Tomorrow's Battery Today

Newsletter

CRCES™ (Carbon Reduction Clean Energy Storage)

INTRODUCTION

CRCES™ technology supplies an alternative storage solution to traditional batteries for renewable applications and stabilization of the power grid. 100% of CRCES™ technology and equipment is supplied from the U.S.

Electrical Energy Storage (EES) is the paramount impediment to transforming America to green energy. For the past 18 months The CRCES team has identified alternate technologies for EES. Forecasting that battery prices may increase, and noting the poor carbon footprint of traditional batteries, the process was started to find a solution to support the evolution to clean energy.

The CRCES team efforts have focused on:

- Solar and wind renewables
- Replacement of the needed standby fuels currently stored as: coal, fuel oil, natural gas, etc.
- Grid expansion for EV's
- Waste heat utilization (or low-grade heat)

Today it is estimated that the U.S. grid has approximately 4.7 GW of storage capacity for stabilization. To replace coal, natural gas, and nuclear generation in the U.S. 700 GW of storage will need to be installed. Whether you run the numbers for supporting the intermittent aspect of renewable energy or the energy storage demand from EV expansion, each segment requires an investment of billions of USD in the next (10) years.

EES (ELECTRICAL ENERGY STORAGE)

To supply EES there are a variety of applications each with their own strengths and weaknesses. The Environmental and Energy Study Institute published Table 1 in 2019 of selected energy storage technology that provide large capacity (at least 20-MegaWatts of supply).

Each of the listed technologies have merits, but are also burdened with issues in the form of incomplete technology, application limitations, geographic requirements, or poor economic performance. Therefore; the supply of EES for grid growth will require new technology to not only fill the gaps, but cover most of the expansion. CRCES™ technology has a small footprint, does not require any unique geographical structures, and can distribute power for long periods of time with high efficiency. This, combined with carbon reduction and low costs, helps recognize CRCES™ technology as the theoretical leader over in EES technologies.

CRCES™ TECHNOLOGY

CRCES™ technology starts by utilizing ALBERT™ (Accumulation of Latent BTU's and Electricity for Retention and Transfer) process technology. The technology is named for ALBERT Einstein's work in the 1930s to patent the refrigerator. This basic technology, utilized today, is one of the cornerstones to the ALBERT™ Process. The ALBERT™ process is based on:

- Mixed Refrigerants
- Rankin Cycle
- Upscading™ technologies
- Continuous or batch process
- No carbon elements consumption

This process can utilize electricity and/or low-grade waste heat and compete with current battery storage costs and functionality. CRCES™ is based on solid thermodynamics, existing U.S. equipment, and supports three new patent elements. As an example of the ALBERT™ Process with CRCES™ technology, we have constructed a cost comparison (Table 2) between PV solar with battery storage versus thermal solar and CRCES™. The example is for a (20) year overall life cycle. CRCES™ will easily support a (20) year life and, with proper maintenance, a (40) year life.

The ALBERT™ Process supports renewable energy sources on the grid and can revitalize the carbon storage terminal industry. ALBERT in combination with CRCES has the following attributes:

- 100% U.S. materials and manufacturing
- Ease of operation
- Efficient long term electrical discharge
- Creates U.S. jobs in fabrication and field construction
- Reduces the carbon footprint of EES

CURRENT BUSINESS PLAN

AT&V will continue to seed design efforts for the first Alpha facility in Moss Point, MS, continue engineering for additional patents, and search for outside sources of capital. Efforts are being made to source federal and state grants, tax credits, and/or other renewable energy funds. Meetings are underway to build alliance relationships for 4 Alpha plants.

ALPHA PLANT 1

The first CRCES™ facility, known as Alpha 1, will be built at AT&V's Lucedale, MS facility to help support a lower initial cost footprint, a faster construction schedule, continuing R&D work to optimize components of the system, and future fabrication plans. Lucedale was chosen for a variety of reasons, which include: Mississippi's positive attitude about the energy revolution, the need for economic stimulation in the area, and AT&V's current engineering, fabrication, and construction capacity in Lucedale, MS. Alpha 1 will turn AT&V's Lucedale's fabrication facility into a clean energy technology center.

Over the last (30) years AT&V has invested and expanded the Lucedale facility to incorporate over a quarter-million sq. ft. of heavy fabrication capacity, along with a QA/QC department, Safety department, Maintenance, and Inventory System. Ultimately, a dedicated facility will be constructed in Lucedale for the fabrication of CRCES™ technology; however, initially all components can be fabricated within AT&V's current facilities.

PRIVATE EQUITY SOURCE

Traditionally, AT&V has self-funded development of technology and projects from within. However, CRCES™ technology is too large a footprint for AT&V to financially support without significant outside funding. Funds are required to:

- Build and run the Alpha facilities
- Invest in human capital
- Establish a global market
- Pursue government funding
- Finance project equity

AT&V's Private Equity target process will ultimately focus on firms that are committed to a healthy energy evolution, have a realistic perspective of achieving a lower carbon footprint, support a global presence or can syndicate to support a global effort, and are equipped to achieve an aggressive timeline to market.

TARGET MARKETS

CRCES has at least two primary markets and several secondary markets. The first market is utility sized EES. This can support renewables, decarbonizing the current potential energy storage system, and/or the expansion from EV demand. The second targeted market is the conversion of traditional global hydrocarbon storage terminals to energy storage facilities. This industry is threatened by the energy evolution

	Max Power Rating (MW)	Discharge Time	Max Cycles or Lifetime
Pumped Hydro	3,000	4h - 16h	30 - 60 Years
Compressed Air	1,000	2h - 20h	20 - 40 Years
Molten Salt (Thermal)	150	Hours	30 Years
Li-ion Battery	100	1min - 8h	1,000 - 10,000
Lead-Acid Battery	100	11min - 8h	6 - 40 Years
Flow Battery	100	Hours	12,000 - 14,000
Hydrogen	100	Mins - Weeks	5 - 30 Years
Flywheel	20	Secs - Mins	20,000, 100,000

Table 1: Characteristics of selected energy storage systems (source: The World Energy Council)

and has existing assets that are undervalued and under-utilized. CRCES™ technology can repurpose some of these assets for clean energy and improve ROIs of facilities.

The third target identified is partnering with industries who have low quality waste heat (85° - 185° F) or other forms of energy that CRCES ™ can capture and store, enhancing the value of the energy. For years companies have wanted to utilize waste heat streams and commercialize them. CRCES™ can economically monetize low temperature waste heat sources that have been previously passed over. One example currently under investigation is a property adjacent to multiple sources where underground piping would be utilized to bring waste heat streams to the CRCES™ facility for aggregation of generating or storing energy. Each of the multiple sources could be operated as independent closed systems.

EES industry is projected to grow significantly and exponentially within the next several years. The Center for Substantial Systems at the University of Michigan recently published: “storage technologies are becoming more efficient and economically viable. One study found that the economic value of energy storage in the US is $228 Billion Dollars over a (10) year period”.

ALLIANCE MARKET CONCEPTS

AT&V will build alliances to help market and apply the CRCES™ technology. Meetings have already begun to establish partnerships in specific industries, that include the following:

- Crypto data mining
- Geothermal sources
- Hydrocarbon Storage Terminals
- Large gas storage and production of propane, butane, LNG, etc.
- Large power transmission companies
- Petrochem industry plants
- Photovoltaic plants (over 25 MW)
- Refining industry
- Traditional hydrocarbon-based power plants
- Wind turbine plants (over 25 MW)

AT&V’s goal is to identify leaders in these markets and establish an alliance to apply the technology to each industry. As an example, AT&V would align our technology with a global terminal company and convert hydrocarbon terminals to clean energy storage locations. The agreements with an alliance partner would not only support terminals they operate and own, but the application being utilized in non-owned terminals. These relationships ensure that the art of the application and the concepts of its operation are within the confines of the existing industries today. Such alliance agreements will place the product into these industrial markets at a faster pace. AT&V will be licensing to these alliance partners based on a limited application, geography, and/or industry sector.

HISTORY OF AT&V

Over AT&V’s (40) year history almost (30) years have been dedicated to developing technology for the energy storage industry. This includes technology that helps to reduce VOC emissions, create safer work environments, reduce operational costs of hydrocarbon storage, improve and reduce costs of repairing hydrocarbon tanks, test tank bottoms for leaks, and provide process technology to improve the efficiency of LNG facilities. From environmental to process performance, AT&V’s technology has had a major impact over the last (30) years on the hydrocarbon industry. During that period new construction of hydrocarbon storage in the U.S. has shrunk significantly while AT&V has continued to grow.

INTERESTED PARTIES

Parties interested in the CRCES™ technology can visit the American Tank & Vessel website at www.at-v.com and click on the Carbon Reduction link for more information about the technology. The News and Media link will direct you to publications and two previous articles, "For a Greener Tomorrow" and "Tomorrow’s Battery Today".

If you have further interest, please do

Cost Comparison of CRCES™	Solar with Lithium-Ion Batteries	Thermal Solar with CRCES™
Solar Production (Actual)	83 MW	83 MW
Energy Storage	300 MWhr	300 MWhr
EES Discharge Time	6 Hours	6 Hours
Solar Land Required	570 Acres	400 Acres
Storage Land Required	575 Acres	402 Acres
Carbon Footprint	High	Low
Origin of Materials	China/U.S.	U.S.
CAPEX Costs	322MM USD	262MM USD
LCE	$.1452/kWhr	$.1044/kWhr

Table 2: Refer to "Table 2 Reference Data" at the end of the document for more information

not hesitate to contact myself, W.T. Cutts, AT&V Director and CRCES™ technology sponsor, at AT&V. My email is wtc@at-v.com and phone number is 281-492-7778.

TABLE 2 REFERENCE DATA

- Location of example: Lucedale, MS
- Cost of land and property tax not considered
- Cost of finance 8%
- ROI 18% before income taxes
- (LCE) Levelized Cost of Energy
- PV total investment = $102MM solar + $220MM battery
- CRCES™ total investment = $146MM solar + $116MM CRCES™
- Annual operation cost of battery replaces batteries over 20 year life
- All OPEX include 5% inflation
- Data based on solar energy technology office data from August 2021
- (EES) Electrical Energy Storage
- PV and CRCES™ system will dispatch 50MW per hour for 9 hours (if solar is available) + 6 hours of dispatch from EES
- Can provide in excess of 100MW/hour of power
- Can be started in as little as a few minutes
- Can continue in continuous service over 24 hours
- With regular maintenance can support a 40 year life <<<