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The Premier Energy Training Workshop and Trade Show for Federal Agencies

A River of Energy Solutions

Ground Source Heat Pump Case Studies

Paul Bony - ClimateMaster

Ground Source Heat Pump Case Studies

- Describe actual case studies from one of the leading GSHP manufacturers.
- Provide insight on how to avoid problems

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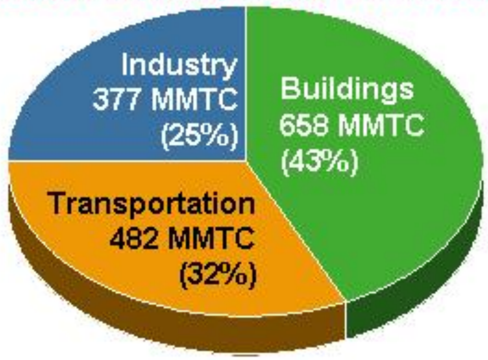
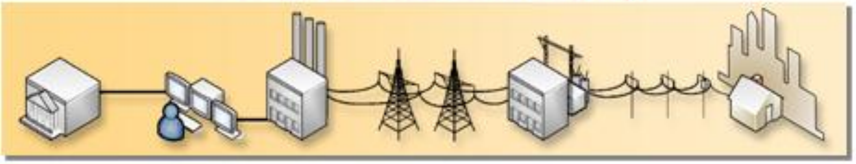
Buildings Dominate U.S. Energy Use and Carbon Emissions
with Heating, Cooling, and Water Heating being the Largest Contributors

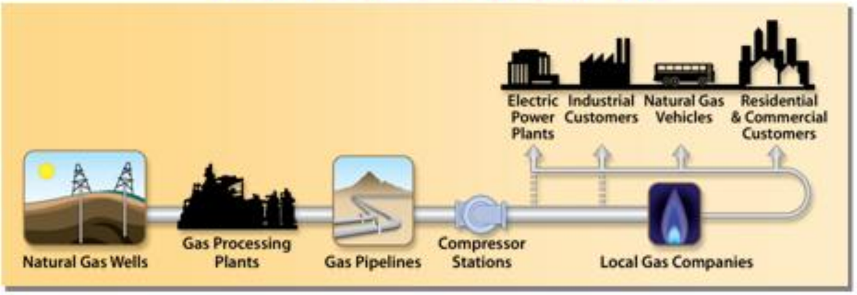
43% of U.S. Carbon Emissions



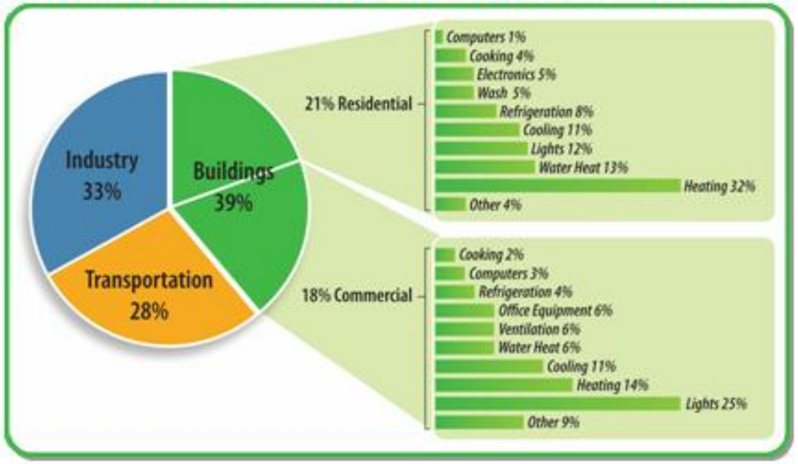
71% of U.S. Electricity



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

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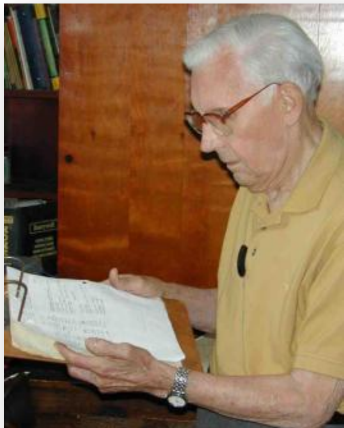
History

- Heat pumps are not new -
  - 1748: William Cullen demonstrates artificial refrigeration
  - 1834: Jacob Perkins builds a practical refrigerator with diethyl ether
  - 1852: Lord Kelvin describes heat pump theory
  - 1855–1857: Peter Ritter von Rittinger develops and builds the first heat pump
  - Ice-making ammonia brine plants were in use in the latter part of the 19th century

History



Mr. Bill Loosley, designed and installed a direct exchange geothermal system in his home in Burlington, ON in 1950

Courtesy Mr. Ed Lohrenz, CGD, GeoXergy

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History

Belt drive compressor

Air coil in old oil furnace

Desuperheater added to hot water tank

Courtesy Mr. Ed Lohrenz, CGD, GeoXergy

History

Compressor was initially powered by hand crank diesel motor… changed to electric motor (still being used!!) in 1953 when his wife couldn't start it.

Courtesy Mr. Ed Lohrenz, CGD, GeoXergy

Geothermal Heat Pumps

Statue of Liberty Gift Shop

ASHRAE Headquarters - Atlanta, GA

Galt House Hotel - Louisville, KY

Black Point Inn - Prouts Neck, ME

Alta Condos, 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

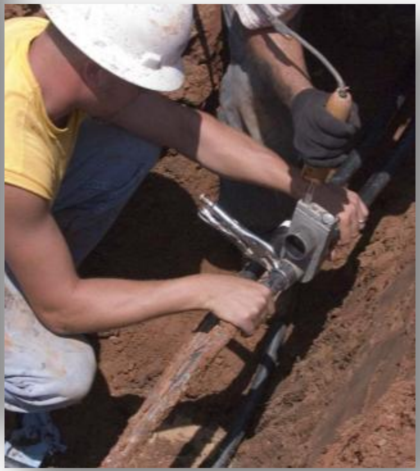
Hirschfeld Towers – Denver, CO

Commercial Buildings

Basics

Drilling*

Pipe Loop Insertion



Fusing Piping

Loops Ready for Unit

Installed Heat Pump

* or horizontal, surface water

Basics

Oak Creek School, CO ←

Fleming School, CO →

Las Animas School, CO ←

Greybull School, WY →

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GSHP System Example Installations – Horizontal Loop Installations

Basics

Manitoba, Canada

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Basics

- GSHP efficiency, the real world:
  - 3,200 ft² residence, Montrose, Colorado, $325 per year to heat and cool – forced air, water-air HP, new construction
  - 3,600 ft² residence, Gunnison, Colorado, $250 per year to heat – radiant floor, water-water HP, new construction
  - 2,700 ft² residence, Golden, Colorado, $355 per year to heat, cool & make 100% of the domestic hot water – forced air, water-air/water HP, retrofit of 25+ year old home
- Each of these examples use separate power meters to monitor the electricity consumed for the GSHP system

Basics

Geothermal Heat Pumps are a Scalable Technology

1,300 Sq. Ft. Low Energy Habitat for Humanity Homes- Oklahoma City

Alta Condos, Washington DC

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Hope Crossing Project Oklahoma City, OK

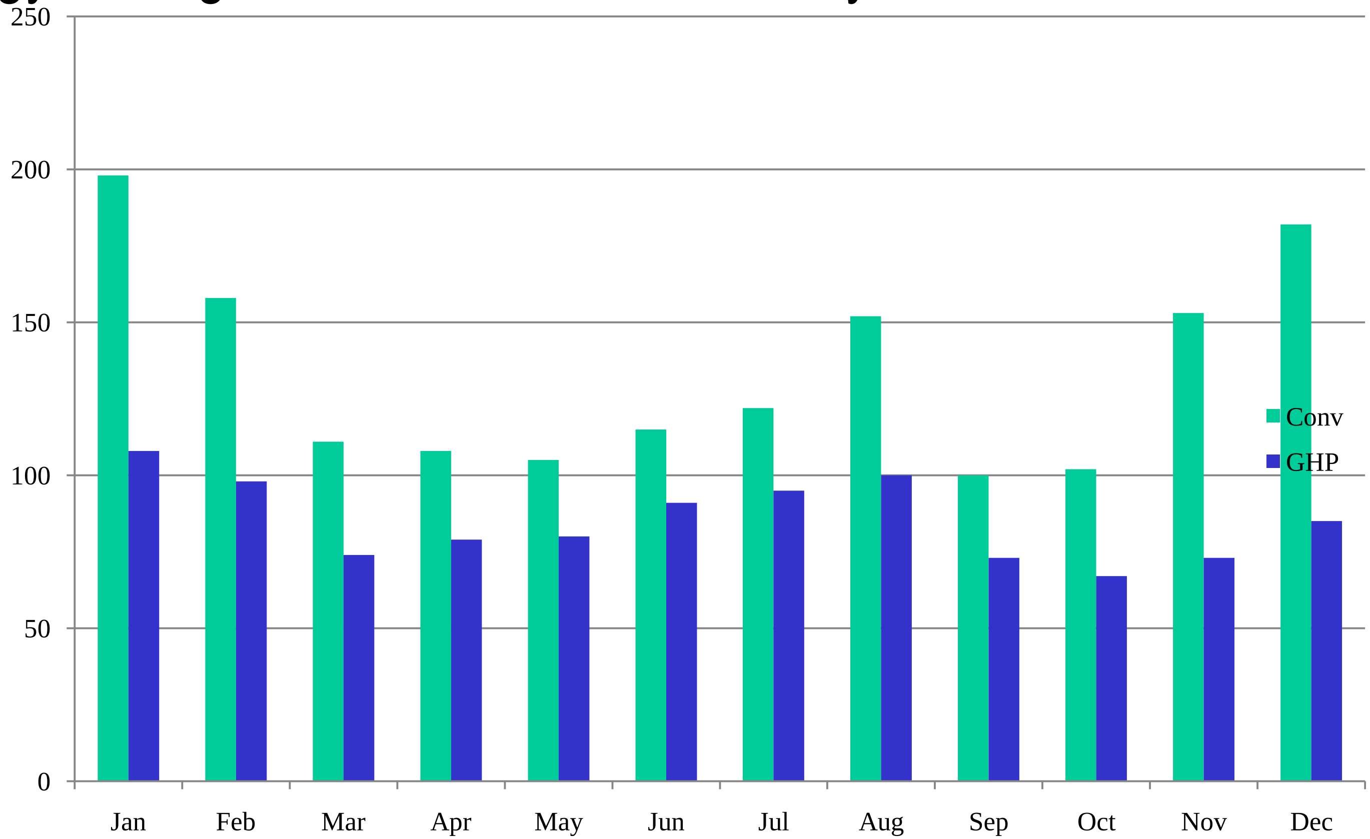
- Administered by Habitat for Humanity, Int'l
- Construction Started in 2004
- GHP home construction began in 2006
- Goal of an additional 240 homes with GHP
- Goal - to demonstrate cost savings on a mass market scale

Hope Crossing Project Oklahoma City, OK

- Break the GHP first cost barrier
- Install one 400 ft loop under the foundation
- Achieve the greatest cost-effective energy efficiency level
- Track energy use to establish baselines
- Use the program for publicity purposes to:
  - Make it the "default" case in future HFHI projects
  - Attract more donations to HFHI to create more projects

Hope Crossing Metered Energy Costs ($)

Energy Savings = $1606 - $1023 = $583/yr



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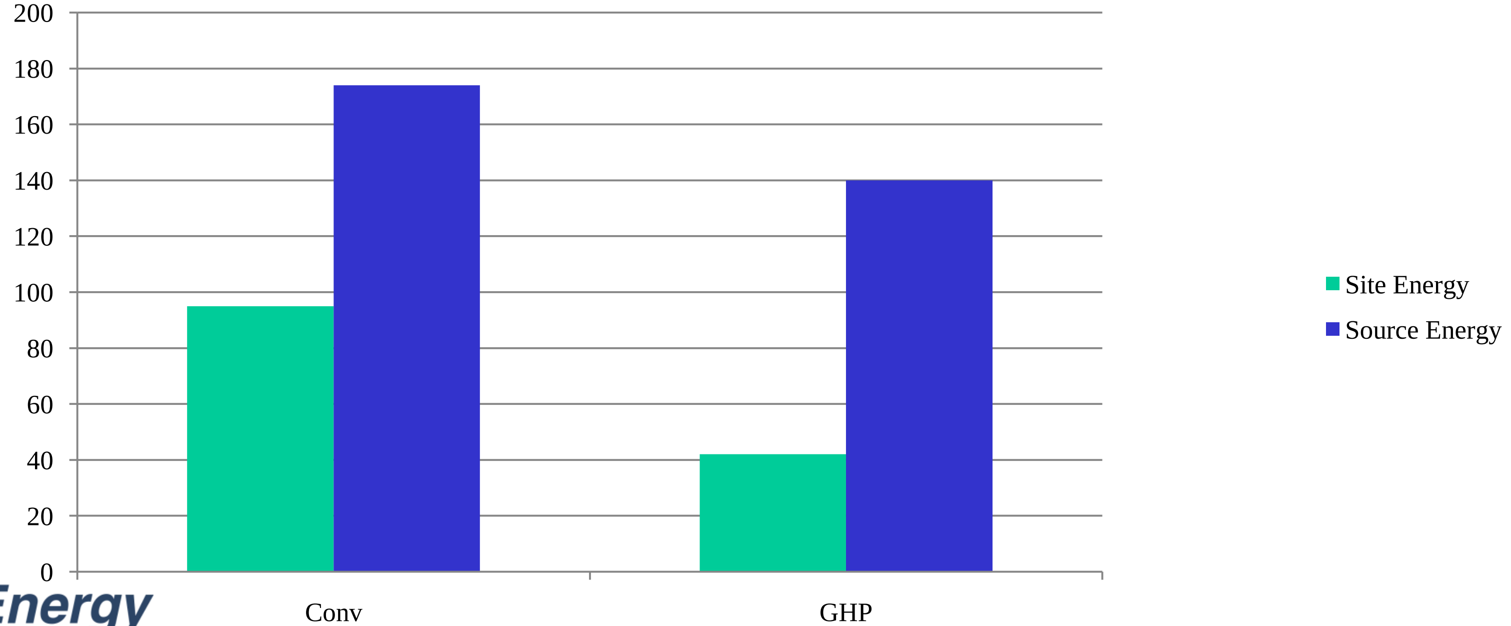
Hope Crossing Site and Source Energy Consumption (MM Btu/ton)

Source Energy Benefits of GHP

34 MM Btu /yr lower for GHP = 17 MM Btu per Ton

1 ton of CO_2/yr reduction per ton of GHP



A Tale of Two Buildings

PROJECT RESULTS FROM:

A "side by side" Comparison of a Ground Source Heat Pump System vs. Conventional HVAC System between two "identical" buildings.

- Palo Alto, CA
- Oklahoma City, OK

Oklahoma City Buildings

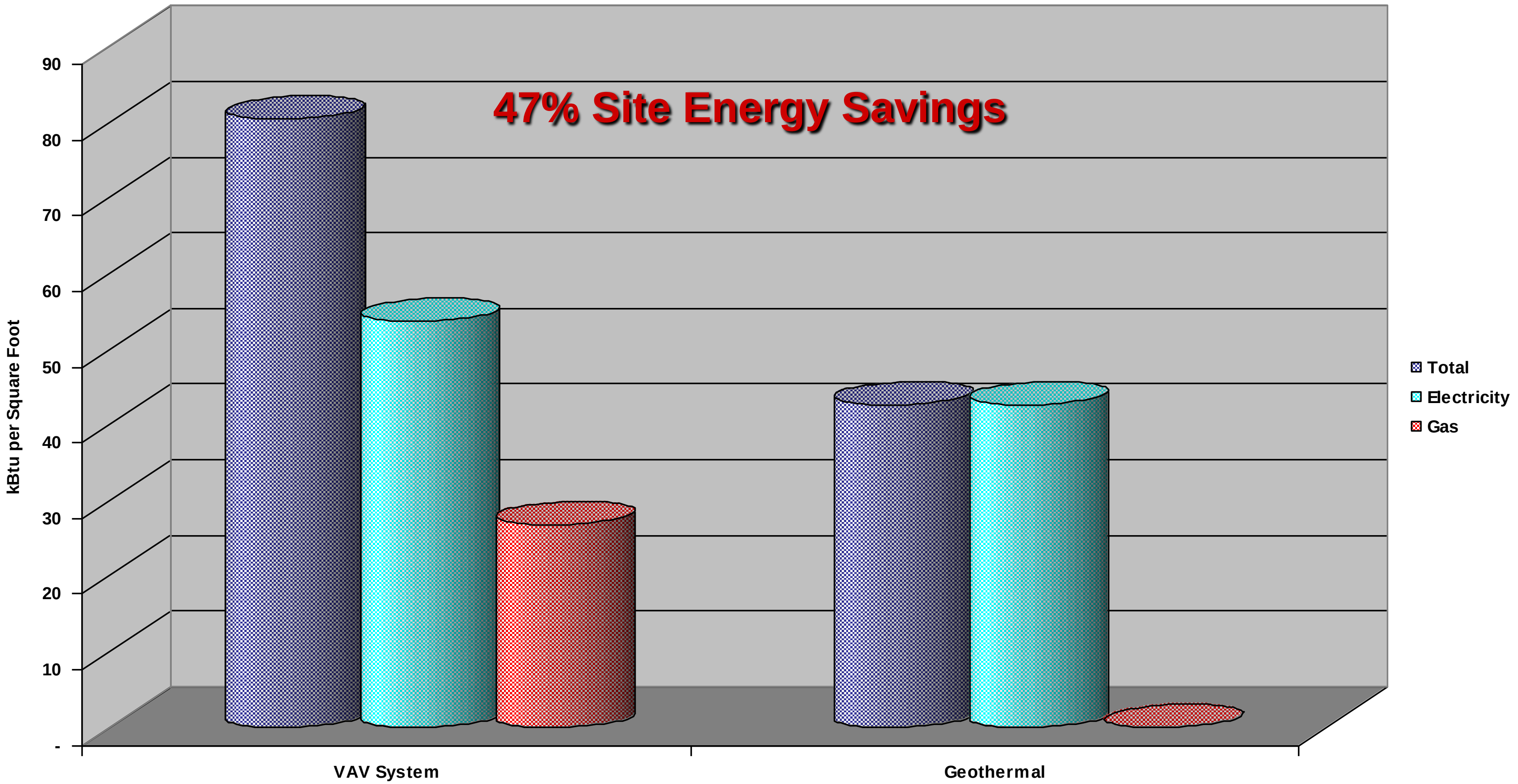
Conventional 15,000 sq ft Built in 1987

Conventional Roof Top VAV Building

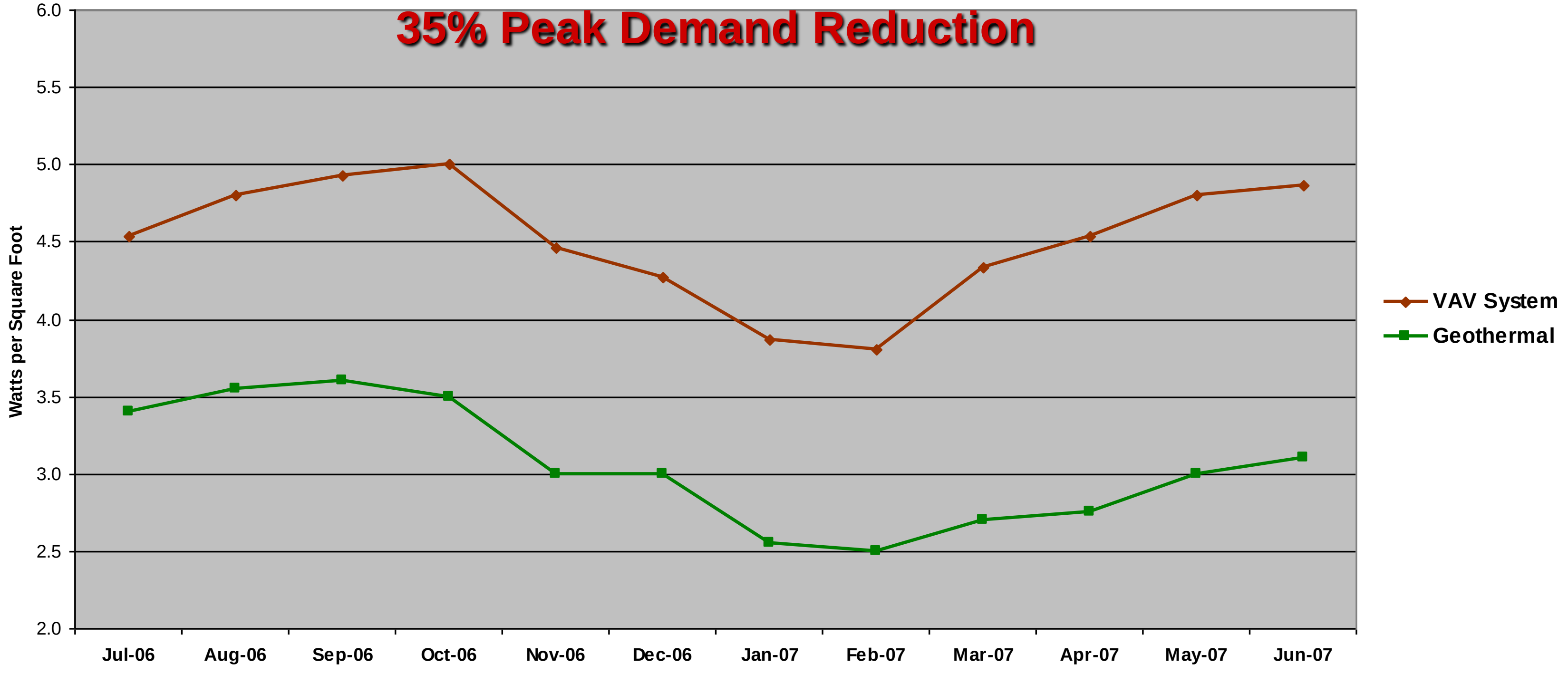
GHP 20,000 sq ft Built in 1997

- 40 boreholes drilled 250 feet deep on 20 foot centers and 3/4 inch PE pipe
- 16 Ceiling Mounted Units

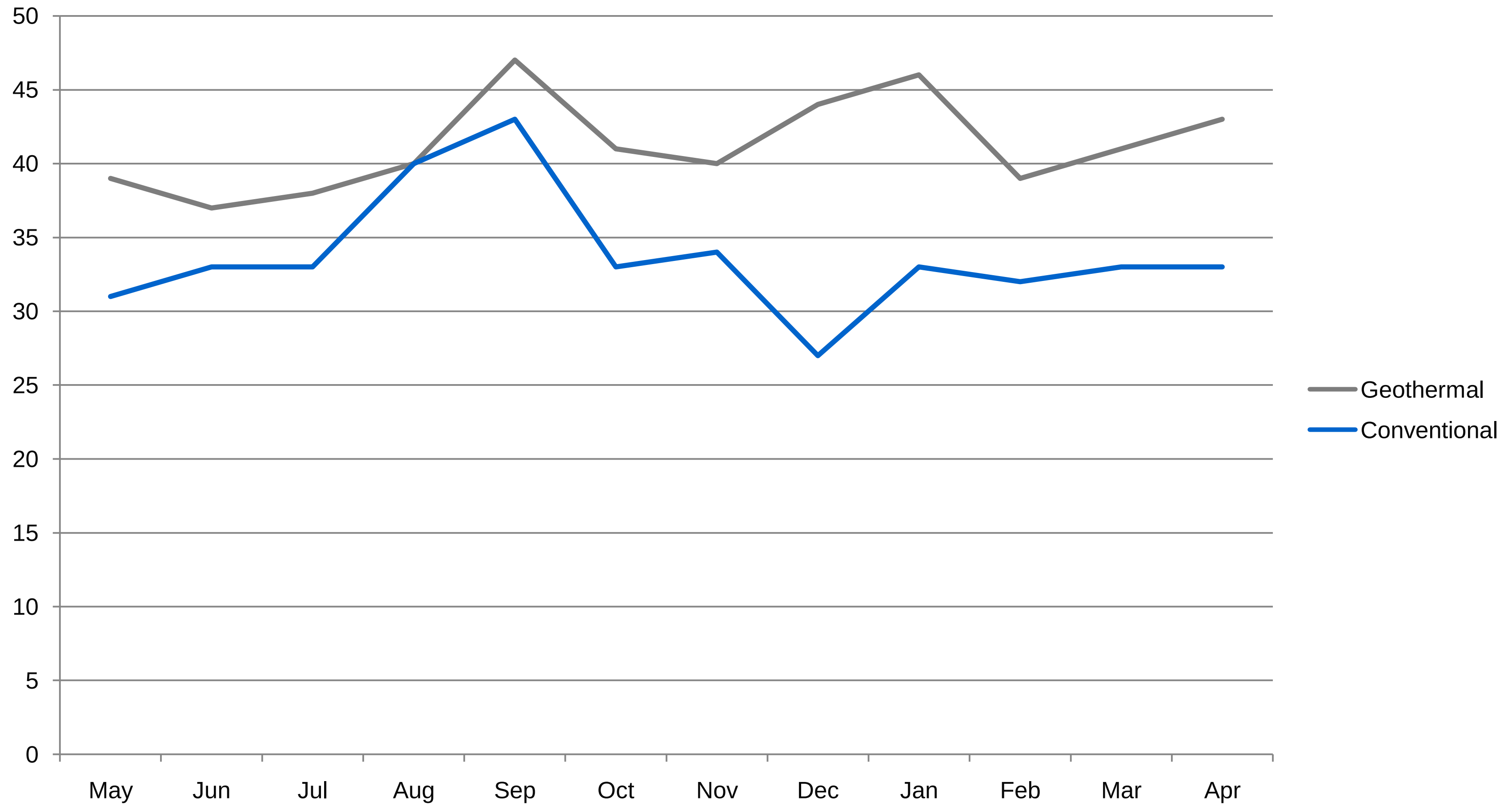
Garrett Office Buildings
Actual Metered Annual Energy Use 2006-2007



Garrett Office Buildings
Monthly Peak Demand 2006-2007



Load Factor (4 yr Monthly Average)



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Palo Alto, California Buildings

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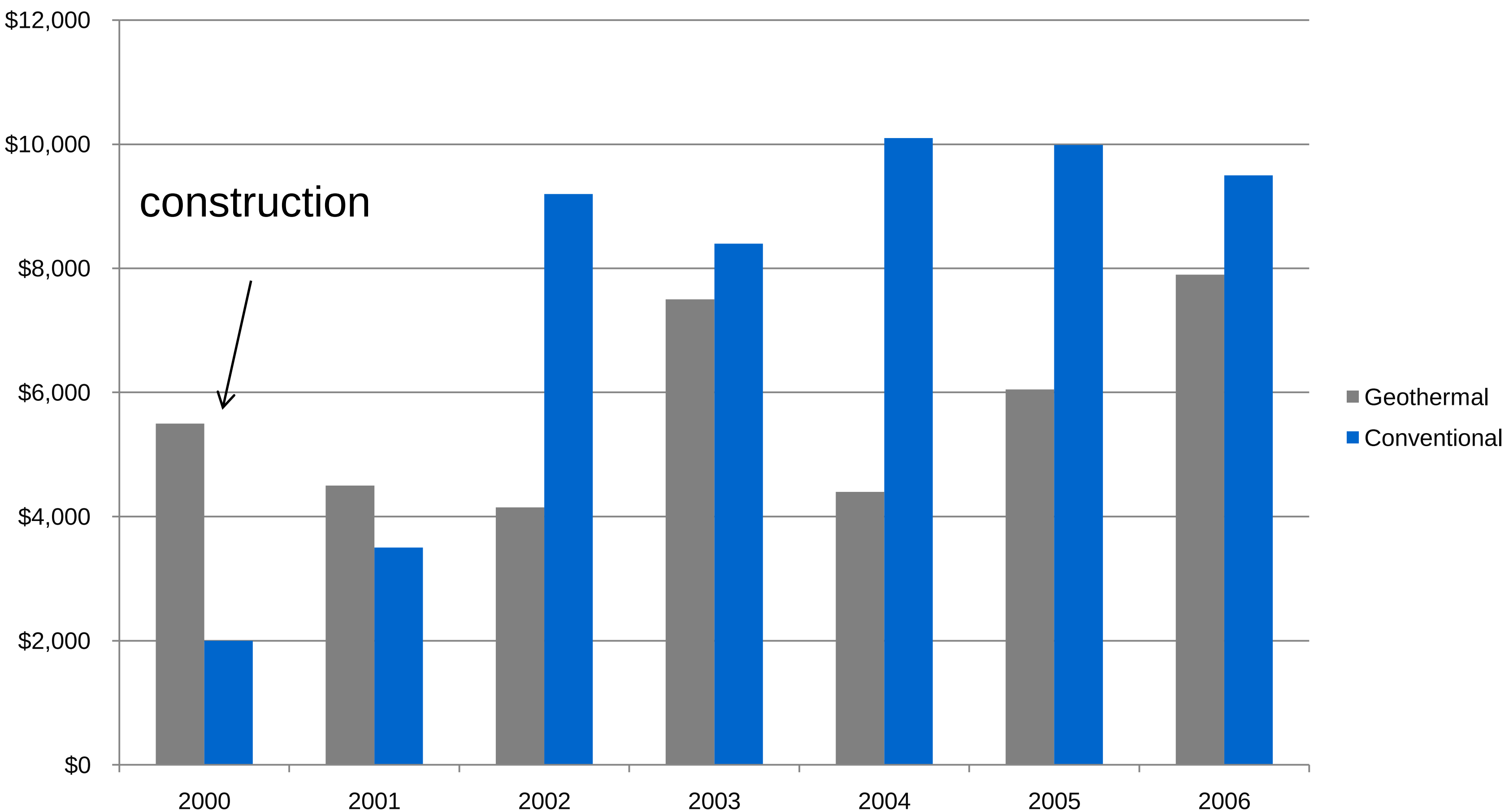
2183 and 2185 Park Blvd Buildings

- Two Stories
- 10,000 sq ft each
- Built in the 1960s

Palo Alto Buildings Energy Costs



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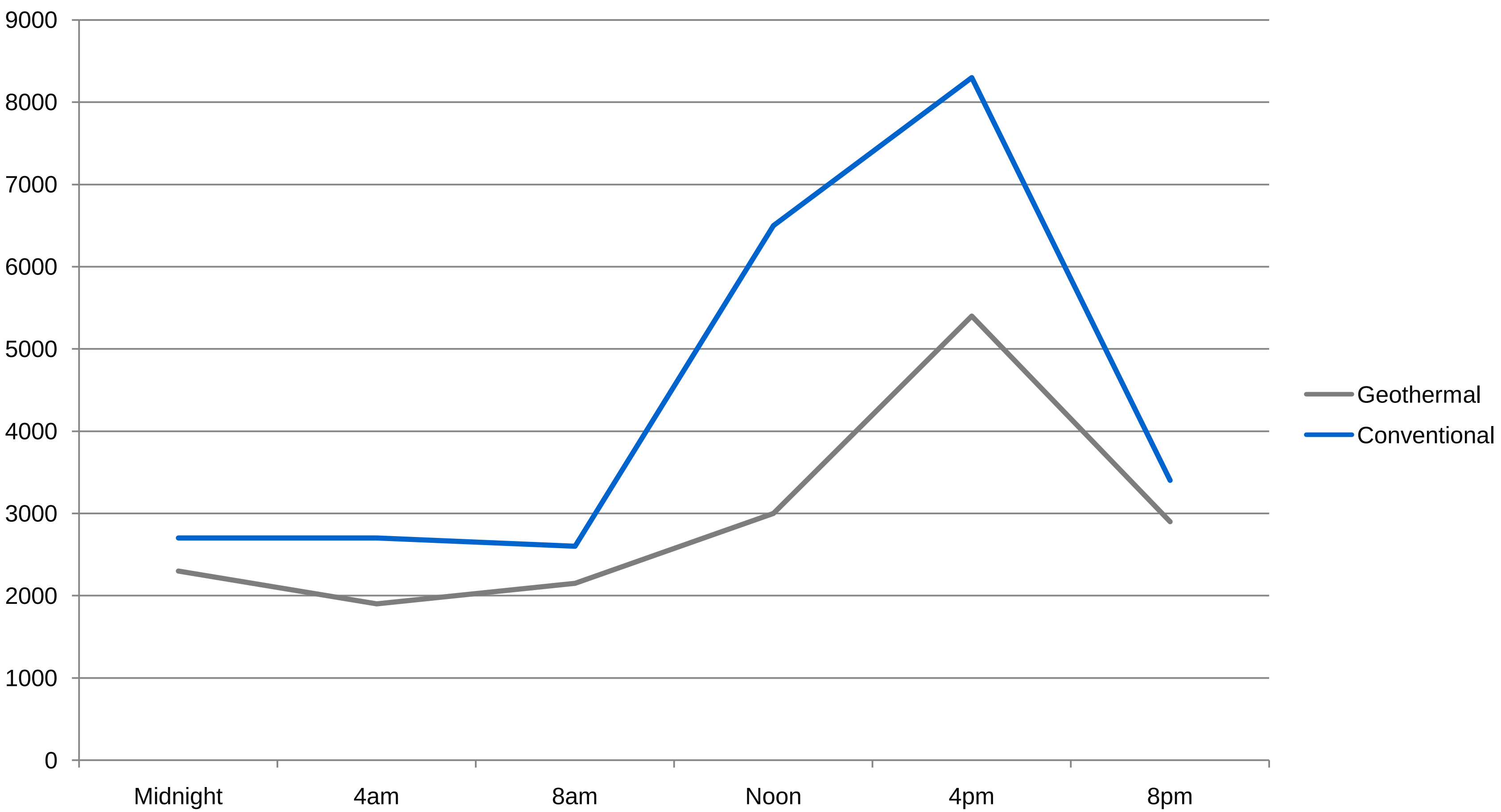
Hourly Load Curve Sample 08/22/2006



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Testimony of a Building Owner

"We have always dealt with hassles short term.

What is valued now is looking at the long term hassle of the decisions we make with a short term attitude."

Brion McDonald, President, Universal Building Systems

GHP Non-Energy Benefits

- **Fewer Space Requirements**
- **Less Noise**
- **Lower Maintenance**
- **Better Ambient Conditions (occupant comfort)**

Police officer's home, MA

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Vertex Mechanical jobs, PA

Vertex Mechanical jobs, PA

"Bridges," Lincoln, NE

"Bridges," Lincoln, NE

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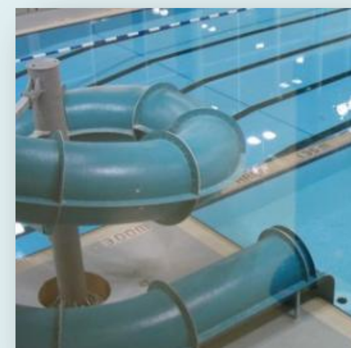
Ohio bank barn . . . in Colorado

Canadian Rec Center

- The average sheet of ice for a hockey rink can heat two or more Olympic size swimming pools, with heat to spare, the only cost being pumping to heat the pools

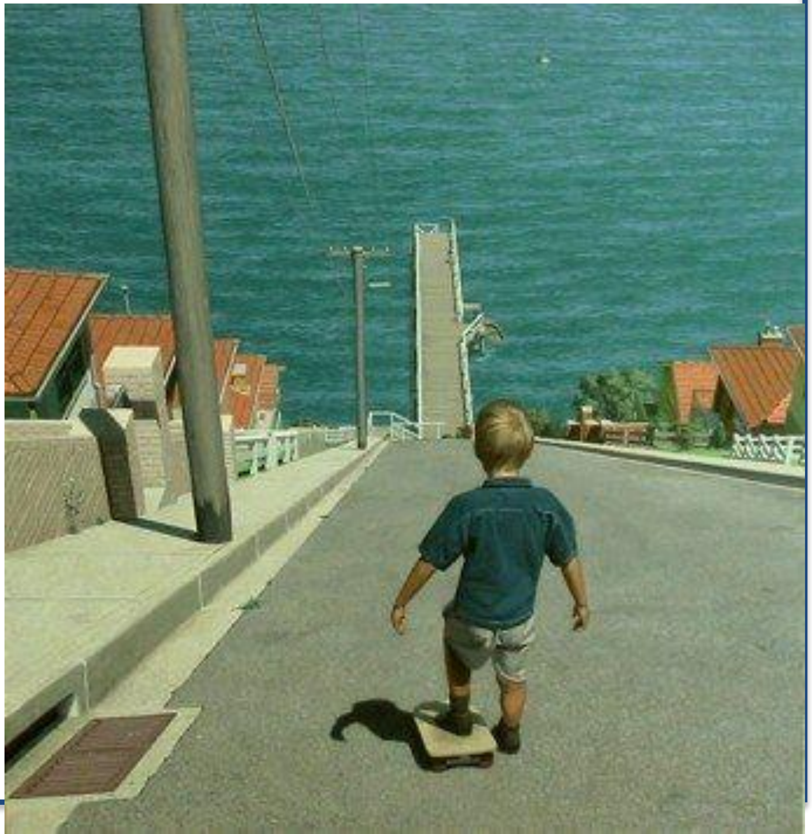


Risk Considerations

Higher (maybe!) first-cost of GHP systems

Lack of:

1. Knowledge and/or trust in benefits
2. **GHP design infrastructure**
3. GHP installation infrastructure



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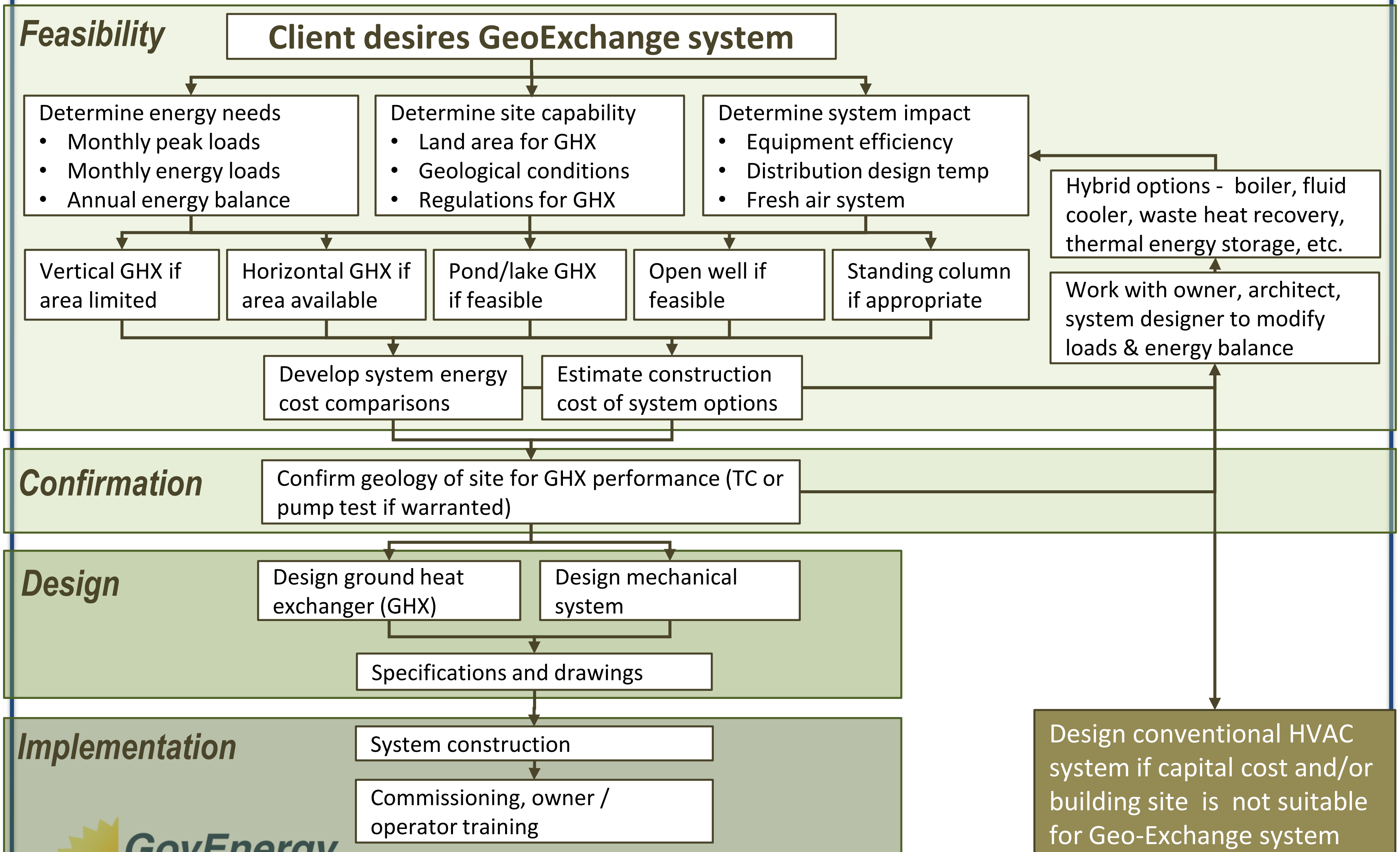
GSHP Systems – Evaluation and Design Process



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The Future -Zero Energy Buildings

- North Pointe in Downtown Frederick, Md. will contain 55 dwellings, all designed to use little if any energy. The house uses solar panels that blend into the roof, geothermal heating and cooling, and a high-tech system that allows control of climate and security using an iPhone or laptop.
- "It is all about vision," said Kevin Lollar, director of development for the Housing Authority of Frederick
- "We are changing the dynamics of what a house is, and we can visualize the streetscape of the future," Paul Zanecki, CEO of Nexus EnergyHomes

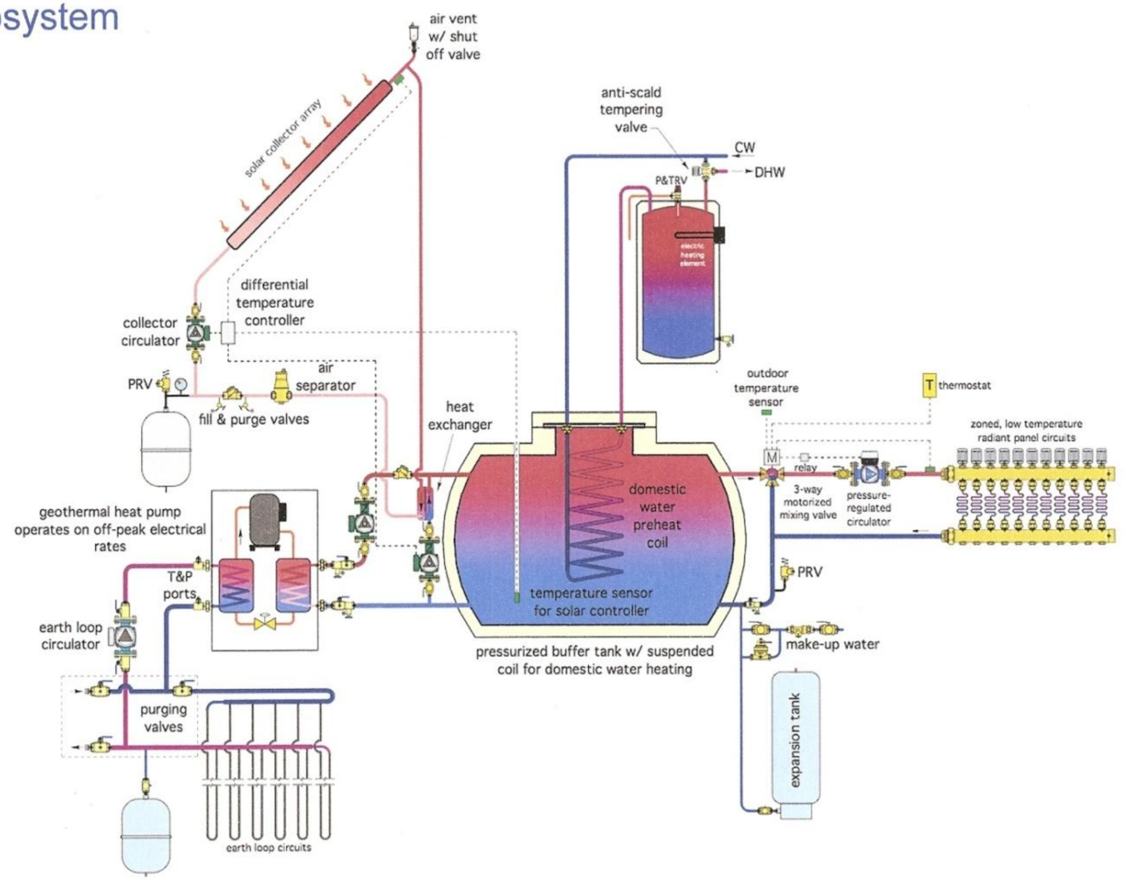
Jun 18 - McClatchy-Tribune Regional News 6/21/11

The Future -Zero Energy Buildings

Geo Solar = $.07 - $.12/kWh life cycle electricity

GHPs & Thermal Storage

10. GSHP operated on “off-peak” electrical rate w/ thermal storage & solar subsystem



Thank You For Your Attention!
Questions?

If you ever need a hand you can reach me at:

Paul Bony

paulsbony@yahoo.com

970-249-8476

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