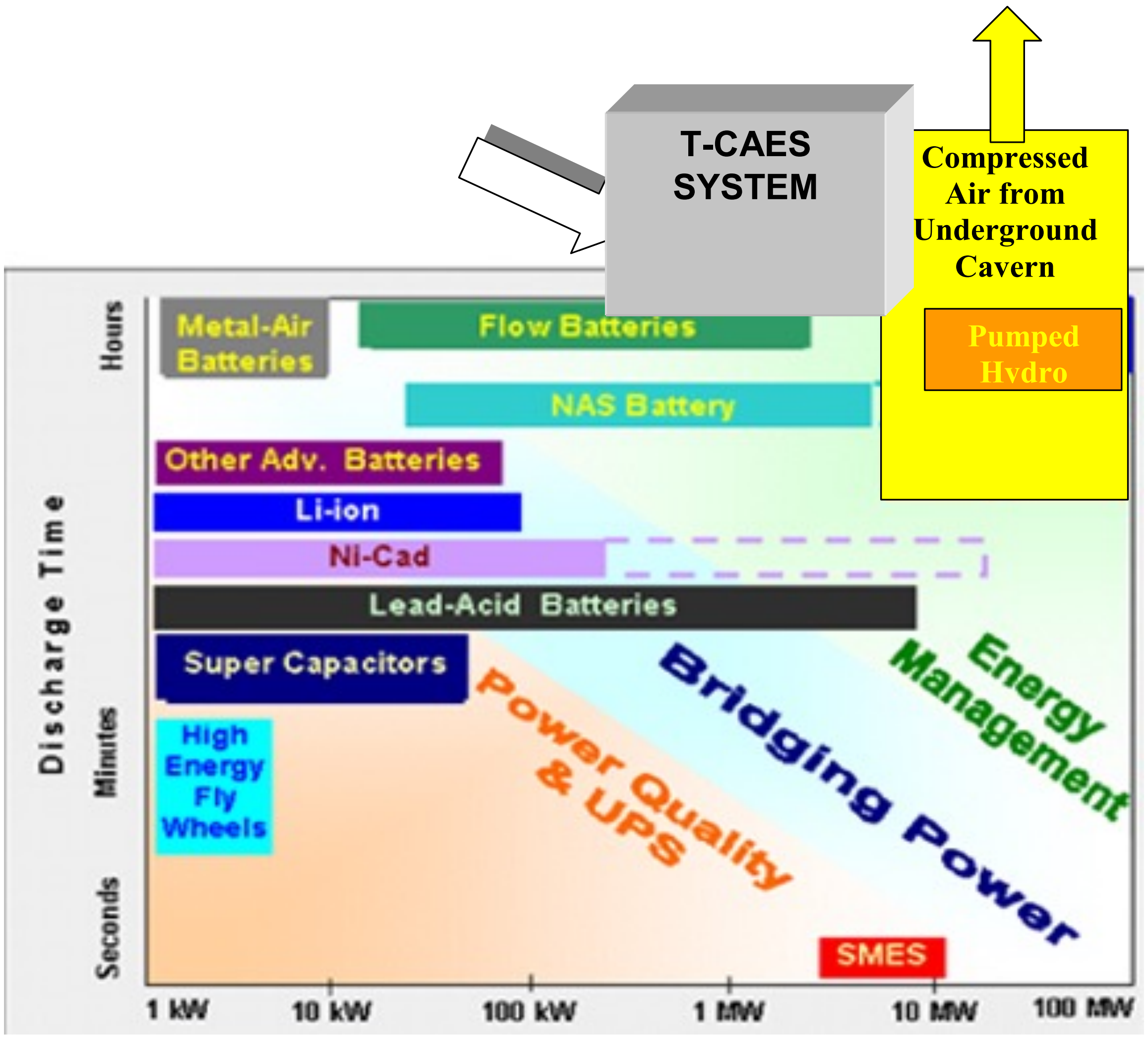
EEG LLC TRANSPORTABLE COMPRESSED AIR ENERGY STORAGE (T-CAES) SYSTEM



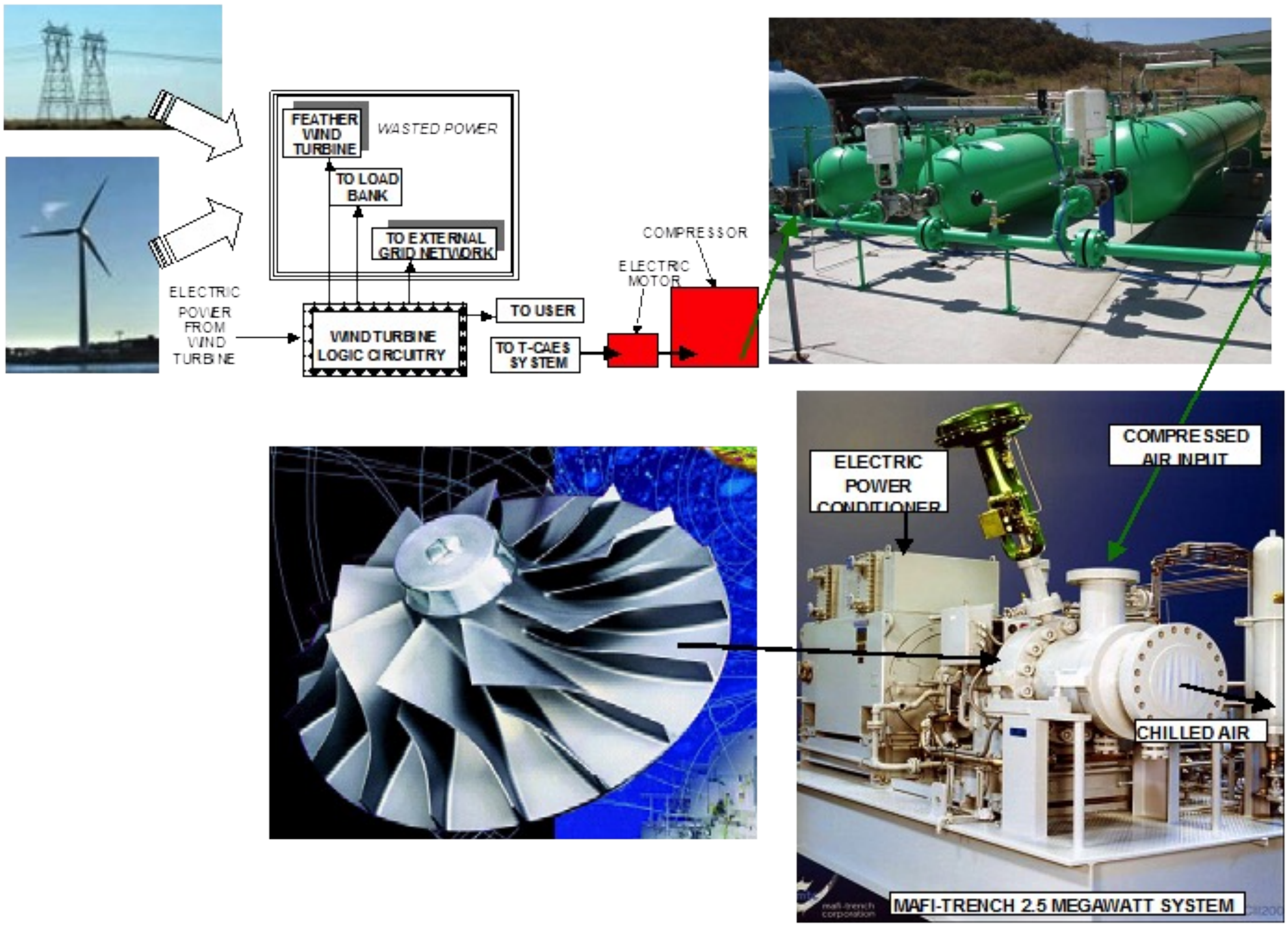
ADVANTAGES OF EEG LLC T-CAES SYSTEM

- Provides energy storage in a domain not covered by other technologies (see above chart)
- Provides backup power when grid fails
- Amenable to all geological & geographical sites
- Operates at power levels 0.5 to 10 MW applicable to large market
- Operates in three modes for different daily scenarios in same facility
    - electrical power mode
        - provides peak shaving
        - provides power smoothing
        - emergency electric power
    - High air mass flow of super chilled air (-175^{o}F) cogeneration
- High overall system efficiencies when waste heat is recovered
- Long lifetime for key components ~50 years, whereas battery systems need 2 and 3 complete replacement with associated expenses
- Environmentally clean
    - no corrosive liquids
    - no toxic chemicals
    - no explosive gaseous emissions
    - no combustion and no combustion products (unlike underground CAES systems)
- Can bypass turboexpander/generator system to operate pneumatic systems at lower pressures

T-CAES Systems vs Battery Systems

- Battery systems only supply electricity
- T-CAES systems supply electricity…**AND** high mass flow of super-chilled air
    - HVAC (directly, without other equipment)
    - Cold storage (directly, without other equipment)
    - Water purification (with other equipment)
    - T-CAES SYSTEM: For each 1 MW of electrical power there is 1 MW of thermal chill power.

TRANSPORTABLE COMPRESSED AIR ENERGY STORAGE (T-CAES) SYSTEM



PRINCIPLE OF OPERATION

Our patented innovative and highly flexible **T**ransportable **C**ompressed **A**ir **E**nergy **S**torage (T-CAES) technology provides the capability to pneumatically store energy generated by any source (Wind, Solar, Electric Grid, Nuclear, Geothermal and others) when demand is low, for later use when demand is high.

In its basic mode of operation, the T-CAES system uses power from any of the above **green** sources to drive a compressor that pressurizes air in storage tanks for the T-CAES system (or in a long pipeline to 1,200-psig for the TL-CAES system) for later use. When electrical power is required, a control valve releases 200-psig air to the intake of a turboexpander that, in addition to driving a turbo-generator to produce electric power, also produces, as a byproduct, super chilled air that has many useful applications.

The following two schematics show how the overall system operates…without the combustion of fuel.

All commercial CAES systems compress air for storage but then release the compressed air at a later time when it feeds a combustion chamber wherein natural gas and compressed air combust and drive the gas turbine of an electric generator. There is electricity that is produced as well as a flow of hot combustion gases exhausted from the turbine that is sent to a “recuperator” to recover the waste heat.

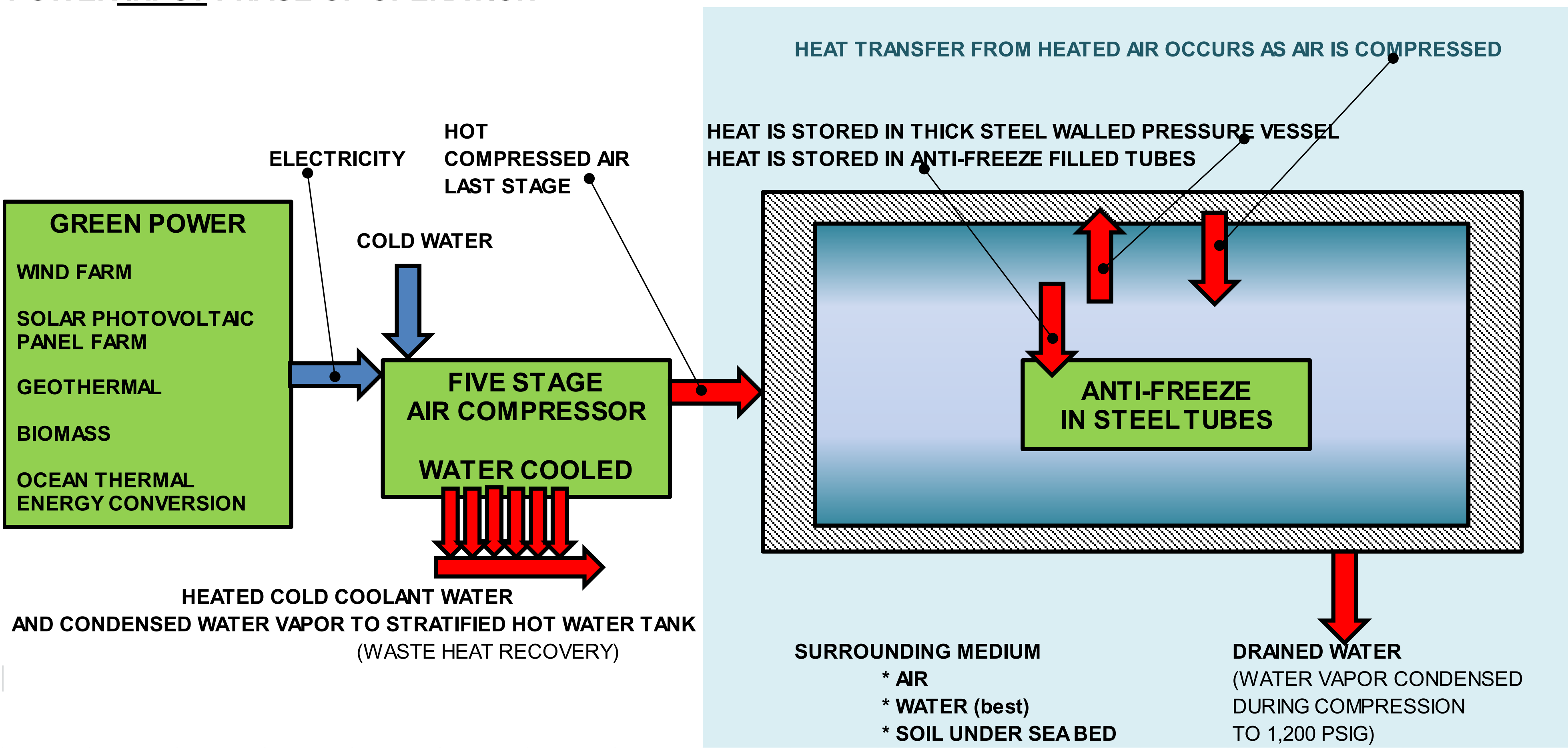
Since we do not burn fuel there is no heat source to cause the expanding air released from the fixed volume storage tank to keep from getting colder and colder as it feeds air to the turbine input port of the turboexpander/generator set. This will cause the turbine to rotate with less energy and furthermore cause less electricity to be produced. Without a heat source, this system would cease functioning.

The solution lies in using the thick steel pressure vessel walls an large surface area to perform the necessary function of drawing heat from the surrounding air when the wall temperature starts to drop in temperature. As the wall temperature tries to drop further in temperature when the pressure in the tank starts to reach unacceptable levels, the greatest heat exchange into the steel wall from across the outer surface of the pressure vessel wall and also across the inner surface of the pressure vessel wall and into the cold and colder air to slow the drop in air temperature. The heat transfer coefficients across the tank/air surface, volume of the pressure vessel, and shape of the vessel were studied under a California Energy Commission project to establish the design parameters of the rate of electricity that can be generated from a specified pressure vessel.

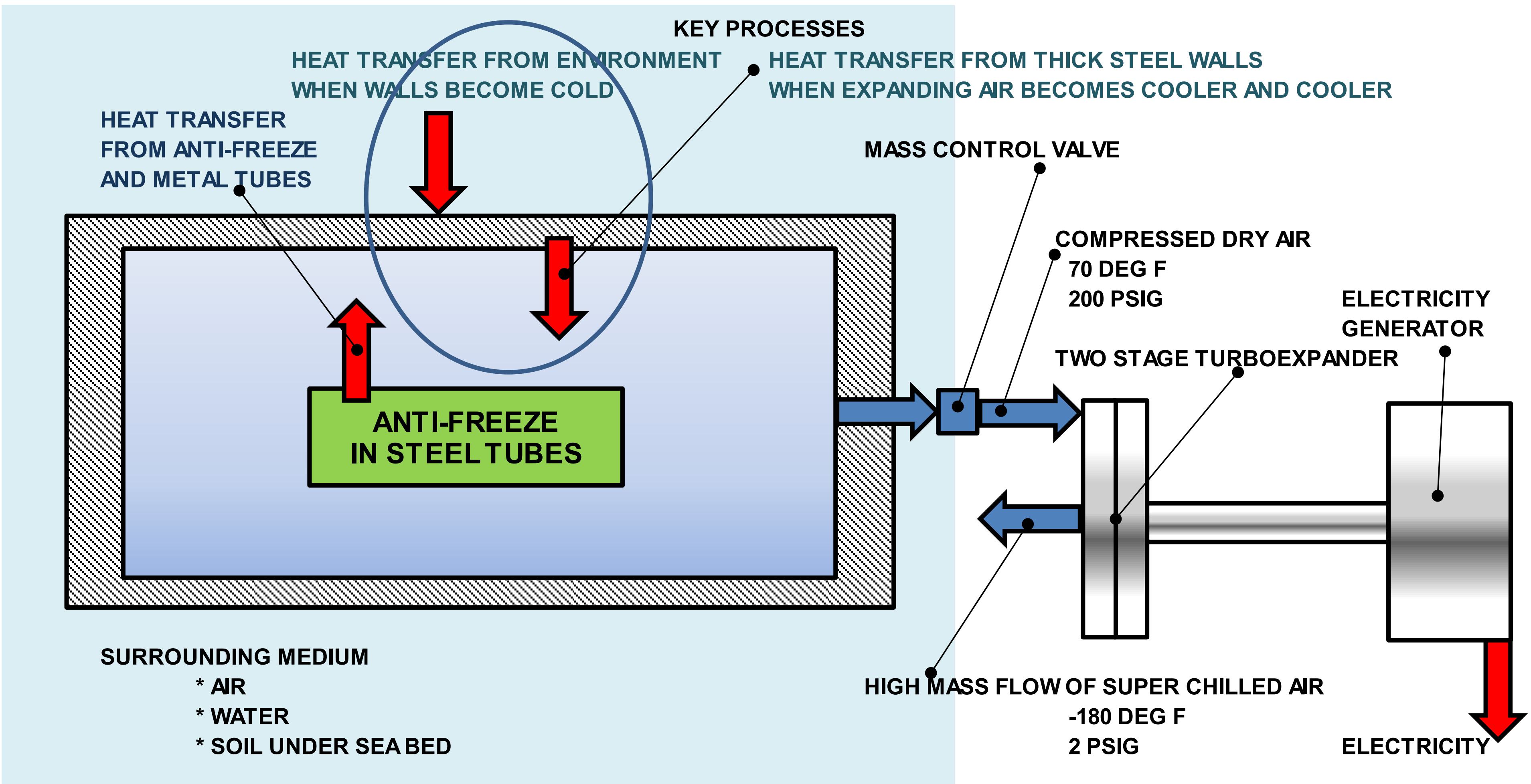
The heat of compression is recovered in the earlier stages of the compressor via coolant water. However, the final stage of compression has heat that is sent into the pressure vessel where coolant liquid inside coils that absorb the heat of compression for later release.

When the surrounding medium is water or wet soil the heat transfer is simpler and more efficient because we are dealing with heat transfer across water/metal interface and across metal/high-density-air interface as well as from an infinite source (ocean, river or lake) at fixed temperature.

POWER INPUT PHASE OF OPERATION



POWER <u>OUTPUT</u> PHASE



75 kWe DEMONSTRATION TEST

In June 2004, a 75 kWe version of the Enis/Lieberman Transportable Compressed Air Energy Storage (T-CAES) System was tested at National Technical Systems in Santa Clarita, CA. The CAES system was comprised of a compressor, piping system, high pressure storage vessels and a turboexpander/generator set. General Electric supplied the turboexpander/generator set and S2M of St. Marcel, France supplied the special high speed (28,000 RPM) bearing. S2M is the world's biggest producer of magnetic bearings. We arranged the control system, sensors, instrumentation and recorders to display the proof that we would generate 75 kW of electrical power and 75 kW of thermal power. The thermal power was the high mass flow of super-chilled (-175^{o}F) air. Hot water was collected from the inter-stage condensation of the air compressor.

Three governmental agencies sent their reviewers:

Dr. Robert Schainker, Electric Power Research Institute, Palo Alto, CA
Mike Gravely, California Energy Commission, Sacramento, CA
Garth Corey, Sandia National Laboratory, Albuquerque, New Mexico

There were key persons from the electrical power community:

Dr. Reza Agahi, Director, Marketing, GE Oil & Gas Operations, LLC
Dr. Behrooz Ershaghi, GE Oil&Gas Operations, LLC
Dr. Randy Wu, GE Rotoflo
Yannick Paul, Société de Mécanique Magnétique (S2M), St-Marcel, France
John Maskulak, President, L.A. Turbine
Lance Hays, President, Energent Corp
Dr. Reza Agahi, GE
Rik Krull, President, Mafi-Trench (Now Atlas-Copco)
Dr. Jack Lin, CEO, NTS
Aaron Cohen, Majority stockholder of NTS

No fuel was burned to achieve this remarkable result. Note the photos of the pressure vessels and piping used in the figure of the Enis/LiebermanT-CAES system.

The T-CAES System was comprised of an air compressor, high pressure vessels, and a GE turboexpander/generator set. The expected electrical power was generated and the extremely cold air temperature of the turboexpander exhaust air was measured. The design power and air temperatures were achieved.AIR COMPRESSOR


FVG