NEW

Justin Briggs
Co-founder & Chief Technology Officer
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Solid State Thermal Battery
Antora Energy

The Antora Energy team will develop a thermal energy storage system that contains thermal energy in inexpensive carbon blocks. To charge the battery, power from the grid will heat the blocks to temperatures exceeding 2000 °C. To discharge, the hot blocks are exposed to thermophotovoltaic panels that are similar to traditional solar panels but specifically designed to efficiently use the heat radiated by the blocks. The team will seek to double panel efficiency through new materials and smart system design, allowing such a concept to be used cost effectively as a grid storage solution.

NEW

Asegun Henry
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Thermal Energy Grid Storage Using Multi-Junction Photovoltaics
Massachusetts Institute of Technology

This project involves the development of key components for a new, cost-effective system to store electricity as heat at the grid level and discharge it on demand, using multi-junction photovoltaics. The system combines a low-cost sensible heat storage liquid at an extremely high-temperature and uses innovative multi-junction photovoltaic cells to convert the light emitted/heat back into electricity. The tasks are focused on demonstrating the high efficiency cells, their reliable operation, and critical components of the thermal infrastructure.

NEW

Howard K. Schmidt
Chief Technology Officer
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Geomechanical Pumped Storage
Quidnet Energy Inc.

The Quidnet Energy team will develop a modified pumped hydro energy storage system using rocks beneath the Earth's surface. The team will pump pressurized water into gaps in underground rocks. When energy is needed later, the induced strain in the surrounding rock will force water back through a generator to produce electricity.

NEW

Reversible Turbomachine to Enable Laughlin-Brayton Cycle

Brayton Energy

James Kesseli
President
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This grid-scale energy storage system combines thermal storage and a gas turbine in generation mode with an electric motor-driven Brayton cycle heat pump to recharge the thermal storage. The simplicity of an all gas system enables long life and high efficiency. As formally studied, two separate turbomachines were required; one for generation mode, and one for charge mode. Integrating the two turbomachines with recuperator, source and sink heat exchangers creates significant pressure losses and requires high temperature valves. The overall cost, efficiency, and viability of the system would be improved if a reversible turbomachine were used, as originally envisioned by the inventor Professor Laughlin.

NEW

Grid-Scale Electricity Storage at Lowest Possible Cost: Enabled by Pumped Heat Electricity Storage

Southwest Research Institute

Brittany Tom
Research Engineer
Power Cycle Machinery
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Southwest Research Institute (SwRI) is developing an advanced pumped heat electricity storage system based on a novel thermodynamic cycle to store energy in hot and cold fluids. This large energy storage system will help integrate renewables with the electric grid. This technology relies on system simplification, high round-trip conversion efficiencies, and low plant costs to surpass existing state-of-the-art energy storage technologies. At full scale the technology would provide more than 10 hours of electricity at rated power. SwRI will build a small kW-scale electric demonstrator to validate this novel technology.

NEW

Low-cost, Long-duration Electrical Energy Storage Using a CO_2-based Pumped Thermal Energy Storage System

Echogen Power Systems

Timothy J. Held
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The Echogen Power Systems team will develop an energy storage system that uses a carbon dioxide (CO_2) heat pump cycle to convert electrical energy to thermal energy by heating a "reservoir" of low-cost materials such as sand or concrete. The reservoir will retain heat that will be converted back into electricity on demand. To generate power, liquid CO_2 will be pumped through the high-temperature reservoir to a supercritical state, after which it will expand through a turbine to generate electricity from the stored heat.

NEW

Joerg Petrasch
Associate Professor
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Scalable Thermochemical Option for Renewable Energy Storage (STORES)
Michigan State University

STORES is a revolutionary technology for cheap and ubiquitous grid-level electricity storage. Shipping container sized storage modules are integrated into gas-fired power plants. When electricity demand is low, the modules are electrically heated up to 1500 °C (2730 °F). At these temperatures a chemical reaction that stores large amounts of energy takes place. When electricity demand is high, the stored energy is released heating compressed air that drives a gas turbine. STORES is cost effective and environmentally friendly because it solely relies on cheap and abundant materials such as steel, Magnesium and Manganese.

NEW

Zhiwen Ma
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Buildings and Thermal Sciences Center
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Economic Long-duration Electricity Storage by Using Low-cost Thermal Energy Storage and High-efficiency Power Cycle
National Renewable Energy Laboratory

The National Renewable Energy Laboratory team will develop a high temperature, low-cost thermal energy storage system using a high-performance heat exchanger and closed-loop Brayton cycle turbine to generate power. When electric power is cheapest, heaters will warm stable, inexpensive solid particles to temperatures greater than 1100°C, effectively "charging" the system. Once it is time to discharge this energy, the particles will be fed through the heat exchanger, heating a working fluid to drive the gas turbine attached to a generator. The electric-storage system is designed to be deployed economically anywhere in the United States.

William Woodford
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NEW

Aqueous Sulfur Systems for Long-duration Grid Storage
***Form Energy, Inc*.**

Form Energy will develop a long-duration energy storage system that takes advantage of the low cost and high abundance of sulfur in a water-based solution. The team will pursue several competing approaches and ultimately select a single candidate to deliver as a prototype system.

NEW

Gerardo Jose (GJ) la O'
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Minimal Overhead Storage Technology (MOST) for Duration Addition to Electricity Storage

Primus Power

MOST DAYS rethinks the structure of a zinc bromine battery to realize a low-cost, long-duration and long calendar life energy storage platform for grid-scale energy storage. Our concept is based on a single chamber zinc-bromine (Zn/Br) battery that achieves similar performance to a tradition Zn/Br cell with a substantially reduced balance of plant (BOP) for grid scale applications. The combined team has demonstrated scientific development and product commercialization of minimal BOP energy storage systems using the abundant, energy dense yet non-flammable Zn/Br chemistry.

NEW

Tom Zawodzinski
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Reversible Fuel Cells for Long-duration Storage

University of Tennessee – Knoxville

The University of Tennessee, Knoxville team will develop an energy storage system based on an innovative electrolyzer/fuel cell combination. Typically, fuel cells make water from hydrogen and oxygen, which can be stored in tanks. The Tennessee team will instead use the fuel cell to produce hydrogen peroxide, a liquid that can be easily stored and converted to oxygen. When extra power is needed on the grid, the fuel cell will produce peroxide and electricity. Available electricity then can be used to efficiently convert the peroxide back to hydrogen and oxygen during the charging cycle.

NEW

Mike L. Perry
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High-performance Flow Battery with Inexpensive Inorganic Reactants

United Technologies Research Center (UTRC)

UTRC's DAYS project team shall develop a new redox-flow-battery (RFB) system using two inexpensive and earth-abundant active materials, sulfur and manganese. This unique chemistry presents both challenges and opportunities. Innovative strategies shall be developed to overcome these key challenges by a diverse team of researchers who are at the forefront of RFB technology. The net result shall be an energy-storage system that is credibly projected to meet ARPA-E's aggressive LCOS target and can be readily sited wherever it is needed. This should enhance resiliency of the future grid, support transmission and distribution infrastructure, and enable greater diversity of electricity-generation resources.

ONGOING

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Synergistic Membranes and Reactants for a Transformative Flow-Battery System

United Technologies Research Center (UTRC)

UTRC's IONICS team is developing redox flow batteries (RFBs) that combine new reactants with inexpensive membranes. The polymer membranes being developed include benzimidazole or pyridine structures, and the ionic conductivity is derived from the structure that enables electrolyte-imbibed membranes (EIMs). These polymers are inherently less expensive than perfluorosulfonic acids, and these EIMs are also durable, selective, and highly conductive. High performance EIMs have successfully been developed for all-V RFB (VRFB) cells. The team is now developing EIMs for the new RFB reactants, which are large organic and organometallic molecules, which enable significantly higher selectivity than VRFB cells.

ONGOING

Vijay K. Ramani
Roma B. & Raymond H. Wittcoff
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Reinforced AEM Separators Based on Triblock Copolymers for Electrode-Decoupled RFBs

Washington University - St. Louis

We have developed proprietary inexpensive, highly selective, durable, highly conductive and scalable reinforced membrane separators for electrode-decoupled redox flow batteries (Fe-Cr, V-Ce and other proprietary chemistries). This disruptive technology has permitted the use of different redox chemistries at each electrode of the flow battery, dramatically enhancing versatility and providing a pathway to lowering costs. Our approach has used polymers manufactured at industrial scales and functionalized with positively charged cationic groups. We have enhanced the positive charge density within the separator by using reinforced membranes, and organic-inorganic composite membranes, to enhance selectivity and have demonstrated membranes with exceptionally low area-specific resistance (ASR).