

U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Hydrogen/Metal Hydride Based Heat Pump System, for Large HVAC Applications, Utilizing an Ionic Liquid Desiccant Sub-system

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Team



- **Xergy Inc.:** Global Leader in Integrating (i.e. packaging) Ionic Systems; including Electrochemical Compressor and Ionic Liquid Systems
- **University of Delaware:** Center For Fuel Cell Research, Dr. Ajay Prasad, Leadership in Electrochemical Engineering & Testing Infrastructure
- **ORNL:** Dr. Omar Abdel-Aziz, Leadership in Heat Pumps, and HVAC Systems & Testing Infrastructure
- **NREL:** Dr. Jason Woods, Leadership in Ionic Liquid Systems & Testing Infrastructure

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The Problem

The Need:

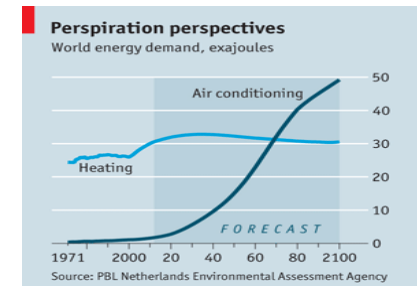
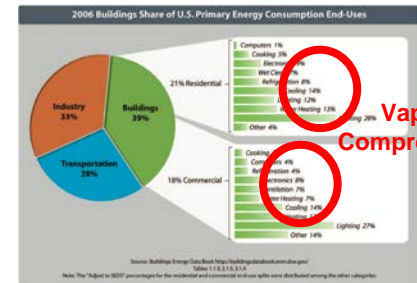
Average commercial buildings in U.S. consume 17.3 Kw-Hr's per sq. ft. for electricity, or for an average building (15,000 sq. ft.) this translates to \$26,000/year. Heat Pumps (and HVAC systems) account for 40%+ of energy utilized in buildings. Improving HVAC efficiency by 20% would translate to operating cost reduction of \$2,000/year for an average building owner.



The Challenge(s)

- 1) Develop a higher efficiency heat pump technology platform
- 2) Augment heat pump operation with a secondary system that Separates Sensible and Latent Cooling (SSLC), to further improve efficiency.

Once proven, there is a further challenge to position these technologies to meet market needs cost effectively; without any limitations on scalability.



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The Solution

The team is combining three technology platforms to build a multi-ton HVAC system for Commercial buildings: Electrochemical Compression, Metal Hydride Heat Exchangers, and Ionic Liquid Systems. Taken together these technologies can improve energy efficiency for HVAC systems by more than 20%!

Electrochemical Compressors (ECC's):

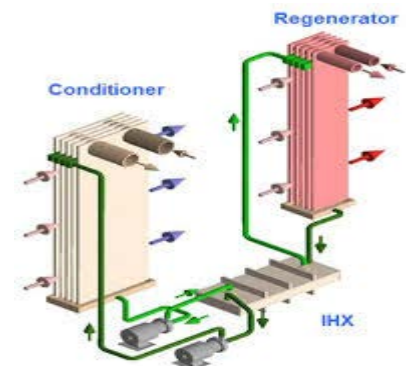
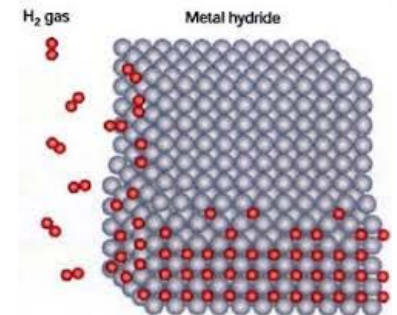
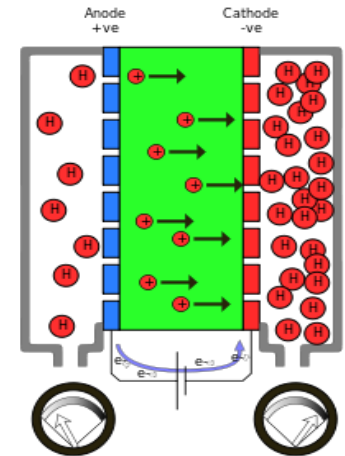
- ECC's are solid state, vibration free, modular and scalable that provide inherently higher exergy efficiency for compressing working fluids

Metal Hydride Heat Exchangers (MHHX):

- MHHX provide thermal exchange more efficiently, for a wider temperature range with less volume than typical refrigerants.

Ionic Liquid Desiccants (ILDs):

- ILDs are able to separate Sensible and Latent Cooling. They absorb moisture on one side of the HVAC system and then utilize low grade waste heat (from heat pump condensers) for regeneration.



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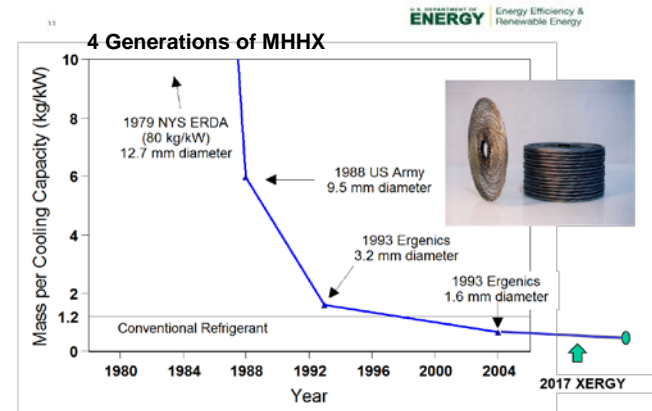
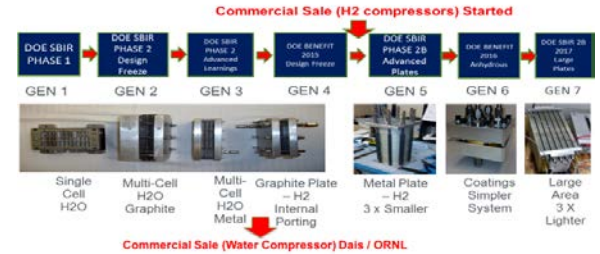
The Impact :

The team will demonstrate a state-of-the-art multi-ton system at a commercial site (with our partners), validating >20% reduction in power consumption; leading to reduction of 1 Quad+ in U.S. power needs and >100 million tons in CO2 emissions.

Other Advantages:

- Eliminating traditional refrigerants, while at the same time providing a more efficient heat pump.
- There are synergies between these technologies, where for example Heat Pump condenser is used to regenerate ionic liquid system.
- Collectively, these technology platforms are all scalable, modular and can be easily integrated with other HVAC systems separately.

7 Generations of ECC's



Thank You

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