



# California Energy Commission Staff Workshop on AB 2339

Geothermal Heat Pump System Potential for California  
Net Zero Buildings

By

Paul Bony

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ClimateMaster

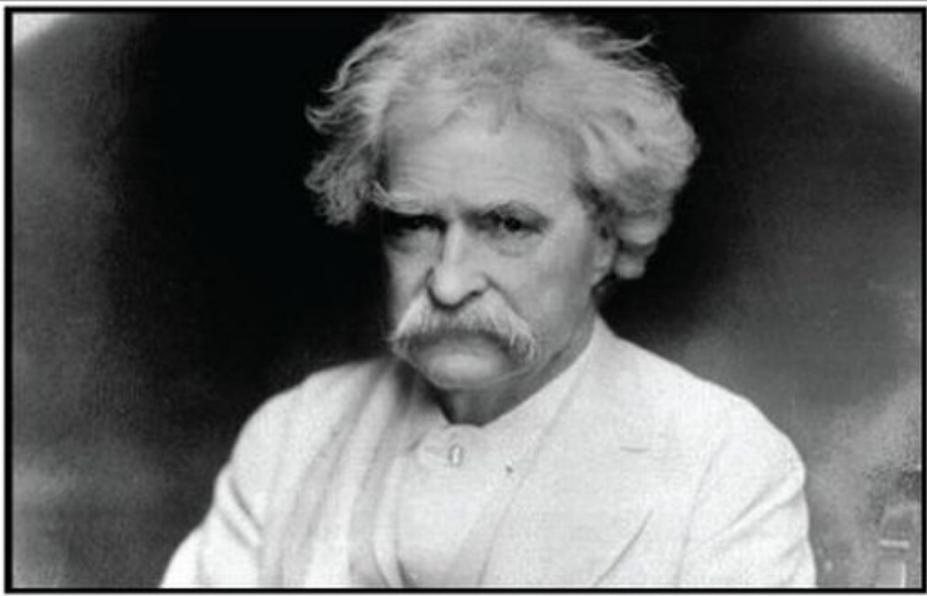
March 21, 2013





# Geothermal Heat Pumps a Key Ingredient in a Net Zero - Low Carbon Diet

sloshspot.com



**DIET**

“Part of the secret of success in life is to eat what you like and let the food fight it out inside.”

A black and white portrait of Mark Twain, looking slightly to the left. The portrait is framed by a white border. The text 'sloshspot.com' is in the top right corner of the image area. Below the portrait, the word 'DIET' is written in a large, serif font. At the bottom, a quote is written in a smaller font.



# California Can Develop a Net Zero Low Carbon Building Market

Efficient Envelope



Super Efficient GHP Equipment



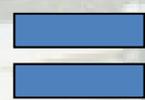
Renewable Energy Systems



New financing Tools



Thermal Energy Policy

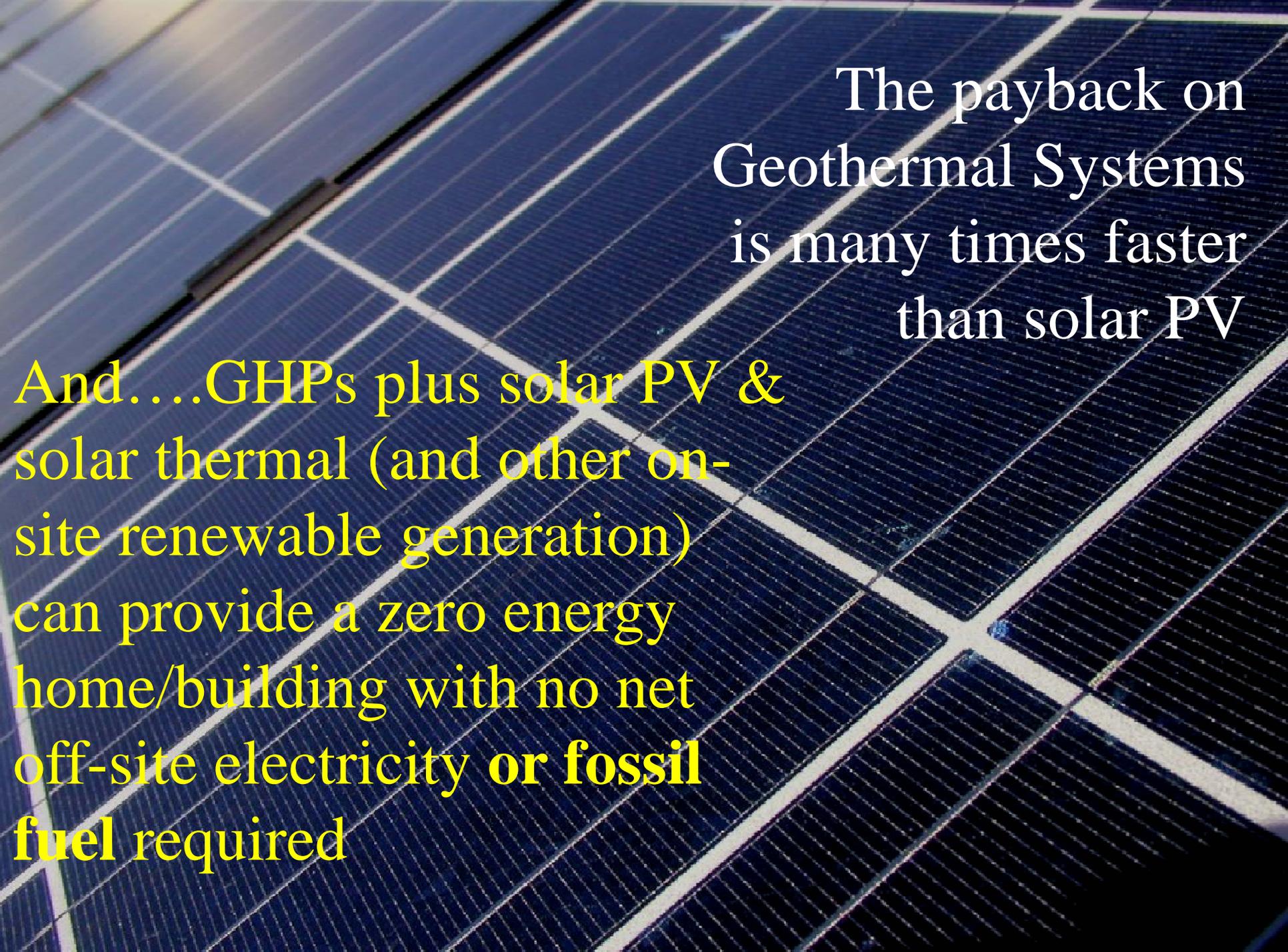


*Annually producing as much energy as consumed with minimal carbon emissions*

# Zero Energy Buildings



- ZEBs are buildings that use no more energy over the course of the year than they produce from on-site renewable sources.
  - You can not produce natural gas, oil, or propane on site.
- The efficiency levels needed for ZEBs are readily obtainable, with current technology and at reasonable incremental costs, for many common building types. (New Buildings Institute, March 2012)



The payback on  
Geothermal Systems  
is many times faster  
than solar PV

And....GHPs plus solar PV &  
solar thermal (and other on-  
site renewable generation)  
can provide a zero energy  
home/building with no net  
off-site electricity or fossil  
fuel required

# Zero Energy Buildings



- PV limitation
  - Even if every home had PV on the roof, where would heating energy come from?
- GHPs combine the benefits of building & HVAC system efficiency, renewable thermal energy and PV electricity.
  - GHPs allow the storage and harvest of thermal energy
- Perfect mix for true Net Zero or Near Zero buildings

# Zero Energy Buildings



- GHPs provide 50% minimum reduction in total energy needed
- Net-zero electric bill
  - Can easily hit 100% using the electric grid as a battery
- Natural Gas use offset with Geothermal Heat Pumps and solar thermal



The Net-Zero Energy Residential Test Facility in Gaithersburg, Md.

# Zero Energy Buildings



- **The most cost effective way to get to zero energy is to utilize a ground source heat pump system.**
  - **Air source heat pumps don't have the cost/benefit ratio to drive the on-site electric generation they need & they have high peak energy demands**
  - **Only GHPs can store thermal energy, using the ground as an energy battery**
    - **GHPs do not produce “needle peaks”**
    - **Loops can be sized to minimize peaks and maximize efficiency**

# Elephant in the Room

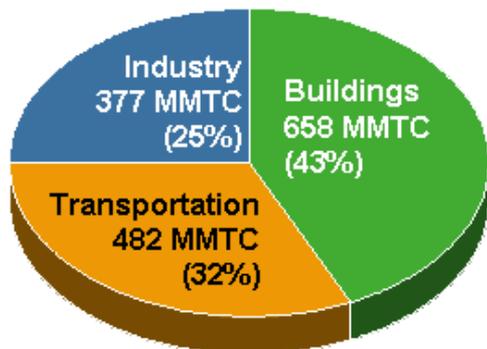


- Even if/when Renewables could supply 80% of total U.S. electricity generation
  - A hopeful target slated for by 2050, according to a new study by the National Renewable Energy Laboratory.
- Carbon emissions will still not be as low as needed/desired.
- Why?

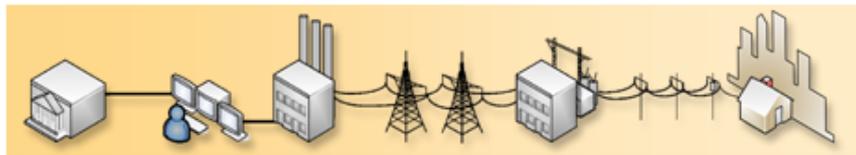
# Buildings Dominate U.S. Energy Use and Carbon Emissions

with Heating, Cooling, and Water Heating being the Largest Contributors

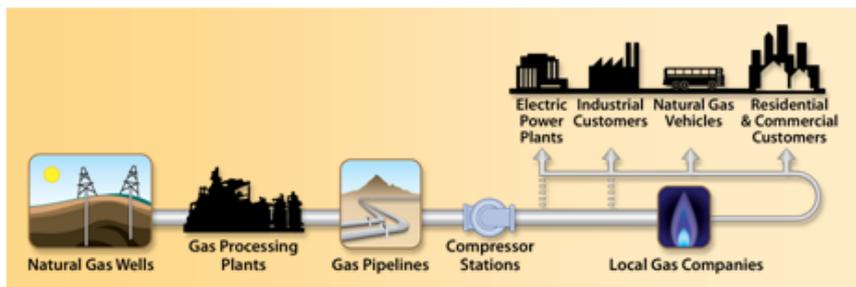
43% of U.S. Carbon Emissions



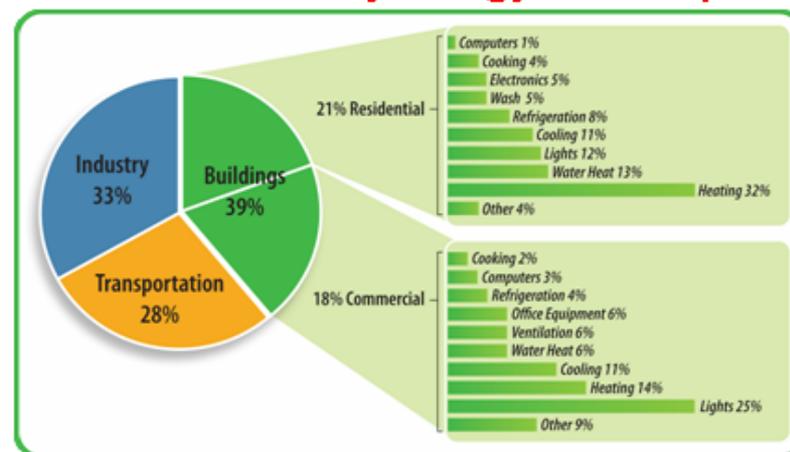
71% of U.S. Electricity



53% of U.S. Natural Gas



39% of U.S. Primary Energy Consumption



## Thermal Loads

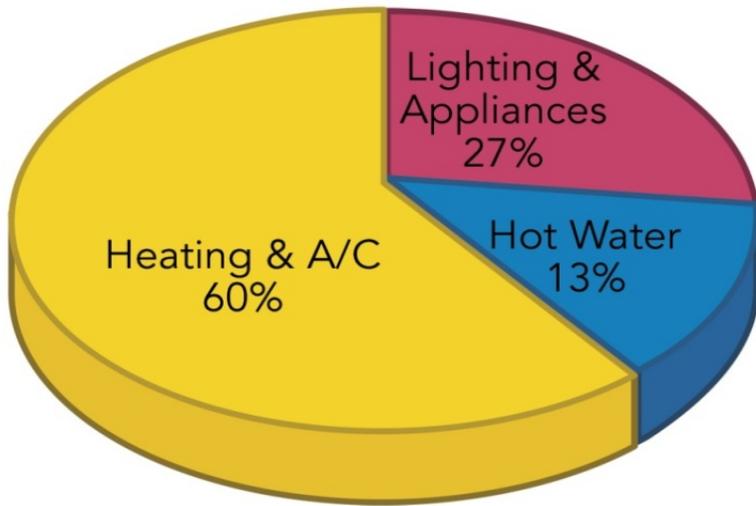
Heating	9.2%
Cooling	4.3%
Hot Water	3.8%
<b>Total</b>	<b>17.3%</b>

~ 20% of all U.S. Carbon Emissions

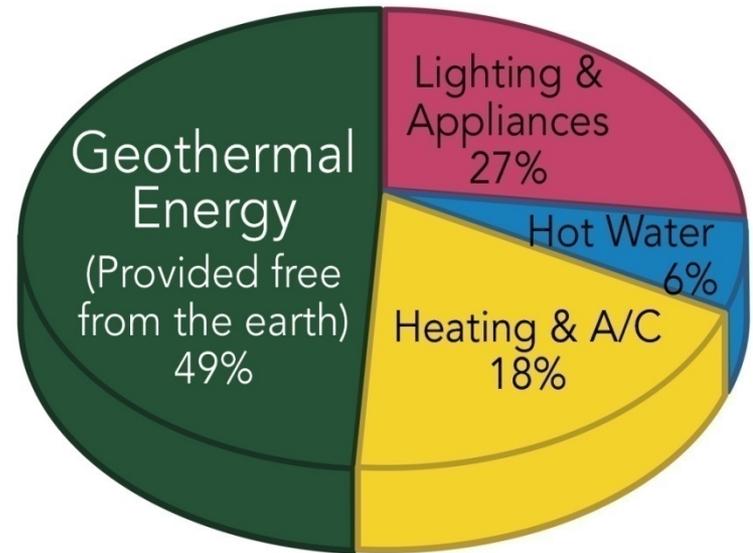
# Zero Energy Buildings



HVAC Energy Use Comparisons – GHPs  
*Reduce total home energy consumption by 50%*



**Conventional HVAC Home**



**Geothermal HVAC Home**

# Public Policy & the Environment



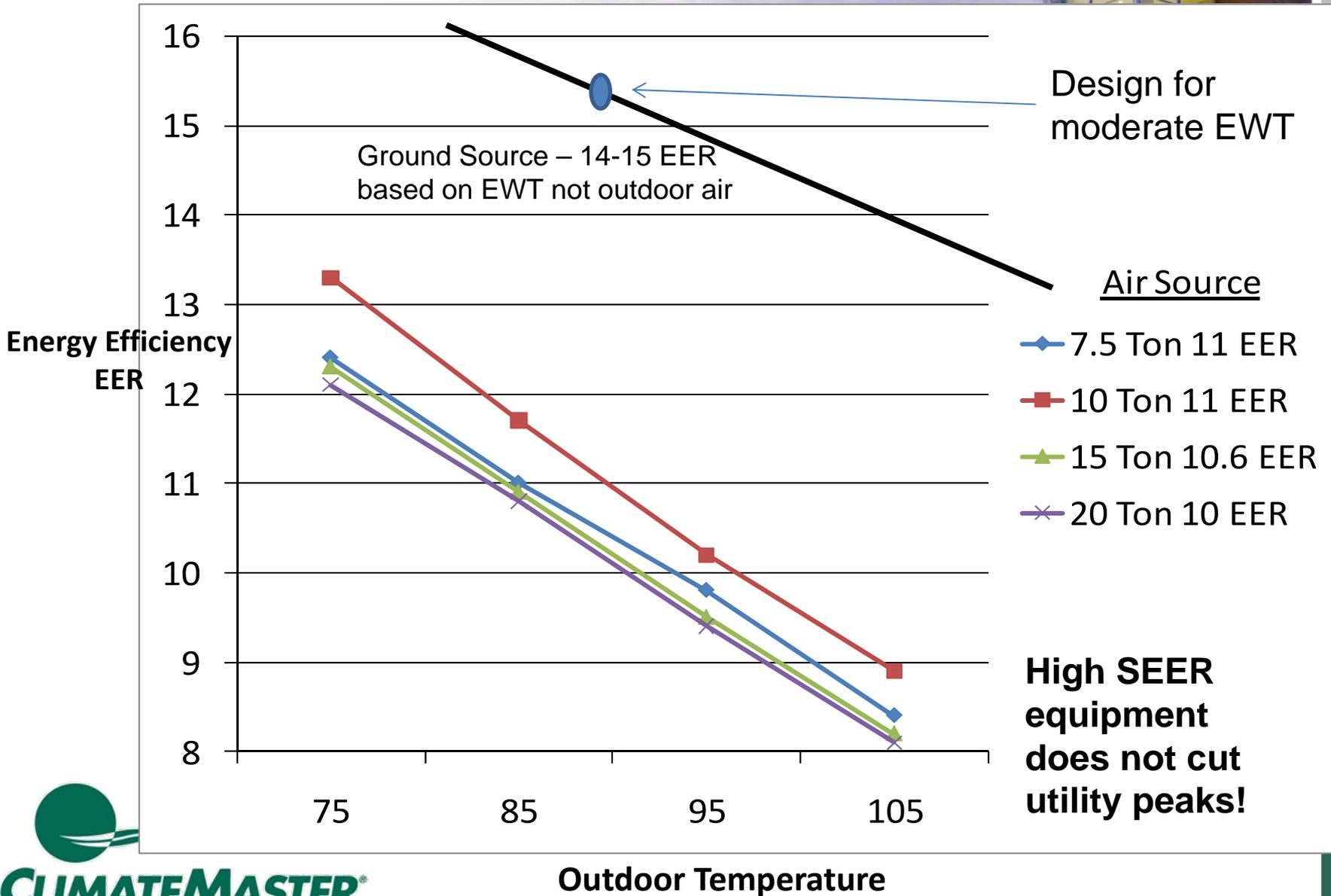
- If the carbon emissions from burning fossil fuels to generate electricity are not acceptable, why should we allow the burning of fossil fuels to heat buildings and water when better, low carbon, technologies are available?
- Especially if electricity from closed carbon generation can be used as well?

# Public Policy & the Environment



- Net Residential Energy Impacts
- GHP Retrofit from Natural Gas (Colorado)
- 5,086 increase in kWh (base is 14,511 kWh) total kWh = 19,597
- 1,479 decrease in Therms of N Gas
  - $147,900,000 \text{ Btu} * 45\% \text{ heat rate} = 19,597 \text{ kWh}$  generation possible with the gas saved
  - Typical thermal efficiency for combined cycle electrical generators is 56 – 60%.
- Equals more (net) kWh generation than the home uses.

# Air Source A/C Vs. Ground Source Efficiency

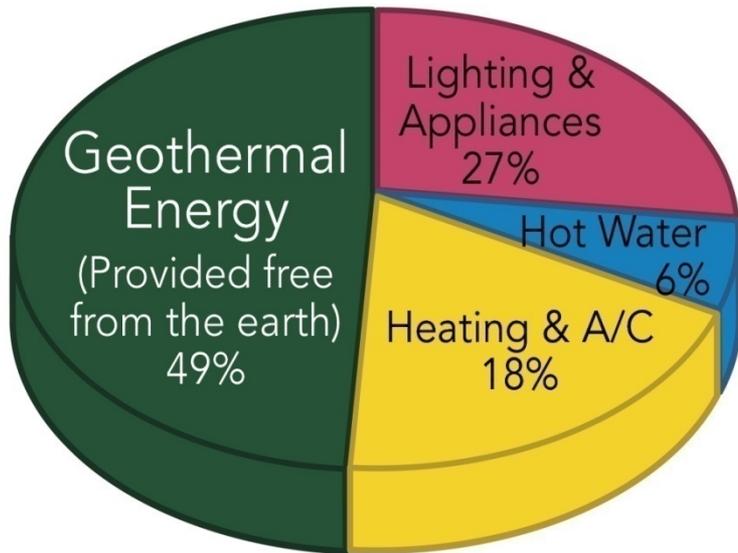


# HVAC Energy Comparisons



- ORNL 2010 Report
  - Found geothermal heat pumps would:
    - Reduce energy consumed for H/C/DW by 45%
    - Reduce peak energy demand for H/C/DW by 56%
    - Reduce consumer's bills for H/C/DW by 48%
    - Reduce CO2 emissions for H/C/DW by 45%

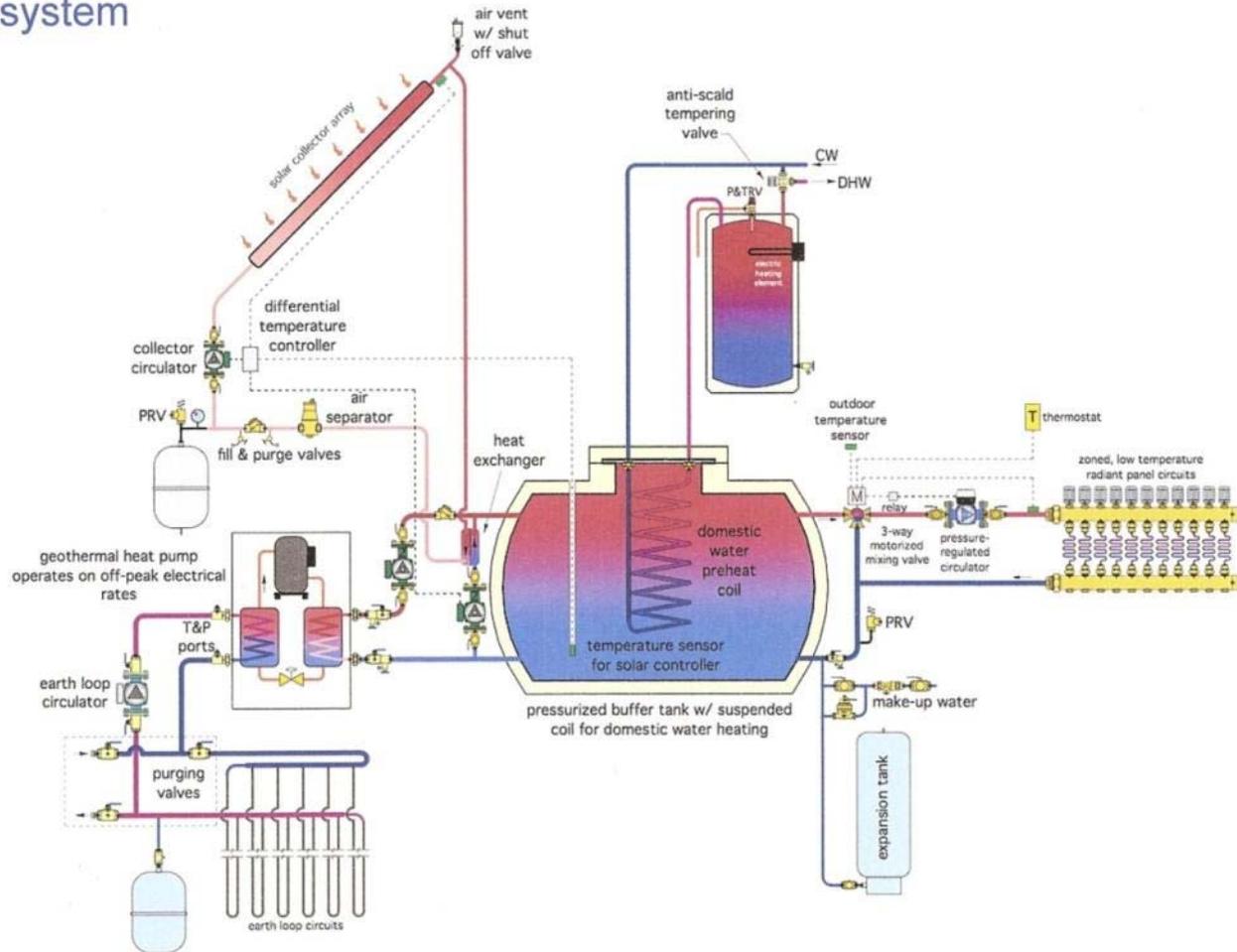
# GHP's & Solar Co-Generation



Next generation Solar-Thermal + GHPs with loop used for thermal storage

# Geothermal Energy can be Stored

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





# 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

No carbon electricity = carbon free heating, cooling & water heating



# GHP Systems are Scalable



1300 sq. ft. Habitat for Humanity Homes – 1 Unit



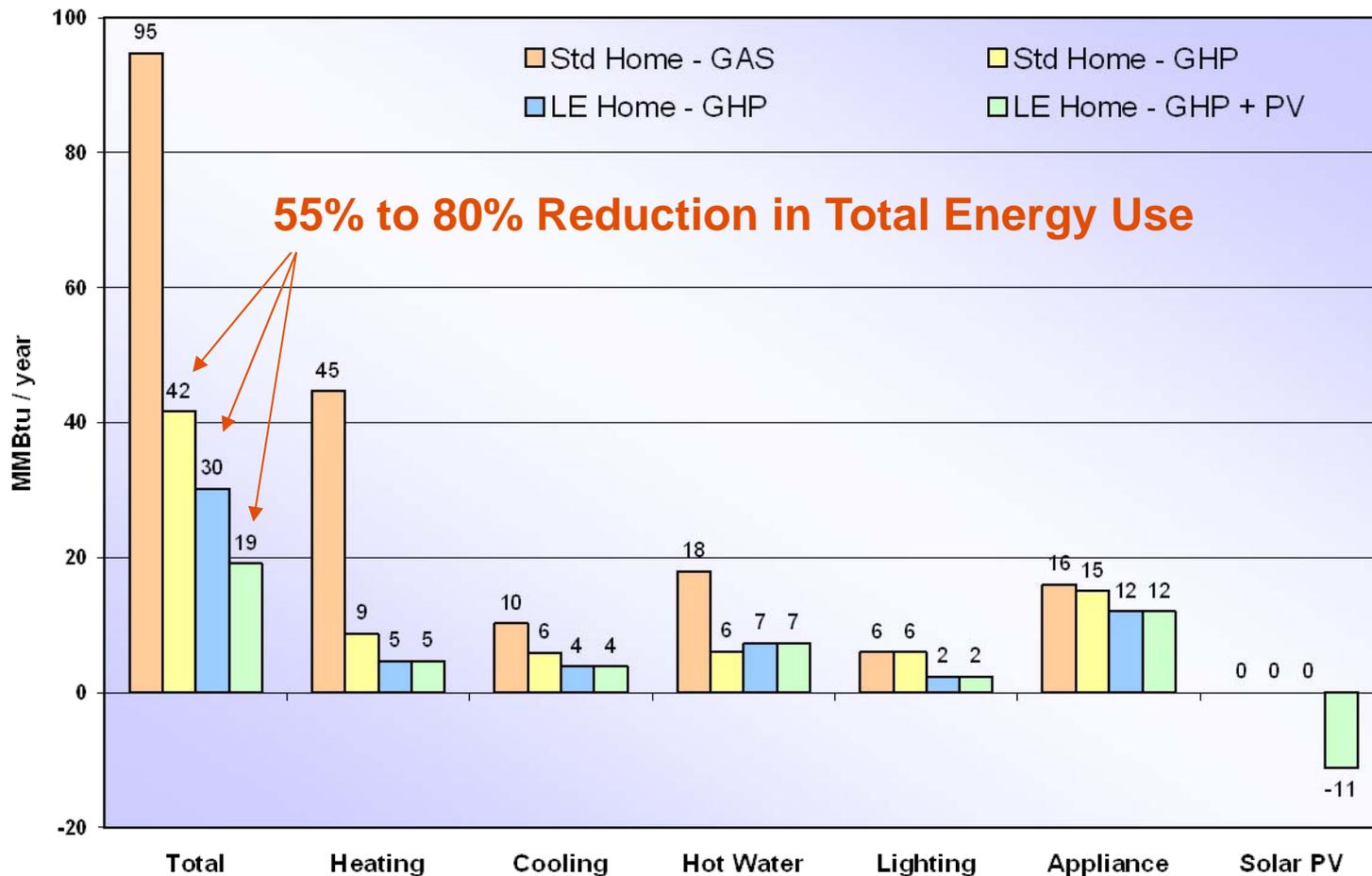
# Small Low Energy Homes



**Geothermal Heat Pump / Foam Insulation / Low-E Glass  
CFL Lighting / Energy Star Appliances**



# Small Low Energy Homes



# Geothermal Heat Pump *Takeaways*

- ❖ *GHPs provide the most efficient (and cost effective) method of heating and cooling a building*
- ❖ *GHPs are both a renewable and an energy efficient technology*
- ❖ *GHPs leverage on-site solar co-generation to Net Zero*
- ❖ ***GHPs reduce utility peaks and improve load factor***
- ❖ *There is no question –**THEY DO WORK!***



- INTERMISSION!



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Geothermal Heat Pumps a Utility and Public Policy  
Perspective

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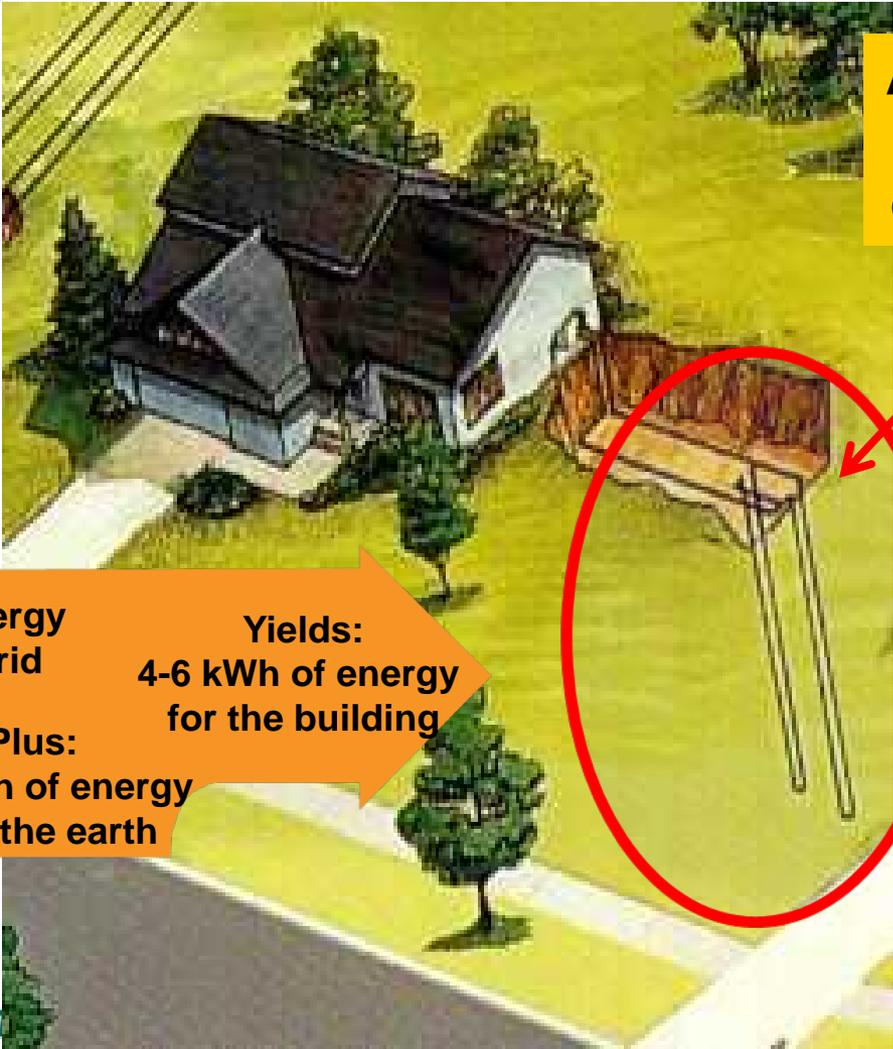
Western Region

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# GHP's & Utilities



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

# Why Should Utilities Support GHPs?

‘Cause somebody has to row the boat!

- **Vision**
- **Patience To Develop A Market**
- **Access to Capital**
- **Economic Incentives**
- **Strong Consumer & Contractor Relationship**
- **Experience In Energy Programs**



# Good News or Bad News?



- The DSIRE data base reports 345 utilities with some form of GHP incentive, mostly rebates or loans.
  - Rebates don't work for GHPS
- There are probably less than 50 “Active” utility programs
  - Creative ongoing efforts with a utility “champion”
- Bit the few active programs are doing well.....

# Public Policy & Utilities



- In an effort to reduce CO<sub>2</sub> emissions, electric utilities have been the primary target of efficiency and renewable energy regulations & policies to cut green house emissions
  - With a focus on reducing kWh consumption.
    - Through PV & wind focused Renewable Portfolio Standards (RPS)
    - Through energy (electric) efficiency programs
      - CFLs to Energy Star appliances
- The focus on kWh has missed the massive opportunity in total building Btu usage – Carbon lives in Btus!

# Public Policy & Utilities



- Based on public interest theory (regulated monopoly)
- State regulation is in the public interest as it makes consumers better off than unregulated commerce
  - “Focused” target – with “easy” oversight
  - Imbedded financing solution
    - Incentives & program costs  Rates
- GHPs can provide utilities with a solid return on a new class of invested capital (loops) while taking pressure off of kWh rates
  - Through improve load factor and return on (new) invested capital

# Geothermal For Utilities



[www.ceres.org](http://www.ceres.org) ceres report 2010

- Changes that have been underway for the past two decades are leading to deep and fundamental changes in the electric industry.
- In a distributed generation and net zero environment, there is increased complexity and uncertainty for the traditional electric utility roles of producing, generating, and delivering electricity.
- Successful electric utilities will position themselves for a new low-carbon, distributed generation business environment.

# Geothermal For Utilities



- The modern utility must develop solutions to cope with climate change and the increasing desire of customers to take a more proactive role in their energy choices.
- New approaches to serving customers with less energy use, cleaner energy and emerging technologies are taking hold at the same time that traditional utility approaches have become more expensive, complicated and risky.

# Geothermal For Utilities



- 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 customer satisfaction goals
  - With out putting pressure on electric rates
  - In fact, they can make rates go down

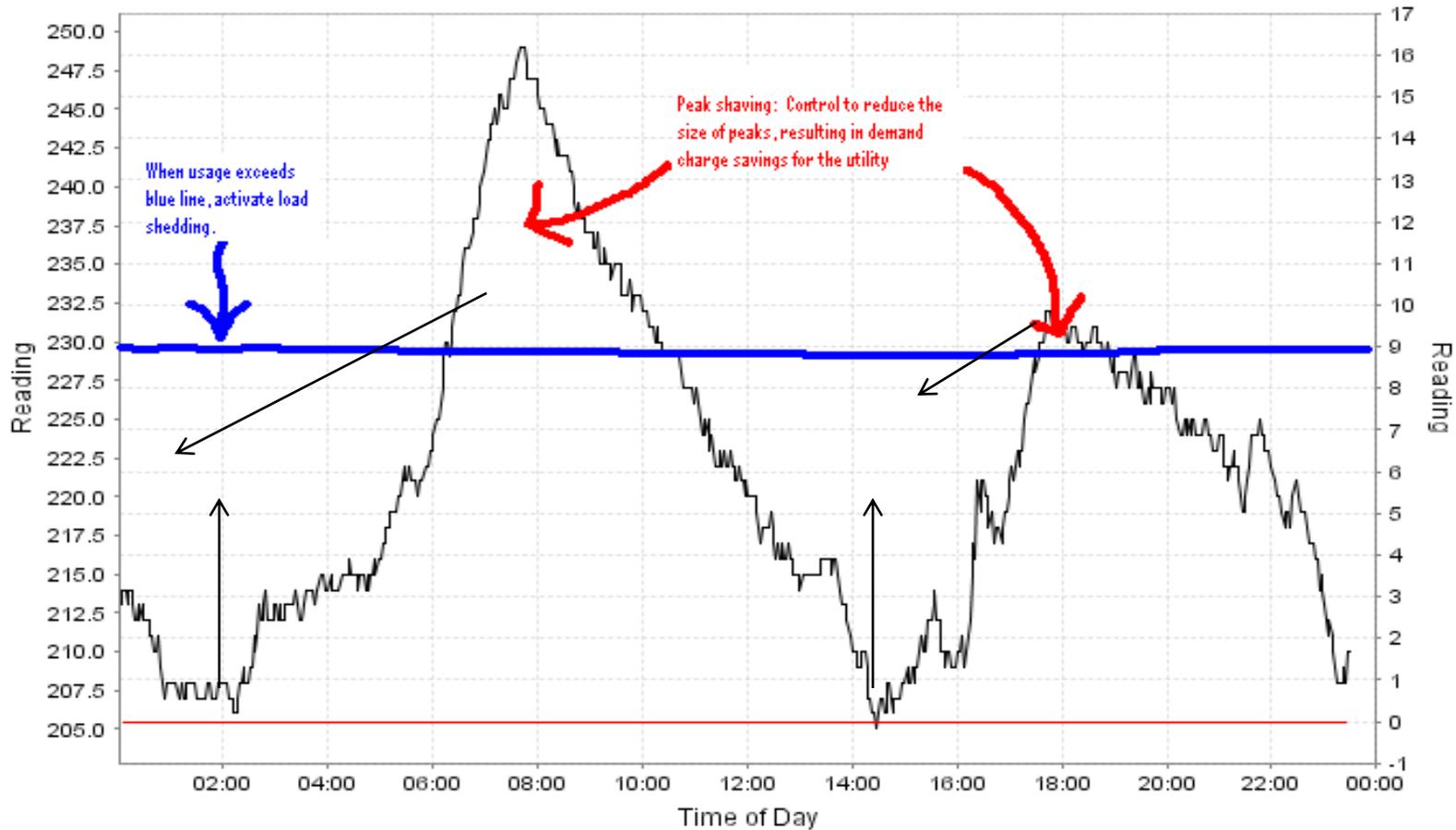
# Geothermal For Utilities

## Other Positive Factors

- Positive Public Relations
- Meeting Vision of Multiple Special Interest Groups
  - Environmental
  - Economic Development
- Positive Utility Economics – Avoid Lost Revenue!
- Makes Energy Efficiency a “No Regrets” Strategy
  - As endorsed by NRECA, APPA, EEI

# Geothermal For Utilities

## Clipping the Peak

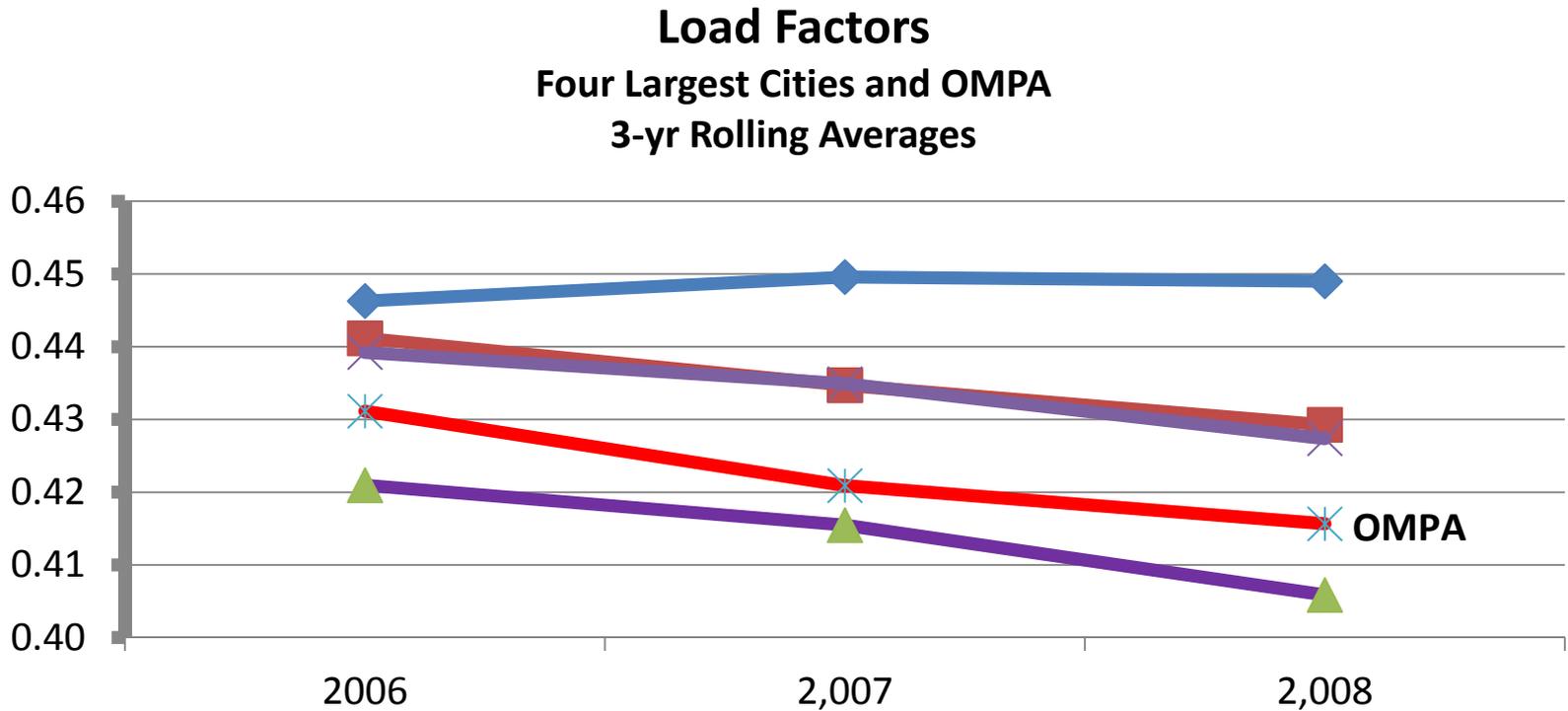


# Oklahoma Comfort Program (OCP)





# OMPA and Member Load Factors





# OCP Program Objectives



- Reduce summer peaks
  - Delay acquisition of new power resources
  - At 105 ° F a 13-SEER AC uses 1.3 kW/ton and GHP uses about 0.8 kW/ton
  - = 0.5 kW/ton GHP Peak savings
- Improve load factor
  - Reduce cost of power for OMPA's member cities
- Focused on geothermal heat pumps to
  - Lower summer peaks
  - Add winter electric load

# OMPA Results

- Over \$3 million in GHP Rebates
  - \$1,800/ton
    - Convinced that dealers raised prices to match
- This Week?
  - 1 Million \$ (+) loan program for member utilities by Power Agency for GHP programs
    - 7 year terms at 1.2% interest
    - Still looking at owning loops

# Western Farmers



- Started with a consumer sweepstakes (Utility Idea),
  - They Abandoned SEER for A/C Rebates pushing \$ to GHPs
- Launched a Go-Go GEO State Wide High School Video Contest
  - Winter Semester 2013
  - All 3 Major Manufacturers. Are “in” (first joint marketing effort ever)
- Multiple co-ops developing “Thermal Energy Services”
  - Stand alone efforts
  - Or partnering with 3d party contractors

# Western Farmers



- Many member co-ops looking at loop leasing, financing or 3d party financing support
- Now working on a multi million \$ loan program for member utilities funded by the Feds (RUS) and Co-Bank
  - Farm Bill (passed Senate now in the House)
    - 7 – 15 year terms at 0.00% interest
    - Talking with us on running the loan program
- Several also looking at owning/leasing loops
  - Loop Tariffs

# Western Farmers



- Also Bringing GHPs Into Key Account Efforts
  - Leveraging Federal tax credits that make commercial GHP installations & retrofits the lowest equipment first cost option.
  - Because most commercial applications save both peak demand and kWh
- Dairy analysis in New Mexico
  - Less than 2 year paybacks for Dairy farmers
    - Hung up due to current milk prices vs. farm operations costs

# Western Farmers



- Have Identified over 60 Mw of Demand Reduction in the New Mexico Dairy Industry alone
- Active effort to train utility staff to identify commercial applications / retrofits
- Using a “Design - Build” Implementation Model
- 240 + home subdivision in the first co-op to implement a Thermal energy (rate based) service

# Western Farmers



- Check out all the great GoGoGeo videos and vote on your favorites to give a student a chance to win up to \$10,000 in college scholarships. Anyone can vote daily until March 21, 2013 at midnight.
- [www.gogogeochallenge.com/content](http://www.gogogeochallenge.com/content)



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What Is Geothermal?

About GoGoGeo

The Rules

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### Here's the Deal

The GoGoGeo Scholarship Video Challenge is go-go-going on right now. Submit your educational video about the awesomeness of Geothermal Energy by February 22, 2013 for your shot at winning up to \$10,000 in college scholarships.

GET EDUCATED

GETTING STARTED

**UPLOAD YOUR VIDEO**

# GHPs & Utilities



## Findings From National Focus Groups:



25-30% of participants said they would participate in a utility “CO-Z” program! (Higher acceptance than anti-lock brakes received when originally tested)

This was a turn-key monthly payment utility installation & financing program that provided a positive monthly cash flow

# GHPs & Utilities

- On bill financing
- Midwest Energy
  - Hays Kansas co-op puts up the efficiency funding
- No up-front capital is required for qualifying investments.
- Monthly How\$mart<sup>®</sup> surcharge covers the cost of qualifying improvements. **The surcharge is always less than the projected savings.**
- The How\$mart<sup>®</sup> **surcharge is tied to the location.** If you move or sell the property, the next customer pays the surcharge.



Click here to learn more and get started saving >

Now you can make **EFFICIENCY IMPROVEMENTS** and reduce your Midwest Energy bill at the same time!



# GHPs & Utilities



## Oak Ridge National Labs

- This begs the question: “Why do we expect building owners to finance GHP infrastructure on their own credit, but not other utility infrastructure?”
  - December 2008

OAK RIDGE  
NATIONAL LABORATORY  
MANAGED BY UT-BATTELLE  
FOR THE DEPARTMENT OF ENERGY

ORNL/TM-2008/232

Geothermal (Ground-Source) Heat Pumps:  
Market Status, Barriers to Adoption, and Actions to  
Overcome Barriers

# GHPs & Utilities



## The Ground Loop “Utility”

- 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”



- The RUS now includes GSHP loops into their standard loan program.
  - The GSHP loops become utility plant.
  - Loops look like street lights for billing.
    - New margin opportunity (earnings on plant).
  - Instant first cost savings for your members.
    - Drives positive cash flow cash flow for members.
    - Long term utility relationship and member satisfaction.
  - Levels the electric utility playing field with natural gas, propane and oil heating.

# GHPs & Utility Key Account Efforts



- Federal tax credits can make commercial GHP installations & retrofits the lowest equipment first cost option.
- This can be used to support key account efforts & program results
- Most commercial applications save both peak demand and kWh

# The Feds Get GHPs



- 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 Feds Get GHPs



- Fed tax credits cover 1/3 of the cost of a **residential** Geo installation.
- Federal tax code (credit) covers 10% of **commercial** Geo installations, plus provides accelerated depreciation (5 years) plus efficient building tax credits (\$1.50/sq. ft.)
  - covering over ½ the total installation cost (and all of the incremental cost).
  - Paybacks under 3 years! (some first year)

# Colorado Gets GHPs



- Renewable Thermal Energy Standard
  - A Local Initiative with a Global View
- Addresses Btus not individual Therms or kWh

# The UK Gets GHPs



- Increasing renewable heat is key to the UK meeting its renewable energy targets, reducing carbon emissions, ensuring energy security and helping to build a low carbon economy.

# The UK Gets GHPs



- They have launched a **Renewable Heat Incentive**, making renewable heat an environmentally sound decision, and financially attractive. This effort is targeted at driving the increased use of Renewables, stimulating the Renewables industry, encourage further innovation and ultimately, bring down the cost of renewable heating.



# Maryland Gets GHPs



- [HB 1186](#) was signed into law on May 22, 2012, the day that Maryland became the first state in the country to make the energy generated by geothermal heating and Cooling (GHC) technologies eligible for the Renewable Portfolio Standard (RPS) as a Tier 1 renewable source.
- Home owners will be eligible to receive Renewable Energy Credits (RECs) for GHC systems that are commissioned on or after January 1, 2013.

# Maryland Gets GHPs



# Maryland Gets GHPs

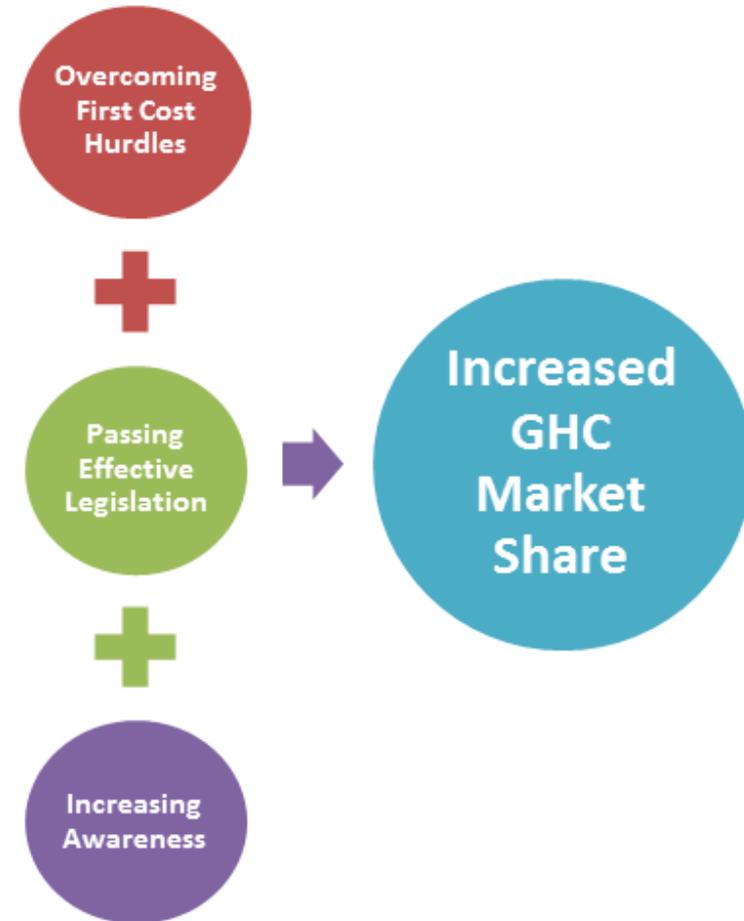


- The GHP industry (GEO) entered into a discussion with the Maryland Energy Office on their RPS efforts
- GHPs now included in Renewable Portfolio Standard
  - On a Btu equivalent basis
- Baltimore Gas & Electric
  - Very interested in GHPs as an alternative to oil heat
- Similar opportunity in California for propane & fuel oil

# Maryland Gets GHPs



- The Maryland Energy Office (MEA) & GHP industry have identified 3 activities that will achieve greater GHC market share:
  - 1. **Overcoming First Cost Hurdles**
  - 2. **Passing Effective Legislation**
  - 3. **Increasing Awareness**
- Hosting a Workshop on “Pointing the Way to Greater GHC Market Share”
- MEA Offices at 60 West Street, Annapolis, MD
- March 25, 2013, from 9:30 am till 12:00 noon
- With The Mid-Atlantic GHP industry, potential GHP end-users, environmentalists, MEA, and other interested participants



# Wyandotte Municipal Services Gets GHPs

- The Wyandotte, Michigan City Council approved the creation of a geothermal utility. The general manager of Wyandotte Municipal Services said there are many reasons to be excited about the introduction of geothermal energy, including its heating and cooling efficiency, its affordability, because geothermal helps Wyandotte Municipal Services improve the operation of the electric system and reduce power supply costs, and benefits to the environment. (August 2010)

# New York City Gets GHPs



- Use of renewable energy will help New York City reduce fossil fuel dependence, improve air quality, reduce adverse public health impacts from poor air quality and help diversify the suite of renewable energy sources used and conserve energy.

# New York City Gets GHPs



- Geothermal technologies represent a major opportunity for reducing national energy use, greenhouse gases and pollution, while delivering comfort, reliability and significant fuel cost savings to building and homeowners.
- Therefore, the Council finds that it is in the best interests of the City to explore measures that would facilitate and increase the use of geothermal energy sources in New York City.

# Policy Elephants In the Room



- Bias towards Natural Gas

- Fuel Switching

- Why is converting electricity to gas & PV good, while switching gas to 500% efficient electricity powered by PV, wind & other Renewables bad?

- Shale Gas

- Is there really a 120 year supply at today's prices with no environmental problems?

- Gas CO2 emissions

- Natural gas production & burning natural gas in furnaces and water heaters generates CO2 emissions, but current policy ignores this fact.

# Public Policy & GHPs



- The Missing Piece is an Energy Policy that Levels the Playing Field for All Renewable Thermal Energy
  - Measuring savings in annual Btus, not just kWh
  - Considers the thermal (and consequently carbon) impacts of all fuels – truly fuel neutral -
  - Based on the cost effectiveness to the end user
  - Allowing equal access to consumers for renewable & efficiency providers

**“We can always count on the regulators to do the right thing, after they have exhausted all the other possibilities.”**



# Thank You For Your Attention!



## Questions?



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

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