

## **GEOHERMAL HEAT PUMPS**

**The 60 year old "NEW" technology**

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(GEO-NII)**

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1615 M Street N.W. Suite 800 Washington DC 20036  
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**GEO-NII is a collaboration between the International  
Ground**

**Source Heat Pump Association (IGSHPA), the  
National**

**Association of State Energy Officials (NASEO), and  
the Geothermal Heat Pump Consortium (GHPC).**

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**The Twin challenges of global warming &  
Energy are the dominant points of  
discussion in every news venue.**

**With oil & gas prices pushing to new highs  
and global demand projected to grow faster  
than production capacity, Energy has  
become an ongoing enigma.**

**30 years after the "Oil Shocks" of the 70's  
signaled the end of cheap oil supplies, we  
are STILL dependent on petroleum...**

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## **Geothermal Heat Pumps:**

**Use the earth's thermal properties (ground  
source energy) , in conjunction with  
electricity, to provide space conditioning  
(heating and cooling) and water heating to  
commercial, institutional, residential and  
other kinds of facilities nationwide.**

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## **Geothermal Heat Pumps:**

**They derive ¾ of their energy from the earth  
and ¼ from the Utility.**

**AKA: Geoexchange, ground couple, earth  
coupled, ground source etc.**

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## **GHP'S-The 60 year old "NEW" technology.**

**GHP's were first written up in the October  
25<sup>th</sup> 1948 issue of Life magazine.**

**In 1954, 3 professors in an article published  
by the University of Wisconsin on Heat  
Conduction, determined that a cubic foot of  
"ordinary" soil has a heat capacity of 40  
btu's (when cooled 1 degree F) and that the  
ground was a heat source that was present  
everywhere.**

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## The Energy Under Our Feet in \$\$\$\$

A cubic acre (200 ft x 200 ft x 200 ft) equals 8 million cubic feet x 800 BTUs per cubic foot at delta T = 20 degrees F = 6,400,000,000 BTUs.

Divide that by 3500 BTUs (3,413 BTUs per kWh) = 1,800,000 kWh at \$.08 per kWh = \$146,285.00 savings annually.

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## It's not Magic.... It's Thermodynamics

The pumping or exchange of energy is done by heat pumps, they work on the same principle as a refrigerator.

They pump refrigerant through a closed loop in a way that creates two distinct zones, a cold zone and a hot zone. This refrigeration cycle concentrates it by either expanding or contracting it and thus provides heating or cooling.

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## The US DOE States:

Residential & Commercial buildings use 65% of all electricity generated in the US.

This is far greater than the total energy used in the transportation sector and nearly equals that of the industrial sector.

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Forty Percent (40%) of the total energy used in buildings is for space conditioning (heating and cooling) and water heating.

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This is far greater than the total energy used in the transportation sector & nearly equals that of the Industrial sector.

Why then do we only talk about CARS!!!!

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Geothermal—  
The Energy Under Our Feet  
Geothermal Resource Estimates for the United States

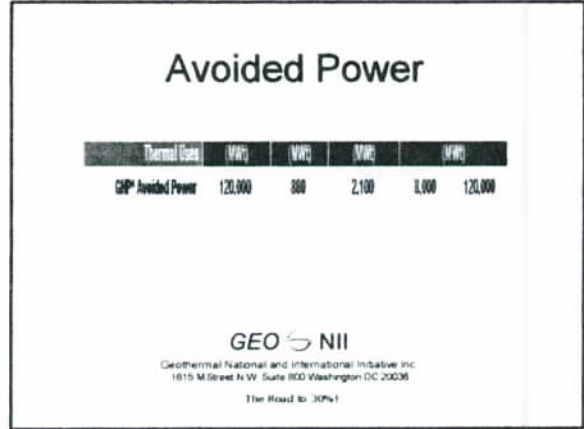
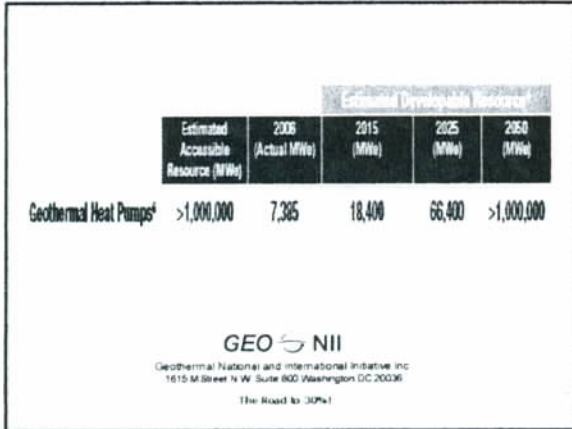
Bruce Green and Gerry Nix,  
National Renewable Energy Laboratory

Technical Report  
NREL/TP-440-40665  
November 2006



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**Table 4. Energy Equivalents by Resource Category (see appendices for calculation method)**

Resource Category	Estimated Accessible Resource	Estimated Developable Resource - 2050
Geothermal Heat Pumps (GHP) <sup>1</sup>	15 Quads 2.5 billion BOE	15 Quads 2.5 BBOE

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### Energy Comparison Information

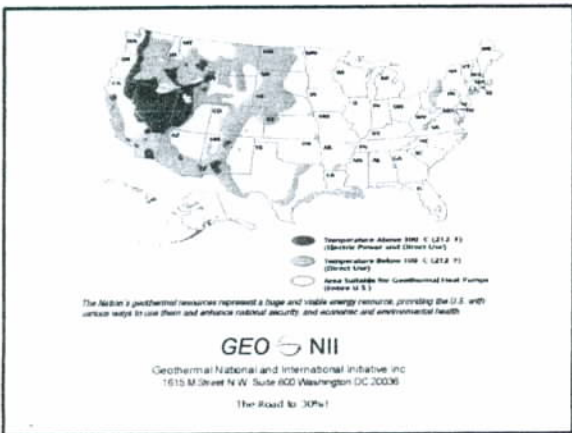
U.S. annual energy consumption equals about 100 quads (EIA, 2004).

U.S. annual electricity production equals about 40 quads (EIA, 2004).

U.S. petroleum demand equals about 21 million bbl/day, 7.67 billion bbl/yr (EIA, 2004).

World petroleum demand equals about 84 million bbl/day, 30 billion bbl/yr (EIA, 2004).

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### Energy Equivalents

1 Quad = 0.170 billion barrels of oil, 170 million barrels of oil  
 1 Quad = 45 million short tons of coal  
 1 Quad = 1 trillion cubic feet of dry natural gas

1000 KWh = 0.59 barrels of crude oil  
 1000 KWh = 0.15 short tons (300 pounds) of coal  
 1000 KWh = 3,300 cubic feet of dry natural gas

1 barrel of crude oil = 1,700 kWh  
 1 barrel of crude oil = 5,600 cubic feet of dry natural gas  
 1 barrel of crude oil = 0.26 short tons (520 pounds) of coal

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### What is the Cost !!!

A four ton system extracts an equivalent of 8.94 Kilowatts of energy from the ground. (NREL)

That equates to 30,510 BTU's is being extracted per hour. 24 / 7, 365 days a year.

One Kilowatt equals 3413 BTU's

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### What is the Cost !!!

A 4 ton system in a 2000 sq ft residence uses \$2,100 of Fossil Fuel annually or \$700.00 of Geo annually. (Rockford IL, 2006)

There is an additional cost of \$10,000 for the Geo, over a 30 Year 6% mortgage that adds \$59.00 to the monthly cost. Or a total of \$708.00 annually.

It saves \$1,400 annually at today's prices, Geo doesn't cost it PAYS !!!!

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### The One Million Units:

**Has an annual savings of over 8 Billion kWh and a reduction of electric demand by over 2.6 million kW. (1 ton of Geo saves .55-.88 kW)**

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### The Road to 30%

**With 30% of the (residential & commercial) HVAC market there would be a savings of 177,239,835 kWh and a demand reduction of 36,564,000 kW or 36,564 mW.**

**This would increase dramatically if we included the institutional market.**

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**This would mean a carbon would be reduced by 35,486,053 metric tons and CO2 would be reduced by 130,115,529 metric tons.**

**This is the equivalence of removing approximately 29 million cars off the road or planting over 8 billion trees.**

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### AND

**It would mean the creation or retention of over 7 MILLION jobs.**

*(Jobs may or may not be mutually exclusive. Individual jobs may be performed by the same individual in a particular classification or position.)*

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**IF IT CAN DO ALL OF  
THESE THINGS, WHY  
AREN'T THEY BEING  
USED MORE????**

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**YOU ARE THE  
REASON !!!!**

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**What do these things have in  
COMMON.**

**Radios, Cars, Telephones,**

**Airplanes, Refrigerators,  
Computers, Blackberry's**

**Movie projectors, IPods,  
MP3's, the IPHONE, etc etc.**

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**The Engineer Creed states that:**

**You are to protect the public and look after  
their welfare.**

**You work for the public good, even though a  
corporation or government may pay you, it is  
the public you are ultimately responsible to.**

**The very practice of Engineering requires  
leadership skills to lead projects, people &  
initiatives and to offer creative solutions to  
seemingly unsolvable problems.**

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**Renewables MUST be considered  
upfront.**

**The design professional must be aware of  
the various technologies which save energy,  
lessens the impact on the environment and  
supports the goals of the Energy Star, LEED  
and the Energy Policy Act along with the  
Executive Orders.**

**The design professional must do an up to  
date Life Cycle Cost Analysis using today's  
prices.**

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**CGD Program**

The Certified Geoexchange Designer program is a partnership between; IGSHPA, GEO-NII and AEE. It has been recognized as the standard of expertise for design of geothermal heat pump systems by numerous states and by the Federal Government.

We would like ASHRAE to become a part of that partnership and welcome any input you have to that program.

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### Other New Developments

GHP's are being reviewed as an ever growing EE business. Ownership of loops or entire systems has become a new way to finance a project.

The advent of Renewable Energy Credits and or emission credits will be another way that utilities can "rate base" this technology.

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### Other New Developments

There are over 28 States that now have or are developing a Renewable or Energy Efficient Portfolio Standard (RPS / EEPS) and GHP's will play a large part in the achievement of the goals outlined in these programs.

Two major GHP manufacturers have been purchased by foreign companies, both of which recognize the potential in this technology.

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### GHP Legislation:

Sec 439 of the Energy Independence & Security Act directs GSA to establish a program to accelerate the use of GHP'S.

Sec 422 directs DOE to develop & disseminate technologies, practices & Policies for the development & establishment of zero net energy commercial buildings.

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### What steps must be taken to develop a viable INFRASTRUCTURE

The adoption of IGSHPA Standards.

Development of a sustainable design community, Certified Geoexchange designer (CGD)

IGSHPA accreditation training for installers and drillers to support this technology.

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If you have any questions or need further information please contact me at 610-659-4998 or e-mail me at [jdienna@geo-nii.org](mailto:jdienna@geo-nii.org)

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