Modular Undersea Compressed Air Energy Storage (UCAES) System

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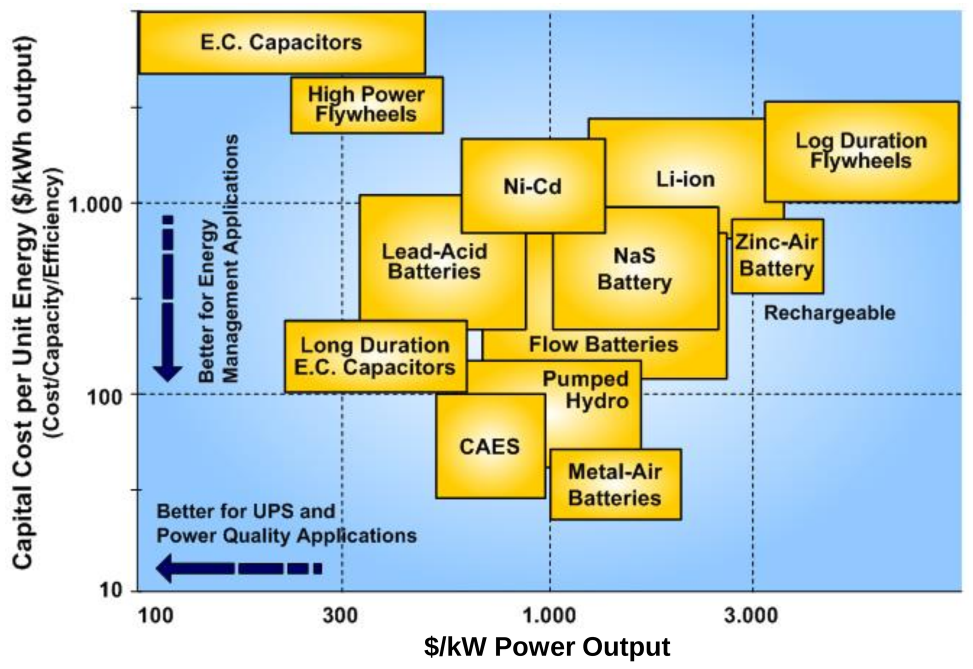
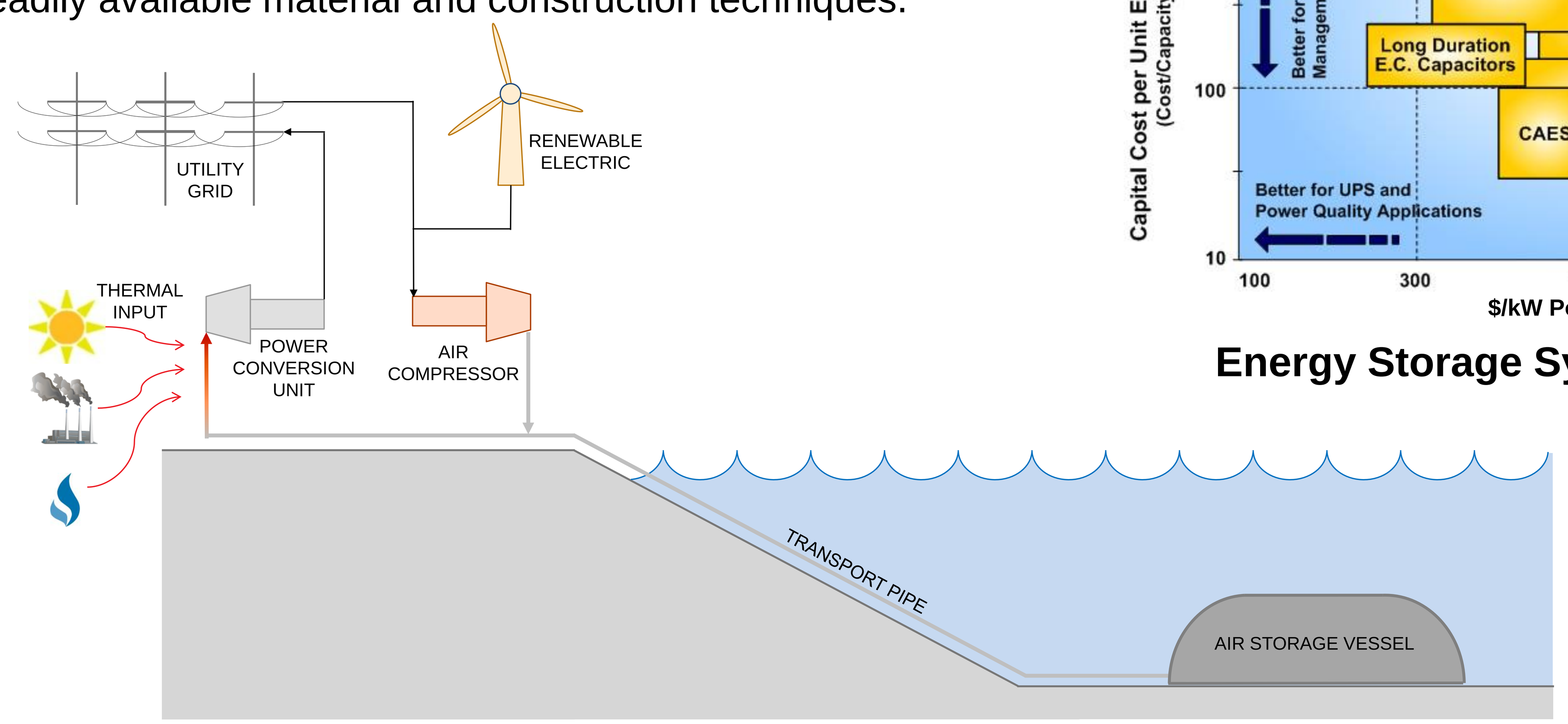
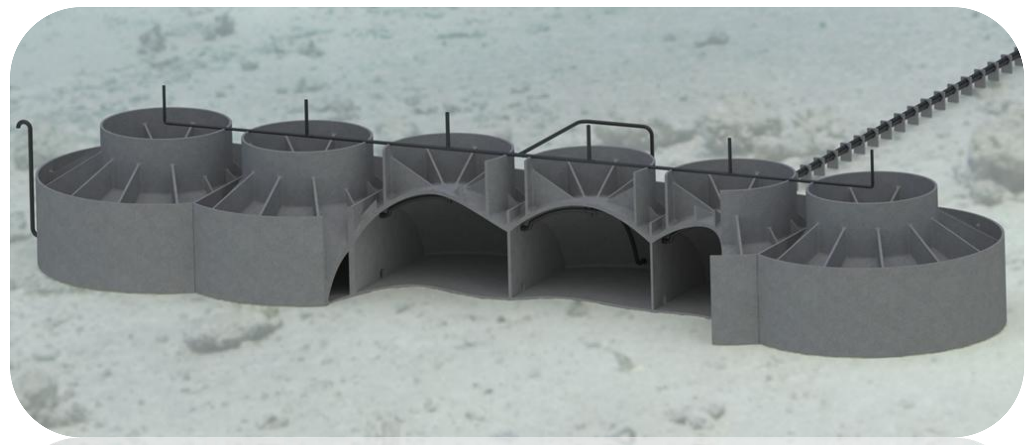
Project Overview

UCAES has the potential to offer modular, grid scale storage capability at competitive costs when coupled with high efficiency power conversion systems. The nature of the design minimizes vessel stress and aesthetic impact, while utilizing readily available material and construction techniques.



Energy Storage System Comparison[1]





Air Storage Vessel

- Proven monolithic concrete dome construction
- Negatively buoyant, eliminating the need for anchors
- Majority of ballast from low cost earth-fill (not shown)
- Rigid concrete skeleton in pure compression
- Static structure with potential for artificial reef classification
- Thick earth-fill outer layer for external protection (not shown)

Transport Pipe

- Proven fused HDPE construction and deployment strategy
- Similar to existing pipe systems
- Pipe is staged at appropriate on-shore construction site
- Sections are fused as the pipe is pulled into the water
- Concrete weights are added to each segment after fusion
- Completed unit is capped and floated to the deployment site

SolarCAT

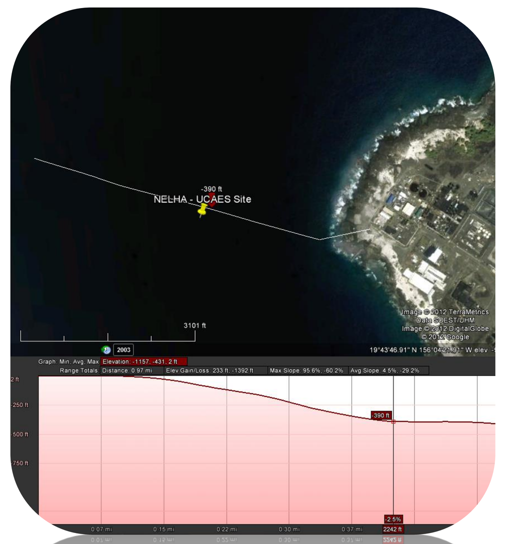
SolarCAT Overview	
Technology	CSP Dish – Open Brayton Cycle
Power output	200 kWe/dish (when used with CAES)
Efficiency (solar thermal to elec.)	35%
Other features	25 year service life, small foot print, modular

Progress

Progress and Partners		
Case Studies	Three sites on the Hawaiian Islands	Preliminary site studies (bathymetric, terrain, & infrastructure) with support from Hawaiian utility company.
Transport Pipe	Fused HDPE	Feasibility and cost study conducted by Hawaii based ocean engineering firm.
Air Storage Vessel	Monolithic concrete dome	Preliminary structural analysis & guidance from concrete dome design firm. Preliminary cost study conducted.
Deployment Strategy	Drydock construction and float out	Feasibility study conducted by marine engineering firm. Preliminary cost study conducted.

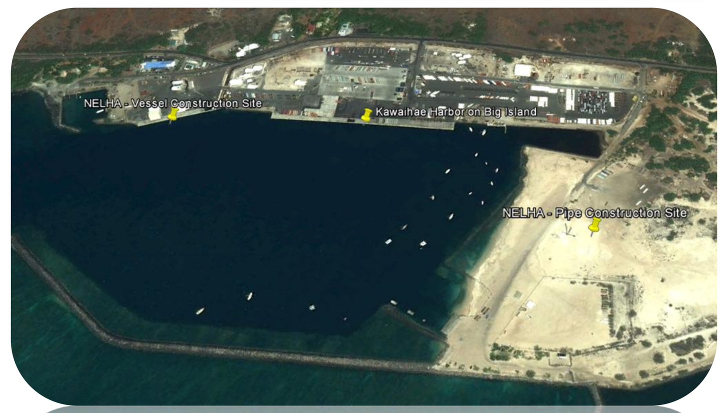
CASE STUDY 1: Kailua Kona, HI		
Ocean Depth	110 *m*	
Storage Vessel Footprint	30 x 100 *m*	
Vessel Volumetric Capacity	25000 m^3	
Pipe Length	520 *m*	
Pipe Diameter	0.5 *m*	
Pressure Drop	<2% *dP/P*	
Power Output	***12 MW***	
Storage Capacity	***56 MWhrs***	
Costs	***$/kWhr***	***$/kWe***
Solar	$762	$3,539
Fossil (Nat. Gas)	$371	$1,723

Construction/ Deployment Study



Bathymetric Studies

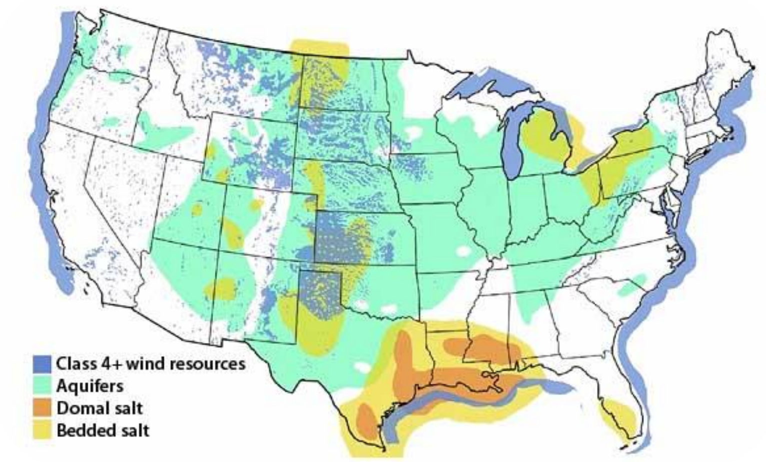
Pipe Laying Feasibility



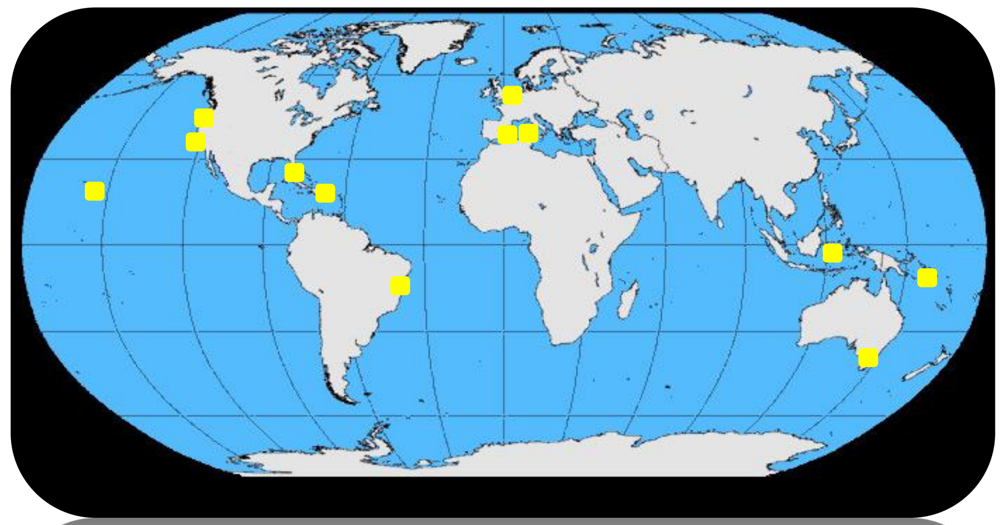
Infrastructure Investigation

Future Work

Further feasibility and cost studies must be conducted by experienced maritime construction contractors.
The market for UCAES systems must be explored further by conducting broader case studies of bathymetry, terrain, infrastructure and natural and/or renewable energy resource potential.



Wind Resource vs. Geological CAES sites[2]



Preliminary Investigation of Potential UCAES Sites

1. Electricity Storage Association
2. "Compressed Air Energy Storage: Theory, Resources, and Applications for Wind Power," Samir Succar and Robert H. Williams, Princeton University (published April, 2008)

U.S. DEPARTMENT OF ENERGY

Brayton Energy LLC