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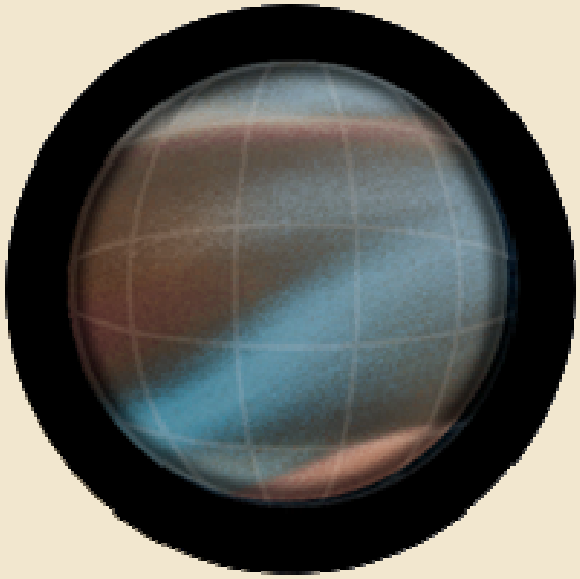
GEOTHERMAL HEAT PUMP CONSORTIUM



GEOEXCHANGE: THE ROAD TO THIRTY PERCENT

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Learning Objectives

- Grasp the fundamentals of indoor carbon dioxide generation and measurement
- Recognize different ways to save energy through demand controlled ventilation
- Understand the principles of outdoor air measurement and control

COMING TO TERMS

- GeoExchange- aka, geothermal heat pumps, ground coupled or earth coupled heat pumps. (GSHP)
- Vertical loops are installed in BORE HOLES. (not Wells)
- Horizontal loops need extra space, campus or ponds.
- Many commercial applications are largely “cooling” dominated.
- Boilers are <u>not</u> needed.

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Geothermal Heat Pumps are:

- **A heating, ventilation and air-conditioning (HVAC) technology that uses the earth's thermal properties, in conjunction with electricity, to provide space conditioning and water heating to homes, schools, buildings, and other kinds of facilities.**

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Geothermal Heat Pump technology is "RENEWABLE".

- **The Federal Energy Management Program (FEMP) exceeded their 2005 renewable goals, as directed by Executive Order 13123 through the use of 179 GWh of GSHPs.**
- **DOD last year saved over 158,000 MWh through the use of GSHPs.**
- **WI.Act 141- Defines GSHPs as an RE technology. Directs new State Buildings to GSHP analysis.**

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Coffee shop information:

- **Geo doesn't work "Up North".**
  - ***Seasonal temperature swings are ideal.***
- **Geo doesn't last.**
  - ***ASHRAE : 19+ yr. ave.***

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GSHP's, Everything old is new again.

- **Patented in 1912.**
- **Geothermal heat pumps (aka, geoexchange, earth coupled, ground coupled heat pumps), was first written up in the October 25th 1948 issue of Life magazine. "Fireless Furnace"**

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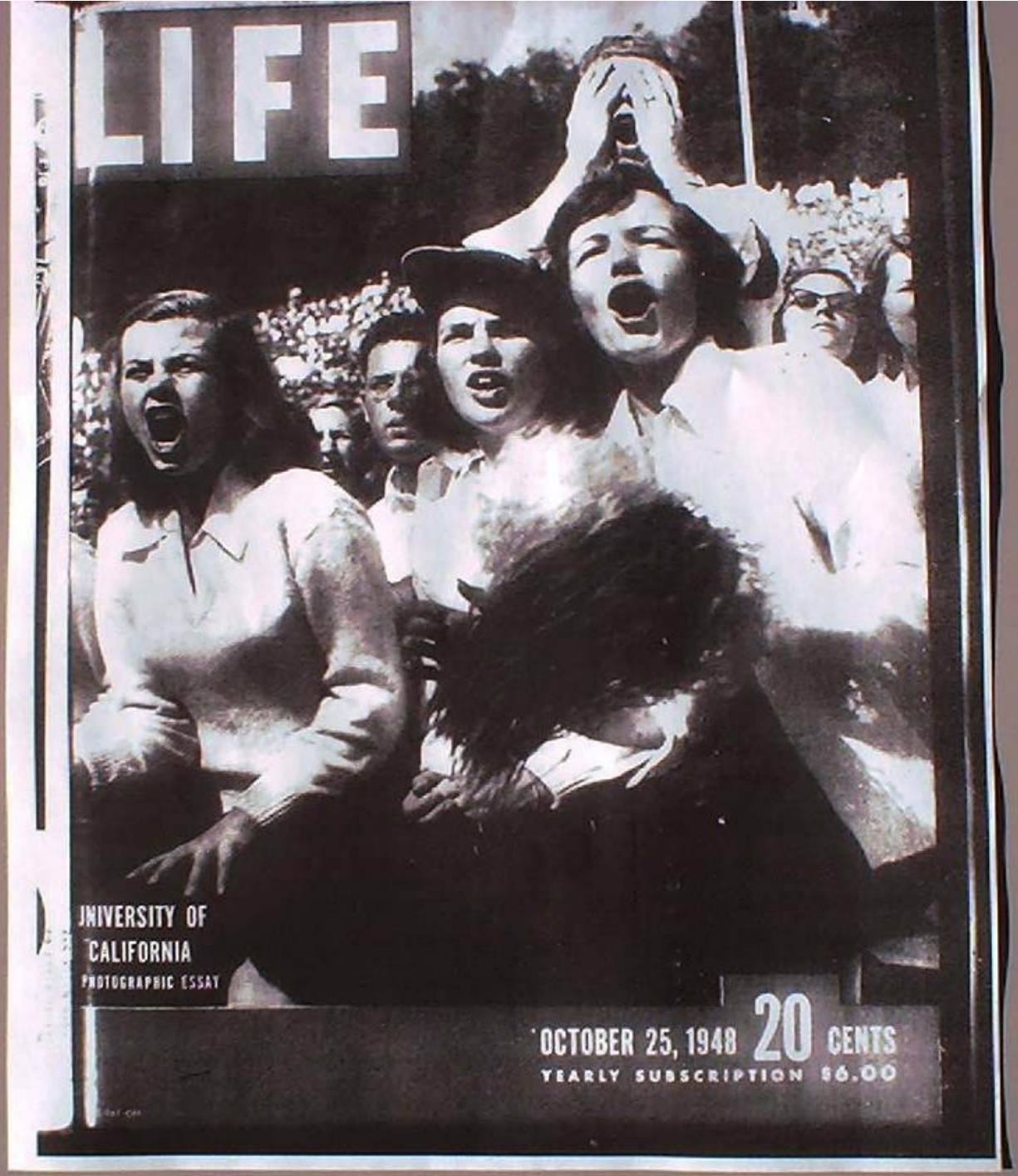

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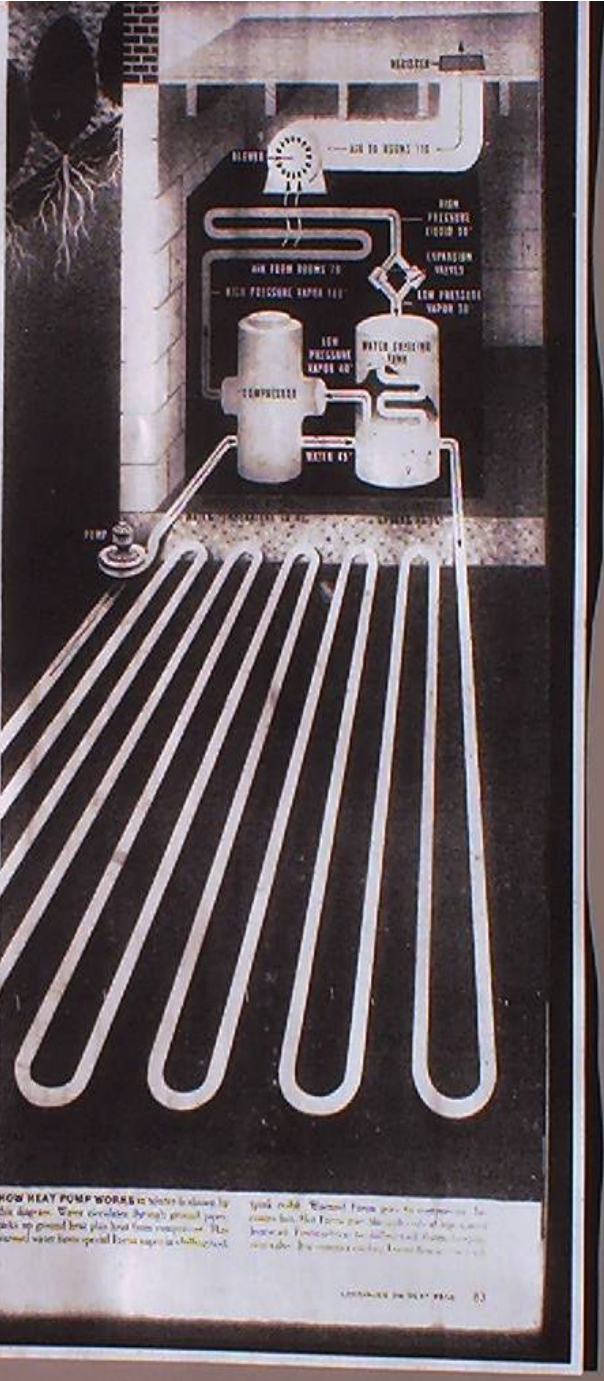
FIRELESS FURNACE

It pumps heat from earth to house



EXPOSED VIEW OF HEAT PUMP shows unit diagramed at right. Compressor is at bottom left, cooling coils at bottom right and blower at top center. Unit is 6 feet 3 inches tall, occupies 6.3 square feet of floor space.

HOW HEAT PUMP WORKS in winter is shown by this diagram. Water circulates through ground pipes, picks up ground heat plus heat from compressor. Thus warmed water heats special Freon vapor in chilled coil [illegible]

The SOLUTION lies UNDER our next step!

- **In 1954, three 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.(Ingersoll, Zobel, Ingersoll "Heat Conduction" University of Wisconsin Press 1954)**

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The Energy "Under our Feet" in $$$$.

- **A cubic acre (208x208x208) equals 8+ million cubic feet, X 800 Btu's per cubic foot at a delta T = 20 degrees F equals 6,400,000,000 btu's divide that by 3500 btu's (actually 3,413 btu's per kWh) equals 1,800,000 kWh at $.08 per kWh that equals $146,285.00 available annually.**

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U.S. Department of Energy on Geothermal heat pumps:

➔ **"No active technology for heating and cooling is more efficient than the geothermal heat pump."**

EIA, *Annual Energy Outlook 1994*, (Washington, DC, January, 1994), Table 21

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The US DOE States:

- **Building, light, appliances, space conditioning and water heating account for 36% of primary energy use in the United States**
  - ***This is far greater than the total energy use in the transportation sector and nearly equals that of the industrial sector***
  - ***Two-thirds of that is supplied by electricity***

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The US DOE States:

- **Residential and commercial buildings use 65% of all electricity generated**
- **40% of the total energy used in buildings is for space conditioning (heating and cooling) and water heating**

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Geothermal heat pumps and the ROAD TO 30 % is all about the " Three E's".

- **ENERGY INDEPENDENCE**
- **ENVIRONMENTAL SECURITY**
- **ECONOMIC DEVELOPMENT**

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GHP's currently have:

- More than 1,000,000 units currently installed nationally.
- This still represents less than 1 % of all the heating and air conditioning units in the United States.
- But they have had a significant impact on energy savings and environmental security.

U.S. Environmental Protection Agency (EPA) on Geothermal heat pumps:

- **"The most energy efficient, environmentally clean, and cost-effective space conditioning systems available today"**

"Space Conditioning: The Next Frontier," EPA 430-R-93-004, April 1993

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GHP's: One Million Units.

➔ Reduce Energy Use

- ***Annual savings of over 8 Billion kWh & over 40 million Btu's of Fossil Fuel.***
- ***Reduction of electric <u>Demand Energy</u> by over 2.6 million kW (1 ton of capacity saves .55-.88kW)***
- ***Saves on building structure which creates a cost/value exchange.***

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Fond du Lac High School

General Contractor

C.D. Smith Construction

Fond du Lac, WI

Architect

Bray Associates Architects, Inc.

Sheboygan, WI

Plumbing & Heating

J.F. Ahern

Fond du Lac, WI

Electrical

Suburban Electric

Appleton, WI

C.D. SMITH CONSTRUCTION

BrayAssociates ARCHITECTS, INC.

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400,000 sq.ft. 9mo. Cooling load.
14ac. of Ponds serve 720T of Geo

GSHP's: One Million Units.

- **Reduces Greenhouse Gas Emissions by 40 Percent**
  - *This Accounts For:*
    - More than 2 Million metric tons of carbon equivalent eliminated every year
    - More than 6 Million metric tons CO2 eliminated annually
  - *This Is Equivalent To:*
    - Taking more than 1,294,696 cars off the road
    - Planting more than 514 million trees

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Historical site applications

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GeoExchange

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DESTINATIONS OF "THE ROAD TO 30%..... ENERGY EFFICIENCY!!!

- **889,000,014 Mmbtu's of fossil fuel & 177,239,835 kWh**
- **Demand reduction of 36,564,000 Kw.or 36,564 Mw**

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ICE
KUBE
HEAT
TM
Frontier
KUBE 4


OLYMPIA


HORICON BANK

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➔ **Heating & Cooling at $.14 /sq. ft.**

Energy Policy Act 0f 2005

- Homebuilders who install a geothermal system in a new home can improve the efficiency enough to earn a $2,000 tax credit.
- Must exceed IEEC by 50%.
- WESH Geo home beats the IRS' IEEC+50% std. by an added 40%
- Homeowners who retrofit a geothermal heat pump will qualify for a $500 tax credit.

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Geoexchange
vs
Fossil Fuel

- **Analysis: 4 ton, 2000 sq.ft. home**
- **Geo: $708.00 Annual vs FF $2,100.00**
- **$10,000 additional cost, over 30 year mortgage is $59.00 per month.**
- **$708 returns $1,400 in savings at today's energy prices. ($10,000/$1400 = 7.1)**
- **"72"/ 7.1yr.s = 10.14% ROI**
- **Future savings grow as Fossil Fuel costs continue to rise at dramatic levels.**
- **GEO DOESN'T COST… IT PAYS!!!**

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Geoexchange: One Million Units.

- **Reduces our dependency on foreign oil. Saves over 21 million barrels of crude annually: Electric Peaking Demand is lowered.**
- **Supports Economic Development: One commercial project can create or retain approximately 22 jobs, including designers, installers, manufacturers, sales and marketing, etc.**
- **WI. Apollo Alliance RE & ED 2006: GSHPs = 5000+ WI. jobs**

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DEFINITION OF "THE ROAD TO 30%.

- **30% of the Residential market (14,400,000) and Commercial market (1,164,000).**

- **This does not include the institutional or industrial markets.**

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DESTINATIONS OF "THE ROAD TO 30%.... ENVIRONMENTAL SECURITY.

- **Reduction of Carbon by 35,486,053 metric tons and Co2 reduction of 130,115, 529 metric tons.**

- **This is the equal to removing approximately 29 million cars or planting over 8 billion trees.**

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DESTINATIONS OF "THE ROAD TO 30%..... ECONOMIC DEVELOPMENT

- **The creation or retention of over 10 million jobs both in the commercial or Institutional sector and the residential market.**
- **(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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YOU ARE THE ANSWER !

- **An engineer's creed states:**
  To protect the public and look out for their welfare.
  Though you may be paid through a corporation or the government, you must remember, that it is the public you are ultimately responsible to.

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YOU ARE THE ANSWER !

- **Engineers improve our health, our safety and our lives. In decades past, engineers were considered to be leaders in the progress of society. We need you to accept that role again. The geothermal heat pump industry needs you to become involved.**

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YOU ARE THE ANSWER !

- **We need you to get the necessary training that allows you to design a ground loop heat exchanger that will provide highly efficient heating, cooling and water heating to a facility decades to come. That training is the Certified Geoexchange Designer or CGD certification.**

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The Geothermal National & International Initiative (GEO-NII).

- **Is a collaborative effort between the Geothermal Heat Pump Consortium (GHPC), The International Ground Source Heat Pump Assoc. (IGSHPA) and the National Association of State Energy Officials (NASEO).**

GEO-NII's mission is to:

- **Promote gshp technology to all market segments**
- **To develop a sustainable infrastructure through professional development training**

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The Geothermal National & International Initiative (GEO-NII).

- **To support the adoption of IGSHPA standards, both nationally and internationally, for the design, installation and commissioning of ghp technology.**
- **To advocate securing renewable energy credits and/or emission credits for the ground loop heat exchanger (glhe)**

For more information please contact;

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610-659-4998 or jdienna@geo-nii.org

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Geothermal heat pumps are a SOLUTION TECHNOLOGY.

IT IS THE “ENERGY UNDER OUR FEET”

It’s a technology that is “DIRT CHEAP” It saves energy, the environment, water and creates jobs.

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"We cannot solve our problems with the same thinking we used when we created them."
Albert Einstein

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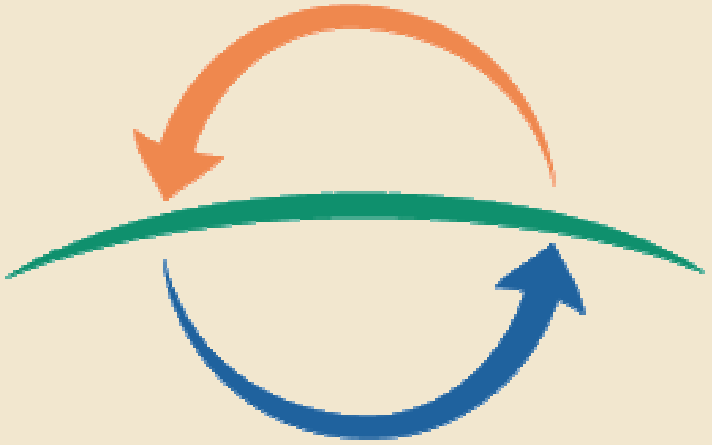

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Thank You