

The **Blake** GROUP

Serving All of New England & New York

Near Net Zero Energy HVAC By Design

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Hydronic Alternatives

BLAKE EQUIPMENT

BLAKE WATER SOLUTIONS

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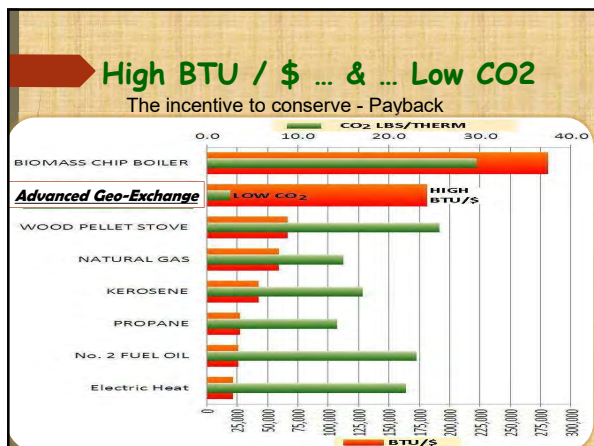
The Blake Research Facility East Windsor CT

4 different borehole heat exchangers, each with their own BTU meter.

Special manifolds allow mixing in total, or various combinations or total separation of loops

All pipe is HDPE

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Typical Net BTU Values by Energy Source


	BTU/\$	to	BTU/\$
Propane	18,000	to	33,000
Electric	20,000	to	22,000
Fuel Oil	26,000	to	45,000
Natural Gas	33,000	to	56,000
Wood / Coal	40,000	to	80,000
Air Source Heat Pumps	45,000	to	55,000
As-Built Geo-Exchange	45,000	to	75,000
IGSHPA Geo-Exchange	70,000	to	75,000
Advanced Geo-Exchange	90,000	to	220,000

Commonly found BTU/\$ value during forensic engineering review

Value we have obtained

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Housing Vermont - Red Clover Commons - Brattleboro VT



55 Apartments
 62,850 Sq-Ft
 8 btu/sf @ -20°F (41.6 Tons)
 All HVAC = 19.7 Kbtu/SF/Yr
 24 500' GPX U-Tubes
 Typical Dual Mode Chiller Load 12 to 16 Tons Heating with 3 to 9 Tons Cooling

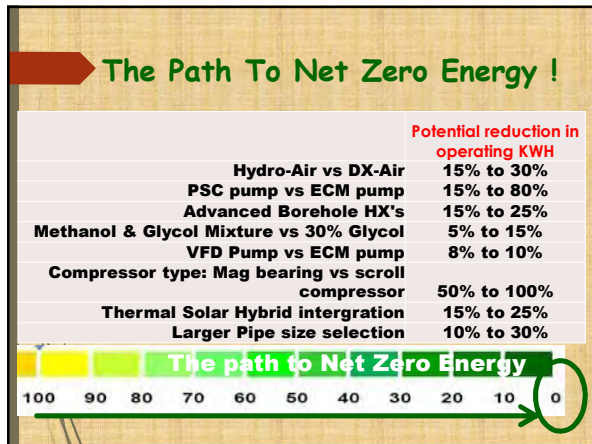
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Verified Results @ Housing Vermont - Red Clover Commons - Brattleboro

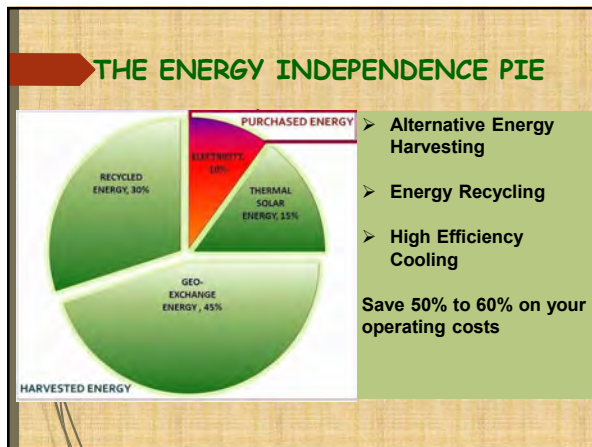
RCC Net BTU/\$	Total Net BTU/\$	CO2 LBS/Therm.
Heating Only Mode	144,000	5.78
4 Pipe Simultaneous Heating and Cooling	267,000	3.12
Seasonal Average	170,000	4.90

R.C.C. > Exceptional BTU/\$ & Smallest Carbon Footprint

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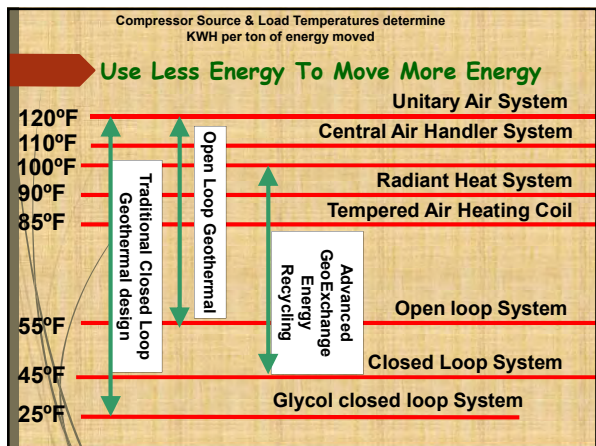
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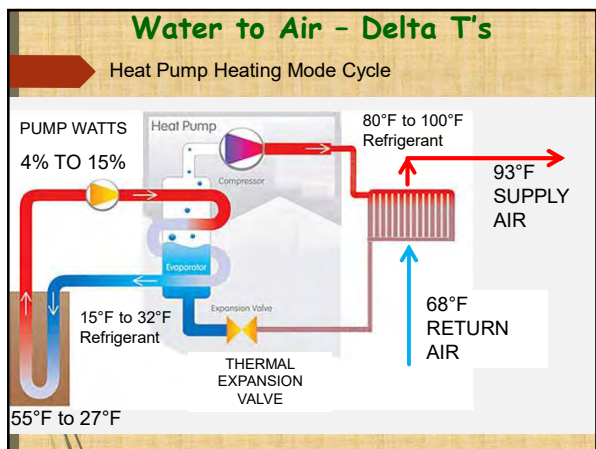
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- ### Keys to Success for N.N.Z.E.
- > Air Sealed Building Construction > Blower door testing
 - > Low Source to load delta T > Better G.S. H/X > Load Coils
 - > Cost efficient pumping > ECM > Push Pull > Low Head
 - > Hybrid Designs: > + Thermal Solar > - Dry Coolers
 - > Buffer tank Design > Direct to Load Configuration
 - > Piping Materials: > HDPE > Self Insulating

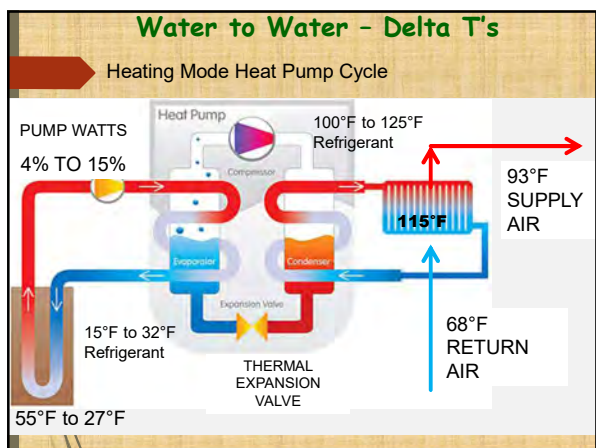
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C.O.P. Sensitivity

Heat Pump - Heating Performance

LOAD GPM = 70										
SOURCE EWT	LOAD EWT	SOURCE GPM	SOURCE WPD FT	SOURCE LWT	HEATING MBH	POWER Kw	HEAT OF ABSOR	COP	LOAD LWT	LOAD WPD FT
30.0	60.0	70.0	18.9	25.7	183.5	9.92	149.6	5.4	65.2	13.9
30.0	80.0	70.0	18.9	26.1	181.0	12.82	137.3	4.1	85.2	12.2
30.0	100.0	70.0	18.9	26.5	178.6	16.47	122.4	3.2	105.2	11.0
30.0	120.0	70.0	18.9	27.0	176.2	20.95	104.7	2.5	125.1	10.1
50.0	60.0	70.0	15.1	44.0	246.3	11.01	208.7	6.6	67.0	13.9
50.0	80.0	70.0	15.1	44.5	240.9	13.80	193.8	5.1	86.9	12.2
50.0	100.0	70.0	15.1	45.0	235.4	17.42	176.0	4.0	106.8	11.0
50.0	120.0	70.0	15.1	45.6	230.0	21.91	155.2	3.1	126.6	10.1

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Borehole Design Variable: Drilling Depth

Borehole Depth Selection ΔT & $^{\circ}F$

NEW-ENGLAND TEMPERATURE GRADIENT AVERAGES ABOUT $.9^{\circ}F/100'$

HEAT FLUX : W/m^2
 25-39 40-59 60-74 75-89 90-150+

ANNUAL GROUND TEMPERATURE $^{\circ}F$

Twister
 U-Tube Designs
 Double U-Tube
 4" x 2" GPX Concentric Design
 5" x 3" GPX

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Enhanced Thermal Conductivity HDPE

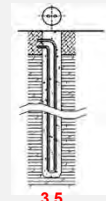


Enhanced thermal conductivity HDPE pipe can reduce the required borehole length for a geo-exchange field by 10% TO 40%.

The pipe has a greater advantage in buildings that cool by day and heat by night. "put and take" Geo-Exchange

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Geo-Exchange: Heat Exchanger Basic Comparison

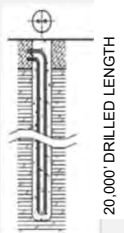
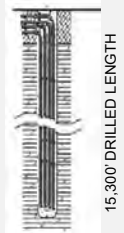

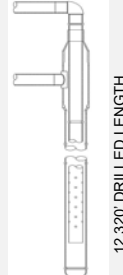
Comparison of borefield designs at an equal system heat pump operating efficiency

 3.5 500' 1-1/4"Ø HDPE U-TUBE BOREHOLES	=	 1 1,100' 5"Ø HDPE CONCENTRIC	=	 1 bed 150' x 50.6' 10,000 LF Thermally Enhanced HDPE TUBE HORIZONTAL GEOEXCHANGE BED
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HDPE Vs. Graphite Enhanced HDPE

133 Tons +/-

 40 500' 1-1/4"Ø HDPE U-TUBE BOREHOLES 20,000' DRILLED LENGTH	=	 34 450' (4) 3/4"Ø Twister BOREHOLES 15,300' DRILLED LENGTH	=	 18 800' (2) 1-1/2"Ø GPX Double U BOREHOLES 14,400' DRILLED LENGTH	=	 8 1,540' 5"Ø CONCENTRIC GEOPERFORMX 12,320' DRILLED LENGTH
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Twin Loop: 1-1/4" or 1-1/2"

QUADLOOP™ HDPE GEO PIPE with DUPLEX HEAD

- Longer lifespan: The patented geometry of Duplex U-bend Head is engineered to withstand abrasion and minimize the insertion force.
- More energy out of the borehole: The double heat exchanging surfaces allows the dual circuit loops to get up to 30% more energy performance out of the same borehole.
- More safety: If the pipes of one circuit are damaged, you can still use the other circuit and maintain more than 70% energy performance.
- All QUADLOOP™ fittings will be manufactured and tested to ASTM standards.

UNIQUE IN NORTH AMERICA
Almost 95% of geothermal loops used in Europe are Duplex dual circuit loops.

PROGRESSIVE BANDING
Loop is Strapped Every 2 Levels of Pipe for Controlled Insertion.

IN-PLANT TESTED
40PSI Pressurized Loops Heat-Treated and Spiced Before Shipping.

COIL OR REEL OPTIONS
Available in Various Loop Lengths on Coil or Reel.

The Double U-Bend
15% to 40% less drilled length required

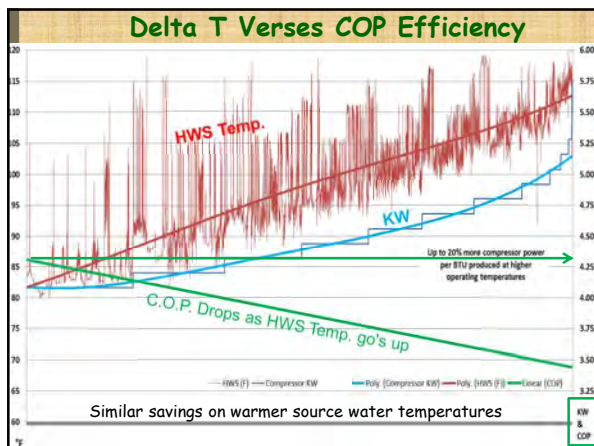
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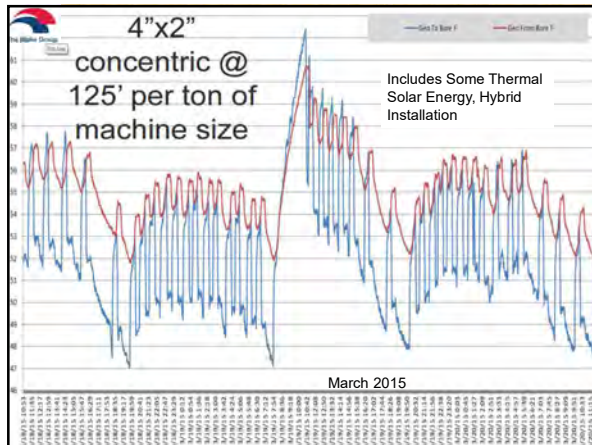
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Innovation In Design - Low Temperature Thermal Solar

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Each of the 4 zones are balanced to deliver the same return water temperature from a matched set of identical horizontal geo-exchange beds

The 2 left flow meters connect to a total of 3000' of **3/4" GeoperformX Thermally Enhanced DR11 HDPE**, Balanced to 16 GPM producing 32,000btu/hr (Ti=37°F, To= 41°F)

The 2 right flow meters connect to a total of 3000' of **3/4" PE-3608 DR-11 HDPE**, Balanced to 8 GPM producing 16,000btu/hr (Ti=37°F, To= 41°F)

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**Magnetic Bearing
Near Frictionless Compressor**
**SEER of 18 to 28
& COP of 6 to 11**



Efficient frictionless centrifugal compressor

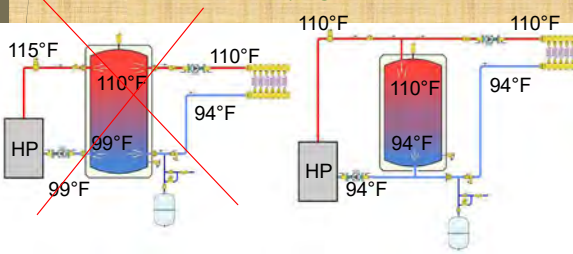
Oil Free Compressors =

- Ultra High Efficiency Chillers
- Heating COP > 8 to 14
- Cooling EER > 27 to 47
- Unloadable to 20% before HGBP



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**Hydronic Efficiency
Buffer Tanks
Direct to Load Piping**




Buffer tank / Hydronic separator piped in bypass configuration reduces compressor power by 10% to 15%

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ECM PUMPS - HIGHEST WIRE TO WATER PUMP EFFICIENCY



AC 3-Phase induction motor w/ Variable Frequency Drive
+8% to +20% +/- KWH



Single Phase Capacitor start
3 speed selectable
+11% to +80% KWH



E.C.M. Higher torque per watt

DC Permanent Magnet Variable Speed Motor

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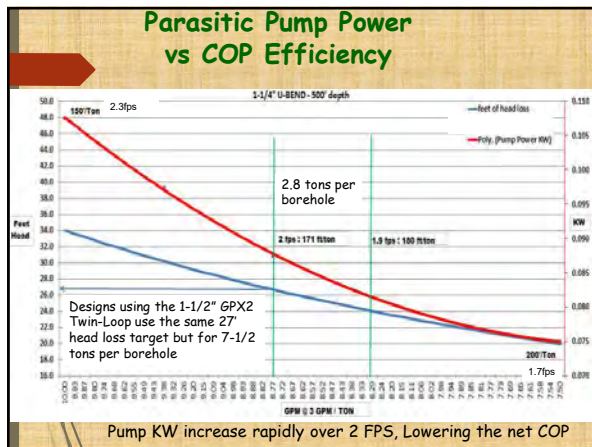
PUMP REDUNDANCY via Push - Pull

Old School:

- parallel redundant pumps
- 60 to 125' Head
- Separate VFD
- Pump KW = Pipe Velocity³

- ECM variable speed
- Push - Pull
- 35' to 45' Head
- Save \$35K/ station

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Flow Control Do's and Don'ts

1/2" to 6" self
controlling balance
valve


Allows full bypass flow for
cleaning and air purge.

Many variations of auto
balance valves, all require
individual service to clean
each valve of debris,


No bypass for air purge.

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4 Pipe Ductless Heating and Cooling



Ceiling Mount



Wall Mount



3 modes - Never Mixes

- Proportional Heating
- Off
- Proportional Cooling

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Propylene Glycol Losses


For a 30% mixture of propylene glycol for freeze protection to 27°F outlet from the heat pump.

- Added flow GPM required = 10% -15%
- Added head loss = 7% - 10%
- Added pump H.P. = 25% - 30%
- Added cost of chemical and replacement

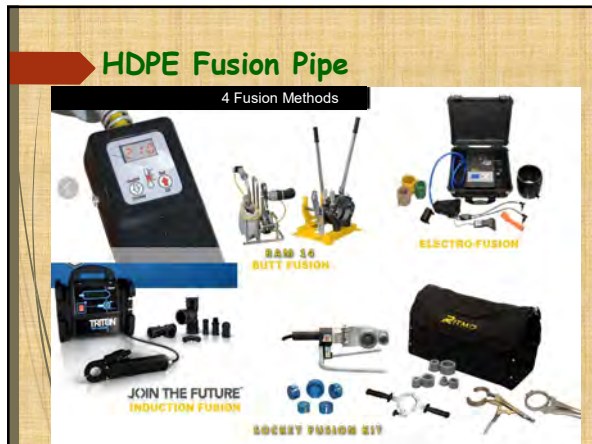
Pump run time hours can often exceed compressor run time hours by 50% making added pump H.P. very costly for yearly operating costs.

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GeoExchange Water Room



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Choate Rosemary Hall **The Blake GROUP**

CASE STUDY

Design Temperature: 50°F / 84°F
60 500' 1-1/4" U-Bend
V.E. Re-Design:
40 500' 1-1/4" HDPE U-Bend OR
15 Geoperform-X 900' Deep DR11
1-1/2" Twin Loop

Savings to Owner = \$300,000



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The Community Music School of Springfield, MA **The Blake GROUP**

CASE STUDY

Urban City Location
Available area: Side Alley
Deep Borehole H/X Design

6 Geoperform-X
1,100' Deep
DR17 4" x 2" Concentric BHE
Grout ONLY top 100'
Design Temperature: 50°F/75°F



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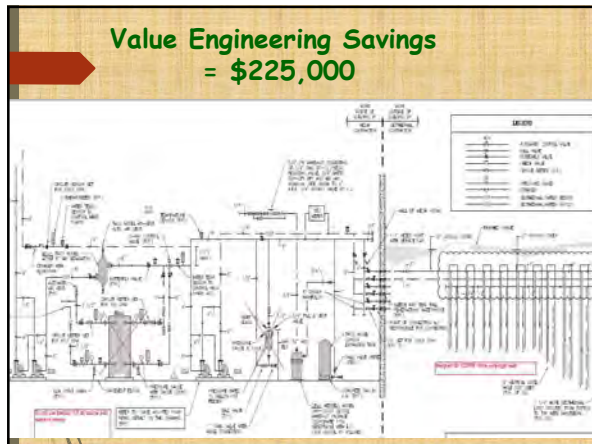
Excessive Parasitic Pump Power

PUMP SCHEDULE										
NO.	SERVES	MAKE & MODEL	CPM @ FT OF HEAD	RPM	HP	ELECTRICAL			STARTER BY I.E.C.	REMARKS
						VOLTS	PH	CT		
PH-2	BUILDING HEATING LOOP	TACO MODEL SKV1006	200.0 @ 80'	1765	3/4	208	3	40	YFC WITH RECONNECT	① ② ③
PH-3	GEOTHERMAL PRIMARY PUMPS	TACO MODEL SF3310C	300.0 @ 90'	1765	1.0	208	3	40	YFC WITH RECONNECT	① ② ③
PH-4	GEOTHERMAL SECONDARY PUMPS	TACO MODEL SF3300F	300.0 @ 75'	1765	0.9	208	3	40	YFC WITH RECONNECT	① ② ③
PH-7	DOMESTIC HOT WATER LOOP	TACO MODEL SKV2009	100.0 @ 35'	1765	1.1	208	3	40	YFC WITH RECONNECT	① ② ③
PH-8	HEAT EXCHANGER #1 LOOP	TACO MODEL SKV2006	80.0 @ 35'	1765	1.5	208	3	40	YFC WITH RECONNECT	① ② ③
PH-1	BOILERS	TACO MODEL SKV2107	80.0 @ 40'	1765	2.1	208	3	40	YFC WITH RECONNECT	① ② ③

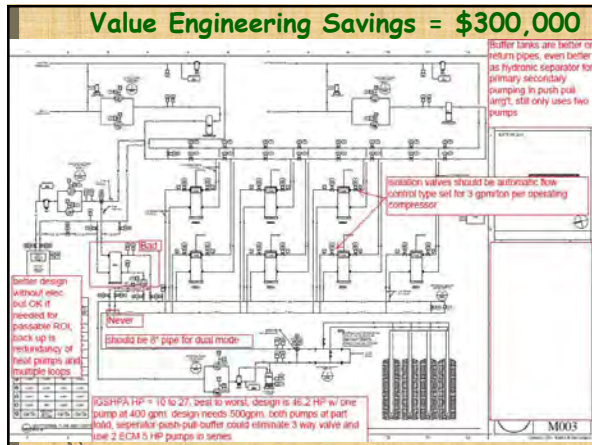
① SEE AISC SPECIFICATIONS FOR SEQUENCE OF OPERATION.
 ② PUMPS SELECTED FOR OPERATION WITH 100% AIR WATER/PROPYLENE GLYCOL MIX.
 ③ I.E.C. TO PROVIDE AND WIRE RECONNECT.

**Distributed heat pumps,
45' max head design vs 165'**

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Pre-Engineered water rooms for ground mount, retrofit penthouse or packaged skids for your mechanical room


Modular Heat-Pump Package
40 to 600 Ton Capacity

Skid Mounted Mechanicals:

Prefabricated Package may include:

- Modular compressor units, 7, 15, 60, 90 tons each
- On board ECM Push-Pull pumping for HW, CHW, GEO
- Combination Buffer Tank / Hydronic Separator
- DDC package, Open Source BACnet
- Single Point Electrical Connection
- Units over 165 tons w/ magnetic bearing compressors
- Continually Self Balancing Geo Return Manifold
- Multi-Source Geo Hybrid Air-Source Options

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Our Locations:
East Windsor CT
Danbury CT
Pine Island NY
Oneonta NY
Syracuse NY
Albany NY
Rutland VT
Greenfield MA
Hermon ME
Portland ME

Questions?

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**Near Net Zero Energy HVAC by Design:
We look forward to working with you.**
