

# Isothermal Compressed Air Energy Storage

Demonstrating a modular, market-ready energy storage system that uses compressed air as a storage medium

SustainX will demonstrate an isothermal compressed air energy storage (ICAES) system.

Energy can be stored in compressed air, with minimal energy losses, and released when the air is later allowed to expand. Many traditional compressed air energy storage (CAES) projects store energy in underground geological formations such as salt caverns. However, in these systems, the air warms when it is compressed and cools when it is expanded. CAES systems generally use gas combustion turbines to reheat the cooled air before expansion. This process creates inefficiencies and emissions.

SustainX's ICAES system captures the heat from compression in water and stores the captured heat until it is needed again for expansion. Storing the captured heat eliminates the need for a gas combustion turbine and improves efficiency. SustainX achieves isothermal cycling by combining patented innovations with a design control on mature industrial components and principles.

The system is designed for a 20-year lifetime. It achieves full power output from start-up in less than one minute, and it does not use toxic chemicals.

## SustainX's ICAES System



**The ICAES Pilot is a 1.5 MW, multi-hour storage system.**

**SustainX's technology can be sited anywhere, and the power and energy requirements can be scaled independently.**



## Project Benefits

- Substitutes for transmission and distribution upgrades
- Supports the delivery of variable renewables
- Maintains the stability of the grid, when connected to the grid
- Reduces the need for gas-fired peaker units
- Increases grid efficiency through new grid management strategies
- Reduces greenhouse gas emissions
- Reduces electricity costs
- Uses no toxic chemicals

## More About the Technology

SustainX's ICAES technology offers several advantages:

- It can be sited anywhere, and it is not dependent on advantageous geological formations.
- It allows power and energy to scale independently
- It consumes no fuel and produces no emissions.
- It utilizes proven mechanical systems and is composed almost entirely of steel, water, and air.
- It offers 20 years of performance at full power and capacity and 100% depth of discharge.

## Budget

### Total Project Value:

\$13,046,588

### DOE/Non-DOE Share:

5,396,023/\$7,650,565

## Timeline

- August 2010:**  
Kilowatt-scale pilot built and ready to test
- March 2011:**  
Kilowatt-scale pilot testing complete
- Second Half of 2011:**  
Driveline selected for megawatt-scale pilot
- First Half of 2012:**  
System-Level design complete
- Second Half of 2012:**  
Megawatt-scale pilot assembly begins
- First Half of 2013:**  
Megawatt-scale pilot built and energized
- December 2013:**  
Performance testing of pilot completed

## Objectives

- Demonstrate the viability of isothermal compressed air technology to provide cost-effective energy storage
- Validate scalability for applications in both low- and medium-voltage distribution or sub-transmission grids

## Project Partners

- SustainX, Inc.  
[www.sustainx.com](http://www.sustainx.com)
- Northeast Power Coordinating Council, Inc.  
<https://www.npcc.org>
- ReliabilityFirst Corporation  
[www.rfirst.org](http://www.rfirst.org)

## Award-Winning Technology Advancement

SustainX's design has received numerous awards, including a GE Ecomagination award and Cleantech 100 awards in 2010, 2011, and 2012.



## For More Information

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## Related Reading

Sandia National Laboratories, "Energy Storage Systems Program (ESS)," <http://www.sandia.gov/ess/>.

PR Newswire, "SustainX Finalizes \$5.4M of Funding From U.S. DOE", June 2010, <http://www.prnewswire.com/news-releases/sustainx-finalizes-54m-of-funding-from-us-doe-96906854.html>.

## Importance of Energy Storage

Large-scale, low-cost energy storage is needed to improve the reliability, resiliency, and efficiency of next-generation power grids. Energy storage can reduce power fluctuations, enhance system flexibility, and enable the storage and dispatch of electricity generated by variable renewable energy sources such as wind, solar, and water power. The Office of Electricity Delivery and Energy Reliability Energy Storage Program funds applied research, device development, bench and field testing, and analysis to help improve the performance and reduce the cost of energy storage technologies.