ASES National Solar Conference 2016

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Solar Thermal Collection with Seasonal Storage

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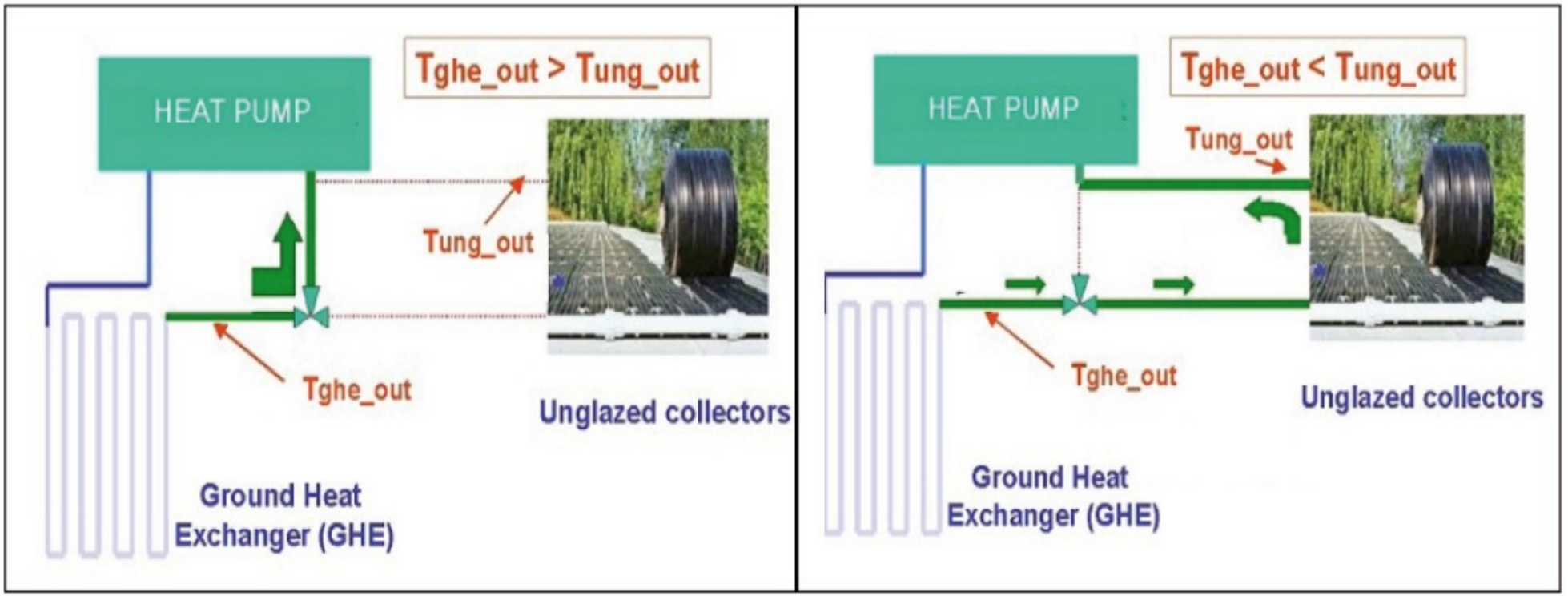
908 229 9056

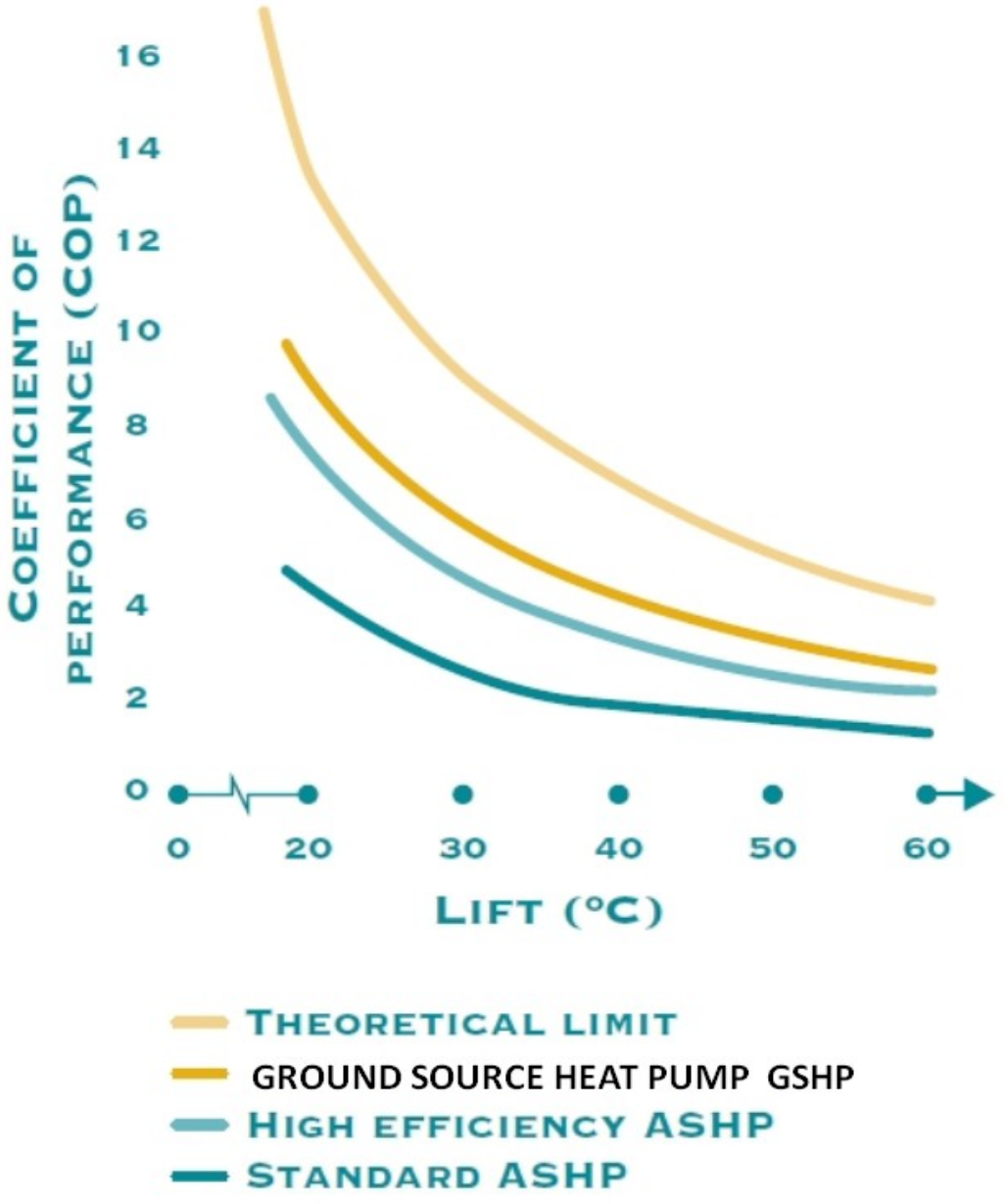


Hybrid heat source principle (photo: HELIOPAC)

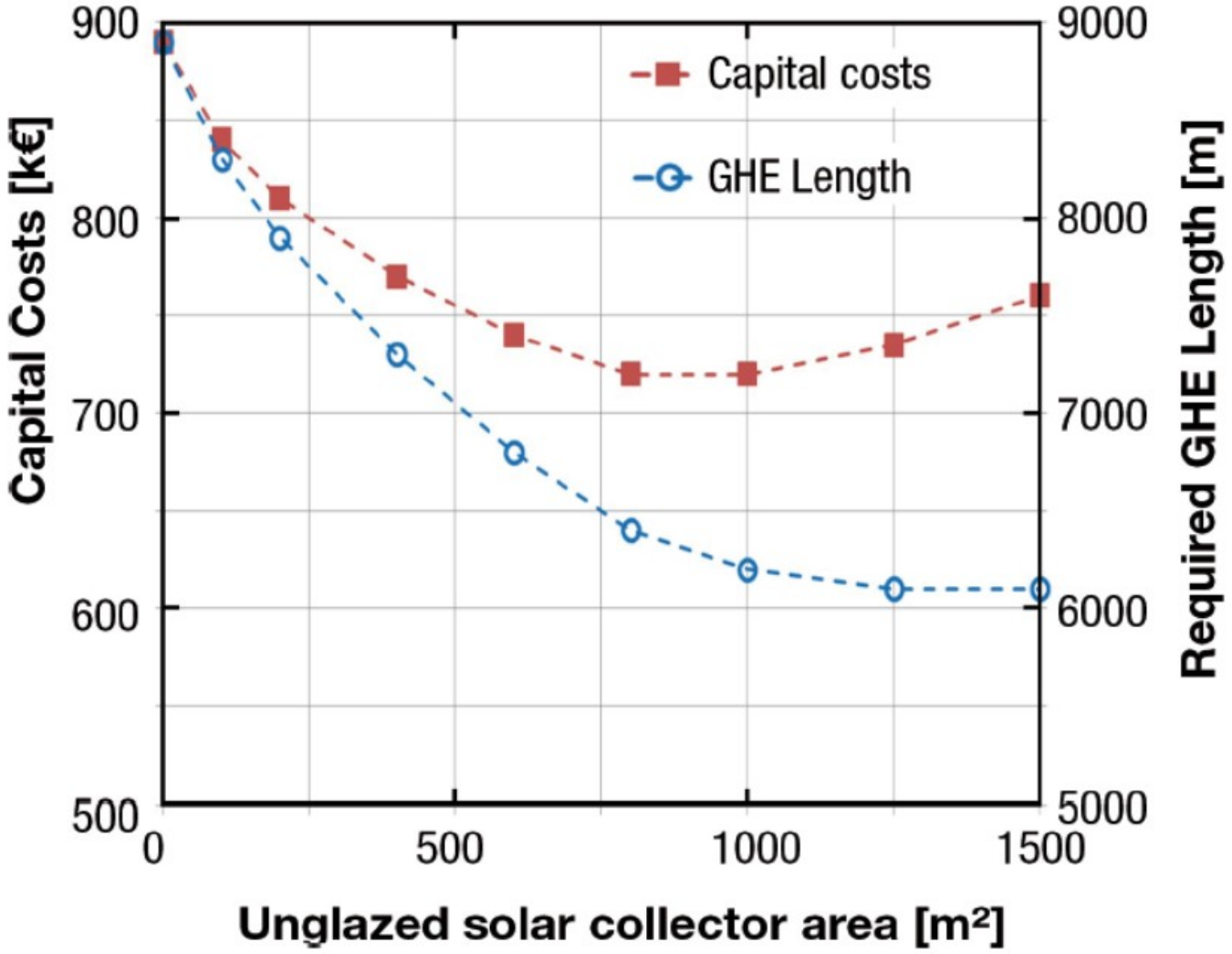
REHVA Journal – August 2011

From: Odile Cauret, Michael Kummert. 2011. Potential of solar assisted ground source heat pumps with unglazed solar collectors for French office buildings. REHVA Journal, August 2011, pp 16-20

HEAT PUMP PERFORMANCE



From: commercial Earth Energy Systems: A Buyer's Guide, Natural Resources, Her Majesty the Queen in Right of Canada, 2002



Impact of unglazed collectors on the required ground heat exchanger (GHE) sizing and the capital costs.

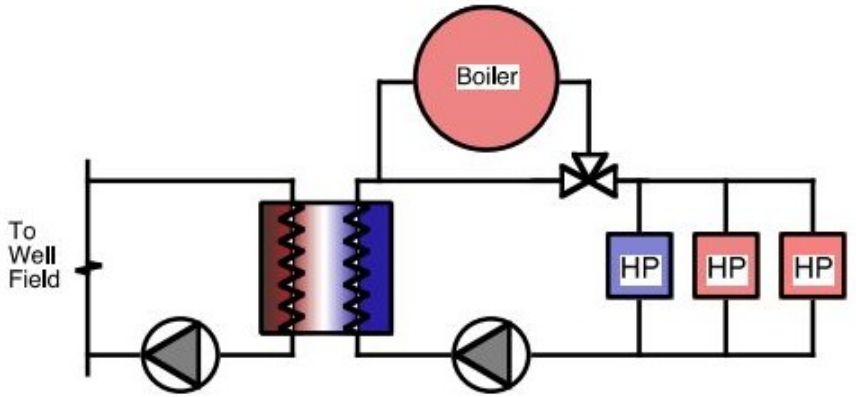
From: Odile Cauret, Michael Kummert. 2011. Potential of solar assisted ground source heat pumps with unglazed solar collectors for French office buildings. REHVA Journal, August 2011, pp 16-20

www.globalengineeringconference.com/GEC2012Presentations/
Workshops/2012_GEC_ALDERSON_3_23_12.pdf

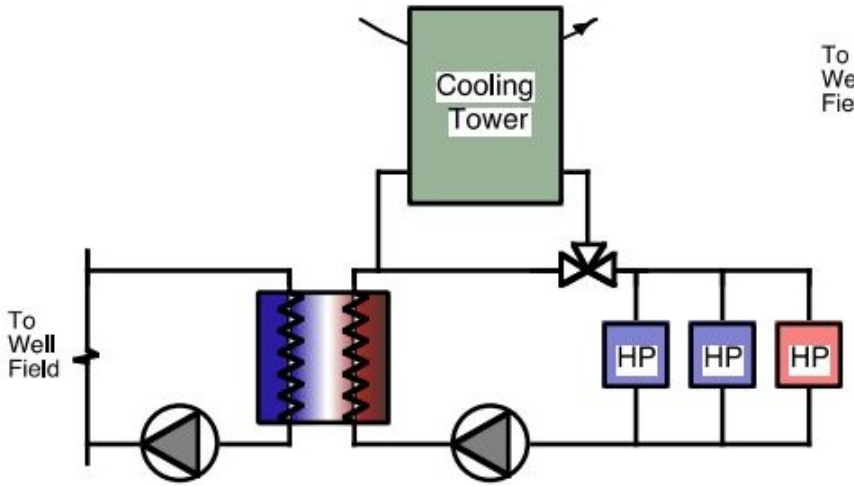
Hybrid Systems

2012 GLOBAL ENGINEERING CONFERENCE

Hybrid System with Boiler



Hybrid System with Cooling Tower



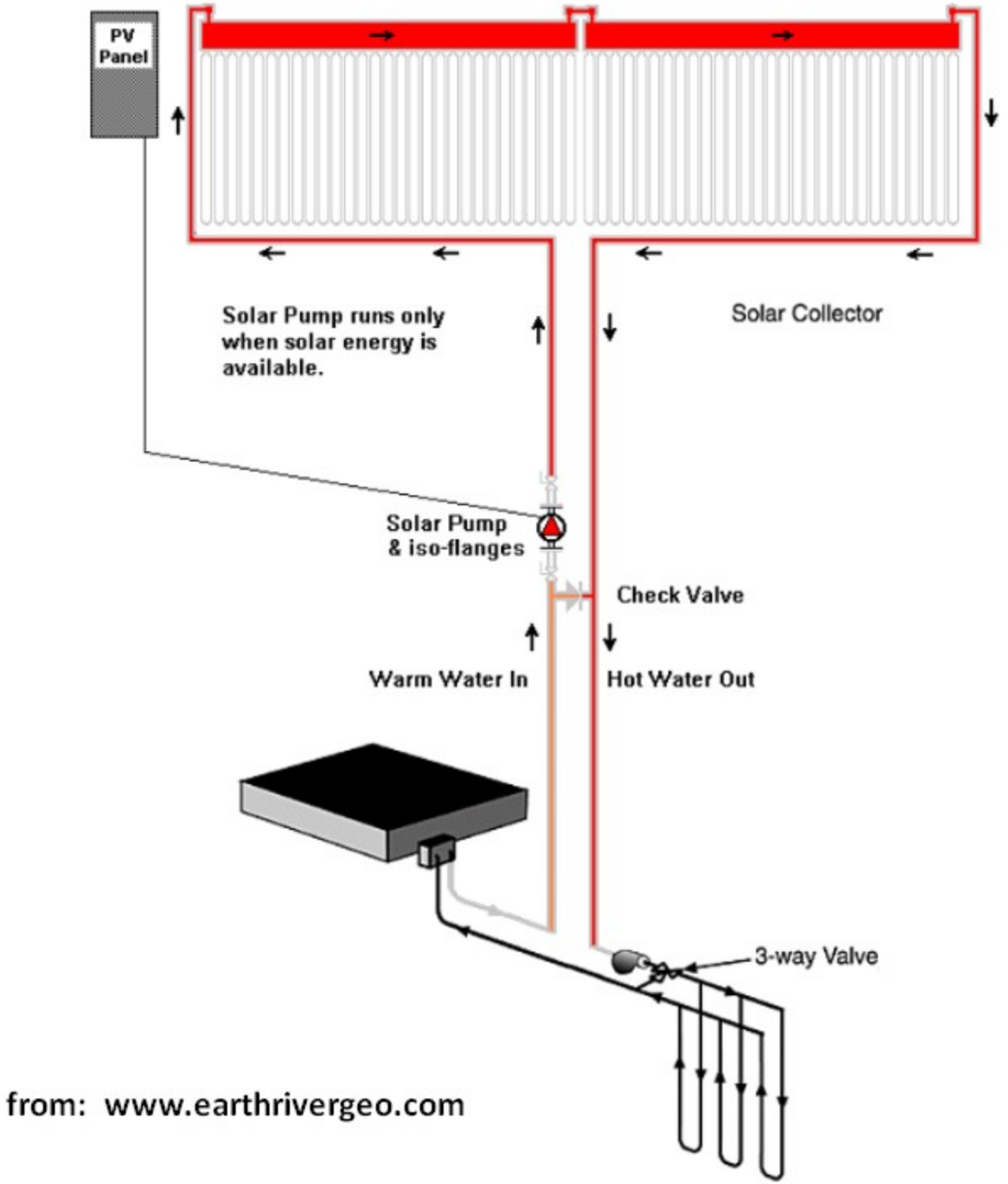
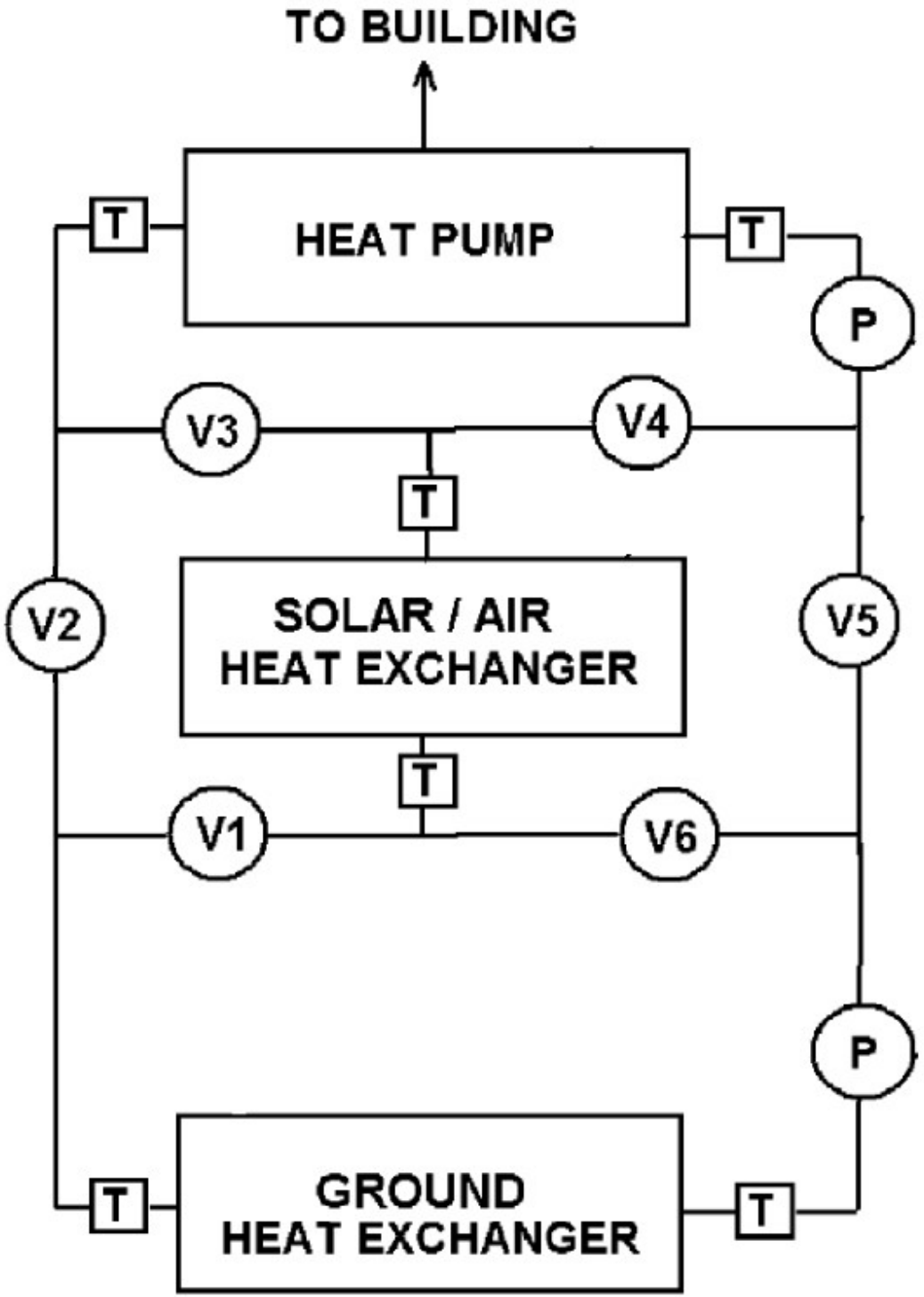
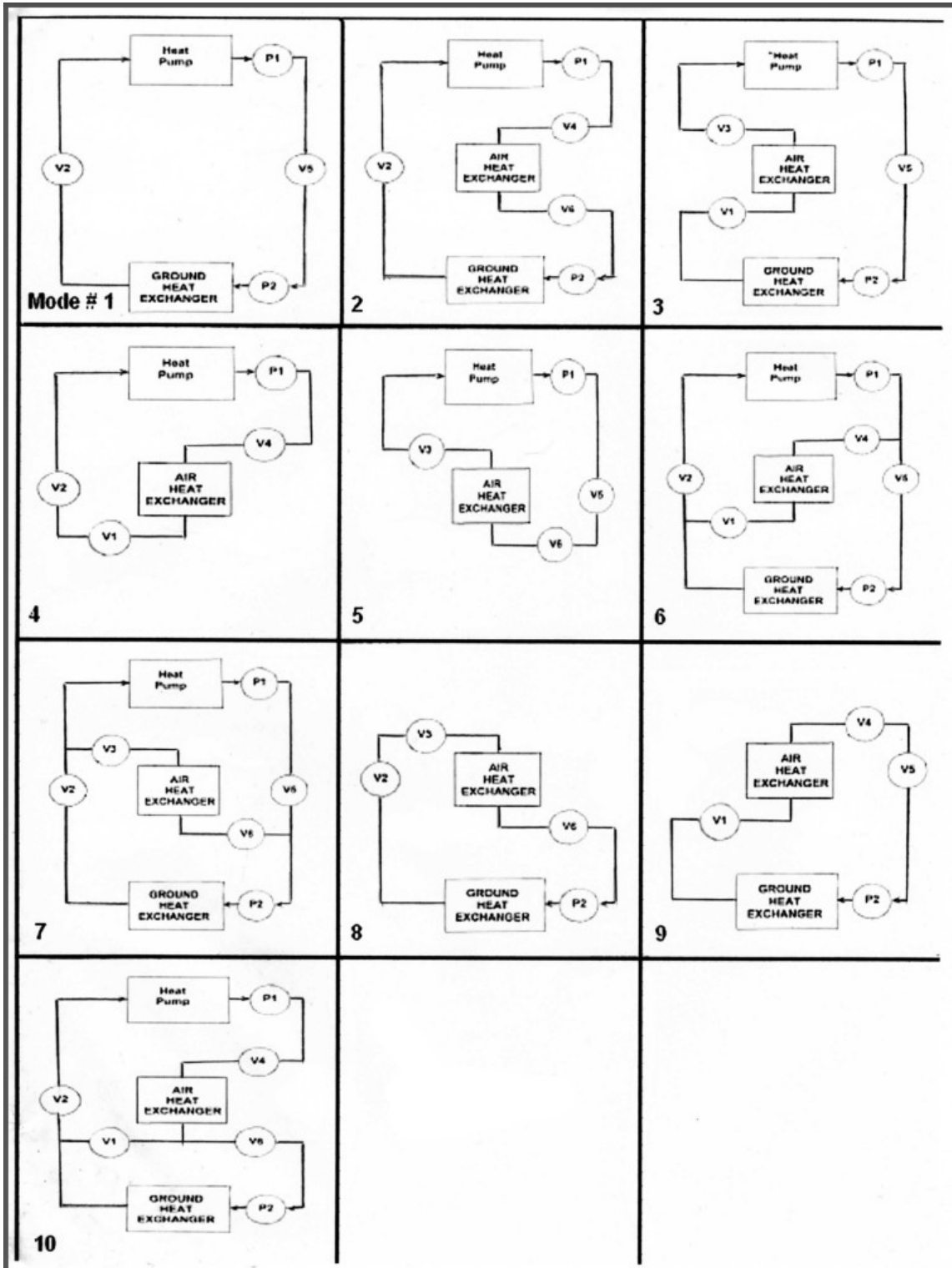
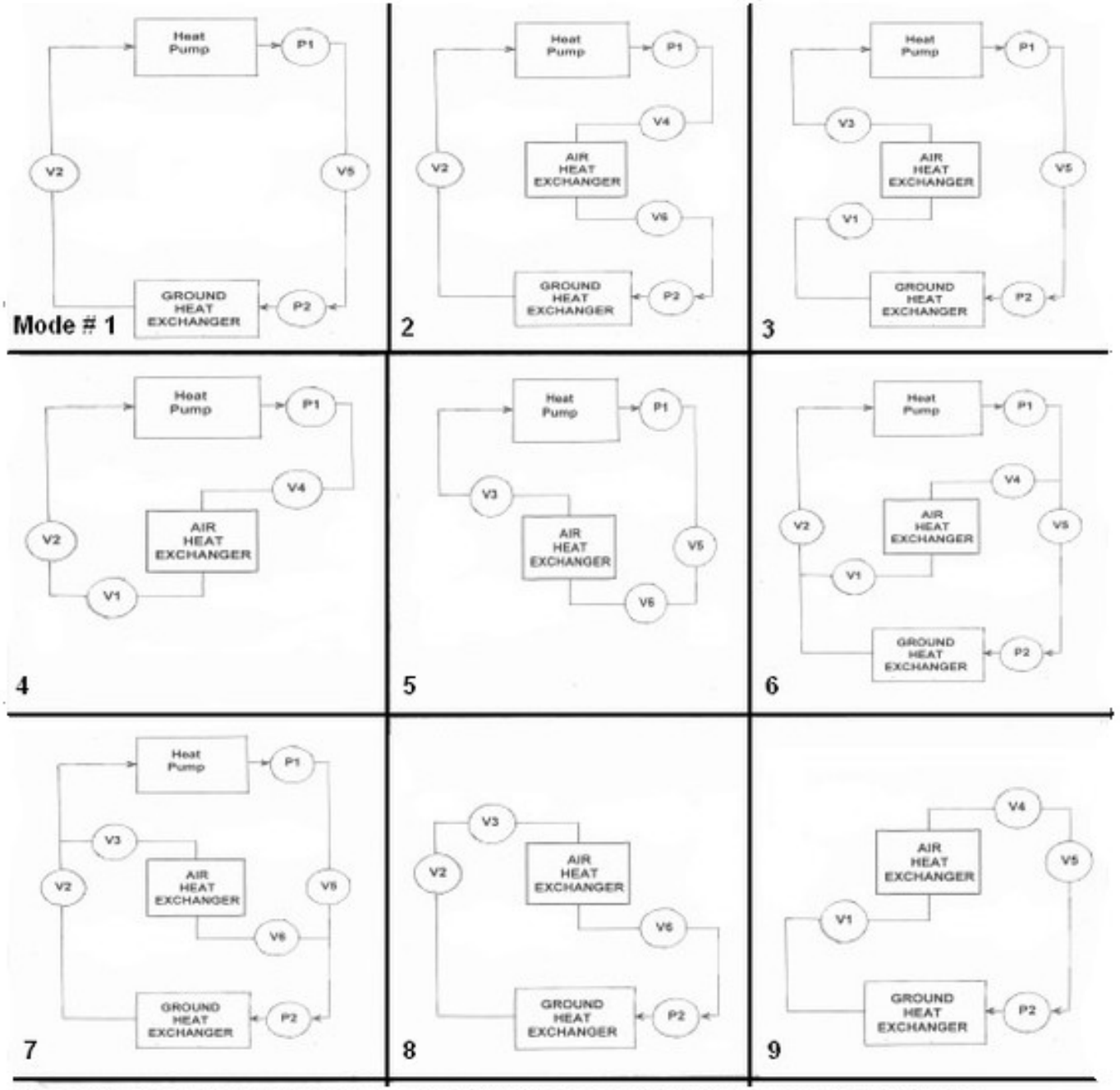


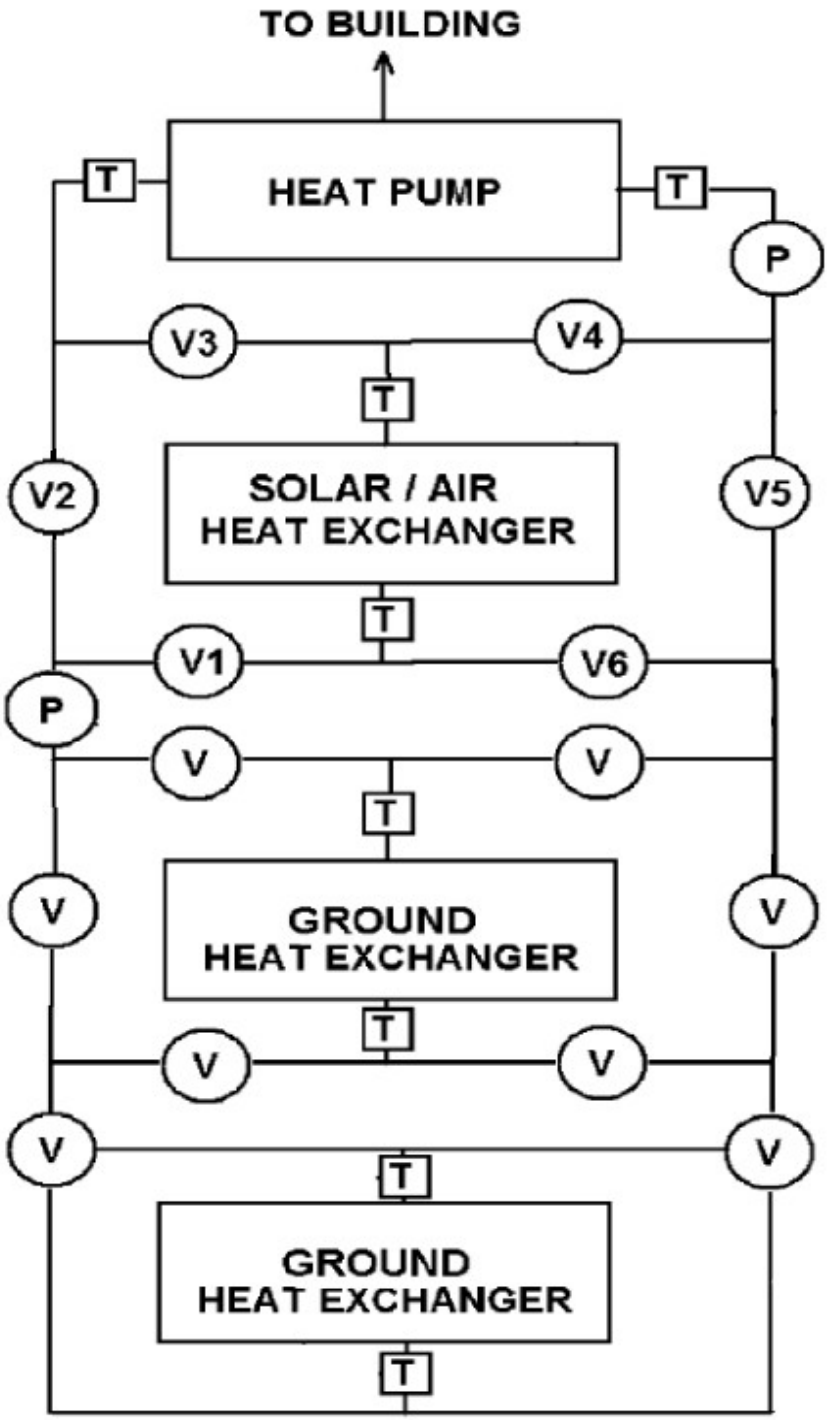
Diagram of a hybrid GHP system with supplemental solar thermal collector


TO BUILDING
HEAT PUMP
T
T
P
V3
V4
T
V2
SOLAR / AIR
HEAT EXCHANGER
V5
T
V1
V6
P
T
GROUND
HEAT EXCHANGER
T


Mode # 1
Heat Pump
P1
V2
V5
GROUND HEAT EXCHANGER
P2
2
V4
AIR HEAT EXCHANGER
V6
3
V3
V1
4
5
6
7
8
9
10



Note: The central module could be a solar thermal collector and the central and bottom modules could be interchanged


TO BUILDING
HEAT PUMP
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HEAT EXCHANGER
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GROUND
HEAT EXCHANGER
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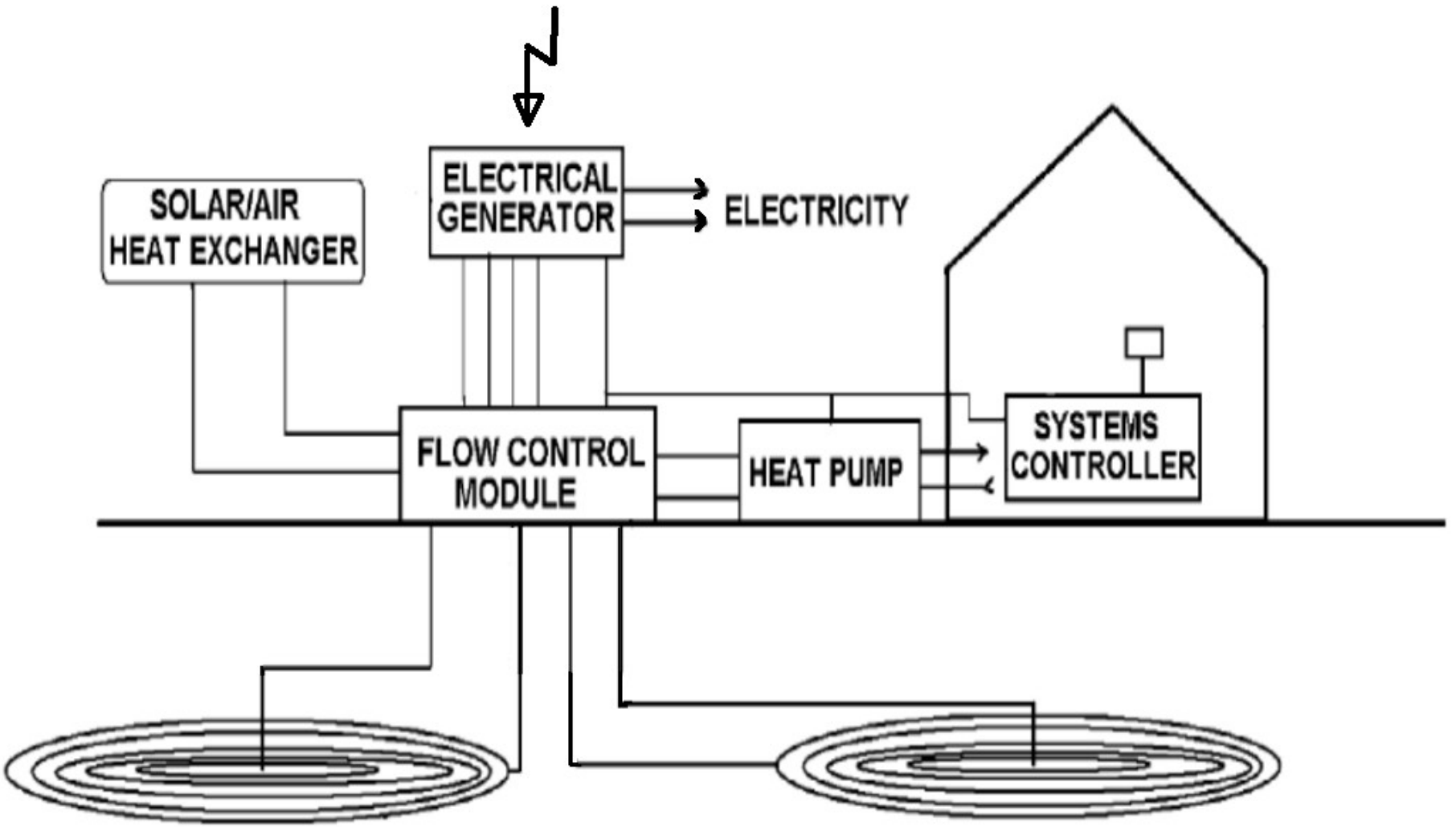
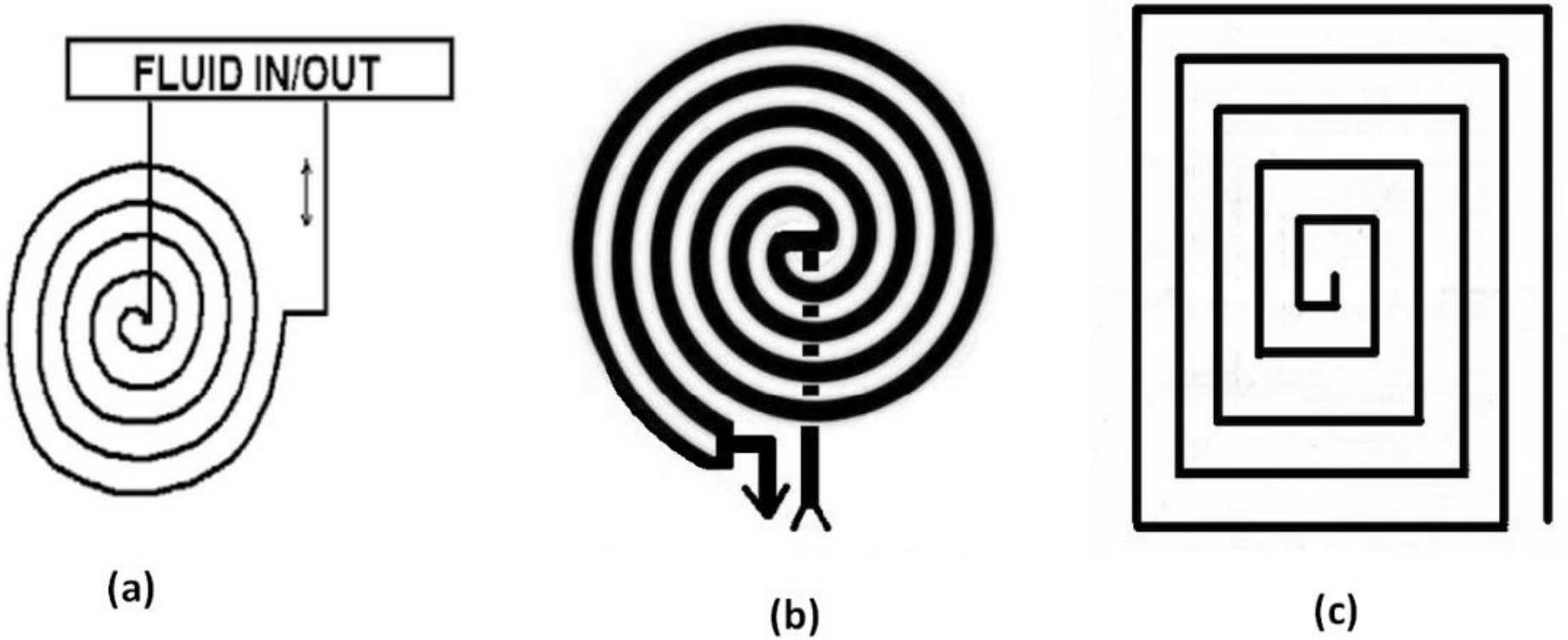
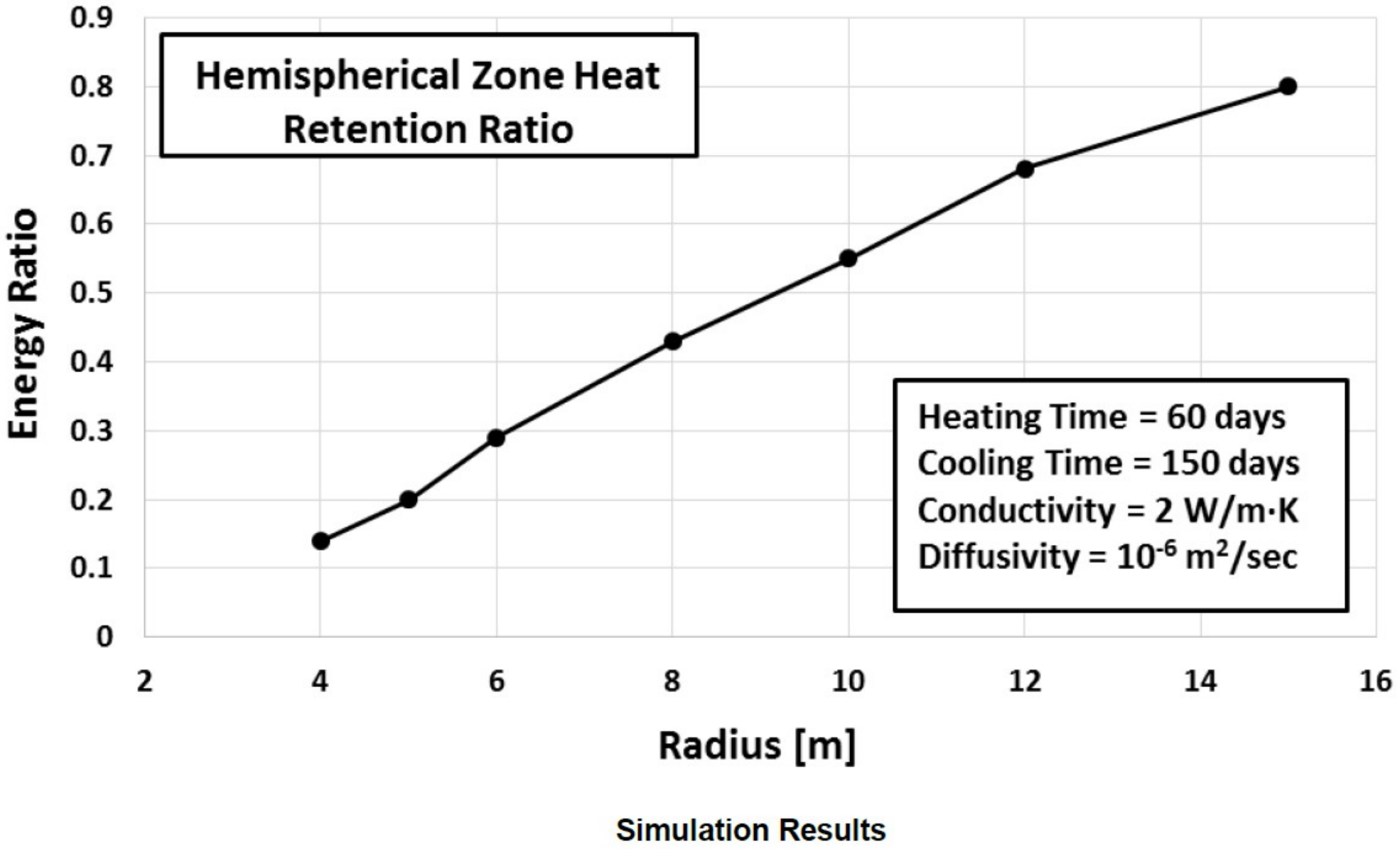
Organic Rankine Cycle (ORC) power system
as described here: http://www.kcorc.org/en/

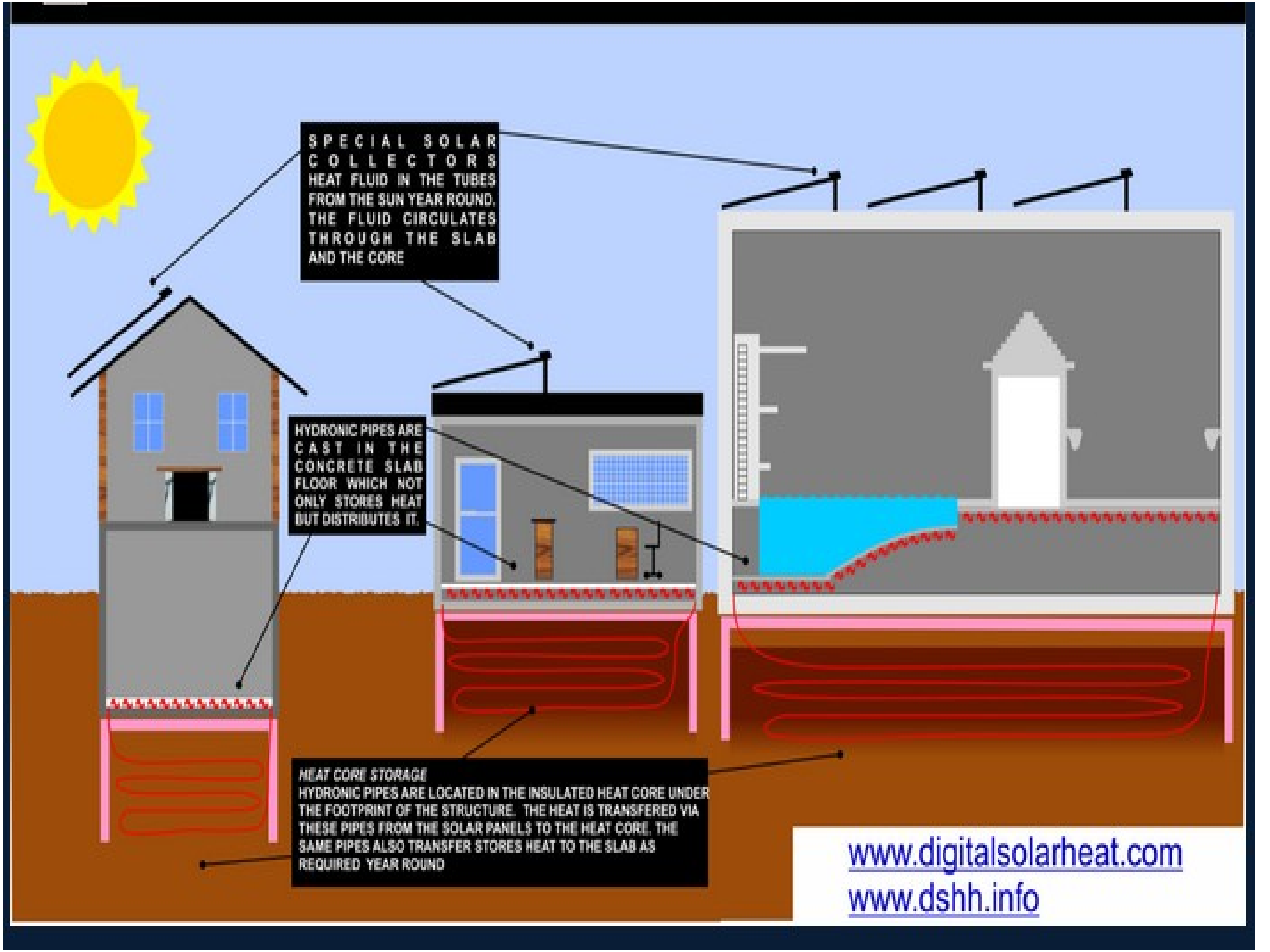




Horizontal Spiral Pipe Arrays



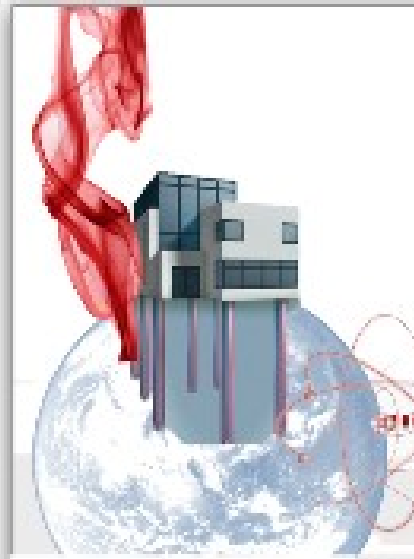
Simulation Results

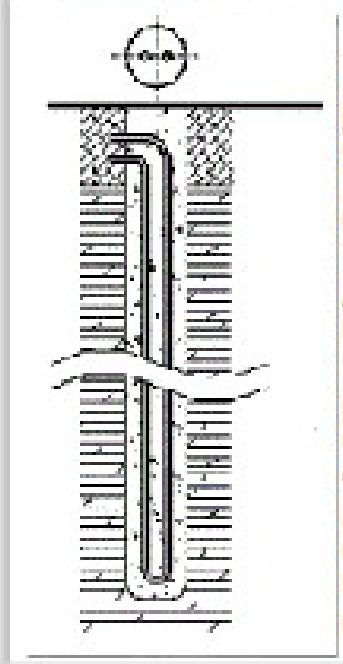

SPECIAL SOLAR COLLECTORS HEAT FLUID IN THE TUBES FROM THE SUN YEAR ROUND. THE FLUID CIRCULATES THROUGH THE SLAB AND THE CORE
HYDRONIC PIPES ARE CAST IN THE CONCRETE SLAB FLOOR WHICH NOT ONLY STORES HEAT BUT DISTRIBUTES IT.
HEAT CORE STORAGE
HYDRONIC PIPES ARE LOCATED IN THE INSULATED HEAT CORE UNDER THE FOOTPRINT OF THE STRUCTURE. THE HEAT IS TRANSFERED VIA THESE PIPES FROM THE SOLAR PANELS TO THE HEAT CORE. THE SAME PIPES ALSO TRANSFER STORES HEAT TO THE SLAB AS REQUIRED YEAR ROUND
www.digitalsolarheat.com
www.dshh.info

From: http://www.bts-hvac.com/residential/GEOEXCHANGE.html

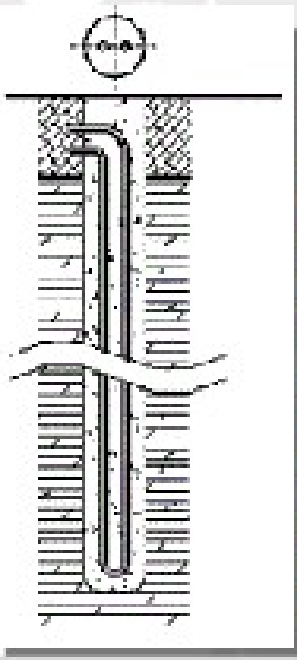
HDPE Vs. GEOPERFORM-X

54 Tons

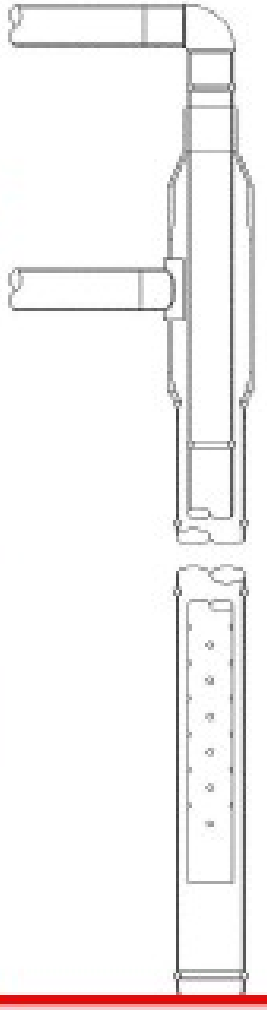




9,000' DRILLED LENGTH



7,500' DRILLED LENGTH



4,400' DRILLED LENGTH

HORIZONTAL GEOEXCHANGE BED

18
500' 1-1/4"Ø
HDPE U-TUBE
BOREHOLES

=

15
500' 1-1/4"Ø
GPX® U-TUBE
BOREHOLES

=

4
1,100' 4"Ø
CONCENTRIC
GEOPERFORMX

=

1 bed
300' x 115'
46,000 LF
GEOPERFORMX
TUBE

Graphic Courtesy of Jeffrey. J. Harrison, PE. The Blake Group

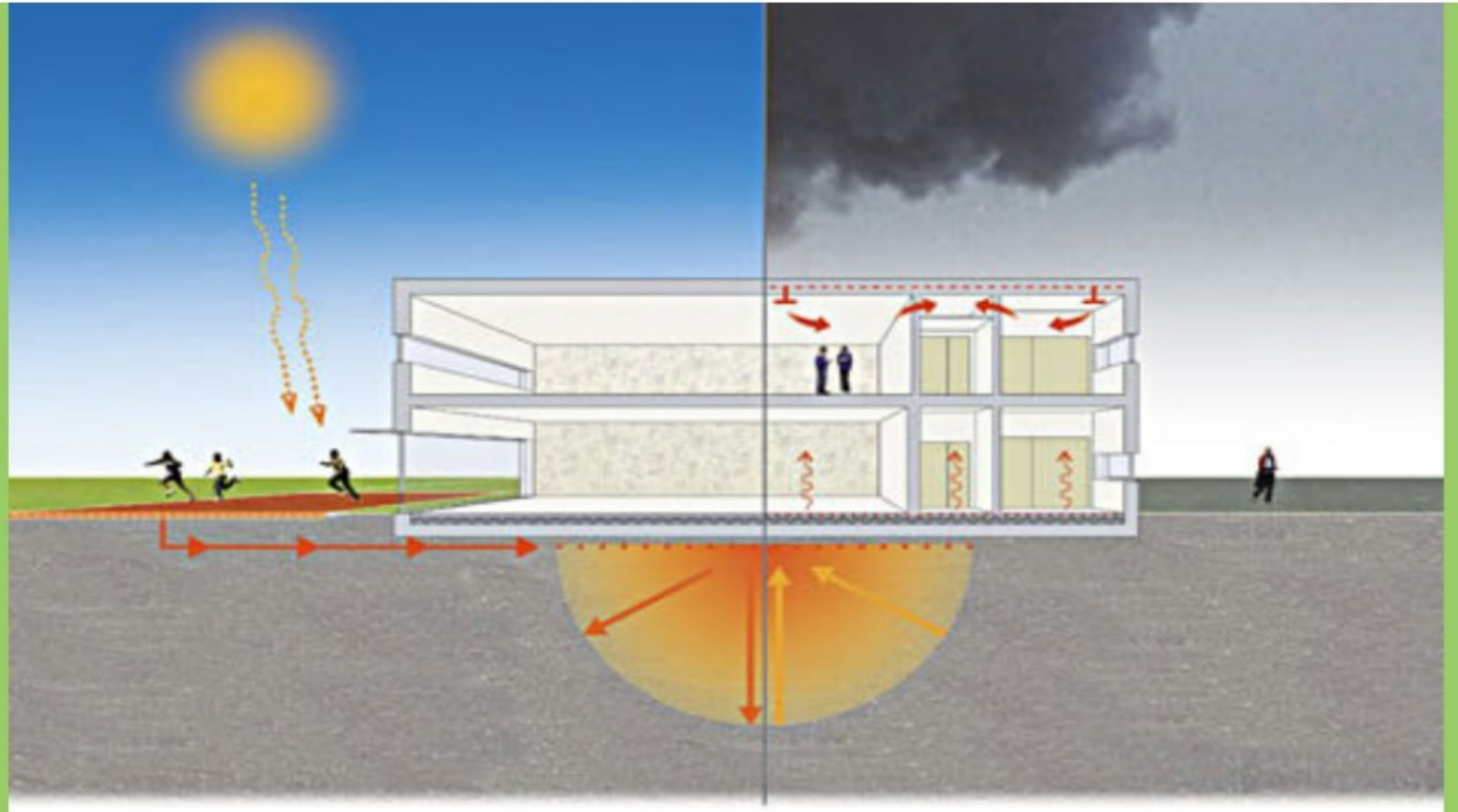
http://www.bts-hvac.com/residential/GEOEXCHANGE.html

Geo-Exchange Configuration Economics

	FT/Ton	Cost / Ton
U-Bend 500 FT	175	3,400
GeoperformX U-Bend 500 FT	150	3,100
Twister four ¾" U's -440 FT	125	2,800
Concentric 4" GeoperformX - 1100 FT	110	2,900
Horizontal grid/header Bed Under slab	640	1,100
Horizontal grid/header Bed exposed	900	1,600

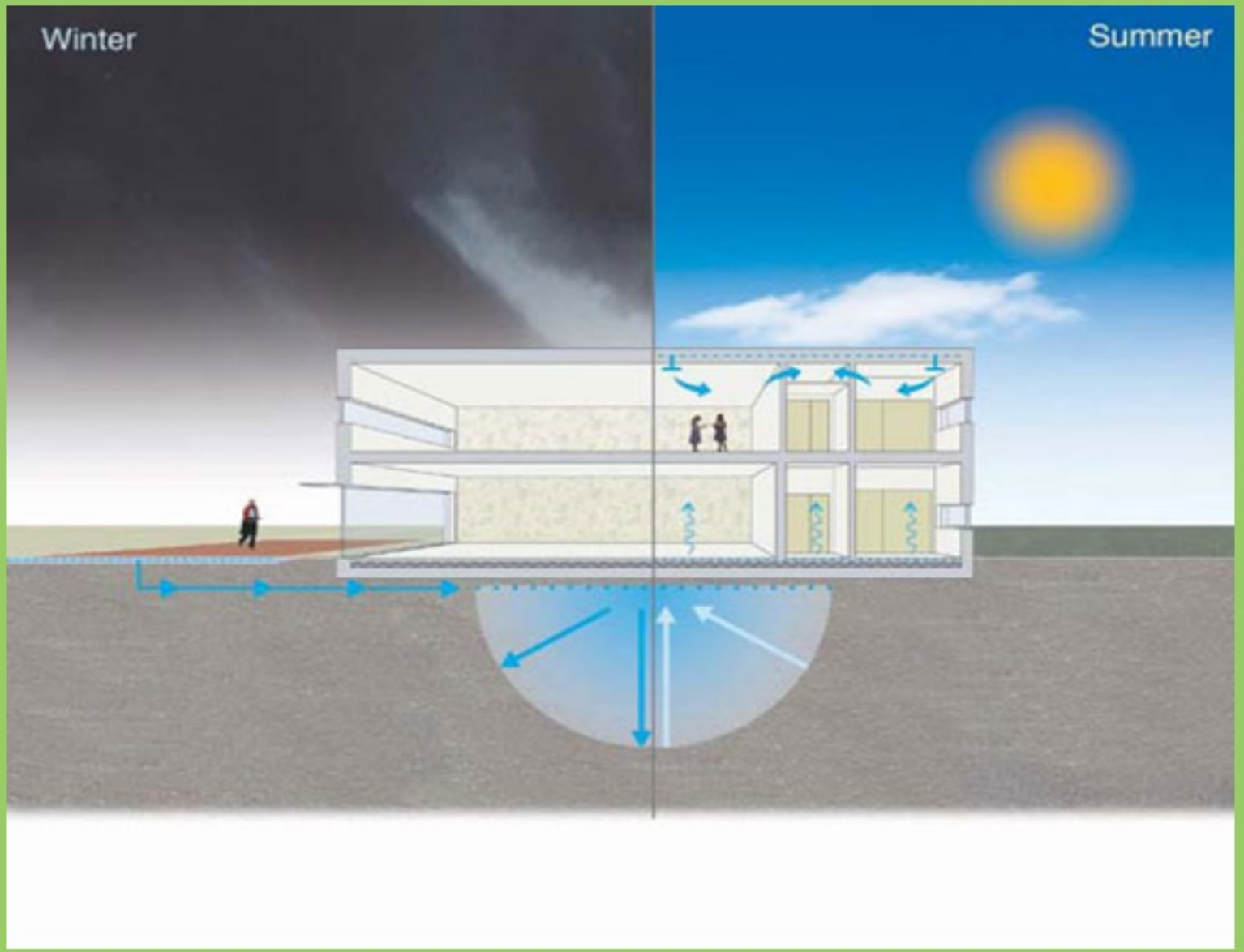
In addition to lower cost per ton of deep bores, lower costs for horizontal run-outs can make an even larger cost impact on the project as well as reducing the need to use a vault.

Graphic Courtesy of Jeffrey. J. Harrison, PE. The Blake Group



from: www.icax.co.uk

Interseasonal Heat Transfer (IHT) recycles heat from an Asphalt Solar Collector down to a ThermalBank in summer.
IHT uses a heat pump to recycle heating in winter without burning fossil fuels.
IHT doubles the Coefficient of Performance of the heat pump by starting from a warm ThermalBank.



IHT allows the playground collector to reject heat from a ThermalBank in winter.
IHT allows the building to reject heat to a cold ThermalBank in summer.
IHT provides "critical period cooling" by allowing Natural Cooling to take place.

More importantly, IHT allows you to keep your cool from the previous winter and recycle it in summer.

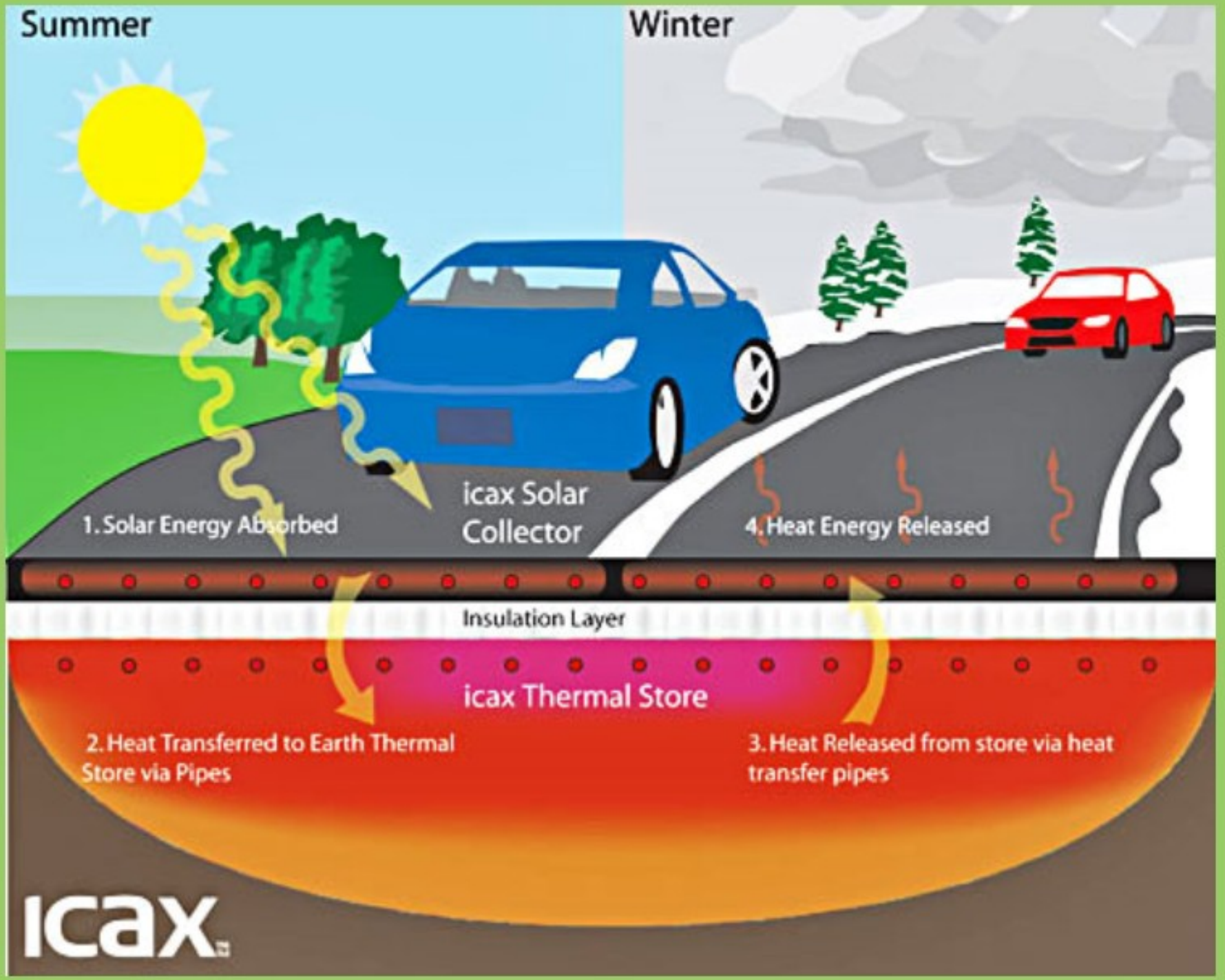
From: www.icax.co.uk

Laying down a ThermalBank at Howe Dell School before the insulated foundations of the building are installed.

The ThermalBank stores Renewable Heat directly in the ground – this is retrieved in winter for heating.

ICAX doubles the performance of the heat pump by starting with a warm ThermalBank instead of cold ground.

From: www.icax.co.uk



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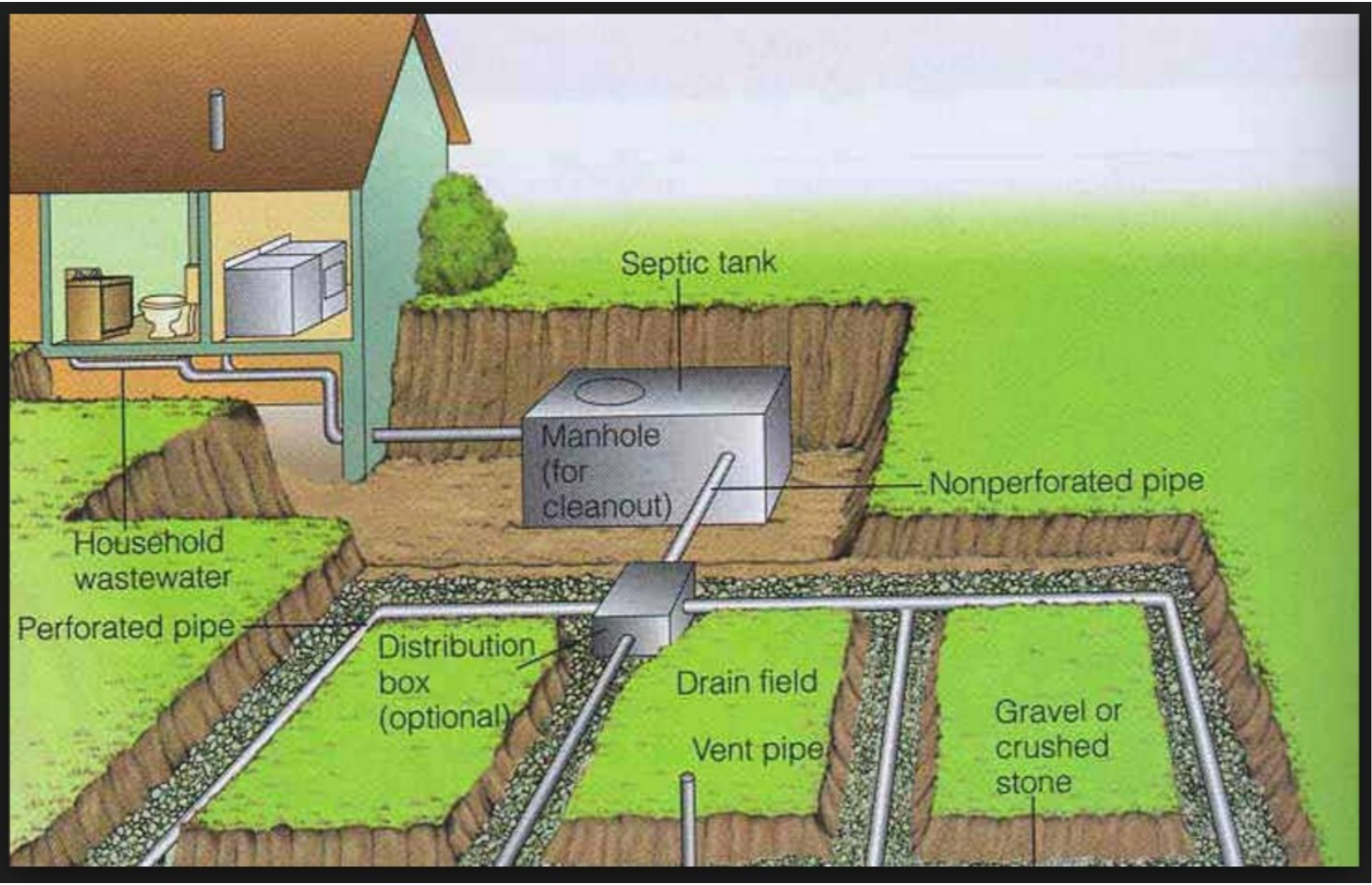

From: http://www.buttsconcrete.com/excavating.html





MODEL **FWAS24WH**

Flo-Well Kit

NDS Flo-Well® is a manufactured dry well that is an easy to install and sustainable solution for storm water runoff. Flo-Well® units collect, retain, and discharge storm water on-site, offering a gravel-free alternative to a traditional dry well. Includes 3 side panels and 1 lid. 24 x 28.75

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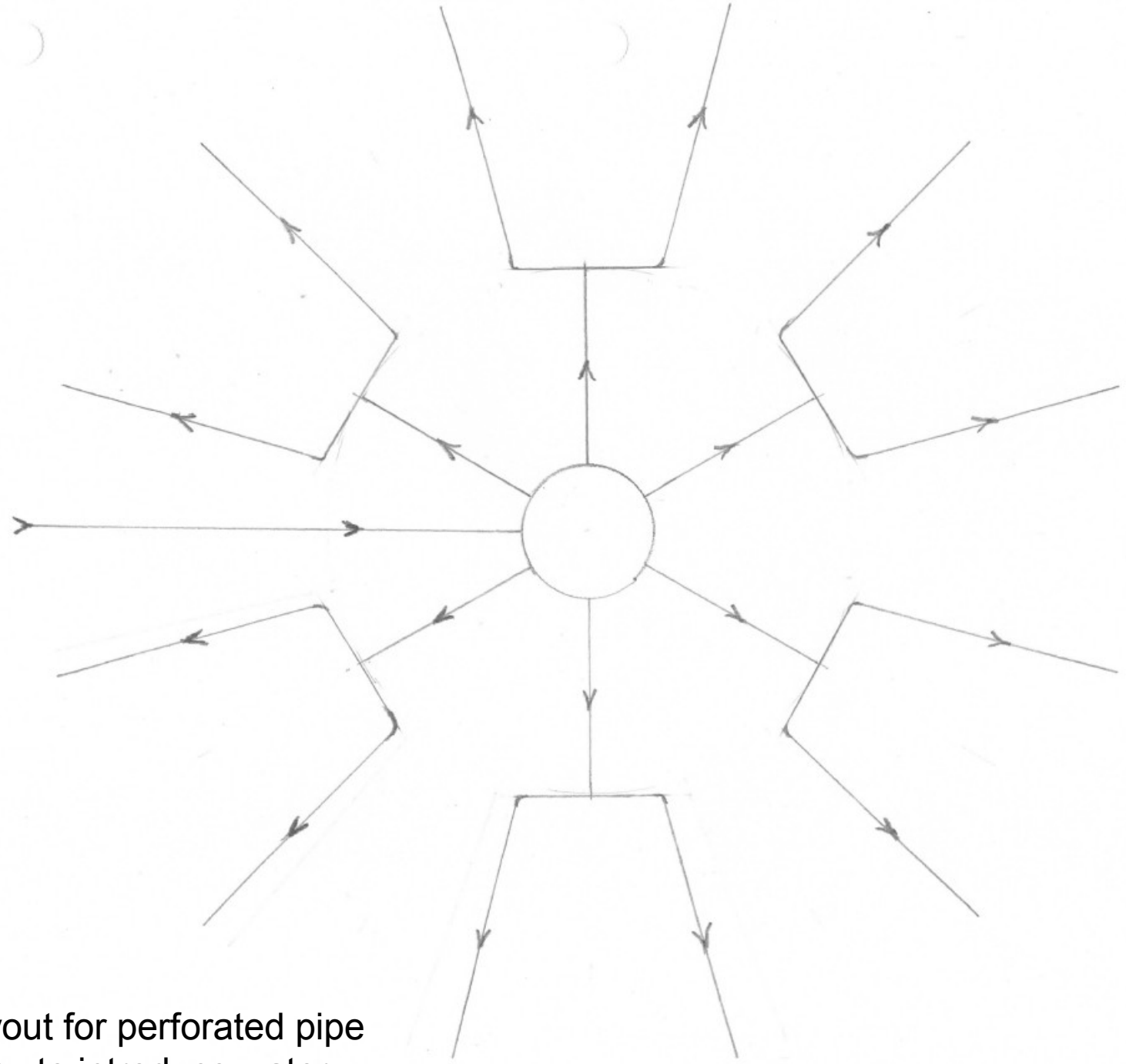
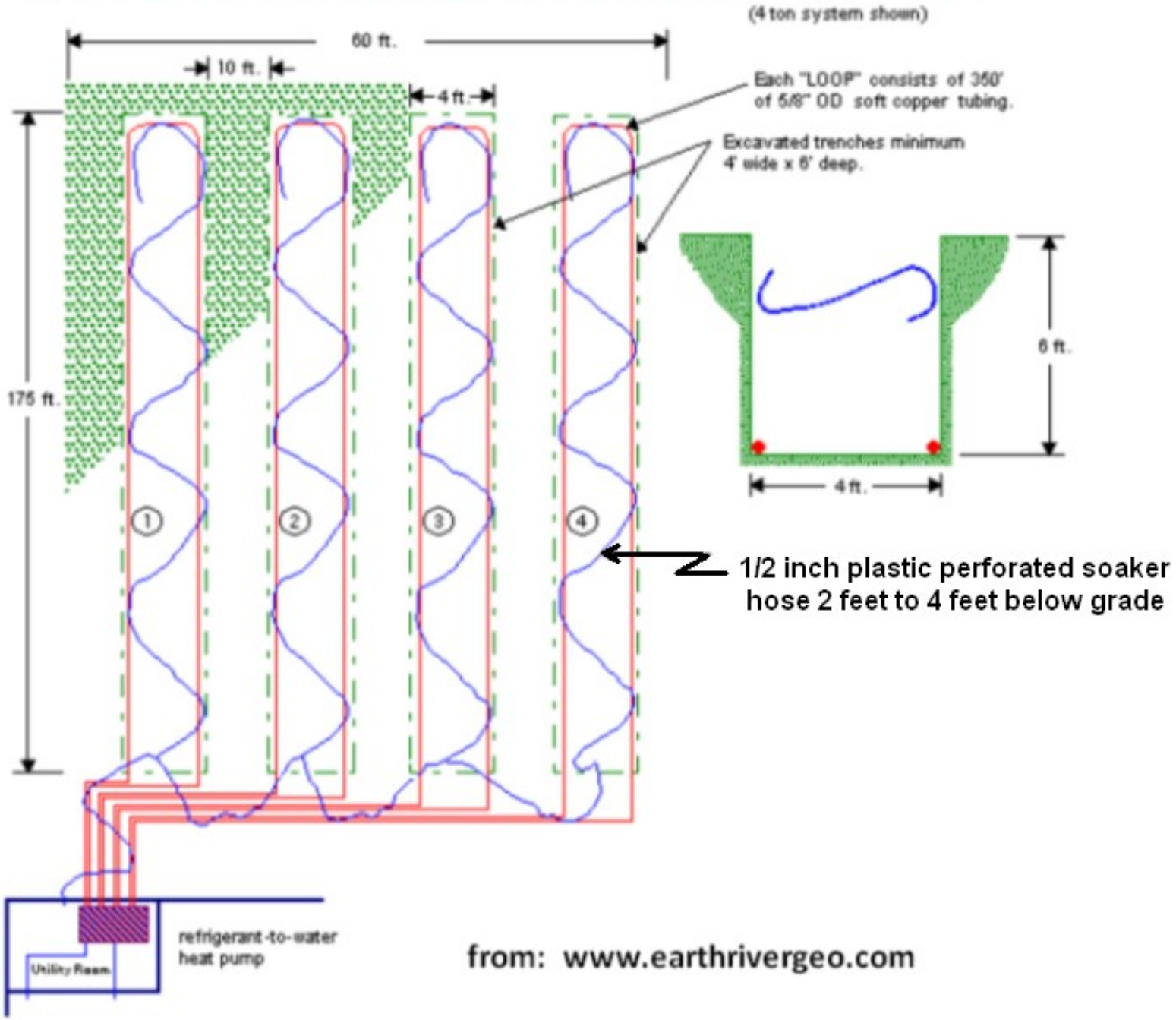
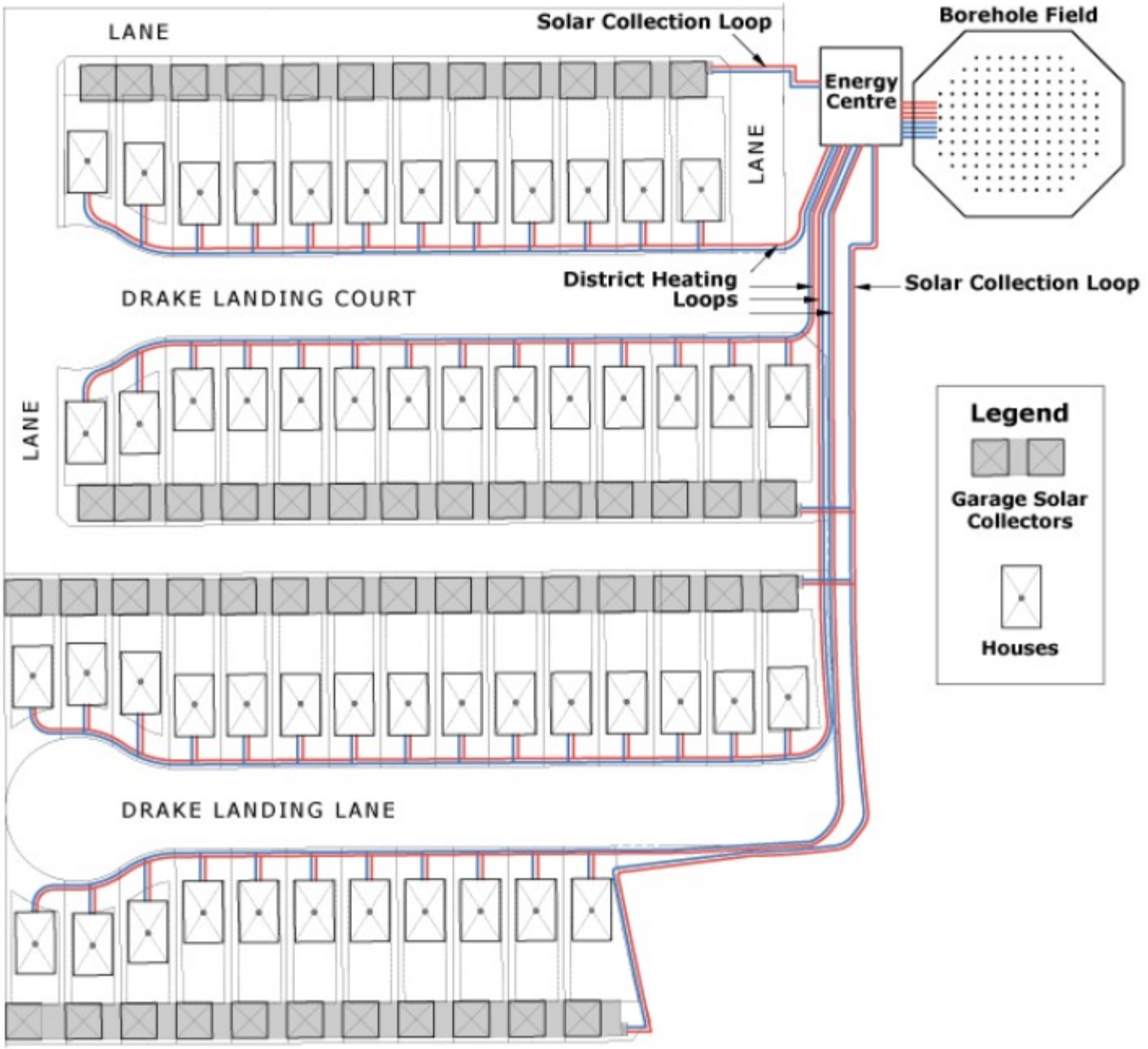


Layout for perforated pipe array to introduce water below the spiral heat exchange array

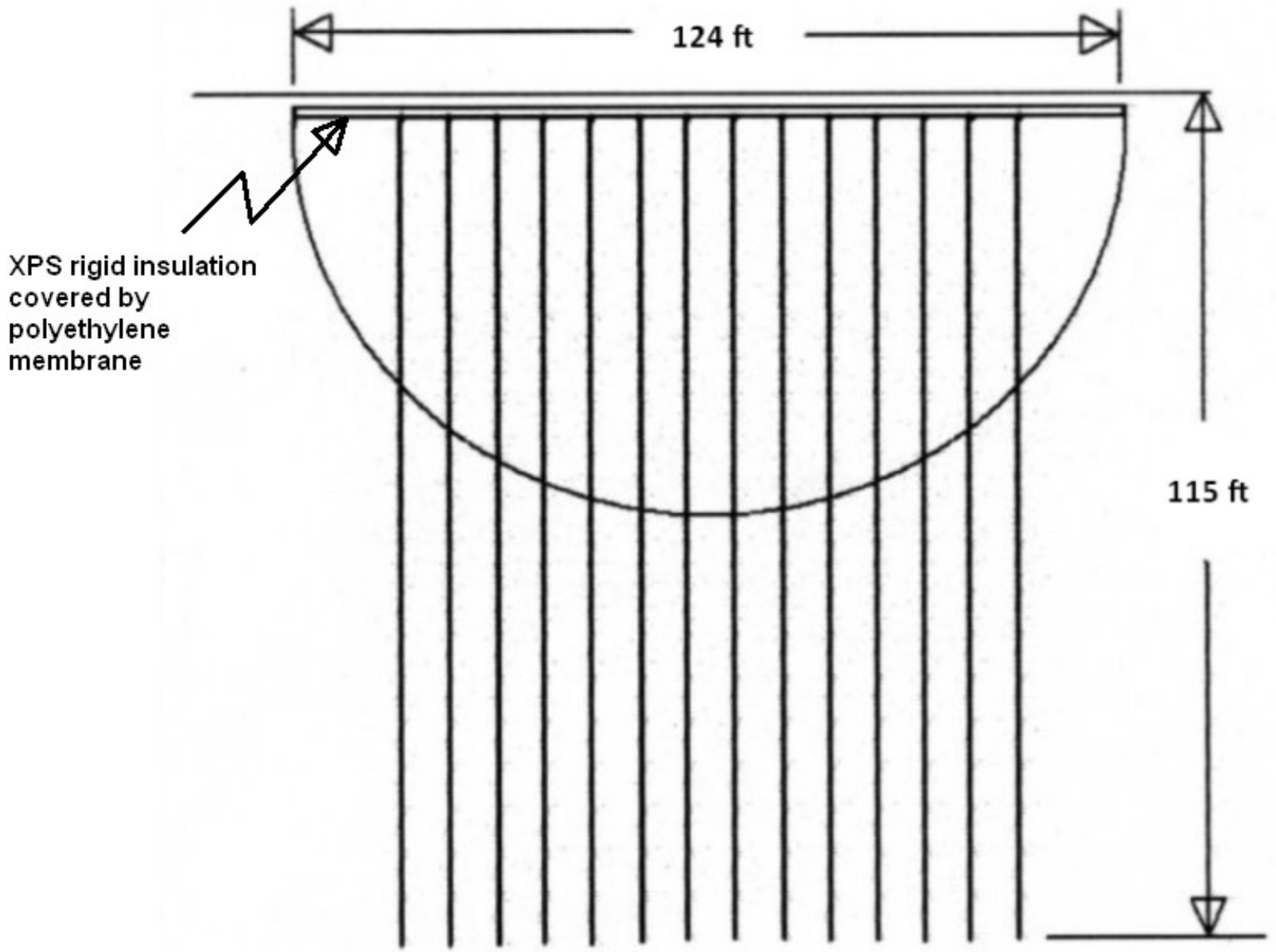
Layout of Horizontal Direct Expansion Heat Pump System



Drake Landing Solar Community Site Plan



From: http://www.dlsc.ca/



Drake Landing Borehole Array Side View

Drake Landing Solar Community

System Cost Summary

Item	Cost (CAD$ 2005-07)
Solar Collectors	710,000
Installation of Solar Collectors	430,000
Seasonal Storage Borehole Field	620,000
District Heating & Solar Collection Loops	1,025,000
Energy Centre including STTS Tanks	600,000
Total	3,385,000

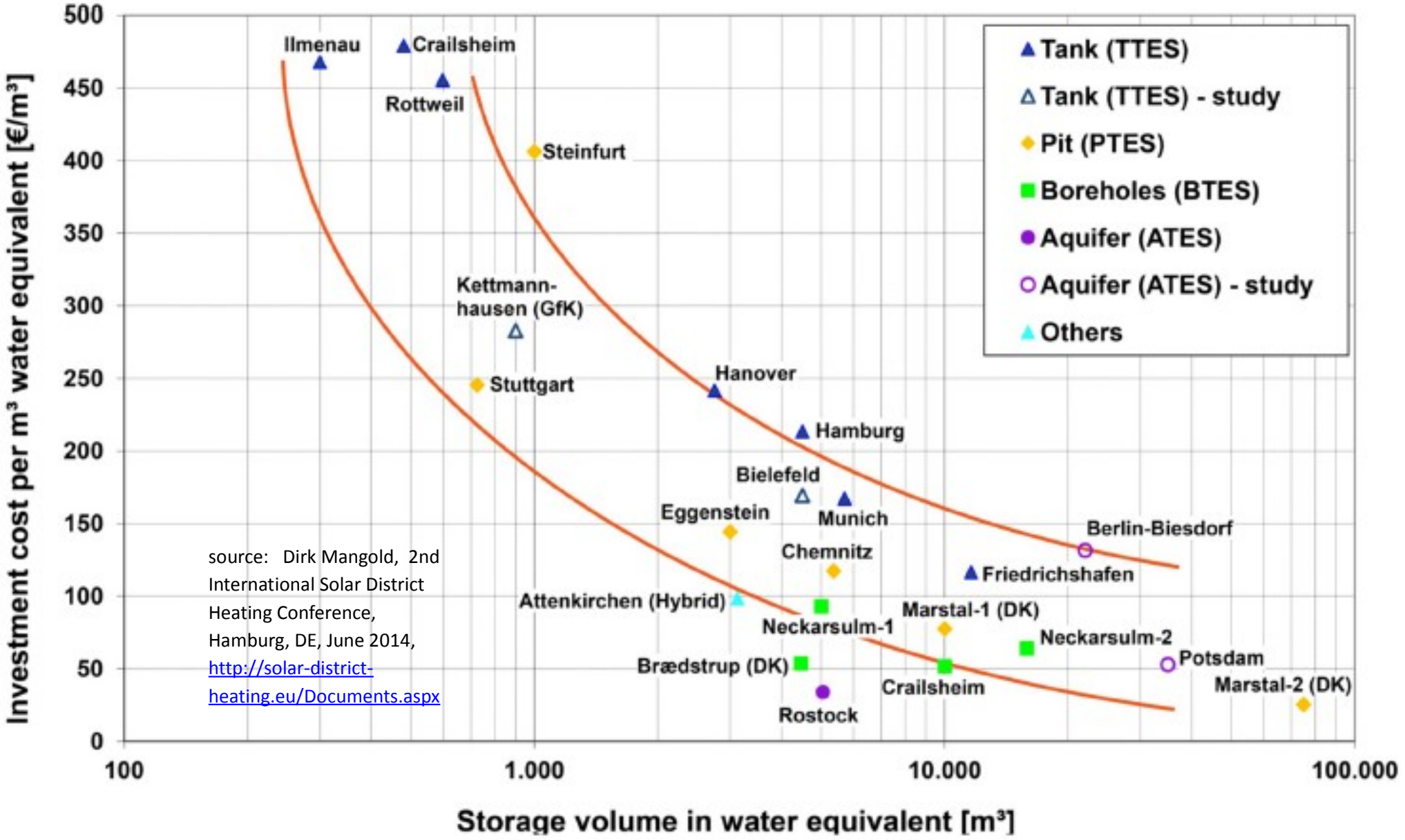
Borehole cost is $37 per foot

With 10,000 square feet of surface area, the

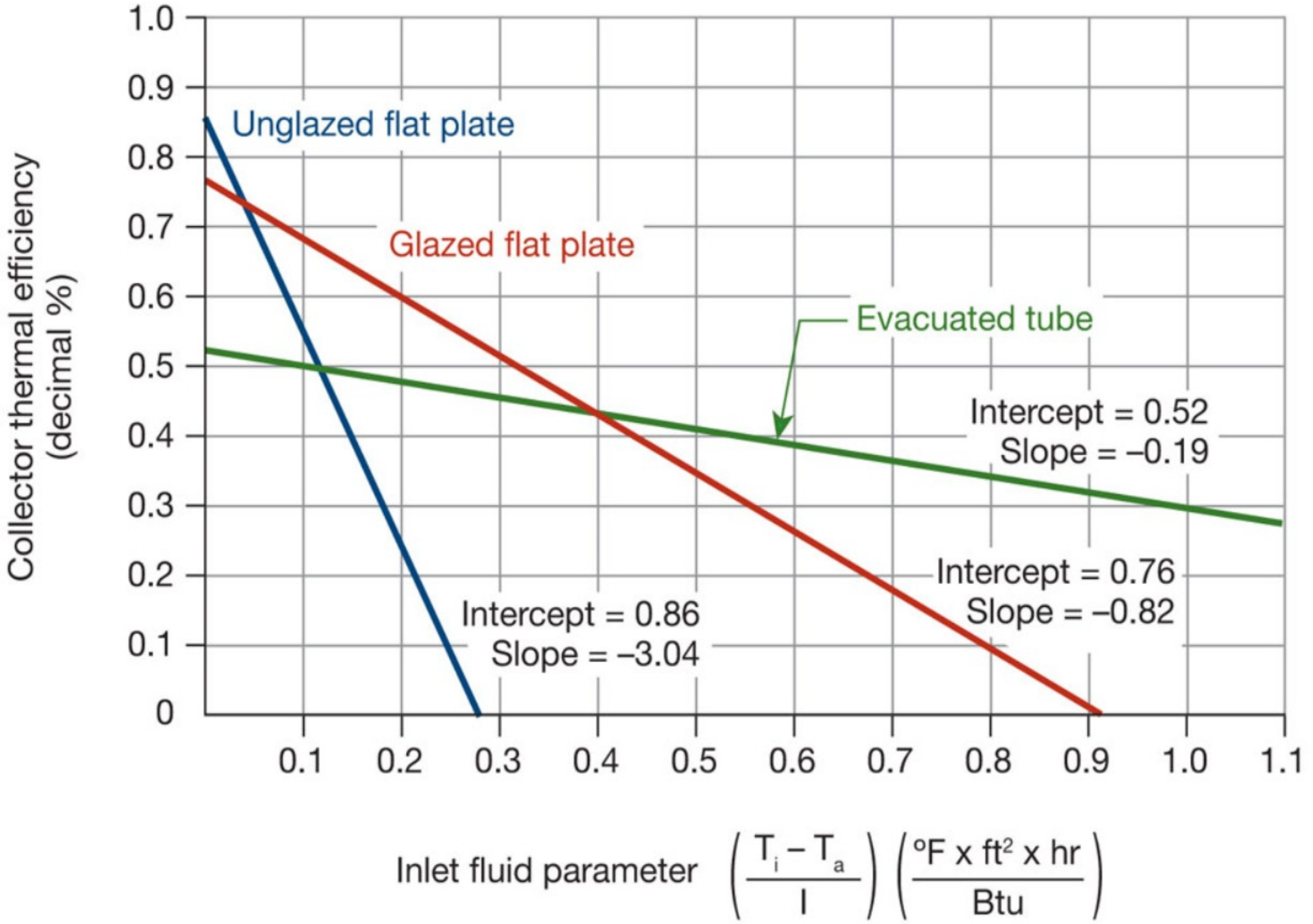
borehole array cost is $62 per square foot

Source: Bruce Sibbitt, Doug McClenahan, Reda Djebbar, Jeff Thornton, Bill Wong, Jarrett Carriere, and John Kokko. 2011. Measured and simulated performance of a high solar fraction district heating system with seasonal storage. Proceedings of the ISES Solar World Congress, Kassel, 2011.

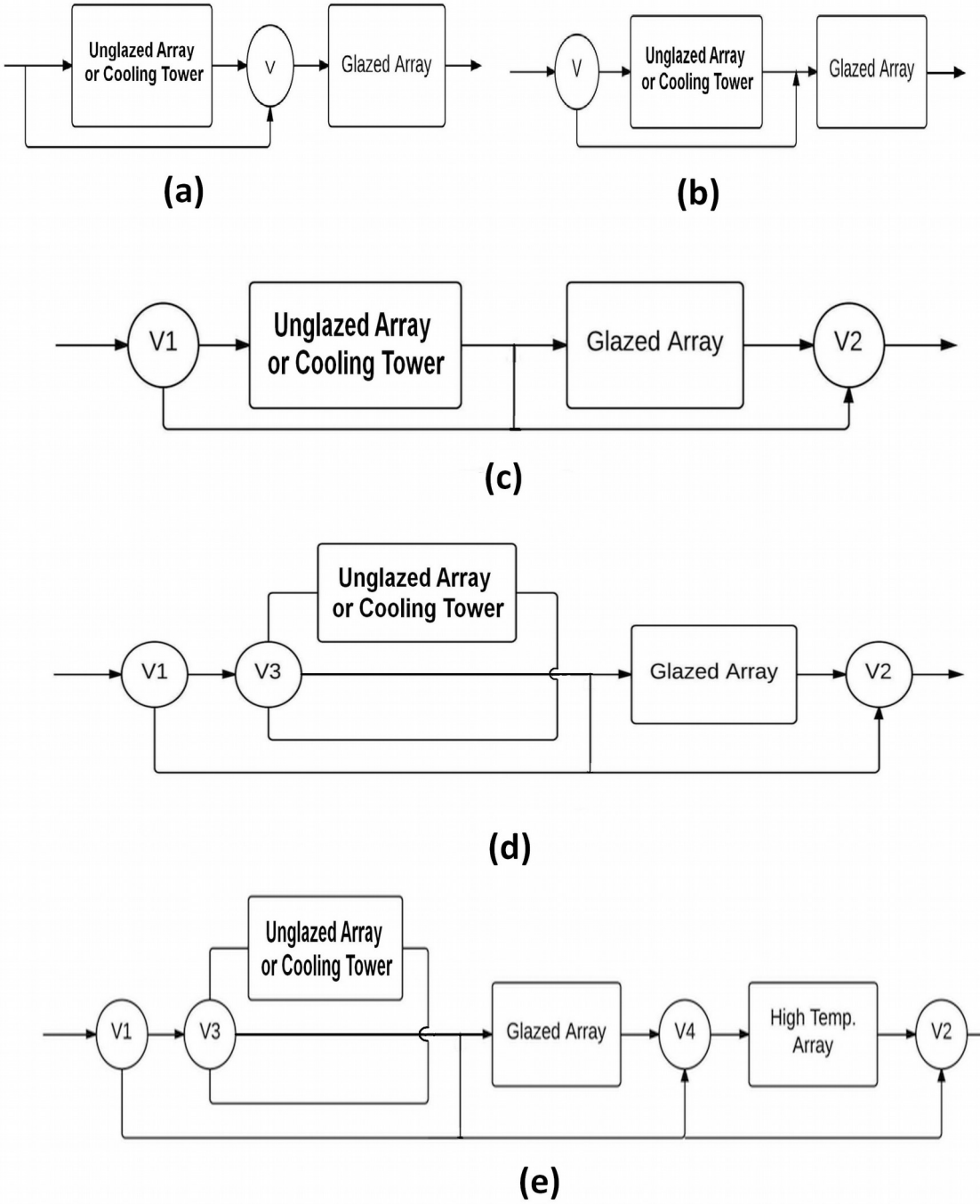
Investment cost of seasonal thermal energy storages



source: Dirk Mangold, 2nd International Solar District Heating Conference, Hamburg, DE, June 2014, http://solar-district-heating.eu/Documents.aspx

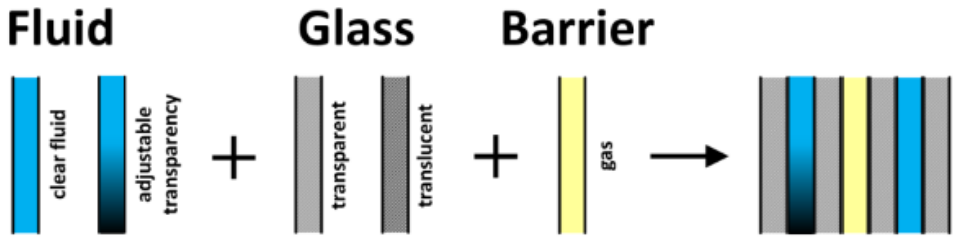


From: solarprofessional.com



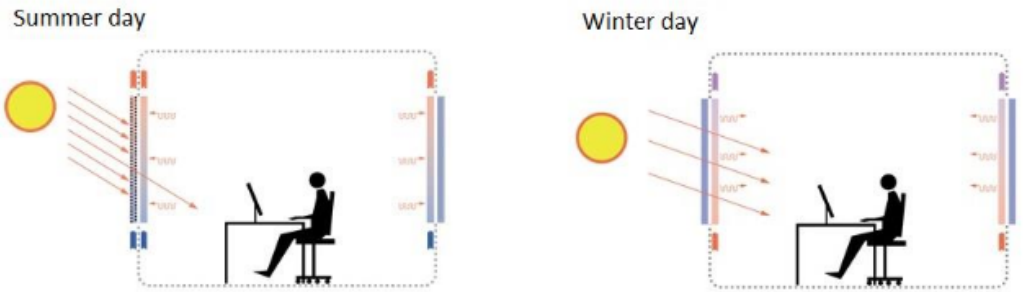
Multiple Collector Types for either Heat or Cold

The collector panel is a combination of fluid and glass layers and a thermal barrier. In this way an optimized configuration of the layers can be assembled for different applications and different sections of the building envelope. The basic element of FLUIDGLASS remains the same, but the combination of the different layers allows wide applicability and simple production process. For example: Shading can be provided by tinted glass or fluid (fixed or adjustable). This modular approach has the advantage to offer customized panels depending on the user's need.



Modular layer approach

In the most advanced approach, two fluid filled layers are implemented in the glass façade. These two layers regulating all energy flow within the façade. The fluid layer to the interior space keeps the inside surface temperature just below or above room temperature for heating and cooling, while the liquid layer to the exterior controls the energy transmission by absorption of the solar irradiation.



Basic operating modes of advanced approach with two fluid layers

Consortium:

Universität Liechtenstein	LI
Mayer Glastechnik GmbH	AT
NTB Buchs	CH
Tech. Univ. München	DE
GlassX AG	CH
Hoval AG	LI
CEA-INES	FR
Universität Stuttgart	DE
Cyprus R&I Center	CY
ALCOA Europe Commercial	FR
AMIRES s.r.o.	CZ

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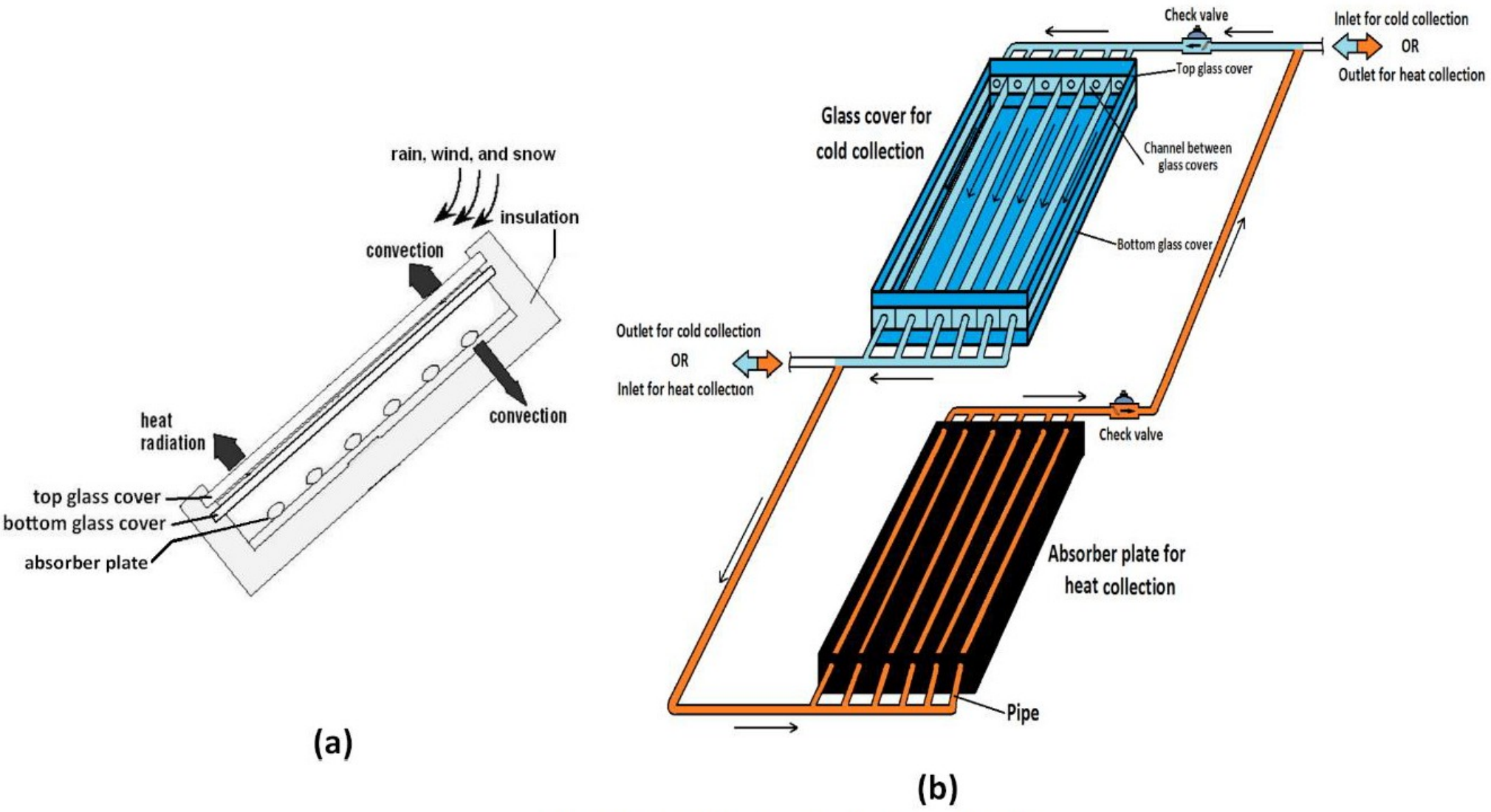
www.fluidglass.eu



Flat Plate Collector for Heat and Cold