calfordseaden

Revised Energy Strategy

(Full Planning Application Submission)

For

Kidbrooke Station Square

On behalf of:

Kidbrooke Partnership LLP

Date	October 2019
Reference	G39/K180038/CH
Rev	Rev 08

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Revision Note

REVISION		
Rev.	Date:	Description
01	26/10/18	First Draft
02	09/11/18	Second Draft
03	15/11/18	Full Planning Application Submission
04	19/11/18	Full Planning Application Submission
05	29/01/19	GLA Comments
06	28/08/19	Air Source Heat Pumps replaced CHP
07	08/10/19	Incorporation of DLF - Draft
08	14/10/19	Final Issue

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1 EXECUTIVE SUMMARY

This energy strategy has been prepared on behalf of Kidbrooke Partnership LLP in support of full planning application for the comprehensive redevelopment of Kidbrooke Station Square site, Greenwich. This document details the energy efficient measures and technologies proposed in order to meet the London plan and Royal Borough of Greenwich requirements.

The energy statement follows the Be Lean, Be Clean, Be Green framework described by the London Plan 2019.

The original Energy Strategy for the development proposed the usage of a Combined Heat and Power (CHP) engine in order to achieve the CO2 reductions of the development in line with the London Plan 2016 hierarchy.

Since January 2019 the GLA encourage the use on the SAP10 emissions factors and the SAP10 calculation spreadsheet, with consultation with the GLA it has been decided that the amended Energy Strategy for the Kidbrooke Station Square development will incorporate this guidance and as a result of that the CHP has been replaced with Air Source Heat Pumps (ASHPs).

In this report it will be demonstrated the reduction of the C02 emissions with the revised emission factors and provide supporting calculations how the ASHP will achieve the specified average yearly efficiency in supplying the required annual heat load percentage of the development.

This change will ensure that the calculations for the reduction of the C02 emissions is in line with the current emission factors and hence better reflects the actual carbon emissions associated with the expected operation

1.1 Description of Development

A comprehensive development comprising 619 residential dwellings (Class C3 use), retail use (Class A1/A3 uses), business use (Class B1 use), a nursery (Class D1 use), new station and residential squares and other public realm, hard and soft landscaping, highways works including bus stop provision, parking, access and servicing arrangements, plant and associated works.

1.2 Relevant Planning Policies

It is the developer's intention for the proposed development that;

- The development will be designed and constructed to meet the London Plan 2019, through a combination of energy conservation measures, low carbon technologies, and exploring renewable technologies considering the site particulars.
- The development will comply with Royal Greenwich Local Plan: Core Strategy with Detailed Policies (2014)
- The non-residential spaces will be designed to achieve high scoring BREEAM "Very Good", proposed reduction on policy which states "Excellent". Refer to section 8 for justification.

2 INTRODUCTION

This report will investigate the various options for provision of low carbon and renewable technologies on behalf of Kidbrooke Partnership LLP in relation to the development at Kidbrooke Station Square. This report will discuss the most appropriate options available in order to offset a proportion of the total predicted energy loads of the development using passive measures, low carbon and renewable energy technologies.

This report will demonstrate how the development proposals make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Target emissions are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations 2013 Part L.

At the request of GLA the SAP10 calculations have also been used for the production of this report. As the SAP2012 do not take into account the planned decarbonisation of the electricity grid, SAP10 has been used for the calculations

3 POLICY GUIDANCE & PROJECT STRATEGY

LB Greenwich Policies

Housing

POLICY H5

New residential development, redevelopment, refurbishment or conversions will be expected to achieve a high quality of housing design and an integrated environment. The Royal Borough will take into account the key relationships between the character of the area, site location and housing densities and expect the following:

- *i. For new build homes, the achievement of Code for Sustainable Homes of at least code level four (4);**
- *ii. The design of the development is consistent with Policy DH1 and, for all new build housing developments, is also consistent with the Mayor of London's Housing SPG;*
- *iii. An acceptable level of noise insulation being achieved by means of sensitive design, layout and in developments vulnerable to transportation noise and vibration;*
- *iv. A presumption against single-aspect north facing units and a presumption in favour of dual aspect units where possible;*
- *v. In flats, a good-sized balcony, a terrace or enclosed communal gardens should be provided;*
- *vi. Family housing should normally have direct access to a private garden. Schemes with predominantly family housing should, as far as practicable, be within reasonable walking distance of nursery and primary schools, local shops, play areas and amenities;*
- *vii. Safety and security of residents and public (see also Policy CH1);*
- *viii. The provision of new housing to Lifetime Homes standards;*
- *ix. In residential developments of 25 or more units, 10% of dwellings to be built to full wheelchair standard, or easily adaptable for residents who are wheelchair users;*
- *x. New build developments of flats that are three or more storeys will be required to have sufficient lifts;*

Climate Change Mitigation

POLICY E 1 Carbon Emissions

Carbon emissions will be reduced in accordance with the Mayor's energy hierarchy by:

- *i. First, requiring all development to reduce demand for energy through its design (Be Lean);*
- *ii. Second, requiring all developments, with a gross floor area greater than 500sqm, or residential developments of five or more units, to connect to an existing decentralised energy network. Where this is not available a site wide decentralised energy network is required. Where it is demonstrated that a site wide decentralised energy network is unfeasible and / or unviable, developments will be required to provide sufficient infrastructure to enable a connection to a decentralised energy network for immediate or future use (Be Clean);*
- *iii. Third, supporting the incorporation of renewable energy generation within development proposals (Be Green).*

All major development proposals will require an energy assessment.

London Plan 2016

POLICY 5.2: Minimising Carbon Dioxide Emissions

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:
    1. Be lean: use less energy
    2. Be clean: supply energy efficiently
    3. Be green: use renewable energy
B. The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings

Year	Improvement on 2013 Building Regulations
2016 – 2031	Zero Carbon

Non-domestic buildings

Year	Improvement on 2013 Building Regulations
2016 – 2031	35%

C. Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.
D. As a minimum, energy assessments should include the following details:
    a. calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy
    b. proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
    c. proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)
    d. proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.
E. The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.3 Sustainable Design And Construction

Strategic

A. *The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of the new developments and to adapt to the effects of the climate change over their lifetime.*

Policy 5.5 Decentralised energy networks

Strategic

a. The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

LDF preparation

b. Within LDFs boroughs should develop policies and proposals to identify and establish decentralised energy network opportunities. Boroughs may choose to develop this as a supplementary planning document and work jointly with neighbouring boroughs to realise wider decentralised energy network opportunities. As a minimum boroughs should:
    a. identify and safeguard existing heating and cooling networks
    b. identify opportunities for expanding existing networks and establishing new networks. Boroughs should use the London Heat

Policy 5.6 Decentralised energy in development proposals

Planning decisions

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.
B. Major development proposals should select energy systems in accordance with the following hierarchy:
    1. Connection to existing heating or cooling networks;
    2. Site wide CHP network;
    3. Communal heating and cooling;
C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7 Renewable energy

Strategic

A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning decisions

A. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

LDF preparation

B. Within LDFs boroughs should, and other agencies may wish to, develop more detailed policies and proposals to support the development of renewable energy in London – in particular, to identify broad areas where specific renewable energy technologies, including large scale systems and the large scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.
C. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

3.1 Energy Strategy measures checklist:

The scheme has incorporated the following measures as part of the energy strategy:

Maximised potential of building orientation and massing	√
Maximised potential of natural shading for cooling	√
Increased building fabric performance above Building Regulations	√
Connect to an existing energy network (where available)	
Created an energy network (where technically and economically viable)	
Communal heating	√
Combined Heat and Power	
Efficient individual heating systems	
Ground Source Heat Pump	
Air Source Heat Pump	√
Solar Thermal	
Photovoltaics	√
Biomass Boiler	

The scheme has demonstrated the following emissions reductions from each stage of the energy hierarchy for the site:

Target	**Regulated tonnes CO_2 savings per stage**	**Regulated percentage CO_2 savings per stage**
	Tonnes CO_2/annum	%
Be Lean Emissions	71.1	11.8%
Be Clean Emissions	0	0%
Be Green Emissions	164.7	27.4%
Cumulative on site savings	**235.8**	**39.2%**

TABLE 1 - REDUCTIONS OVER BUILDING REGULATIONS PART L 2013 FOR REGULATED EMISSIONS – SAP10

Summarising from the Greenwich Core Strategy and London Plan 2016 the development shall achieve a 42.1% CO_2 reduction over 2013 Building Regulations based on SAP10 calculations. The non-residential spaces in the development are also required to achieve BREEAM “Excellent” however it is proposed to meet a high scoring “Very Good”. Refer to section 8 for justification.

As described in policy 5.2 of the London Plan 2016 the first stage of the development would be to reduce the energy demand by improving the thermal performance of the building fabric and reducing the energy used by proposing energy efficient equipment. At the “Be Clean” stage technologies to deliver the energy in a more efficient manner will be considered. The Be Green stage will show any eventual proposal for renewable energy system for the development.

4 Baseline Emissions

In accordance with the London Plan the energy demand and carbon dioxide emissions for the residential units have been estimated in compliance with the current building regulations and in particular the requirement of Part L of the 2013 Building Regulations using Standard Assessment Procedure 2013 (SAP).

The carbon dioxide emissions for the residential units are based on initial stage SAP data (see Appendix). This section of the report will review the initial baseline load for the development as laid down in the London Renewable Toolkit and demonstrates the potential energy and CO_2 savings from the initial proposed enhancements to the scheme including the following areas:

1. Enhancements to the building fabric
2. Enhancements to low energy technologies
3. Renewable energy

Baseline is taken as compliance with the current building regulations and in particular the requirement of Part L of the 2013 Building regulations.

4.1 Part L 2013 Baseline Emissions

The following tables provide emissions data for the development extrapolated from test SAP assessments for worst case scenario flats. The flats have been chosen based on the number of exposed external wall, their orientation (i.e. top floors, corner flats and ground floor flats) and based on their typology (i.e. 1bed flat, 2 bed flat etc.), this to make sure that the initial SAP assessments is representative of the worst case scenario.

4.2 Baseline emissions

Unit Ref	Area	TER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m²	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Type 01 (1 Bed 2P)	50	16.7	0.8	243	201.8
Type 07 (3bed 5P)	84	14.3	1.2	52	62.1
Type 22 (studio)	39	16.2	0.6	28	17.8
Type 26 (2 bed 3P)	62	13.7	0.8	287	242.1
Type 25 (3 Bed 6P)	135	17.0	2.3	9	20.7
Total Baseline Emissions					**544.6**

Table 2 – Baseline emissions for the residential units – SAP10

Unit Ref	Area	TER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m^2	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Coffee shop	104	66.2	6.9	1	6.9
Flexible use	479	46.2	22.1	1	22.1
Gym	104	109.7	11.4	1	11.4
Nursery	262	15.8	4.1	1	4.1
Workshop	1172	10.1	11.9	1	11.9
Total Baseline Emissions					**56.4**

TABLE 3 - BASELINE EMISSIONS FOR THE NON-RESIDENTIAL SPACES – SAP10

5 PROPOSED BE LEAN ENHANCEMENTS

In accordance with London Plan Policy 5.3 *Sustainable Design and Construction,* the first priority is to reduce the site baseline emissions through energy efficient design measures.

It is proposed that all domestic and non-domestic building on the development will be constructed with improvements to the building fabric, opting for a fabric first approach.

The 'Be Lean' performance values, shown in Table 4 represent the best construction practice applied to this development and represent a significant improvement over the Building Regulations Part L 2013 criteria.

Passive measures	**PART L 2013**	**Proposed (TBC)**
U-values (W/m^2K)	-	-
External Walls	0.30	0.17
Party Walls	0.20	Full filled and sealed cavity (SAP U-value – 0)
Exposed Ground	0.25	0.13
Exposed Roof	0.20	0.13
Windows	2.0	1.4
Doors	2.0	1.4
Air-tightness	10 $m^3/(h\ m^2)$	4.5$m^3/(h\ m^2)$
Thermal bridging	0.15	0.08
Water (l/person/day)	125	105
Low energy lighting	100%	100%

TABLE 4 - BUILDING FABRICS CHARACTERISTICS

Mechanical Ventilation

The ventilation strategy shall be system 4 mechanical supply and extract ventilation with heat recovery as described in Approved Document F. The use of MVHR will provide background and extract ventilation to kitchens / bathrooms and habitable rooms. Purge ventilation will be provided by opening windows.

Additional energy efficient measures considered at the design stage:

- Luminaire efficacy - please see SAP and BRUKL assessments for detail information

Lighting controls and HVAC efficiencies:

- Time switching
- Occupancy sensing time switch (when suitable)
- Average Heat Recovery Efficiency for MVHR: 88%
- Condensing boilers gross seasonal efficiency: 96% (benchmark boiler: ELCO R3605SB)

Heating Controls:

- Central time control
- Optimum start/stop control
- Local time control
- Local temperature control
- Weather compensation control

The Be Lean emissions for the scheme are shown in the tables below.

Unit Ref	Area	DER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m^2	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Type 01 (1 Bed 2P)	50	14.8	0.7	243	178.3
Type 07 (3bed 5P)	84	13.2	1.1	52	57.4
Type 22 (studio)	39	15.1	0.6	28	16.6
Type 26 (2 bed 3P)	62	11.9	0.7	287	211.1
Type 25 (3 Bed 6P)	135	14.6	2.0	9	17.8
Total Be Lean Regulated Emissions					**481.3**

TABLE 5 - BE LEAN FOR THE RESIDENTIAL UNITS – SAP10

	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	63.2	11.6%
Be Clean Emissions		
Be Green Emissions		
Cumulative on site savings	**63.2**	**11.6%**

TABLE 6 - CARBON EMISSIONS ASSOCIATED TO FABRIC IMPROVEMENTS FOR THE RESIDENTIAL UNITS –SAP10

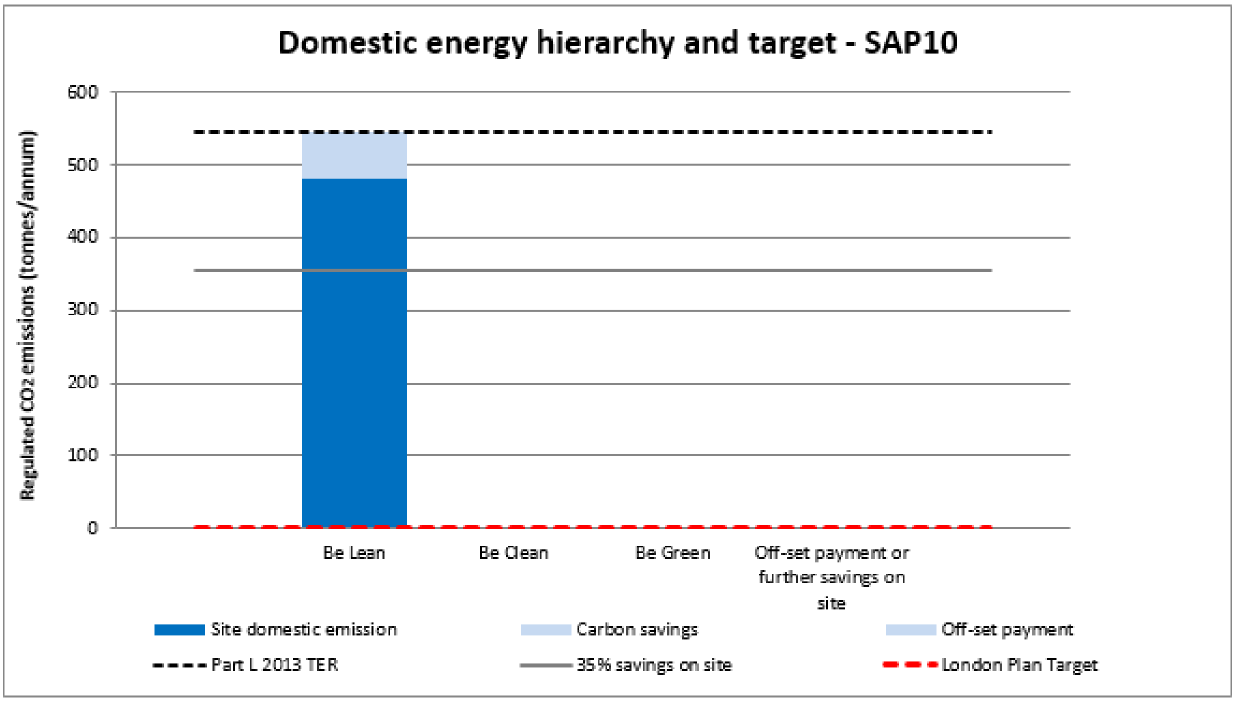


FIGURE 1 – BE LEAN CARBON REDUCTION EMISSIONS FOR RESIDENTIAL UNITS –SAP10

Unit Ref	Area	DER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m²	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Coffee shop	104	60.3	6.3	1	6.3
Flexible use	479	38.8	18.6	1	18.6
Gym	104	107.1	11.1	1	11.1
Nursery	262	13.9	3.6	1	3.6
Workshop	1172	7.6	9	1	9
Total Be Lean Regulated Emissions					**48.5**

TABLE 7 - BE LEAN CARBON EMISSIONS FOR NON-RESIDENTIAL SPACES –SAP10

Target	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	8	14.0%
Be Clean Emissions		
Be Green Emissions		
Cumulative on site savings	**8**	**14.0%**

TABLE 8 - CARBON EMISSIONS REDUCTIONS ASSOCIATED TO FABRIC IMPROVEMENTS FOR NON-RESIDENTIAL SPACES – SAP10

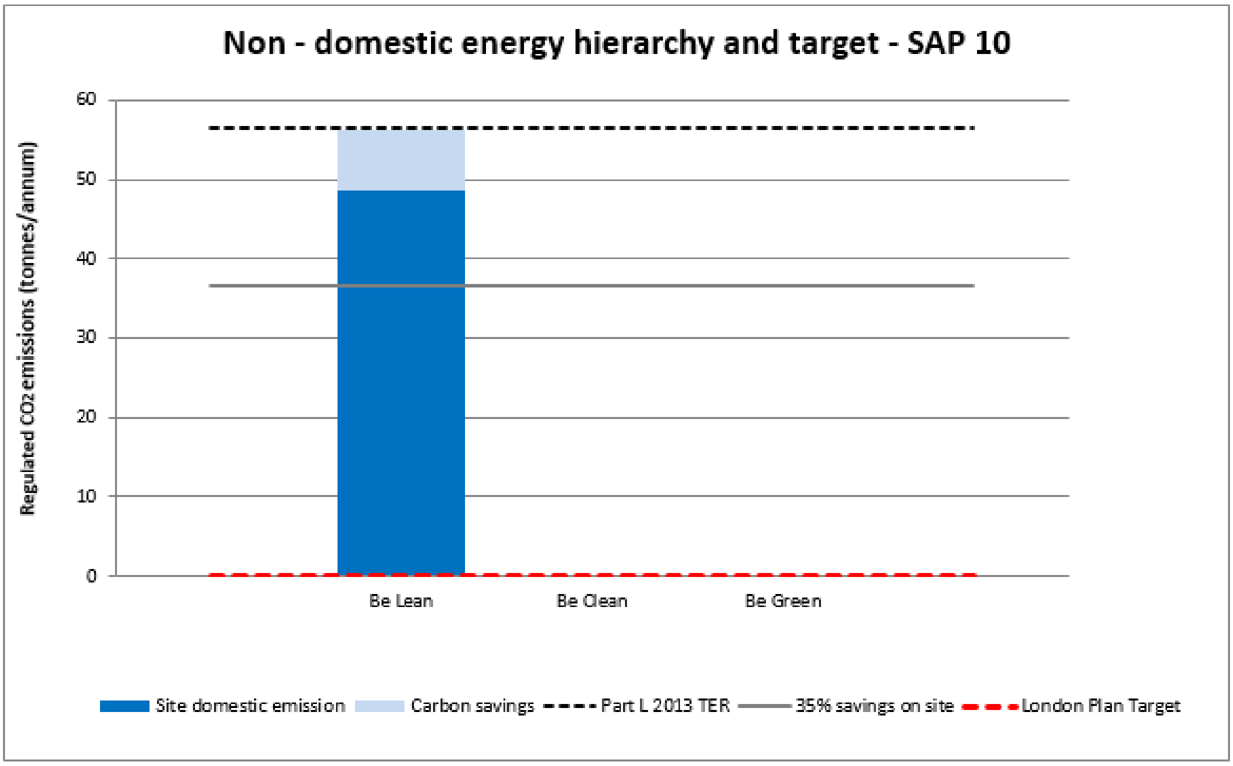


FIGURE 2 - BE LEAN CARBON REDUCTION EMISSIONS FOR NON-RESIDENTIAL SPACES –SAP10

Building use	Energy demand following energy efficiency measures (MWh/year)				
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling
Domestic	575.5	1238.3	165.6	103.8	0.0
Non-domestic	28.1	127.8	39.7	10.1	19.5

TABLE 9- ENERGY DEMAND FOLLOWING ENERGY EFFICIENCY MEASURES – SAP10

Cooling Energy					
	Actual			Notional	
	m2	kWh/m2year	MJ/year	kWh/m2year	MJ/year
Coffee shop	103.7	6.53	2437.7796	13.85	5170.482
Nursery	261.5	20.89	19665.846	31.28	29446.992
Flexible use	478.5	9.12	15710.112	16.65	28681.29
Workshop	1172.7	7.17	30269.7324	8.1	34195.932
Gym	103.6	5.9	2200.464	7.63	2845.6848
Total			**70283.934**		**100340.3808**

TABLE 10 – COOLING DEMAND FOR THE DEVELOPMENT

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	36.27	34.13	5.91%

TABLE 11- FABRIC EFFICIENCY IMPROVEMENT RESIDENTIAL UNITS– SAP10

6 PROPOSED BE CLEAN ENHANCEMENTS

In accordance with GLA Guidance, proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks;
2. Zero-emission or local secondary heat sources (in conjunction with heat pump);
3. Low –emissions CHP (only for area-wide heat network);
4. Ultra-low NOx gas boilers.

6.1 Connection to existing heating or cooling networks

In line with the requirements of the London Plan, the report has considered the feasibility of connecting into an existing or planned local district heating network.

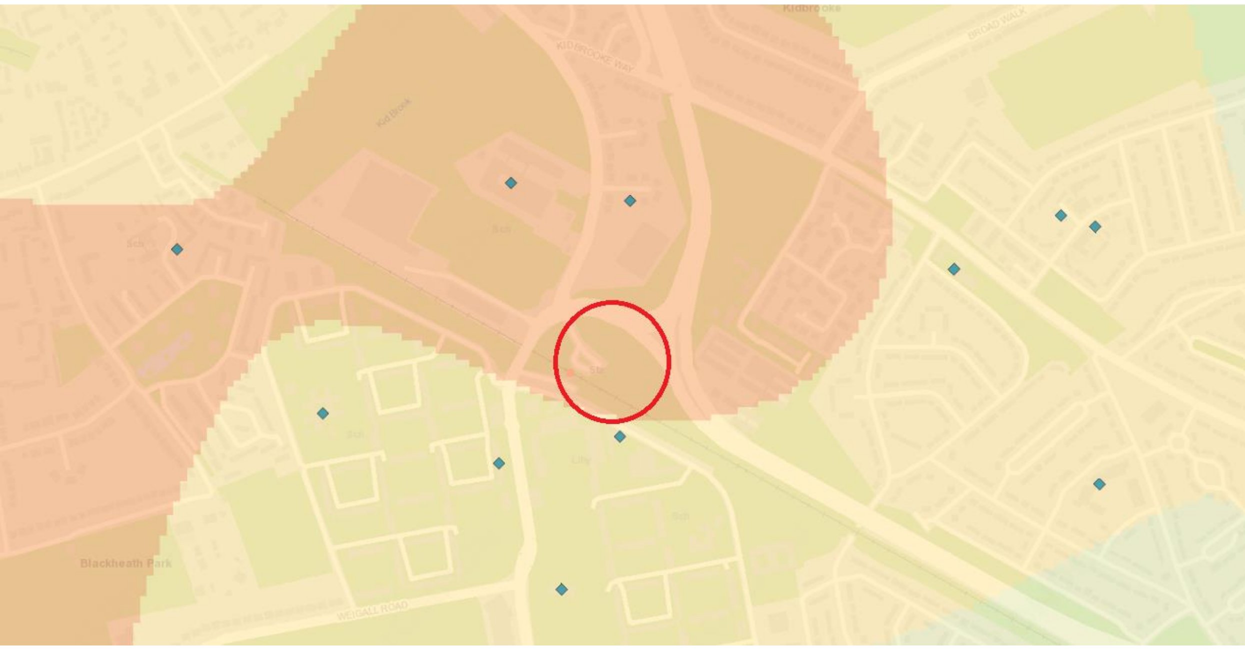
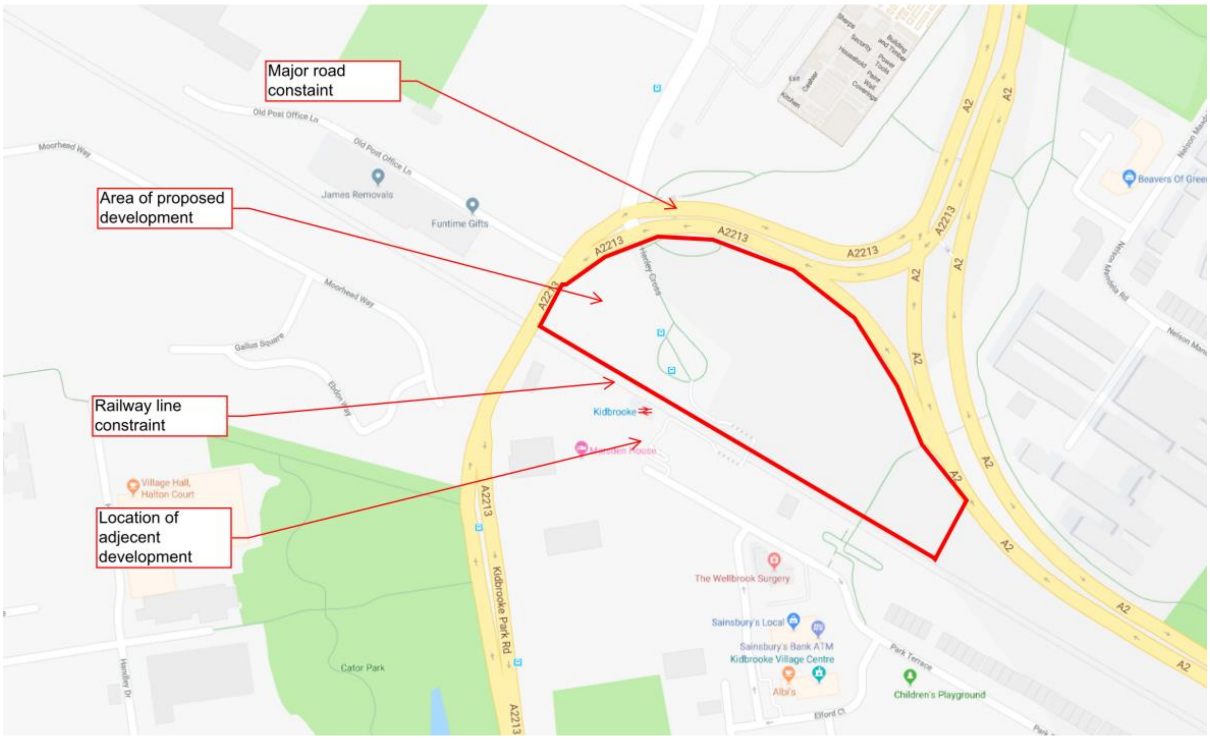


FIGURE 3 – LONDON HEAT MAP SCREENSHOT

The London heat map shows that the site is located within an area of heat decentralised energy potential in accordance with the Heat Map toolkit and planned district heating networks are in the vicinity of the development. RGB have confirmed that the only large scale communal heat system is located in the neighbouring development from Berkeley, with whom an investigation was undertaken to establish whether it was possible for Kidbrooke Square Station to connect to their Energy Centre. An initial response has now been received where Berkeley have stated their concerns regarding the feasibility of the connection.

In addition Berkeley have responded regarding the capacity of their systems and have said that: “the Energy Centre in Phase 3 has capacity for our (Berkeley Homes’) current proposals for Kidbrooke Village. Significant additional work would be required to understand if additional capacity could be added to the network. “The Berkeley Homes Energy Centre has not been designed to accommodate the demand from adjacent sites outside of the Kidbrooke Village Masterplan.

At this stage we have based our proposal on a site energy centre containing Air Source Heat Pumps, in addition infrastructure will be installed from the energy centre to the site boundary to facilitate future connection if feasible.



Hi Dimitrios

The area of Kidbrooke Station development is the area of decentralised energy potential. Large scale communal systems will be present in the Berkley homes development in the vicinity. There are no other planned DNH I am aware of.

Best regards,

Lawrence

Thanks for your email. Tamsin raised this with me yesterday and she is looking into the detail. This may take a little time but she will come back to Sam. In the meantime, please see below a brief summary.

There is no Esco in place for KV at present, however this is our intention in the long term. The DH Network does not extend north of the railway line it crosses Kidbrooke Park Road, east-west between Phase 3 and Phase 2/6 only.

The railway line, the railway bridge and the third party land ownership (Network Rail?) are a physical impediment to any DH Network connection, which in my view, might make the likelihood of sharing any capacity extremely complicated and costly to undertake.

Tamsin will come back to you with the detail we can ascertain asap.

Kind regards

Hi Sam

I hope you are well and apologise for the delayed response.

In response to your question regarding capacity, the Energy Centre in Phase 3 has capacity for our current proposals for Kidbrooke Village. Significant additiona work would be required to understand if additional capacity could be added to the network.

I think David has addressed the remaining queries in his previous email, but any further queries, please just let me know.

Many thanks

6.2 Site-wide Network

GLA has advised to explore the utilisation of Air Source Heat Pumps in favour of a site wide CHP network as per the draft London Plan Policy SI3 Energy Infrastructure and GLA Energy Assessment Guidance (Oct 18). Therefore improvements from ASHPs are demonstrated in the "Be Clean" section of this report

Unit Ref	Area	DER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m^2	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Type 01 (1 Bed 2P)	50	14.8	0.7	243	178.3
Type 07 (3bed 5P)	84	13.2	1.1	52	57.4
Type 22 (studio)	39	15.1	0.6	28	16.6
Type 26 (2 bed 3P)	62	11.9	0.7	287	211.1
Type 25 (3 Bed 6P)	135	14.6	2.0	9	17.8
Total Be Lean Regulated Emissions					**481.3**

TABLE 12 - BE CLEAN REDUCTIONS OVER 2013 BUILDING REGULATION BASELINE FOR THE RESIDENTIAL UNITS – SAP10

	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	63.2	11.6%
Be Clean Emissions	0	0%
Be Green Emissions		
Cumulative on site savings	**63.2**	**11.6%**

TABLE 13 - BE CLEAN REDUCTIONS OVER 2013 BUILDING REGULATION BASELINE FOR RESIDENTIAL UNITS– SAP10

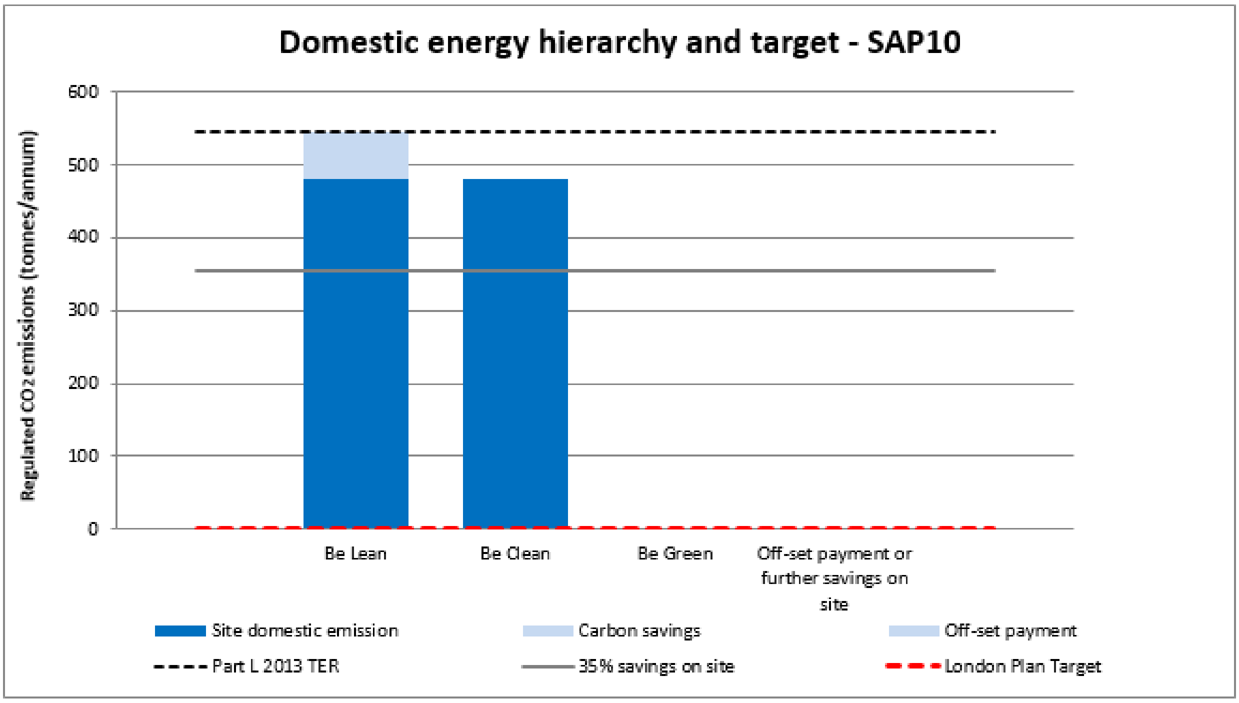


FIGURE 4 - BE CLEAN CARBON REDUCTION EMISSIONS FOR RESIDENTIAL UNITS – SAP10

Unit Ref	Area	DER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m²	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Coffee shop	104	60.3	6.3	1	6.3
Flexible use	479	38.8	18.6	1	18.6
Gym	104	107.1	11.1	1	11.1
Nursery	262	13.9	3.6	1	3.6
Workshop	1172	7.6	9	1	9
Total Be Lean Regulated Emissions					**48.5**

TABLE 14 - BE CLEAN REDUCTIONS OVER 2013 BUILDING REGULATION BASELINE FOR THE NON-RESIDENTIAL SPACES – SAP10

Target	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	8	14.0%
Be Clean Emissions	0	0%
Be Green Emissions		
Cumulative on site savings	**8**	**14.0%**

TABLE 15 - BE CLEAN REDUCTIONS OVER 2013 BUILDING REGULATION BASELINE FOR NON-RESIDENTIAL UNITS SPACES – SAP10

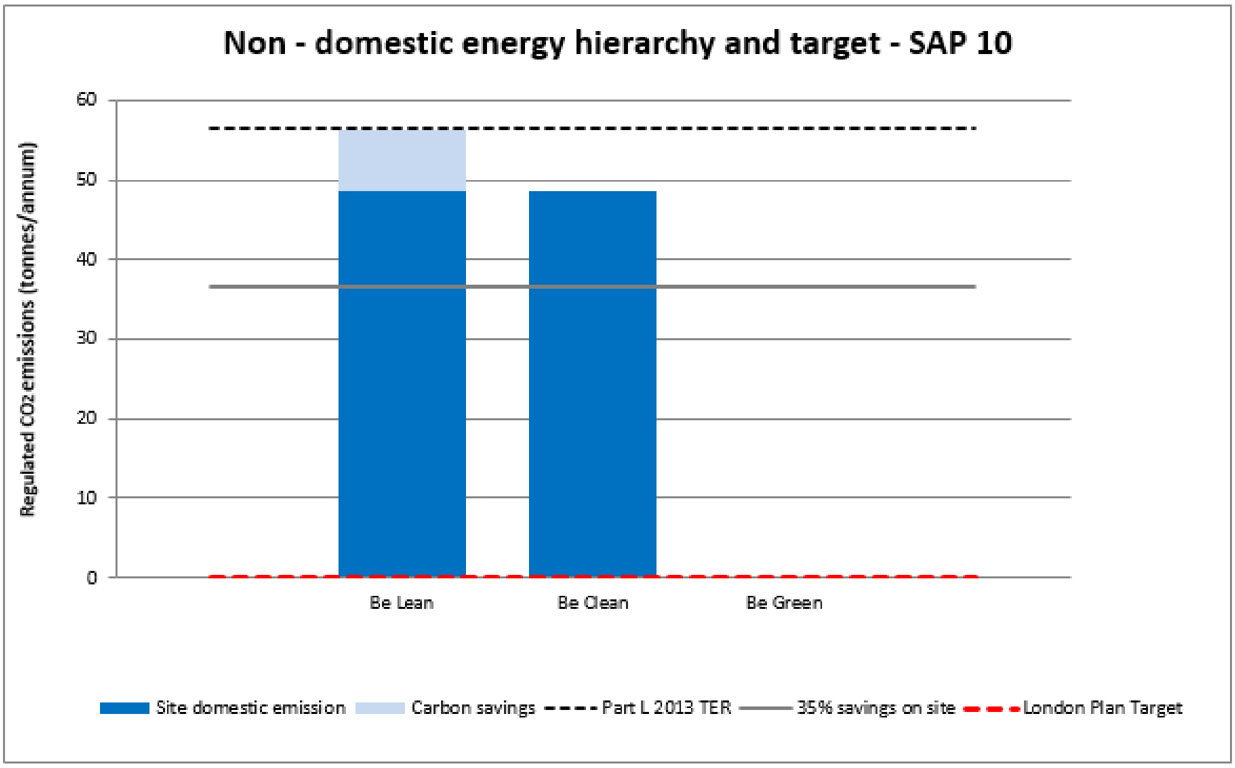


FIGURE 5 – BE CLEAN CARBON REDUCTION EMISSIONS FOR NON-RESIDENTIAL SPACES–SAP10

7 PROPOSED 'BE GREEN' ENHANCEMENTS

The following section examines the potential feasibility of also incorporating renewable technologies to provide a further carbon dioxide reduction though onsite renewable.

The following technologies have been reviewed:

- Wind Turbines
- Photovoltaic
- Solar Thermal
- Heat Pumps
- Biomass Heating

Wind Turbines

Wind turbines can have outputs ranging from a few watts to several megawatts and produce electricity without emitting CO_2. Energy is extracted from the wind using a rotor generally consisting of two or three blades, which have a profile similar to that of an airplane wing. If the diameter of the rotor is doubled, the power output from the turbine is quadrupled at a given wind speed.

Correct assessment of the resource and sighting is critical before considering the installation of a turbine. Potential sites generally need average wind speeds of greater than 5m/s at hub height to be economically viable in the UK, although small roof mounted wind turbines (typically 1.5kW) can work at wind speeds as low as 3.5m/s. Wind energy availability varies on a seasonal basis and peaks during the winter months, which matches well with the seasonal variation in energy requirements in a development.

Although best suited to rural environments, modern wind turbines are becoming increasingly cost effective in low-density areas where there is often the opportunity to connect them immediately to the grid, or use the electricity generated directly in a dwelling. For higher density housing, they are not as cost-effective as their output will be affected by lower and disrupted average wind speeds. Rooftop mounted turbines are becoming increasingly available, where the higher average wind speeds at increased hub heights contribute to improved performance.

SUMMARY:

A stand-alone wind turbine can be excluded from consideration, as it would require sufficient open space available on the site to locate the turbine and to be far enough away from building to be able to work effectively with minimum turbulence. There appears to be no open space of sufficient size around the development to allow for this and so has been removed from consideration.

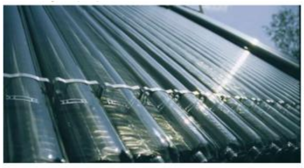
Also building mounted wind turbines may be limited due to the environmental conditions of the site, in that it may be difficult to achieve the requisite wind speeds in order make this technology a feasible option. There may also be potential issues with regard to visual amenity and noise generation associated with certain types of wind turbine. Wind turbines have therefore been excluded from further consideration for the development.

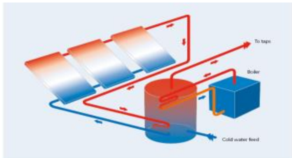
Photovoltaic	
Photovoltaic or 'PV' systems convert energy from the sun into electricity through semi-conductor cells. A cell consists of a junction between two thin layers of dissimilar semi-conducting materials, based on silicon. When light shines on the junction, a difference in energy is created – otherwise known as 'voltage' or 'potential difference'. This voltage is used to produce an electrical current or direct current (DC), which can be used directly or converted into alternating current (AC). The brighter the sunlight, the more power is produced – although PV cells still produce a reduced level of power when the sun is hidden by clouds. Shading from other objects (such as nearby buildings and trees) is a key issue, as PV cells are more likely to show a drop in system output than solar thermal panels. Ideally panels should face as close to due south as possible, and not be shaded. Individual PV cells only produce a small amount of power, so are connected together to form a module. Modules can then be linked to form an array and sized to meet a particular load. There are three main types of solar cells readily available in the UK: *Monocrystalline* – very thin wafers of silicon cut from a small seed crystal. More efficient than polycrystalline, but more expensive due to the manufacturing process. *Polycrystalline* – instead of one crystal, several different crystals are used for producing the slices. The result is cheaper PV cells than monocrystalline but lower efficiencies. *Amorphous silicon* – silicon is made into a continuous strip of film. Cells can be produced more quickly and hence cheaply than mono or polycrystalline, but with substantially lower efficiencies.	  
SUMMARY: A photovoltaic system has been included to provide further carbon reduction. The PV panels will be installed on the building flat roof. Vertical photovoltaic panels are not viable on the proposed development not only due to their decreased efficiency and significant higher maintenance cost, but also due to the nature of the development which is mostly residential and thus the fenestrations inhibit the installation.	

Solar Thermal

Solar thermal or solar hot water (SHW) systems for use in dwellings use a heat collector, which is generally mounted on a roof and contains a fluid (typically water with glycol) that is heated by the sun. The heated liquid is then passed through a coil in a hot water storage vessel. The heated water in the vessel may then be supplied directly, or raised to a higher temperature (if required) by a supplementary heater. In this way the 'free' energy obtained from the sun can be used to offset the amount of energy that would be required to heat the water, and will reduce both running costs (due to the fuel being displaced) and the associated CO_2 emissions. These systems do not generally provide space heating, and are among the most cost-effective renewable energy systems that can be installed on dwellings in rural or urban environments.

It must be remembered that solar thermal load must be matched to the hot water load and storage vessel sized appropriately to maximise the solar thermal energy.





SUMMARY:

Solar thermal systems have not been considered suitable as will be in conflict with the ASHPs for the summer time thermal load of the development.

Heat Pumps – Ground Source

Ground Source - In the UK the earth, a few meters below the surface, keeps a constant temperature of about 11-12°C throughout the year. This temperature is maintained due to the ground's high thermal mass, which stores heat from the sun during the summer. Ground Source Heat Pumps (GSHP) can transfer this heat from the ground by a vapour compression cycle into a building to provide space heating and, in some cases, pre-heating for domestic hot water. For every unit of electricity used to operate the heat pump, 3-4 units of heat are produced, this is known as a heat pumps Coefficient of Performance (COP).

There are three important elements to a GSHP:

Ground loop - comprises lengths of pipe buried in the ground, either in a borehole or a horizontal trench. The pipe is a closed circuit and is filled with a mixture of water and antifreeze, which is pumped round the pipe absorbing heat from the ground. (Pictured)

Heat pump – Exchanges the heat in the buried pipe work through a heat exchanger to a secondary water circuit.

Heat distribution system - under floor heating or oversized radiators for space heating and in some cases water storage for hot water supply.

SUMMARY:

Ground Source Heat Pumps systems would be in conflict with the ASHPs for the summer time thermal load of the development therefore have not been considered suitable for this site.

Heat Pumps – Air Source
Air Source Heat Pumps extract heat energy from a source and transfers that heat into a building by means of either, under-floor heating system (most efficient), radiators (oversized to counter the low flow temperatures). An electric heat pump can potentially deliver 4kW of heat energy for every 1kW of electrical energy used to power the pump (CoP 4:1). This technology could provide the majority of the heating for an individual dwelling or development for the year. Back up heating is provided by either a standard boiler or electric heating unit integral within the system. ASHP's require either an area to mount an external condenser or ducting for internal exhaust air systems. There are two main types of Air Source Heat Pumps, Air-to-Water- comprises of an external heat pump unit and an internal unit containing the cylinder, expansion vessel and electric heater. The heat pump extracts heat energy from the outside atmospheric air. The heat pump removes the heat in the air and transfers that heat energy via a refrigerant, where the temperature is raised to heat domestic hot water and heating water systems. Back up heating is provided by an electric heating unit integral within the systems. Exhaust Air Heat Pumps – Mechanical ventilation system combined with a heat pump, which extracts air via ductwork connected to the warm areas of the dwelling such as bathrooms, kitchens and utility rooms. Heat is removed from the air and transferred into the heat pump where the temperature is raised to heat the domestic hot water and radiator water. Back up heating is provided by an electric heating unit integral within the system.
Summary: Air Source Heat Pumps systems have been selected to provide a percentage of the heat load of the development as it will be demonstrated in this report

Biomass Boiler

Biomass is a term used to define all plant and animal material and has been used as an energy source for centuries. Although there are a number of different technologies available that extract heat from biomass, wood burning systems are most likely to be appropriate for use in community systems. Biomass or wood burning systems differ from other renewable energy sources in that CO_2 is emitted when it is burned to produce heat. However the amount of CO_2 released is only the same as the amount of carbon absorbed by the tree whilst it was growing and therefore considered essentially a carbon neutral approach.

Wood fuel can be sourced in three main forms, logs, pellets and woodchip. Logs are one of the simplest, quickest and cheapest forms of using wood fuel, although their energy density is half that of pellets, and a quarter of the energy density in woodchip.

When the technology is used on a large development for burning wood fuel it involves the use of large automatic wood chip/pellet boilers situated in a main heating centre with adjacent wood pellet fuel stores to supply the boiler. Due to the slow response rates of the boilers a thermal store can be included in the installation to smooth out the demand requirements and allows the boilers to charge the store and then set back to stand-by mode as the energy store is used.

The following must be considered at the early stages of a project to ensure a successful biomass scheme:

1. Fuel sourcing
2. Delivery of the fuel to the fuel store
3. Fuel handling
4. Boiler sizing and control
5. Local Environmental Pollution


SUMMARY:

A biomass system is not considered viable due to limited room available (require a large fuel storage), high maintenance requirements, embodied carbon of fuel deliveries and effects to local air quality.

For these reasons is not a suitable renewable technology for this development.

7.1 General

To complete the energy hierarchy renewable energy systems have been considered and Air Source Heat Pumps have been selected. The ASHPs along with the use of Photovoltaic panels are able to achieve and surpass 35% savings of CO_2 emissions against Building Regulations 2013.

7.2 Air Source Heat Pumps

It is proposed to install ASHPs to minimise the carbon emissions for the development. The ASHPs are to cover the 60% of the heat demand of the annual load of the development with an annual efficiency of 285%. In the evaluation of the annual efficiency on the ASHP the London_LHR_DSY1_2020High90 weather file has been utilised. As the manufacturers provide the efficiency of the unit in temperature ranges, the worst case scenario was considered in the estimation of the efficiency and output of the ASHP (e.g. for the temperature range 7 °C >= and <10 °C it has been assumed that efficiency and output of the ASHP will be that of 7°C). For the calculations for the proposed development the 4 No Mitsubishi CAHV-P500YA models has been considered to be serving the development, however any air source heat pump arrangement can be utilised providing the cover the 60% of the heat demand of the annual load of the development with an annual efficiency of 285%.

Capacity kW		External/ Intake Temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet Water temperature °C	35	0	0	40.3	42.2	42.4	42.7	42.8	43.5	45	45	45	45	45	45	45	45
	45	32	37.4	40.6	42.4	42.6	42.9	43	43.5	45	45	45	45	45	45	45	45
	55	32.2	37.7	40.8	42.7	42.8	43.1	43.2	43.6	45	45	45	45	45	45	45	45
	60	32.2	37.8	40.9	42.8	42.9	43.2	43.3	43.7	45	45	45	45	45	45	45	45
	65	32.2	37.9	41	42.9	43	43.3	43.4	43.7	45	45	45	45	45	45	45	45
	70	0	0	41.1	43	43.1	43.4	43.5	43.7	45	45	45	45	45	45	45	45

TABLE 16 – MITSUBISHI CAHV-P500YA OUTPUT CAPACITY PER UNIT

Input kW		External/ Intake Temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet Water temperature °C	35	0	0	17	16.9	16.2	14.7	14.2	12	10.9	9.82	8.2	7.4	6.6	6.3	6.02	5.77
	45	18.4	19.4	19.4	19.5	18.7	17	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	20.1	19.5	17.5	16.5	15.2	13.2	12.1	11	10.3	9.75	9.24
	60	22.9	24.5	24.8	25	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	24.6	23.9	22.2	21.3	19.6	16.9	15.4	14	13	12.1	11.4
	70	0	0	30.2	30.8	29.8	27.6	26.9	25.7	25.6	23.9	19.9	18	16	14.8	13.8	12.9

TABLE 17 – MITSUBISHI CAHV-P500YA ELECTRICAL INPUT PER UNIT

COP		External/ Intake Temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet Water temperature °C	35	0.00	0.00	0.00	2.37	2.50	2.62	2.90	3.01	3.63	4.13	4.58	5.49	6.08	6.82	7.14	7.48
	45	1.74	1.74	1.93	2.09	2.17	2.28	2.52	2.62	3.06	3.49	3.78	4.46	4.96	5.59	5.82	6.05
	55	1.52	1.52	1.68	1.80	1.87	1.95	2.14	2.22	2.49	2.73	2.96	3.41	3.72	4.09	4.37	4.62
	60	1.41	1.41	1.54	1.65	1.71	1.78	1.95	2.02	2.29	2.53	2.71	3.06	3.31	3.63	3.88	4.17
	65	1.29	1.29	1.41	1.50	1.55	1.65	1.76	1.82	1.97	2.11	2.30	2.66	2.92	3.21	3.46	3.72
	70	0.00	0.00	0.00	1.36	1.40	1.45	1.57	1.62	1.70	1.76	1.88	2.26	2.50	2.81	3.04	3.26

TABLE 18 – MITSUBISHI CAHV-COP (COP CALCULATED AS DESCRIBED ABOVE)

Heat Requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Residential HWS Demand (MWh)	160.14	104.64	59.64	14.74	2.64	0.00	0.00	0.00	0.00	23.88	92.84	166.34
Residential HTG Demand (MWh)	130.78	115.49	121.83	109.95	108.29	97.54	94.41	102.58	102.08	113.98	119.59	127.88
Commercial HTG Demand (MWh)	3.75	2.45	1.39	0.34	0.06	0.00	0.00	0.00	0.00	0.56	2.17	3.89
Commercial HWS Demand (MWh)	0.10	0.09	0.10	0.09	0.09	0.08	0.07	0.08	0.08	0.09	0.09	0.10
Total	294.77	222.67	182.96	125.12	111.08	97.61	94.48	102.66	102.16	138.51	214.70	298.22

TABLE 19 – HEAT REQUIREMENTS

In order to maximise the utilisation of the ASHPs it has to be considered that any difference between the outlet temperature of the ASHP and the temperature of the flow of the communal heating system constricts the utilisation of the ASHP, for example if the communal heating system is designed to run at70°C-40°C and the outlet of the ASHP is at 55°C, the ASHP would only be able to cover up to 50% of the load as it would only be able to raise the temperature to 55°C and the rest 15°C raise in temperature had to be covered from the boilers. Therefore the system flow temperature should be minimised to enable the ASHP to cover the maximum allowable percentage of the total heating requirements.

As the HIUs have to be able to achieve 55°C at the hot water outlets in the flats it is proposed that the heating system flow temperature is to be set at 65°C

At the same time it has to be considered that the ASHP have to run efficiently (at an average of 285% efficiency in this case) and as well as cover a significant proportion of the total heat demand (60% in this case).

Additional factors that need to be considered is that the ASHP have to be utilised at the maximum practically degree to minimise the installation, maintenance and infrastructure costs and that the ASHP should be able to be used without the use of boilers as the later would minimise the CO_2 emissions during warm periods. The importance of the latter is increased the predictions for rising average temperatures.

Therefore it is proposed that the ASHP would have a varying outlet temperature based on the temperature of the air intake (which shall be determined by a temperature sensor located next to the ASHPs). With this method the controls of the system are simplified and the ASHP utilisation and efficiency is maximised and in addition any adaptation to changing weather conditions is straight forward. For the development the proposed outlet temperatures are as per Table 20. When the ASHP output is at 65°C the ASHP would be supplying the development (or filling the buffer vessels) directly and when it is set lower they will be used in conjunction with the boilers. During the hours at which the ASHP is set to deliver water less than 55°C their output is restricted to accordingly (66.67% and 33.33% in this case) of the heating requirement extrapolated for that duration.

External Temp ºC	40	35	30	25	20	16	10	7	5	2	0	-5	-7	-10	-15	-20
ASHP Outlet Temp ºC	65	65	65	65	65	55	55	45	35	35	35	35	35	35	35	35

Table 20 – ASHP Outlet Temperature VS Intake Air Temperature

Month	Heat Demand kWh	System Flow Temp ºC	System Return Temp ºC	Heat Demand Covered By ASHP kWh	Heat Demand Covered By ASHP	Average COP	Hours of ASHP operation
Jan	293234	65	35	116280.0	39.7%	2.89	646.0
Feb	221882	65	35	101700.0	45.8%	2.91	565.0
Mar	182910	65	35	121940.3	66.7%	2.88	677.4
Apr	125684	65	35	84020.6	66.9%	2.89	466.8
May	111820	65	35	101383.8	90.7%	2.85	563.2
Jun	98314	65	35	93287.1	94.9%	2.88	518.3
Jul	95162	65	35	95161.8	100.0%	3.05	528.7
Aug	103400	65	35	103399.7	100.0%	2.91	574.4
Sep	102895	65	35	102895.1	100.0%	2.81	571.6
Oct	138962	65	35	115410.6	83.1%	2.82	641.2
Nov	214121	65	35	112680.0	52.6%	2.88	626.0
Dec	296567	65	35	123840.0	41.8%	2.89	688.0
Total	1984951			1271999.0	64.1%	2.89	7066.7

Table 21 – Summary of ASHP Operation

To ensure that the Air Source Heat Pumps are operating for the maximum timeframe per day; buffer vessels will be utilised.

External Temperature	40 ºC			35 ºC			30 ºC			25 ºC		
Month	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh
Jan	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	0
Feb	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	0
Mar	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	1440
Apr	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	0
May	65	3.72	0	65	3.46	360	65	3.21	8280	65	2.92	28080
Jun	65	3.72	0	65	3.46	1440	65	3.21	18900	65	2.92	26100
Jul	65	3.72	720	65	3.46	9180	65	3.21	29160	65	2.92	47700
Aug	65	3.72	0	65	3.46	180	65	3.21	20340	65	2.92	53460
Sep	65	3.72	0	65	3.46	0	65	3.21	5580	65	2.92	45720
Oct	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	5760
Nov	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	0
Dec	65	3.72	0	65	3.46	0	65	3.21	0	65	2.92	0

Table 22 – Detail Operation of ASHP 1 of 4

External Temperature	20 °C			16 °C			10 °C			7 °C		
Month	ASHP Outlet Temp °C	ASHP COP	Actual Output kWh	ASHP Outlet Temp °C	ASHP COP	Actual Output kWh	ASHP Outlet Temp °C	ASHP COP	Actual Output kWh	ASHP Outlet Temp °C	ASHP COP	Actual Output kWh
Jan	65	2.66	0	55	2.96	54360	55	2.73	44460	45	3.06	17460
Feb	65	2.66	900	55	2.96	48420	55	2.73	31320	45	3.06	21060
Mar	65	2.66	8820	55	2.96	71820	55	2.73	32040	45	3.06	7820
Apr	65	2.66	540	55	2.96	57960	55	2.73	25521	45	3.06	0
May	65	2.66	37080	55	2.96	22704	55	2.73	4340	45	3.06	540
Jun	65	2.66	37440	55	2.96	3827	55	2.73	5040	45	3.06	540
Jul	65	2.66	8402	55	2.96	0	55	2.73	0	45	3.06	0
Aug	65	2.66	29420	55	2.96	0	55	2.73	0	45	3.06	0
Sep	65	2.66	51595	55	2.96	0	55	2.73	0	45	3.06	0
Oct	65	2.66	52560	55	2.96	55282	55	2.73	1809	45	3.06	0
Nov	65	2.66	4680	55	2.96	59580	55	2.73	36540	45	3.06	11880
Dec	65	2.66	1260	55	2.96	47340	55	2.73	48960	45	3.06	26280

Table 23 – Detail Operation of ASHP 2 of 4

External Temperature	5 °C			2 °C			0 °C			-5 °C		
Month	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh
Jan	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Feb	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Mar	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Apr	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
May	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Jun	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Jul	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Aug	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Sep	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Oct	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Nov	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0
Dec	35	3.01	0	35	2.90	0	35	2.62	0	35	2.50	0

Table 24 – Detail Operation of ASHP 3 of 4

External Temperature	-7°C			-10°C			-15°C			-20°C		
Month	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh	ASHP Outlet Temp oC	ASHP COP	Actual Output kWh
Jan	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Feb	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Mar	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Apr	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
May	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Jun	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Jul	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Aug	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Sep	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Oct	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Nov	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0
Dec	35	2.37	0.0	35	0.00	0.0	35	0.00	0.0	35	0.00	0.0

TABLE 25 – DETAIL OPERATION OF ASHP 4 OF 4

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Table 26 &Table 27below are illustrating the estimated, as per the government approved SAP software NHER Plan Assessor v 6.2.3, the yearly fuels costs per flat type for the heating and hot water for the baseline flat types and the design flat types. Please also note that this does not take into consideration occupants varying usage of heating and hot water nor the percentage of occupancy of the development which affects pumping cost.

	Type 01 (1 Bed 2P)	Type 07 (3bed 5P)	Type 22 (studio)	Type 26 (2 bed 3P)	Type 25 (3 Bed 6P)
Boilers HTG	£61.26	£106.54	£33.23	£55.37	£293.76
ASHP HTG	£0.00	£0.00	£0.00	£0.00	£0.00
BOILERS HWS	£77.63	£91.73	£72.75	£83.45	£98.08
ASHP HWs	£0.00	£0.00	£0.00	£0.00	£0.00
Pumps/ Fans	£0.00	£0.00	£0.00	£0.00	£0.00
Electricity for Lighting	£30.63	£48.31	£25.14	£38.36	£63.15
Service Charges	£25.00	£25.00	£25.00	£25.00	£25.00
Metering & Billing	£80.00	£80.00	£80.00	£80.00	£80.00
Plant Maintenance	£110.00	£110.00	£110.00	£110.00	£110.00
ASHP Maintenance	£20.00	£20.00	£20.00	£20.00	£20.00
Total	£404.52	£481.58	£366.12	£412.18	£689.99

TABLE 26 – BASELINE YEARLY FUEL COSTS (ONLY) PER FLAT TYPE AS PER SAPS - BOILERS

	Type 01 (1 Bed 2P)	Type 07 (3bed 5P)	Type 22 (studio)	Type 26 (2 bed 3P)	Type 25 (3 Bed 6P)
Boilers HTG	£16.48	£35.85	£8.94	£12.59	£96.00
ASHP HTG	£24.72	£53.77	£13.41	£18.89	£144.00
BOILERS HWS	£35.12	£41.24	£33.00	£37.64	£44.00
ASHP HWs	£52.67	£61.86	£49.49	£56.47	£65.99
Pumps/ Fans	£15.27	£25.70	£10.66	£18.98	£55.72
Electricity for Lighting	£30.31	£47.06	£24.84	£37.47	£63.15
Service Charges	£25.00	£25.00	£25.00	£25.00	£25.00
Metering & Billing	£80.00	£80.00	£80.00	£80.00	£80.00
Plant Maintenance	£110.00	£110.00	£110.00	£110.00	£110.00
ASHP Maintenance	£20.00	£20.00	£20.00	£20.00	£20.00
Total	£409.57	£500.48	£375.34	£417.04	£703.86
Increase (%)	**1.25%**	**3.92%**	**2.52%**	**1.18%**	**2.01%**

Table 27 –Yearly Fuel Costs (Only) Per Flat Type As Per SAPs – Boilers & ASHPs

Clarifications

- **Taken directly from SAP’s*
- *Costs are based solely on desktop study with information available at the time of calculation*
- *The costs presented here are preliminary, as commensurate with the current stage of design, and therefore may be subject to change during detailed design of the development*
- *Inflation of utility costs have not been incorporated*
- *Final costs for maintenance / PPM and metering and billing are subject to appointment of specialist provider post construction.*
- *Consumption is based on SAP’s calculations only.*

As it can be observed based on the SAP calculations the anticipated increase in energy costs due to the incorporation of the proposed technologies to reduce the carbon emissions have been kept to a minimum.

7.3 Heat Distribution Losses

In order to minimise the heat distribution losses enhanced insulation compared to building regulations and BS5422:2009 are proposed for the development. For the aboveground pipework it is proposed that the heating shall be insulated in accordance with the enhanced requirements of ECA & Y50 while the underground shall be Logstor Series 2 (Twin pipe for the 99% of the route). On the tables below are shown the distribution heat losses for the pipework compared to the building regulations requirements. For the calculation the following assumptions have been made; the average external temperature (in regards to underground pipework is 12^{o}C for the underground pipework, an internal temperature of 25^{o}C for pipework in the risers and ceiling voids and 20^{o}C for the exposed internal pipework has been assumed.

Below Ground Heat Distribution Losses									
			Proposed			Building Regulations			
Pipe Size (mm)	**Soil cover (mm)**	**Length**	**Insulation Thickness (mm)**	**Heat Loss W/m**	**Heat Loss W**	**Insulation Thickness (mm)**	**Heat Loss W/m**	**Heat Loss W**	**Improvement %**
125	900	160	150	9.84	1574	30	21.67	3467	55%
100	900	58	116	10.47	607	30	18.52	1074	43%
65	600	43	83	9.61	413	25	15.31	658	37%
100	600	40	116	10.55	422	30	18.52	741	43%
80	600	50	92	10.67	534	25	17.20	860	38%
Total					3550			6800	48%

TABLE 28 – BELOW GROUND HEAT DISTRIBUTION LOSSES

Risers- Ceilings Pipework Distribution Losses								
Pipe Size (mm)	Length	Proposed			Building Regulations			Improvement %
		Insulation Thickness (mm)	Heat Loss W/m	Heat Loss kW	Insulation Thickness (mm)	Heat Loss W/m	Heat Loss kW	
20	1548	25	6.64	10276	20	6.82	10552	20%
25	1506	25	6.99	10520	20	8.08	12162	11%
32	230	25	8.07	1856	20	9.13	2100	12%
40	51	30	7.95	406	20	9.98	509	21%
50	133	30	9.21	1224	25	10.25	1361	10%
65	267	35	9.86	2634	25	12.10	3232	19%
80	10	35	11.00	110	25	13.60	136	19%
100	2	35	16.73	33	30	15.55	31	10%
Total				25277			30083	16%

TABLE 29 – PIPEWORK IN RISERS & CEILINGS HEAT DISTRIBUTION LOSSES

Combined Pipework Above Ground Distribution Losses								
Pipe Size (mm)	Length	Proposed			Building Regulations			Improvement %
		Insulation Thickness (mm)	Heat Loss W/m	Heat Loss W	Insulation Thickness (mm)	Heat Loss W/m	Heat Loss W	
100	2	35	16.73	33	30	18.52	37	10%
80	10	35	13.90	139	25	17.20	172	19%
65	75	35	12.45	934	25	15.31	1148	19%
Total				1,106			1,357	18%

TABLE 30 – EXPOSED INTERNAL PIPEWORK HEAT DISTRIBUTION LOSSES

Distribution Losses For Kidbrooke Station Square						
Annual Load (kWh)	**Proposed**			**Building Regulations**		
	Heat Losses (kWh)	**Heat Loss (W)**	**Dlf**	**Heat Losses (kWh)**	**Heat Loss (W)**	**Dlf**
1736261	262,221	29,934	1.15	334,987	38,240	1.19

TABLE 31 – TOTAL HEAT DISTRIBUTION LOSSES

7.4 Photovoltaic Panels

It is proposed to install photovoltaic panels to provide further carbon reduction for the development. Hence the installation of PV panels of total output of 74.5kWp of monocrystalline PV panels with a nominal efficiency of 19.7% is proposed.

7.5 Be Green Summary

With the adoption of the "be green" measures as described above the development achieved the minimum 35% reduction in CO_2 emissions as demonstrated in the tables below:

Unit Ref	Area	DER	Unit Emissions	No. Units	regulated Emissions
	m²	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Type 01 (1 Bed 2P)	50	10.0	0.50	243	120.9
Type 07 (3bed 5P)	84	9.1	0.76	52	39.6
Type 22 (studio)	39	10.1	0.40	28	11.1
Type 26 (2 bed 3P)	62	8.2	0.51	287	144.9
Type 25 (3 Bed 6P)	135	10.2	1.38	9	12.4
Be Green - Emissions					**329.0**

TABLE 32 – BE GREEN - CO_2 REDUCTION FOR RESIDENTIAL OVER 2013 BUILDING REGULATION BASELINE – SAP10

Target	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	63.2	11.6%
Be Clean Emissions	0.0	0.0%
Be Green Emissions	152.4	28.0%
Cumulative on site savings	**215.6**	**39.6%**

TABLE 33 - BE GREEN REDUCTIONS FOR RESIDENTIAL OVER 2013 BUILDING REGULATION BASELINE – SAP10

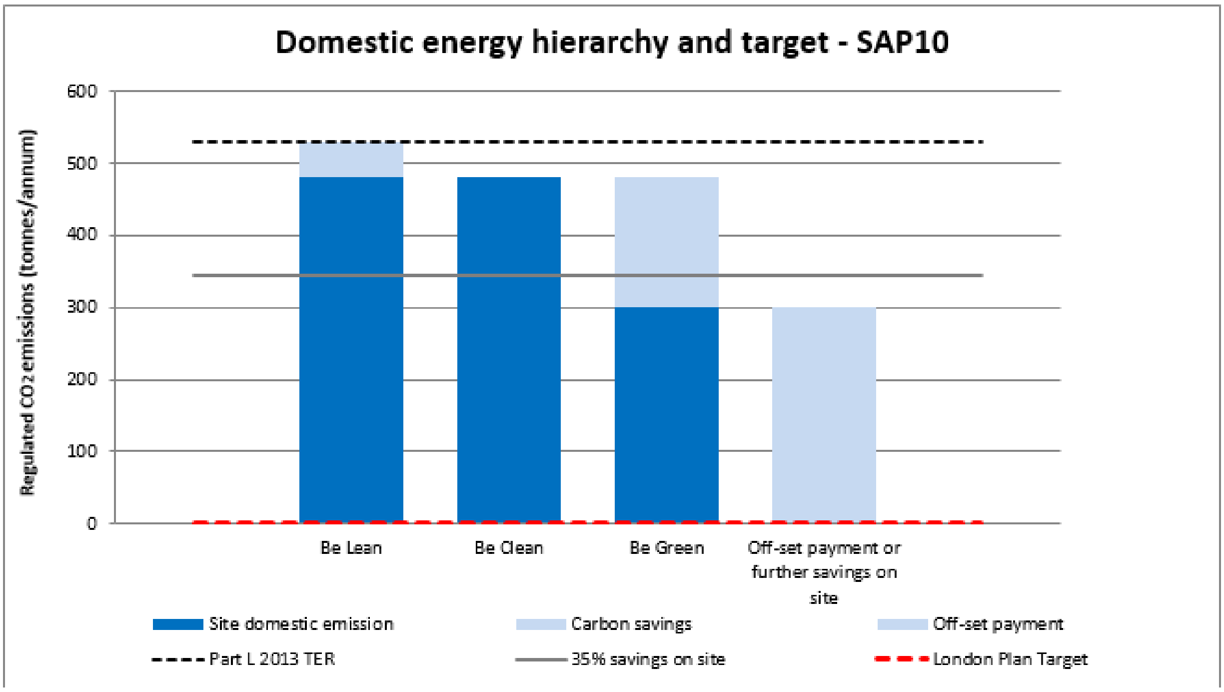


FIGURE 6 BE GREEN CARBON REDUCTION EMISSIONS FOR RESIDENTIAL UNITS–SAP10

Unit Ref	Area	BER	Unit Regulated Emissions	No. Units	Total Regulated Emissions
	m²	$KgCO_2/m^2$	Tonnes CO_2/annum	-	Tonnes CO_2/annum
Coffee shop	104	42.2	4.4	1	4.4
Flexible use	479	27.9	13.4	1	13.4
Gym	104	69.1	7.2	1	7.2
Nursery	262	13.5	3.5	1	3.5
Workshop	1172	6.6	7.8	1	7.8
Total Be Lean Regulated Emissions					**36.2**

TABLE 34 - BE GREEN - CO_2 REDUCTION FOR THE NON-RESIDENTIAL SPACES OVER 2013 BUILDING REGULATION BASELINE–SAP10

Target	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	8	14.0%
Be Clean Emissions	0	0%
Be Green Emissions	12	22%
Cumulative on site savings	**8**	**36.0%**

TABLE 35 - BE GREEN REDUCTIONS FOR THE NON-RESIDENTIAL SPACES OVER 2013 BUILDING REGULATION BASELINE –SAP10

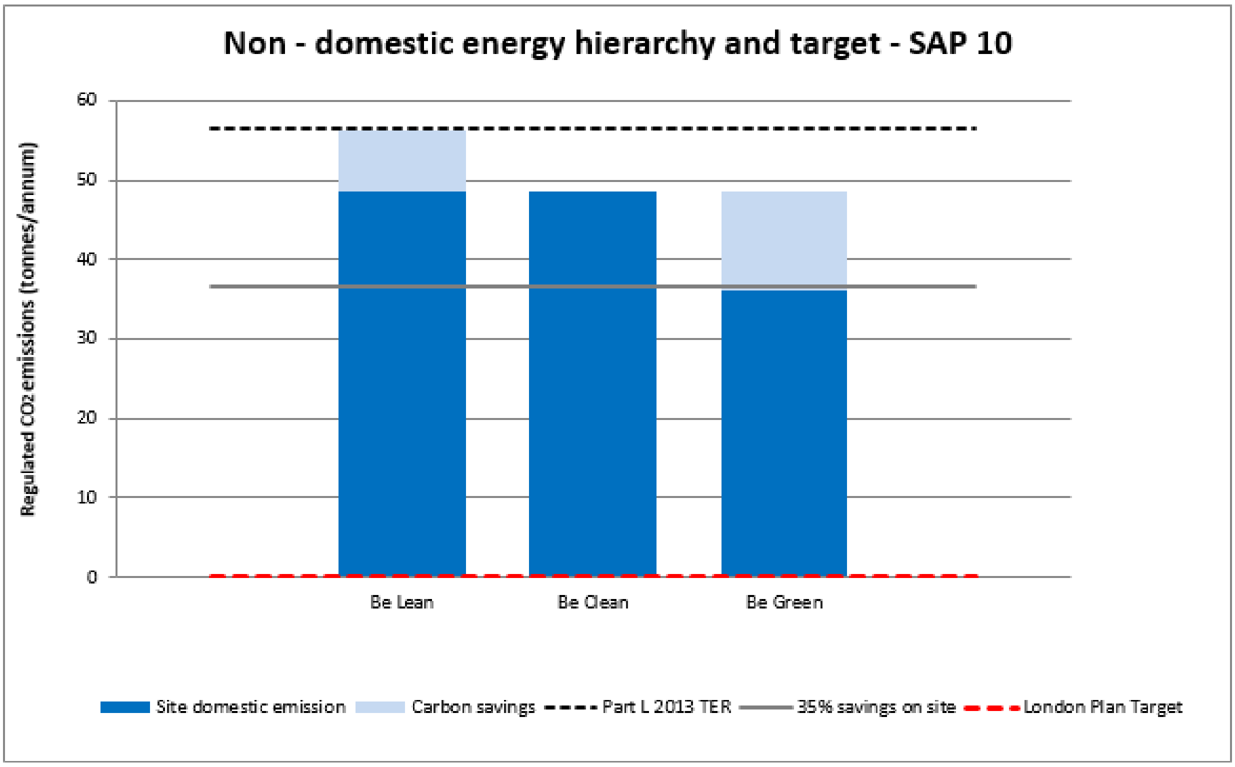


Figure 7 Be Green carbon reduction emissions for non-Residential Spaces – SAP10

Target	Regulated tonnes CO_2 savings per stage	Regulated percentage CO_2 savings per stage
	Tonnes CO_2/annum	%
Be Lean Emissions	71.1	11.8%
Be Clean Emissions	0	0%
Be Green Emissions	164.7	27.4%
Cumulative on site savings	**235.8**	**39.2 %**

Table 36 – Total Be Green carbon reduction percentage for Kidbrooke Station Square Development – SAP10

8 BREEAM

BREEAM UK NC 2014.

The commercial units within this development all fall under the category of 'Shell & Core' under BREEAM New Construction 2014. The assessment of the B1 Office space however, also takes account of an enhanced level of finish and significantly reduces the level of fit-out to be undertaken by the prospective tenants.

In order to address the current flexible nature of the commercial space, the units have been grouped by 'Use Class' and several assessments conducted based on each building type as follows:

- A1: Retail – shop
- A3: Retail – restaurant
- B1: Office – general office building
- D1: Other Buildings – community space

It is understood that the Royal Greenwich Local Plan: Core Strategy, Policy DH1: Design, highlights their vision to promote 'high quality design that positively contributes to the improvement of both built and natural environments across their development programmer by avoiding negative impacts on the environment and aiming to meet their sustainability objectives.

The Royal Greenwich Local Plan: Core Strategy, Policy DH1: Design, requires non-domestic buildings in major developments to achieve a BREEAM rating of 'Excellent' with a minimum building score of 70%.

The BREEAM Pre-assessments of the commercial areas within the Kidbrooke Station Square development have undergone several reviews of the design. They have been recently revised based on the agreed design targets to provide a final indication of the BREEAM Rating that the developments commercial units are expected to achieve if proposed specifications and actions are implemented at the construction stage.

A final overall BREEAM Rating of 'high' Very Good has been demonstrated for the majority of building types with an excellent rating just being achieved for the B1 and D2 building types. The BREEAM Pre-assessment has been re-developed in cooperation with the design team to reflect the overall Building Ratings based on the current design information and desired targets**.**

The design approach taken throughout has been to enhance the sustainability performance standards as far as possible in key areas in line with BREEAM UK New Construction 2014 criterion and Royal Greenwich Core Strategy Policy DH1: Design.

Minimum sustainability performance standards and targets remain at the previous enhanced level of 'Outstanding' in all the required key sustainability areas within the assessment in order to demonstrate a high level of sustainable design. Key issues where minimum performance standards have been enhanced to improve the overall building score are as follows:

- Man03: Responsible Construction Practices – Outstanding performance level targeted
- Man04: Commissioning & handover – Outstanding performance level targeted
- Ene01: Reduction of Energy use and Carbon emissions – Outstanding performance level targeted
- Ene02: Energy Monitoring – Outstanding performance level targeted
- Wat02: Water Monitoring – Outstanding performance level targeted
- Mat03: Responsible Sourcing of Materials – Outstanding performance level targeted
- Wst03: Operational waste – Outstanding performance level targeted
- Le03: Minimising impact on existing site ecology – Outstanding performance level targeted

The current assessments reflect a BREEAM NC 2014 rating of 'Very Good' with scores exceeding the minimum requirement of 55% for A1, A1-A3 and D1 Use Classes. A BREEAM rating of Very Good is representative of the top 25% of all UK non-domestic buildings and a 'high' Very Good, as targeted on this development, is demonstrative of a positive move towards best practice.

Several challenges of achieving a rating of Excellent for Shell & Core buildings with sufficient buffer to maintain the rating throughout the construction stage have were encountered during the stage 2 design. This review has demonstrated that several credits are not currently achievable in several areas due to 'Shell & Core' design; feasibility of some issues at this stage; practicality, and a summary of some of these issues shown below:

- The pre-assessment reports and credit tracker clearly identify the credits targeted and those which will become a pre-requisite of achieving an excellent rating however, Kidbrooke Partnership LLP has indicated that the fit-out will be passed to a future tenant and as such, would be reticent to submit 'Shell and Core' BREEAM pre-assessment(s) with an excellent rating at the planning stage for units of a small size, thus placing the obligation on to a future SME tenant to achieve an excellent fit-out. The costs for this undertaking would fall to the tenant and could render the commercial space less affordable for a prospective SME's.

- Commissioning & Handover: Testing & inspecting of Building Fabric – The commercial units are being constructed to shell & core with limitations to internal finishes and therefore, it would not be technically feasible to achieve credit under this issue unless the building fabric is finished to such an extent to enable full thermographic survey and air pressure testing to be undertaken and any defects rectified in full prior to units being handed over.
- Daylighting – Credit for daylighting are assessed based on the building type and functions that apply. Based on the flexible nature of the commercial units, the daylighting has not been assessed at this stage as this will require more detailed information of internal layouts and use that are not generally available for a shell & core assessment.
- Cycle Storage – Credit for cycle storage has not been taken as the number of spaces required is calculated on the building type/function and number of staff/visitors for each building use. Due the flexible nature of some of the commercial units, the number of spaces and area required would negatively impact on the open community streetscape and play space available.
- Cyclist facilities - Compliant cyclist facilities (showers, changing areas etc.) can be demonstrated where the shell and core building is designed to facilitate future installation of the compliant number and type of cyclist facilities by the tenant/owner-occupier through the provision of an appropriately sized and dedicated space in the base building, including either the installation of the appropriate services (for showers) or infrastructure to allow the future installation of the relevant services e.g. capped water supply, service or ventilation ducts, drainage etc. The number and type of facilities is based however, on the number of cycle spaces and building users for each building type and function.
- Functional Adaptability – This issue requires a building specific functional adaption strategy to be undertaken at RIBA Stage 2 which includes recommendations for measures to be incorporated to facilitate the adoption of functional adaption measures by RIBA Stage 4. Due to the flexible nature of some of the commercial space and that it is being constructed to shell & core, this issue has been considered as impractical at this stage.

The assessments of the A1, A1-A3 and D1 units reflect that a high rating of Very Good can be achieved and the current scores for each assessment also demonstrate a buffer of approx. 10% providing a reasonable safety margin to ensure that the rating of Very Good is achieved at the Post Construction stage. The assessment of the B1 units however, have only just achieved ratings of Excellent but have no flexibility within the scores to maintain a suitable buffer.

Generally a buffer of 10% is considered suitable to ensuring that the final rating is achieved at the Post Construction Stage as it is not always possible to claim every point targeted within the pre-assessment.

9 Overheating

In order to mitigate the risks of overheating the following measures are to be adopted:

- Cold water pipe work is not to be installed in the same riser, or if unavoidable the distance between hot and cold services shall be maximised as far as possible. This is inclusive of horizontal services within ceiling voids.

- All distribution pipe work is to be insulated throughout to the requirements greater than that of the building regulations as NES Y50 (including the use of insulated pipe brackets).

- All floors between mechanical and electrical risers at each floor level are constructed with an open metal grid arrangement to aid the flow of air through the riser's vertical length, at the top the risers shall be vented to atmosphere with at least 2no weather proof vents. The open metal grid arrangement is to be able to support all required safe access for maintenance. The access door/s are to be fire rated to comply with building regulations and the fire strategy of the building, and ensure the riser can be used for ventilation of the pipe work and equipment.

- All natural AOV shafts / AOV windows shall have environmental and rain sensor control in addition to their fire and smoke control. The environment control will be connected to each corridor area to ensure the AOV opens when the communal corridor areas rise above 25oC.

- Where provided; mechanical AOV shafts shall be provided with an additional fan within the fan assembly for environmental ventilation, with floor louvres controls activated by environment controls connected to each corridor area to ensure the AOV opens when the communal corridor areas rise above 25^{o}C.

- For mechanical or natural AOV systems, as part of the environmental controls permanent ventilation will be provided to the top of each stair core and above each stairs lobby door shall be provided with an adjustable fire damper / grille ventilating the stair core into the communal corridors ceiling void. The communal corridors ceiling will then be provided with grilles to provide fresh air make up as extracted by the AOV shaft.

- AOV environmental controls shall activate 1 hour in the AM and PM. Vents also should open automatically when triggered by dedicated thermostatic sensors in the communal areas.

- Communal corridor doors including fire doors are to be on magnetic door hold open controls to allow ventilation to all communal corridor areas. The control will have override for triggered by activation of the fire detection system and/or have fail safe operation. Alternatively louvers approved by the fire consultant will be provided at low levels at the doors to allow for air circulation

- Heat Interface Units (HIU's) will be mounted in the closest cupboard to the dwellings front door to minimise pipework length / heat loss within the dwellings hallway.

- HIU's shall be mounted within the dwellings utility cupboard and spaced off the wall by at least 25mm with the use of wood battens or spacers to promote air circulation behind the HIU (where allowable/ accepted by the HIU manufacturer).

- The utility cupboard will be provided with extract ventilation above the HIU.

- Communal area ceiling voids are to have means of natural ventilation to allow free movement of air in the ceiling voids throughout.

In addition to the above, dynamic overheating modelling has been carried out (please refer to overheating assessment report) for a sample of representative dwellings in line with the latest CIBSE Guidance TM52, TM59. Dynamic overheating simulations have been carried out for flats that have large glazing surfaces and predominantly facing south and west orientation as well as for communal corridors.

The overheating assessment demonstrated that the scheme complies with CIBSE TM 59 criteria when is assessed against Design Summer Year 1 (DSY1) weather file for London.

The simulations demonstrated that in order for the domestic spaces to pass CIBSE TM59 criteria windows facing east, south and west require a g-value of 0.4 with the inclusion of internal blinds. When detail design will be carried out more details can be provided.

Additional simulations for overheating against DSY2 & DSY3 weather files have also been carried out. The addition of any additional passive measures is considered to have a significant impact on the daylight factor of the habitable rooms.

Commercial spaces have large glazing surfaces hence it is important to minimise g-values. At this stage g-value of 0.4 has been suggested to minimise solar gains and ultimately the cooling demand.

9.1 Overheating Checklist

Section 1 - Site Features affecting vulnerability to overheating		Yes or No
Site Location	Urban - within central London [29] or in a high density conurbation	Greenwich Borough. Inner London as defined by 2.2 of the London Plan Map.
	Peri-urban - on the suburban fringes of London [30]	Greenwich Borough. Inner London as defined by 2.2 of the London Plan Map.
Air quality and/or Noise sensitivity - are any of the following in the vicinity of buildings?	Busy roads / A roads	Noise from A2
	Railways / Overground / DLR	Yes
	Airport / Flight path	No
	Industrial uses / waste facility	No
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	10% Disabled residential units.
	Are residents likely to be at home during the day (e.g. students)?	Low occupation. Predominantly young working professionals. Approx. 15% daytime occupation.
Dwelling aspect	Are there any single aspect units?	272 (44%).
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	
	If yes, is this to allow acceptable levels of daylighting?	
Security - Are there any security issues that could limit opening of windows for ventilation?	Single Storey ground floor units	None. Duplex units at ground floor only.
	Vulnerable areas identified by the Police Architectural Liaison Officer	N/A
	Other	No single storey units at ground. Very few single storey units at first floor.

[29] Urban - as defined in CIBSE Guide TM29. Broadly equivalent to Central Activities Zone and Inner London areas in Map 2.2 of the London Plan

[30] Peri-urban - as defined in CIBSE Guide TM29. Broadly equivalent to Outer London areas in Map2.2 of the London Plan

Section 2 - Design features implemented to mitigate overheating risk		Please respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Please refer to Standerwick 'Landscape Design Statement'. Wide range of trees provided around public and podium areas.
	Will green roofs be provided?	Please refer to Standerwick 'Landscape Design Statement'. Mixture of green and brown roofs.
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Blue roof for water attenuation only
Materials	Have high albedo (light colour) materials been specified?	
Dwelling aspect	% of total units that are single aspect	272 (44%).
	% single aspect with N / NE / NW orientation	NW - 24%
	% single aspect with E orientation	0%
	% single aspect with S / SE / SW orientation	SE - 19%, SW - 1%
	% single aspect with W orientation	15%
Glazing ratio - What is the glazing ratio (glazing: internal floor area) on each façade?	N / NE / NW	Block A 29.9% Block B 19.5% Block C 22.2% Block D 16.4% Block E 20.0% Block F 19.9% Block G 17.4% Block H 29.8%
	E	
	S / SE / SW	
	W	
Daylighting	What is the average daylight factor range?	
Windows opening	Are windows openable?	Varies per window type.
	What is the percentage of openable area for the windows?	Varies per window type. Please refer to typical GHA bay studies.
Windows opening - What is the extent of the opening	Fully openable	Restricted to 100mm. Can be unlocked for purge.
	Limited (e.g. for security, safety, wind loading reasons)	Restricted for safety.
Security	Where there are security issued (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	No ground floor flats. Very low percentage of single storey units at second floor. No alternative natural vent method yet proposed.

Shading	Is there external shading?	No
	Is there internal shading?	No
Glazing Specification	Is there any solar control glazing?	Yes
Ventilation - What is the ventilation strategy?	Natural - background	No
	Natural - purge	Yes
	Mechanical - background (e.g. MVHR)	Yes (MVHR)
	Mechanical - purge	No
	What is the average design air change rate	As Per Approved Document F
Heating System	Is communal heating present?	Yes
	What is the flow/ return temperature?	70-40
	Have horizontal pipe runs been minimised?	Yes
	Do the specification include insulation levels in line with the London Heat Network Manual [31]	Yes

[31] http://www.londonheatmap.org.uk/Content/uploaded/documents/LHNM_Mnaual2014Low.pdf

Single Aspect Units

LP policy 3.5 refers to design guidance in the Mayor's Housing SPG (March 2016). The SPG Standard 29 indicates that developments should minimise the number of single aspect units. It does not specify a prescribed level. What it does indicates is that where the number of single aspect units are provided, they adequately address issues such as noise, ventilation and daylight.

The KSS development responds to the site constraints so that the massing and orientation of buildings is designed to maximise access to natural light, provide privacy and security to residents and promote a social community. The aspect of units has evolved positively following as series of RBG Pre-app meetings, following which all single facing north facing units were removed and the number of dual aspect units increased from 54-56% (to 346 units). None of the 3-bed units are single aspect.

The Noise Chapter of the ES (para 14.6.5) finds that, with the proposed mitigation measures, there would be no operational phase noise impact to any of the residential rooms within the site: "With the glazing and ventilation specified installed. SLR anticipate that there would be no noise impact internal to sensitive rooms at the Site".

The Energy Strategy (pg.13) explains that all habitable rooms will benefit from mechanical ventilation to assist with heat recovery. Purge ventilation will also be provided by opening windows.

Finally, on daylight, the 17 April 2019 amendment submission included the re-planning of 91 of the homes to improved internal daylight/sunlight. These were all 1B2P homes located in Buildings A, D, G, H & F. As a result of the changes, 88% of the proposed habitable rooms now meet or exceed the Average Daylight Factor recommended by BRE, an improvement from 80%, thereby offering good levels of daylight.

The design of the development therefore accords with the Development Plan and the Mayor's Housing SPG in this respect.

Passive Design Measures

Balcony locations across blocks B-G have been designed to provide solar shade to L/K/D spaces in units below. With increased shading provided to private amenity areas in Blocks A+H using inset balconies. Apartment layouts have been designed to focus on providing good levels of daylight, with 1444 (88%) of the proposed habitable rooms meeting or exceeding the levels of Average Daylight Factor (ADF) recommended by BRE. Additionally, the vast majority of the rooms have been designed in accordance with the Room Depth Criterion (RDC) where applicable, and 77% of the assessed rooms will also see good levels of sky visibility.

Additional passive measure, for example external fixed or operable shading to control solar gain would decrease the percentage of habitable rooms achieving acceptable levels of ADF.

The fixing and operation of blinds to be used shall not lead to the reduction of the required free area of the windows. The specification of a product can only be detailed during detail design when the full specifications of the windows are available. Additionally, a dwelling operation manual including the overheating mitigation strategy shall be provided to all occupants.

Also please note that the majority of the habitable rooms under DY2 & DSY3 are still passing the overheating criteria (94.3% and 73.45% respectively as per the overheating report)

10 London Zero Carbon Homes

"Zero carbon" homes applies to homes forming part of the mayor's development application (10 or more residential units) where the residential element of the application needs to achieve at least a 35 per cent reduction in regulated carbon emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).

The "zero carbon" target as defined above will be implemented for Stage 1 schemes received by the Mayor on or after the 1st October 2016 here detailed.

To summarise, the emission reduction targets the GLA will apply to applications are as follows:

- *Stage 1 schemes received by the Mayor up until 30 September 2016 – 35% below Part L 2013 for both residential and commercial development.*
- *Stage 1 schemes received by the Mayor on or after the 1st October 2016– Zero carbon (as defined in section 5.2 of the Housing SPG) for residential development and 35% below Part L 2013 for commercial development*

The criterion for Zero Carbon homes applications includes:

- *Strategic Applications (Development of 150 residential units or more, over 30 meters or are located on Green Belt or Metropolitan Open Lan).*
- *Major Development Applications (10 dwellings or more)*

The technical implementation of this policy should be in line with this guidance document. The mayor's Housing Standard's Viability Assessment assumed a carbon off-set price of £60 per tonnes of carbon dioxide for a period of 30 years. Where the borough applies a carbon dioxide off-set price of £60 per tonnes, it is not considered necessary for boroughs to carry out a further viability assessment of the policy approach.

Policy 5.2B's emission reduction targets for non-domestic uses were intended to ensure a smooth trajectory towards a zero carbon standard and the upcoming requirement for 'Nearly Zero Energy Buildings' by 2020 however at this moment in time the GLA will only continue to require that non-domestic developments seek to achieve a 35 per cent reduction against Part L 2013.

In the light of the above considerations, the Zero Carbon Homes policy does apply to the development as it is a construction of more than 10 homes deeming it to be a major development bearing in mind that the carbon off set payment applies only to the residential units. Table 38 below shows the offset cost to be paid over 30 years.

	Regulated Emissions	**Cost for tonnes of CO_2 emissions**	**Cumulative savings for off-set payments over 30 years**
	Tonnes CO_2/annum	£/tonnes CO_2 per 30 years	
London Plan Policy 5.2B - zero carbon -	329	£1,800.00	£592,167

Table 37 - Off set payments according the London Plan Policy 5.2B

In accordance with London Plan 5.2 any shortfall in achieving the carbon dioxide reduction on-site might be provided off-site, but only in cases where there is an alternative proposal identified and delivery is certain, or where funding can be pooled to support specific carbon dioxide reduction projects or programmes. In this specific case no specific proposal has been identified and therefore a cash in lieu contribution to Greenwich has been offered to secure delivery of carbon dioxide savings elsewhere.

11 CONCLUSION

A series of energy efficiency and best practice measures has been adopted in order to meet the London Plan and Royal Borough of Greenwich requirements, which in summary are:

- Enhanced building fabric as described within this document (see Table 4)
- Adoption of an Air Source Heat Pump system and heat network as described in this report
- Photovoltaic panels of 74.5kWp capacity

This report has demonstrated how the development proposals make the fullest contribution to minimising carbon dioxide emissions in accordance taking into account the new GLA guidance and the revised emissions factors included in SAP10 with the following energy hierarchy:

1. Be lean: use less energy – fabric improvements, highly efficient systems and lighting
2. Be clean: supply energy efficiently – N/A
3. Be green: use renewable energy in the form of Air Source Heat Pumps and Photovoltaic Panels

11.1 Overall CO_2 emissions

Table 38 shows the final carbon emissions for the development site and the percentage of improvement over the baseline emissions 2013 (SAP10).

Target	**Regulated tonnes CO_2 savings per stage**	**Regulated percentage CO_2 savings per stage**
	Tonnes CO_2/annum	%
Be Lean Emissions	71.1	11.8%
Be Clean Emissions	0	0%
Be Green Emissions	164.7	27.4%
Cumulative on site savings	**235.8**	**39.2 %**

TABLE 38 - FINAL CO_2 REDUCTION FOR KIDBROOKE STATION SQUARE DEVELOPMENT

Signed:

Dimitrios Anthopoulos MSc BEng (Hons)

Principal Mechanical Engineer, for and on behalf of Calfordseaden LLP

NOTES:

All outputs are based on initial design stage SAP/SBEM assessments for the development and need to be confirmed by final design SAP/SBEM calculations once they have been completed for the development.

SAPs have been based on Part L 2013 Building Regulations.

Examination of roof areas and photovoltaic module specification with manufacturer's details and requirements.

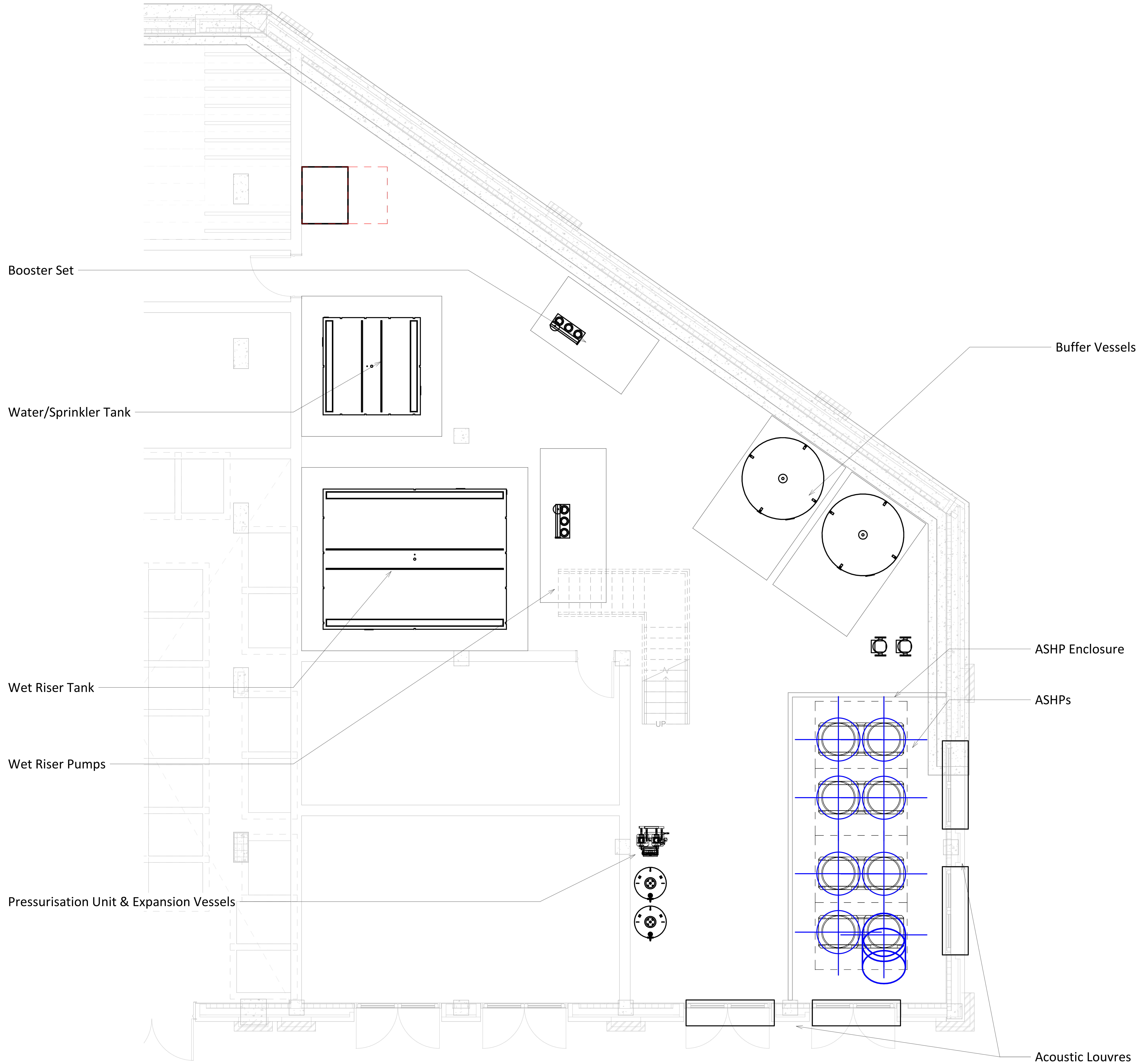
12 APPENDICES

1. **Energy Centre Layout**
2. **Heat Network Layout**
3. **Photovoltaic Array Layout**
4. **ASHP Data Sheet**

A1 SHEET

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES, UNLESS OTHERWISE STATED.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER CONTRACT DRAWINGS.



1 0 - Mech

1 : 50

02	Preliminary	30/07/19	DA	DA
REV	DESCRIPTION	DATE	INIT	CHKD

calfordseaden

Client
NHG
Project
Kidbrooke Station Square
Title
Energy Centre Ground Floor

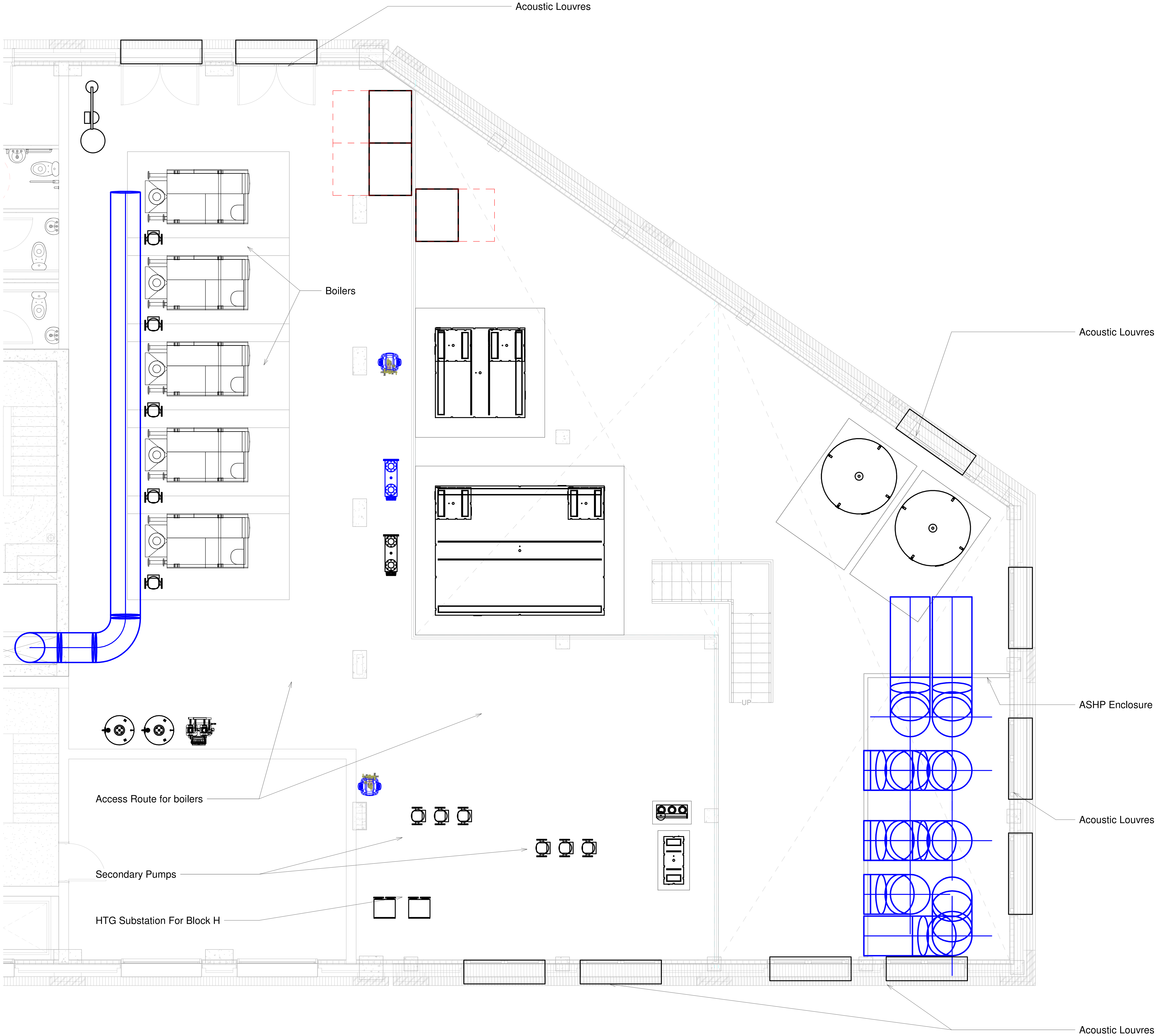
Scale	Date	Drawn By	Checked By	Project No:	Drawing No:	Revision
1 : 50	30/07/19	DA	DA	L180038	CS-M-SK-200	02

St John's House 1a Knoll Rise Orpington Kent BR6 0JX
01689 888222 orpington@calfordseaden.com

A1 SHEET

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES, UNLESS OTHERWISE STATED.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER CONTRACT DRAWINGS.



1 1 - Mech
1 : 50

REV	DESCRIPTION	DATE	INIT	CHKD
02	Preliminary	30/07/19	DA	DA

calfordseaden

Client
NHG
Project
Kidbrooke Station Square
Title
Energy Centre First Floor

Scale	Date	Drawn By	Checked By	Project No:	Drawing No:	Revision
1 : 50	30/07/19	DA	DA	L180038	CS-M-SK-201	02

St John's House 1a Knoll Rise Orpington Kent BR6 0JX
01689 888222 orpington@calfordseaden.com

A1 SHEET

DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS TO BE VERIFIED BY THE CONTRACTOR ON SITE

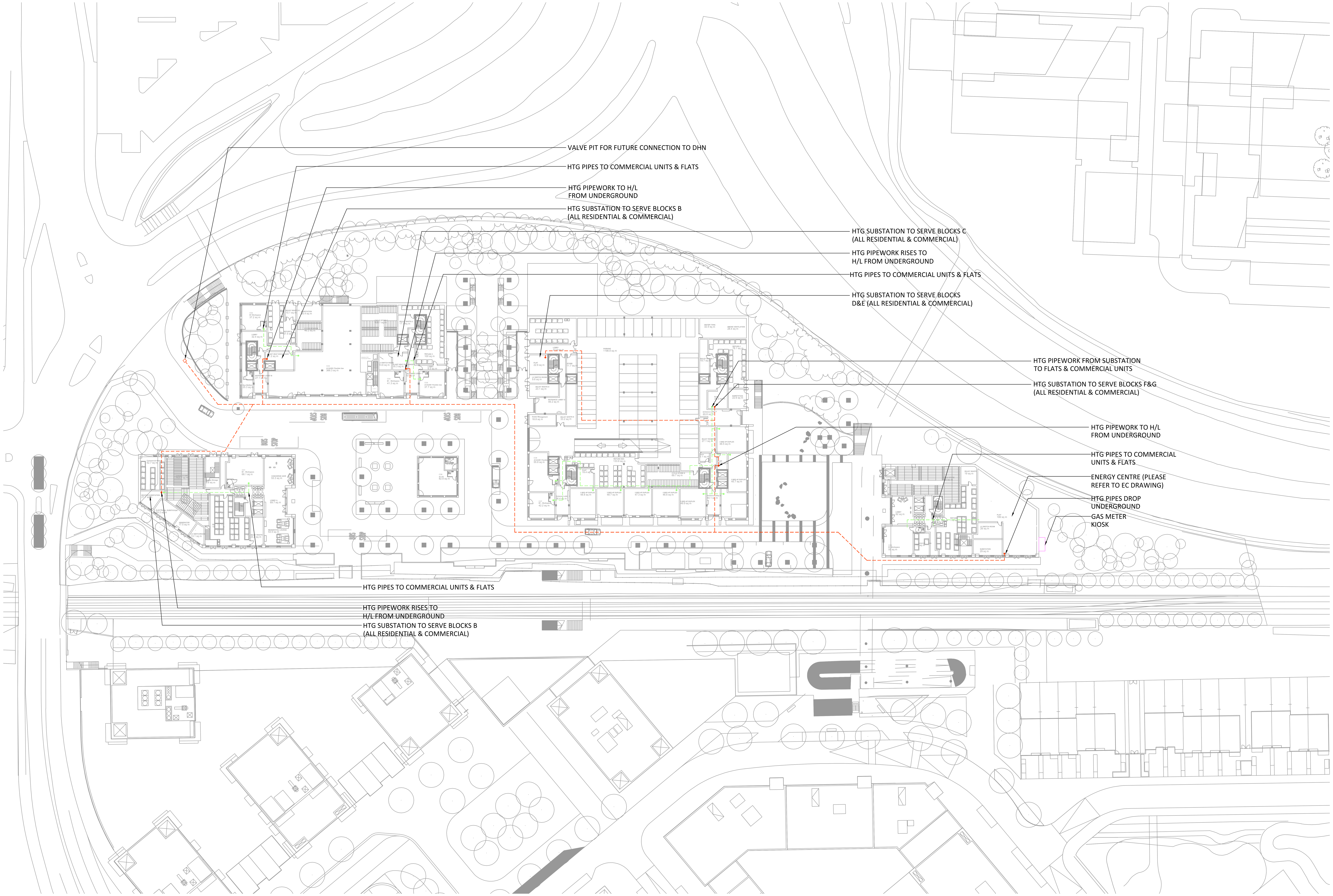
General Notes:

1. ALL DIMENSIONS IN MILLIMETERS, UNLESS OTHERWISE STATED.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER CONTRACT DRAWINGS.
3. NOT ALL INDIVIDUAL CONNECTIONS & BRANCH ARE SHOWN.

Legend

HTG PRIMARY DISTRIBUTION

HTG SECONDARY DISTRIBUTION



FOR INFORMATION

REV	DESCRIPTION	DATE	INIT	CHKD

calfordseaden

Client
Nottinghill Genesis
Project
Kidbrooke Estate
Title
Block H Energy Centre Ground Floor Layout

Scale	Date	Drawn By	Checked By	Project No:	Drawing No:	Revision
1:50@A1	01.11.17	JB	LC	L180038	M_DR_001	

Notting Hill Genesis

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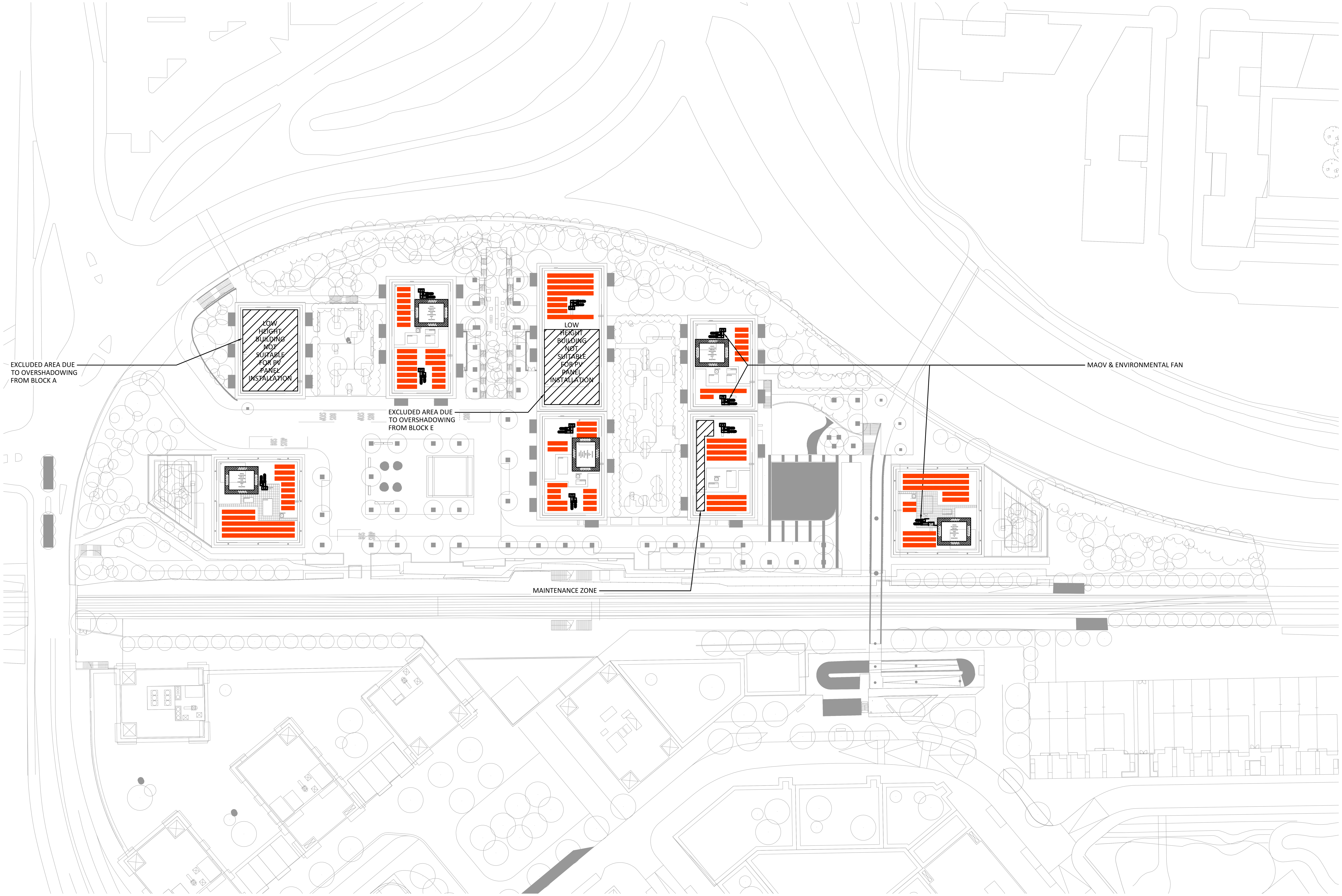
A1 SHEET

DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS TO BE VERIFIED BY THE CONTRACTOR ON SITE



General Notes:

1. ALL DIMENSIONS IN MILLIMETERS, UNLESS OTHERWISE STATED.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER CONTRACT DRAWINGS.
3. PV ARRAYS TO BE CO-ORDINATED WITH SVP'S AND ANY ROOF OBSTACLES.
4. WHERE NECESSARY, ROOF LEVEL AC AND DC CABLES ARE TO CONTAINED/ROUTED IN HD GALVANISED 50mm TRAY SUPPORTED OFF FINISHED ROOF USING ZIPP CLAMPS (FINAL ROUTES TO BE DETERMINED ON SITE).
5. ANGLE OF PV TILES FROM HORIZONTAL TO BE 10° MINIMUM FOR SELF CLEANING PURPOSES.
6. INVERTORS AND DC AND AC ISOLATORS TO BE LOCATED WITHI RISERS.
7. PRECISE PANEL LOCATIONS & CONFIGURATION ON ROOF SUBJECT TO SURVEY AT POINT OF INSTALLATION.
8. PV PANELS WILL BE SOUTH ORIENTATED WITH A TILT ANGLE OF 10°.
9. PROPOSAL PROVIDES 74.5kWp FOR ALL BLOCKS IN ACCORDANCE WITH THE ENERGY STRATEGY.

Legend

PV DISTRIBUTION BOARD

SP&N ISOLATOR

DC ISOLATOR

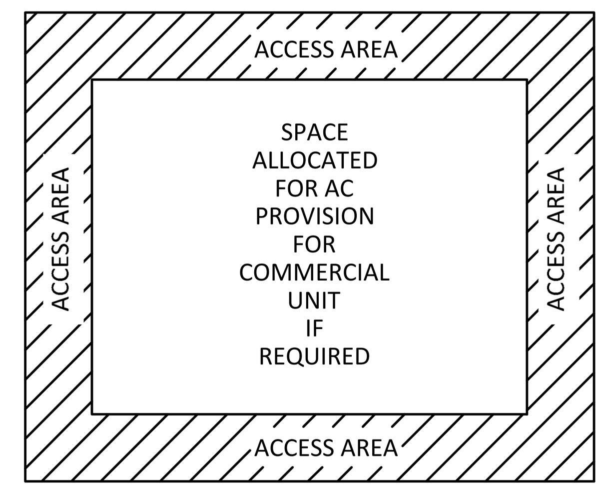
TP&N ISOLATOR

PV GENERATION METER

PHOTOVOLTAIC PANEL

PROPOSED DC CABLE TRAY ROUTE

MCCB CIRCUIT BREAKER



REV	DESCRIPTION	DATE	INIT	CHKD
C3	Updated Block H	27.06.19	AC	DA
02	Updated Blocks D/G & H	14.06.19	JB	DB
01	Issued for Information	21.03.19	JB	DA

FOR INFORMATION

calfordseaden

Client
Nottinghill Genesis
Project
Kidbrooke Estate
Title
Sitewide PV Layout

Scale	Date	Drawn By	Checked By	Project No:	Drawing No:	Revision
1:500@A1	01.11.17	JB	LC	L180038	E_SK_101	03

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MITSUBISHI ELECTRIC

Changes for the Better

for a greener tomorrow

HOT WATER HEAT PUMP

MODEL

CAHV-P500YA-HPB(-BS)

DATA BOOK

2nd edition

Contents

I Product Specifications

II Product Data

III Installation

IV System Design

V Wiring Design

VI Controller

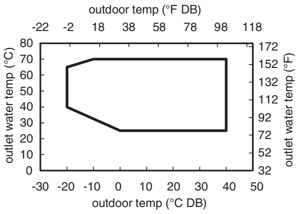
I Product Specifications

1. Specifications

Model			CAHV-P500YA-HPB
Power Source			3-phase 4-wire 380-400-415V 50/60Hz
Capacity *1		kW	45
		kcal/h	38700
		BTU/h	153540
	Power input	kW	12.9
	Current input	A	21.78-20.69-19.94
	COP (kW / kW)		3.49
Capacity *2		kW	45
		kcal/h	38700
		BTU/h	153540
	Power input	kW	25.6
	Current input	A	43.17-41.01-39.53
	COP (kW / kW)		1.76
Maximum current input *3		A	57.77-54.88-52.90
Water pressure drop *1			12.9kPa (1.87psi)
Temp range	Outlet water temp *4		25~70°C 77~158°F
	Outdoor temp *4	D.B	-20~40°C -4~104°F
Circulating water volume range			7.5 m^3/h-15.0m^3/h
Sound Pressure level (measured in anechoic room) *1		dB (A)	59
Sound Pressure level (measured in anechoic room) *3		dB (A)	63
Diameter of water pipe	Inlet	mm (in.)	38.1 (Rc 1 1/2") screw
	Outlet	mm (in.)	38.1 (Rc 1 1/2") screw
External finish			Acrylic painted steel plate <MUNSELL 5Y 8/1 or similar>
External dimension H × W × D		mm in.	1710 (without legs 1650) × 1978 × 759 67.3 (without legs 65.0) × 77.9 × 29.9
Net weight		kg (lb)	526 (1160)
Accessories			Y strainer Rc 1 1/2
Design Pressure	R407C	MPa	3.85
	Water	MPa	1.0
Drawing	Wiring		KC94G723X01
	External		KC94G195X01
Heat exchanger	Water side		stainless steal plate and copper brazing
	Air side		Plate fin and copper tube
Compressor	Type		Inverter scroll hermetic compressor
	Maker		MITSUBISHI ELECTRIC CORPORATION
	Starting method		Inverter
	Motor output	kW	7.5 × 2
	Case heater	kW	0.045 × 2
	Lubricant		MEL32
FAN	Air flow rate	m^3/min	185 × 2
		L/s	3083 × 2
		cfm	6532 × 2
	External static press *5		0Pa, 60Pa (0mmH_2O/6.1mmH_2O)
	Type × Quantity		Propeller fan × 2
	Control, Driving mechanism		Inverter-control, Direct-driven by motor
	Motor output	kW	0.46 × 2
HIC circuit (HIC:Heat inter-Changer)			Copper pipe
Protection	High pressure protection		High pres.Sensor & High pres.Switch at 3.85MPa (643psi)
	Inverter circuit		Over-heat protection, Over current protection
	Compressor		Over-heat protection
	Fan motor		Thermal switch
Defrosting method			Auto-defrost mode (Reversed refrigerant circle)
Refrigerant	Type × original charge		R407C × 5.5(kg) × 2
	Control		LEV and HIC circuit

*1 Under Nominal heating conditions at outdoor temp, 7ºC DB/6ºC WB(44.6°F DB/42.8°F WB) outlet water temp 45ºC(113°F), inlet water temp 40ºC(104°F)
*2 Under Heating conditions at outdoor temp, 7ºC DB/6ºC WB(44.6°F DB/42.8°F WB), outlet water temp 70ºC (158°F)
*3 Under Heating conditions at outdoor temp, 7ºC DB/6ºC WB(44.6°F DB/42.8°F WB) when this unit is set to capacity priority mode by non-voltage B contact
*5 Dip SW on the unit control board need to be changed.
* Due to continuing improvement, the above specifications may be subject to change without notice.
* Please don't use the steel material for the water piping material.
* Please always make water circulate or pull out the circulation water completely when not using it.
* Please do not use groundwater and well water.
* Install the unit in an environment where the wet bulb temp will not exceed 32ºC (89.6°F).
* The water circuit must use the closed circuit.

*4



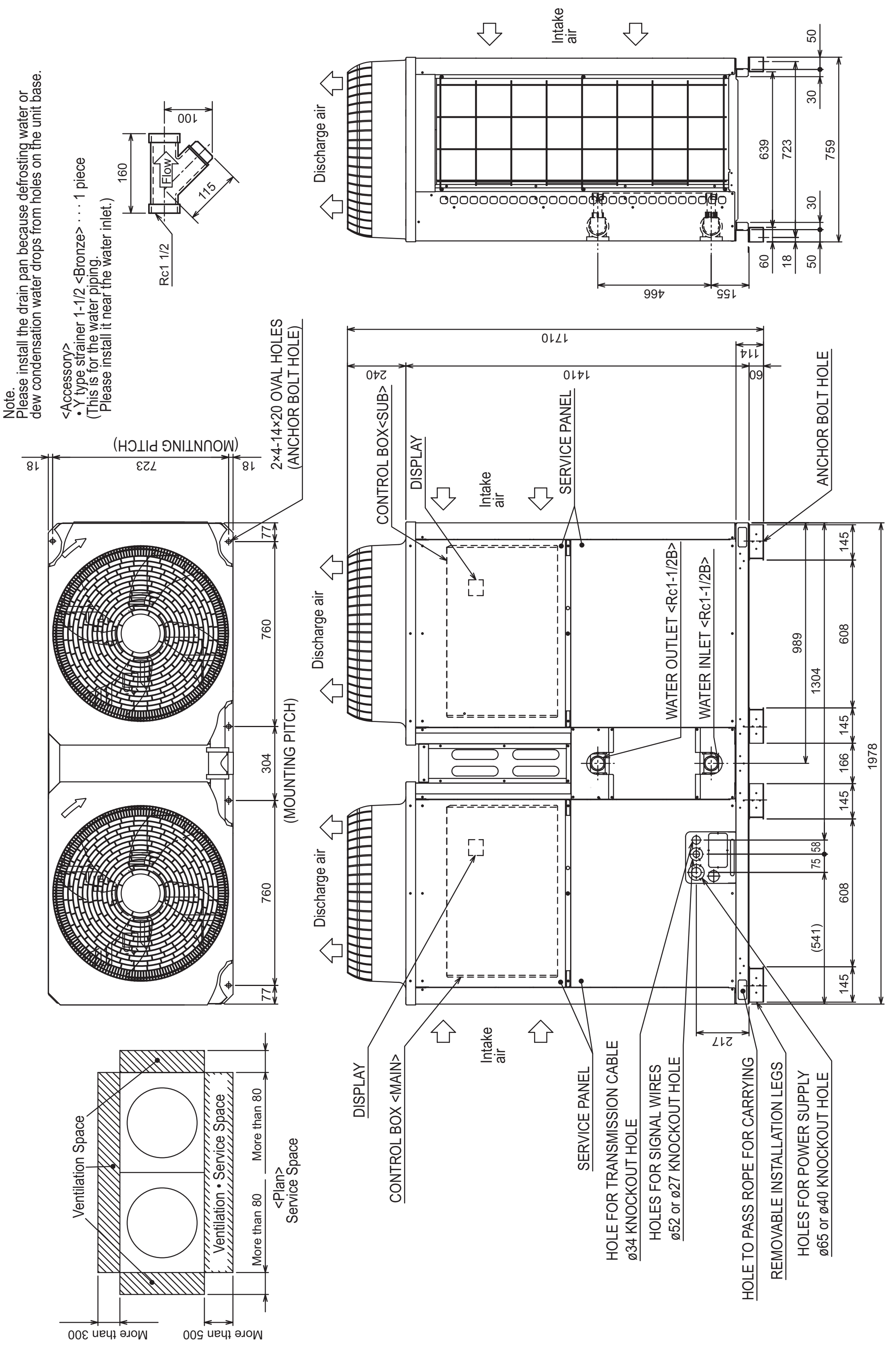
Outdoor temp -20°C DB/ Outlet water temp 40~65°C
(Outdoor temp -4°F DB/ Outlet water temp 104°F~149°F)
Outdoor temp -10°C DB/ Outlet water temp 33°C~70°C
(Outdoor temp 14°F DB/ Outlet water temp 91°F~158°F)
Outdoor temp 0°C DB/ Outlet water temp 25°C~70°C
(Outdoor temp 32°F DB/ Outlet water temp 77°F~158°F)

Unit converter
kcal = kW x 860
BTU/h = kW x 3,412
cfm = m^3/min x 35.31
lb = kg/0.4536

2. External Dimensions

• CAHV-P500YA-HPB(-BS)

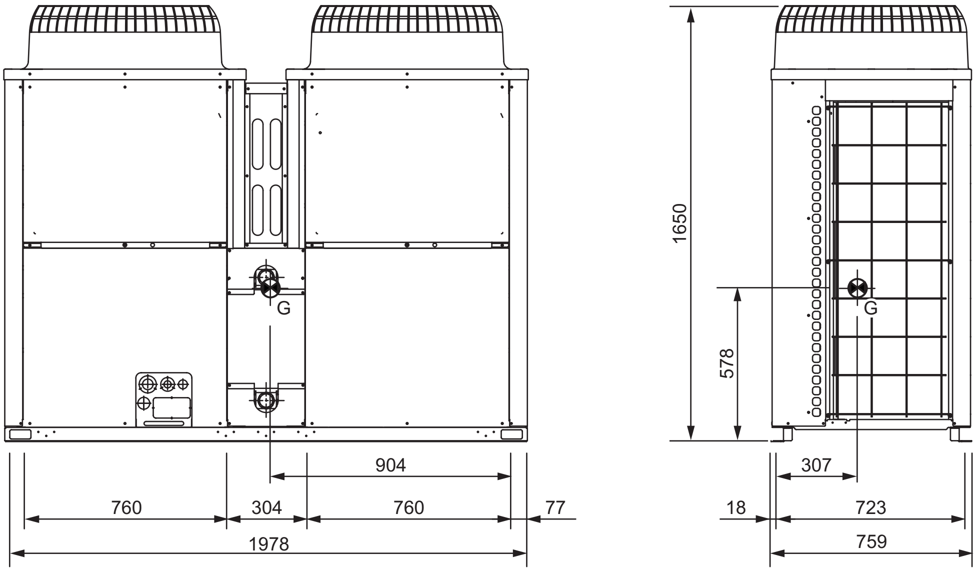
Unit: mm



3. Center of Gravity

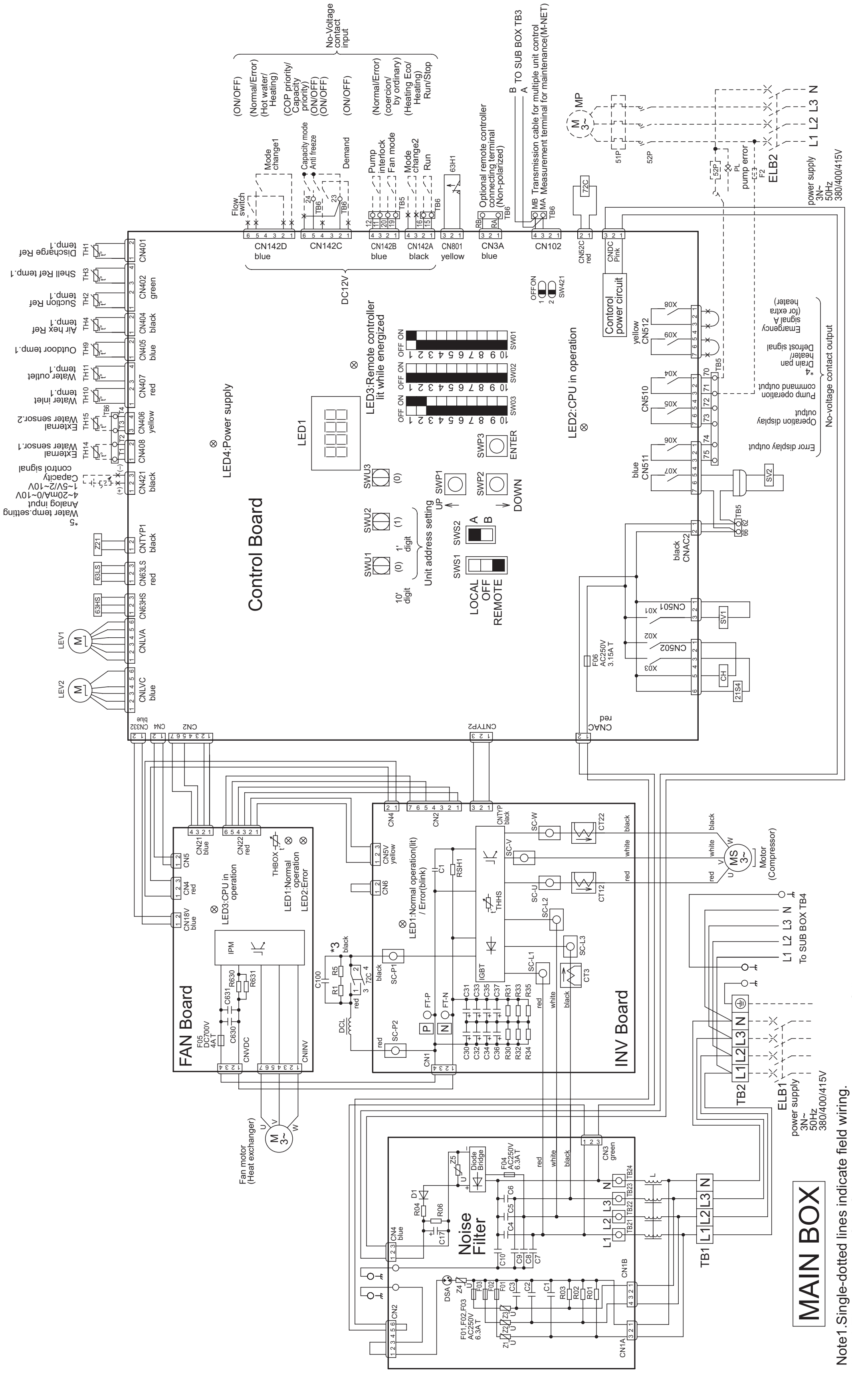
• CAHV-P500YA-HPB(-BS)

Unit: mm



4. Electrical Wiring Diagrams

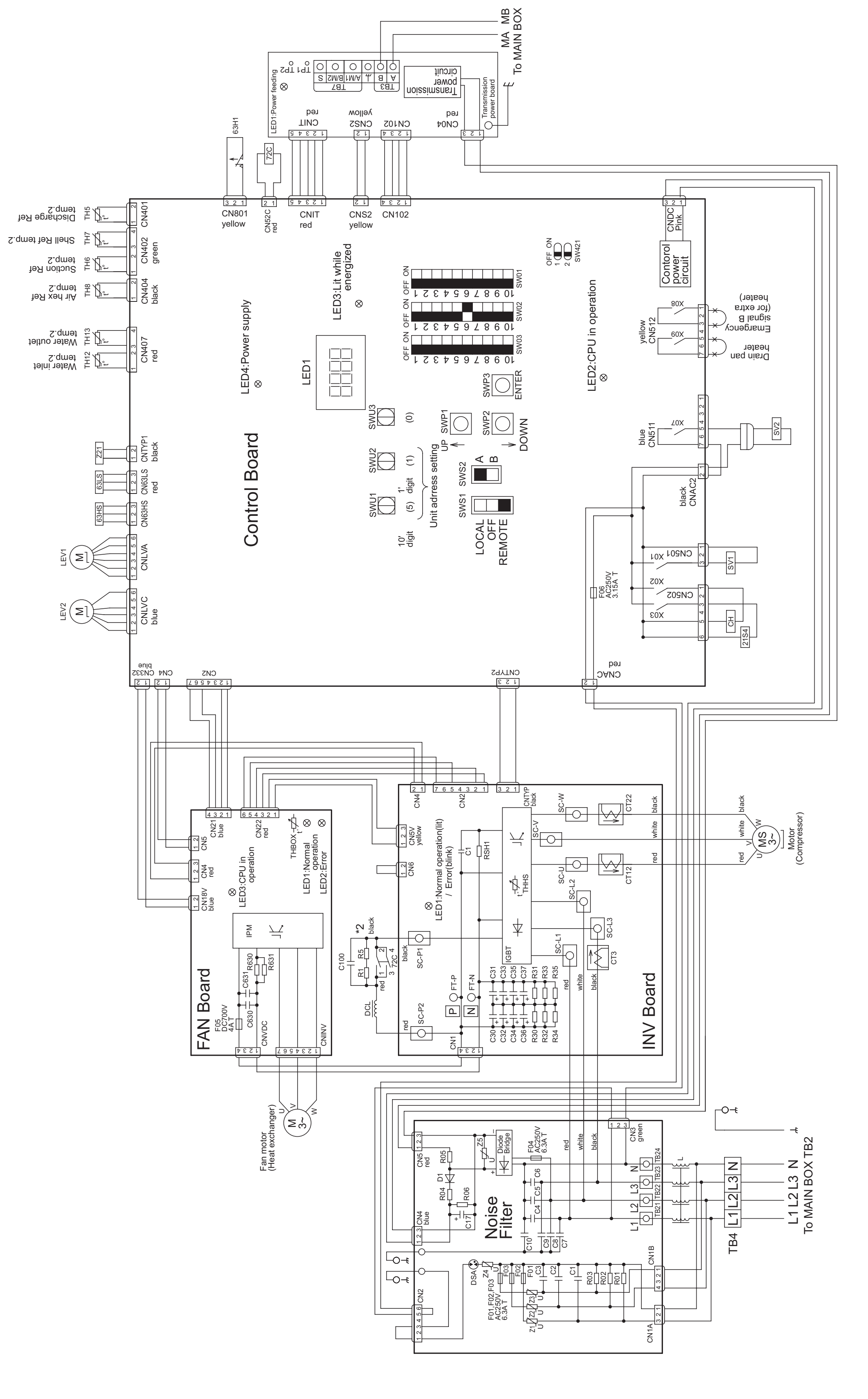
• CAHV-P500YA-HPB(-BS)



Note1.Single-dotted lines indicate field wiring.
Note2.The symbols of the field connecting terminals are as follows.
○:Terminal block ×:Connection by cutting the short circuit wire
Note3.Faston terminals have a locking function.
Press the tab in the middle of the terminals to remove them.
Check that the terminals are securely locked in place after insertion.
Note4.Selects either Drain pan signal or Defrost signal by SW2 and SW3 settings. (Item code 1056)
Note5.Selects either Water temperature setting input signal or Capacity control input signal by SW2 and SW3 settings. (Item code 1051)

Due to continuing improvement, the above specifications may be subject to change without notice.

• CAHV-P500YA-HPB(-BS)



SUB BOX

Note1.Single-dotted lines indicate field wiring.
Note2.Faston terminals have a locking fanction.
Pess the tab in the middle of the terminals to remove them.
Check that the terminals are securely locked in place after insertion.

• CAHV-P500YA-HPB(-BS)

Note

1. The broken lines indicate the optional parts,field-supplied parts, and field work.

2. Make sure to connect a pump interlock contact.
   A short-circuit may cause abnormal stop or malfunctions.

3. Operation signals can be received from the remote controller or through the dry contact. The temperature setting can be changed by a signal received through the dry contact or by using the schedule setting.

4. Leave a space of at least 5 cm between the low voltage external wiring (no-voltage contact input and remote controller wiring) and wiring of 100V or greater.Do not place them in the same conduit tube or cabtyre cable as this will damage the circuit board.

5. When cabtyre cable is used for the control cable wiring, use a separate cabtyre cable for the following wiring.
   Using the same cabtyre cable may cause malfunctions and damage to the unit.
   (a) Optional remote controller wiring
   (b) No-voltage contact input wiring
   (c) No-voltage contact output wiring
   (d) Remote water temperature setting

6. Use a contact that takes 12VDC 5mA for no-voltage contact input.

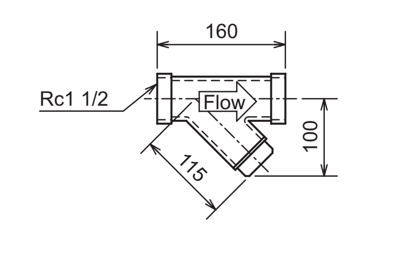
Symbol explanation

	Symbol	explanation
MAIN BOX and SUB BOX	CH	Crankcase heater (for heating the compressor)
	CT12	Ac current sensor
	CT22	
	CT3	
	C100	Capacitor (Electrolysis)
	DCL	DC reactor
	F01	Fuse
	F02	
	F03	
	F04	
	F05	
	F06	
	LEV1	Electronic expansion valve (Main circuit)
	LEV2	Electronic expansion valve (Injection)
	M	Fan motor
	MS	Compressor motor
	R1	Electrical resistance
	R5	
	SV1	Solenoid valve (Injection circuit)
	SV2	Solenoid valve (Hot gas circuit)
	THHS	IGBT temperature
	Z21	Function setting connector
	21S4	4-way valve
	63HS	High pressure sensor
	63H1	High pressure switch
	63LS	Low pressure sensor
	72C	Electromagnetic relay (Inverter main circuit)
MAIN BOX	TH1~4	Thermistor
	TH9~11	
	TH14	
SUB BOX	TH5~8	Thermistor
	TH12,13	
Field-supplied	<ELB1,2,3>	Earth leakage breaker
	<F2,3>	Fuse
	<MP>	Pump motor
	<51P>	Overcurrent relay (Pump)
	<52P>	Electromagnetic contactor (Pump)

5. Accessories

• CAHV-P500YA-HPB(-BS)

(A) Strainer

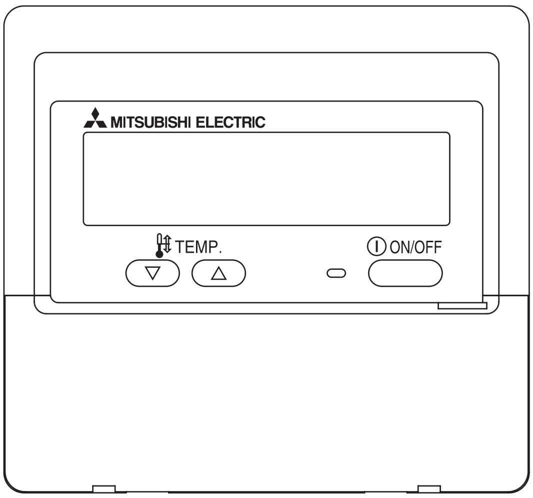


(A) Install the strainer at the water pipe inlet.

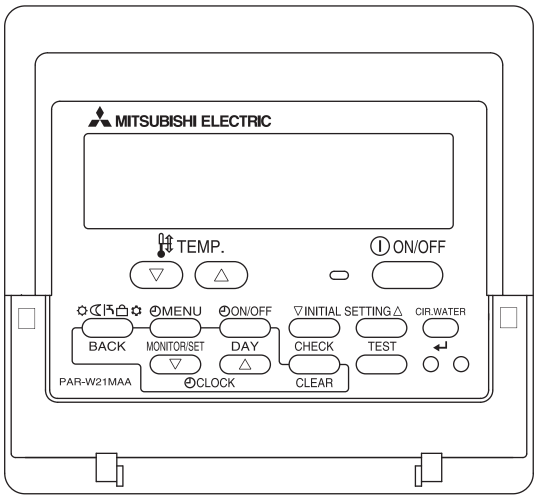
6. Optional parts

(1) Remote controller PAR-W21MAA

Refer to Chapter VI “Controller”, section 1. “PAR-W21MAA specifications”.



Panel closed



Panel open

(2) Representative-water temperature sensor TW-TH16

(2)-1 Required parts for installing a representative-water temperature sensor

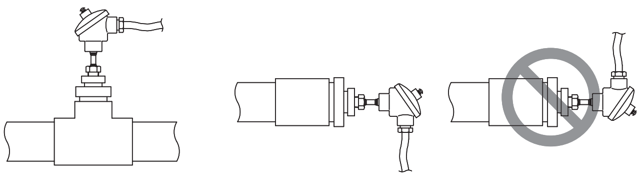
ⓐ Representative-water temperature sensor
ⓑ Cable for connecting between the sensor and the unit*
ⓒ Cable terminal for connecting to the sensor and the unit terminal block*
(Terminals for M4 screws x 4)*
* ⓐ and ⓑ are field-supplied.

Cable specifications

Size	2-core, 1.25 mm^2 or larger
Type	CVVS or CPEVS
Length	20m

(2)-2 Installing a representative-water temperature sensor

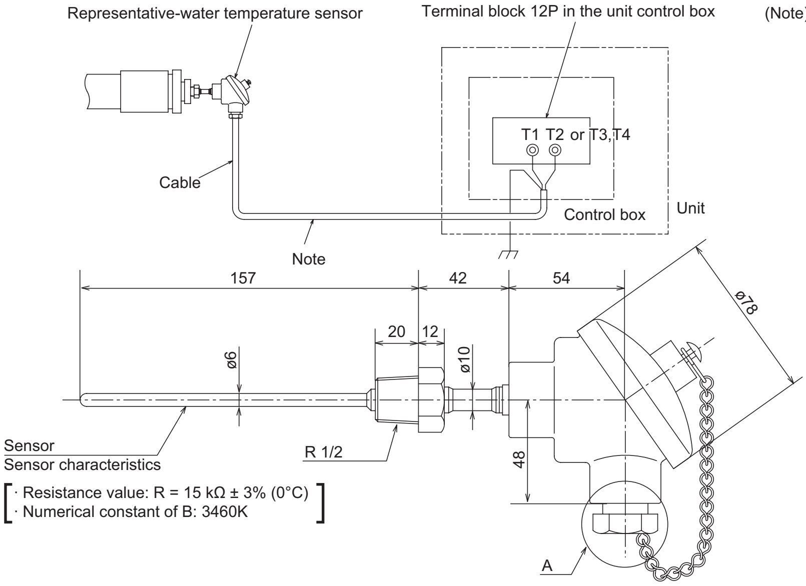
As shown in the figures at right, install the sensor at the merged part of water pipes or the load-side tank.
The sensor can be installed in either the vertical or the horizontal position.
When installing the sensor in the horizontal position, make sure to place the cable-access-hole side down.



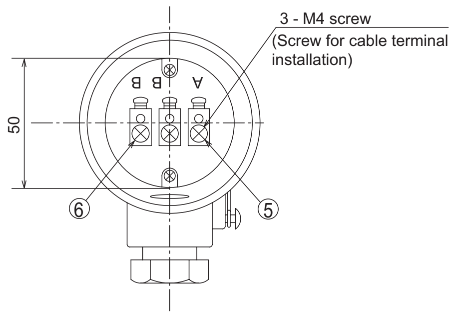
Vertical installation　　Horizontal installation

(2)-3 Wiring for a representative-water temperature sensor

As shown in the figures below, connect the cable to the representative-water temperature sensor and the terminal block in the unit control box.



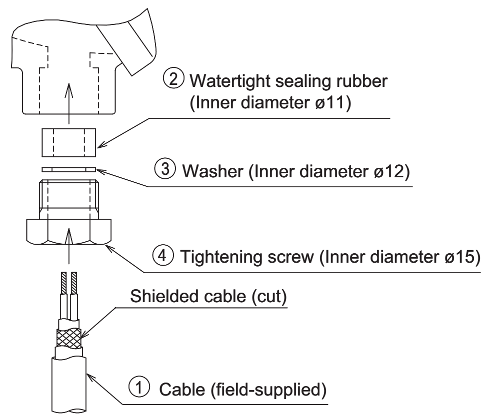
(Note) Install the sensor cable at least 5 cm away from the power cable to which 100 V or higher voltage is applied.



Terminal block on the sensor

On the unit side, connect the sensor cable to the terminals T1 and T2 in the terminal block 12P in the unit control box.
Connect the shielded cable to the ground terminal.
On the sensor side, as shown in the figure at right, run the cable through ④, ③, and ②, attach the field-supplied terminals for M4 screws to the cable, and then connect the terminals to the screws ⑤ and ⑥ (terminal A and B).
Cut the shielded cable and leave it unconnected. (On the unit side, the shielded cable should be connected to the ground terminal already.)

Tighten the tightening screw ④, and caulk the gap between the tightening screw ④ and cable ① to prevent water leakage.



Enlarged view of area A: Cable installation

II Product Data

1. Capacity tables

(1) Correction by temperature

• CAHV-P500YA-HPB(-BS)

(1)-1 Efficiency Priority Mode

● Capacity

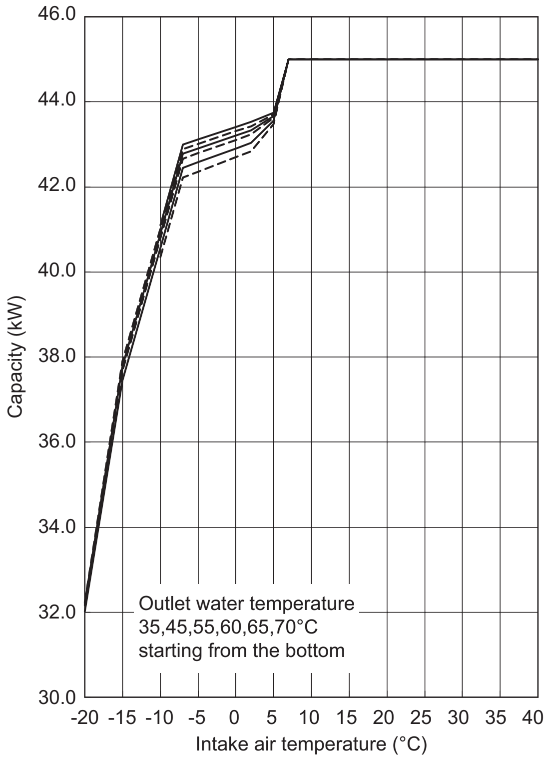
		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	40.3	42.2	42.4	42.7	42.8	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	45	32.0	37.4	40.6	42.4	42.6	42.9	43.0	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	55	32.2	37.7	40.8	42.7	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

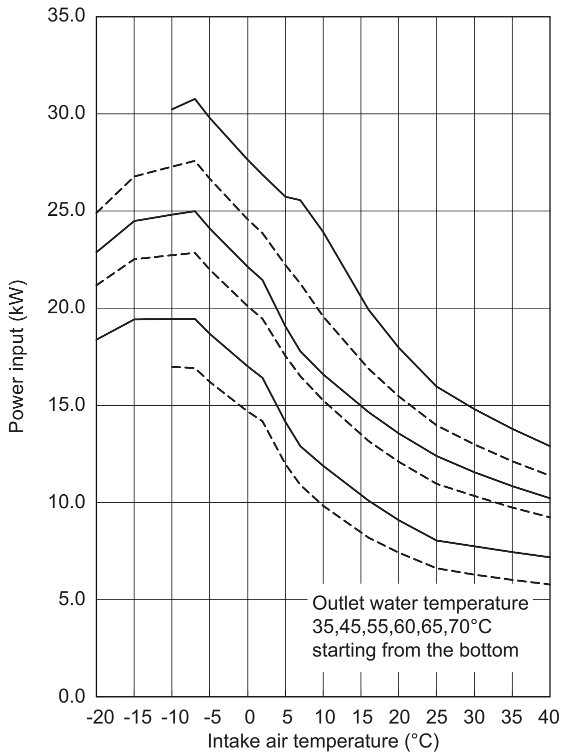
This table shows the capacity when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

● 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.





(1)-2 Capacity Priority Mode

● Capacity

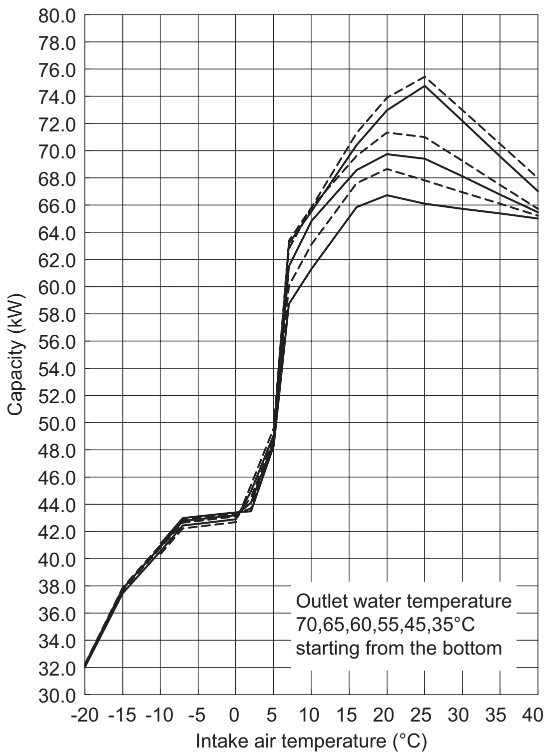
		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	40.3	42.2	42.4	42.7	45.4	49.6	63.4	65.9	71.3	73.9	75.4	73.0	70.5	68.0
	45	32.0	37.4	40.6	42.4	42.6	42.9	45.0	49.1	63.2	65.6	70.4	73.0	74.8	72.2	69.6	67.0
	55	32.2	37.7	40.8	42.7	42.8	43.1	44.5	48.8	62.8	65.9	69.6	71.3	71.0	69.2	67.5	65.7
	60	32.2	37.8	40.9	42.8	42.9	43.2	44.1	48.6	61.5	64.8	68.6	69.7	69.4	68.1	66.8	65.5
	65	32.2	37.9	41.0	42.9	43.0	43.3	43.7	48.5	60.1	63.1	67.6	68.7	67.8	66.9	66.1	65.2
	70	-	-	41.1	43.0	43.1	43.4	43.5	48.3	58.7	61.3	65.8	66.7	66.1	65.7	65.4	65.0

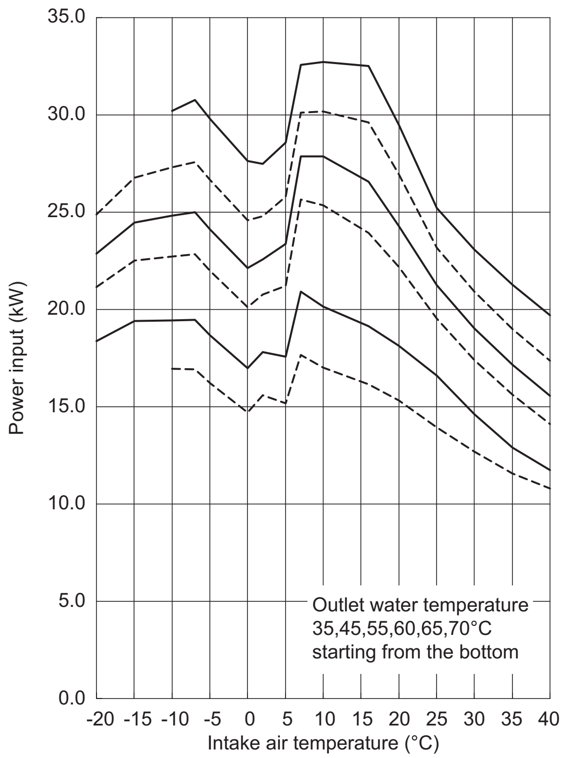
This table shows the capacity when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

● 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	15.6	15.2	17.7	17.0	16.2	15.3	13.9	12.7	11.6	10.8
	45	18.4	19.4	19.4	19.5	18.7	17.0	17.8	17.6	20.9	20.2	19.2	18.1	16.6	14.6	12.9	11.8
	55	21.2	22.5	22.7	22.8	22.0	20.1	20.8	21.2	25.6	25.3	23.9	22.2	19.5	17.4	15.6	14.1
	60	22.9	24.5	24.8	25.0	24.1	22.1	22.6	23.4	27.9	27.9	26.6	24.3	21.3	19.0	17.2	15.6
	65	24.9	26.8	27.3	27.6	26.7	24.6	24.8	25.8	30.1	30.2	29.6	27.0	23.2	20.9	19.0	17.4
	70	-	-	30.2	30.8	29.8	27.6	27.5	28.6	32.6	32.7	32.5	29.5	25.2	23.1	21.3	19.7

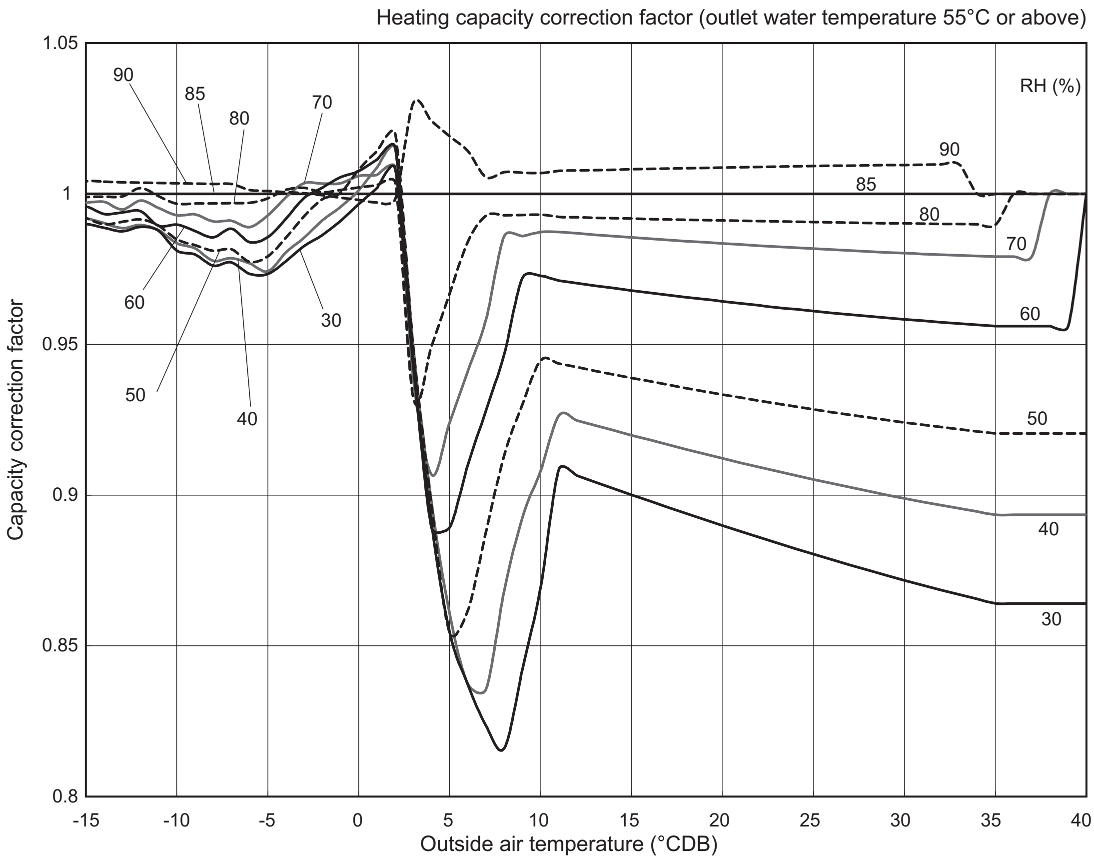
This table shows the power input when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.





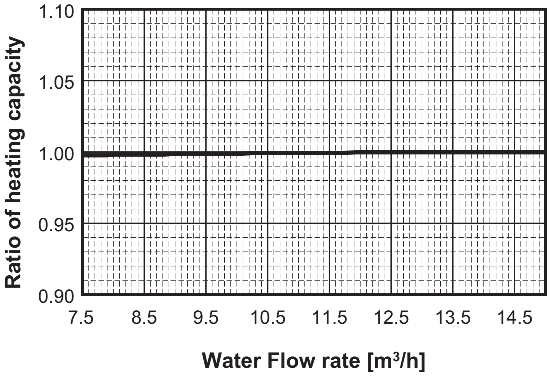
(2) Correction by relative humidity

• CAHV-P500YA-HPB(-BS)

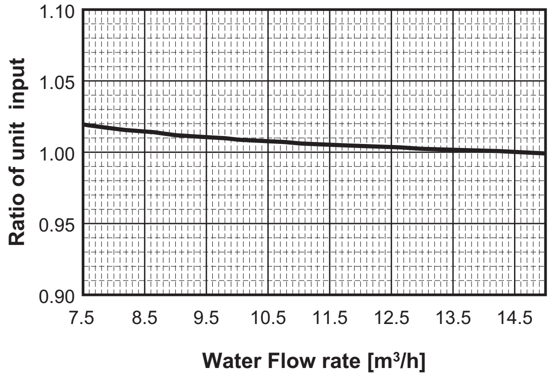


(3) Correction by water flow rate

• CAHV-P500YA-HPB(-BS)



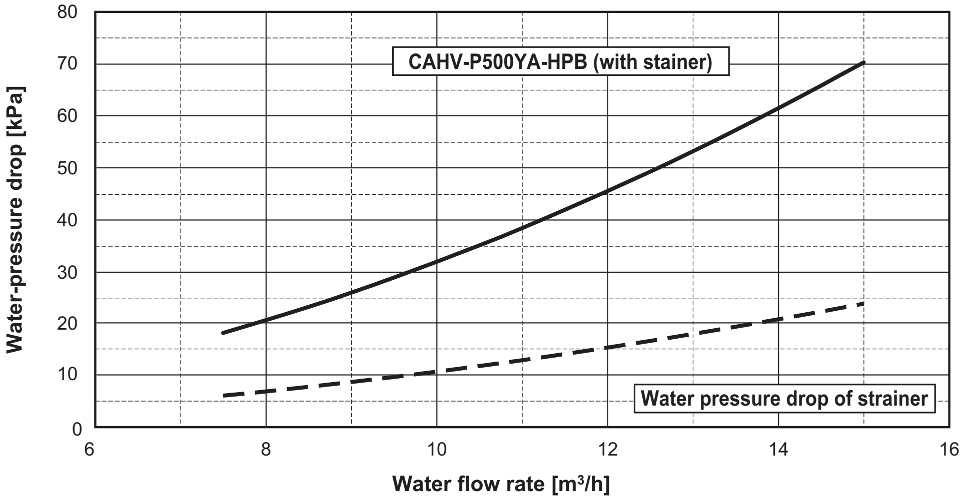
*Conditions Outdoor temperature 0°C
Intake water temperature 65°C
Frequency of compressor 100Hz



*Conditions Outdoor temperature 0°C
Intake water temperature 50°C
Frequency of compressor 100Hz

(4) Water pressure drop

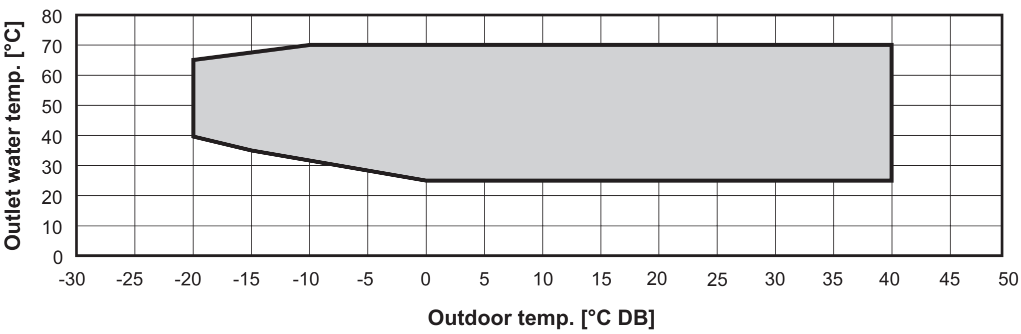
• CAHV-P500YA-HPB(-BS)



(5) Operation temperature range

• CAHV-P500YA-HPB(-BS)

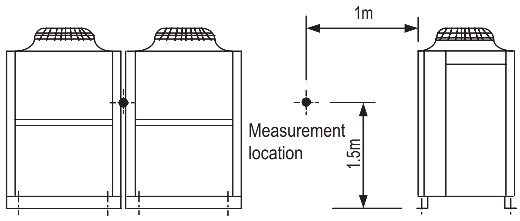
Heating



2. Sound pressure levels

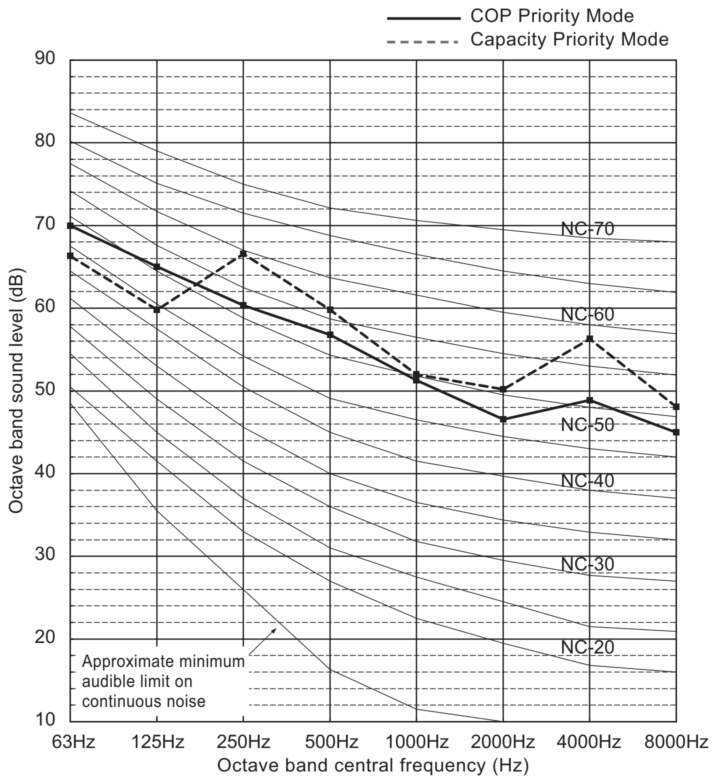
Measurement condition

• CAHV-P500YA-HPB(-BS)



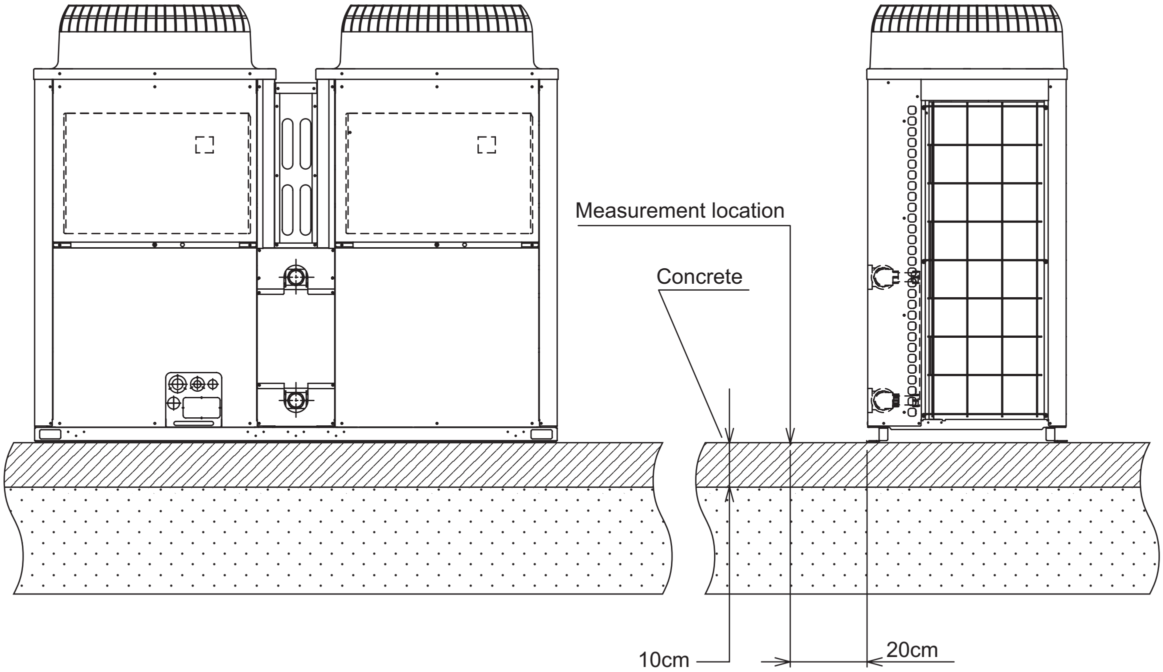
Sound Pressure Level: 59.0 / 63.0 dB (COP Priority Mode / Capacity Priority Mode)

Opetation condition… Spring, Autumn: Outdoor temp.: 16°CDB/12°CWB, Inlet water temp.: 40°C, Outlet water temp.: 45°C
Winter: Outdoor temp.: 7°CDB/ 6 °CWB, Inlet water temp.: 65°C, Outlet water temp.: 70°C



3. Vibration levels

• CAHV-P500YA-HPB(-BS)



Model	Vibration Levels [dB]
CAHV-P500YA-HPB(-BS)	47 or less

III Installation

1. Selecting the Installation Site

(1) Installation conditions

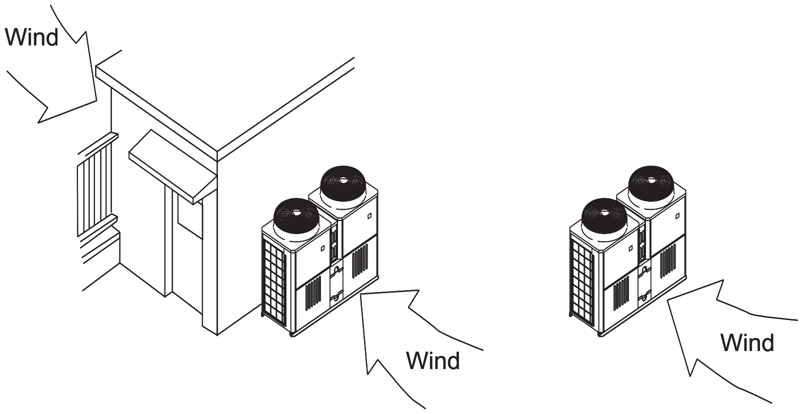
Select the installation site in consultation with the client.

Select a site to install the outdoor unit that meets the following conditions:

- The unit will not be subject to heat from other heat sources.
- The noise from the unit will not be a problem.
- The unit will not be exposed to strong winds.
- Water from the unit can be drained properly.
- The space requirements (specified on page 17) are met.

(1)-1. Providing protection against winds

Using the figures at right as a reference, provide adequate protection against winds.
A unit installed alone is vulnerable to strong winds. Select the installation site carefully to minimize the effect of winds.
When installing a unit in a place where the wind always blows from the same direction, install the unit so that the outlet faces away from the direction of the wind.



- Install the outdoor unit in a place where it is not exposed to direct wind, such as behind a building.
- Install the outdoor unit so that the outlet/inlet faces away from the wind.

(1)-2. Cold Climate Installation

Observe the following when installing the units in areas where snow or strong winds prevail.

- Avoid direct exposure to rain, winds, and snow.
- When deciding the high of the unit stand for snow damage prevention, consider the snow accumulation.
- There is a possibility that an icicle may form under the unit stand. Consider this when installing the unit on the roof for this may injure person or the property.
- If the units are installed in the direct line of rain, winds, or snow, install the optional snow hood (on both the discharge and suction ducts). Use a snow net or snow fence as necessary to protect the unit.
- Install the unit on a base approximately twice as high as the expected snowfall.
- If the unit is continuously operated for a long time with the outside air temperature below the freezing point, install a heater at the base of the unit to prevent the water from freezing at the unit bottom.

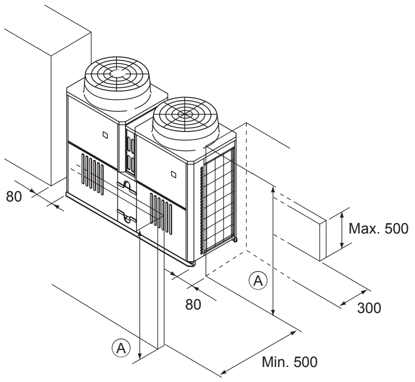
(2) Installation space requirements

(2)-1. Single unit installation

Secure enough space around the unit as shown in the figures below.

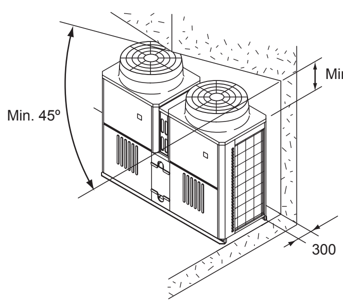
<Unit: mm>

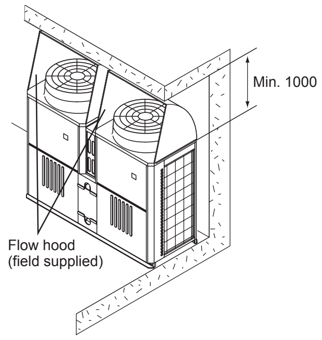
(2)-1-1. Walls around the unit do not exceed the height limit.



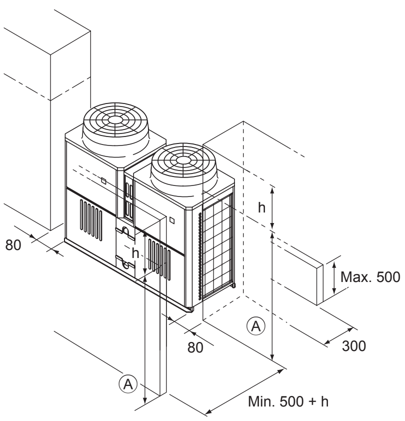
Ⓐ Walls are lower than the unit's height.

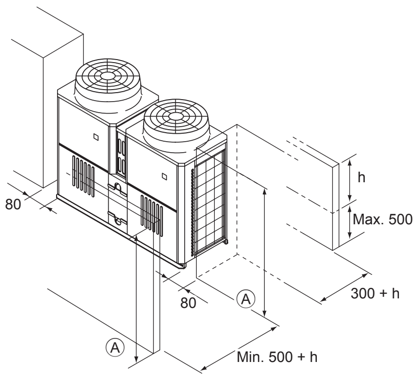
(2)-1-2. There is a wall above the unit.

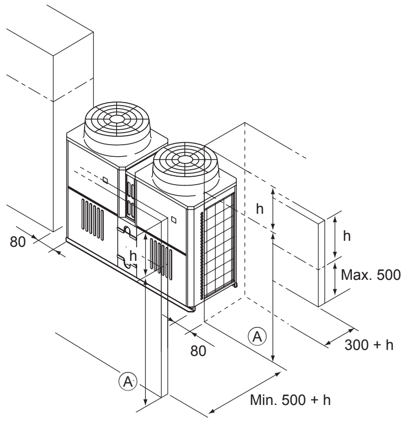




(2)-1-3. One or more of the walls around the unit are taller than the maximum allowable height <h>.

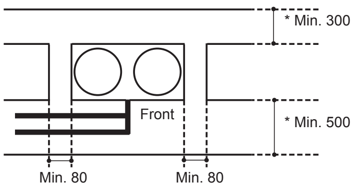




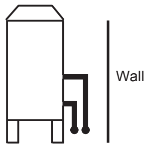


Ⓐ Walls are lower than the unit's height.

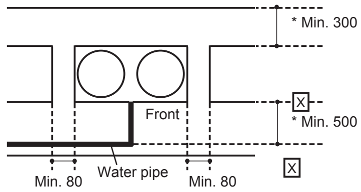
(2)-1-4. Water pipe installation



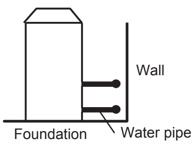
<Top view>



<Side view>



<Top view>



<Side view>

Leave a space of at least 500 between the unit and the water pipe if it is not possible to install the unit on a raised foundation. (SEE ☒ in the figure.)

(2)-2. Grouped and side-by-side installation

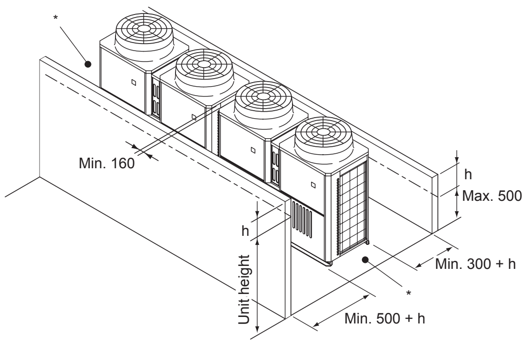
When multiple units are installed adjacent to each other, allow enough space for air circulation and a walk way between groups of units as shown in the figures below.

* Leave both sides of each group of units open.

As with individual installation, if the wall height exceeds the height limit, widen the space in the front and the back of a given group of units by the amount that exceeds the limit (labeled <h> in the figure).

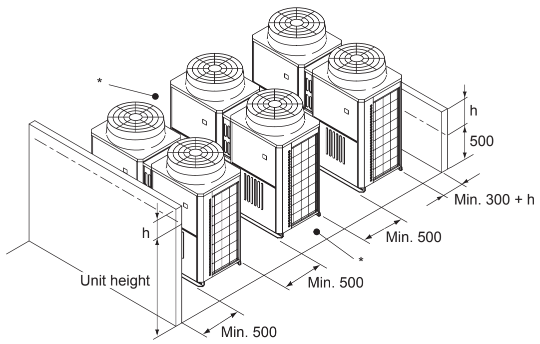
<Unit: mm>

(2)-2-1. Side-by-side installation

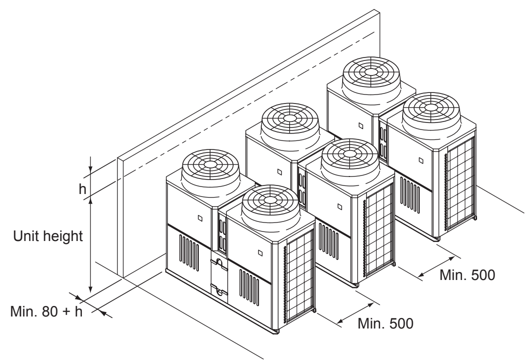


(2)-2-2. Face-to-face installation

- There are walls in the back and the front of a given group of units.

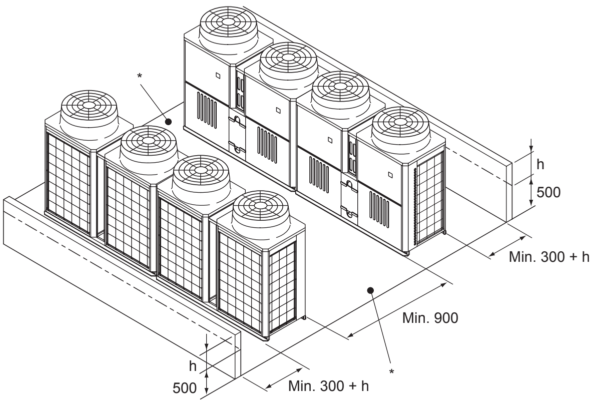


- There is a wall on one side.

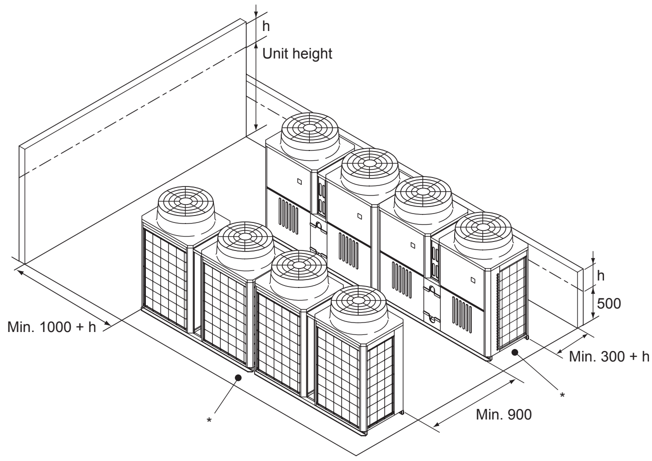


(2)-2-3. Combination of face-to-face and side-by-side installations

- There are walls in the back and the front of a given group of units.

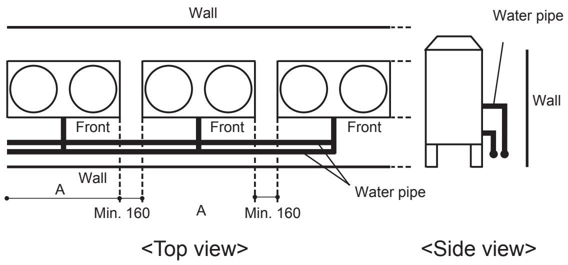


- There is a wall on one side and either the front or the back of a given group of unit.



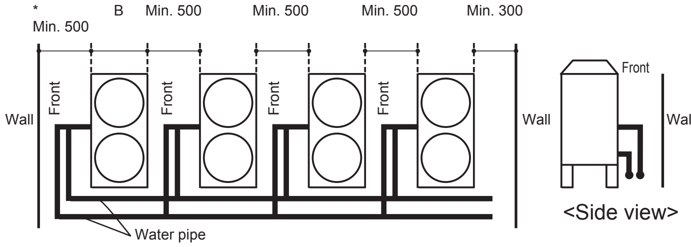
(2)-2-4. Water pipe installation

Pattern A



If the product width (labeled A in the figure) times the number of units that are installed side by side exceeds 6 m, leave a space of 1000 mm between each block. Each block is defined as a group of units that fit within 6 m.

Pattern B



If the product depth (labeled B in the figure) times the number of units that are installed in rows exceeds 6 m, leave a space of 1000 mm between each block. Each block is defined as a group of units that fit within 6 m.

(2)-3. Required airflow rate for the unit

Unit: m^3/min

Model	Standard airflow rate	Minimum airflow rate	Allowable external static pressure (Unit: Pa)
CAHV-P500YA-HPB(-BS)	370	333	10

2. Installation of unit

Units should be installed only by personnel certified by Mitsubishi Electric.

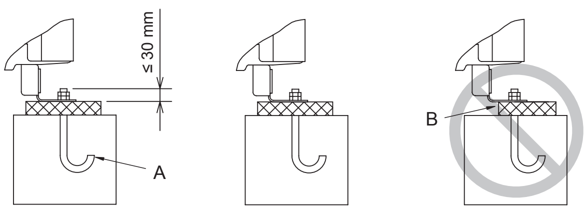
- Fix unit tightly with bolts so that unit will not fall down due to earthquakes or strong winds.
- Use concrete or an angle bracket as the foundation of unit.
- Vibration may be transmitted to the installation section and noise and vibration may be generated from the floor and walls, depending on the installation conditions. Therefore, provide ample vibrationproofing (cushion pads, cushion frame, etc.).
- Build the foundation in such way that the corner of the installation leg is securely supported as shown in the figure. When using a rubber isolating cushion, please ensure it is large enough to cover the entire width of each of the unit's legs. If the corners are not firmly seated, the installation feet may be bent.
- The projecting length of the anchor bolt should be less than 30 mm.
- Hole-in anchor bolts are not compatible with this product. However, if fixing brackets are mounted on the 4 locations of the unit attachment part, hole-in anchor bolts can be used.
- The detachable leg can be removed at the site.
- Detaching the detachable leg
  Loosen the three screws to detach the detachable leg (Two each in the front and back).
  If the base leg finish is damaged when detaching, be sure to repair at the site.

⚠Warning:

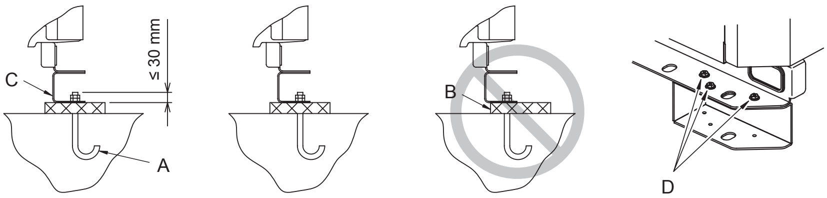
- **Be sure to install unit in a place strong enough to withstand its weight.**
  Any lack of strength may cause unit to fall down, resulting in a personal injury.
- **Have installation work in order to protect against strong winds and earthquakes.**
  Any installation deficiency may cause unit to fall down, resulting in a personal injury.

When building the foundation, give full attention to the floor strength, drain water disposal <during operation, drain water flows out of the unit>, and piping and wiring routes.

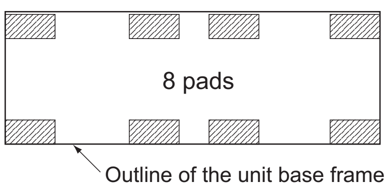
Precautions when routing the pipes and wires below the unit (Without detachable leg)
When routing the pipes and wires below the unit, be sure that the foundation and base work do not block the base through-holes. Also make sure the foundation is at least 100 mm high so that the piping can pass under the unit.



A: M10 anchor bolt procured at the site.
B: Corner is not seated.
C: Detachable leg
D: Screws

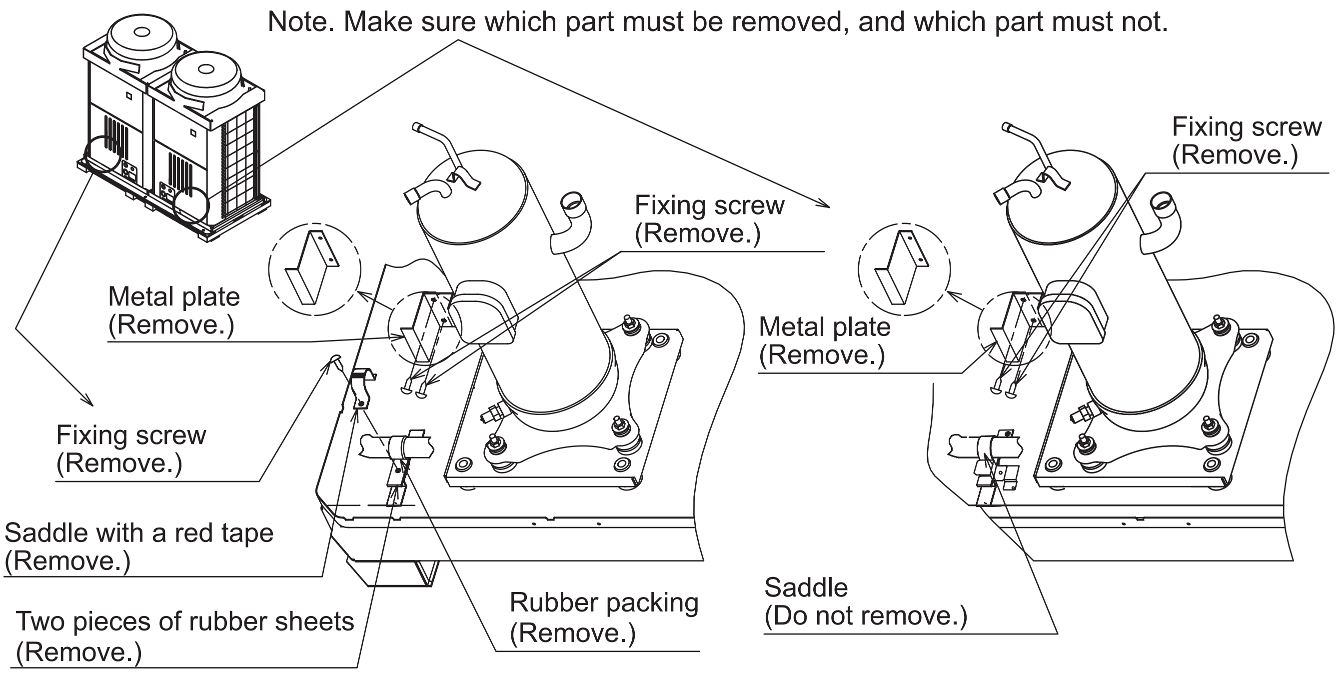


(1) Position of anti-vibration pads



3. Removing the metal plates and saddles around the compressor

> ⚠ The metal plates and saddles are used only for transportation. Remove the metal plates and saddles before operating the unit to keep the unit from vibrating excessively.



4. Installing the unit in a snow area

In snowy areas, sufficient protection against snow and winds should be provided to ensure proper operation.

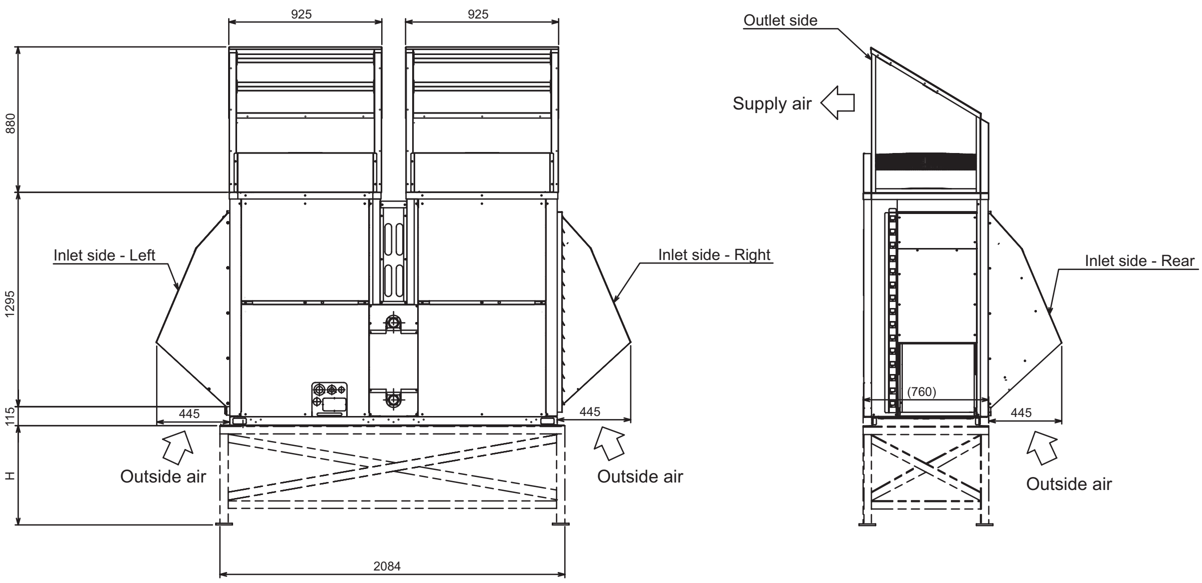
Even in other areas, appropriate measures should be taken to minimize the effects of winds and snow to ensure normal operation.

To ensure proper operation, install a field-supplied outlet/inlet duct if the unit is directly exposed to wind, rain, or snow and is operated in the cooling mode with the outside air temperature of 10ºC or below.

(Note)

- Install the unit on a base approximately twice as high as the expected snowfall. The base must be made of angle steel or something to let snow and wind slip through the structure. The base width must not exceed the unit size, otherwise snow will accumulate on the base.
- Install the unit so that the outlet/inlet faces away from the wind.

• CAHV-P500YA-HPB(-BS)

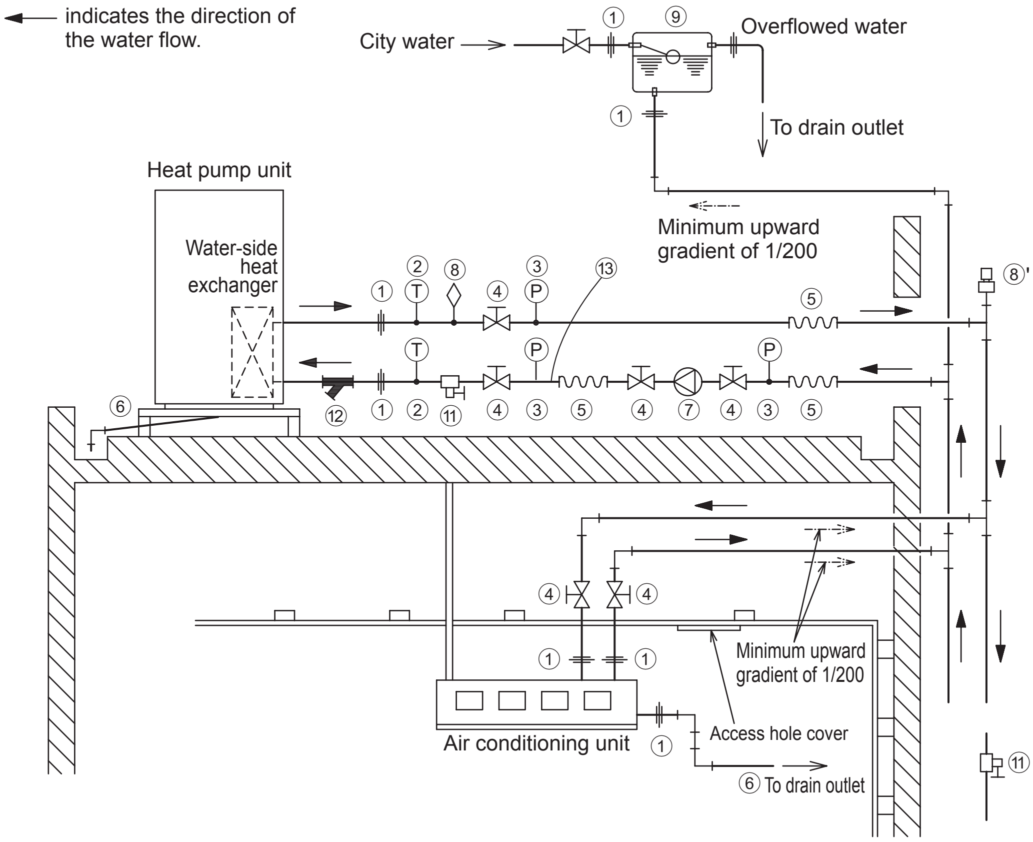


(Note)
1. Install the unit so that the outlet/inlet faces away from the wind. Secure enough space around the unit to avoid a short cycle.
2. Do not install the unit in a place where snow may fall from the roof. Also, remove the snow on the unit before it accumulates.
3. Refer to the figure above when installing the base on site.

IV System Design

1. Water pipe installation

(1) Caution for water pipe installation



① Union joints/flange joints etc.	Required to allow for a replacement of equipment
② Thermometer	Required to check the performance and monitor the operation of the units.
③ Water pressure gauge	Recommended for checking the operation status.
④ Valve	Required to allow for a replacement or cleaning of the flow adjuster.
⑤ Flexible joint	Recommended to prevent the noise and vibration from the pump from being transmitted.
⑥ Drain pipe	Install the drain pipe with a downward inclination of between 1/100 and 1/200. To prevent drain water from freezing in winter, install the drain pipe as steep an angle as practically possible and minimize the straight line. For cold climate installation, take an appropriate measure (e.g., drain heater) to prevent the drain water from freezing.
⑦ Pump	Use a pump that is large enough to compensate for the total water pressure loss and supply sufficient water to the unit.
⑧ Air vent valve	Install air venting valves to the places where air can accumulate. Automatic air vent valves (such as ⑧') are effective.
⑨ Expansion tank	Install an expansion tank to accommodate expanded water and to supply water.
⑩ Water pipe	Use pipes that allow for easy air purging, and provide adequate insulation.
⑪ Drain valve	Install drain valves so that water can be drained for servicing.
⑫ Strainer	Install a strainer near the unit to keep foreign materials from entering the water-side head exchanger (supplied).
⑬ Flow switch	Required to protect the unit.

(1)-1 Notes on pipe corrosion

Water processing and water quality control

When the circulating water quality is poor, the water heat exchanger can develop scales, leading to a reduction in heat-exchange power and possible corrosion of the heat exchanger. Please pay careful attention to water processing and water quality control when installing the water circulation system.

- Removal of foreign objects or impurities within the pipes.
  During installation, be careful that foreign objects, such as welding fragments, sealant particles, or rust, do not enter the pipes.

- Water Quality Processing

(1)-1-1 Depending on the quality of water used, the heat exchanger may become coroded or scaled up. We recommend regular water quality processing.
Water circulation systems using open heat storage tanks are particularly prone to corrosion.
When using an open-type heat storage tank, install a water-to-water heat exchanger, and use a closed-loop circuit on the air conditioner side. If a water supply tank is installed, keep contact with air to a minimum, and keep the level of dissolved oxygen in the water no higher than 1 mg/ℓ.

(1)-1-2 Water quality standard

Items			Lower mid-range temperature water system Water Temp. ≤ 60ºC		Higher mid-range temperature water system Water Temp. > 60ºC		Tendency	
			Recirculating water	Make-up water	Recirculating water	Make-up water	Corrosive	Scale-forming
Standard items	pH (25 ˚C)		7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	7.0 ~ 8.0	○	○
	Electric conductivity	(mS/m) (25 ˚C) (μs/cm) (25 ˚C)	30 or less [300 or less]	30 or less [300 or less]	30 or less [300 or less]	30 or less [300 or less]	○	○
	Chloride ion	(mg Cl^-/ℓ)	50 or less	50 or less	30 or less	30 or less	○	
	Sulfate ion	(mg $SO4^{2-}$/ℓ)	50 or less	50 or less	30 or less	30 or less	○	
	Acid consumption	(pH4.8) (mg $CaCO_3$/ℓ)	50 or less	50 or less	50 or less	50 or less		○
	Total hardness	(mg $CaCO_3$/ℓ)	70 or less	70 or less	70 or less	70 or less		○
	Calcium hardness	(mg $CaCO_3$/ℓ)	50 or less	50 or less	50 or less	50 or less		○
	Ionic silica	(mg SiO_2/ℓ)	30 or less	30 or less	30 or less	30 or less		○
Reference items	Iron	(mg Fe/ℓ)	1.0 or less	0.3 or less	1.0 or less	0.3 or less	○	○
	Copper	(mg Cu/ℓ)	1.0 or less	1.0 or less	1.0 or less	1.0 or less	○	
	Sulfide ion	(mg S^{2-}/ℓ)	Not to be detected	Not to be detected	Not to be detected	Not to be detected	○	
	Ammonium ion	(mg NH_4^+/ℓ)	0.3 or less	0.1 or less	0.1 or less	0.1 orless	○	
	Residual chlorine	(mg Cl/ℓ)	0.25 or less	0.3 or less	0.1 or less	0.3 or less	○	
	Free carbon dioxide	(mg CO_2/ℓ)	0.4 or less	4.0 or less	0.4 or less	4.0 or less	○	
	Ryzner stability index		—	—	—	—	○	○

Reference: Guideline of Water Quality for Refrigeration and Air Conditioning Equipment. (JRA GL02E-1994)

(1)-1-3 Please consult with a water quality control specialist about water quality control methods and water quality calculations before using anti-corrosive solutions for water quality management.

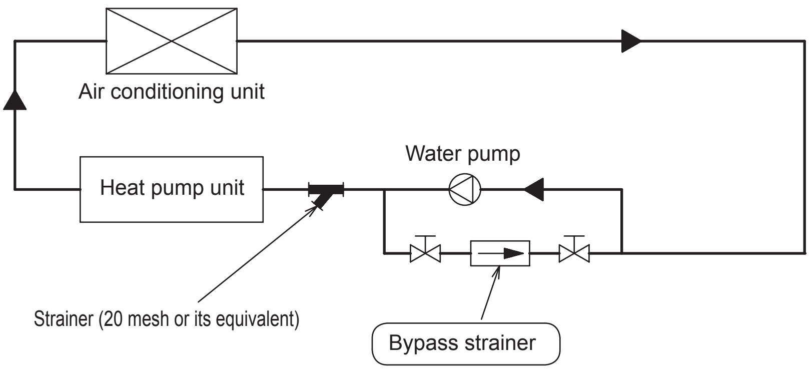
(1)-1-4 When replacing a previously installed air conditioning device (even when only the heat exchanger is being replaced), first conduct a water quality analysis and check for possible corrosion.
Corrosion can occur in water systems even if there has been no prior signs of corrosion.
If the water quality level has dropped, please adjust water quality sufficiently before replacing the unit.

(1)-1-5 Suspended solids in the water

Sand, pebbles, suspended solids, and corrosion products in water can damage the heating surface of the heat exchanger and cause corrosion. Install a good quality strainer (20 mesh or better) at the inlet of the unit to filter out suspended solids.

Removing foreign substances from the water system

Consider installing a settlement tank or a bypass strainer to remove foreign substances from the water system. Select a strainer capable of handling two to three percent of the circulating water. The figure below shows a sample system with a bypass strainer.



(1)-1-6 Connecting pipes made from different materials

If different types of metals are placed in direct contact with each other, the contact surface will corrode.

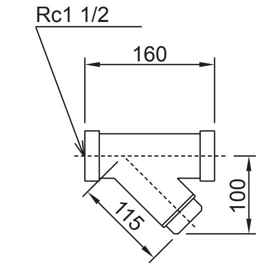
Install an insulating material between pipes that are made of different materials to keep them out of direct contact with each other.

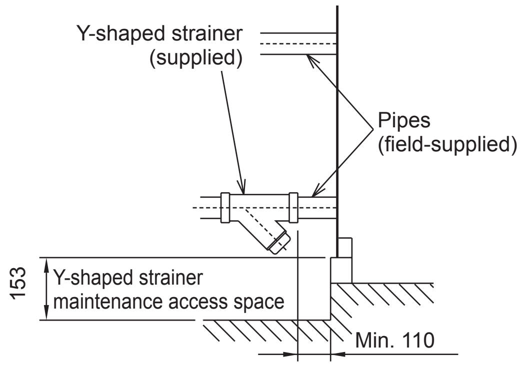
(2) Installing the water pipes

(2)-1 Installing the strainer

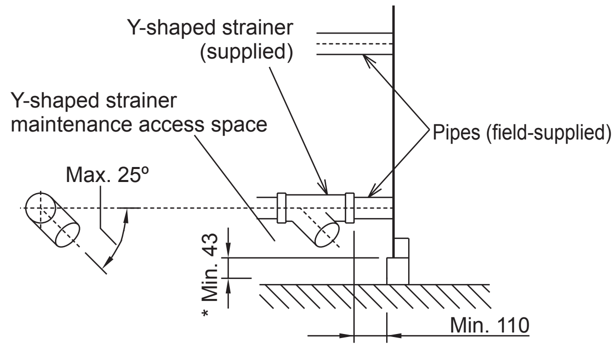
Install the supplied strainer on the inlet water pipe near the unit to filter out suspended solids and prevent clogging or corrosion of the heat exchanger.
Install the strainer in a way that allows for easy access for cleaning, and instruct the user to clean it regularly.
Operating the units with a clogged strainer may cause the units to make an abnormal stop.
Select a location to install a strainer, taking into consideration the installation angle, insulation thickness, and maintenance space.
* The dimensions given below indicate the amount of space necessary when screwing in a Y-shaped strainer.

<Unit: mm>





Sample installation 1



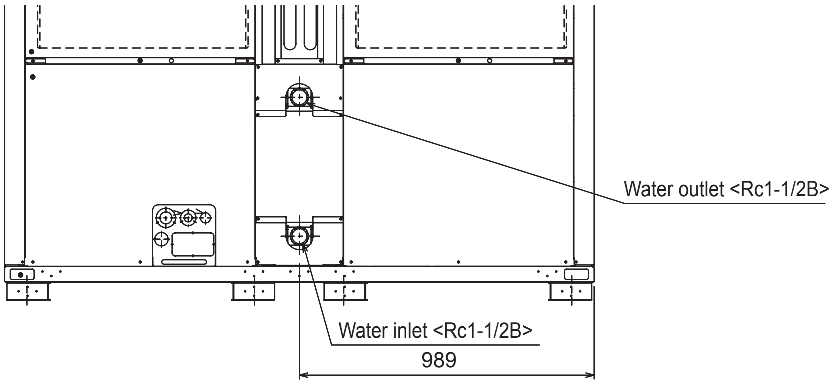
Sample installation 2

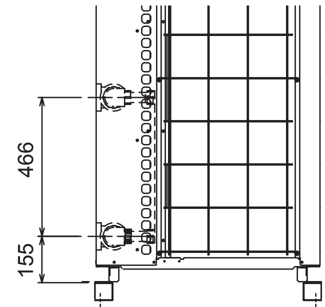
(2)-2 Installing a flow switch

Install a flow switch that meets the following specifications on the water pipe.
Connect the flow switch to the flow switch contact on the unit.

Minimum flow rate= 7.5 m^3/h (125 L/min)
Unit usage range (water flow rate): 7.5 - 15.0 m^3/h

(3) Water pipe hole size and location





2. Ensuring enough water in the water circuit

(1) Required amount of water

If the amount of water in the water circuit (circulating water circuit) is insufficient, the unit operation hours may become shorter or the amount of water temperature change to be controlled may become extremely large. Also, the defrost operation during the heating mode may not function properly. Refer to the table below for the minimum amount of water required in the circuit. If the water pipe is too short to keep enough amount of water, install a cushion tank in the water pipe to ensure enough amount of water.

Model	Minimum amount of water (ℓ)
CAHV-P500YA-HPB(-BS)	360

(2) Calculating the required amount of water in the water circuit

The required amount of water in the water circuit can be obtained from the following formula.

(Required amount of water in the water circuit) = (Amount of water that can be held in the water pipe) + (Amount of water that can be held in the heat source unit) + (Amount of water that can be held in the load-side unit)

The amount of water that can be held per meter of the water pipe (ℓ/m)

Pipe size					
3/4B (20A)	1B (25A)	1 1/4B (32A)	1 1/2B (40A)	2B (50A)	1 1/2B (65A)
0.37	0.60	0.99	1.36	2.20	3.62

The amount of water that can be held in the heat source unit (ℓ)

CAHV-P500YA-HPB(-BS)
14

3. Inlet/Outlet pipe connection size and material

The table below shows the inlet/outlet pipe connection size.

Inlet/Outlet pipe connection size

Model	Inlet pipe connection	Outlet pipe connection
CAHV-P500YA-HPB(-BS)	R1 - 1/2 Female screw <SUS304>	R1 - 1/2 Female screw<SUS304>

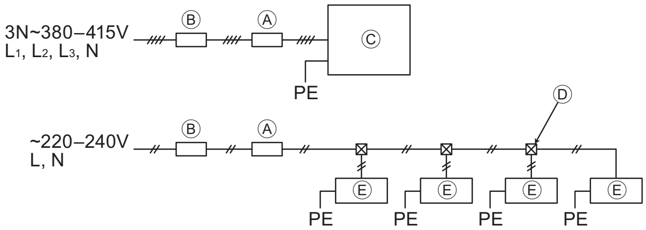
V Wiring Design

1. Electrical wiring installation

(1) Wiring of main power supply and equipment capacity

Schematic Drawing of Wiring (Example)

Ⓐ: Switch (Breakers for wiring and current leakage)
Ⓑ: Breakers for current leakage
Ⓒ: Outdoor unit
Ⓓ: Pull box
Ⓔ: Indoor unit



Thickness of wire for main power supply, capacities of the switch and system impedance

Model	Minimum wire thickness (mm^2)			Breaker for current leakage	Local swtich (A)		Breaker for wiring (NFB) (A)	Max. Permissive System Impedance
	Main cable	Branch	Ground		Capacity	Fuse		
CAHV-P500YA-HPB	25	-	25	75A 100mA 0.1sec. or less	75	75	75	0.28 Ω

1. **Use dedicated power supplies for the unit. Ensure each units are wired individually.**
2. **Bear in mind ambient conditions (ambient temperature,direct sunlight, rain water,etc.) when proceeding with the wiring and connections.**
3. **The wire size is the minimum value for metal conduit wiring. If the voltage drops, use a wire that is one rank thicker in diameter.**
   Make sure the power-supply voltage does not drop more than 10%.
4. **Specific wiring requirements should adhere to the wiring regulations of the region.**
5. **Power supply cords of parts of appliances for outdoor use shall not be lighter than polychloroprene sheathed flexible cord (design 60245 IEC57).**
6. **A switch with at least 3 mm contact separation in each pole shall be provided by the Air Conditioner installer.**
7. **Do not install a phase advancing capacitor on the motor. Doing so may damage the capacitor and result in fire.**
   The figure in the parentheses indicates the capacity necessary when the "Maximum capacity operation" setting is selected.

⚠ Warning:

- **Be sure to use specified wires for connections and ensure no external force is imparted to terminal connections. If connections are not fixed firmly, heating or fire may result.**
- **Be sure to use the appropriate type of overcurrent protection switch. Note that generated overcurrent may include some amount of direct current.**

⚠ Caution:

- **Some installation sites may require attachment of an earth leakage breaker for the inverter. If no earth leakage breaker is installed, there is a danger of electric shock.**
- **Do not use anything other than a breaker and fuse with the correct capacity. Using a fuse or wire of too large capacity may cause malfunction or fire.**

Note:

- **This device is intended for the connection to a power supply system with a maximum permissible system impedance shown in the above table at the interface point (power service box) of the user’s supply.**
- **The user must ensure that this device is connected only to a power supply system which fulfils the requirement above.**
  If necessary, the user can ask the public power supply company for the system impedance at the interface point.
- **This equipment complies with IEC 61000-3-12 provided that the short-circuit power SSC is greater than or equal to SSC (*2) at the interface point between the user’s supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power SSC greater than or equal to SSC (*2).**

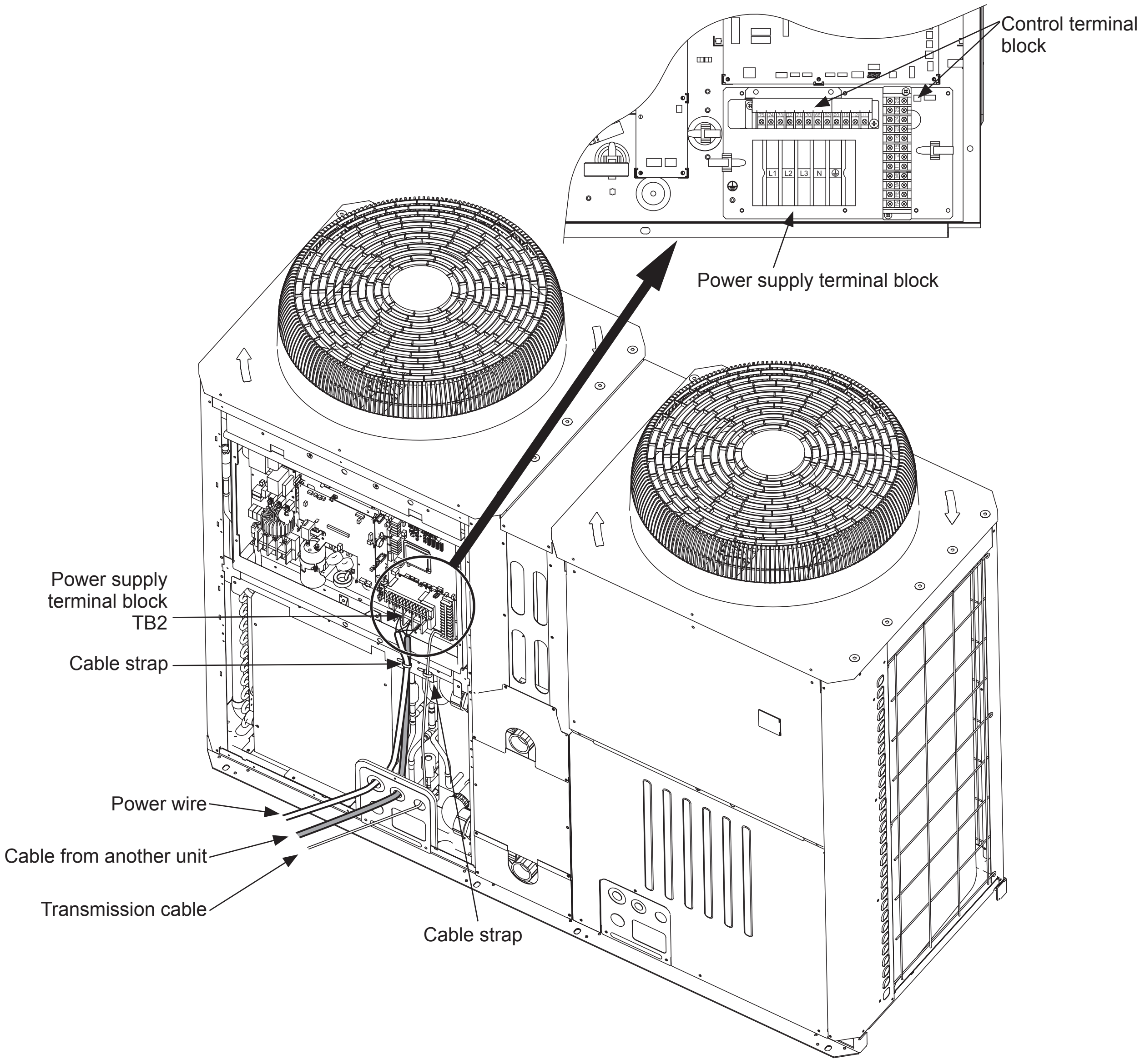
S_{SC} (*2)

Model	S_{SC} (MVA)
CAHV-P500YA-HPB	4.11

(2) Cable connections

(2)-1 Terminal Block Arrangement

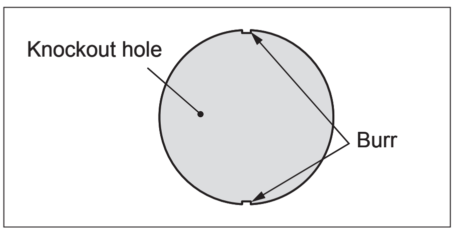
To remove the front panel of the control box, unscrew the four screws and pull the panel forward and then down.



Important: Power supply cables larger than 25 mm² in diameter are not connectable to the power supply terminal block (TB2). Use a pull box to connect them.

(2)-2 Installing the conduit tube

- Punch out the knockout hole for wire routing at the bottom of the front panel with a hammer.
- When putting wires through knockout holes without protecting them with a conduit tube, deburr the holes and protect the wires with protective tape.
- If damage from animals is a concern, use a conduit tube to narrow the opening.



2. System configurations

(1) Types of control cables

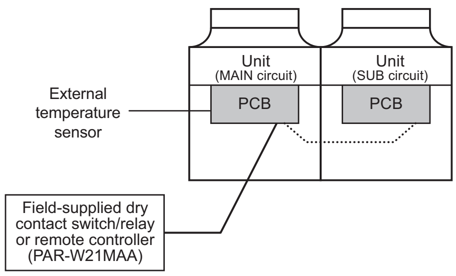
Control cable wiring	Remote controller cable	Size	0.3 - 1.25 mm² (Max. 200 m total)
		Recommended cable types	CVV
	M-NET cable between units *1	Size	More than 1.25 mm² (Max. 120 m total)
		Recommended cable types	Shielding wire CVVS, CPEVS or MVVS
	External input wire size		Min. 0.3 mm²
	External output wire size		1.25 mm²

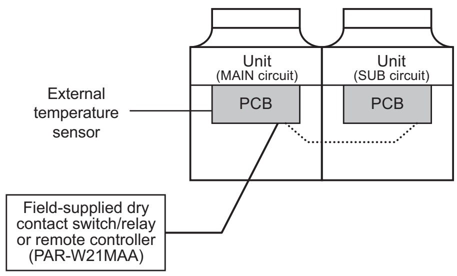
*1. Use a CVVS or CPEVS cable (Max. total length of 200 m) if there is a source of electrical interference near by (e.g., factory) or the total length of control wiring exceeds 120 m.

(2) System Configuration

(2)-1 Individual system

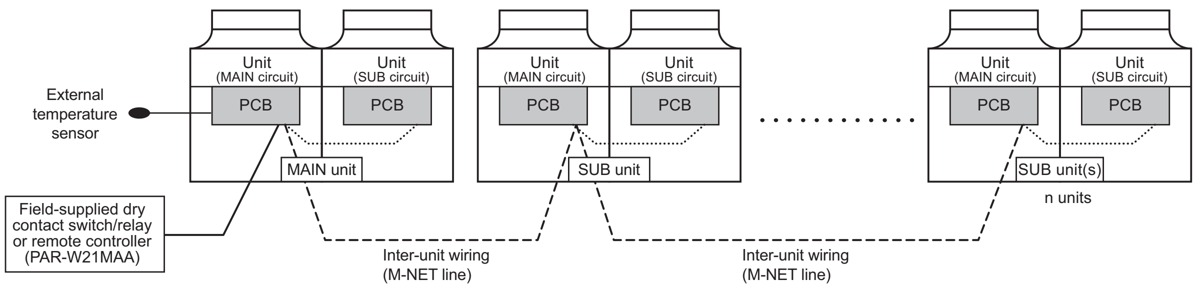
- Each unit is operated individually by connecting a dry contact switch/relay to each unit.





(2)-2 Multiple system (2-16 units)

- A group of unit that consists of one main unit and up to 15 sub units is operated collectively by connecting a representative water temperature sensor and a dry contact switch/relay to the main unit.



VI Controller

1. PAR-W21MAA specifications

Item	Description	Operations	Display
ON/OFF	Runs and stops the operation of a group of units	○	○
Operation mode switching	Switches between Hot Water / Heating / Heating ECO / Anti-freeze / Cooling * Available operation modes vary depending on the unit to be connected. * Switching limit setting can be made via a remote controller.	○	○
Water temperature setting	Temperature can be set within the ranges below. (in increments of 1°C or 1°F) Hot Water 30°C ~ 70°C Heating 30°C ~ 45°C Heating ECO 30°C ~ 45°C Anti-freeze 10°C ~ 45°C Cooling 10°C ~ 30°C * The settable range varies depending on the unit to be connected.	○	○
Water temperature display	10°C ~ 90°C (in increments of 1°C or 1°F) * The settable range varies depending on the unit to be connected.	×	○
Permit / Prohibit local operation	Individually prohibits operations of each local remote control function :ON/OFF, Operation modes,water temperature setting, Circulating water replacement warning reset. * Upper level controller may not be connected depending on the unit to be connected.	×	○
Weekly scheduler	ON / OFF / Water temperature setting can be done up to 6 times one day in the week. (in increments of a minute)	○	○
Error	When an error is currently occurring on a unit, the afflicted unit and the error code are displayed.	×	○
Self check (Error history)	Searches the latest error history by pressing the CHECK button twice.	○	○
Test run	Enables the Test run mode by pressing the TEST button twice. * Test run mode is not available depending on the unit to be connected.	○	○
LANGUAGE setting	The language on the dot matrix LCD can be changed. (Seven languages) English/German/Spanish/Russian/Italian/French/Swedish	○	○
Operation locking function	Remote controller operation can be locked or unlocked. • All-switch locking • Locking except ON/OFF switch	○	○

DATA BOOK CAHV-P500YA-HPB(-BS)

for a greener tomorrow

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

⚠ Warning

■ Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the nameplate.

- Doing so may cause the unit or pipes to burst, or result in explosion or fire during use, during repair, or at the time of disposal of the unit.
- It may also be in violation of applicable laws.
- MITSUBISHI ELECTRIC CORPORATION cannot be held responsible for malfunctions or accidents resulting from the use of the wrong type of refrigerant.

MITSUBISHI ELECTRIC CORPORATION

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