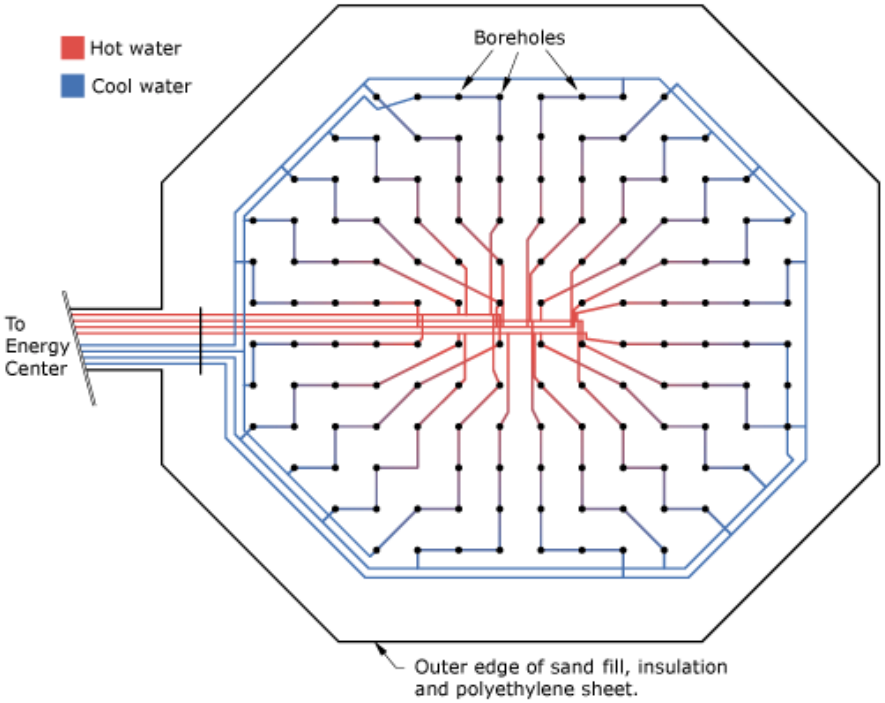
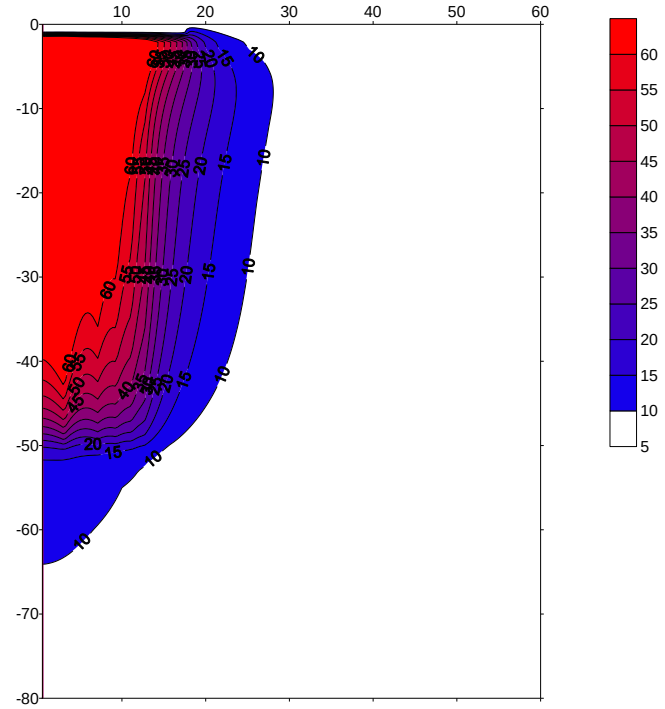
Working Towards 100% Solar Heated Communities

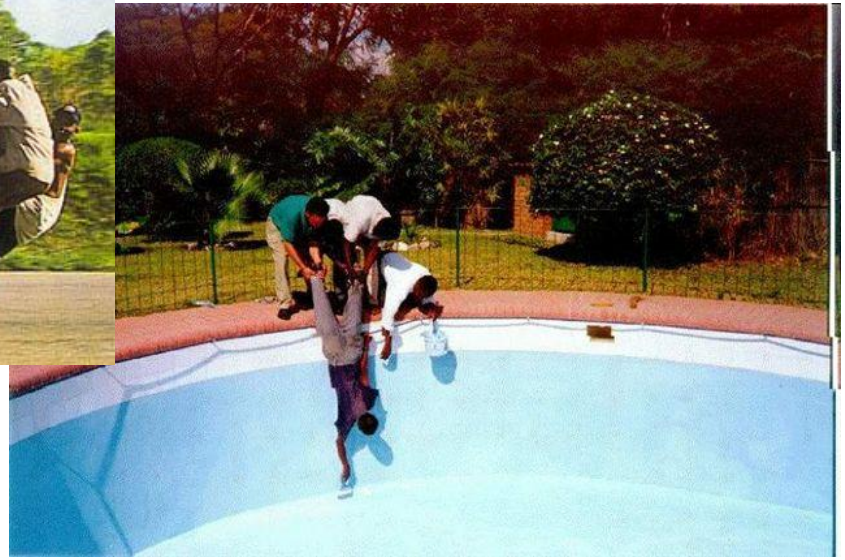




Drake Landing Solar Community

Good Planning & Design before you Build

Use of Appropriate Technology and Installation Techniques



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Effective Communication

Why High Solar Fraction
Solar Heating Cost vs Solar Fraction

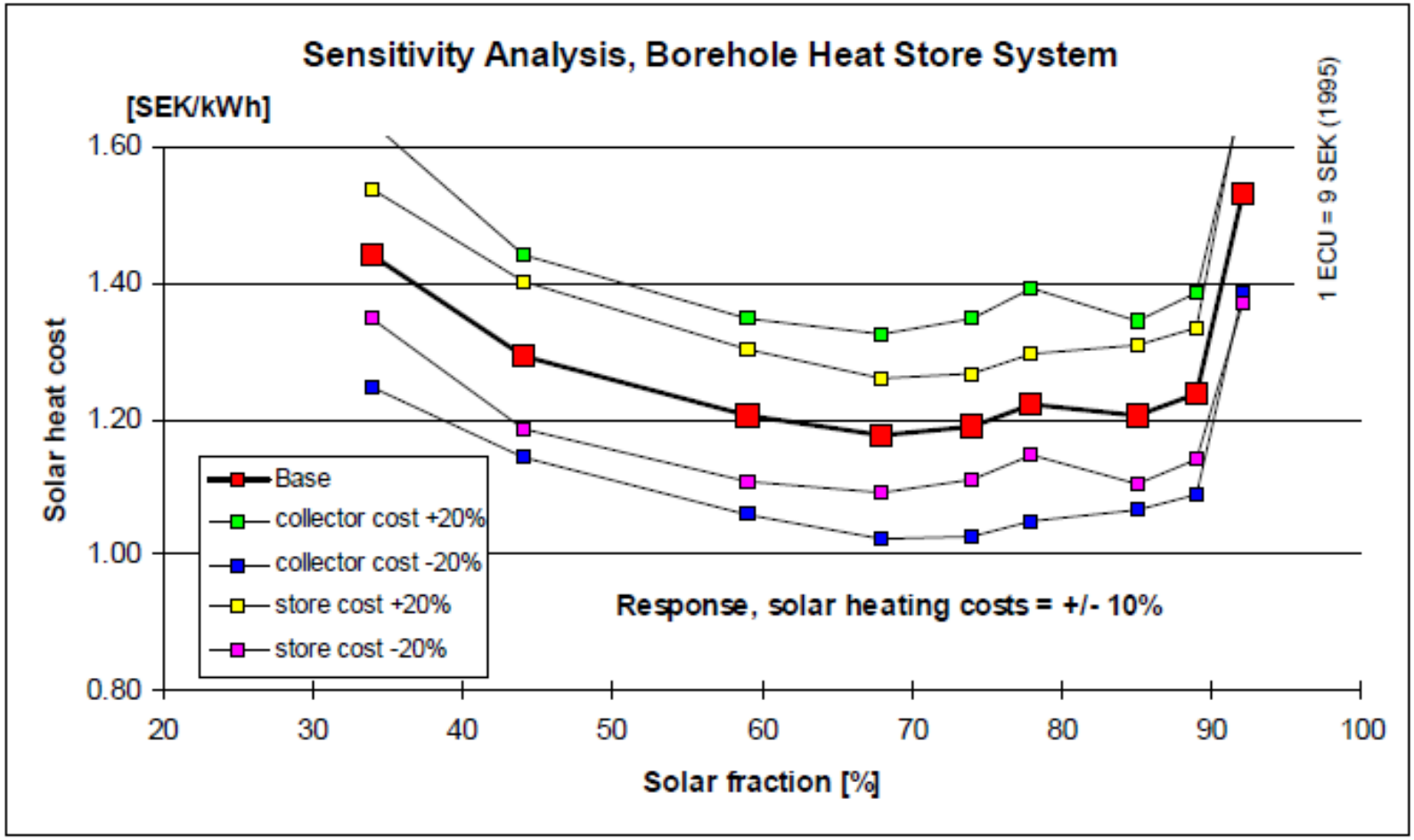

Figure 7.7 Sensitivity analysis of a borehole heat store system. Response of the solar heat cost to a ± 20 % variation in investment costs.

Drake Landing Solar Community

- First solar seasonal storage community in North America
- First in world >90% solar fraction
- Reduction of 5 tonnes GHG per home per year
- Largest subdivision of R-2000 single family homes in Canada (52 homes)

Major Objectives

- Demonstrate the technical feasibility of achieving substantial fuel energy savings using seasonal storage of solar energy for residential space heating
- Use the measured performance to calibrate computer models for use in a detailed assessment of the potential for solar seasonal storage in Canada.

Weather Data Comparison

	Heating Degree Days					
	Calgary	Amsterdam	Copenhagen	Munich	Stockholm	Vienna
Annual	5199	3010	3611	3733	4291	3167
Rank (1=coldest)	1	6	4	3	2	5

	Incident Solar Radiation (MJ/m^2)*					
	Calgary	Amsterdam	Copenhagen	Munich	Stockholm	Vienna
Latitude (N)	51.12	52.28	55.62	48.12	59.56	48.12
Annual	6426	3937	4289	4750	4280	4731
Rank (1=sunniest)	1	6	4	2	5	3

* *Incident solar irradiation is calculated from horizontal data using the Reindl model. The surface tilt angle is equal to the Latitude.*

Data Source: http://apps1.eere.energy.gov/buildings/energyplus/weatherdata_about.cfm
Calgary weather data: CWEC
European weather data: IWEC

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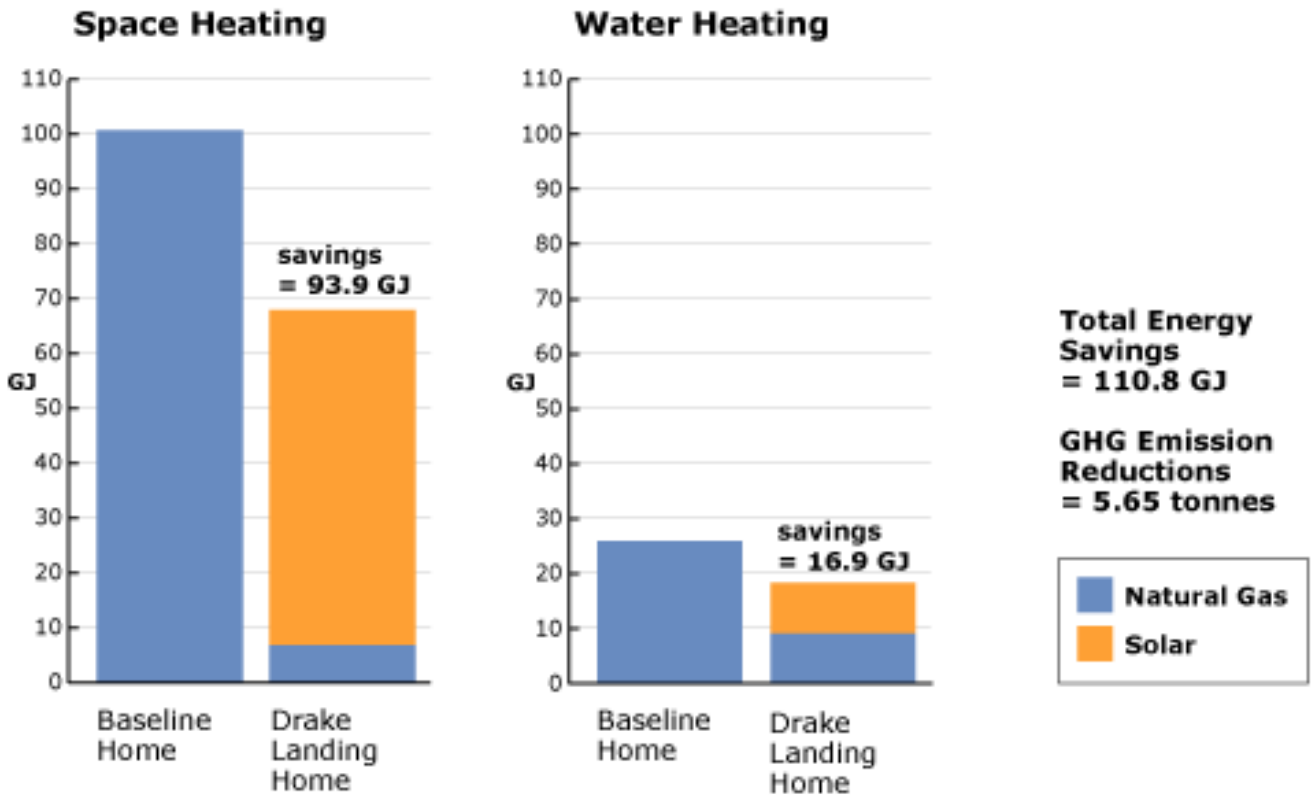
Drake Landing Solar Community



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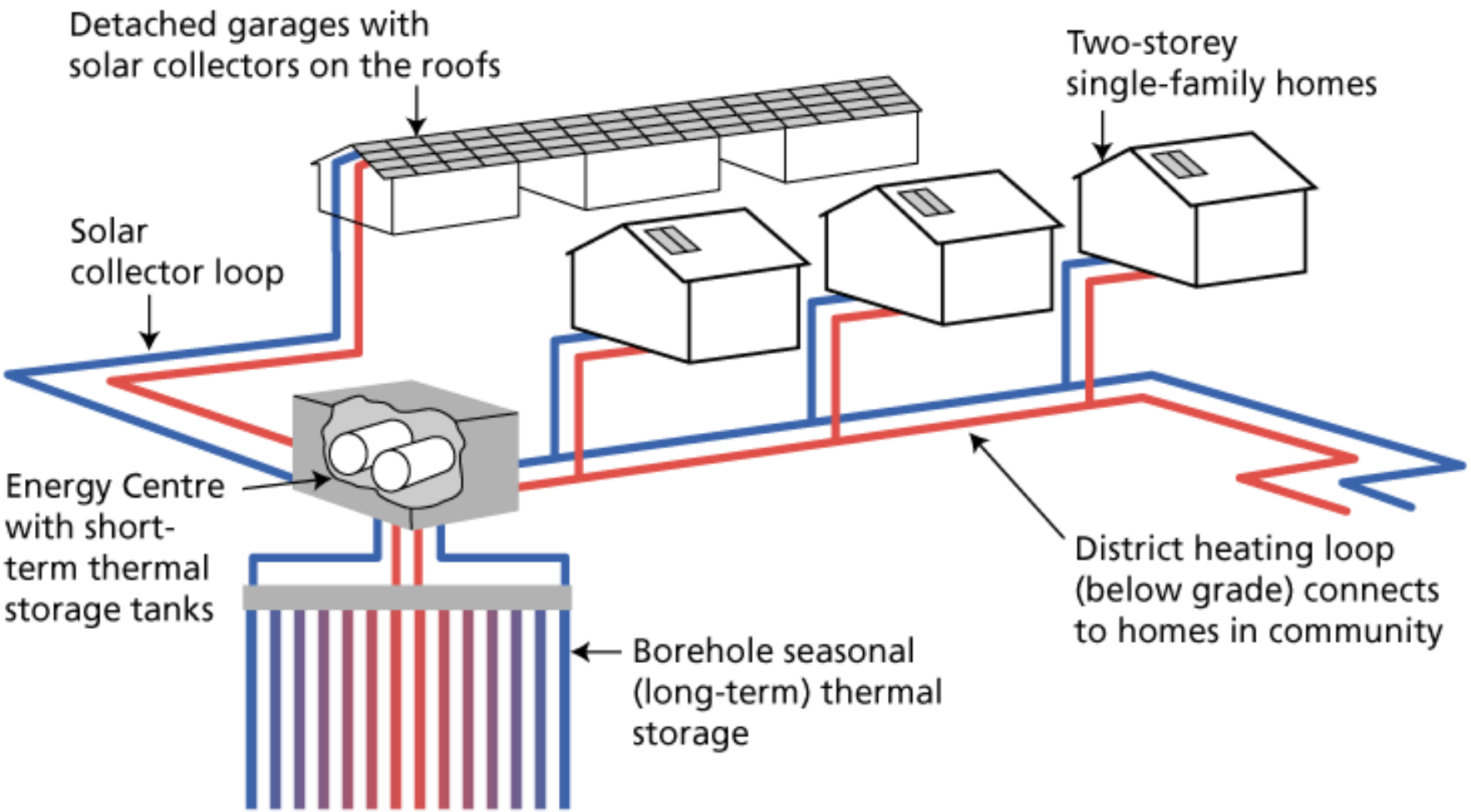
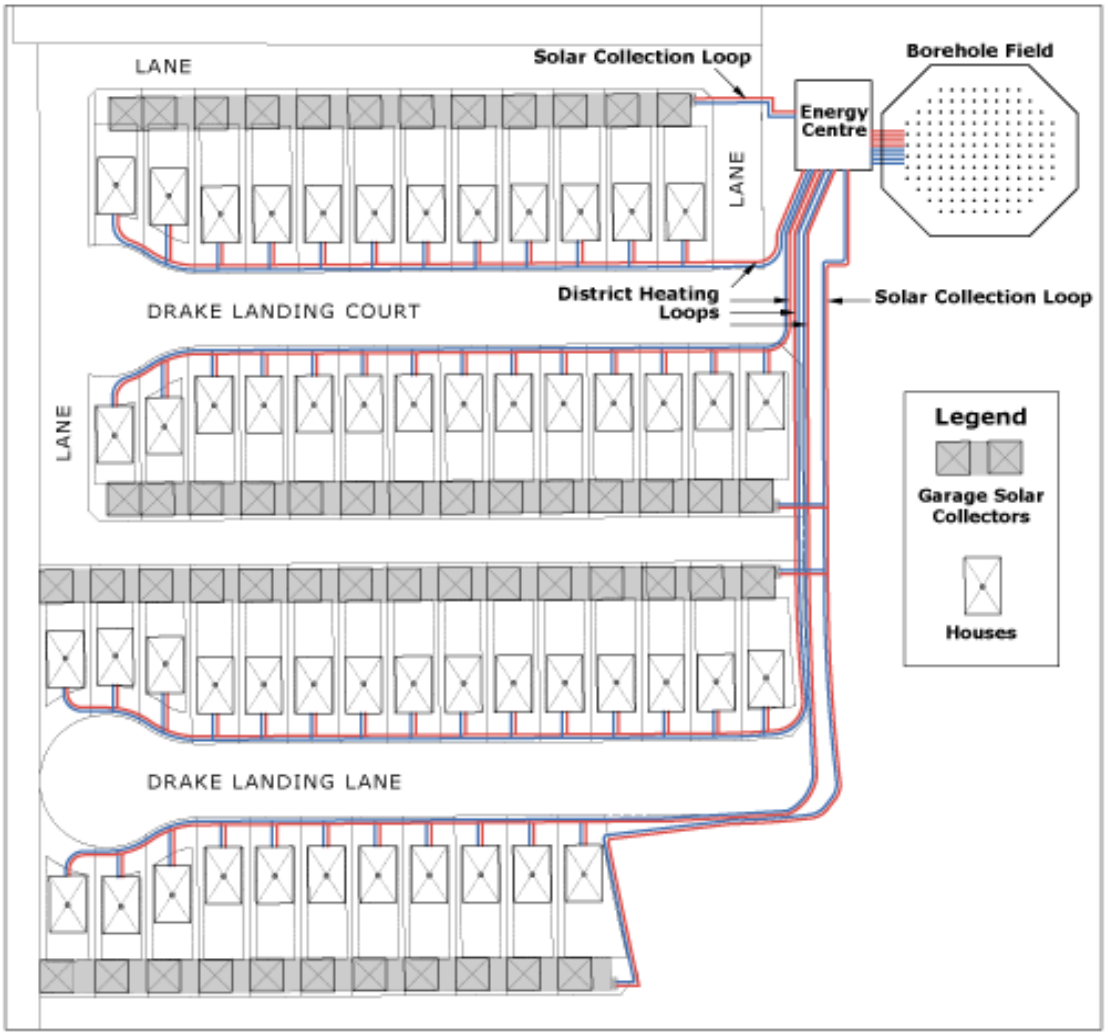
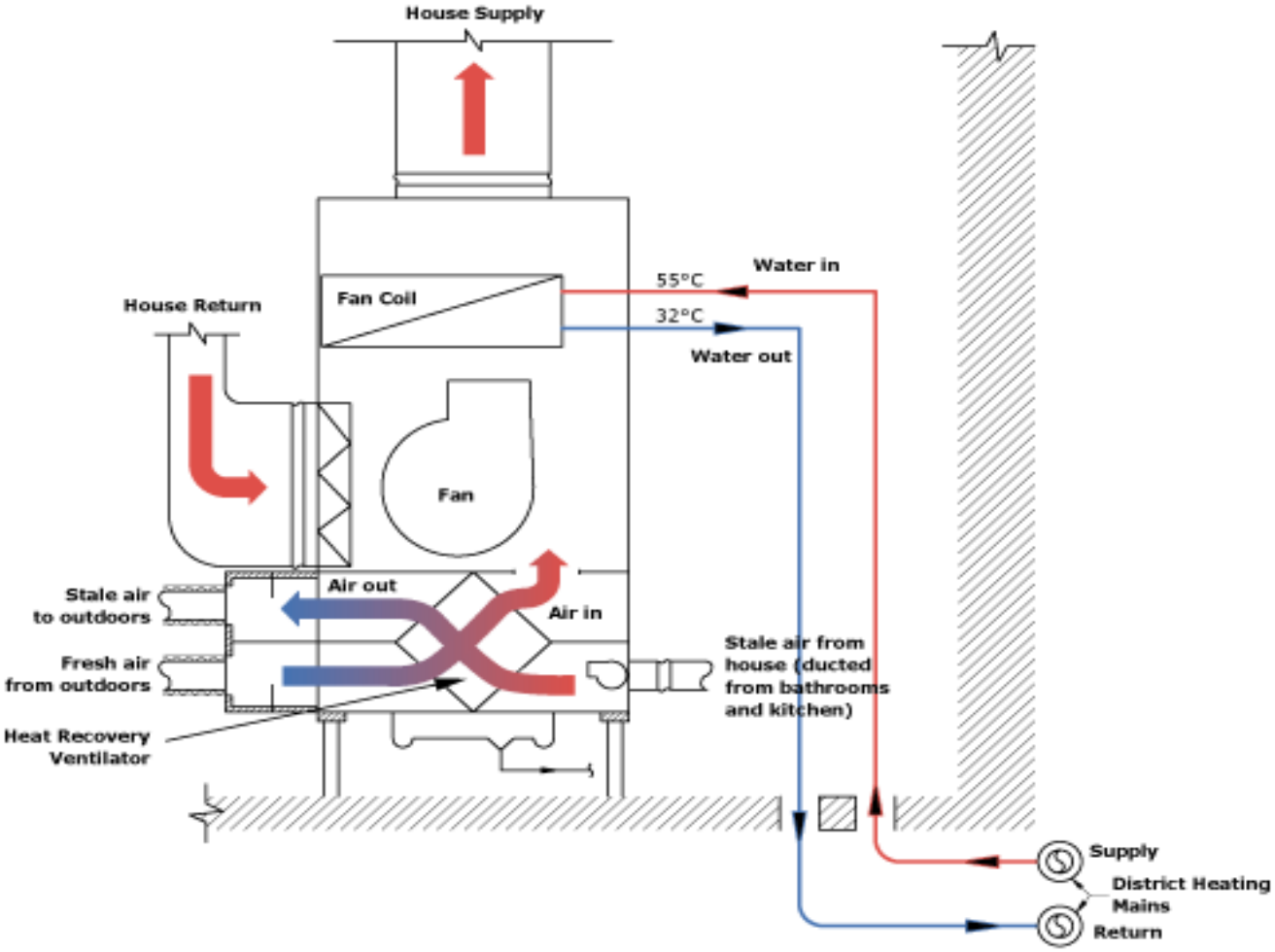
Simplified Schematic

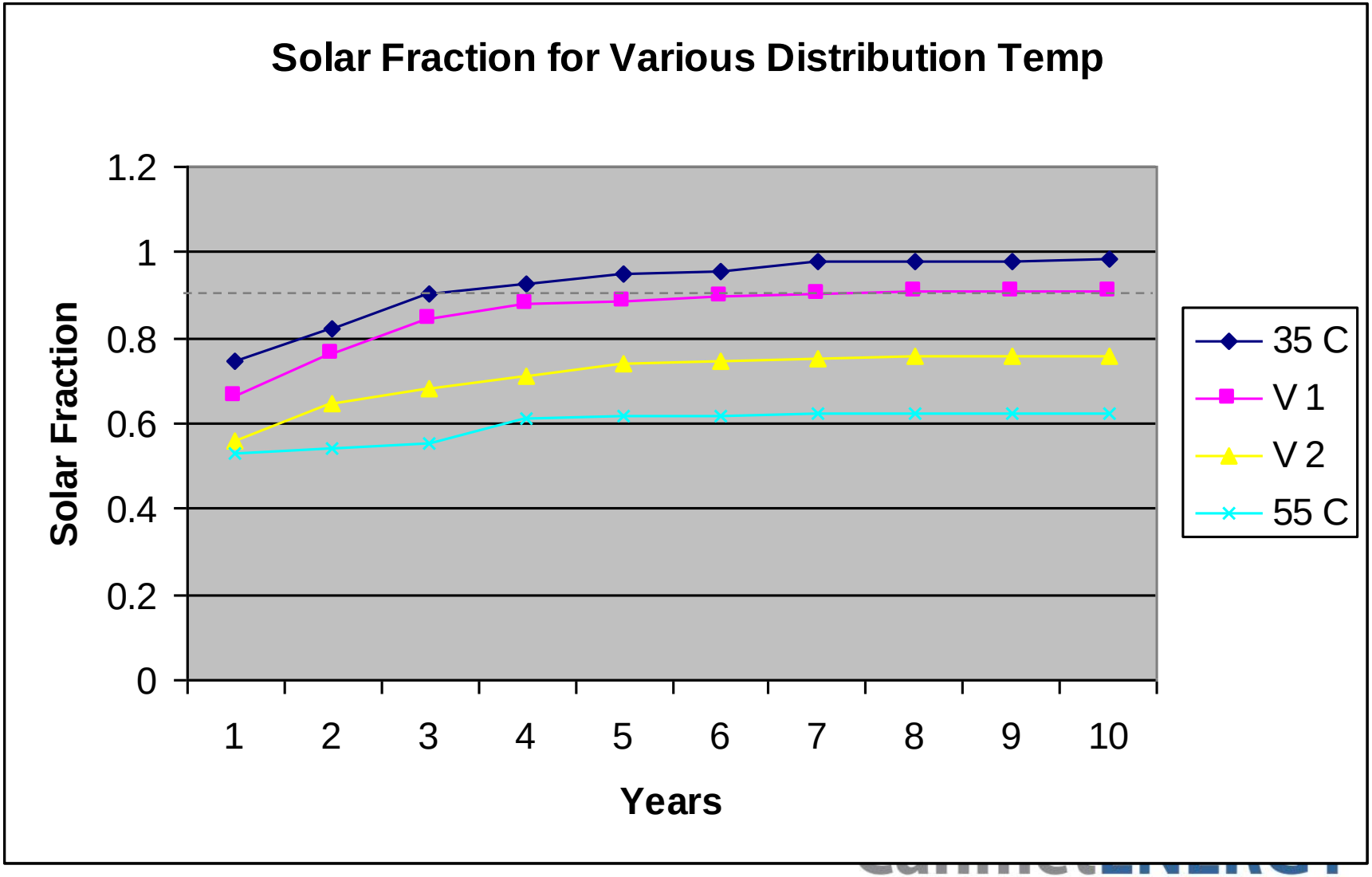


Energy Distribution

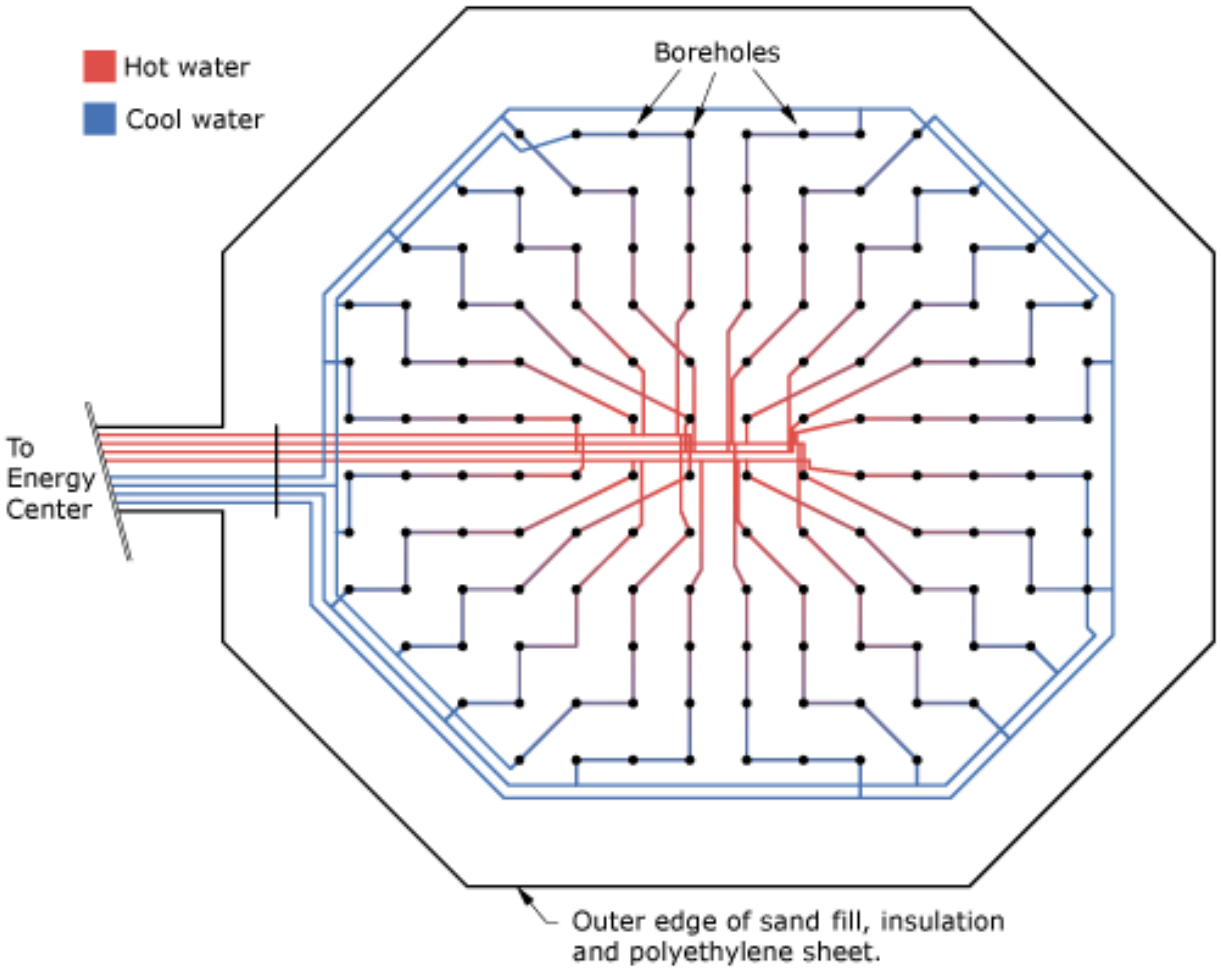


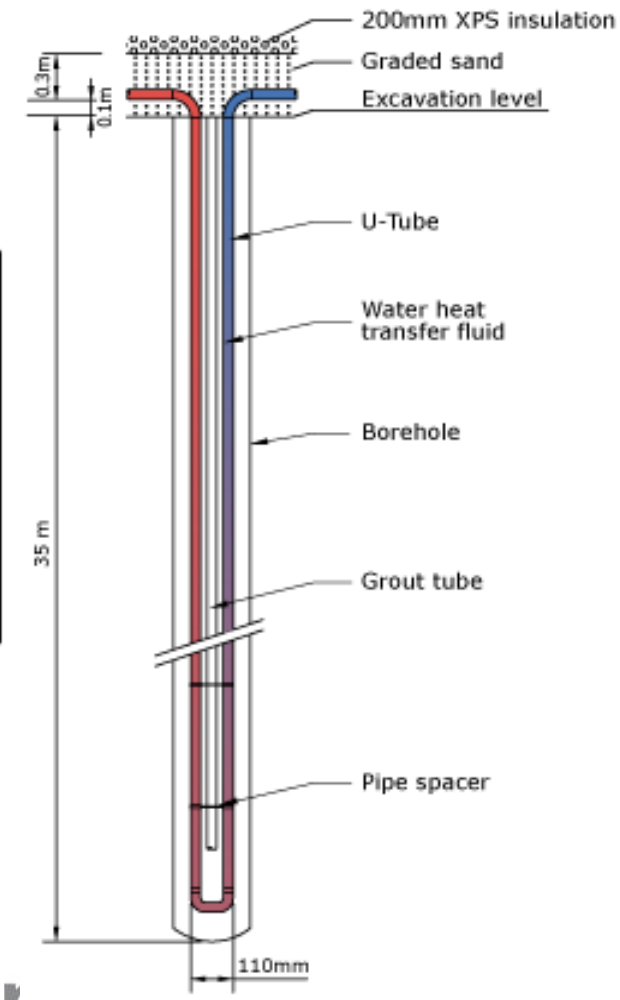
Air Handler Unit




Solar Fraction for Various Distribution Temp
Solar Fraction
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
6
7
8
9
10
Years
35 C
V 1
V 2
55 C

Borehole Thermal Energy Storage





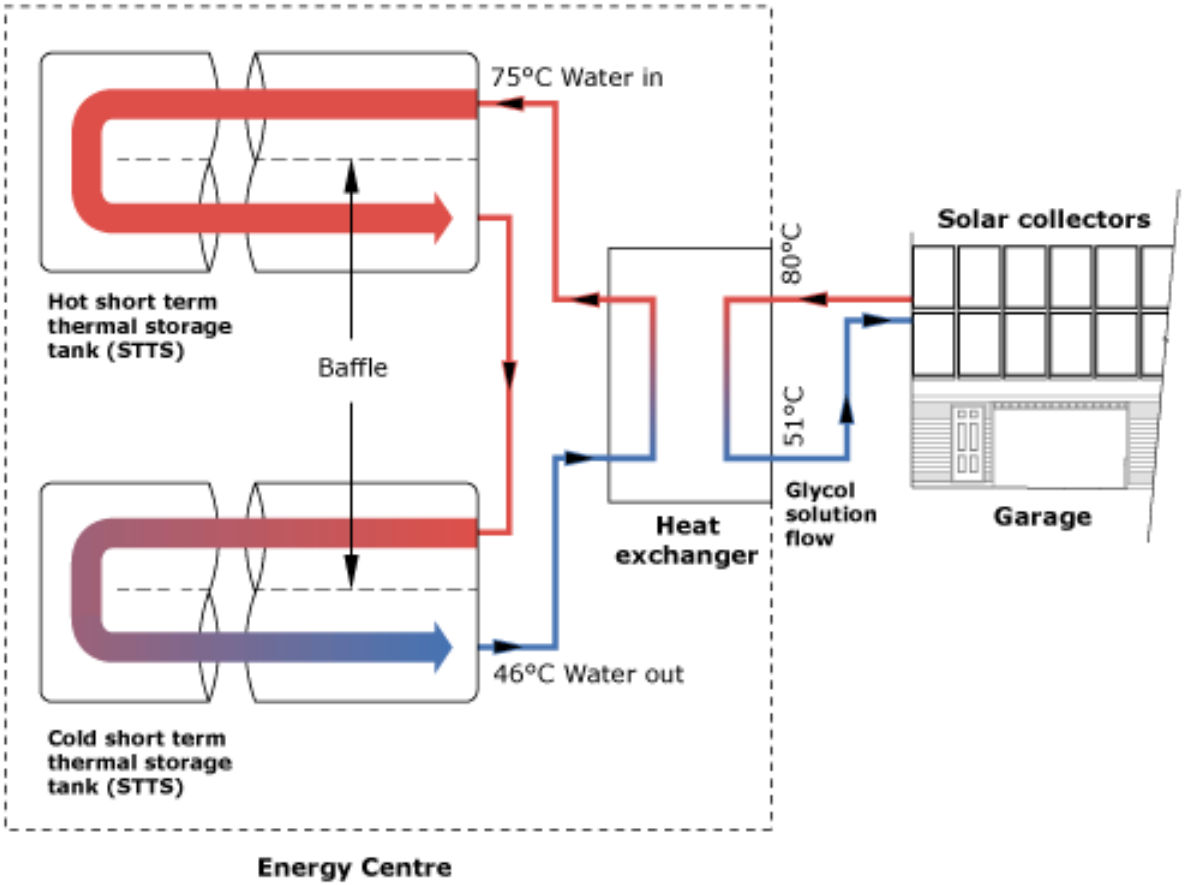

2005/10/18


June 2005
BTES Field flooded

Impact of Soil Type on Solar Fraction

# Bores	Depth (m)	Calibrated Soil	Dense Rock	Heavy Saturated Soil	Heavy Damp Soil	Heavy Dry Soil	Light Damp Soil	Light Dry Soil
288	35	0.80	0.77	0.79	0.77	0.75	0.75	0.67
144	70		0.76	0.78	0.78	0.77	0.77	0.72
96	105		0.72	0.75	0.76	0.75	0.75	0.72

The Energy Centre

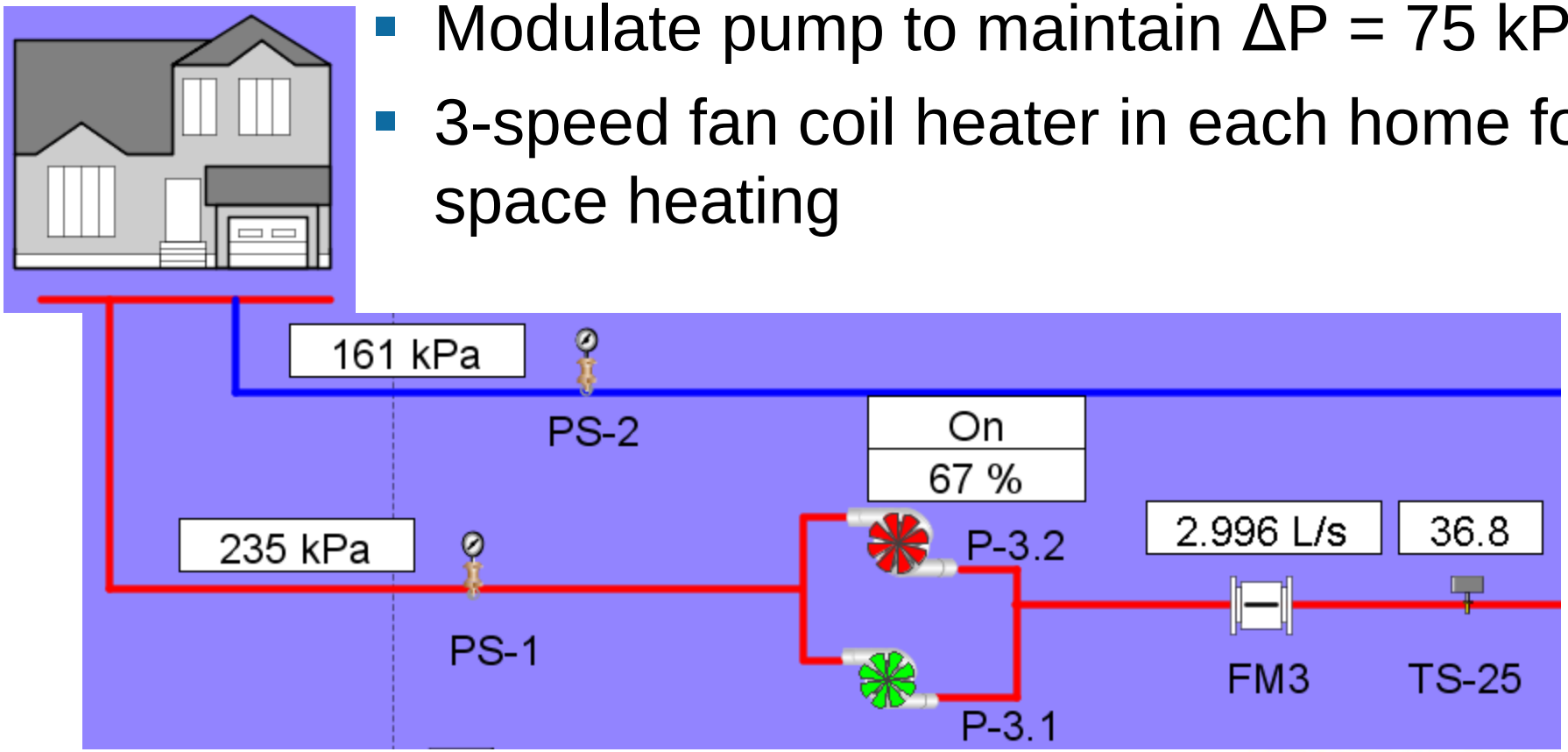


Solar collector loop controls

- Flow modulated using VFD drive:
  T_{HX}(in – out) = 15°C
- Overheat protection provided by dry cooler on Energy Centre rooftop
- Power outage protection provided by PV powered battery backup system

District heating loop controls

- Modulate pump to maintain ΔP = 75 kPa
- 3-speed fan coil heater in each home for space heating

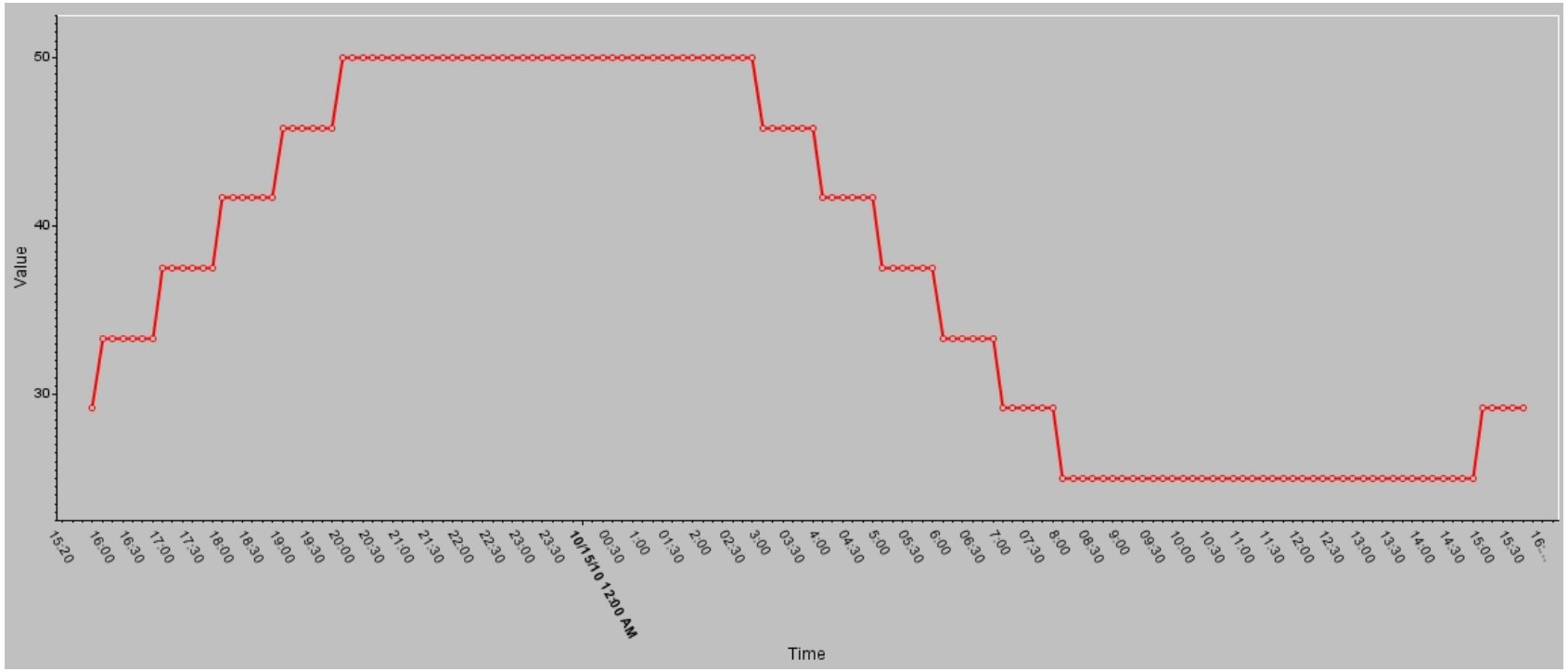


Pump Electrical consumption

Pump	P-1.1	P-2.1	P-3.1/.2	P-4	P-6.1/.2
Rating (kW)	7.5	2.3	3.8	1.5	1.1
Loop	Collector	STTS – HX1	District Loop	STTS – HX2	BTES

- Total rated pump power: 16.2 kW
- Total pump consumption: 38 MWh/yr

Be Smart about When you Charge and Discharge BTES in Winter



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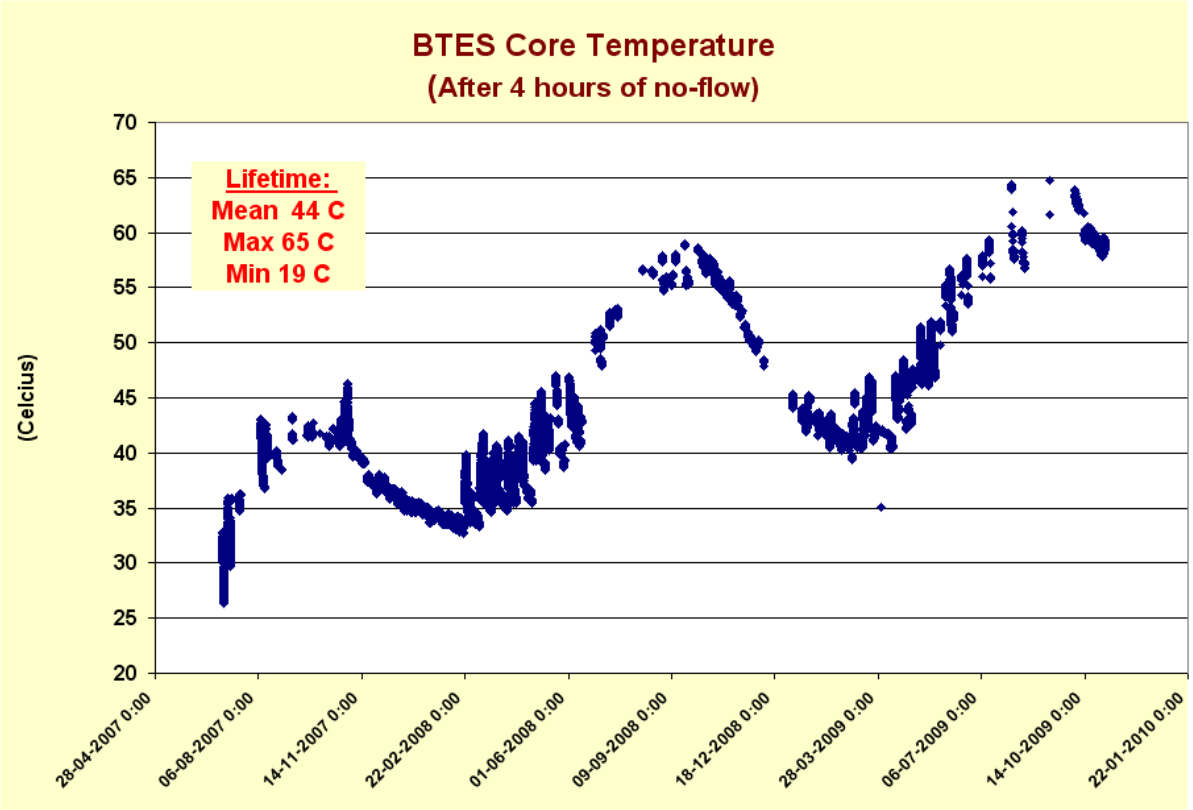
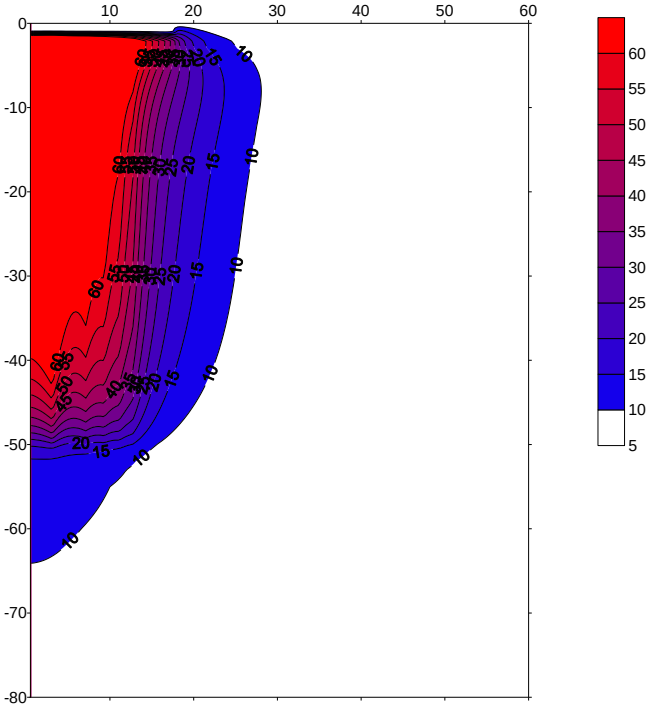
BTES Core Temperature





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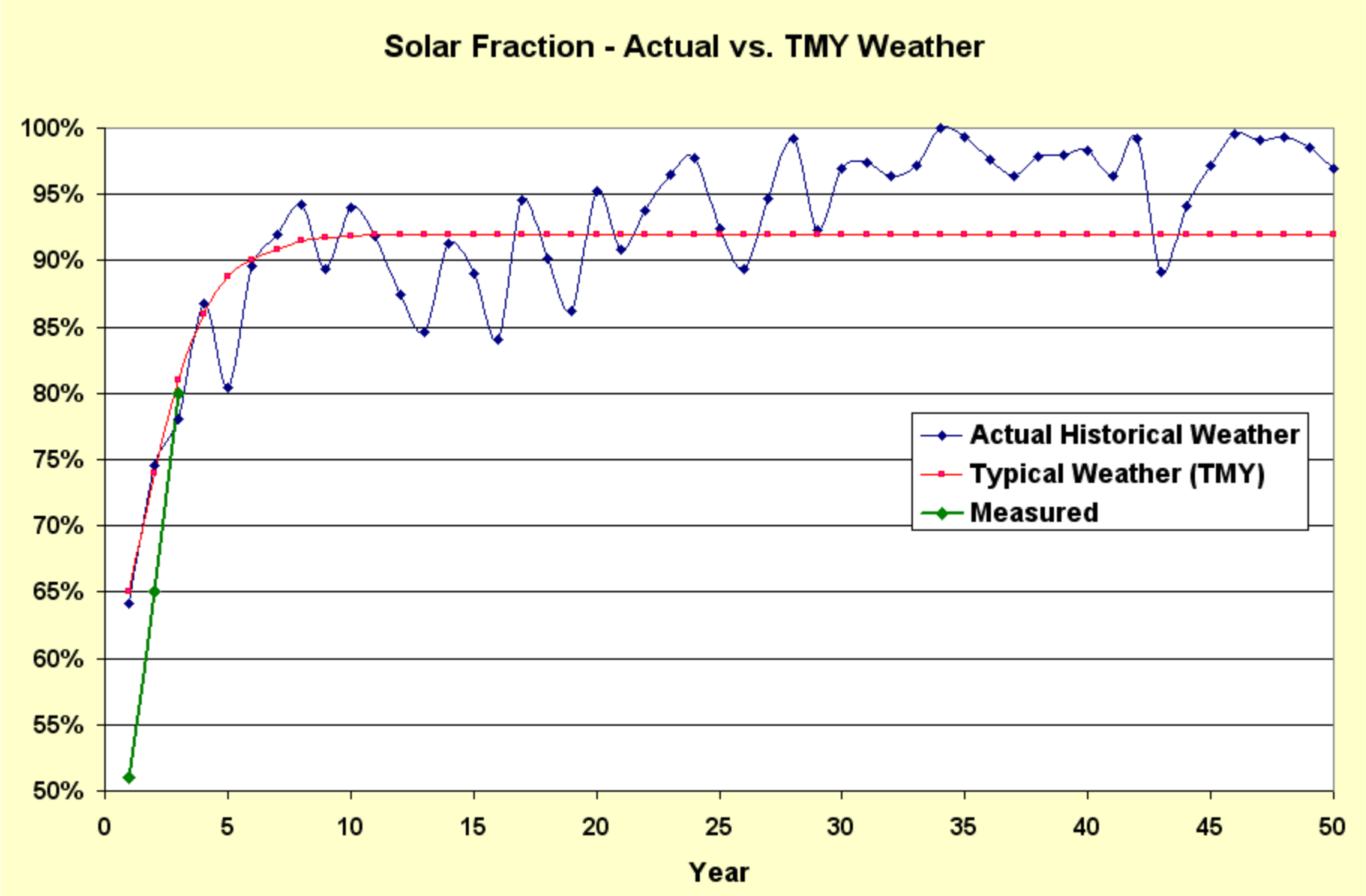
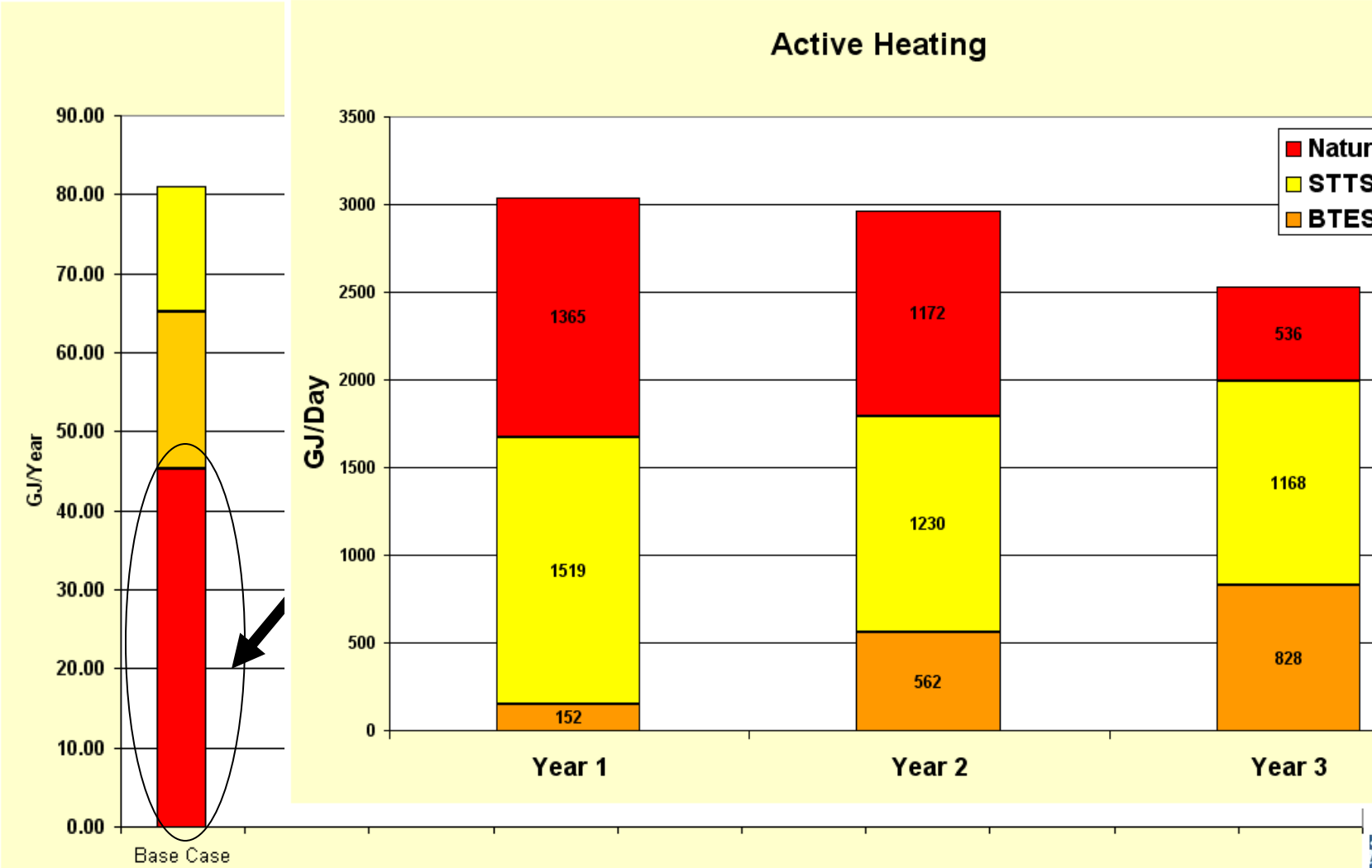
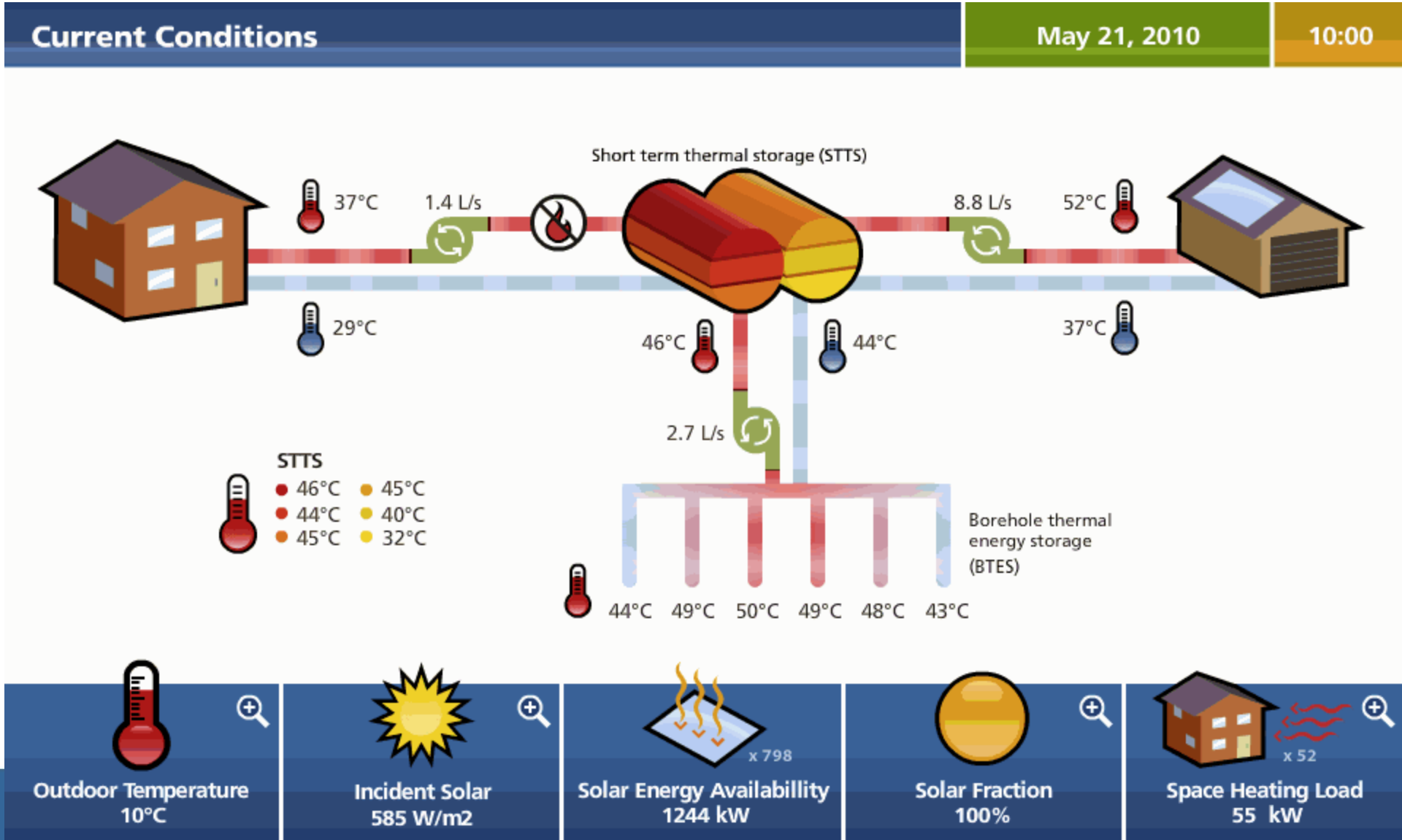
Solar Heating Performance



Space Heating Load – Active Portion



Visit dlsc.ca for live performance updated every 10 minutes



Solar System Costs

- Energy Centre (incl. short term tanks) $600K
- Seasonal Storage Borehole Field $620K
- Heating & Solar Collection Loops $1025K
- Solar Collector Supply $710K
- Solar Collector Installation $430K

Solar Energy Life Cycle Cost: $0.13/kWh (40 yr.)
$0.17/kWh (25 yr.)

Solar Thermal Seasonal Storage

Replication Potential

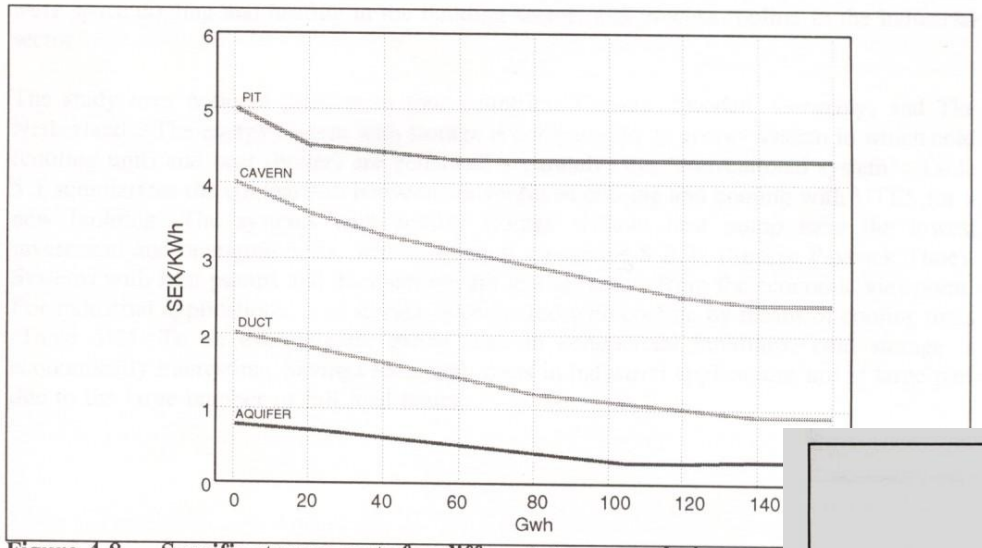


Figure 4.8 Specific storage costs for different storage techniques as storage size

Cost depends on type of storage and system size

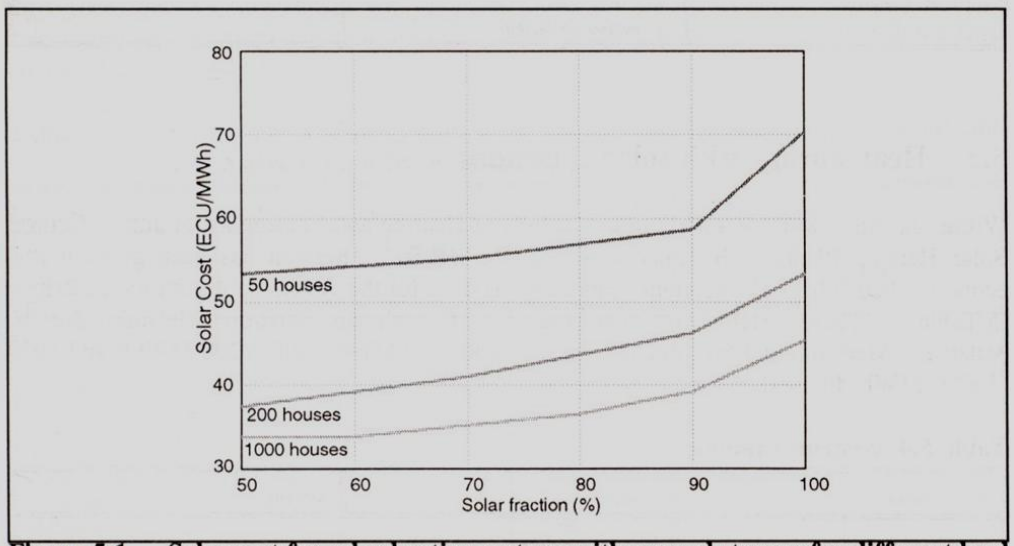
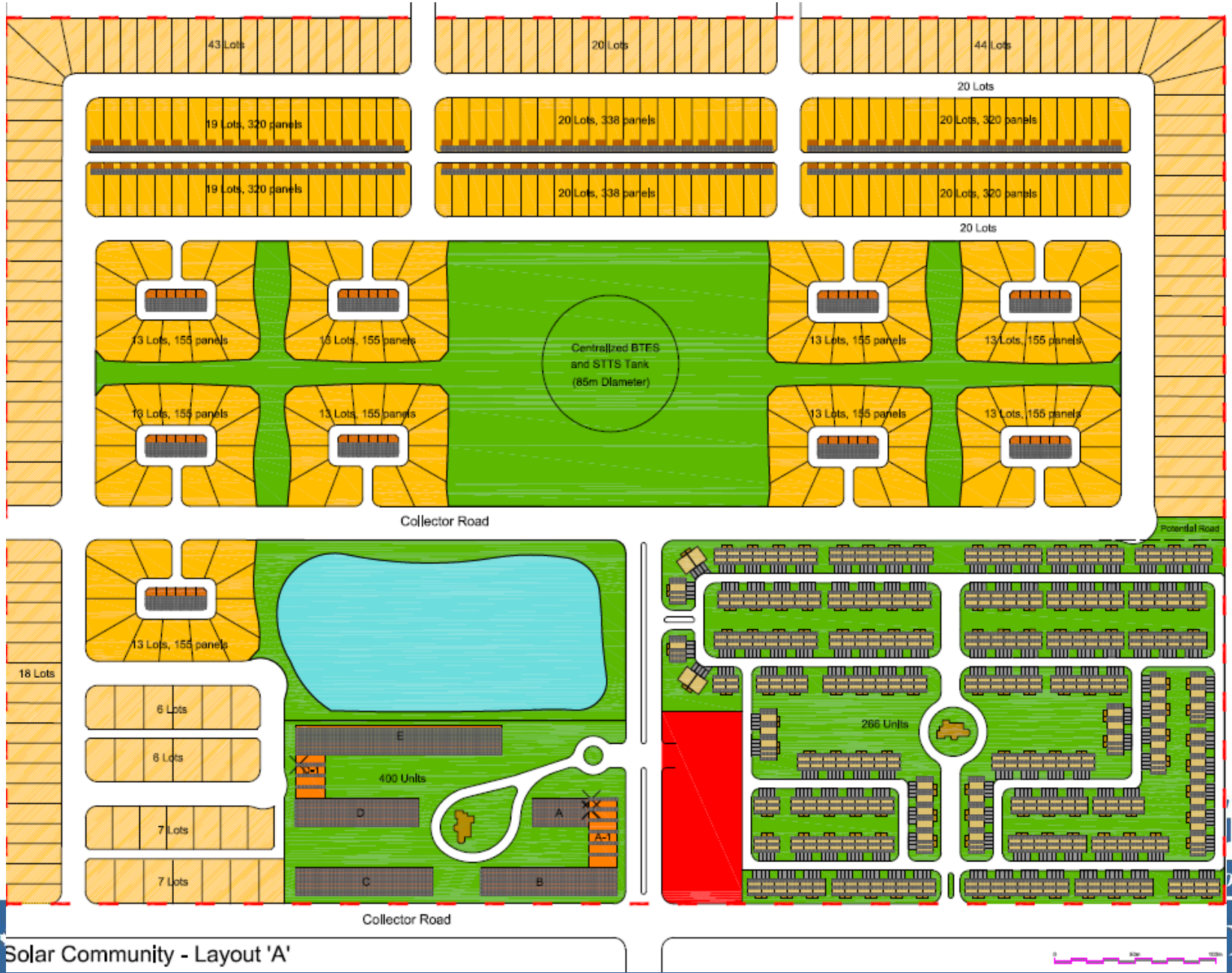


Figure 5.1 Solar cost for solar heating systems with ground storage for different load sizes in Milano

+1000 Home Community Plan



Initial System Sizing Estimates

- 30,000 m2 solar thermal collectors
- 85 m diameter centralized BTES field
- 20 MWth peak output

Expecting 25 - 40% cost reduction compared to Drake Landing

Thank you !

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