

MAIN TRENDS FOR RECHARGEABLE BATTERY MARKET 2009-2020

Christophe PILLOT

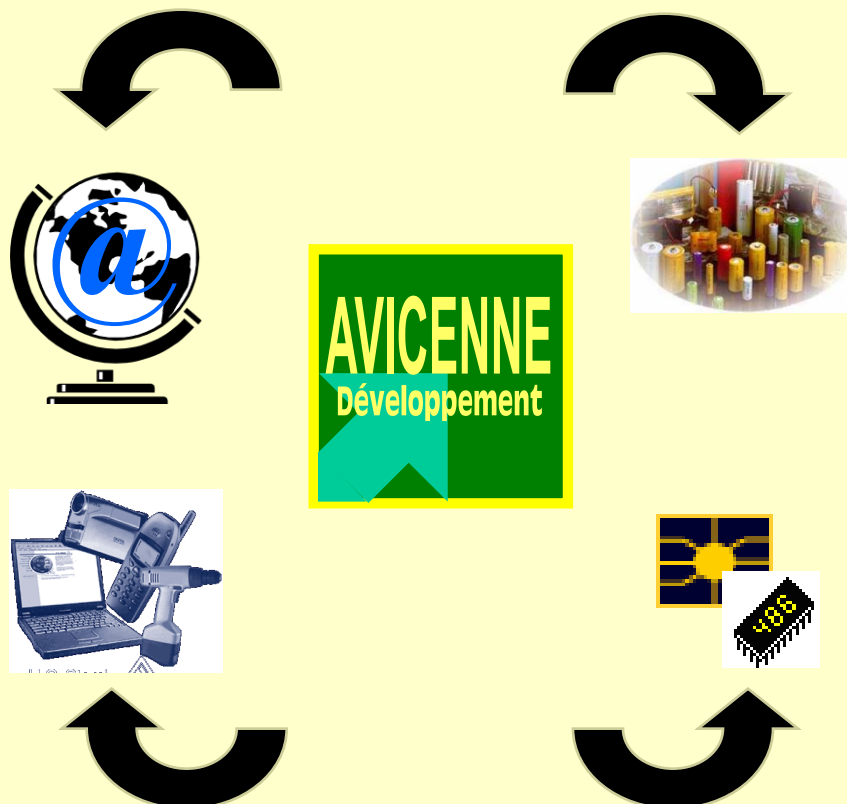
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PROFILE AVICENNE

Information for a competitive Edge
Powering your company's market strategy with in-depth research

- Creation: 1992
- Headquarter: Paris
- Liaison Office: Japan, USA
- Director: M. Madani
- Battery Survey Manager: C. Pillot

Batteries 2010
www.batteriesevent.com
The International Energy & Power Supply Conference and Exhibition



METHODOLOGY: EXTENSIVE FIELD RESEARCH TO RETRIEVE & CROSS CHECK INFORMATION

Top management contact network



Conferences & Exhibitions



2nd Int'l Rechargeable Battery Expo
BATTERY JAPAN

THE BATTERY SHOW
Bringing end user and supplier together
6-8 OCTOBER 2010 - 100000 sqm - Paris

CIBF2010
9th China International Battery Fair

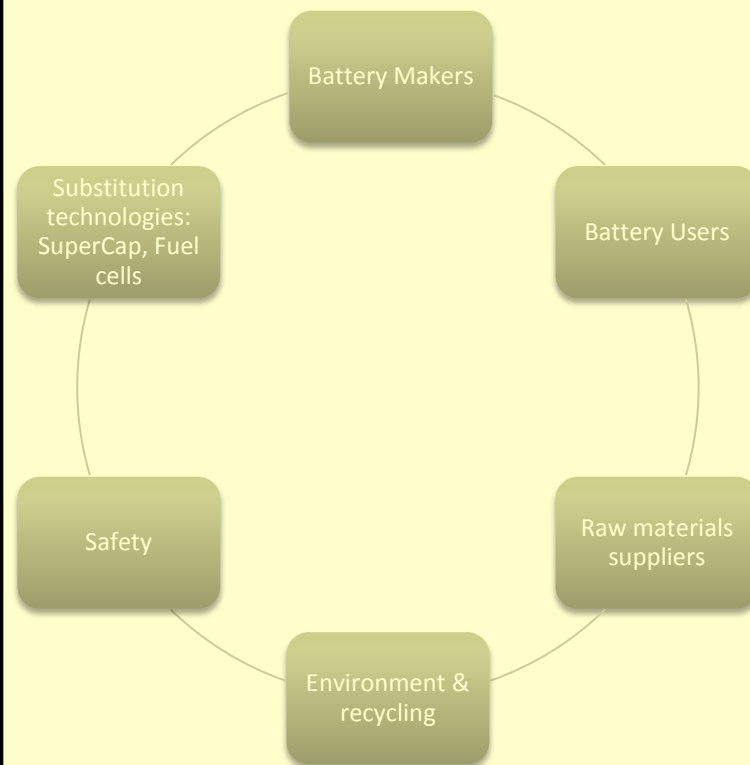
JAPAN ELECTRONICS SHOW

CeBIT

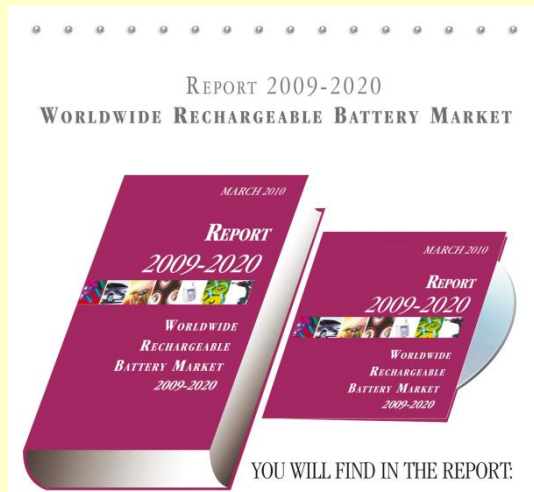
In Depth analysis Of applications



Cross Check Analysis



OUR SURVEY



www.avicenne.com

➤ Specific surveys

&

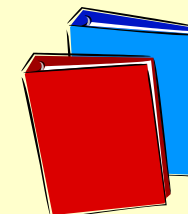
➤ “The rechargeable Battery market & its main application 2009 -2020” 19th Edition - (last Up-date SEPT 2010)

- o Published yearly since 1994
- o More than **650** slides
- o Available in English, on CD Rom, E-mail, or Paper version
- o 10 years forecasts
- o Divided and purchasable by Applications : HEV, P-HEV, EV, Cellular Phones, Portable PCs, Cordless Tools, Toys, Home Appliances, Security lighting systems, RC Cars, Digital Camera, ...
- o Geographic Areas : North America, Japan, Western Europe, Asia-Pacific, China, Others
- o More than 60 yearly customers



➤ HEV, P-HEV & EV – Battery is the key – Jan 2010

➤ Small & Micro Fuel cells market (2003 - 2010)



MORE THAN 100 REFERENCES WORLDWIDE

Information for growth

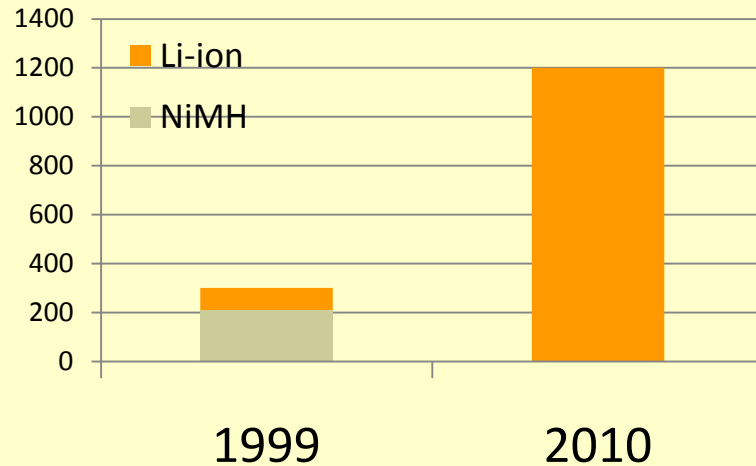
➤ A123	➤ Dialog Semiconductor	➤ ITRI	➤ Rhodia
➤ Air Liquide	➤ Dow Chemical	➤ ITS	➤ Saft
➤ Air Product	➤ Dupont	➤ Johnson Controls	➤ Samsung SDI
➤ Alcatel	➤ Duracell	➤ JBC	➤ Sanik
➤ Amperex (ATL)	➤ EDF	➤ Kodak	➤ Schroder Venture
➤ Aros Securities	➤ Electro Energy	➤ Kruger	➤ Scotent Enterprise
➤ ARC	➤ Ener 1	➤ Lazard	➤ Shenzhen High Power Technology
➤ Atofina - Arkema	➤ Energizer	➤ Leclanché	➤ Schott AG
➤ AT Kearney	➤ ETC AB	➤ Legrand	➤ SKC
➤ Axelon	➤ Facom	➤ LG Chemical	➤ SVE - Dassault
➤ Bain	➤ Falcon Bridge	➤ Lion cells	➤ Solvay
➤ Battery R&D Association of Korea	➤ Fairchild semiconductor	➤ Little Fuse	➤ Sony
➤ B&D	➤ Fameart	➤ Lilipucian	➤ Stibat
➤ BHP Billiton	➤ FIST	➤ Lynas Corp	➤ Storck
➤ Brand Licencing Partners (BLP)	➤ Floridienne de Chimie	➤ Matsushita	➤ Toda Kogyo
➤ Bourns	➤ FMC Lithium	➤ Microsoft	➤ TOTAL
➤ Bosch	➤ Fortu Power Cell	➤ MTI Micro Fuel Cells	➤ Total Wireless Solution
➤ BYD	➤ France Telecom	➤ Mindbranch	➤ Toyota
➤ Cap X	➤ Fulton Innovation	➤ Moltech	➤ Tyco
➤ Catella	➤ GAIA	➤ Molycorp	➤ Umicore
➤ Carbone Lorraine	➤ GIL Import Batteries Ltd.	➤ Motorola	➤ Uniross
➤ CDN Cobalt	➤ GS Melcotec	➤ NCCP - Russia	➤ Varta
➤ CEA/LITEN	➤ HC Starck (Bayer)	➤ Nitech	➤ Warburgpincus
➤ Celgard	➤ HILTI	➤ NKKPC – Brett Nelson	➤ World Industrial Information Center
➤ Chemetall	➤ Hitachi Maxell	➤ Norilsk Nickel	➤ WR Grace & Cie
➤ CIAPS	➤ Hollingsworth & Vose Cie	➤ NTK Powerdex	➤ Zebra
➤ CIBA	➤ Honeywell	➤ OMG Inc	➤ ZPower
➤ CNRS	➤ HPL (High Power Lithium)	➤ Panasonic	
➤ Cogema	➤ Hutchinson	➤ Philips	
➤ CRU Group	➤ IER	➤ PK & Wise	
➤ CSC Challenge Strategy Change	➤ IGL Export.	➤ PRAYON	
➤ DELTA	➤ International Component	➤ PSA	
➤ DGA	➤ Inco	➤ Rayovac	
	➤ Intersil	➤ Renault	

KEY ISSUES

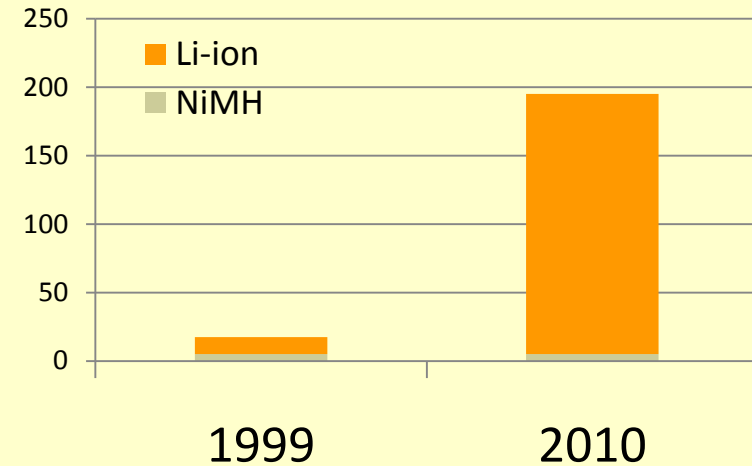
- What is the Battery market today ?
- NiCd, NiMH, Li-ion Battery Market
- What are the driven applications?
- NiCd Future?
- Li-ion Development: Which Cathode?
- HEV, P-HEV, EV market: which battery?
- What will be the market in 2015, 2020?
 - o Energy storage market?
 - o Li-ion cost?
 - o New development?
 - o New applications?

How to bridge the gap between power or energy needs and what the market offers today while still providing safe solutions?

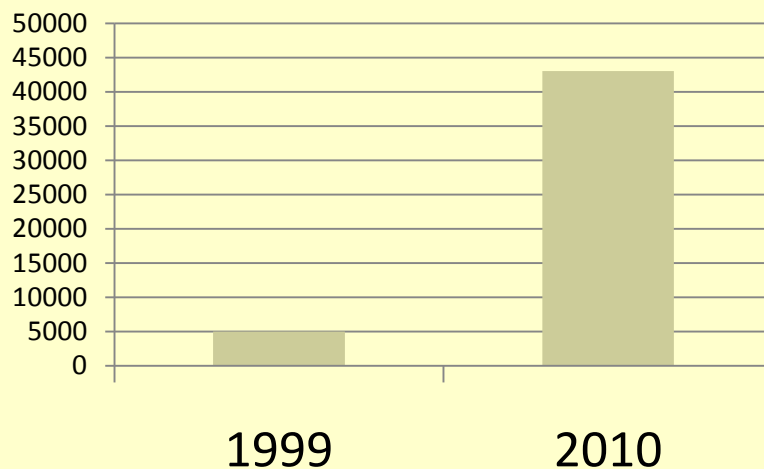
M of Cellular Phones sold



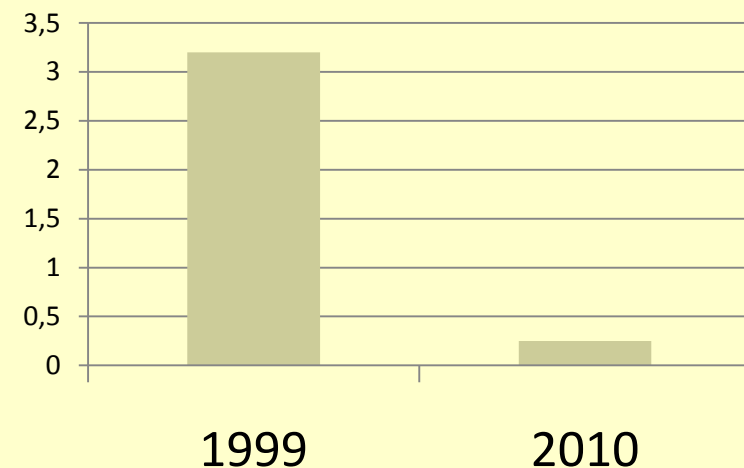
Million of Portable PC sold



Tons of Li-ion Cathode



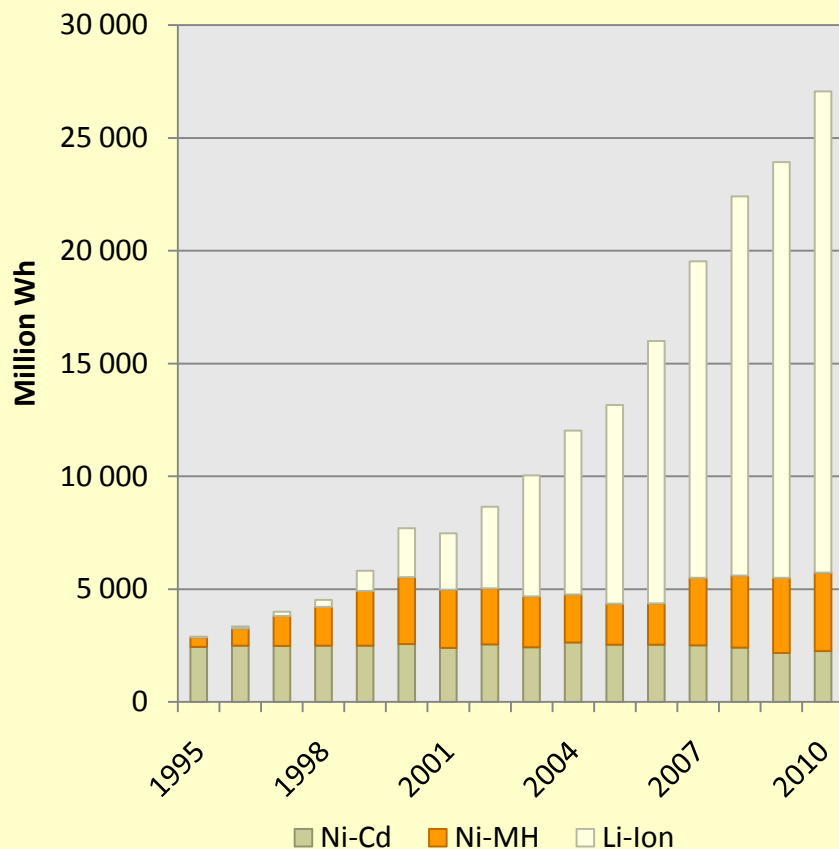
Li-ion cell price (\$/Wh)



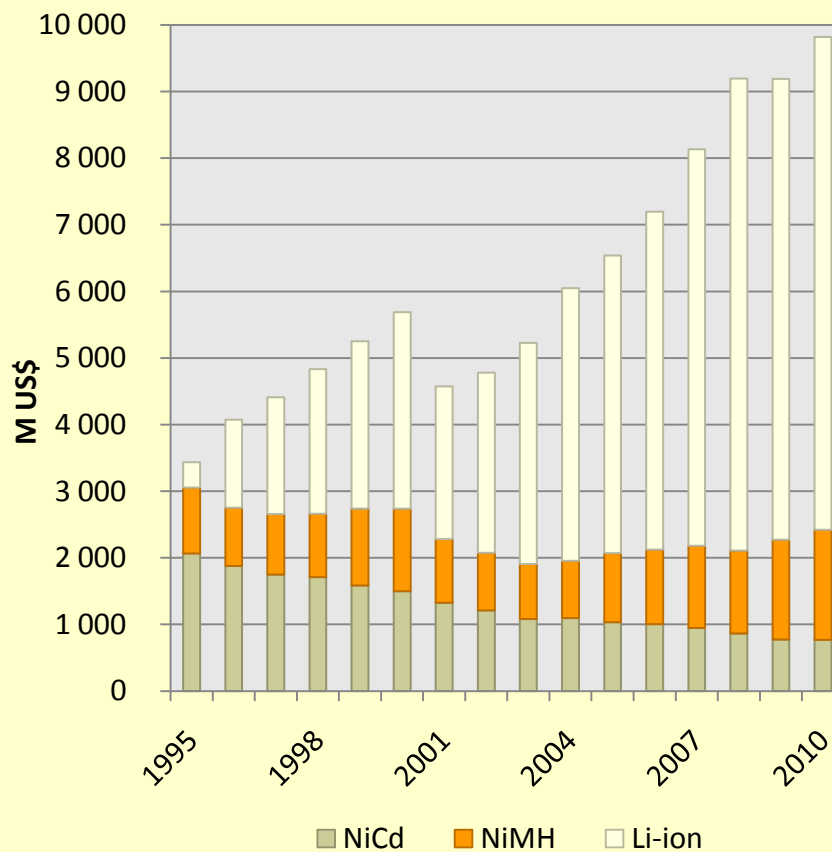
1. Rechargeable battery market 2010
2. Battery market trends
3. EV, HEV & PHEV battery market
4. Forecasts by 2015 & 2020

WORLDWIDE RECHARGEABLE BATTERY MARKET

The worldwide rechargeable battery market, MWh, 1995-2010



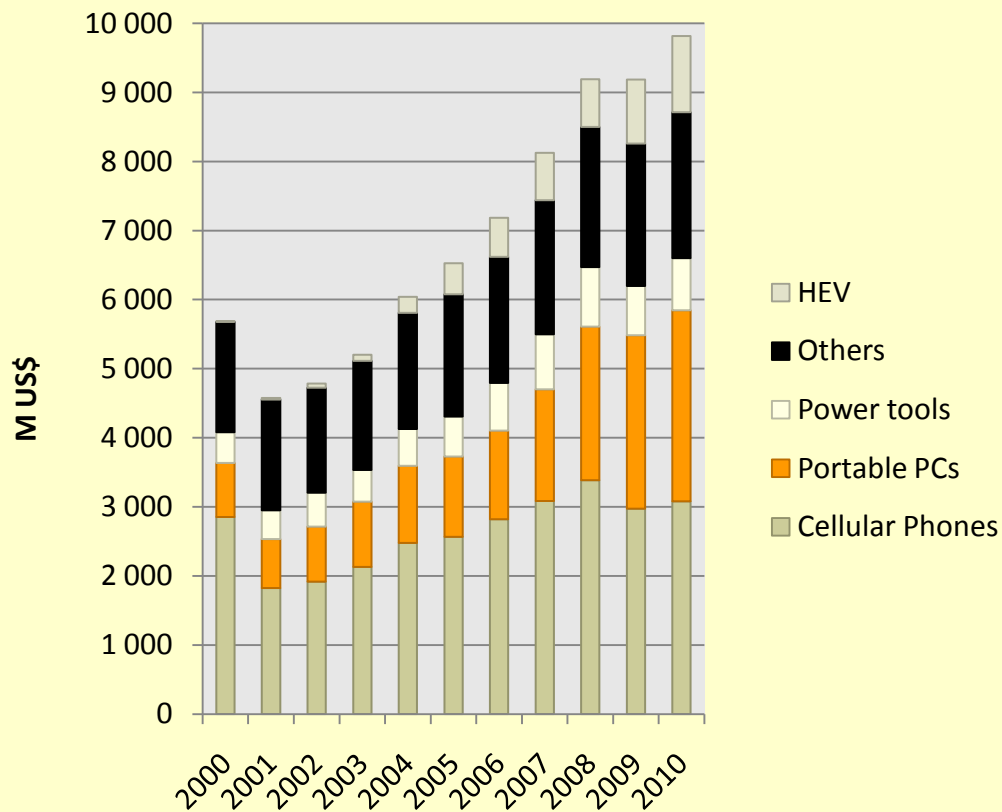
Battery sales, M US\$, Worldwide, 1995-2010



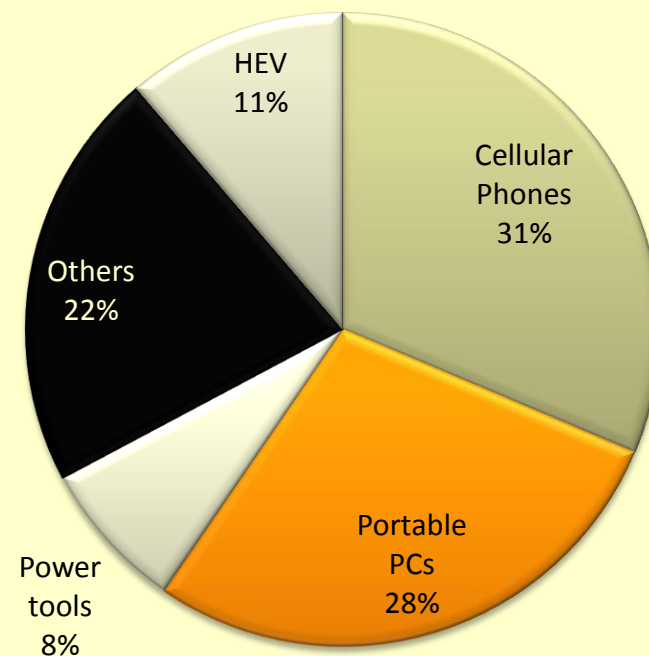
SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

THE RECHARGEABLE BATTERY MARKET IN 2010

**Battery sales, M US\$, Worldwide, by application
2000-2010**



**Battery sales, M US\$, Worldwide, by
application
2010**



SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

JAPANESE, CHINESE & KOREAN MARKET SHARE, IN VALUE, 2010

Japanese market share (value) decreases : from 82 % of the market in 2001 to less than 75% in 2003 & 48% in 2010

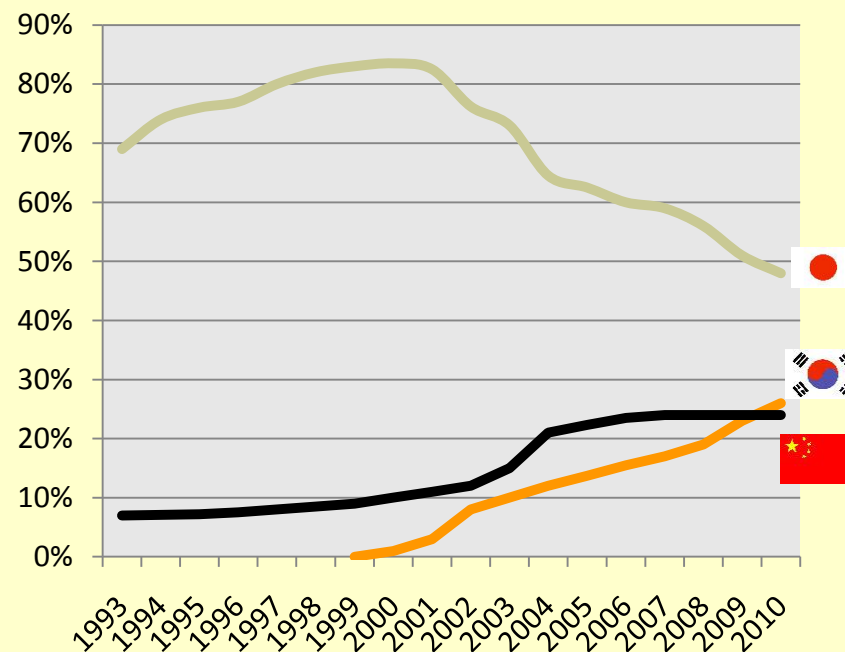
JAPANESE SALES
4.8 Billions \$ in 2010
(09/10 growth : +7 %)

CHINESE SALES
2.4 B\$ in 2010
(09/10 growth : +9 %)

KOREAN SALES
2,5 B\$ in 2009
(09/10 growth : +19%)

REST OF THE WORLD
< 0.1 B\$ in 2009

Rechargeable battery market by country



Source : AVICENNE Compilation, March 2010

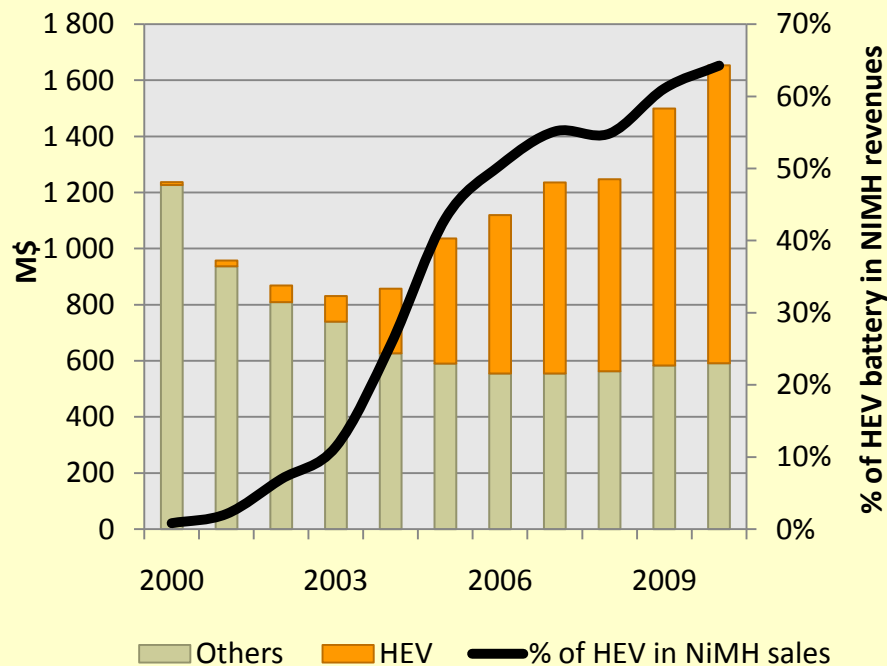
NIMH IN 2010

MAIN APPLICATION: HEV

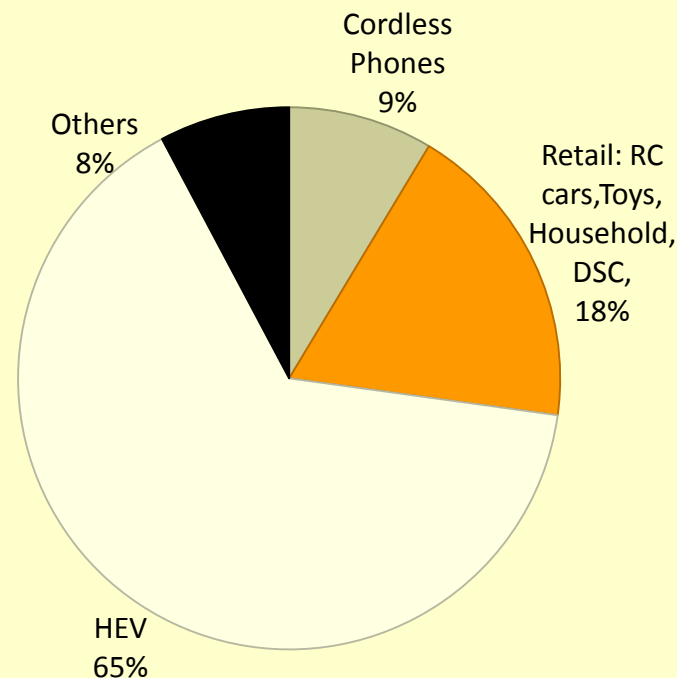
1 200 M NiMH cells – 3 500 MWh
1.65 B\$

CAGR 2005/2010
+14% per year in Volume
+10% per year in value

**NiMH battery market worldwide in value
% for HEV application**



NiMH battery by applications, worldwide, % in value, 2010



SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

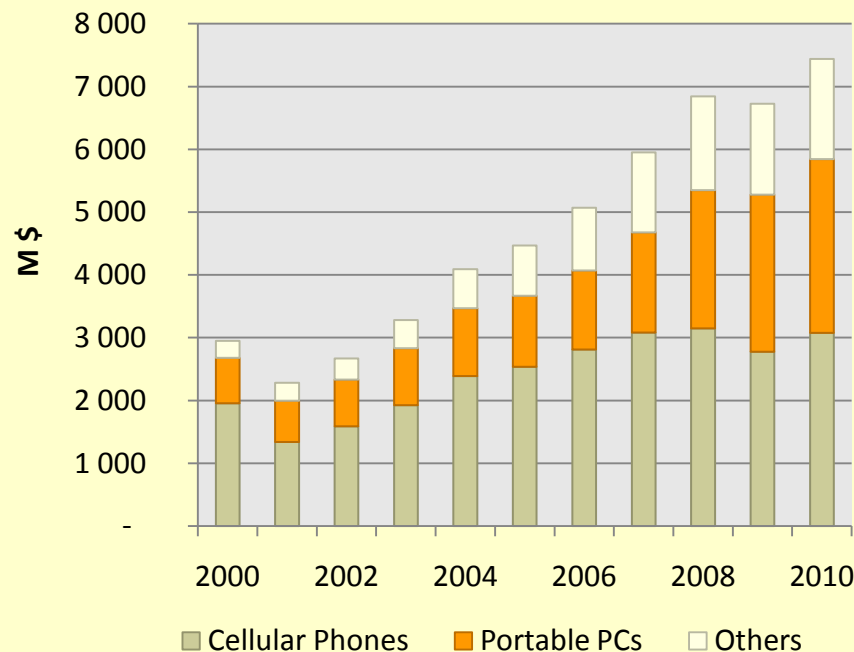
LI-ION IN 2010

MAIN APPLICATION: CELLULAR, NOTEBOOK

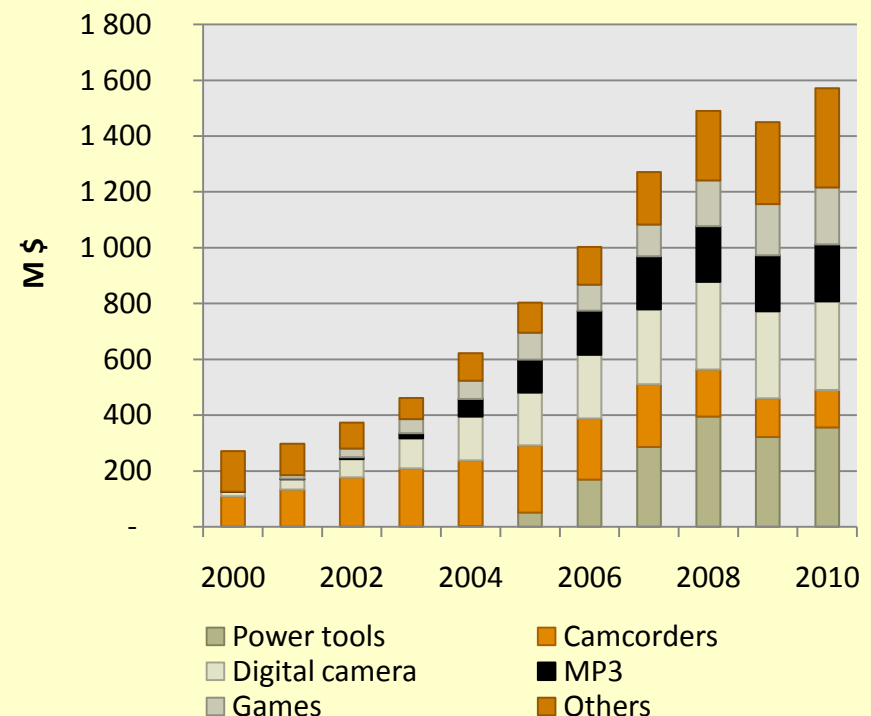
3 200 M Li-ion cells – 21 000 MWh
7 400 M\$

CAGR 2004/2009:
+19% per year in volume
+10% per year in value

Li-ion Battery sales,
M\$, Worldwide, 2000-2010



Li-ion Battery sales,
M\$, Worldwide, 2000-2010

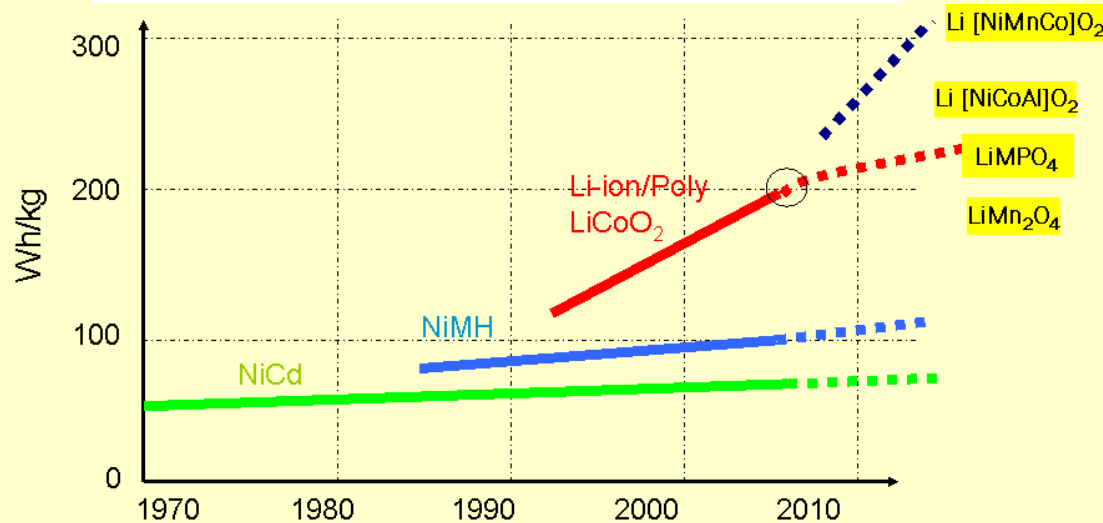
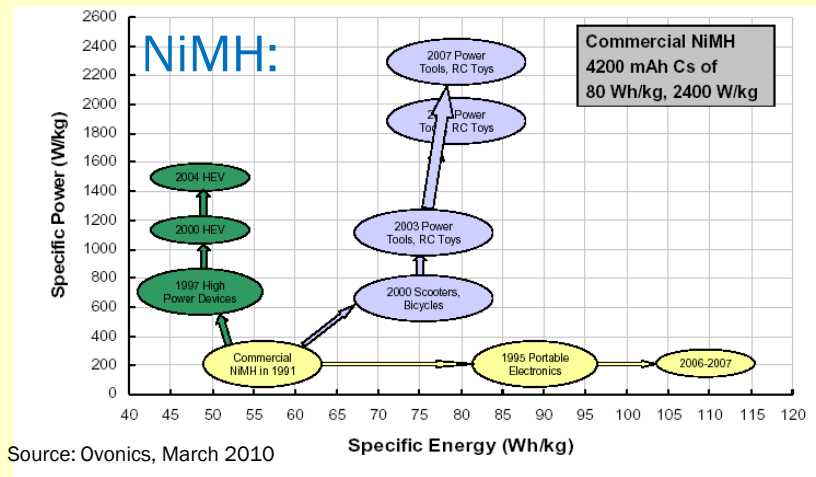


SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

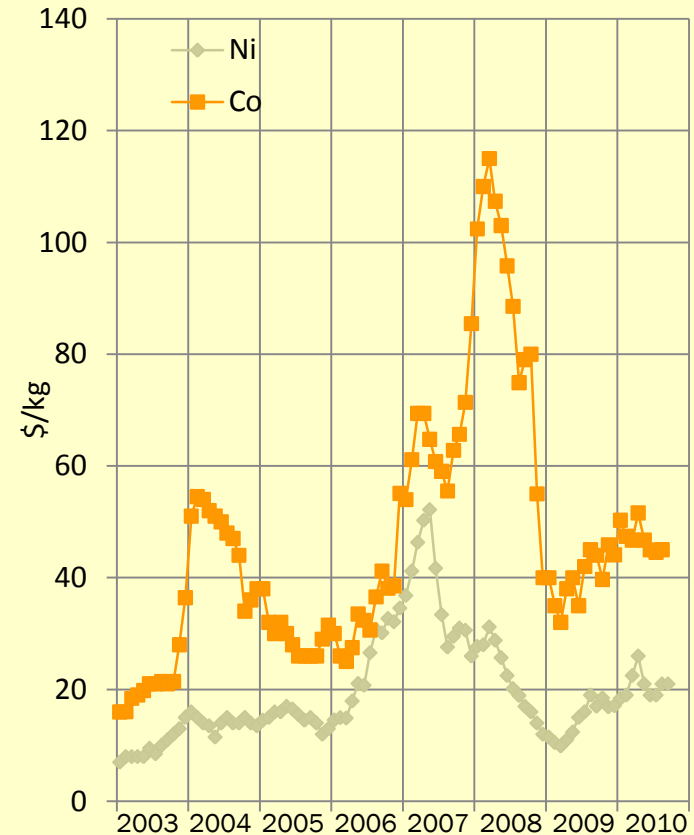
NEW MATERIALS FOR HIGHER CAPACITY OR LOWER PRICE

Information for growth

INCREASING ENERGY & POWER



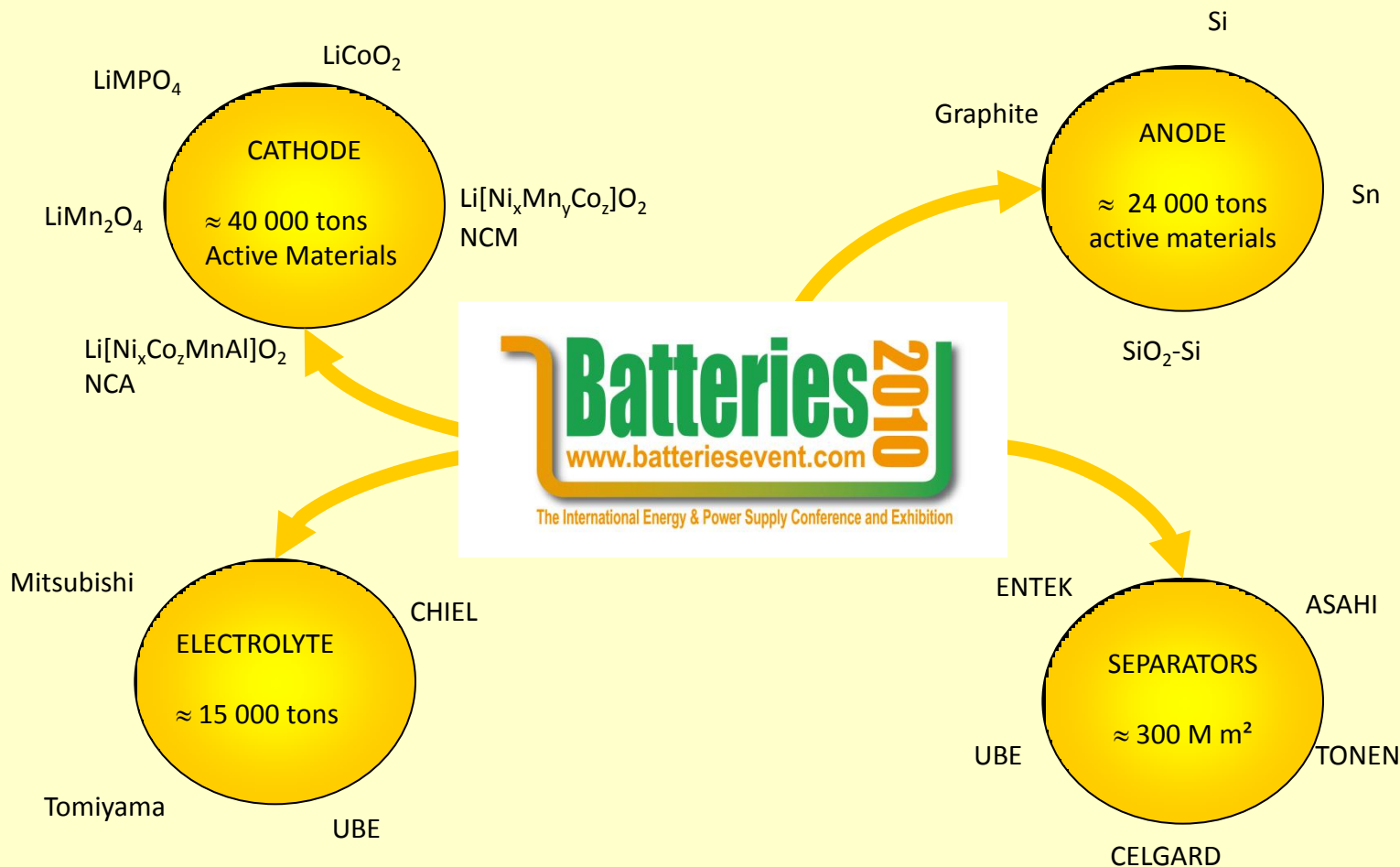
Ni & Co LME PRICES



SOURCE: LME, SEPT 2010

Source : AVICENNE Compilation, September 2010

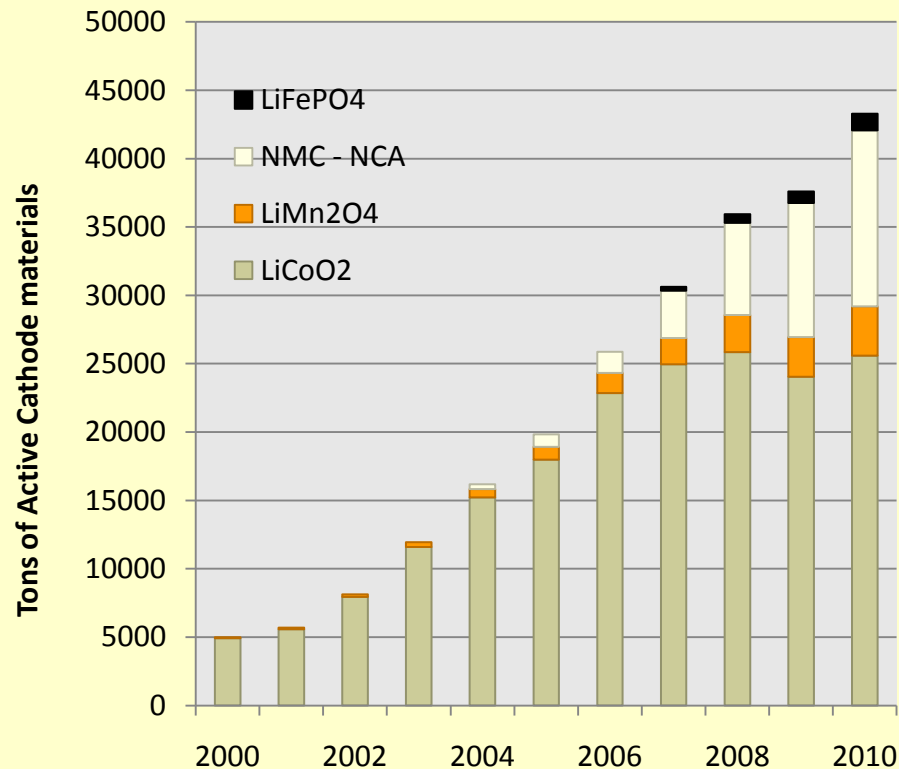
RAW MATERIALS FOR LI-ION BATTERIES – 2010



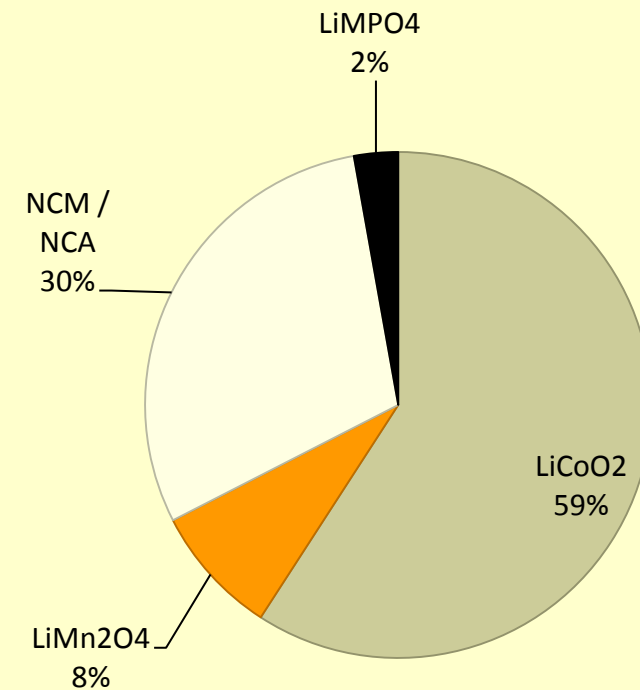
CATHODE ACTIVE MATERIALS NEEDS BY CHEMISTRY

Information for growth

**Cathode active materials for Li-ion batteries,
in Tons, 2000-2010**



**Cathode active materials for Li-ion
batteries, % of volume, 2010**



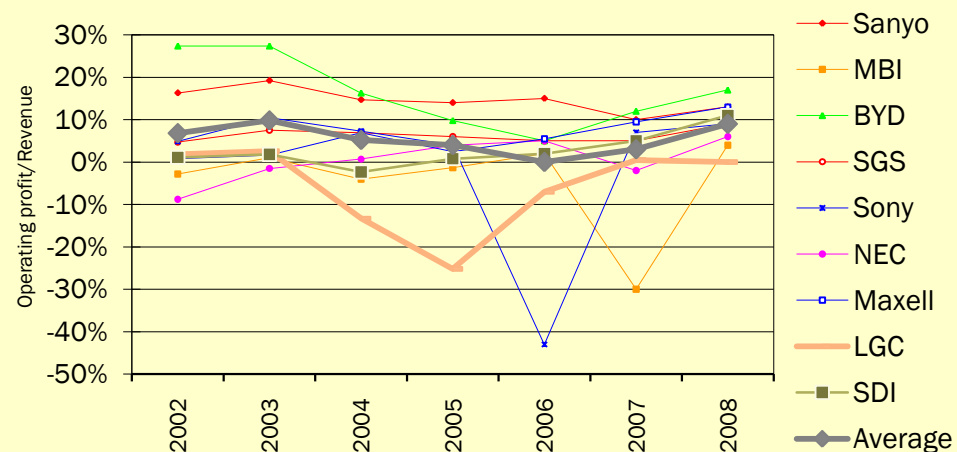
Source : AVICENNE Compilation, September 2010

SAFETY ISSUE

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

Battery Makers	OEM	Battery recall	Date	Cost
Matsushita	Nokia	46 M cells	08/07	100–200 M\$
Sanyo	Mitsubishi	1.3 M cells	12/06	35 M \$
Sony	Dell, Apple, Toshiba, Lenovo,...	10 M Packs 65 M cells	2006	430 M\$
.....				

RECALL SLASH BATTERY PROFIT



SOURCE : THE RECHARGEABLE BATTERY MARKET 2008-2020 , AVICENNE, SEPT 2009

PARAMETERS IMPACTING THE BATTERY MARKET FORECATS

DRIVERS

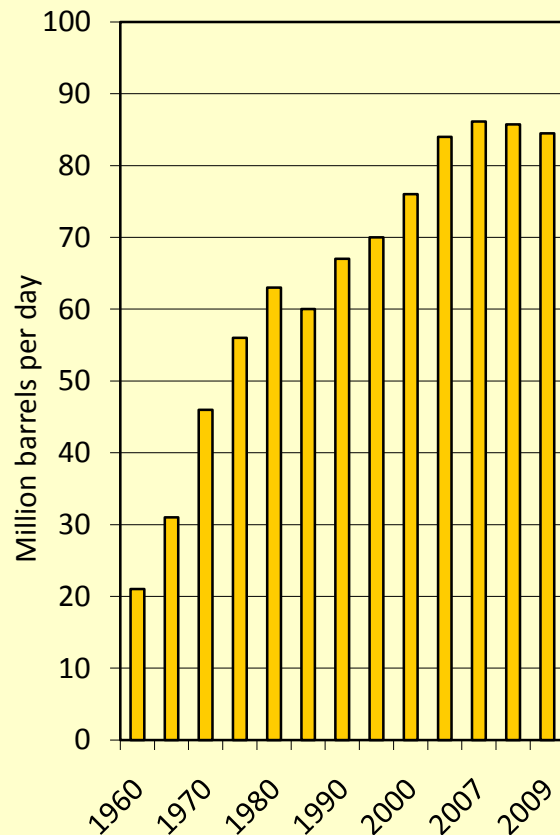
- ☺ Electronic devices (Portable PCs) market is increasing
- ☺ Requiring more & more energy
- ☺ Electronic devices usage is increasing
- ☺ Electric Vehicle market is increasing
 - ☺ Government incentives (CO₂ Emission, ...)
 - ☺ Gasoline Prices
 - ☺ High investments for new battery plants worldwide

LIMITERS

- ☹ SAFETY issues for both portable & HEV Li-ion batteries
- ☹ Raw materials price increase: Ni for NiMH & Co for Li-ion
- ☹ Less Investment
 - ☹ Profit are low even negative in case of recall
 - ☹ ASP will decrease
 - ☹ Li-ion Next Step?
- ☹ HEV, P-HEV & EV market
 - ☹ Gasoline price decrease (??)
 - ☹ EV mass market (??)
 - ☹ Li-ion cost
 - ☹ 8 to 10 years of battery life is required
 - ☹ Safety problems, accident, recall

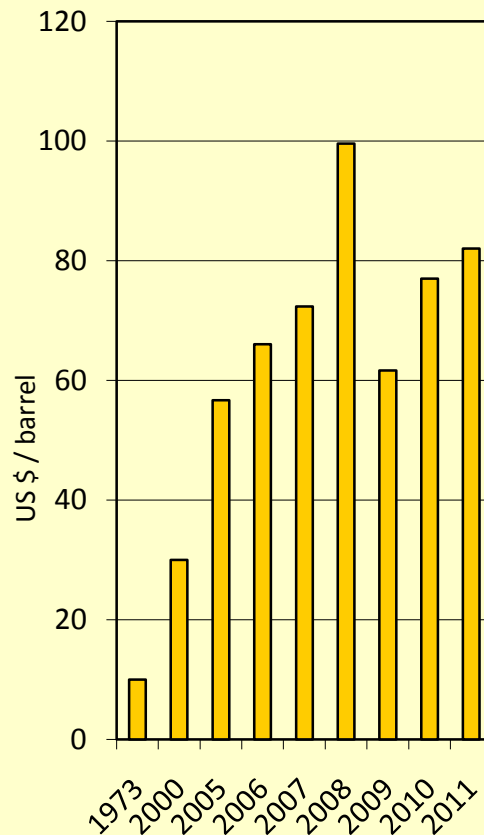
WHY ELECTRIC VEHICLES?

Petroleum consumption worldwide 1960-2009



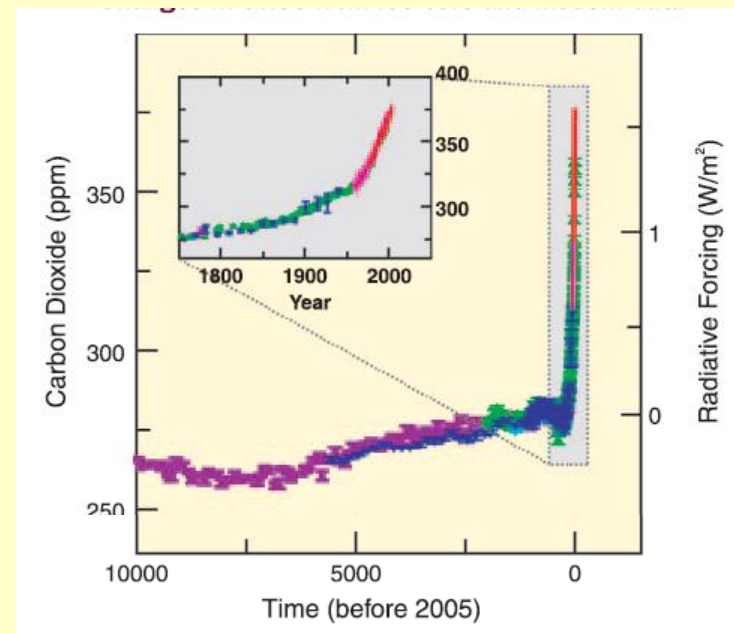
Source :Energy Information Administration, US Government

Price of the WTI barrel of oil, US \$



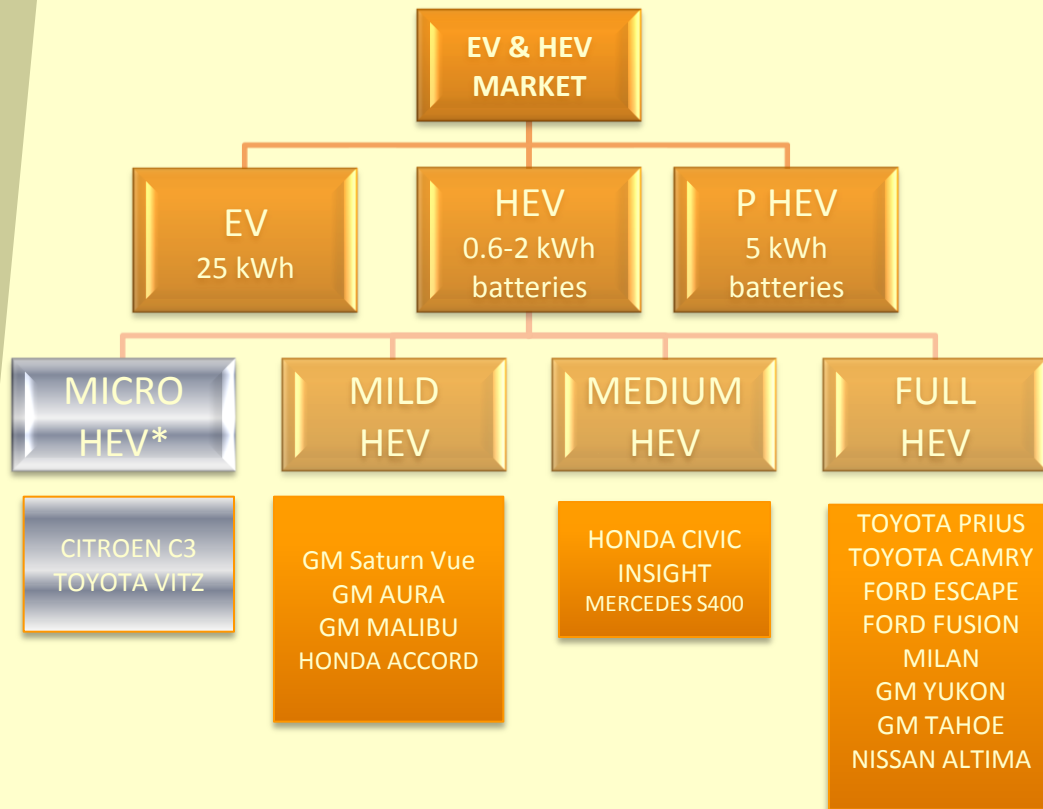
Source :<http://www.eia.doe.gov/emeu/steo/pub/contents.html>

CO₂ density in the atmosphere increase



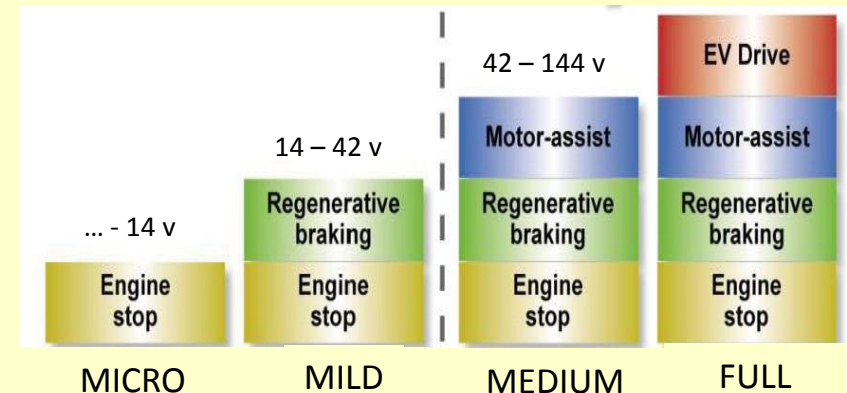
IPCC, Intergovernmental Panel on Climate Change, Climate Change 2007, Synthesis Report p38

HEV, P-HEV & EV DEFINITION & SEGMENTATION

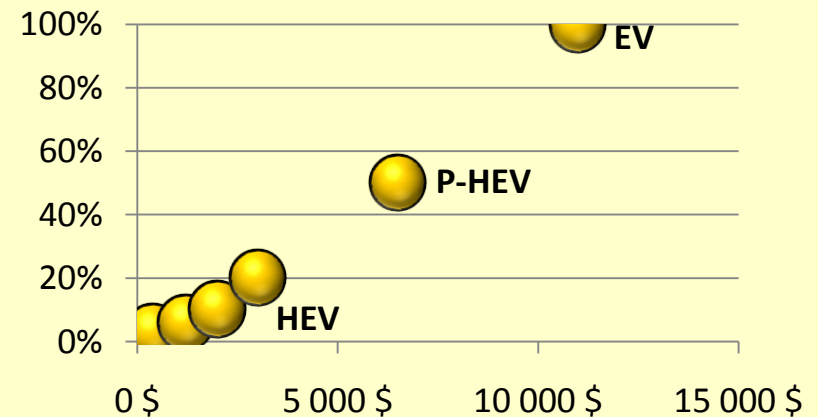


HYBRID LEVELS:

> 144 v



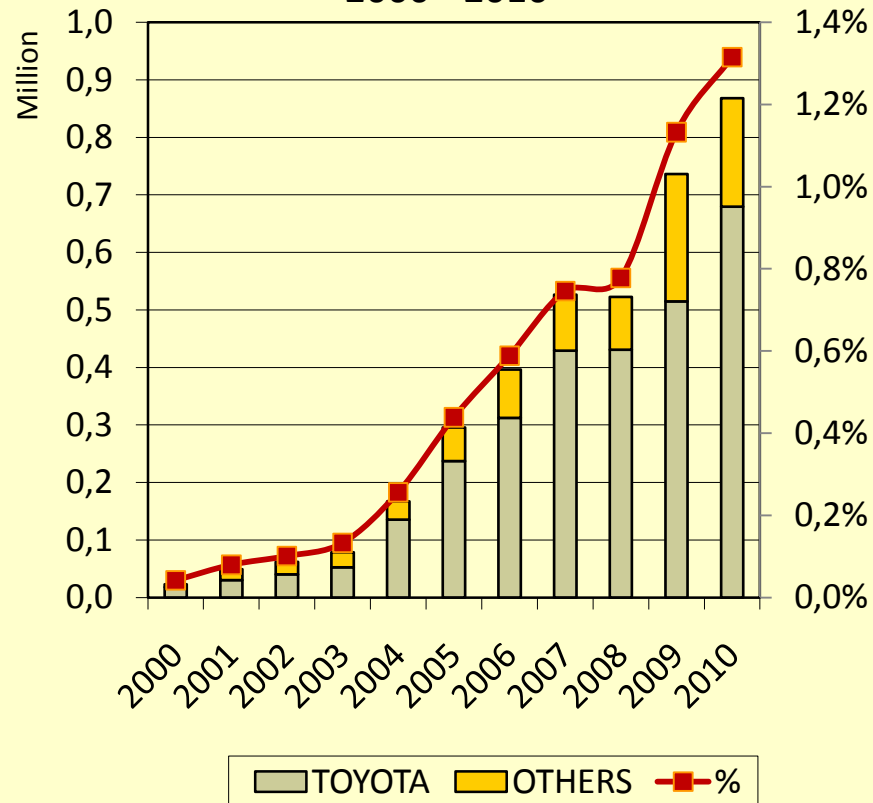
Fuel saving Vs. Cost



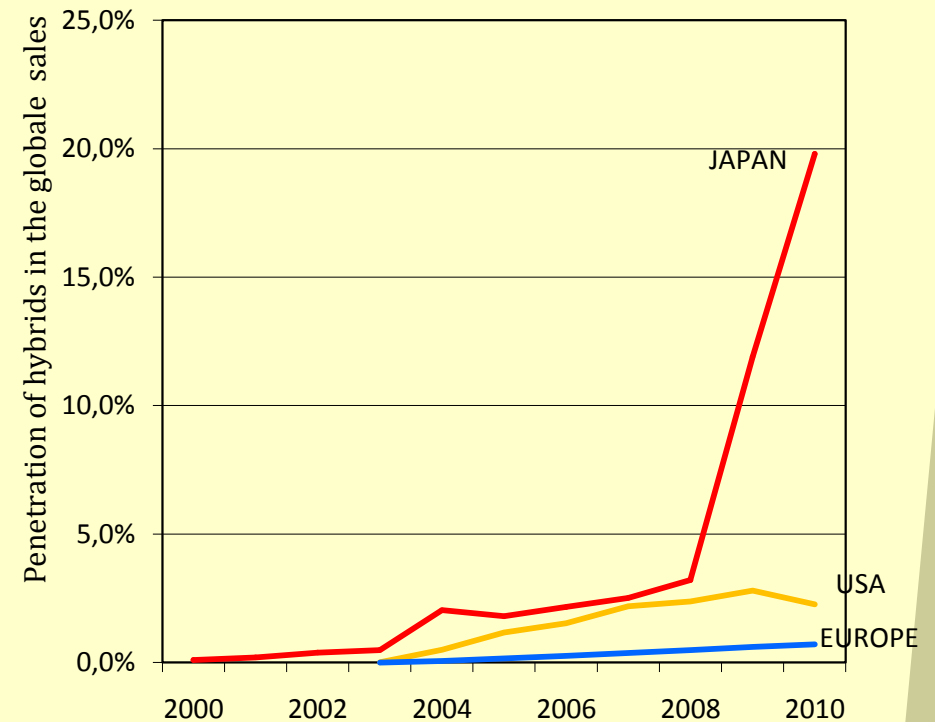
*Note: Micro HEV are not in the HEV statistics & HEV forecast

1,3% of vehicle sold worldwide in 2010 was Hybrid

HEV sold per year, M units, worldwide,
2000 - 2010



Penetration of hybrids in the global sales,
2000-2010

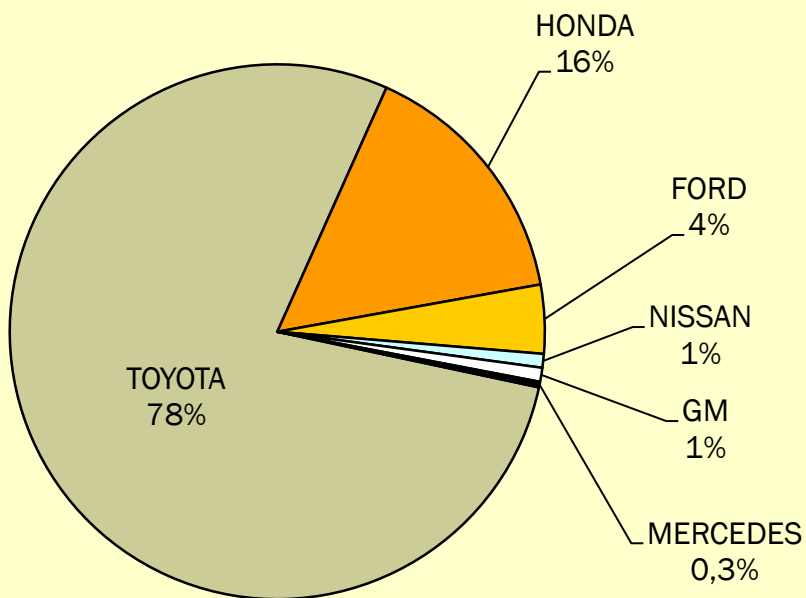


Note: Micro HEV are not in the HEV statistics & HEV forecast

SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

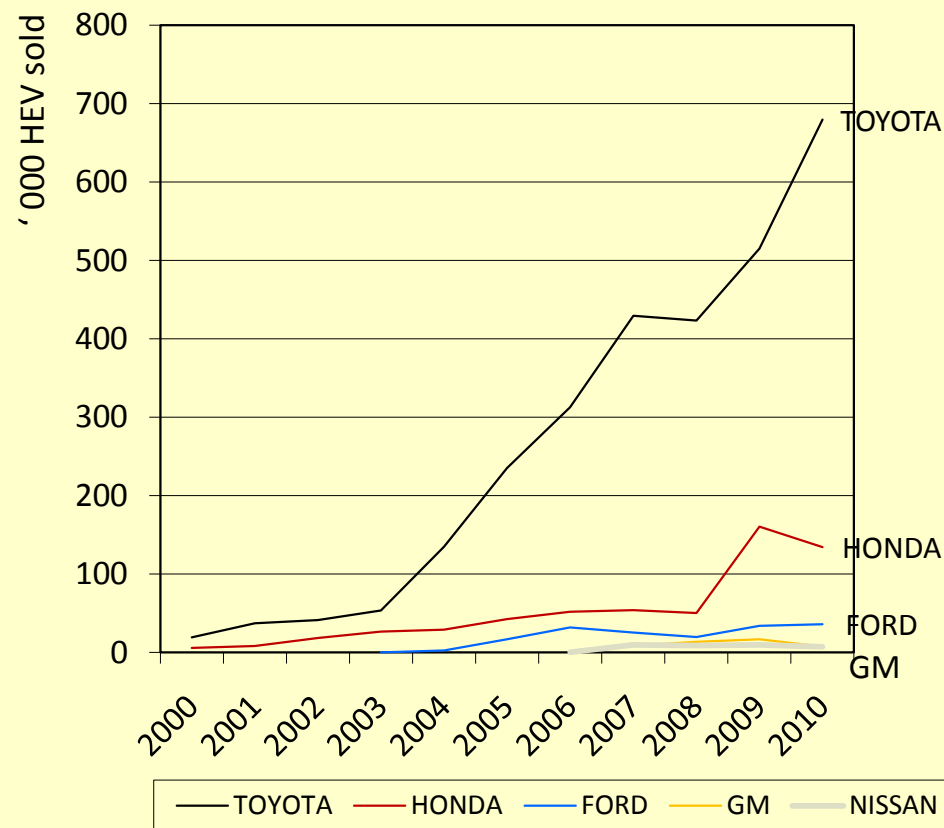
HEV WORLDWIDE IN 2010

Total HEV Vehicles:
≈ 900 000 units in 2010



SOURCE : TOYOTA, HONDA, GM, FORD, CHRYSLER

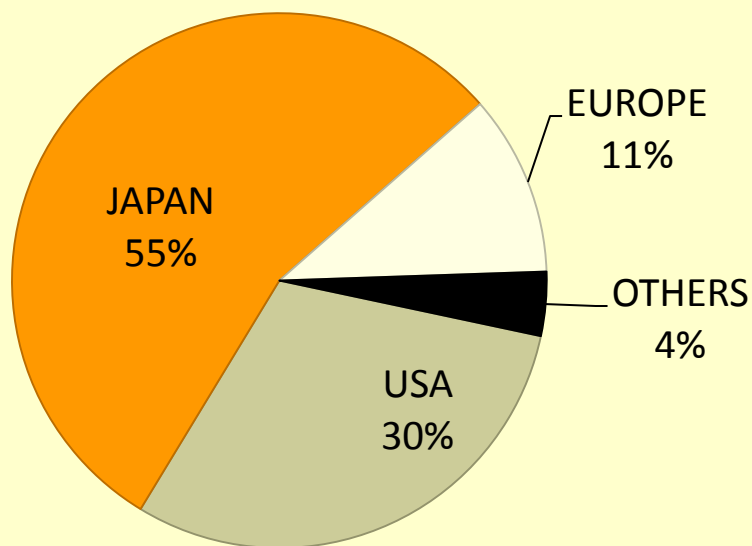
HEV sold per year, M units per car manufacturers, 2000-2010



SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

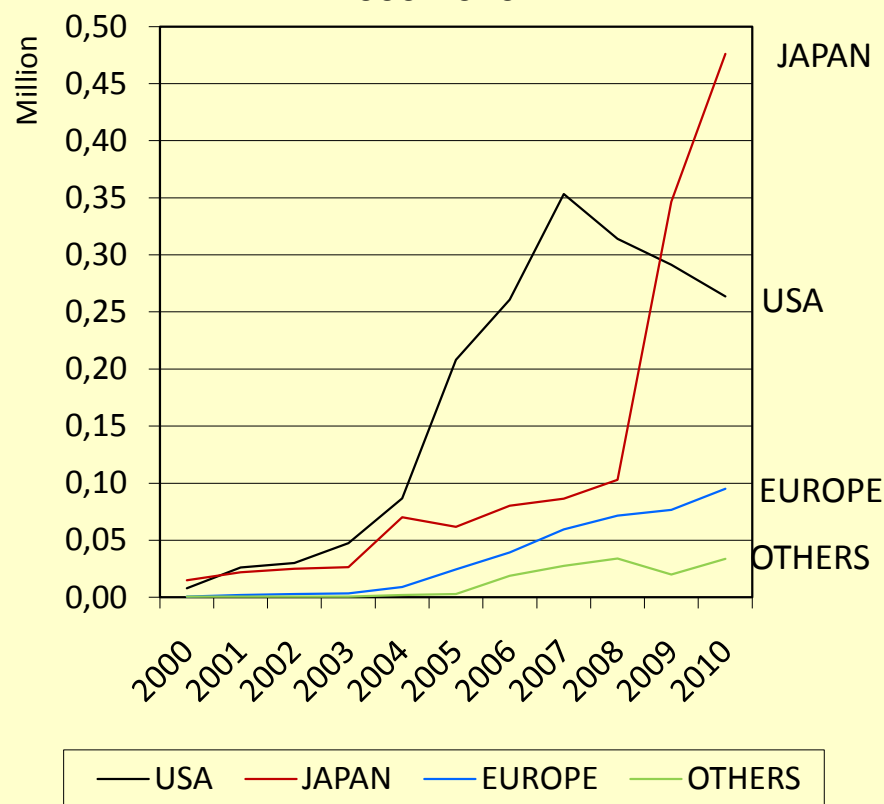
HEV WORLDWIDE IN 2010

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

HEV sold per year, M units per country, 2000-2010

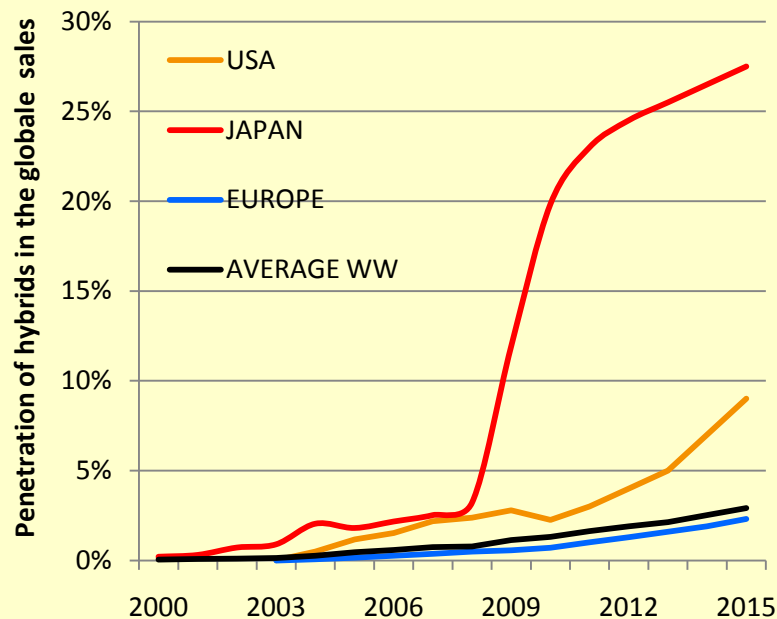


SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

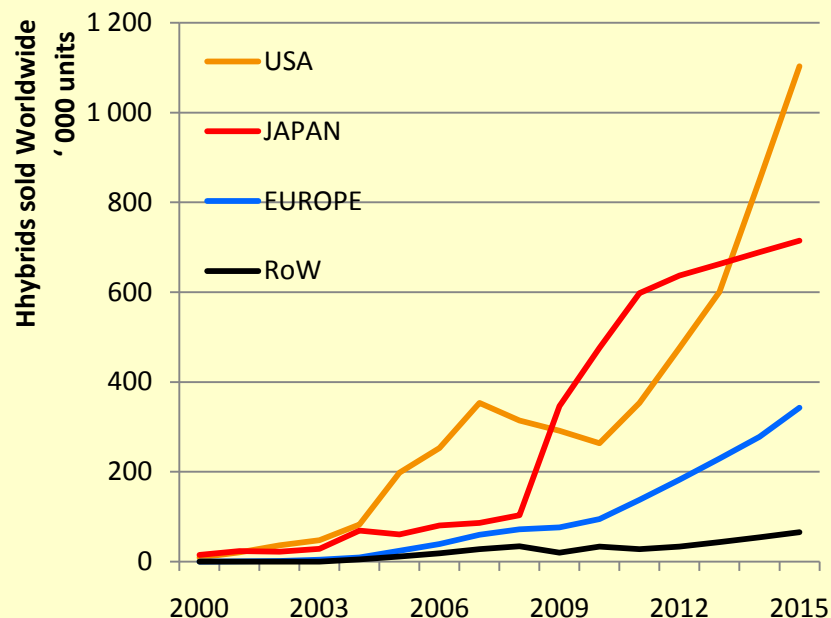
HEV FORECASTS UP TO 2015

HEV MARKET IN 2015 : 2,2 Million units ⁽¹⁾

Penetration of hybrids (2) in the global sales, 2000-2015



Penetration of hybrids (2) in the global sales, 2000-2015



(1) Assumptions:

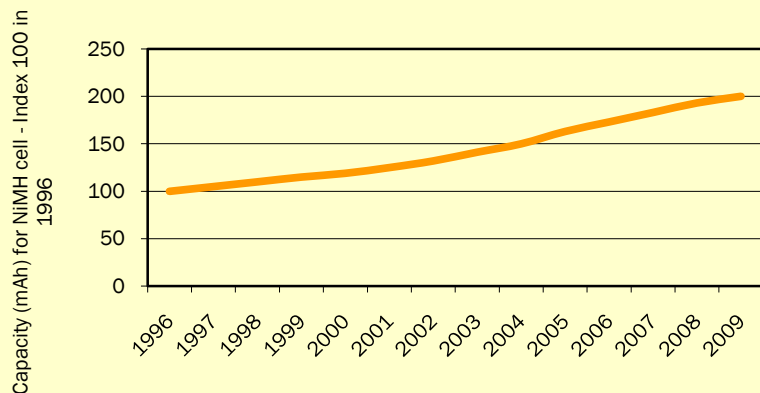
- >75 M vehicle sold WW in 2015
- 3% Hybrids

(2) HEV & hybrid excluding micro hybrids

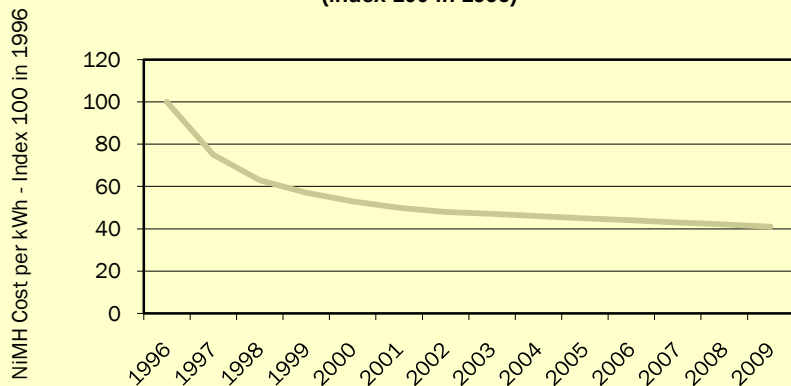
SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

NIMH BATTERY DEVELOPMENTS

NiMH Capacity is increasing
Exemple of AA NiMH
(index 100 in 1996)



NiMH cost per kWh is decreasing
(index 100 in 1996)



	PRIUS II	PRIUS III
Capacity	6.5 Ah	6.5 Ah
Cells	228 (38 * 6)	168 (28 * 6)
Voltage	273.6 v	201.6 v
Specific power	1000 W/kg	1300 W/kg
Specific energy	46 Wh/kg	46 Wh/kg
Total power/HEV	36 kW	37.8 kW
Total energy/HEV	1778 Wh	1310 Wh

SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

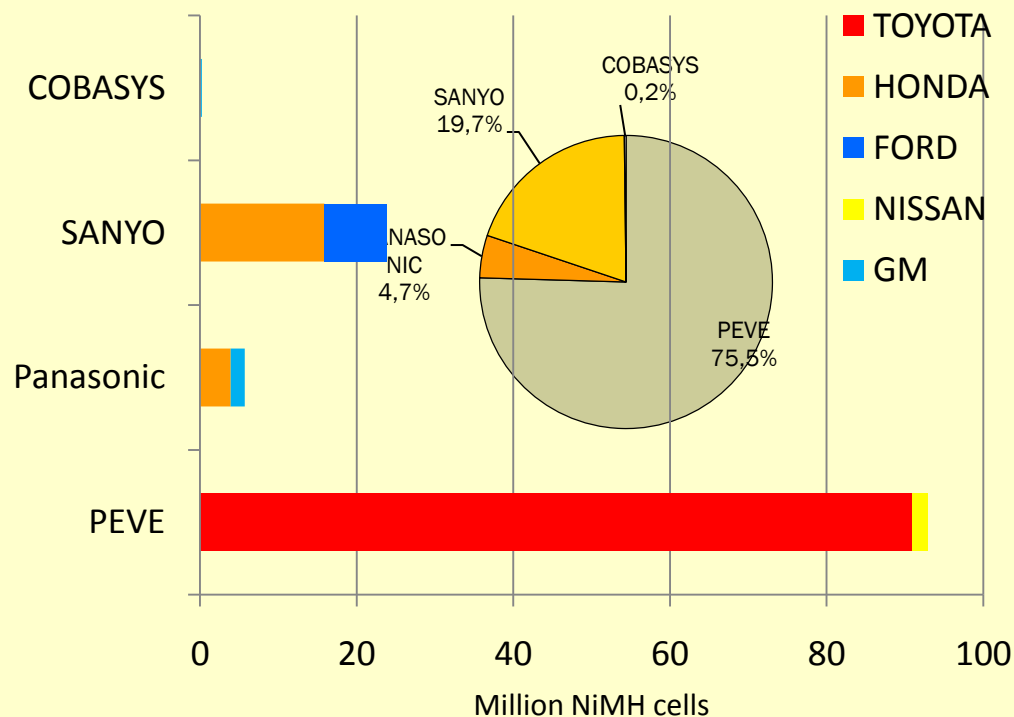
NIMH BATTERIES FOR HEV IN 2009/2010

Thanks to TOYOTA, Panasonic EV, got more than 75% of the HEV battery market and a large know-how

		PEVE	SANYO	Panasonic	COBASYS	JCS
PRODUCTION	TOYOTA	■				
	LEXUS	■				
	HONDA		■	■		
	FORD		■			
	NISSAN	■				
	GM			■	■	
	BMW				■	
	DAIMLER				■	
	CHRYSLER	■				
DEVELOPMENT	VW		□			
	DAIMLER					□
	BMW		□			
	PSA	□				
	CHERY					□

■ Supply - □ Development

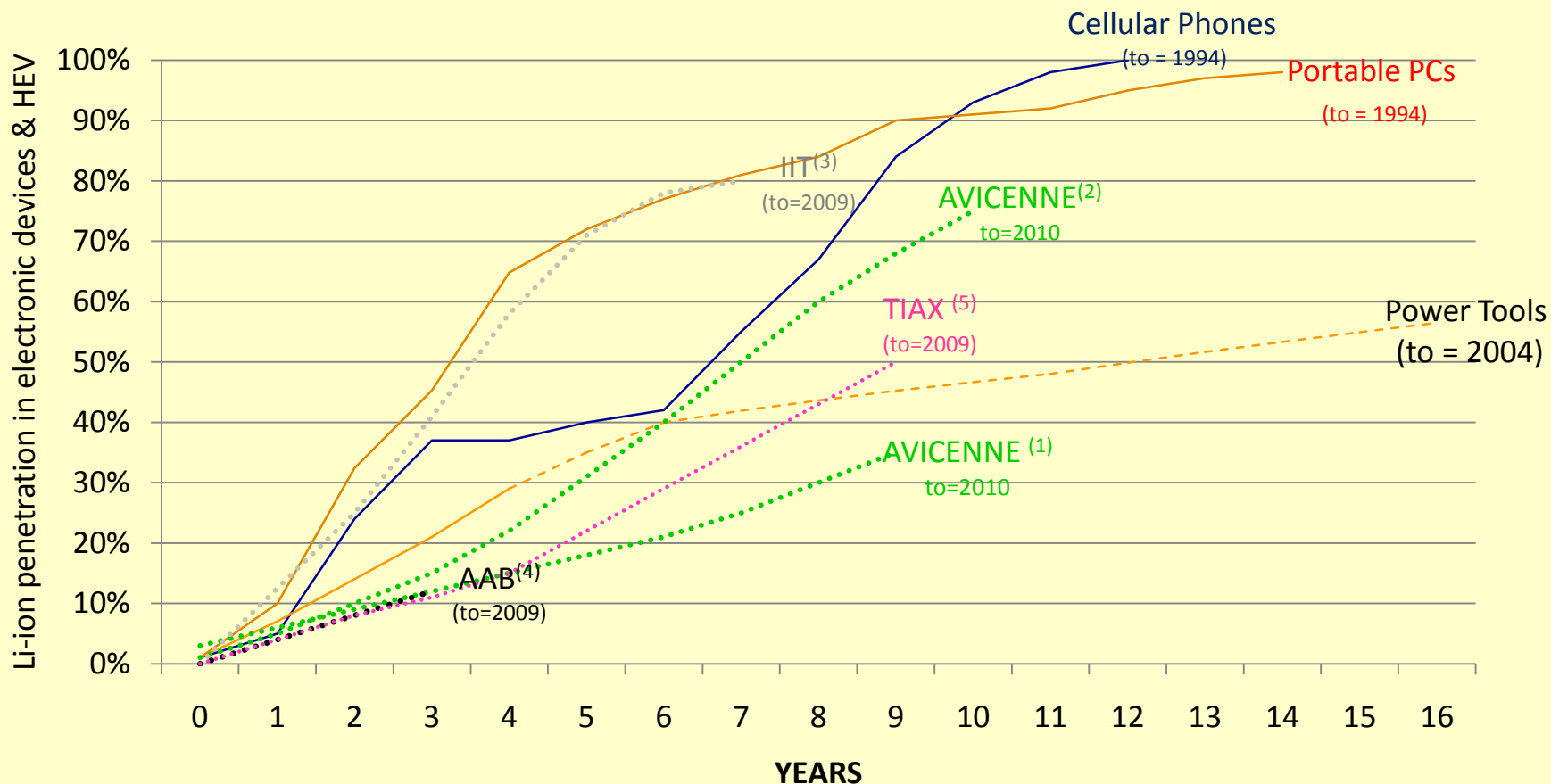
NiMH battery & Car makers relationships in 2009/2010



SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPT 2010

LI-ION PENETRATION IN VARIOUS DEVICES

AVICENNE & OTHER ANALYSTS FORECAST

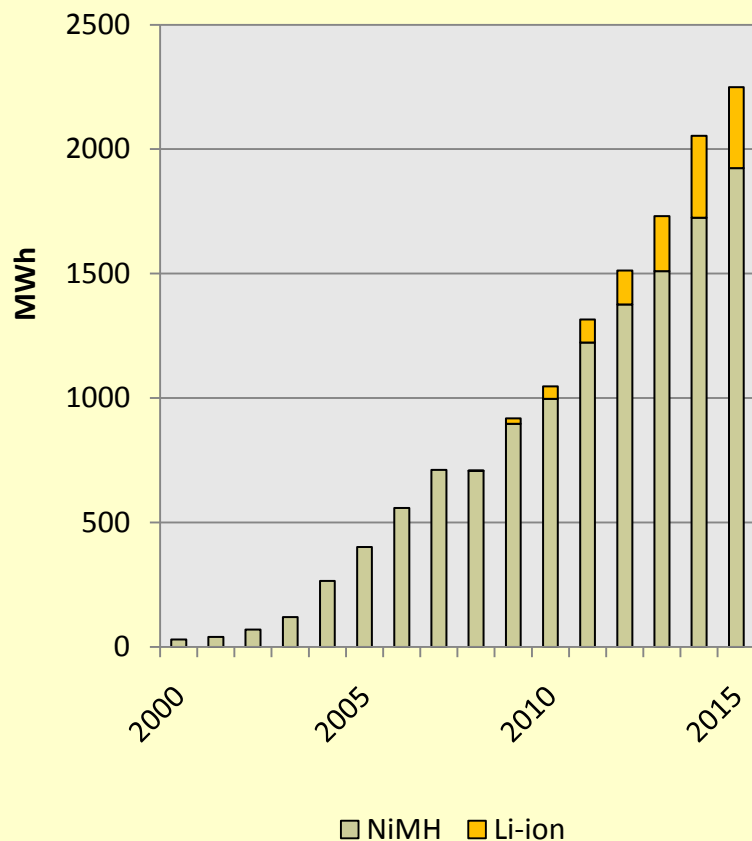


- (1) AVICENNE HEV Forecasts, march 09, Relevant scenario
- (2) AVICENNE HEV Forecasts, march 09, Li-ion Optimistic scenario
- (3) IIT, TAKESHITA, March 08, THE 25th INTERNATIONAL BATTERY SEMINAR & EXHIBIT, Slide 8 & March 2009, 26th Battery Seminar, Slide 5
- (4) AAB, Menahem ANDERMAN, Ph.D, Tampa, Florida, May 2009
- (5) TIAX, Brian BARNETT, Ph.D, Testifying Expert for University of Texas , March 2009

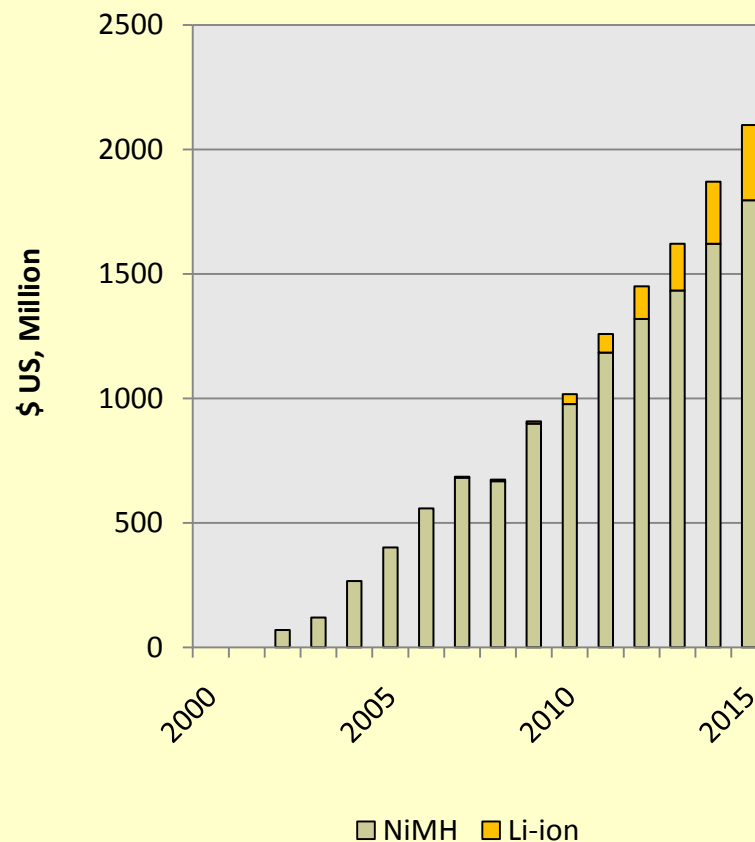
SOURCE: AVICENNE COPMPILATION, MARCH 2010

NIMH & LI-ION BATTERY FOR HEV MARKET FORECASTS (2002-2015)

NiMH & Li-ion cells sold per year, MWh, worldwide, 2000-2015



NiMH & Li-ion market for HEV, Million \$US, worldwide, 2000-2015



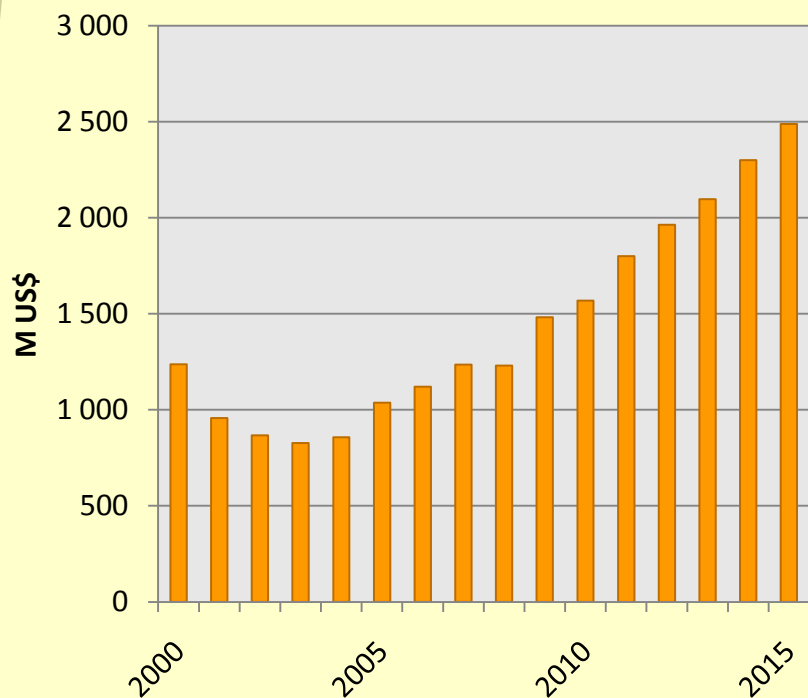
SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, MARCH 2010

SHORT TERM HEV IMPACT ON NIMH BATTERY MARKET

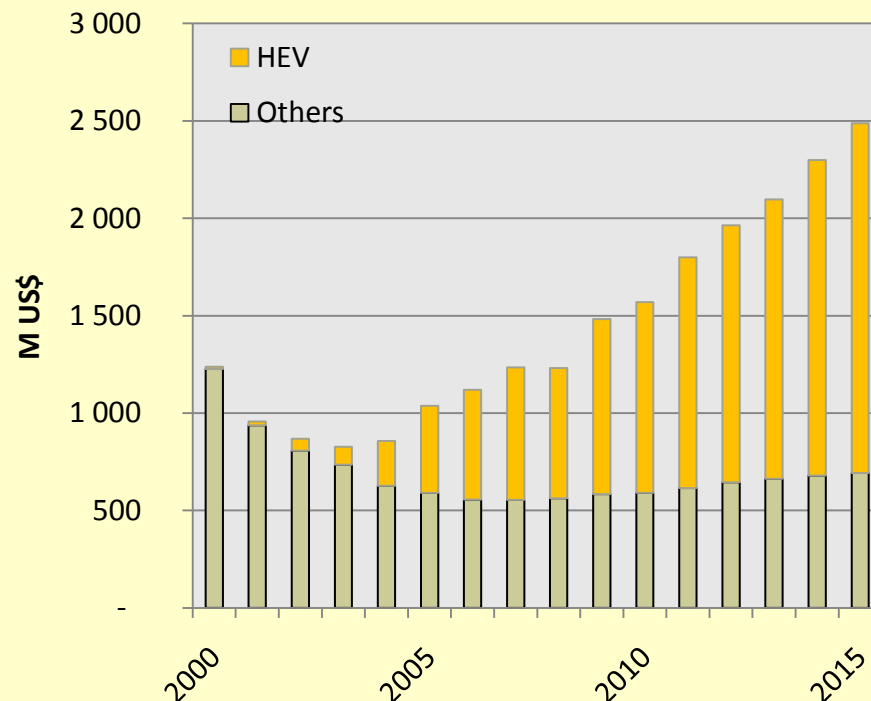
THE NIMH BATTERY MARKET WILL INCREASE THANKS TO HEV

IN 2015, >70% OF THE NIMH BATTERIES WILL BE SOLD FOR HEV

NIMH Battery sales, M US\$, Worldwide, 2000-2015



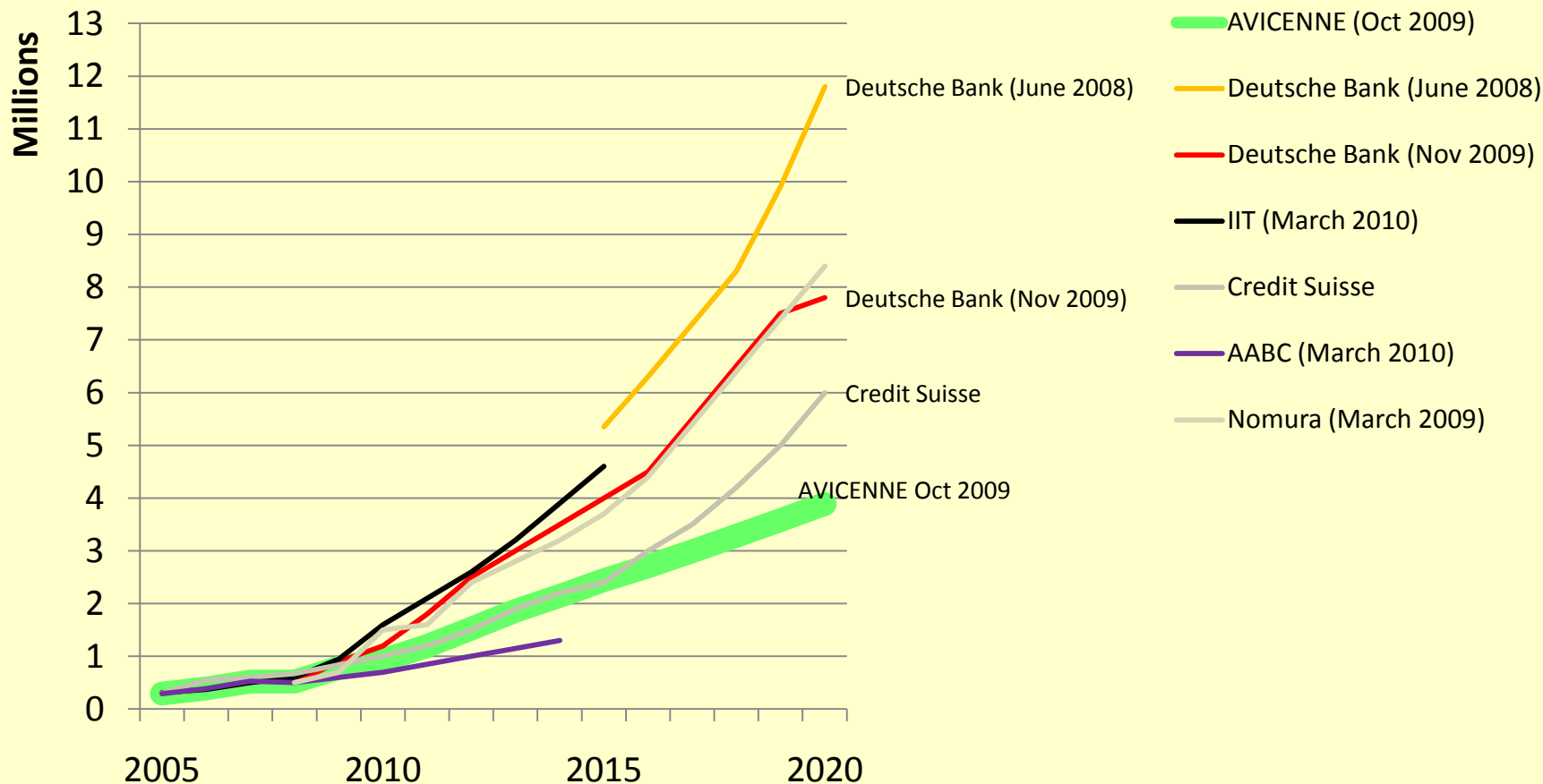
NiMH Battery sales, M US\$, Worldwide, 2000-2015



SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, MARCH 2010

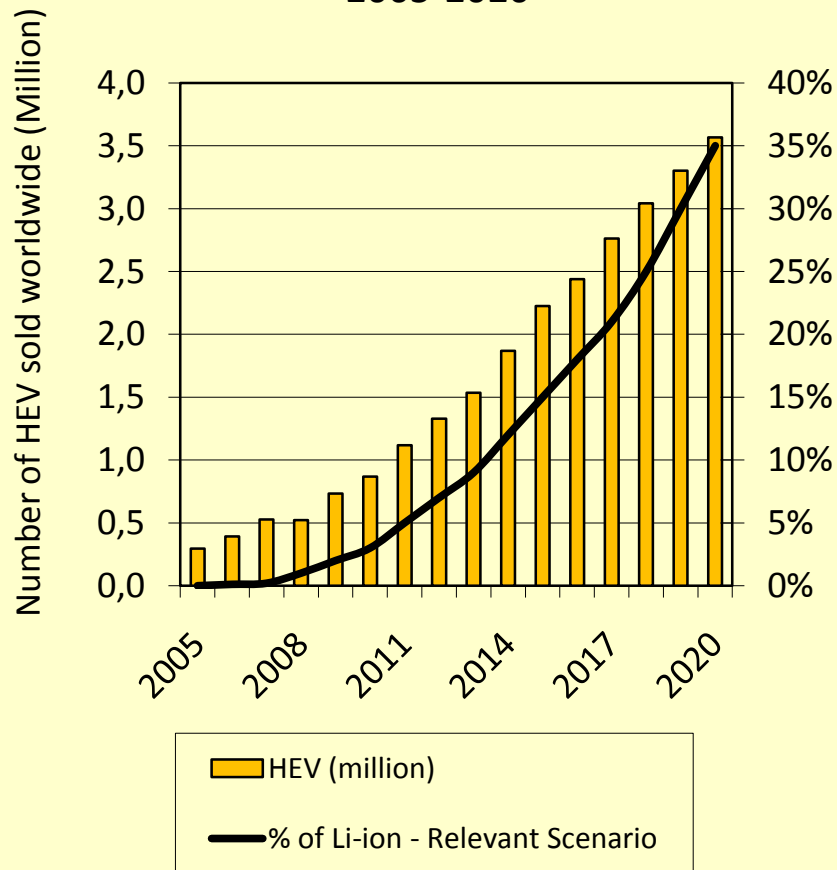
LONG TERM HEV FORECAST FROM 3 TO 8 M HEV IN 2020

HEV FORECASTS (Million)

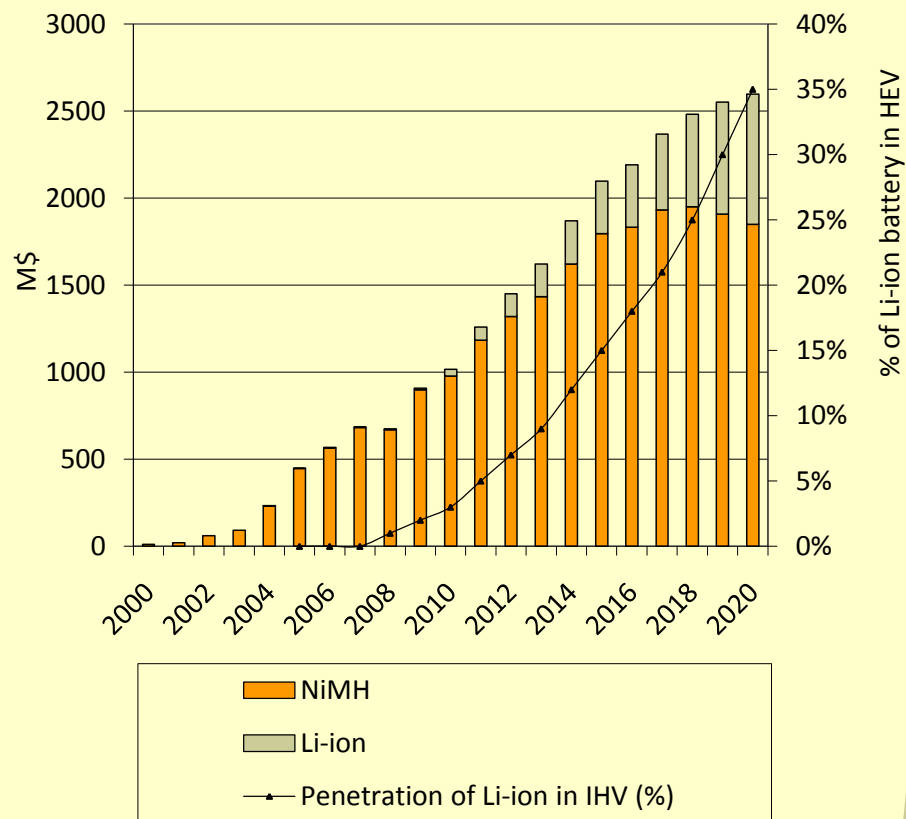


LONG TERM HEV BATTERY FORECASTS

HEV market, million units, worldwide,
2005-2020



HEV battery market worldwide, million \$
2000-2020



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

SOURCE : THE RECHARGEABLE BATTERY MARKET 2009-2020 , AVICENNE, SEPTEMBER 2010

LI-ION BATTERIES DEVELOPMENTS FOR HEV, P-HEV & EV

Information for growth

- Li-ion is **THE** solution for the future
 - BUT, SAFETY, LIFE TIME & COST issues
 - Lot of technical solutions (NMC, NCA, LFP, LCO...)
 - Lot of EXPENSIVE Developments...
- So,
- Lot of JV, partnerships etc...

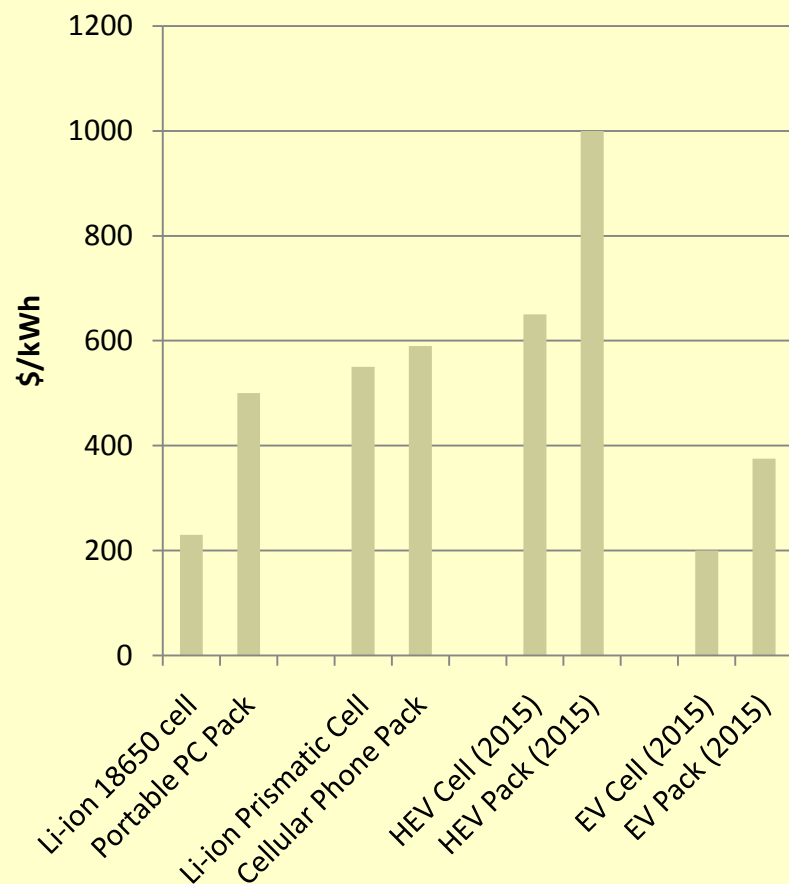
	PRIUS III NiMH	PRIUS x - Li-ion
Volts	201.6	201.6
Cells	168 (28*6)	56
Capacity	6.5 Ah	3.8 Ah
Energy	1310 Wh	766 Wh
Weight	38 kg	25 kg
T°C Range	+	+
Cyclability	+	++
Safety		
Cost		

JOINT VENTURE & STRONG PARTNERSHIP

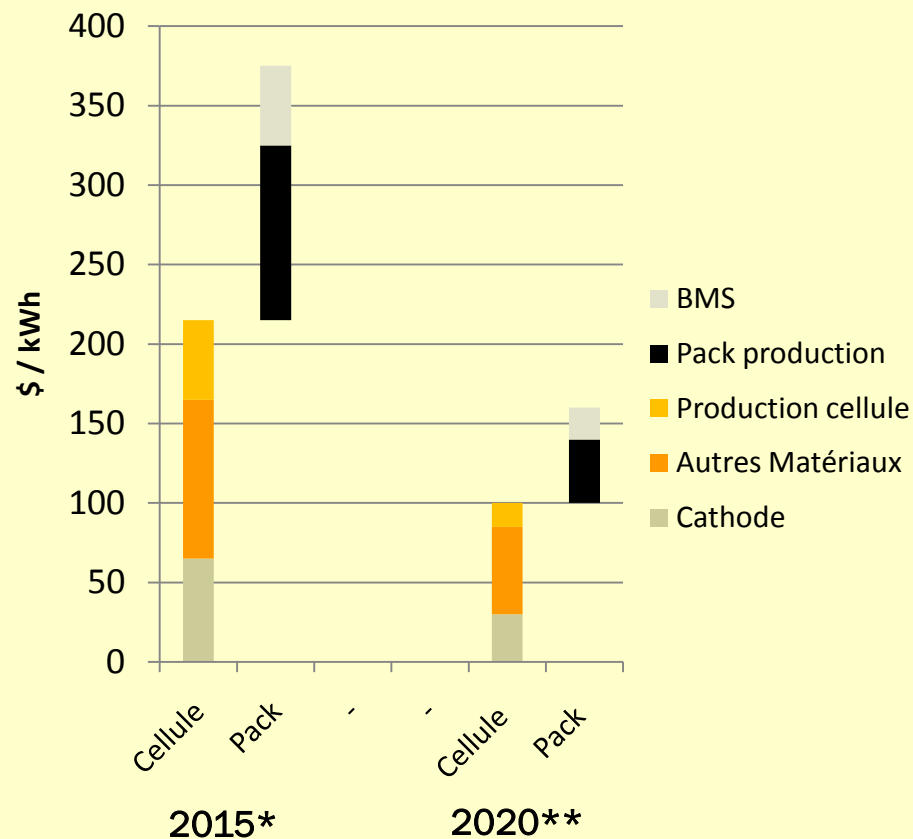
	TOYOTA	NISSAN	HONDA	FORD	MITSUBISHI	DAIMLER	BYD AUTO	BOSCH	CONTINENTAL	JC
PANASONIC	PEVE									
NEC		AESC								
GSY			JV (HEV)		LEJ (EV)					
SDI								SB LiMotive		
SAFT										JV
BYD						JV in China	HEV, EV			
ENAX									Partner	
MAGNA				Partner						

LI-ION BATTERY COST

**LI-ION BATTERY COST
CELLS / PACK**



**LI-ION BATTERY PACK COST FOR EV
AVICENNE FORECASTS**



* For Production > 100 000 packs/year

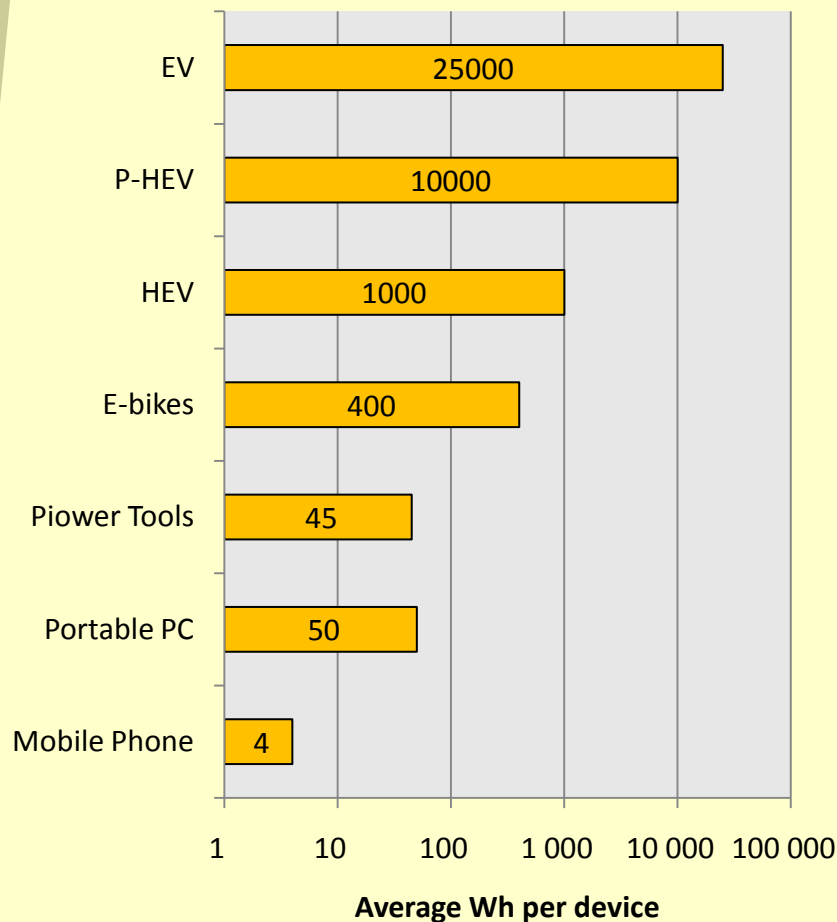
** USBAC Goal in 2020

Source : AVICENNE Compilation, September 2010

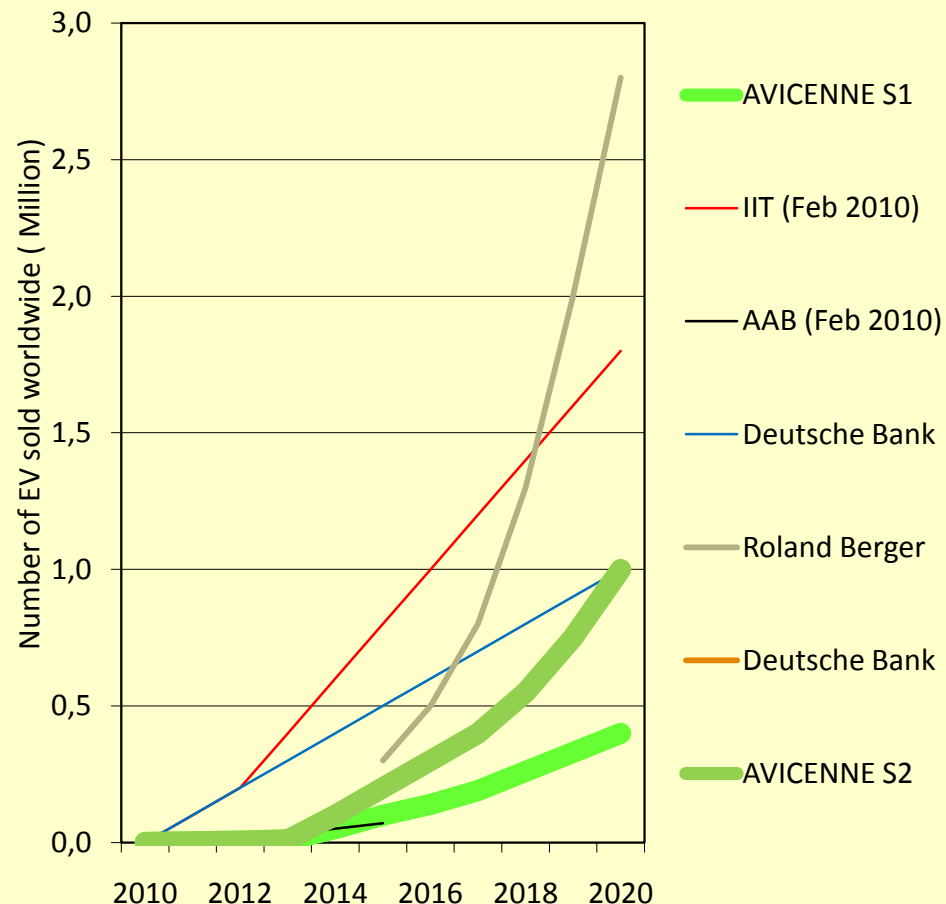
HEV, P-HEV & EV LONG TERM FORECASTS

EV ENERGY NEED: 25 MORE THAN HEV!

Information for growth



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



LONG TERM EV, PHEV & HEV BATTERY FORECASTS

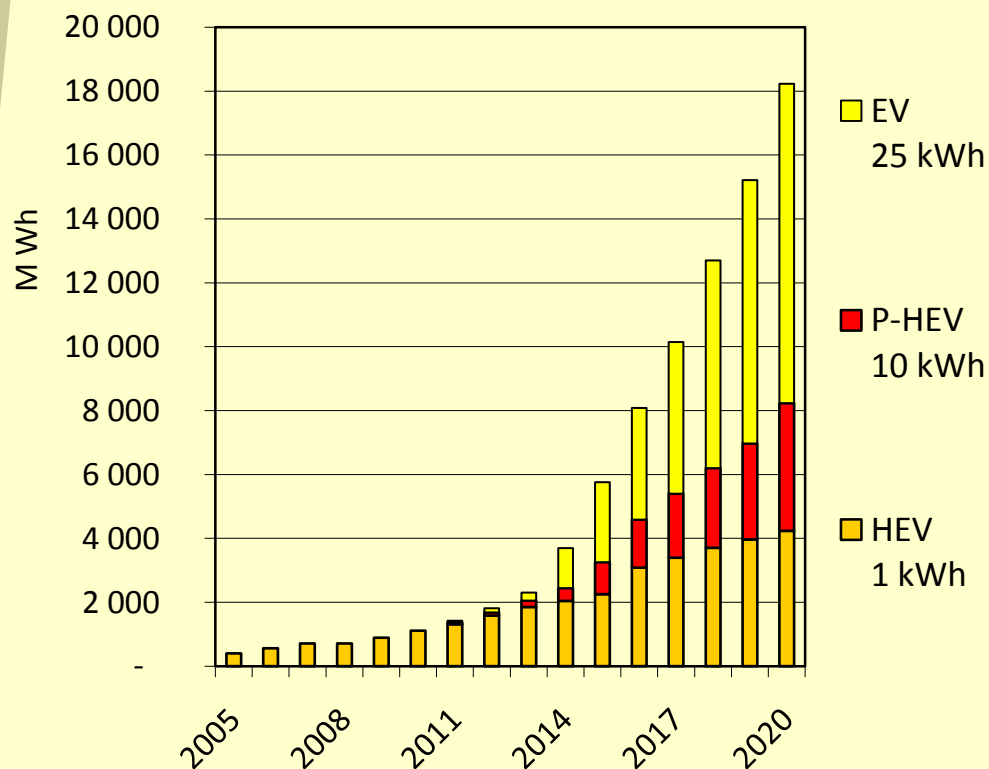
Assumptions

100 000 EV in 2015
400 000 in 2020
100% Li-ion

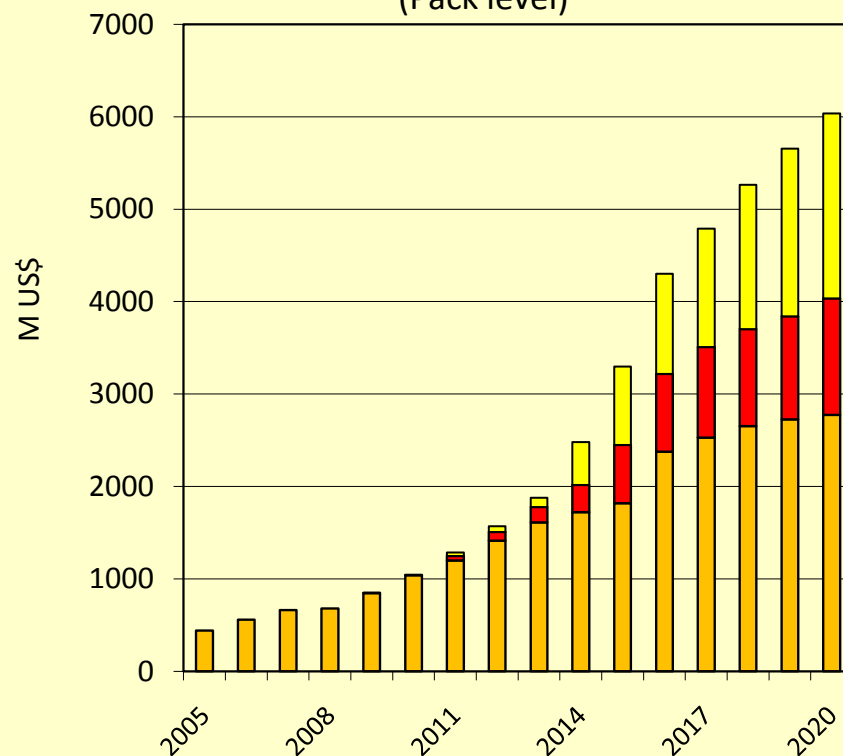
0.1 M P-HEV in 2015
0.4 M in 2020
100% Li-ion

2,2 M HEV in 2015
3,5 M in 2020
35% Li-ion in 2020

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



AUTOMOTIVE RECHARGEABLE BATTERY
MARKET M US\$, Worldwide, 2005-2020
(Pack level)



TOTAL LIB DEMAND

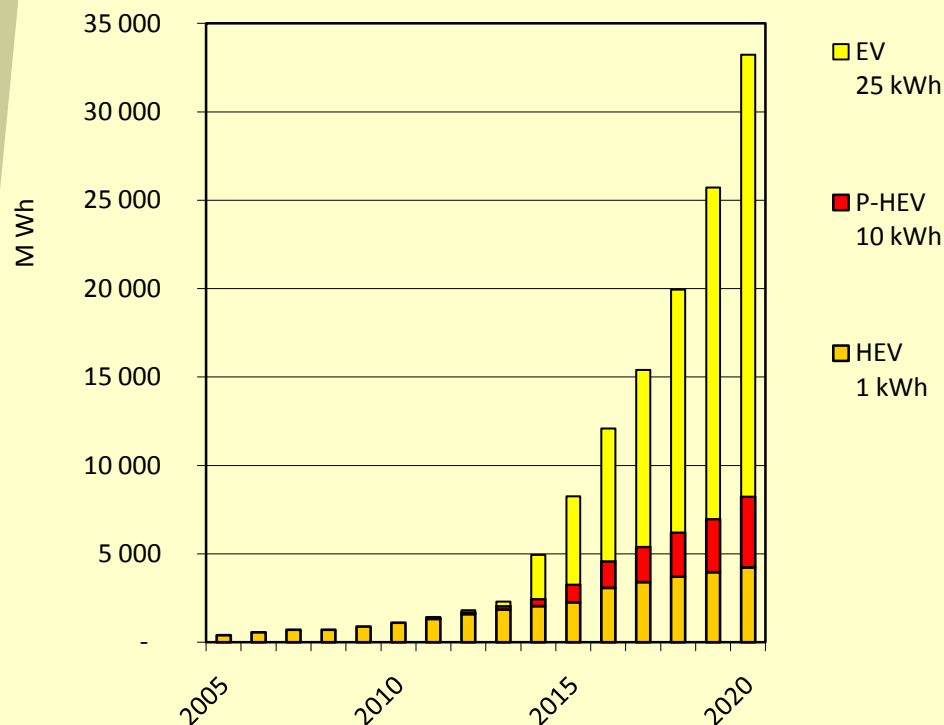
Assumptions

200 000 EV in 2015
1M in 2020
100% Li-ion

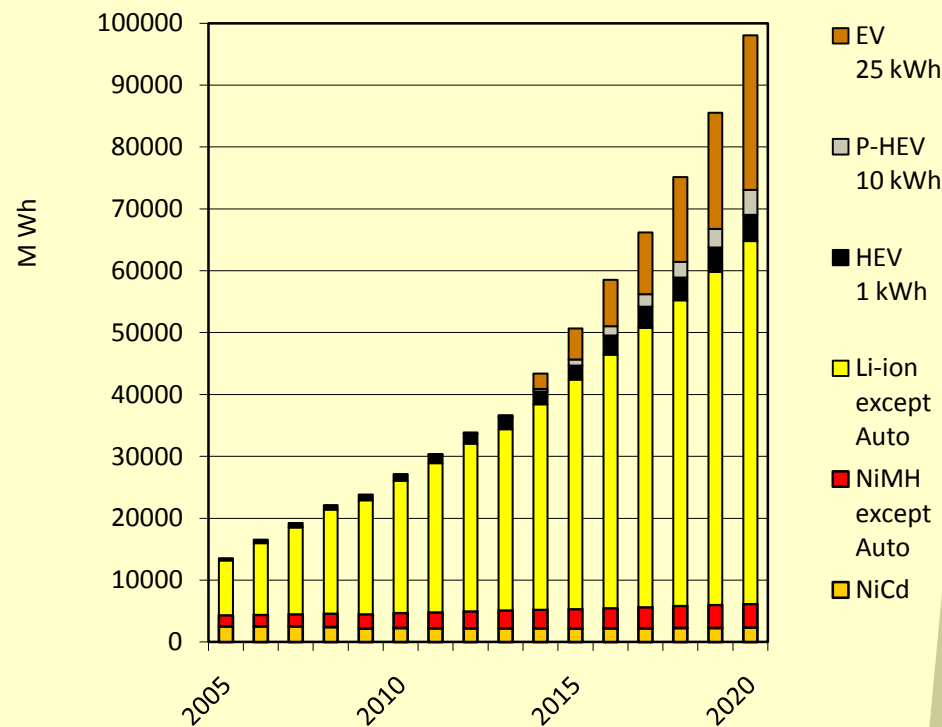
0.1 M P-HEV in 2015
0.4 M in 2020
100% Li-ion

2,2 M HEV in 2015
3,5 M in 2020
35% Li-ion in 2020

EV, HEV & P-HEV Battery needs (M Wh)
2005 – 2020 (Scenario 2)



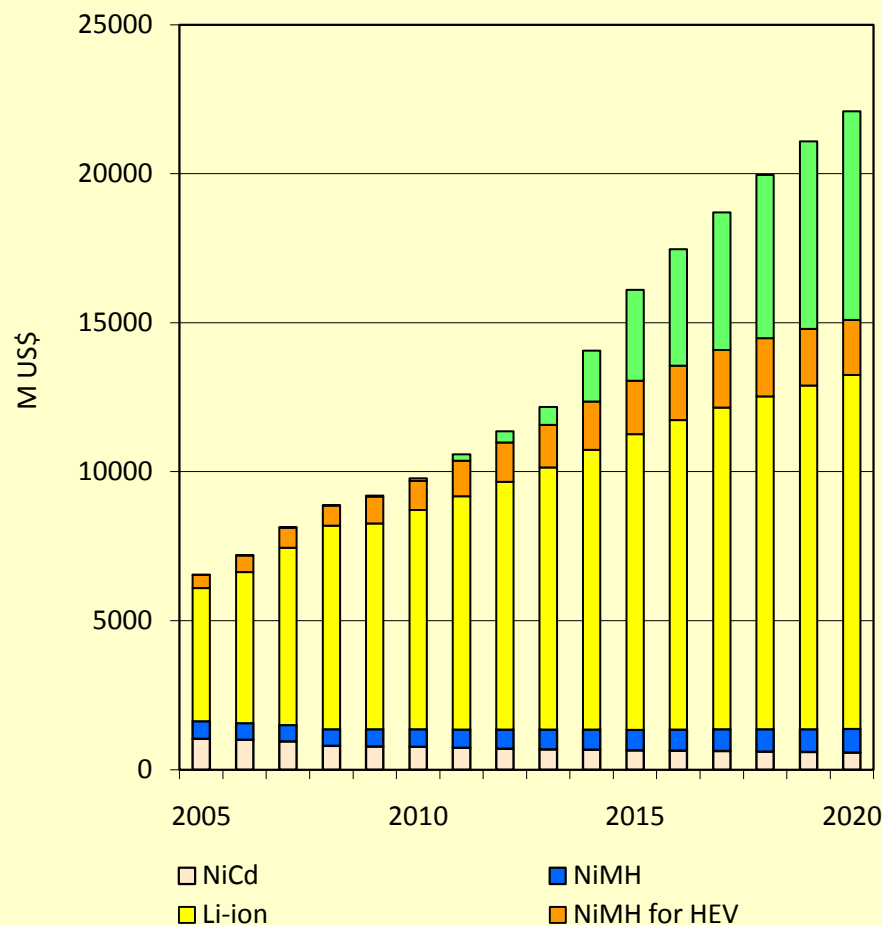
Total battery demand (M Wh)
2005 – 2020



TAKEAWAYS

- The Hybrid vehicle is the only mass market choice for electric traction cars today
- Toyota opened this market and earn money with HEV models
- The hybrid vehicles is now a niche market: in 2015 we believe more than 2,1 million Hybrid cars will be sold worldwide
- The battery technology is today the NiMH, we don't expect the Li-ion to be significant on the HEV mass market
- P-HEV & EV will be powered by Li-ion
- 1 M EV represent roughly 20 000 MWh, or 40 000 tones of cathode materials!
- HEV, P-HEV & EV will change the gasoline dogma in the car Industry. In the next decade, we are expecting one of the world most important disruption in the car industry
- Then, EV could change totally the battery market on a long term basis.

RECHARGEABLE BATTERY MARKET M US\$,
Worldwide, 2005-2020 - PACK LEVEL (\$2)



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Thank you!



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