Webinar Series:
Manufacturing Opportunities in the Geothermal Heat Pump (GHP) Industry
Objectives

- Increase number of domestic suppliers in clean energy sectors
- Help communities expand job creation opportunities in clean energy sectors

Services

- supply chain opportunity workshops / webinars
- technical assistance to companies
- clean economy strategic plans for communities
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<td>Manufacturing Opportunities in Mass Transit</td>
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*View archived webinars at [www.thecemc.com](http://www.thecemc.com) under “Latest News”*
Agenda

- Jacques Koppel, CEMC Director
- Market Conditions and Forecasts for GHP
  - Ted Clutter, Manager of Outreach and Member Services at Geothermal Exchange Organization
- Manufacturing Perspective
  - Herb Batrouny, Sr. Vice President of Asia Pacific Operations at WaterFurnace International
  - David Henrich, Vice President, Bergerson Caswell, Inc
- Questions and Answers
  - Submit using Chat

www.theCEMC.com
Geothermal Heat Pumps
Market Perspectives and Challenges

Ted J. Clutter for GEO – The Geothermal Exchange Organization
GEO is the Voice of the Geothermal Heat Pump Industry in the United States

Advocacy • Partnerships • Outreach • Standards

OUR OBJECTIVES

• Sensible Public Policy
• Common Interests with Allies for Strength In Numbers
• Public Relations and Outreach
• Promotion of Quality in Training, Certification and Accreditation
Geothermal Heat Pumps 101
Buildings Dominate U.S. Energy Use
Especially for Heating, Cooling, and Water Heating

43% of U.S. Carbon Emissions
- Industry 377 MMTC (25%)
- Buildings 668 MMTC (43%)
- Transportation 482 MMTC (32%)

71% of U.S. Electricity

53% of U.S. Natural Gas

39% of U.S. Primary Energy Consumption

Thermal Loads
- Heating 9.2%
- Cooling 4.3%
- Hot Water 3.8%
- Total 17.3%

~ 20% of all U.S. Carbon Emissions
What are Geothermal Heat Pumps?

Geothermal Heat Pumps harness the Sun’s renewable energy that is stored in the ground beneath our feet through a process called “GeoExchange.” They help our environment by saving energy, cutting use of fossil fuels, and reducing carbon emissions.

It’s Simple!

- Underground temperatures are cooler than the outside air in the summer, and warmer than the outside air in winter.

- So during the winter, a Geothermal Heat Pump System transfers heat from the ground into your building.

- And in summer, a Geothermal Heat Pump System removes heat from your building and puts it back into the ground.
What GeoExchange IS NOT

GeoExchange and geothermal heat pumps ARE NOT a renewable energy technology for geothermal electric power generation, which depends upon the presence of deep, hot geologic resources.

“Heat transferred from the ground or recycled from waste streams by a GHP system is just as ‘renewable’ as geoheat and far more economical....”  
Source: Patrick Hughes, ORNL - 2008
Solar energy maintains a nearly constant temperature year-round within several feet of the Earth’s surface.
U.S. Underground Temperatures

* At well depths of 30 to 60 ft
Geothermal Heat Pump System Basics

Geothermal heat pumps circulate water through a sealed pipe loop underground...

Where it is naturally warmed or cooled by the Earth.
Geothermal Heat Pumps

GHPs are self-contained units that efficiently heat and cool both commercial buildings and homes while providing hot water.

They use standard duct systems and electronic thermostats, making ideal for retrofits of standard HVAC systems.
How Geothermal Heat Pumps Work

Cooling Mode

Supply Air

Return Air

Heating Mode

Supply Air

Return Air

water heater

heat dispersion

heat absorption
Geothermal Heat Pump Components
GHP Ground Loop Options

There are several ways to connect your home to the Earth’s “Energy Battery”

**Horizontal loop**
Where space allows, the sealed piping loop is buried in trenches from 3 to 6 feet deep.

**Vertical loop**
Where space is limited, the sealed piping loop is inserted in boreholes from 150 to 400 ft. deep.

**Well water loop**
Where groundwater is adequate, well water can be used directly without a sealed piping loop.

**Pond loop**
When a water body is available, the sealed piping loop can be submerged beneath the surface.

**Standing Column Well**
Where near-surface bedrock is available and groundwater is of limited quantity and adequate quality. With adequate well length, well water can be directly used instead of the sealed piping loop.

**Closed Loop Systems**
- The loops reject and absorb heat to and from the ground
- High Density Polyethylene Pipe
- Guaranteed 50 Year+ Life
- 0.75” to 1.5” diameter in size
- Contains water or water and anti-freeze solution for heat exchange
- Invisible after land is graded
GHPs Efficiently Transfer Heat

1 kWh of electricity from the grid to operate a GHP system

PLUS

3 to 5 kWh of energy absorbed from the Earth

FREE

YIELDS

4-6 kWh of energy for your building

400 to 600% Efficiency!
GHPs Cut Home Energy Use by Half

Over 70% of the energy consumed by a typical single-family detached home is used to meet thermal loads.

Total residential site energy consumption is cut in half using a Geothermal Heat Pump System.

**Source:** U.S. Department of Energy
Pensacola McDonald’s with a GHP

47% Less Power Consumption Compared to Conventional System

Source: Gulf Power
GHP Market Perspectives
The U.S. Geothermal Heat Pump Market

- Current rate of ~85,000 units installed annually
- Average GHP system is 3 tons, and costs approximately $17,000
- Approximately 1.5 million TOTAL Geothermal Heat Pumps installed

U.S. Geothermal Heat Pump installations have doubled in past decade

Geothermal Heat Pumps are now a $1.7 billion per year domestic industry

Currently 670 MW$_{TH}$ Renewable Geothermal Capacity installed per year

The GHP Industry is poised to explode when the U.S. economy rebounds
GHP Share of Housing Market

Stages of Development in the International GHP Market

GHPs ~5% of U.S. new single-family HVAC in 2010

While Europe Installs a Million GHPs per year!
North American Geothermal Heat Pump Industry Shipments

Single Family Residential - Currently 40% of Total
- New Homes 30%
- Existing Home Retrofits 70%

Commercial – Currently 60% Total
- Schools and Universities
- Public and Government
- Religious Buildings
- Multi-family Housing
- Office Buildings
- Retail

Graph showing the trend of North American Geothermal Heat Pump Industry Shipments from 1983 to 2011 with estimated values.
## The Geothermal Market

AHRI North American Geothermal Industry Shipments 2010

<table>
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<tr>
<th>Reported shipments</th>
<th>78,758</th>
<th>% of market</th>
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<tbody>
<tr>
<td>PA</td>
<td>6,662</td>
<td>8%</td>
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<tr>
<td>OH</td>
<td>6,120</td>
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<tr>
<td>NY</td>
<td>4,448</td>
<td>6%</td>
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<tr>
<td>IN</td>
<td>4,401</td>
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<tr>
<td>MI</td>
<td>3,802</td>
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</tr>
<tr>
<td>IL</td>
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<tr>
<td>GA</td>
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<tr>
<td>NE</td>
<td>2,137</td>
<td>3%</td>
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<tr>
<td>IA</td>
<td>2,128</td>
<td>3%</td>
</tr>
<tr>
<td>DC</td>
<td>1,961</td>
<td>2%</td>
</tr>
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</table>
GHPs are used in Large Commercial and Government Buildings

Statue of Liberty Gift Shop
ASHRAE Headquarters - Atlanta, GA
Galt House Hotel - Louisville, KY
Black Point Inn - Prouts Neck, ME

Naval Observatory, Washington DC
Harvard Library – Cambridge, MA
French Laundry Rest.- Napa, CA
Whistler Village - BC, Canada

Yale Art Bld. – New Haven, CT
Gaillardia Offices – Okla. City
California University of PA
Hirschfeld Towers – Denver, CO
U.S. Department of Defense

2010 Energy Management Report
Directs U.S. Military Energy Efficiency Efforts, While Various Branches Use GHPs at Many of Their Installations

ARMY - Fort Lee

AIR FORCE - Charleston

NAVY - Oceana
A ground- or water-source heat pump system **must** be considered for any new or retrofit heating and cooling system.

“The ground-source or water-source heat pump systems must have field-installed controllers, current-sensing devices that transmit information to the BAS for calculating the energy consumption of the pump and compressor motors, and metering devices for determining energy consumption data and must be capable of transmitting the data to the central building automation system.”
Federal Tax Incentives

**RESIDENTIAL Income Tax Credit**
- 30% of total GHP system cost
- No cap on maximum credit
- Can be used to offset AMT
- Can be combined with other tax credits
- Can be used in more than one year

**Eligibility**
- Home must be located in the U.S.
- Includes houses, coops, condos, mobiles
- Does not have to be your main place of residence
- GHP must meet Energy Star requirements set by the EPA
- GHP heating and cooling system must be placed in service before 2017
Federal Tax Incentives

COMMERCIAL Tax Credit
- 10% of total GHP system cost, no cap
- Can be used to offset AMT tax
- Can be combined with subsidized financing
- Can be used in more than one year

Accelerated Depreciation
- 5-year MACR depreciation entire system
- Bonus depreciation (50% write-off first year) through 2013

Eligibility
- Building must be located in the United States
- Original use begins with taxpayer
- Must be placed in service before 2017
- Can be used by regulated utilities
- Must be claimed by property owner
State Incentives for GHPs

37 States have Financial Incentives for GHPs
- Sales and property tax exemptions, income tax credits, grants
- 17 States have tax credits or grants

28 States have Regulatory Incentives for GHPs
- Green public building requirements

36 States have Utility Incentives for GHPs
- Voluntary DSM
- Mandated RES and EES
- Loans and rebates
- **Utility Interest is Growing**
Potential GHP Market Drivers

Continued Federal and State Tax Credits

Delivered Energy Cost
• Fuel Oil
• Propane
• Natural Gas
• Electricity (Pacific Northwest)

Utility and State Financing Programs

Zero Energy Buildings and Homes
Zero Energy Buildings are GeoSolar Buildings

Cost-effective Zero Energy Buildings use solar systems AND geothermal heat pumps

- The perfect mix for true Net Zero or Near Zero buildings.

- GHPs combine the benefits of building & HVAC system efficiency, renewable thermal energy and PV electricity.

- Air source heat pumps simply use too much power for the work they do, and create high peak energy demands.

- Only GHPs can store thermal energy, using the ground as an “energy battery,” and their ground loops can be sized to maximize unit efficiency.
GHP Market Challenges
Geothermal Market Barriers

- Consumer Awareness and Confidence
- High “First Cost” vs. Other HVAC Options
- Qualified Design and Installation Work
- Energy Savings Not Appraised or Appreciated
- Utility Partnering, Promotion and Innovation
- Equal Treatment Under Environmental Rules
- Strong Industry Voice and DOE Program

Source: Industry / DOE Meeting, National Renewable Energy Laboratory, 2009
GHP Policy Challenges

We don’t fit into existing boxes

• Efficiency or Renewable?

• Geothermal or Building Technology?

• Good or Bad?
  - Increase electricity use, but decrease fossil fuel use
  - Environmental aspects of drilling
  - Continuing problems with poor designs and installations in the wrong places
Geothermal Heat Pumps Deserve More Respect
Current GEO Initiatives

Support for Geothermal Technologies Research
• Geothermal Exploration and Technology Act

GHP Program Office and EIA Data Collection (DOE)

Inclusion of GHPs in Energy Efficiency Legislation
• SBI 761, Energy Savings & Industrial Competitiveness Act

Retention of Residential and Commercial Tax Credits

Inclusion of Thermal (GHP) Technologies in any new Renewable or Clean Energy Standard Legislation

Support of State-Level GHP Association Activities and Initiatives

Support of Federal "Green" Building Initiatives
GSA, FEMA, EPA, and Departments of Education and Defense

Partnering to Develop GHP Installation Certification Standards
No Regrets
For More Information About Geothermal Heat Pumps...

**GEO** - Geothermal Exchange Organization

www. GeoExchange.org

International Ground Source Heat Pump Association

www.igshpa.okstate.edu

Call GEO with specific questions at **(888) 255-4436**
Manufacturing Opportunities in Geothermal Clean Energy

-Herb Batrouny

herb.batrouny@waterfurnace.com
Agenda

• Market Size
• Supply Base Ties to Air Source Products
• Key Components
Geothermal Market Size
(annual in units)

• Domestic Systems - 180,000
  o Ground Source, Boiler/Tower
  o Residential/Commercial

• International
  o Data is not reported although technology is used in UK, Europe and Asia
  o Mostly Commercial applications and large villa projects as mini-splits dominate Residential space
Component Ties to Air Source Products

• Many Suppliers and components used in the manufacturing of Geothermal Heat Pumps are common with the Air Source HVAC equipment industry (5,000,000+ units sold annually)

• Supply base for the most part is mature and entrenched

• Most suppliers produce in LCC (China, Mexico) or both
Residential Variable Speed System
Key Components % of Material Cost

- Compressors: 19%
- Coax Hx: 17%
- Air Coils: 15%
- Controls: 12%
- Sheet Metal: 11%
- Motors: 7%
- Valves: 5%
- Pumps: 4%
- Packaging: 2%
- Refrigerent: 1%
Compressors

- “Heart of the System”
- Common with Air Source
- Mostly made in Mexico and China, few in USA
- One per unit
- Insides are hermetic motor and mostly steel, copper, aluminum
- Technology will move to inverter driven, VS over next decade
Coax Heat Exchanger

- Not Common with Air Source
- Made in the USA
- One or two per unit
- Insides are copper, steel, nickel
Air Coils

- Common with Air Source
- Made in the USA
- One per unit
- Aluminum tube, Aluminum fin
Controls

- Common with Air Source, in general
- Made in USA
- Two or three per units depending on functionality
- Joint development between OEM and Supplier
Sheet Metal

- Most Air Source make their own
- Made in the USA, steel is a mix between domestic and foreign
- Parts are steel, insulated, powder coated
Motors

- Common with Air Source
- Made in Mexico and China
- One per unit
- Insides are steel, copper, aluminum
Thank You!!!
Herb Batrouny
herb.batrouny@waterfurnace.com
GHP Field Installation

Presented by:
David Henrich
Bergerson-Caswell, Inc.
GHP Loop Well Drilling
GHP Loop Well Installation
GHP Loop Well Grouting
GHP Horizontal Pipe Installation
GHP Manifolds and Vaults
Materials Used During Drilling and Installation

**Drilling**
- Bentonite drilling fluids
- Drill rods, bits and other drill tools
- Steel pipe
- Drilling fluid additives (polymers)

**Loop Well Installation**
- HDPE Pipe
- Bentonite grout
- Silica sand
- Pipe cutters and other small hand tools
- Duct tape
- Disposable weights
- Portland cement (MN & MI)
Materials Used During Horizontal Piping

**In-Trench Headers**
- HDPE Pipe sizes 3/4” - 4”
- Fittings - tees, elbows, reducing tees
- Heat fusion irons, faces, and other equipment
- Tracer wire
- Foil backed tape
- Styrofoam insulation

**Manifolds & Vaults**
- Large diameter HDPE pipe 4” and up
- Butterfly valves
- Balancing valves
- Pressure, temperature and flow sensors
- Flanges and adapters
- Pipe insulation
- Propylene glycol (anti-freeze), inhibitors, biocides
Thank You!

David Henrich
Vice - President
Bergerson - Caswell, Inc.
david@bcgeo.com
Direct: 952.255.7000
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For Further Information

• Contact Linda Nielsen, Program Manager, Clean Energy Manufacturing Center, lindan@thecemc.com, 612.466.4506

• Or visit our website at www.thecemc.com

Be with us next month as we provide a quick 1 hour overview of manufacturing opportunities in a variety of Clean Energy markets – 4th Wednesday at 1:00 Eastern