), Hilti (2M)…

LIB penetration in power tools



Power tools maker battery choice



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

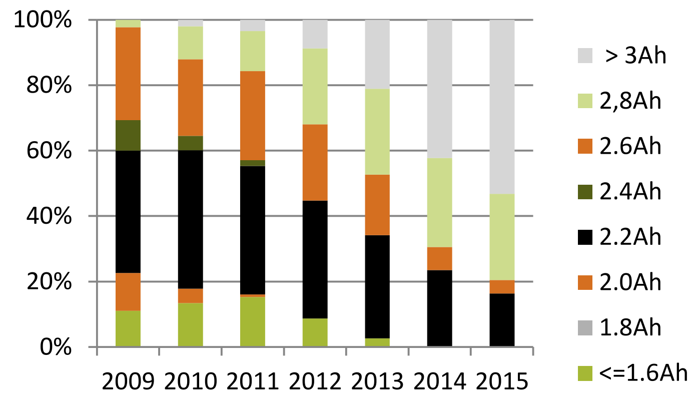
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

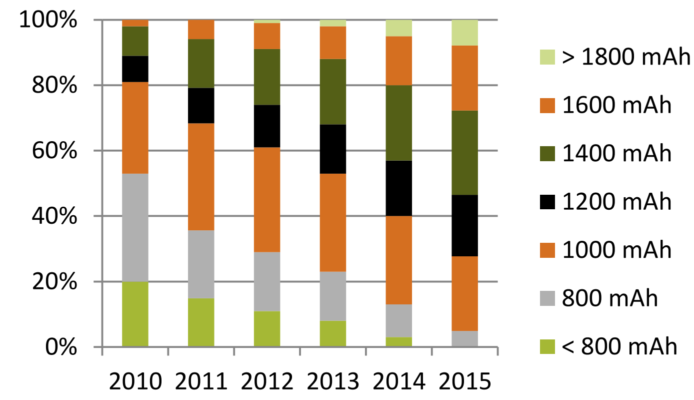
LIB BATTERY SHORT TERM TRENDS

18650 battery capacity*

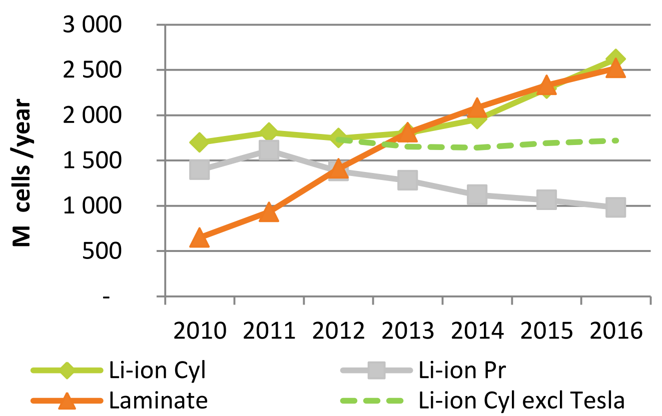


**1C rate or laptop type 18650 cells*

Cellular phones battery capacity

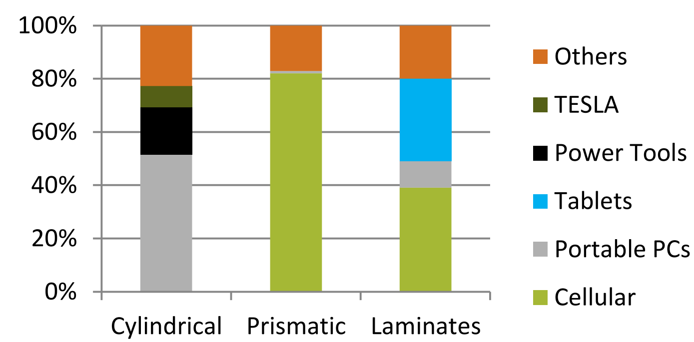


Cylindrical/Prismatic/Laminates



Li-ion cylindrical: "Tesla impact": 150 M cells in 2013, 300M in 2014, 600 M in 2015

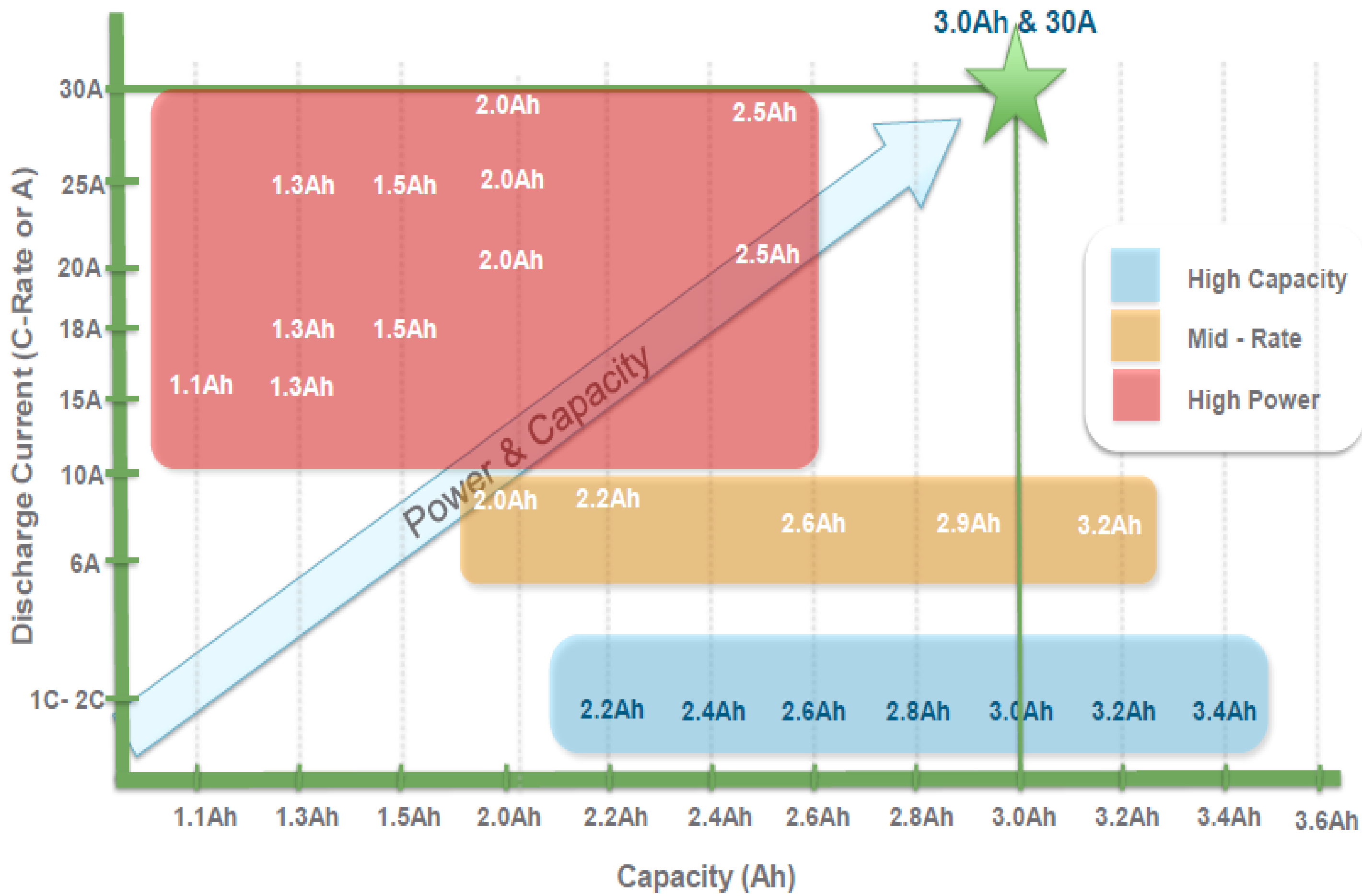
Cylindrical/Prismatic/Laminates in 2013



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

CYLINDRICAL LIB 18650 ROADMAP (CAPACITY + POWER)



Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

Source : ICCNEXERGY™

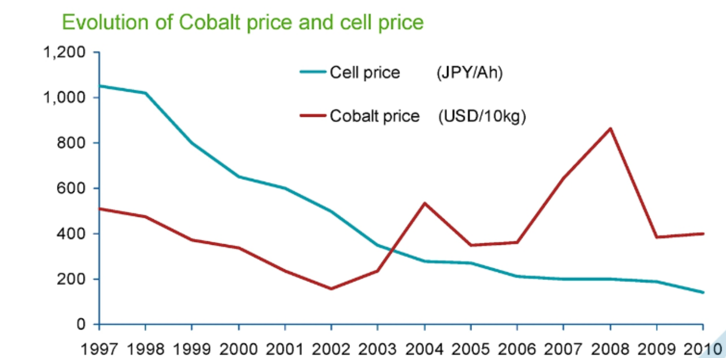
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

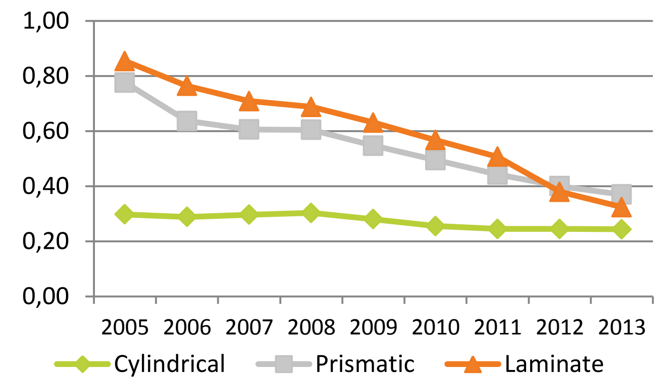
BATTERY PRICE IS DECREASING DRASTICALLY

In 10 Years 80% price decreasing despite a fluctuating Co price



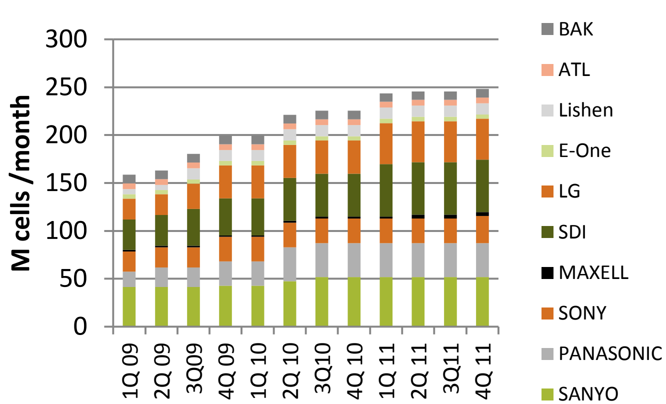
Source: UMICORE, march 2011

Average LIB cell price ($/Wh)

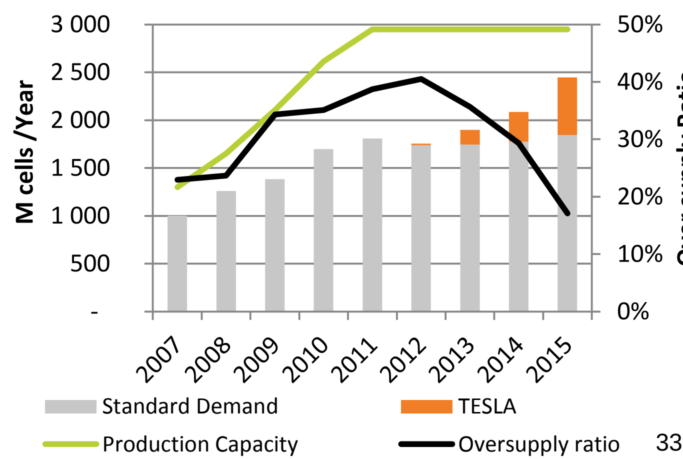


Note- Q4 2013: Cylindrical: 0,17 $/Wh ; Laminates: 0,3$/Wh

Production capacity 2009/2011: from 150 to 250 M cells/month



18650 oversupply ratio is decreasing thanks to TESLA



BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

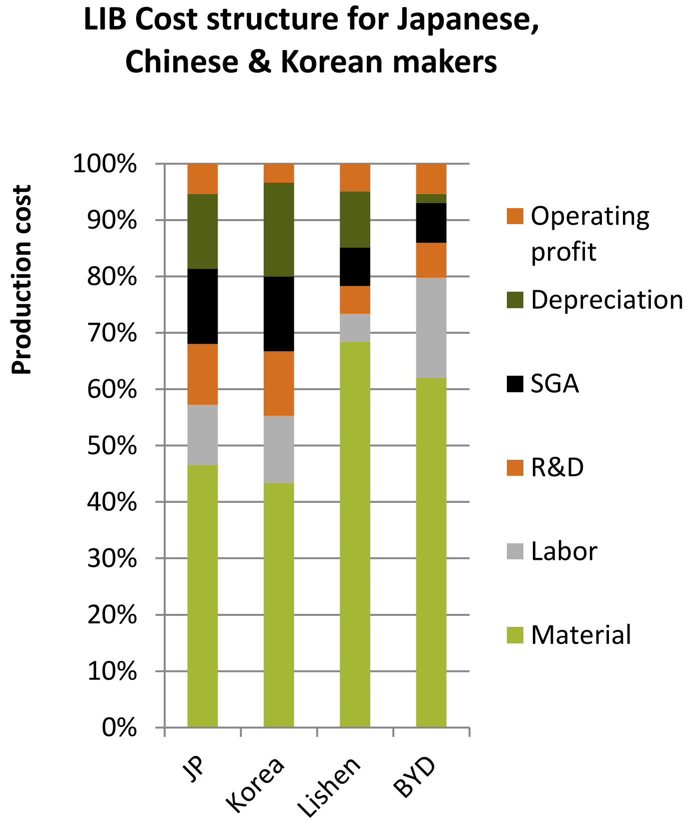
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

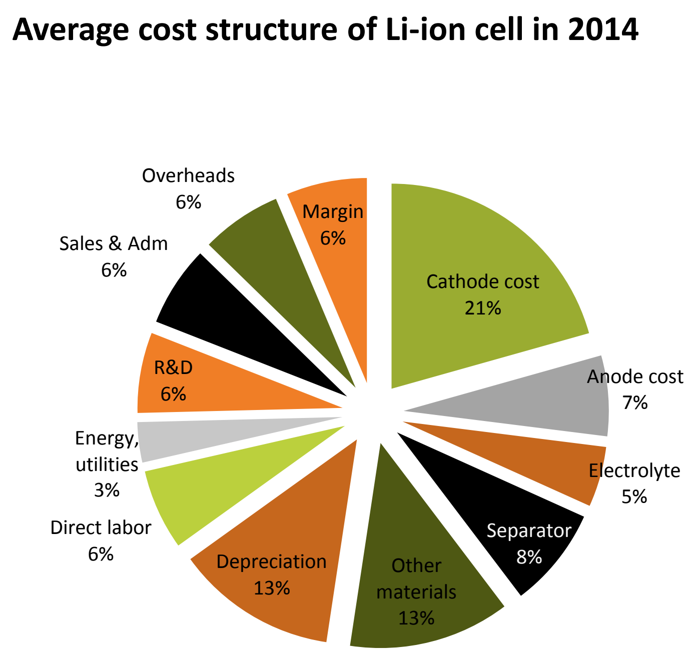
LIB: THE BIGGEST PART OF THE COST IS RAW MATERIALS

RAW MATERIALS ACCOUNT FOR 50 TO 80% OF LIB CELLS BUSINESS

RAW MATERIAL COST IMPACT DRASTICALY ON THE BATTERY MAKERS PROFIT



Note: Average mix of cylindrical, prismatic & laminate cells



Lithium ion cell average cost

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

LI-ION VALUE CHAIN – MARKET DEMAND

CATHODE
>110 000 T in 2014
Revenues: 2,5 B$
CAGR 04/14: +16%

ANODE
>55 000 T
Revenues: 0,8 B$
CAGR 03/13: +14%

ELECTROLYTE
>45 000 T
Revenues: 0,7 B$
CAGR 04/14 : 20%

SEPARATOR
> 700 M m²
Revenues: 1,15 B$
CAGR 04/14 : 18%

BINDER
7 500 Tons
Revenues: 0,2 B$
CAGR 08/13 : 15%

ANCILLARY
Revenues: 0,8 B$

→ CELL MANUFACTURERS
Revenues: 15 B$
Gross margin: <10%

→ PACK MANUFACTURERS
Revenues: 21 B$
Gross margin: <10%

→ **OEMs**

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT www.batteriesevent.com The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

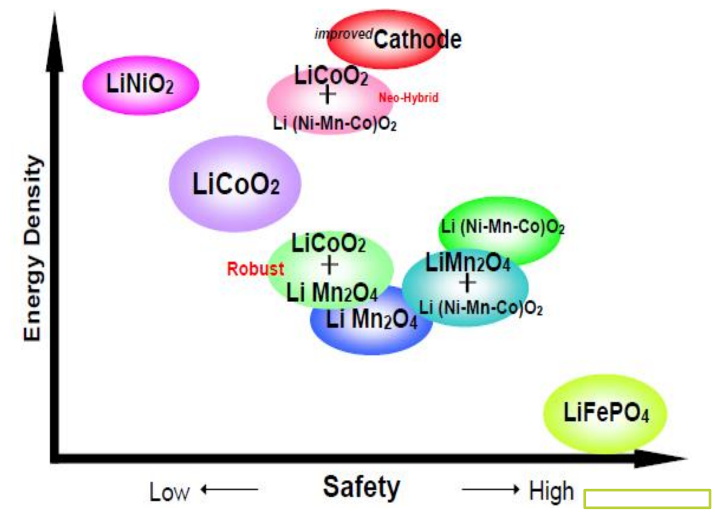
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

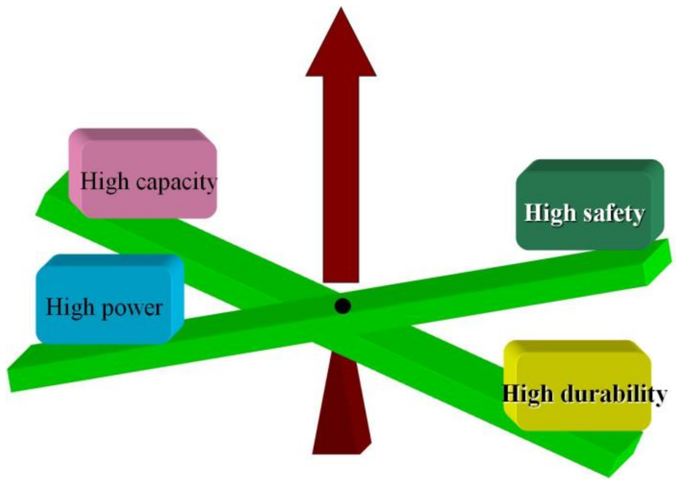
LIB CATHODE MATERIAL

- Cathode raw materials market
  - LiCoO2 (LCO)
  - LiMn2O4 (LMO)
  - LiMPO4[1] (LFP)
  - Li[NixMnyCoz]O2 - NMC
  - Li[NixCoyAlz]O2 – NCA
- Supplier/customer by chemistry
- Forecasts

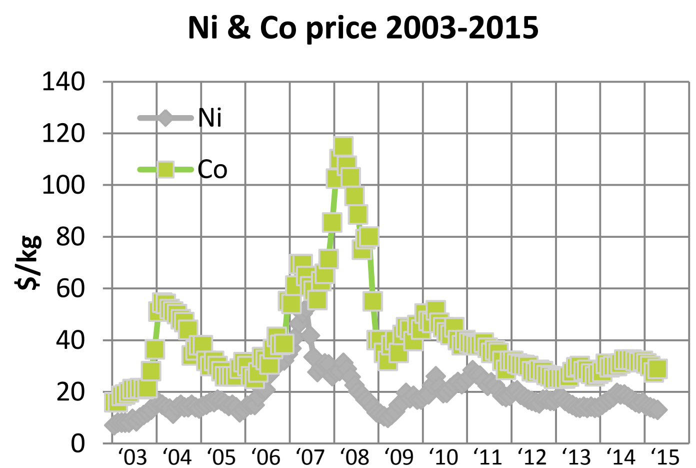
(1) M= Fe or Mn



Source: SANYO, March 2011



Source: Mitsubishi, Batteries 2012 – Nice



Source: LME

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

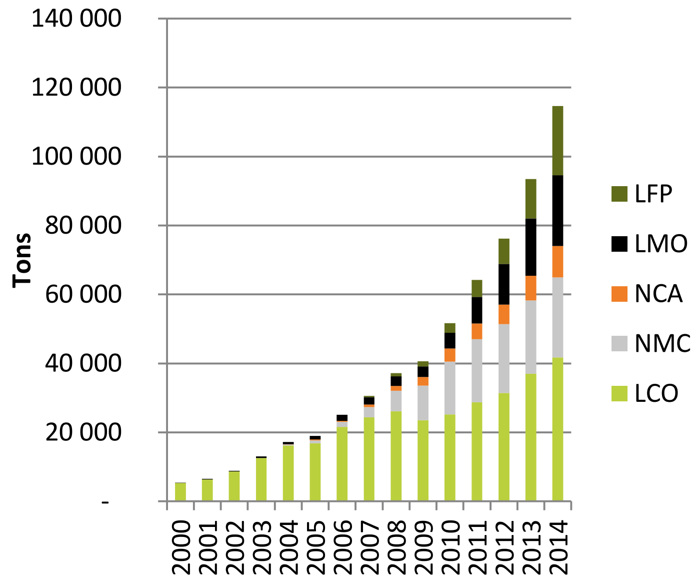
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

CATHODE ACTIVE MATERIALS NEEDS

Cathode active materials for LIB in Tons, 2000-2014 (**Demand**)



LEADERS:

umicore

NICHIA

当升科技 EASPRING

SHANSHANTECH

NEW ENTRANTS ON THE FIELD:

LG Chem

MITSUBISHI

3M

DOW

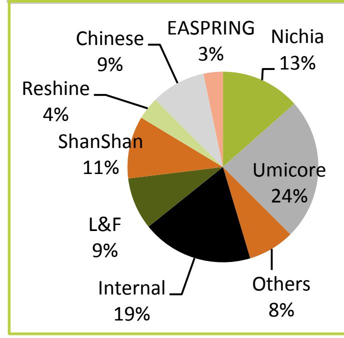
BASF The Chemical Company

DUPONT

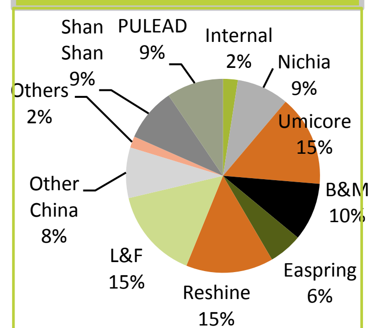
(…)

SUPPLY

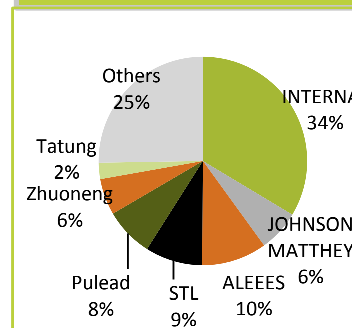
NMC – > 25 KT (2014)



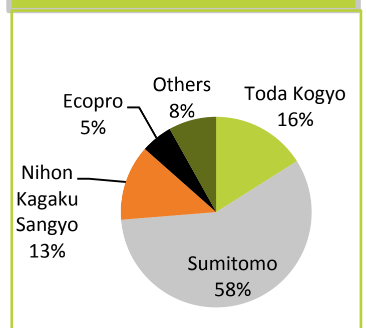
LCO – >45 KT (2014)



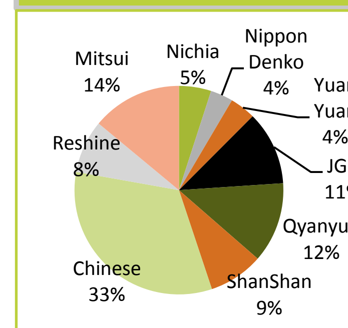
LFP – > 20 KT (2014)



NCA – > 10 KT (2014)



LMO – > 18 KT (2014)



The Rechargeable Battery Market and Main Trends 2014-2025

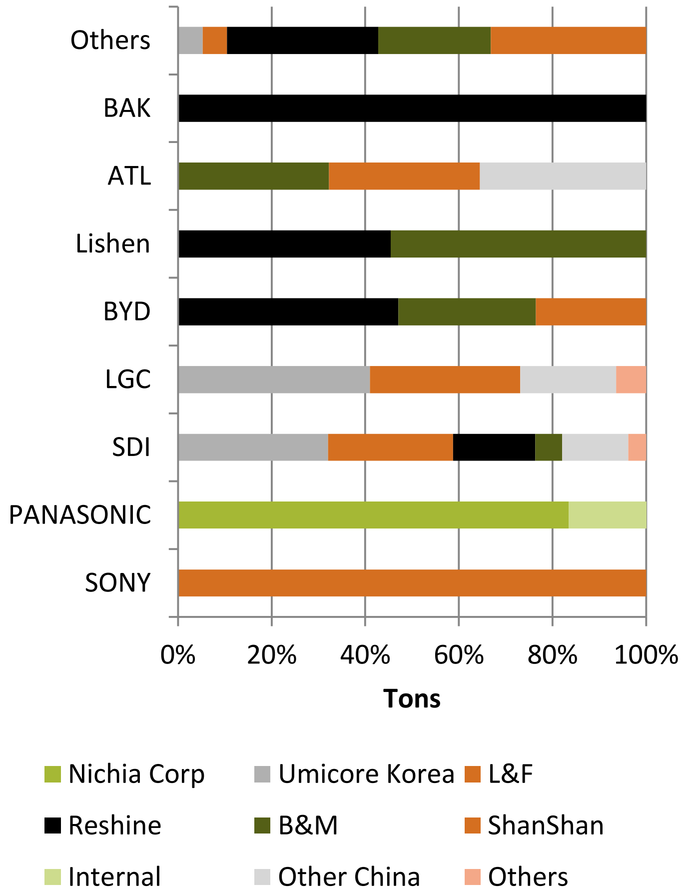
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

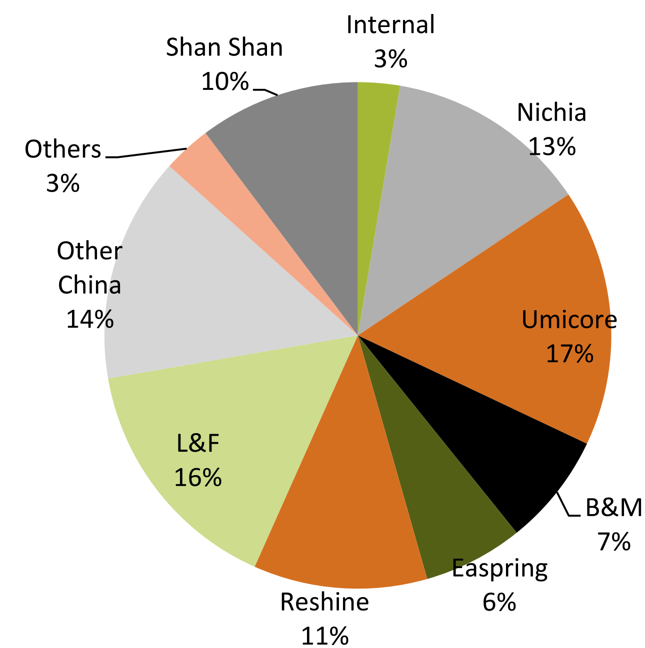
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LCO SUPPLIERS/CUSTOMERS IN 2014 SUPPLY >45 000 TONS IN 2014

LCO Battery makers & suppliers relation in 2014



LCO market share in 2014 (Volume)



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

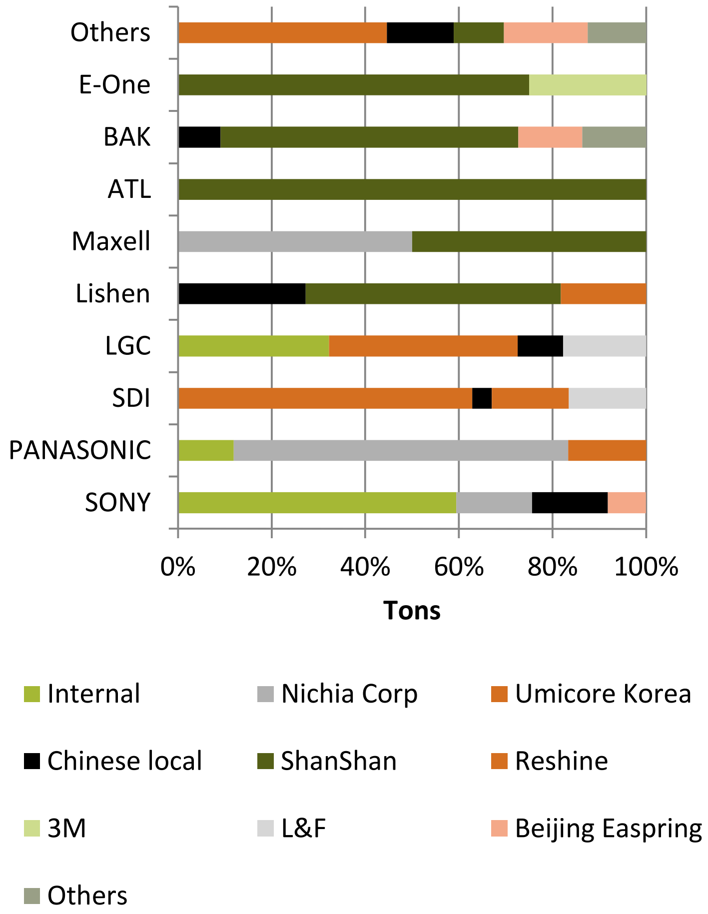
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

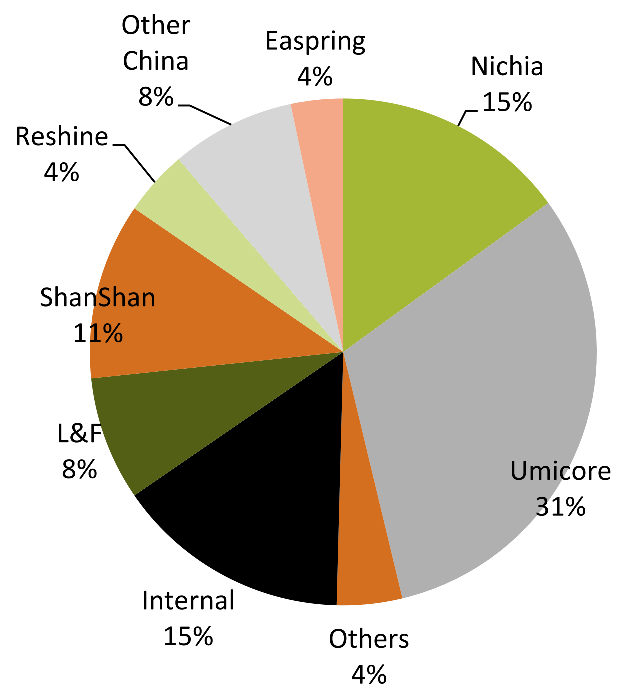
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

NMC SUPPLIERS/CUSTOMERS IN 2014 SUPPLY > 25 000 TONS IN 2014

NMC Battery makers & suppliers relation in 2014



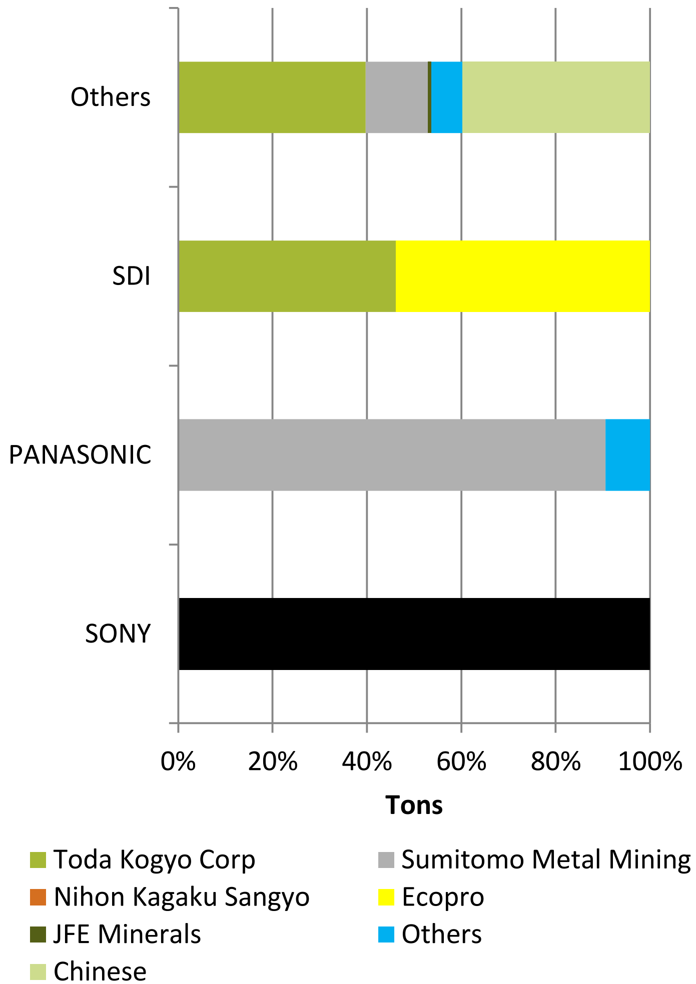
NMC market share in 2014 (volume)



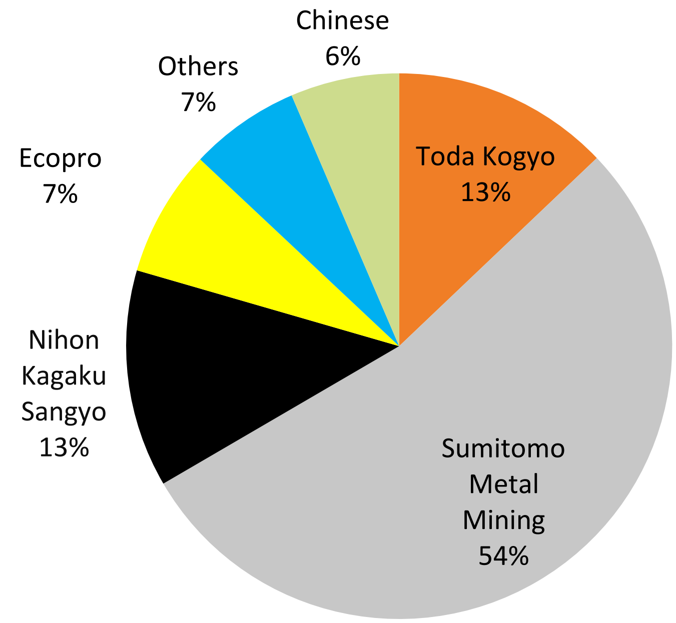
avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

NCA SUPPLIERS/CUSTOMERS IN 2013
SUPPLY > 9 000 TONS IN 2014

NCA Battery makers & suppliers relation in 2014



NCA market share in 2014 (Volume)



The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

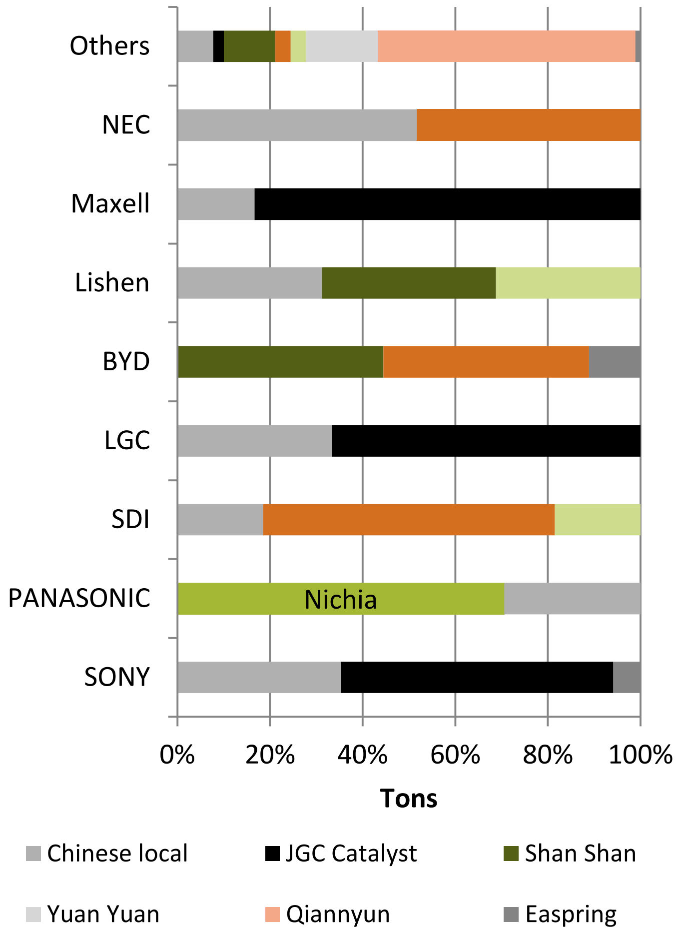
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

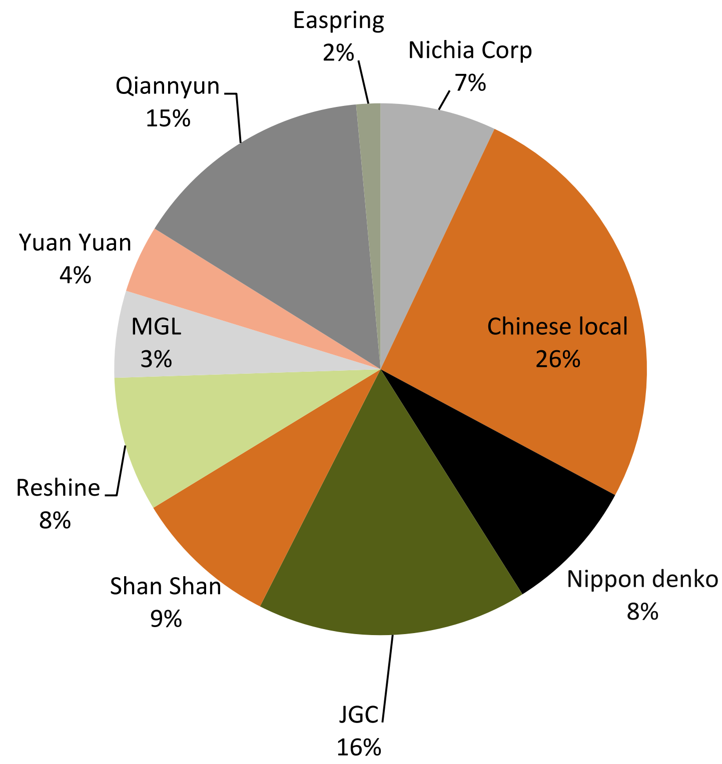
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LMO SUPPLIERS/CUSTOMERS IN 2014 SUPPLY >18 000 TONS IN 2014

LMO Battery makers & suppliers relation in 2014



LMO market share in 2014



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

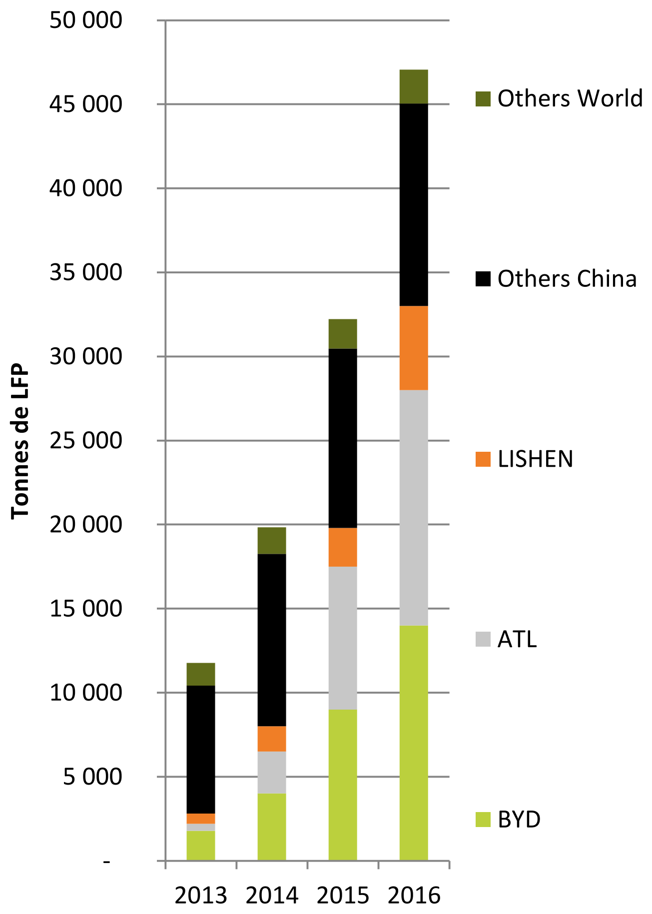
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

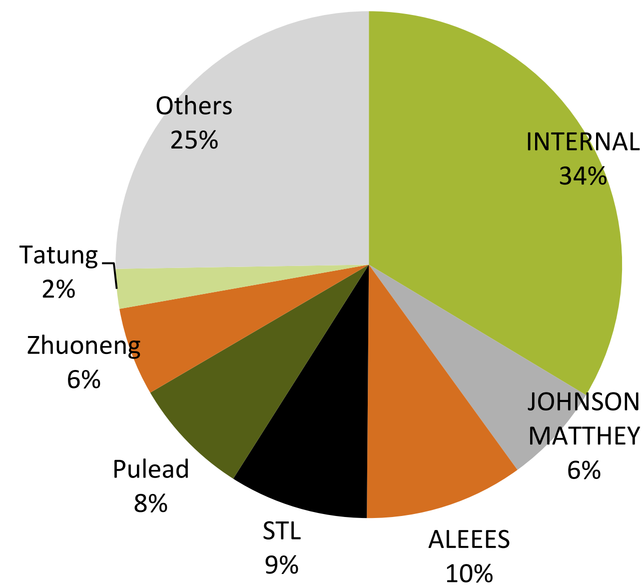
LFP SUPPLIERS/CUSTOMERS IN 2014 SUPPLY - 20 000 TONS IN 2014

LFP market is icreasing drasticaly, mostly in China



2015, 2016 : AVICENNE forecasts

LFP market share in 2014



Others: Sumitomo, BeLife (Umicore-Prayon), BASF, etc…

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

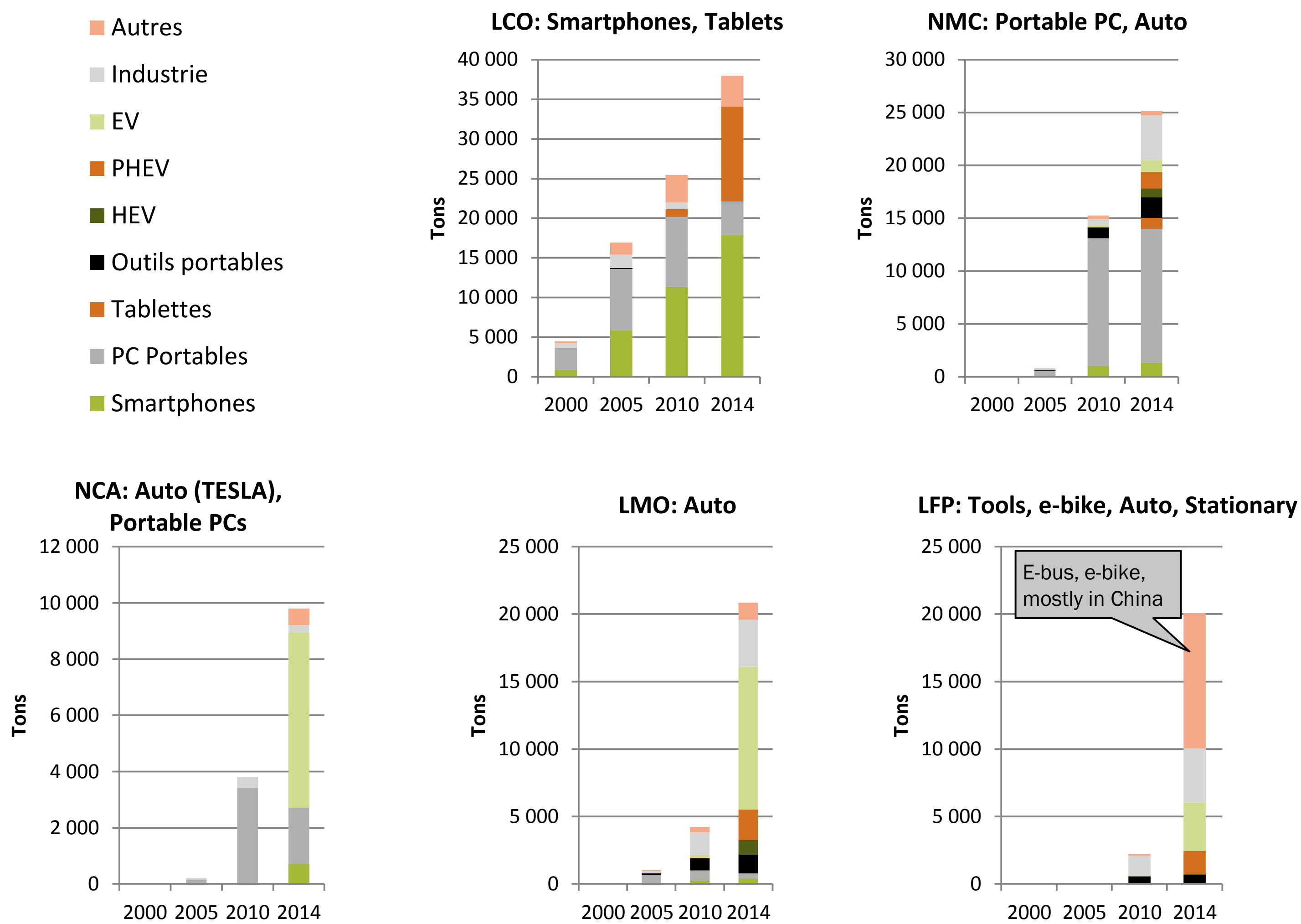
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

CATHODE ACTIVE MATERIAL DEMAND MAIN DRIVER APPLICATIONS



Sources: AVICENNE ENERGY Analyses

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

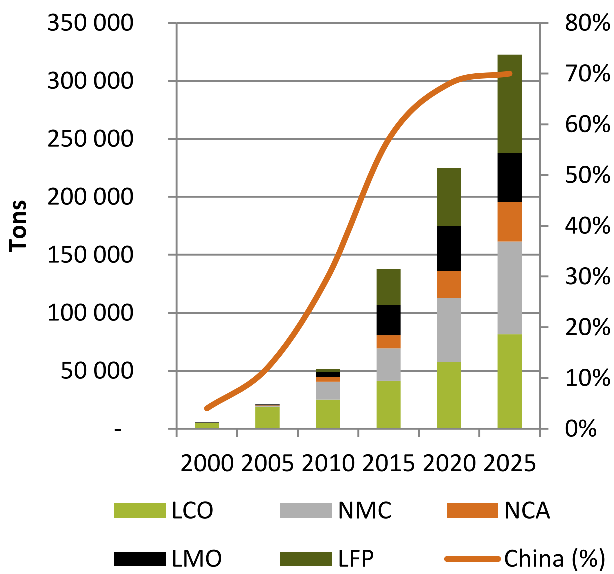
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

CATHODE ACTIVE MATERIAL FORECASTS 2000-2025

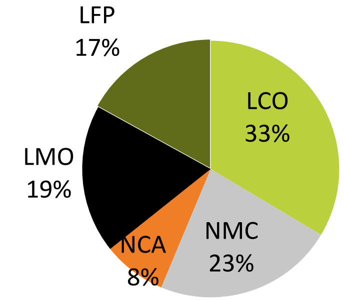
Cathode active materials 2000-2025 - Tons



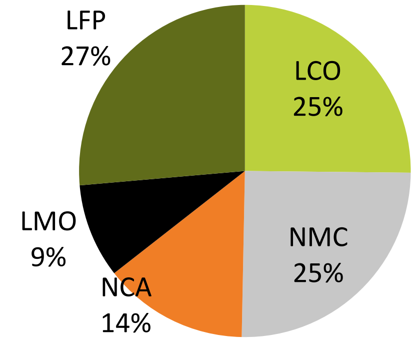
ASSUMPTIONS:

- Portable devices:
  2013-2025: +11% per year in volume
- HEV
  4,8 M HEV/year in 2020 - 35% LIB
  6,8 M HEV in 2025 90% LIB
- P-HEV
  0,4 M P-HEV/year in 2020, 0,7 M in 2025
  100% LIB
- EV
  1M EV/year in 2020, 1,5M/year in 2025
  100% LIB
- Industrial & stationary
  2013-2025: +16% per year

Cathode active materials in 2014: > 110 000 Tons



Cathode active materials in 2025: > 300 000 Tons



Assumption: Tesla keep NCA chemistry and have a relative success (200 000 EV sold per year in 2025 – TESLA forecast 500 000)

LFP part could be higher thanks to explosion of Chinese EV market

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

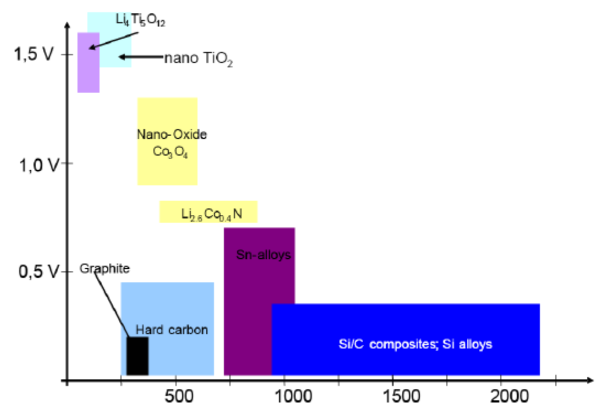
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

ANODE ACTIVE MATERIALS > 55 000 TONS IN 2014

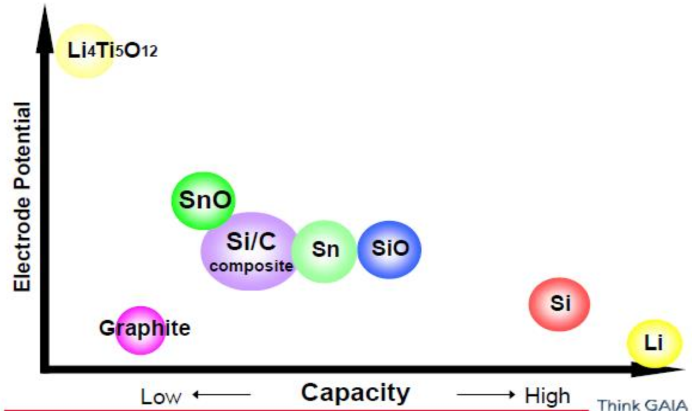
LIB Anode Materials



Source: A. Jossen, IRES 2007

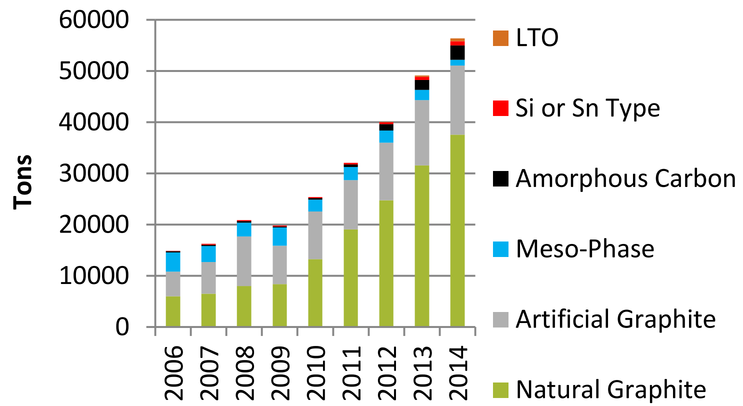
Source: Hitachi Chemical

LIB Anode Materials



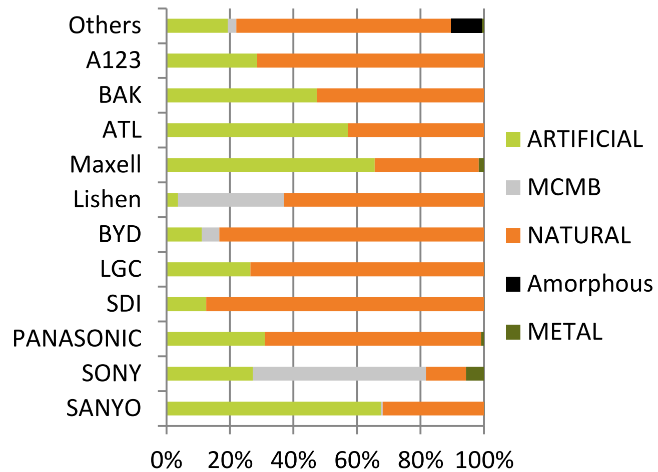
Source: Sanyo, March 2013

LIB Anode market, (Tons)

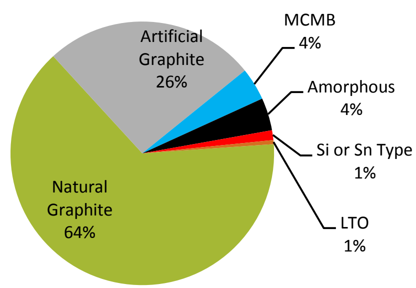


ANODE FOR LIB IN 2014

Natural graphite become a commodity



Carbon for LIB anodes by type (2013)



Note: MCMB: Mesocarbon Microbeads

	Hard Carbon	Soft Carbon	Graphite
Capacity (/g)	400 mAh/g	250 mAh/g	325-375 mAh/g
Capacity (/cc)	++	0	+
Power	++	+	0
Stability	++	+	0
Cyclability	++	+	0
Precursors	Petroleum Pitch, Resin, cellulose, wood, coconuts…	Petroleum coke	Natural or petroleum coke
COST 2012->2020	30 -> 25 $/kg	25->20 $/kg	15 -> 10 $/kg
SUPPLIERS	KUREHA	HITACHI	HITACHI BTR & many others

LEADERS:

HITACHI

BTR power your life

Nippon Carbon

NEW ENTRANTS ON THE FIELD:

3M DUPONT DOW envia Shin-Etsu DOW CORNING

(…)

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT www.batteriesevent.com The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

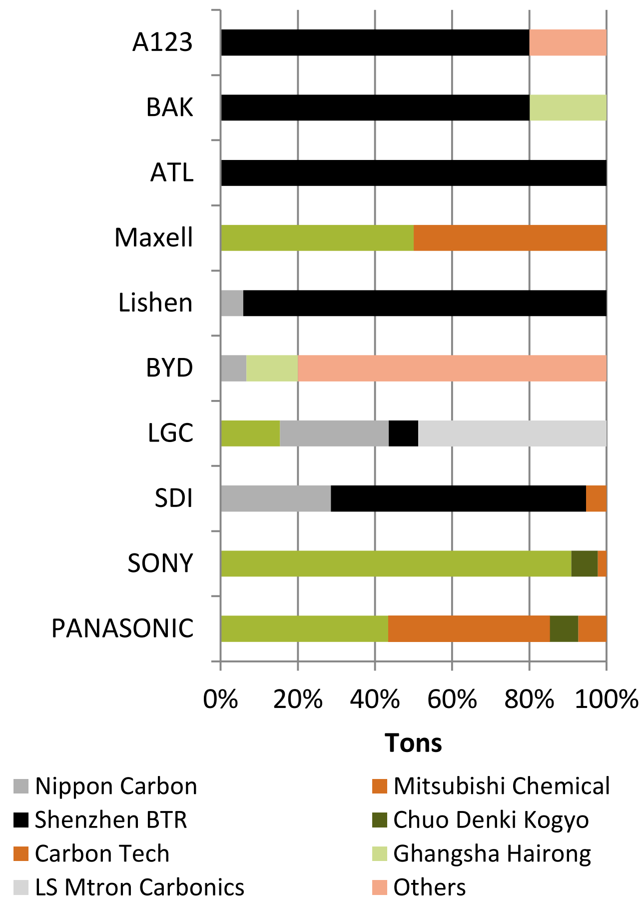
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

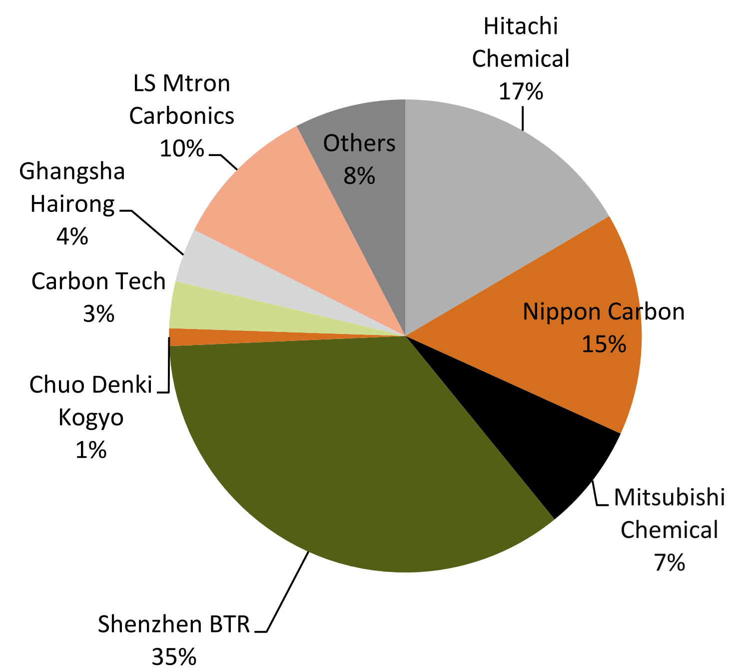
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

NATURAL GRAPHITE SUPPLIERS/CUSTOMERS 38 000 TONS IN 2014

Natural Graphite Battery makers & suppliers relation in 2014



Natural Graphite market share in 2014



Others: Sumitomo, Mitsui, LG, etc…

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

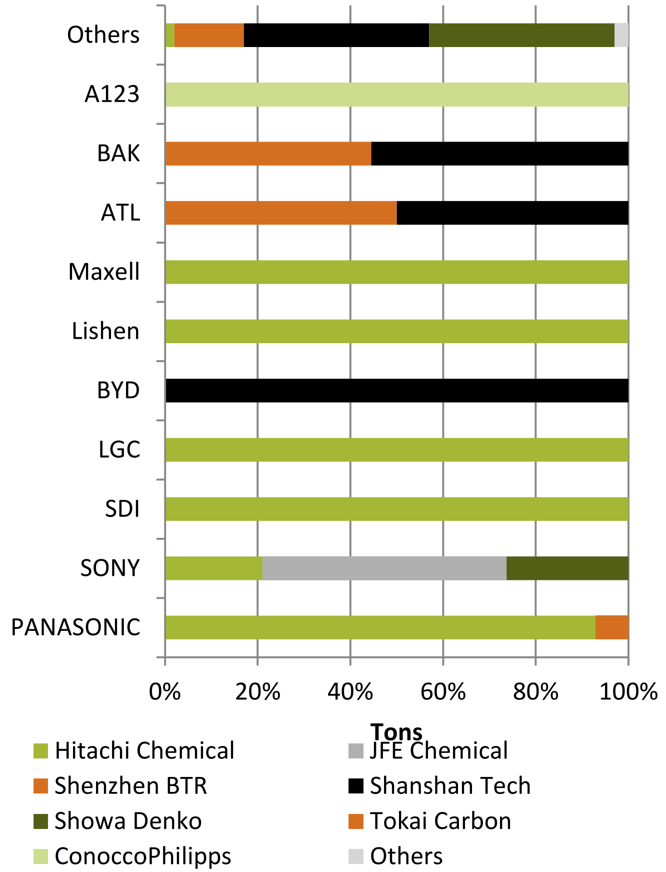
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

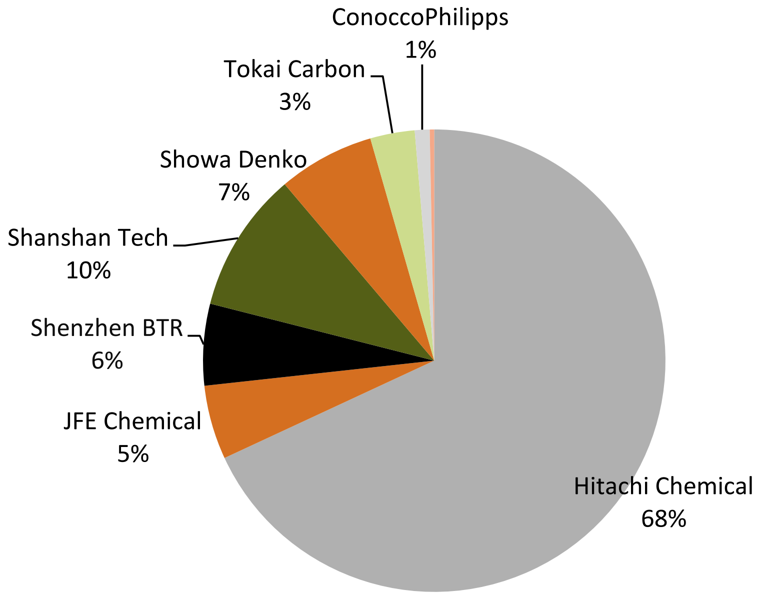
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

ARTIFICIAL GRAPHITE 14 000 TONS IN 2014

Artificial Graphite Battery makers & suppliers relation in 2014



Artificial Graphite market share in 2014



avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

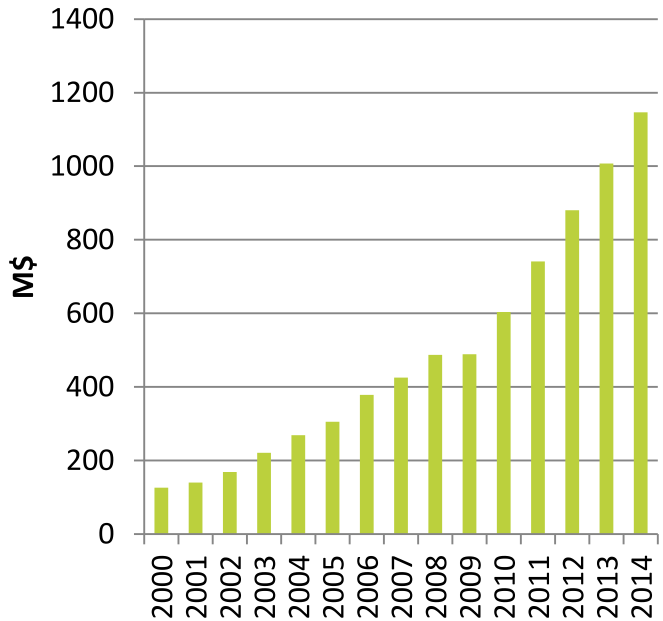
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

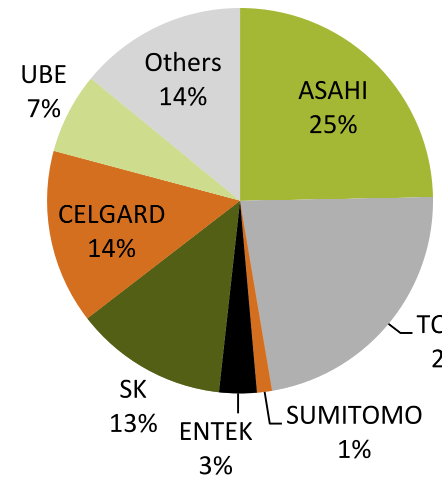
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB SEPARATOR MARKET 2014

LIB separator market, M$, CAGR 2004/2014: +17%



LIB Separator supplier, market share in 2014



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

LEADERS:

AsahiKASEI, CELGARD, UBE, ENTEK INTERNATIONAL, TORAY

NEW ENTRANTS ON THE FIELD:

DUPONT, LG Chem, DOW, MITSUBISHI

Evonik, TEIJIN,
HIFUTURE, UBE-MAXELL (…)

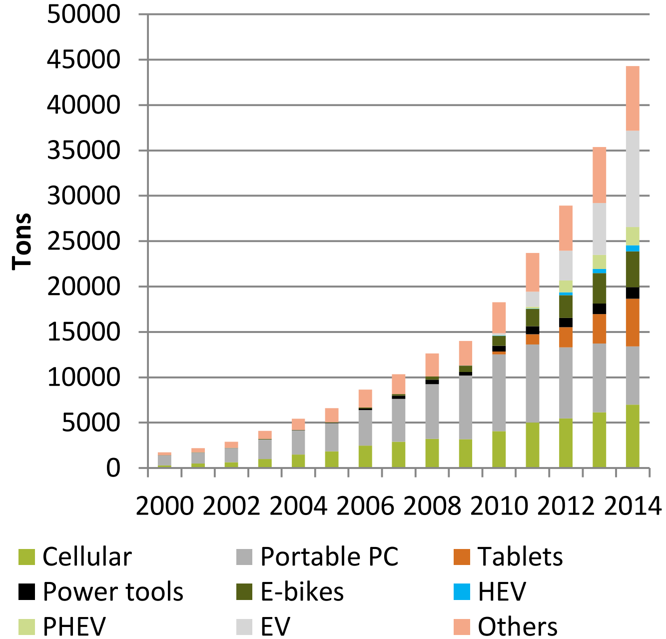
avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

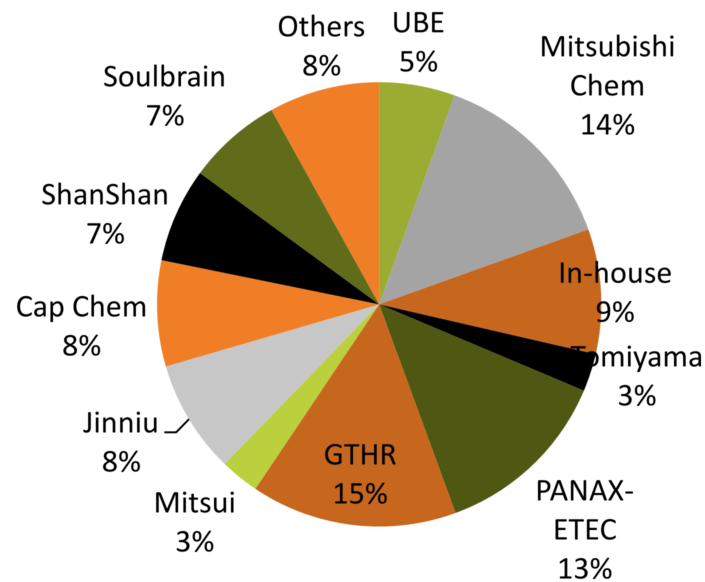
BATTERIES 2015
October 6, 2015
Nice, FRANCE

ELECTROLYTE SUPPLIERS/CUSTOMERS 44 000 TONS IN 2014

LIB electrolyte market, Tons, CAGR 2004/2014: +23%



LIB electrolyte supplier, market share in 2014



LEADERS:

MITSUBISHI
panaX etec
UBE
SHANSHANTECH
Zhangjiagang Guotai-Huang
JINNIU

NEW ENTRANTS ON THE FIELD:

LG Chem
BASF The Chemical Company
Dow
UBE INDUSTRIES LTD.
DUPONT
DAIKIN

Note: (1) GTHR: Zhangjiagang Guotai-Huarong

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

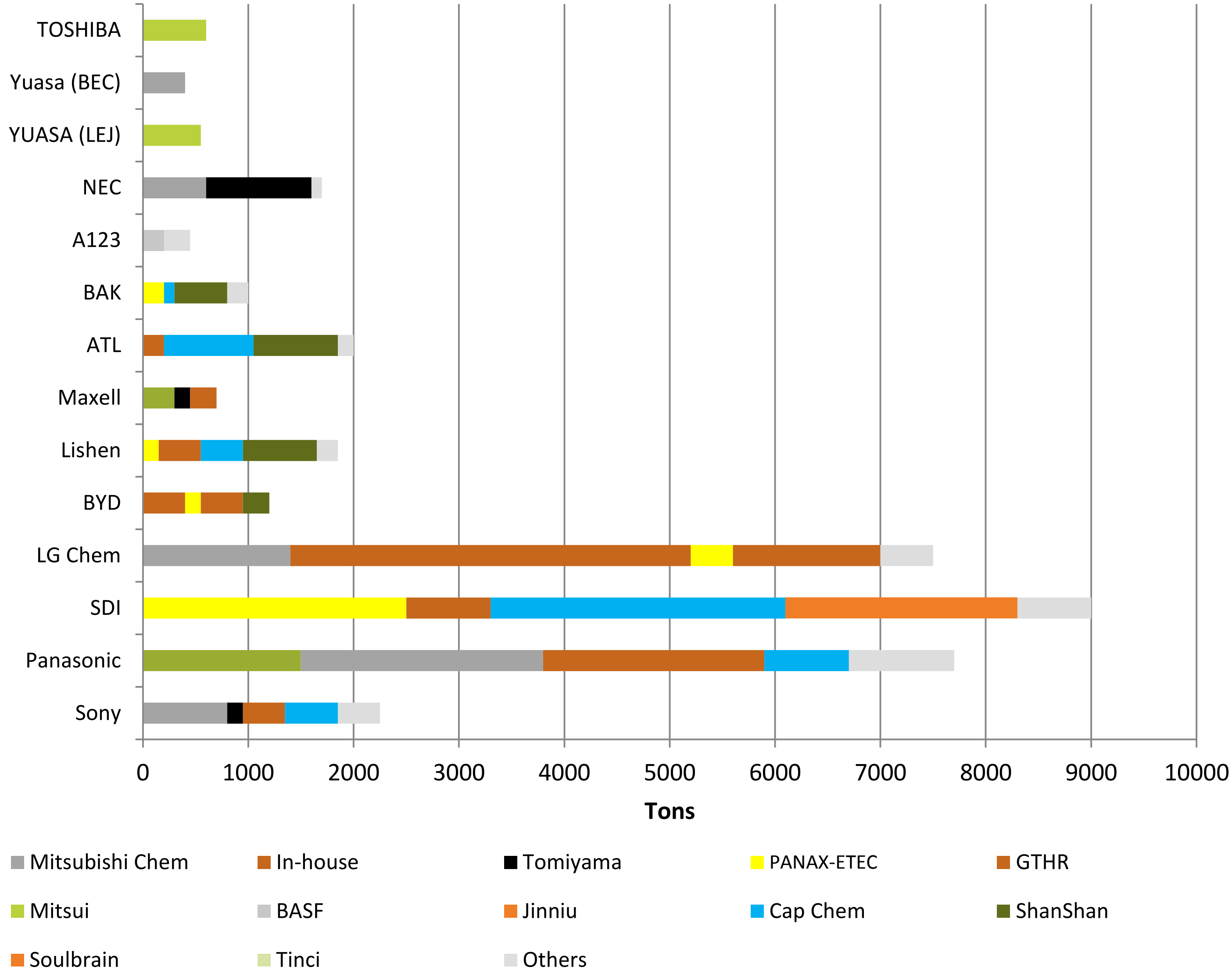
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB ELECTROLYTE MARKET 2014

Electrolyte Battery makers & suppliers relation in 2014 (Tons)

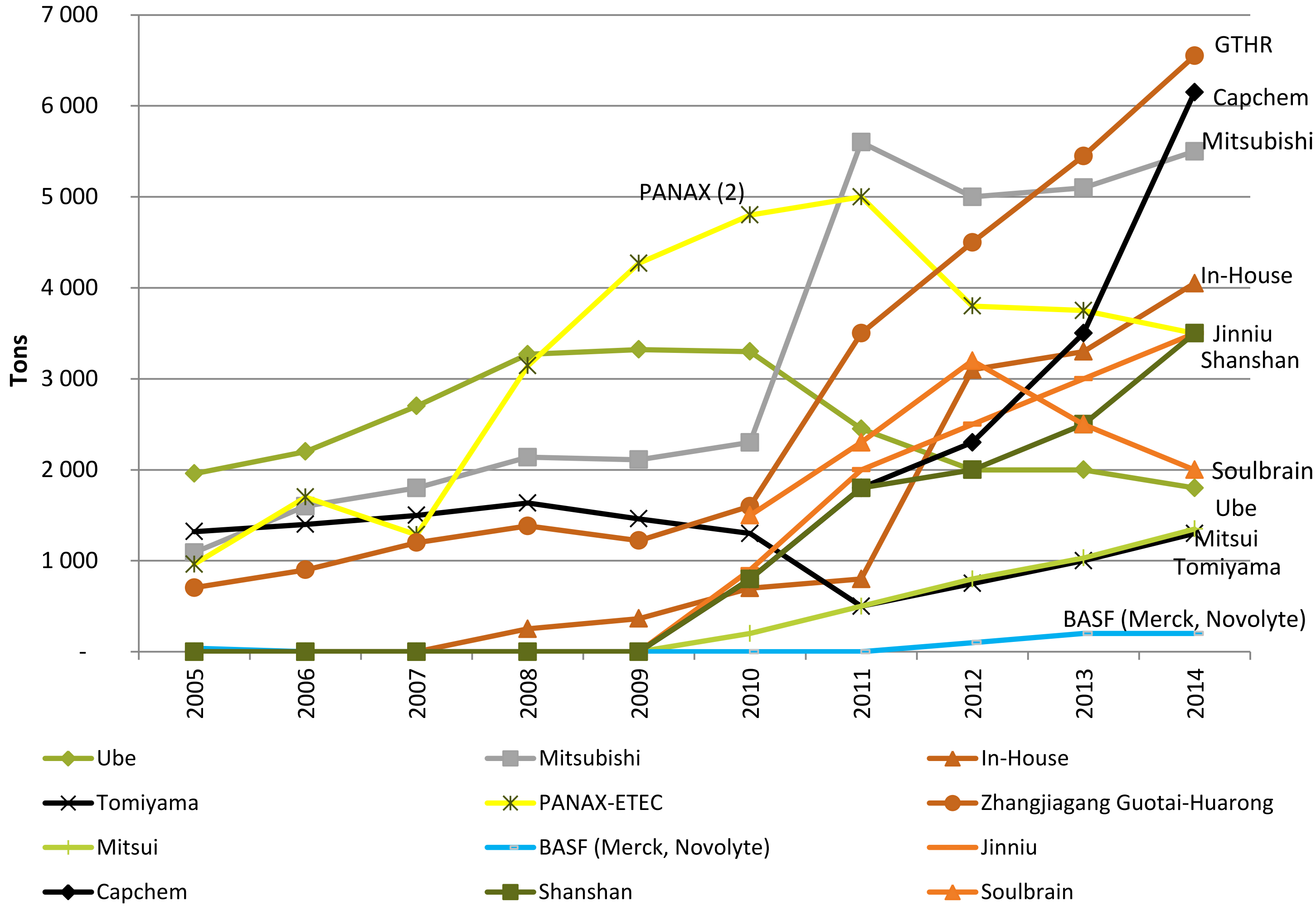


(1) Full electrolyte formulation in-house

(2) Panax-Etec bought Samsung Chiel activities in 2010

LIB ELECTROLYTE MARKET 2005-2014

Electrolyte maker sales 2005-2014



(1) Full electrolyte formulation in-house

(2) Panax-Etec bought Samsung Chiel activities in 2010

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

BATTERY MARKET FORECASTS 2014-2025

Applications covered

- Portable PCs, net-book, Ultra-book
- Cellular Phones, Smart-phones
- Tablets
- Camcorders
- Cordless Tools, Gardening tools
- Digital Camera
- Games, MP3
- Cordless Phones
- Shavers, Toothbrush,
- RC Cars
- E-bikes
- Power tools
- Security lighting
- Vehicles: HEV, P-HEV, EV
- Industrial motive (forklift)
- Industrial stationary (UPS, Telecom)
- Medical
- Energy Storage (Small / large)

Parameters analysis

- Main segment trends
- Power need trends (volume, weight, capacity, running time)
- Penetration rate for each Chemistry, each form factor,
- 2013 -2025 Forecasts
- OEM strategies and positions
- Main drivers & limiters

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

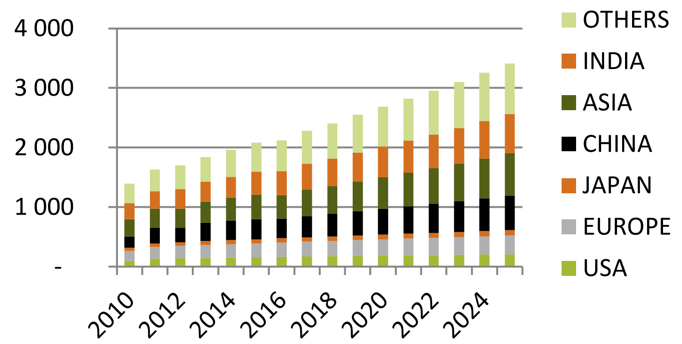
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

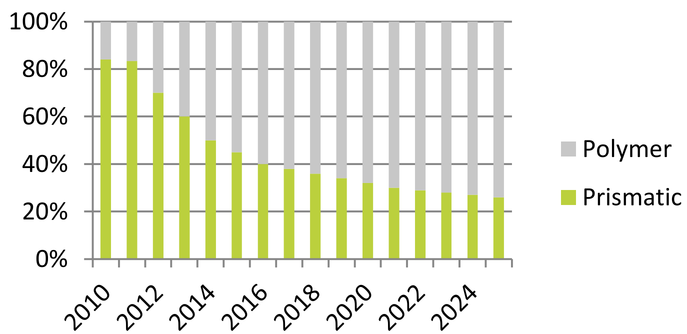
PORTABLE ELECTRONIC DEVICES FORECASTS 2010-2025

Cellular phones demand (M Units) CAGR 2010-2025: +6%



LIB cells demand 2010-2025

Polymer penetration: 30% -> 75%



Source: AVICENNE ENERGY Analyses

Cellular Phones market Drivers

- Emergent market
- Renewal ratio increase
- Smartphone penetration increase

LIB cells for cellular phones trends

- Laminates ratio increase
- Increase of Thickness
- Increase of >1400 mAh capacity

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

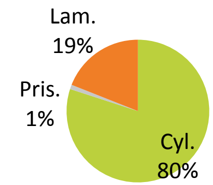
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

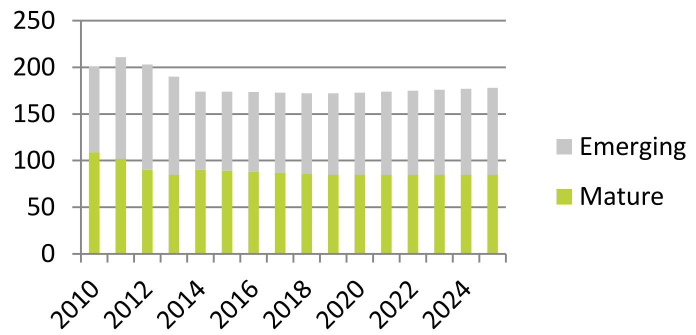
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

PORTABLE ELECTRONIC DEVICES FORECASTS 2010-2025



Portable PCs demand (M Units) 2014-2025 – Almost stable



Source: IDC, Gartner, AVICENNE Energy

Portable PCs 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 cells demand 2014-2025 Polymer penetration: 20% -> 40%

Source: AVICENNE ENERGY Analyses

LIB cells for portable PCs trends

- Thinner cells
- Polymer penetration increasing from 7% in 2010 to 28% in 2025
- > 2800 mAh for Premium/corporate
- 2.2 Ah for consumer, emerging market

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

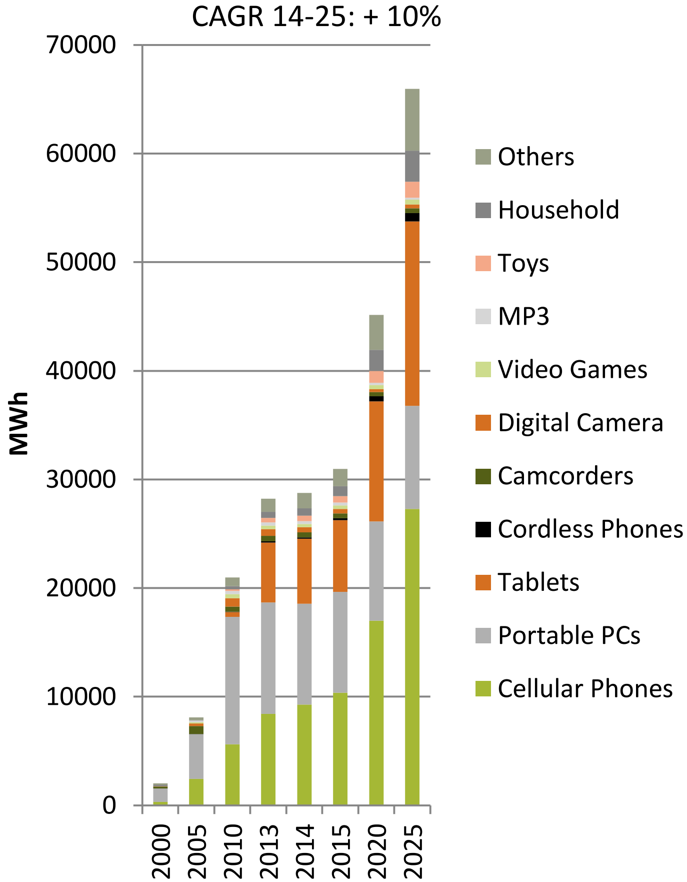
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

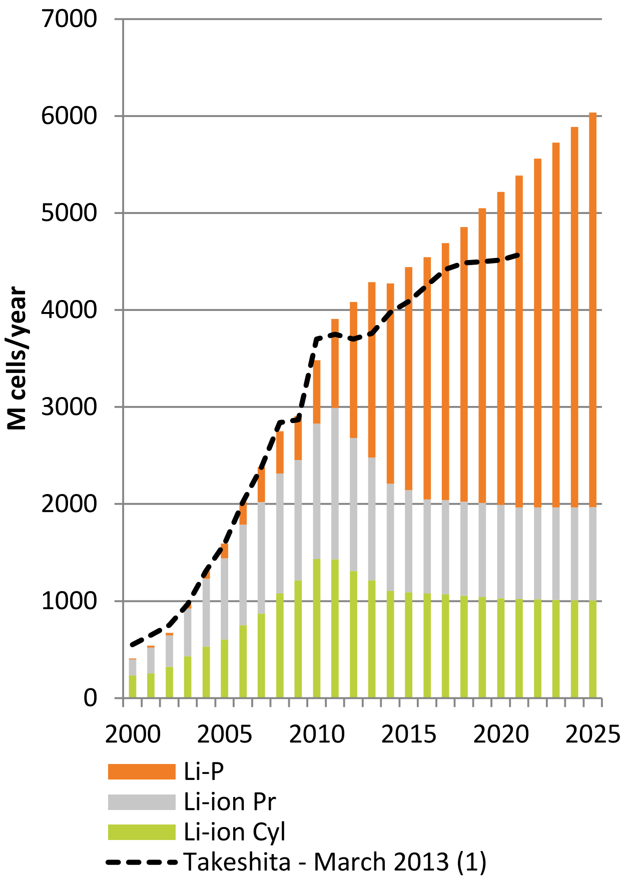
2025 LIB FORECASTS FOR PORTABLE ELECTRONIC DEVICES

2000-2025 LIB market, MWh, by application (3C)



Source: *AVICENNE ENERGY Analyses*

2000-2025 LIB market, M cells, by form factor (3C)



(1) Source: Takeshita, Battery Japan 2013 BJ-3 conference Slide p 4

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

X-EV MARKET

- Why x-EV ?
- Definition & segmentation
- X-EV worldwide in 2014
  - By country
  - By car makers
  - By battery chemistry
- X-EV forecasts
  - AVICENNE ENERGY & other analyst forecasts
  - Battery chemistry forecasts
  - Battery cost forecasts
- X-EV battery forecasts

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

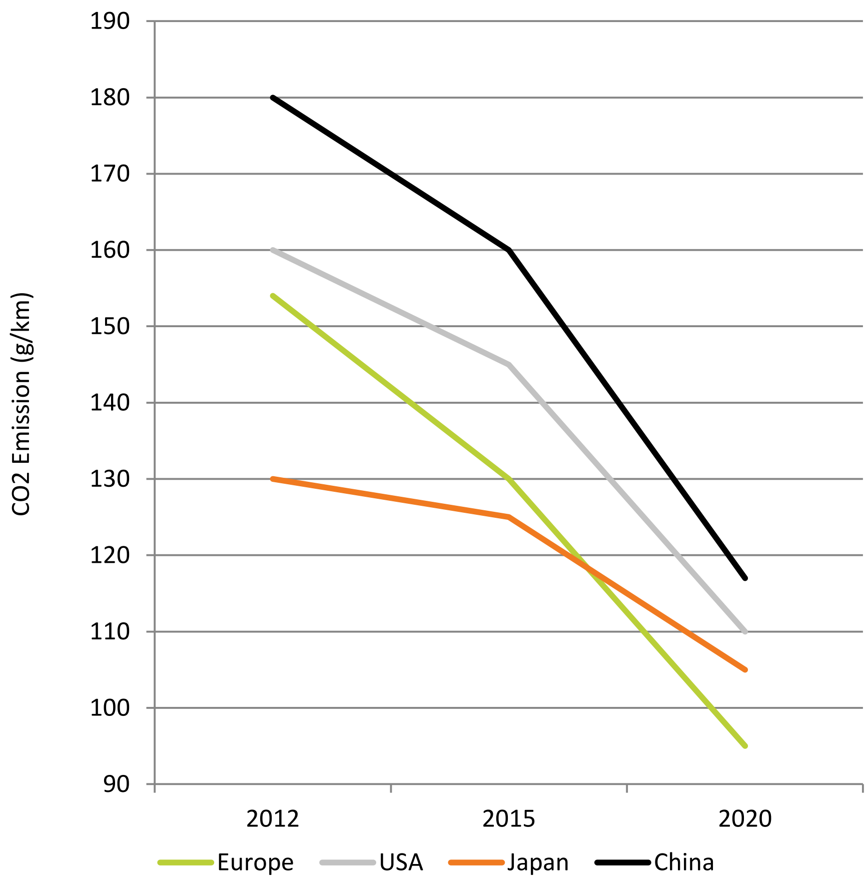
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

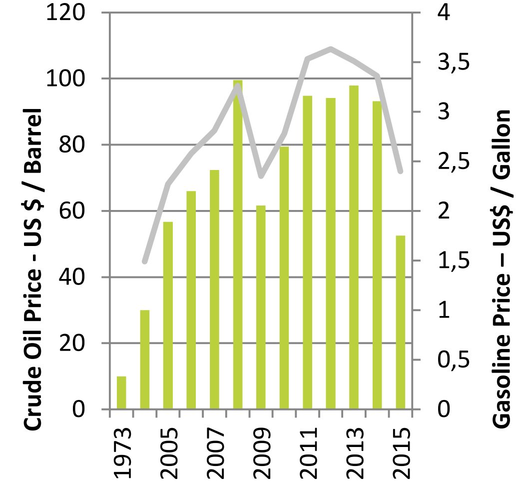
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

WHY X-EV ?

MAJOR DRIVER: CO_2 regulation worldwide: From 2013 to 2014 Oil price decrease but HEV sales increase by 5%, P-HEV by 30% and EV by 60%

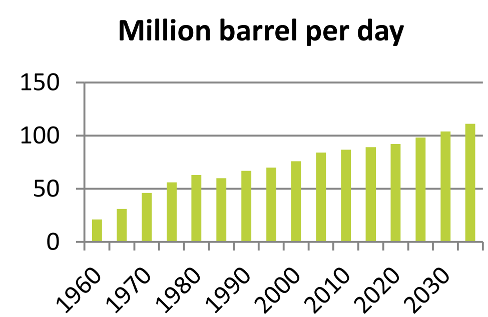


Price of the WTI[1] barrel of oil, US $



Source: *http://www.eia.doe.gov/emeu/steo/pub/contents.html*

Petroleum consumption worldwide 1960-2030



Source: Energy Information Administration, US Government

Note
[1] WTI: West Texas Intermediate

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

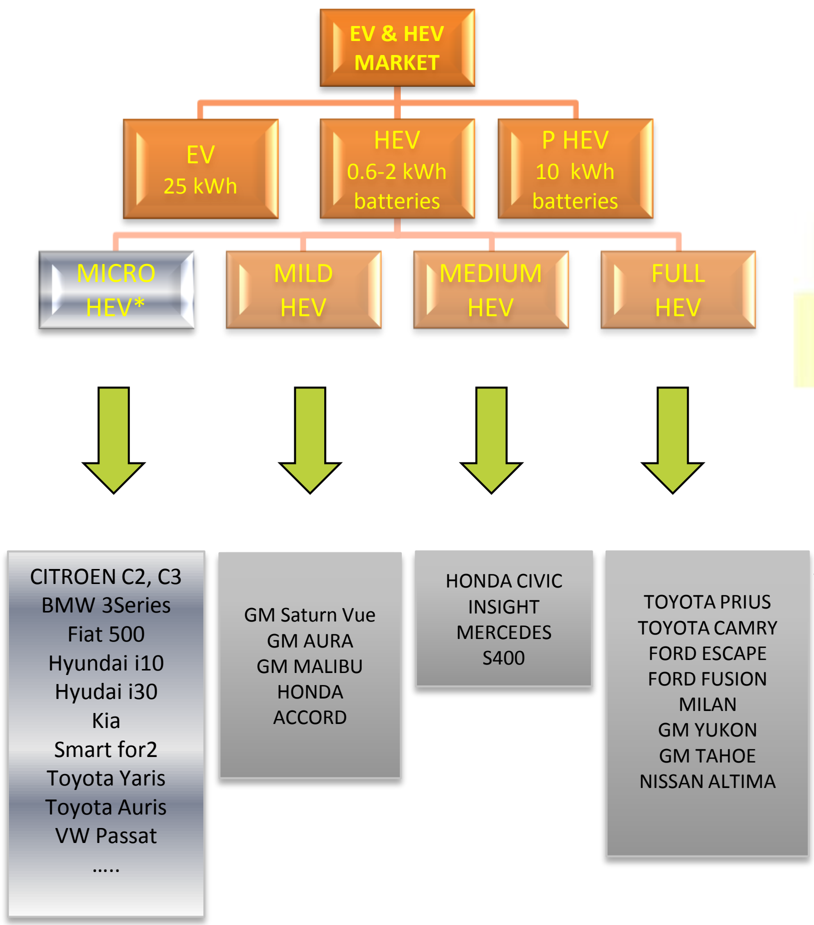
The Rechargeable Battery Market and Main Trends 2014-2025

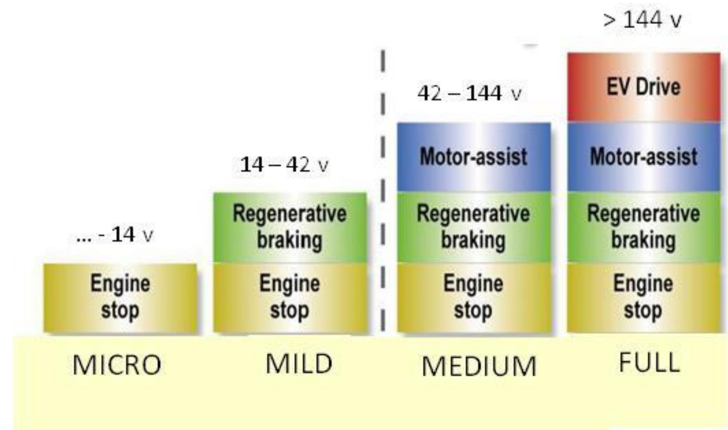
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

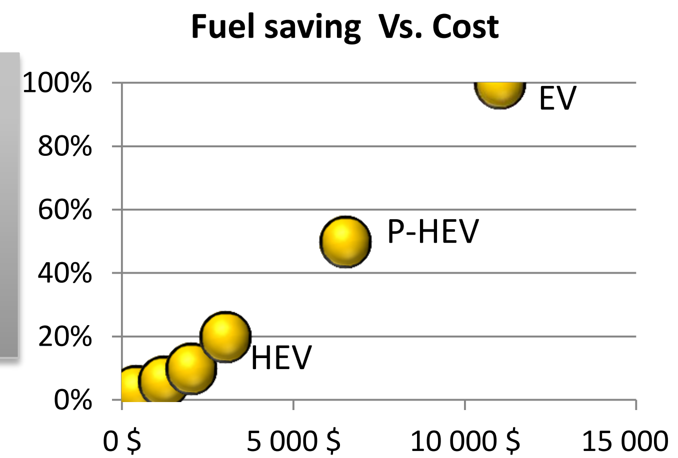
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

HEV, P-HEV & EV DEFINITION & SEGMENTATION







Note: Micro HEV are not in the HEV statistics & HEV forecast

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

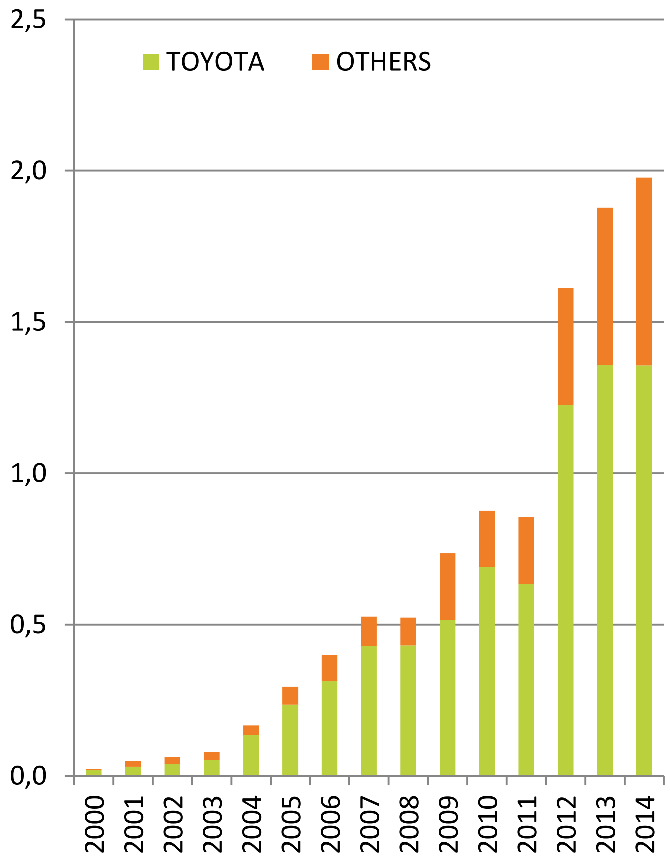
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

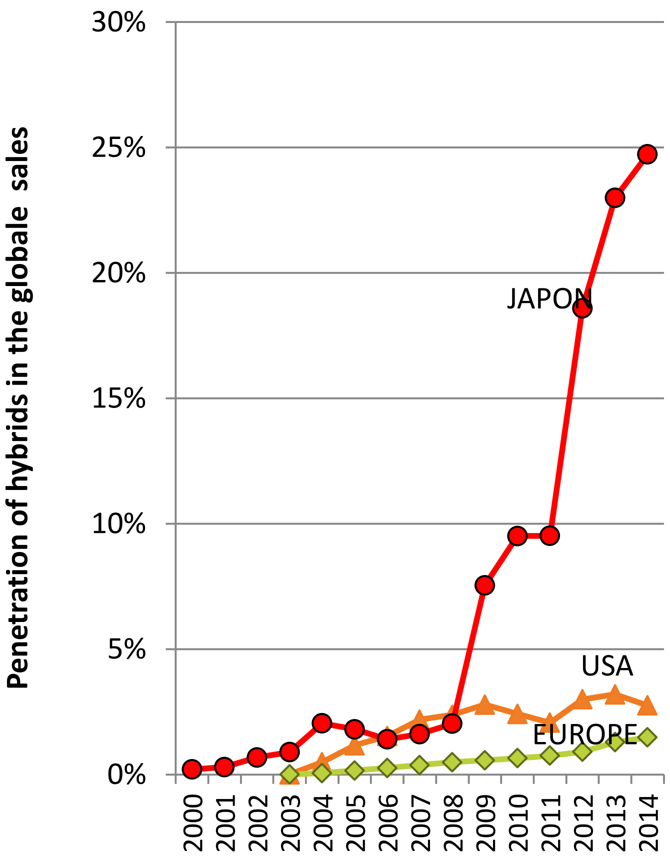
HEV WORLDWIDE IN 2014
2 M HEV

Growth 2013-2014: +5%
From 1,9 M to 2 M HEV

HEV sold per year, M units, worldwide, 2000 - 2014



Penetration of hybrids in the global sales, 2000-2014



Source: TOYOTA, HONDA, NISSAN, FORD, GM, HYUNDAI, MERCEDES, GM, BMW, VW, PORSCHE… Compilation AVICENNE ENERGY
Micro hybrid not included

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

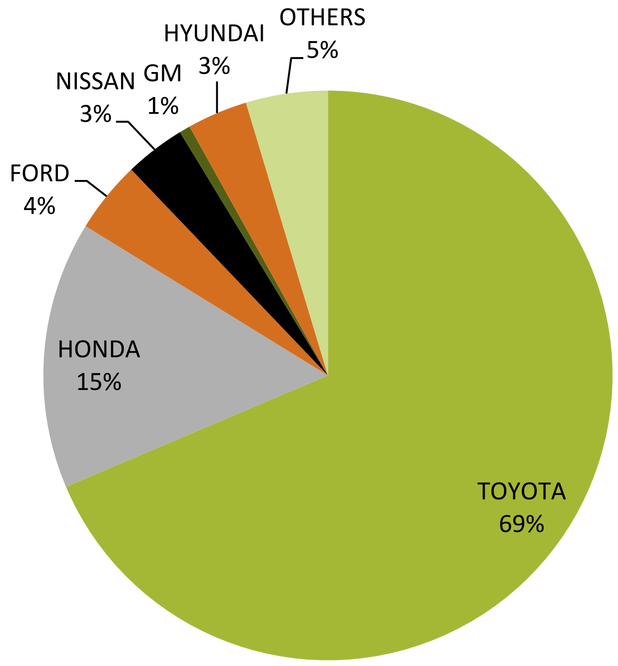
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

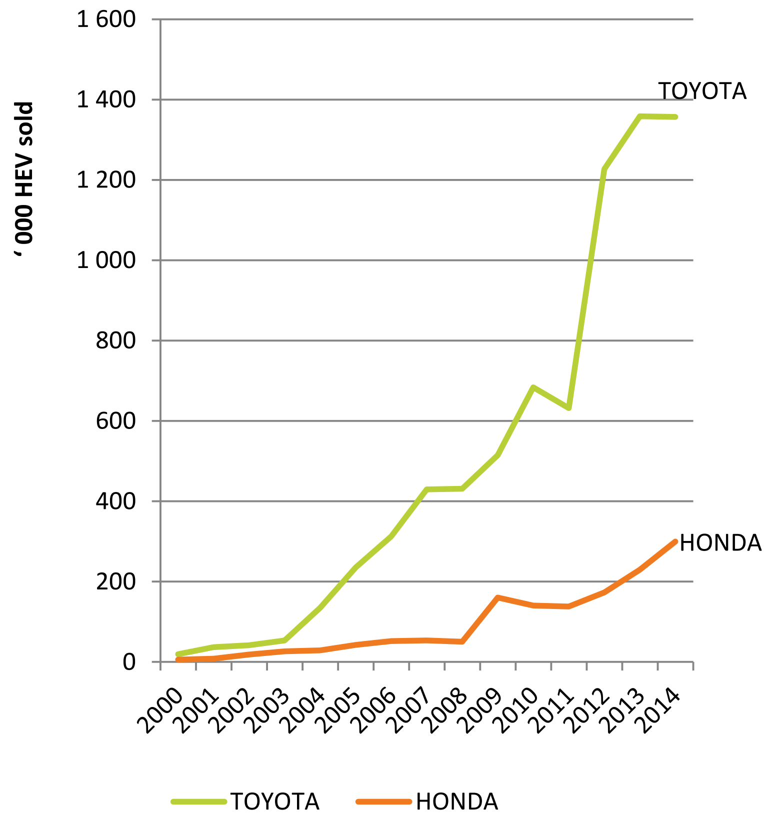
HEV WORLDWIDE IN 2014 BY CAR SUPPLIER

HONDA & FORD market share growing

Total HEV Vehicles
2 Million HEV in 2014



HEV sold per year, M units per car manufacturers, 2000-2014



Others: Chineses, VW, Porsche, Mercedes, Mazda, Audi, Subaru etc…

Source: TOYOTA, HONDA, NISSAN, FORD, GM, HYUNDAI, MERCEDES, GM, BMW, VW, PORSCHE… Compilation AVICENNE ENERGY
Micro hybrid not included

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

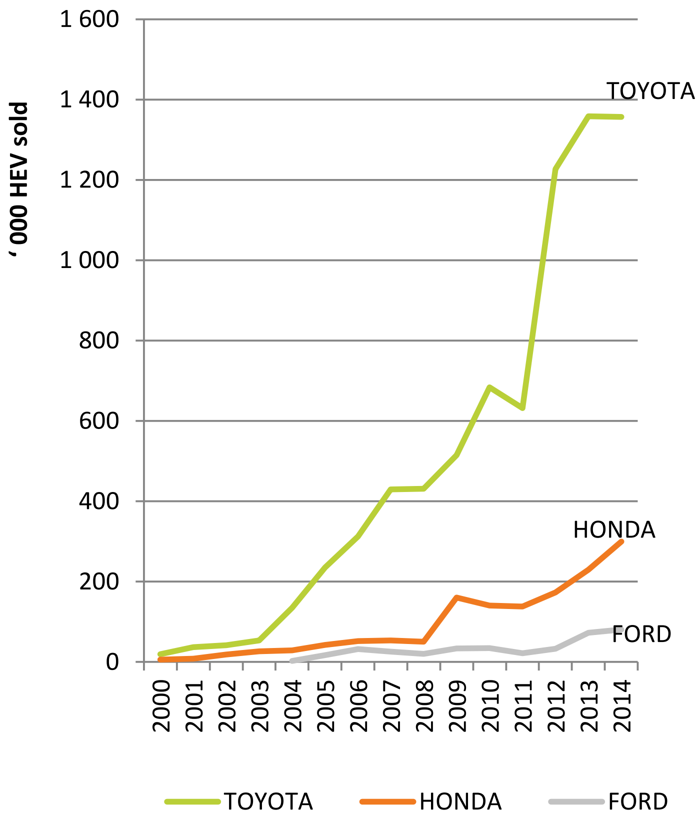
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

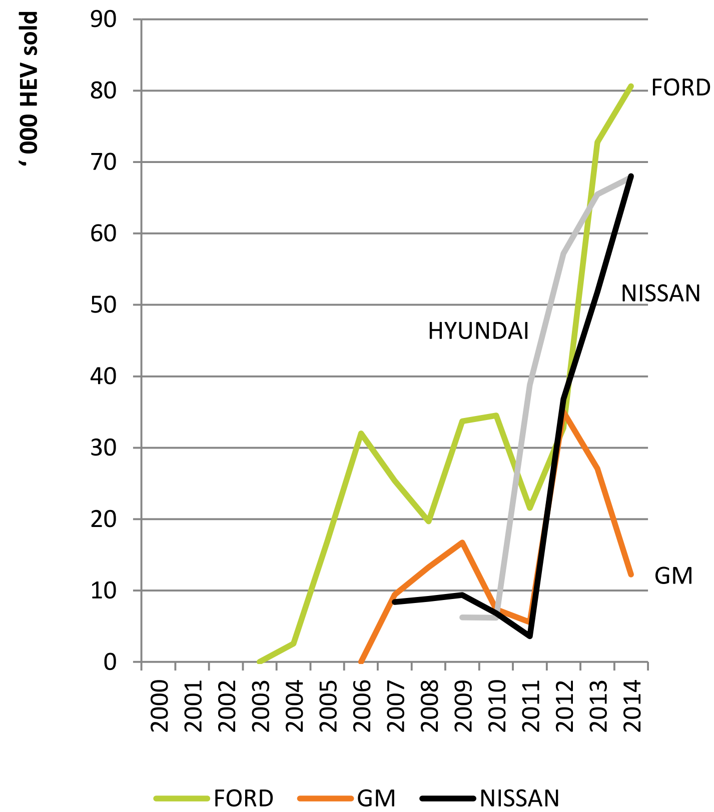
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

HEV WORLDWIDE IN 2014 BY CAR SUPPLIER

TOP 3: TOYOTA, HONDA, FORD



OTHERS: FORD, GM, …



Source: TOYOTA, HONDA, NISSAN, FORD, GM, HYUNDAI, MERCEDES, GM, BMW, VW, PORSCHE… Compilation AVICENNE ENERGY
Micro hybrid not included

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

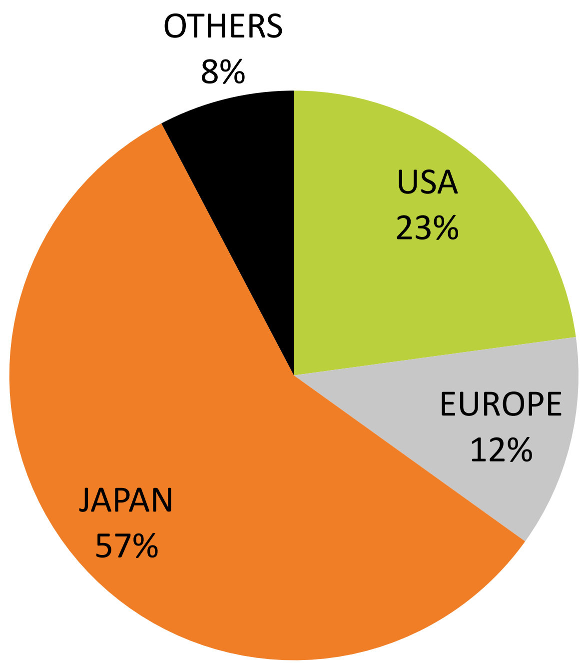
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

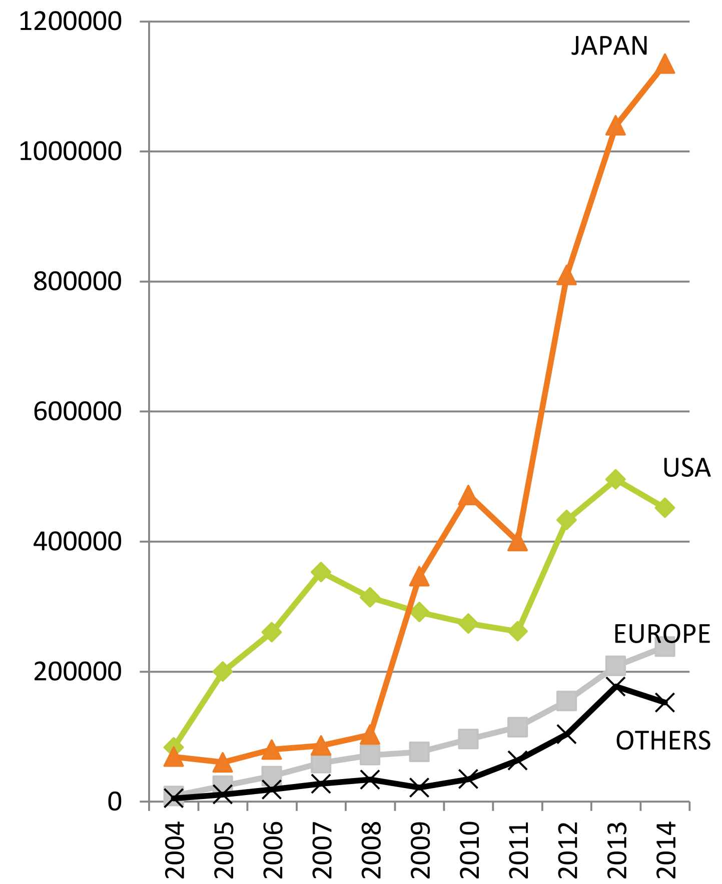
HEV WORLDWIDE IN 2014 BY COUNTRY

Total HEV Vehicles 2 M in 2014



Source: AVICENNE ENERGY Analyses 2015

HEV sold per year, M units per country, 2004-2014



Micro hybrid not included

avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

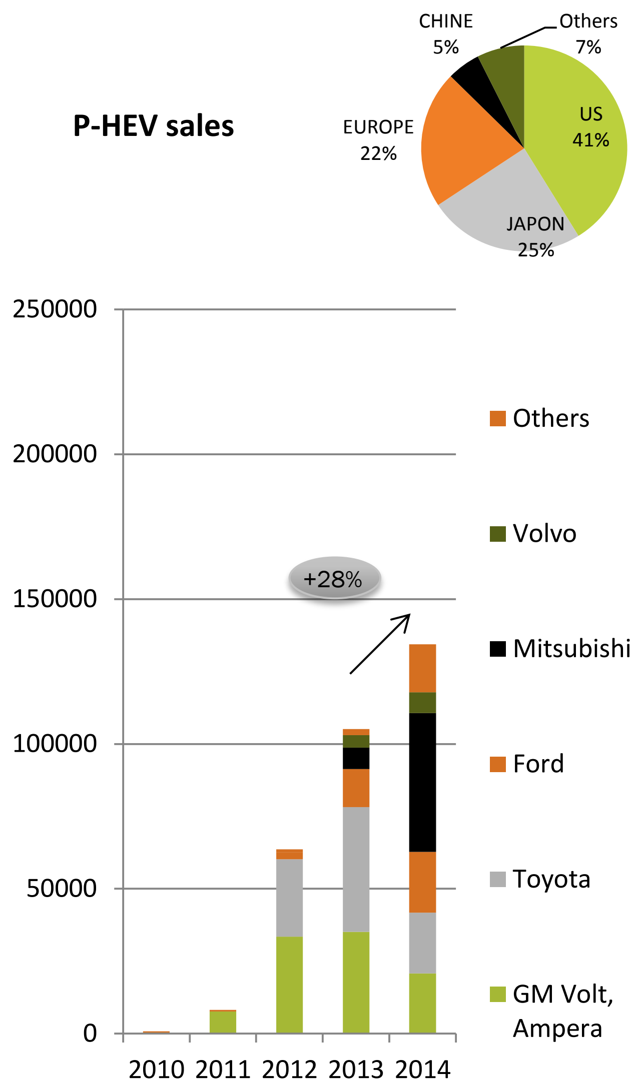
Batteries EVENT www.batteriesevent.com The International Energy & Power Supply Conference and Exhibition

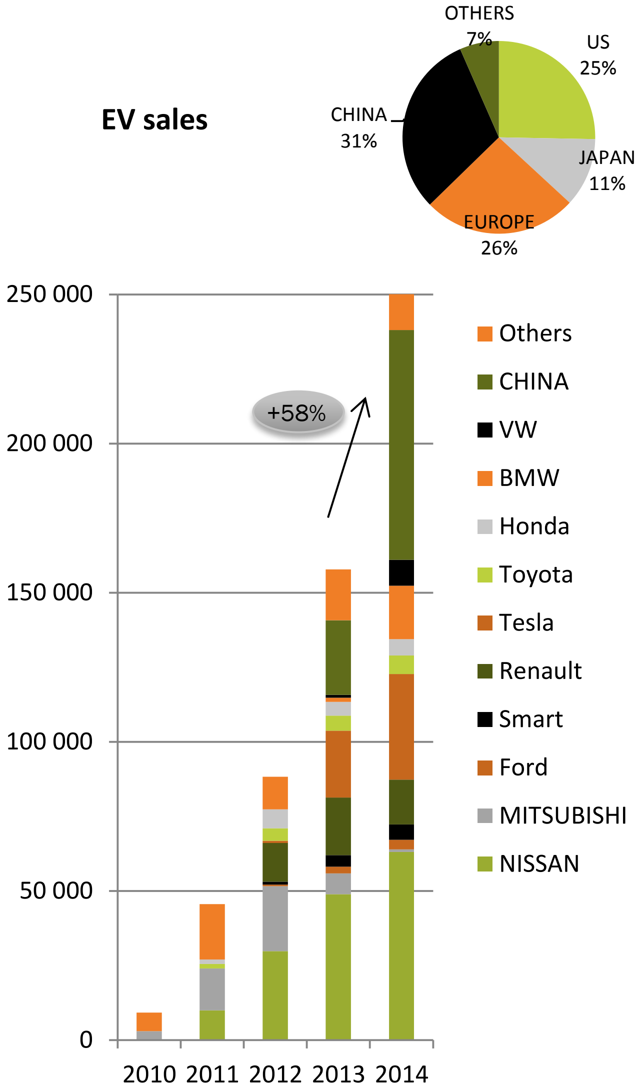
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

P-HEV & EV SALES 2010-2014 (YEARLY)





Source: AVICENNE ENERGY Analyses

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

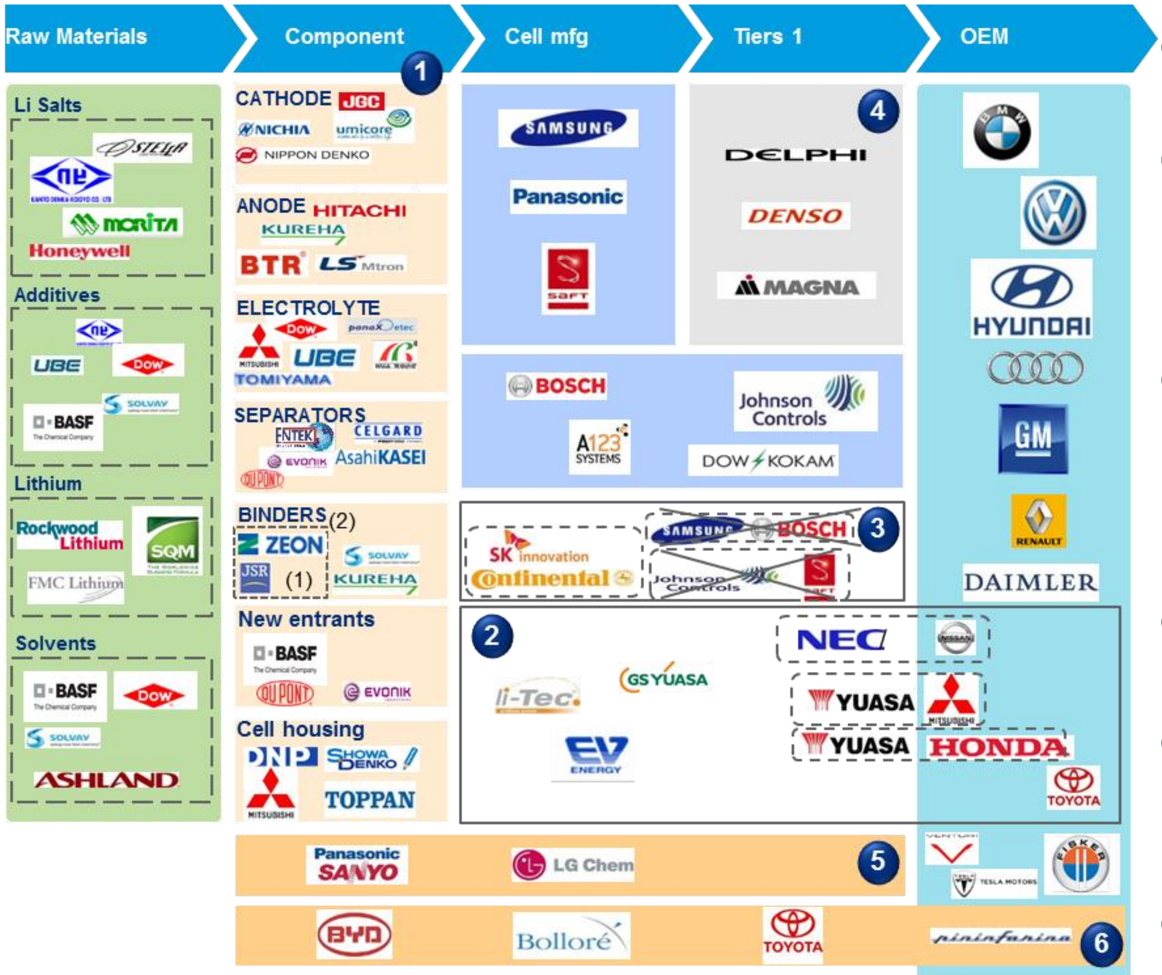
The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB FOR AUTOMOTIVE VALUE CHAIN



Comments

1. The largest share of the value (40%) comes from cell components
2. Cell manufacturers & OEM alliance may be the winning model but comes with high risk if the wrong cell manufacturer is selected
3. Tiers 1- cell manufacturers alliance: most of them disappear (eg. Saft-Johnson Controls, Bosch-Samsung, Enerdel-Delphi…)
4. Tiers 1- OEM alliance on Battery are not successful
5. Panasonic and LG Chem, cell manufacturers develop raw -material in-house and make the pack integration for OEM
6. On a different scale, Toyota, BYD or BOLLORE are fully integrate

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

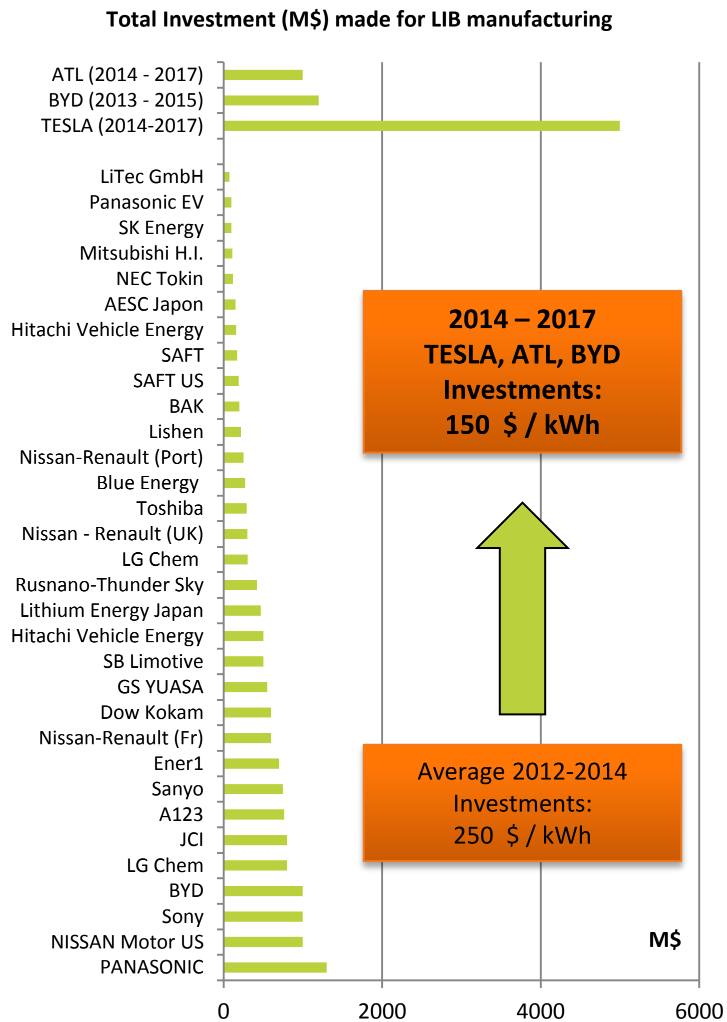
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

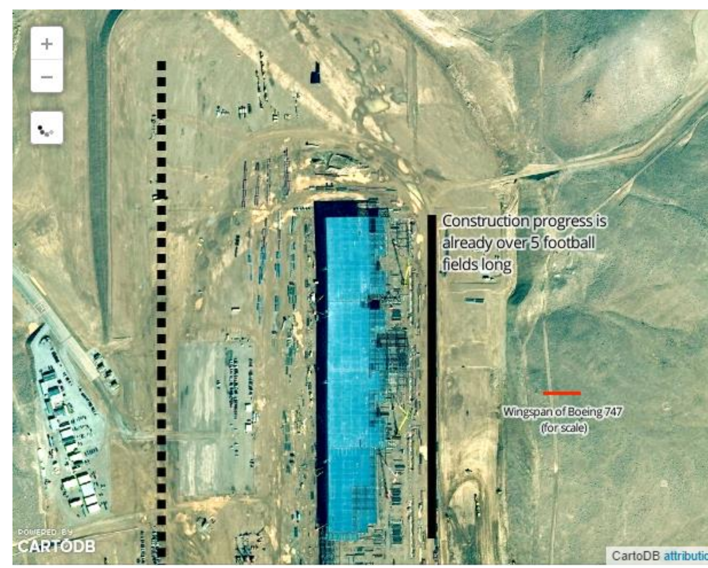
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB MANUFACTURING INVESTMENTS 2009-2015

10-12 B$ WORLDWIDE >50 GWh invest from 2011 to 2014)
< 7 B$ invested from 2014 to 2017 by TESLA (5), BYD (1,2), ATL (1)



TESLA Plant, Nevada, Feb 2015



TESLA GIGA FACTORY, Feb 2015

Source: AVICENNE ENERGY Analyses 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

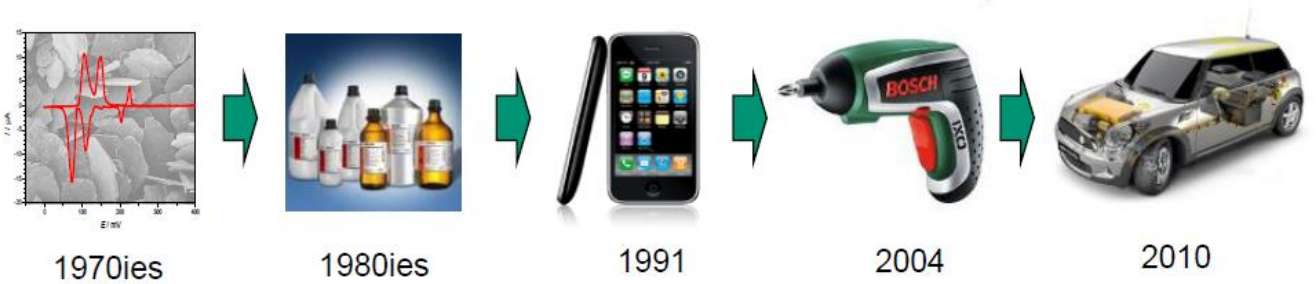
The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

TIME TO MARKET FOR NEW MATERIALS IN LIB INDUSTRY



- 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 launched by Sony in 1991 with LCO cathode, graphite, $LiPF_6$ electrolyte & polyolefin membrane. It was 20 years ago.
- LTO was invented by Matsushita in 1993 (22 years ago)
- Lithium iron phosphate was invented in 1995 (20 years ago).
- So, it takes between 10 & 20 years to commercialize a new material in the battery industry.

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

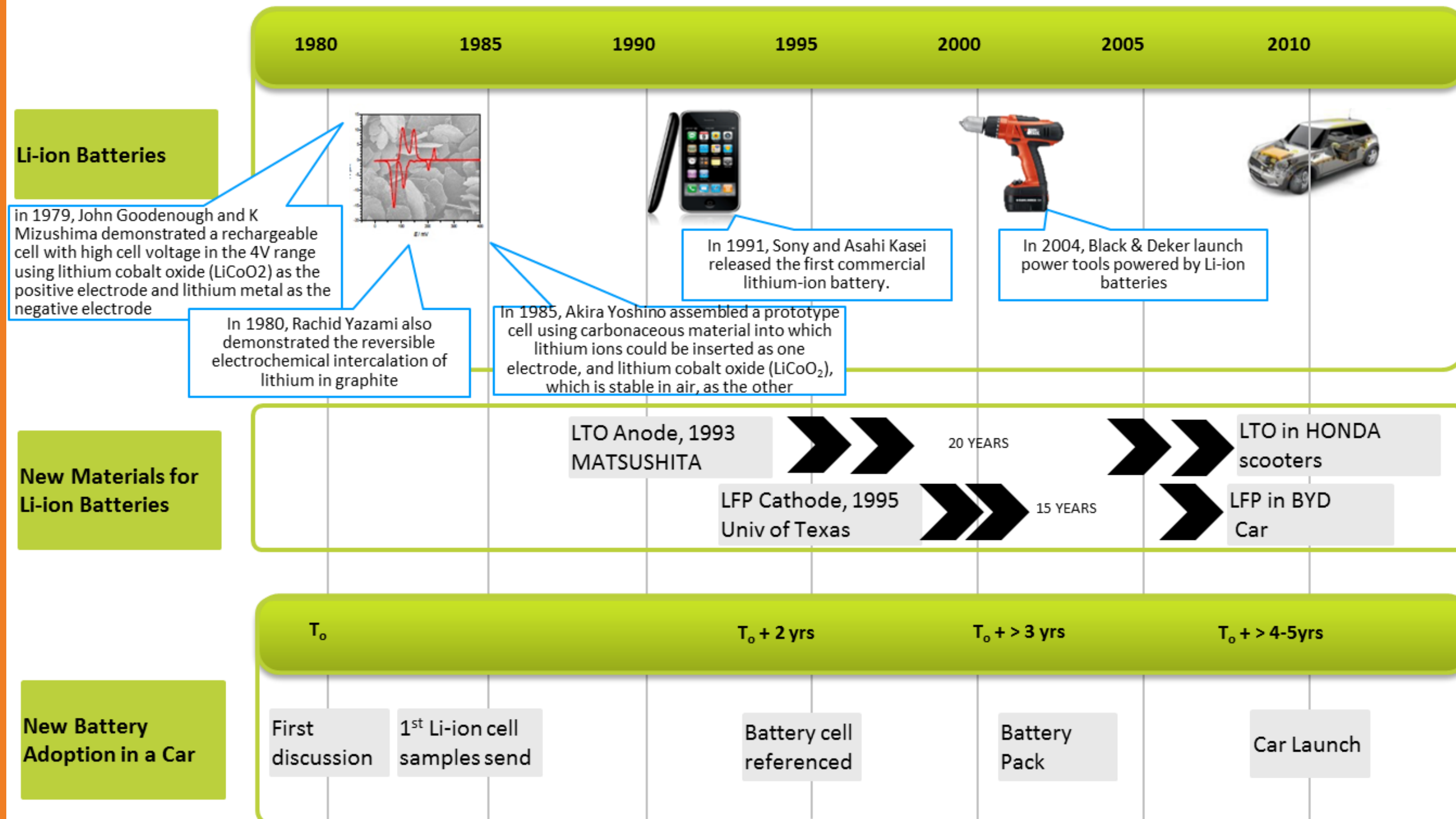
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

BATTERY TECHNOLOGY ROADMAP

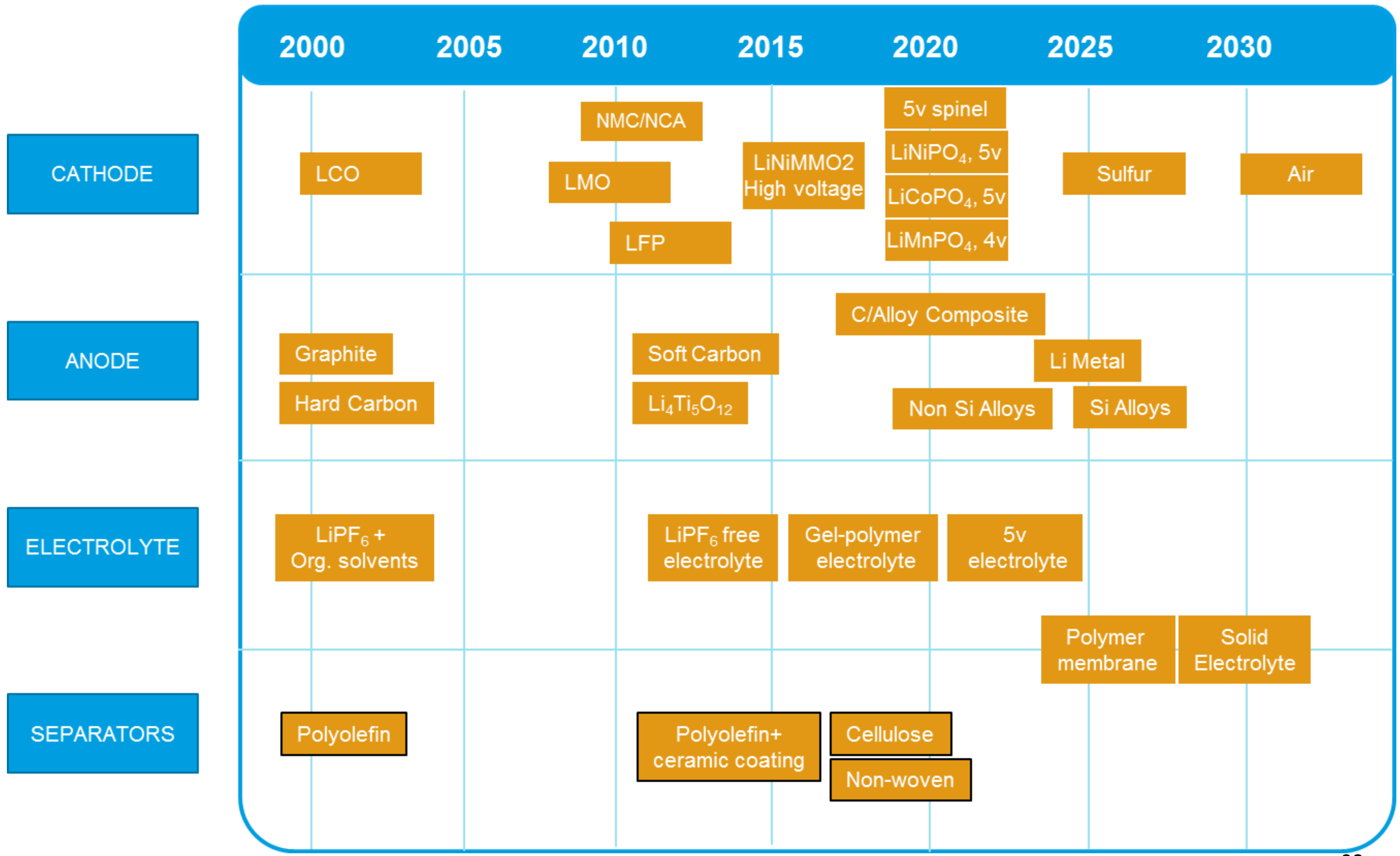
Batteries take a long time to develop; to reach the automotive market, another 4 to 5 years are needed



Source: Avicenne Energy analysis

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

TIME TO MARKET FOR NEW MATERIALS IN LIB INDUSTRY



The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

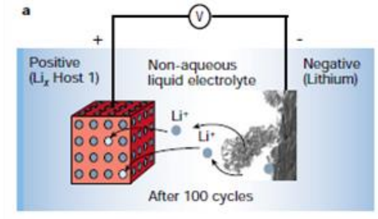
SAFETY ISSUES

Li-ion and LMP are not thermally stable what raises serious safety concerns

Background

In the 80's, lithium metal batteries were put into the markets (Moli Energy). Their further development has for a long time been slow because of a low cycle efficiency and safety issues: High chemical reactivity and a low melting point enable strong chemical reactions, even explosions. In the charging-discharging process, lithium metal can form dendrite and accumulate on electrodes. The growing lithium dendrite could puncture the separator and result in an internal short circuit.

- CONSEQUENCES: Except BOLLORE, all the companies developing Li metal batteries cancelled their projects



Mobile

Li-ion batteries for mobile devices mostly used a Lithium Cobalt Oxide Cathode and liquid electrolyte.
In case of overcharging or short-circuit (contact between anode & cathode) a chain reaction starts -> heating & gasing -> fire ("Thermal runaway")
CONSEQUENCES: In 2006, SONY had to recall millions of portable PCs for total costs of 400 million USD, more than there profit-to-date

Automotive

With new cathode chemistry, most of the automotive today on the markets experienced safety concerns:

(1) BYD Taxi in China with a lithium iron phosphate cathode
(2) GM Volt in the US with a LG Chemical battery using LMO cathodes (as a result of a crashed tested Chevrolet Volt caught three weeks after the testing !)
(3) PRIUS P-HEV in the US (converted from HEV Prius by a local engineering company without any authorisation by Toyota)

Aircraft

Boeing 787: The fire that burned near the tail of a parked Boeing 787 in Boston was caused by an overheating Lithium ion battery pack. The battery fire could have been hot enough to melt the carbon-fiber reinforced plastic that makes up the plane's shell.
CONSEQUENCES: All the 787 worldwide are grounded. Considerable losses for Boing.

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

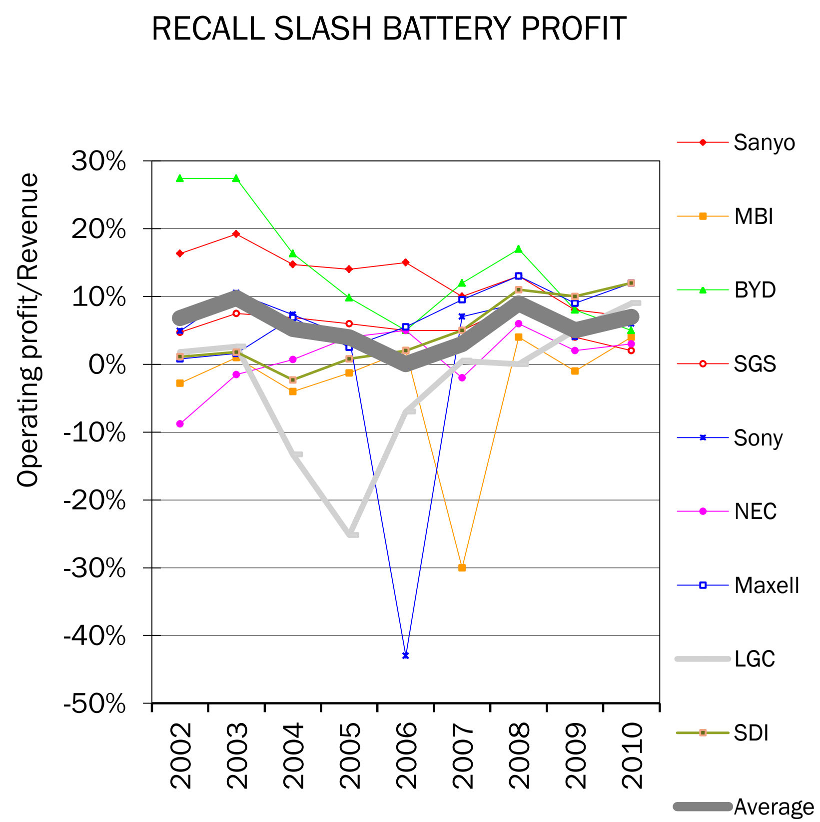
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB BUSINESS
RECALLS 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



avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

SAFETY IS A SINE-QUA-NON SELECTION CRITERIA FOR BATTERY TECHNOLOGIES

Some technologies are already out of the game due to stability issues

Cathode

	LCO	NMC	LMO	LFP	High V	Sulfur
SAFETY						?
xEV ?	NO	YES	YES	YES	?	?

Anode

	Graphite	Hard Carbon	Soft Carbon	LTO	Si/C	Li Metal
SAFETY						
xEV ?	YES	YES		No (1)	?	?

Electrolyte

	Liquid	+ Additive	Gel Polymer	5 V	Polymer membrane	Solid
SAFETY				?		
xEV ?	NO	YES	YES	No	YES	> 2025

Separator

	PE, PP membrane	+ coating	Non woven	Polymer membrane	Solid
SAFETY					
xEV ?	YES	YES	YES	YES	> 2025

BMS

- Most of the BMS function is to manage the safety of the cell & the battery pack:
  - Overcharge management
  - Over voltage management

Packaging

- Use "safer" material in the pack:
  - Flame retardant,
  - High shock resistance

Thermal

- Thermal management improve both the safety and the life time

Very Safe   Unsafe

(1) Low energy density ; mostly developed for stationary applications, or LV start light & ignition batteries

The lithium ion technologies that win will win partly on their safety argument, possibly sacrificing some energy density.

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

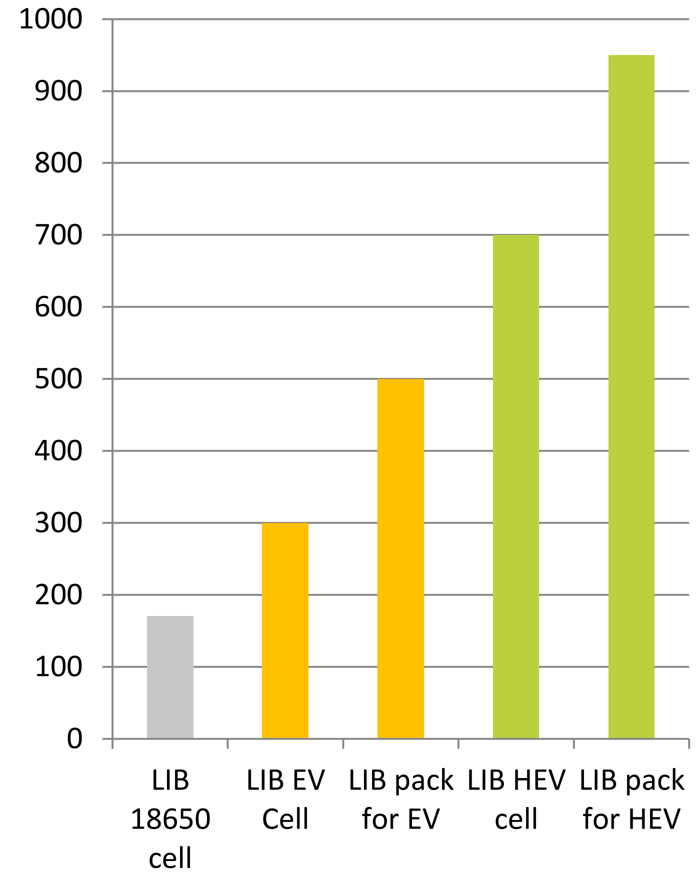
LIB BATTERY COST

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
- …

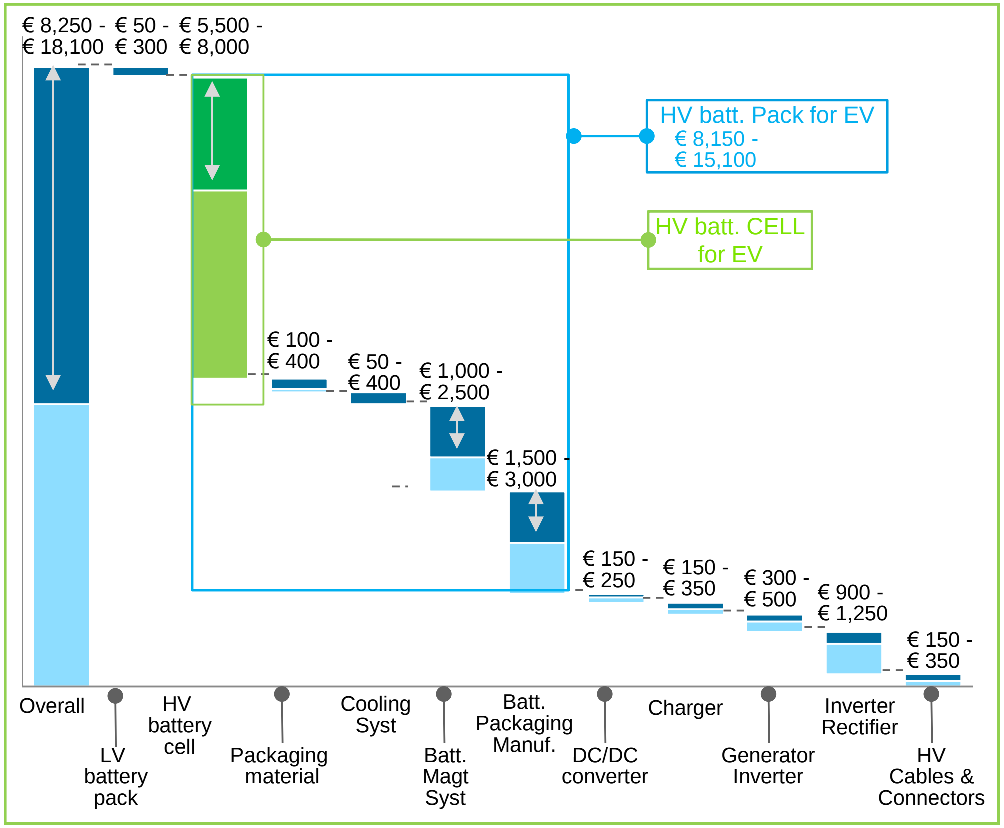
Battery price in 2014

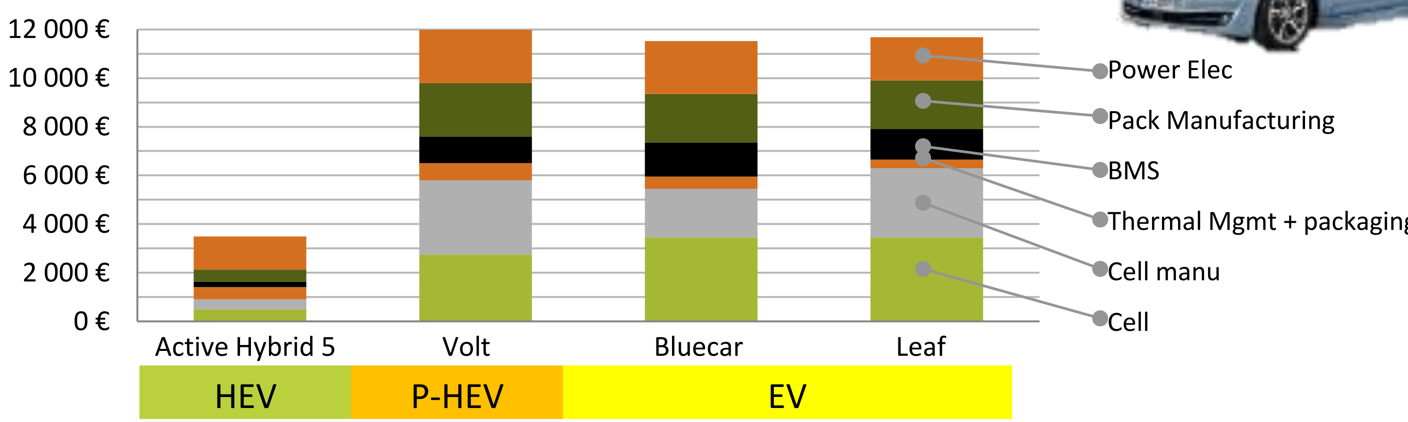
$/kWh



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

BATTERY & POWER ELEC. COST IN EV





The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

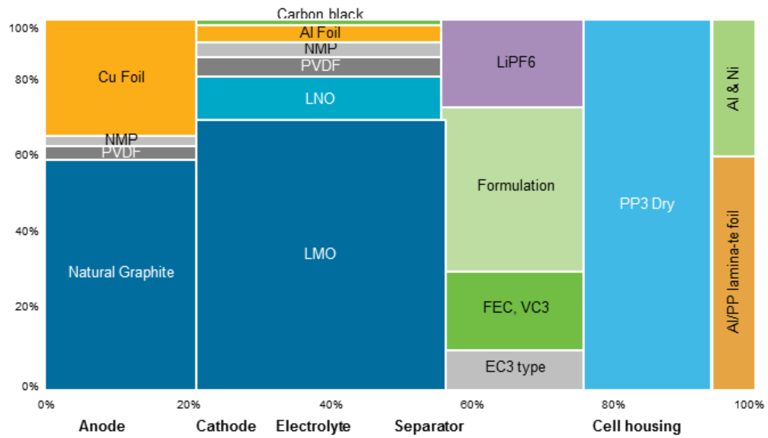
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

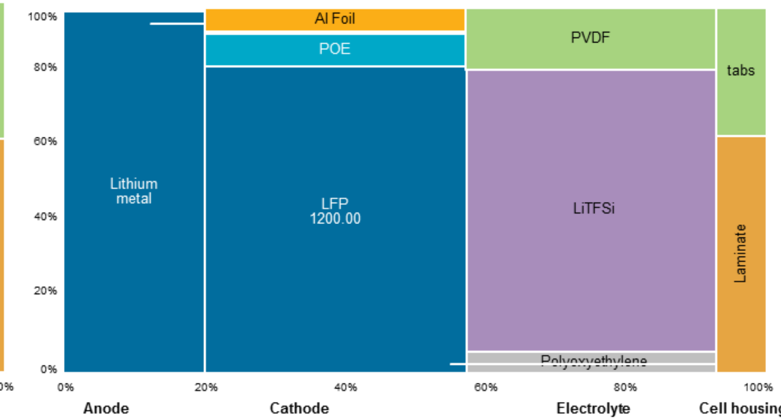
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

LIB CELL BILL OF MATERIALS

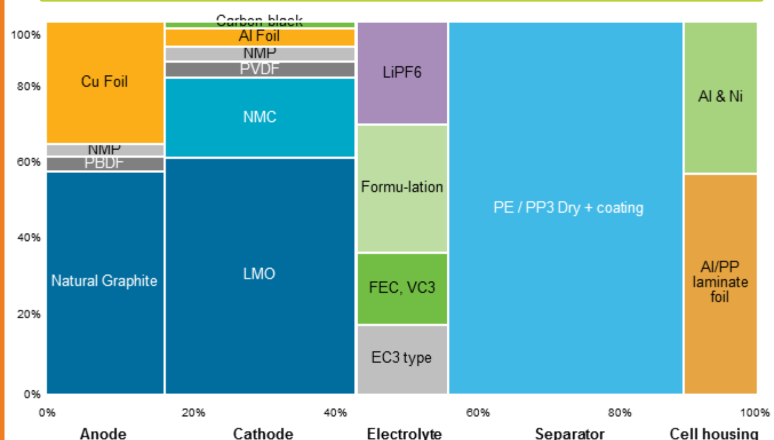
NISSAN LEAF



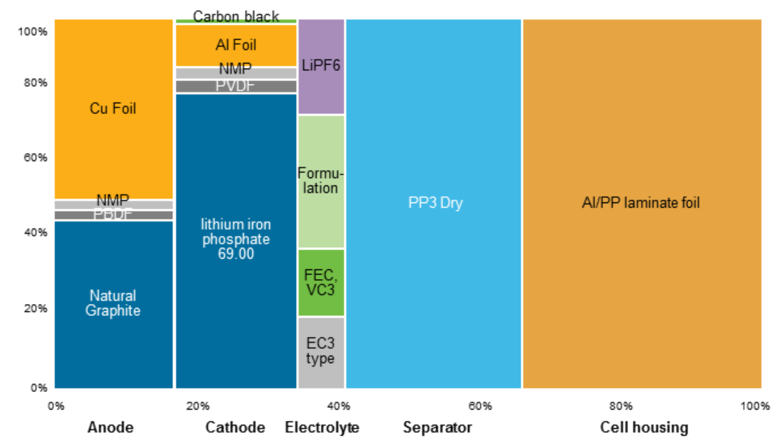
BOLLORE BLUE CAR



GM VOLT



BMW ACTIVE HYBRID 5



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

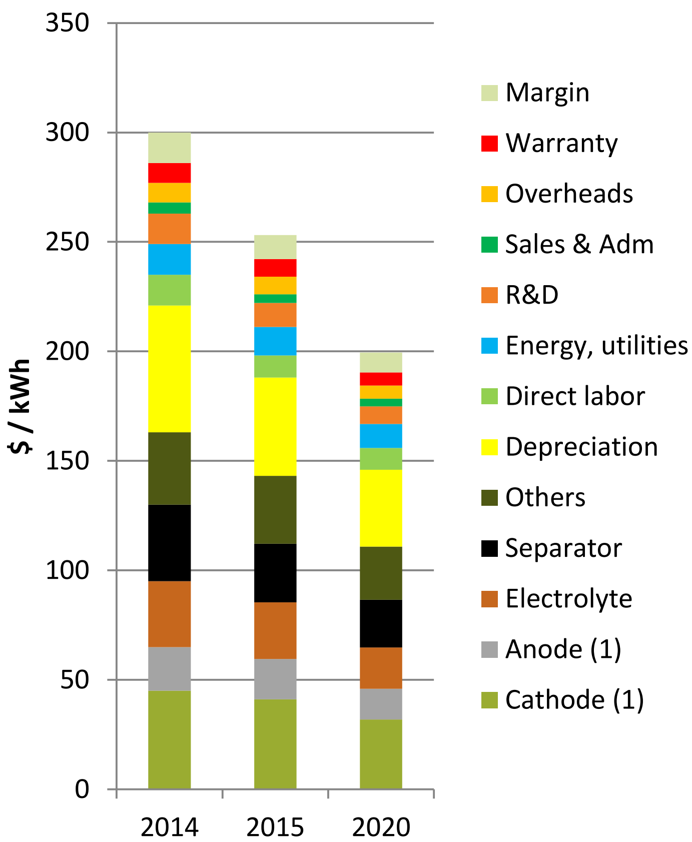
Batteries EVENT www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

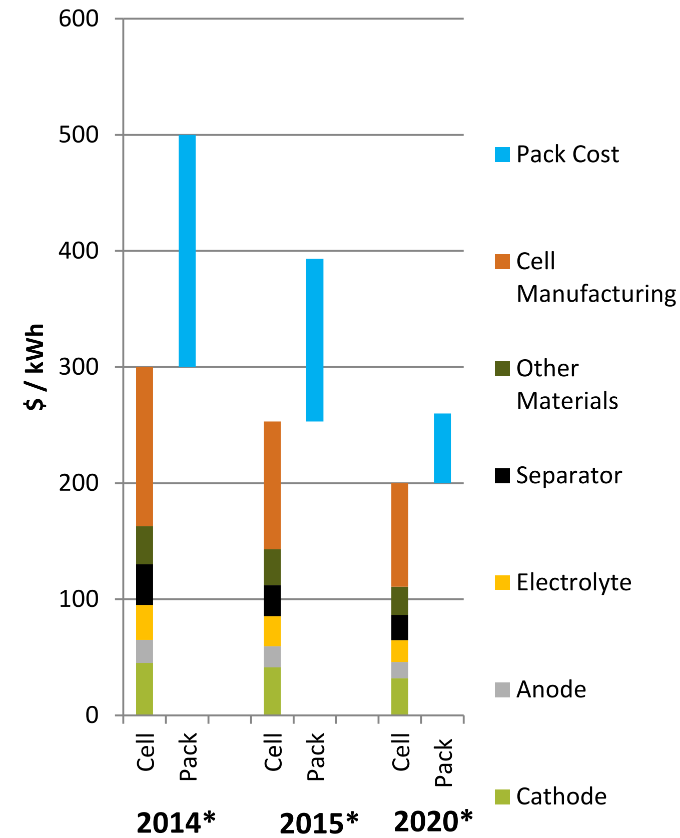
LI-ION BATTERY COST 2013-2020

LIB cell average cost (36Ah pouch) (EV design ; LMO/NMC cathode)



(1) Active materials only

LI-ION BATTERY PACK COST FOR EV



** For Production > 100 000 packs/year*

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

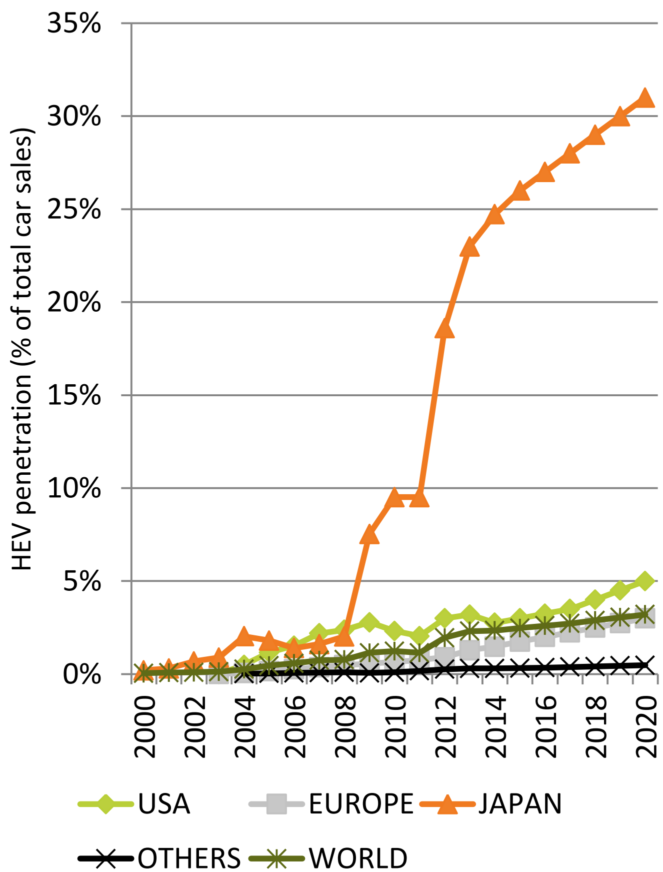
BATTERIES 2015
October 6, 2015
Nice, FRANCE

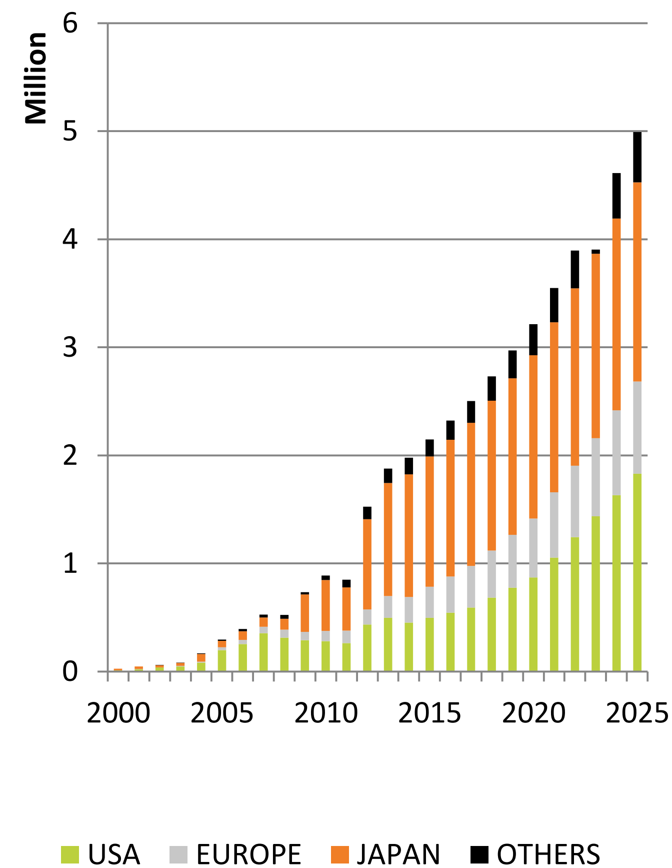
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

HEV FORECASTS 2000-2020

HEV MARKET: >2 Million units in 2015 – 3 M in 2020 – 5 M in 2025





Micro hybrid not included

Source: AVICENNE ENERGY Analyses 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

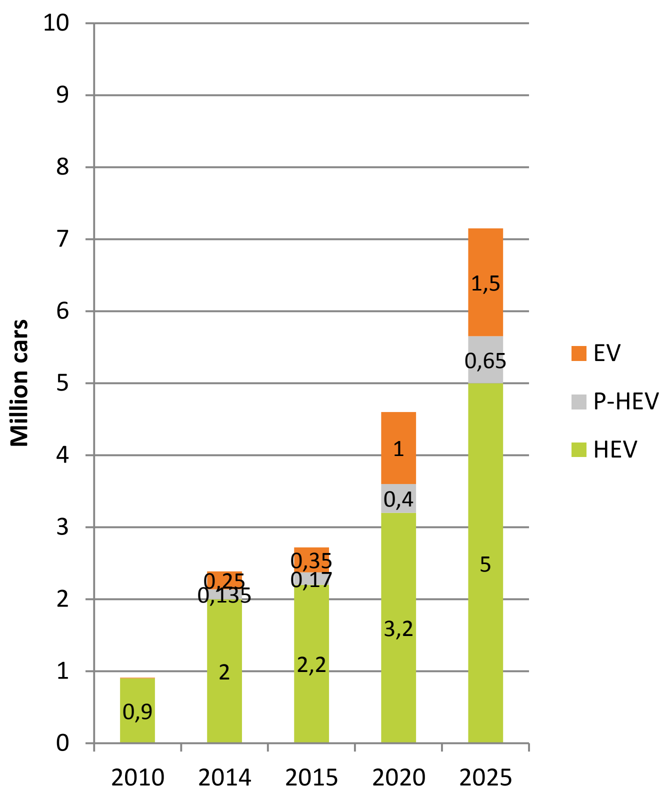
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

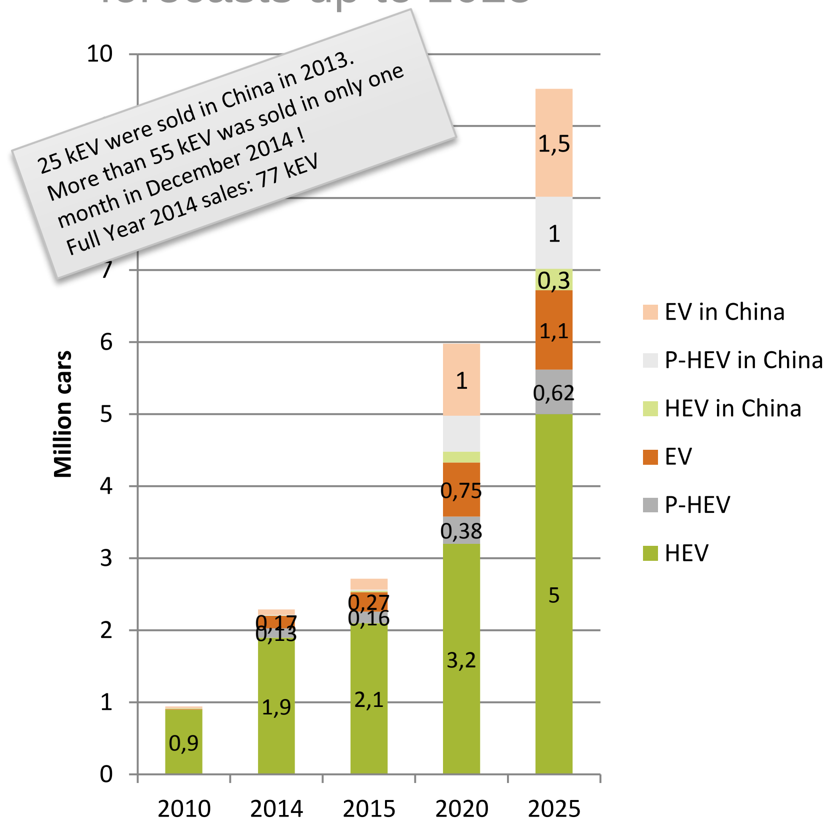
EV, P-HEV, EV 2025 FORECASTS

Scenario 2: thanks to very high incentives, China could change the game

S1: HEV, P-HEV & EV market forecasts up to 2025



S2: HEV, P-HEV & EV market forecasts up to 2025



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

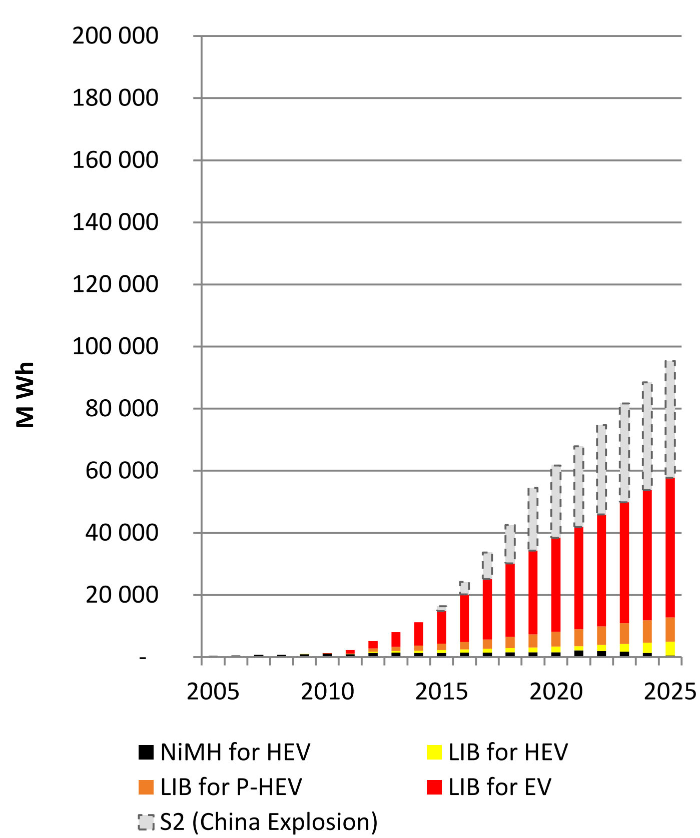
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

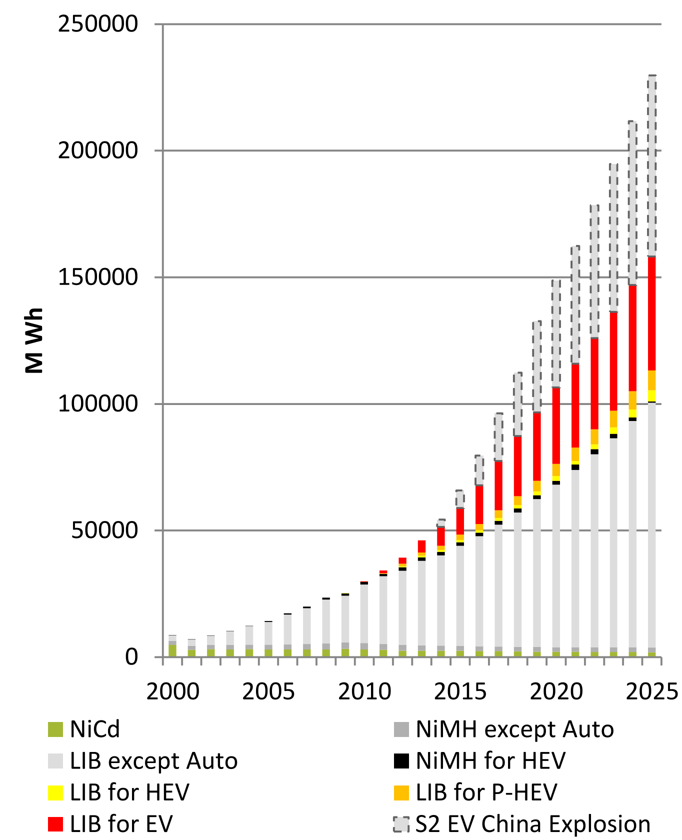
TOTAL BATTERY DEMAND 2025 FORECASTS

Scenario 2: thanks to very high incentives, China could change the game

EV, HEV & P-HEV Battery needs (MWh)
CAGR 2014-2025: +16% / S2:+22%



Total battery demand (MWh)
CAGR 2014-2025: +11% / *S2: +14%*



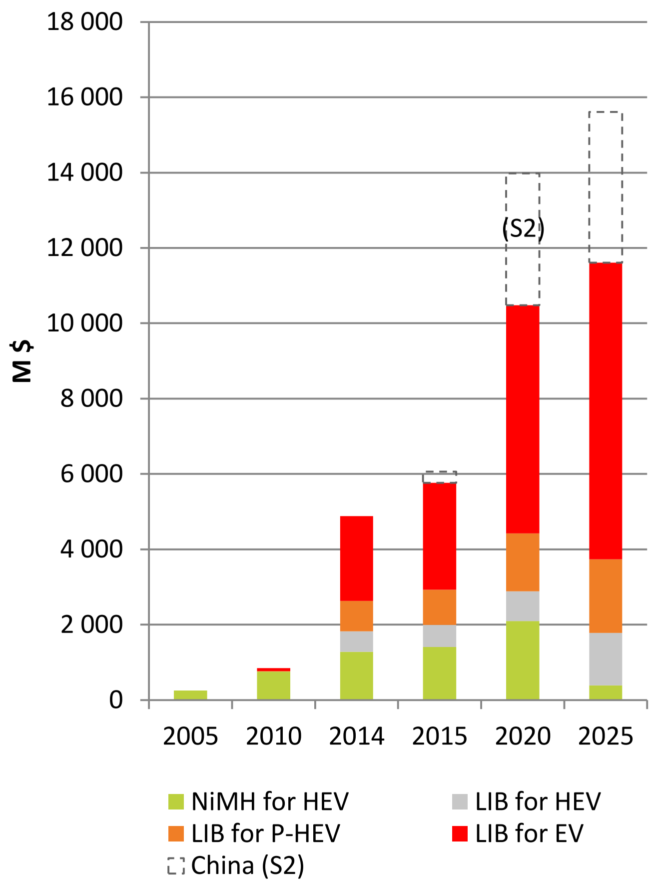
X-EV BATTERY MARKET 2000 – 2025 IN M$

Rechargeable battery market, M$ for x-EV 2000-2025

Cell Level

CAGR 2014-2025: +8% / S2:+11%

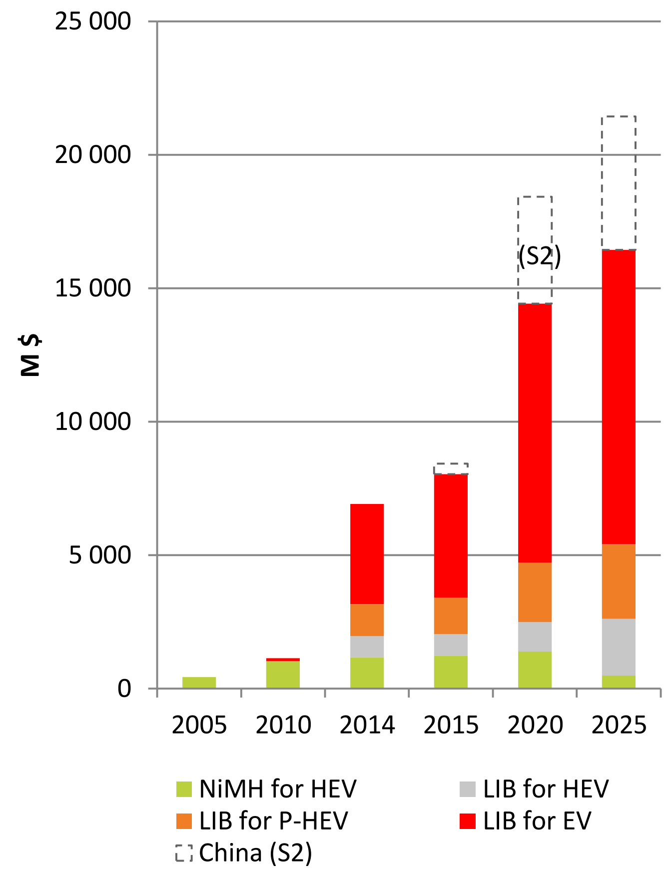
CAGR Li-ion 2014-2025: 11% / S2: 14%



Pack Level

CAGR 2014-2025: +8% / S2:+11%

CAGR Li-ion 2014-2025: 10% / S2: 13%



avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

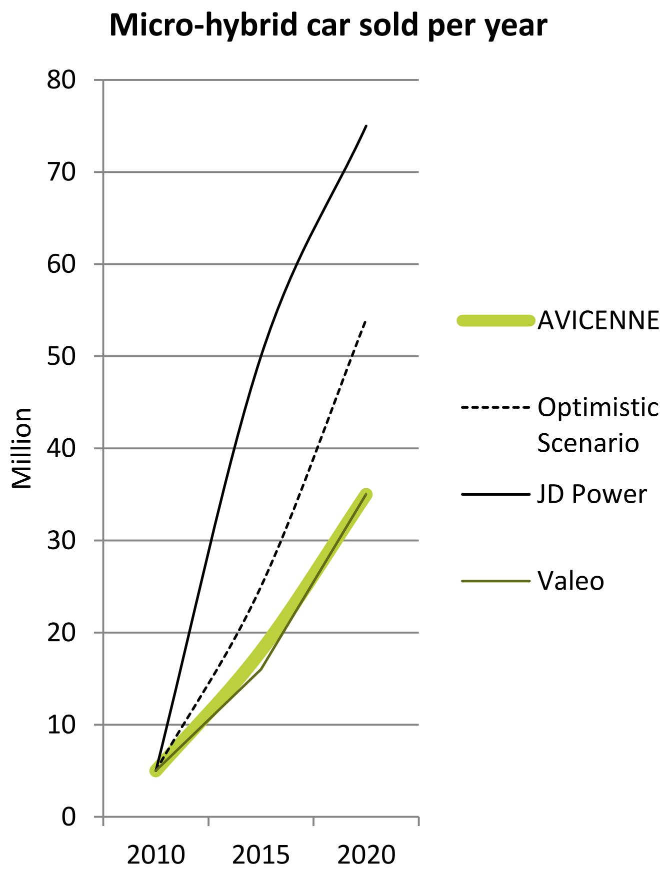
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

35 MILLION MICRO-HYBRIDS CAR IN 2020

Micro-hybrids car market 2010-2020



Advantages of micro-hybrid compare to HEV

- Powered by Advanced lead acid batteries
- Much more profitable than full HEV: 8 to 10 times less expensive than full HEV to save 5% gasoline instead of 20% (4 times less)
- Much more impact on CO2

	Micro-hybrid	Full HEV
Battery	Advanced lead acid	NiMH or LIB
Cost ($)	300	3000
Fuel saving	5%	20%
Million Vehicle sold per year in 2020	35	3.5

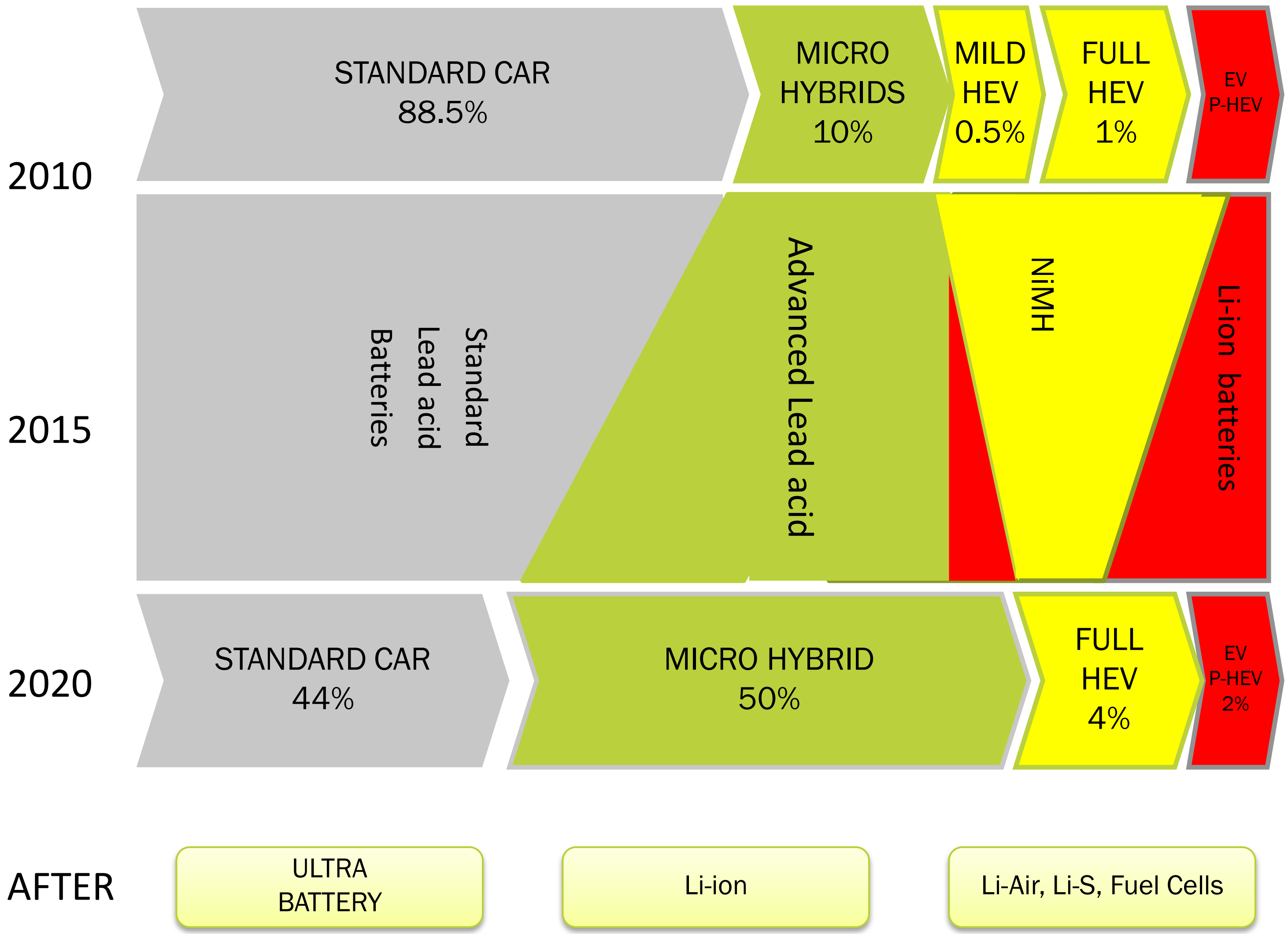
avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

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



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

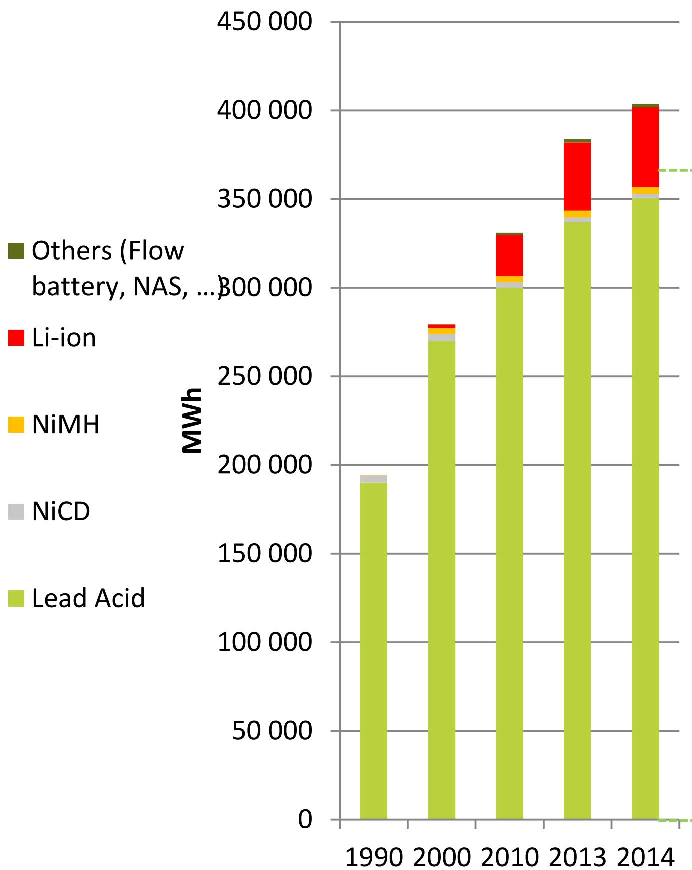
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

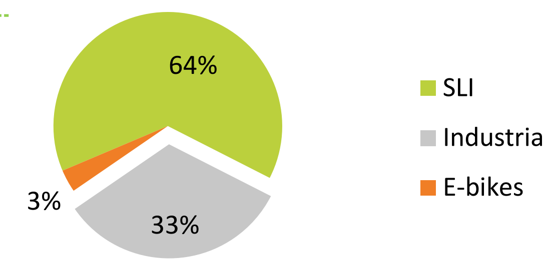
THE WORLDWIDE BATTERY MARKET 1990-2013

Lithium Ion Battery: Highest growth & major part of the investments
Lead acid batteries: By far the most important market (90% market share)

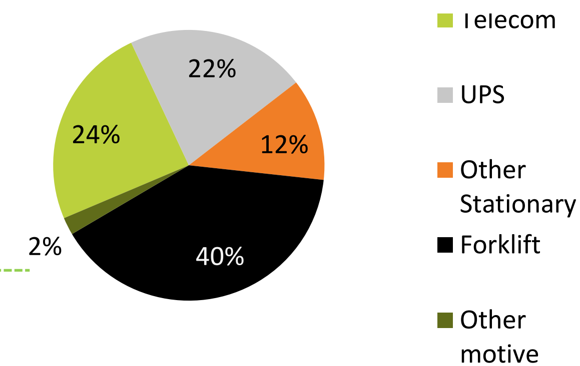


Source: AVICENNE ENERGY, 2014

Lead Acid Batteries
+350 GWh for > US $ 30 Billion



Industrial Batteries
58 GWh for US $ 13 Billion



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

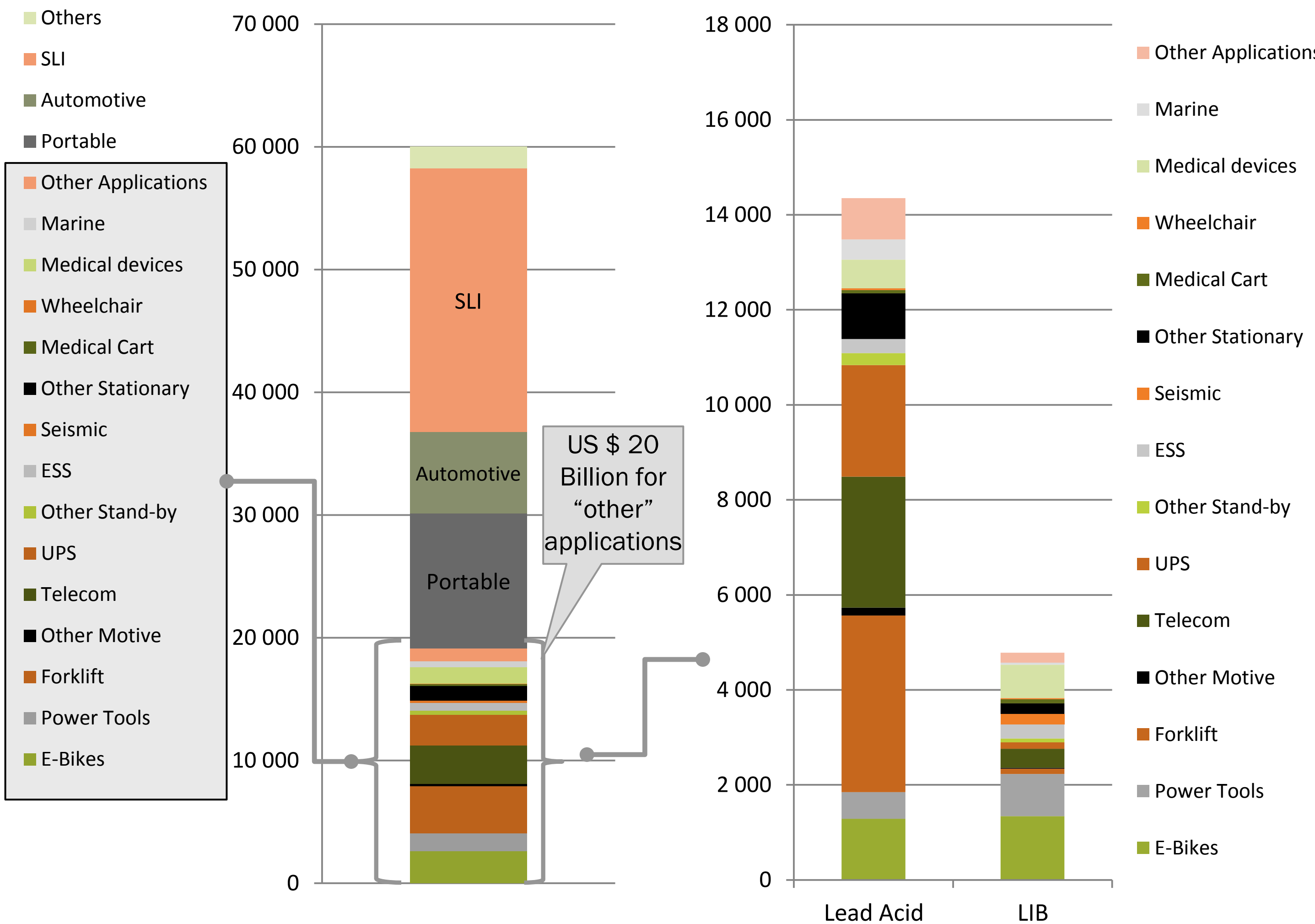
Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THE WORLDWIDE BATTERY MARKET IN 2014: US $ 60 BILLION (1)

Battery market in 2014 (M$)



(1) Pack level: Pack including cells, cells assembly, BMS, connectors – Power electronics (DC DC converters, invertors…) not included

Source: AVICENNE ENERGY, 2015

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

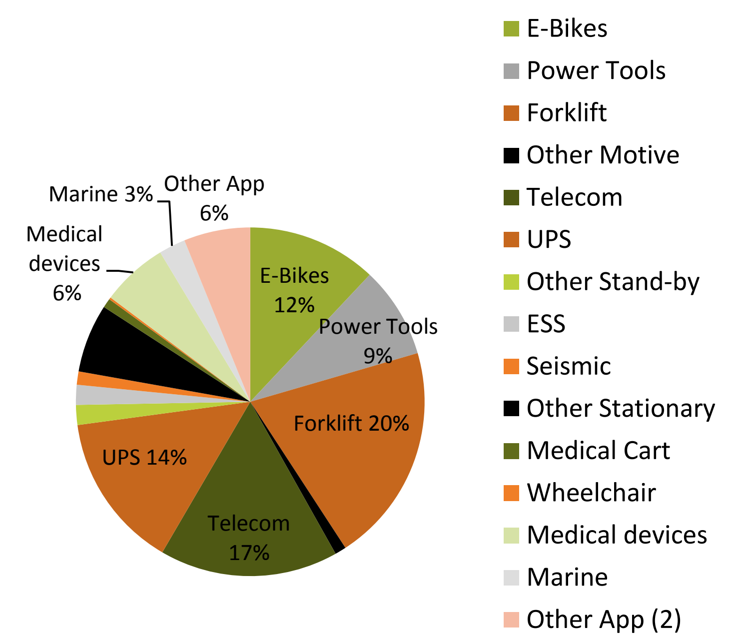
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

TOTAL POTENTIAL MARKET ANALYZED IN THE SURVEY (M$, PACK LEVEL[1])

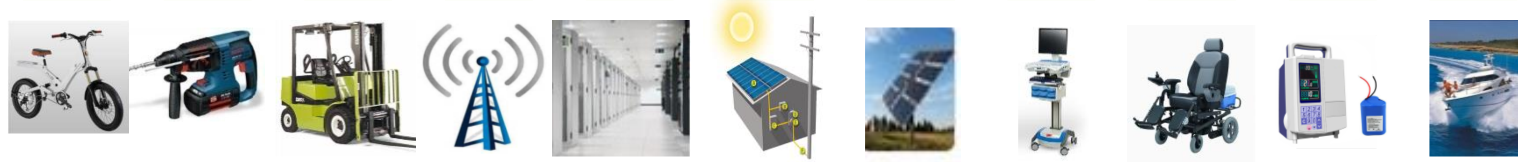
Application details

Battery Market			(%)
Power Tools			8%
E-bikes			13%
Industrial	Motive	Forklifts	20%
		Others	1%
		TOTAL MOTIVE	21%
	Stationary	Telecom back-up	16%
		UPS	14%
		Misc. Standby	2%
		ESS	3%
		Seismic (1)	1%
		Other Stationary	6%
		Total STATIONARY	42%
	TOTAL INDUSTRIAL		63%
Medical Cart			1%
Wheelchair			0%
Medical Device			7%
Marine			3%
Others (2)			6%
TOTAL			17 600

US$ 20 Billion in 2014 (1)



1 2 3 4 5 6 7 8 9 10 11



Source: AVICENNE ENERGY 2013

1- Pack level: Pack including cells, cells assembly, BMS, connectors – Power electronics (DC DC converters, invertors…) not included

2- Other App: Military, aerospace, Oil & Gas, Railways, Aviation, Utility metering,…

avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

MARKET SEGMENT SYNTHESIS TEMPLATE

Battery market in value 2012/2025 - CAGR

ASP in 2012 & 2020

LIB market in value 2012/2025 - CAGR

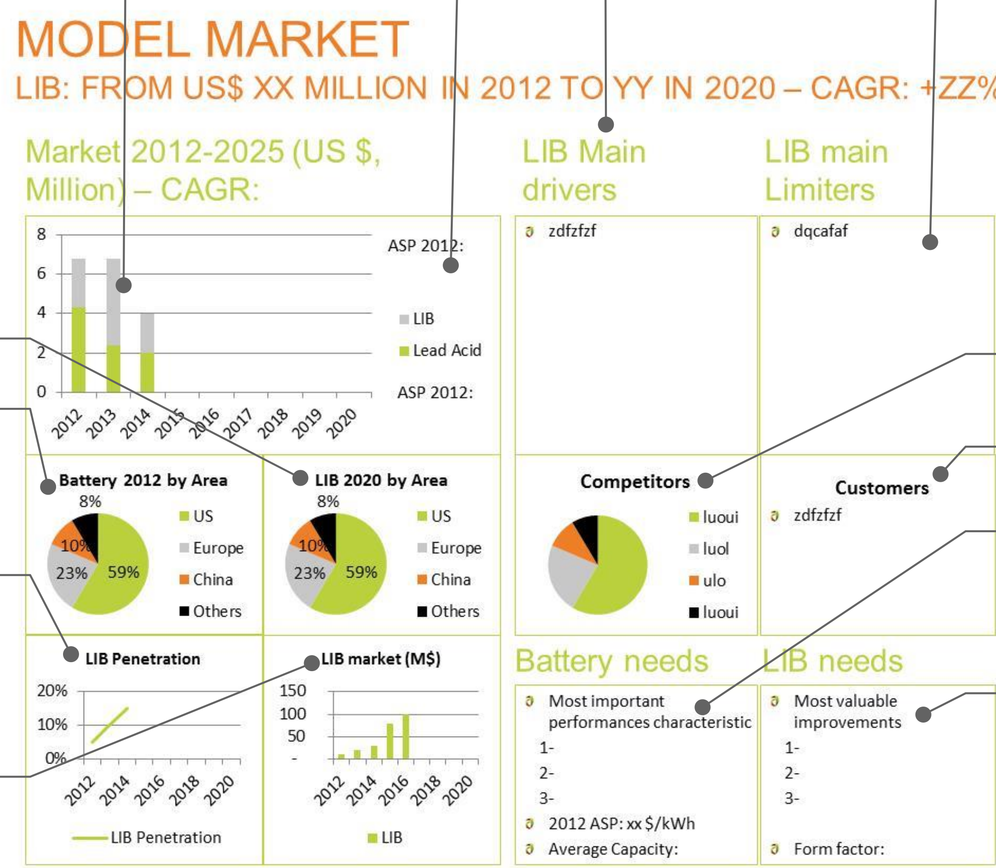
LIB main drivers & limiters

LIB market by Area

Battery market by Area

LIB Penetration in % of total device

LIB market in M$



Major competitors

Major customers

Most important performances characteristic, ASP, Average capacity

LIB most valuable improvement

LIB form factor

Source: AVICENNE ENERGY Analyses

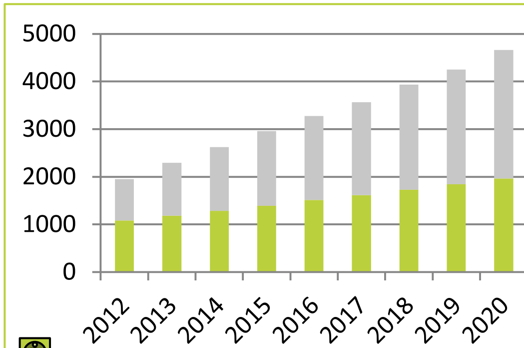
avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

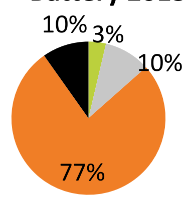
1- E-BIKES

LIB: FROM US$ 1,1 BILLION IN 2013 TO 2,7 IN 2020[1] – CAGR: +18%

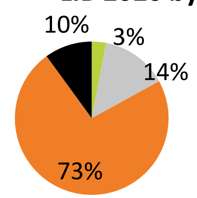
Market 2013-2020 (US $, Million) – CAGR: 13%



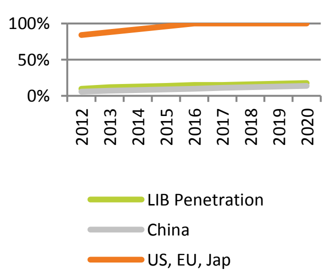
Battery 2013 by Area



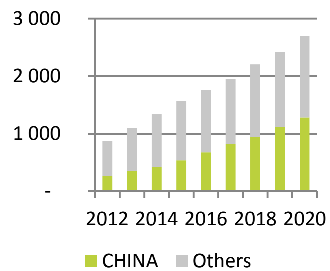
LIB 2020 by Area



LIB Penetration (% device)



LIB market (M$)



Main drivers

- E-bike in China: Banning of gasoline powered motorcycles in china boost e-bikes: "Necessary"
- In US, Europe and Japan, "Green image", sport, leisure, transportation: "Environment & Health"
- LIB penetration in China from 6 to 14%

Main Limiters

- In Japan, US and Europe, E-bikes are already equipped by Li-ion
- In China the only parameter to choose a battery is the cost
- Chinese E-bike ASP: 320 $/kWh: very difficult to penetrate this market

Competitors

- BMZ (Germany)
- AXEON[2] (UK)
- HITECH (Taiwan)
- Phylion (China)
- …

Customers

- Bosch,
- Panasonic
- Bion-X
- TranX-Z
- + > 500 e-bike mfg.

Battery needs

- Performances characteristic
  1- Cycle life
  2-Energy density
  3- Low cost
- Average Capacity:300 Wh

LIB needs

- Most valuable improvements
  1- Price decrease
  2- Cycle life
  3- Fast charge
- Form factor: from cylindrical to Laminate
- No standardization

www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

Source: AVICENNE ENERGY Analyses

Note: 1- Pack level – 2- A Johnson Matthey affiliate

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

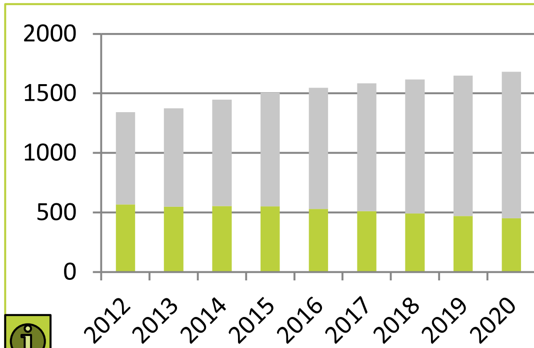
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

2- POWER TOOLS

LIB: FROM US$ 0,8 BILLION IN 2012 TO 1,2 IN 2020[1] – CAGR: +7%

Market 2013-2020 (US $, Million) – CAGR:+3%



ASP[1]
2012:560 $/Kwh
2020: 390 $/Kwh

ASP:
2012: 335 $/kWh
2020: 275 $/kWh

LIB Main drivers

- Higher voltage
- NiCd substitution
- NiCd regulation
- Cordless power tools & gardening tools market increase (+4% per year)
- Higher energy density, less weight

LIB main Limiters

- LIB average sales price
- Reliability
- High rate discharge
- Fast charge
- Life time

Battery 2013 by Area

- >75% of the power tools are made in China
- But, battery pack could be made on the end-user area (Ex: Bosch – Axeon Poland)

LIB 2020 by Area

- Power tools will be made in Europe
- Local demand in Europe, US, next to the end user to increase flexibility & Just in Time mfg.

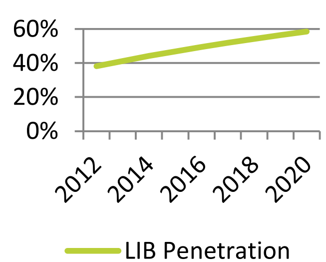
Competitors

- Cell/Pack Mfg.: TOP3: Samsung, Panasonic, Sony (> 75%)
- Pack makers: AXEON (Bosch),

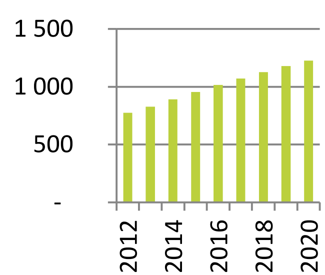
Customers

- Bosch
- B&D
- TTI
- Makita
- Jingding
- Hilti
- …

LIB Penetration



LIB market (M$)



Battery needs

- Important characteristic:
  1- Higher power & capacity
  2-Fast recharge
- 2012 ASP NiCd: 350 $/kWh
- 2012 ASP LIB: 550 $/kWh
- Average Capacity: 60 Wh

LIB needs

- Most valuable improvements
  1- Price decrease
  2- Fast charge
  3- High rate discharge
- Form factor: Cylindrical
- No standardization

Source: AVICENNE ENERGY Analyses

Note: : 1- Pack level

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

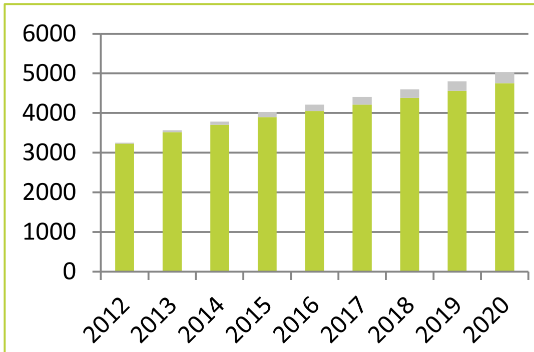
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

3- MOTIVE INDUSTRIAL: FORKLIFTS[2]

LIB: FROM US$ 60 MILLION IN 2013 TO 375 IN 2020[1] – CAGR: >40%

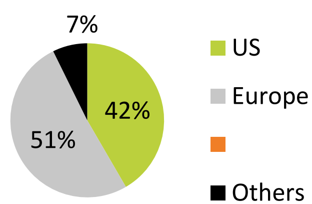
Market 2013-2020 (US $, Million) – CAGR:7%



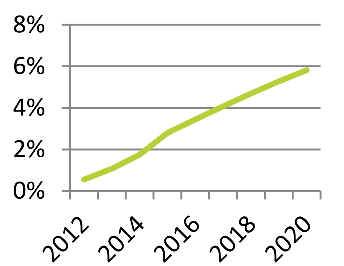
Battery 2012 by Area

Europe – largest producer of motive power batteries – has higher percentage of electric vs. gas trucks (75%) than in N. America (64%) – China: High % of Gas/propane trucks (> 80%)

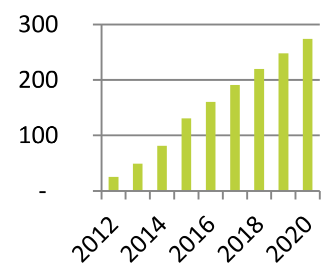
LIB 2020 by Area



LIB Penetration



LIB market (M$)



Main drivers

- Where economies are healthy, they reflect strong motive power production
- Europe & US got high E-forklift ratio compare to Asia
- LIB higher life time (* 3 to 5)
- Multiple shift operation where battery change is required (time consuming)

Main Limiters

- Low penetration of E-forklift in Asia
- High LIB capital price (x 5 compare to lead acid)
- Safety concerns
- in two of the lift truck types, sit-down rider and high reach, the counterbalance for the lift truck is supplied mainly by a lead acid battery

Competitors

- Lead Acid & LIB: Enersys (35%), Exide (10%), East Penn (10%), Hoppecke (10%), Crown (10%)
- LIB systems: BMZ, Lithium Balance, …

Customers

For lead acid, After market represent 60% of the market: lot of different customers (industrials)

For LIB, OEM Forklift: TOYOTA, Kion , Jungheinrich, NACCO , Crown, Mitsubishi Caterpillar

Battery needs

- important characteristic
  1-high charge/discharge rates and capacity
  2-high life time, range,
- Average Capacity: 22 kWh

LIB needs

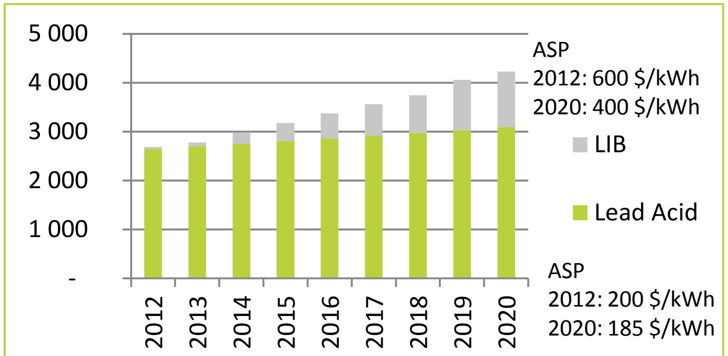
- Most valuable improvements
  1- Price
  2- Convince customers on “total cost of ownership”
- Form factor: large format prismatic – size standardization

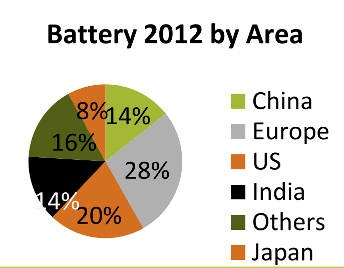
Source: AVICENNE ENERGY Analyses *Note: : 1- Pack level 2- Including all kind of Material handling equipment*

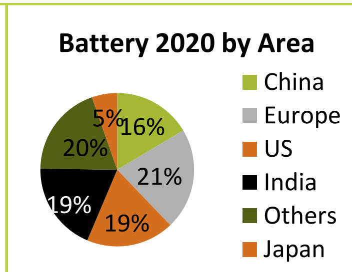
4- STATIONARY: TELECOM MARKET

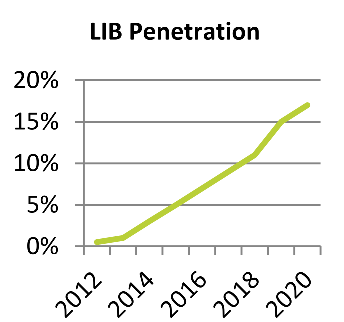
LIB: FROM US$ 0,2 BILLION IN 2013 TO 1,1 IN 2020[1] – CAGR: >50%

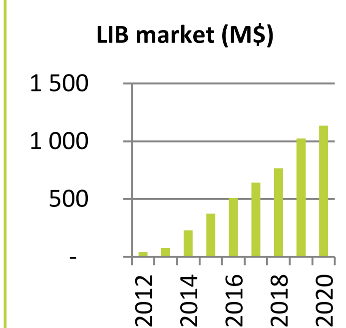
Market 2013-2020 (US $, Million) – CAGR: +7%











Main drivers

- LIB developed for new equipment
- Increased Bandwidth requirements
- Wireless Market driving growth
- Strong Network Growth in China, India, E. Europe & S. America
- 2G-> 3G -> 4G … need new equipment's
- LIB: **Specially in Hot climate**

main Limiters

- Lead Acid Vs. Li-ion…
- Lead Acid capital cost 5 times cheaper
- Total cost of ownership could be compare with Lead acid

Competitors

- Lead Acid & LIB: Enersys (35%), Exide (10%), and local suppliers in each countries
- LIB systems: "large companies" : SAFT, others?

Customers

- Not so many customers; big telecom carriers in each countries

Battery needs

- Most important performances characteristic
  1- Hot T°C performances
  2- Customized for the new Equipment network
- Average Capacity: 5-10 kWh modules (100 Ah)

LIB needs

- Most valuable improvements
  1- Capital costs
  2- Safety Proof
  3- Reliability
- Customized battery developed for new equipment

Source: AVICENNE ENERGY Analyses

Note: : 1- Pack level

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

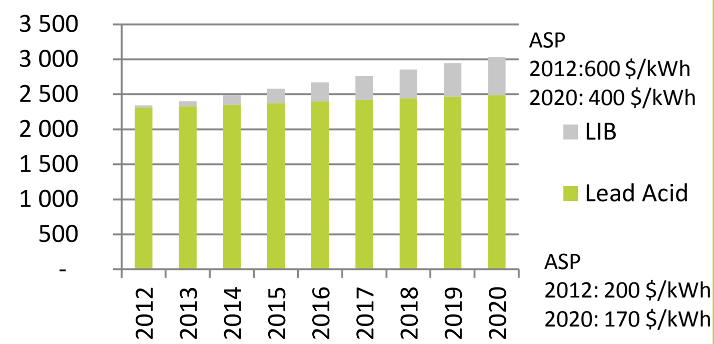
BATTERIES 2015
October 6, 2015
Nice, FRANCE

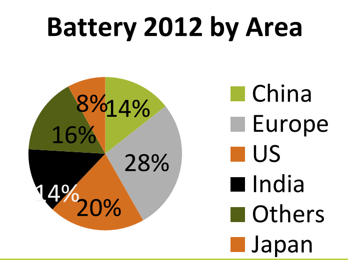
CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

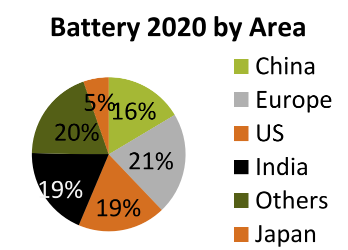
5- STATIONARY: UPS MARKET

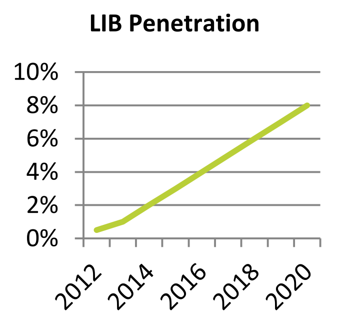
LIB: FROM US$ < 0,1 BILLION IN 2013 TO 0,5 IN 2020[1] – CAGR>+40%

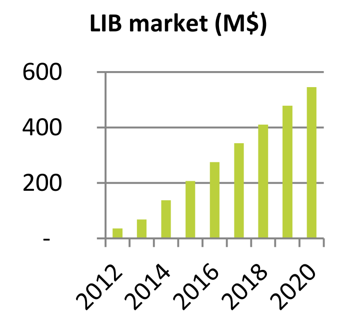
Market 2013-2020 (US $, Million) – CAGR: +4%











Main drivers

- UPS Drivers:
  - New Data Storage Centers
  - Mobile Society
- LIB drivers:
  - Less volume, less place
  - > Life time
- LIB is more needed where data are sensitive
- Li-ion battery could also help to save electricity during peak time

main Limiters

- Safety could be an important issue here

Competitors

- Lead Acid & LIB: Enersys (35%), Exide (10%), and local suppliers in each countries
- LIB systems: local companies providing > services

Customers

- Few leaders/many products:
  - Emerson/Liebert
  - Schneider/APC
  - Eaton Powerware
  - Gamatronic
  - Riello

Battery needs

- Most important performances characteristic
  1- Back-up at high current
  2- weight, volume
  3- life time
- Average Capacity: 3-5 kWh modules

LIB needs

- Most valuable improvements
  1- Convince on Safety
  2- Capital Cost
  3- Reliability
- Form factor: Cylindrical
- New development for new equipment

Source: AVICENNE ENERGY Analyses

Note: UPS: Uninterruptible Power Supply
APC: American Power Conversion

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

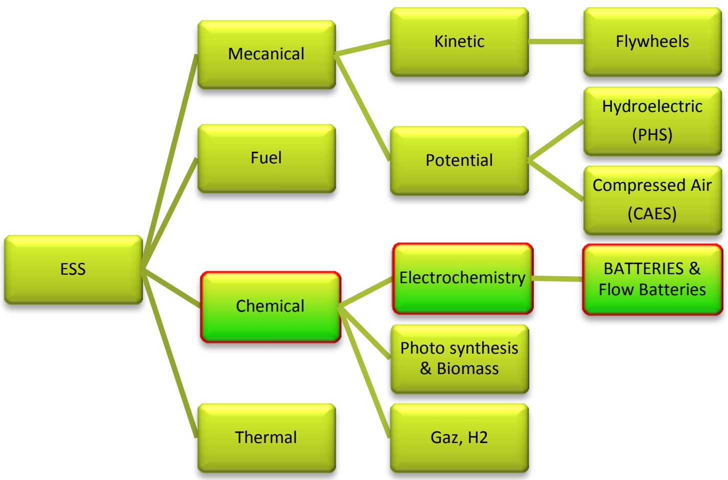
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

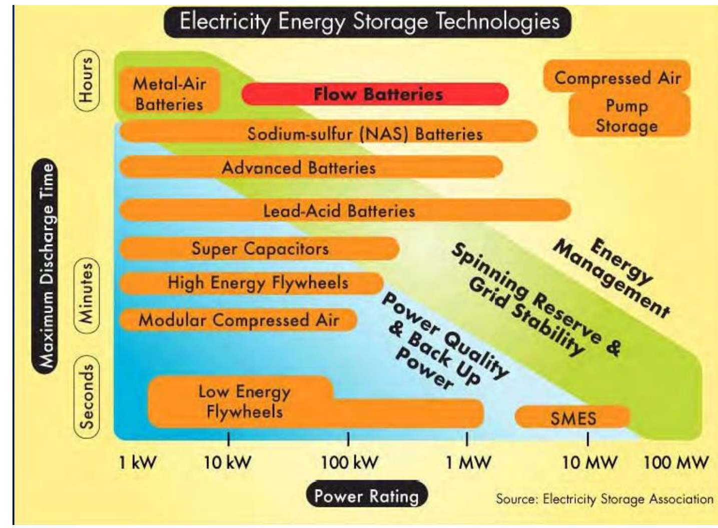
THE BATTERY MARKET FOR ENERGY STORAGE SYSTEM (ESS)

ESS segmentation

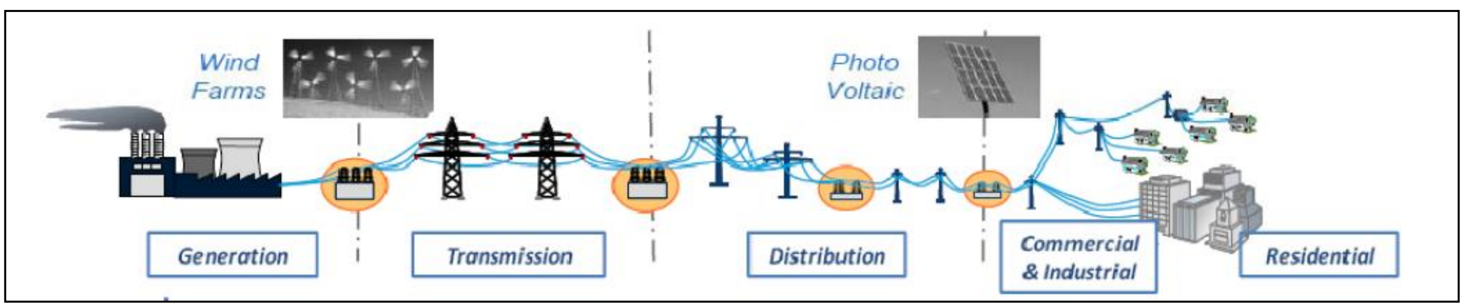


PHS: Pumped Hydroelectric Storage
CAES: Compressed air energy storage

ESS by power rating



Source: Electricity Storage Association

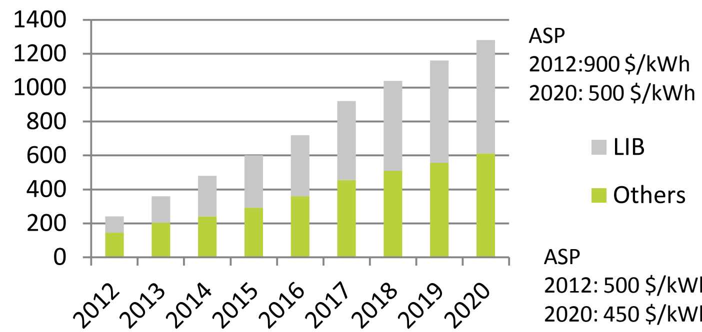


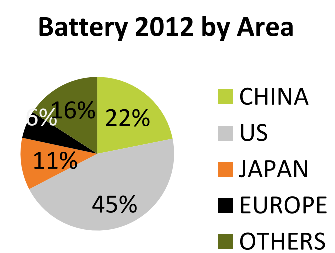
Source: KEMA, Market Evaluation for Energy Storage in the United States, 2012

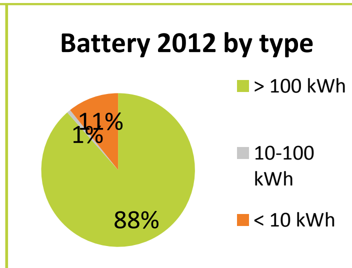
6- ESS (LARGE SYSTEMS²))

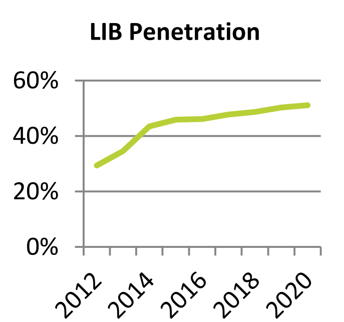
LIB: FROM US$ 0,2 BILLION IN 2013 TO 0,7 IN 2020¹ – CAGR: +30%

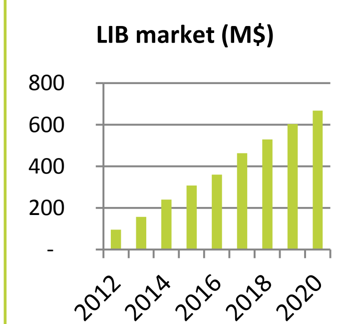
Battery Market 2013-2020 (US $, Million) – CAGR: +25%











Main drivers

- Integration of Renewable energy
- Poor electricity network
- Gas Turbine Replacement
- Purpose:
  - Frequency Regulation
  - Peak Shifting
  - Load Leveling

main Limiters

- Not a mature market
- Business model ?
- Regulation?
- Battery capital cost (leasing could be a good solution)

Competitors

- All big LIB suppliers: Panasonic, Samsung, LG, …
- A123,
- Johnson Controls
- Yuasa
- SAFT
- Tesla
- Altairnano
- …

Customers

- Large Electricity providers
- New comers with renewable energy
- Often support by local government

Battery needs

- Most important performances characteristic
  1- Life time
  2- Power capabilities
  3- Cost
- Average Capacity: from 10 kWh to MWh

LIB needs

- Most valuable improvements
  1- cost of ownership
- Customized development

Source: AVICENNE ENERGY Analyses

Note: : 1- Pack level – 2- > 10 kWh systems

.

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

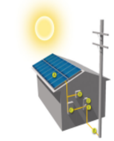
The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com



7- ESS (SMALL SYSTEMS)[2]

LIB: FROM US$ 40 MILLION IN 2013 TO 170 IN 2020[1] – CAGR>30%

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

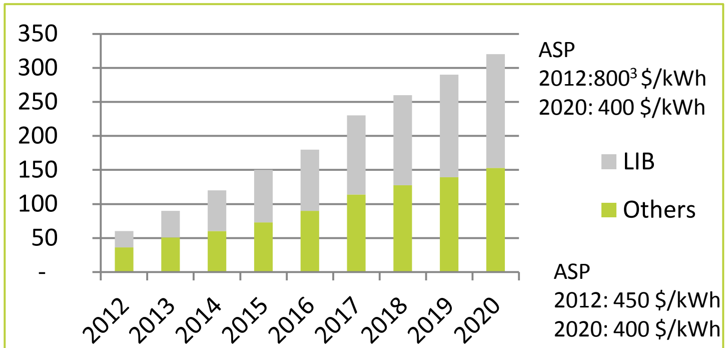
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

Battery Market 2013-2020 (US $, Million) – CAGR: +27%



Main drivers

- Residential back-up
- PV Integration
- « Net Zero Energy Home »
- Electricity cost
- Government subsidiaires

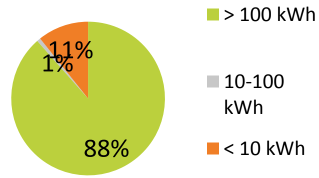
main Limiters

- Not a mature market
- Business model ?
- Regulation?
- Battery capital cost (leasing could be a good solution)

Main countries

- Germany
- France
- US
- Japan

Battery 2012 by type



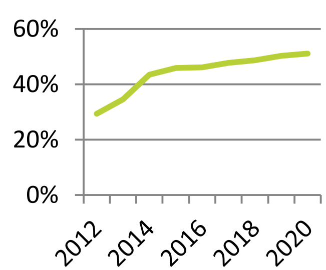
Competitors

- All big LIB suppliers: Panasonic, Samsung, LG, …
- A123,
- Johnson Controls
- Yuasa
- SAFT
- Tesla
- Altairnano
- …

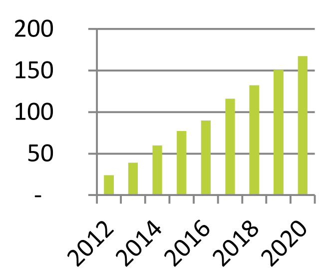
Customers

- Large Electricity suppliers
- Private companies: (Ex: Solarcities, One Energy Corp., SunRun's)
- PV residential solution providers: Panasonic, Kyocera, Sharp, SMA …

LIB Penetration



LIB market (M$)



Battery needs

- Most important performances characteristic
  1- Energy density
  2-Life time
  3- Power capabilities
- Average Capacity: < 10 kWh

LIB needs

- Most valuable improvements
  1- Cost of ownership
  2- Life time
  3- Charge acceptance
- Customized development
- Standardization?

Source: AVICENNE ENERGY Analyses

Note: : 1- Pack level – 2- < 10 kWh systems for home or office
3- Battery pack only, not including the management system, power electronics, installation, …
The total price of a 7 kWh system from SAFT is 10 k€ (1800 $/kWh)

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

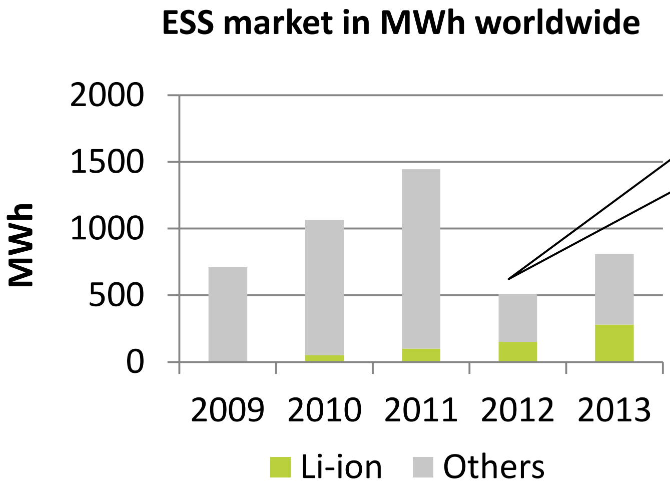
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

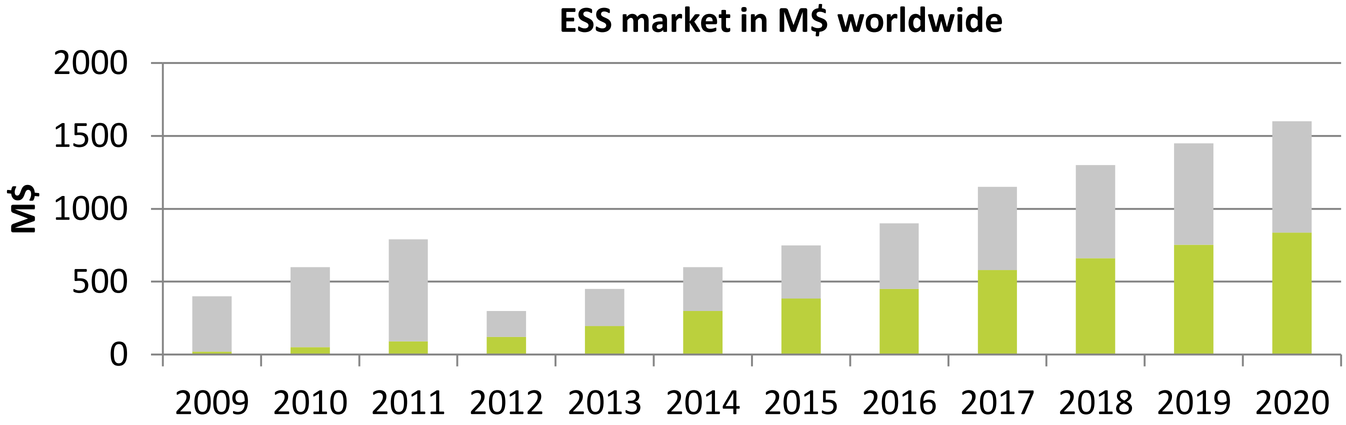
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THE BATTERY MARKET FOR ESS IN 2013-2020

AVICENNE ENERGY estimates the ESS market in 2013 < 500 M$



On Sept 2011 NGK-manufactured NaS batteries plant caught fire. Following the incident, NGK temporarily suspended production



avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

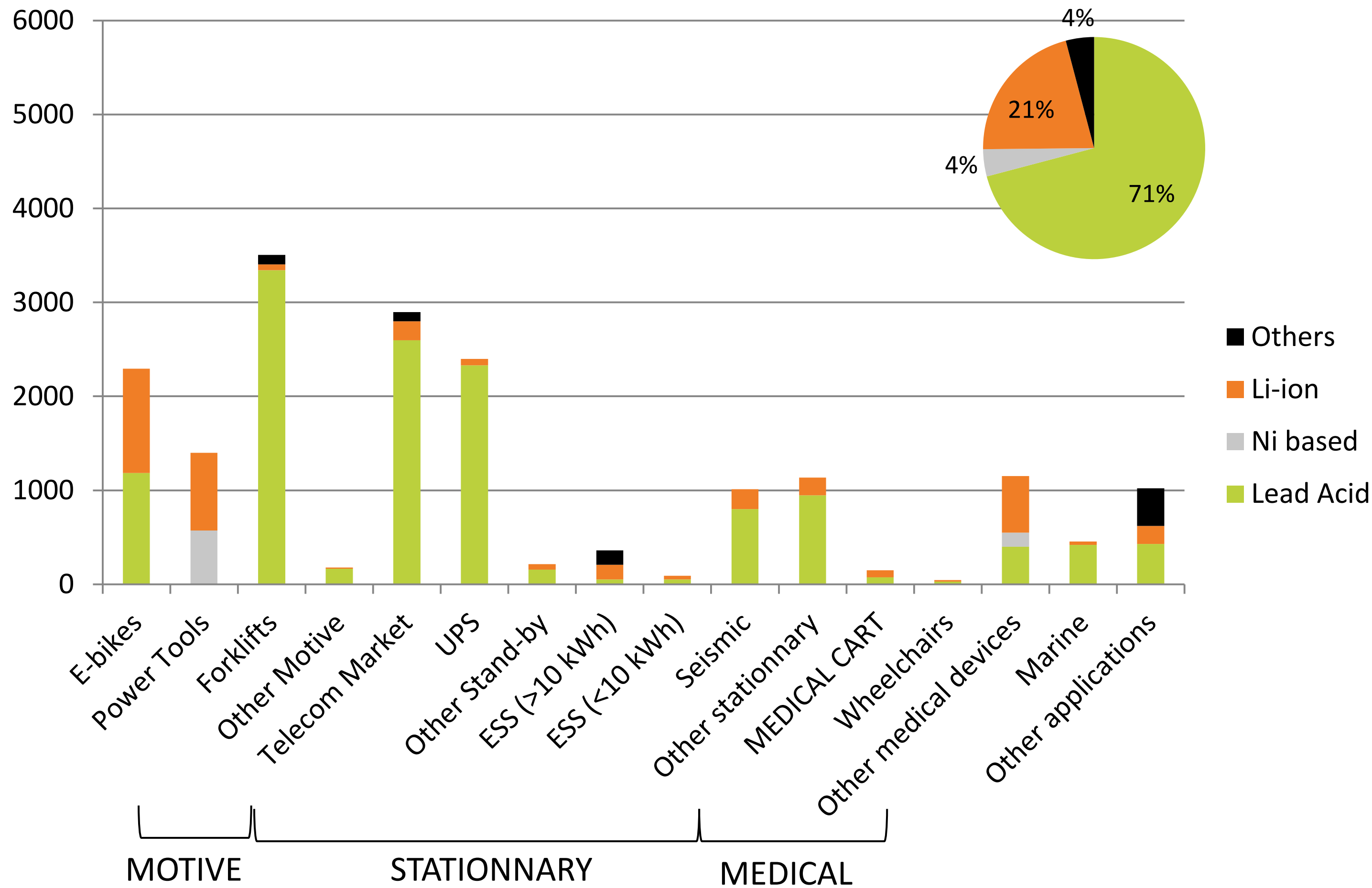
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

2013 OTHER APPLICATION MARKET US$ MILLION

US $ 18 Billion in 2013



avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

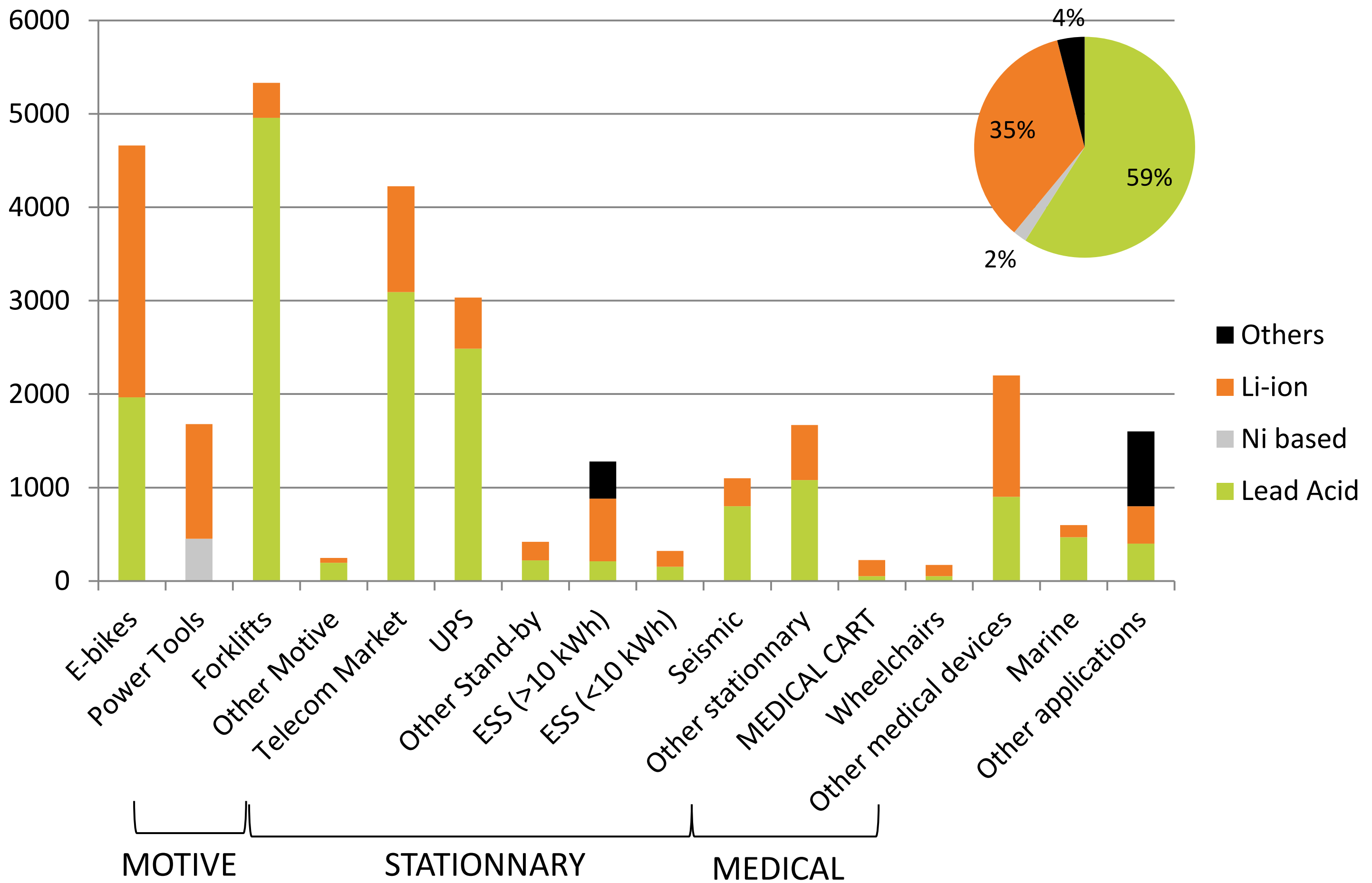
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

2020 OTHER APPLICATION MARKET US$ MILLION

US $ 28 Billion in 2020 – CAGR 2013/2020: +8%



avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

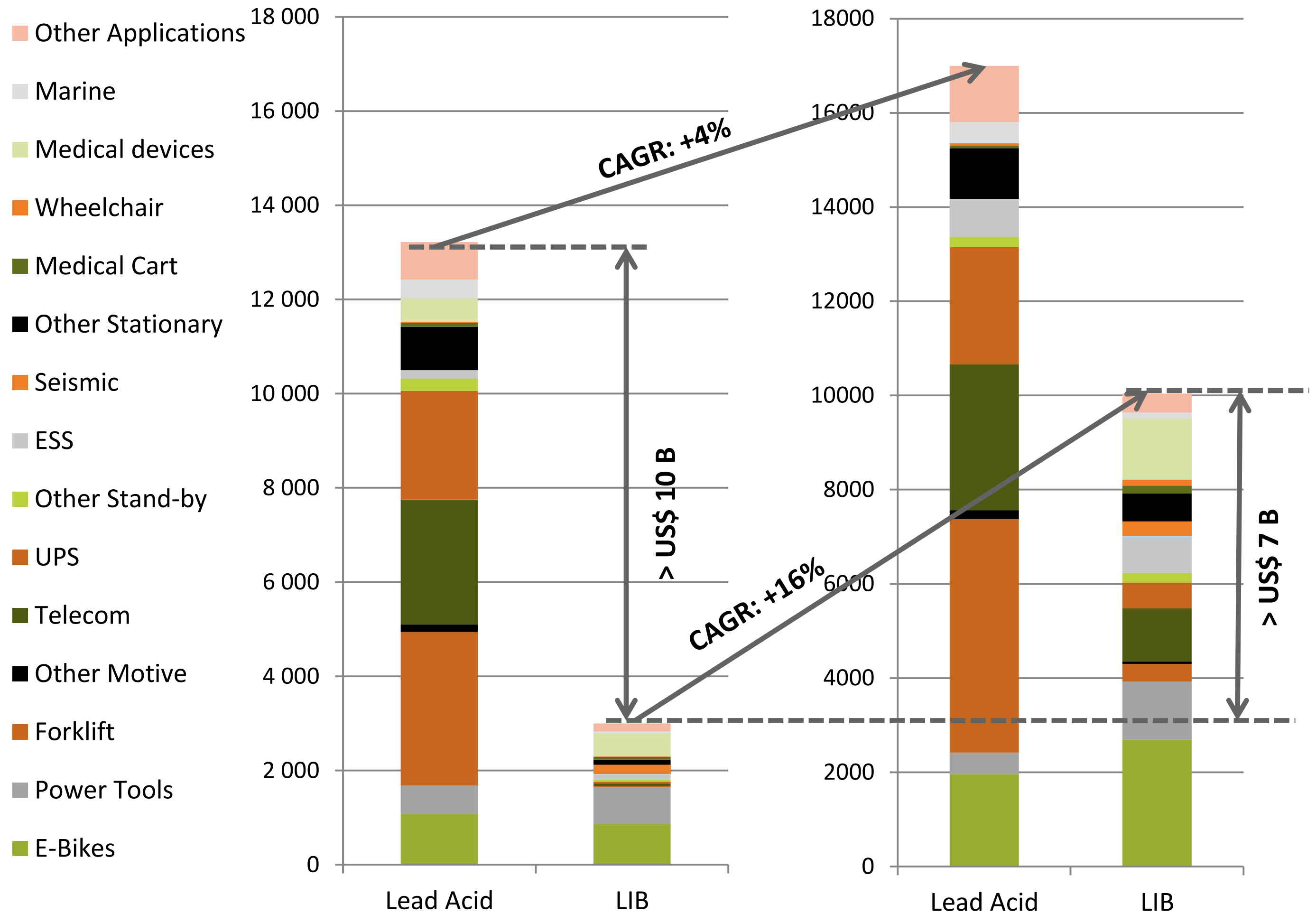
BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

"OTHER APPLICATIONS" 10 B$ POTENTIAL MARKET[1]

Battery market in 2012 (M$)

Battery market in 2020 (M$)



Source: AVICENNE ENERGY, 2013

For Power tools, NiCd batteries are used rather than lead acid batteries

1- Pack level

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

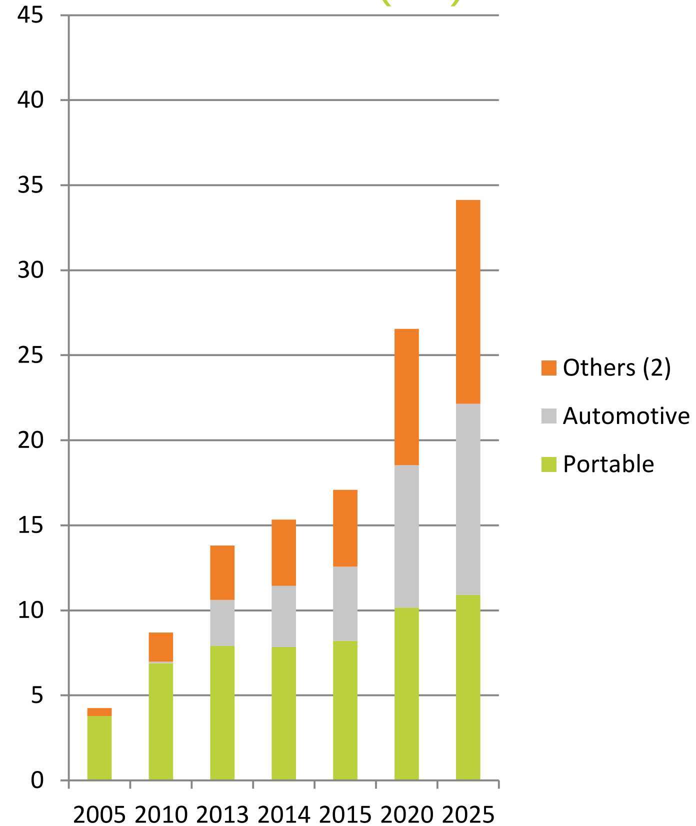
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

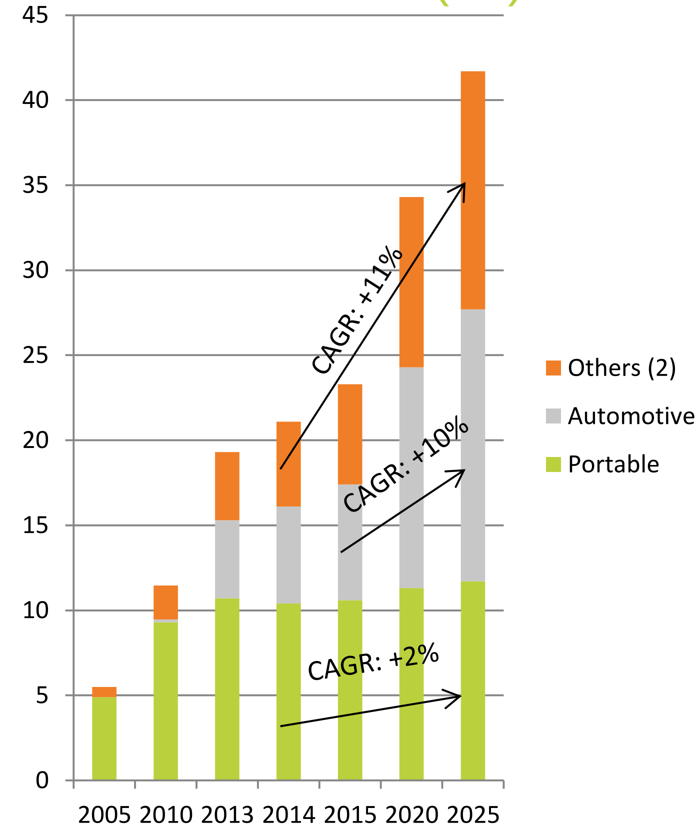
LI-ION CELL & PACK MARKET DETAILS

2014 -2025
- Portable: from 29 to 65 GWh
- Automotive: from 10 to 60 GWh / S2: 100 GWh
- Others: from 7 to 32 GWh

Li-ion cell market (B$)



Li-ion Pack market[1] (B$)



1- Pack: cell, cell assembly, BMS, connectors – Power electronics (DC DC converters, invertors…) not included

2- Others: Batteries for Power tools, E-bikes, Industrial, medical…

S2: Chinese EV market explosion

Source: AVICENNE ENERGY Analysis 2015

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

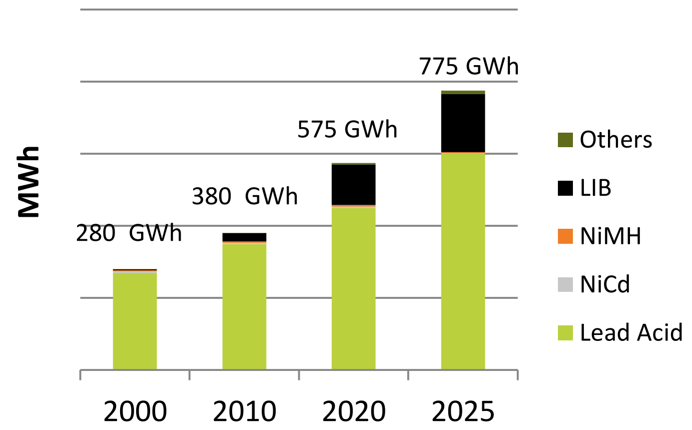
TAKEAWAYS

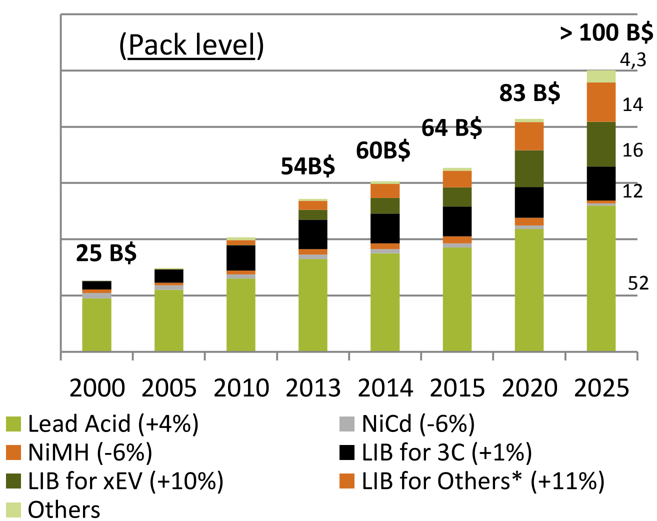
Battery Market 2010-2025

CAGR = +10%

- Li-ion battery is driven today by Portable PCs & electronic devices (smartphones, tablets)
- For HEV, the battery technology is today the NiMH
- In 2012, most of the car makers (except Toyota) switch to Li-ion
- P-HEV & EV will be powered by Li-ion:
  6 B$ market in 2015 - 11 B$ in 2020 & 15 B$ in 2025
- 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
- Huge Chinese Market appears in 2014: to be followed !
- Micro-hybrid will achieve >50%
- Lead acid battery will be the first market in 2025 in volume & value
- A very small EV market in the automotive world will represent a huge market for batteries
- New LIB applications: UPS, Telecom, Forklift, Medical, Residential ESS, Grid ESS: CAGR > 15% in the next 15 years
- In 2020, Energy storage will represent less than 5% of the total battery market

RECHARGEABLE BATTERY MARKET WORLDWIDE 2000-2025





(CAGR 2014-2025)

Others: Automatic handling equipment, forklifts, back-up, UPS, Telecom, medical devices, Residential ESS, Grid ESS, …

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THANK YOU

Christophe PILLOT
AVICENNE ENERGY
c.pillot@avicenne.com
Phone: +33 1 47 78 46 00
Mobile: + 33 6 88 82 79 49

avicenne
ENERGY

avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

CONTACT

About AVICENNE ENERGY

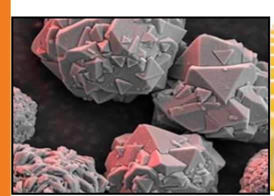
avicenne ENERGY

INFORMATION FOR GROWTH

www.avicenne.com

AVICENNE ENERGY

JANUARY 2015






CONTACT

Christophe PILLOT
c.pillot@avicenne.com
+33(0)1 4778 4600

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

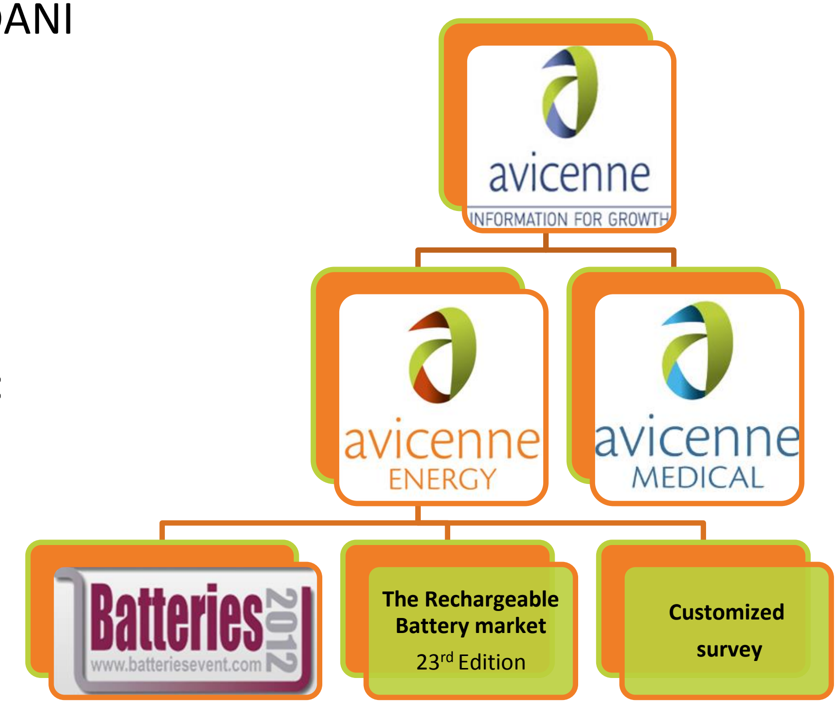
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

AVICENNE PROFILE

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

- Creation: 1992, by Ali MADANI
- Headquarter: Paris
- Liaison Office: Japan, USA
- AVICENNE Energy Director: Christophe Pillot
- 5 consultants
  - A Madani
  - C Pillot
  - JP Salvat
  - X Zhang
  - A Yassari



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT
Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

OUR BUSINESS STORY

- **1992**
  - AVICENNE Creation
- **1994**
  - AVICENNE advised French Industry Ministry on the European battery business opportunities
  - AVICENNE open its office in JAPAN
- **1999**
  - « BATTERIES » congress 1st edition in Paris
- **2003**
  - AVICENNE work on the due diligence process for the sales of SAFT by ALCATEL
- **2008**
  - AVICENNE: expert witness in the NTT-Hydro Quebec conflict
- **2009**
  - AVICENNE presented its market forecasts to industrials (CIAPS) in Beijing – China
- **2010**
  - Avicenne developed partnership with BATTERY JAPAN
  - 20thEdition of “The rechargeable battery market worldwide 2010-2020
- **2011**
  - AVICENNE Energy division is created
  - 13th Edition of BATTERIES Congress
- **2012**
  - 21st Edition of “The rechargeable battery market worldwide 2011-2025
- **2014**
  - 23rd Edition of our Battery Market Syrvey
  - 16th Edition of BATTERIES Congress in NICE, France
  - 1 month mission in China: Qinghai EV Rally, CIBF, 50 companies visited

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

OUR METHODOLOGY

Track valuable Information's

Strategic Analysis

Presentation of the results

Q&A with customers

Customer Evaluation

INFORMATION COLLECTION

	Primary Research	Secondary Research
SUPPLY SIDE	Executive Interviews Vendor Briefings Product Demos and Tours	Company News & Financials Technology & Product Specs Government Data Economic, Demographic Data
DEMAND SIDE	Consumer Surveys Business Leader Surveys	Case Studies Reference Customers

MARKET & STRATEGIC ANALYSIS

Qualitative	Quantitative	Strategic
Business Models & Trends Technology Issues Policy & Regulatory Factors Competitive Landscape Profiles of Key Players	Company News & Financials Technology & Product Specs Government Data Economic, Demographic Data	SWOT Analysis Gap Analysis Business Plan Value Proposition Due Diligence Merger & Acquisition

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

METHODOLOGY: EXTENSIVE FIELD RESEARCH TO RETRIEVE & CROSS CHECK INFORMATION

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

Top management contact network
> 19 000 contacts

Conferences & Exhibitions

Batteries 2011
www.batteriesevent.com

aabc

2nd Int'l Rechargeable Battery Expo
BATTERY JAPAN

THE BATTERY SHOW

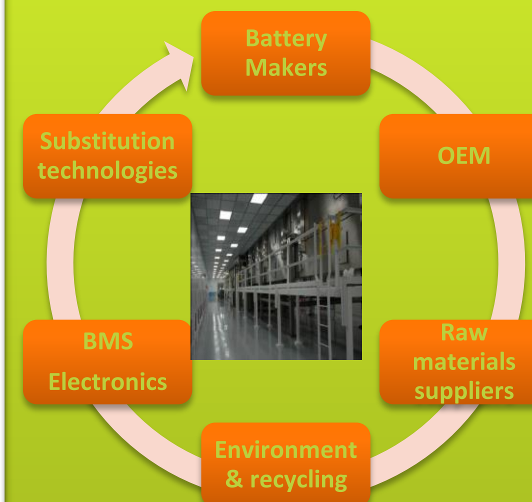
CeBIT

CIBF2010
9th China International Battery Fair

JAPAN ELECTRONICS SHOW

In Depth analysis
Of applications

Cross Check Analysis



avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

CUSTOMIZED & MULTICLIENT SURVEY FOR ALL THE VALUE CHAIN

Raw Materials → Materials → Cells → Pack → OEM

Source : Photo from BASF

Raw Materials	BMS & Electronics
Batteries	
Cooling Systems	Power Electronics

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

MORE THAN 200 REFERENCES WORLDWIDE

- 3M
- A123
- AIR LIQUIDE
- AIR PRODUCT
- AHLSTROM
- ALCATEL
- AMPEREX (ATL)
- APPLIED MATERIALS
- ARKEMA
- AROS SECURITIES
- ARC
- ASHLAND
- ATL AMPEREX
- AT KEARNEY
- AUSTRIAN INSTITUTE OF TECHNOLOGY
- AXEON
- BAIN
- BASF
- BATTERY ASSOCIATION OF KOREA
- BAYER
- BLACK & DECKER
- BHP BILLITON
- BRAND LICENCING PARNERS (BLP)
- BOURNS
- BOSCH
- BOOZ
- BRUCKNER
- BUHLER GMBH
- BYD
- CABOT
- CALL2RECYCLE
- CAP X
- CATELLA
- CARBONE LORRAINE
- CARLYLE
- CATELLA
- CATERPILLAR INC.
- CDN COBALT
- CEA/LITEN
- CELGARD
- CHEMETALL
- CHEMISHE FABRIK BUDENHEIM
- CIBA
- CIAPS CHINA
- COGEMA
- CONOCO PHILIPS
- CRU GROUP
- CSC CHALLENGE STRATEGY CHANGE
- DELTA
- DGA
- DIALOG SEMICONDUCTOR
- DOW CHEMICAL
- DOW CORNING
- DUPONT
- DURACELL
- EDF
- ELECTRO ENERGY
- ENER 1
- ENERGIZER
- EOLITE
- EPCOS OHG
- ERAMET
- ETC AB
- FACOM
- FALCON BRIDGE
- FAIRSHILD SEMICONDUCTOR
- FAMEART
- FIST
- FLORIDIENNE DE CHIMIE
- FMC
- FORTU POWER CELL
- FRANCE TELECOM
- FREUDENBERG VLIESSTOFFE SE & CO
- FRAUNHOFER INSTITUTE
- FULTON INNOVATION
- GAIA
- GIL IMPORT BATTERIES LTD.
- GS MELCOTEC
- HC STARCK
- HILTI
- HITACHI MAXELL
- HOLLINGSWORTH & VOSE CIE
- HONEYWELL
- HPL (HIGH POWER LITHIUM)
- HUTCHINSON
- ICC NEXERGY
- IER
- IGL EXPORT.
- INTERNATIONAL COMPONENT CORP.
- INTERNATIONAL RECTIFIER
- INTEK
- INTEL
- INTERSIL
- INCO
- ISRAEL CONSULTING
- ITRI
- ITS
- JBC
- JETRO
- JOHNSON CONTROLS
- JOHNSON MATTHEY
- KODAK
- KRUGER
- LAZARD
- LECLANCHÉ
- LEGRAND
- LG CHEMICAL
- LION CELLS
- LITTLE FUSE
- LILIPUCIAN
- LYNAS CORP
- MATSUSHITA
- MICROSOFT
- MTI MICRO FUEL CELLS
- MOLTECH
- MOLYCORP
- MOMENTIVE
- MOSAID TECHNOLOGIES
- MOTOROLA
- MUNSTER UNIVERSITY
- NANOCYL
- NCCP – RUSSIA
- NEC
- NITECH
- NKKPC
- NORILSK NICKEL
- NOVALED
- NTK POWERDEX
- OLIVER WYMAN
- OMG INC
- ORANGE
- OSKR
- PANASONIC
- PHILIPS
- PHOTON
- PK & WISE
- PLEXTRONICS
- POWER GENIX
- PRAYON
- PRISMARK
- PSA
- RAYOVAC
- RECHARGE
- RENAULT
- RHODIA
- ROLAND BERGER
- ROSKILL INFORMATION SERVICES
- SAFT
- SAGENTIA
- SAINT GOBAIN
- SAKTI
- SAMSUNG SDI
- SANIK
- SCHRODER VENTURE
- SCOTENT ENTREPRISE
- SEPCELL
- SFPZ
- SHENZHEN HIGH POWER TECHNOLOGY
- SCHOTT AG
- SKC
- SQM
- SVE - DASSAULT
- SOLVAY
- SONY
- STIBAT
- STORCK
- STRATEGY ANALYSIS
- TERRAROSSA CAPITAL
- TIGER GLOBAL
- TODA KOGYO
- TOTAL
- TOTAL WIRELESS SOLUTION
- TOYO
- TOYOTA
- TREOFAN
- TYCO
- UMICORE
- UNIROSS
- URALELEMENT
- US NAVY
- VARTA
- VOLTRACK
- WACKER CHEMIE AG
- WARBURGPINCUS
- WILDCAT
- WORLD INDUSTRIAL INFORMATION CENTER
- WR GRACE & CIE
- YASLAMEN
- ZEBRA
- ZPOWER

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

SPEAKER, CHAIRMAN OR WORKSHOP MODERATOR

Tens of INTERNATIONAL CONFERENCES per year

- Extended Battery Life Working Group on battery technology development for mobile devices Meeting
  Tokyo Japan , Dec 2014 – 1h30 Presentation
  "The battery market for mobile 2013-2025"
- BATTERIES 2014, FRANCE – (1999-2014)
  Owner, chairman & speaker
  "The battery market 2013-2025"
- INTERNATIONAL Li-ion BATTERY SUMMIT – Dec 2013, Shenzhen, China
  "The Li-ion battery raw materials market 2012-2020"
- AABC Europe, Mainz (2012, 2013, 2015)
  "The Lithium ion raw material battery market 2010-2020"
- THE INTERNATIONAL BATTERY SEMINAR - FLORIDA
  Fort Lauderdale, Florida , March 2014 – 2h tutorial
  "HEV, PHEV & EV market 2010-2020 ; Battery is the key" (From 2004 to 2014)
- EVER 2009, 2011, MONACO
  "Challenges for EV market in Europe"
- EVS 2011, 2013
  "Battery market for automotive industry"
- CIAPS (China Industrial Association of Power sources), BEIJING, Dec 2009
  "Advanced battery market & raw materials worldwide"
- Advanced Battery for Vehicles, IQPC, Frankfort, 2009, 2010, 2012
  Chairman & speaker,
  "The battery business 2009-2020"
- EET-2008 European Ele-Drive, MOTOR SHOW GENEVA,
  International Advanced Mobility Forum – Geneva Motor Show
  (Professor Gaston Maggetto Award: C. Pillot as the best rated paper & presentation by EET-2008 Scientific Reviewing Committee)
  "The HEV & EV market trends & main challenges"
- China Industry Battery Fair 2006, 2010, 2014
  "The Chinese battery Industry"
- …

AVICENNE ENERGY: RENOWNED TO HAVE REALISTIC FORECASTS

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

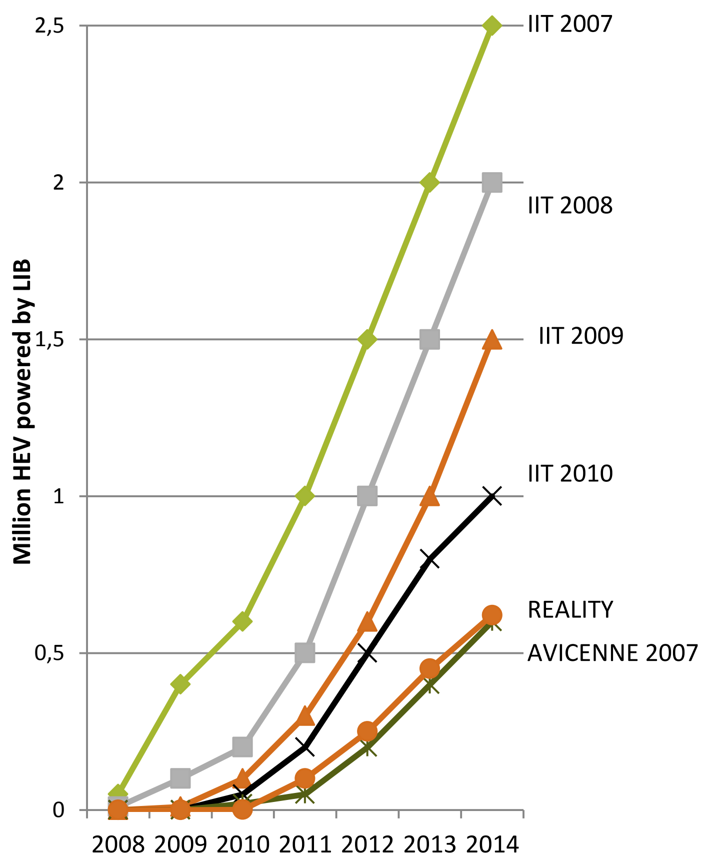
The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

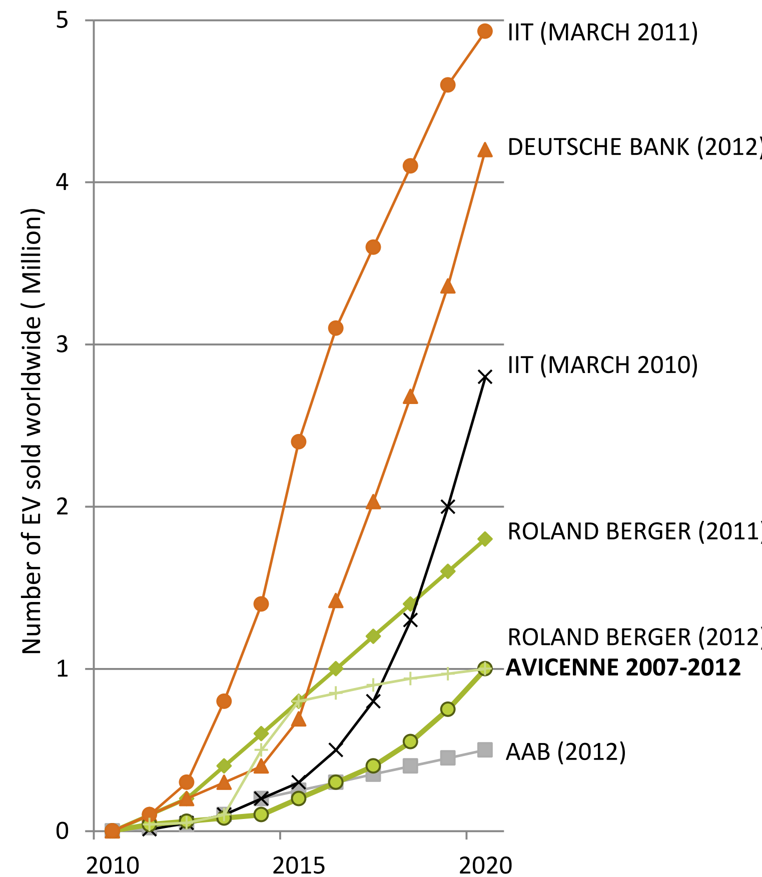
CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

HEV powered by Lithium ion battery forecasts from 2008 to 2014



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



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

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

BATTERIES 2015

www.batteriesevent.com

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

- 3 days congress in France (Paris, Nice, Cannes)
- 17th Edition (first edition in 1999)
- 500 attendees
- 40 Booths
  Battery makers, raw materials suppliers, IC & BMS suppliers, tests, machining, coating,
- 80 international experts:
  Researchers, industrial process, marketing, financials,

avicenne ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

SUMMARY

- A small team dedicated on the battery industry since almost 20 years
- Working with large group worldwide: FMC, Umicore, Dupont, Dow, Panasonic, LG, Samsung, JCI, Nokia, Bosch, Siemens, Toyota, Renault, …
- Synthetic presentation to management & CEO of major groups

We will help and support your growth

avicenne
ENERGY
INFORMATION FOR GROWTH
www.avicenne.com

The Rechargeable Battery Market and Main Trends 2014-2025

Batteries EVENT
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition

BATTERIES 2015
October 6, 2015
Nice, FRANCE

CONTACT

Christophe PILLOT
+ 33 1 47 78 46 00
c.pillot@avicenne.com

THANK YOU

Christophe PILLOT
AVICENNE ENERGY
c.pillot@avicenne.com
Phone: +33 1 47 78 46 00
Mobile: + 33 6 88 82 79 49

avicenne
ENERGY