



Information for growth

PRESENT AND FUTURE MARKET SITUATION FOR BATTERIES

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ADVANCED BATTERY TECHNOLOGIES

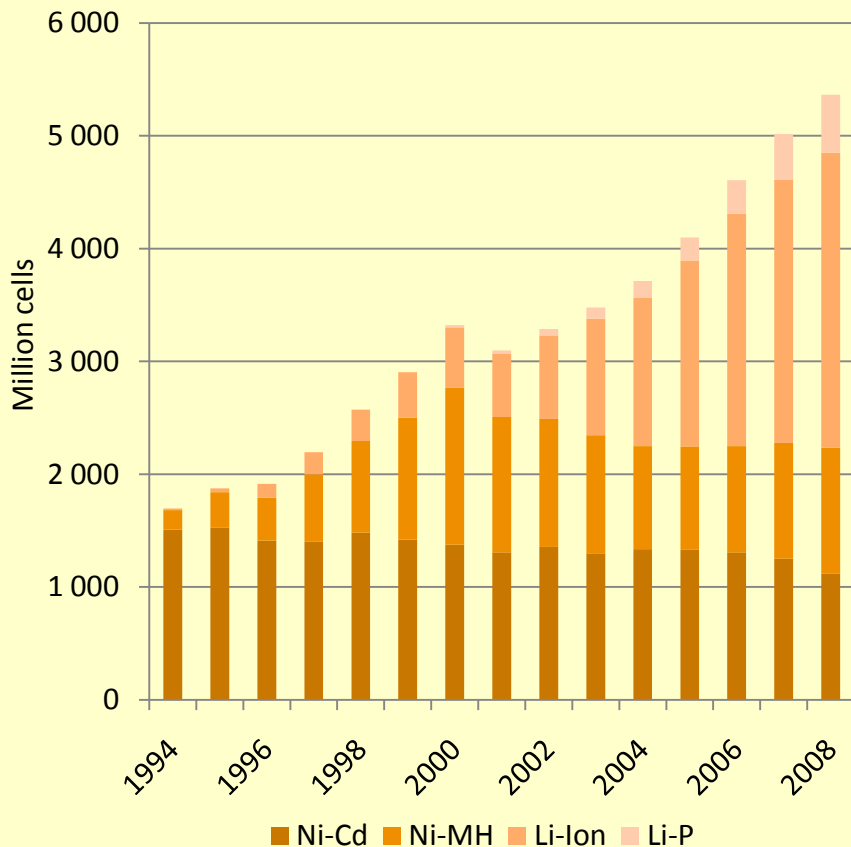
Frankfurt, GERMANY

30th June – 2nd July 2009

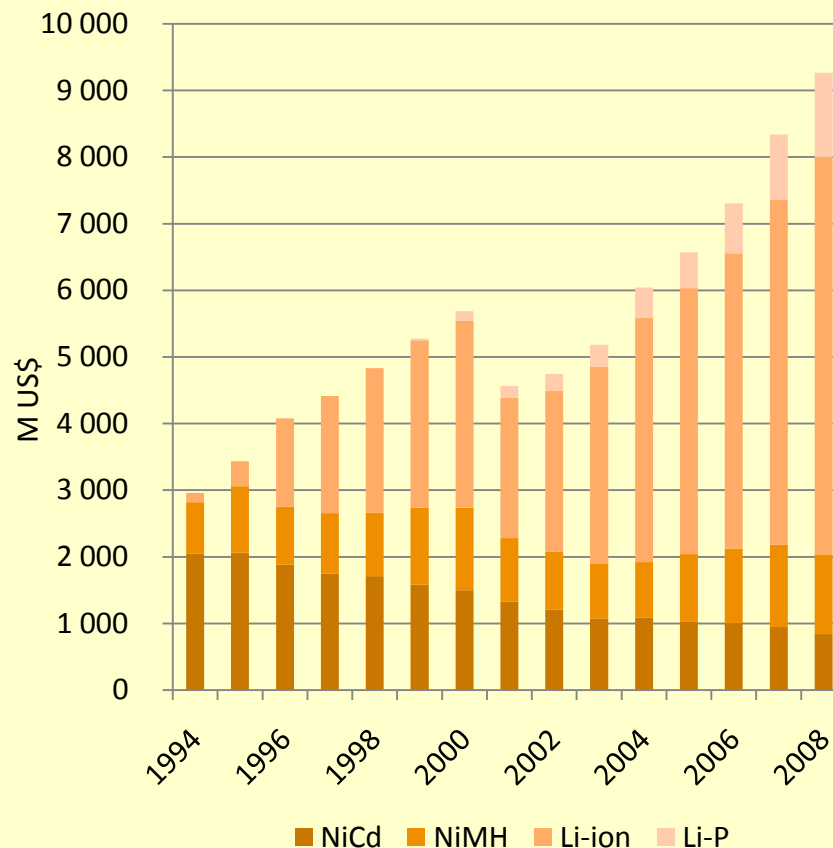
1. Worldwide Rechargeable battery market 2008
2. Main trends 2008- 2020
3. HEV batteries in the total market in 2008
4. EV, HEV & PHEV segmentation
5. HEV market by competitor and by area
6. Forecasts by 2015 & 2020

WORLDWIDE RECHARGEABLE BATTERY MARKET

The worldwide rechargeable battery market, Million cells, 1994-2008



Battery sales, M US\$, Worldwide, 1994-2008

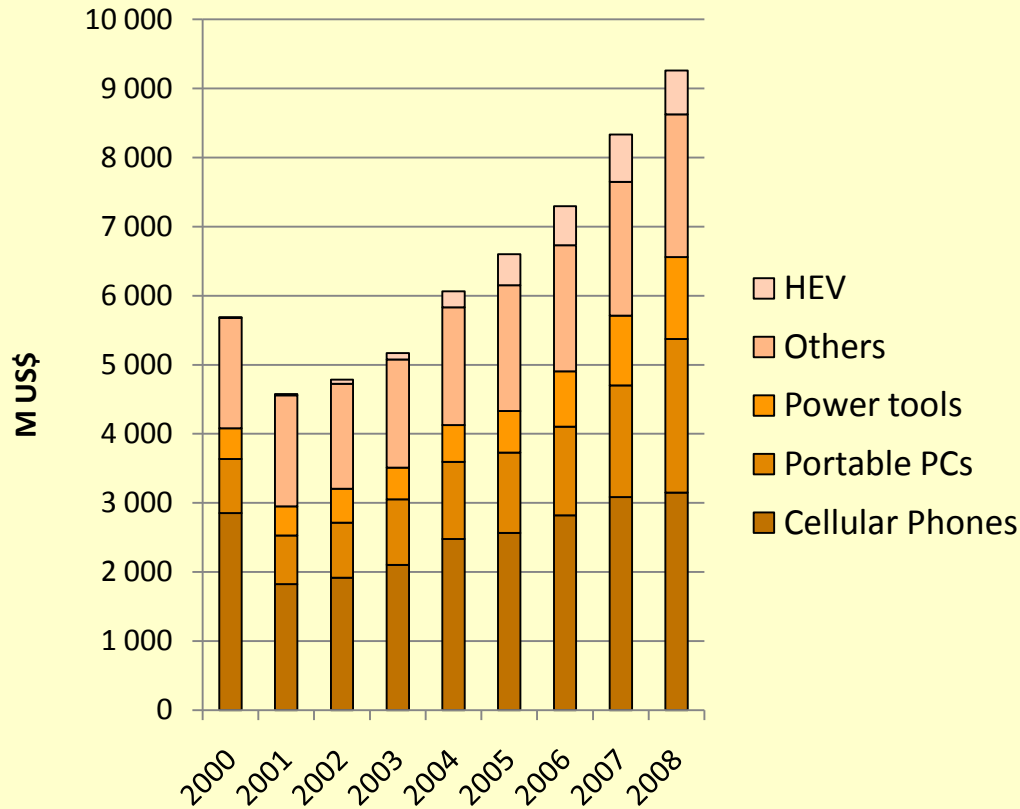


SOURCE : THE RECHARGEABLE BATTERY MARKET 2008-2020 , AVICENNE, JUNE 2009

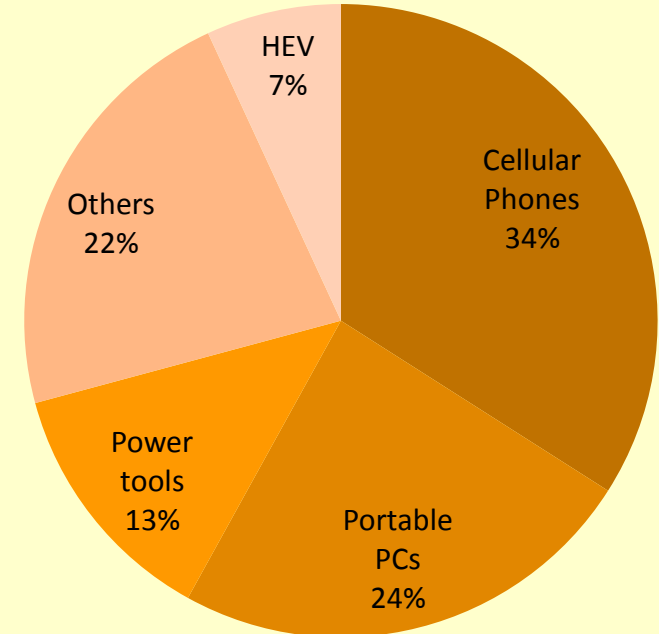
THE RECHARGEABLE BATTERY MARKET IN 2008

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Battery sales, M US\$, Worldwide, by application
2000-2008



Battery sales, M US\$, Worldwide, by application
2000-2008



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

JAPANESE, CHINESE & KOREAN MARKET SHARE (IN VALUE), 2008

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Japanese market share (value) decreases : from 82 % of the market in 2001 to less than 75% in 2003 & 56% in 2008

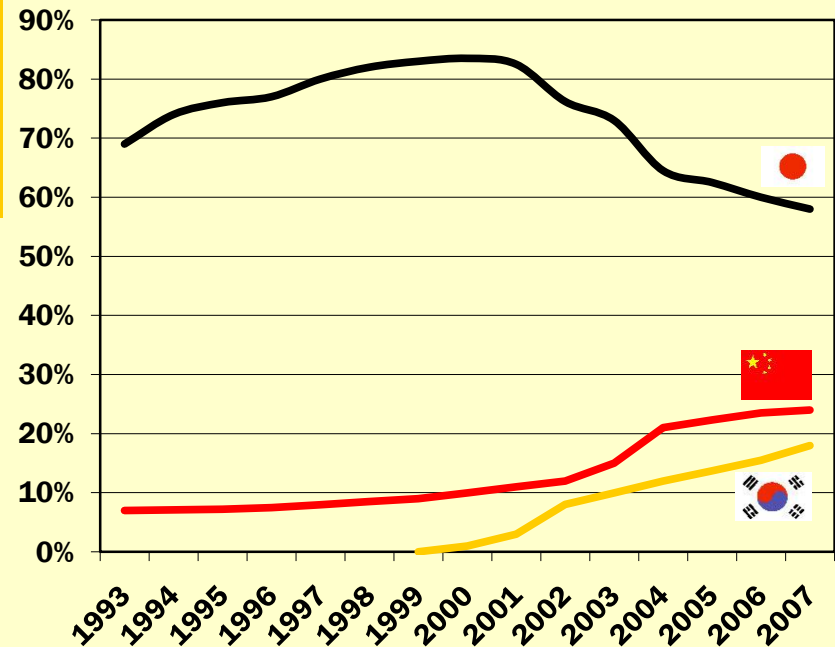
JAPANESE SALES
5.1 Billions \$ in 2008
(07/08 growth : +13%)

CHINESE SALES
2.3 B\$ in 2008
(07/08 growth : +10%)

KOREAN SALES
1.8 B\$ in 2008
(07/08 growth : +13%)

REST OF THE WORLD
< 0.1 B\$ in 2008

Market share by country, %

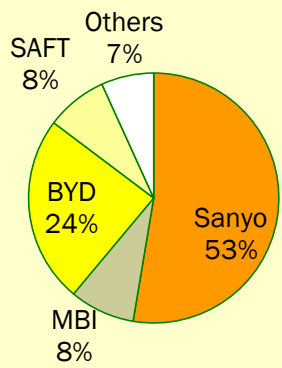


SOURCE : THE RECHARGEABLE BATTERY MARKET 2008-2020 , AVICENNE, JUNE 2009

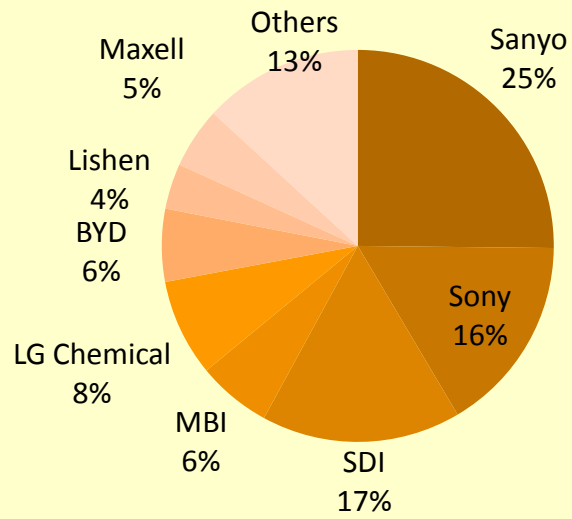
BATTERY INDUSTRY IN 2008

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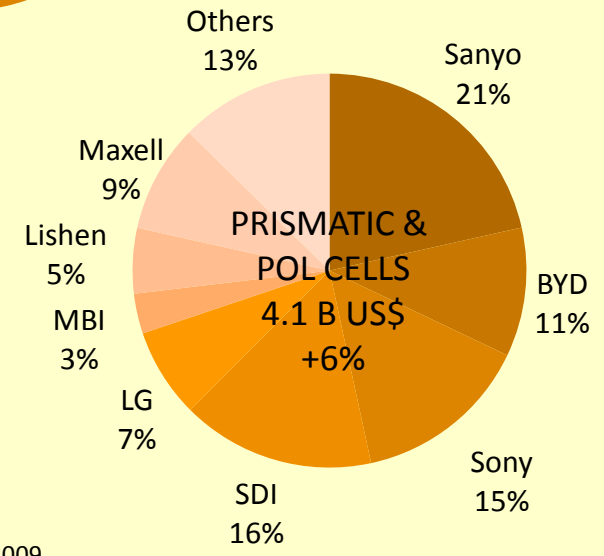
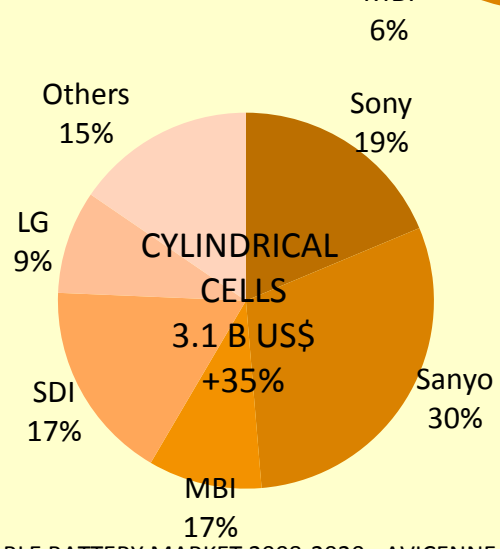
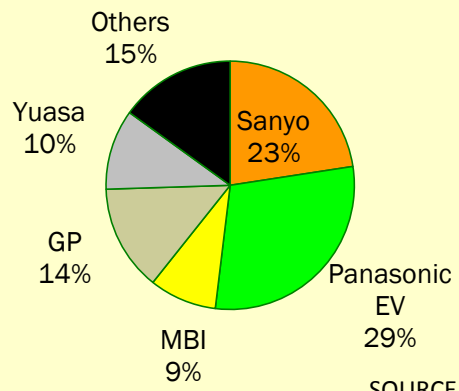
NiCd: 0.8 Billion US\$
Annual Growth = - 16%



Li-ion & Polymer: 7.2 Billion US\$
Annual Growth = +20%



NiMH: 1.2 Billion US\$
Annual Growth = 0%



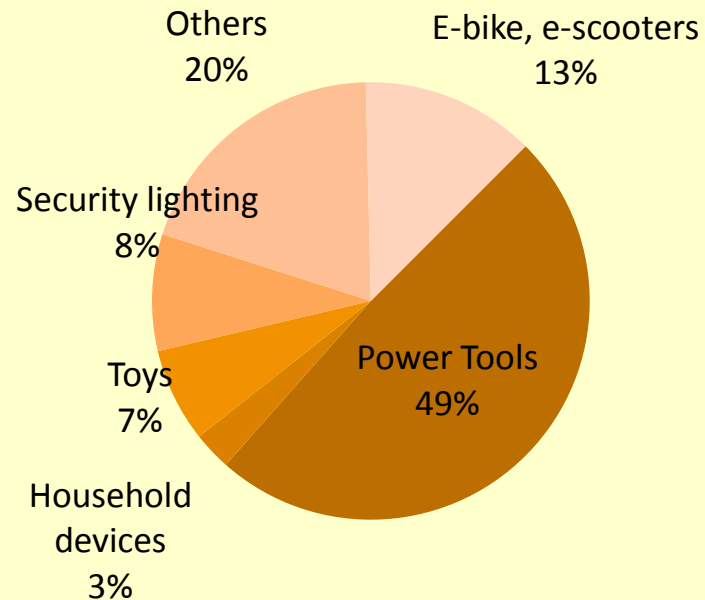
SOURCE : THE RECHARGEABLE BATTERY MARKET 2008-2020 , AVICENNE, JUNE 2009

MAIN APPLICATION: POWER TOOLS

1 050 Million NiCd cells
800 M\$

CAGR 2003/2008
-4% per year in volume
-6% per year in value

NiCd by application worldwide, % in value, 2008



- All the market segments are stable or decreased a little except e-bike which is increasing.
- Strong competition with
 - NiMH for Toys, cordless Phones, Household devices
 - Li-ion for power tools
- What will be the next step?

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

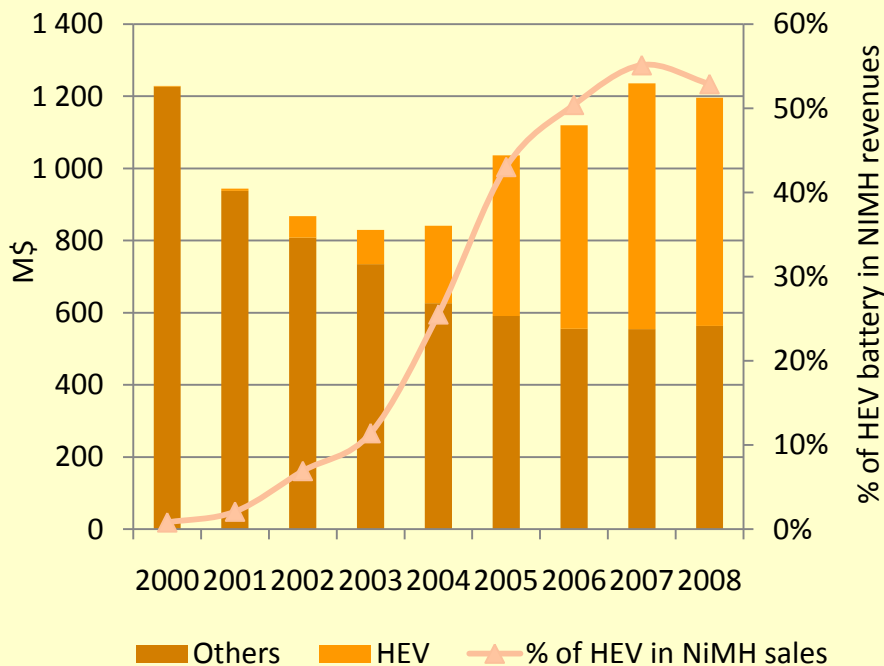
NIMH IN 2008

MAIN APPLICATION: HEV

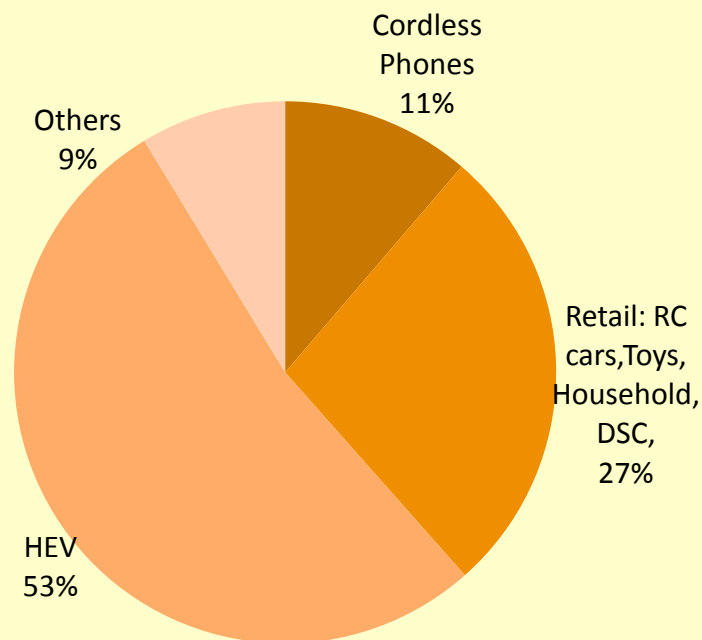
1 100 M NiMH cells
1.2 B\$

CAGR 2003/2008
+2% per year in Volume
+8% per year in value

NiMH battery market worldwide in value
% for HEV application



NiMH battery by applications, worldwide, % in value, 2008



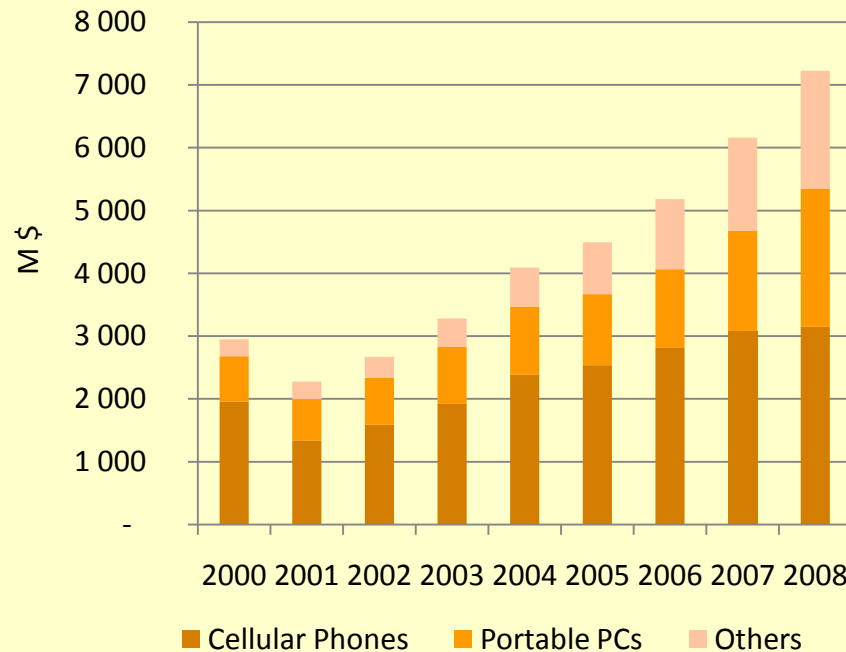
SOURCE : THE RECHARGEABLE BATTERY MARKET 2008-2020 , AVICENNE, JUNE 2009

MAIN APPLICATION: CELLULAR, NOTEBOOK

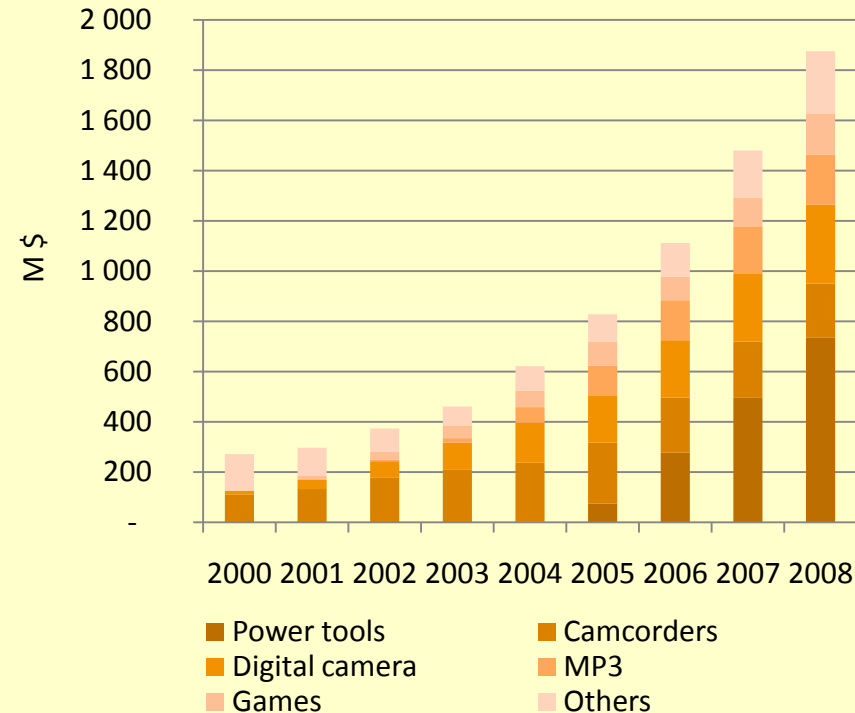
3 100 M Li-ion & Polymer cells
7 200 M\$

CAGR 2003/2008:
+22% per year in volume
+17% per year in value

Li-ion & Polymer Battery sales,
M\$, Worldwide, 2000-2008



Li-ion & Polymer Battery sales,
M\$, Worldwide, 2000-2008



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

BATTERY MAIN TRENDS

Economical trends

Price decreases,
Investment,

Technical trends

New technologies, higher capacities, higher power, improving reliability & performances for raw materials,

Regulation trends

Products banned,
cyclability, durability

Applications trends

Mobile - Portable PC - VEHICLES - Digital Cameras - PDA - Power Tools - Toys - Wireless Phones - Home Appliances - Security systems - RC Cars - Video games - MP3 - ...

Geographic Area

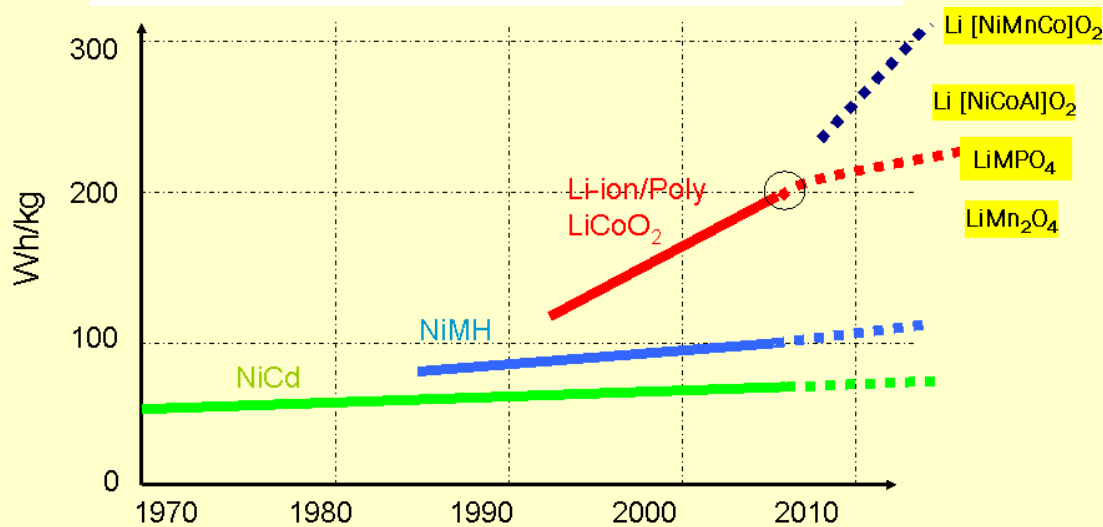
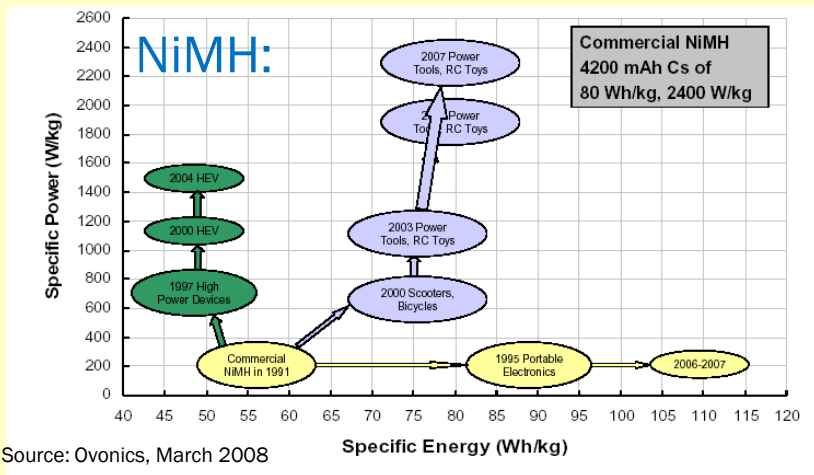
US - Western Europe - Japan - China - India - Latin America - Eastern Europe - Asia Pacific - Middle East - Row

& SAFETY

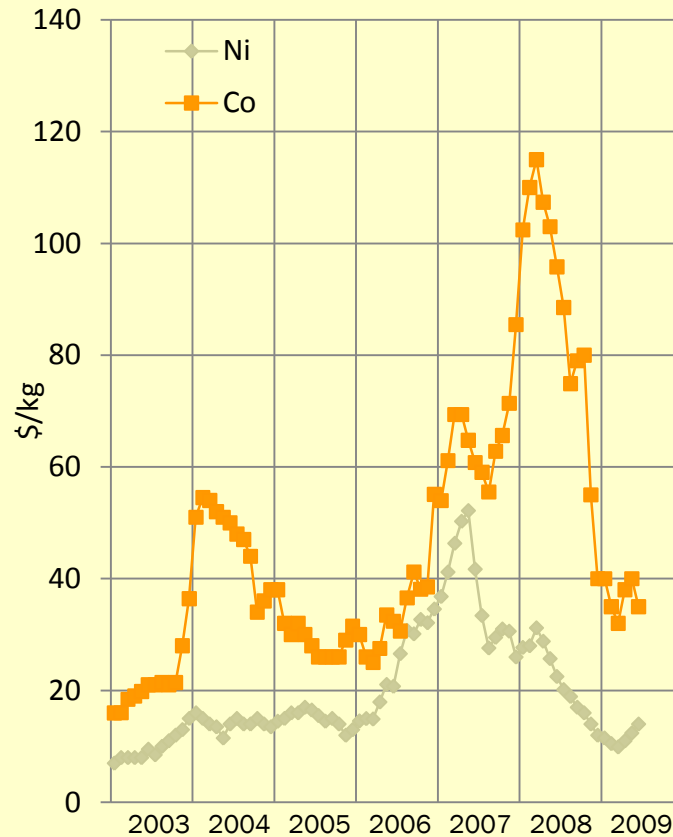
NEW MATERIALS FOR HIGHER CAPACITY OR LOWER PRICE

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INCREASING ENERGY & POWER



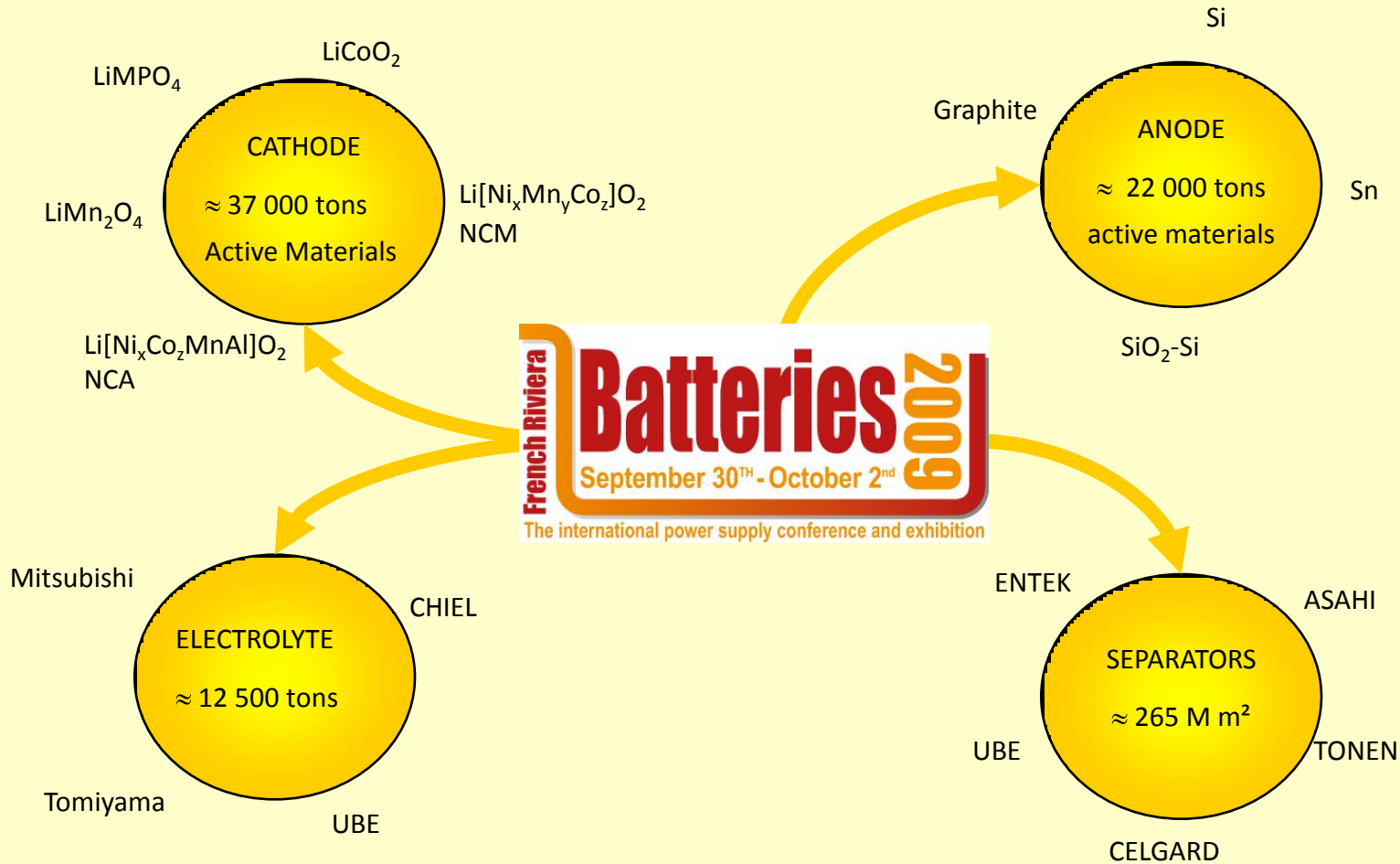
Ni & Co LME PRICES



SOURCE: LME, JUNE 2009

BATTERY RAW MATERIALS MARKET – 2008

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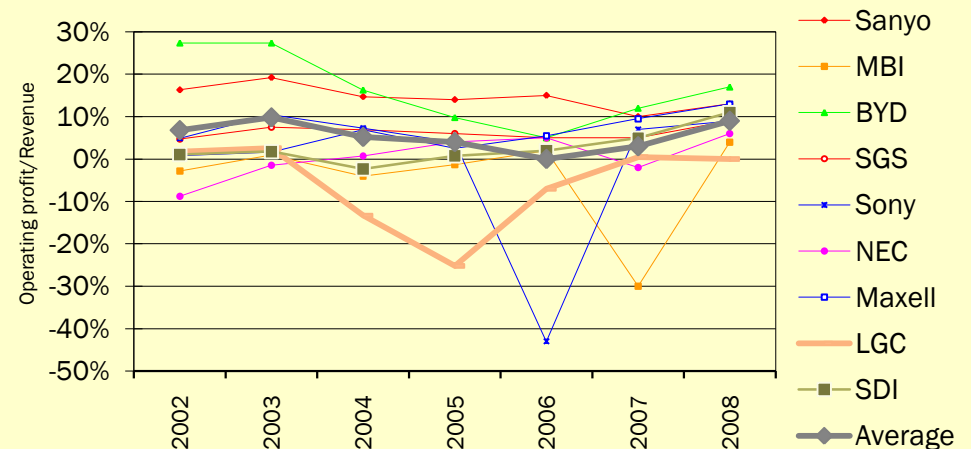
SOURCE : THE RECHARGEABLE BATTERY MARKET 2008-2020 , AVICENNE, JUNE 2009

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, JUNE 2009

DRIVERS

- ☺ Electronic devices market is increasing
- ☺ Requiring more & more energy
- ☺ Electronic devices usage is increasing
- ☺ HEV market is increasing
 - ☺ Government incentives (CO₂ Emission, ...)
 - ☺ Gasoline Prices
 - ☺ New Diesel Hybrid in Europe

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 market
 - ☹ Gasoline price decrease (??)
 - ☹ 8 to 10 years of battery life is required
 - ☹ Safety problems, accident, recall

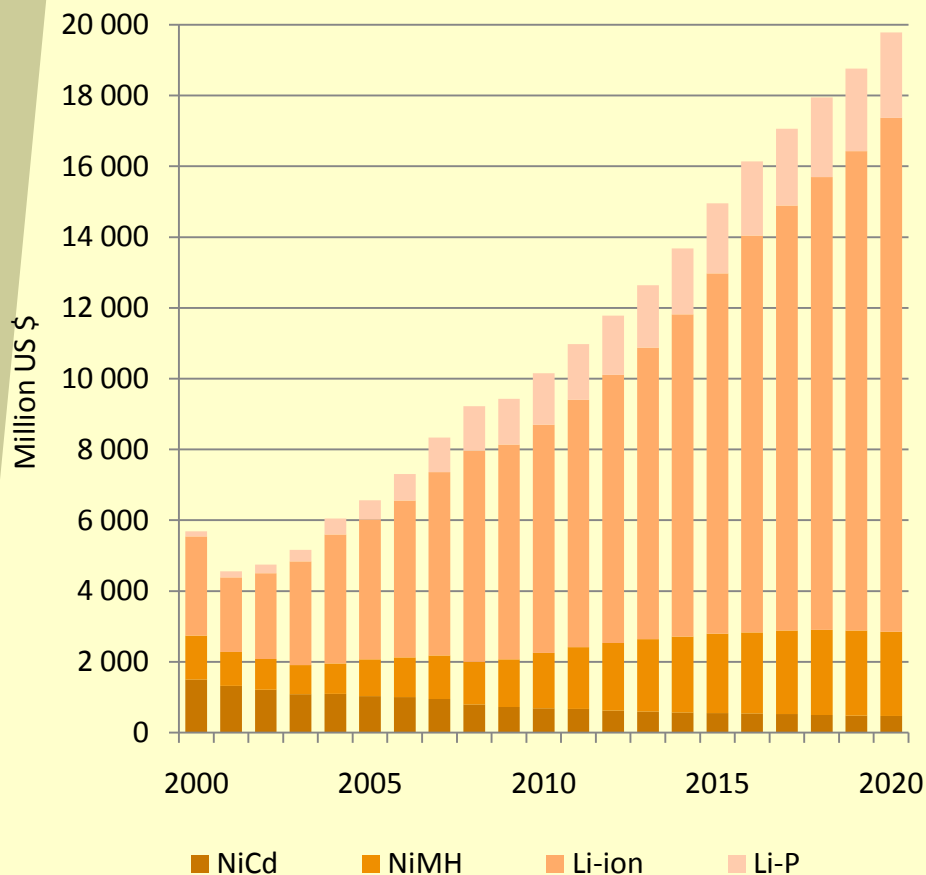
RECHARGEABLE BATTERY MARKET

2000-2020

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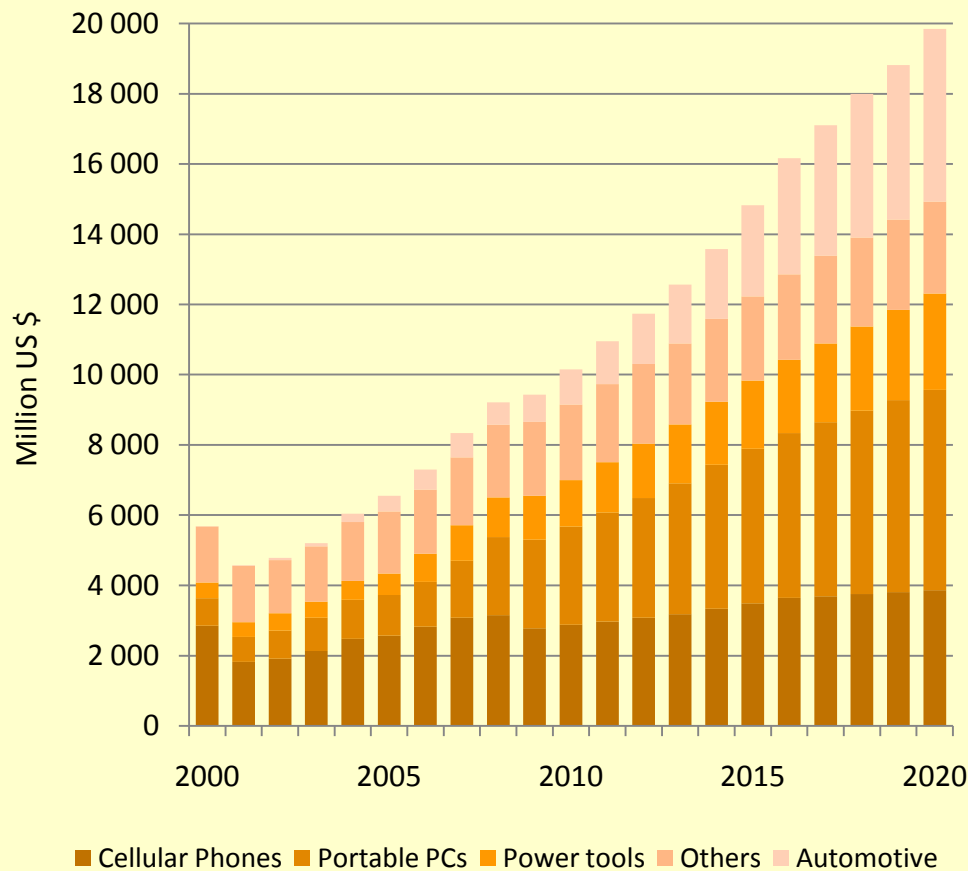
Rechargeable battery market by chemistry

M US\$, 2000-2020 (PACK LEVEL)



Rechargeable battery market by Applications

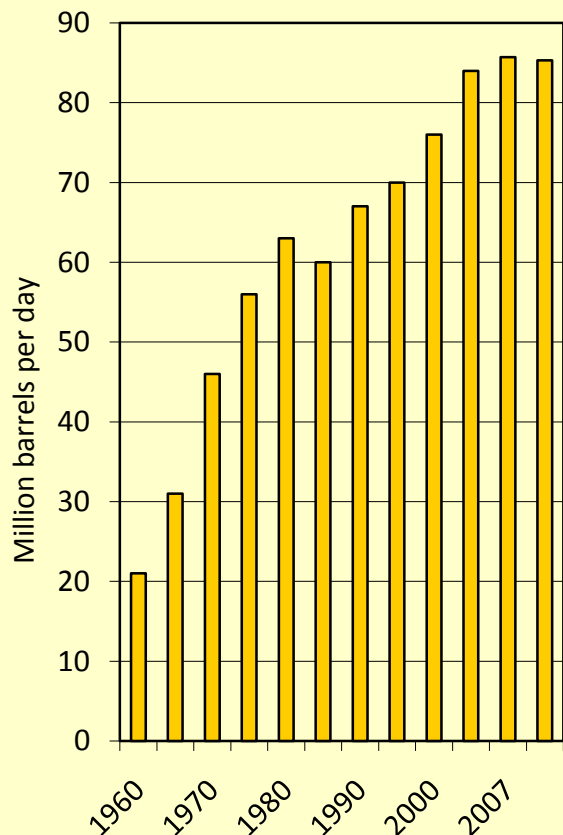
M US\$, 2000-2020 (PACK LEVEL)



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

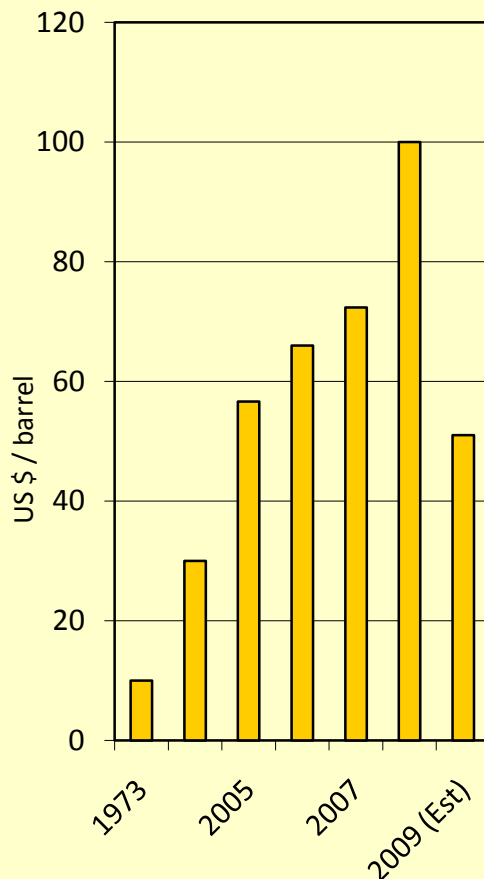
WHY HEV?

Petroleum consumption worldwide 1960-2008



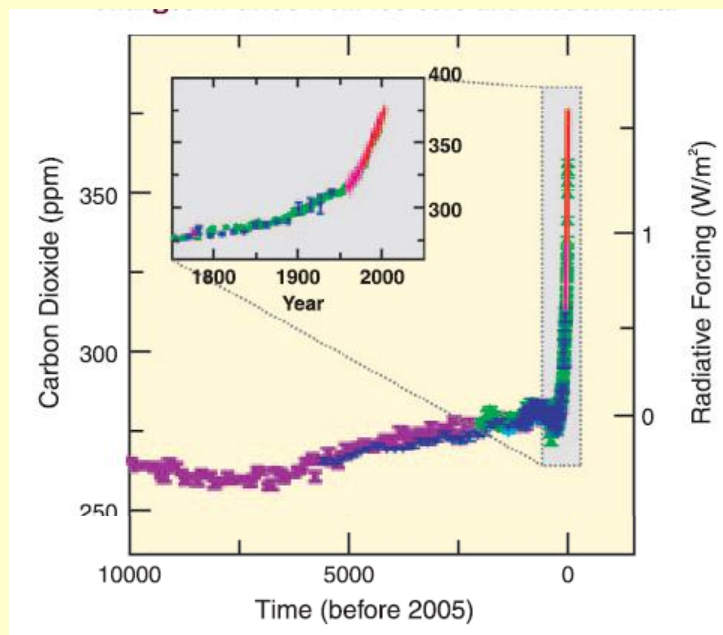
Source :Energy Information Administration, US Government

Price of the WTI barrel of oil, US \$



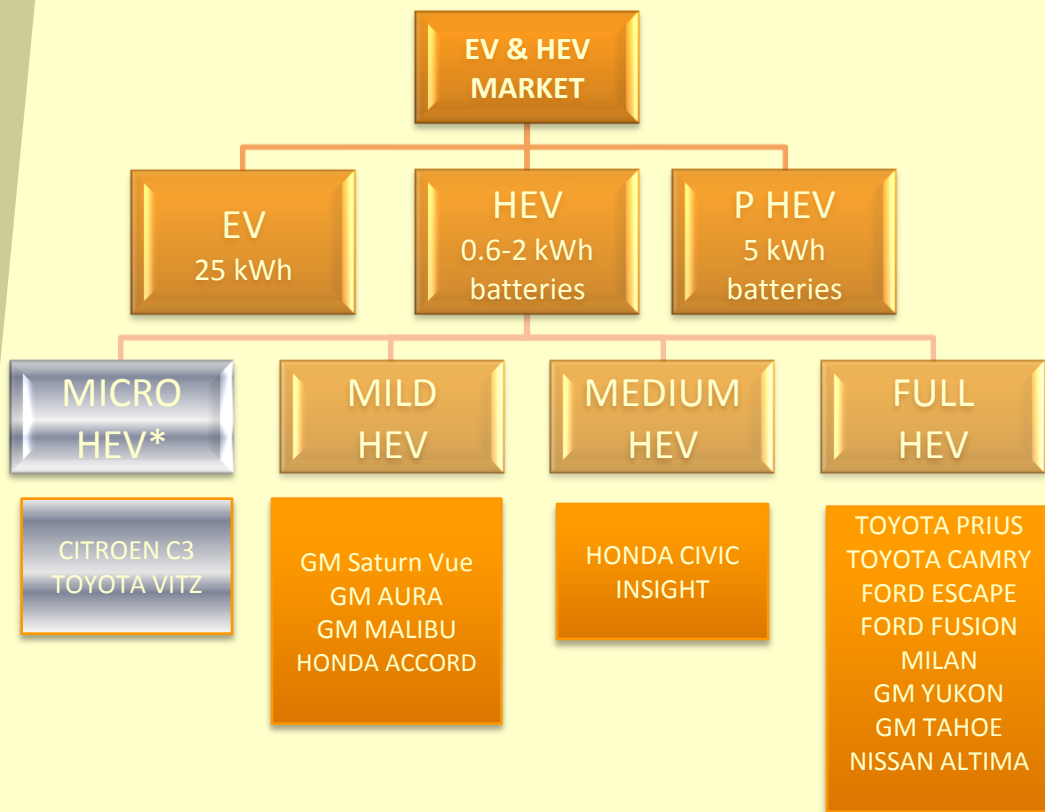
Source :<http://www.eia.doe.gov/emeu/steo/pub/contents.html>

CO₂ density in the atmosphere increase

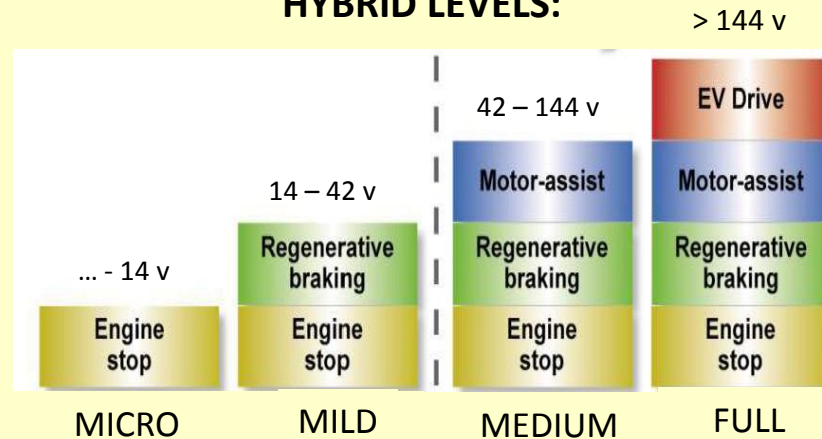


IPCC, Intergovernmental Panel on Climate Change, Climate Change 2007, Synthesis Report p38

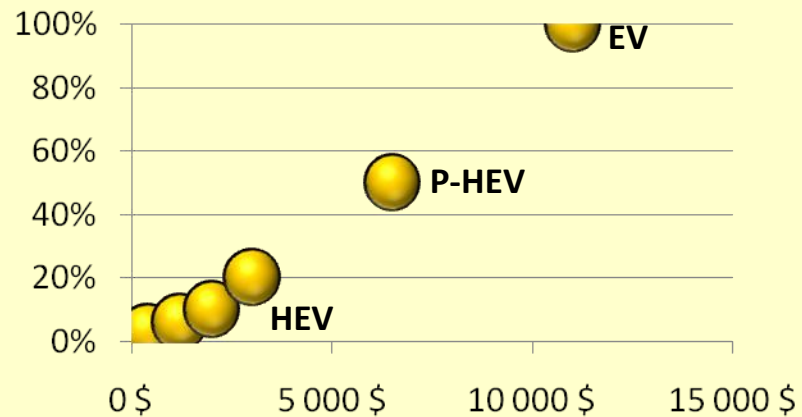
HEV SEGMENTATION



HYBRID LEVELS:



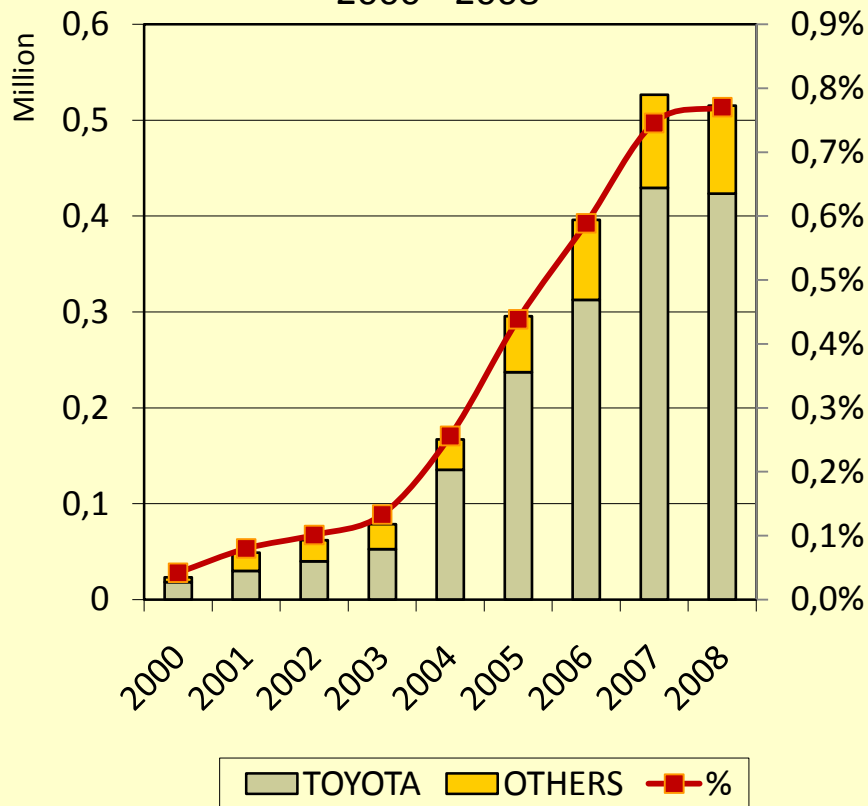
Fuel saving Vs. Cost



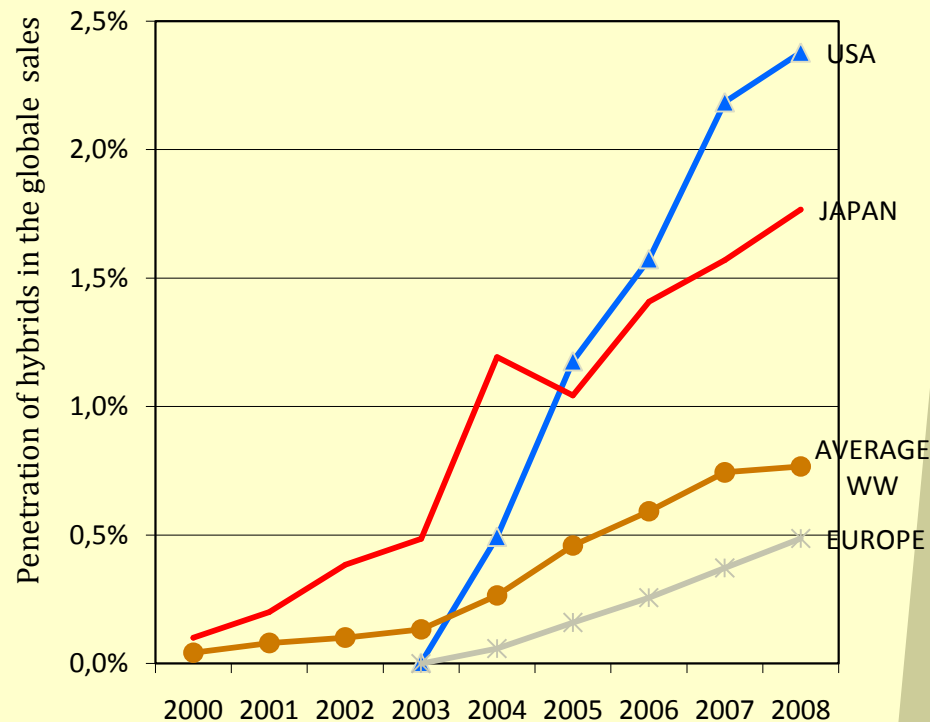
*Note: Micro HEV are not in the HEV statistics & HEV forecast

Less than 1% of vehicle sold worldwide in 2008 was Hybrid

HEV sold per year, M units, worldwide, 2000 - 2008



Penetration of hybrids in the global sales, 2000-2008

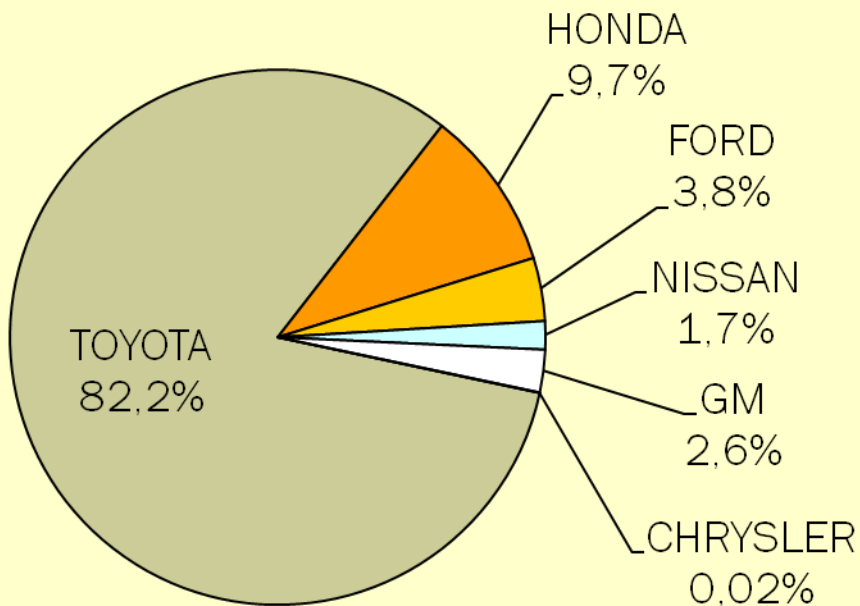


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SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

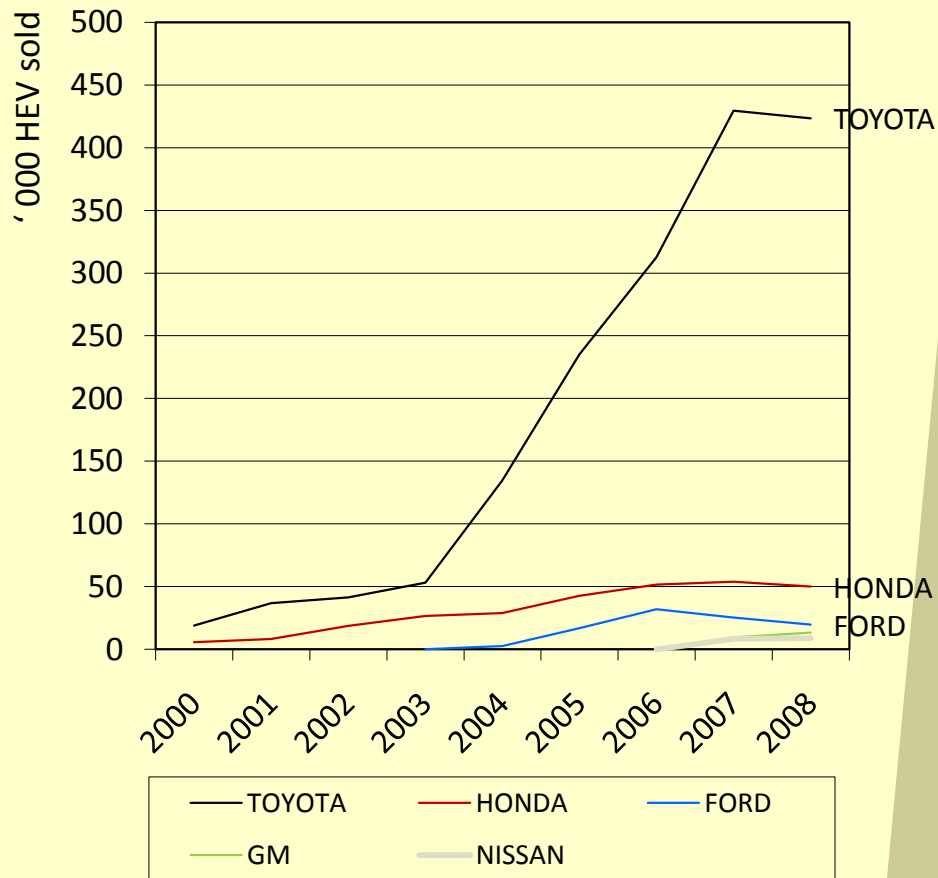
HEV WORLDWIDE IN 2008

**Total HEV Vehicles:
More than 515 000 units in 2008**



SOURCE : TOYOTA, HONDA, GM, FORD, CHRYSLER

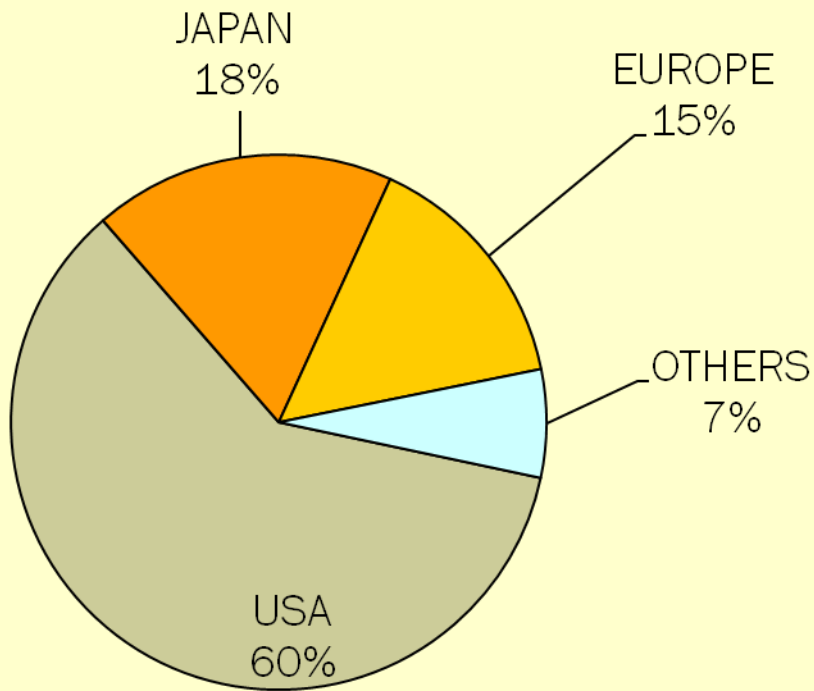
HEV sold per year, M units per car manufacturers, 2000-2008



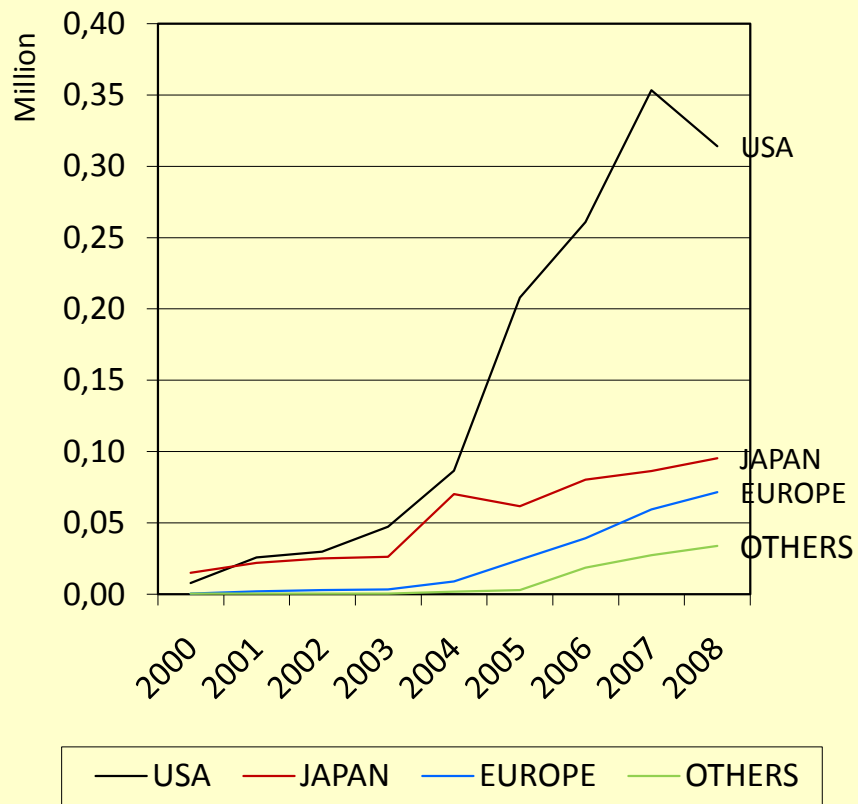
SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

HEV WORLDWIDE IN 2008

**Total HEV Vehicles:
More than 515 000 units in 2008**



HEV sold per year, M units per country, 2000-2008



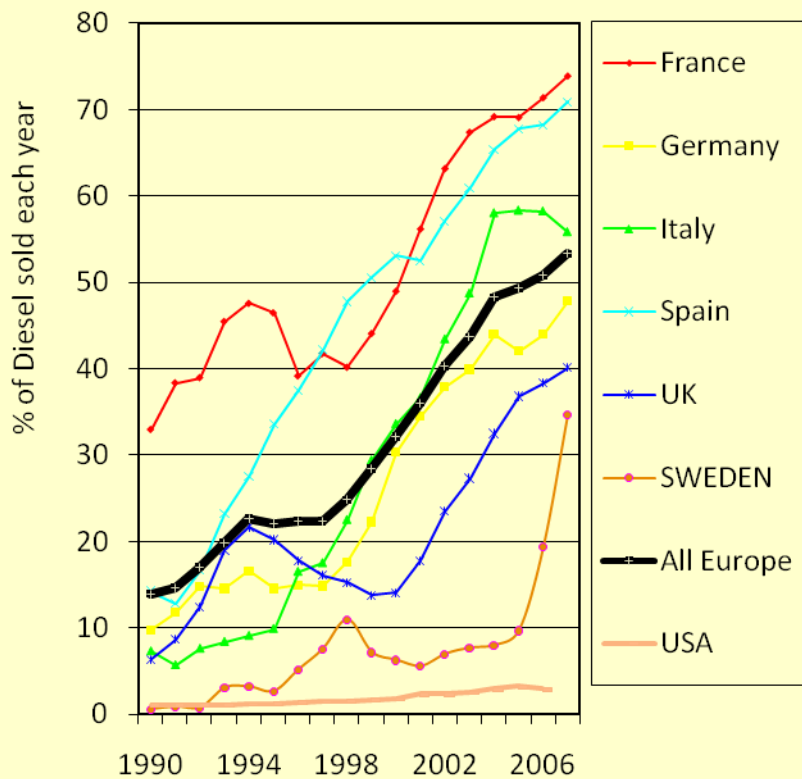
Note: Micro HEV are not in the HEV statistics & HEV forecast

SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

WHY HEV MARKET IS SO SMALL IN EUROPE?

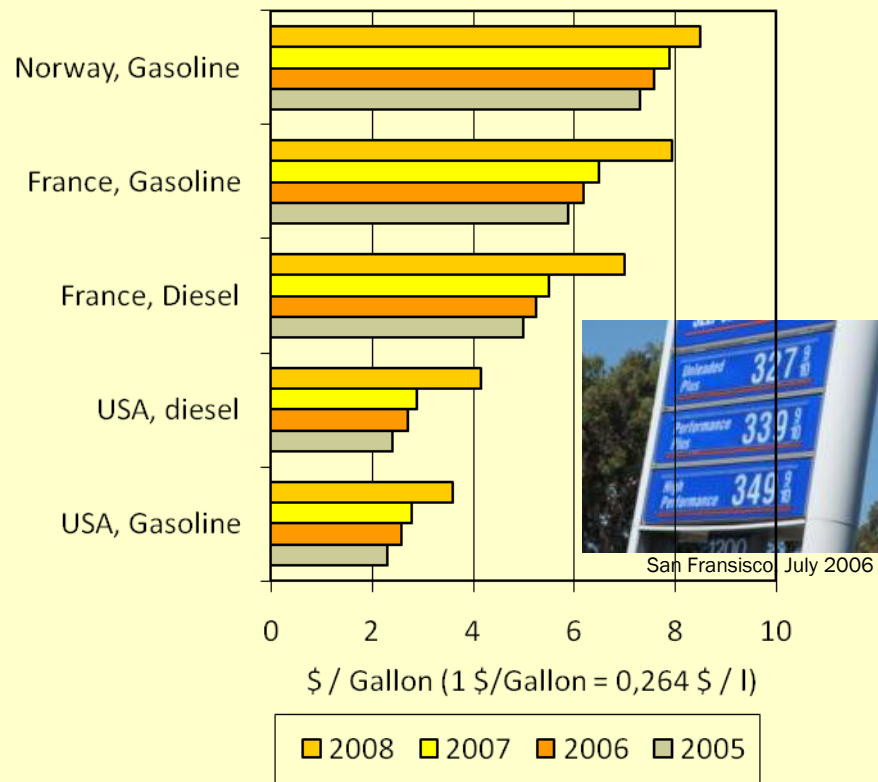
Thanks to lower taxes, Diesel is very popular in Europe

Diesel penetration in Europe & USA



SOURCE: AVICENNE COMPILATION

Gasoline price is 3 times higher in Europe than USA

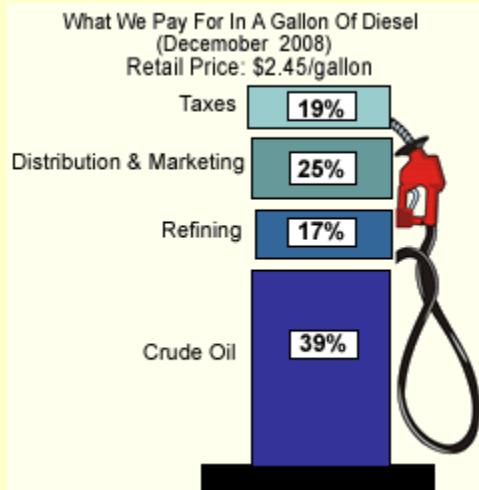
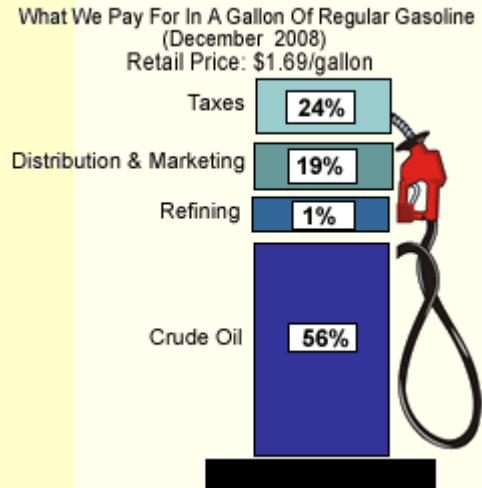


SOURCE: [HTTP://WWW.EIA.DOE.GOV](http://www.eia.doe.gov)

EUROPEAN & USA TAXES FOR GASOLINE

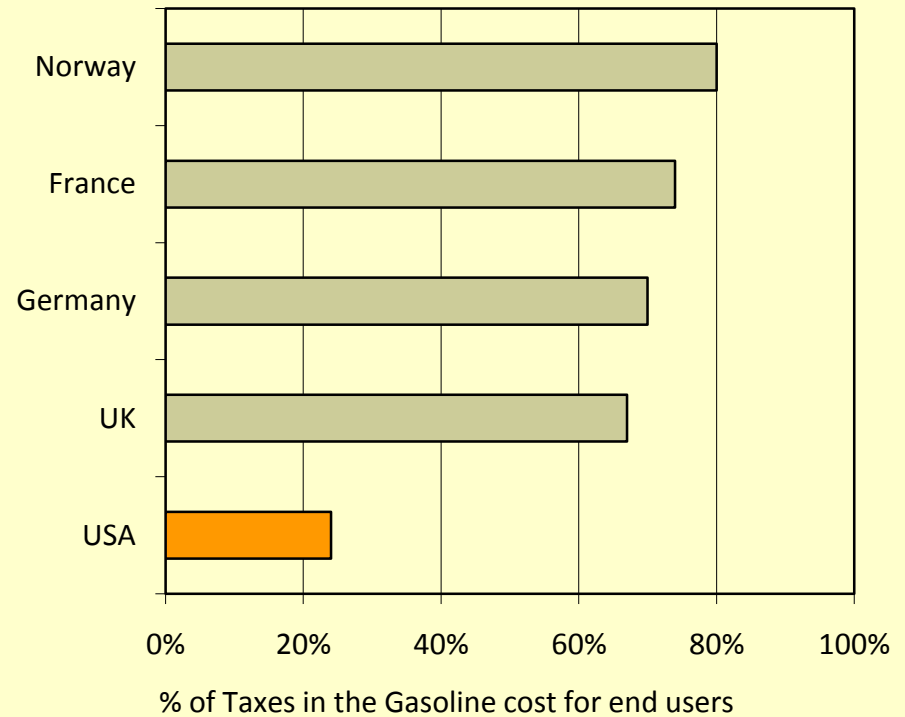
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USA cost of Gazoline



Source: http://www.eia.doe.gov/oil_gas/petroleum

% of taxes in Gasoline cost for end users
January 2009

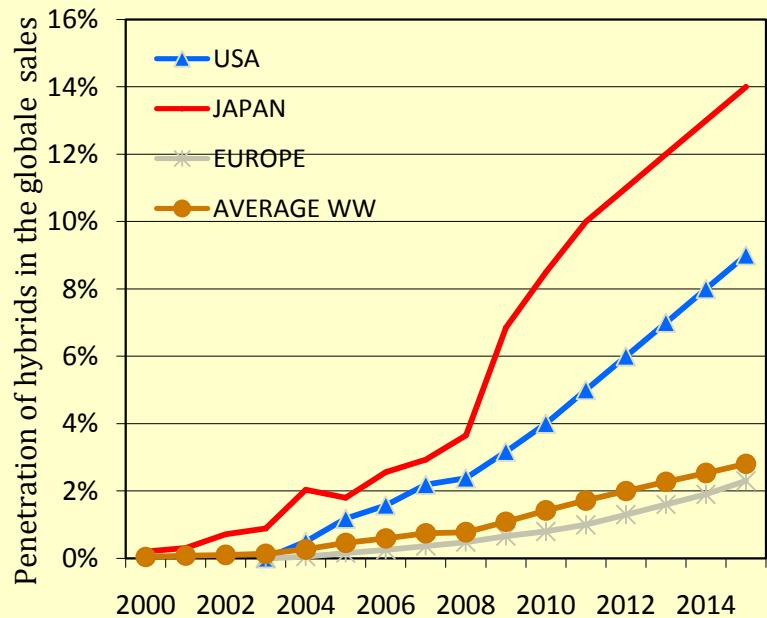


Source: AVICENNE Compilation

HEV FORECASTS UP TO 2015

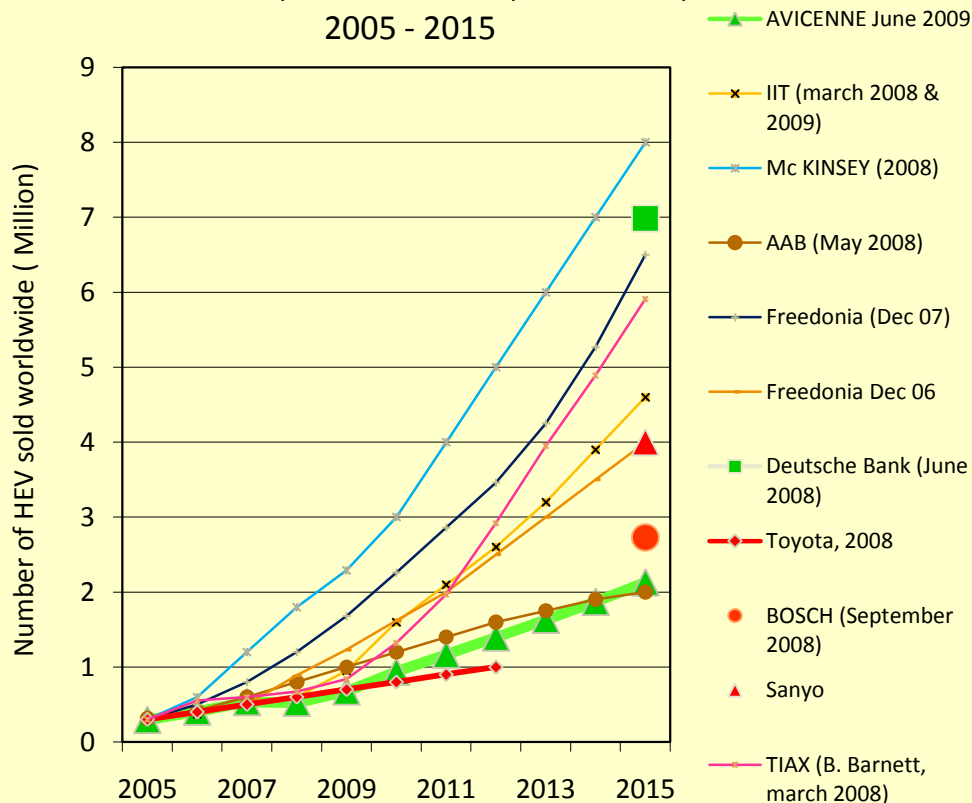
HEV MARKET IN 2015 : > 2 Million units ⁽¹⁾

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



- (1) Assumptions:**
- 76 M vehicle sold WW in 2015
 - 2.8% Hybrids

HEV⁽²⁾ sold, in million units, worldwide, 2005 - 2015



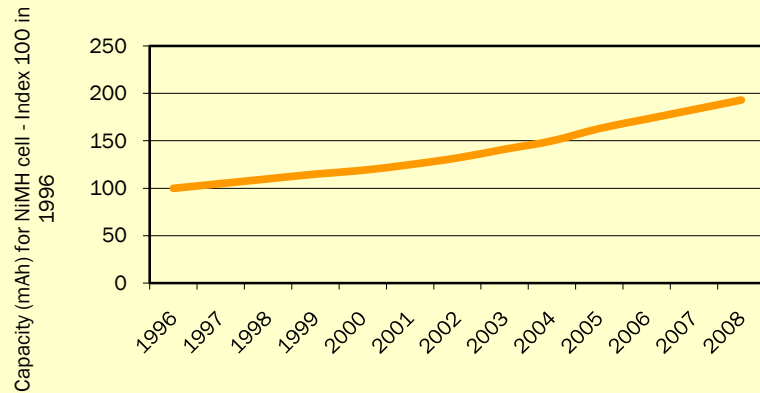
(2) HEV & hybrid excluding micro hybrids

SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

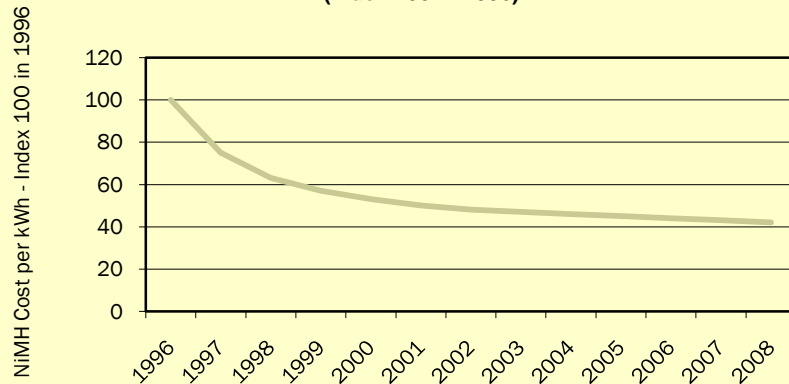
NIMH BATTERY DEVELOPMENTS

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



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



	PRIUS I	PRIUS II
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

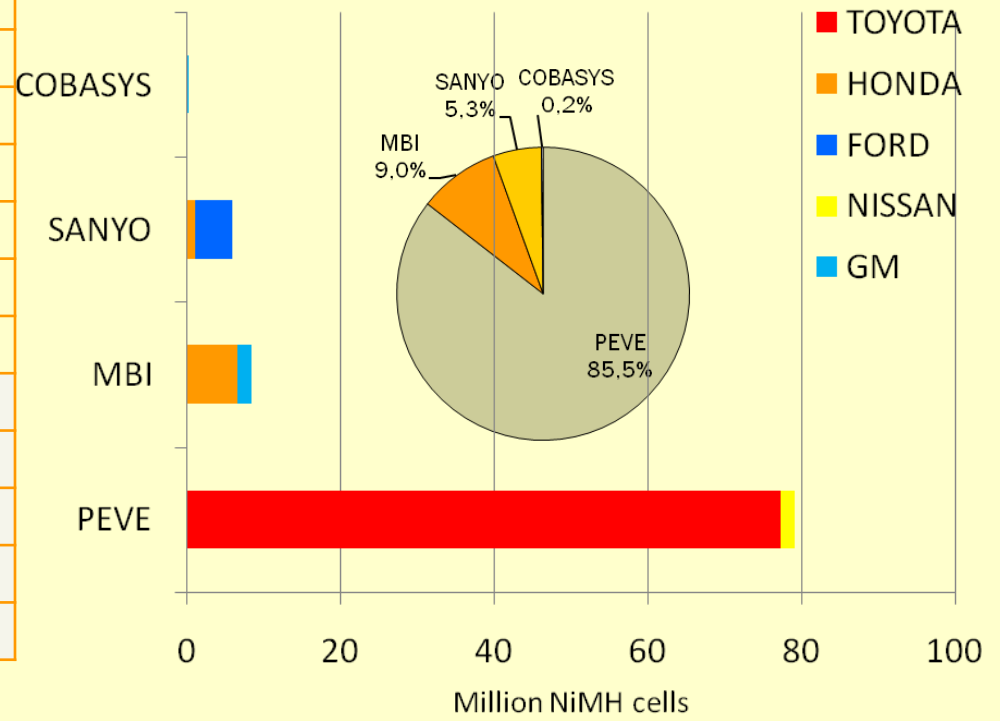
SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

NIMH BATTERIES FOR HEV IN 2008

Thanks to TOYOTA, Panasonic EV, got more than 85% of the HEV battery market and a large know-how

		PEVE	SANYO	MBI	COBASYS	JCS
PRODUCTION	TOYOTA	✓				
	LEXUS	✓				
	HONDA		✓	✓		
	FORD		✓			
	NISSAN	✓				
	GM			✓	✓	
	CHRYSLER	✓				
DEVELOPMENT	VW		◆			
	DAIMLER					◆
	BMW		◆			
	PSA	◆				
	CHERY					◆

NiMH battery & Car makers relationships in 2008



✓ Supply - ◆ Development

SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

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

Information for growth

- Li-ion is **THE** solution for the future
 - BUT, SAFETY & COST issues
 - Lot of technical solutions (NMC, NCA, LFP, LCO...)
 - Lot of EXPENSIVE Developments
 - 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	BYD AUTO	BOSCH	CONTINENTAL	JC
PANASONIC	PEVE								
NEC		AESC							
GSY			JV (HEV)		LEJ (EV)				
SDI							SB LiMotive		
SAFT									JV
BYD						HEV, EV			
ENAX								Partner	
MAGNA				Partner					

LI-ION BATTERIES DEVELOPMENTS

* Not confirmed

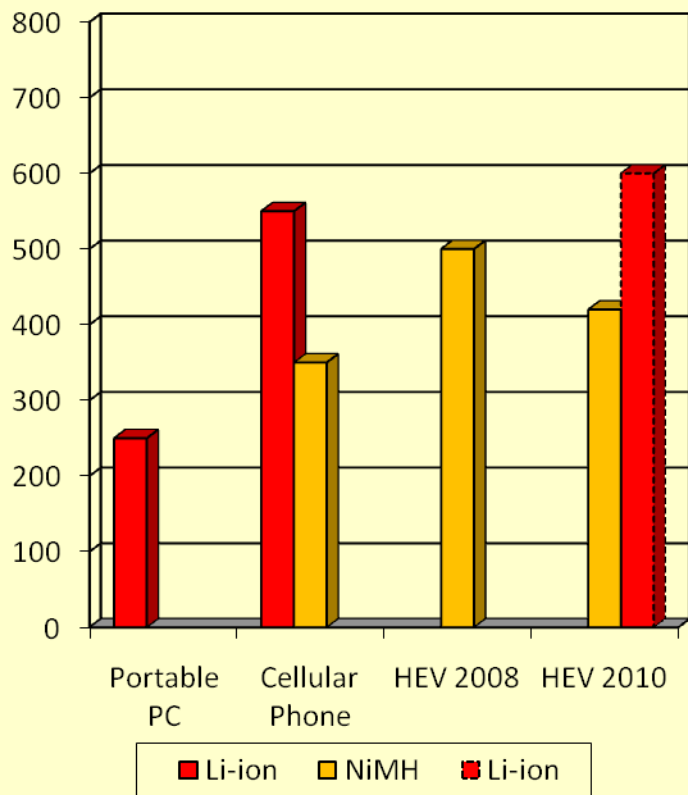
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Li-ion	TOYOTA	NISSAN	HONDA	GM	FORD	DAIMLER	CHRYSLER	VW	MITSUBISHI	HYUNDAI	BMW	BYD Auto	PSA	SUBARU	MAZDA	SUZUKI	THINK	TESLA	PININFARINA	SAIC	FISKER	
Sanyo	HEV*					Tesla		PHEV*														
PEVE																						
AESC (Nec-Nissan)																						
JC-SAFT				HEV*																		
JV GSY - HONDA																						
A123				PHEV*		HEV*					HEV*										HEV*	
MBI	EV*																					
LG					PHEV*			P-HEV*														
LEJ (GSY-Mitsubishi)																						
LiMotive (SDI-BOSCH)								HEV* PHEV*		PHEV*			HEV*						EV*			
ENAX - CONTINENTAL																						
MAGNA																						
GAIA								PHEV*														
TOSHIBA																						
BYD																						
SK										PHEV*												
BATSCAP (BOLLORE-EDF)																						
OTHERS						LiTec Enax					ACP/E -One							Enerdel				ACP/E- One

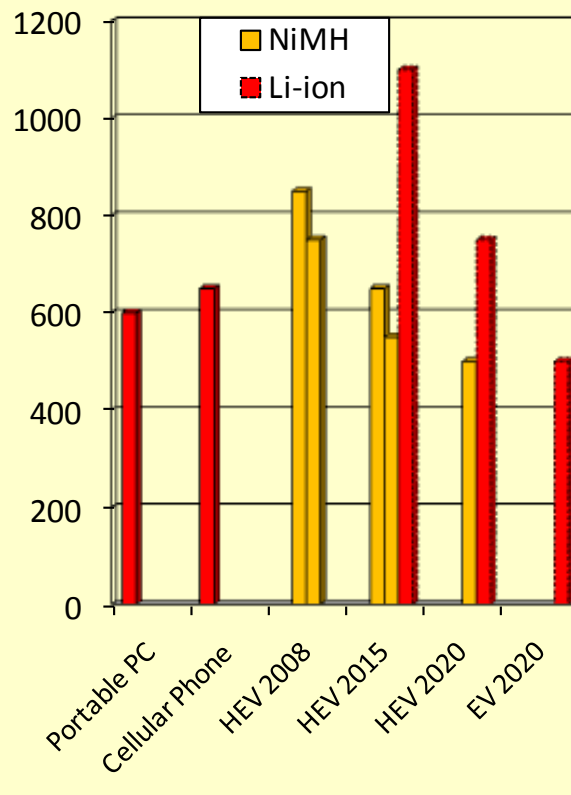
NIMH VS. LI-ION: ENERGY & POWER COST

CELL level Vs. Pack level – Energy Vs. Power cost - Industrial Vs. Target pricing

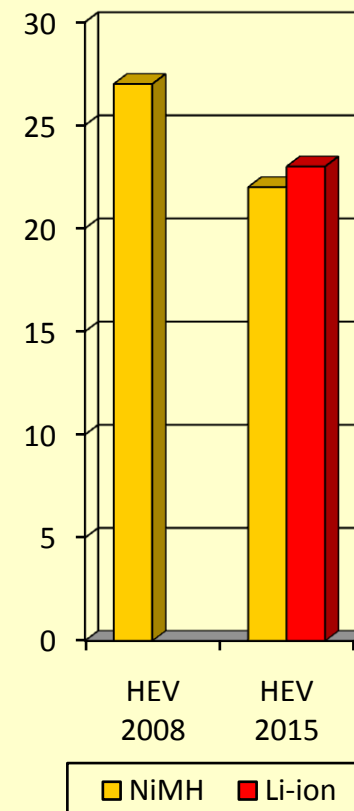
Battery Price in \$/kWh
CELL LEVEL



Battery Price in \$/kWh
PACK LEVEL



Battery Price in \$/kWh
PACK LEVEL

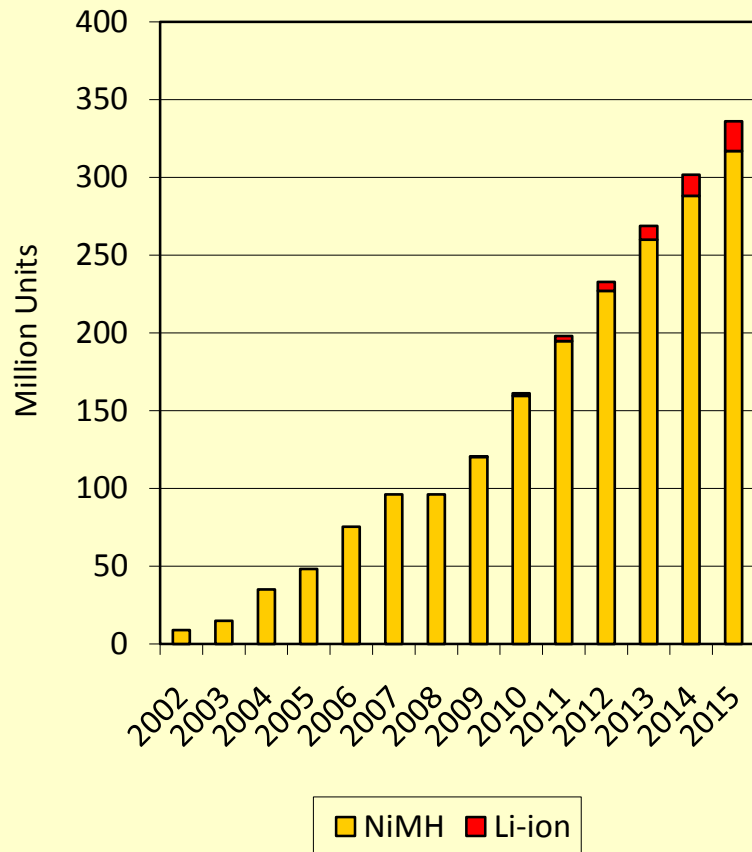


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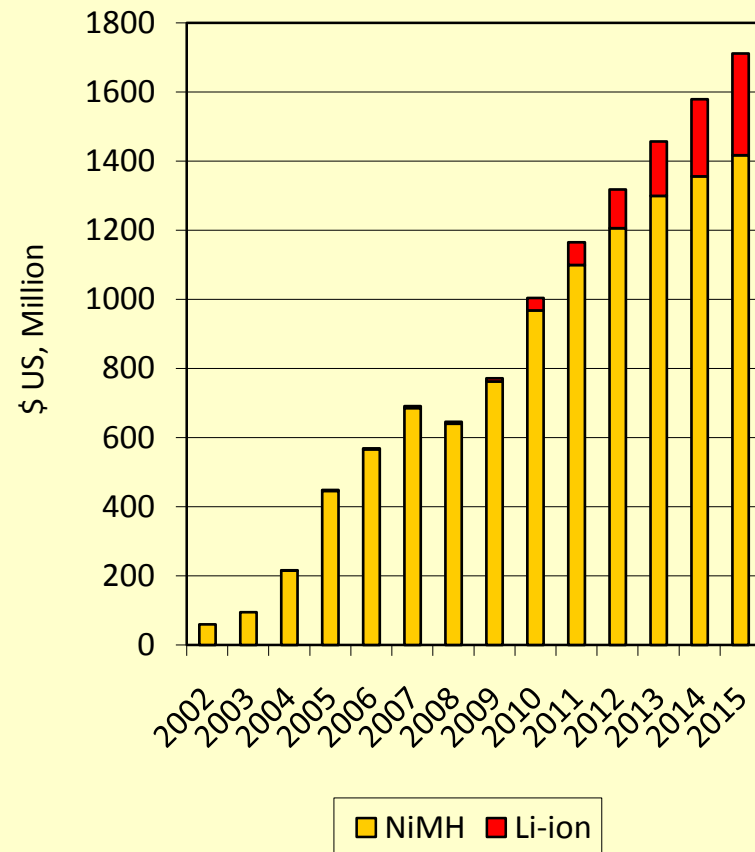
NIMH & LI-ION BATTERY FOR HEV MARKET FORECASTS (2002-2015)

Information for growth

NiMH & Li-ion cells sold per year, Million units, worldwide, 2002-2015



NiMH & Li-ion market for HEV, Million \$US, worldwide, 2002-2015

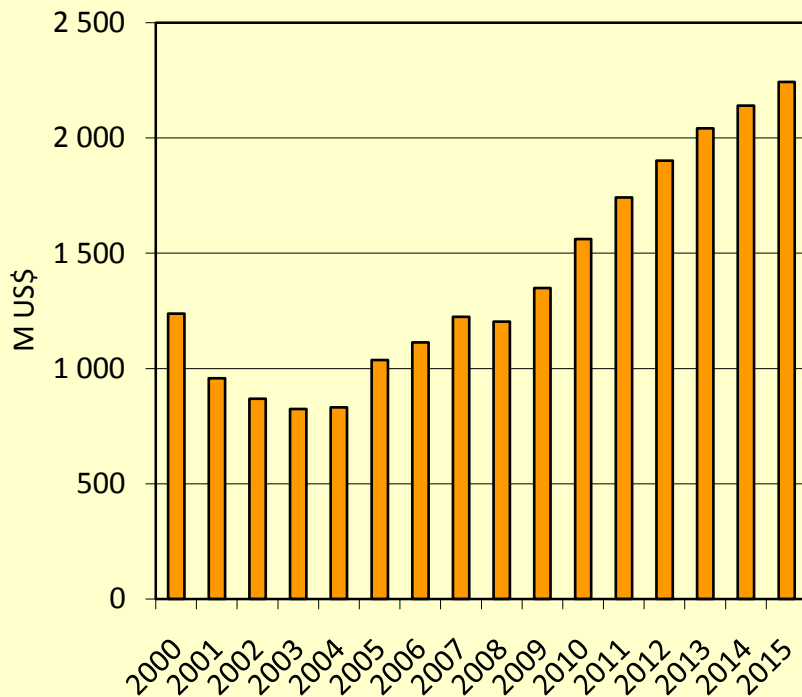


SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

SHORT TERM HEV IMPACT ON NIMH BATTERY MARKET

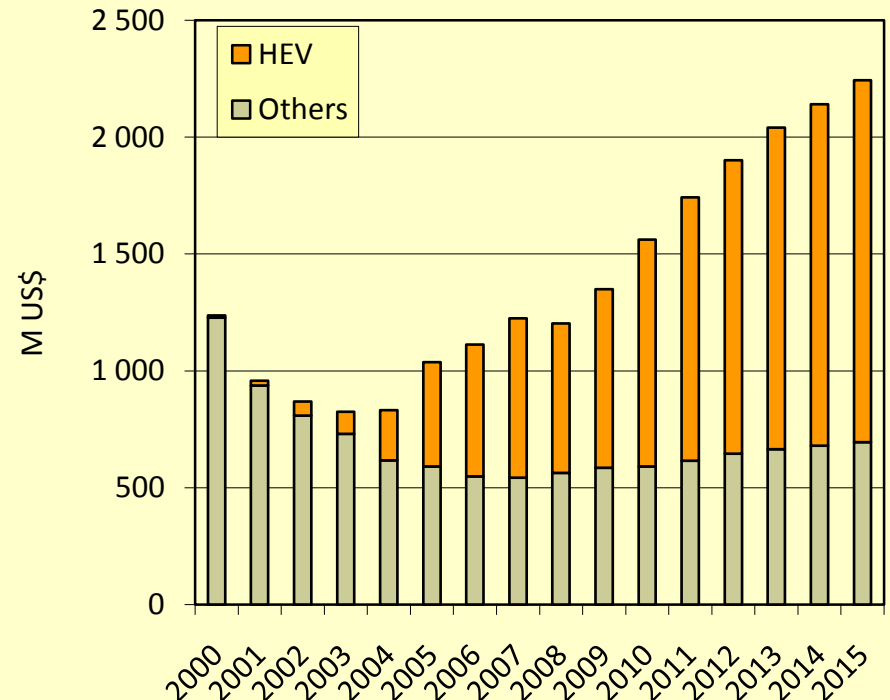
THE NIMH BATTERY MARKET IS INCREASING THANKS TO HEV

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



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

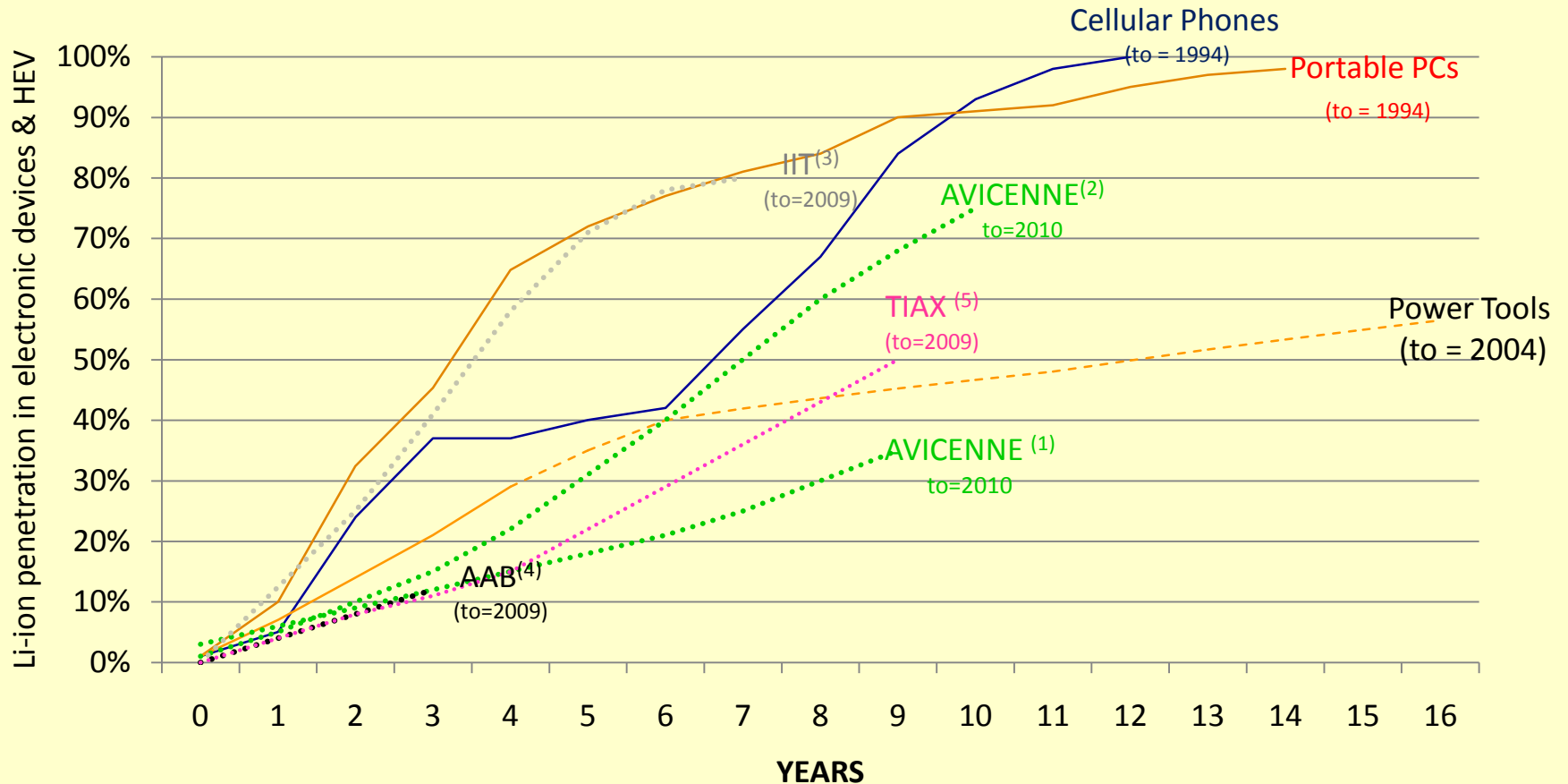
NiMH Battery sales, M US\$, Worldwide, 2000-2015



SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

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

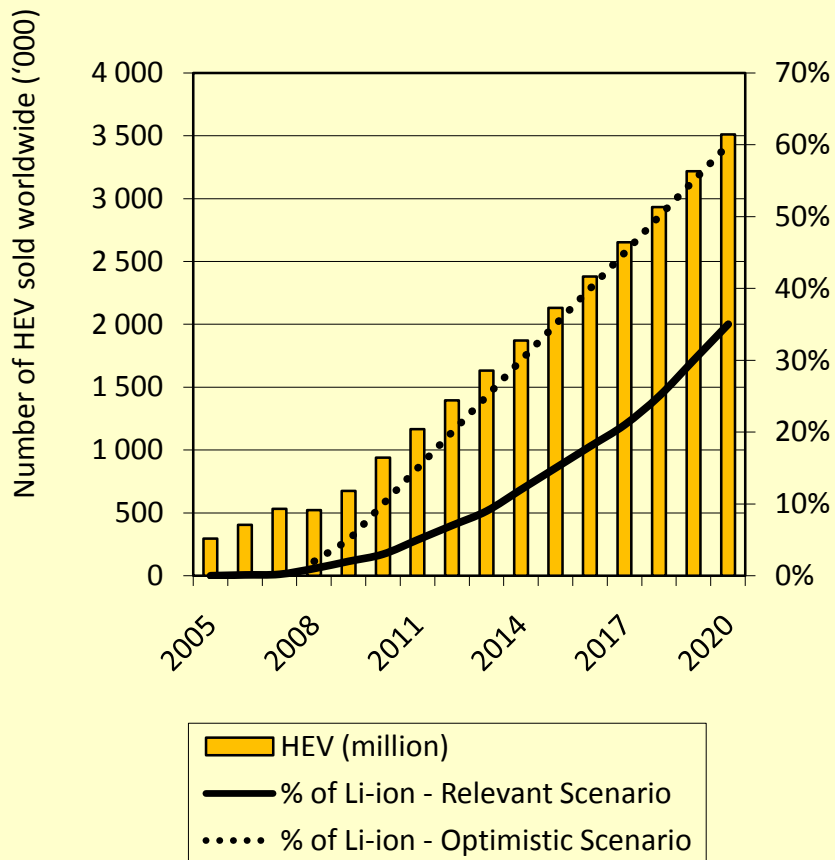
Information for growth



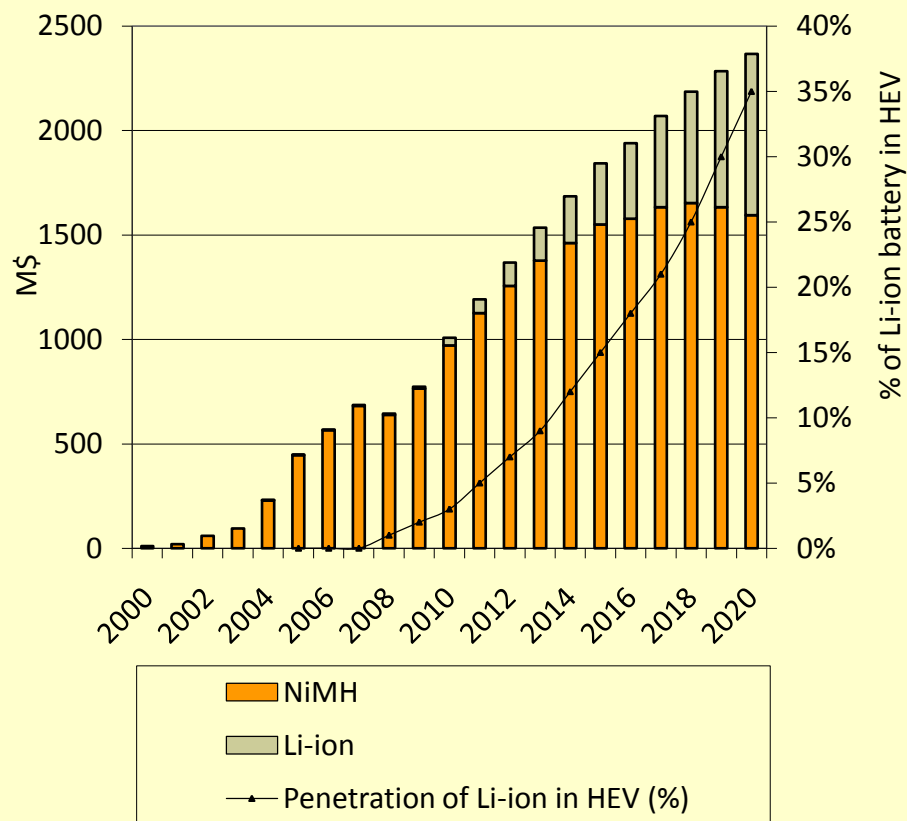
- (1) AVICENNE HEV Forecasts, march 09, Relevant scenario
- (2) AVICENNE HEV Forecasts, march 09, Li-ion Optimistic scenario
- (3) IIT, TAKESHITA, March 08, THE 25th INTERNATIONAL BATTERY SEMINAR & EXHIBIT, Slide 8 & March 2009, 26th Battery Seminar, Slide 5
- (4) AAB, Menahem ANDERMAN, Ph.D, Tampa, Florida, May 2008
- (5) TIAX, Brian BARNETT, Ph.D, Testifying Expert for University of Texas , March 2008

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 : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

EV, PHEV & HEV BATTERY FORECASTS

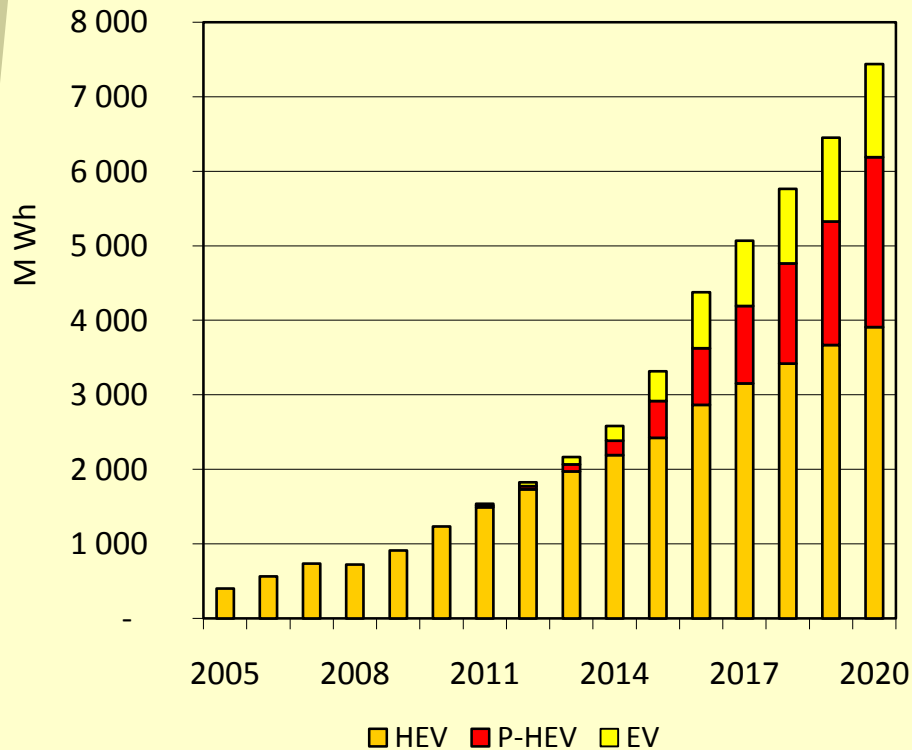
Assumptions

16 000 EV in 2015
50 000 in 2020
100% Li-ion

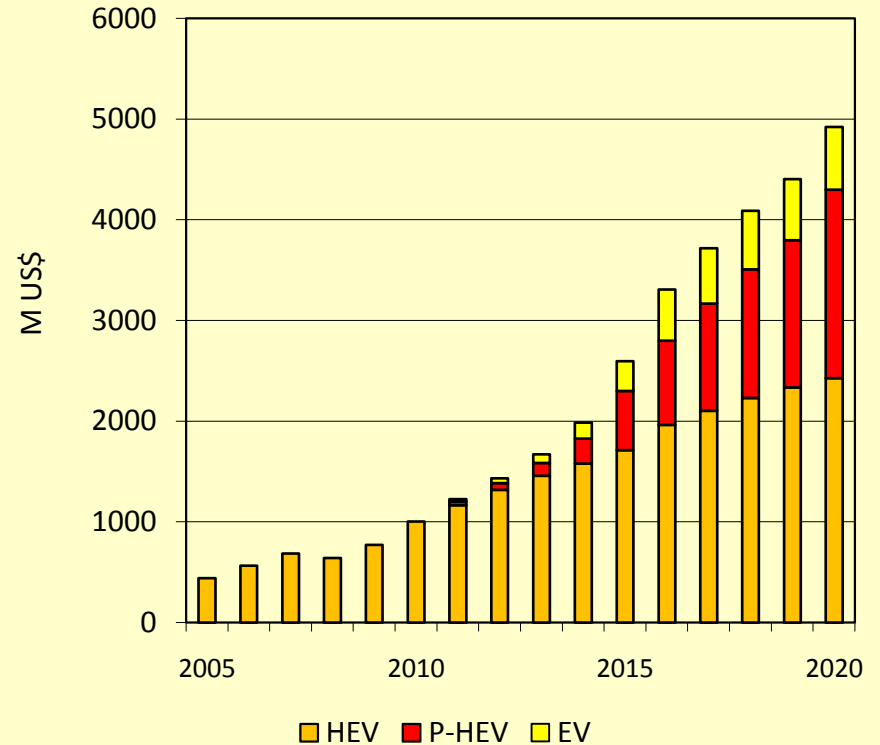
0.1 M P-HEV in 2015
0.4 M in 2020
100% Li-ion

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)



LONG TERM EV, PHEV & HEV BATTERY FORECASTS

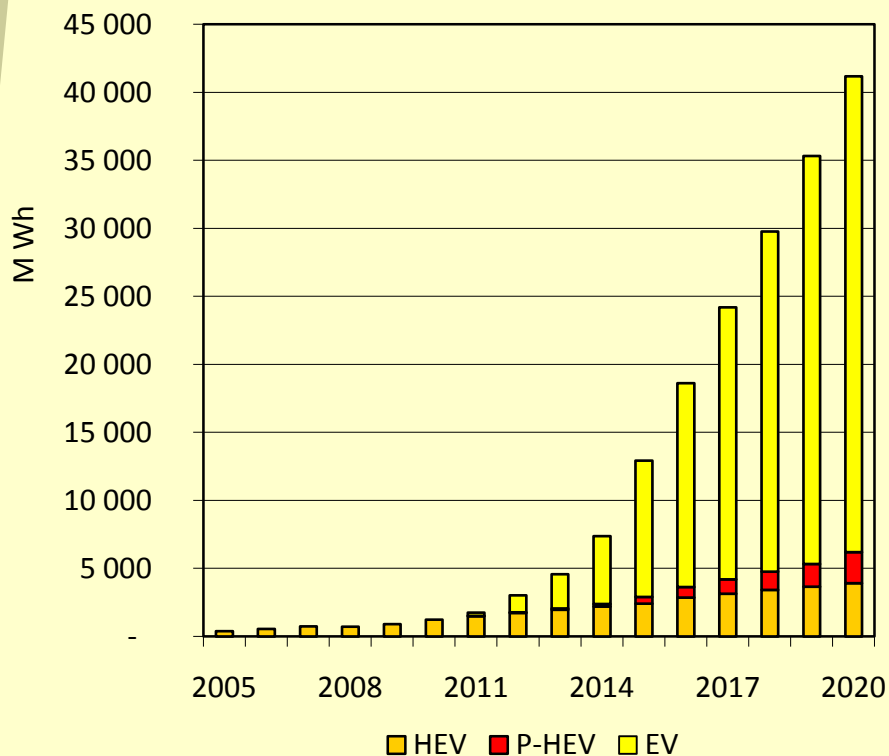
Assumptions

0,4 M EV in 2015
1,4 M in 2020
100% Li-ion

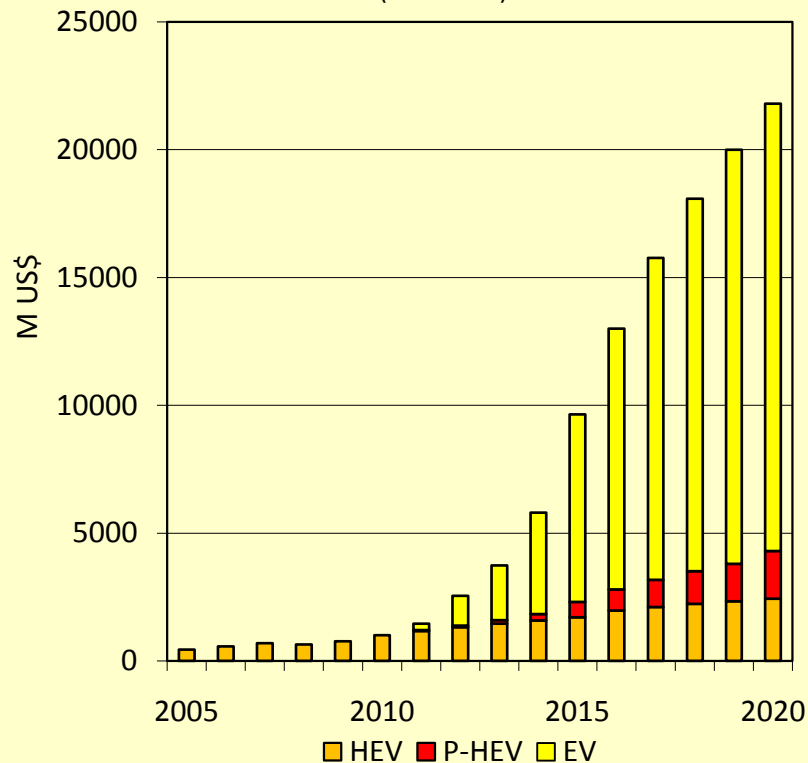
0.1 M P-HEV in 2015
0.4 M in 2020
100% Li-ion

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

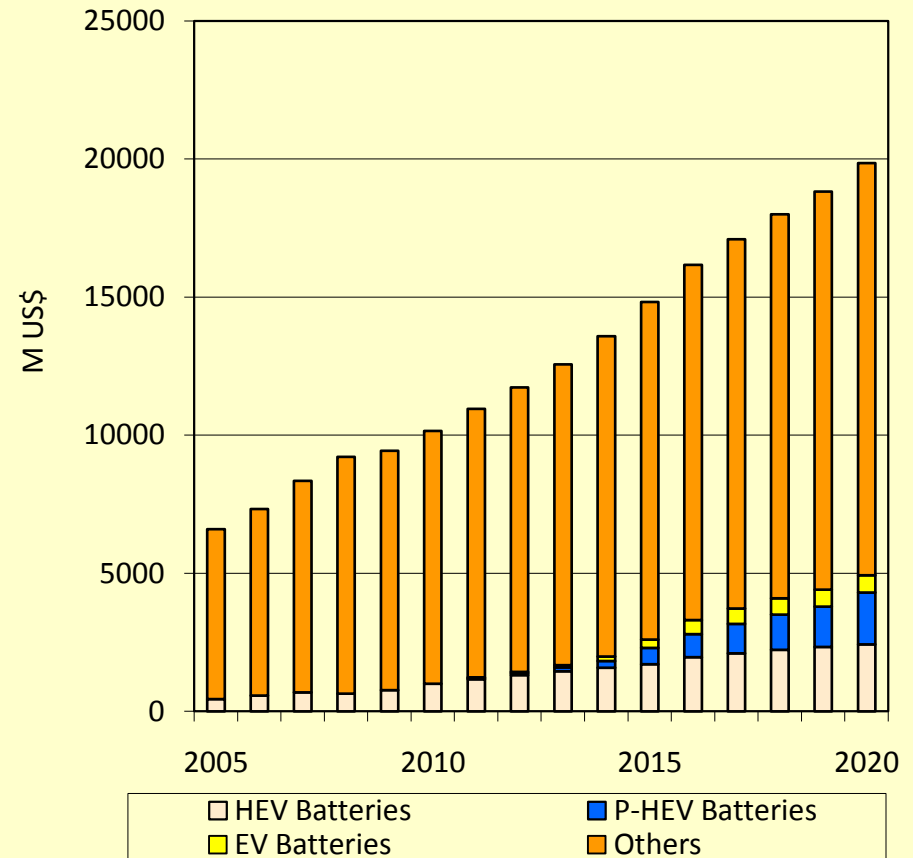


AUTOMOTIVE RECHARGEABLE BATTERY
MARKET M US\$, Worldwide, 2005-2020
(Pack level)



- 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 1.6 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 10 B US \$ for batteries or 20 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



SOURCE : EV, PHEV & HEV WORLDWIDE MARKET 2008-2020 - BATTERY IS THE KEY, AVICENNE, JUNE 2009

Thank you!

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