Geothermal HVAC and Coastal Carolina Community College, Jacksonville, NC

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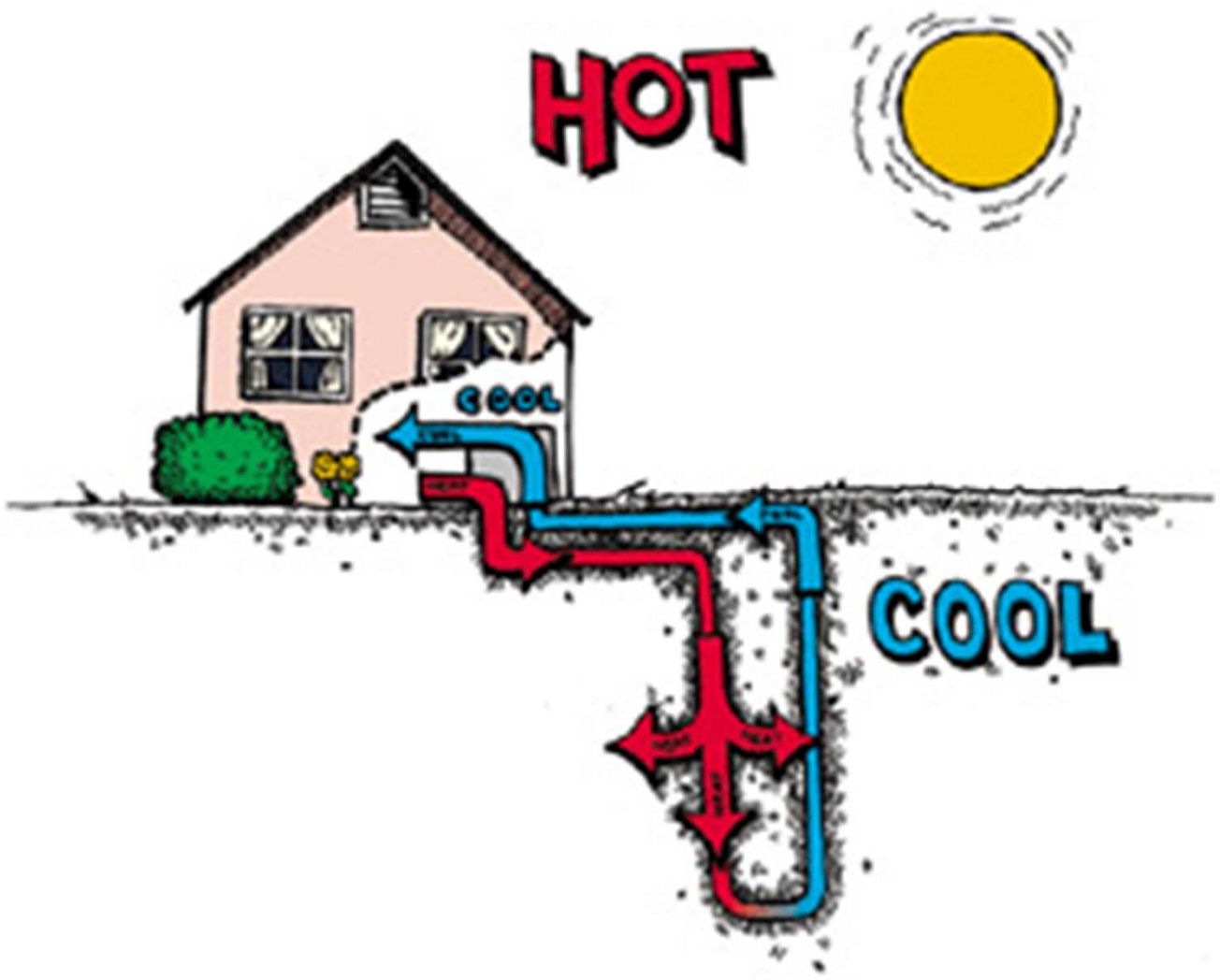
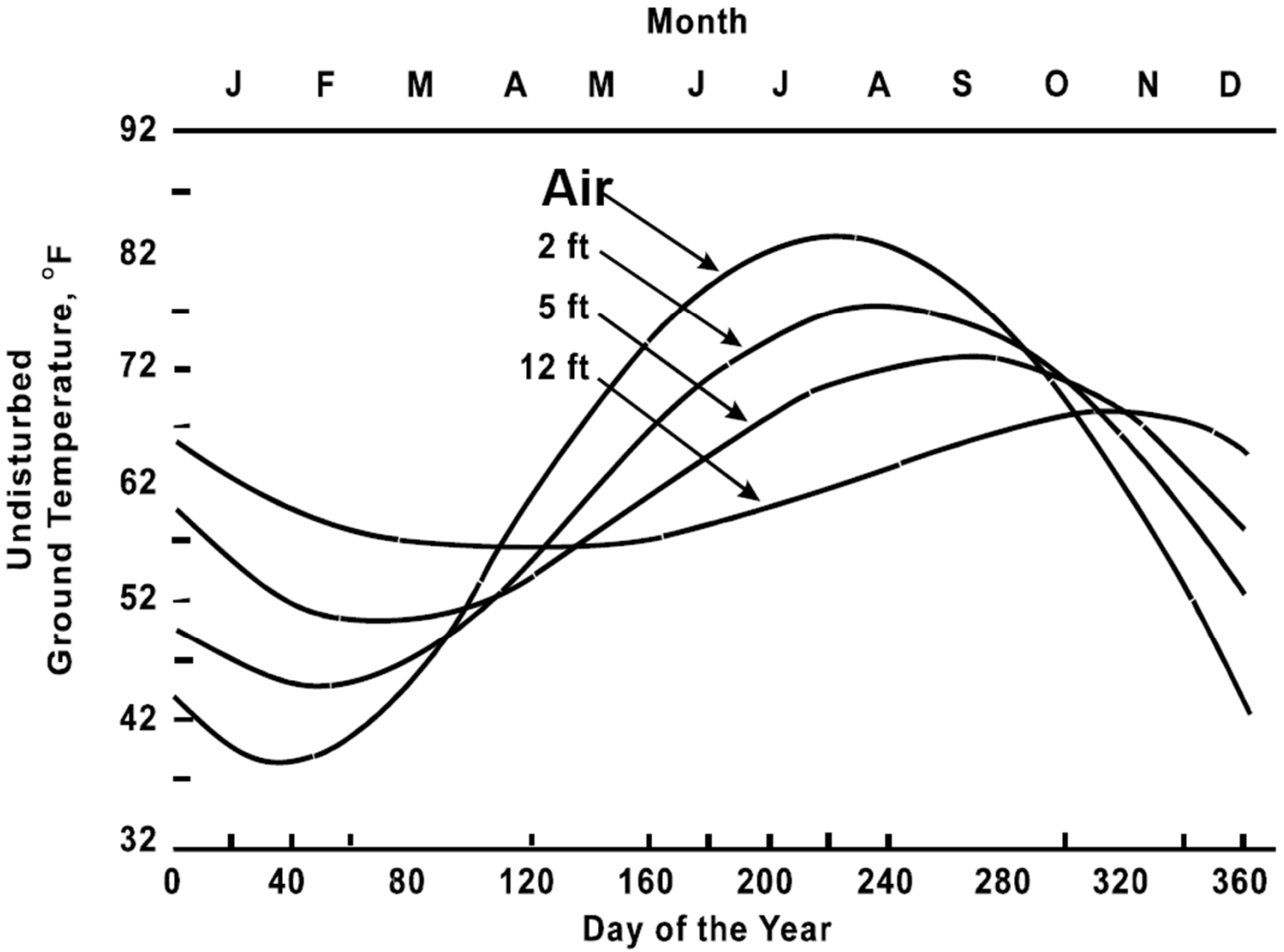
Objectives

- Geothermal HVAC overview
- Application Basics
- Coastal Carolina Community College Experience
- Key items for Success

Too Technical?



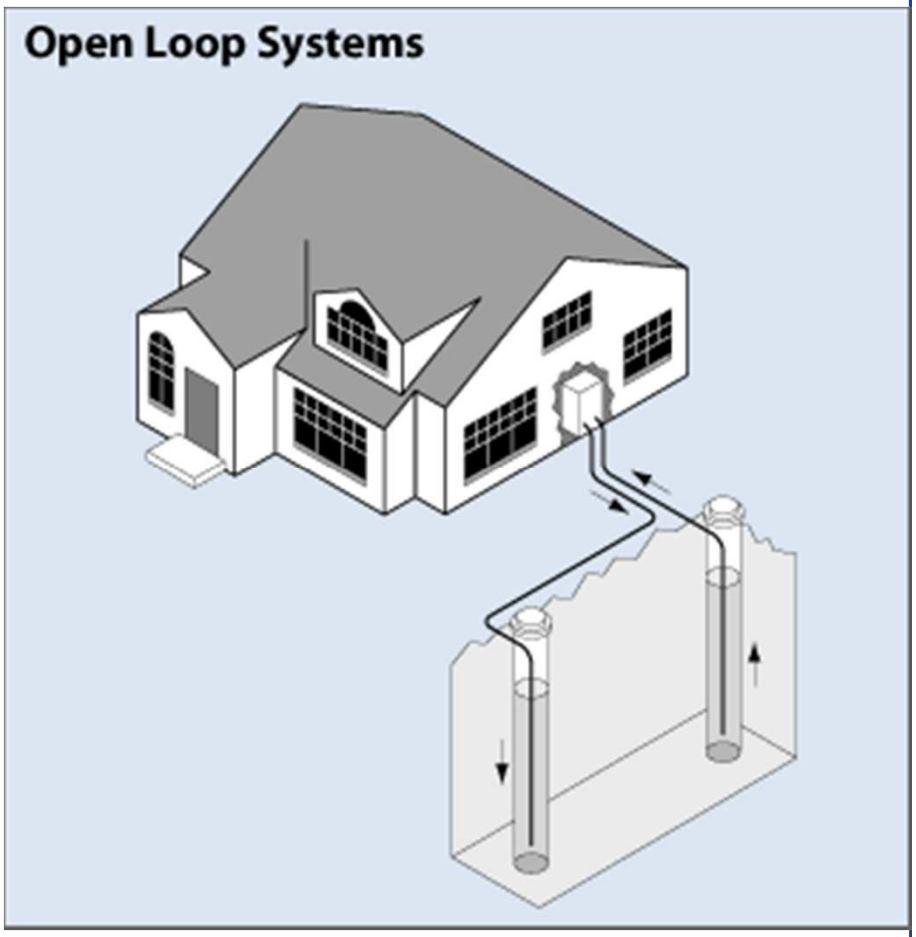
Shallow Earth Crust Stores Solar Energy



Common Types of Geothermal Heating and Cooling (HVAC) Systems

1) Open Loop
- with Reinjection

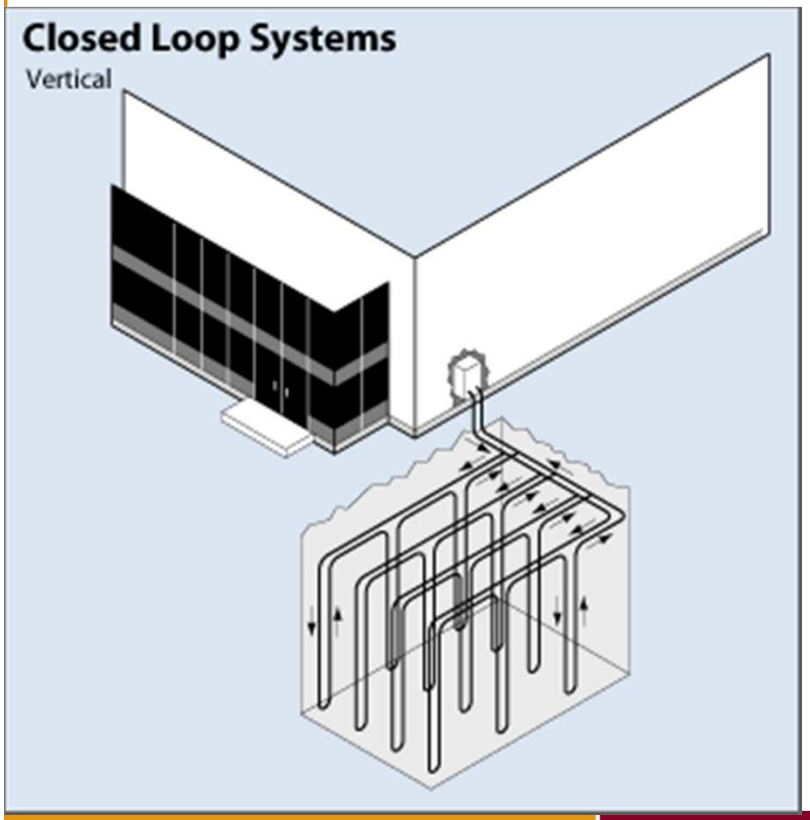
- “Pump and Dump”

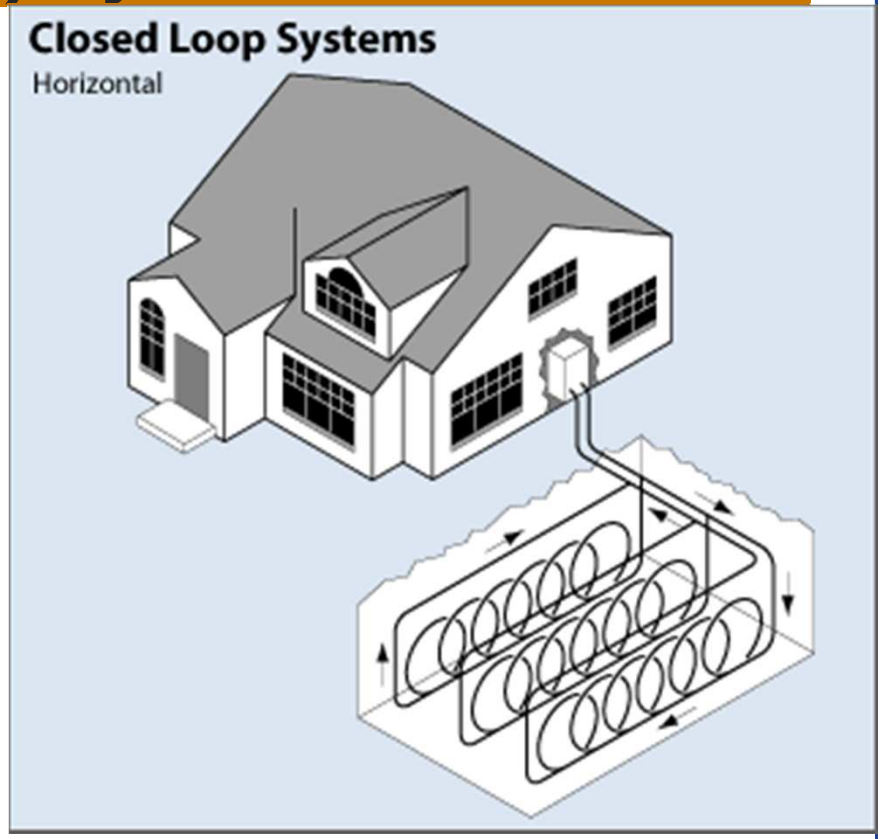


Common Types of Geothermal Heating and Cooling (HVAC) Systems

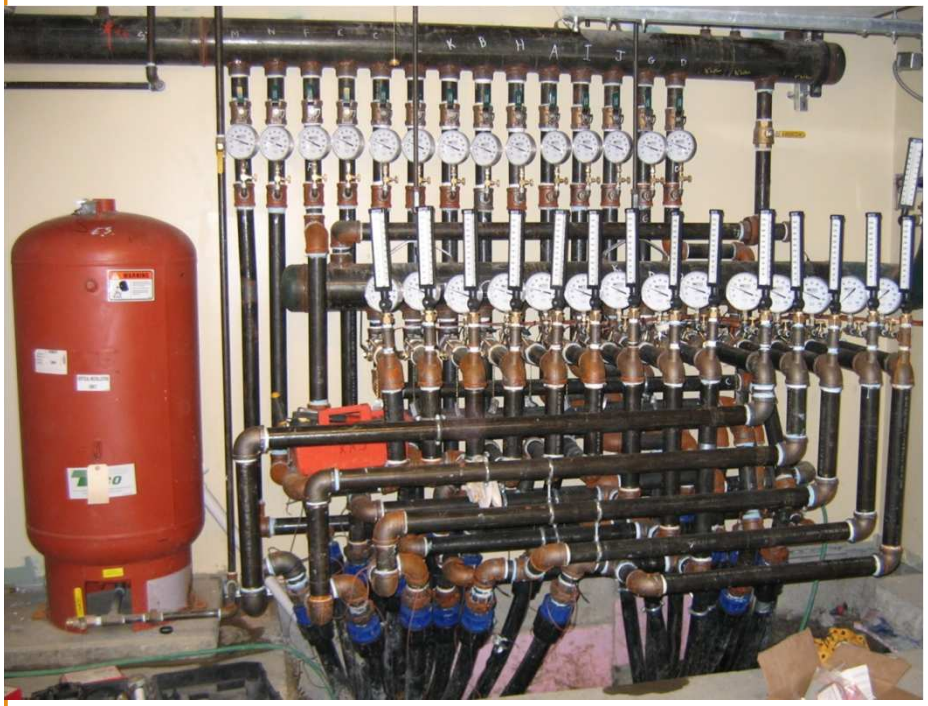
2) Closed Loop

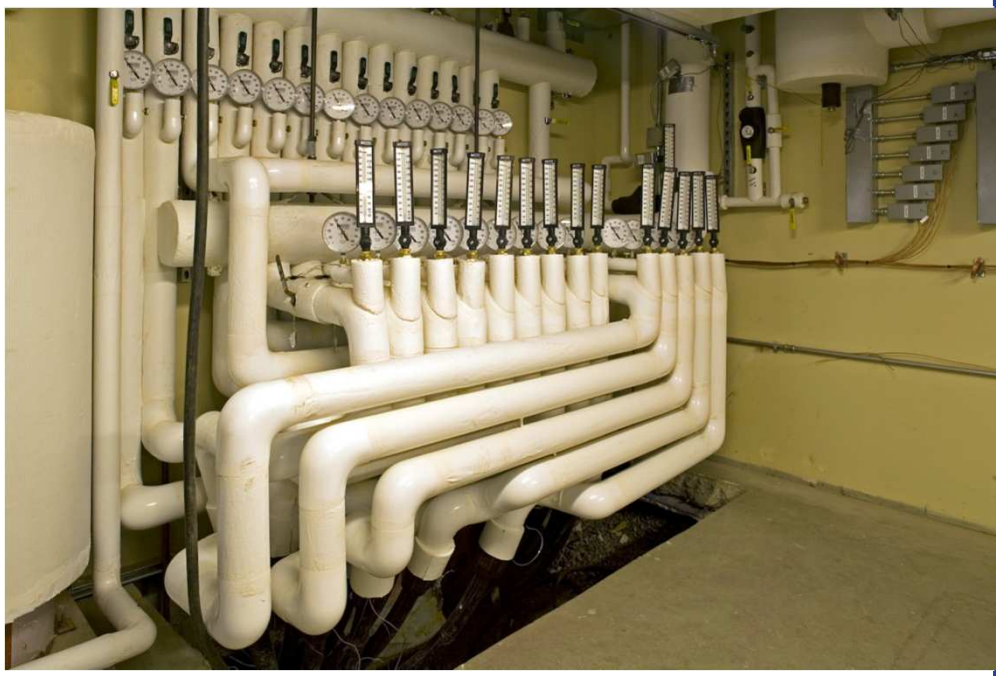
- Horizontal
- Vertical



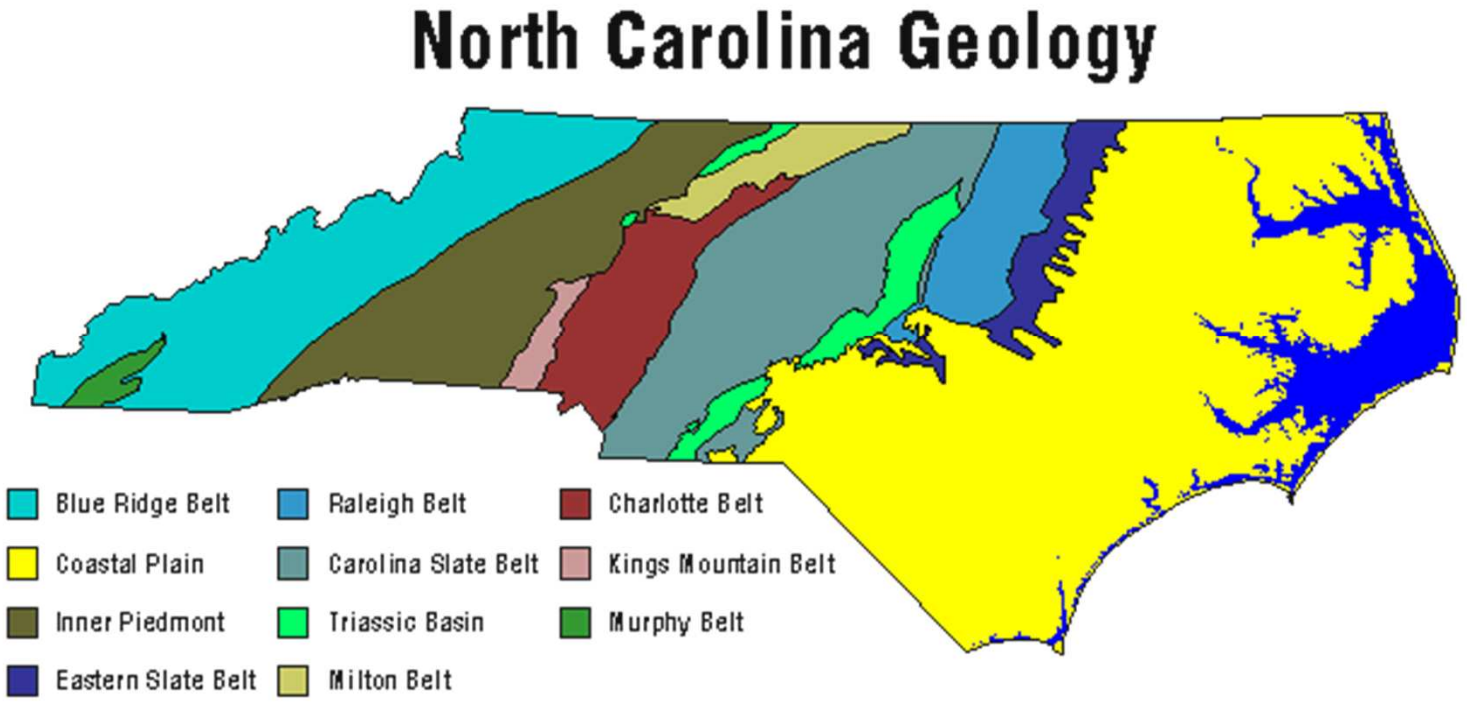


Well Field Manifold





Geothermal Systems - Geology



Geothermal Systems - Geology

- Why be concerned with geology?
  - Formation Thermal Conductivity

Rock Type	Range of Values
Shale (Dry)	0.6 – 1.7
Shale (Wet)	0.5 – 2.3
Limestone	0.7 – 3.1
Gneiss	1.1 – 2.6
Quartzite	1.7 – 3.2
Sand / Clay	0.29 – 1.94

Formation Thermal Conductivity Testing

- Provides site specific thermal conductivity and diffusivity, static earth temperatures
- Tests run for 40 to 48 hours according to ASHRAE standards
- Provides critical input for calculation using design software

Coastal Carolina Situation:

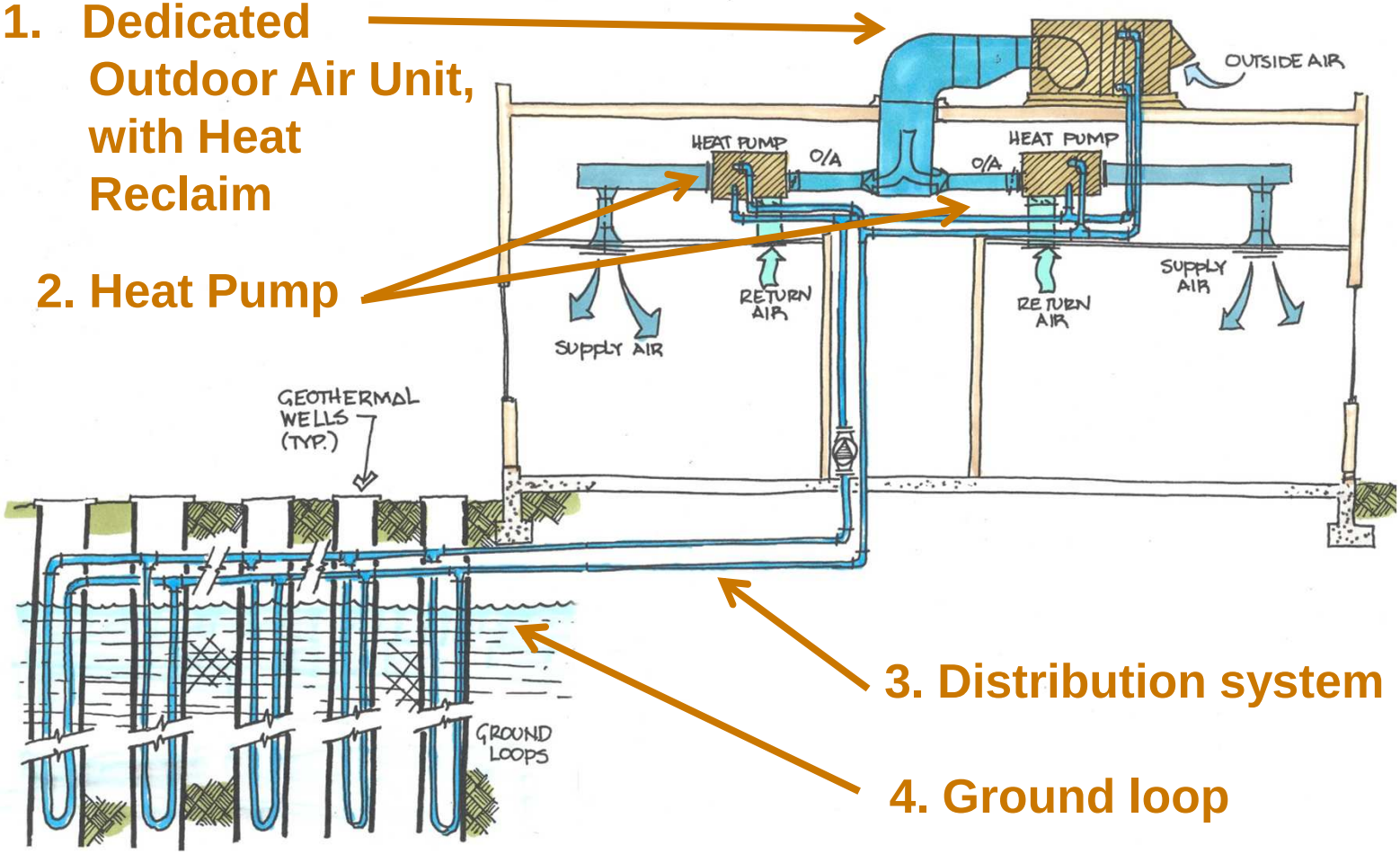
- Older buildings with failing HVAC
  - 200,000 SF > 20 years old
- Coastal Plain soils compatible with geothermal
- 3 HVAC replacement options examined
  - Fan-coils with boilers, chillers (in-kind)
  - Water-source heat pump / boiler
  - Geothermal heat pump

Projected Costs and Savings

	Geothermal	WSHP	Fan Coil
	$/sf	$/sf	$/sf
Capital Cost Estimate	16.33	13.15	15.00
Annual Energy (HVAC only)	0.85	1.22	1.02
Annual Maintenance	0.71	0.98	1.12
Total Annual	1.56	2.20	2.14

1. Dedicated Outdoor Air Unit, with Heat Reclaim

2. Heat Pump



3. Distribution system

4. Ground loop

Energy Costs and Consumption

		$/sf	kBTU/sf-yr
All Energy for Entire Campus			
2007-08	**$**	**3.07**	**143**
2008-09	**$**	**3.14**	**148**
2009-10	**$**	**2.75**	**128**
CBECS Higher Education Average			**120**
NC Energy Div. suggested Benchmark			**94**

Notes:

1) **"Baseline" Energy consumption (before conversion) not available**
2) **Sub metered data for HVAC-only energy not available**
3) **Campus is 72% geothermal heated & cooled**

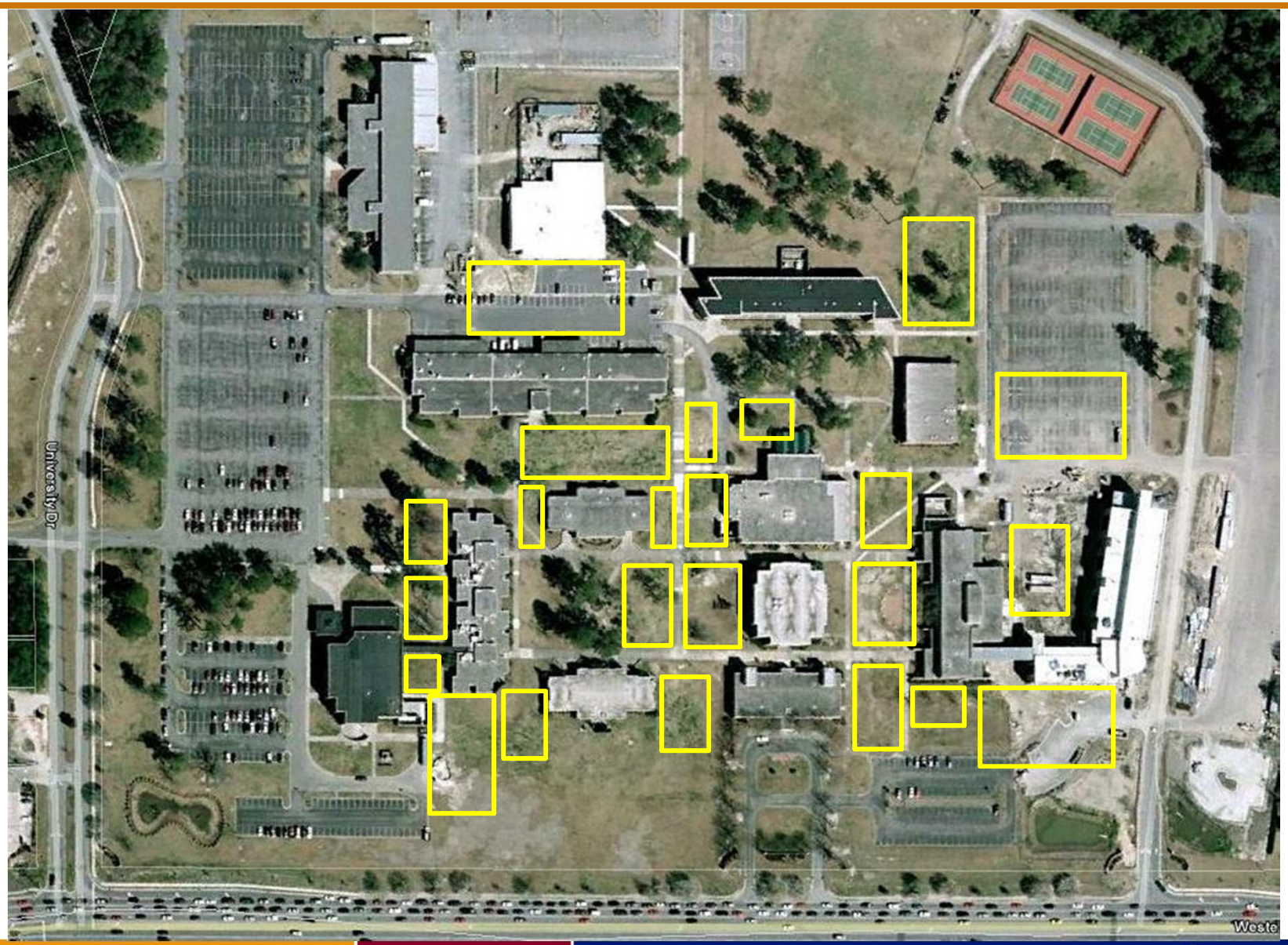
Capital Costs (9 buildings, totaling 239,000 sf)

	$	$ per ton	$ per SF
Building HVAC Systems Cost	3,581,000	6,200	19
Geothermal Field & Piping Cost	1,809,000	3,100	10
Total	5,390,000	9,300	29

NOTES:

1) Projects Bid in 2003 and 2005
2) Building HVAC was renovation work (some associated cost premium)
3) 2006 Math & Science Building costs not included

CCCC Campus and Geothermal Fields



Stantec

Short Checklist to Ensure System Success:

- Geothermal are site-specific
- Do not ‘guess’ regarding Geology
- Require documentation of annual heating and cooling balance (365 day analysis)
  - Building types can vary greatly
- Piping Manifolds in buildings if possible ($)
- Survey & record piping locations, plus use locator tape.
- Packaged heat pumps rarely work well as make-up air units
- All-geothermal systems may not always be the “best value” – consider hybrids

Coastal Carolina Community College Summary

Saving energy using Geothermal Heat Pumps.

- 2 times more efficient than air-source heat pumps,
- 5 times more efficient than most boilers
- Geothermal heat pumps solved a lot of maintenance problems by eliminating old boilers and chillers in 10 buildings (over 200,000 sq. ft.)

CONTACT FOR SITE VISIT

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Note: A special thanks to Carol for hosting the site visit and for all her help providing information for this presentation

Questions?