WEIR HOUSE - UXBRIDGE

ENERGY STATEMENT & M&E STRATEGY REPORT

June 2026 - Revision 0

1. EXECUTIVE SUMMARY

This report covers the proposed energy strategy for the Weir House project with consideration of the various systems applicable and the energy efficiency of those systems particularly relating to carbon emissions and the use of renewable energy.

The report finds that the centralised system using air source heat pumps is the most advantageous in terms of the energy as for this system all the space heating and domestic hot water is provided from the heat pump low carbon renewable energy system.

This will be combined with roof mounted photovoltaic panels, the number and total output in kW will be concluded during the detailed design stage.

1. INTRODUCTION

This report covers the options for the Energy used for space heating and domestic hot water system serving the residential units within the Weir House development.

The comparative advantages and disadvantage of each system are given. The space heating and domestic hot water systems considered also impact the ventilation system strategy as it can be an integral part of a combined system and therefore this is also included in the system evaluation.

When looking at the options the energy efficiency is considered along with the space requirements in terms of the utility cupboard footprint within the apartments as well as the plant and distribution space requirement and other relevant factors such as additional riser space.

2. SYSTEMS CONSIDERED

The following are the main systems that are applicable to this project, there are other variations of these main system types depending on the particular chosen manufacturer, but generally the differences do not significantly change the main characteristics and the overall evaluation.

We cover the main characteristics of each system and do not go into the fine detail to avoid over complicating the analysis and getting stuck in the details.

2.1 CENTRALISED SYSTEMS

These systems have a communal central plantroom which generates the heating and domestic hot water using air source heat pump units. The heat pump units are roof mounted and the heated water from the units is distributed out to each apartment through a series of distribution pipework.

There are two types of centralised systems that have been considered most applicable for the Weir House project:

System 1A : Centralised system with HIUIs (heat interface units) within each apartment providing both domestic hot water and space heating.

System 1B : Centralised system with WSHPs (water source heat pumps) within each apartment (Ambient loop system) providing the domestic hot water and space heating.

2.2 DECENTRALISED SYSTEMS

These systems do not include any centralised communal system and all heating and domestic hot water is from equipment located within each apartment or individual units connected directly to the apartment.

There are three decentralised systems that have been considered most applicable:

System 2A : In-apartment ducted ASHP for the domestic hot water & direct electric panel heaters for the space heating with separate MVHR system for ventilation.

System 2B : Exhaust air heat pump (EAHP) Nilan unit for MVHR ventilation and domestic hot water and space heating with direct electric back-up panel heaters for periods of very cold weather.

System 2C : Individual apartment external air source heat pup units connecting to cylinders within the apartment providing domestic hot water and space heating.

3. DESCRIPTION OF THE SYSTEMS

SYSTEM 1A : CENTRALISED SYSTEM WITH HIUs

This has been the most commonly used system in larger residential buildings over the last 10-15 years. The system requires a single central plantroom at ground floor incorporating the pumps and thermal storage vessel interconnected to roof mounted air source heat pump units on the roof.

The heated water from the central plant is distributed at a temperature of approximately 60 to 65 ^{0}C to each apartment where it connects into a HIU. The HIU provides hydraulic separation between the distribution pipework throughout the building and each individual apartment.

The HIU incorporates two separate plate heat exchangers, one for the space heating which connects to the radiators, and another for the domestic hot water. There is no hot water storage in the HIU, it is instantaneous.

The distribution heat losses from the pipework are continuous 24/7 and can make up a significant part of the total heat energy used. This can also add to the problem of the communal corridors within the blocks becoming uncomfortably warm.

We have indicated the space required for the roof mounted air source heat pump units and the pipework distribution and indicative risers in the following diagram:

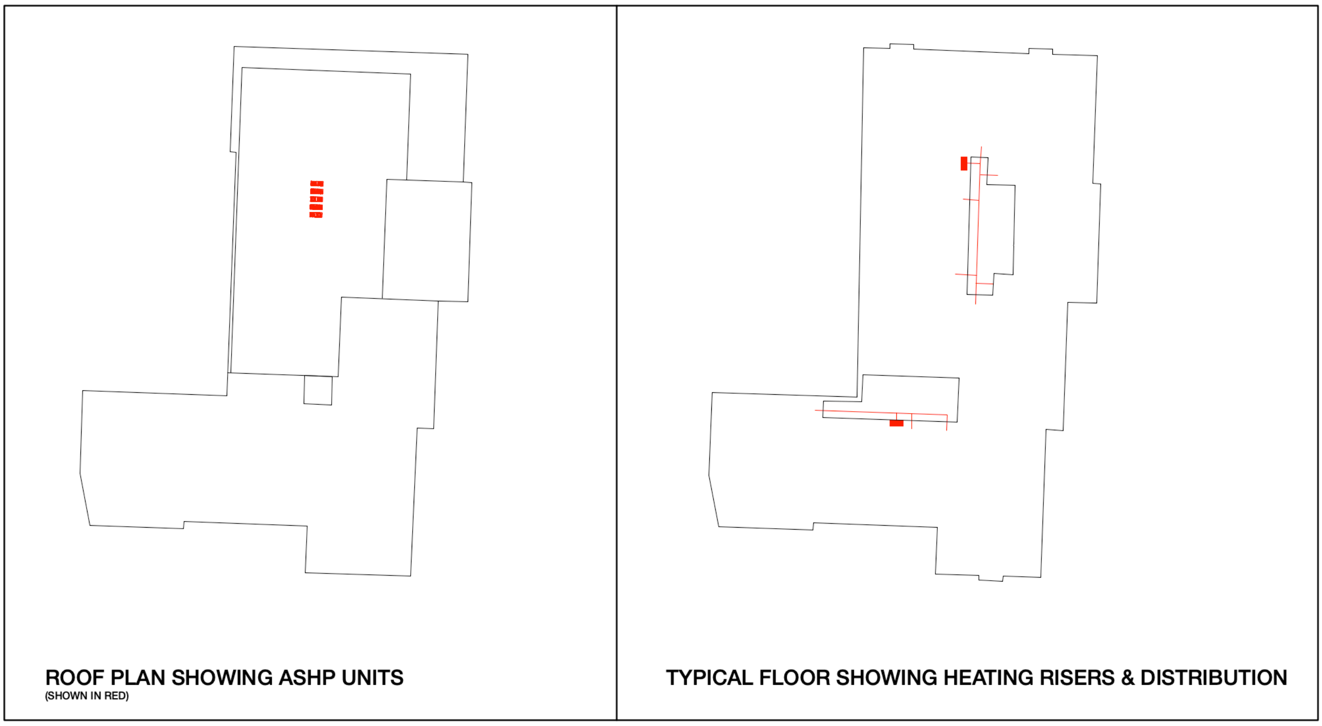


Diagram of Distribution Pipework and Roof Plant

This system requires a heat metering and billing system providing information on the heat usage in each apartment and this is done by a heat meter within each HIU wired back to a data logging system. The HIU system requires a separate MVHR system for the apartment ventilation.

Within the apartments the system schematic is shown below, this shows the HIU unit providing the heating and domestic hot water with the heat distributed from the central plant into each dwelling. Both the domestic hot water and the space heating are derived from the central ASHP system.

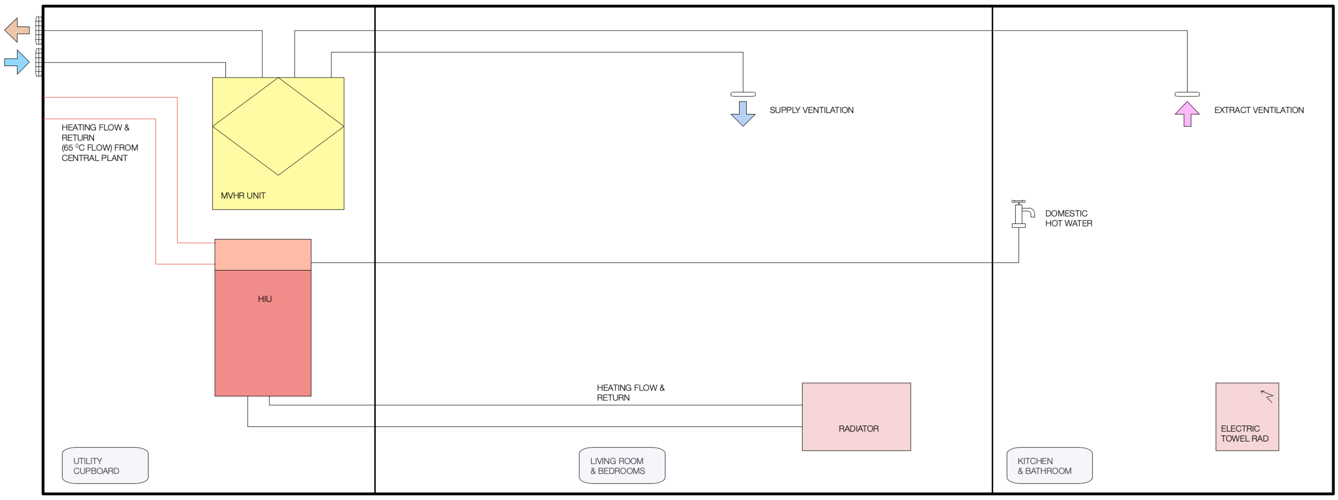


Diagram of System 1A

A typical manufacturer of the HIU is Danfoss/SAV series 7 model.

Summary of advantages and disadvantages of System 1A :

Advantages	Disadvantages
The system is well established and has been used for many years.	Plantroom space required for central plant: 30m^2 taken from ground floor
Utility cupboard space/footprint is minimised within the apartment. MVHR unit can be located above the HIU.	Large pipework distribution system required running from the ground floor central plantroom out to each apartment- Heat losses from this distribution pipework are significant and add to a higher energy running cost.
No domestic hot water storage - Hot water does not run out and is available instantly.	No cooling can be provided by this system if required to minimise overheating risk and for Part O compliance.
Failure in the main plant can effect all the units within the building.	Heat metering and billing system required.
	Separate MVHR system required.
	Higher maintenance cost for central plant and distribution pipework when compared to system 2A, 2B and 2C.
	Additional riser space required within each core for distribution pipework.

SYSTEM 1B : A CENTRALISED SYSTEM WITH WSHPs

The description of the central plant and distribution pipework are the same as for System 1A. There are two main differences with this system. Firstly the water is distributed from the central plant at a lower temperature than that for system 1A. The distribution flow temperature is 25 ^{0}C and this is why the system is termed an ambient loop system. Secondly within each apartment there is a heat pump unit which is a water to water heat pump.

The water to water heat pump within each apartment raises the temperature of the ambient loop water to a higher temperature that is required for the radiators and the integral domestic hot water cylinder. The ambient loop water enters the heat pump at 25 ^{0}C and is returned at around 15 ^{0}C, heat is extracted from the ambient loop for the apartment's space heating and domestic hot water. The 15 ^{0}C water returns to the central plantroom and is heated back to 25^{0}C by the roof mounted air source heat pumps.

The lower distribution temperature results in much lower/minimal heat losses from the pipework distribution system which improves the overall energy efficiency of the system and avoids the potential problem of the communal corridors overheating.

The water to water heat pump units also have the capability of providing cooling, this requires a system of fan coil units in addition to the radiators for the heating. It is an option if cooling is needed to get compliance with part O.

The heat metering and billing system required is the same as for System 1A. It is however possible to omit this system and include the central plant energy as a standing order service charge as there are no mandatory metering requirements for this system. The electrical energy consumed by the in-apartment heat pump is paid for as part of the apartments standard utility bill.

The space requirements for the central plant, the pipework distribution and the roof mounted ASHPs are as indicated in the diagrams for System 1A.

Within the apartments the system schematic is shown below. This shows the WSHP unit providing the heating and domestic hot water with the heat distributed from the central plant connecting into the WSHP. Both the domestic hot water and the space heating are derived from the central ASHP units.

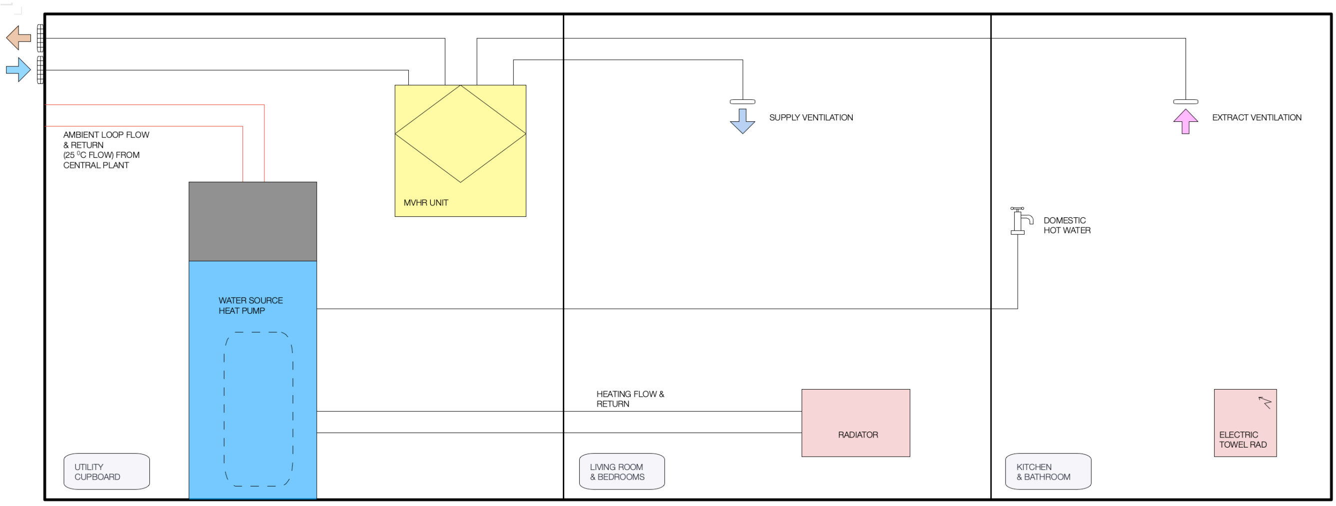


Diagram of System 1B

A typical manufacturer of the WSHP unit is Daikin Altherma model.

Summary of advantages and disadvantages of System 1B :

Advantages	**Disadvantages**
Very low carbon emissions.	Plantroom space required for central plant: 30m² taken from the ground floor area.
This system is the most energy efficient of all the systems considered in this report.	Large pipework distribution system required running from the central plantroom out to each apartment.
In-apartment WSHP units can provide cooling if required (with addition of fan coil units).	Heat metering and billing system may be required. (not mandatory)
Distribution pipework heat losses significantly reduced/ minimal compared with System 1A.	Separate MVHR system is required
System provides heating to radiators using the heat pump energy so is more economical than a direct electric panel heater system.	Capital cost higher than the other systems considered.
Failure in the main plant can effect all the units within the building.	In-apartment WSHP units have higher maintenance requirement than the System 1A HIUs.
	Utility cupboard size larger than System 1A due to the WSHP unit with integral domestic hot water cylinder being larger than the HIU and the MVHR unit cannot be located above the WSHP unit.
	Additional riser space required within each core for distribution pipework.
	Higher maintenance cost for central plant and distribution pipework when compared to system 2A, 2B and 2C.

SYSTEM 2A : IN-APARTMENT ASHP & DIRECT ELECTRIC PANEL HEATERS

This system comprises of a domestic hot water cylinder within each apartment with an integral ASHP above the cylinder which is ducted with insulated intake and discharge ducts to the exterior. The heating within the apartment is by direct electric panel heaters. The system also requires a separate MVHR system for the ventilation system resulting in four external ductwork penetrations to air bricks and two ductwork systems within each apartment.

The system schematic is shown below, this shows the ASHP unit providing the domestic hot water. The space heating is provided with direct electric panel heaters. There is no central plant for the heat energy & no heat distribution pipework system throughout the building within the communal areas.

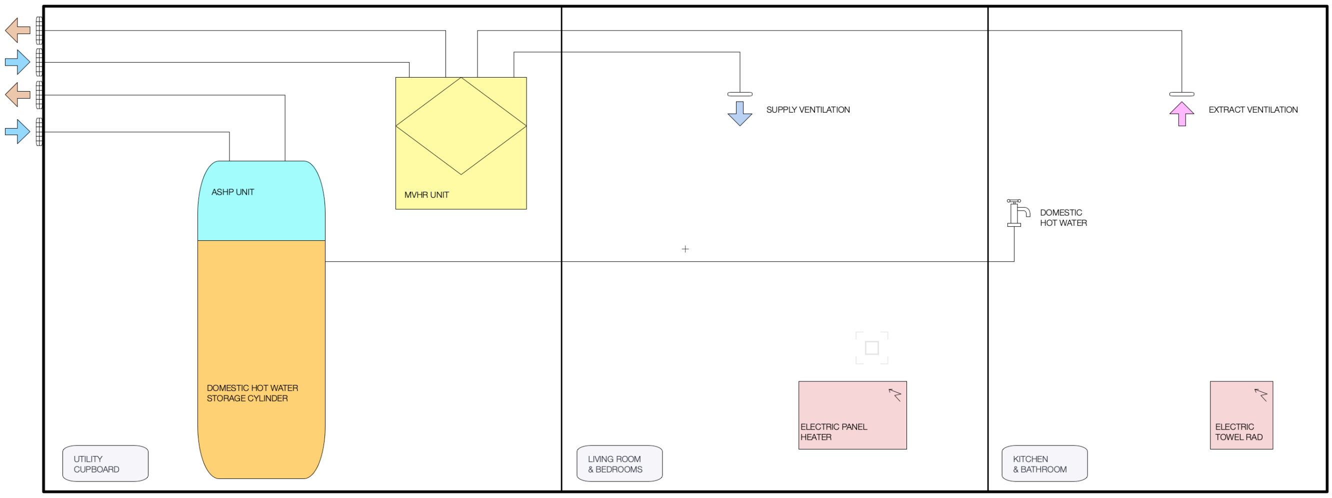


Diagram of System 2A

A typical manufacturer for the ASHP unit would be Dimplex Edel or Valiant Arostor models.

Summary of advantages and disadvantages of System 2A :

Advantages	Disadvantages
No central plant required for the heating and domestic hot water system.	Insulated intake and discharge ducts required in addition to the MVHR system, four external connections to air bricks required.
No heating distribution pipework system required, no riser space required in the cores.	Space heating is by direct electric panel heaters which is more expensive to run than space heating provided from a heat pump system.
Metering and billing system not required.	No cooling can be provided with this system.
Each flat is totally independent and any unit failure only affects the one apartment.	A larger utility cupboard is required within each apartment for the domestic hot water system and a separate MVHR system unit.
	Carbon emissions are higher than systems that provide the space heating through a heat pump system.

SYSTEM 2B : INTEGRATED EAHP WITH CYLINDER AND MVHR

This system comprises of a single internal integrated unit which includes the EAHP (exhaust air heat pump), domestic hot water storage cylinder and MVHR system all in one unit. The heating within the apartment is by proving heated air through the ventilation supply air ductwork but also requires direct electric panel heaters for back-up during periods of very cold weather. The EAHP unit can operate to provide partial cooling through the cooled supply air into the apartment. This partial cooling has been found to be sufficient to get overheating apartments into compliance with Part O on similar projects.

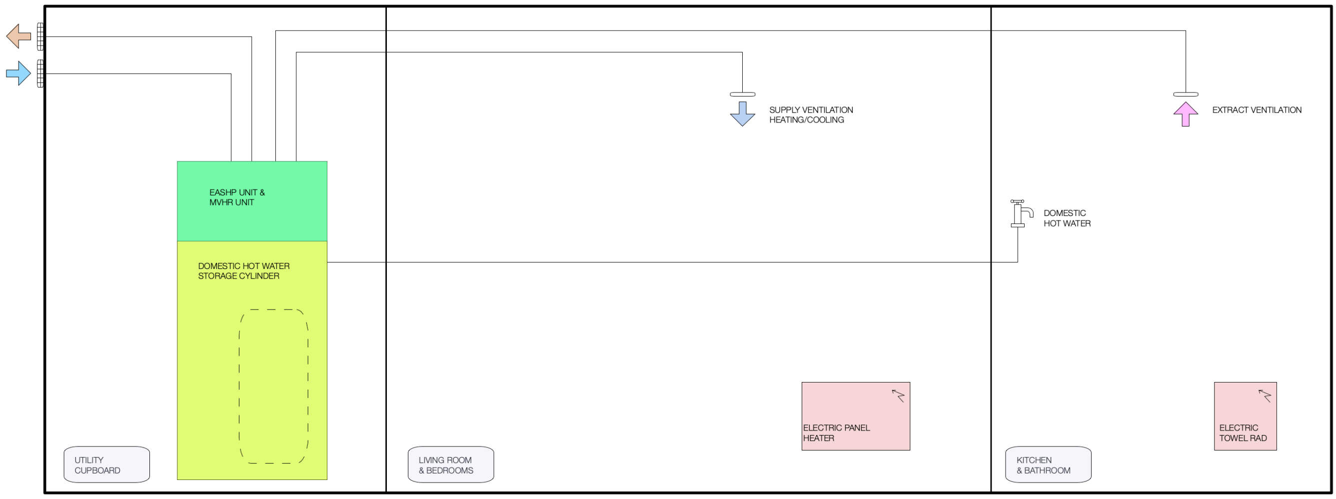


Diagram of System 2B

The supplier of the EAHP unit in the UK is Nilan. Summary of advantages and disadvantages of System 2B :

Advantages	Disadvantages
Smaller size required for service cupboard within apartments when compared to system 1B and 2A.	Failure of the unit would result in loss of both domestic hot water, and ventilation.
No separate MVHR system required.	Space heating is partly by direct electric panel heaters during very cold weather which are more expensive to run than space heating provided entirely from the heat pump system.
Can provide partial cooling to the dwelling.	The integrated EAHP unit is relatively complex and may require specialist maintenance. (the local plumber would probably not be able to do it)
Minimum number of penetrations through the air tight layer. Two double air bricks are required.	The heat up time for the domestic hot water cylinder is longer than a normal conventional system.
No heat metering and billing system is required.	The system is relatively new and there is not the long term experience gained in the UK over a long operating period.
Each flat is totally independent and any system failure only affects the one apartment.	
Overall system is much simplified compared to other systems considered.	

SYSTEM 2C : INDIVIDUAL AIR SOURCE HEAT PUMP UNITS WITH INTERCONNECTING EXTERNAL CONDENSING UNITS

This system comprises of individual condensing units for each apartment connecting to the domestic hot water cylinder and providing the heating for the space heating system.

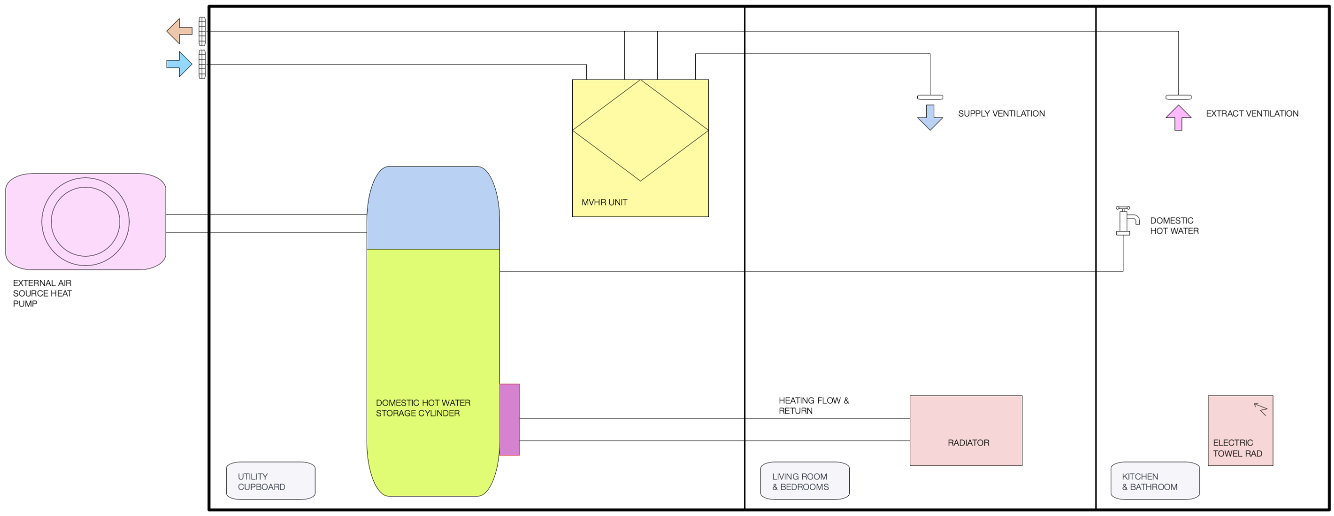
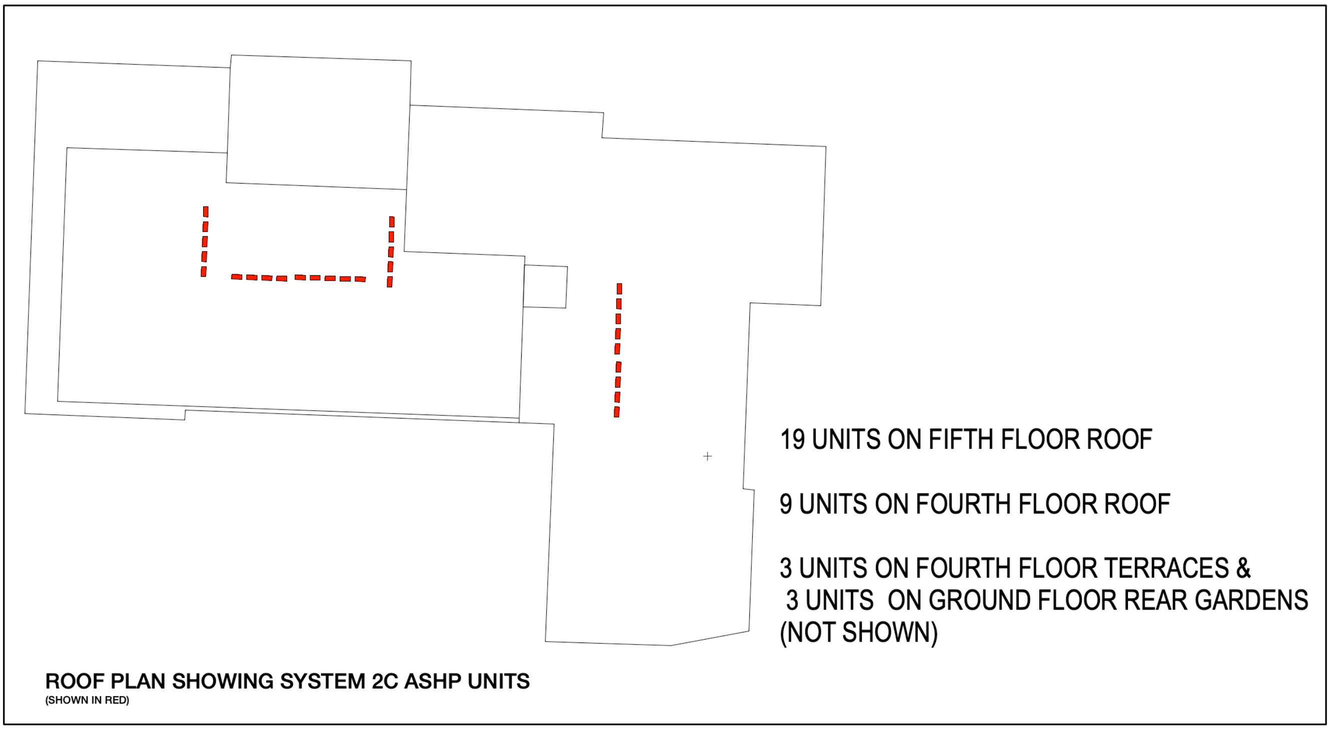


Diagram of System 2C

For this system we need to find suitable positions for 34 external condensing units with interconnecting pipework back to each apartment.



Roof Plan Showing Individual ASHP units for System 2C

For the ground floor units there are suitable locations within the rear gardens. However on the typical first, second and third floors the interconnecting pipework between the indoor and outdoor units will need to run up to the roof area, this does not look to be a problem as small risers for the pipework could be introduced opening onto the communal corridor areas.

We would not propose to locate the external condensing units on the apartment balconies as this is thought to be unacceptable normally from a planning perspective.

Summary of advantages and disadvantages of System 2C :

Advantages	Disadvantages
System has been used over many years and is well established.	Separate MVHR system required.
No heat metering and billing system is required.	There is quite of lot of pipework to interconnect the indoor units to the external units on the roof.
Each flat is totally independent and any system failure only affects the one apartment.	There is some loss of space where the pipework risers are required, although these are relatively small.
Minimum number of penetrations through the air tight layer. Two double air bricks are required for each apartment.	A lot of individual outdoor units required.
	No cooling can be provided with this system.

4. ANALYSIS

ENERGY EFFICIENCY

Of the five systems considered the most energy efficient system is considered to be the WSHP system, System 1B. The heating and domestic hot water are both supplied from the heat pump system and the distribution losses from the pipework system are very low because of the ambient loop low temperature design.

The least energy efficient system is the System 2A, this is due to the space heating being done by direct electric heating panels rather than a heat pump which would by comparison use only about a third of the energy.

The energy efficiency of System 1A is somewhere between the most efficient and the least efficient, it is thought to be an average energy efficient system fully utilising the heat pumps for both domestic hot water and space heating.

The other systems, System 2B and System 2C have very similar energy efficiencies however System 2B utilises a heat pump system to extract heat from the exhaust air from the general ventilation system for the dwelling so is slightly more efficient overall. The heat pump allows System 2B to recover more energy in comparison that would otherwise be lost in the exhaust air. Note that both systems incorporate heat recovery ventilation plate type heat exchangers but only System 2B has the heat pump in the MVHR system.

System 2A fan energy is higher than that of System 2B. The reason for this is that System 2A has two separate fan systems, one for the domestic hot water ASHP and one for the MVHR unit. System 2A requires a higher air flow rate for its ASHP which is approximately double that of System 2B. The fan energy however is only a small part of the overall energy of the systems so it is not too significant overall.

The coefficient of performance (COP) of System 2B which is 3.9 is slightly higher by approximately 15% than that of System 2A which has a COP of 3.4. The higher the COP of the heat pump the lower the amount of energy it uses to supply the heat and therefore the higher COP is better in terms of energy efficiency.

For the System 2A the quantity of the fresh air intake and exhaust air ductwork, the total length, would be approximately double that for System 2B & 2C. This is because the System 2A includes ducts for the domestic hot water ASHP and another set of ducts for the separate MVHR unit; whereas with the integrated System 2B & 2C there is only one set of ducts required.

The ducts are thermally insulated but they still introduce a relatively significant heat loss from the dwelling with heat being transferred from the dwelling and lost through to the cold air within the intake and discharge ducts. For this reason it is better for energy efficiency if the length of these intake and exhaust air ducts are minimised.

SPACE REQUIREMENTS WITHIN THE APARTMENTS

The comparison of the space requirements within the dwellings for the five systems is illustrated in the following diagram showing the utility cupboard space required in plan view for each of the system options.

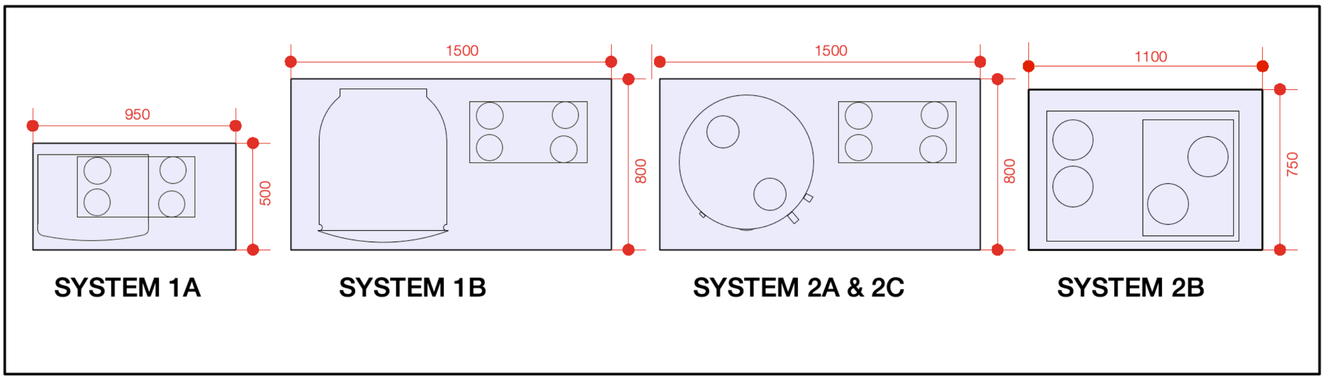


Diagram of Services Cupboard Space Comparison

The dimensions shown are the minimum clear internal dimensions for the hot water and ventilation systems and do not include additional space that may be required for an SVP, depending if the utility cupboard is positioned close to an SVP that is there for the kitchen or bathroom.

For System 1B, 2A and 2C it is possible to incorporate a washing machine below the MVHR unit without any increase in the plan size requirement. Whereas it is not possible to incorporate a washing machine in the System 1A and 2B utility cupboard.

It should be noted that the plan dimensions given are for comparison of the five systems and do not include space for the electrical equipment such as the consumer unit, broadband and IRS. The utility cupboards would need to be larger if the electrical was to be included.

In relation to the ceiling service zone required it is considered that the systems will all require a similar zone depth, System 2A may require slightly more depth as there are six ducts in this system compared with four in the other systems and it will be difficult to avoid a cross-over of the ducts.

6. CONCLUSION AND RECOMMENDATION

There is a decision to be made between environmental benefits and complexity on the one hand and capital cost and simplicity on the other.

The system 1B is not recommended due to the high capital cost and the system 2A is not recommended because of the lower energy efficiency.

From our analysis we think the most favourable systems are:

System 1A - Centralised ASHP system with HIUs in the apartments.

System 2B - Decentralised Integrated EAHP with Cylinder and MVHR (Nilan Unit)

System 2C - Decentralised individual Air source heat pump units with interconnecting external condensing units.

Our conclusion and recommendation is that the **System 1A** should be adopted for this project, this is based on the following:

- Best overall energy efficiency and low carbon solution
- System uses renewable energy for both space heating and domestic hot water
- Well proven system with many installations throughout the UK for this type of building
- Less penetrations through the air tight layer, reduction of 68 penetrations compared with System 2A