Vehicle Technologies Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Annual Merit Review

Overview of the Batteries for Advanced Transportation Technologies (BATT) Program

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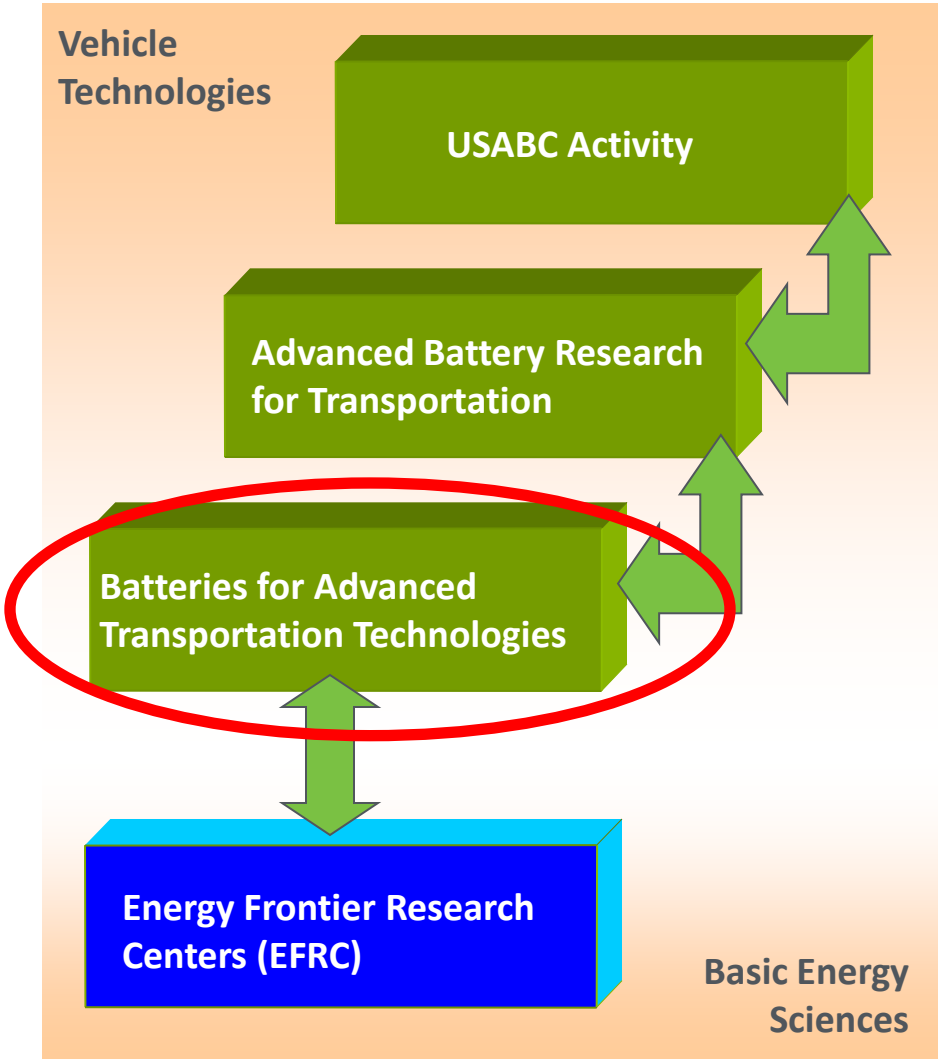
DOE Battery Research Portfolio



- ❑ Cost-shared development activity with industry leading to full battery systems
- ❑ Benchmark and assess existing and candidate battery technologies

- ❑ Assist battery developers to overcome barriers for high power Li-ion batteries

- ❑ Innovative, cutting-edge long-term research to understand and solve life and performance limitations of next-generation batteries

- ❑ High-risk, high-reward research to identify new battery chemistries

Batteries for Advanced Transportation Technologies Program

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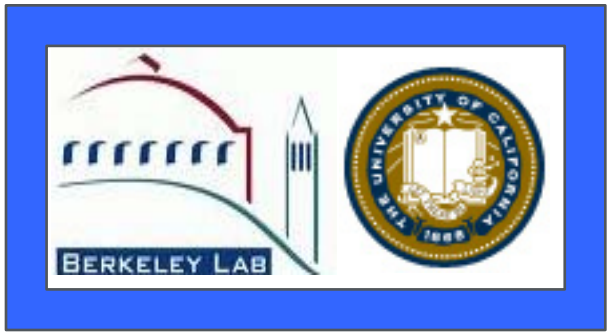
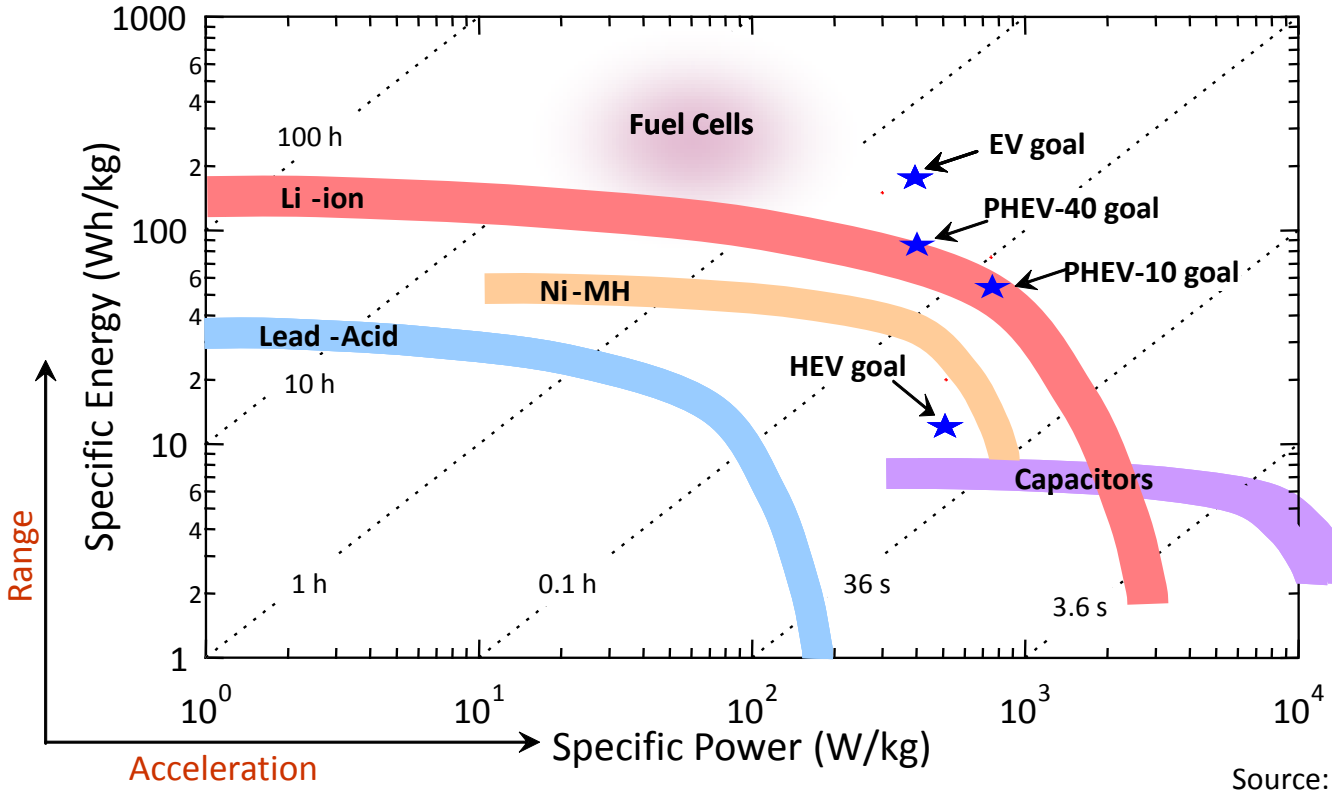


Relative Performance of Various Electrochemical Energy Storage Devices



IC Engine-2500 Wh/kg

EV – Electric Vehicle
HEV – Hybrid-Electric Vehicle
PHEV– Plug-in Hybrid-Electric Vehicle

Source: Product data sheets

- Goals developed in cooperation with DOE and United States Advanced Battery Consortium (USABC)
- Li-ion batteries have higher performance compared to Nickel-metal hydrides batteries
  - However, research is needed to simultaneously address **the life, cost, and abuse tolerance issues**

BATT Program Mission

- Presently, BATT focus is on lithium-based systems (Li-ion and Li-metal)
- Consists of 31 projects from various universities, national labs, and one company
- Program Director: Prof. John Newman, UC-Berkeley
- Program Manager: Venkat Srinivasan, LBNL

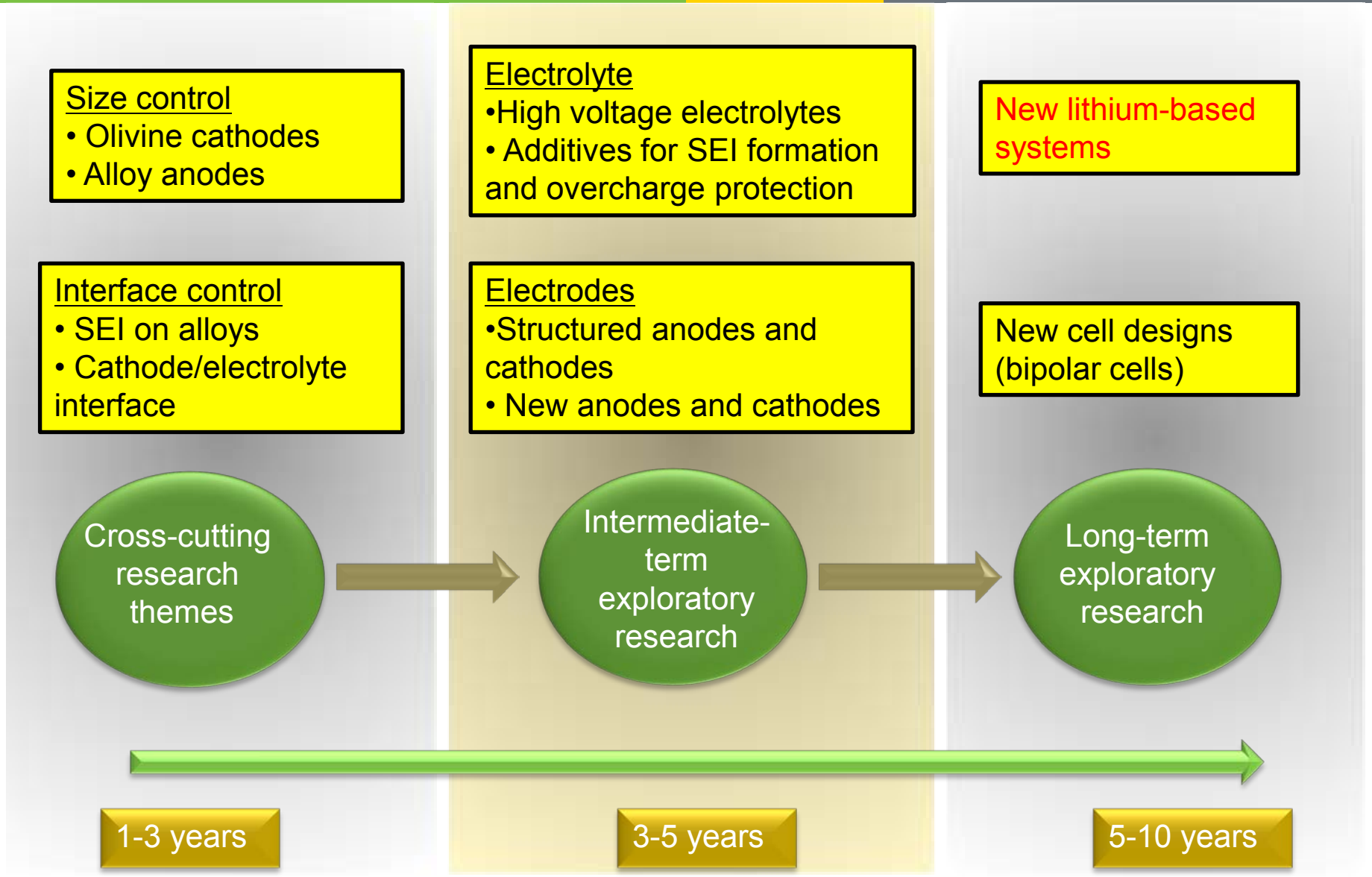
Critical Challenges

- Cost
- Life
- Abuse tolerance
- Performance (low-temperature operation, energy, and power)

Choice of application decides the critical problems to be solved:

- EV: Need double the energy density of presently available Li batteries
- HEV: low-T operation, cost, and abuse tolerance
- Plug-in hybrid: life (especially calendar life), cost (related to energy)

Structure of BATT in 2010-11



BATT and the Battery Industry

- Block copolymer electrolytes for Li-metal batteries (Balsara) being commercialized by Seeo, Inc.

- Advanced cathode materials (Manthiram) being commercialized by ActaCell

- Simulation method for materials design (Ceder), partly funded by BATT, used by CMC, Inc.

- Novel manufacturing technologies and computational simulations (Sastry), being used by Sakti3.

- Molecular dynamics code (Smith), developed with BATT funding, basis of company to simulate electrolyte properties.

- Numerous patents have resulted over the year, with some licensed to companies for commercialization.
  - High-rate $LiFePO_4$ material (MIT) licensed to two companies.
  - Tin-based anode materials (ANL) licensed to one company
  - Composite cathode materials (ANL) licensed to one materials company and one battery company