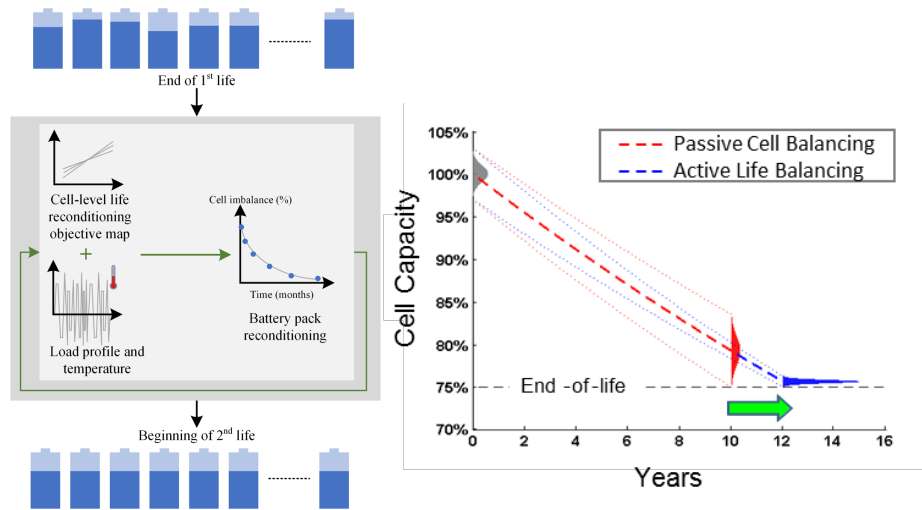


## Saving Solar Power | Energy For All

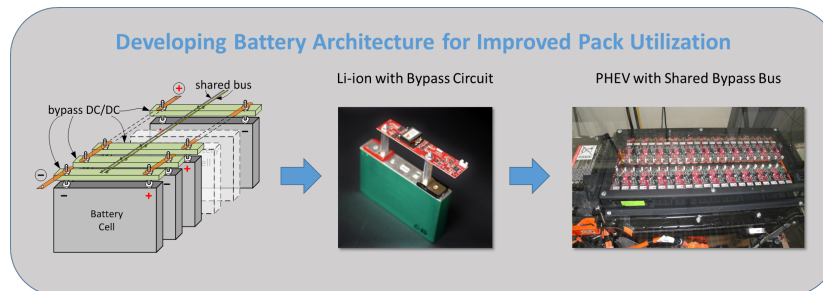
### DOE American-Made Solar Prize Round 4 · Technical Assistance Request

Team Energy For All (E4A) has developed an Active Battery Management and Reconditioning System (ABMRS) that actively manages and balances cell capacity in a series-connected battery. Our technology has been proven through DoE, ARPA-E, and ONR programs to extend the useful life of both new and reconditioned PV and EV battery packs by up to 30%. Figure 1 shows the conceptual model and results from our teammate's previous ARPA-E program (AMPED).



**Figure 1:** Left: Battery pack reconditioning concept; Right: initial results of ARPA-E program showing extension of battery life by target 20% goal

ABMRS consists of both a set of proprietary software control algorithms for active balancing, and a hardware module that enables bypassing and precise loading of individual cells using a small DC-DC converter to enable efficient active balancing in a series-connected battery pack. This is shown below in Figure 1.



**Figure 2:** E4A Battery Management System architecture using bypass DC-DC converter

Using our ABMRS technology, spent PV and EV battery packs can be reconditioned and repurposed as solar energy storage at 10-20% of the cost of a comparable retail system. Additionally, ABMRS can extend the lifetime of new solar energy storage, actively eliminating

battery degradation from uneven capacity fade of individual battery cells, thereby conserving and preserving the value and performance capacity of new and legacy PV batteries.

As ABMRS becomes more streamlined and affordable, it will reduce the cost of recycling and reconditioning spent PV and EV batteries below the cost of decommissioning, and will drive down the cost of solar energy storage using reconditioned PV and EV batteries as an alternative to cost-prohibitive comparable retail systems. ABMRS is currently a TRL-6 solution, and through the Ready!, Set!, and Go! Challenges, we intend to advance ABMRS to a TRL-9 solution.

To reach our goals, Team E4A is seeking technical assistance in the following key areas:

### **Large-scale Hardware Production & Manufacturing**

To drive down the cost of our hardware modules, improve their design and economic viability, we are seeking partners with experience manufacturing high-volume power electronics hardware that can potentially mass-produce our DC-DC conversion modules for active battery management. In the later stages of the contest (Set! and Go!), we will be seeking a partner that can also manufacture certified hardware for use in PV and EV power electronics. If you are a high-volume manufacturer of small power electronics hardware, and are passionate about revolutionizing the solar energy storage industry – or know someone who is – please reach out.

### **Industry Pilots with Industrial/Commercial PV Operators and Utilities**

To demonstrate the efficacy of our technology in the solar industry, Team E4A is seeking industry partners to conduct pilot projects and proof-of-concept studies wherein we integrate a set of reconditioned batteries with commercial, industrial, and residential PV generation systems. In these projects, we will demonstrate that batteries reconditioned using ABMRS can perform as efficiently and reliably as retail solar energy storage systems, providing capabilities for flexible PV energy dispatch and showing financial benefits to PV owners.

### **Access to High-Volume Affordable Spent PV/EV Battery Packs**

To enable commercialization of ABMRS and the outcomes of this challenge, Team E4A requires reliable access to high volumes of spent and recycled battery packs from PV storage, Electric Vehicles (EVs), and other sources. If you have access to an abundance or reliable source of spent and/or recycled PV, EV, and other high-capacity lithium-ion battery packs, we would love to work together to find an economical way to acquire battery packs from you that meet the requirements for reconditioning.