ENERGY STRATEGY

FOR

ACTON GARDENS

DISTRICT HEATING
MASTERPLAN ADDENDUM

VERSION 0.3

Issued by:-

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Revision V0.3

Date of first issue – 23 October 2020

Prepared by: Andrew Sturt

Revision	Date	Details	Changes	Author	Checked
0.1	18 Nov 20	Draft	Heat network temperature lowered	A Sturt	
0.2	27 Nov 20	Planning Issue	Minor alterations	A Sturt	
0.3	14 Jan 21	Planning Issue	Metering and Monitoring details included	A Sturt	A. Singh

EXECUTIVE SUMMARY

Silcock Dawson and Partners have been appointed by Countryside to provide an addendum to the District Heating Masterplan prepared by Hodkinson Consultancy in January 2020. The masterplan describes a strategy for heat generation and methodology for installing the distribution pipe network to installed and proposed phases of the development.

The aim of this report is to document the findings of the investigation into alternative heat sources to minimise future fuel costs for the residents whilst developing a scheme that will continue to comply with forthcoming Part L amendments and GLA energy target updates.

The district heating network has already commenced and will continue as future phases are constructed, however due to the complexity with crossing Bollo Bridge Road and the relatively low heat demand from the phases to the South of the road it is proposed that phases 1, 2, and 3.1 will not be connected to the network, and instead retain their independent plant as currently installed and operating. Therefore Phases 1, 2, and 3.1 are excluded from this assessment leaving 2933dwellings with a useful floor area of 218,547m^2 is considered within this addendum.

The baseline energy use has been determined from the benchmark data from similar projects. Current GLA guidance requires all dwellings to reduce emissions from the baseline by 10%. The specific measures taken to achieve this target are a matter for the future applications and are not discussed in this report. Phases that are complete, or are in construction were assessed at the time when it was only necessary to not be worse than the baseline building.

The change of carbon factors described within SAP 10, which are intended to more closely reflect the emission rates in the gas and electricity networks has a significant effect on the performance of combined heat and power plant, to the point where CO_2 emissions increase when CHP plant is in operation. This addendum therefore proposes a change to the strategy, by omitting the central CHP plant and installing air source heat pumps as alternative technology to provide renewable heat for the development.

The heat network will continue to follow the principles of the District Heating Masterplan and will continue to be designed and installed in accordance with CIBSE CP1 (Code of Practice for Heat Networks in the UK)

The central plant serving the development is proposed to be located within Phase 7.2, and an eventual air source heat pump installation with a total capacity of around 1700kW mounted at roof level. The boilers and heat pumps are modular and the system will be designed to allow the capacity to generate heat from both gas fired plant and heat pumps to be increased as the connected load to the heat network increases.

Existing phases and those in construction are designed to connect into a series of sub plant rooms that replicate the design operating conditions of a network fed from a CHP lead district heating system, which deliver higher temperature hot water than would be expected from a heat pump lead system. To maintain high efficiencies from the energy centre it is proposed that heat will continue to be supplied to all Phases (with the exception of 1,2 and 3.1), however, the sub plant rooms will be retained and used to raise the water temperature from the heat network to their current operating temperatures.

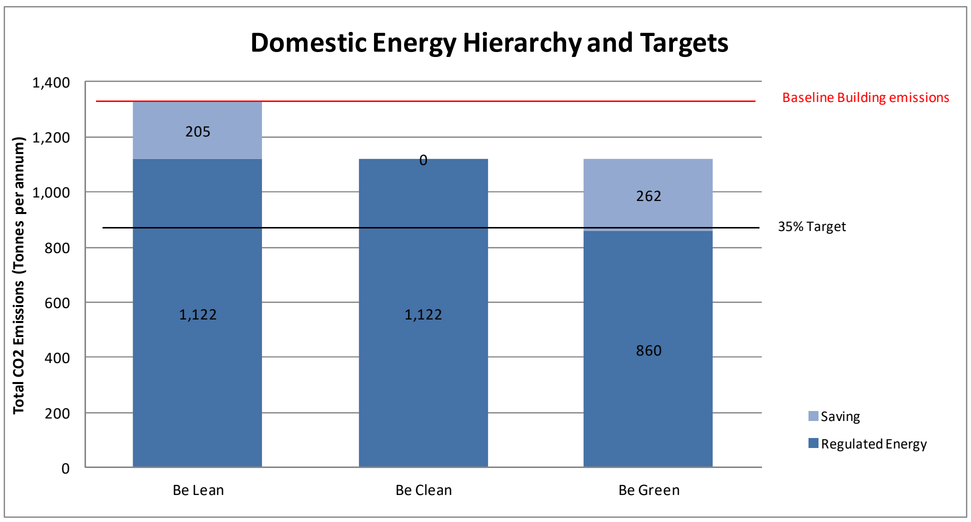
This arrangement will allow the heat pumps to supply around 57% of the annual heat demand new phases (7.2 and later) and 43% of the heat to existing phases and those in construction designed to connect to the existing sub plant rooms.

The heat pumps have the potential to reduce the emissions on the new phases by 181 tonnes, or 13.5%. It would be more appropriate to assess the phases connected to the sub plant rooms by comparing these to a system operating with a CHP to reflect the standards in place when the phases were designed and gained planning consent. Under these conditions the dwellings served from the sub plant rooms are predicted to emit 1376 fewer tonnes of CO_2 resulting in a 43% reduction, or 7% if the CHP units are disconnected leaving just the boilers providing the additional heat.

The heat pump installation is predicted to need support to ensure the future phases of the development achieve a minimum of 35% CO_2 reduction on site, and a series of photovoltaic panel installations spread across the remaining phases comprising a total installed capacity of 422 kWp would reduce the emissions by 81.5 tonnes, or 5% below the baseline emissions and generate approximately 350,000kWh of electricity.

The following table and graph illustrate that the combination of energy efficiency measures, renewable heat generation and power generated from photovoltaic panels has the potential to reduce the emissions of the new phases (7.2 onwards) by a minimum of 35% below the baseline building model.

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy (Future Phases)		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	205	15
Savings from CHP	0	0
Savings from renewable energy	262	20
Cumulative on site savings	467	35



The performance of the existing phases is expressed below as a comparison to the strategy of combined heat and power as the consented schemes.

Carbon Dioxide Emissions from each stage of the Energy Hierarchy				
	CHP		ASHP	
	Emissions	Reduction	Emissions	Reduction
Baseline	2,108		2,108	
Savings from energy demand reduction	1,971	137	1,971	137
Savings from CHP	3,212	-1,240	1,971	0
Savings from renewable energy	3,180	32	1,804	167
Total cumulative savings		-1,072		304

Estimated emissions of 1,804 tonnes from a system with air source heat pumps and PV panels represents a 43% reduction below 3,180 tonnes of CO2 from a system with a CHP providing 75% of the heat demand.

1 INTRODUCTION

1.1 Background

Silcock Dawson and Partners have been appointed by Countryside to provide an addendum to the District Heating Masterplan prepared by Hodkinson Consultancy in September 2019. The masterplan describes a strategy for heat generation and methodology for installing the distribution pipe network to installed and proposed phases of the development.

The aim of this report is to document the findings of the investigation into alternative heat sources to reduce CO2 emissions, and minimise future fuel costs for the residents.

This report provides a strategy for future phases to reduce emissions by 35% in accordance with current GLA guidance and the Intent to Publish London Plan. The actions described within this strategy will also reduce the emissions for the previous phases below the lean building model and the equivalent development with heat generated by CHP plant.

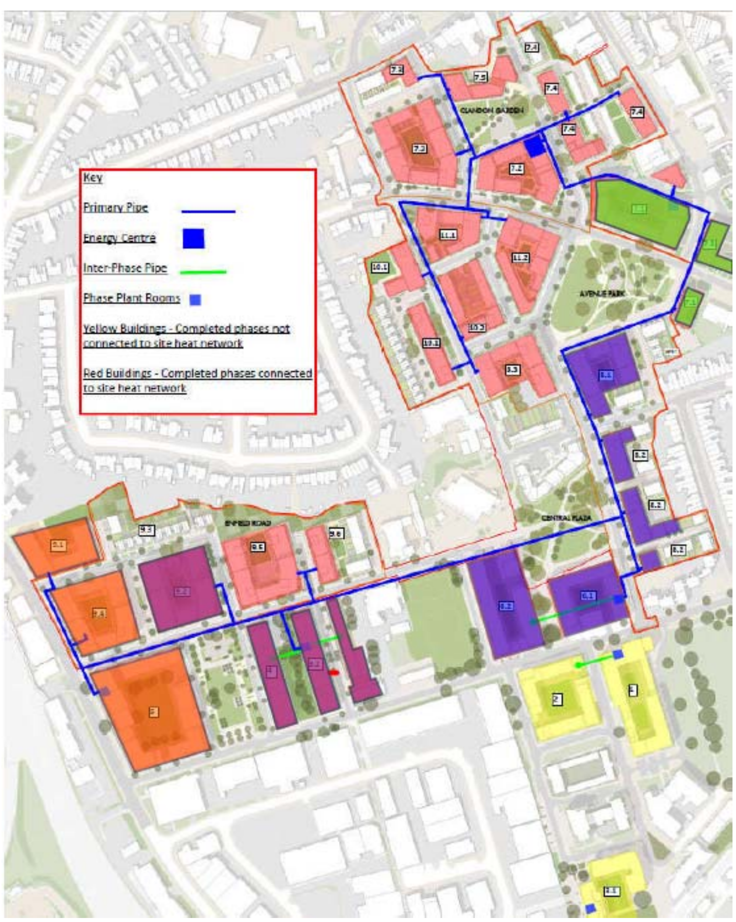
1.2 Description of the Site and Building

The number of dwellings and corresponding area considered in this report is 2933 units with total useful floor area of 218,547m2, of which 1803 dwellings are either in occupation, or varying stages of construction.

The different shading applied to the phases indicated on the image below represent the phases that are complete or are varying stages of construction proposed to be served by the sub plant rooms.

The phases that are proposed to not connect to the sub plantrooms are:

7.2, 7.3, 7.4, 7.5, 8.3, 9.5, 9.6, 10.1 and 10.2.



2 RELEVANT PLANNING CRITERIA

2.1 Initial Consents for Acton Gardens Site

2.1 A total of 1,513 units are being delivered by Acton Gardens LLP under the original consents. This includes the following:

> 167 dwellings for Phase 1 (this phase pre-dated the masterplan and hence is excluded from calculations of the total number of homes built under the masterplan);

> 1,346 dwellings for Phases 2-6, Phase 9.1 and Phase 7.1 under an original Outline Consent (2013)

> 3,398m2 of mixed non-residential.

2.2 Remaining Masterplan Consent (2018)

2.2 A new consent (hybrid, with Phase 9.2 in detail and remainder in outline) was approved by the London Borough of Ealing (LBE) in December 2018 and covers the remaining area of the site. This permission granted a maximum of, the following, which are within Phases 7.2, 7.3, 7.4, 7.5, 8.1, 8.2, 8.3, 9.2, 9.4, 9.5, 9.6, 10.1, 10.2, 11.1 and 11.2.

> 1,950 residential units;

> 1,000m2 flexible commercial space;

> 1,200m2 community space.

2.3 Regional Policy – The Draft London Plan (Intend to Publish)

The following policies are relevant to this addendum and future reserved matters applications.

2.3.1 Policy S 12 Minimising Greenhouse Gas Emissions

A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1. be lean: use less energy and manage demand during operation.
2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.
3. be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.

3a be seen: monitor, verify and report on energy performance.

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1. through a cash in lieu contribution to the borough's carbon offset fund, or
2. off-site provided that an alternative proposal is identified and delivery is certain.

2.3.2 Policy S 13 Energy Infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1. major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2. heat loads from existing buildings that can be connected to future phases of a heat network
3. major heat supply plant including opportunities to utilise heat from energy from waste plants
4. secondary heat sources, including both environmental and waste heat
5. opportunities for low and ambient temperature heat networks
6. possible land for energy centres and/or energy storage
7. possible heating and cooling network routes
8. opportunities for future proofing utility infrastructure networks to minimise the impact from road works
9. infrastructure and land requirements for electricity and gas supplies
10. implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11. opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C Development Plans should:

1. identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2. identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system

1. the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

   a) connect to local existing or planned heat networks

   b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

   e) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)

f) use ultra-low NOx gas boilers.

2. CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy SI1 Part B

3. where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

E Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE CP1 Heat Networks: Code of Practice for the UK or equivalent.

3 ENERGY DEMAND ASSESSMENT

3.1 National Calculation Methodology (NCM)

For the purposes of this assessment phases that are yet to be granted to be submitted for detailed planning approval (7.2, 7.3, 7.4, 7.5, 8.3, 9.5, 9.6, 10.1 and 10.2.) will be referred to as **future** phases. All other phases are either in occupation, or in varying stages of design and construction and will be referred to as **previous** phases.

The baseline energy use has been determined from the benchmark data from similar projects all future phases are expected to comply with current GLA guidance for energy efficiency with all dwellings achieving a CO_2 reduction of 10% below the baseline.

The previous criteria which was applicable for all applications until the end of 2018, is assumed for all previous phases. These dwellings are assumed to have achieved a small CO_2 reduction below the baseline of just below 2% below the baseline.

Following the principles of the GLA guidance an assessment of unregulated emissions are provided and based on the methodology described within BREDEM 2012 V1.1

The apartments benchmarking was modelled using Stroma FSAP 2012

It should be noted that as the energy consumption values illustrated within this report are generated from the SAP methodology and is not a prediction of the actual energy consumption.

Emissions within this report are based on the following CO_2 emission rates as described within SAP 10 and described within GLA energy assessment guidance dated April 2020.

Natural Gas	0.210 $kgCO_2/kWh$
Grid electricity	0.233 $kgCO_2/kWh$
Grid displaced electricity	0.233 $kgCO_2/kWh$

4 ENERGY EFFICIENT DESIGN

4.1 Baseline and Lean Building Models

Since 2013 it has been a requirement that all developments are no worse than the baseline building, and from 2019 this was revised to a 10% improvement. Unlike the overall CO2 reduction, the energy efficiency measures assess the building performance using current (SAP 2012) emission rates.

This assessment assumes that this target will be achieved for future phases with the following emissions

SAP 2012 Emission Rates (Future Phases)	DER kgCO2/m2
Baseline Dwellings	17.75
Energy Efficient (Lean) Dwellings	15.97
Improvement	**10%**

The measures required to demonstrate a 10% improvement would typically include:

- U values and air permeability better than the Notional Dwellings
- Good quality mechanical ventilation with Heat recovery
- Low Energy Lighting

Energy efficiency measures for the previous phases are assumed to exceed the baseline emissions by 2% as illustrated below.

SAP 2012 Emission Rates (Previous Pahses)	DER kgCO2/m2
Baseline Dwellings	17.75
Energy Efficient (Lean) Dwellings	17.43
Improvement	**2%**

The specific details of the energy efficiency measures will be submitted as part of the Reserved Matters Applications. It should also be noted that GLA guidance will be amended as and when Part L is updated, and this may influence the level of improvement requested for future energy assessments.

The tables below indicate that an improvement of 15% should be achieved when SAP 10 emission rates are applied to the future phases

Energy Consumption for energy baseline dwellings			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Heating (gas)	15.0	3286732	690,214
DHW (gas)	11.4	2500575	525,121
Cooling	0.0	0	0
Auxiliary Energy	0.4	96005	22,369
Lighting	1.7	382355	89,089
Equipment	21.8	4,759,177	1,108,888
Total	**50**	**11,024,845**	**2,435,681**
Total no Equip	**29**	**6,265,667**	**1,326,792**

Energy Consumption for energy efficient dwellings (Future Phases)			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Heating (gas)	10.2	2236312	469,626
DHW (gas)	10.7	2337935	490,966
Cooling	0.0	0	0
Auxiliary Energy	1.4	316739	73,800
Lighting	1.7	376992	87,839
Equipment	21.8	4,759,177	1,108,888
Total	**46**	**10,027,156**	**2,231,120**
Total no Equip	**24**	**5,267,978**	**1,122,231**

GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy (Future Phases)		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L compliant	1,327	1,109
After energy demand reduction	1,122	1,109

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy (Future Phases)		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	205	15

A similar approach has been carried out for the previous phases to estimate the emissions for the earlier phases, which indicates a 6% improvement.

Energy Consumption for energy efficient dwellings (Previous Phases)			
Item	kWhrs/m²/ Year	kWhrs/ Year	Kg CO_2 /year
Heating (gas)	20.3	4440414	932,487
DHW (gas)	17.0	3714825	780,113
Cooling	0.0	0	0
Auxiliary Energy	2.3	511615	119,206
Lighting	2.7	599016	139,571
Equipment	34.6	7,562,019	1,761,950
Total	**77**	**16,827,889**	**3,733,328**
Total no Equip	**42**	**9,265,870**	**1,971,377**

GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy (Previous Phases)		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L compliant	2,108	1,762
After energy demand reduction	1,971	1,762

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy (Previous Phases)		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	137	6

5 HEATING INFRASTRUCTURE

The site will be served by a dedicated heat network, currently being constructed to suit the phased nature of the development, generally as described within the District Heating Masterplan produced by Hodkinson in January 2020.

Due to the phased nature of the development and the location of the initial blocks it is proposed that phases 1, 2 and 3.1 remain independent of the heat network and are excluded from further calculations within this report.

These are the only phases located on the South side of Bollo Bridge Road, which is known to have extensive buried services beneath the surface including extra high voltage electricity cables. This alone would be a considerable risk and cost given the relatively small number of dwellings.

Phases 1 and 2 are adjacent to each other and are currently served by a common plant room, and Phase 3.1 is at the extremity of the development and extensive excavation works would be required to access the building.

Each of the phases complies with the planning requirements in place at the time of construction, and the onsite CO_2 reduction targets were achieved.

Phases 1 and 2 were also designed and construction prior to updates in general design guidance (eg CIBSE Code of Practice CP1 first published in 2015) for community heating systems which promoted lower flow and return temperatures.

The heat network operator (L&Q Energy) have agreed that they will treat the residents of these phases in the same way as those served from the heat network with equivalent charges for heat and maintenance.

An allowance has also been allocated to provide heat to the Berrymede Schools and South Acton Children's Centre, although discussions are still ongoing. Given the age of the heating systems with these buildings it may still be necessary for each of the above to retain some form of independent heating to elevate the water temperatures to satisfy the peak load periods and domestic hot water.

There is also a potential additional connection to the sub plant room within Phase 6.2 to serve a nursery unit.

5.1 Amendment of GLA Guidance

This section of the energy hierarchy was largely rewritten in the 2018 update of the Energy Assessment Guidance notes.

The priority of developing district heating networks remains, but the reduction of grid electricity Carbon emissions had a significant effect on the performance of Combined Heat Power plant with regards to carbon emissions.

The district heating masterplan sets out an outline criteria for the CHP selection stating that is should provide at least 75% of the annual heat demand for the whole development, which is a typical expectation for the CHP lead district heating scheme.

The emissions of such a scheme would be higher than the energy efficient buildings due to the reduced emissions of the electricity grid as illustrated in the tables below for the previous phases and complete development combining all previous and future phases.

Carbon Dioxide Emissions from each stage of the Energy Hierarchy (Previous Phases)		
	Total Regulated Emissions	CO2 Savings
	(Tonnes CO2/year)	(Tonnes CO2/year)
Part L 2013 Baseline	2,108	
Savings from energy demand reduction	1,971	137
Savings from CHP	3,212	-1,240

GLA Table 6: Carbon Dioxide Emissions from each stage of the Energy Hierarchy (whole development)		
	Total Regulated Emissions	**CO2 Savings**
	(Tonnes CO2/year)	**(Tonnes CO2/year)**
Part L 2013 Baseline	3,435	
Savings from energy demand reduction	3,094	341
Savings from CHP	5,080	-1,986

The table above confirm that the emissions will increase following the adoption of SAP10 emission rates. With predicted emission at 5000 Tonnes for the whole development an increase of almost 2000 Tonnes if a CHP plant sized to served the whole development was installed.

Therefore it is proposed to deviate from the District heating Masterplan and not include combined heat and power within the central plant serving the heat network and alternative heat sources will be explored to provide low carbon heat to the district heating network as detailed in the following sections.

6 LOW & ZERO CARBON TECHNOLOGIES FOR ENERGY PRODUCTION

A verity of renewable technologies are available, that can be used to reduce the emissions for the development, and number of these can generate low carbon heat such as:

- Biomass
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Solar Thermal Hot Water Generation

And renewable power is widely generated from the following sources.

- Photovoltaic Panels
- Wind

A brief explanation and the viability of the various technologies are discussed in the table below.

The GLA energy assessment guidance also states that distribution losses should be considered within this section of the energy hierarchy. For the purposes of this assessment it is assumed that best practice values as detailed within the draft Code of Practice for Heat Networks 1.2 will be achieved within the new phases of the development and the sections of buried pipework. A target of 10% of the annual demand is therefore assumed for the distribution pipework and 550kWh/dwelling/year for the pipework within the buildings leading to the dwellings. A value of 1000kWh/dwelling/year has been assumed for the dwellings within previous phases.

6.1 Preliminary Technology Appraisal

Technology	Feasibility*			Comments
	H	M	L	
Biomass			✓	Not suitable for the site on grounds of fuel storage and deliveries within city centre site and wider issues relating to high levels of NOx and particulate matter generated from combusting biomass fuels.
Ground Source heat pumps			✓	Ground source heat pumps extract heat from the ground, and convert it to low grade heat for space heating and hot water. Despite the wider adoption of ground source heat pumps, the cost of installing bore holes particularly on a phased development such as this will be prohibitively expensive. The current design also requires all the renewable heat to be sourced local to the heat network plant room restricting the heat that can be extracted to a relatively small area.
Air Source Heat Pumps	✓			Air source heat pumps extract heat from the air and convert it to low grade heat for space heating. Air source heat pumps are generally more cost effective than ground source heat pumps. Air to water heat pumps can now generate hot water a higher temperatures within the

Technology	Feasibility*			Comments
	H	M	L	
				range capable of achieving a meaningful contribution towards to the heat demand of the development.
Photovoltaic Panels	✓			Photovoltaic modules convert daylight directly into DC electricity and can be integrated into buildings. Space is available at roof level on the various buildings and is proposed that arrays will be installed where possible to maximise the power generation.
Solar Hot water			✓	Solar thermal installations are a well established renewable energy system and can be one of the most cost-effective renewable energy systems available. Solar thermal installations are best suited to single occupancy installations such as houses or hotels, where the hot water can feed directly into the users hot water storage vessel and are not viable for a community heating scheme such as this with heat interface units located within apartments.
Wind			✓	The urban environment and the close proximity of other buildings are not favourable conditions for the installation of wind turbines. The uneven air flow caused by surrounding buildings and the potential negative impact on the visual and noise amenity of the area militate against the use of wind turbines for this development.

H - High Feasibility - No Obvious restrictions

M - Medium feasibility - Significant issues that need to be addressed

L - Low feasibility – Site unlikely to support technology

Based on this preliminary evaluation, the following technologies will be assessed:

- Air source heat pumps
- Photovoltaic Panels (PV)

6.2 Air Source Heat Pumps

6.2.1 Application

The technology makes use of the energy available in the ambient air. Essentially, heat pumps take up heat at a certain temperature and release it at a higher temperature. This is achieved by means of a simple heat exchanger in the case of air source heat pumps.

The efficiency of any type of heat pump is very much dependent on the temperature level at which it has to provide the heat: the lower the temperature level, the better the coefficient of performance.

Almost all heat pumps in operation are based on the vapour compression cycle, which combines efficiency, safety and reasonable cost. The efficiency of heat pumps is measured by the ratio of the heating capacity to the power input, referred to as the Coefficient of Performance (COP). A seasonal COP of around 2.8 is possible for an air to water system operating within the low temperature hot water range required to serve a modern community heating system.

The effectiveness of heat pumps with regards to CO_2 emissions improves as the carbon content of grid electricity reduces. This is reflected in the use of SAP 10 emission rates in which gas and electricity have similar emission rates, and in the future the carbon content of electricity is likely to reduce further.

6.2.2 Constraints

The following constraints have been identified for the application of air source heat pump technology at the site.

1. Space needs to be allocated for the heat pumps in a location that provides a good air flow through and around the units. - This is achieved through allocation of sufficient space on the roof of Phase 7.2.
2. Straightforward connection to central distribution plant room. – This is met by locating the heat pumps above the heat source serving the whole of the heat network.

6.2.3 Energy Reduction

Within the heating plant assembly, air source heat pumps can be installed to preheat the return water temperature to reduce demand from the gas fired boilers. This arrangement allows the heat pump to operate constantly at lower temperatures, and an SCOP of 2.87 has been calculated for this assessment using data supplied from the manufacture included within Appendix 1.

The assessment of heat generation and potential CO_2 reduction is based on equipment manufactured by a particular manufacturer, this is to determine that the CO_2 reduction as a result of the inclusion of the heat pumps is verifiable and not based on assumed performance values. This assessment is based on modular heat pumps with a total capacity of 1680kW generating hot water at 55°C. The heat pumps will be used to pre heat the system return water, before passing thorough gas fired boilers.

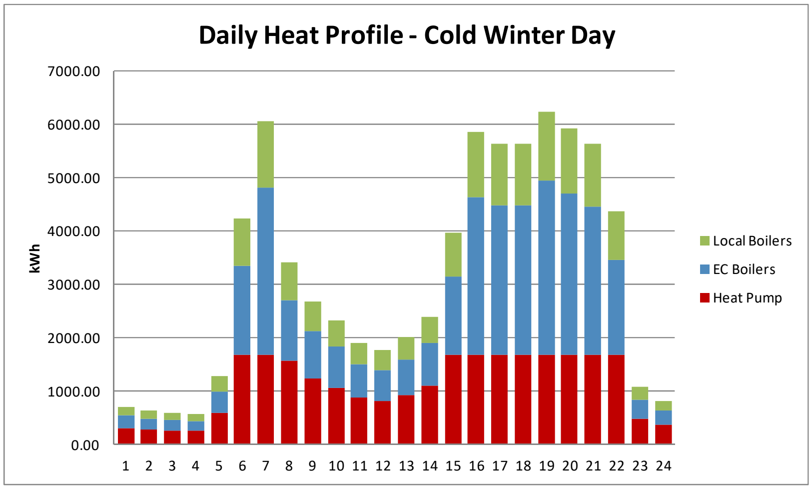
The heat network supply temperature must be suitable to deliver space heating and domestic hot water at temperatures suitable for the previous and future phases. The earlier phases are currently connected to sub plant rooms which contain gas fired boilers and CHPO units. These supply hot water to the apartments and a number of which from each sub plant room are heated via radiators designed with a flow temperature of 70°C. Therefore if the heat network temperature is to be lowered to reduce the distribution losses and improve the efficiency of future phases then the existing sub plant rooms have to be retained, and modified to provide a boost to the network distribution temperature.

The energy centre will be designed to deliver hot water at 65°C in the winter and 62°C in the summer, with return water from the new phases 30°C cooler. All future phases shall be designed to accept water at these temperatures allowing the blocks and the heat network to have reduced heat losses and maximise the proportion of heat supplied from the heat pumps. This approach allows approximately 76% of the annual heat demand to the previous phases to be supplied from the Energy Centre with just 24% supplied from the existing local boilers.

The graphs below illustrate the respective heat output of the heat pumps, energy centre boilers and sub plant room boilers over a typical winter day for the whole development.

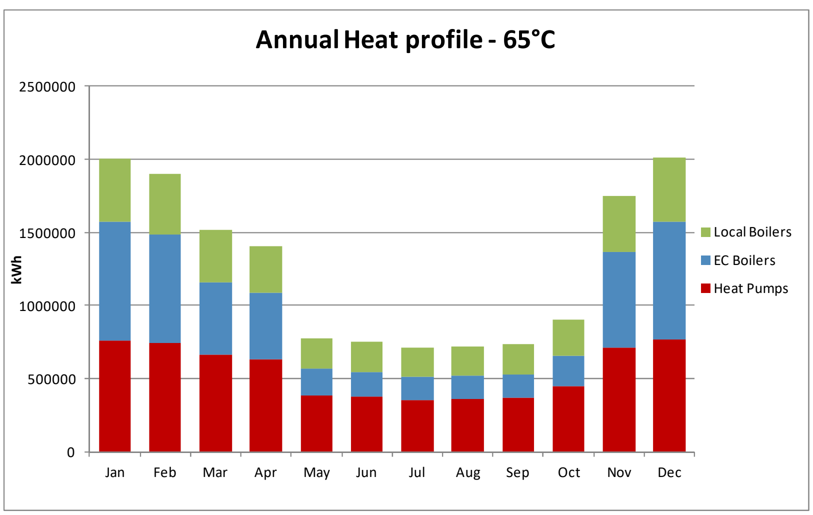
This arrangement allows the heat pumps to provide around 59% of the annual heat demand of the new phases and 44% of the annual heat demand of the existing blocks

The performance of the heat pumps will be monitored via the Building Management System, with sub meters monitoring the heat generated from the heat pumps and the power consumption. This will then be periodically compared to the building gas consumption and heat generated by the boilers.



Winter Day profile

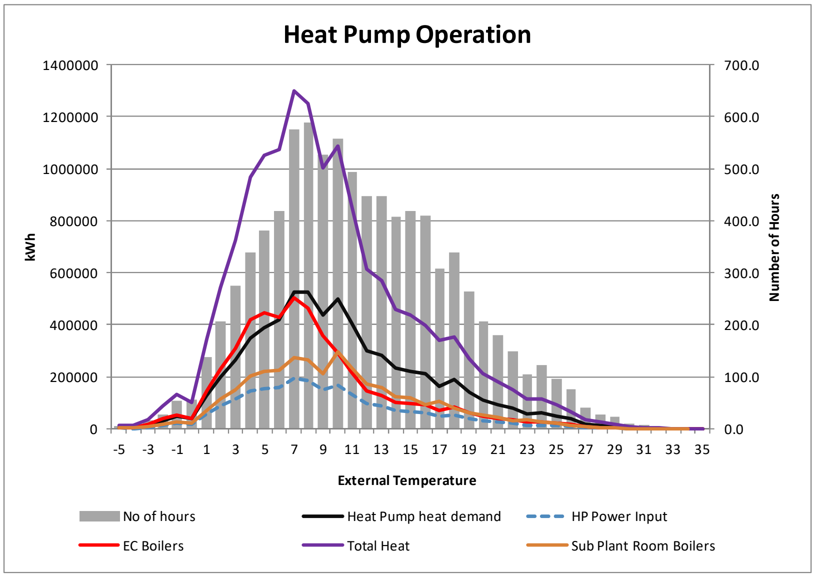
As the heat demand during the summer period is lower the heat pumps are predicted to generate a greater proportion of the annual heat demand as illustrated below.



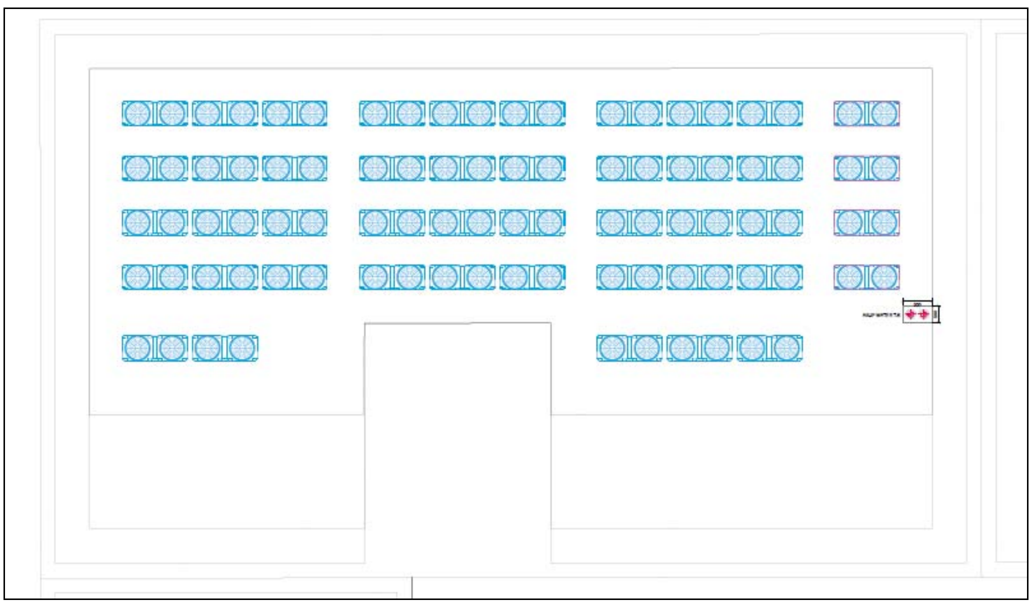
Annual Heat Profile

This heat pump performance is based on equipment manufactured by Mitsubishi Electric, and outside conditions from the CIBSE London Heathrow Test Reference Year.

The graph below illustrates the proportion of heat supplied to the development at the different temperatures used within the weather data set. The graph shows that air tempertaures in the range of 7°C to 11°C occur with the greatest frequency and that the energy centre boilers contribute a smaller proportion of the heat at the air tempertaure increases.



The extract from the roof drawing below illustrates the approximate area that would be occupied by the heat pumps on the roof on Phase 7.2.



The installation of the heat pumps would increase to reflect the demand from the buildings and connected load on the heat network. The modular nature of the installation allows small increments to be added, as phases are connected to the energy centre.

Installing the heat pumps and central energy plant at this stage will allow continual monitoring of the operating temperatures and system operation to assess the proportion of heat actually delivered by the heat pumps and the boilers.

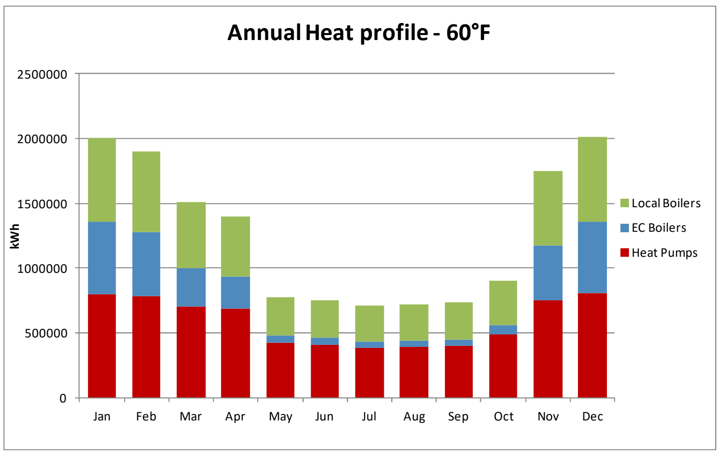
Detailed spacial plans of the roof plant and boiler room are included within Appendix 2.

The heat pumps are predicted to reduce the emissions for future phases by 181 tonnes or 13.5%.

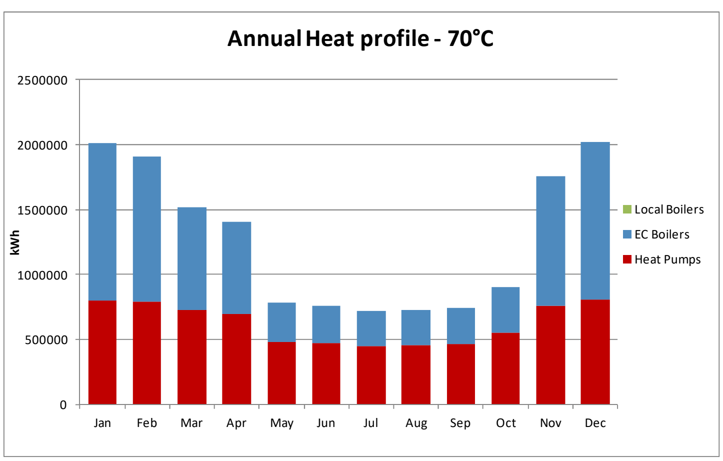
6.2.4 Determining Selected Operating Temperature

A heat network supply temperature of 65°C winter / 62°C Summer has been determined on the basis that this is lowest temperature hot water can be delivered to the hot taps at 55°C, to comply with all current guidance. Several guidance documents including HSE guidelines suggest that a supply temperature of 50°C would be acceptable, and if this were the case the network temperature could be reduced by up to 5°C to 60°C winter / 57°C Summer. All apartments within future phases are proposed to have underfloor heating, allowing effective operation at the low temperatures required from systems with heat pumps.

Operating at a reduced temperature of 60°C winter / 57°C summer will reduce the distribution losses within the buried sections of pipework and the circulating pipework within the future phases. These are estimated to be 1% and 4% respectively, but as the previous phases would continue operate at the same temperature the losses from the phases will remain constant. This will have the potential to increase the proportion of heat from the heat pumps exiting the energy centre, from 60% to 70%, but the lower temperature will increase the heat supplied from the sub plant rooms as illustrated in the graph below.



A further simulation was carried to assess the impact of increasing the water temperature to 70°C Winter / 65°C summer, to increase the proportion of heat from the heat pump to the previous phases at the expense of reducing the contribution to the future phases which occupy a smaller proportion of the development as a whole. The distribution losses have also been increased by 1% for buried pipework and 4% for distribution pipework within the future phases. As the temperatures are not changing within the previous phases no change to the distribution losses within these phases has been assumed. Increasing the system temperatures will have the added benefit of allowing the sub plant rooms to be disconnected from the network, with the loads illustrated in the graph below.



Operating the heat network at different temperatures will affect the overall emissions of the development as the distribution losses increase or decrease against the proportion of heat supplied from the heat pumps and the impact of the sub plant room boilers serving the previous phases. All of this is summarised in the table below which compares the emissions at the three different operating temperatures.

Network Flow Temperature	60°C	65°C	70°C
Emissions	2624 T CO2/Yr	2752 T CO2/Yr	2765 T CO2/Yr

The above illustrates that it is beneficial to reduce the flow and return temperatures within the heat network, and whilst the calculations within this assessment are based on a 65°C flow temperature during the winter, the energy centre and distribution network will be designed to allow sufficient heat to be supplied to all future dwellings should all applicable guidance for domestic hot water supplies be reduced as anticipated, allowing the system flow temperatures to be reduced to 60°C Winter / 57°C Summer.

6.2.5 Alternative Heat Pump Technologies

Alternative air source heat pumps were considered, recent advances by a leading manufacturer have enabled heat pumps using CO_2 as the refrigerant operate within heating systems, where up to until now they have been used to generate domestic hot water. The evaporating and condensing points of the refrigerant mean they are capable of generating hot water at temperatures above 60°C, but they rely on very low return or inlet temperatures. The recent advance is that this temperature has been increased to 35°C, which is in the range achievable by modern heating systems. However, connecting the existing sub plant rooms to the heat network affects to the return water temperature, which is predicted to continually exceed 35°C, due to the higher operating temperatures required within the previous phases.

6.3 Photovoltaic Panels

6.3.1 Application

Photovoltaic modules convert daylight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and flat roofs, in facades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles. Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form.

6.3.2 Constraints

The following constraints have been identified for the application of the PV technology at the site.

1. Connection points into the LV distribution system.

6.3.3 Energy Reduction

The following assessment of PV arrays is based on the area required to meet the minimum onsite CO_2 reduction of 35% for each future phase. The table below is intended to demonstrate the approximate roof area that should be made available.

The assessed PV installation across all future phases generates approximately 350,000kWh, the final capacities on the individual phases will be subject to the reserved matters applications as the phases are brought forward.

Phase	Target Number of PV panels	Approximate total roof area required (m2)
7.2	205	845
7.4	161	663
8.1	188	776
9.5	151	624
9.6	46	192
7.5	57	236
7.3	226	933
11.1	125	516
10.1	119	491
10.2	32	133
8.3	155	639
11.2	68	280

6.3.4 Conclusion

Photovoltaic panels are a viable technology for the development arrays of the above capacity are not exceptional and it should be possible for these to be accommodated on the various phases as they come forward to allow each phase to reduce the emissions by a further 6.5% and achieve the minimum 35% CO_2 reduction.

6.4 Energy & Carbon Emissions Following the Application of Renewable Technologies

The tables below detail the energy consumption from the heat pumps and boilers to generate space heating and hot water across the future phases of development, and the performance of the associated PV panels.

Energy Consumption for energy efficient dwellings with Renewable Technology (Future Phases)			
Item	**kWhrs/m²/ Year**	**kWhrs/ Year**	**Kg CO_2 /year**
Heating (gas)	5.6	1,223,593	256,955
DHW (gas)	5.9	1,279,233	268,639
Heating (Heat Pump)	2.4	528,351	123,106
DHW (Heat Pump)	2.5	550,905	128,361
Cooling	0.0	0	0
Auxiliary Energy	1.5	328,204	76,472
Lighting	1.7	376,992	87,839
CHP Heat	0.0	0	0
CHP Electricity	0.0	0	0
PV Electricity	-1.6	-350,000	-81,550
Equipment	21.8	4,759,177.2	1,108,888
Total	**40**	**8,696,455**	**1,968,709**
Total no Equip	**18**	**3,937,278**	**859,821**

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy (Future Phases)		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	**(%)**
Savings from energy demand reduction	205	15
Savings from CHP	0	0
Savings from renewable energy	262	20

The effect of the of the heat pumps in comparison to the combined heat power units currently proposed for the previous phases is illustrated below incorporating the CO_2 reduction from the associated PV panels.

Energy Consumption for previous phases dwellings with CHP / Comunity Htg			
Item	**kWhrs/m²/ Year**	**kWhrs/ Year**	**Kg CO_2 /year**
Heating (gas)	5.1	1,110,103	233,122
DHW (gas)	4.2	928,706	195,028
Heating (Heat Pump)	0.0	0	0
DHW (Heat Pump)	0.0	0	0
Cooling	0.0	0	0
Auxiliary Energy	2.3	511,615	119,206
Lighting	2.7	599,016	139,571
CHP Heat	28.0	6,116,429	1,284,450
CHP Electricity	25.0	5,461,097	1,272,436
PV Electricity	-0.6	-137,292	-31,989
Equipment	34.6	7,562,019	1,761,950
Total	**101**	**22,151,694**	**4,973,774**
Total no Equip	**67**	**14,589,675**	**3,211,824**

Energy Consumption for previous phase dwellings with ASHP / Community Htg			
Item	**kWhrs/m²/ Year**	**kWhrs/ Year**	**Kg CO_2 /year**
Heating (gas)	14.6	3,193,530	670,641
DHW (gas)	12.2	2,671,751	561,068
Heating (Heat Pump)	3.7	798,236	185,989
DHW (Heat Pump)	3.0	666,035	155,186
Cooling	0.0	0	0
Auxiliary Energy	2.4	532,056	123,969
Lighting	2.7	599,016	139,571
CHP Heat	0.0	0	0
CHP Electricity	0.0	0	0
PV Electricity	-0.6	-137,292	-31,989
Equipment	34.6	7,562,019	1,761,950
Total	**73**	**15,885,351**	**3,566,385**
Total no Equip	**38**	**8,323,332**	**1,804,435**

Carbon Dioxide Emissions from each stage of the Energy Hierarchy				
	CHP		ASHP	
	Emissions	Reduction	Emissions	Reduction
Baseline	2,108		2,108	
Savings from energy demand reduction	1,971	137	1,971	137
Savings from CHP	3,212	-1,240	1,971	0
Savings from renewable energy	3,180	32	1,804	167

The emissions from the system incorporating the air source heat pumps and other renewable technologies is 43% lower than the equivalent system with the CHP performance as described in the district heating masterplan.

7 NEXT STEPS

Upon approval of the energy strategy contained here within the Developer and LBE agrees to the following:

1. Any future phase at Acton Gardens to come forward will comply with this Energy Strategy unless otherwise agreed in writing by all parties.
2. Any future phase to come forward at Acton Gardens will consult with London Borough of Ealing (LBE) through the planning application and pre app process.
3. Each remaining future phase at Acton Gardens will arrange a ‘milestone meeting’ with LBE to ensure LBE keeps clear track of progress with regard to the energy strategy and when existing and future phases will be connected to the emerging heat network.
4. The Developer will share information with LBE on the heating systems strategy as it is progresses through design to construction, and finally to commissioning. If a site visit is required LBE may request this with 28 days notice.
5. Changes to the evolving heat network design, and the future phase (Reserved Matters) application energy strategies, will be logged into the project tracking dashboard tool of the Ealing Automated Energy Monitoring Platform. Project changes and associated information are logged onto rolling (date registered) info/comment boxes. Timeline events (deadlines, meetings, actions, etc) are date stamped and the software sends out automated email reminders on the relevant trigger dates.
6. Physical energy systems monitoring will be required to monitor the heating systems. The requirements of monitoring will follow LBE_ENERG Technical monitoring guidance_ACTON GARDENS.
7. The data-logging equipment and PV meters will be funded through a S106 contribution, but the heat meters will be sourced by the Developer in consultation with LBE.

8 CONCLUSIONS

Following a review of the relevant National and Local Planning Policies, this addendum to the District Heating Masterplan proposes a strategy that positively responds to Intent to Publish London Plan, Policies SI2 and SI3. The London Borough of Ealing Development Management Plan Policy 5.2 broadly reflects the London Plan at the time of its issue in December 2013.

The district heating network has already commenced and will continue as future phases are constructed, however, due to the complexity with crossing Bollo Bridge Road and the relatively low heat demand from Phases 1, 2, and 3.1 it is proposed that these phases will not be connected to the network, but retain their independent plant as currently installed and operating.

An assessment of the development energy consumption has been carried out using benchmark performance data to reflect the phases currently in design, construction or occupation combined with all future phases.

All future phases from 7.2 will implement energy efficiency measures to demonstrate an improvement of at least 10% on Part L 2013 or equivalent standard as regulations and standards evolve in the future.

The heat network will continue to follow the principles of the District Heating Masterplan and will continue to be designed and installed in accordance with CIBSE CP 1 (Code of Practice for Heat Networks in the UK)

The combined heat and power unit is no longer proposed to be installed, and low carbon heat will instead be supplied from an array of air source heat pumps. The heat pumps will be assisted with gas fired boilers particularly at peak periods, and the network will be designed to operate at a temperature suitable for hot water generation.

The heat pumps are predicted to generate over 57% of the annual demand within future phases and reduce the emissions by 181 tonnes or 13.5% of the emissions

A series of Photovoltaic panel installations spread across the remaining phases comprising a total installed capacity of 422 kWp would reduce the emissions by 81.5 tonnes or 6% below the baseline emissions and generate approximately 350,000kWh of power annually once SAP 10 emission rates are applied.

Following the measures discussed in this assessment it is viable to achieve a 35% CO_2 reduction through energy efficient fabric and fixed building services, along with renewable heat supplied by air source heat pumps and photovoltaic panels within future phases as illustrated below.

GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy (Future Phases)		
	Carbon dioxide emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L compliant	1,327	1,109
After energy demand reduction	1,122	1,109
After CHP	1,122	1,109
After Renewable Energy	860	1,109

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy (Future Phases)		
	Regulated Carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	205	15
Savings from CHP	0	0
Savings from renewable energy	262	20
Cumulative on site savings	467	35

All earlier phases will receive lower carbon heat from the omission of the combined heat and power and the installation of the proposed air source heat pumps. The heat pumps are predicted to contribute 43% of the heat to these phases of the development, and the exiting sub plant rooms will be required to maintain the existing boilers to ensure these earlier phases can be served with hot water to suit the design conditions.

The earlier phases are predicted to see a reduction in emissions of 43% when compared to the approved strategy with combined heat and power and 8.5% when compared to an equivalent development without the CHP plant.

A1 APPENDIX 1 – HEAT PUMP CAPACITY TABLE

II Product Data

1. Capacity tables

(1) Correction by temperature

• CAHV-P500YA-HPB(-BS)

(1)-1 Efficiency Priority Mode

● Capacity

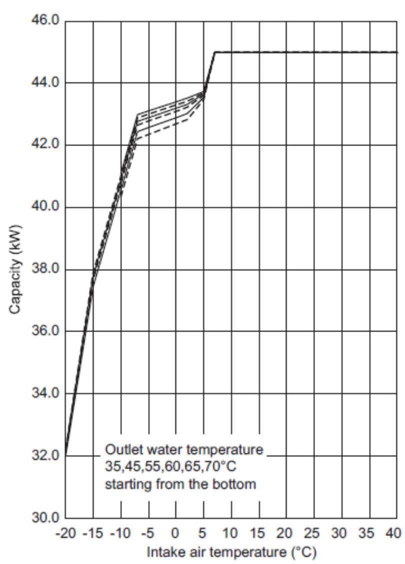
		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	40.3	42.2	42.4	42.7	42.8	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	45	32.0	37.4	40.6	42.4	42.6	42.9	43.0	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	55	32.2	37.7	40.8	42.7	42.8	43.1	43.2	43.6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	60	32.2	37.8	40.9	42.8	42.9	43.2	43.3	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	65	32.2	37.9	41.0	42.9	43.0	43.3	43.4	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	70	-	-	41.1	43.0	43.1	43.4	43.5	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

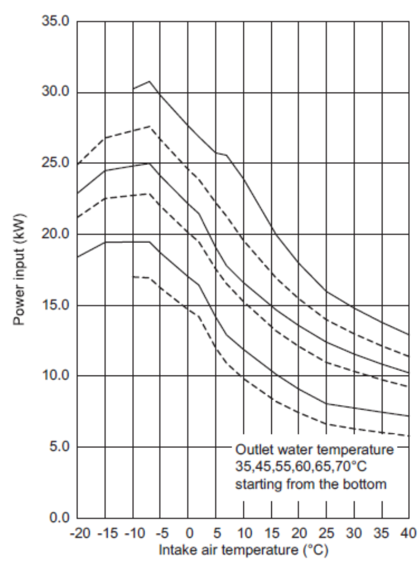
This table shows the capacity when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

● Power input

		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	17.0	16.9	16.2	14.7	14.2	12.0	10.9	9.82	8.20	7.40	6.60	6.30	6.02	5.77
	45	18.4	19.4	19.4	19.5	18.7	17.0	16.4	14.2	12.9	11.9	10.1	9.08	8.05	7.73	7.44	7.17
	55	21.2	22.5	22.7	22.8	22.0	20.1	19.5	17.5	16.5	15.2	13.2	12.1	11.0	10.3	9.75	9.24
	60	22.9	24.5	24.8	25.0	24.1	22.1	21.4	19.1	17.8	16.6	14.7	13.6	12.4	11.6	10.8	10.2
	65	24.9	26.8	27.3	27.6	26.7	24.6	23.9	22.2	21.3	19.6	16.9	15.4	14.0	13.0	12.1	11.4
	70	-	-	30.2	30.8	29.8	27.6	26.9	25.7	25.6	23.9	19.9	18.0	16.0	14.8	13.8	12.9

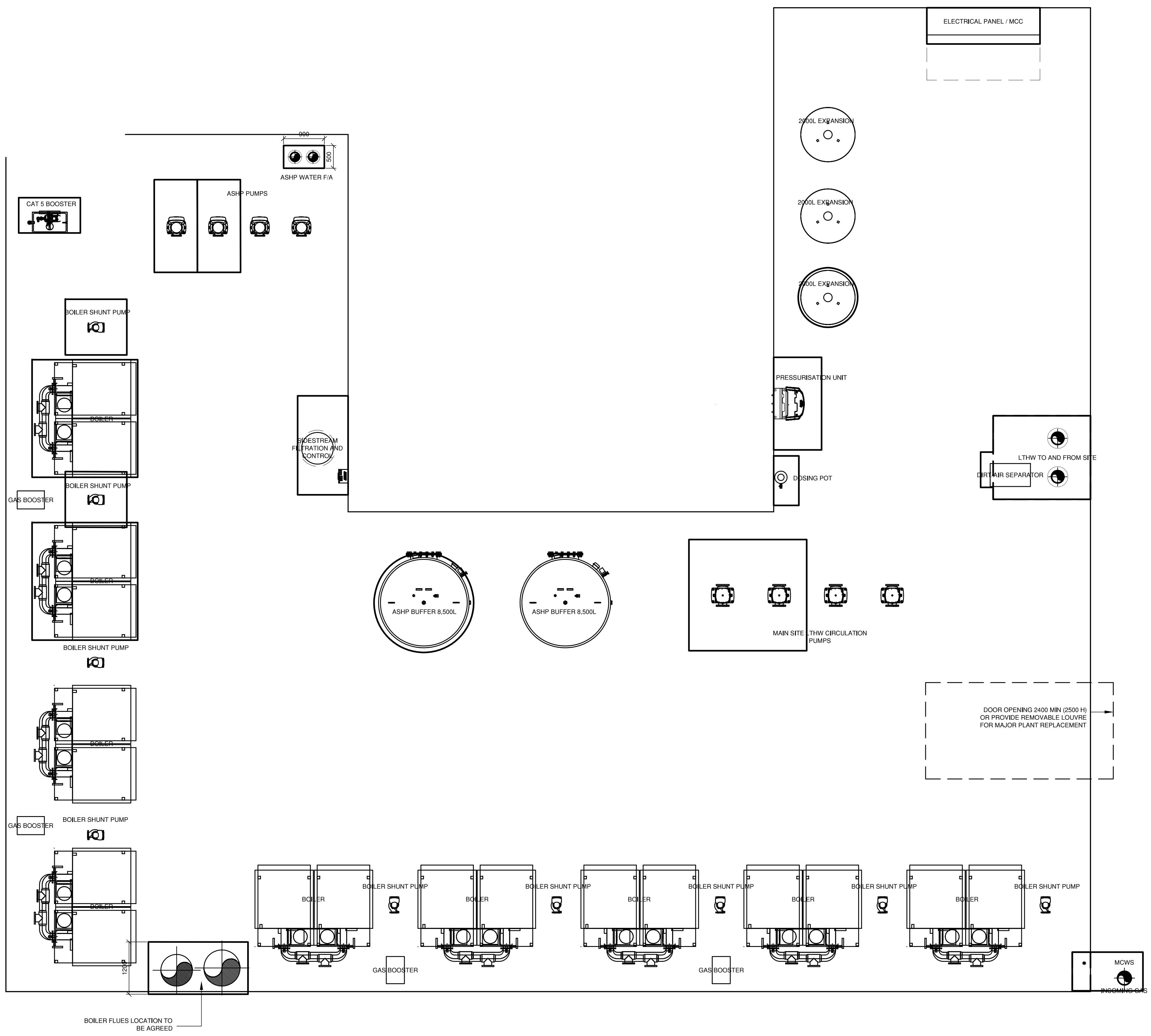
This table shows the power input when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.





- 10 -

A2 APPENDIX 2 – DRAWINGS



Origin Arch.		Rev.	Cad Ref	
Origin Struc.		Rev.	Drawn by	AJM

Standard Notes
1. DO NOT SCALE THIS DRAWING, WORK TO DIMENSIONS GIVEN.
2. ALL DIMENSIONS TO BE VERIFIED FROM SITE MEASUREMENT.
3. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.

NOTES:

KEY

PLANT REQUIRED FOR PHASE 7.2

Version	Date	Description	By	Chkd
P3	23.10.20	ENERGY STRATEGY UPDATED FOR ENERGY STRATEGY	AJM	ZR
P2	29.09.20	UPDATED PUMP QUANTITIES AND STYLE HIGHLIGHTED PHASE 7.2 PLANT REQUIREMENTS REMOVED ADDITIONAL MCC PANELS ADDED PROPOSED PLANT SCHEDULE	AJM	ZR
P1	31.07.20	NEW DRAWING	AJM	ZR

Drawing Status

PRELIMINARY

SILCOCK DAWSON & PARTNERS

Princes Risborough
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Client

COUNTRYSIDE PROPERTIES PLC

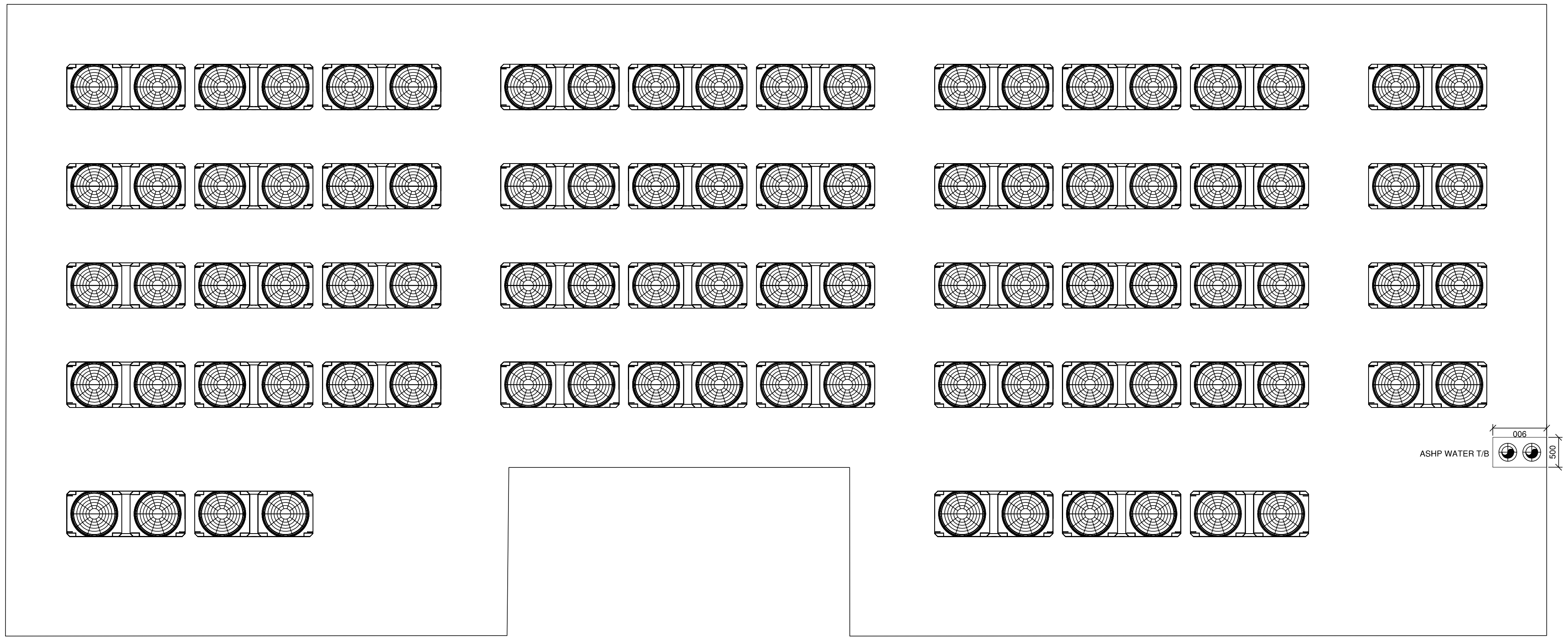
Project

ACTON GARDENS
DISTRICT HEATING

Drawing Title

MECHANICAL & ELECTRICAL
DISTRICT HEATING EQUIPMENT
GROUND FLOOR PLANT
SKETCH LAYOUT

Drg No.				Rev.
190349-ME-100				P3
Scale	Date	Engineer	Checked	
1:50@A1	JUL 2020	AJM	ZR	



Origin Arch.		Rev.	Cad Ref
Origin Struc.		Rev.	Drawn by AJM

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NOTES:

Version	Date	Description	By	Chkd
P3	23.10.20	ENERGY STRATEGY UPDATED FOR ENERGY STRATEGY	AJM	ZR
P2	29.09.20	HIGHLIGHTED PHASE 7.2 PLANT REQUIREMENTS ADDED PROPOSED PLANT SCHEDULE	AJM	ZR
P1	31.07.20	NEW DRAWING	AJM	ZR

Drawing Status
PRELIMINARY

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Client
COUNTRYSIDE PROPERTIES PLC

Project
ACTON GARDENS
DISTRICT HEATING SYSTEM

Drawing Title
MECHANICAL & ELECTRICAL
DISTRICT HEATING EQUIPMENT
ROOF PLANT
SKETCH LAYOUT

Drg No.			Rev.
190349-ME-109			P3
Scale	Date	Engineer	Checked
1:50@A1	JUL 2020	AJM	ZR

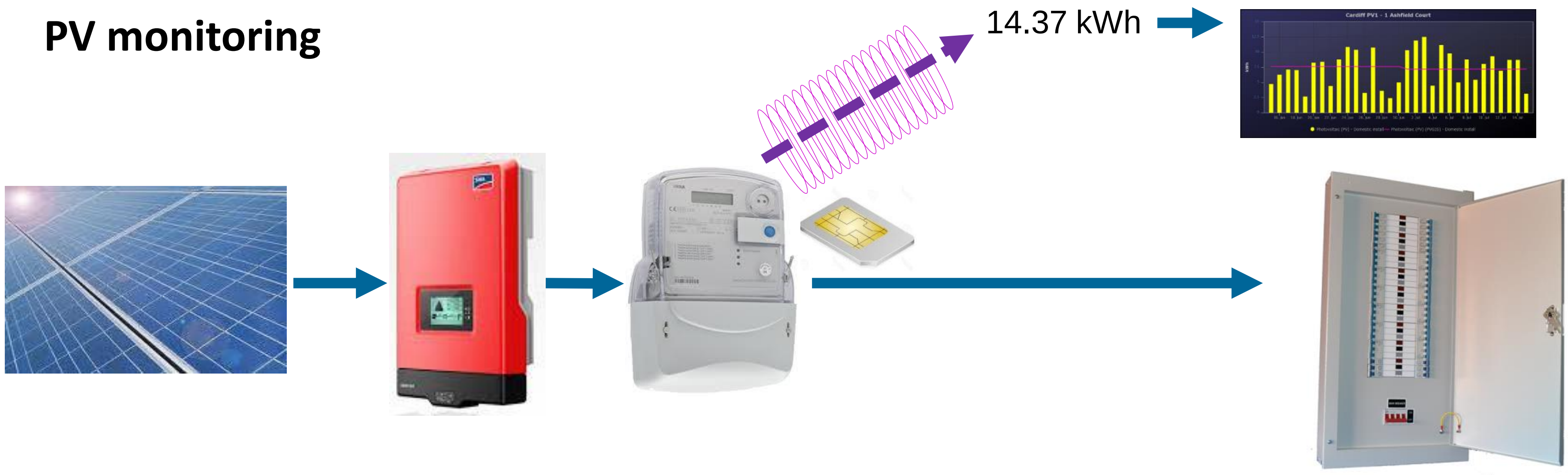
A3 APPENDIX 3 – EALING METERING DESIGN NOTES

Monitoring equipment - technical (basic) and administrative guidance

1. The Developer's energy equipment contractor(s) should be aware of **Ealing Council's** technical and administrative monitoring requirements which are part of the legal planning application process.
2. The energy equipment contractor(s) must liaise with Ealing/Energence regularly throughout the design and construction phases to ensure that the agreed energy strategy is being adhered to.
3. Before sourcing or installing any monitoring equipment the energy equipment contractors should contact Energence on the numbers or emails supplied on the last page. This should be at least three months prior to the installation of the energy equipment. Most monitoring problems (and additional costs) result from not doing this.
4. When the meters are to be imminently fitted then the meter installer must contact Energence at least 10 days prior to installation so the SIM cards can be activated in time. Meters supplied by Ealing/Energence will come with pre-activated SIM cards unless otherwise instructed.
5. At the time the meter is being installed and energised the engineer must contact Energence by phone before leaving site so that a live reading can be confirmed. *See contact details on last page.*
6. If the meters are <u>not</u> to be energised for some time, then the SIM cards must <u>not</u> be activated until 10 days prior to the PV being switched on. An example of this might be a phased development where the PV panels are fitted but the systems not energised until the properties are occupied. If the SIM cards are activated prior to the PV/Heat Pump/etc becoming fully operational, then the full monitoring period will be compromised. *Smart meters supplied by Ealing/Energence come with pre-paid data processing to resolve this issue.*
7. If the PV is commissioned in order to get the MCS certification, and then turned off until the property is occupied (for example in a phased development), then the PV engineer must contact Energence when the PV is briefly energised to ensure that the smart meter is online and ready to send data when the PV is finally switched on permanently.

System partner Energence Ltd

PV monitoring

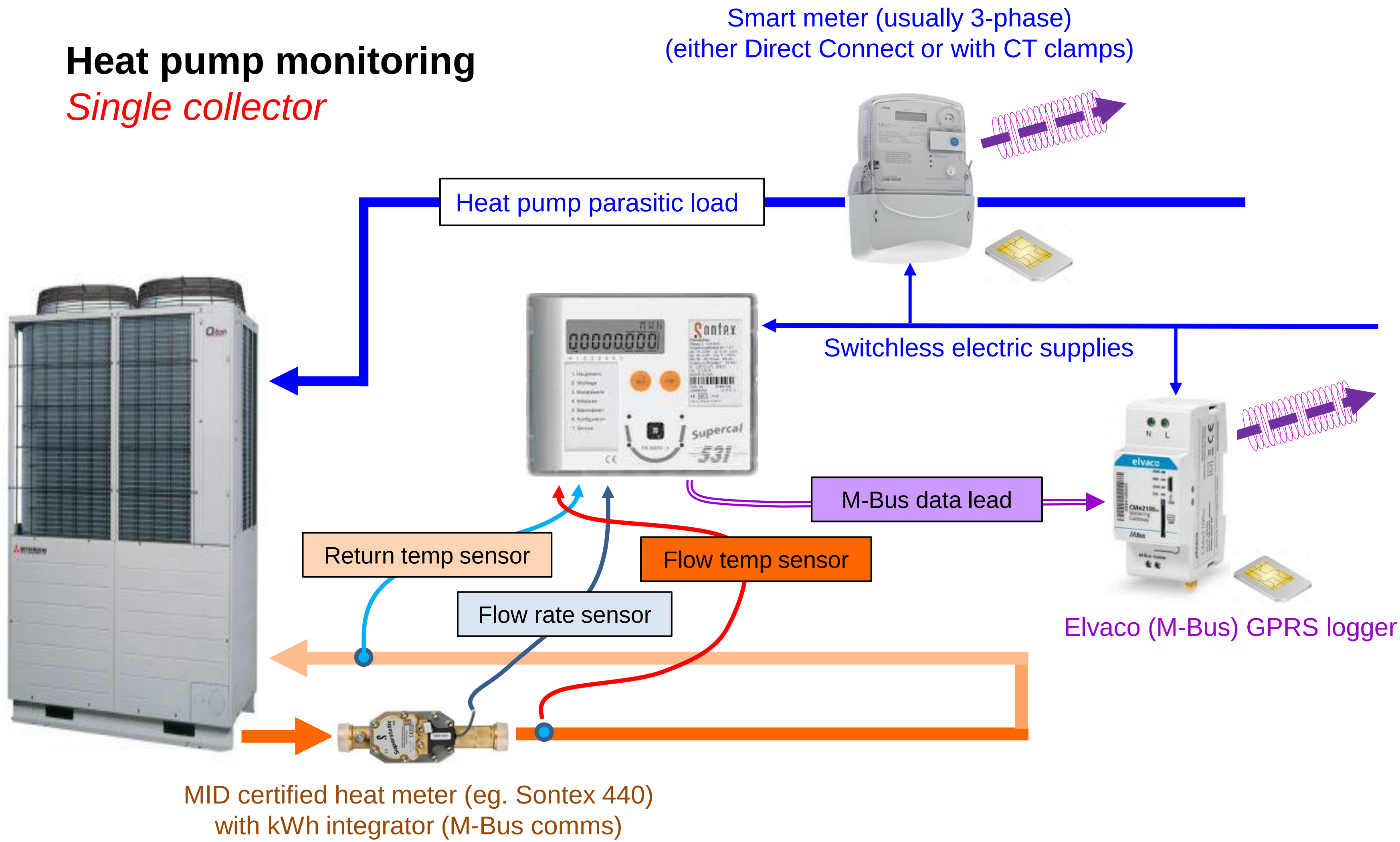


- Smart meters supplied by Ealing/Energence are pre-fitted with roaming SIM cards that latch onto the strongest 2G broadband network.
- The SIM cards need to be activated by Energence, therefore <u>the installer should contact Energence at least 10 days prior to the meter installation</u>.
- Prior to installation (at least 10 days) the installer should check that there is reasonable broadband signal strength at the exact location (to within 5cm) of the smart meter. This should be done with a signal strength analyser, but if a mobile phone gets a reasonable (2+ bars) signal then it should be OK.
- If the signal strength is poor then request Energence to supply a 25cm booster antenna (which is why the check needs to be made prior to the meter installation). This antenna has a 3 meter cable and is secured to an adjacent wall where the signal strength is better.

Contact: Adrian Hewitt (Ealing contract manager) adrian.hewitt@energence.co.uk 07941 055596 or 01865 423678 (DD)

Heat pump monitoring

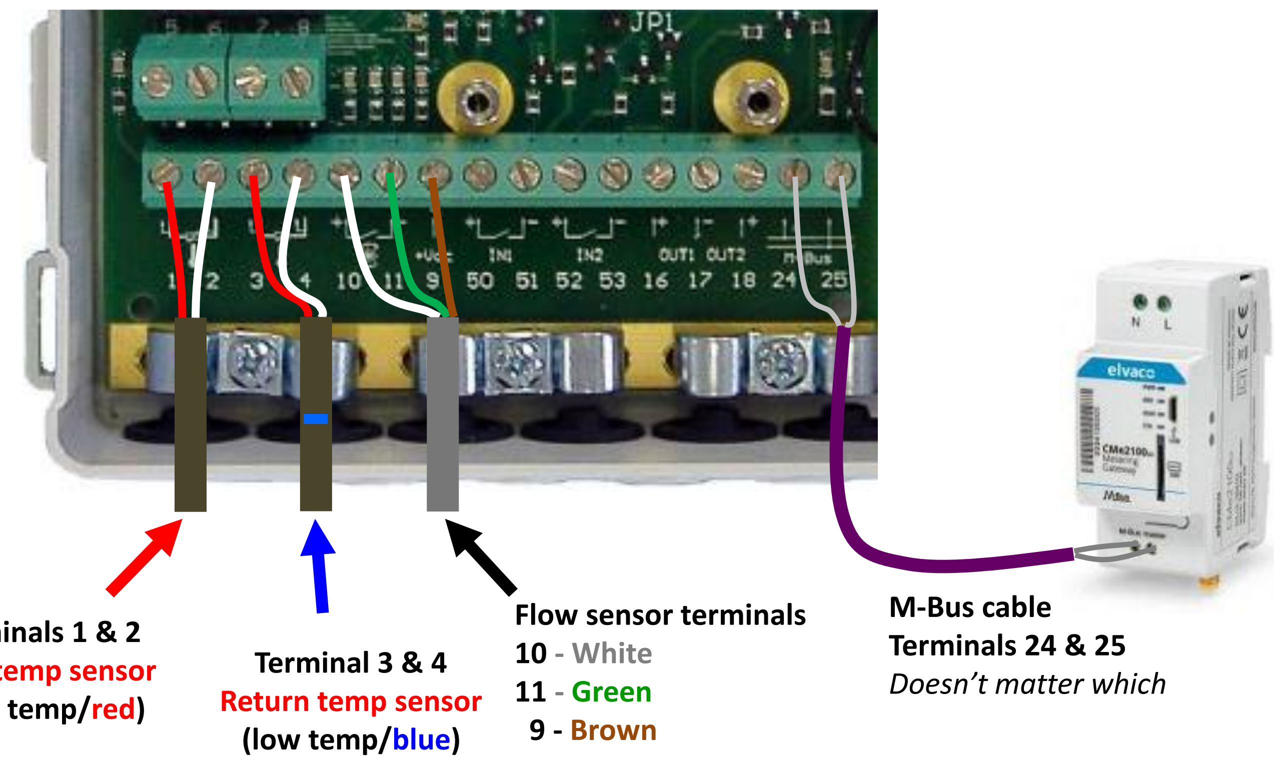
Single collector



Contact: Adrian Hewitt (Ealing contract manager) adrian.hewitt@energence.co.uk 07941 055596 or 01865 423678 (DD)

Heat meter (Sontex/Supercal) and Elvaco logger wiring

- The heat meter (integrator unit) and (for CHP) the gas meter (converter) data is transferred to the data-logger via M-Bus.
- The M-Bus addresses must be configured on the Integrator and Converter so they can "talk" to each other.
- Energence staff can carry out this task onsite if required.
- The meter installer must speak to an Energence staff member before leaving site to ensure a live heat meter reading.

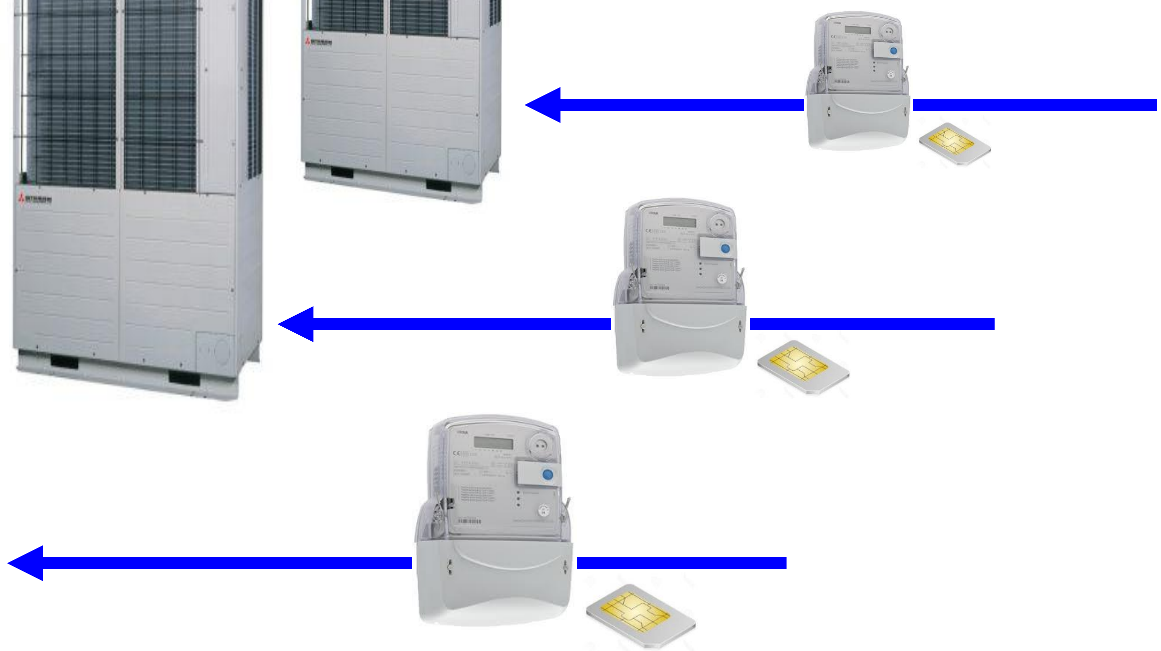


Contact: Adrian Hewitt (Ealing contract manager) adrian.hewitt@energence.co.uk 07941 055596 or 01865 423678 (DD)

Heat pump monitoring

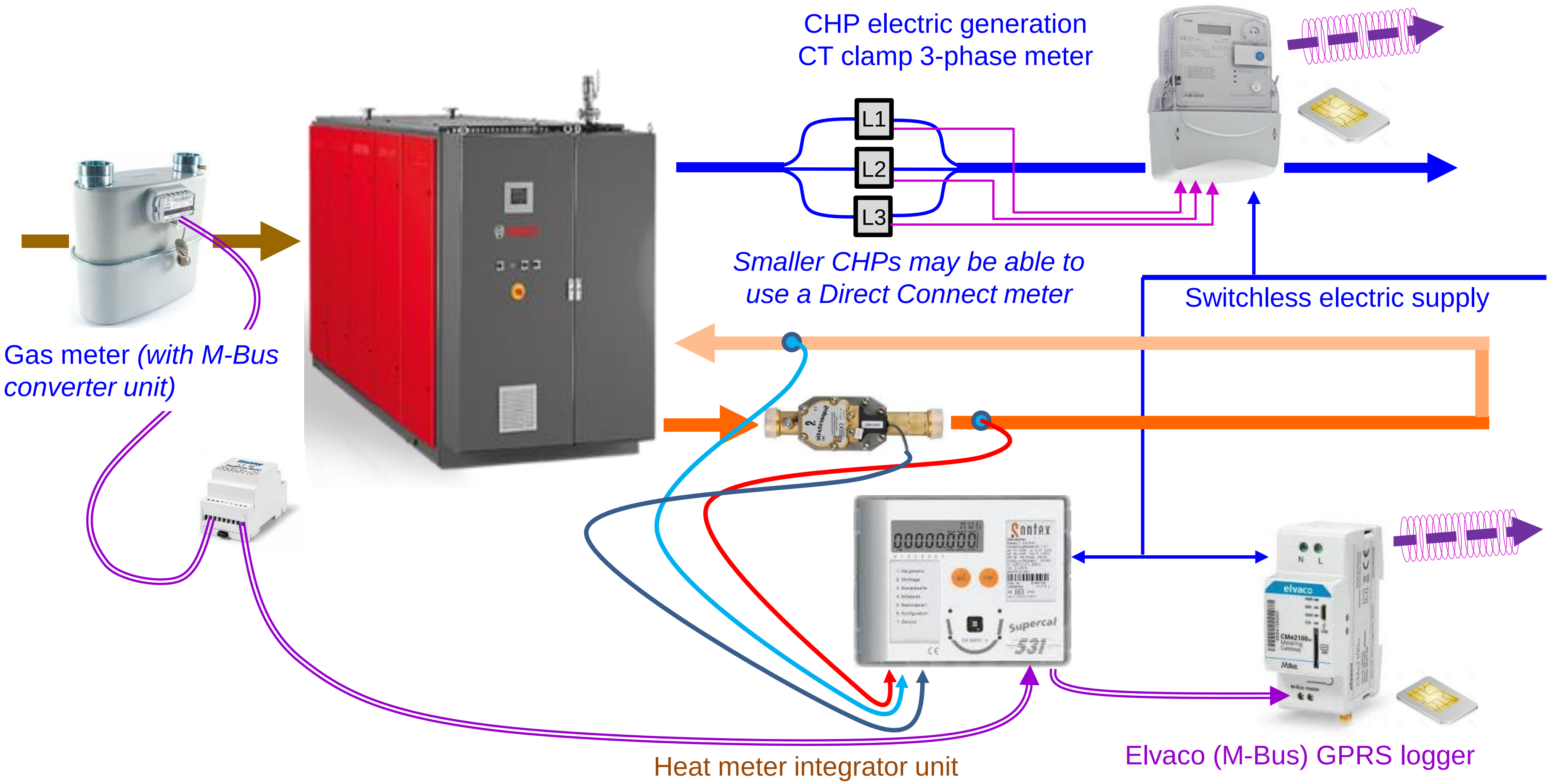
Multiple collectors

All parasitic loads must be monitored – either individually or through a single supply meter



Contact: Adrian Hewitt (Ealing contract manager) adrian.hewitt@energence.co.uk 07941 055596 or 01865 423678 (DD)

CHP monitoring

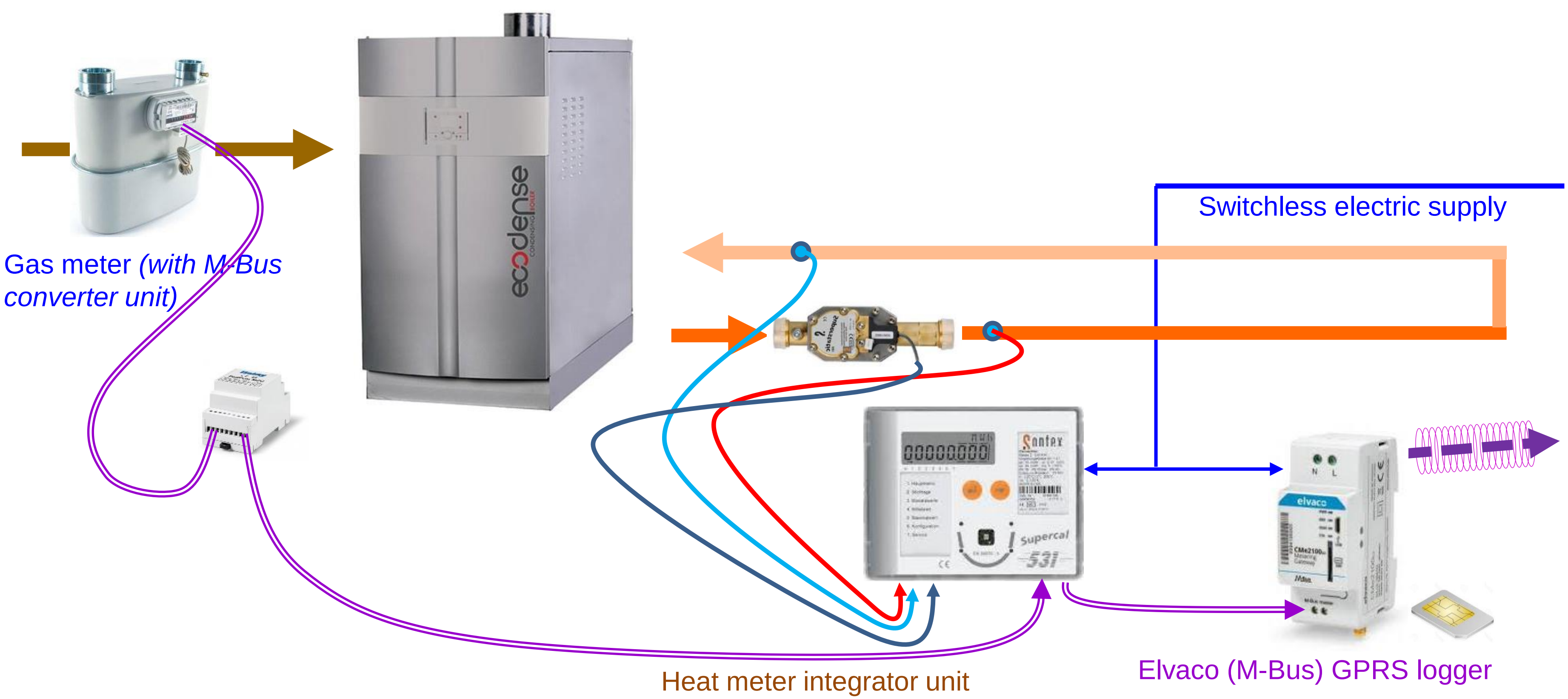


Basic calculation for CT meter ratio e.g.

Watts output	Phases	W p/phase	Volts	Amps p/phase	CT ratio
50,000	3	16,667	230	72	100:5A

Contact: Adrian Hewitt (Ealing contract manager) adrian.hewitt@energence.co.uk 07941 055596 or 01865 423678 (DD)

Gas boiler monitoring



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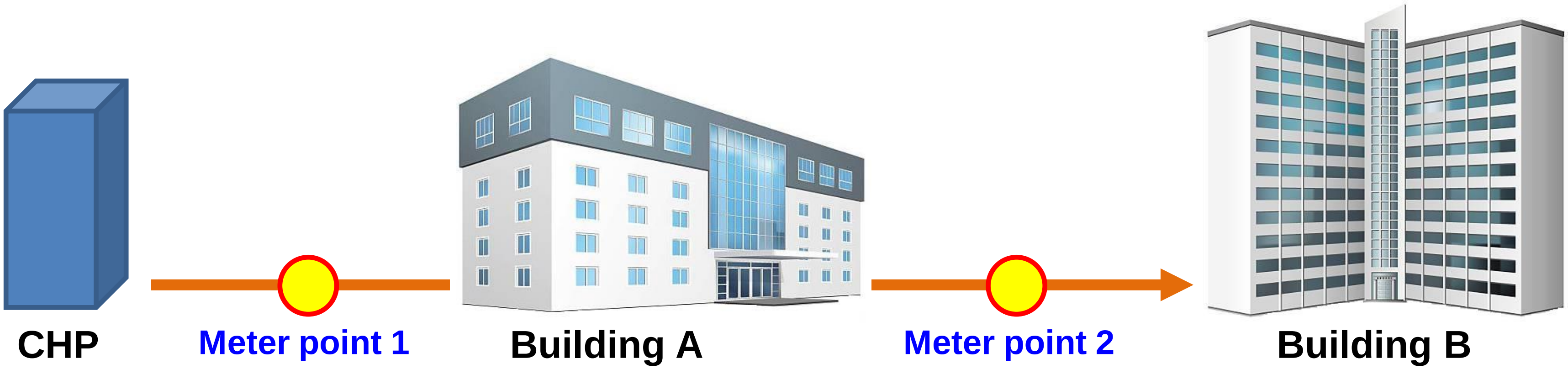
CHP for District Heating (heat element)



Deduct meter 2 kWh from meter 1 = building A usage

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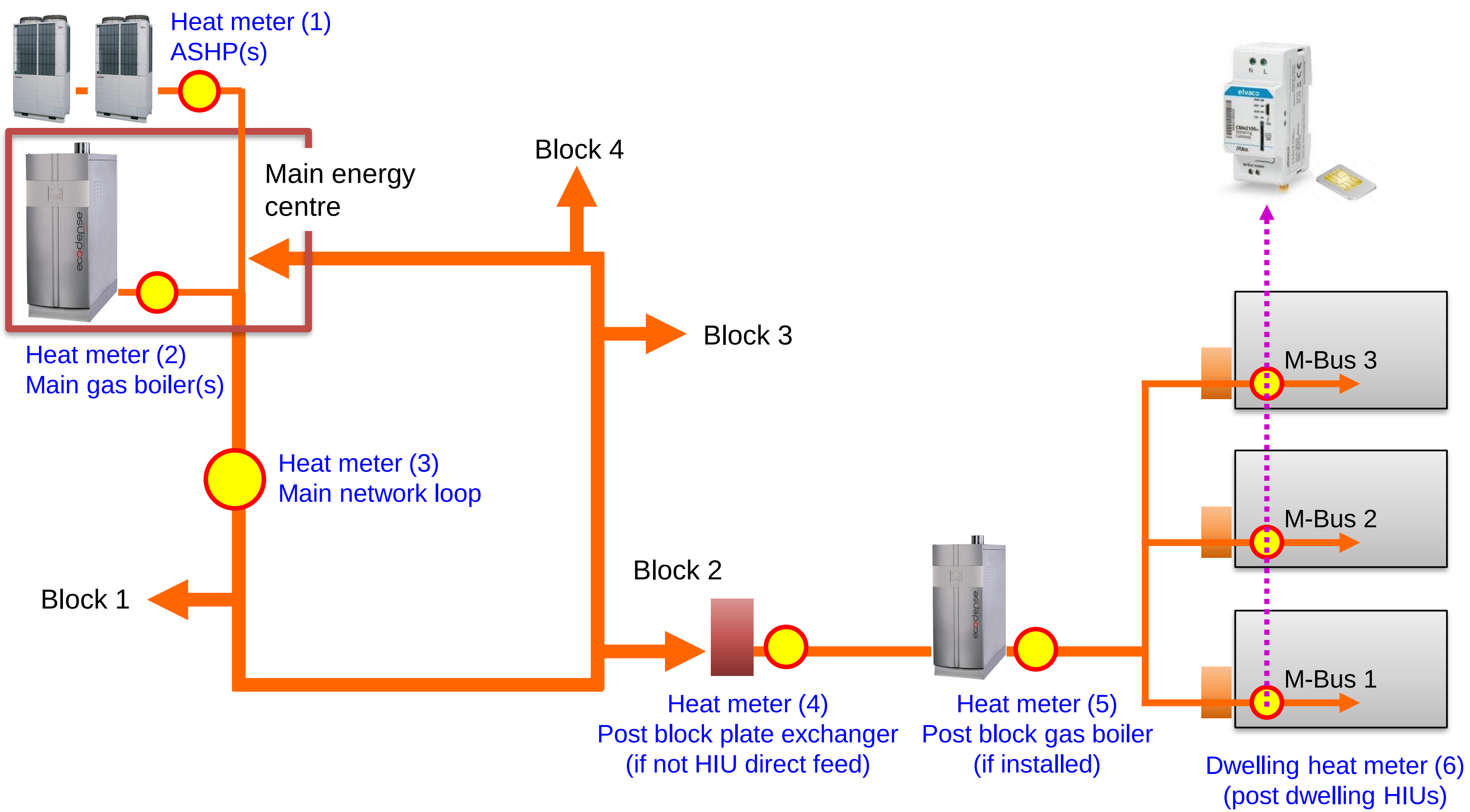
District Heat Network (DHN) monitoring

Heat (and heat pump parasitic load) meter data transfer via GPRS data-logger



Contact: Adrian Hewitt (Ealing contract manager) adrian.hewitt@energence.co.uk 07941 055596 or 01865 423678 (DD)

Energence accepts no liability for electrical works carried out by any third party. The technical guidance and diagrams in this document are basic and aimed at providing non-electricians with an understanding of the monitoring process.

All electrical works should be scoped out and undertaken by a qualified contractor.

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