GABI WORKSHOP - Torino, December 2016

Practical Construction Aspects of Designing, Installing & Operating a GSHP Solution Connected to Energy Foundations.

Tony Amis MSc Business Development Director for GI Energy

This presentation will set out good practice guidelines for designing, installing a ground sourced heat pump solution that uses geothermal loops installed within energy foundations and structures. It will highlight the importance and benefits of providing long term management and operation of such a system, to ensure that the system not only delivers the designed heating and/or cooling loads, but can be optimised to enhance returns on investment to make a project more attractive…

Practical Construction Aspects Of Designing, Installing & Operating a GSHP Solution, Connected To Energy Foundations.

Tony Amis

Business Development Director

5th December 2016

gi energy

GREEN APPLE AWARD WINNER

NATIONAL RAIL AWARDS 2016 WINNER SUSTAINABILITY AWARD

HEVNEWS AWARDS 2016 | WINNER

The GI Energy Journey

gi energy

First Large Scale GSHP in UK

First Energy Pile Installation

Largest Lake Loop in Europe

1st prize winner 2009
The Ashden Awards for sustainable energy

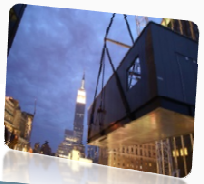
One New Change

Oxford Earth Sciences

THE GREEN APPLE AWARDS 2011

First Supermarket

GI Energy Expands in US



First Renewable Energy Solution Old Oak Common Depot

2001 02 03 04 05 06 07 08 10 12 13 14 2016

WaterFurnace

geothermal heating international

SSE

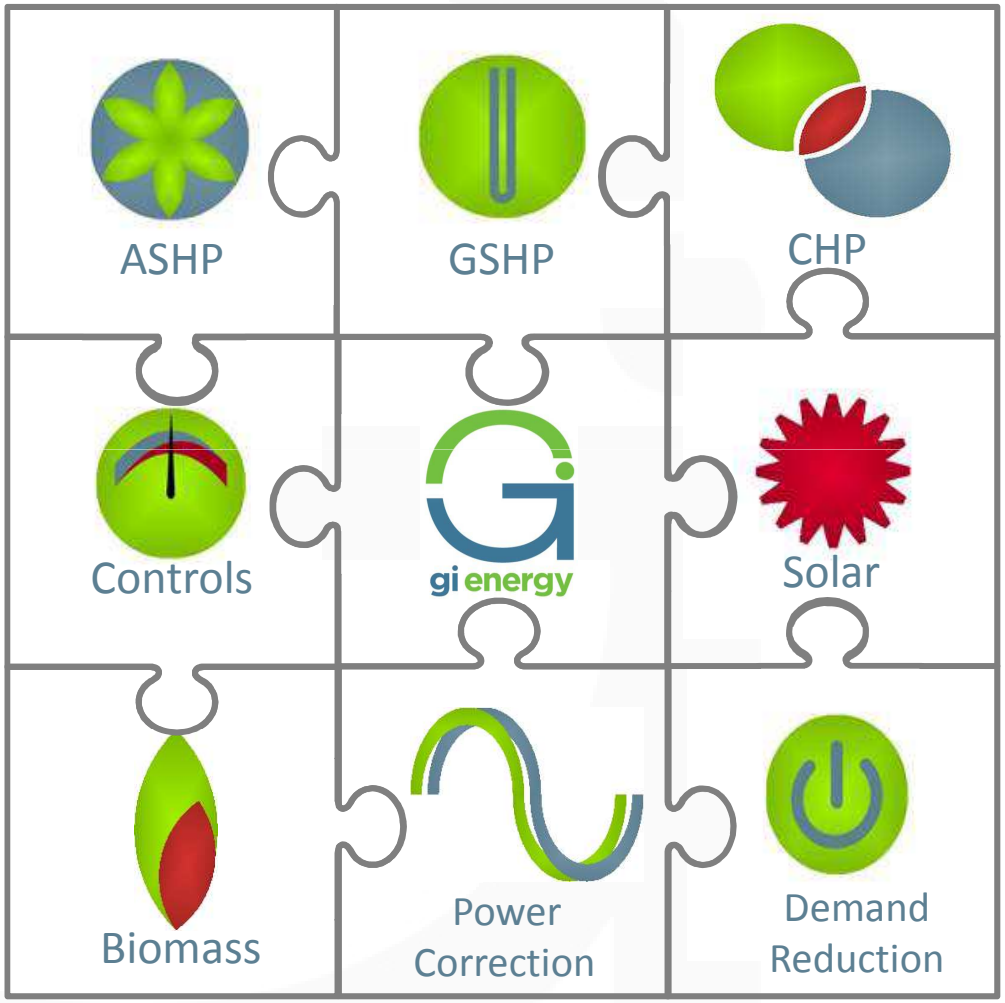
geothermal international

gi energy

Our Unique Skills & Experience allow us to Deliver Bespoke Solutions via a Diverse Technology Portfolio

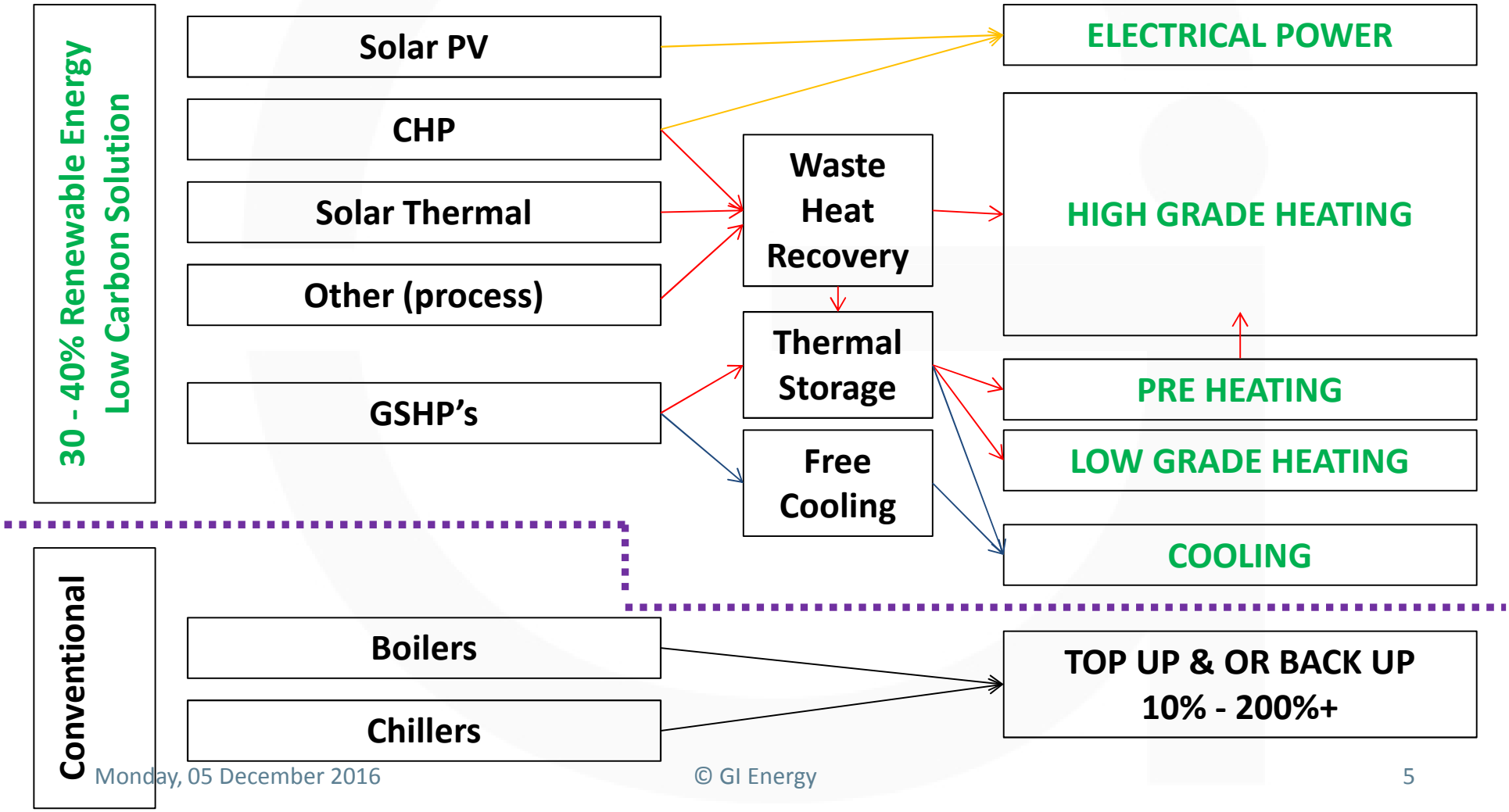
Bringing the Elements Together as a Coherent Whole increases benefits

Commitment to an on-going energy partnership for the long-term



GI ENERGY
Supply & Management

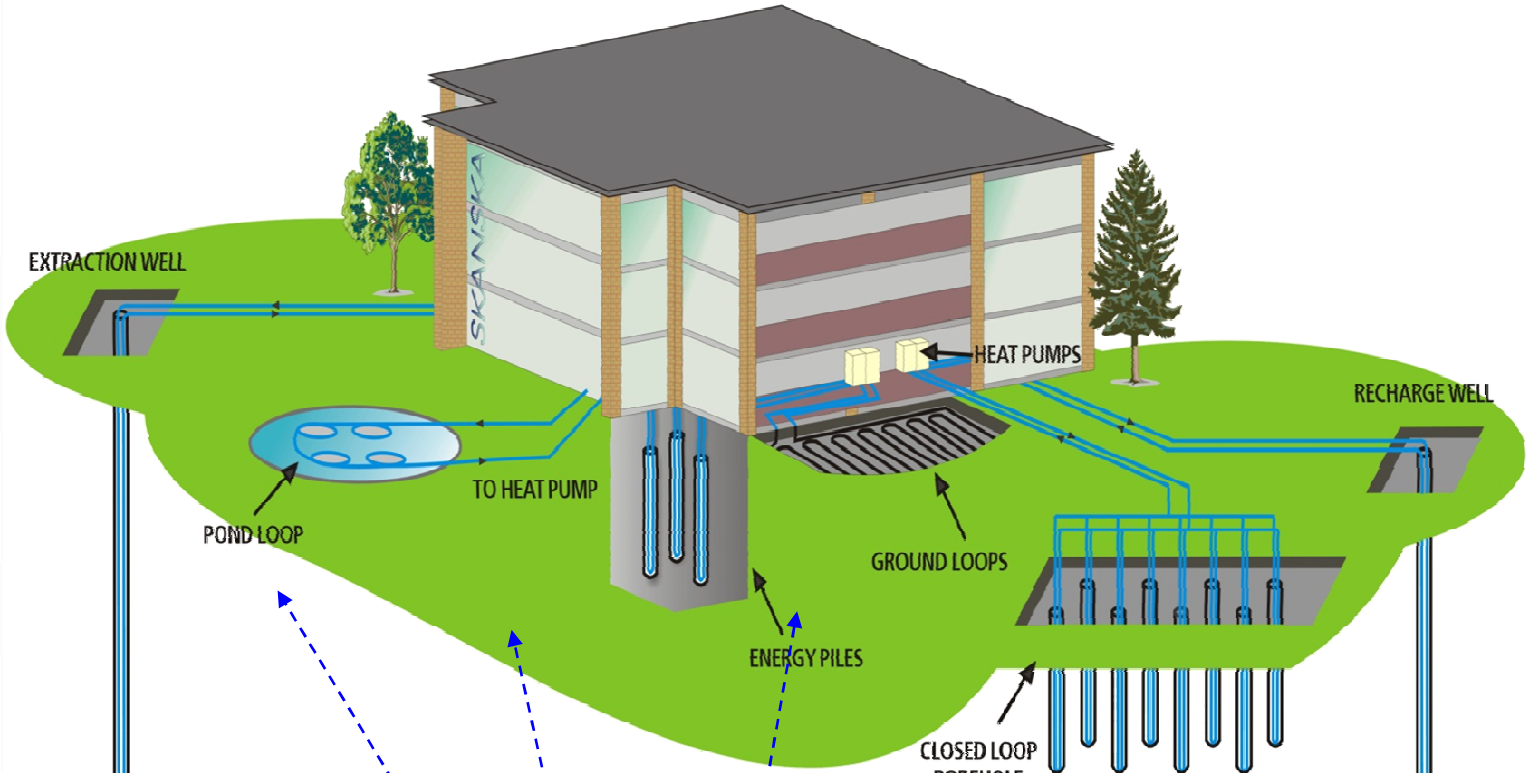
Aim
Long Term System Optimisation
Maximising CO2 & Run Cost Savings



‘The whole is greater than the sum of the parts’

Aristotle

Primary circuit options for GSHP systems



Closed Loop Systems

Open Loop System

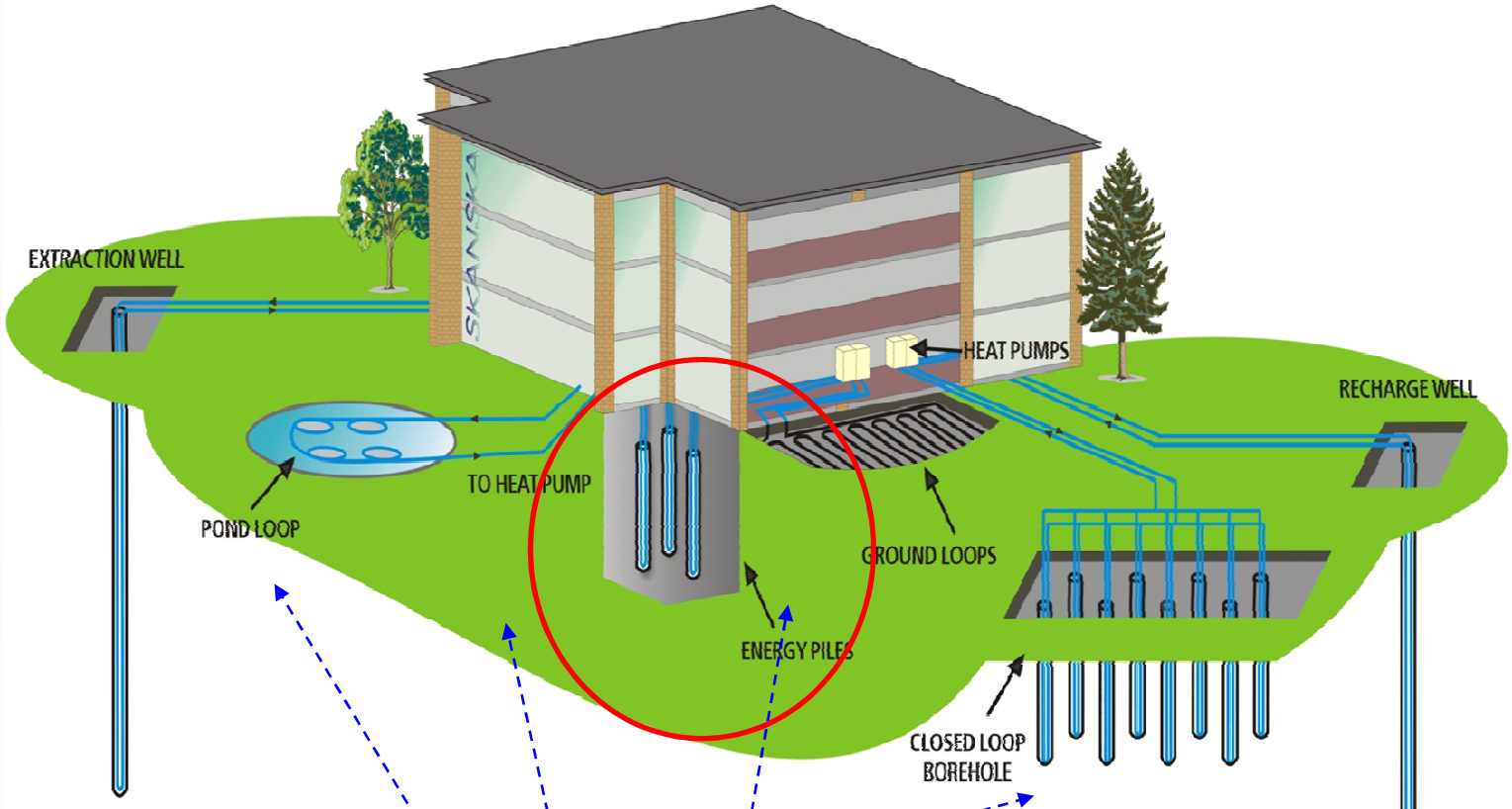
Systems can be combined to give optimal solution

Advantages of GSHP Systems

- Lower operational costs
  - 4 times more efficient than gas fired boilers
- Reduced CO2 emissions
- Enhances benefits of other renewable solutions
- Reduced plant room requirements
  - units can provide heat and coolth
- Advantage for BREEAM / LEED buildings

- **Provides Stable & Sustainable Renewable Energy**

Primary circuit options for GSHP systems



Closed Loop Systems

Open Loop System

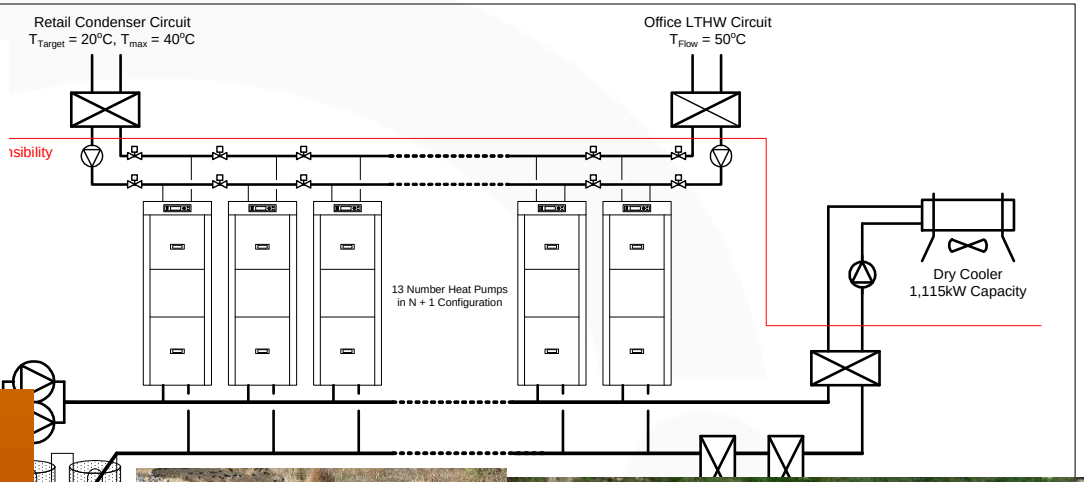
Systems can be combined to give optimal solution

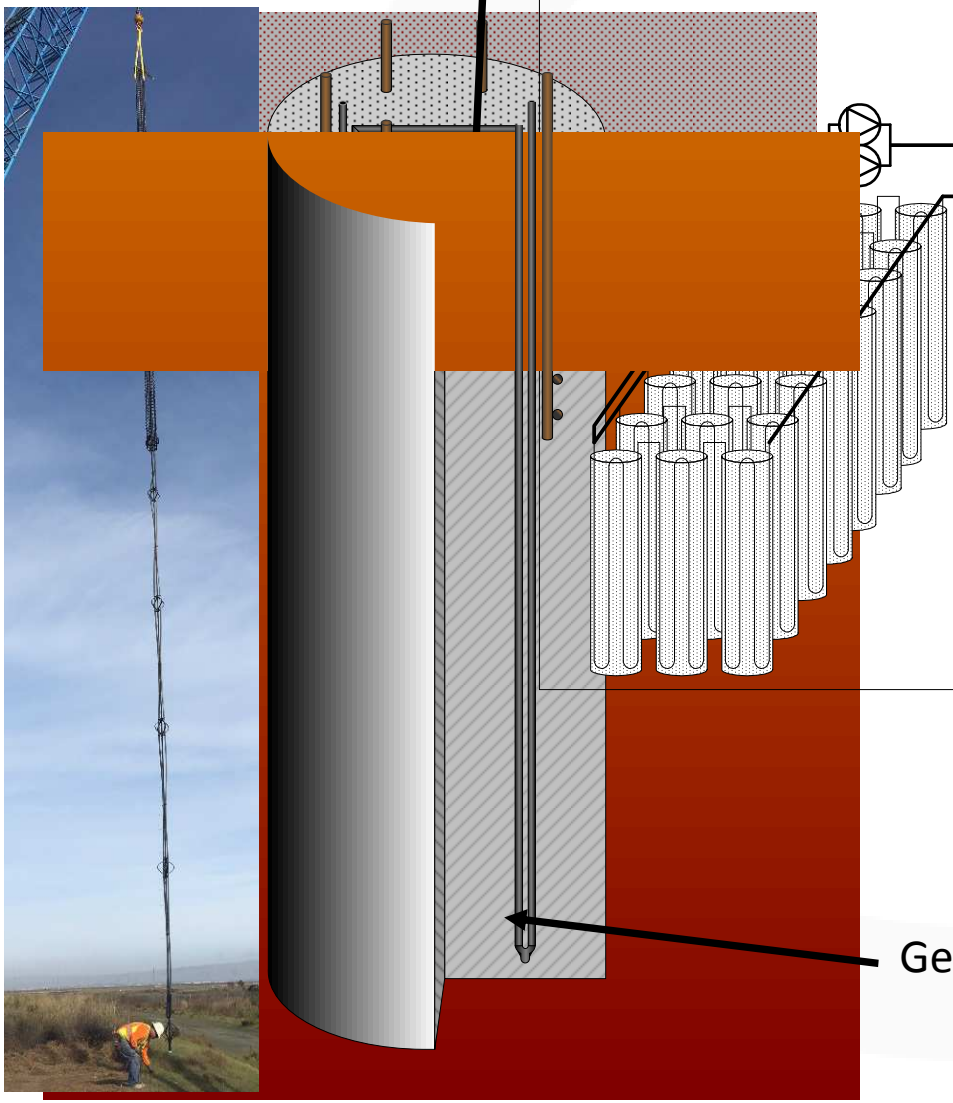
Key Benefits of using an Energy Pile solution

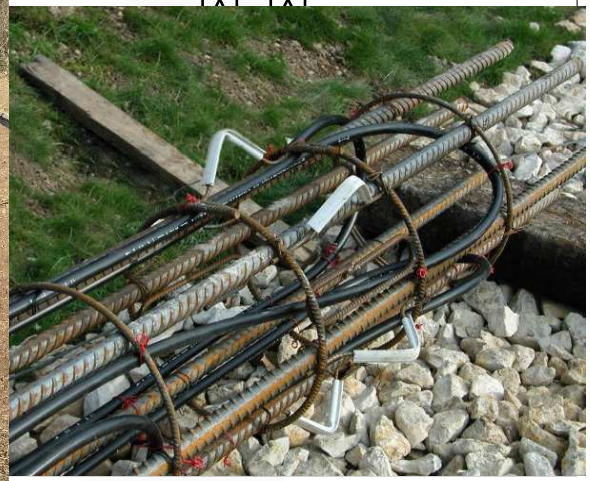
- No additional drilling required
- Critical Path on programme remains unaffected
- Building protects loops from damage by external activities
- Using energy piles ensures area surrounding site is not sterilised for future expansion.
- Energy piles make a great **Thermal Battery**. Remember night storage heaters
  - Warm up in summer to enhance winter heating
  - Cool down over winter to enhance summer cooling

What is an Energy Pile

Reinforcement cage at top of the pile

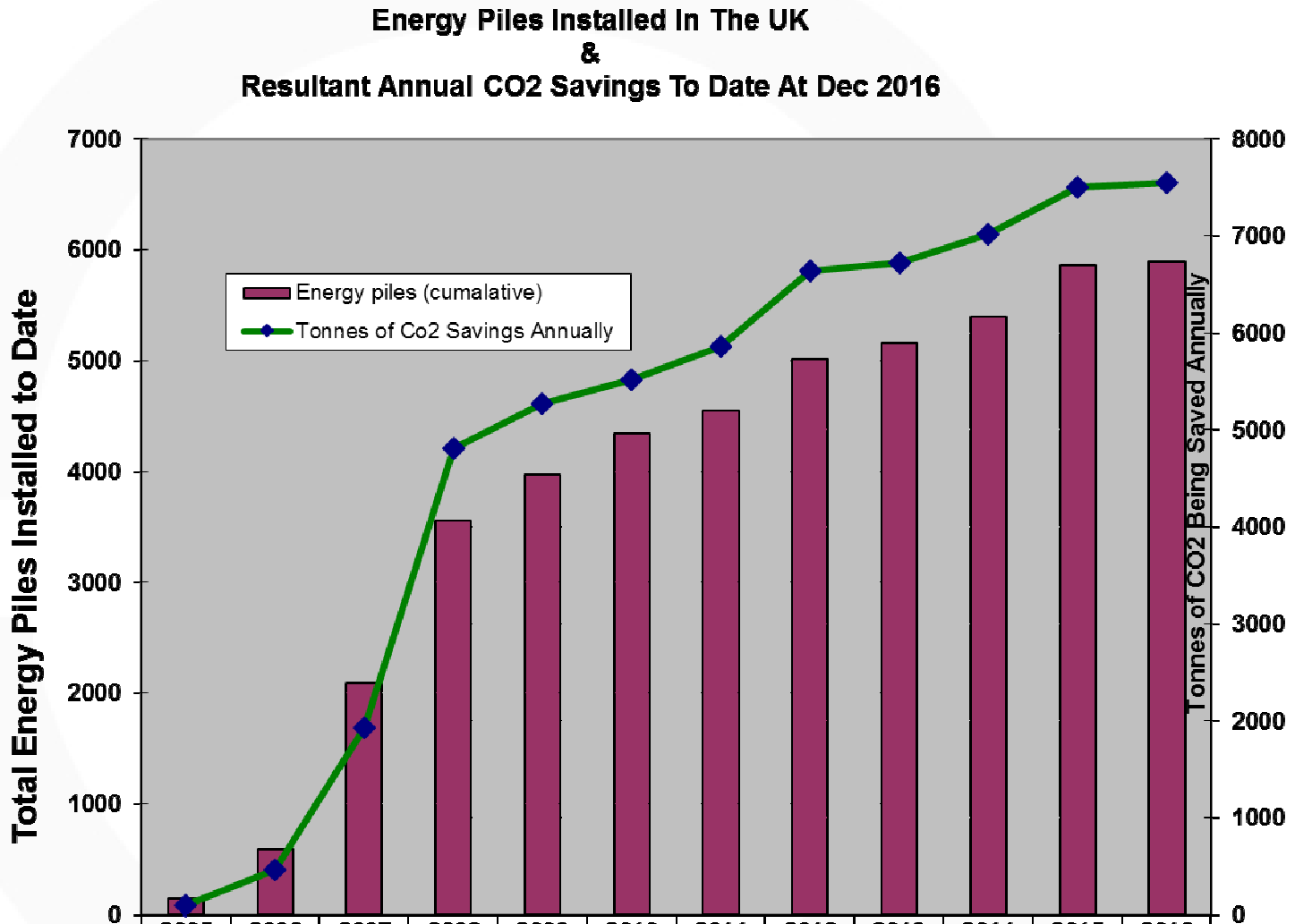






Geothermal loops generally installed full depth of pile to maximise geothermal energy

GI Energy has installed 90% of the Energy Piles in the UK Today



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Energy piles (cumalative)	150	590	2085	3552	3967	4339	4554	5012	5157	5397	5863	5891
Tonnes of Co2 Savings Annually	93	467	1930	4809	5268	5513	5858	6641	6718	7018	7499	7545

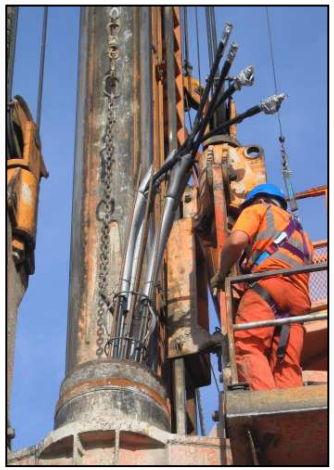
Cost Comparison of Borehole Loop / Thermal Pile

Item	Borehole Loop	Thermal Pile
Diameter	0.2m	0.6m
Heat transfer	35W/m	35W/m
Number of loops	One	Two
Length	100m (3500W)	27m x 2No (1750W)
Boring / installation cost	£35/m x 100m = £3500	Pile included anyway Allow 2 hours attach loops £200 / crew time
Thermal Grout	£5/m x100m = £500	N/A
Pipe – 25mm ID	£5/m – 1 loop= £500	£5 x 2 x (27m x 2) = £540
Total Installation	£4500	£740
Header pipes	£1100/ borehole + trenching	£800 per pile
Grand Total for 3500W	£5600 + trenching	£3080 (2 piles)
Construction work	Not on critical path	On Critical path

Geothermal Loops Have Now Been Installed Successfully In All Foundation Types

- Small / large diameter bored piles –

  Westminster Academy / One New Change / Crossrail
- Piles under bentonite or dry bore – Bankside London
- CFA piles - Crossrail depot / Belfast Police station
- Driven Cast In-situ piles. North Kent Police Station
- Driven Precast Piles – Balmore Glasgow
- Diaphragm walls - Bulgari Hotel Knightsbridge / Crossrail Stations



- Limit Ground Loop temperature ranges
  - Pile / Soil interface - +2°C to +35°C (No freezing)
  - Monitor – Control heat pump output temp

Ground Loop Designer

- Assess likely pile and ground movements
- Assess concrete stresses – dead load and thermal
  - Max concrete stress < Concrete strength $(q_c)/4$
- Pile design - conventional Factors of Safety
  - F of S > 2.0 to 3.0 – sufficient to allow for thermal effects
- Confirm ability and depth to install loops

Piling Contractor

Systems work best when they have a balanced heating & Cooling load..
However they can be designed as a heating or cooling only solution

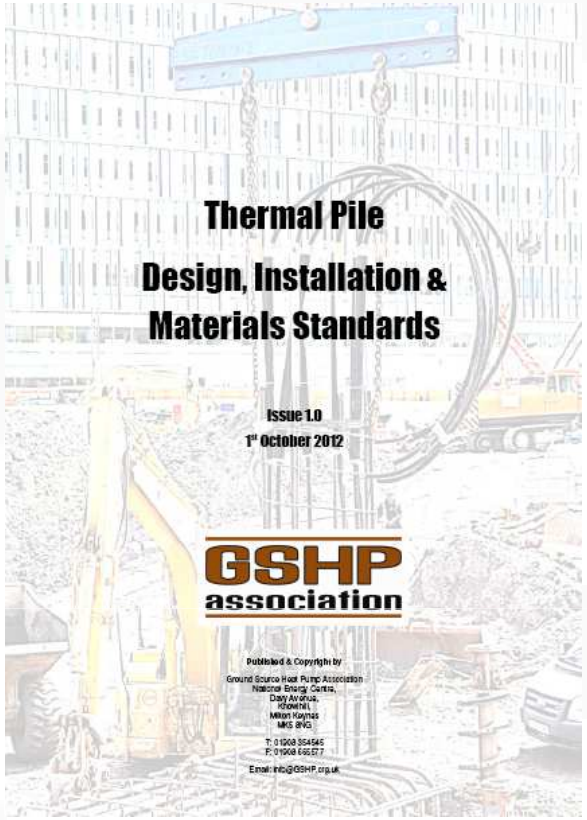
Bond Street , West Entrance
Crossrail
Results from groundloop modelling Exercise

Energy Piles	Number of piles	Number of loops	Heating Peak (kW)	Heating (kWh)	Cooling Peak (kW)	Cooling (kWh)
Heating &Cooling	14	84	86	86,000	86	51,600
Heating only	14	84	54	45,900	0	0

Diaphragm Wall	Number of panels	Number of loops	Heating Peak (kW)	Heating (kWh)	Cooling Peak (kW)	Cooling (kWh)
Heating &Cooling	22	58	100	95,000	100	60
Heating only	22	58	70	54,600	0	0

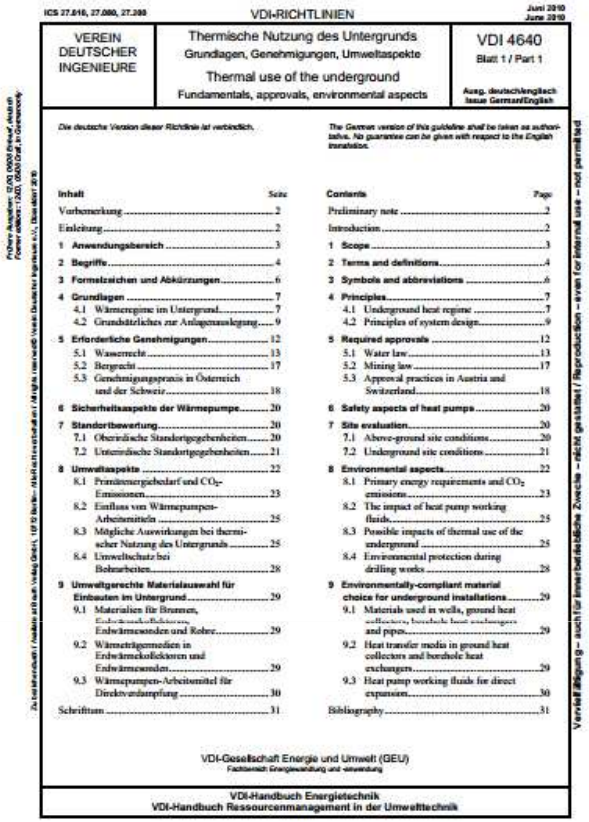
Beginning the design process

- Where to go
- What to look for
- What information is needed



UK Thermal Pile Standard

Can be downloaded **free** from
www.gshp.org.uk/shop.html



German Geothermal Standard

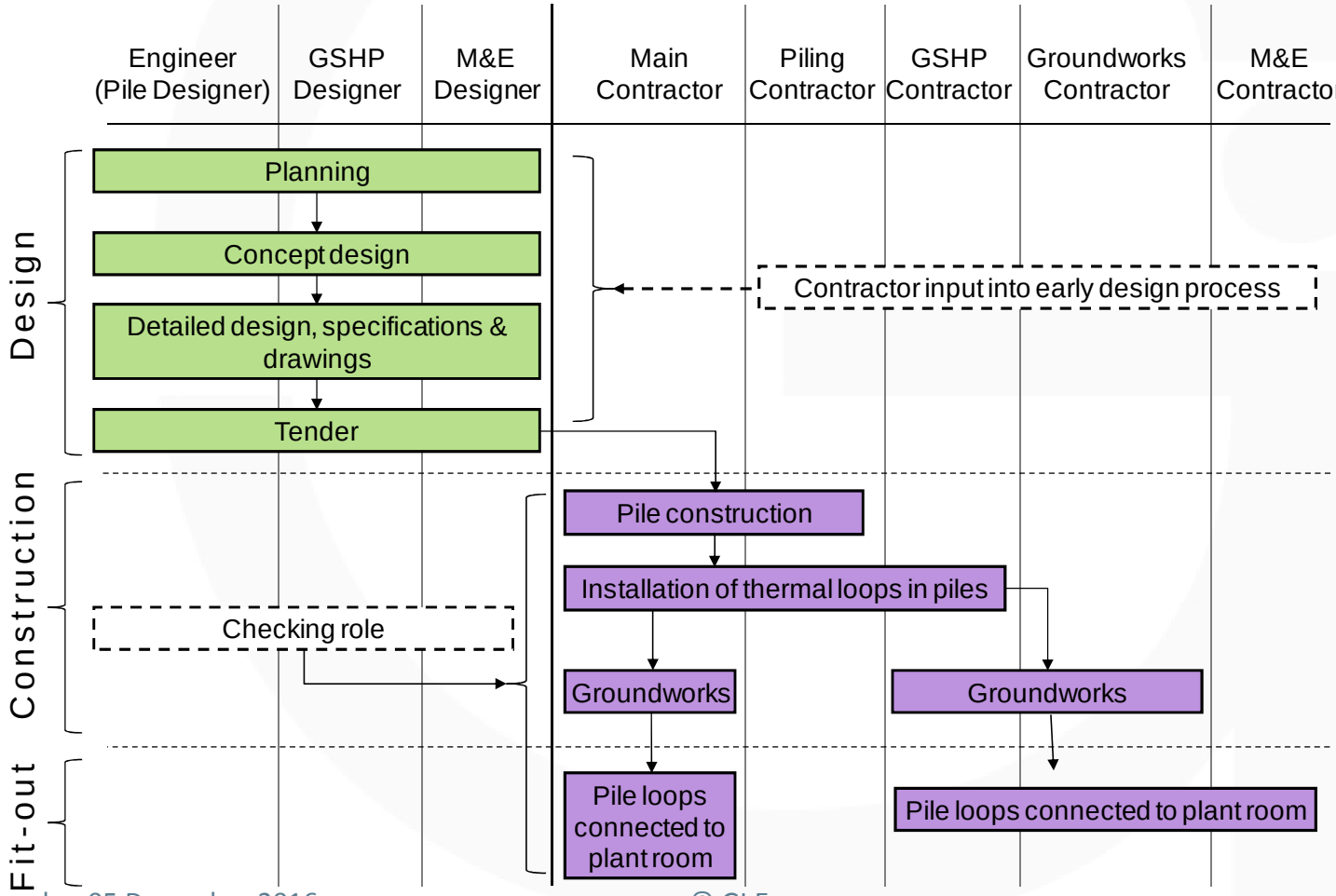
VDI 4640 part 1 and 2

Considerable Publications now exist Substantiating Use of Energy Piles:

Check Out www.researchgate.net

UK GSHPA Thermal Pile Standard
Sets out clear guidance on roles & responsibilities

GI Energy's Role



ESSENTIAL
Long term Management & System Optimisation
DO NOT WALK AWAY

- Contractual relationships : potential limitations
- Agreement of scope and responsibility at each stage
- Don’t under estimate importance of **coordination**
- Evaluate critical points (installation and connection levels)
- Consider any system redundancy (who is assigned the redundancy) and any fall back plan.
- Consider your risk assessment throughout the process

ESSENTIAL

Long term Management & System Optimisation

DO NOT WALK AWAY

1. **Heating and cooling data from Building Modelling Software**
    a. Peak heating and cooling loads required for sizing plant room equipment
    b. Hourly run time data required for designing ground loop
2. **Site layouts and plans**
3. **Energy Foundation details – Pile schedule**
    a. Depths
    b. Diameters
    c. Spacing
4. **Geotechnical Data**
    a. Geology
    b. Water table
    c. Conductivity values

Consider Design Risks

1. Damage to loops during installation / pile trimming/ follow on trades
2. Damage to headering loops from follow on trades
3. Conductivity values lower than anticipated
4. Ground temperature higher than expected
5. Clashes with services
6. Access difficulties

Mitigation:

All above risks can be significantly reduced through

1. Early coordination with design team and contractors.
2. Ground loop design – Recommend providing in the region of 10% redundancy

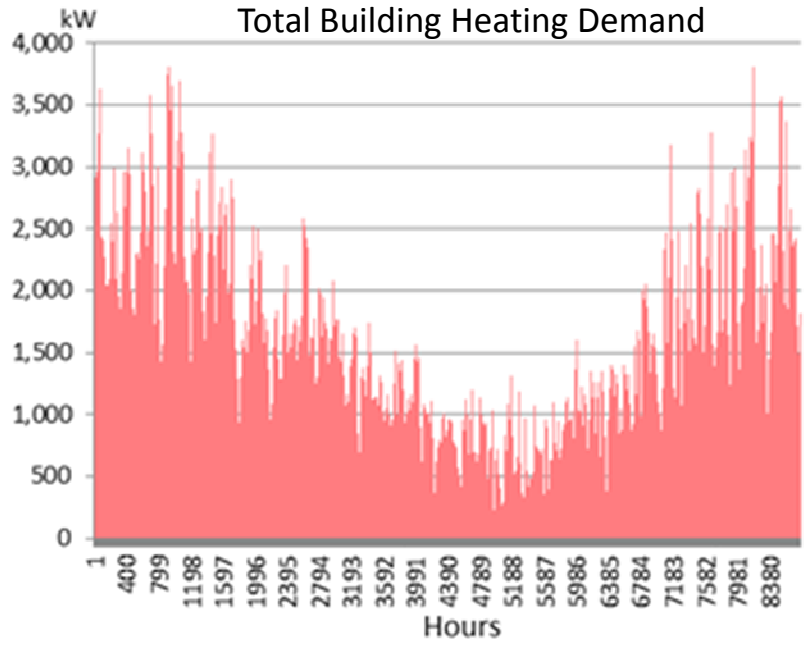
However - Biggest risk remains the building profile.
Mitigation is:
Long term management & monitoring by designer

Biggest Risk to Ground loop design is-
The anticipated building heating & profile

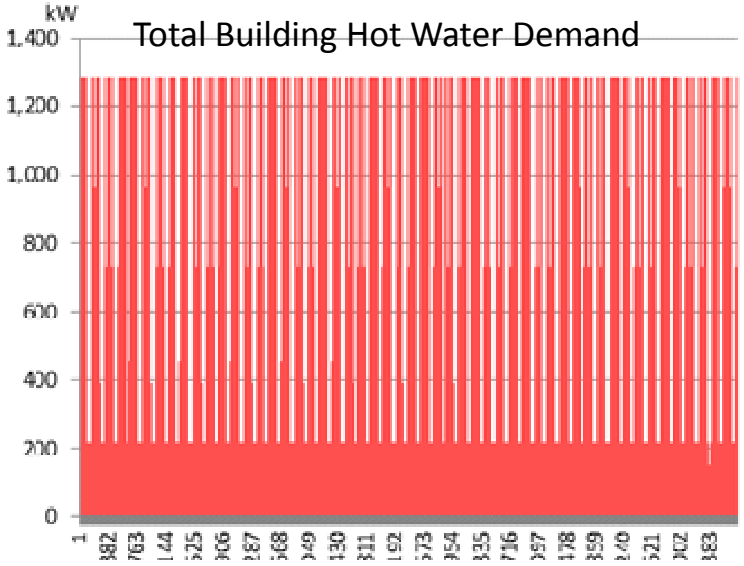
	TOTAL Heating	Peak Heating	TOTAL Hot Water	Peak Hot Water	TOTAL Cooling	Peak Cooling	Electricity	Electricity
	kWh	kW	kWh	kW	kWh	kW	kWh	kW
January	1,470,515		250,635	1,288	190,316		729,935	
February	1,335,411		221,382	1,288	169,331		644,348	
March	1,196,911		244,179	1,288	415,281		846,972	
April	940,445		234,428	1,288	405,720		821,854	
May	709,596		250,635	1,288	449,800		886,641	
June	436,403		234,428	1,288	812,187		1,002,914	
July	259,959		244,179	1,288	911,499	6,590	1,074,864	5,015
August	253,768		250,635	1,288	971,871		1,114,516	
September	440,649		227,971	1,288	529,591		868,819	
October	816,399		250,635	1,288	430,688		876,587	
November	1,142,586		240,884	1,288	273,464		775,073	
December	1,367,011	3,809	237,722	1,288	183,684		728,816	
TOTAL	**10,369,652**		**2,887,712**		**5,743,431**		**10,371,341**	
	Total Annual Space Heating Load		Total Annual Hot Water Heating Load		Total Annual Space cooling Load			

MEP Engineers Information

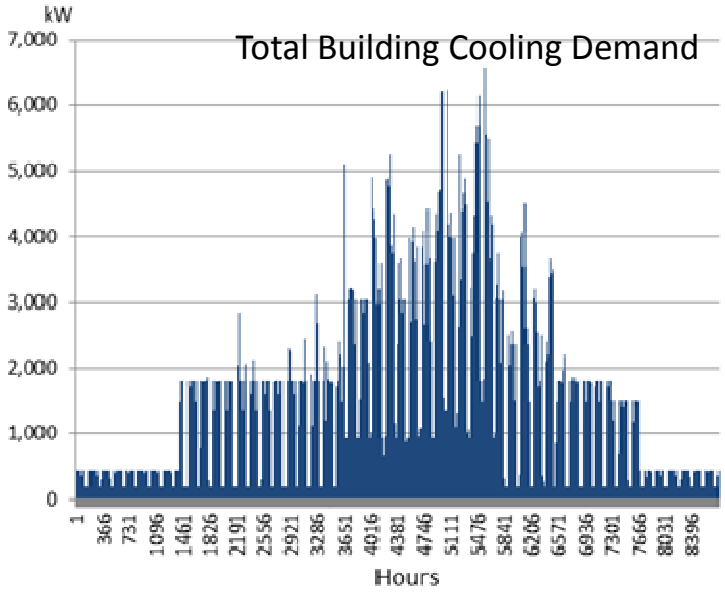
Total Building Heating Demand



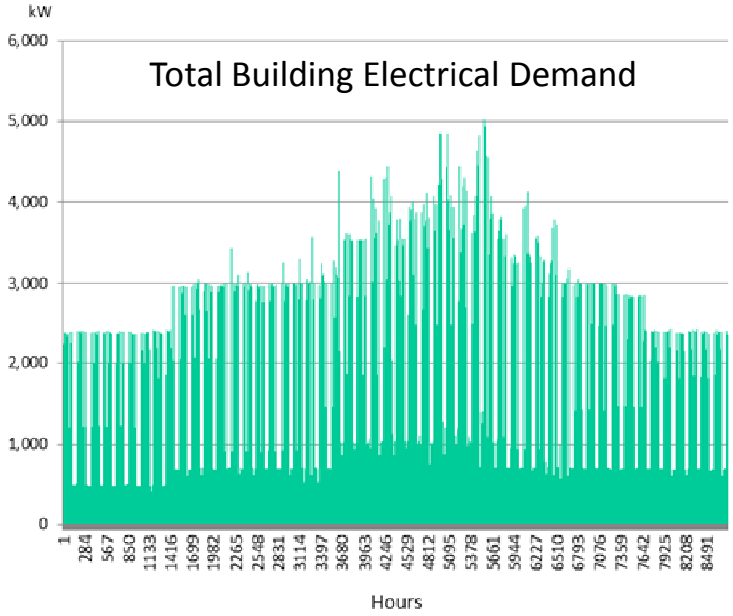
Total Building Hot Water Demand



Total Building Cooling Demand

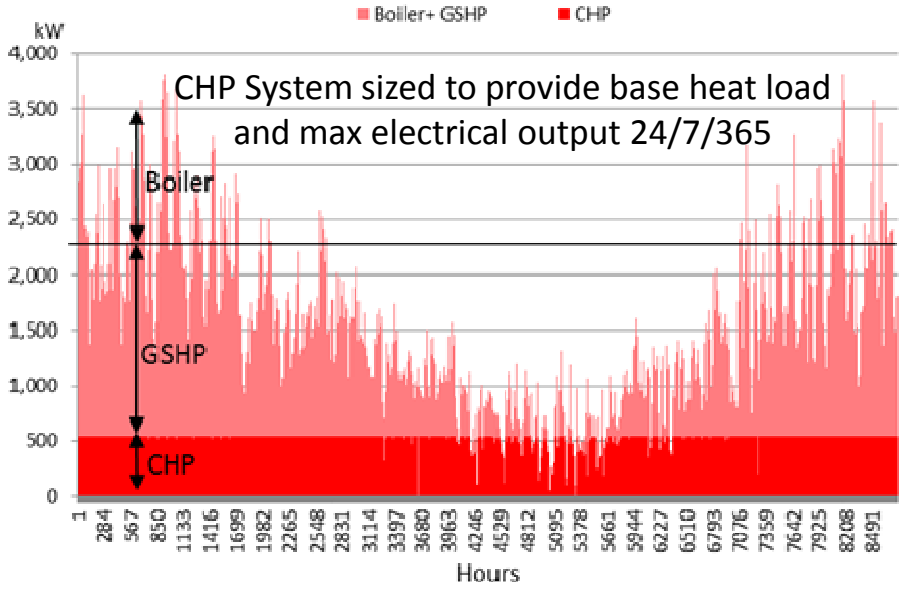


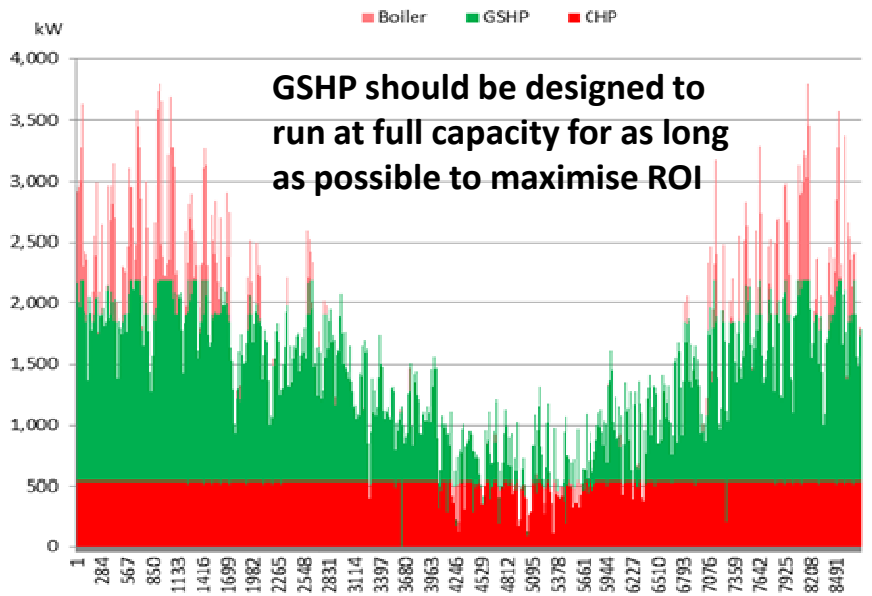
Total Building Electrical Demand



GI Energy Dynamic load profile

	HOT WATER SUPPLY		SPACE HEATING			SPACE COOLING		
	CHP (+80)	Boiler (+80)	CHP (+45)	GSHP (+45)	Boiler (+45)	Passive (+10)	GSHP (+10)	Chiller (+10)
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
January	197,215	53,421	284,676	1,018,772	167,067	90,071	100,244	0
February	171,016	50,365	257,763	921,974	155,674	81,467	87,864	0
March	191,434	52,744	283,228	843,230	70,453	67,684	347,210	386
April	180,425	54,002	274,669	648,989	16,787	15,014	384,527	6,178
May	197,215	53,421	272,692	436,817	87	2,884	432,169	14,747
June	182,039	52,389	223,398	213,005	0	242	572,009	239,936
July	190,670	53,509	175,059	84,900	0	0	605,020	306,479
August	196,092	54,543	170,880	82,887	0	0	623,750	348,121
September	180,418	47,553	233,116	207,532	0	0	430,288	99,303
October	194,915	55,720	277,218	530,566	8,615	16,764	412,415	1,509
November	189,786	51,098	276,560	806,434	59,592	33,254	240,210	0
December	185,034	52,688	290,380	937,943	138,688	66,705	116,979	0
TOTAL	**2,256,259**	**631,453**	**3,019,640**	**6,733,050**	**616,962**	**374,086**	**4,352,686**	**1,016,659**





But how accurate is it…One New Change, London

- System:
  - Piles & Open Loop
- Size:
  - 2,300kW Heating
  - 2,300kW Cooling
- Collector type:
  - 219 Energy Piles
  - Open Loop Wells
- Operational 2010
- BREEAM Excellent

Bovis Lend Lease

LandSecurities DEVELOPMENT

Cementation SKANSKA

BUT: How accurate is this information likely to be?

ONC Key Facts:
219 Energy piles combined with Open Loop

- 2,300kW Cooling
- 2,300kW Heating
- Completed 2010

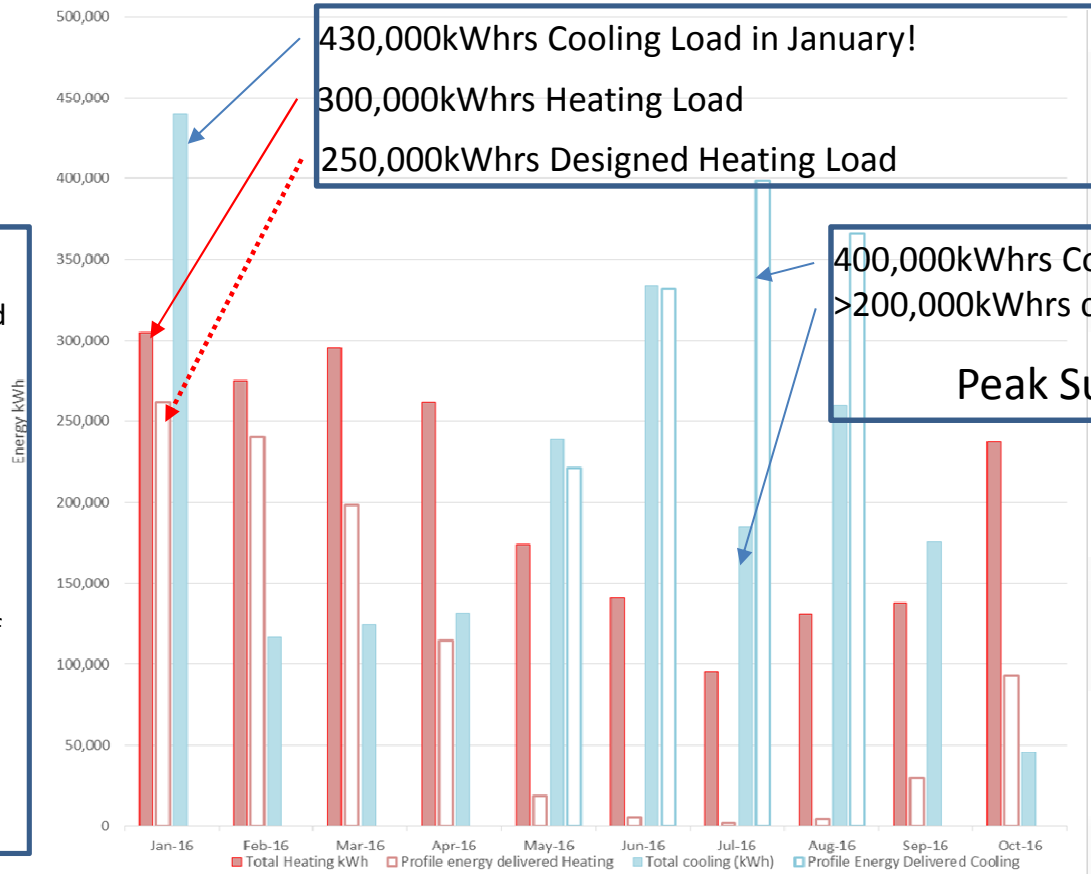
Headlines on System Operation

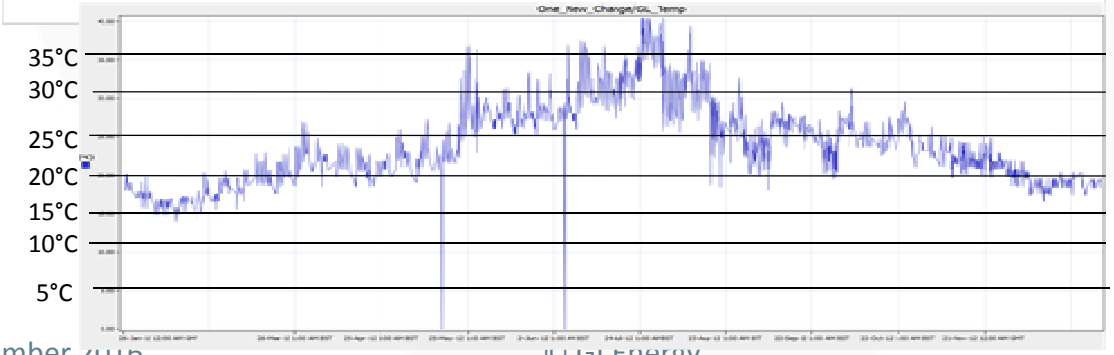
Global Annual Efficiency of the GSHP System **4.1**

Annual CO2 Savings **294 Tons**

Annual Financial Savings **£62,374**

One New Change Energy Delivered V Designed Profile





Actual Ground Loop Temperature

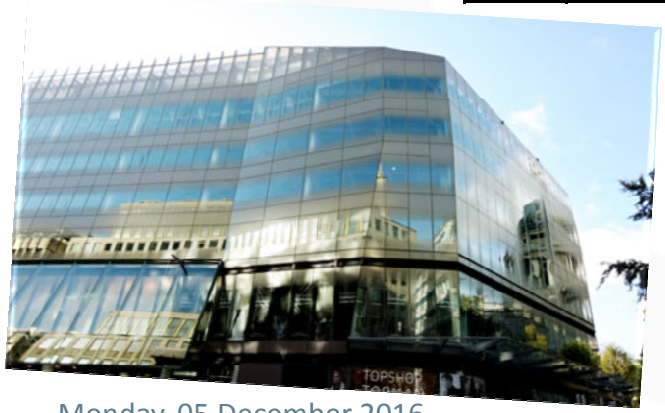
Heat pump – Typical daily cycle range is 4- 8°C

ONC -The reality

	Total Energy Delivered (kWh)		Profile (Energy del.) (kWh)	
2016	Total heating (kWh)	Total cooling (kWh)	Heating	Cooling
Jan	305,200	440,100	261,950	0
Feb	275,400	116,500	240,318	0
Mar	295,500	124,800	198,761	0
Apr	261,900	131,400	114,782	0
May	174,100	239,100	18,812	221,174
June	141,100	334,200	5,325	332,067
July	95,800	185,300	2,169	398,912
Aug	130,900	259,900	4,372	366,085
Sept	138,100	175,600	29,823	0
Oct	237,300	45,600	93,011	0
Nov			177,149	0
Dec			247,741	0
Tot	2,055,300	2,052,500	1,394,213	1,318,238

Key Facts:

- Ground Source Heat Pump with Open Loop
- 2,300kW Cooling
- 2,300kW Heating
- Completed 2010



Monday, 05 December 2016

Through system management we identified

- System running outside of design parameters
- Ground loop warmer than expected

Optimisation opportunities currently underway to

- Deliver enhanced heating supply to building
- Work ground loop harder
- use gas boilers less

Long Term System Management

Energy Pile solutions benefit most, from integrating other renewable /Low to Zero Carbon Technologies..

- Solar Thermal Solutions →
- Combined Heat & Power →
- Refrigeration waste heat →
- Passive Cooling

WASTE HEAT CAN BE CAPTURED ENHANCING OVERALLL GSHP SOLUTION

PROVIDE LONG TERM SYSTEM MANAGEMENT & OPTIMISATION

Design energy foundations as thermal stores

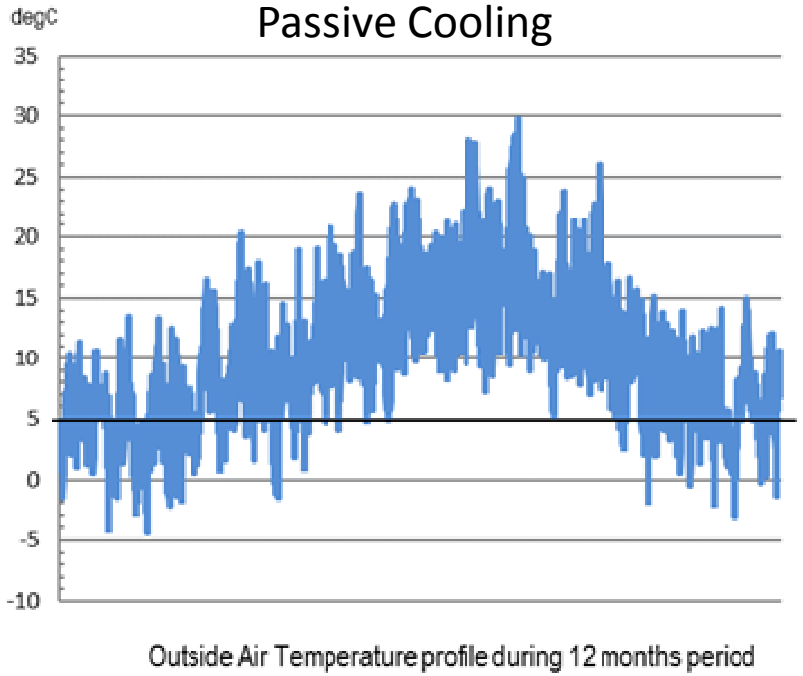
Deliver greater heating in winter > cool ground down

Deliver Summertime cooling from a cooler ground

GREATER ENERGY SAVINGS & CO2 SAVINGS

SYSTEM ENHANCEMENT - Passive Cooling & Heat Recovery

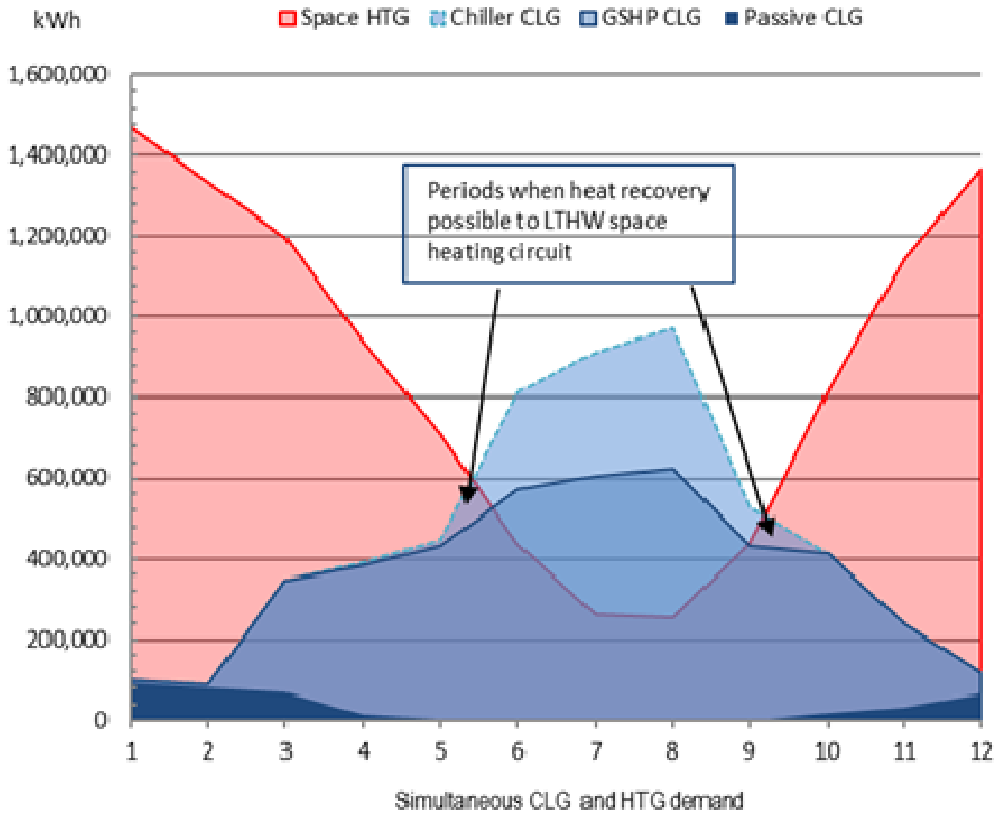
Passive Cooling



Outside Air Temperature profile during 12 months period

When the external temperature is at or below +5degC will coincide with building cooling demand. In the UK this estimated to be about 1550 hours per year.
During this period, passive cooling could be provided directly to the CHW circuit assisting the GSHP

Heat Recovery



Simultaneous CLG and HTG demand

Heat recovery from the chiller condenser water circuit - Reject waste heat from chillers directly into the LTHW space heating circuit.

CONNECT - PV Opportunity

Roof mounted PV

Using electricity generated on site is better than importing it.

Self Generation tariff = 2.03p/kWh (UK)
Import tariff = 9.5 to 14p/kWh(UK)

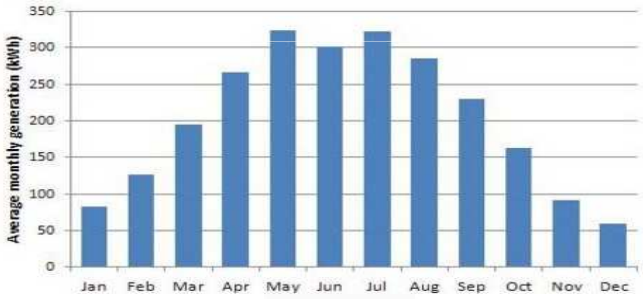
A GSHP with a COP of 4 running on electricity generates heat at **2.4p/kWh**.

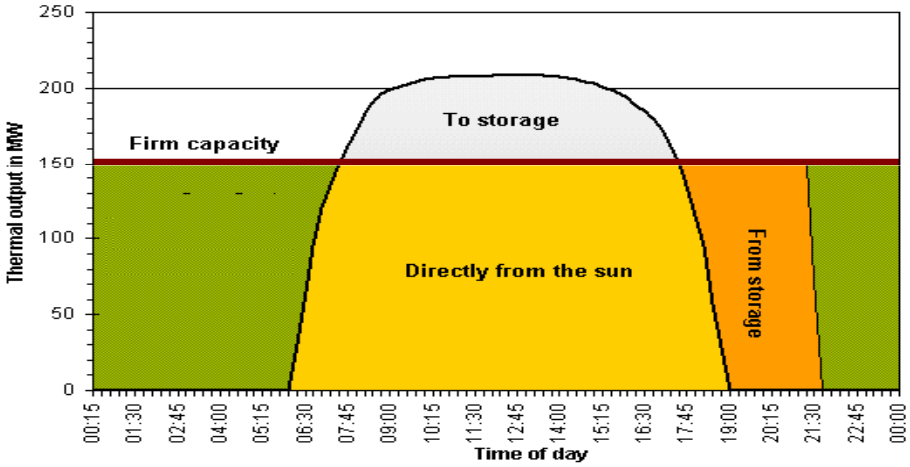
A GSHP running on PV electricity is effectively providing free heat

At Crossrail Depot this means a further saving of 281,270kWe/ annum x 2.4p = £6,750/ annum or £216,000 over the life time of the project

CONNECT - Solar Thermal

The size of thermal array limited by maximum energy used on hottest day of the year. 100% load only a few days of the year.

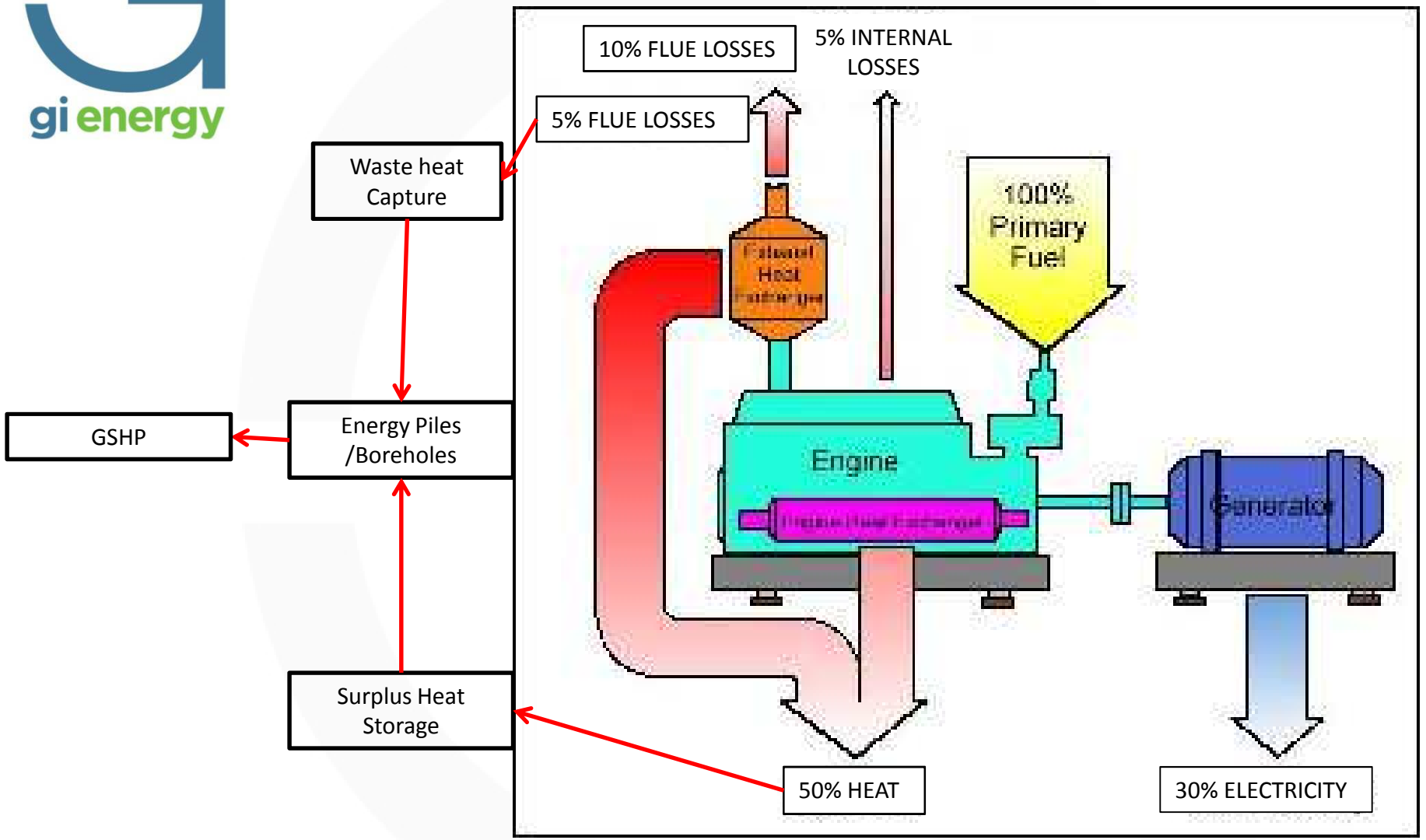


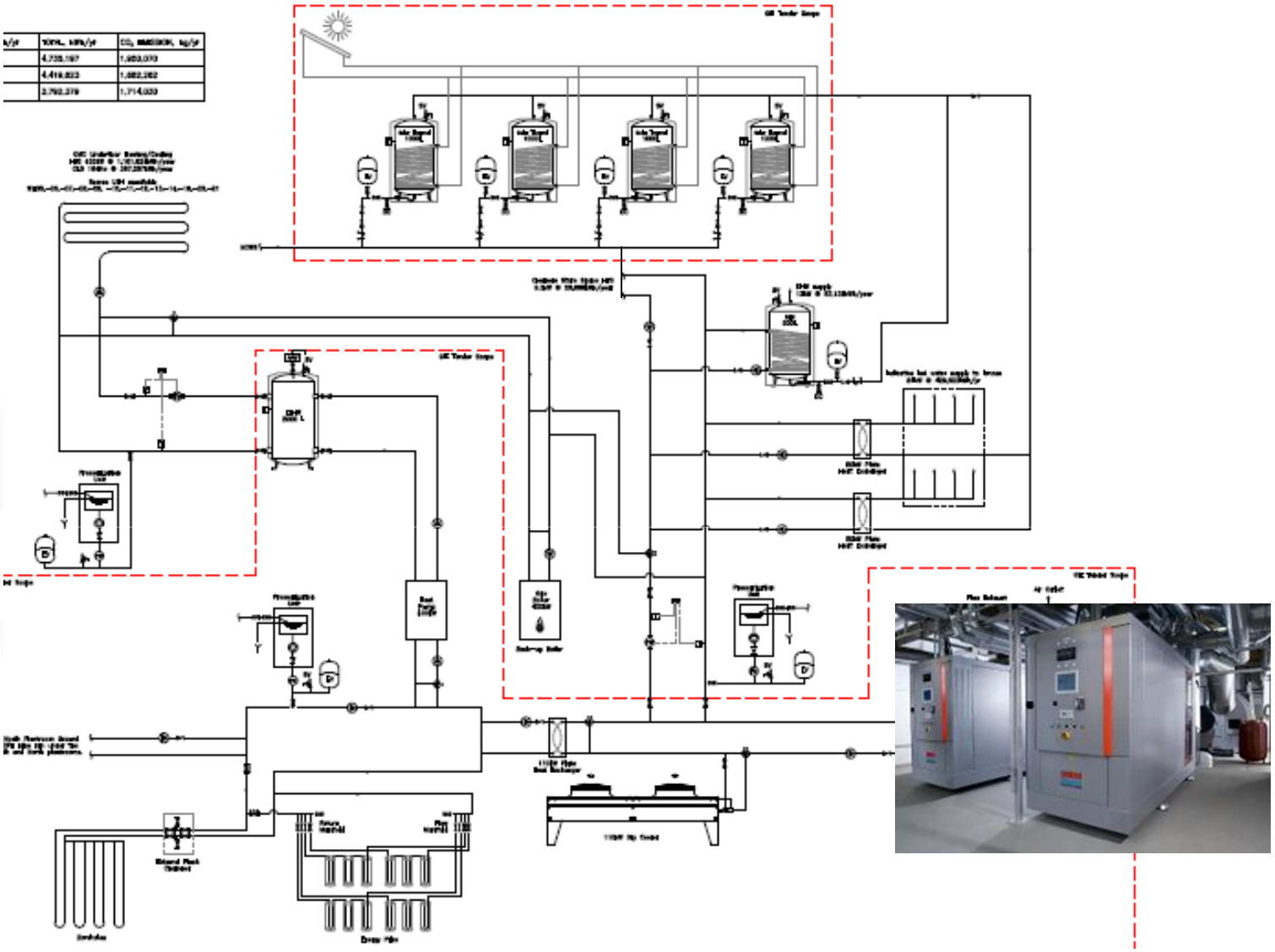


By capturing and storing the peak energy, we deliver a greater daily and annual load to satisfy more demand.

By storing a lower grade heat in the ground we can capture 5 times more energy from the sun than would ordinarily be used for DHW or heating only.

CHP Improvements when integrated with GSHP's





Heat recovery loop connected to Combined Heat & Power Unit will ensure that the ground loop is able to meet the peak heating load required throughout the heating season.

Lets Build it!

Important Considerations

All piling techniques use reinforcement.

The logical and economical step is to attach the geothermal loops to the reinforcing cage :

- Cage must robust enough to cope with transportation / lifting / installation
- Fabrication – on or off site, fusion welding is best under controlled conditions. Use bullet type shoes at base of loops. Must prevent leaks.
- What type of fixings – how and where – must prevent the loops from choking
- To overcome the potential to 'float' in wet concrete an additional weight of steel may be required

GOOD COORDINATION BETWEEN GEOTHERMAL TEAM & PILING CONTRACTOR ESSENTIAL

Proposed Piling Technique

Piling Contractors Responsibility

- Take delivery of loops
- Store and maintain in safe place
- Attach loops to reinforcement
- Provide Single bar, rigid enough for the depth
- Pipe protection at pile head
- Spacers
- Install Loop to designed depth without damage
- Use a vibrator if required – no mechanical surging
- Flush test

Installation of Geothermal Loops into 25m deep 900mm Rotary Bored Piles at Westminster Academy

Loop Delivery

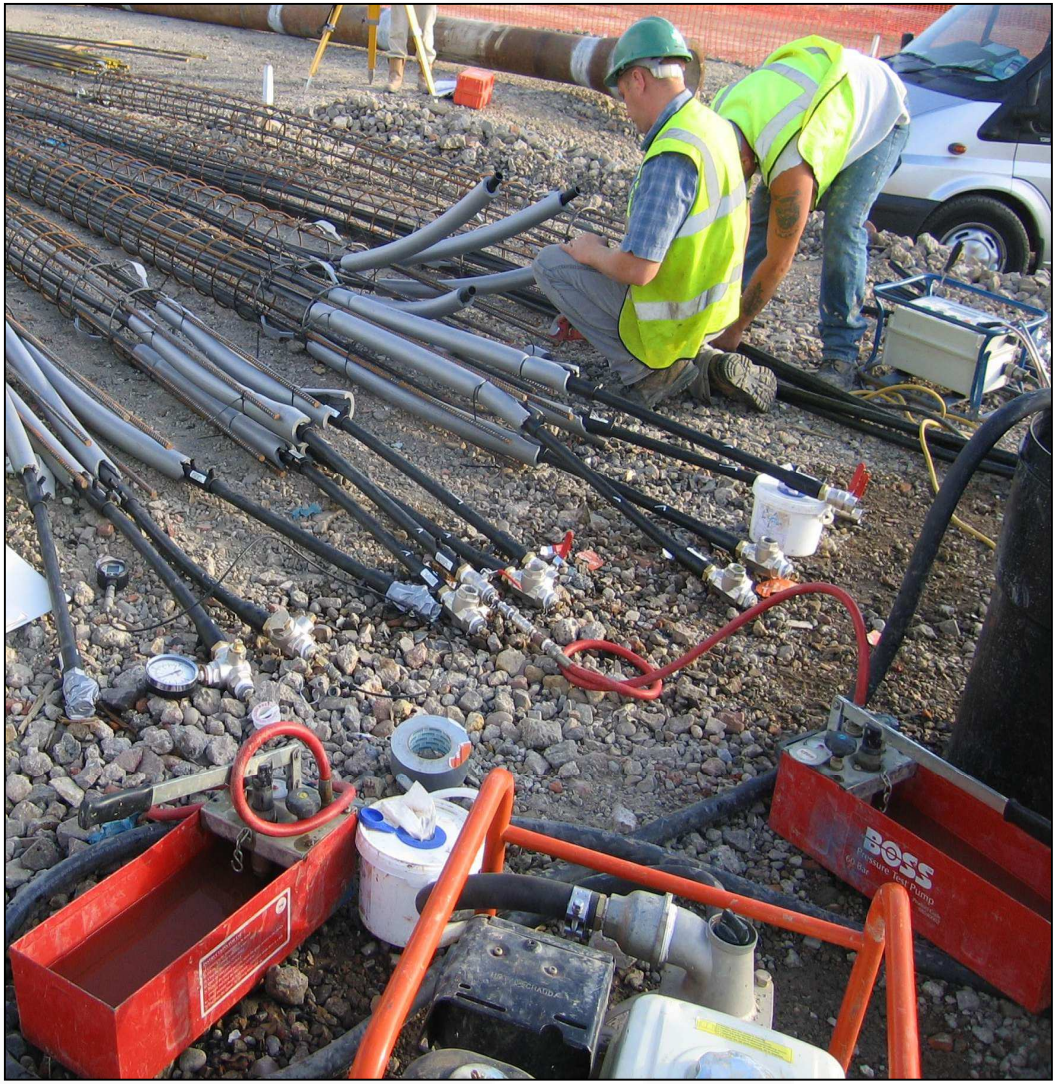
Pre-installation Quality Control & Testing

Protection to loops

- Foreign objects internally – block all ends
- Protect with foam or steel to prevent mechanical damage from pile trimming
- Dialogue with ground worker
- Protection from other trades

- Install full of water
- Preferably under pressure
- Testing involved for acceptance at every stage and handover

Non critical activity 10 minutes /pile



Ensure best practices, installation, laboratory testing, field testing

Good Practice

Bad practice

Installing the Loops

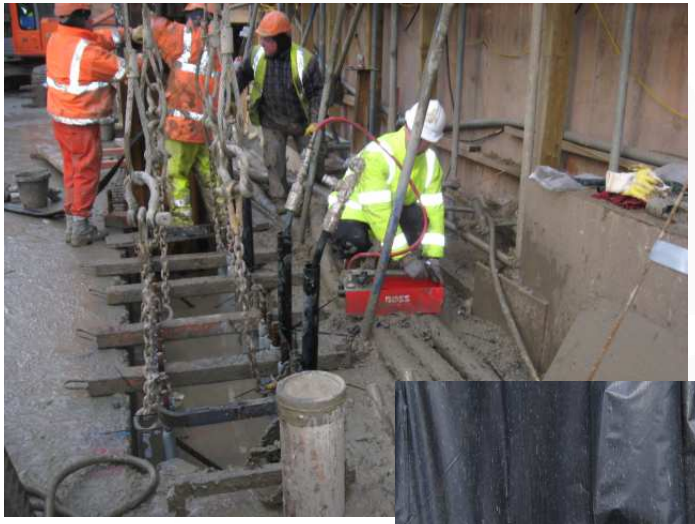
Loop Reeler

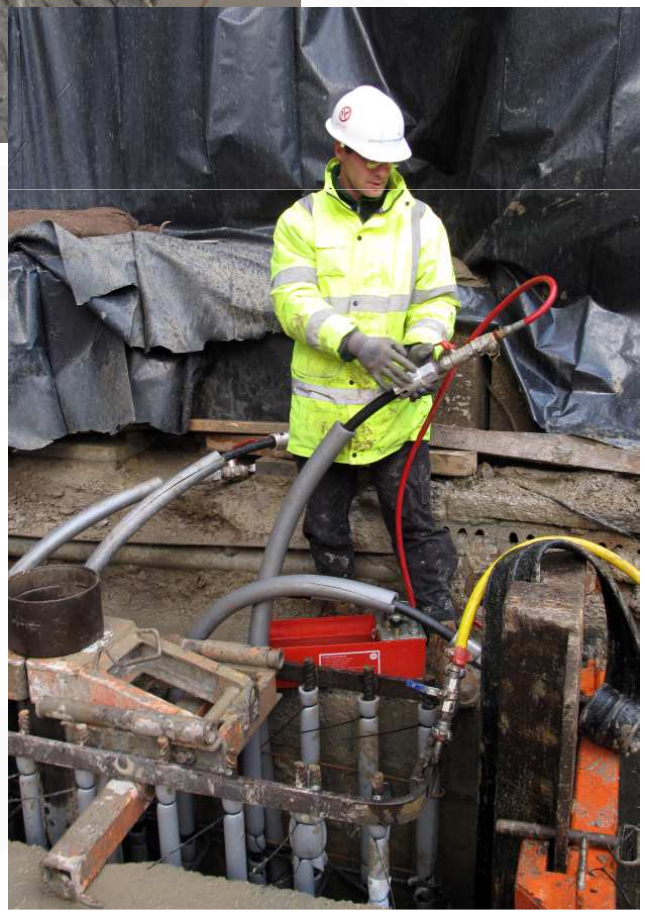
Loop Installation - piles

Joining the reinforcement cages

Fixing the loop protection in situ

Pre-concrete Pressure Test



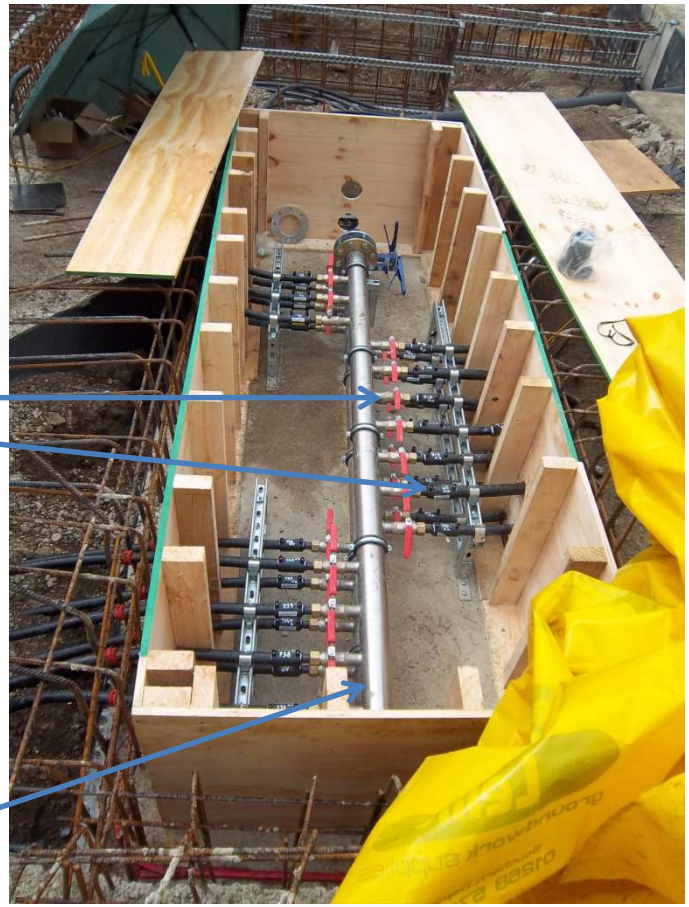


Design Requirements

- Loops to each pile need to be balanced and allow turbulent flow
- Decide how many piles are connected in series
  - Large piles with multiple loops - single flow and return to sub manifold
  - Small piles with single loops – combine groups of piles in series and run to sub manifolds
- Sub manifold chambers
  - Design to suit construction sequence / slab pour sequence
  - Enhance system resilience, by enabling smaller zones to be isolated
  - Locations will need to be identified and agreed with Architect at an early stage of the project
- Main flow and return manifold, located in the plant room bring together the field sub manifolds enabling combined flow through a dirt and air separator and circulation pumps ahead of passing through the heat pump and or plate frame heat exchanger.

Sub manifold chamber Options

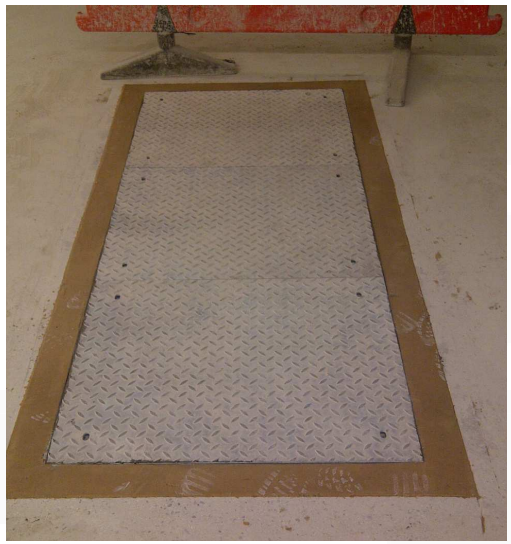
Sub Manifold Chamber



Flow & Return Loops from energy piles

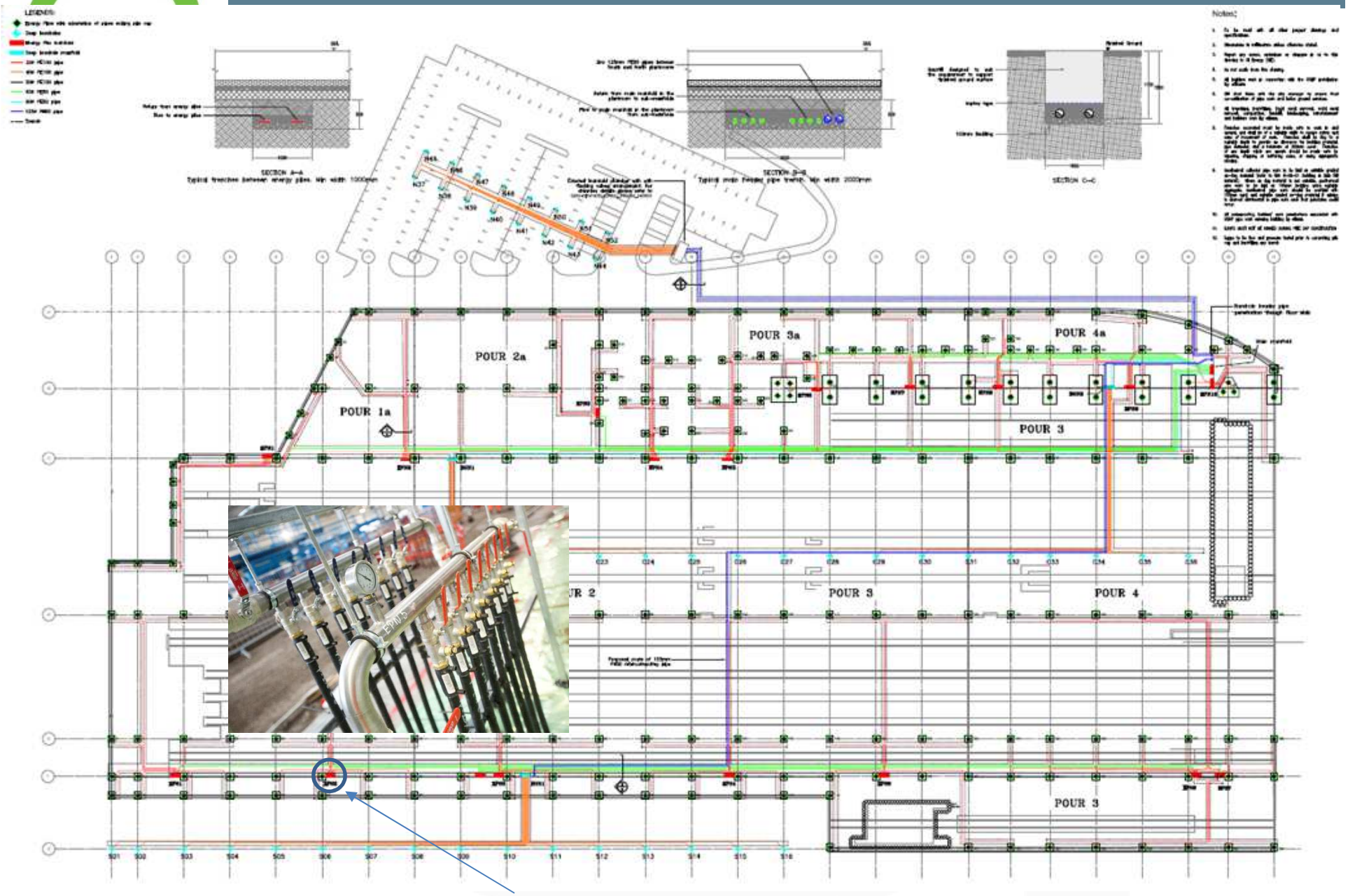
90mm Flow & Return Loop to plantroom

Completed Sub Manifold Chamber



Alternative Wall mounted Sub Manifold

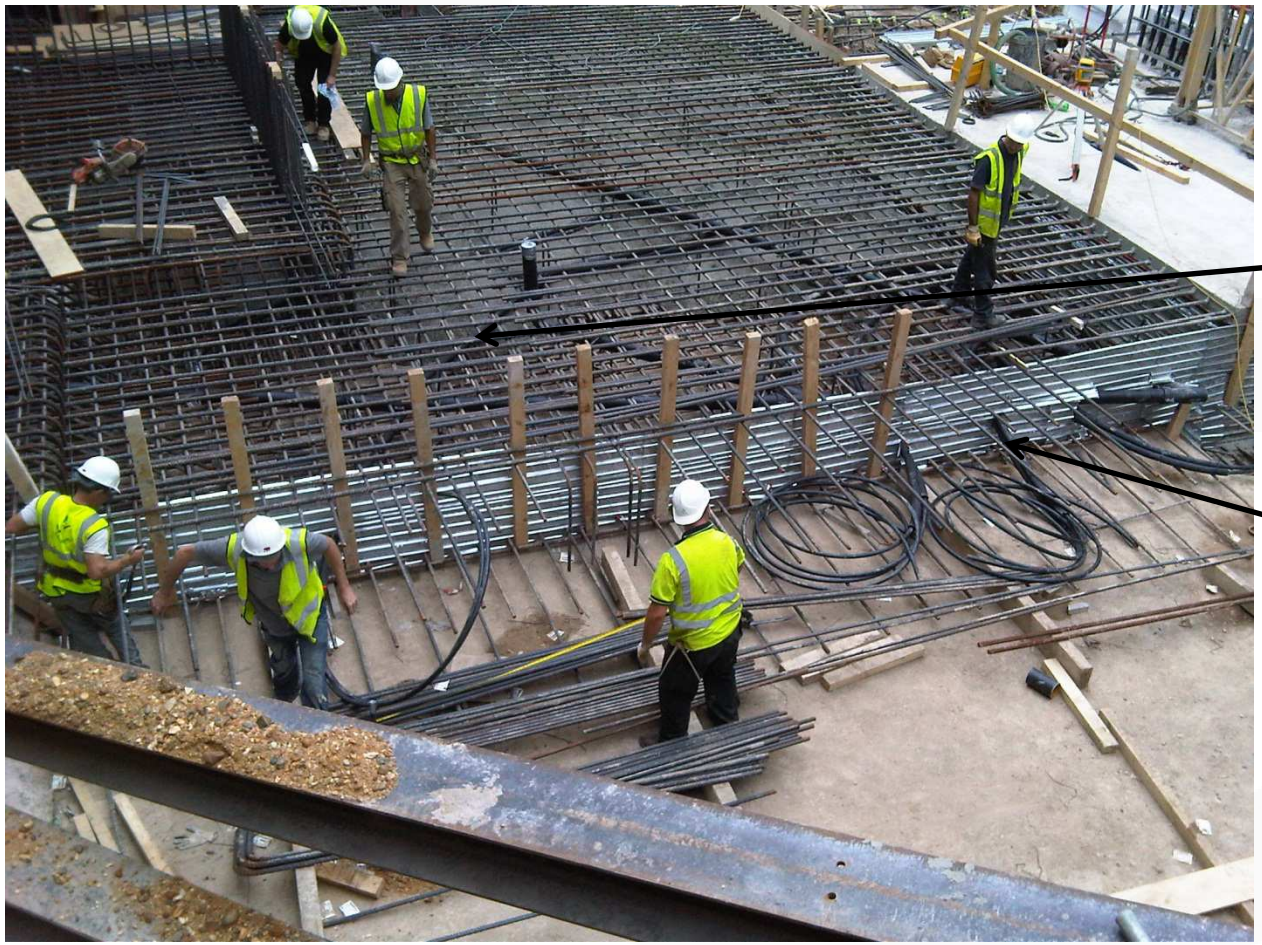
Illustrations - Combined Geothermal Technologies



Crossrail Depot 488 Piles > 20 sub manifolds> 2 Main Manifolds North & South Plant room

Headering Works

Proposed Detail – Lay loops on bottom mat of slab reinforcement – with good coordination - no critical path programme effects



Loops laid on bottom mat of reinforcement

Detail at edge of slab pour – Loops filled with water & pressurised

Crossrail Bond Street WTH - Capping beams with loops

Loops collecting up inside the capping beam

Loops at central collection point

Non Critical Path activities

•Flush, Dip test and pressure test of loops on site to verify no damage during pile trimming to approve commencement of main headering work

•Header pipe work from pile groups to sub manifold - pile to sub manifold, fill and flush test, leave under 4 bar pressure

Critical path activities

None other than risks associated with

• delay arising from damaged loop and trying to flush out any blockage

GOOD COORDINATION BETWEEN GEOTHERMAL TEAM & BUILDING CONTRACTOR ESSENTIAL

Headering Works

Key Hold Point

Flow & pressure test prior to concreting

Headering Works

Main flow returns to piles in Plant room

Wall mounted Sub Manifold

Ensure good practices, installation, laboratory testing, field testing

Good Practice

Bad Practice

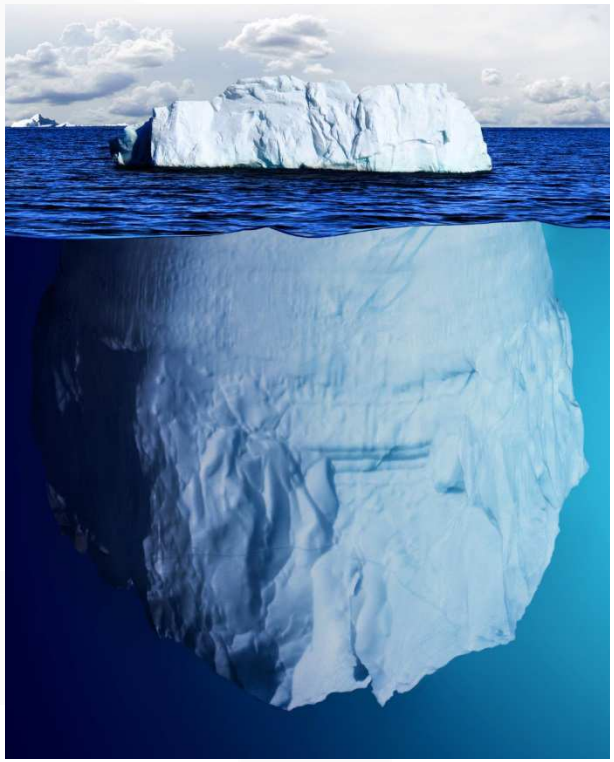
- 90°/ Straight Connections
- Gravel Bedding
- Coordinated Positions of joints
- Pressure test

Good Practice

Bad practice

Good Practice

Bad Practice



CONTROLS

MONITORING

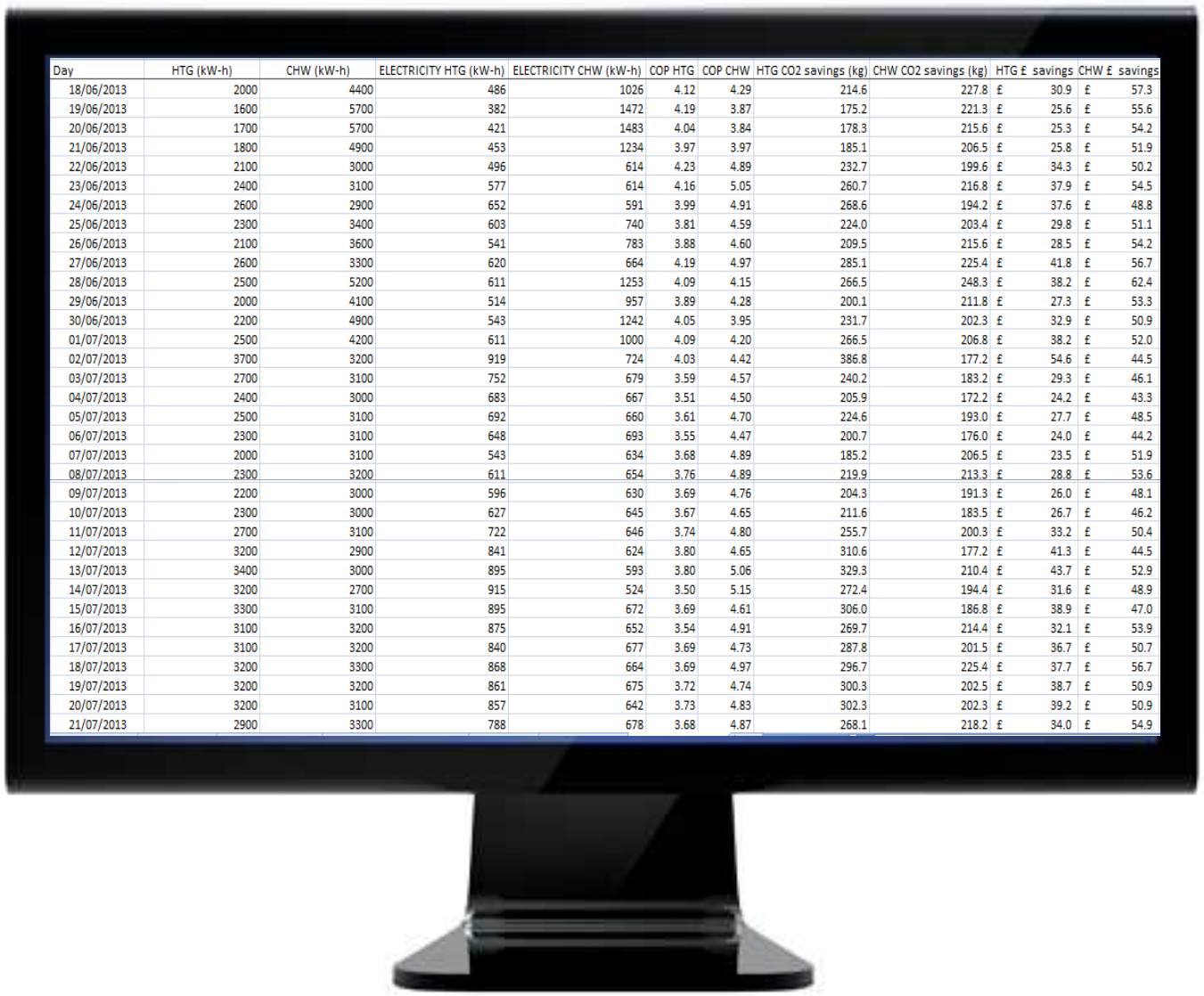
PERFORMANCE

MAINTENANCE

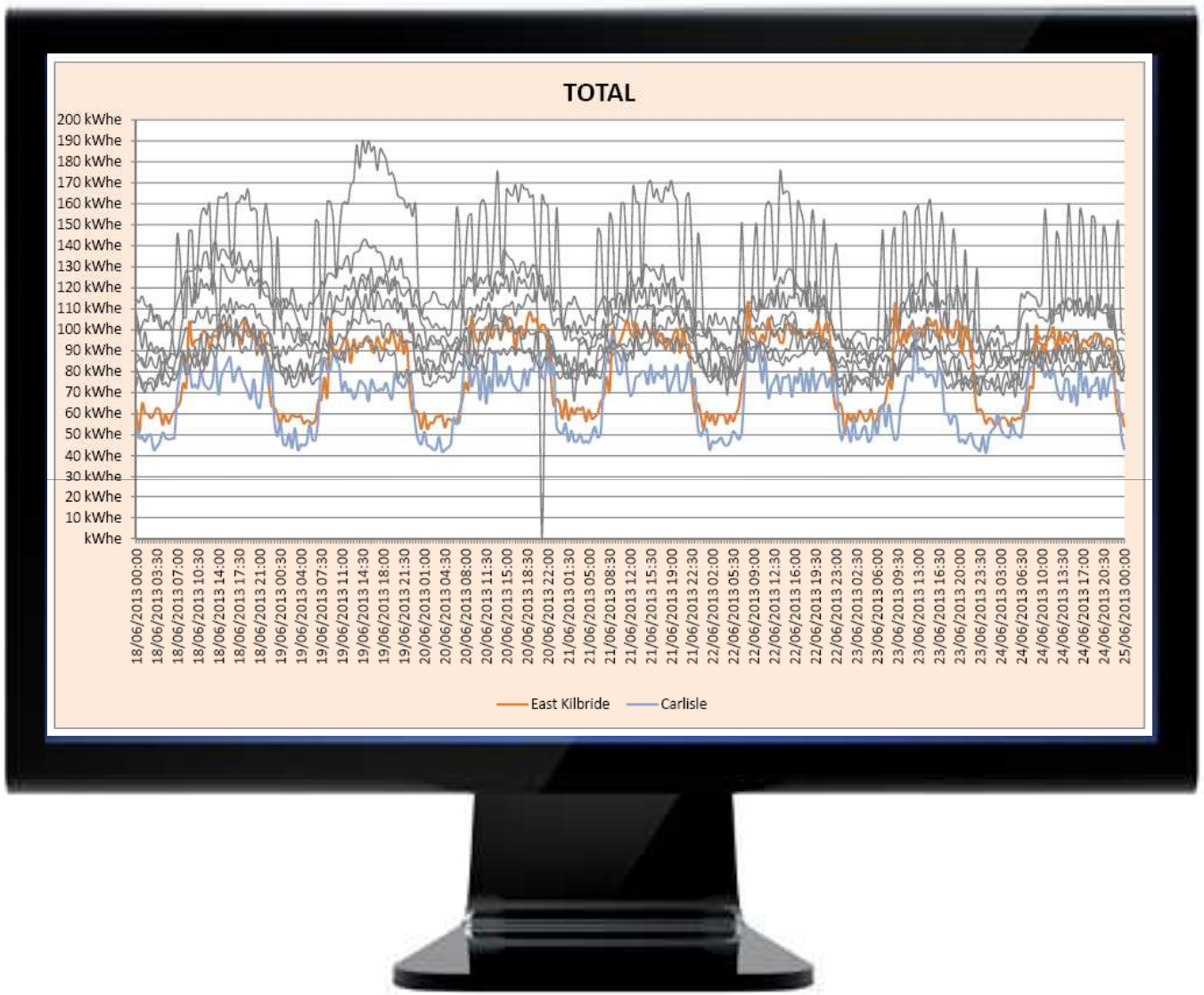
Completed Plant Room

Computer driven according to various scenarios

GI Controls



Day	HTG (kW-h)	CHW (kW-h)	ELECTRICITY HTG (kW-h)	ELECTRICITY CHW (kW-h)	COP HTG	COP CHW	HTG CO2 savings (kg)	CHW CO2 savings (kg)	HTG £ savings	CHW £ savings
18/06/2013	2000	4400	486	1026	4.12	4.29	214.6	227.8	£ 30.9	£ 57.3
19/06/2013	1600	5700	382	1472	4.19	3.87	175.2	221.3	£ 25.6	£ 55.6
20/06/2013	1700	5700	421	1483	4.04	3.84	178.3	215.6	£ 25.3	£ 54.2
21/06/2013	1800	4900	453	1234	3.97	3.97	185.1	206.5	£ 25.8	£ 51.9
22/06/2013	2100	3000	496	614	4.23	4.89	232.7	199.6	£ 34.3	£ 50.2
23/06/2013	2400	3100	577	614	4.16	5.05	260.7	216.8	£ 37.9	£ 54.5
24/06/2013	2600	2900	652	591	3.99	4.91	268.6	194.2	£ 37.6	£ 48.8
25/06/2013	2300	3400	603	740	3.81	4.59	224.0	203.4	£ 29.8	£ 51.1
26/06/2013	2100	3600	541	783	3.88	4.60	209.5	215.6	£ 28.5	£ 54.2
27/06/2013	2600	3300	620	664	4.19	4.97	285.1	225.4	£ 41.8	£ 56.7
28/06/2013	2500	5200	611	1253	4.09	4.15	266.5	248.3	£ 38.2	£ 62.4
29/06/2013	2000	4100	514	957	3.89	4.28	200.1	211.8	£ 27.3	£ 53.3
30/06/2013	2200	4900	543	1242	4.05	3.95	231.7	202.3	£ 32.9	£ 50.9
01/07/2013	2500	4200	611	1000	4.09	4.20	266.5	206.8	£ 38.2	£ 52.0
02/07/2013	3700	3200	919	724	4.03	4.42	386.8	177.2	£ 54.6	£ 44.5
03/07/2013	2700	3100	752	679	3.59	4.57	240.2	183.2	£ 29.3	£ 46.1
04/07/2013	2400	3000	683	667	3.51	4.50	205.9	172.2	£ 24.2	£ 43.3
05/07/2013	2500	3100	692	660	3.61	4.70	224.6	193.0	£ 27.7	£ 48.5
06/07/2013	2300	3100	648	693	3.55	4.47	200.7	176.0	£ 24.0	£ 44.2
07/07/2013	2000	3100	543	634	3.68	4.89	185.2	206.5	£ 23.5	£ 51.9
08/07/2013	2300	3200	611	654	3.76	4.89	219.9	213.3	£ 28.8	£ 53.6
09/07/2013	2200	3000	596	630	3.69	4.76	204.3	191.3	£ 26.0	£ 48.1
10/07/2013	2300	3000	627	645	3.67	4.65	211.6	183.5	£ 26.7	£ 46.2
11/07/2013	2700	3100	722	646	3.74	4.80	255.7	200.3	£ 33.2	£ 50.4
12/07/2013	3200	2900	841	624	3.80	4.65	310.6	177.2	£ 41.3	£ 44.5
13/07/2013	3400	3000	895	593	3.80	5.06	329.3	210.4	£ 43.7	£ 52.9
14/07/2013	3200	2700	915	524	3.50	5.15	272.4	194.4	£ 31.6	£ 48.9
15/07/2013	3300	3100	895	672	3.69	4.61	306.0	186.8	£ 38.9	£ 47.0
16/07/2013	3100	3200	875	652	3.54	4.91	269.7	214.4	£ 32.1	£ 53.9
17/07/2013	3100	3200	840	677	3.69	4.73	287.8	201.5	£ 36.7	£ 50.7
18/07/2013	3200	3300	868	664	3.69	4.97	296.7	225.4	£ 37.7	£ 56.7
19/07/2013	3200	3200	861	675	3.72	4.74	300.3	202.5	£ 38.7	£ 50.9
20/07/2013	3200	3100	857	642	3.73	4.83	302.3	202.3	£ 39.2	£ 50.9
21/07/2013	2900	3300	788	678	3.68	4.87	268.1	218.2	£ 34.0	£ 54.9

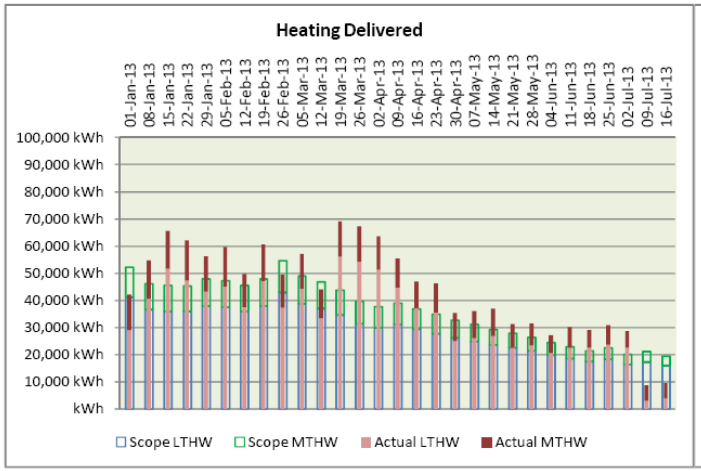

TOTAL
200 kWhe
190 kWhe
180 kWhe
170 kWhe
160 kWhe
150 kWhe
140 kWhe
130 kWhe
120 kWhe
110 kWhe
100 kWhe
90 kWhe
80 kWhe
70 kWhe
60 kWhe
50 kWhe
40 kWhe
30 kWhe
20 kWhe
10 kWhe
kWhe
East Kilbride
Carlisle

Performance analysis

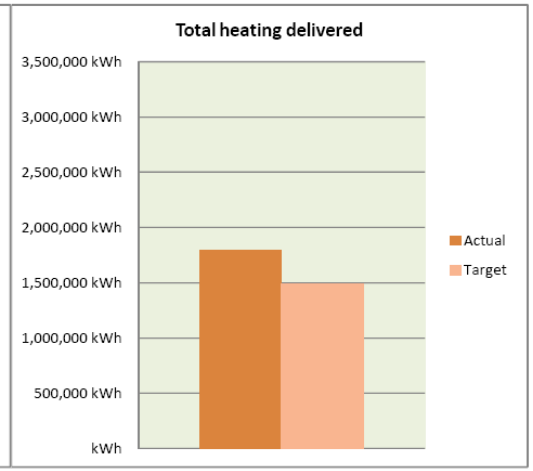
Performance analysis – Trends and Totals

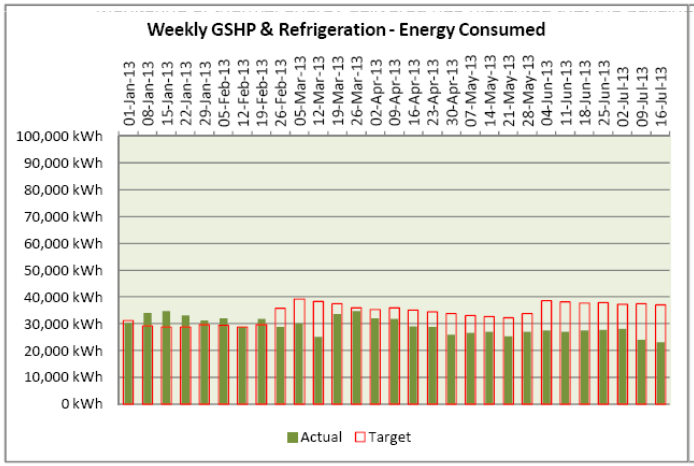
Energy delivered and consumed

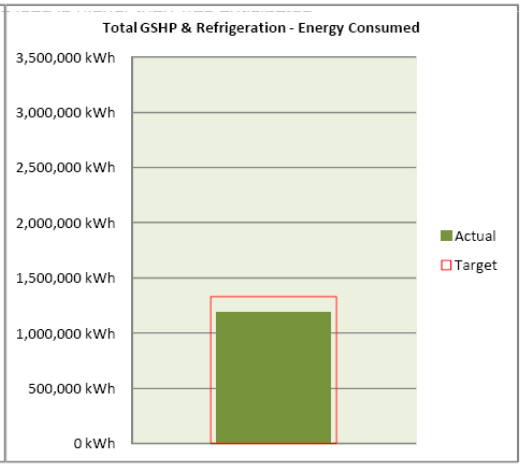
Weekly trends



Period totals

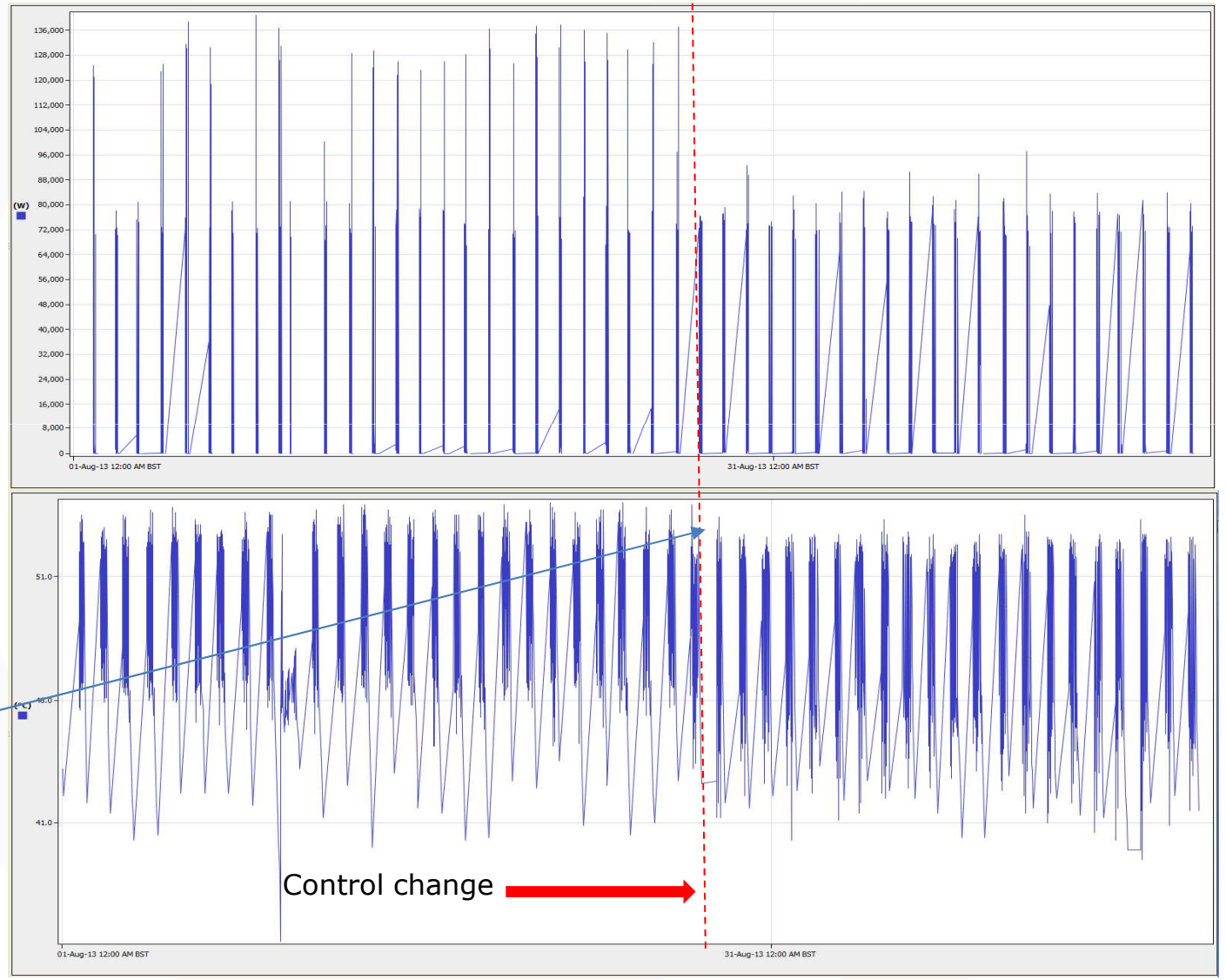






FINE TUNING

DHWP_PI Loop Point	
Out	8.0 {ok}
Loop Enable	true {ok} @ 10
Controlled Variable	47.1 {ok}
Setpoint	51.0 {ok} @ def
Loop Action	Reverse
Proportional Constant	0.500
Integral Constant	0.200
Derivative Constant	0.000
Maximum Output	34.00
Minimum Output	0.00



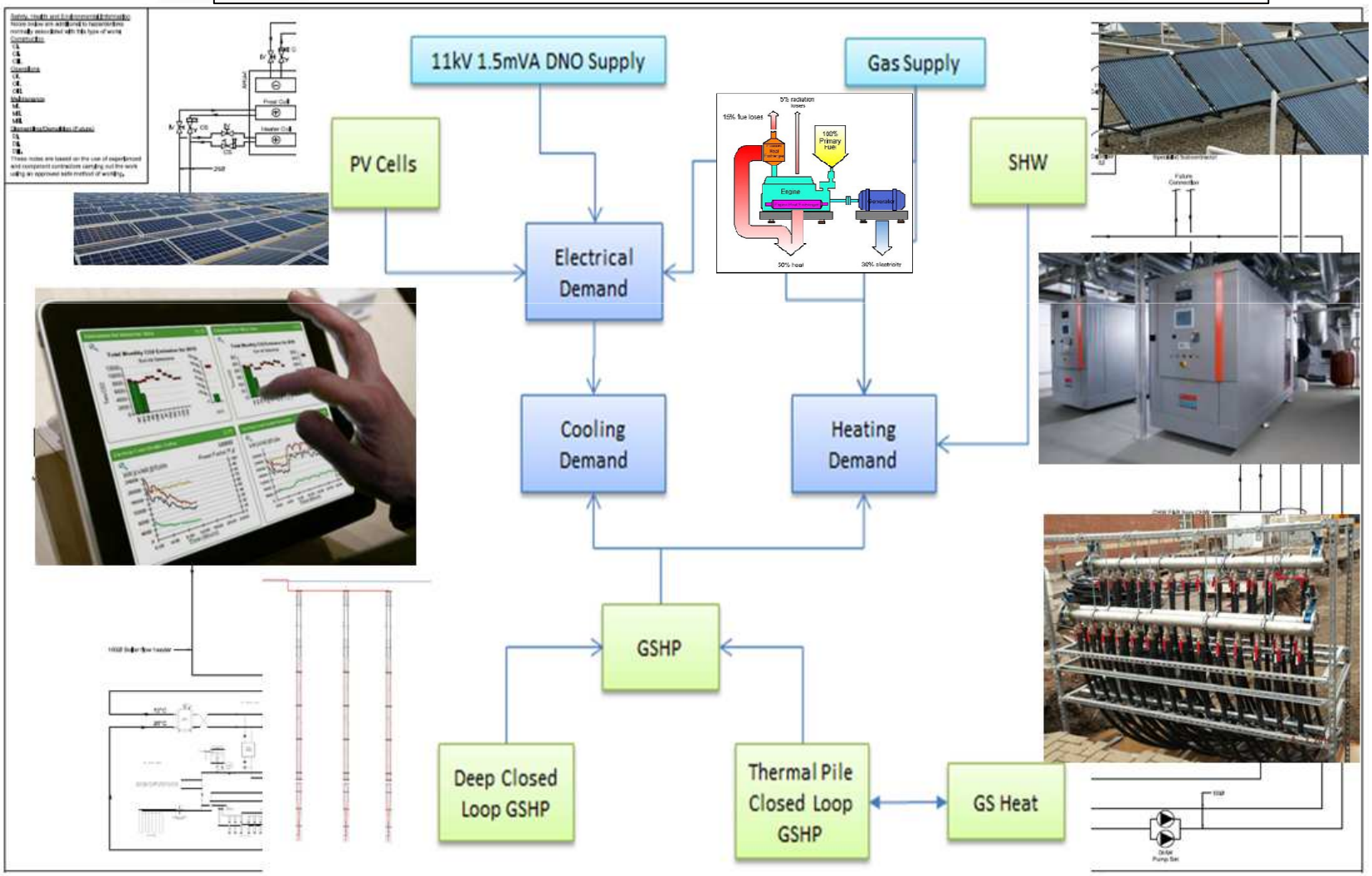
Reducing Set point on heat pump by 1°C Saved £15K/year

ESSENTIAL

Long term Management & System Optimisation

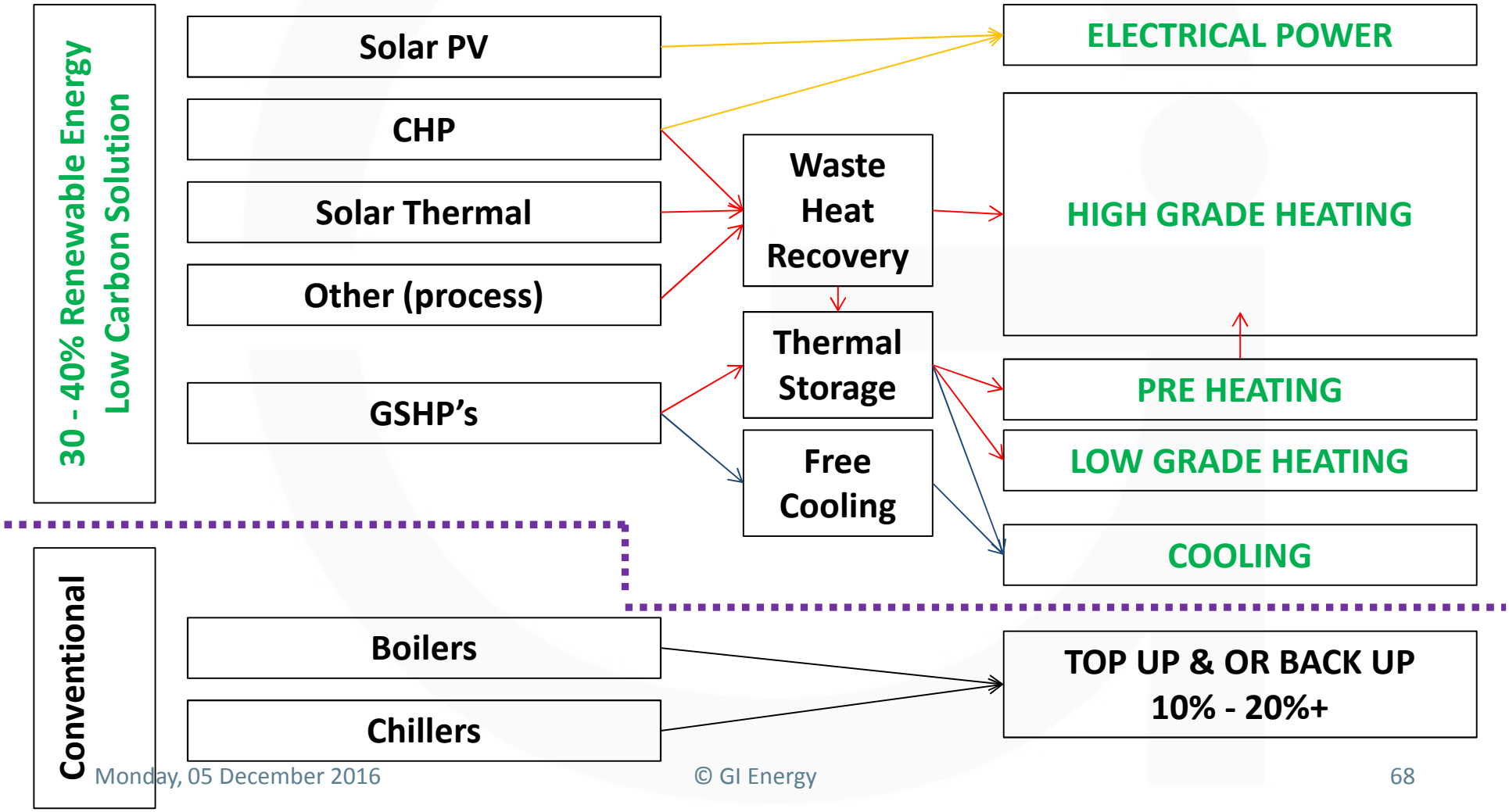
DO NOT

WALK AWAY



GI ENERGY
Supply & Management

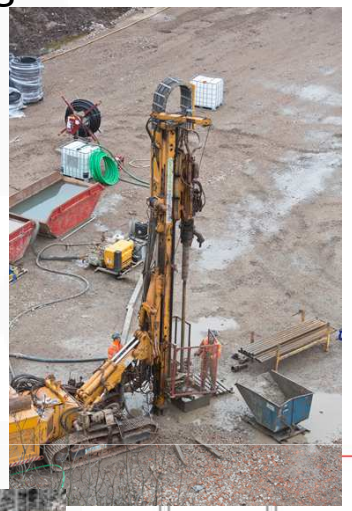
Aim
Long Term System Optimisation
Maximising CO2 & Run Cost Savings

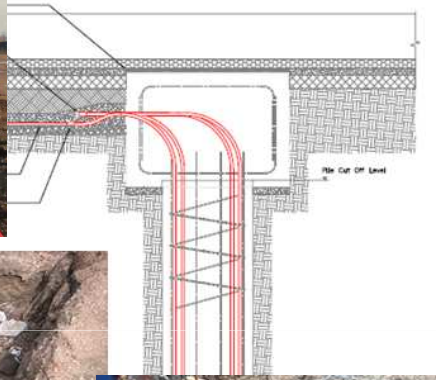


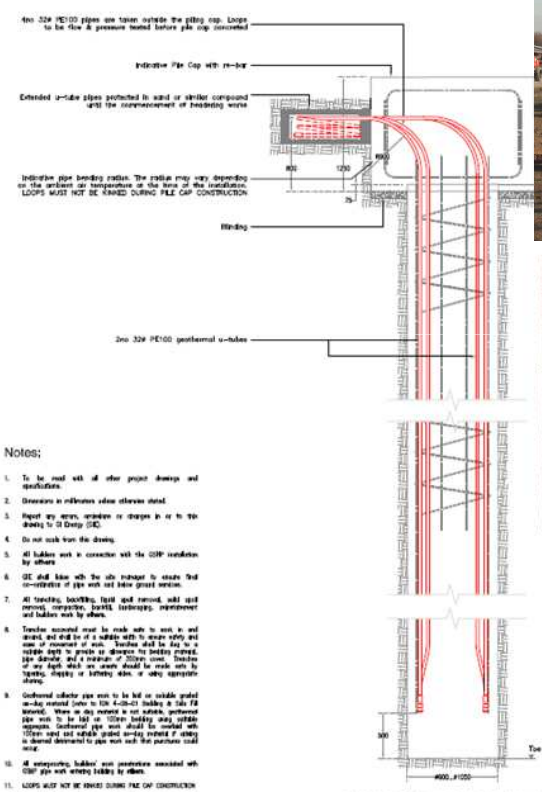
Illustrations – Geothermal piles and boreholes

Crossrail Depot

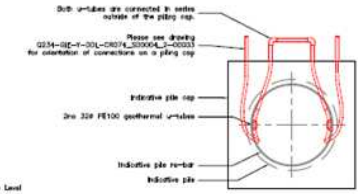
466no Energy piles and 52 no boreholes will deliver 1000kWth heating and 600kWth cooling

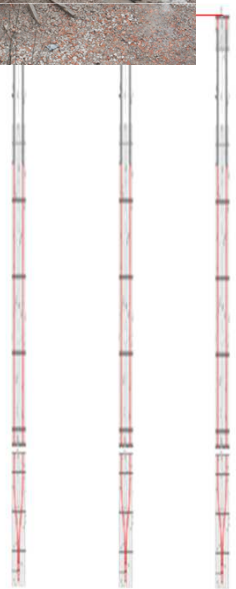






ENERGY PILE DURING CONSTRUCTION PHASE





Notes:

1. To be read with all other project drawings and specifications.
2. Dimensions in millimetres unless otherwise stated.
3. Report any errors, omissions or changes in or to this drawing to GI Energy (Ltd).
4. Do not scale from this drawing.
5. All builders work in connection with the GSHP installation by others
6. GSE shall liaise with the site manager to ensure final co-ordination of pipe work and below ground services.
7. All trenching, backfilling, liquid spoil removal, solid spoil removal, compaction, backfill, landscaping, reinstatement and builders work by others.
8. Trenches excavated must be made safe to work in and around, and shall be of a suitable width to ensure safety and ease of movement of men. Trenches shall be dug to a suitable depth to provide an allowance for bedding material, pipe diameter, and a minimum of 350mm cover. Trenches of any depth which are unsafe should be made safe by battering, shoring or bottoming out, or using appropriate shoring.
9. Geothermal collector pipe work to be laid on suitable graded un-dug material (refer to SDK 4-08-01 Building in Side Fill Material). Where an dug material is not suitable, geothermal pipe work to be laid on 150mm bedding using suitable aggregate. Geothermal pipe work should be overlaid with 150mm sand and suitable graded un-dug material if arising in material detrimental to pipe work such that punctures could occur.
10. All waterproofing, builders' work penetrations associated with GSHP pipe work entering building by others.
11. LOOPS MUST NOT BE KINKED DURING PILE CAP CONSTRUCTION
12. Loops to be flow and pressure tested prior to concreting pile cap and backfilling any trench.

Through our controls & long term management we will be looking to outperform on current assessed performance..

Based Upon Electrical, Heating and cooling profiles provided by Atkins

- 54% Heating and cooling will be provided from renewable technology
- 20% of electrical load generated on site from CHP / Solar PV
- 33% Renewable energy solution

Providing Demonstrated Savings Of.....

- Run cost savings £97,000 per annum when compared against conventional equipment
- Renewable Heat Incentive £193,628/ annum
- 530Tonnes of CO2 per annum
- Potential payback on investment < 10 Years

Ultimately

GI Energy's Solution will reduce the clients projected energy costs over the 32 year contract term by approx. £10.5M (a projected 1500% ROI on £700k capex increase and a 450% ROI on the total renewable energies package)

thank you

www.gienergy.net

GI Energy Headquarters

Contact - Tony Amis

tony.amis@gienergy.co.uk

Shillingwood House

Westwood Way

Westwood Business Park

Coventry

West midlands

CV4 8JZ

Email tony.amis@gienergy.net
Mobile: +44 (0)7595 278 428
Phone: +44 (0)2476 850 403

www.gienergy.net