

# The Path to a Zero Net Energy Building and Geothermal

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# WHAT IS A NET ZERO ENERGY BUILDING?

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- A ZNE building produces enough renewable energy equal to the amount of energy it procures from the power and/or the gas grid.
- Energy produced on site equals what is purchased on an annual basis.

# What's Driving the Market?

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- The COE has a net zero initiative to have 17 pilot projects open by 2020.
- The Department of the Navy has a goal to have 1-GW of renewable energy on line by the end of 2015.
- The AIA and ASHRAE have an initiative to have carbon neutral buildings open by 2030.

# What's Driving the Market?

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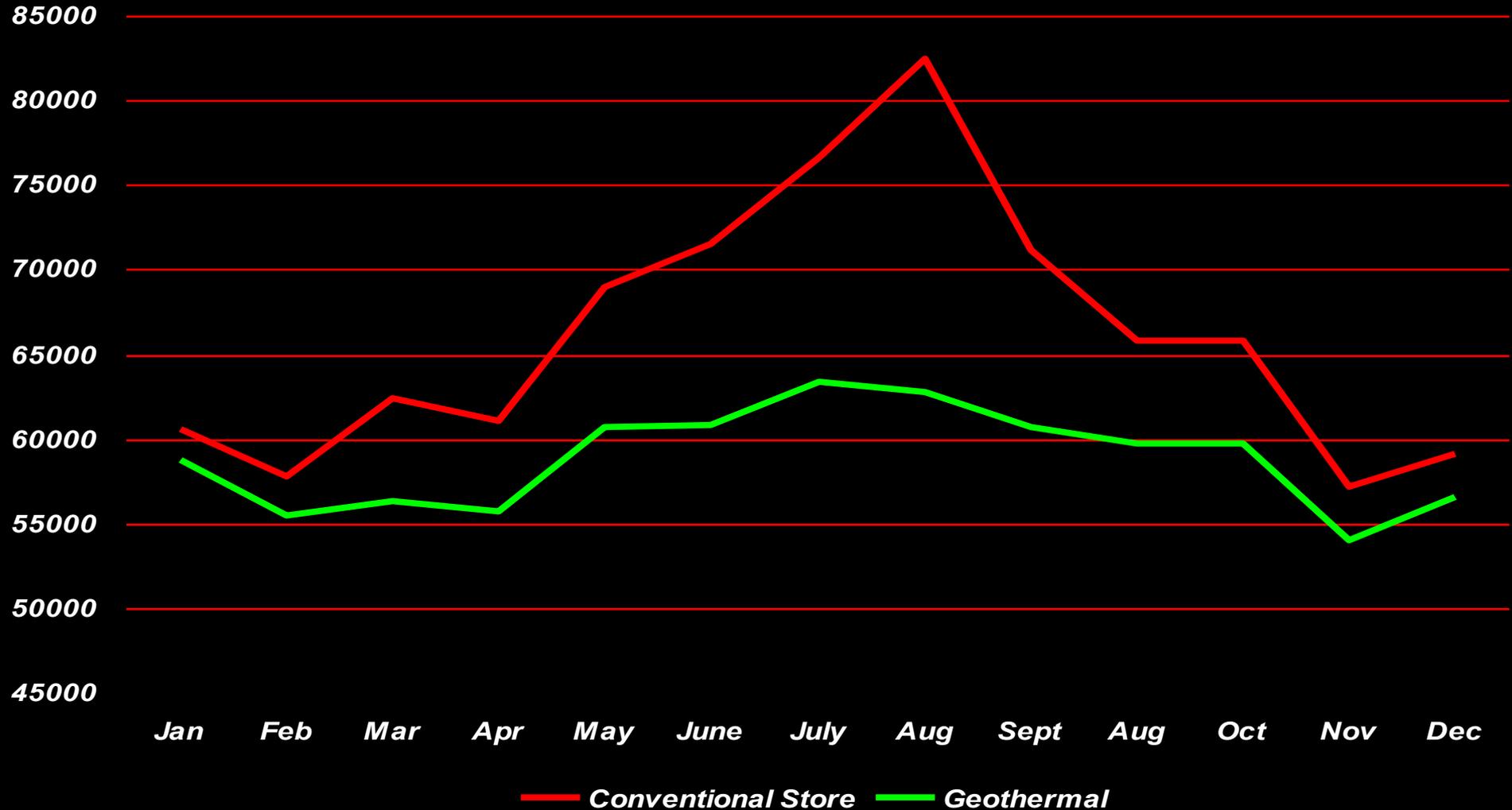
- In California, all new residential construction will be net zero by 2020.
- In California, all new commercial construction will be net zero by 2030.
- Executive order 13693 on sustainability recognizes geothermal heat pumps are one technology that can help reach its goals.

# A Team Effort

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- Architect: An efficient enclosure, Understanding the client energy profile.
- MEP: Integrating highly efficient systems
  - Photo Voltaic
  - Geothermal
  - LED lighting
- Comprehensive commissioning.
- Other peoples money-PACE.

# ENERGY PROFILE OF THE BUILDING- "FLAT LOAD PROFILE"



# Garrett Office Buildings Edmond, Oklahoma

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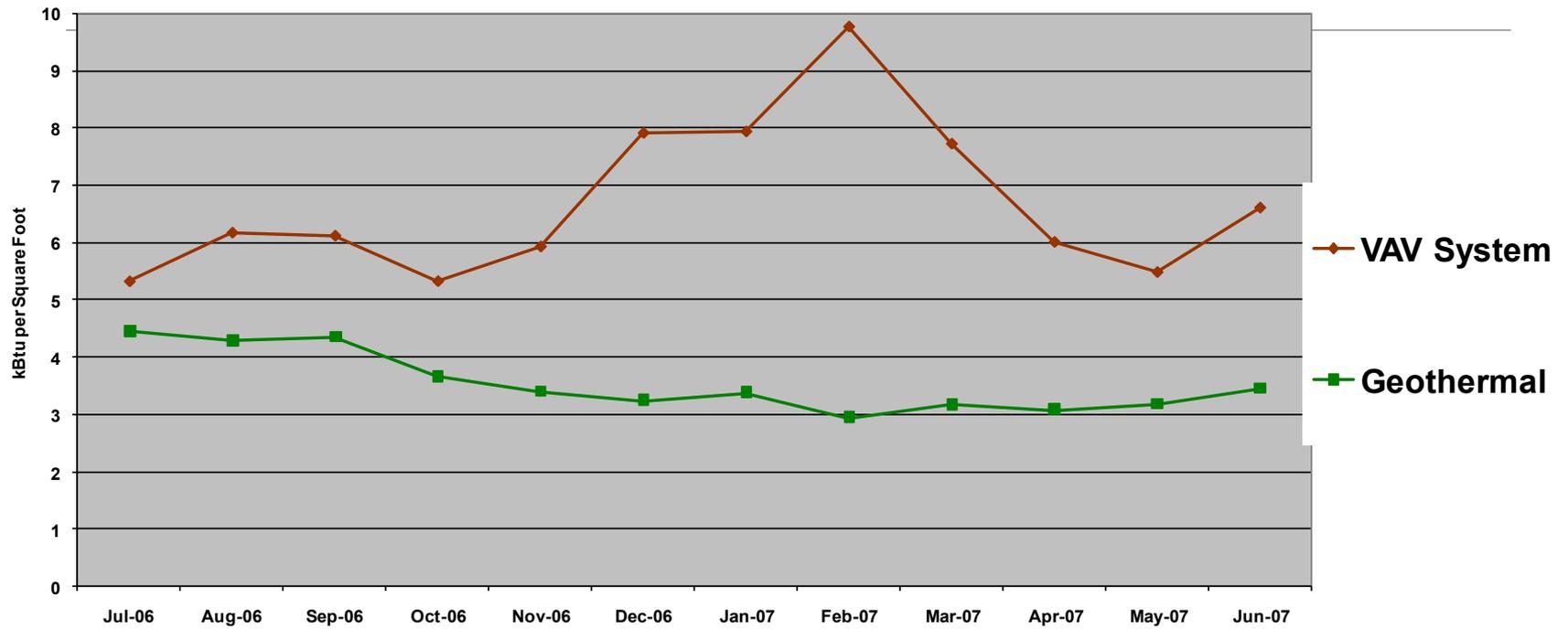


# Conventional Variable Air Volume (VAV) Building 15,000 Sq. Ft.



# Geothermal Building 20,000 Sq. Ft.





# Photo-Voltaic Panels

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- Over the past five years, energy output per SF of panel has doubled, and the cost has been cut in half!
- The installed cost has come down dramatically in the last 5 years.
- Greater ROI, depending on state and local utility rates, as low as 5-8 years.

# Different Inverter Technologies

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- Centralized Inverters
  - Large Utility type scale, useful if large quantities of land is available.
  - ~200kW - 500kW output range.
- String Inverters
  - Smaller, scalable to meet different orientations.
  - ~4kW -25kW output range.

# Photo-Voltaic Cost

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- 30% investment tax credit (ITC) if you are a commercial (Section 48) or residential (Section 25D).
- ITC helped annual installation grow by 1600% since its inception in 2006.
- Currently available thru 2016.
- Non-profits can engage EPC to take advantage of the ITC.

# Geo-Thermal

30% investment tax credit (ITC) if you are a Residential (Section 25D) or 10% for Commercial (Section 48) + Energy Property classification.

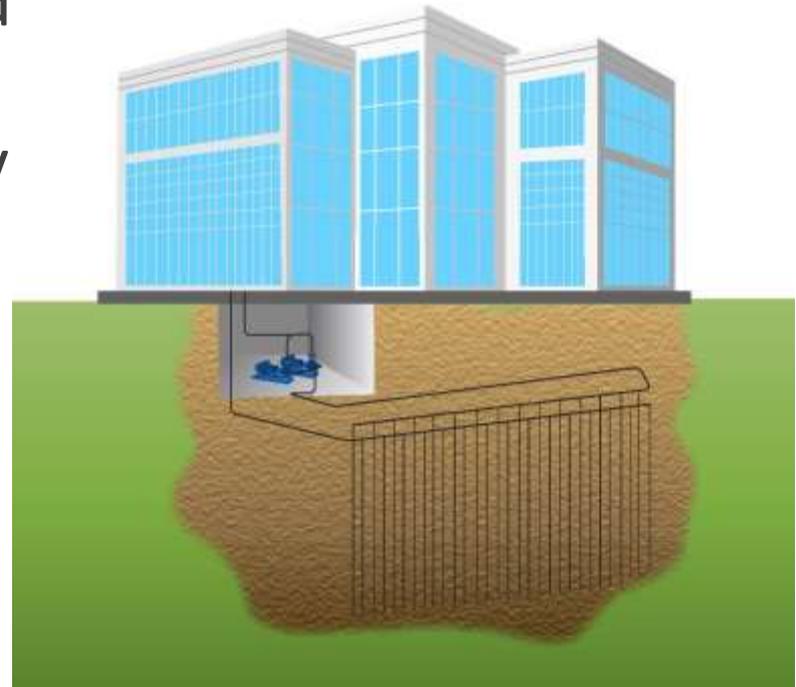
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- A potential 50% reduction in total heating and cooling cost.
- Mainstream technology, it's here to stay.
- Depending on available land, there are three methods:
  - Horizontal
  - Vertical
  - Deep Well Vertical
  - Pond heat exchangers

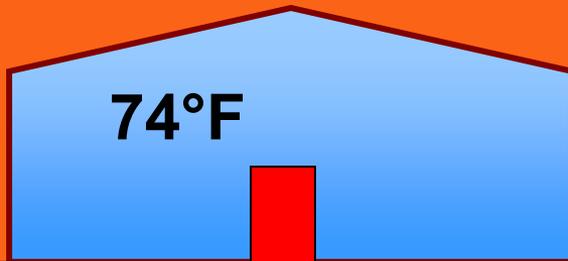
# Typical Commercial Geothermal

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- Geothermal is an engineered system. This is a diagram of a Vertical Heat Exchanger. They are very site specific and Storage driven.



# The Earth is an Efficient Place to Reject Heat in Summer...



Outdoor air  
design temperature:  
98°F in summer

Delta T = \$ to operate!!!

Insulating layer of earth

72°F

A geothermal heat pump cools the building in summer by rejecting heat into the earth

...and is the Source of Stored Heat in Winter...

Outdoor air  
design temperature:  
38°F in winter

72°F

Delta T = \$ to operate!!!

Insulating layer of earth



80°F

A geothermal heat pump takes heat from the earth during winter and transfers it into the building



*Surface Water or Lake Loop  
(detention ponds)*



*Vertical Closed Loop*



*Horizontal Closed Loop*



*Open Loop "Well Water"*

# LED Lighting, buy into the Technology

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- LED Fixtures fall under IES LM-79 (Photometric Measurements of Solid State Lighting Products)
  - Requires Manufacturers to provide Input Voltage, Input Current, Input Power and Power Factor
- LED Fixtures fall under IES LM-80 (Measuring Lumen Maintenance of LED Light Sources)
  - Provides standardized testing standards to comparisons can be made to select the appropriate fixture.

# LED vs Fluorescent

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- Historically fluorescent fixtures have not included ballast losses and have not provided an overall fixture input wattage.
- In a comparison of two 2'x4' fixtures:
  - the LED fixture used 61 watts (total input wattage)
  - the equivalent Fluorescent fixture used 84 watts (total input wattage)
  - 27% more energy!

# Comprehensive Commission

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- Start-up is not commission!
- Commissioning is a comprehensive process that verifies all MEP systems perform as designed.
- It needs to be done at heating and cooling seasons.
- It needs to be repeated on a regular basis to ensure proper equipment operation. This is termed as “On-going Commissioning”.

# Other Peoples Money

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- Owner: Use PACE (Property Assessed Clean Energy) funding from the local tax office.
- There are several renewable energy grants out there and this takes a little more work.
- There is significant tax incentives for most of the renewable technologies for “Profit Corporations” and “Leasing” for non-profits.
- For Geothermal, there are also “Thermal Utilities” that can help. And PV has similar funding methods.

# Case Study: CDC Paris Island

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- Architect: VOA
- Engineer: VanWaggen and Beavers
- Energy Modeling/Geothermal Design: KCI
- Photos by: Paul Keyserling Photography

# NZE Project for Parris Island

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The roof of the building and Parking shelters are all PV Panels. Total Energy = 278 KW, 20,000 square feet of PV panels.



# NZE Project for Parris Island

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# NZE Project for Parris Island

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# Domestic Hot Water

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The roof of this mechanical yard has 21 solar thermal panels to meet 50% of the daily hot water and stores 1200 gallons.

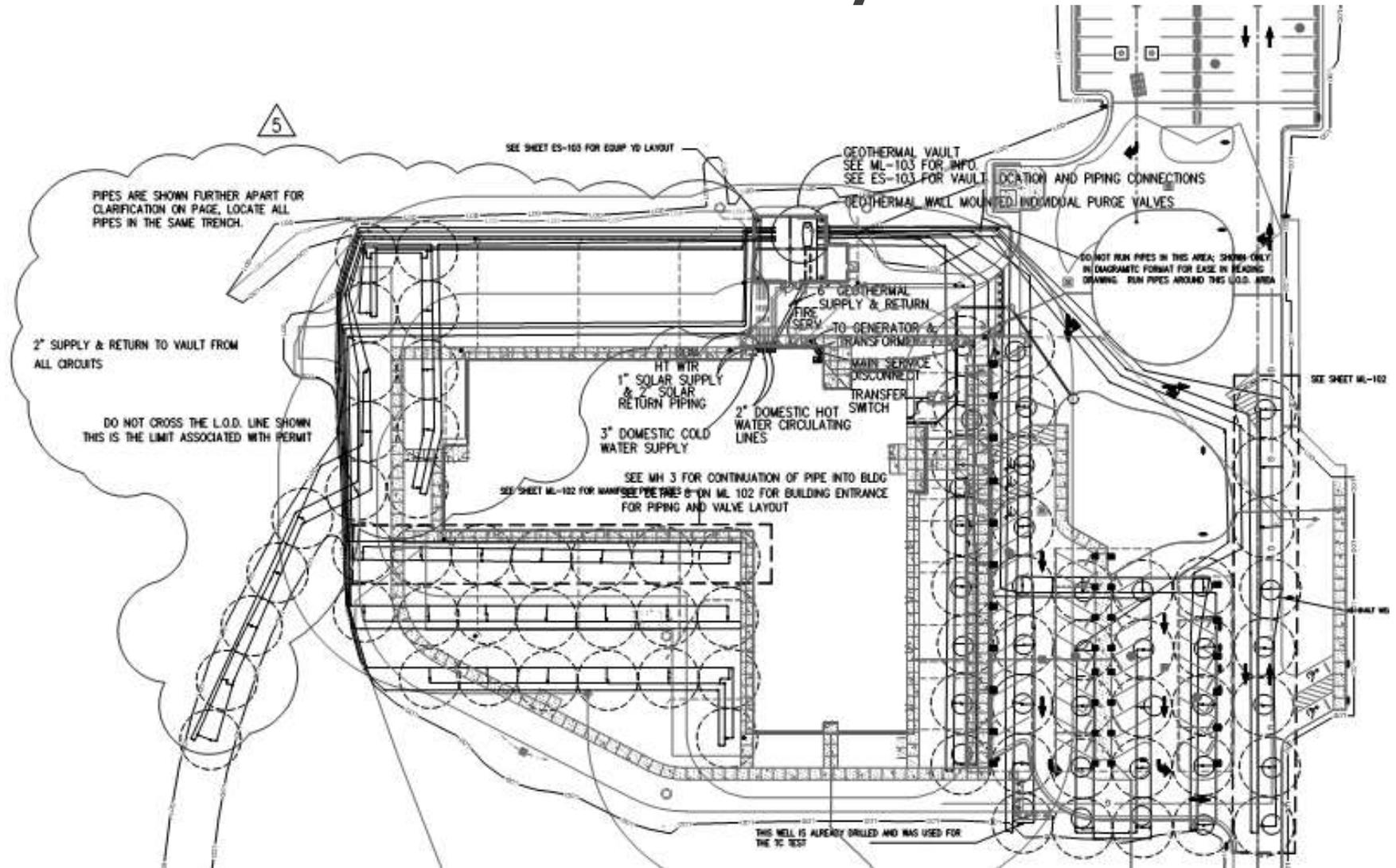


# Mechanical Room

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# Geothermal Field Layout



# Google Earth View



# Geothermal Vaults

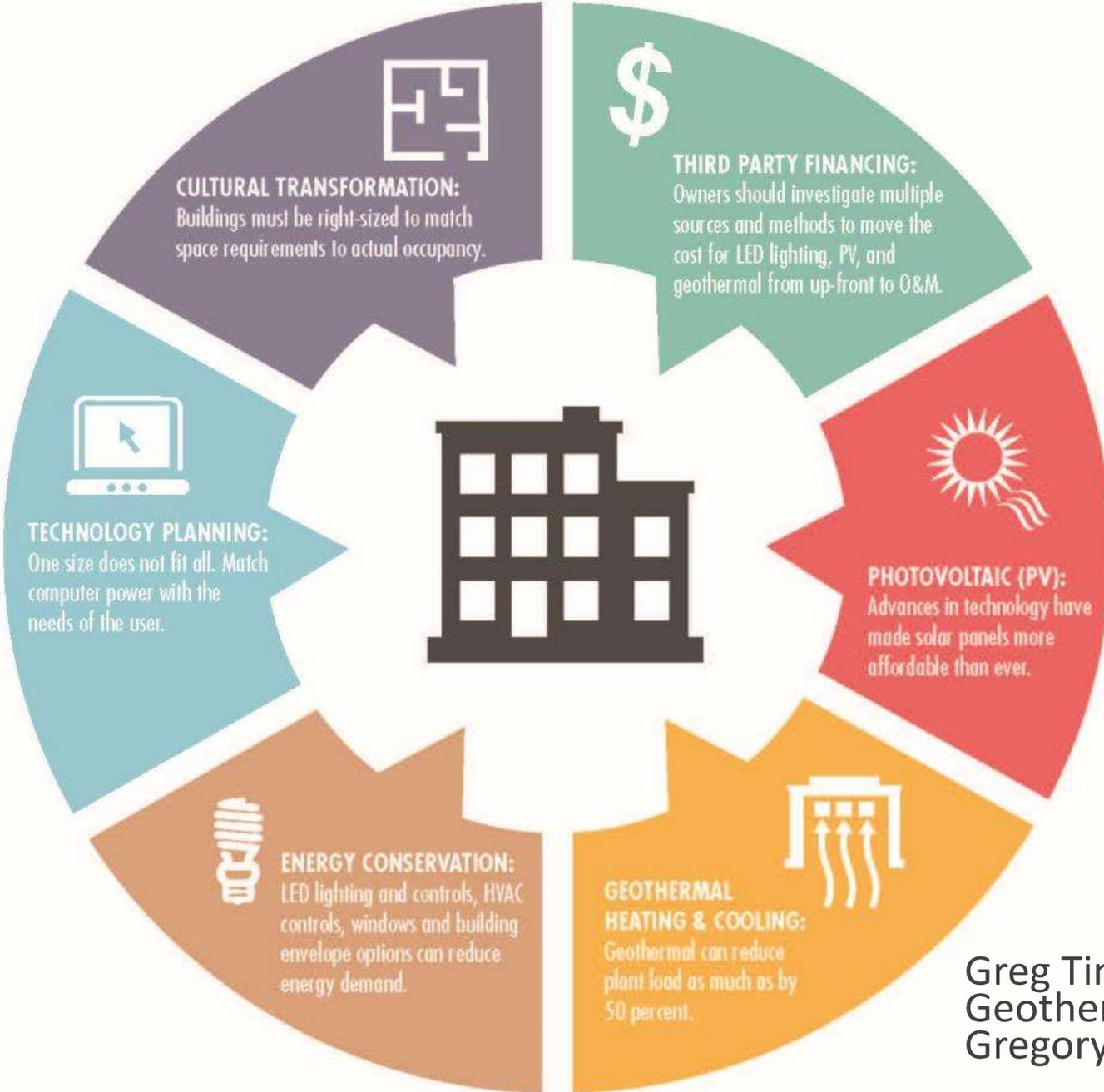
When there is no space in the building

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# Q & A

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