



*Zebra (H)EV battery*



*Lithium HEV battery*



*NiMH HEV battery*

# Advanced Vehicle Batteries

## *Market & Basics*

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11 December 2007  
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## Goal of class: Basics of large automotive batteries, most important battery types, feeling for numbers

### (H)EV battery system

- Voltage / energy / power
- Prismatic/cylindrical/coffee bag cells  
*large/small*
- BMS / electronics
- Cooling (air!)
- Charger
- Cell/pack specifications  
*V/Ah, continuous- and pulse C-rate*

### Battery chemistries

- Lithium
  - *iron-phosphate*
  - *titanate*
  - *polymer?*
  - *cobalt → do not use!*
- Nickel-metal-hydride
- Zebra

### Feeling for numbers

- Wh/km
- Energy content (electric *and* electrolyte)
- Weights (kg/KWh *or* kg/km)
- Cycle life
- Price (\$/kWh)
- Battery efficiency
- Motor/inverter efficiencies

### Basic definitions

- BMS (Battery Management System)
- SOC (State of Charge) / SOH / SOF
- DOD (Depth of Discharge)
- Cut-off voltage
- CC-CV charge profile  
*80-90% fast, 10-20% slow*
- Peukert effect
- Weakest cell concept
- Cell-balancing
  
- C-rate
- Power cell / Energy cell
- Ragone plot
- Cycle window
- Battery life
  - *calendar life*
  - *cycle life (full cycle, micro cycle)*
- Cycle efficiency
  
- PHEV
  - *charge-depleting hybrid mode*
  - *charge-sustaining hybrid mode*
  
- Well-to-wheel efficiency
  - *tell-to-tank*
  - *tank-to-wheel*