

Technical Assistance Request - Zitara Technologies

We're writing to request engineering feedback on our predictive models for lithium battery aging, and access to battery X-ray tomography imaging and other testing and analysis support. We'd also like help simulating and evaluating the monetary value of our product proposition to energy grids.

Zitara is particularly excited about the Solar Prize for its connection to national laboratories that are leading the way in energy storage and battery research. We are thrilled to have support from such an incredible resource for innovation in the battery space.

Our project relates to battery aging, modeling, and failure mode analysis, and NREL-driven work in the space has been of particular interest to us. We've referred to:

- NREL's Battery Lifetime Analysis and Simulation Tool¹, which incorporates electrical and thermal models and charge/discharge use case history to provide predictions of battery aging in stationary storage applications.
- Recent NREL-led work in the use of X-ray tomography and diffraction to study modes of cell degradation and thermal runaway.^{2,3}
- Various public resources available from NREL on the aging of cells, thermal modeling of battery systems, and analyses of the solar + energy storage markets.^{4,5}

Our scientific advisors have also directed us to relevant work and equipment at the Lawrence Berkeley Lab, only 20 minutes drive from Zitara's Oakland headquarters - in particular for their use of high resolution X-ray tomography, which is mentioned significantly in our proposal.

We'd be eager to take advantage of testing support and engineering feedback from battery researchers - particularly for use of X-ray tomography, other incredibly valuable equipment resources on site, and expertise on interpreting and applying results.

Thanks,
The Zitara Team

1. "BLAST: Battery Lifetime Analysis and Simulation Tool Suite." NREL.gov, www.nrel.gov/transportation/blast.html.

2. Finegan, Donal P., et al. "Thermal Runaway: Identifying the Cause of Rupture of Li-Ion Batteries during Thermal Runaway (Adv. Sci. 1/2018)." *Advanced Science*, vol. 5, no. 1, 2018, p. 1870003., doi:10.1002/adv.201870003.

3. Finegan, Donal P., Antonis Vamvakeros, Lei Cao, Chun Tan, Thomas M. M. Heenan, Sohrab R. Daemi, Simon D. M. Jacques, Andrew M. Beale, Marco Di Michiel, Kandler Smith, Dan J. L. Brett, Paul R. Shearing, and Chunmei Ban. "Spatially Resolving Lithiation in Silicon-Graphite Composite Electrodes via in Situ High-Energy X-ray Diffraction Computed Tomography." *Nano Letters* 19.6 (2019): 3811-820. Print.

4. Denholm, Paul, et al. *The Value of Energy Storage for Grid Applications*. NREL, www.nrel.gov/docs/fy13osti/58465.pdf.

5. Fu, Ran, et al. *2018 U.S. Utility-Scale Photovoltaics Plus-Energy Storage System Costs Benchmark*. NREL, <https://www.nrel.gov/docs/fy19osti/71714.pdf>