Predictive Battery Management System for Commercial HEVs

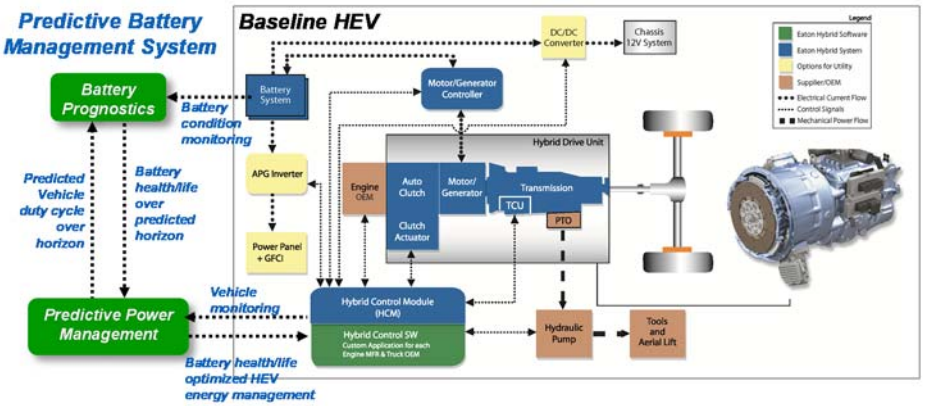
❖ Proposed Technology

1.Electrochemical model-based battery prognostics

- Combined empirical and first-principles models captures salient battery electrochemical dynamics
- Reduced order modeling for fast real-time implementation

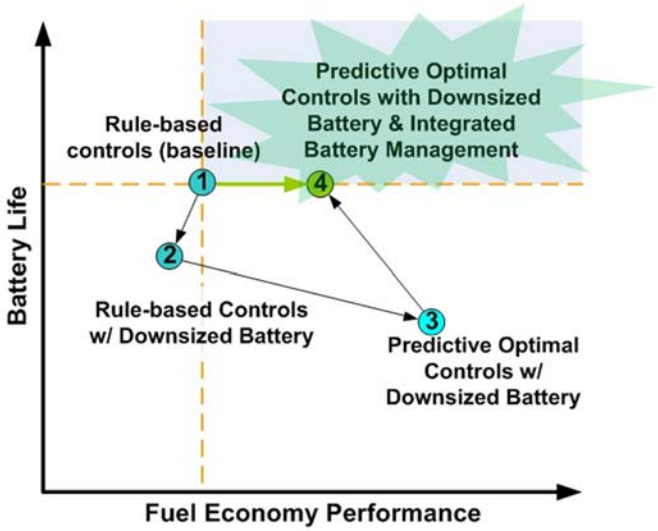
2.Duty cycle predictive energy management

- Integrated with battery model
- Dynamic battery utilization



❖ Challenges & Opportunities

1. Current HEVs design and control.
2. Simply downsizing battery only will result in drop in FE performance & battery life.
3. Aggressive duty-cycle predictive controls provide fuel economy improvement at the expense of battery life
4. **Proposed solution maintains baseline battery life while maintaining or improving FE performance with downsized battery.**



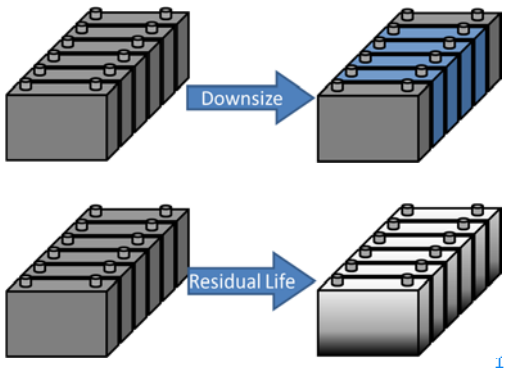
❖ Value Proposition

1.Reduced battery pack size → Lower up-front HEV cost → Better ROI

- **Target: >25% reduction over current design**

2.Accurate residual life estimation → Secondary market value

- **Target: <10% error in useful capacity/power**

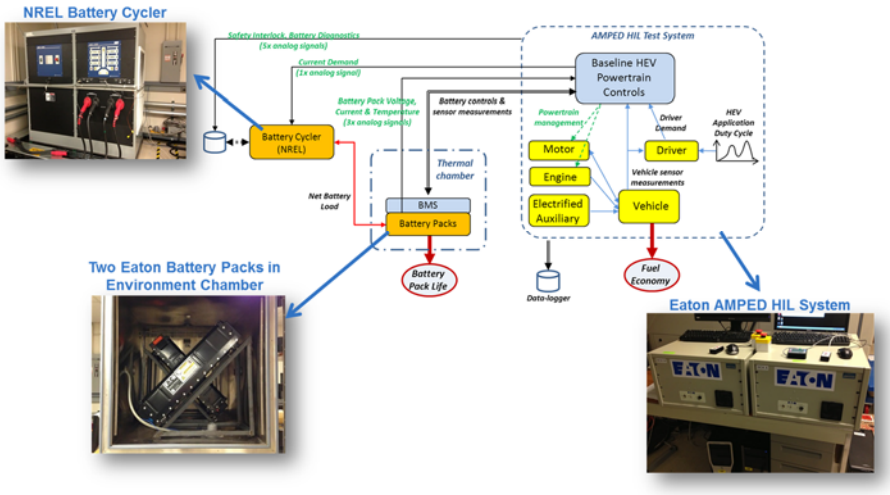


Powering Business Worldwide

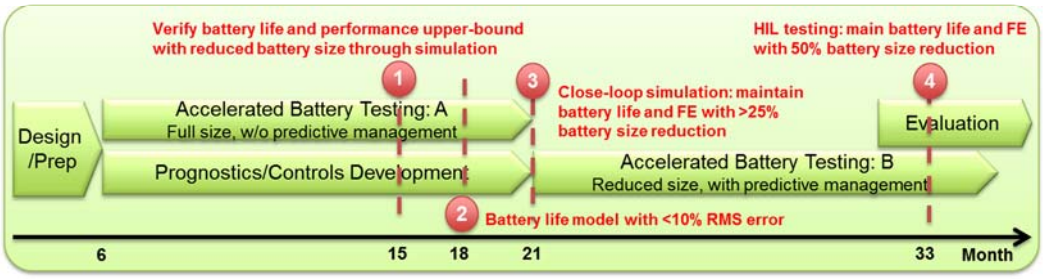
PROGRAM:	AMPED
TECH TOPIC:	Modeling & Controls
AWARD:	$2,000,000
DURATION	1/1/13 – 12/31/15

❖ Development & Validation

Battery-in-loop Testing & Validation

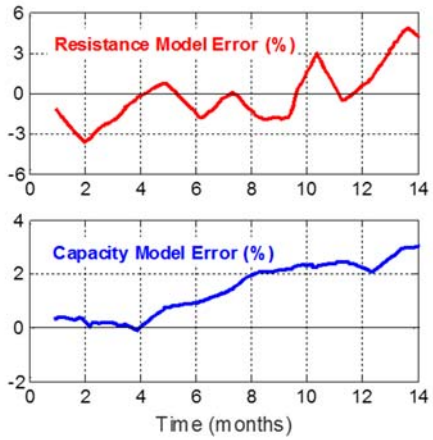


Project Timeline



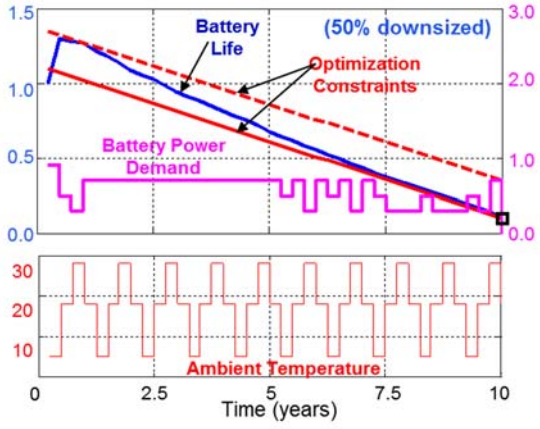
❖ Progress Update

Battery Aging Model Estimation Error



- Battery aging model with low estimation error
- Fast computing for online implementation

Optimal Battery Utilization Simulation



- Model-based controls determines optimal battery utilization
- Maximize fuel economy while satisfying application requirements