

*Ground Source Heat Pumps: A
national overview of policies and
program implementation tools designed
to meet energy and environmental goals*



Utility Energy Forum

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Background

- ★ The electric utility industry is in a new policy era driven by the needs to:
 - Reduce green house gas emissions
 - Deliver peak load management
 - Deploy energy efficiency as a tool for job growth and energy independence.





Background

- ★ This presentation will touch on the tools being considered by various electric utilities, regulators and national utility organizations to accelerate the deployment of ground source heat pumps (GHPs).
 - Loop tariffs
 - Financing
 - Regulatory policy
- ★ That recognize the unique aspects of ground source heat pumps to provide energy efficiency, peak load reduction, renewable energy capture, carbon emission reduction and consumer energy bill savings.





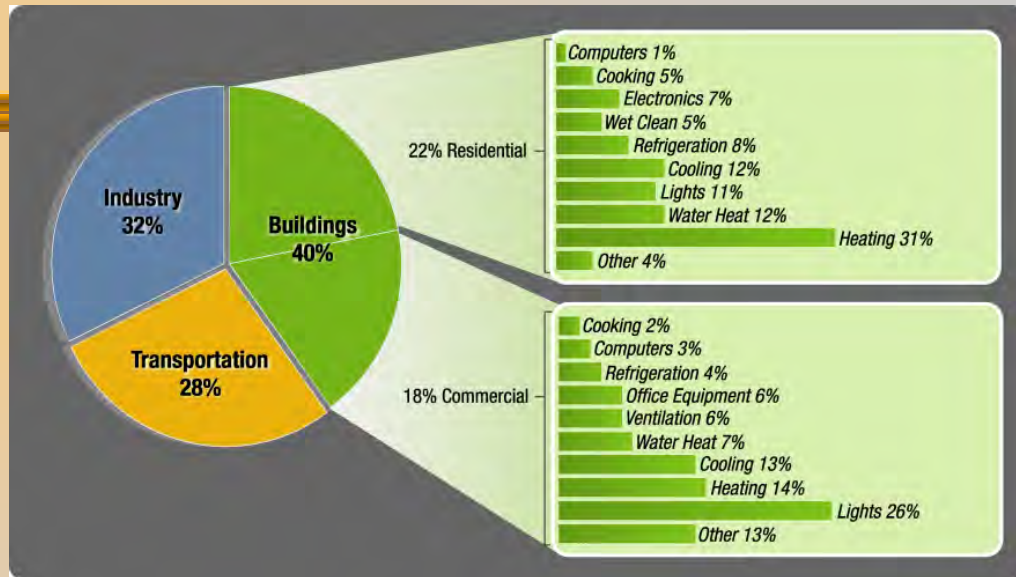
New Policy Era

- ★ Geothermal heat pumps offer utilities an excellent tool to:
 - Obtain significant peak load reduction
 - Improve load factor
 - Generate large carbon emission reductions
 - Meet efficiency, renewable energy and employment stimulation goals
 - With out putting pressure on electric rates





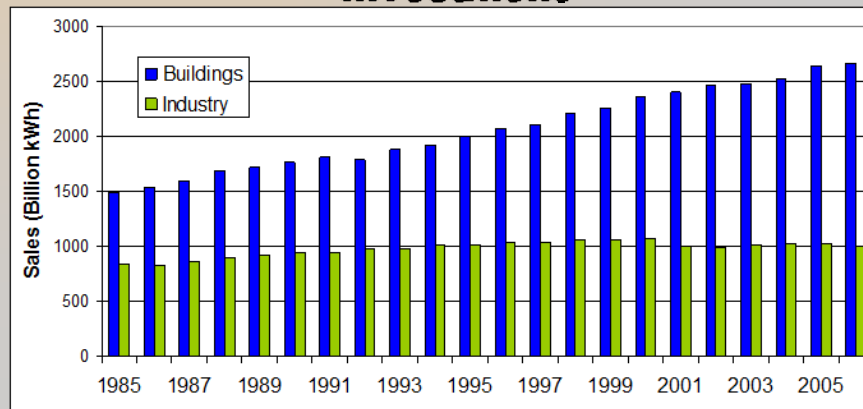
Buildings drive 40% of U.S. Primary Energy Consumption & 39% of U.S. Carbon Emissions



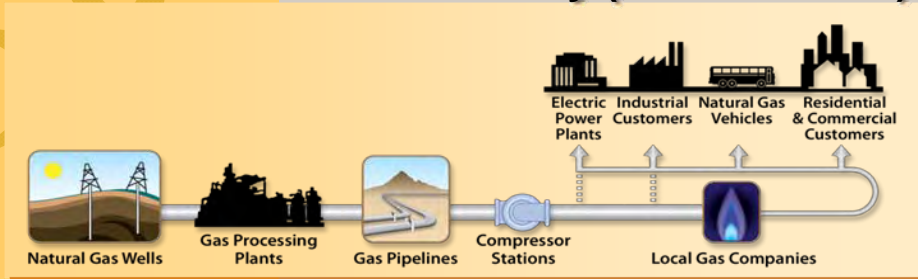
73% of U.S. Electricity



Buildings Drive Electricity Supply Investment



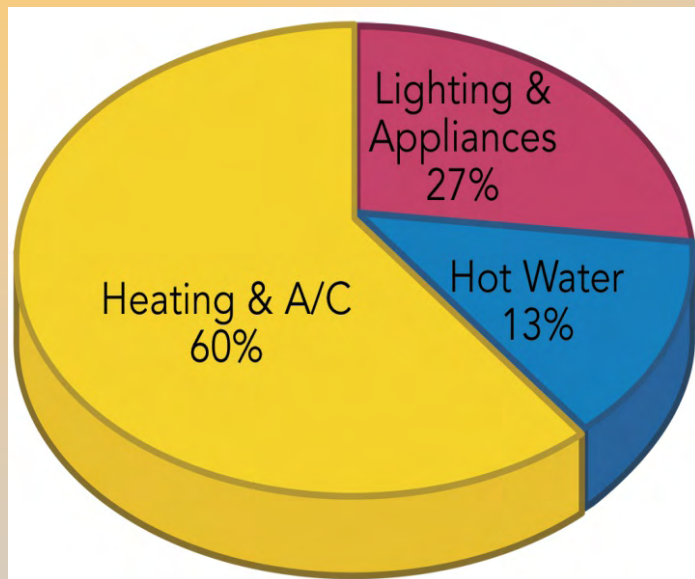
34% of Natural Gas Directly (55% Incl. Gen)



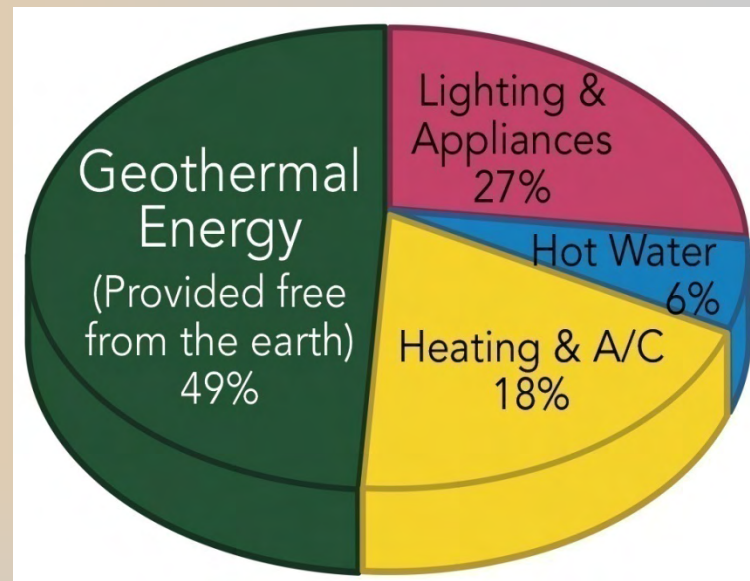
Source: EIA Annual Energy Review, Table 8.9, June 2007



Geothermal Heat Pumps



Conventional HVAC



Geothermal HVAC





Geothermal Heat Pumps

**1 kW Electrically generated
Energy to power the
system**

**4-6 kW Heat
Delivered**

**3-5 kW of Geothermal
Energy moved from the
Earth**

400-600% Efficient

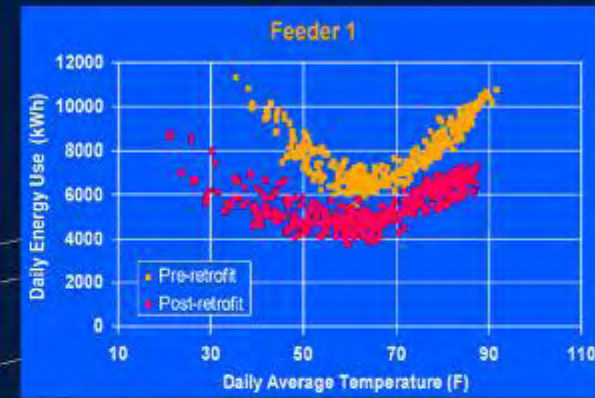


Benefits Were Proven Long Ago: GSHP retrofit of 4000 homes at Fort Polk

Evaluation showed 33% kWh savings, 43% lower summer peak kW demand, and improved load factor (0.52 to 0.62)

ORNL/CON-460 @ www.ornl.gov/sci/ees/etsd/btrric/ground-source.shtml

Typical distribution feeder
(16 in all)



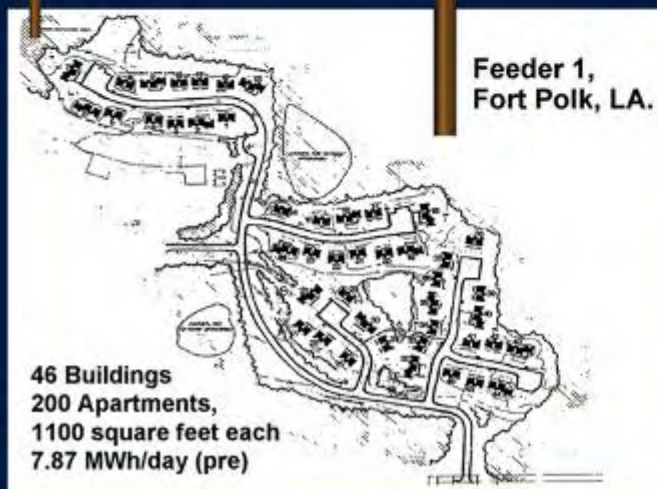
Army's
existing meter

New recording watt
meter, modem,
and phone line

Buried phone line to
nearest pedestal

Current transducers
on secondary leads to
existing meter

To recorder

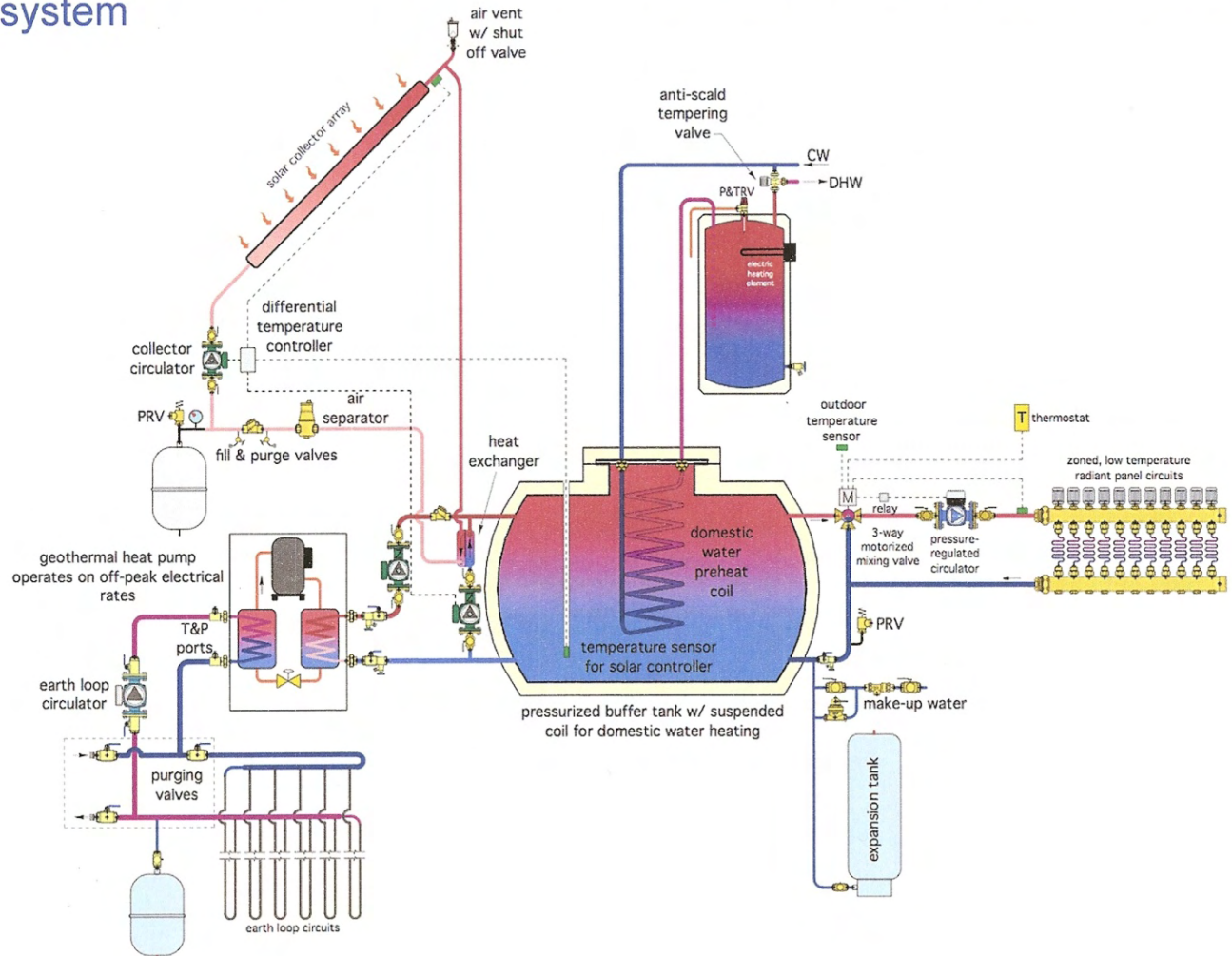


Geothermal Heat Pumps
are the Most Efficient way to convert
Green Energy
into Heating, Cooling and Water Heating

Making the most effective use of this precious resource

Geothermal Heat Pumps

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





Geothermal Heat Pumps

Stages of market development



**GHPs were installed in 1 out of 38 new US homes in 2008
(2.6% share)**

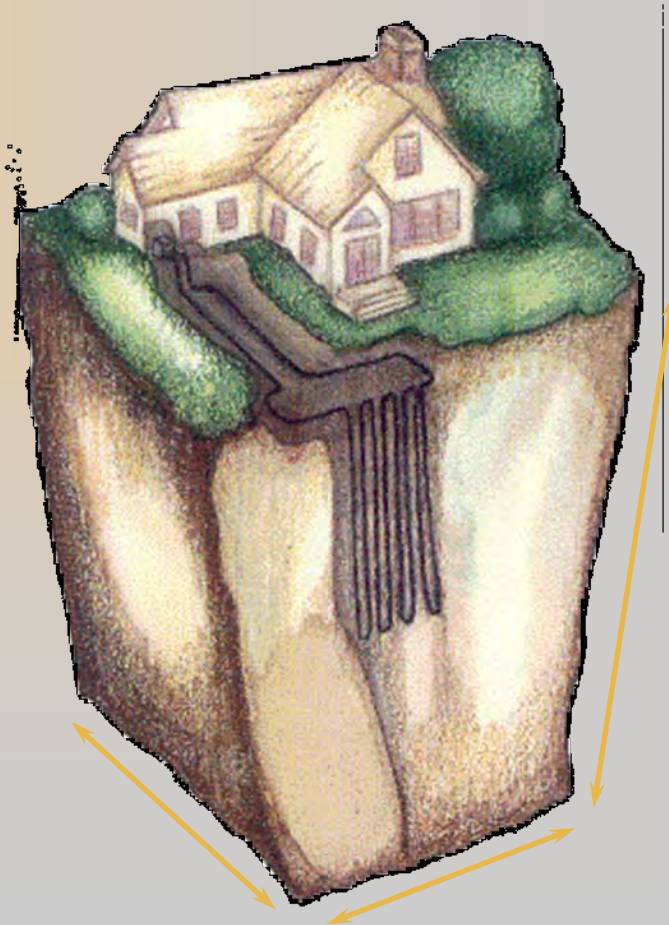


Market Barriers

Mass market approach for geothermal heat pumps

GreenHeat

heating & cooling a different world
with renewable energies

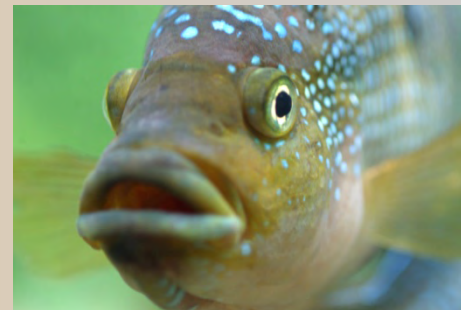




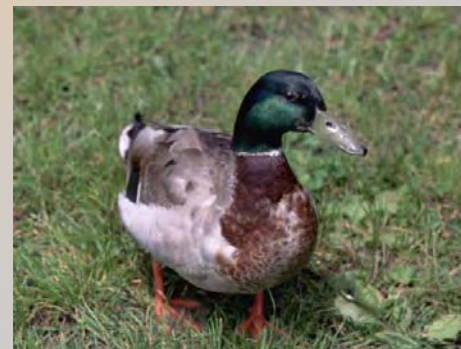
Geothermal Heat Pumps

★ What is a Ground source heat pump?

★ Efficiency measure?



★ Renewable energy?

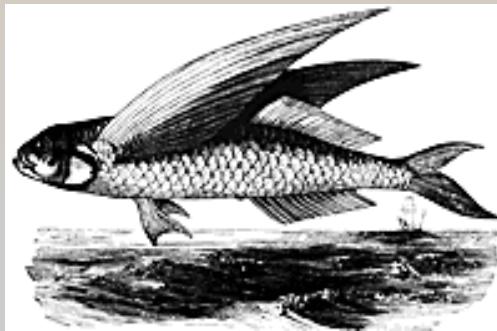




Geothermal Heat Pumps

The Texas PUC is considering a new category:

Renewable demand side management technologies – Equipment that uses a renewable energy resource (renewable resource) and/or a generation offset technology, that, when installed at a customer site, reduces the customer's net purchases of energy, demand, or both. Examples of renewable DSM technologies include customer-sited solar water heaters, and geothermal heat pumps.





Geothermal Heat Pumps

★ A utility ~~may~~ shall provide a set-aside of ~~10%~~ at least 20% of the utility's demand goal for solar and other distributed renewable technologies that provide quantifiable demand and energy reductions, including geothermal heat pumps.

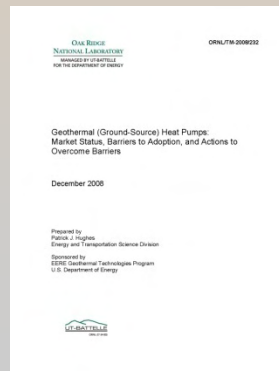




Oak Ridge National Labs – U.S. DOE

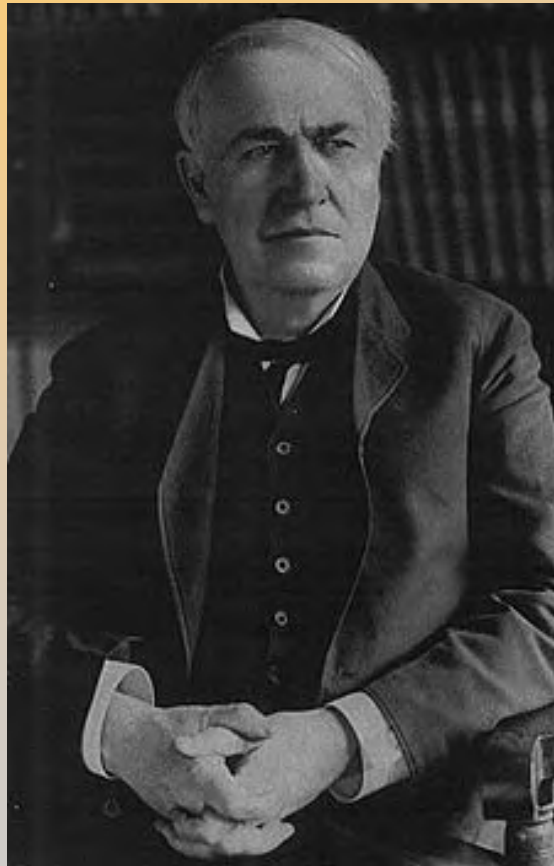
December 2008

- ★ The primary GHP market failure is the expectation that building owners should finance the ‘GHP infrastructure,’ or outside-the-building ...ground heat exchanger. GHP infrastructure will outlive the building and many generations of heat pumps, and is akin to utility infrastructure (poles and wires, and underground natural gas piping).





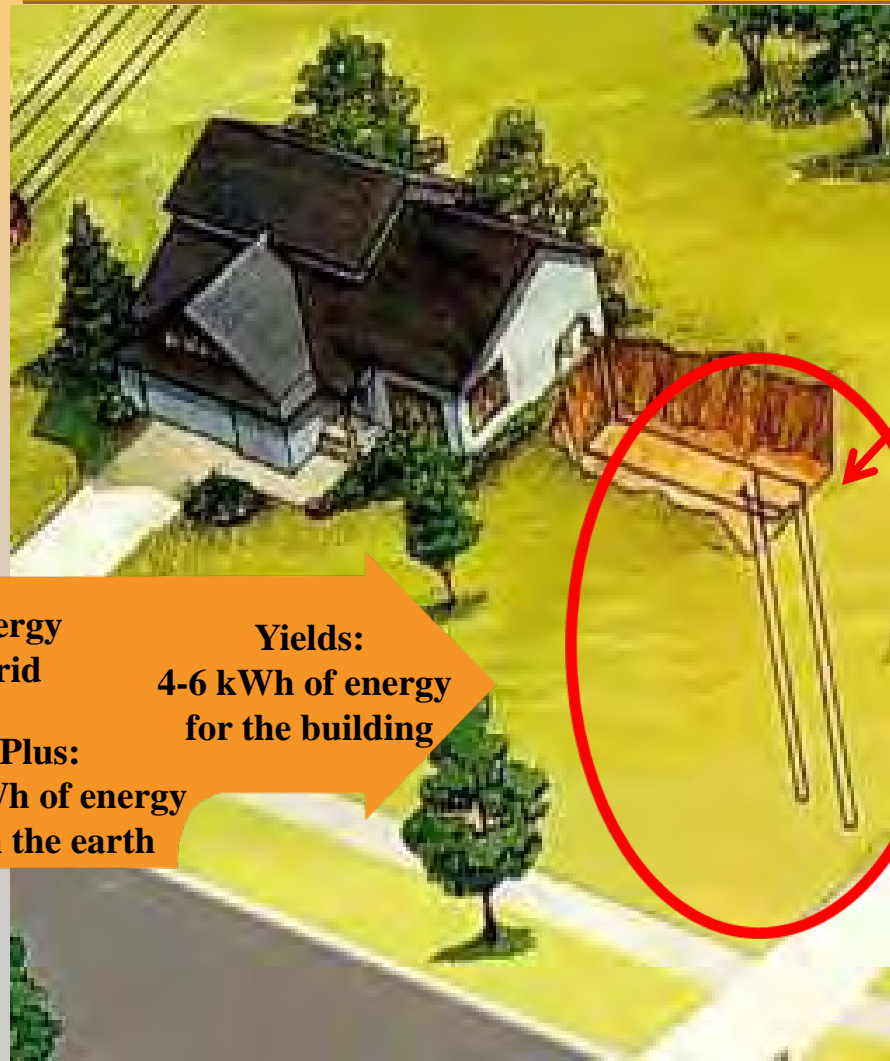
The Ground Loop “Utility”



- 1- Water/Sewer
- 2- Electricity
- 3- Natural gas
- 4- Telephone
- 5- Cable TV
- 6- Renewable DSM ?



The Ground Loop “Utility”



Another form of utility plant
for delivering renewable
energy supplies to the load

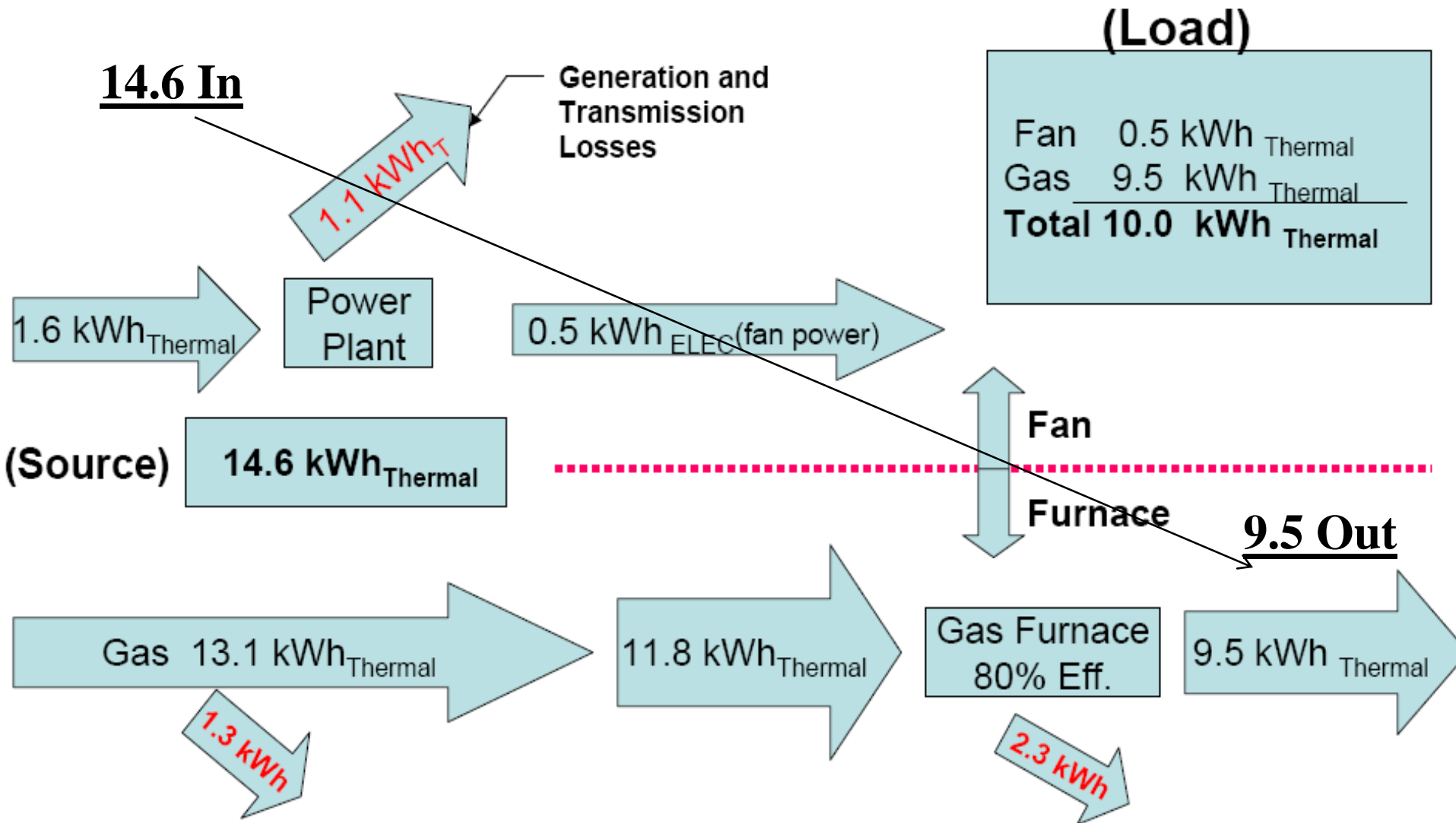
1 kWh of energy
from the grid

Yields:
4-6 kWh of energy
for the building

Plus:
3-5 kWh of energy
from the earth

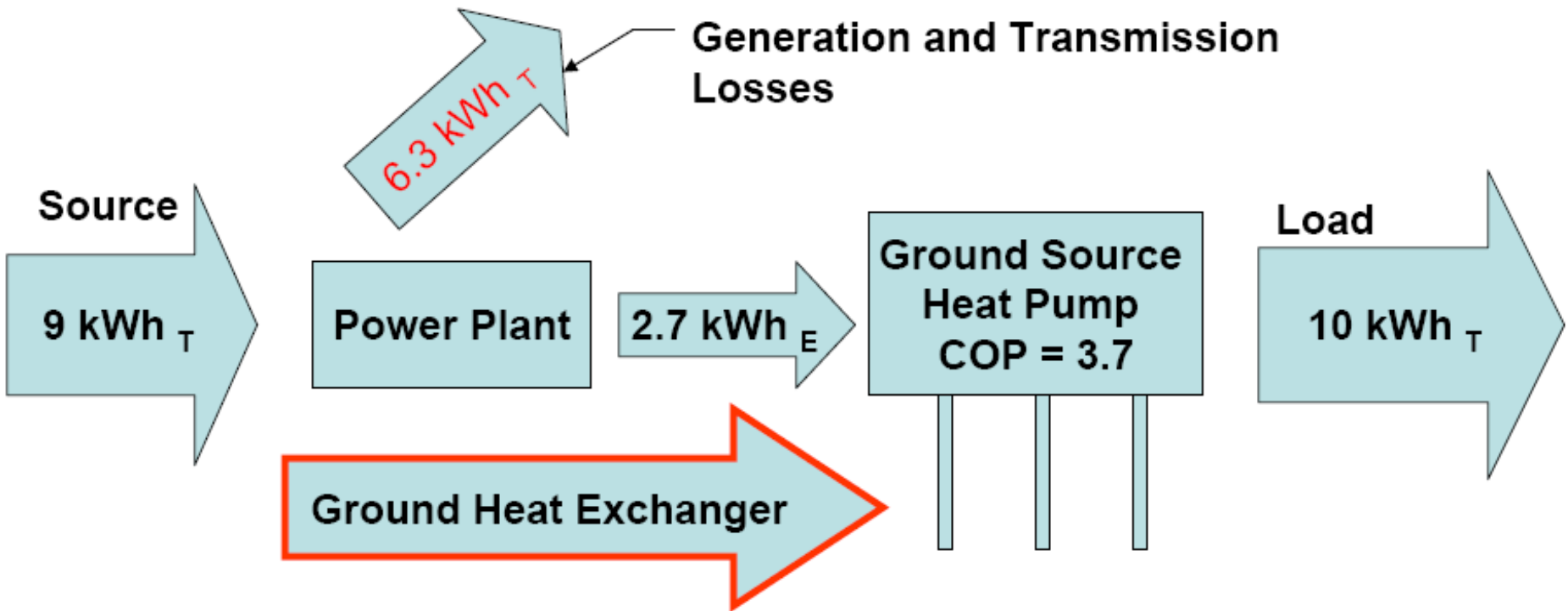


Gas/Electric HVAC System



The natural gas system loses about 10% in the transmission process and another 10 to 20% at the furnace. Electricity is also needed for the furnace fans. The total required to deliver 10 kWh to the building is 14.6 from the source. This is an overall efficiency of 68% source to delivered.

Ground Source Heat Pump



GSHP require only 9 kWh_T from the source to provide 10 kWh_T to the building since they can provide a COP of 3.7

COPs of **6+** are possible with advanced equipment



The Ground Loop “Utility”



★ The difference in the before and after system efficiency = carbon emissions savings.



★ 300,000 GSHP retrofits could equal the carbon emissions of a 500 mW coal plant (which serves 300,000 -? homes!)





The Ground Loop “Utility”

The Utility Loop Concept

- ★ Utility owns and recovers the cost of the loop, interest expense, program costs, and profit or operating margin.
 - Utility installs or contracts out loop construction.
 - Controls system design and installation quality
 - Utilities gets improved load factor & incremental kWh revenue.
 - System load factor is even better with load control.
 - Future carbon credits may stay with the utility

- ★ Consumers Get:
 - Lower total energy bills.
 - Utility grade service and reliability
 - Reduced or no incremental cost for participating





The Ground Loop “Utility”



- ★ Electric co-ops can access 35 yr. Rural Development loan funds for GHP loops
- ★ H.R. 2419 - Food and Energy Security Act of 2007 (Engrossed Amendment as Agreed to by Senate)
 - SEC. 6108. ELECTRIC LOANS TO RURAL ELECTRIC COOPERATIVES.
 - “The committee notes that assistance is authorized for renewable energy including geothermal ground loops”



The Ground Loop “Utility”

- ★ HR-4785 (Rural Star) introduced 3-10-10
- ★ The bill from Rep. James Clyburn (D-S.C.) and Sens. Lindsey Graham (R-S.C.) and Jeff Merkley (D-Ore.) would create a **\$4.9 billion** consumer loan program administered by the nation's rural electric cooperatives.
- ★ The cooperatives would borrow the funds at **0% interest**
- ★ Then make that money available to their members at no more than **3% for up to 10 years** for energy efficiency upgrades to their homes.
- ★ Enabling the co-ops to combine 35 year loop financing with 10 year GSHP equipment retrofits and home efficiency improvements
- ★ Consumers get a 30% tax credit on the GSHP Equipment



The Geothermal “Utility”

- ★ PACE financing
 - Financing initiative for efficiency and renewable, including GSHPs
 - “OPT-IN” special tax district to secure financing
- ★ Powerful tool for municipal utility GSHP program implementation.
- ★ Consumer gets 30% tax credit on entire GSHP system





The Geothermal “Utility”

★ What about Investor Owned Utilities?

- Loop Tariff in rate base?
- ESCO model?
- Or?





State of Colorado - PUC Rule

LexisNexis(TM) CD

<http://198.187.128.12/mbDownload/Colorado2GeothermalHeatSupp...>

Document 1 of 7

Source:
Colorado Statutes/TITLE 40 UTILITIES/GEOTHERMAL HEAT/ARTICLE 40 GEOTHERMAL HEAT SUPPLIERS

ARTICLE 40 GEOTHERMAL HEAT SUPPLIERS

Cross references: For the "Colorado Geothermal Resources Act", see article [90.5](#) of title [37](#).

Section

[40-40-101. Short title.](#)

[40-40-102. Legislative declaration.](#)

[40-40-103. Definitions.](#)

[40-40-104. Public utility status - exceptions.](#)

[40-40-105. Operating permits.](#)

[40-40-106. Continuing review.](#)

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Source:
Colorado Statutes/TITLE 40 UTILITIES/GEOTHERMAL HEAT/ARTICLE 40 GEOTHERMAL HEAT SUPPLIERS/40-40-101. Short title.

[40-40-101. Short title.](#)

This article shall be known and may be cited as the "Geothermal Heat Suppliers Act".

Source: L. 83: Entire article added, p. 1422, § 2, effective June 10.

ANNOTATION

Am. Jur.2d. See 27A Am. Jur.2d, Energy and Power Sources, §§ 52, 56.

C.J.S. See 39A C.J.S., Health and Environment, § 109.

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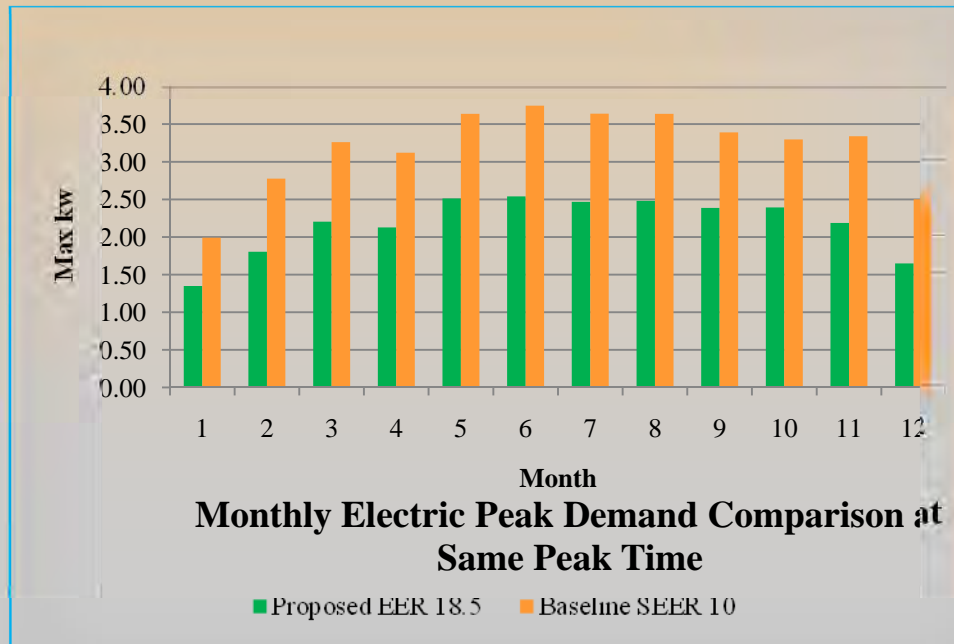
Document 3 of 7

The Colorado Geothermal Heat Suppliers Act, passed in 1984, is a little known statute that gives suppliers of geothermal heat including GSHP loops an exclusion from the certificated utility's exclusive territory rights. This allows 3rd party providers to own GSHP loops and provide them to consumers who pay for the thermal energy.



The Geothermal “Utility”

- ★ ClimateMaster is working with the Utility Geothermal Working Group and Oak ridge National Lab to develop a GSHP demand and energy savings “map” using eQuest (DOE 2) modeling for utility program managers.



Austin
TX model
results



eQuest models peak by hour of day



HVAC System
Peak Time
1/30/09 16:00
2/22/09 17:00
3/20/09 18:00
4/15/00 18:00
5/26/09 19:00
6/21/09 19:00
7/31/09 19:00
8/19/09 19:00
9/1/09 19:00
10/1/09 18:00
11/14/09 17:00
12/25/09 15:00

There is not much solar energy available at these peak hours





Thank You For Your Attention!

Questions?



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