

# Milestones of a European Battery Roadmap

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# Battery Roadmaps

- **U.S. Department of Energy (2009)**

- 1 Mio. EV/PHEV on the U.S. roads by 2015

- Battery Packs:

2009 → 2014

Cost: 1000 \$/kWh → 300 \$/kWh

Energy Density: 3.4 kWh / 80kg → 11.6 kWh / 120kg

Lifetime: 3 yrs → 10 yrs

- **Japanese Ministry of Economy, Trade and Industry (METI) (2007)**

METI Battery R&D Targets					
	2007	2010	2015	2020	2030
Application	Small EV	Commuter EV High-performance HEV	Commuter EV FCV PHEV	Advanced PHEV	“Real” EV
Efficiency	1	1	1.5	3	7
Cost	¥200,000/kWh US\$1,644/kWh	¥100,000/kWh US\$822/kWh	¥30,000/kWh US\$247/kWh	¥20,000/kWh US\$164/kWh	¥5,000/kWh US\$41/kWh

# Battery Roadmap

-preliminary, based on survey-

Batteries for EVs	today	2012	2016	2020
Energy Density (cells)	140 Wh/kg (200 for laptop batteries)	220 Wh/kg (140-300)	300 Wh/kg (150-500)	450 Wh/kg (250-700) >1000 (LiO <sub>2</sub> )
Life time (calendar life)	7 yrs. (lack of reliable data for EV)	9 yrs (8-10)	11 yrs. (10-12)	17 yrs. (10-20 yrs)
Cost (cells)	700 Euro/kWh	500 Euro/kWh (350-600)	400 Euro/ kWh (250-500)	250 Euro /kWh (200-300) 100 (LiO <sub>2</sub> )

x 3

x 3

x 1/3

## Notes:

- Consider safety and power requirements
- Describe at both cell and pack levels
- Consider supercapacitors, too
- Pay attention to trade-off of energy density / lifetime / cost  
(less lifetime required for cheap batteries / more lifetime by thermal management = less energy)