DISCUSSION AGENDA

1. INTRODUCTIONS
2. Utility GEO PLANS
3. SEG, LLC AS AN IMPLEMENTER
4. FRE AS A THIRD PARTY OWNER/FINANCIER
5. MIX AND MATCH MODELS TO REMOVE THE HIGHER FIRST COST BARRIER
6. UTILITY BENEFITS
7. USING THE GLIDESLOPE TO CPP
8. INDUSTRY RESEARCH
9. IDENTIFYING THE BEST MARKET STRATEGY
10. NEXT STEPS
There are two paths to go by, but in the long run; there is still time to change the road you are on!

• Utility Incentives
  – Do they really do anyone good; or just raise the price to the consumer? Maybe mess with the competition?

• Manufacturer Rebates
  – Why would a manufacturer extend discounts?

• Contractor Discounts
  – Is the trade (HVAC/R) that slow?

• Federal Tax Credits
  – Tax Credits expire at the end of 2016 for our industry!
WHAT IS THE FUTURE OF HVAC/R

• SHORT TERM HARD TO FORECAST
• LONG TERM ALL SPACE CONDITIONING AND WATER HEATING WILL BE WITH HEAT PUMPS..
  – {Citation: Bob Wyman, consultant}
Abstract:

Space conditioning is critical for productivity and consumes massive energy flows. Historically, space conditioning was just part of the home or facility. Higher energy prices and environmental consequences required new considerations. Air conditioning and heating units have improved and become more efficient over time but require considerable inputs of fossil fuels. The space conditioning market is segmented by consumers, industries, and trades; and an opportunity exists to bring together these segments. Dual Source Heat Pump units can bridge these segments with the innovation of uniting an ASHP, GHEX, and a thermal services agreement. A dual sourced heat pump system builds upon:

The very large production, installations and low unit costs of ASHPs

Renewable and recoverable energy, making energy sustainable, is obtained from the earth with a GHEX. And by using third party funding, through a thermal service agreement, the GHEX can be built. Therefore, it overcomes the higher first cost barrier due to the GHEX for the consumer.

Dual Source Heat Pumps and third party financing would attract electric, natural gas and water utilities with year round consumers of their services and products. Utilities could offer thermal service agreements for the GHEX.

Additionally, the bridging will require the use of the following:

- Initial Feasibility Study
- Design, Build, Easement of Record, Thermal Services Agreement, and Fee Schedule(s) Agreement
- Easement of Record
- Design, Build, Install and Start-up Fee Schedule
- EGT Thermal Service Agreement
- Limited Partnership Agreement Of Ground Source and Heat Exchanger Utility
“The Engineers Explanation”
using the Big Picture
Comparing Darcy’s Law (flow of water) with Fourier’s (flow of heat) and Ohm’s (flow of current)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Flow of water</th>
<th>Flow of heat</th>
<th>Flow of current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>Volume- ( V ) (m(^3))</td>
<td>Heat- ( Q ) (J)</td>
<td>Electric charge (C)</td>
</tr>
<tr>
<td>Potential</td>
<td>Head- ( h_t ) (m)</td>
<td>Temperature- ( T ) (K)</td>
<td>Voltage (V)</td>
</tr>
<tr>
<td>Gradient</td>
<td>Hydraulic- ( i_h ) (unitless)</td>
<td>Temperature- ( i_t ) (K/m)</td>
<td>Electric field- ( E ) (V/m)</td>
</tr>
<tr>
<td>Flux</td>
<td>Flow rate- ( Q ) (m(^3)/s)</td>
<td>Heat transfer rate- ( H ) (J/s)</td>
<td>Current flow (C/s)</td>
</tr>
<tr>
<td>Flux density</td>
<td>Velocity- ( v ) (m/s)</td>
<td>Heat flow- ( q ) (J/s.m(^2))</td>
<td>Electrical flux density (C/m(^2))</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Hydraulic conductivity- ( \kappa ) (m/s)</td>
<td>Thermal conductivity- ( \kappa ) (J/s.K.m)</td>
<td>Electrical conductivity- ( \sigma ) (S/m)</td>
</tr>
<tr>
<td>Storage</td>
<td>Compressibility</td>
<td>Specific heat- ( c ) (J/kg.K)</td>
<td>Capacitance/Inductance</td>
</tr>
<tr>
<td>Decay coefficient</td>
<td>Coefficient of consolidation- ( c_v ) (m(^2)/s)</td>
<td>Thermal diffusivity- ( \alpha ) (m(^2)/s)</td>
<td>Electrical diffusivity- ( D ) (m(^2)/s)</td>
</tr>
<tr>
<td>Law</td>
<td>Darcy</td>
<td>Fourier</td>
<td>Ohm</td>
</tr>
</tbody>
</table>

*Heat, \( Q \), is a quantity of energy (classical) measured in Joules (N x m), (ft x lb), or BTUs. Power is the rate of usage in kW·hr or MCF (BTUs prior to combustion) per unit time {Citation: Jean-Luis Briaud, Geotechnical Engineering}*
Three forms of Energy

1. Q (mass and absolute temperature)
2. Potential (or stored, such as a battery or water tower),
3. Kinetic (in motion),
There are two paths to go by, but in the long run; there is still time to change the road you are on!

What is this 3.23 increase all about?
There are two paths to go by, but in the long run; there is still time to change the road you are on!

Energy in the form of BTUs
There are two paths to go by, but in the long run; there is still time to change the road you are on!

Energy in the form of BTUs

60%
So Where has the Proceeding Taken the Market?

Maevelle Energy, Scott Emery, 18th November 2014
Energy Star Certified Geothermal Heat Pump Shipments

2007 - 2013

Source: EPA unit shipment data for ENERGY STAR qualified products, Unit Shipment and Sales Data Archives (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives).
Energy Star Certified Geothermal Heat Pump Shipments
2007 - 2013

Source: EPA unit shipment data for ENERGY STAR qualified products, Unit Shipment and Sales Data Archives

Calendar Year

Geothermal Heat Pump Shipments (units)

2007 2008 2009 2010 2011 2012 2013
Consider Only the Residential and Commercial Markets

• ~10 Quadrillion BTUs by GHEXs
  – Together Residentially and Commercially:
    • How big is this number???? Position as Energy Storage
  – Collective Energy Supply by others, i.e., site sourced and stored renewable energy, onsite power generation (fueled, wind, PV), Electric Utility supply
    • Jeremy Rifkin? Energy Internet? The Third Industrial Revolution? The Second Great Electrification?
    • Remember the 3.23 to 1 loss?
Estimated U.S. Energy Use in 2013: ~97.4 Quads

Source: LLNL 2014. Data is based on DOE/EIA-0035(2014–03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant “heat rate.” The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 63% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527
Residential and commercial combine for a total of 19.99 Quadrillion BTUs of energy usage.

*What are Gas and Electric utilities really good at? “Managing Energy” is their core competence.

*What customers really want from utilities is “how to implement energy systems that are more efficient and use less energy”. Energy costs are eclipsing labor costs in some markets.

*{Citation: Jeremy Rifkin, The Third Industrial Revolution}
What would this look like if HPs and GHEXs were used to meet all the space conditioning and water heating (SC&DHW) needs in Residential and Commercial Markets?
What would this look like if GSHPs and GHEXs were used to meet all the **space conditioning and water heating (SC&DHW)** needs in Residential and Commercial Markets?

Residential 65% of 11.4 = 7.4 for SC&DHW Leaving 4 Quads

Commercial 60% of 8.59 = 5.15 for SC&DHW Leaving 3.44 Quads

That is a total of 12.55 Quads for SC&DHW from Ground Source HVAC/R

Since a GHEX is direct use and a GSHP requires on 20% Electrical Power INPUT (with good design)........
Since a GHEX is direct use and a GSHP requires on 20% Electrical Power INPUT from utility generation or on-site solar PV or wind kW........

65% of 11.4 = 7.4 x 80% = 5.92 direct supplied Leaving 7.4 - 5.92 = 2.2 Quads inputs by electric powering GSHPs

60% of 8.59 = 5.15 x 80% = 4.12 direct supplied Leaving 5.15 - 4.12 = 1.03 Quads inputs by electric powering GSHPs

Source: LLNL 2014. Data is based on DOE/EIA-0035 (2014–03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant “heat rate.” The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527
Since a GHEX is direct use and a GSHP requires only 20% Electrical Power INPUT from generation or solar PV........
Since a GHEX is direct use and a GSHP requires on 20% Electrical Power INPUT from generation or solar PV or wind kW……..

A real opportunity for utilities and/or third party owners (TPO)--
To increase market share, revenue, investment, and reduce CO$_2$e and particulate emissions
and this DOES NOT address the reduction in REJECTED energy, FERC 745, EPA “Haze” or CPP, EPA Rule 111 (d)

Source: LLNL. 2014. Data is based on DOE/EIA-0035(2014–03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant “heat rate.” The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 63% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527
The Second Chapter: “Positioning and Marketing for Ground Source Systems”

--ADVOCACY--
First Cost Barrier

• Currently only those capable to purchase Ground Sourced systems do!
• How do we make it “affordable”? Life cycle costing!
• How do those with a modest income get a Ground Source system? 3rd party financing! Copy solar PV business model!
First Cost Barrier

• Would you invest in a ground heat exchanger?
• None of the heat pump manufacturers or electric utilities are using their federal tax dollars to invest in GHEXs; or their employees 401Ks.
First Cost IS THE Barrier

• Just pay for the GHEX if you are capable, and what is the payback?
• Incentives
  — Utility Incentives
    • Do they really do anyone good; or just raise the price to the consumer?
  — Manufacturer Rebates
    • Why would a manufacturer extend discounts?
  — Contractor Discounts
    • Is the trade (HVAC/R) that slow?
  — Federal Tax Credits
    • Tax Credits expire at the end of 2016 for our industry!?
• On-Bill financing by Utility
• On-Bill payments through Utility
• Utility Tariff for the GHEX (SEG, EW_BANK, IGSHPA, AND AEEOK ARE ready to help, others?)
• 3rd Party financing for the GHEX (requires sophisticated financiers)
  — PACE (FHFA removed their objections (Investor Confidence Project))
  — Debt
  — Operating lease
  — Capital lease
  — Tariff, Thermal Services Agreements, PPA, Easements of Record
  — LPs, MLPs, REITs (the GHEX is essential to space conditioning water heating)
  — Rural Electric Coops using USDA Energy Efficiency and Loan Program (within a tariff)
Oklahoma Geothermal Technology Seminar

Attack the “First Cost Barrier”: Change Markets/Customers

David Thomison
GHP Company Targeted Customers

✓ Residential Home Builders \((New)\)
  
  • Competes on $/Sq. Ft. in Market
  • Constrained Capital Resources
  • Moderate to High Cost of Capital

✓ Residential Homeowners \((New \& Retro-fit)\)
  
  • Mortgage Loan & Equity Down Payment
  • High Marginal Cost of Capital
  • Sensitive to Payback Term
  • Retro-Fit Time Delays Challenge

✓ Commercial Property Owners
  
  • Spread between Total Tenant Rent vs. Cost Capital
## Current Market/Product Fit Status

### Residential/Commercial Markets
- Not Technologically ‘Savvy’
- Capital Constrained
- Short Payback
- Brand Preference
- Educational/Custom Sale
- Fixed Energy Rate
- Renewable/Green

### GHP Products
- Technologically ‘Scary’
- Larger Capital Investment
- Moderate Payback
- Multiple Installers/Parties
- Customer Acquisition Cost
- No Fuel Escalation
- Renewable/Green
Energy Star Certified Geothermal Heat Pump Shipments
2007 - 2013

Source: EPA unit shipment data for ENERGY STAR qualified products, Unit Shipment and Sales Data Archives (https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data_archives).
## Current Market/Product Fit Status

### Utility Markets
- Technologically ‘Savvy’
- Strong Capital/Finance
- Long-term Payback (Assets)
- Manages Multiple Vendors
- Large Customer (Resales)
- Fuel Mix Diversification
- Renewable/EPA Compliant

### GHP Products
- Technologically ‘Scary’
- Larger Capital Investment
- Moderate Payback
- Multiple Installers/Parties
- Customer Acquisition Cost
- No Fuel Escalation
- Renewable/Green
Residential or Commercial/Utility Company Market/Product Fit

**Residential/Commercial Markets**
- Monthly Energy/Geo Bill
- Reduce Inflationary Fuel Risk
- Competitive Energy Price
- Strong Energy Brand
- Renewable/Green Energy
- Purchases Comfort

**Utility GHP Products**
- Geothermal Rate Tariff
- No Fuel/Fuel Diversification
- Drive Geo Econ. Of Scale
- Main Energy Supplier
- EPA Compliant/Tax Credits
- Sales Energy Units - BTUs
Utility Value/Motivations

• Convert Fuel Revenue into Profitable Revenue
• Increase Rate Base & Earnings
• Diversify Fuel Mix to Strength Long-term Competitive Positioning
• Increase Marketing Options
  ▪ Fixed Price Contracts
  ▪ Green Power Premium Pricing
  ▪ Federal (Commercial Customer) Mandates
• Leverage Customer Databases – Low Acquisition Costs
• EPA Compliance/Tax Credits
• Leverage Low Marginal Customer Costs
• Pre-emptive Decentralized Generation Strategy
• Smaller Cost Effective Capacity Increments
Utility Geothermal Rate Tariff

Weighted Average Cost of Capital (WACC):

\[
WACC = (% \text{Debt} \times \% \text{Debt Rate}) + (% \text{Equity} \times \% \text{ROE})/(1-\text{Tax Rate})
\]

\[
= (47\% \times 4\%) + (53\% \times 10\%)/(1-.35)
\]

\[
= 10\%
\]

Cost of Capital Revenue Requirement:

\[
\text{Capital Revenue} = \text{Rate Base} \times \text{WACC}
\]

\[
= $450,000 \times 10\%
\]

\[
= $45,000
\]

\[
\text{Depreciation Rev.} = \text{Rate Base} / \text{Asset Life}
\]

\[
= $450,000 / 45 \text{ years}
\]

\[
= $10,000
\]
Customer Energy Conversion
Value Proposition

Current Commercial Customer Billing:

\[
\text{Energy Units} \times \text{Energy Rate} = \text{Customer Cost}
\]

\[
1,000,000 \text{ kWh} \times \$0.12/\text{kWh} = \$120,000 \quad \text{Total} = \$120,000
\]

Energy/Geothermal Commercial Billing:

Geothermal Savings = 500,000 kWh

Geothermal Energy Unit Rate = $55,000 / 500,000 kWh

\[
= \$0.11/\text{kWh}
\]

\[
\text{Energy Units} \times \text{Energy Rate} = \text{Customer Cost}
\]

\[
500,000 \text{ kWh} \times \$0.12/\text{kWh} = \$60,000 \quad \text{Total} = \$115,000
\]

\[
500,000 \text{ kWh} \times \$0.11/\text{kWh} = \$55,000
\]

Savings = $5,000
Utility Geothermal Earnings Impact

Current Customer:

\[
\text{Energy Revenue} = 1,000,000 \times \$0.12/kWh \quad \$120,000
\]

Less: Fuel Expense = 1,000,000 \times \$0.04/kWh \quad \$40,000

Gross Profit – Current \quad \$80,000

Geothermal Converted Customer:

\[
\text{Energy Revenue} = 500,000 \times \$0.12/kWh \quad \$60,000
\]

\[
\text{Geothermal Revenue} = 500,000 \times \$0.11/kWh \quad \$55,000
\]

Total Revenue \quad \$115,000

Less: Fuel Expense = 500,000 \times \$0.04/kWh \quad \$20,000

Gross Profit – New Program \quad \$95,000
A RATE BASED TARIFF FOR THERMAL STORAGE

- Commercial and residential customers predominantly purchase energy for spacing conditioning (i.e. comfort). A Utility Company’s deployment of a decentralized “Ground Source” energy generation strategically enables the Utility to:

  - Convert “Fuel Revenues” into a NEW rate base energy tariff, which has NO Fuel Revenues, and therefore organically grow the Utility’s earnings with existing customers while potentially not impacting the Customer’s total current energy cost. The strategic renewable offering dramatically improves the Utility’s “gross profit” margin.
A RATE BASED TARIFF FOR THERMAL STORAGE

– The opportunity to invest in a new long life asset class (ground source loops @ 50 years) which possess the potential to actually appreciate in value given that traditional “fossil fuels” increase in price due to traditional inflationary pressures.

– The flexibility to create innovative energy offerings such as premium “Green Power”, “fixed rate” and “LEED Neighborhood Developments” energy contracts for geo portion, individualized customer fuel hedges, etc.
A RATE BASED TARIFF FOR THERMAL STORAGE

– Generate positive Public Relations via an expanded “renewable” energy offering at currently cost competitive energy prices.

– Assist Governmental customer in achieving Federal Energy mandates while ironically increasing Utility earnings.

– Further diversify the Utility’s Generation mix portfolio.

– Reacquire existing Peak Generation Capacity at a negligible cost versus typically current Demand Side Management incentives.
Pivot to a New Market/Product Fit

A real strategic opportunity for utilities grow earnings (or cash flow), leverage existing customer relationships, build competitive barriers to non-utility market entrants, diversify the Fuel Mix, help Federal customers achieve mandates, strengthen public relations with “Green/Renewable” power, and improve compliance to EPA regulations. Make the paradigm shift: Sell Profitable BTUs & comfort!
WHAT DOES THIS MEAN GEOGRAPHICALLY IN USAGE AND DEMAND?

• SITE LOCATION:
  – DUANE HARMAN, P.E. & ANDREW FRENIER
  – 100 TON Consumption Simulation.xlsx
A RATE BASED TARIFF FOR THERMAL STORAGE

• A RATE STUDY FOR DISCUSSION
  – SPREADSHEET analysis by David Thomison, SEG utility member and treasurer
  – INCOME OPTIONS FOR A UTILITY
First Cost Barrier

• HOW TO SCALE THE GHEX INSTALLATIONS WITHIN A TARIFF OR TPO:
  – Source Energy Group, SEG, LLC (THE IMPLEMENTERS)
    • GeoAire (Garry, Garen, Justin)
    • Ewbank Geo Testing (Garen, Duane)
    • Harman Engineering (Duane)
    • HKS (Justin)
  – Francis Renewable Energy, LLC (THE TPO)
    • David Jankowsky
    • Agreements are in place with SEG as the implementer
Dual Source Unit (1)

- HKS CONTROLS AND LOGIC
- GEOAIRE DUAL SOURCED UNITS
- SOURCE ENERGY GROUP
- EWBank GEO TESTING
- HARMAN ENGINEERING
Dual Source Units (2)
Dual Source Units (3)
Logic diagram
CREATING A UTILITY CLASS ASSET

PAST DEPLOYMENTS FAILED!
WHY: LOWERING FIRST COSTS
TO INCREASE PROFIT
MARGINS CAUSED POOR
INSTALLATIONS
CREATING A UTILITY CLASS ASSET

REVIEW A NEW DESIGN STRATEGY
TO ELIMINATE RISKS

DESIGN PROCESS
The Plan

• How to differentiate between “capable”, “affordable”, and “best” (should be our playbook—remember IGSHPA Tulsa in 2008?)

• Earth Storage, using a GHEX, the best of any batteries and/or storage, BTU to BTU, no kW or MCF conversions

• Turn Neighborhoods Developments into Green NDs using 3rd party financing for the GHEX

• Energy Internet--EI (TIR? SGE?)
The Plan is to Join the Third Industrial Revolution (TIR) by Participating in the “The Second Great Electrification (SGE)”

1. Get the marketing types, not the accountants, to write the “GHEX play book within the TIR and SGE” (what is a GHEX worth in 10 yrs?). Discover a Business Model.

2. Demonstrate (engage an implementation team--SEG) the idea of turning a neighborhoods into a “Green Neighborhood Developments (Green ND)”

3. Use Groups (like Energy Wise Partners) to capture “big data” from the Green ND

4. Engage a “Google or OG&E” to explain the Green ND’s “energy value to an energy internet (EI)” from the big data

5. Partner with a sophisticated financier

6. LI + EI + CI = IoT; Logistics Internet + Energy Internet + Communications Internet = Internet of Things