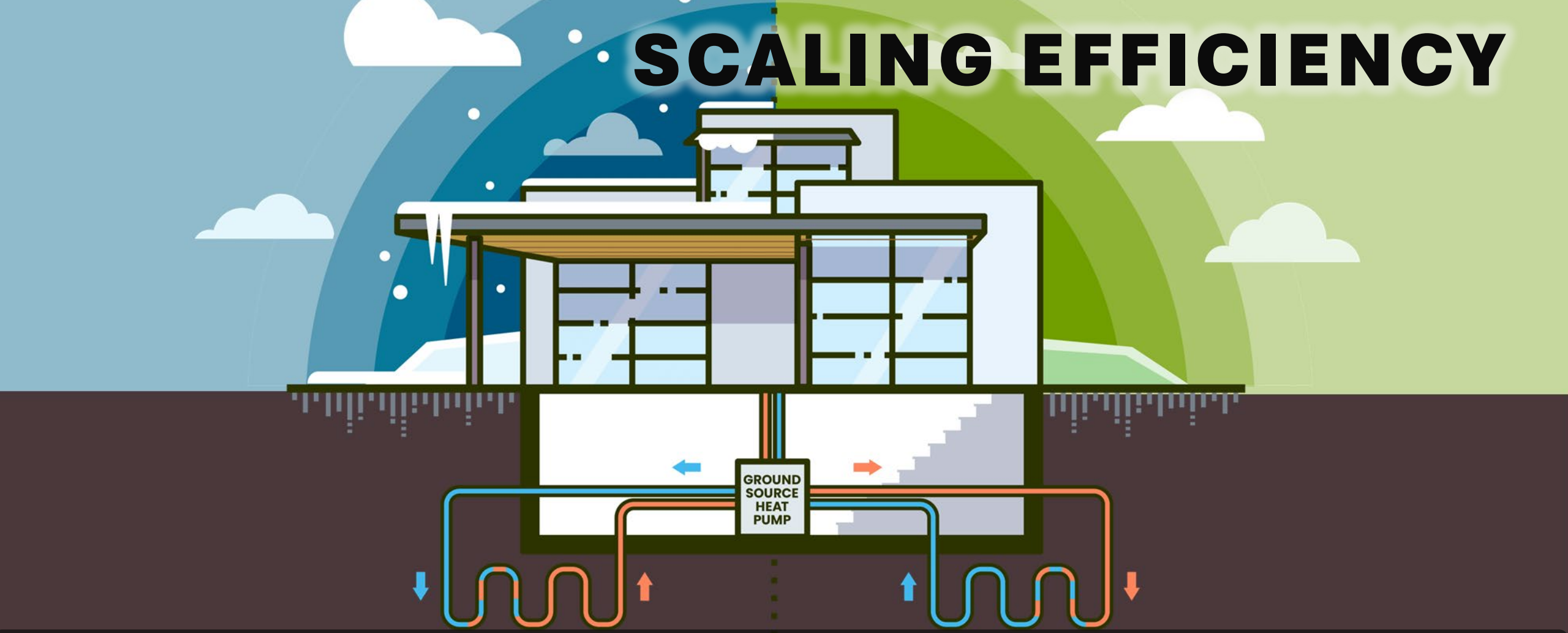
SCALING EFFICIENCY



GEOTHERMAL HEAT PUMP STRATEGIES
LARGE COMMERCIAL

CLIMATEMASTER®


CLIMA COOL®
Modular Chiller/Heater Systems
CLIMATEMASTER®
Water-Source Heat Pump Solutions
IEC®
International Environmental
Hydronic Fan Coil Solutions
ClimateCraft®
Custom Air Handlers

YOUR PRESENTER

MIKE KAPPS

Certified Geothermal Designer (CGD)

Regional Sales Engineer

What about Geothermal?

YOUR RESPONSE....

An integrated design approach provides you and your customer the best possibility of making geothermal make sense for the project financially.

The Inflation Reduction Act provides tax credits that can make geothermal systems affordable.

Become the geothermal champion in your region.

Rules of thumb can ruin the opportunity...
You need 1 Ton/400 sq ft – 200' Borehole/ton - $25 per ft of Borehole = **DEAD PROJECT**

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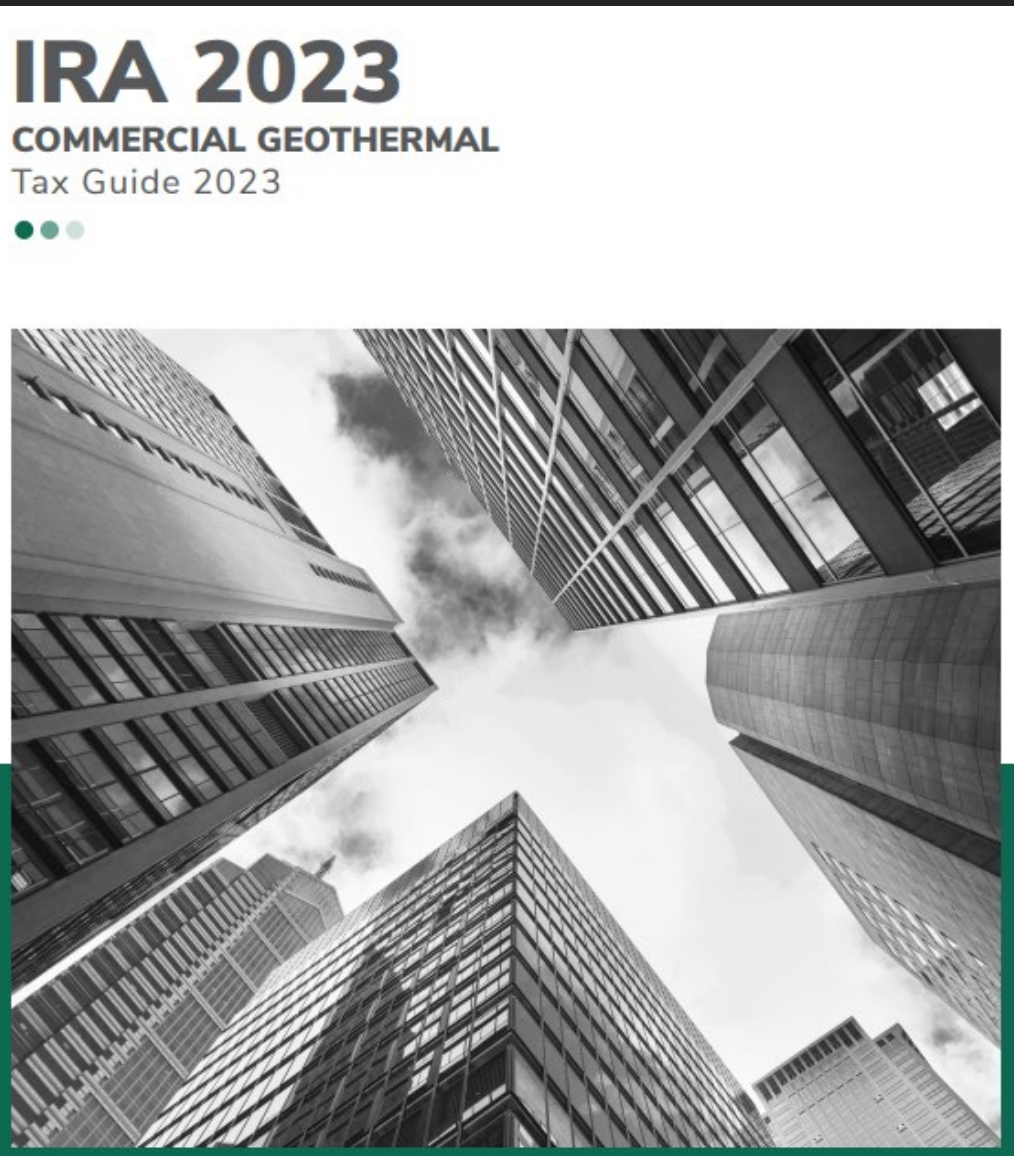
TAKEAWAYS FOR TODAY



Introduce/reintroduce your customers to the concept of geothermal

Utilize our latest updated tax incentive documents

Visit energy.gov to learn more about EERE resources

Identify your geothermal champion, become a Certified Geothermal Designer – CGD

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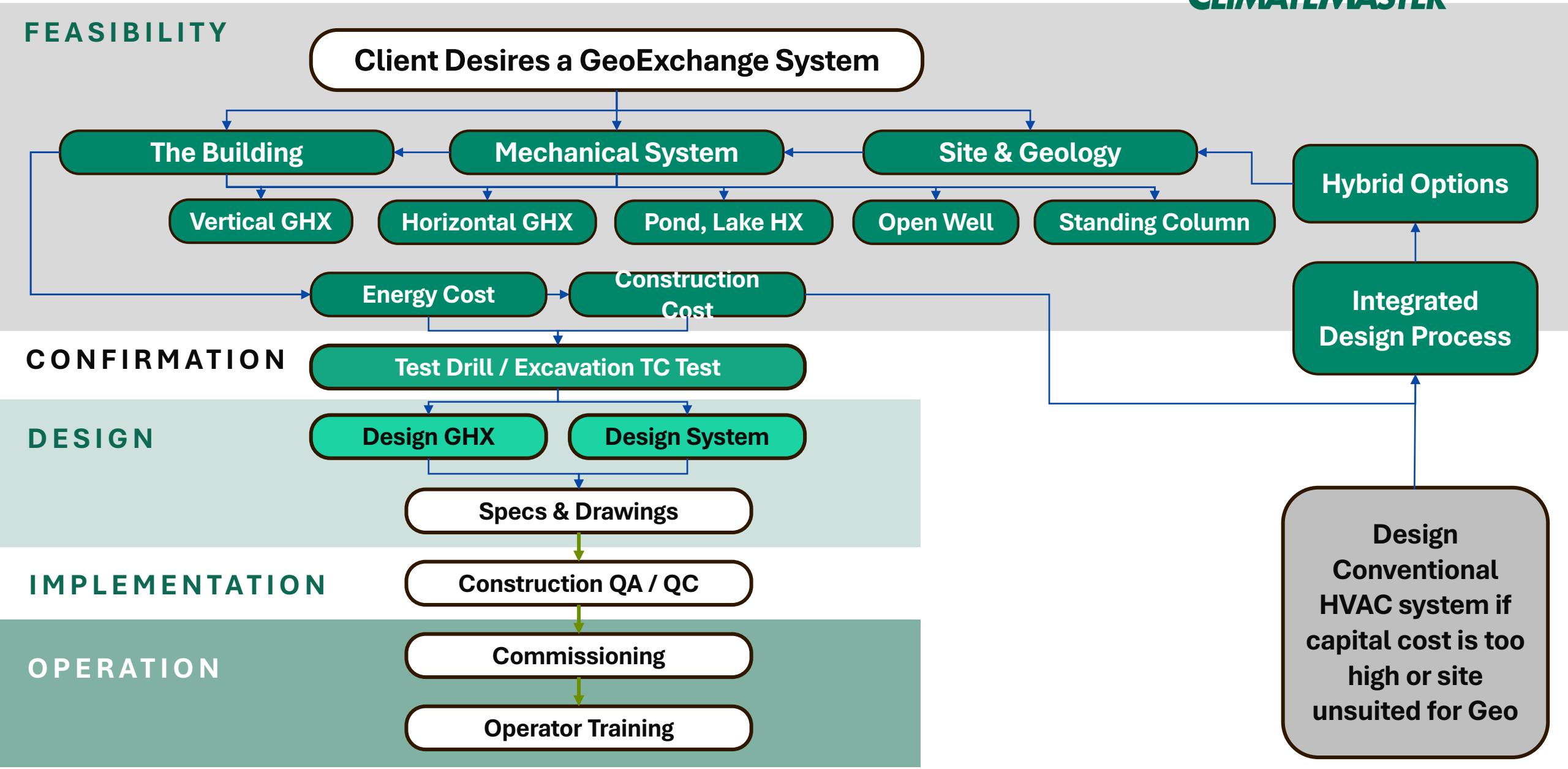
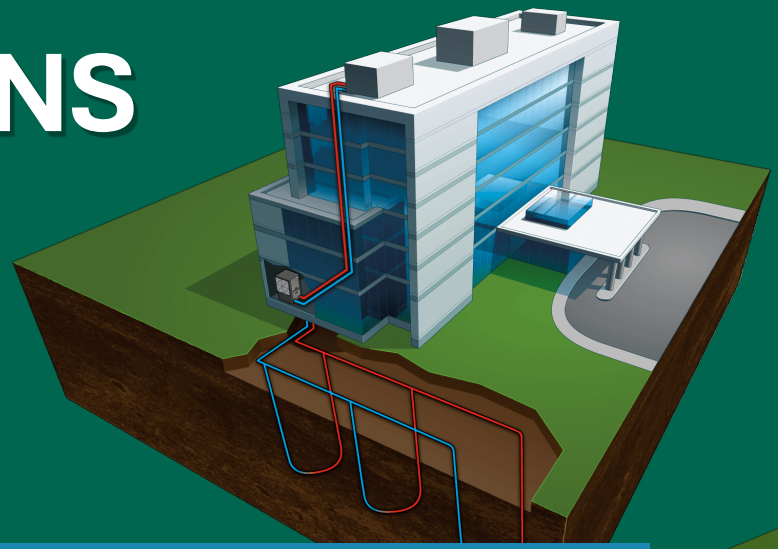
LET'S DISCUSS FEASIBILITY



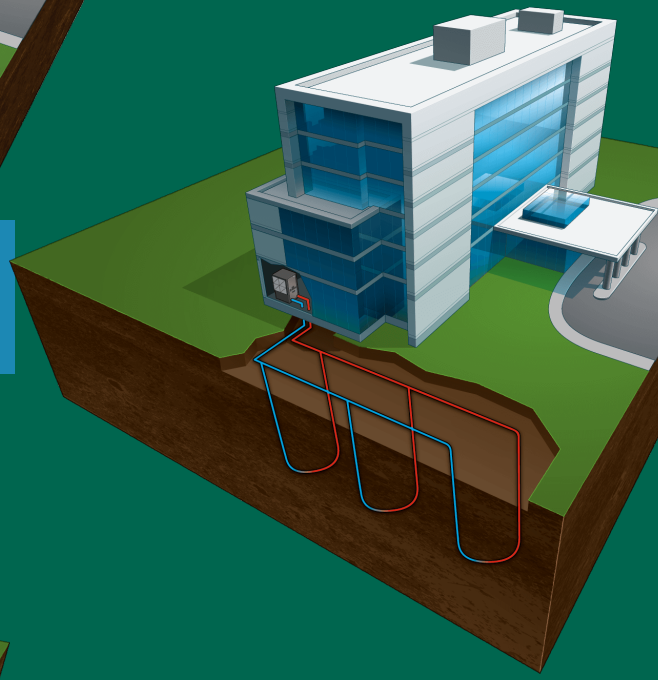
COMMERCIAL

4 CLOSED LOOP OPTIONS

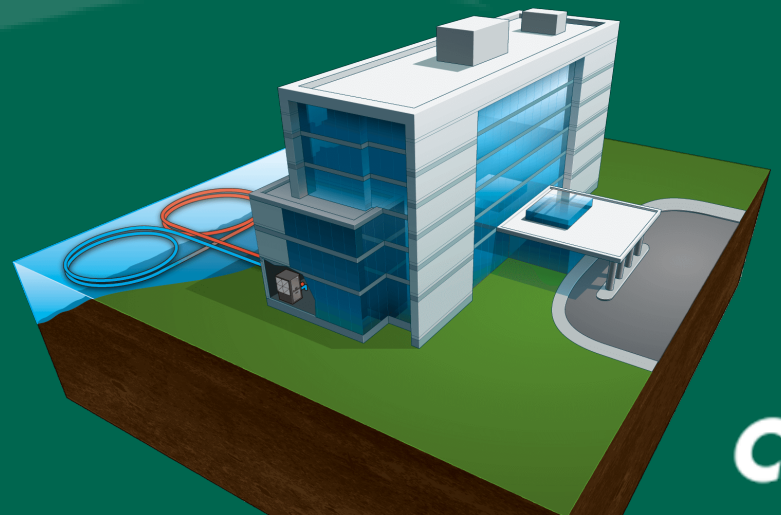
Vertical Loop



Pond/ Lake / Plate Water Loop



Hybrid Loop



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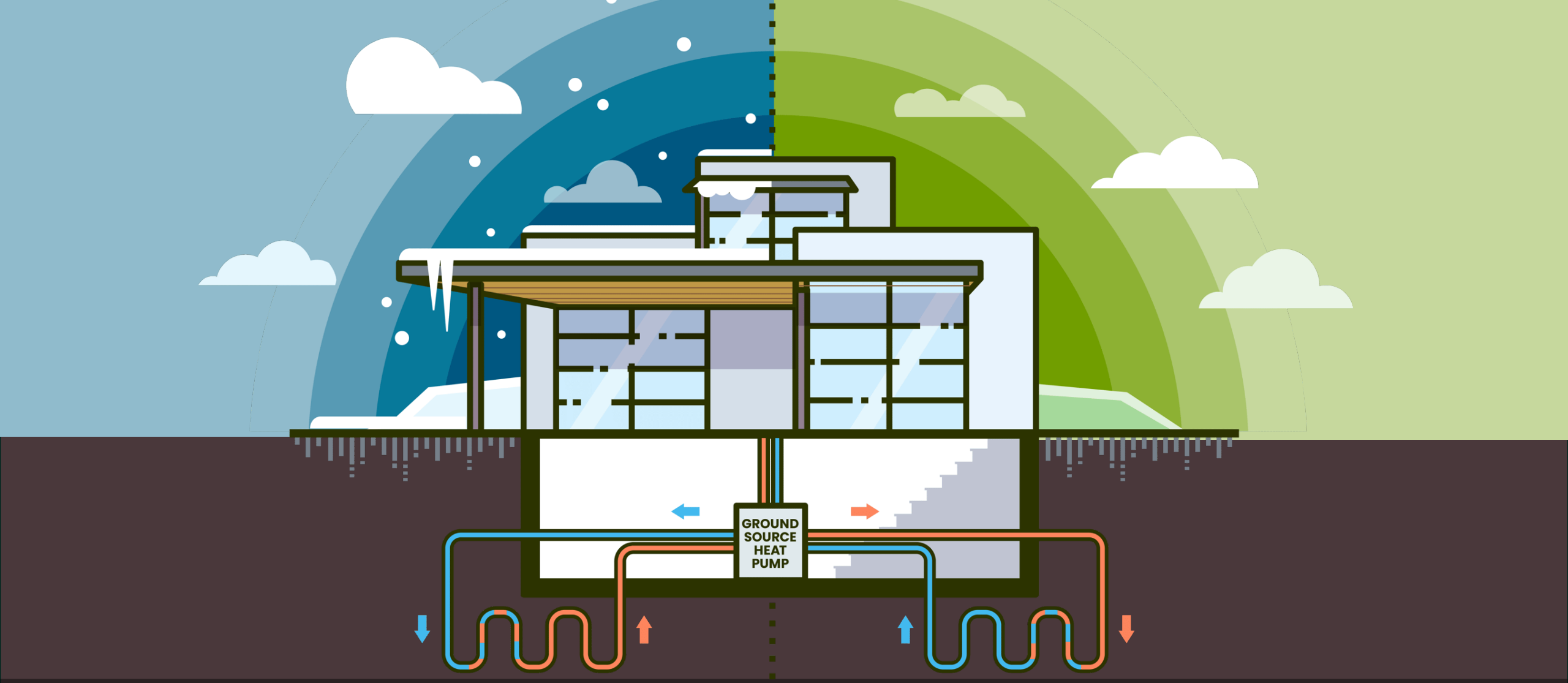
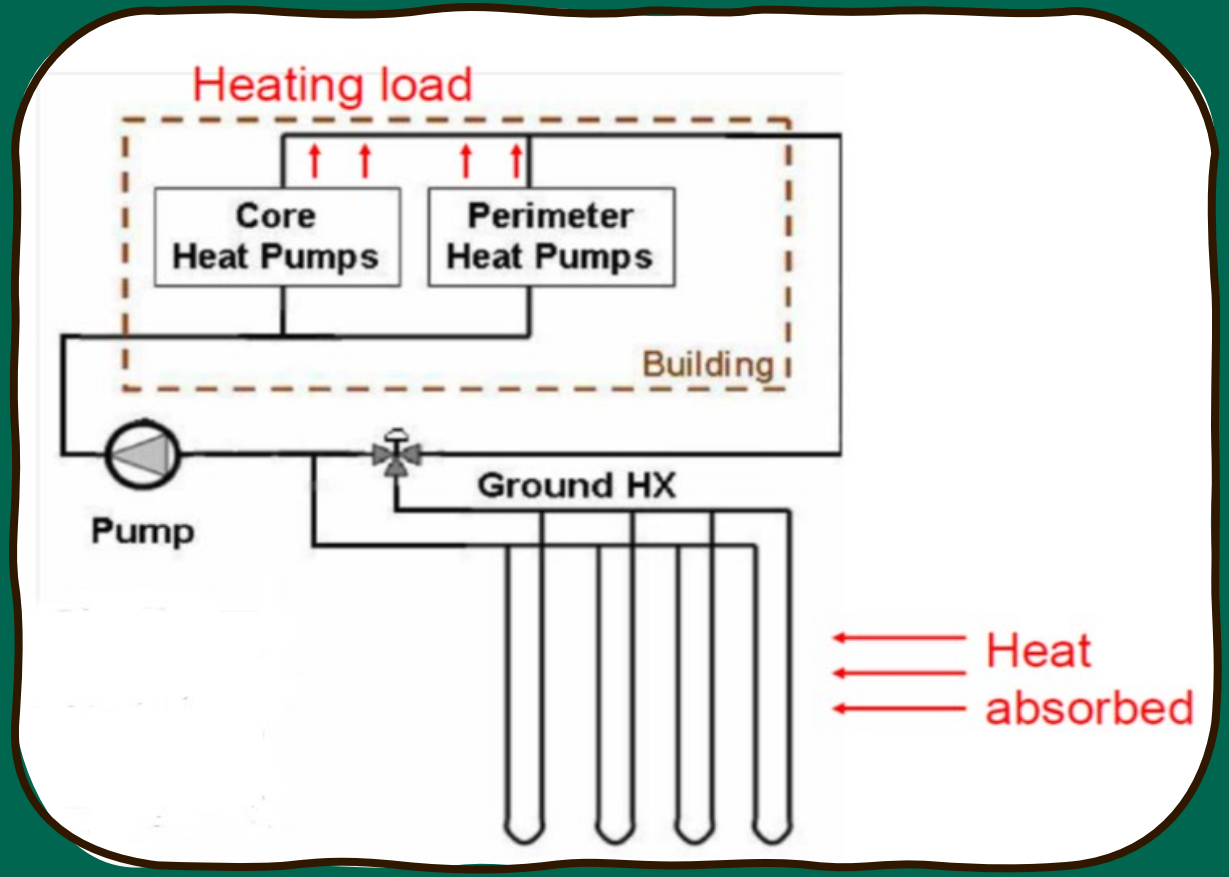


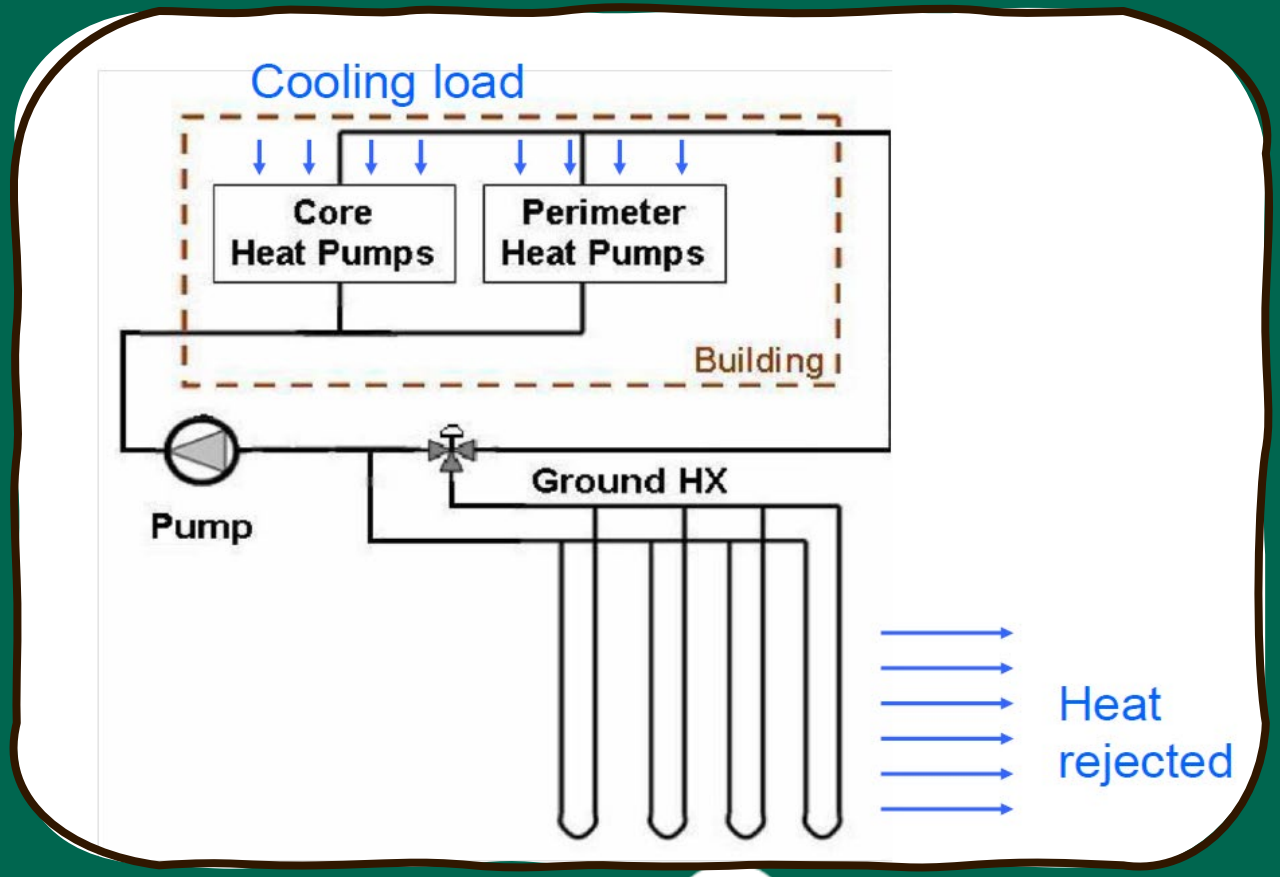
Geothermal Loops

What They Are. How They Work.

Geothermal Heat Pump System

What Is It. How it works.





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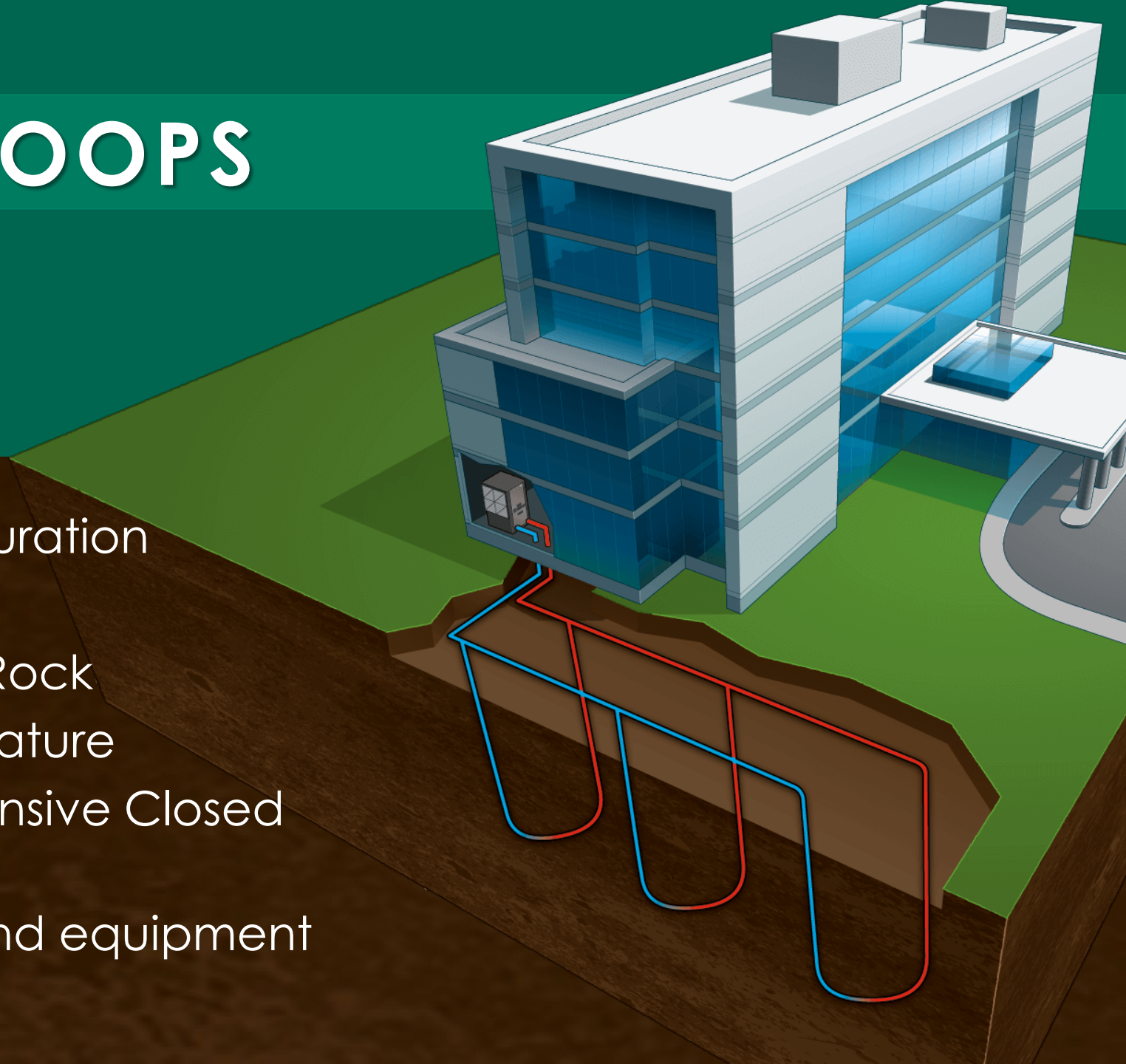
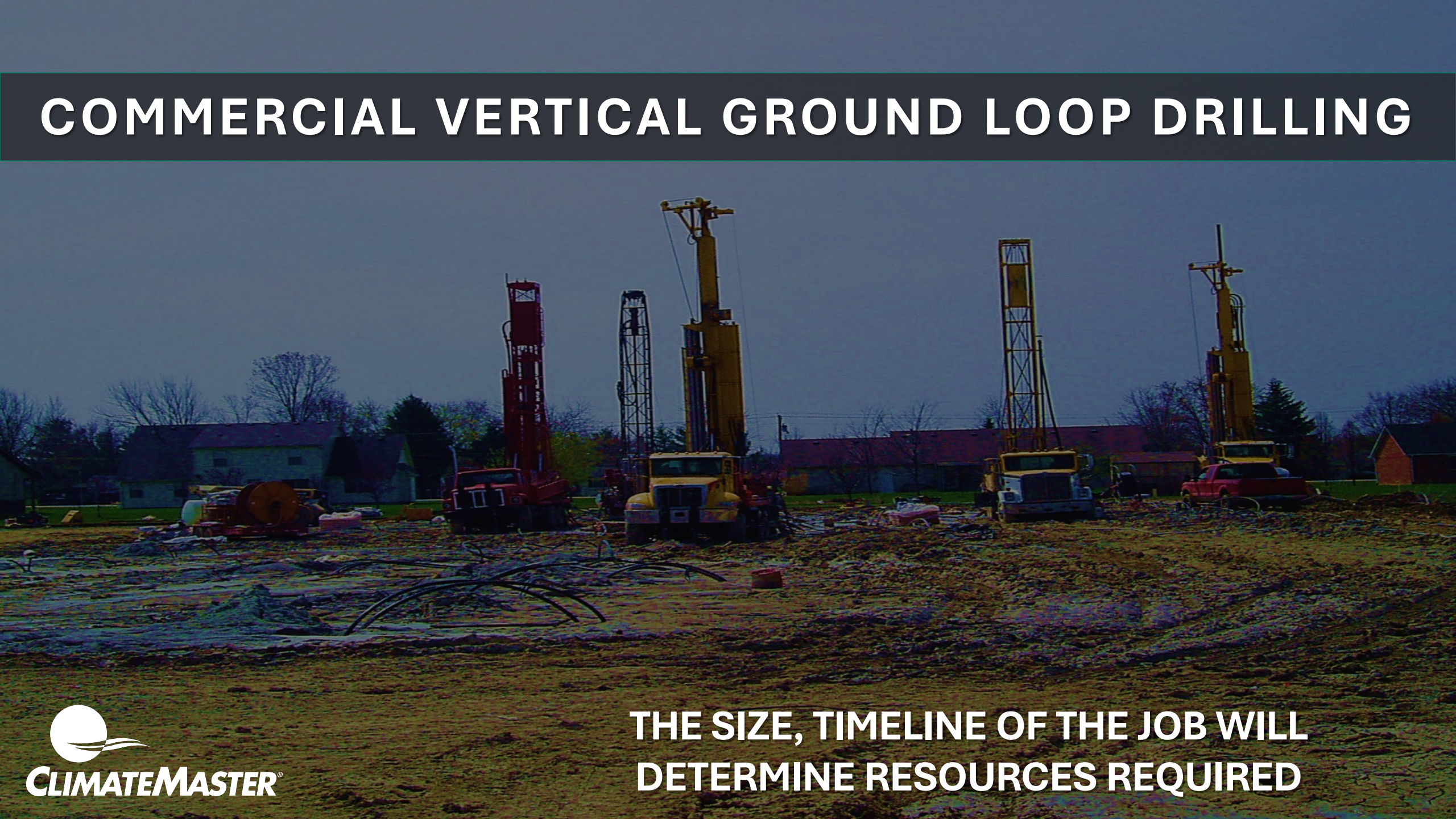
VERTICAL LOOPS

- Most popular Loop Configuration
- Smallest Land requirement
- Overburden is minimum / Rock
- Stable deep earth Temperature
- Tends to be the most expensive Closed loops
- Requires special skills set and equipment



COMMERCIAL VERTICAL GROUND LOOP DRILLING



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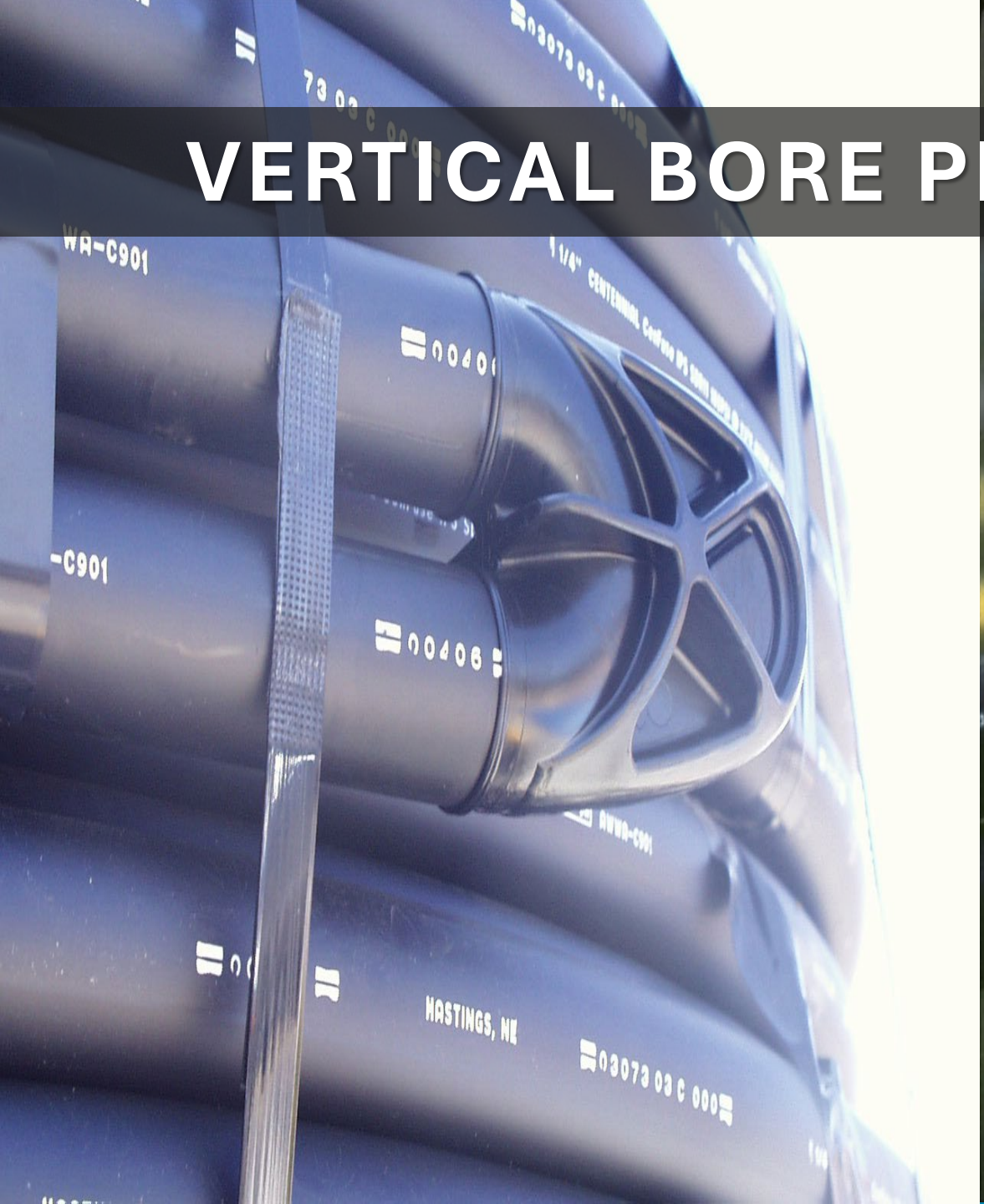
THE SIZE, TIMELINE OF THE JOB WILL DETERMINE RESOURCES REQUIRED

VERTICAL BORE PIPE MATERIAL U BEND

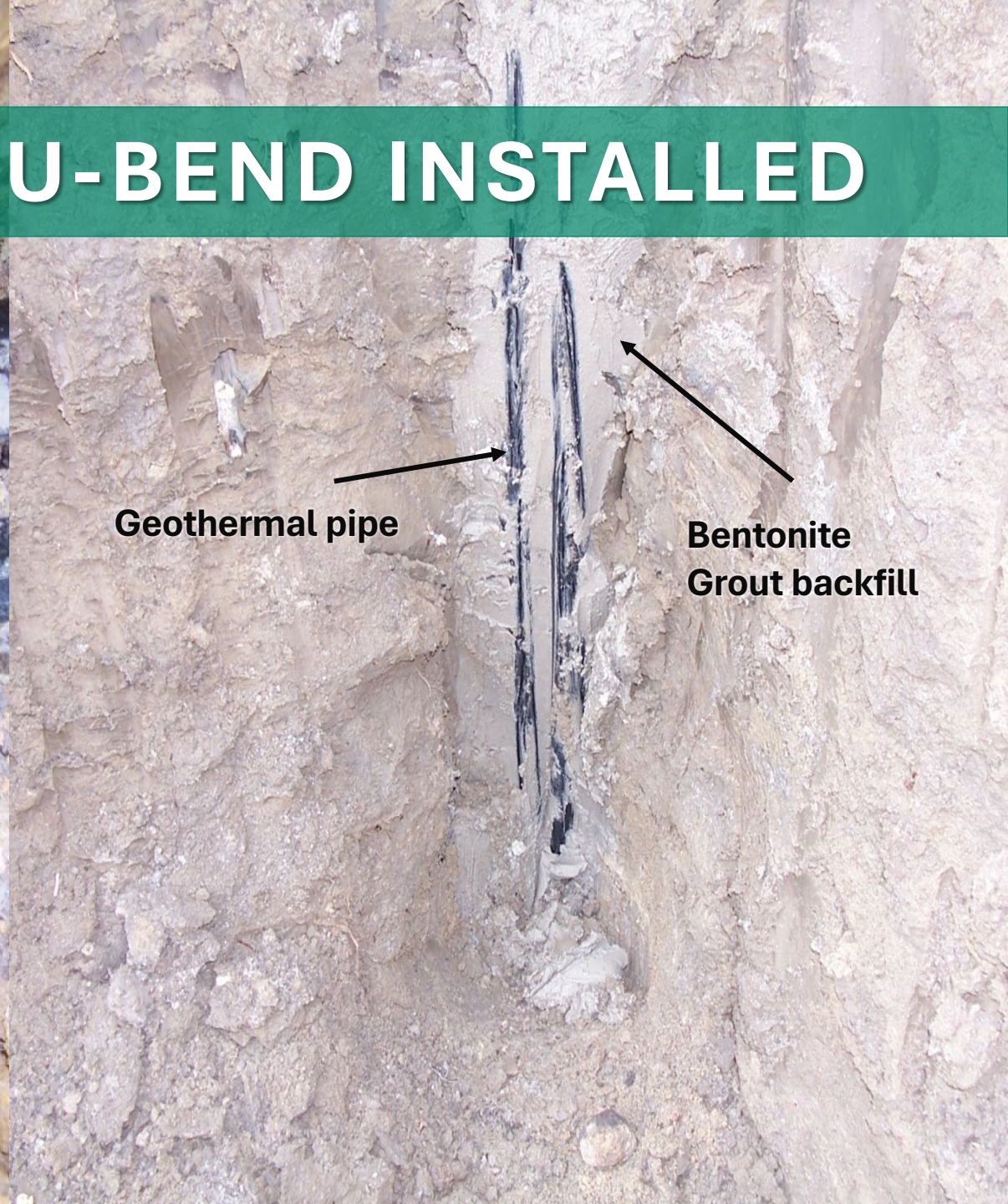


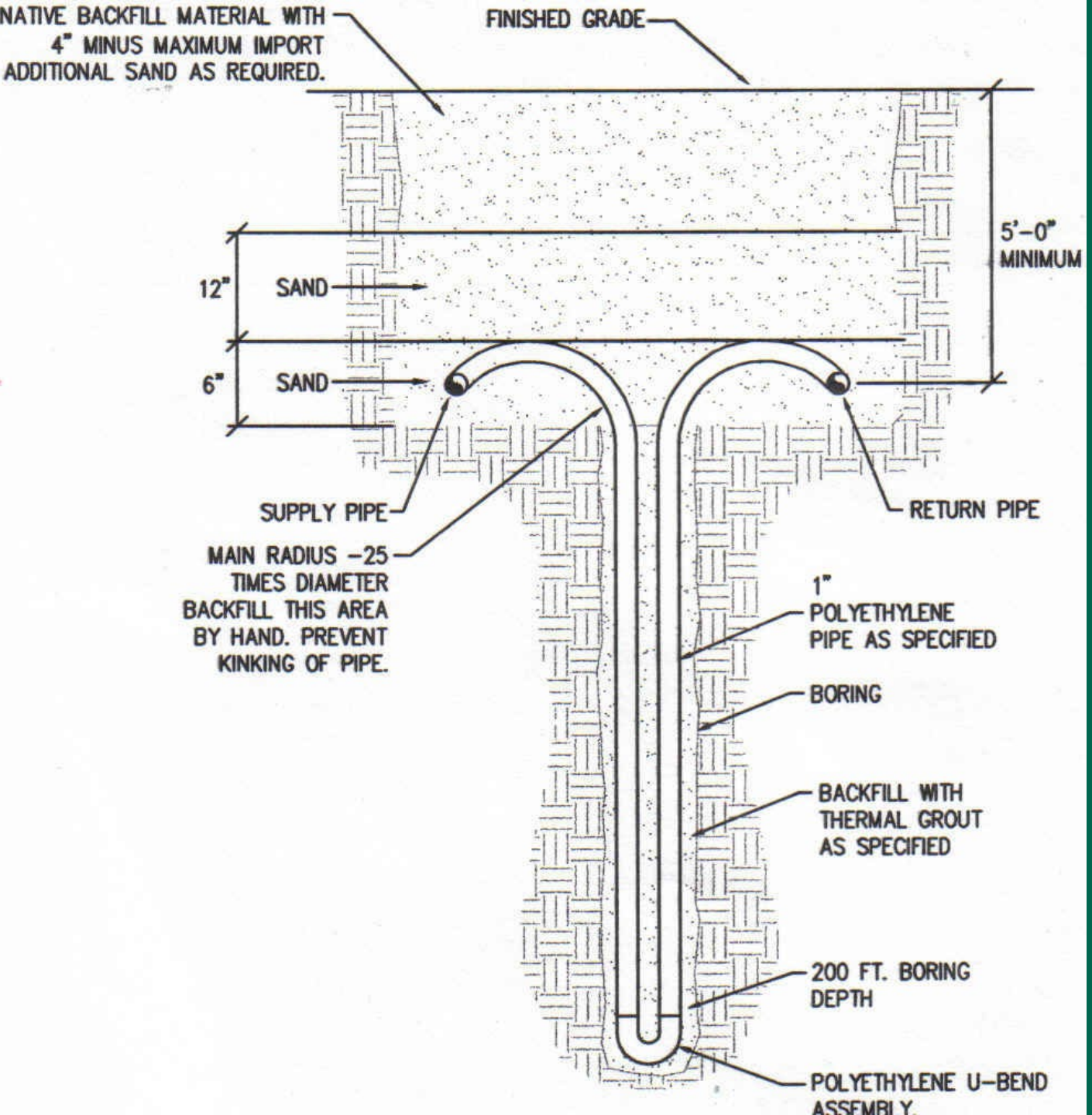
HDPE PIPE
1” – 1 1/4”

BOREHOLE WITH PIPE U-BEND INSTALLED

PROPER BORE BACKFILL/GROUTING IS CRITICAL FOR SYSTEM PERFORMANCE
GROUT PROVIDES HEAT TRANSFER FROM THE BOREHOLE TO GEOTHERMAL LOOP and PROTECTS AQUIFER CONTAMINATION

Vertical bore without grout backfill





Typical Vertical Well PIPE DETAIL

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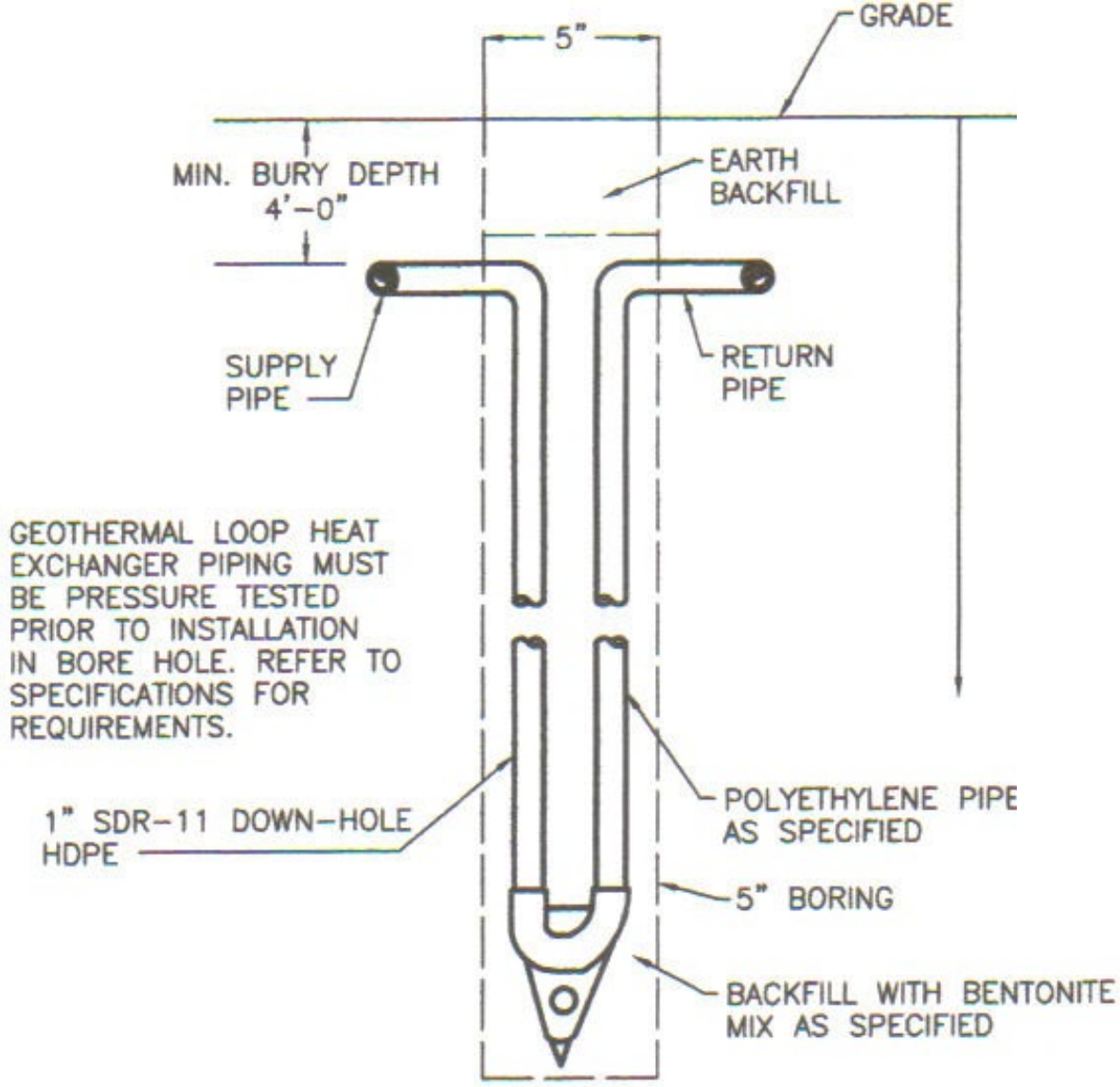
EQUIPMENT EFFICIENCY MAKES A DIFFERENCE

Bore Dept (feet)	Heat Pump Manufacturer	Additional Bore Feet Required	Added Cost $25/lf
300	ClimateMaster	0	
325	Less efficient manufacturer	1650	$68,750

DUE TO THE DIFFERENT LEVELS OF EFFICIENCIES PROVIDED BY THE HEAT PUMP MANUFACTURERS, EXCHANGER WILL BE DIFFERENT DEPENDING ON THE MANUFACTURE OF THE HEAT PUMP THAT ARE INSTALLED. CLIMATEMASTER IS BASIS OF DESIGN.

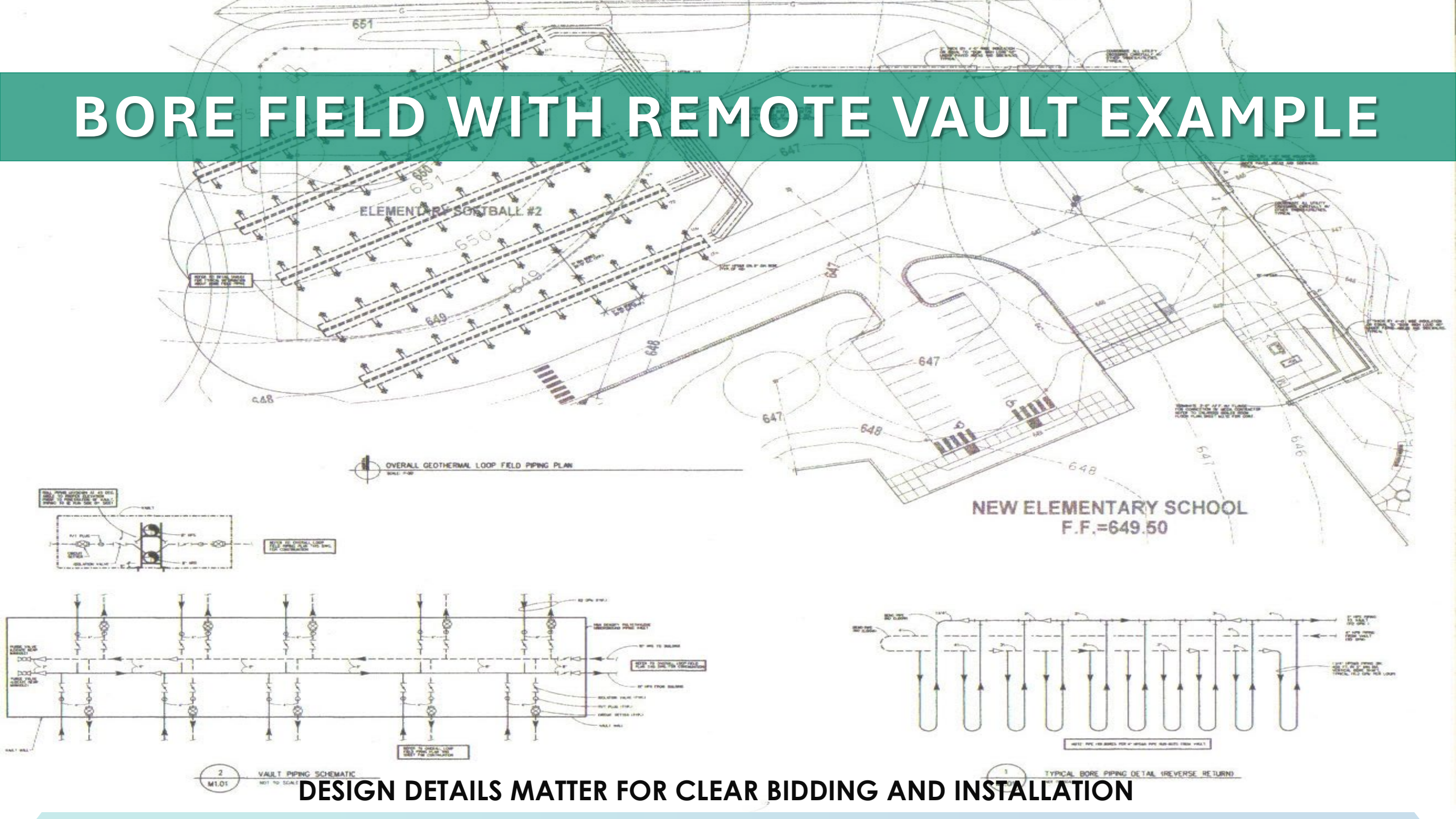
Equipment selection, GSHP design are integrated



TYPICAL BORING DETAIL

N.T.S.

BORE FIELD WITH REMOTE VAULT EXAMPLE



DESIGN DETAILS MATTER FOR CLEAR BIDDING AND INSTALLATION

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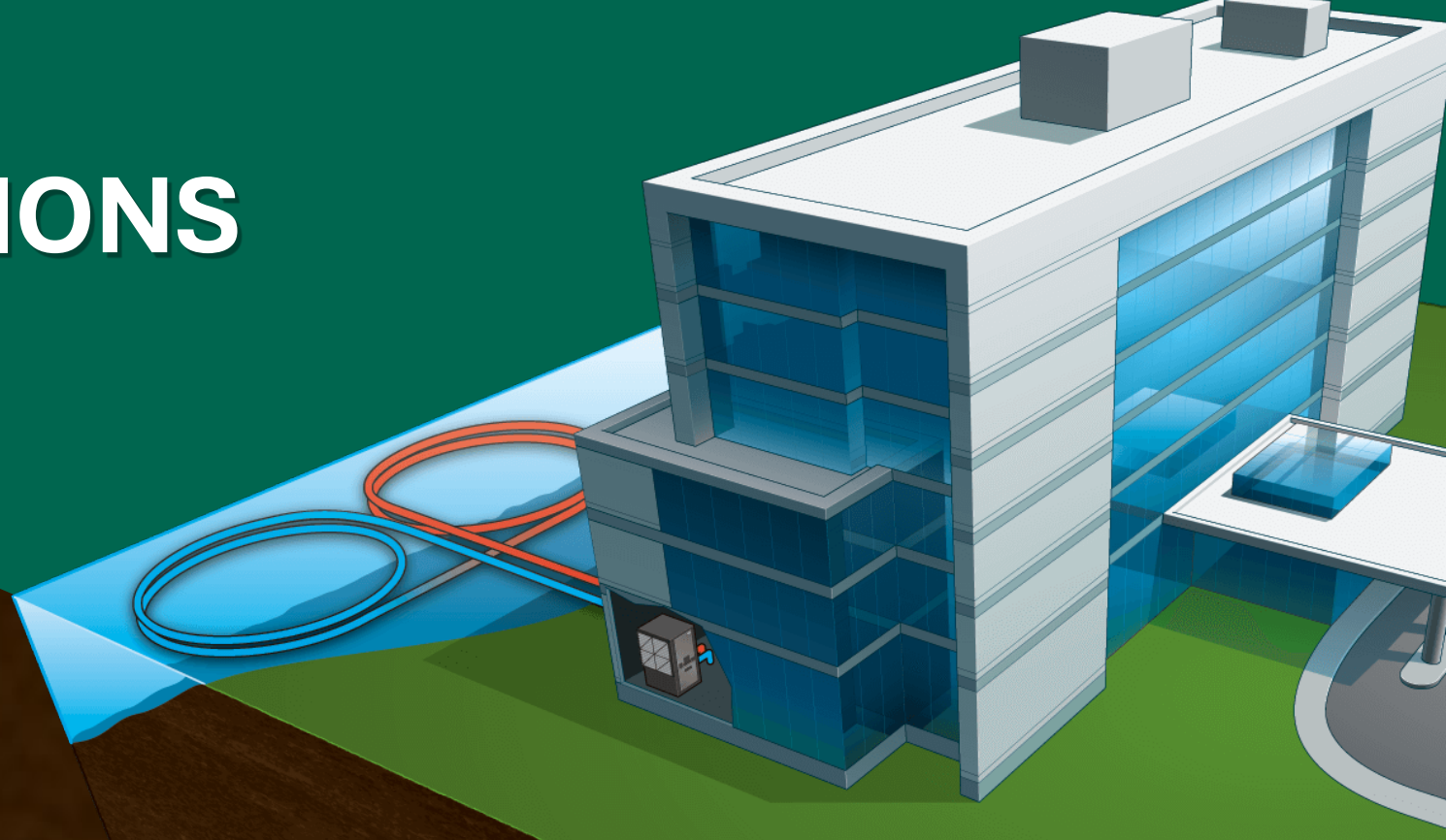
CLOSED LOOP OPTIONS



Pond / Lake / Plate Body of Water Loop

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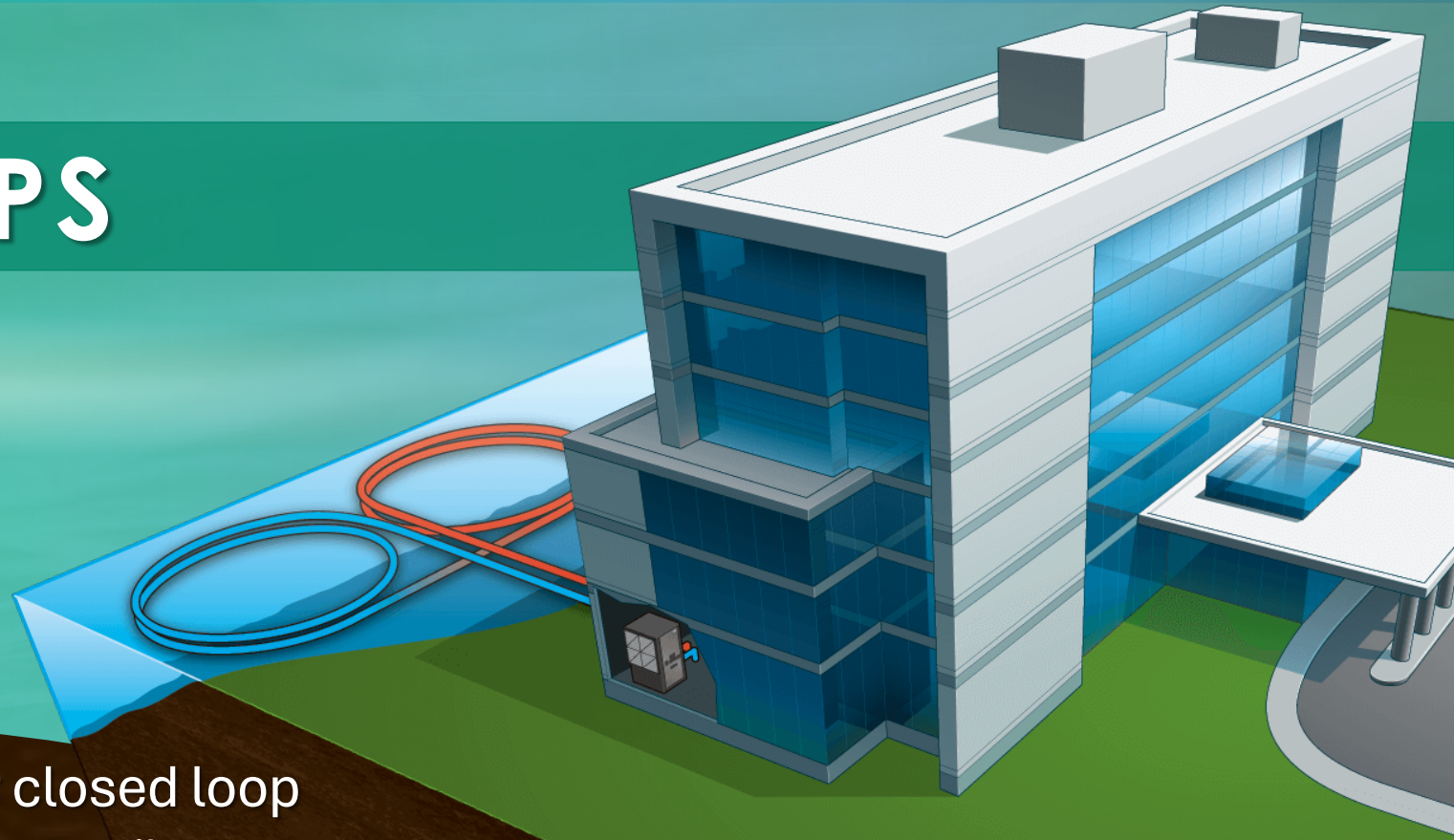
A NIBE GROUP MEMBER

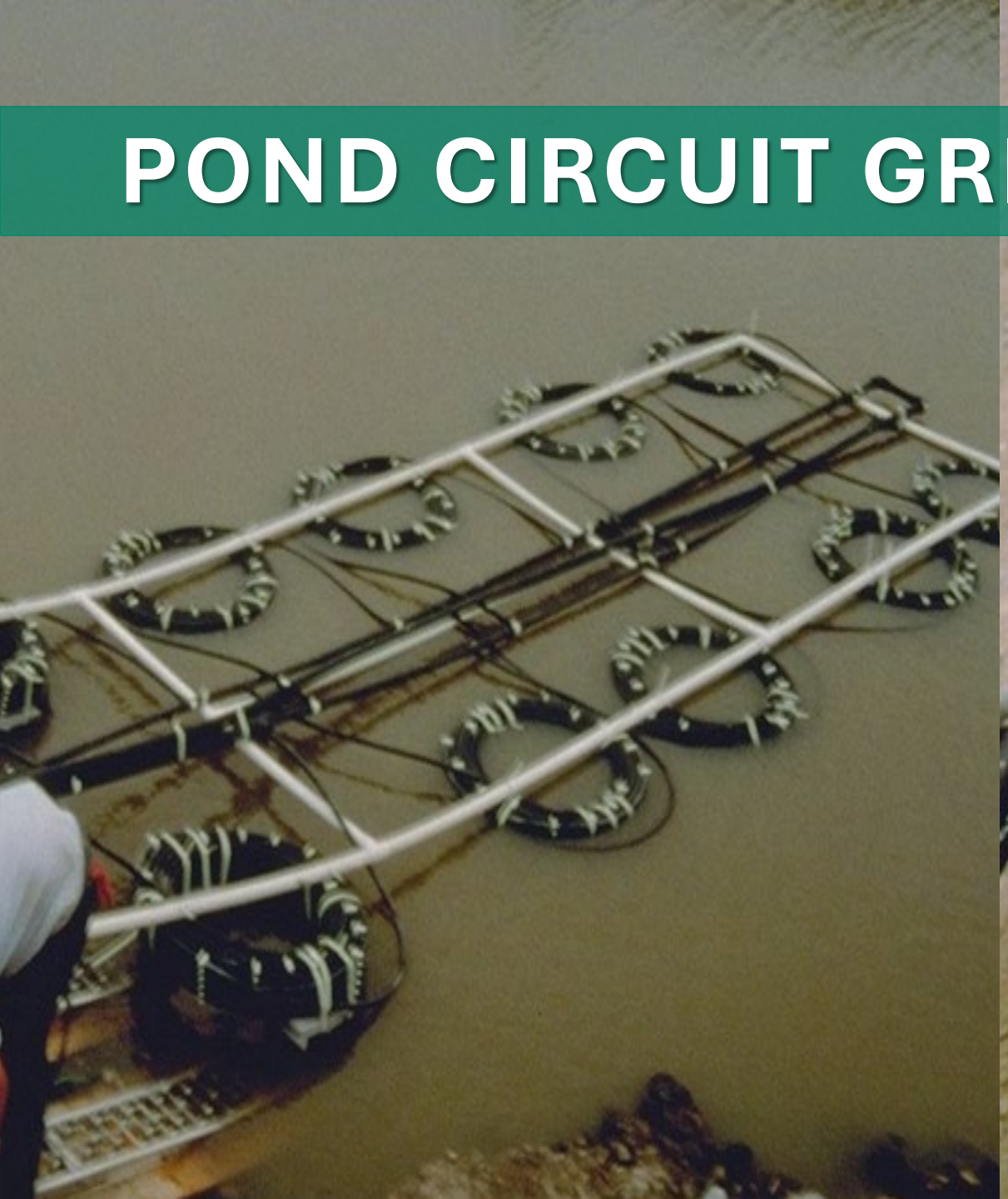
POND LOOPS

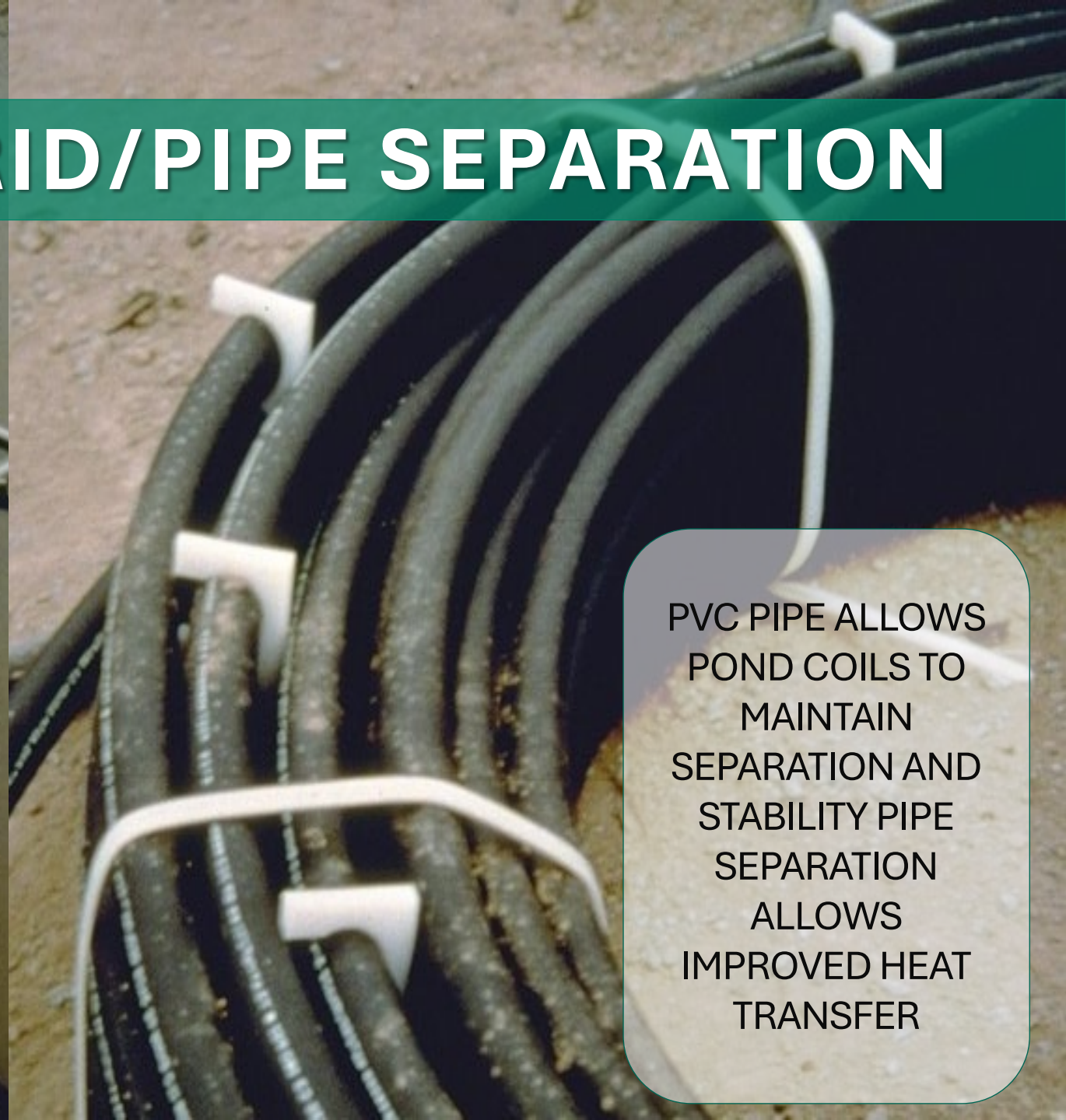


Pond Loop Heat Pump System

- Cost effective alternative to other closed loop systems (average water depth of 8 - 10’)
- Full loop design
- Can be utilized as part of hybrid closed loop system strategy

POND CIRCUIT GRID/PIPE SEPARATION





PVC PIPE ALLOWS POND COILS TO MAINTAIN SEPARATION AND STABILITY PIPE SEPARATION ALLOWS IMPROVED HEAT TRANSFER

PLATE STYLE POND LOOPS

2000 TON FRESH WATER APPLICATION

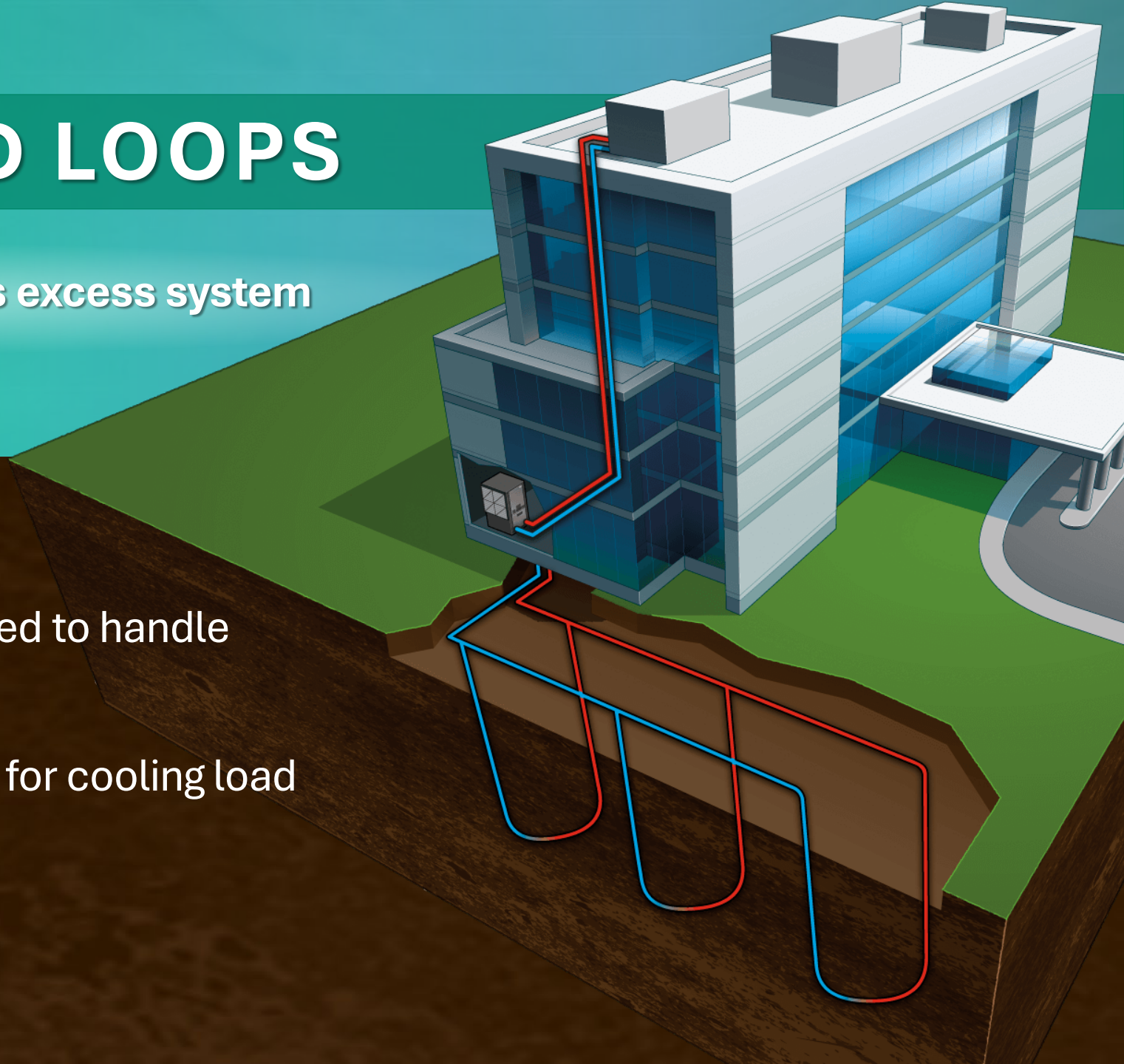
Lake Plates can be stainless steel or titanium – optimal for space constrained applications

1600 TON SALTWATER - SYNDNEY, AUSTRALIA

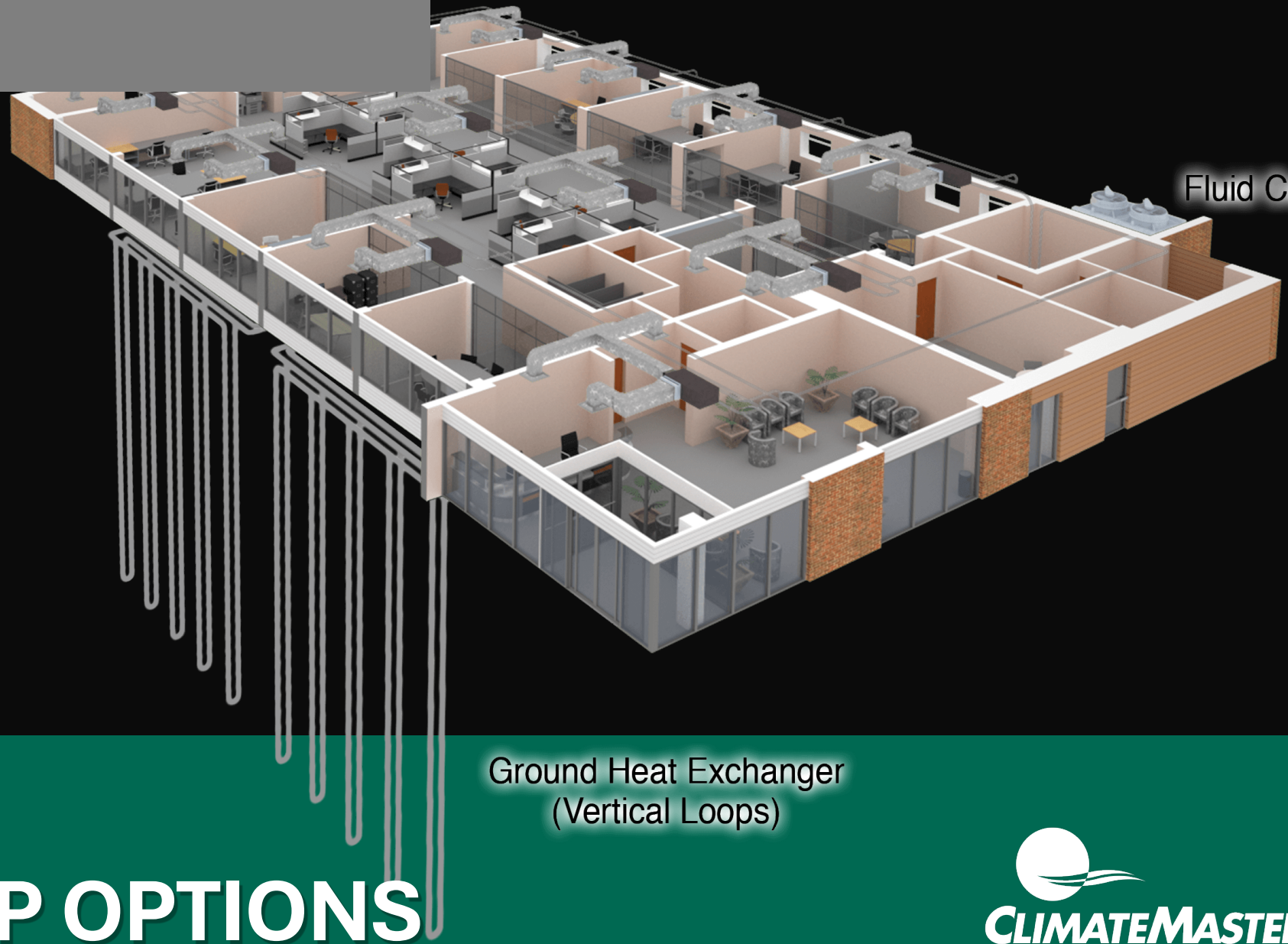
HYBRID GROUND LOOPS

Cooling tower or dry cooler rejects excess system heat during peak cooling demand

- Strategic ground loop design
- Provides heat of extraction needed to handle entire heating load
- Provides heat of rejection option for cooling load design optimization



Hybrid



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CLOSED LOOP OPTIONS

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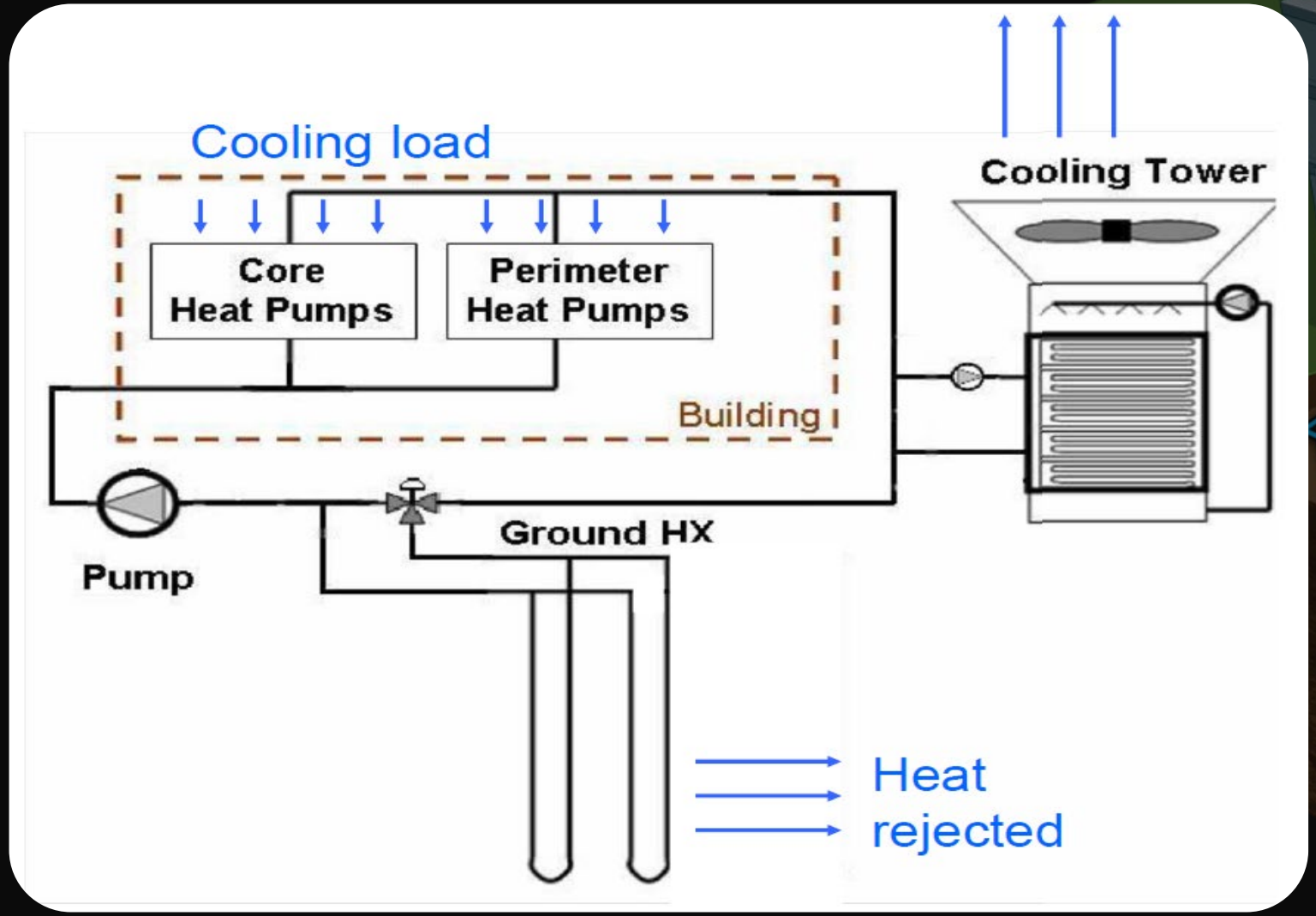
A NIBE GROUP MEMBER

HYBRID GROUND LOOP HEAT PUMP SYSTEM



Cooling tower or dry cooler rejects excess system heat during peak cooling demand

- Strategic ground loop design
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- Provides heat of rejection option for cooling load design optimization

UNDERGROUND HEADER PIPE VAULTS

A vault is a buried structure that holds an external manifold for a geothermal loop-field. This buried mechanical room is where you will access your manifold by climbing down a ladder through the manway.

- Concrete or HDPE construction
- Frees up valuable space inside Mechanical room
- Reduces building penetrations
- Stopping point between loop-field and building
- Prefabricated vault saves field time
- Accommodates larger distance from building
- Easy access for flushing and purging

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SAVES MECHANICAL ROOM IN THE BUILDING

FREEZE PROTECTION OPTIONS

WHAT IS THE REQUIREMENT AND WHY?

Typical Anti-Freeze Products

METHANOL – least expensive and good performance, but toxic and flammable

PROPYLENE GLYCOL – non-toxic, can add pumping penalties.

ETHANOL – a natural mixture environmentally safe with lowest NFPA health warning available

THERMAL CONDUCTIVITY TEST

- ✓ **Identifies the actual ground loop performance** given a specific location and heat exchanger design
- ✓ **Testing** is conducted several days after the ground loop's installation and data is recorded over a 24–48-hour period
- ✓ **Reported data includes:**
  - ❑ Undisturbed soil temperature
  - ❑ Thermal Conductivity (TC)
  - ❑ Thermal Diffusivity
  - ❑ Drill log and time

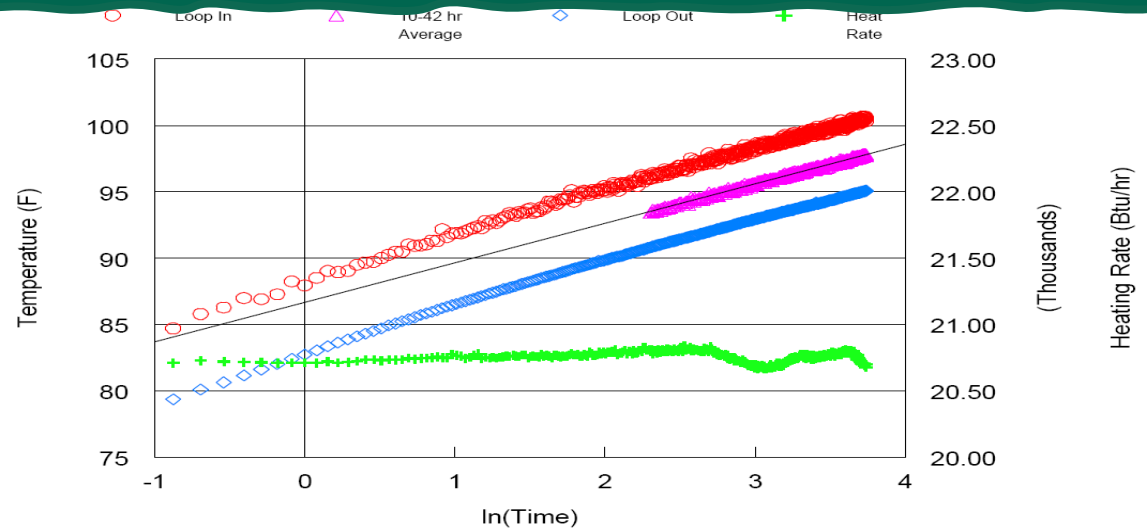

Figure 2: Temperature versus Natural Log of Time

Time Period	Slope: a_1	Average Heat Input (Btu/hr-ft)	(W/ft)	Thermal Conductivity (Btu/hr-ft-°F)
10 – 42.0 hrs	2.97	51.4	15.1	1.37

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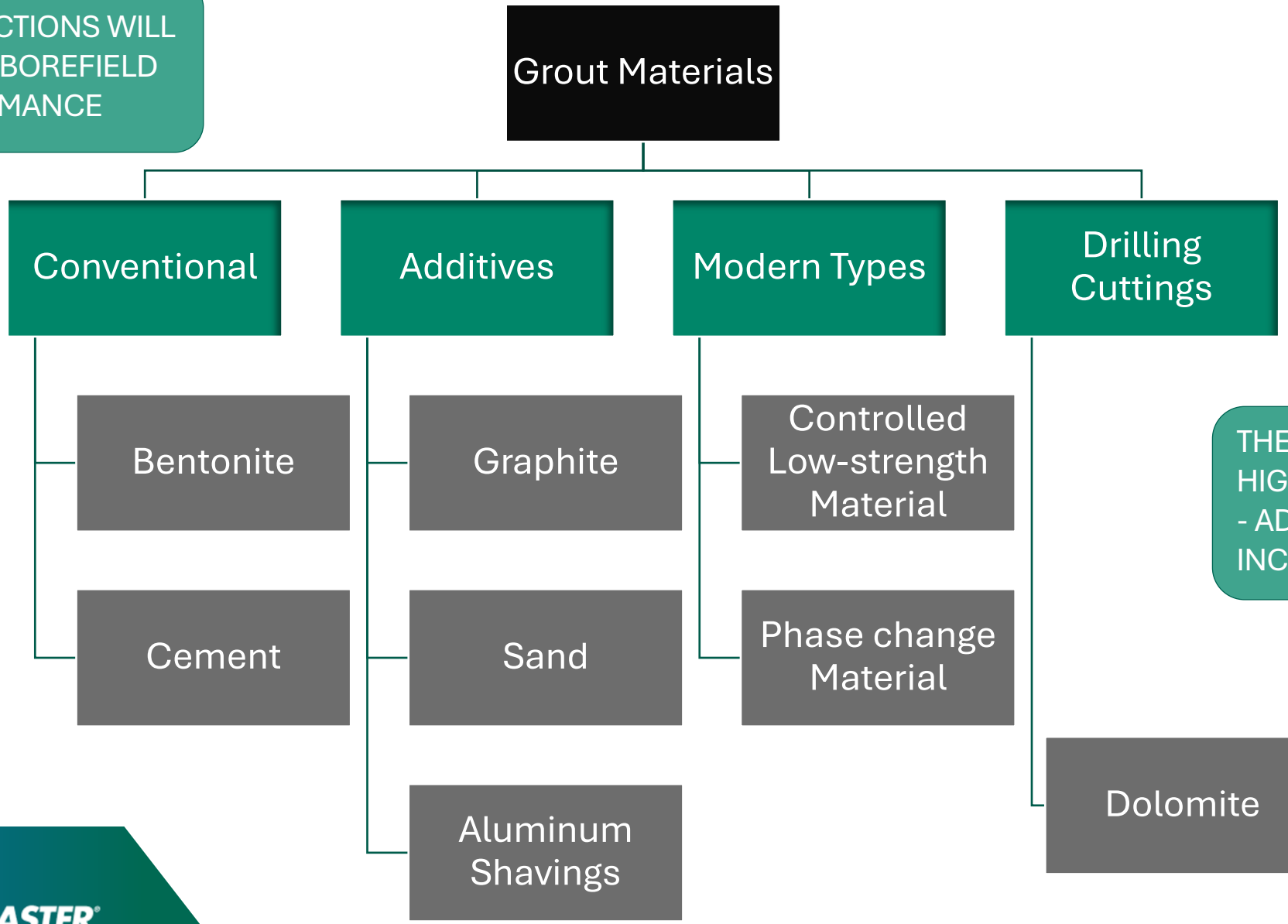
GROUT SELECTIONS

GROUT SELECTIONS WILL DETERMINE BOREFIELD PERFORMANCE



THE HIGHER THE SOLIDS THE HIGHER THE TC
- ADD SILICA SANDS TO INCREASE TC

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YOU

ARE DESIGNING
THE ENERGY SOURCE.

NOT SIMPLY
CONNECTING TO THE GRID.

CLIMATEMASTER®