Energy &
Homeland Security
energy.sandia.gov

GRID ENERGY STORAGE AT SANDIA: LICENSING AND TECHNOLOGY TRANSFER OPPORTUNITIES

Sandia brings innovative battery technologies to the marketplace for commercialization, test and evaluation, or government use to benefit the U.S. economy and increase energy storage on the grid.

OVERVIEW OF SANDIA'S ENERGY STORAGE PROGRAM

Modernization of the electricity infrastructure is critical for the economic vitality and the future of the country. Sandia's support for this modernization includes a broad research program in energy storage. The laboratories' work is focused on making energy storage cost effective through research and development (R&D) in new battery technology development, advancements in power electronics and power conversion systems, improvements in the safety and reliability of energy storage systems, and the deployment of new energy storage technologies onto the electric grid. Sandia's grid energy storage research is primarily supported by the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability – Energy Storage Program.

LICENSING AND TECHNOLOGY TRANSFER

The main challenge facing emerging energy storage technologies is transferring the research and technologies developed in the lab to commercially available products. In order to make extraordinary energy storage ordinary, Sandia partners with companies who share the vision of lowering the cost of energy storage while also improving the safety parameters of the technology.

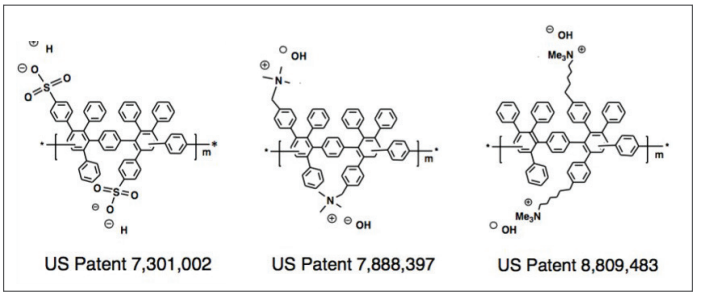
As an engineering lab, Sandia can help companies commercialize the technologies developed in the lab through a variety of methods including:

- Cooperative Research and Development Agreements (CRADA): An agreement between Sandia and the private company to provide technology, personnel, and facilities to commercialize a technology.
- Small Business Innovation Research (SBIRs): A federal based awards program to encourage small businesses to commercialize federal R&D.
- DOE Tech-to-Market (T2M) Programs: A DOE program designed to lower the barriers that usually prevent market adoption of new energy products from companies.

Sandia is currently seeking commercial partners for the following fields of products: membrane technology, flow battery materials, sodium batteries, soft magnetics, high voltage capacitors, power and revenue management, and power conversion.

AVAILABLE TECHNOLOGIES

Membranes: To compete with Perflourosulfonic Acid (PFSA) membranes, Sandia currently holds 3 composition-of-matter patents with 4-5 more pending for poly (phenylene) membranes. This technology can potentially make the cost of the membrane 10x cheaper and improve the cycle life of the battery. It has been tested at PNNL, ORNL, and WattJoule for its flow battery applications along with a Fortune 100 Global chemical company for potential other applications. Next Step: Sandia is looking to license these patents to an existing company or a spinoff company.



Flow Batteries: Sandia holds materials patents for coupled Earth-abundant electrolytes with commercial and custom membranes. These patents have been rapidly tested and tuned by using lab-scale cell designs. Improving the flow battery with these patented electrolytes has the potential to increase the energy density by 4x. Next Step: Sandia is looking for a commercial partner to incorporate these materials into potential products.

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

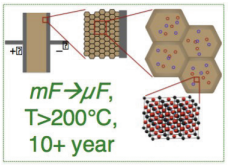
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2010-6954P

Sandia National Laboratories

Sodium Batteries: Sandia has developed component chemistries for materials that enable low-to-intermediate temperature sodium metal halide batteries. Sandia has partnered with Field Upgrading, USA (formerly Ceramatec, Inc.) to develop advanced, large-scale ceramic separator processing for these materials. These materials provide a long cycle life, low cost, low temperature, safe, and nonflammable alternative to Na-S and Li-ion batteries. Prototypes have been demonstrated for large format cells at 100 Wh and 250 Wh. Next Step: Sandia is looking for a commercial partner to build these new Na batteries.

Soft Magnetics: As the first to produce transformer cores using nanocrystalline iron nitrides, Sandia currently holds two patents for the technology. This technology can reduce the size of transformer magnetic cores by 10x and integrate the output transformer within power conversion electronics. It also can leverage higher switching speeds, voltages, and operating temperatures of wide bandgap power electronics. Next Step: This technology is still in early stage production with a low TRL. Sandia is looking for a company with a long–term vision to develop this material for potential applications.

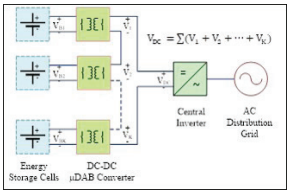
High Voltage Capacitors: Sandia has developed and demonstrated ceramic materials for high voltage capacitors that perform at high temperatures. These capacitors are highly needed to enable the adoption of wide bandgap (SiC, GaN) power modules. Next Step: Sandia is actively looking for a company to implement and commercially develop these capacitors for wide bandgap power modules.



Power and Revenue Management: Sandia has created software tools for the optimization and valuation of electrical energy storage. An article about this software was presented at the IEEE Power and Energy Society General Meeting in July 2016 where it won the Prize Paper award. Money is what keeps the lights on, and these tools can help us better understand the valuation of electrical energy storage. Next Step: Sandia is seeking a company to improve on these tools to make them more robust and user friendly along with maintaining and updating them so industry users can utilize them routinely.

Month	RMCCP Credit	RMPCP Credit	Arbitrage Credit	Total Revenue
06/14	$356,412.73	$130,206.06	$487.16	$487,185.94
07/14	$351,131.53	$135,123.18	-$1,759.82	$484,494.90
08/14	$231,708.06	$124,760.87	-$2,057.32	$354,411.61
09/14	$280,496.49	$121,979.31	-$1,398.84	$401,076.97
10/14	$389,520.38	$148,445.40	-$2,671.94	$535,293.84
11/14	$315,773.83	$117,698.79	-$2,366.21	$431,106.41
12/14	$250,525.71	$92,077.48	-$1,321.73	$341,281.46
01/15	$335,093.93	$102,707.75	$5,634.43	$443,436.10
02/15	$837,537.28	$141,229.67	$19,625.70	$998,392.65
03/15	$561,451.79	$160,354.43	$1,886.07	$723,692.29
04/15	$373,388.33	$155,942.07	-$1,894.29	$527,436.11
05/15	$537,115.47	$129,786.70	-$611.47	$666,290.70
Total	$4,820,155.53 75.38%	$1,560,391.71 24.40%	$13,551.74 0.21%	$6,394,098.97 100%

Power Conversion: Sandia is developing a power electronics device that precisely and optimally controls energy storage systems through cell-level battery management. This device is inherently safer, more reliable, and longer lasting than conventional battery management systems. It provides early detection of performance loss or safety concerns at the cell level and efficient, fault tolerant utilization of cell capacity. Next Step: Sandia is seeking a company to turn these developing prototypes into products that can be integrated into battery systems.



PARTNERING WITH SANDIA

Sandia's energy storage research program relies on collaboration and partnerships with a range of stakeholders, including other national laboratories, universities, electric utilities, industry, federal and state agencies, and international consortia. These partnerships help enable the rapid adoption of new design and simulation capabilities, software tools, and updates to the policy and regulatory framework.

CONTACT:

Bob Westervelt
rtweste@sandia.gov
Phone: (505) 284-6752

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2018-2726 M.

Sandia National Laboratories