NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Three Angles on PEV Battery Second Use

The Battery Show

October 2011

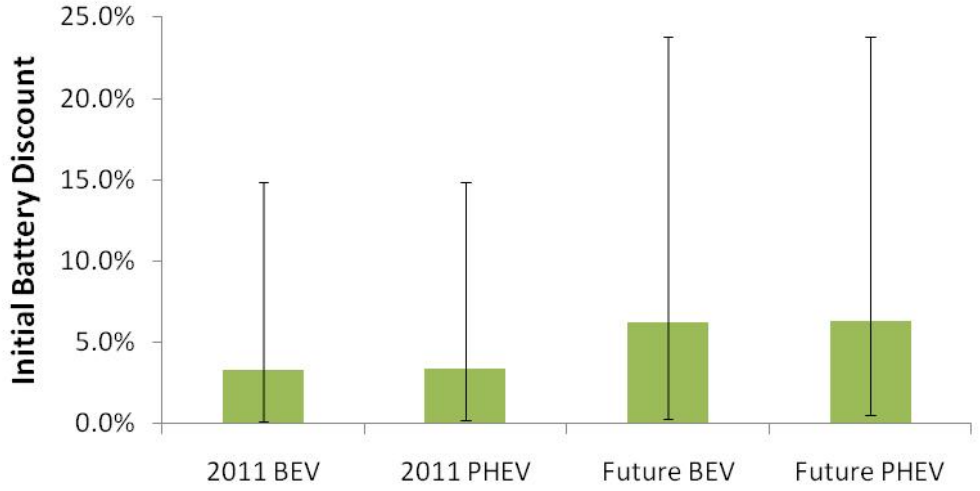
Jeremy Neubauer
Ahmad Pesaran

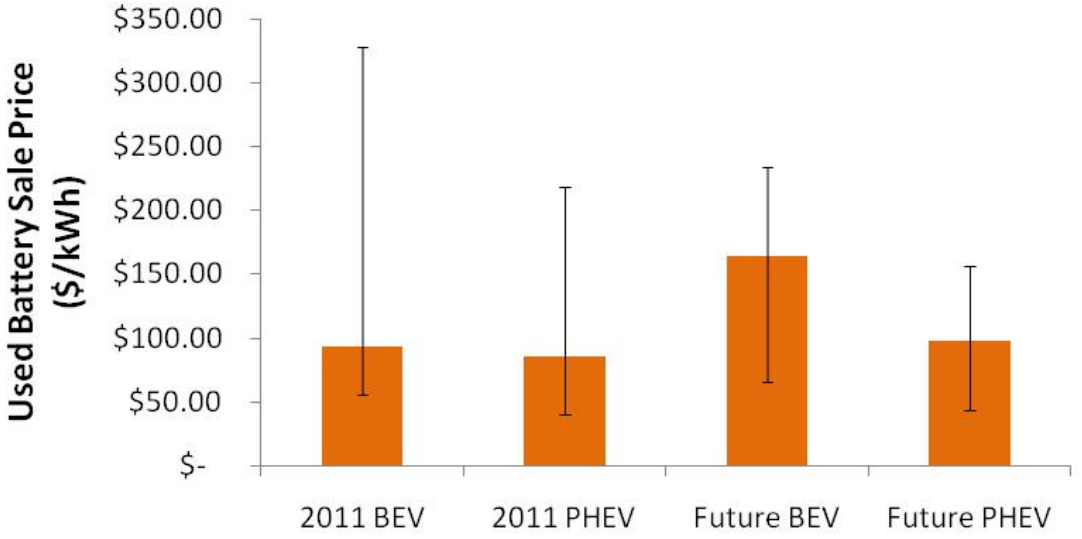
NREL/PR-5400-52632

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

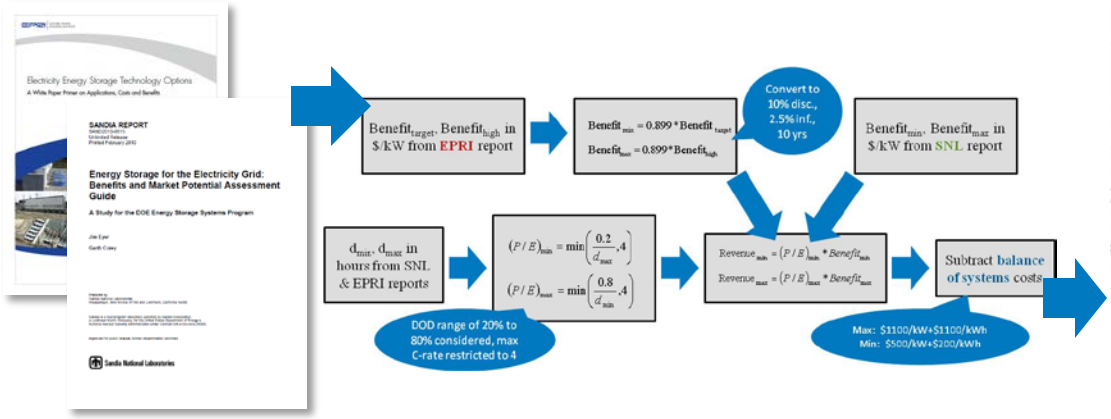
Competitive Technology

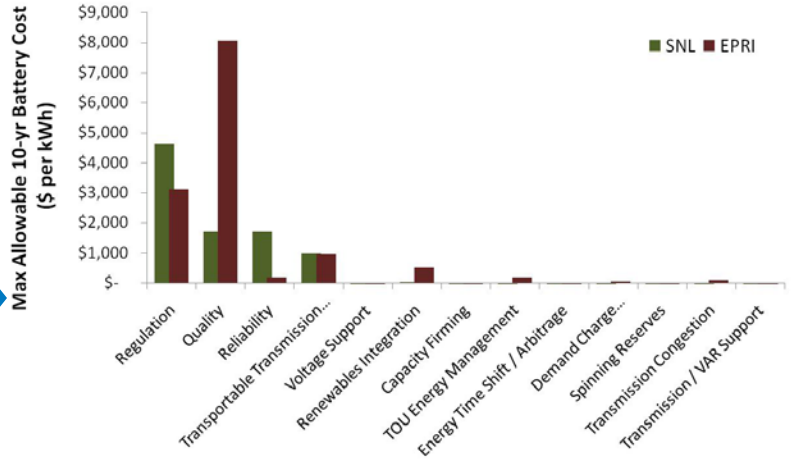
- Maximum salvage value of a used battery will be limited by future battery prices
- Under favorable conditions, second use can only discount today's battery prices by **12%** or less
- However, second use will offer batteries to secondary applications at reduced cost (typically **<$170/kWh**)





Revenue Streams



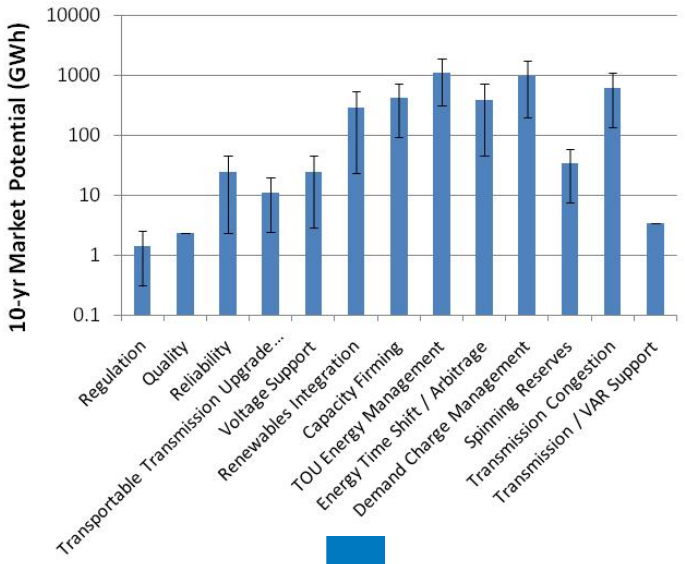


- Revenue is highly variable
- Allowable battery costs are highly sensitive to balance-of-system (BOS) costs
- Batteries need to be very cheap for these applications to be viable

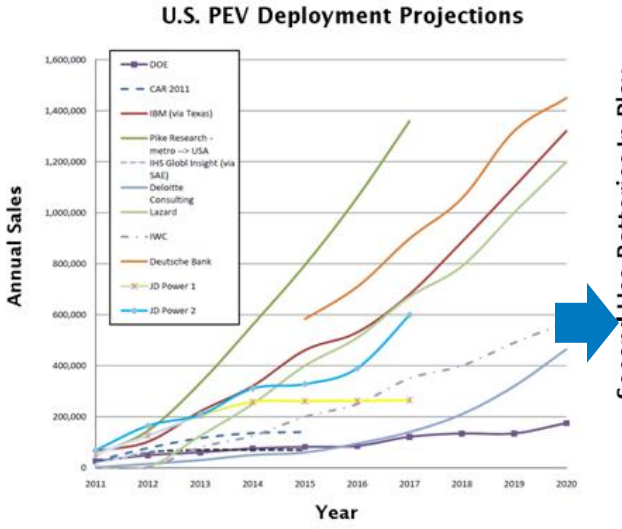
Refined duration, depth of discharge (DOD), rate, and BOS cost for top applications; aggregated quality & reliability

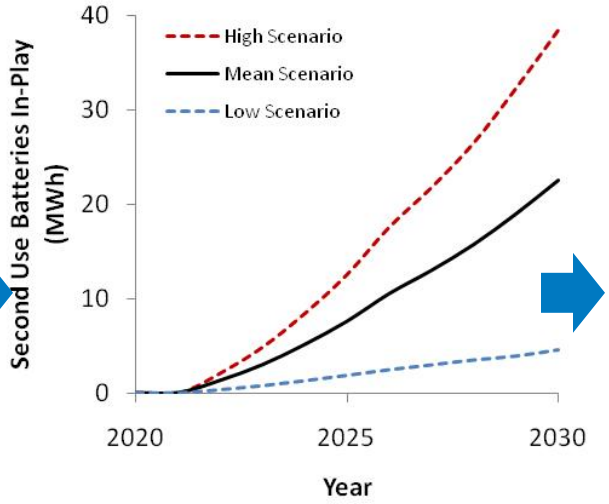
Supply and Demand

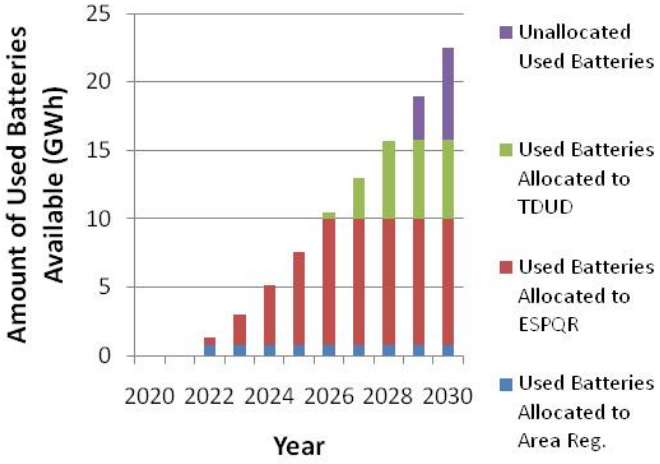
- High-value applications have both competition and small markets
- Supply from PEVs has the potential to overwhelm many second-use markets



Refined duration, DOD, and rate; aggregated quality & reliability







Acknowledgments

- This activity is funded by the DOE Vehicle Technologies Program, Energy Storage Technology

- We appreciate the support provided by DOE program managers
  - David Howell
  - Brian Cunningham
  - Steve Goguen

- Thanks to Mike Ferry and the entire CCSE second use team

- Technical questions regarding battery second use should be directed to Jeremy Neubauer at 303-275-3084 or jeremy.neubauer@nrel.gov