



# ***GEOENERGY ENTERPRISES***

***PRODUCING THE GEOCOLUMN GEOTHERMAL HEAT PUMP***

***NREL's 20th Annual  
Industry Growth Forum  
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# GEOENERGY ENTERPRISES

## Current Operational Model

- To date GEE has been operating primarily as an R&D entity, prototyping and installing proprietary hybrid geothermal heat pump systems, drawing working capital principally through grants.

## Product

- GEE's GeoColumn is an inexpensive hybrid ground source heat pump which utilizes the thermal capacity of the Earth to temper self contained water baths which house copper heat exchangers.



# STATE OF THE ART

- All heat pumps work on the principal of the Carnot cycle and have essentially the same four components:
  - Compressor
  - Condenser
  - Evaporator
  - Expansion Device
- The vast majority of heat pumps in the market are Air-to-Air systems which suffer from the outdoor location of the evaporator or condenser coils.
  - Efficiencies of Carnot systems with freon as the working fluid decrease as the condensing / evaporating temperatures go to the extremes.

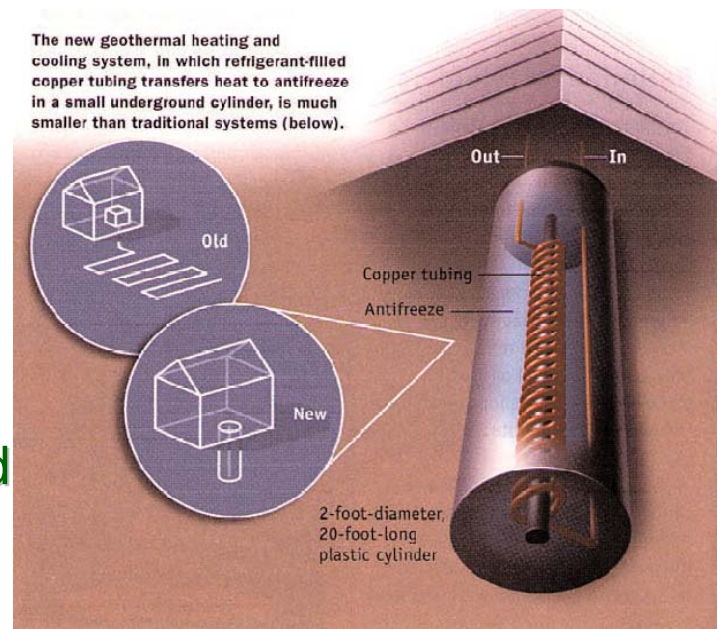
# GEO THERMAL

- Geothermal heat pumps utilize the natural tendency of subterranean environments to maintain a temperature of 55-65<sup>0</sup> F
  - “Outdoor” coil operates in this environment
- Can operate year-round in an optimal temperature range yielding higher overall efficiencies
- Traditionally, there have been two types of geothermal heat pumps:
  - Water source (open or closed loop)
  - Direct expansion



# THE GEOCOLUMN

- The GeoColumn is a hybrid water source / DX system
  - Freon is pumped through coils submerged in water baths
  - Water bath “columns” act as buffers to the earth and store energy as a fluid mass
  - Systems sized at 1-2 columns per ton depending on soils
  - Targets 1-5 ton residential and light commercial systems
  - Requires drilling to only 23’ depth at 2.5’ diameter
  - All columns are tied back to a common distribution manifold before returning to the home
  - Componentized and pre-engineered requiring no on-site design work and installing often in 1 day





# PRODUCT DIFFERENTIATION

- Open Loop Water Source
  - Requires water source (deep well, river, lake) for intake and discharge
  - Utilizes pumping system to move water
  - Each installation is designed to fit the specific site characteristics
- Closed Loop Water Source
  - Typically utilizes glycol solution cycled through a network of HX piping
  - Requires pumping system to move glycol
  - Each installation is designed to fit the specific site characteristics
  - Requires water source or large excavated land mass
- DX (Direct Exchange)
  - Standard heat pump compressor is used to move Freon through copper heat exchanger tubing to interact directly with a land mass
  - Requires large physical footprint and excavation
  - Each installation is designed to fit the specific site characteristics
- **GeoColumn**
  - Standard heat pump compressor is used to move Freon to interact with water bath which in turn interacts with a land mass
  - Requires minimal footprint and excavation
  - Pre-engineered equipment ordered from stock
  - HDPE rigid in-ground containment, proprietary copper tube HX





# COMPETITIVE ADVANTAGES

- Priced to compete with HE air source heat pumps and/or HE air conditioning with fossil heat.
  - 40-60% cheaper per installation than traditional geothermal
- Ease of installation
  - Componentized system
  - All work can be performed by the local HVAC contractor
  - No design and engineering required
  - Typically can be installed in one day
  - A legitimate "retrofit" for aging heat pumps
- Land Use
  - Small footprint required with little excavation
  - Usable in shallow soils and high water tables
  - No risk of finding a well: operational or financial
  - Salinity and pH are not issues
  - Does not utilize or pollute the aquifer or water source
- Serviceability & Long Life
  - Failed HX can be serviced without mass excavation
  - Fewer moving and exposed parts (fans, pumps, coils)
  - HDPE life 600 years plus, copper coils indefinite
  - Lower compressor stresses and amp draws





# MARKET ANALYSIS

- HVAC – Approximately \$20 Billion Industry
  - Includes heat pump, natural gas, fuel oil, etc.
  - \$13.3 billion attributed to equipment sales
- Residential / Light Commercial
  - Roughly 10 million new central air conditioning and heat pump units were sold in 2006
  - ~\$8.5 billion market for new central units
- Heat pumps
  - Heat pumps are making yearly gains in market share of central heating market; projected to be 35% by 2010
  - Driven by rising natural gas, fuel oil, and electricity prices
- Geothermal
  - Leads growth in domestic shipments
  - Driven by desired and required increases in efficiency
  - "Geothermal may grow as much as 800 percent by 2010" (GHPC)
  - Bosch purchased major industry player Florida Heat Pump in 2007
    - \$51 million in sales
    - ~45,000 units production
    - Cite anticipated growth in geothermal heat pump market





# MARKET RELEVANCE

- Benefit to end user is obvious
  - Inexpensive installation of an appliance that saves 33-50% over their existing unit, with a payback period of 4-6 years (area dependant & not including power provider incentives and tax credits)
- Larger market driver is benefit to Power Providers
  - During extreme temperatures electrical demands related to heating and cooling start peaking
    - Daily peaking and seasonal peaking
    - Traditional heat pumps work hardest (and consume the most energy) when the temperatures are at their extremes
    - Additionally nearly all traditional heat pumps rely on inefficient auxiliary electric resistance heat
  - Geothermal efficiencies are not susceptible to extreme temperatures and thus have the ability to smooth peaking loads
    - Results in reduced demand on power plants, electrical transmission lines, and distributed (expensive) power
  - In Power Providers' interest to incentivise energy efficiency
    - Have worked closely with Long Island Power Authority and Keyspan (National Grid) to validate this concept
    - Exploring relationship with Honeywell to market GeoColumnn to power providers as part of energy efficiency package



# PROGRESS TO DATE

- Installations:
  - Hofstra University
  - Sands Point Preserve
  - Empire Clean Energy
  - Suffolk County Habitat for Humanity
  - University of Tennessee, Knoxville
- LIPA
  - Operating under a Research and Development agreement for the testing, refinement, and demonstration of the GeoColumn in the Long Island service area
  - Monitoring of sites is provided by Steven Winters Group
  - Anticipate 5-10 additional demonstration sites through this agreement
- University of Tennessee, Knoxville
  - Working with the Dept. of Chemical Engineering to refine the design of the system and to provide a cloned ARI certification for use in evaluating rebates
  - Have established a fully instrumented laboratory with 3- and 5-ton GeoColumns
  - Have redesigned the HX for optimal oil return and heat exchange



# RESULTS OF NOTE

- Initial runs at University of Tennessee (tank at  $\sim 80^{\circ}\text{F}$ )
  - *Cooling*
    - EER 16.8 (SEER  $\sim 18.6$ )
    - COP 4.91
  - *Heating*
    - EER 18.3 (SEER  $\sim 20.3$ )
    - COP 5.35
    - $49^{\circ}\text{F}$  maximum Delta T
- Initial Heating operation at Habitat House, Suffolk (tank temperatures at  $55\text{-}60^{\circ}\text{F}$ )
  - *Heating*
    - EER 19.4 (SEER  $\sim 21.6$ )
    - COP 5.68
    - $49.46^{\circ}\text{F}$  maximum Delta T
    - $130.23^{\circ}\text{F}$  maximum supply temperature



# RELATIONSHIPS

- Long Island Power Authority / Keyspan
  - Power Provider partner funding demo sites in Long Island as well as R&D efforts
- Steven Winters Group
  - Third party monitoring group providing monitoring of sites and recommendations for improvement
- University of Tennessee, Knoxville
  - College of Engineering providing design, validation, and testing services
  - GeoColumn operation is now a component of the compulsory Unit Operations course as well as the Applied Process Automation Lab
- Empire Clean Energy
  - UL Certified manufacturer and distributor of large scale power electronics and solar-thermal heating devices
  - Key partner for regional manufacturing plan and NYSERDA grant proposals
- Honeywell Power Solutions
  - Provide energy conservation and management programs to power provider clients
- Emerson Climate Technologies
  - Providing new digital scroll compressors for testing in the new prototype
- Nordyne
  - Providing HE air handler and possibly a relationship for OEM manufacturing
- Hancor
  - National manufacturer of HDPE products
- Albano Mechanical
  - Mechanical contractor and model for installer/servicer program





# LEADERSHIP TEAM

- John Genung, Chairman
  - BS Engineering Sciences
  - Involved in two previous national start-up companies in the technology field;
    - President of ANFLOW, Inc., a U.S.-D.O.E. technology transfer company from Oak Ridge National Labs
    - Director of Engineering for ProBac International
  - Aided technology companies seeking mergers or acquisitions as growth and investment strategies as Senior Associate of Millennium Capital Resources
  - Worked with the Tennessee Valley Authority from 1975 to 1983 as a Senior Project Engineer at Hartsville and Browns Ferry Nuclear Plants and as Program Manger for Residential Energy Conservation Programs
  - Former Chief Energy Officer at Fort Campbell, Kentucky.
  - Developed and participated in HVAC dealer technical training programs on design and proper evaluation and installation of equipment
  - Has taught senior level HVAC classes at Tennessee State University as well as Middle Tennessee State University and is qualified to teach ASHRAE/ACCA courses on various HVAC topics to dealers





# LEADERSHIP TEAM

- Tony Penachio, President and Director of Business Development
  - Founder and director of Envirotherm Heating and Cooling, Inc. which manufactured and distributed DX geothermal HVAC products nationally
  - Over 25 years business experience as a both corporate director and secretary, acting COO, CFO and general manager
  - Officer and/or Director of Energy Recycling Group, Inc., The Best Foodservice, R Best Produce, Inc. The Best Marine and Capital Fruit Importers, Inc.
  - Currently involved in the company's business development and the demonstration projects in New York.
  - EPA certified refrigeration technician





# LEADERSHIP TEAM

- Shawn Genung, Chief Technical Officer
  - MBA, MS Industrial Engineering, BS Chemical Engineering
  - Worked with Oak Ridge National Labs in both the Engineering Division and the Department of Technology Transfer and Economic Development, serving as a Strategy and Business Development advisor
  - Consulted as a business and technical analyst with such companies Eastman Chemical Co. and Sun Coke Co.
  - Managing Partner at Project Development Strategy and Validation, providing project management, business modeling, and market due diligence services
  - Currently working with Millennium Power and Energy Technologies to fund development for and commercialize a biofuels technology out of Oak Ridge National Labs





# COMMERCIALIZATION ROADMAP

- Launch Strategy
  - Begin in New York with aim to serve NY, NJ, PA, CT
    - Utilize existing relationships with LIPA, Empire Clean Energy, Albano, etc
    - There are 1 million housing units in LI of which 839k appear to be single family - 70% of LI structures are heated by oil
  - Target additional regions characterized by:
    - High kW power costs
    - High population densities
    - High reliance on fuel oil or natural gas
    - Extreme climates which formerly made heat pump use prohibitive
  - Target Power Providers through Honeywell-type relationships
  - Target Dealer/Installer networks
    - Require GEE dealer and installer training
    - Offer limited territorial exclusivity
    - Require drilling services or contract regionally







# COMMERCIALIZATION ROADMAP

- Manufacturing
  - Assemblies
    - Columns
      - No moving parts, electronics, fragile parts
      - Bend, weld, pressurize
      - Physically large component
    - Compressor unit/Air Handler
      - Complex
      - Requires skilled labor and quality control
      - Can be co-manufactured
      - Easily shipped
  - Methods
    - Regional
      - Contract to local assembly
    - National
      - Partnership with OEM
- R&D
  - Incorporate waste heat and solar
    - Heat pump can quadruple heat value
  - Incorporate existing HE technologies
    - Variable speed compressor, variable speed fans, staged loading, etc
      - If air-to-air heat pumps can utilize it, geothermal can multiply it





# PROJECTIONS

YEAR	1	2	3	4	5
REVENUES	\$ 617,925	\$ 10,637,813	\$ 30,897,738	\$ 67,997,388	\$101,996,081
COST OF SALES	\$ 112,665	\$ 5,367,513	\$ 16,965,988	\$ 38,712,118	\$ 58,068,176
GROSS MARGIN	\$ 505,260	\$ 5,270,300	\$ 13,931,750	\$ 29,285,270	\$ 43,927,905
OPERATING EXPENSES					
Operations	\$ -	\$ -	\$ 447,367	\$ 584,848	\$ 877,272
Sales and Marketing	\$ 422,806	\$ 1,399,488	\$ 1,824,133	\$ 3,376,178	\$ 5,064,267
Development	\$ 168,000	\$ 336,000	\$ 860,785	\$ 2,154,249	\$ 3,231,374
General & Administrative	\$ 389,970	\$ 996,364	\$ 1,740,233	\$ 2,935,830	\$ 4,403,746
Depreciation & Amortization	\$ 9,683	\$ 108,033	\$ 296,800	\$ 667,683	\$ 1,001,525
Total Operating Expenses	\$ 990,459	\$ 2,839,885	\$ 5,169,318	\$ 9,718,789	\$ 14,578,183
OPERATING INCOME	\$ (485,199)	\$ 2,430,415	\$ 8,762,432	\$ 19,566,481	\$ 29,349,722
OTHER ITEMS					
Net Interest Income	\$ 30,081	\$ 423,945	\$ 648,412	\$ 1,199,736	\$ 877,272
PRE-TAX NET INCOME	\$ (455,118)	\$ 2,854,360	\$ 9,410,844	\$ 20,766,217	\$ 30,226,993
Data					
New Exclusive Dealers	6	24	42	60	90
Total Exclusive Dealers	6	30	72	132	198
Units Sold	42	1,805	5,467	12,391	18,587



# NEEDS

- \$3 million initial capitalization
- \$7 million mezzanine funding over years 1-3
- Uses
  - Demo Units \$1,700,000
  - Marketing \$1,200,000
  - Operations \$2,000,000
  - Working Capital \$2,400,000
  - Developmental / R&D \$2,200,000
  - Transaction Fees \$ 500,000

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  - Total \$10,000,000



# IMMEDIATE CAPITAL USES

- Use of Funds
  - Set up Centralized and First Regional Office - NY
  - Commence R&D Activities & Training - TN
  - Finalize LIPA opportunity
  - Identify Additional Regions of Activity
  - Begin Manufacturing and Distribution
  - Commence Marketing and Public Relations Activities
- Exit Strategy
  - Repayment of investment
  - Take Company Public
  - Acquisition by Larger Firm





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