

Technical Assistance Request

Presented by HE3DA USA, as part of the Solar Prize Round 3 Competition

for the project entitled:

Renewable Energy Storage Reimagined: Safe, Recyclable and Cost-effective.

Abstract

HE3DA USA presents a nanotechnology-based new approach to develop robust, safe, fully recyclable, scalable Li-ion batteries that store solar and wind energy efficiently and affordably, while also providing battery end of life solutions to reuse battery active material components. We implement a new approach to lithium-ion battery design by using three dimensional (3D) electrodes made of lithium-nickel-manganese-cobalt (NMC) active materials. Traditional Li-ion batteries have what is referred to as two-dimensional (2D) electrodes. 2D, in this case, indicates that the electrode thickness is typically tens of microns. 3D electrodes, which are several millimeters thick, provide high capacity cells, establish a much higher level of safety, and allow a cheaper manufacturing process. Due to efficient thermal management, this type of battery has a potential unlimited cell size. Our batteries also work with existing battery management systems. Meaning, they can replace current energy storage solutions without the additional cost of replacing the system supporting it.

At this point, we have a working prototype for an NMC Li-ion battery and modules, and we are looking for the following technical assistance from connectors at the American-made network:

1. **Recyclability Profile Testing:** We developed a unique recycling plan for our batteries that allows for recycling of 99% of the battery's materials. As far as we know, there is no standard recyclability test offered by the industry. We kindly ask to work with a national lab or a similar institution to validate our recycling plan.

HE3DA USA's Recycling Plan:

The standard recycling process of conventional li-ion batteries consists of shredding and processing via evaporation, leaching, smelting, and so on. Due to contamination of active materials from metals in the current collectors, and other processes' limitations, the typical recycling process of li-ion accumulators recovers 30% of the original metals and the majority of the processes need to be subsidized to be economically viable.

HE3DA USA's recycling model does not require any subvention to be financially viable. It guarantees the retention of all metals in their pristine purity, active materials with the required properties, and rapid return of these recycled materials into production. The 3D battery is a stack of macroscopic sized electrodes. These compact and stiff electrodes can be several millimeters thick, allowing easy disassembly of the electrode stack. One after one, the electrodes can be removed from the stack and sorted. The absence of binding agents makes it what makes the separation of the active materials via a mechanical process possible. After the disassembled stack is sorted, individual copper and aluminum metal electrode frames elements are received and may be refurbished and reused into production. Initially, solvents evaporate, and the cathode's active materials are dissolved, precipitated, washed, dried, and calcined. In roughly one week, the active materials may be used in a new battery. The anode with graphite is washed in water, and the carbon/graphite is sold as a black pigment or an additive to plastics, concrete, etc. Achieving the 99% recyclability status of HE3DA USA's battery cells not only supports green initiatives but also provides an economical source of components and active materials, some of which are projected to become scarce in the near future.

2. **Safety Testing:** We have performed numerous internal safety tests for our NMC Li-ion battery and concluded them to be comprehensively safe under abuse conditions. We kindly ask for external testings to be done by an American-made connector. This will go a long way to help us validate our product, or find any hidden problem we did not come across.
3. **Partnering with Solar Panel Companies:** We are looking to partner with a solar company to explore offering a combined product of solar panels and energy storage. For example, we are in negotiations with the [Puerto Rico Science, Technology and Research Trust](#) to provide renewable power solutions to areas in Puerto Rico, affected by Hurricane Maria or in danger of future power-loss.
4. **Policy and Regulations:** our product is specifically tailored towards large-utility scale renewable energy solutions. We are looking for partnership and assistance in assessing the regulations and policies we would need to accommodate in order to provide a compatible and competitive product.
5. **Lunar Rover Challenge:** We have started a conversation with NASA, following our participation in the NASA iTech Conference, to develop a battery for the lunar rover. We would like to collaborate with an American-made Network member to develop a battery management system that can overflow energy between cells, keeping them operational even under the extreme cold temperatures on the Moon. The module will have to supply energy for 14 days with no exposure to sunlight.
6. **Investor pitch and pitching mentoring** - We are excited about the wonderful professional among the connectors and the power connectors that might be able to help us to improve our investor pitch and pitching techniques. We would be honored to work with one of these connectors to increase our market, customer, and investor readiness.