

Edward Pearce
Old School House
35 Ewell Road
Surbiton, Surrey KT6 6AF

Tel: 020 8390 6244
www.edwardpearce.com

CLIENT

Private

PROJECT

Energy Statement

41 Sheldon Avenue
London N6 4JP

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SECTION 1

1 PROJECT PROPOSAL

41 Sheldon Avenue is an existing dwelling located in the Haringey Council area. The proposed work involves the demolition of the existing dwelling and it's replacement with a new build dwelling.

The new dwelling will provide approximately 850 m^2 of family accommodation spanning across 4 floors.

SECTION 2

2 PLANNING POLICY

2.1 NATIONAL PLANNING POLICY FRAMEWORK

The National Planning Policy Framework sets out the Government's planning policies for England and how they should be applied.

It provides a framework to which locally prepared plans for housing and other developments can be produced.

Specifically, section 2, 'achieving sustainable development', is relevant to the topics discussed in this energy statement.

2.1.1 Achieving Sustainable Development

Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- a) an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
- b) a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being;
- c) an environmental objective – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

2.2 THE LONDON PLAN

41 Sheldon Avenue is not classified as a major development (floor area is less than 1000 m²).

However, to demonstrate best practice, the below policies of the London Plan will be adhered to.

- Policy SI 2 Minimising Greenhouse Gas Emissions
- Policy SI 3 Energy Infrastructure
- Policy S1 4 Managing Heat Risk

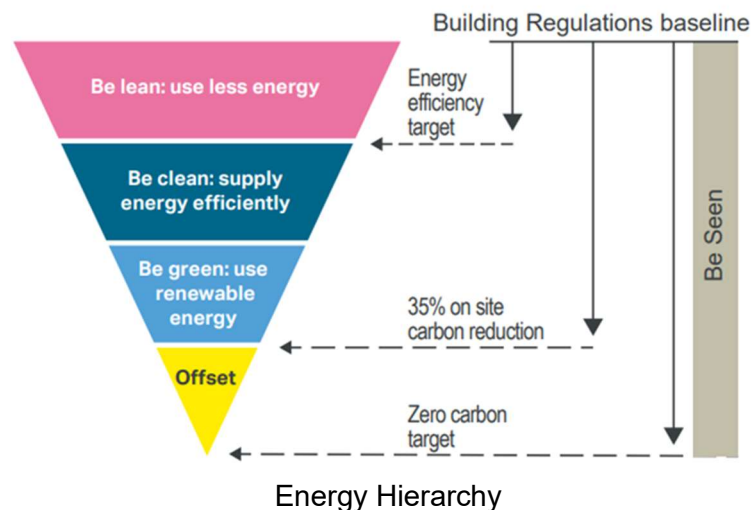
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2.2.1

Policy SI 2 Minimising Greenhouse Gas Emissions

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

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



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

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

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

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- D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.
- E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.
- F. Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

2.2.2

Policy SI 3 Energy Infrastructure

- A. Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.
- B. Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:
 - 1. major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
 - 2. heat loads from existing buildings that can be connected to future phases of a heat network
 - 3. major heat supply plant including opportunities to utilise heat from energy from waste plants
 - 4. secondary heat sources, including both environmental and waste heat
 - 5. opportunities for low and ambient temperature heat networks
 - 6. possible land for energy centres and/or energy storage
 - 7. possible heating and cooling network routes
 - 8. opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
 - 9. infrastructure and land requirements for electricity and gas supplies

Energy Statement

10. implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11. opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C. Development Plans should:

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

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

1. the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
 - a. connect to local existing or planned heat networks
 - b. use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
 - c. use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
 - d. use ultra-low NOx gas boilers
2. CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
3. where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

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

2.2.3 Policy S1 4 Managing Heat Risk

- A. Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

Energy Statement

- B. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:
1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
 2. minimise internal heat generation through energy efficient design
 3. manage the heat within the building through exposed internal thermal mass and high ceilings
 4. provide passive ventilation
 5. provide mechanical ventilation
 6. provide active cooling systems

2.3 HARINGEY COUNCIL

The development relates to policy SP4 (working towards a low carbon Haringey) in Haringey council's local plan.

2.3.1 Policy SP4: Working towards a low carbon Haringey

Over the life time of the Local Plan, reducing energy use in buildings and working towards a low carbon borough will be one of the key challenges facing Haringey. The Council will promote the measures outlined below to reduce carbon emissions from new and existing buildings.

1. In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:
 - a. From 2011 onwards, all new residential development will achieve a minimum 25% reduction in total (regulated) CO2 emissions in line with Code for Sustainable Homes Level 4 energy standards, and should aim to achieve Level 6. All new residential development shall be zero carbon from 2016 onwards; and
 - b. From 2011 onwards all new non-residential development shall be built to at least BREEAM "very good" standard and should aim to achieve BREEAM "excellent" or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.

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2. The Council will promote low and zero-carbon energy generation through the following measures:
 - a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;
 - b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;
 - c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on-site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.

SECTION 3

3

BUILDING REGULATIONS BASELINE

Baseline emissions were calculated using the notional dwelling specification in Building Regulations Part L1. The notional building specification forms the basis of all SAP calculations.

Table 1.1 Summary of notional dwelling specification for new dwelling⁽¹⁾

Element or system	Reference value for target setting
Opening areas (windows, roof windows, rooflights and doors)	Same as for actual dwelling not exceeding a total area of openings of 25% of total floor area ⁽²⁾
External walls including semi-exposed walls	$U = 0.18 \text{ W/(m}^2\text{K)}$
Party walls	$U = 0$
Floors	$U = 0.13 \text{ W/(m}^2\text{K)}$
Roofs	$U = 0.11 \text{ W/(m}^2\text{K)}$
Opaque door (less than 30% glazed area)	$U = 1.0 \text{ W/(m}^2\text{K)}$
Semi-glazed door (30–60% glazed area)	$U = 1.0 \text{ W/(m}^2\text{K)}$
Windows and glazed doors with greater than 60% glazed area	$U = 1.2 \text{ W/(m}^2\text{K)}$ Frame factor = 0.7
Roof windows	$U = 1.2 \text{ W/(m}^2\text{K)}$, when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	$U = 1.7 \text{ W/(m}^2\text{K)}$, when in horizontal position (for correction due to angle, see specification in SAP 10 Appendix R)
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	$5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency, SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, ErP Class V Either: – single storey dwelling in which the living area is greater than 70% of the total floor area: programmer and room thermostat – any other dwelling: time and temperature zone control, thermostatic radiator valves
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = $0.85 \times (0.2 + 0.051 V^{1/2}) \text{ kWh/day}$ where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = $185 \times \text{total floor area}$ Efficacy of all fixed lighting = 80 lm/W
Air conditioning	None
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 × number of storeys in block) System facing south-east or south-west

NOTE:

1. For a dwelling connected to an existing district heat network, an alternative notional building is used. See paragraph 1.8 and SAP 10.
2. See SAP 10 for details.

Notional Building Specification – Part L1

Energy Statement

3.1

BASELINE EMISSIONS

By using Design SAP 10, the baseline emissions for 41 Sheldon Avenue were calculated as follows.

Baseline Emission Rate (kgCO ₂ /yr/m ²)	Baseline CO ₂ Emissions (kgCO ₂ /yr)
9.3	7,817

SECTION 4

4

BE LEAN

By ensuring the building fabric is as efficient as possible whilst implementing passive design principles, the building's baseline carbon emissions can be greatly reduced.

4.1

BUILDING FABRIC

Elements of the building fabric will be constructed to achieve the following U-values.

Element	U-value ($W/m^2 K$)
External Wall	0.14
Roof	0.11
Floor	0.11
External Windows	1.2
External Doors	1.2
Rooflights	1.2

- The U-value of the walls improve on the reference value in Building Regulations Part L1 by $0.04 W/m^2 K$.
- The U-value of the floor improves on the reference value in Building Regulations Part L1 by $0.02 W/m^2 K$.
- The U-value of the rooflights improves on the reference value in Building Regulations Part L1 by $0.5 W/m^2 K$.

4.2

AIR PERMEABILITY

Air permeability is the physical property used to measure the air tightness of a dwelling's building fabric. The greater the air tightness at a given pressure difference across the building envelope, the lower the outside air infiltration.

An air permeability of $3.0 m^3/(h.m^2)$ at 50 Pa is sought for the property. This is an improvement of $2.0 m^3/(h.m^2)$ at 50 Pa when compared to the reference value in Building Regulation Part L1.

4.3

THERMAL BRIDGING

Thermal bridges or cold bridges are weak points in a building's envelop that allow heat to pass through more easily. Materials which are good conductors of heat, facilitate heat transfer from inner to outer surfaces. Minimising thermal bridges reduces the heat gains/losses in the property, resulting in an increase in energy efficiency.

The sum of all heat losses from the thermal bridges at 41 Sheldon Avenue will be kept between $0.05 - 0.1 W/m^2 K$.

SECTION 5

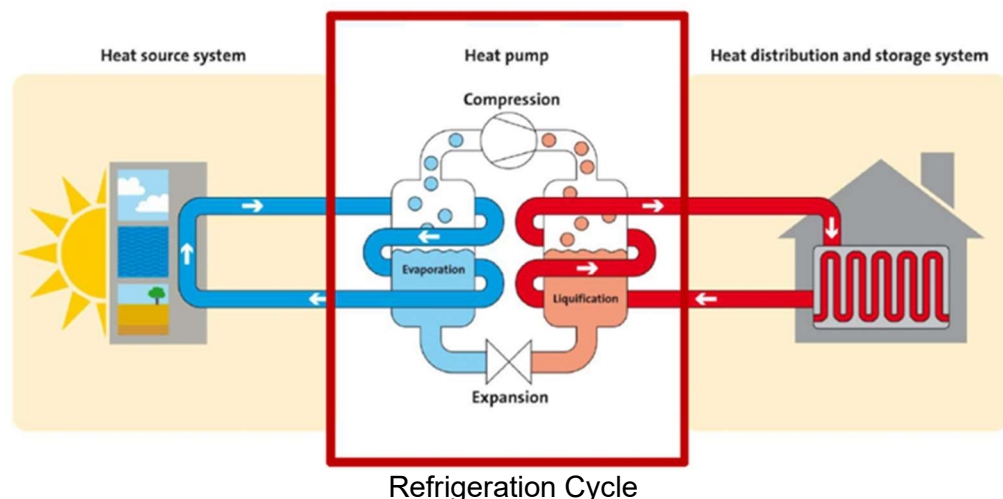
5 BE CLEAN

Policy SI 2 recommends that local energy sources be exploited and energy is supplied efficiently and cleanly. To be 'clean', alternative space and water heating technologies are assessed.

5.1 AIR SOURCE HEAT PUMP (ASHP)

An Air Source Heat Pump (ASHP) scavenges heat from the air which is then absorbed by a refrigerant. This refrigerant is then utilised in an electrically powered refrigeration cycle to produce hot water. The efficiency of ASHP will vary depending on the outside air temperature.

The majority of heat pumps are capable of heating up the water to 55 °C, and some are capable of supplying water at 80 °C to match that of a traditional gas heating system. However, the heat pump becomes much less efficient the higher the water temperature produced, hence the more electricity it consumes.



Heat pumps are therefore more suited to low temperature heating systems (e.g. underfloor heating), but aren't particularly efficient when heating domestic hot water systems which would typically require water to be stored at 60 °C for a commercial premises. It is often the case that direct electric immersion heaters need to be used to raise the stored water to the required temperature.

ASHPs can be located in a plant room or externally. The units require adequate air flow around them. The units will likely need to be housed in an acoustic enclosure.

5.1.1 Recommendation

ASHPs are a viable option for space and water heating. The units will need to be paired with electric immersion heaters to periodically raise the temperature of the stored domestic hot water system for legionella protection.

Energy Statement

5.2 HEAT RECOVERY VRV

Heat Recovery VRV utilises the same refrigeration cycle principle as an ASHP. However, unlike an ASHP, it scavenges waste heat from a zone that is being cooled and utilises it in a zone that is being heated.

Heat Recovery VRV systems can be installed with an air to water connection to heat water for domestic consumption. The technology can heat water to a temperature between 25 - 80 °C without the need for an electric immersion heater.



Typical VRV Heat Recovery Configuration

Heat Recovery VRV external condenser units are generally more compact than ASHP condenser units. The external condensers will require a smaller plant area, which will be require to be ventilated and acoustically designed.

5.2.1 Recommendation

Heat Recovery VRV is a viable option to provide simultaneous heating and cooling to the property. The plant area will be reduced when compared to a traditional ASHP.

A drawback of the system is that it cannot simultaneously provide space heating and domestic hot water production. However, through implementing an efficient controls strategy, the thermal mass of the property can be utilised to ensure it is maintained at the desired temperature.

5.3 GROUND SOURCE HEAT PUMP (GSHP)

Ground Source Heat Pumps (GSHP) extract heat from the ground. Below a depth of 10m, the temperature in the ground generally remains at a constant 11-12°C. At depths above 10m, ground temperatures are more susceptible to seasonal changes.

GSHPs scavenge heat from the ground through the use of ground collectors. Heat transfer to the ground collectors is affected by its surface area and properties of the ground.

A detailed geological surveyed is required before all installs to determine the feasibility of the technology. Depending on the thermal properties of the soil, the ground collectors could be installed either vertically or horizontally.

Energy Statement

5.3.1

Horizontal Collectors

Horizontal collectors generally require a large area that is free from hard rock and underground services.

The horizontal collectors are buried in trenches that range in depth from 0.5m to 1.0m, depending on manufacturer advice and ground conditions.



Horizontal Ground Collectors

5.3.2

Vertical Collectors

Vertical collectors can be used when land is limited. Boreholes are generally drilled to depths between 150 -180m. Greater depths will add to the complexity of the system install.

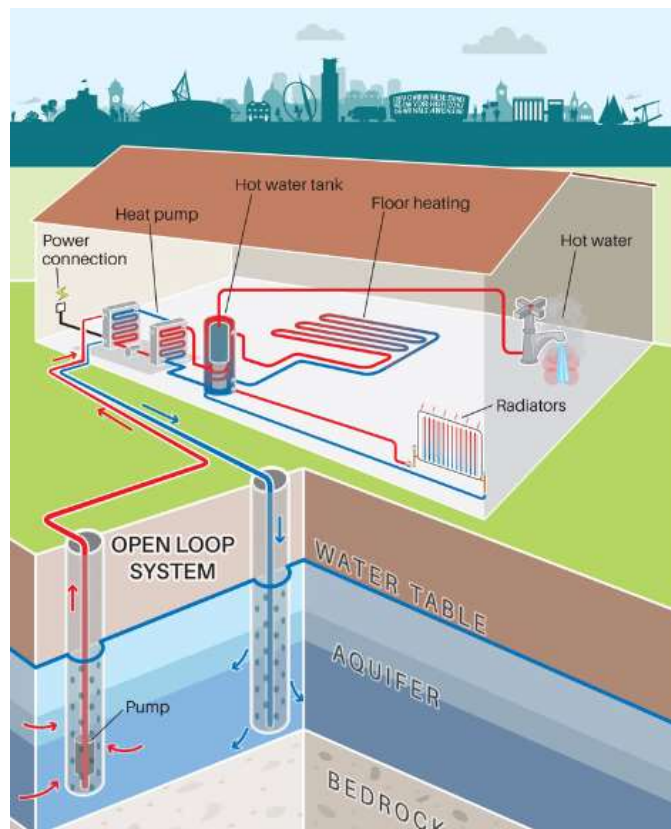
However, vertical collectors at deep depths benefit from stable ground temperatures.

There are two types of vertical collectors, closed loop and open loop.

A closed loop system consists of a sealed pipe circulating water through each of the boreholes. The pipe is sunk into the borehole and encased in grout which ensures a good contact between the pipe and the surrounding ground. The pipe is then connected back to a heat pump within the building.

An open loop system extracts ground water from one part of the site, extracts (or rejects heat during summer) via a heat pump within the building, and discharges the water back into the ground in a separate part of the site.

Energy Statement



GSHP – Open Loop System

5.3.3 Recommendation

GSHPs are not recommended for the property as the required sustainability targets can be met by the ASHP option. There would not be sufficient grounds to be able to install a shallow trench GSHP system and the cost of the vertical collector system is prohibitive.

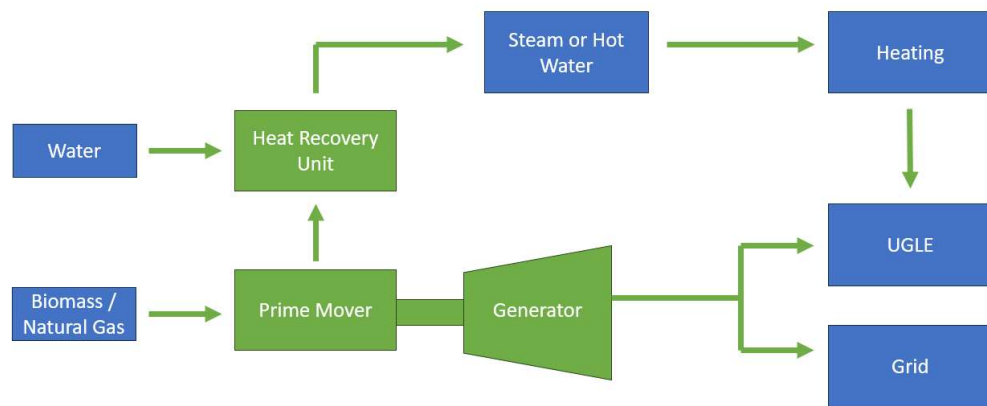
5.4 DOMESTIC COMBINED HEAT & POWER (CHP)

Combined Heat & Power (CHP) units provide simultaneous generation of electricity and heat from the same source. The primary function of the CHP is to meet the baseline heating requirement of the property, with the CHP unit supplemented by an additional heat source. Fluctuating thermal loads will require a modulating output from the engine which will affect the efficiency of the unit.

The electricity generated by a CHP can be used to meet part of the baseload of the property. At times of excess generation, energy could be fed back into the grid on a feed-in tariff, or used to charge an on-site battery system. CHPs are best suited to buildings that have a consistent base electrical and heating load.

The CHP consists of an engine (prime mover) that primarily uses mechanical power to generate electricity. The fuel source for the CHP could either be natural gas or biomass. Other fuel sources such as diesel are considered to be too costly and carbon intensive.

Energy Statement



CHP Schematic

The CHP unit will require a reasonable amount of space. It will require an acoustic enclosure to mitigate noise levels during operation. If Biomass is the preferred fuel source, on-site storage will be required.

5.4.1 Recommendation

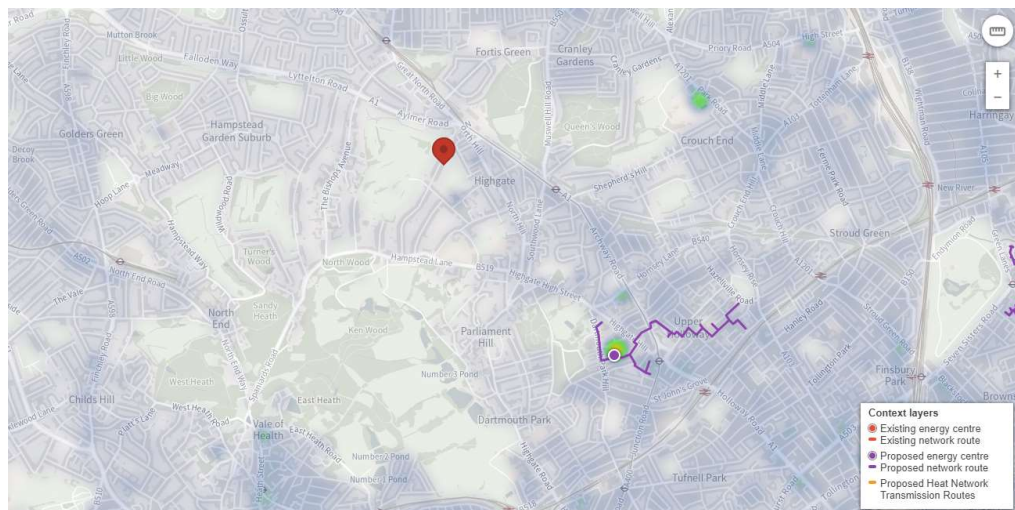
A CHP is not considered to be feasible for the property. Heating loads will not be consistently large enough to benefit from on-site electricity generation.

5.5 HEAT NETWORKS

Heat networks supply heat from a central source to customers via a series of underground pipes. This avoids the need for individual boilers or electric heaters in each building. There are a number of technologies that can provide heat input to a heat network such as CHP, fuel cells, geothermal.

5.5.1 Recommendation

There currently are no heat networks in close proximity to 41 Sheldon Avenue or any proposed in the near future. Hence, connecting the system to an existing or future heat network is not a viable option.



Proximity of Heat Networks to 41 Sheldon Avenue

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5.6 GAS BOILERS

Gas boilers burn natural gas to generate heat, which is transferred to water. This hot water is then circulated throughout the building.

The UK Government intends to introduce a 20% hydrogen blend to the gas grid. Most new gas boilers are able to effectively operate with a 20% hydrogen blend. Natural gas will become a less carbon intensive fuel source as a hydrogen blend is introduced.

5.6.1 Feasibility

Gas boilers can provide a reliable, low-cost heating option for the property. However, gas boilers will not be able to meet the emissions target dictated by Policy SI 2 in the London Plan. As a result, gas boilers are not a feasible option.

5.7 BIOMASS BOILERS

Biomass boilers rely on the direct or indirect combustion of fuels derived from plant sources. They operate in a similar manner to a conventional gas boiler, burning a fuel source to heat water.

Start-up times for biomass boilers are longer when compared to conventional gas boilers. As a result, they are not particularly well suited to loads with modulating demands.

Biomass boilers require regular maintenance to ensure it is free from ash or blockages in the feed system. The heat exchanger and flue may become blocked due to soot. Generally, annual maintenance is required, it may be more frequent depending on the manufacturer's instructions.

5.7.1 Biomass Fuels

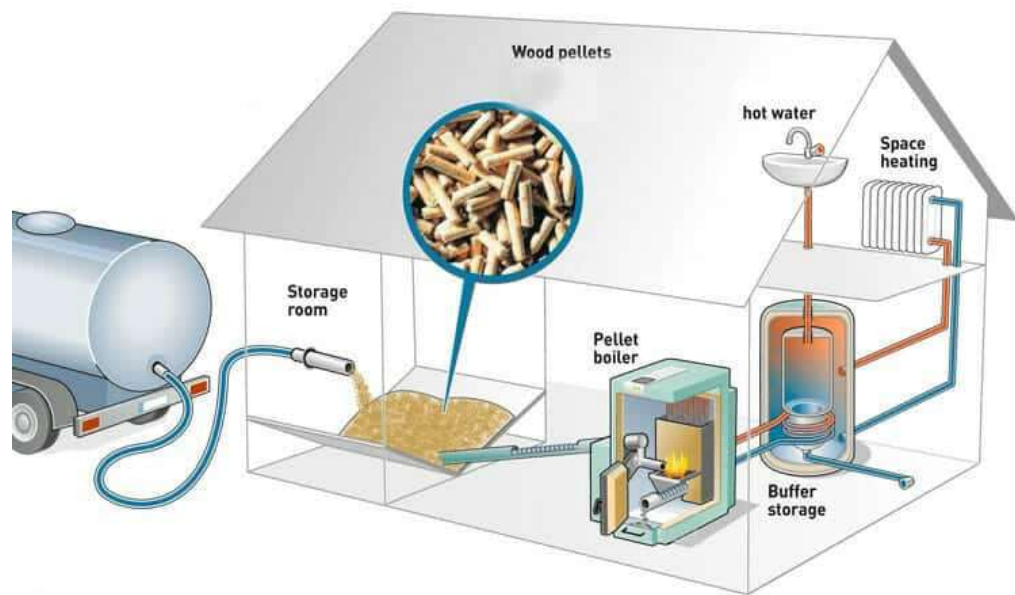
Biomass fuels can produce energy on a consistent basis, unlike some other renewable energy technologies which are weather dependent. They could be used as a potential source of heat and electricity if applied with the appropriate technologies (CHP).

Biomass fuels are derived from organic plants materials. Biomass boilers utilise these fuels in a direct or indirect combustion process.

As plants grow, they absorb carbon from the atmosphere. When they are used in a combustion process, this captured carbon is released back into the atmosphere. As a result, the burning of biomass fuels is considered to produce no net increase to carbon emissions in the atmosphere.

Biomass fuels are not however a completely zero carbon fuel source as carbon emissions are incurred by harvesting, processing, transportation, and storage.

The storage of wood pellets or liquid biofuels require storage space and easy access for lorries to refill the store. The store itself also requires several safety systems to ensure there are no accidental fires or harmful carbon monoxide emissions produced.



Biomass Boiler System

5.7.2 Biomass Fuel Storage

Biomass fuel storage will be required on the property to keep the fuel protected from moisture. The amount of fuel required will be dependent on the capacity of the biomass boilers.

The storage facility needs to have adequate ventilation to prevent mould and to potentially aid in the drying process, as well as limit any chance of dangerous levels of carbon monoxide gas developing.

If the biomass fuel is kept in pristine condition, the risks of fires within the storage facility are low. However, as wood pellets degrade, fine dust may form which will present a fire hazard if it settles on hot surfaces.

Fuel stores therefore require careful design and regular maintenance to prevent the risk of fires.

5.7.3 Recommendation

A biomass boiler is not recommended for the property. The modulating energy demand of the property may not suit the longer start-up times of the biomass boilers. Furthermore, an additional structure will be required on-site fuel storage.

SECTION 6

6 BE GREEN

Being 'green' promotes on-site renewable energy production and consumption. Due to the urban setting of the project, renewable energy sources are limited to solar PV, solar thermal, and wind turbines.

6.1 PHOTOVOLTAIC PANELS

Photovoltaic (PV) cells convert sunlight directly to DC electricity. The DC electricity can be utilised to directly power motors or charge batteries. Typically, the DC electricity generated by the PV is converted to AC through the use of an inverter. This AC power can then be distributed to the property or fed back into the grid. Solar PV can either be roof mounted or ground mounted depending on the property.

PV panels can be used in conjunction with battery storage to provide electricity to the property during periods of no solar generation. A charge controller regulates the charging and discharging of the battery.

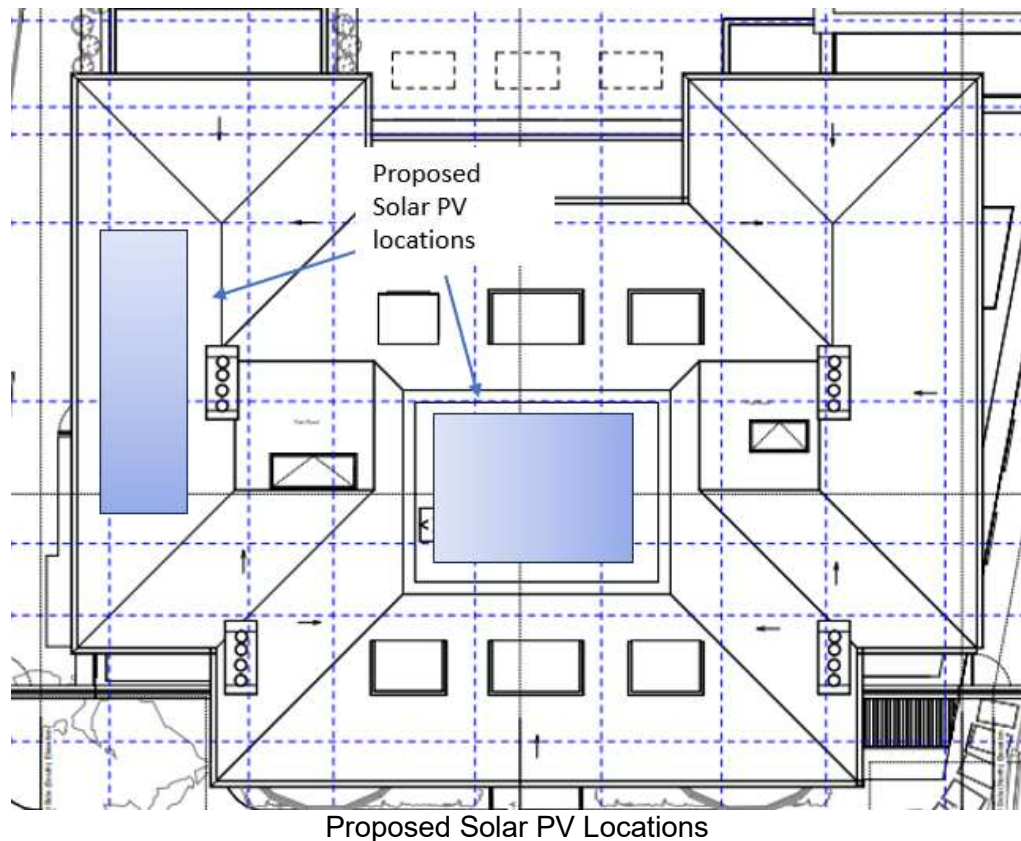


Solar PV & Battery Storage Arrangement

6.1.1 Recommendation

It is recommended that up to 6.0 kW of solar PV be installed. There is adequate space to mount the panels centrally and on the southern slope of the roof. It is noted that the adjacent property has solar PV installed on the southern slope of its roof.

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6.2 SOLAR THERMAL PANELS

Solar thermal water heating systems utilise energy from the sun to heat water. The system incorporates a heat collector that is usually roof mounted. The fluid contained in the heat collector is heated by the sun, the heat from this fluid is then transferred to water in the domestic water system via a coil in the hot water cylinder.

The required surface area of the solar collectors will be dependent on the hot water demand profile. If the property has a large hot water demand, the required solar collector area may not be feasible.

Solar thermal technology could be sized to handle the base heat load of the property. It could be combined with boilers to bring the water up to operating temperature.

6.2.1 Recommendation

Solar thermal panels will not be efficient during periods of low solar radiation. During these periods, traditional forms of heating will need to be relied upon to produce hot water for the property. As a result, solar thermal panels are not recommended.

6.1 WIND TURBINES

Wind turbines harness the power of wind to generate electricity. The blades of the wind turbine capture the energy of the wind and spin the axis of a generator.

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This generator produces DC electricity which is converted AC electricity for household consumption.

Residential wind turbines can be either pole or building mounted. Pole mounted wind turbines are free standing and are mounted in an exposed position. They can generate around 6 kW of electricity.

Building mounted wind turbines are smaller and less intrusive than pole mounted wind turbines. However, they will generate less electricity than the pole mounted version.

6.1.1

Recommendation

Wind turbines are not recommended for the property. A building mounted wind turbine will not generate a significant enough amount of energy to offset the property's electricity consumption. A pole mounted wind turbine will likely be too intrusive for the property. There are structures and trees around the property that may affect electricity generation.

SECTION 7

7 CARBON EMISSIONS OFFSET

The below table highlights the reduction in carbon emissions by practising the be lean, be clean, be green initiative.

	Baseline Emission Rate (kgCO₂/yr/m²)	% Reduction CO₂ Emissions	CO₂ Emissions (t/year)
Baseline	9.3		
Be Lean, Clean, Green	3.4	63.5	2.4

Policy SP4: Working towards a low carbon Haringey, notes that all new developments post 2016 must be net zero.

If the applicant does not achieve policy compliance of reducing 100% emissions on-site, the remaining emissions on-site will need to be off-set.

The cost of offsetting the remaining carbon emissions is £95 per tonne over 30 years.

The outstanding carbon emissions for 41 Sheldon Avenue is 2.4 t/year.

Based on a carbon offsetting cost of £95 per tonne over 30 years, the total cost of offsetting the remaining carbon emissions is estimated to be £6,840.

SECTION 8

8 WATER EFFICIENCY

If the property is to meet the London Plan Policy SI 5 Water Infrastructure, water efficient fittings will need to be installed on the property.

Grey water recycling and rain water harvesting could also be investigated.

8.1 LONDON PLAN POLICY SI 5 WATER INFRASTRUCTURE

- A. In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.
- B. Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.
- C. Development proposals should:
 - 1) through the use of Planning Conditions, minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving a total mains water consumption of 105 litres or less per person per day (excluding allowance of up to five litres for external water consumption)
 - 2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category 160 or equivalent (commercial development)
 - 3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.
- D. In terms of water quality, Development Plans should:
 - 1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans
 - 2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and any associated energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.

Energy Statement

E. Development proposals should:

- 1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided.
- 2) take action to minimise the potential for misconnections between foul and surface water networks.

F. Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.

8.2 WATER EFFICIENT FIXTURES

Installing water efficient fittings on the property will drastically reduce on-site water consumption. Building Regulations Part G targets a water usage of 110 litres per person per day.

The following figures demonstrate the maximum allowable water consumption for fittings to attain the target of 110 litres per person per day.

- | | |
|-------------------|---|
| • Showers | Limited to 8 litres / min with flow restrictor. |
| • WCs | 4 / 2.6 litre dual flush. |
| • Basin Taps | Limited to 5 litres / min with flow restrictor. |
| • Kitchen Taps | Limited to 6 litres / min with flow restrictor. |
| • Baths | Max. 170 litres to overflow. |
| • Washing Machine | Max. 8.17 litres / kg dry load. |
| • Dishwasher | Max. 1.25 litres / place setting. |

8.3 GREY WATER

Grey water is water that has been used by the washing machine, bath tub, shower or bathroom sinks. Grey water is deemed to not be toxic and fit for repurpose.

Grey water can be diverted from the main plumbing system, filtered, and stored in storage tanks. The water can then be reused for toilet flushing or garden irrigation systems.

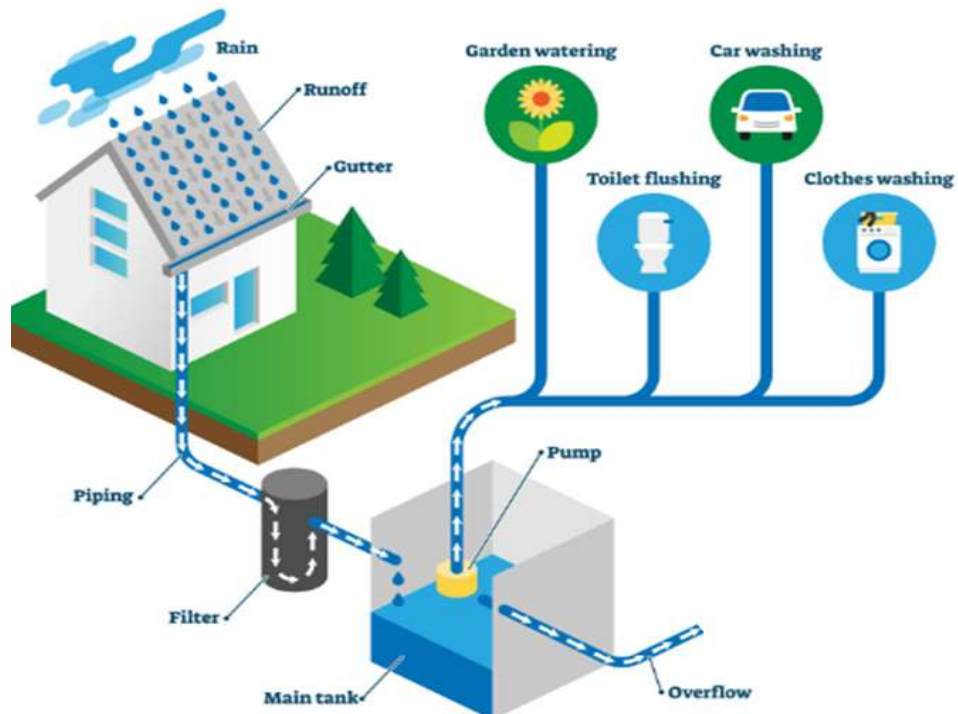
Grey water systems do incur ongoing maintenance costs and are not cost effective if the available grey water does not match demand. A grey water system is not currently recommended for this scheme.

8.4 RAIN WATER HARVESTING

Capturing rainwater provides a cost effective and efficient means of meeting the non-potable water demand on properties.

Energy Statement

The amount of rain water captured will be dependent on the surface area of the roof and annual rainfall. Storage tanks for the rain water harvesting may be located above or below ground.



Rainwater Harvesting Schematic

The stored water is pumped out of the storage tank, filtered and can be supplied to toilets, washing machines and irrigation systems.

With a proper filtration and sterilisation system, the water can be cleaned and used for potable (drinking) water supply to the property. The filtration process does however require a reasonable amount of electricity to run.

Onsite rain water storage will be limited due to space restrictions on the property. The system will be further limited by the amount of rain fall in the area. Due to the high installation cost and possible limited use, the system is not currently recommended for this scheme.

SECTION 9

9

OVERHEATING ANALYSIS

It is noted in Policy SI 4 (Managing heat risk) of the London Plan, that London is experiencing higher than historic average temperatures and more severe hot weather due to climate change.

This combined with a growing population, urbanisation, and the urban heat island effect means that new developments in London must manage the risk of overheating.

9.1

COOLING HIERARCHY

To reduce the risk of overheating and the dependence of air conditioning systems, the London Plan stipulates the use of the cooling hierarchy:

1. reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2. minimise internal heat generation through energy efficient design
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. provide passive ventilation
5. provide mechanical ventilation
6. provide active cooling systems

9.2

ONSITE MEASURES

The below measures have been employed to mitigate the risk of overheating:

1. The proposed U-values on the property exceed the minimum standards listed in building regulations Part L.
2. The construction of the building seeks to achieve a low air permeability, reducing outside air infiltration.
3. Thermal bridges in the building fabric will be minimised in order to maintain the integrity of the thermal envelope.
4. The property is situated in close proximity to green spaces.
5. Lighter colours are used to reflect heat.

Energy Statement

6. The average glazing ratio is below 35%, reducing the amount of solar heat gain entering the property. Some glazing on the property will be fitted with internal shading.
7. High ceilings and exposed internal thermal mass will be present.
8. Windows on the property are operable allowing for sufficient natural ventilation. Mechanical extract to be located through the building.

These measures were assessed using the Good Homes Alliance Early Stage Overheating Risk Tool.

The overheating risk was deemed as low (Appendix B).

SECTION 10

10

SUMMARY

By implementing the be lean, be clean, be green methodology, the emissions at 41 Sheldon Avenue were reduced 65.3%.

Be Lean

- Building fabric structures to achieve U-values below those stipulated in Building Regulation Part L.
- Thermal bridges to be limited to an overall Y-value between 0.05 - 1.0 $W/m^2 K$.
- Air permeability of the property to be $\leq 3.0 m^3/(h.m^2)$ at 50 Pa.

Be Clean

- An ASHP or Heat Recovery VRV is to be used for space and water heating.

Be Green

- 6 kW of solar PV to be installed centrally and on the southern slope of the roof.

Carbon Offset

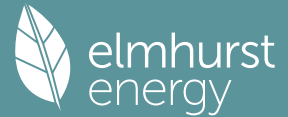
- The remaining 2.3 t/year of CO2 emissions to be offset through the carbon emissions offset fund.

SECTION 11

11

APPENDIX A – SAP CALCULATIONS: BE LEAN, BE CLEAN, BE GREEN

Full SAP Calculation Printout



Property Reference	41 Sheldon Avenue				Issued on Date	13/12/2023
Assessment Reference	Be Lean, Be Clean, Be Green		Prop Type Ref			
Property						
SAP Rating	80 C	DER	3.38	TER	9.26	
Environmental	96 A	% DER < TER				63.50
CO ₂ Emissions (t/year)	2.42	DFEE	43.05	TFEE	46.55	
Compliance Check	See BREL	% DFEE < TFEE				7.51
% DPER < TPER	27.56	DPER	35.81	TPER	49.43	
Assessor Details	Mr. Theolan Govender				Assessor ID	CM44-0001
Client						

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m ²)		Storey height (m)		Volume (m ³)	
Basement floor	242.8000 (1a)	x	3.0000 (2a)	=	728.4000 (1a)	- (3a)
Ground floor	290.9000 (1b)	x	3.0000 (2b)	=	872.7000 (1b)	- (3b)
First floor	221.3000 (1c)	x	3.0000 (2c)	=	663.9000 (1c)	- (3c)
Second floor	89.2000 (1d)	x	3.0000 (2d)	=	267.6000 (1d)	- (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	844.2000				(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2532.6000 (5)	

2. Ventilation rate

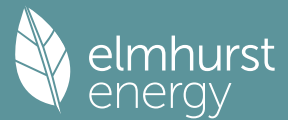
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	8 * 10 =	80.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.0316 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	3.0000 (17)	
Infiltration rate	0.1816 (18)	
Number of sides sheltered	0 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1816 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2315	0.2270	0.2224	0.1997	0.1952	0.1725	0.1725	0.1680	0.1816	0.1952	0.2043	0.2134 (22b)
Effective ac	0.5268	0.5258	0.5247	0.5199	0.5191	0.5149	0.5149	0.5141	0.5165	0.5191	0.5209	0.5228 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			114.5000	1.1450	131.1069		(27)
Opening Type 2			2.7000	1.2000	3.2400		(26)
Opening			4.5000	1.1450	5.1527		(27a)
BASEMENT			242.8000	0.1100	26.7080	110.0000	26708.0000 (28a)
GF			38.6000	0.1100	4.2460	75.0000	2895.0000 (28a)
Basement	190.8000	12.2000	178.6000	0.1400	25.0040	70.0000	12502.0000 (29a)
GF	232.2000	71.4000	160.8000	0.1400	22.5120	70.0000	11256.0000 (29a)
1ST	211.2000	28.8000	182.4000	0.1400	25.5360	70.0000	12768.0000 (29a)
2ND	167.7000	4.8000	162.9000	0.1400	22.8060	70.0000	11403.0000 (29a)
2ND	89.2000	4.5000	84.7000	0.1100	9.3170	9.0000	762.3000 (30)
1ST	132.1000		132.1000	0.1100	14.5310	9.0000	1188.9000 (30)
GF	38.6000		38.6000	0.1100	4.2460	9.0000	347.4000 (30)
Total net area of external elements Aum(A, m ²)			1343.2000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	294.4055		(33)
Basement			437.4000			75.0000	32805.0000 (32c)
GF			391.2000			75.0000	29340.0000 (32c)
1ST			445.2000			75.0000	33390.0000 (32c)

Full SAP Calculation Printout



2ND	154.2000	75.0000	11565.0000 (32c)
Internal Floor 1	89.2000	18.0000	1605.6000 (32d)
Internal Floor 2	221.3000	18.0000	3983.4000 (32d)
Internal Floor 3	290.9000	18.0000	5236.2000 (32d)
1ST	89.2000	9.0000	802.8000 (32e)
GF	221.3000	9.0000	1991.7000 (32e)
BASEMENT	242.8000	9.0000	2185.2000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 202735.5000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 240.1510 (35)
Thermal bridges (User defined value 0.050 * total exposed area) 67.1600 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 361.5655 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	440.2789	439.4091	438.5565	434.5519	433.8026	430.3148	430.3148	429.6689	431.6582	433.8026	435.3184	436.9030 (38)	
Average = Sum(39)m / 12 =	801.8444	800.9746	800.1220	796.1174	795.3682	791.8803	791.8803	791.2344	793.2238	795.3682	796.8839	798.4685 (39)	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9498	0.9488	0.9478	0.9430	0.9422	0.9380	0.9380	0.9373	0.9396	0.9422	0.9440	0.9458 (40)	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.8394 (42)
Hot water usage for mixer showers													
Hot water usage for baths													
Hot water usage for other uses													
Average daily hot water use (litres/day)													
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	185.6159	181.6219	176.7754	169.4468	163.4807	157.0725	154.6403	159.4663	164.5517	171.2752	178.7155	185.1404 (44)	
Energy content (annual)	293.9702	258.6272	271.6971	231.9642	220.0764	193.1390	187.0241	197.4526	202.9088	232.4189	254.6129	289.8852 (45)	
Distribution loss (46)m = 0.15 x (45)m													
Water storage loss:	44.0955	38.7941	40.7546	34.7946	33.0115	28.9709	28.0536	29.6179	30.4363	34.8628	38.1919	43.4828 (46)	
Store volume													600.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.4300 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.8954 (55)
Total storage loss													
If cylinder contains dedicated solar storage	58.7574	53.0712	58.7574	56.8620	58.7574	56.8620	58.7574	58.7574	56.8620	58.7574	56.8620	58.7574 (56)	
Primary loss	58.7574	53.0712	58.7574	56.8620	58.7574	56.8620	58.7574	58.7574	56.8620	58.7574	56.8620	58.7574 (57)	
Combi loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)	
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
WWHRS	407.5852	361.2472	385.3121	341.9142	333.6914	272.5130	269.0439	279.4724	282.2828	346.0339	364.5629	403.5002 (62)	
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)	
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)	
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)	
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)	
Total per year (kWh/year)	407.5852	361.2472	385.3121	341.9142	333.6914	272.5130	269.0439	279.4724	282.2828	346.0339	364.5629	403.5002 (64)	
Electric shower(s)													4047.1592 (64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)	
Heat gains from water heating, kWh/month	141.6312	125.6326	134.2254	119.5985	117.0615	82.2283	80.7954	84.2629	85.4768	121.1654	127.1292	140.2729 (65)	

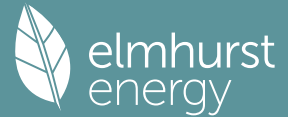
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695 (66)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	443.1377	490.6167	443.1377	457.9089	443.1377	457.9089	443.1377	443.1377	457.9089	443.1377	457.9089	443.1377 (67)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	821.5292	830.0541	808.5717	762.8380	705.1075	650.8489	614.6009	606.0760	627.5585	673.2921	731.0226	785.2812 (68)	
Pumps, fans	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970 (69)	
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)	
Water heating gains (Table 5)	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756 (71)	
Total internal gains	190.3645	186.9533	180.4105	166.1090	157.3407	114.2060	108.5960	113.2566	118.7177	162.8567	176.5683	188.5388 (72)	
	1535.6222	1588.2150	1512.7106	1467.4468	1386.1767	1303.5547	1246.9254	1243.0611	1284.7760	1359.8773	1446.0907	1497.5486 (73)	

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	16.3000	11.2829	0.7000	0.7000	0.7700	62.4510 (75)
Southeast	24.0000	36.7938	0.7000	0.7000	0.7700	299.8580 (77)
Southwest	21.9000	36.7938	0.7000	0.7000	0.7700	273.6204 (79)
Northwest	52.3000	11.2829	0.7000	0.7000	0.7700	200.3795 (81)
North	4.5000	26.0000	0.6300	0.7000	1.0000	46.4373 (82)

Full SAP Calculation Printout



Solar gains	882.7461	1608.2916	2471.9220	3506.9716	4325.7135	4467.2520	4235.1410	3599.2756	2827.1359	1851.3133	1076.5433	742.9256 (83)
Total gains	2418.3684	3196.5066	3984.6326	4974.4184	5711.8902	5770.8067	5482.0664	4842.3367	4111.9118	3211.1906	2522.6341	2240.4742 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.2323	70.3086	70.3835	70.7376	70.8042	71.1161	71.1161	71.1741	70.9956	70.8042	70.6695	70.5293	
alpha	5.6822	5.6872	5.6922	5.7158	5.7203	5.7411	5.7411	5.7449	5.7330	5.7203	5.7113	5.7020	
util living area	1.0000	0.9997	0.9985	0.9888	0.9370	0.7912	0.6176	0.7093	0.9435	0.9973	0.9998	1.0000 (86)	
Living	19.8247	19.9545	20.1666	20.4636	20.7366	20.8946	20.9358	20.9250	20.7828	20.4272	20.0709	19.8034	
Non living	18.7091	18.8763	19.1489	19.5305	19.8644	20.0321	20.0621	20.0574	19.9262	19.4868	19.0290	18.6845	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	28	0	0	0	0	0	0	30	31	
16 / 9	0	0	0	2	0	0	0	0	0	24	0	0	
MIT	21.0000	21.0000	21.0000	20.9797	20.7366	20.8946	20.9358	20.9250	20.7828	20.6195	21.0000	21.0000 (87)	
Th 2	20.1254	20.1262	20.1271	20.1311	20.1318	20.1353	20.1353	20.1359	20.1340	20.1318	20.1303	20.1287 (88)	
util rest of house	0.9999	0.9996	0.9979	0.9842	0.9103	0.7149	0.5053	0.5960	0.9079	0.9958	0.9998	1.0000 (89)	
MIT 2	20.1254	20.1262	20.1271	20.1134	19.8644	20.0321	20.0621	20.0574	19.9262	19.7658	20.1303	20.1287 (90)	
Living area fraction									FLA = Living area / (4) =				0.0692 (91)
MIT	20.1859	20.1867	20.1875	20.1733	19.9247	20.0918	20.1226	20.1174	19.9855	19.8248	20.1905	20.1890 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.1859	20.1867	20.1875	20.1733	19.9247	20.0918	20.1226	20.1174	19.9855	19.8248	20.1905	20.1890 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9999	0.9996	0.9980	0.9844	0.9024	0.7106	0.5036	0.5933	0.8998	0.9950	0.9998	1.0000 (94)
Useful gains	2418.2128	3195.3684	3976.5965	4896.9255	5154.3228	4100.8042	2760.8132	2873.1405	3699.8646	3195.1371	2522.0578	2240.3835 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	12737.9880	12244.2321	10951.6369	8974.8918	6541.7017	4348.8158	2789.4388	2941.3702	4668.4815	7337.1230	10431.5815	12766.7081 (97)
Space heating kWh	7677.9127	6080.8364	5189.4300	2936.1357	1032.2099	0.0000	0.0000	0.0000	0.0000	3081.6375	5694.8571	7831.5855 (98a)
Space heating requirement - total per year (kWh/year)												39524.6050
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	7677.9127	6080.8364	5189.4300	2936.1357	1032.2099	0.0000	0.0000	0.0000	0.0000	3081.6375	5694.8571	7831.5855 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												39524.6050
Space heating per m2										(98c) / (4) =		46.8190 (99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												208.1895 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	7677.9127	6080.8364	5189.4300	2936.1357	1032.2099	0.0000	0.0000	0.0000	0.0000	3081.6375	5694.8571	7831.5855 (98)
Space heating efficiency (main heating system 1)	208.1895	208.1895	208.1895	208.1895	208.1895	0.0000	0.0000	0.0000	0.0000	208.1895	208.1895	208.1895 (210)
Space heating fuel (main heating system)	3687.9448	2920.8185	2492.6477	1410.3191	495.8031	0.0000	0.0000	0.0000	0.0000	1480.2082	2735.4204	3761.7587 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	407.5852	361.2472	385.3121	341.9142	333.6914	272.5130	269.0439	279.4724	282.2828	346.0339	364.5629	403.5002 (64)
Efficiency of water heater (217)m	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800	171.4800 (216)
Fuel for water heating, kWh/month	237.6867	210.6643	224.6980	199.3901	194.5949	158.9182	156.8952	162.9767	164.6156	201.7926	212.5979	235.3045 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	92.0718	73.8634	66.5058	48.7250	37.6366	30.7494	34.3334	44.6278	57.9671	76.0560	85.9050	94.6307 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-103.0874	-160.8211	-252.0908	-297.3629	-305.0827	-250.1327	-246.5247	-227.8589	-195.8698	-186.3725	-117.8048	-87.4700 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-17.1202	-39.7709	-89.5402	-160.4900	-260.5560	-305.9802	-302.2389	-251.5987	-179.6416	-70.0576	-24.7787	-13.1232 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												18984.9206 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)

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Efficiency of water heater	171.4800	
Water heating fuel used	2360.1348	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	743.0720	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4145.3745	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	17942.7528	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	18984.9206	0.1551	2944.4862	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2360.1348	0.1414	333.7501	(264)
Space and water heating			3278.2363	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	743.0720	0.1443	107.2482	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2430.4783	0.1350	-328.0876	
PV Unit electricity exported	-1714.8962	0.1193	-204.5882	
Total			-532.6758	(269)
Total CO2, kg/year			2852.8087	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.3800	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	18984.9206	1.5742	29886.3496	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2360.1348	1.5229	3594.3079	(278)
Space and water heating			33480.6576	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	743.0720	1.5338	1139.7486	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2430.4783	1.4990	-3643.2026	
PV Unit electricity exported	-1714.8962	0.4374	-750.1146	
Total			-4393.3172	(283)
Total Primary energy kWh/year			30227.0889	(286)
Dwelling Primary energy Rate (DPER)			35.8100	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

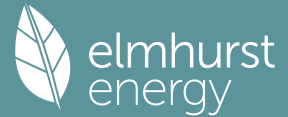
1. Overall dwelling characteristics

	Area (m ²)		Storey height (m)		Volume (m ³)	
Basement floor	242.8000 (1a)	x	3.0000 (2a)	=	728.4000 (1a)	- (3a)
Ground floor	290.9000 (1b)	x	3.0000 (2b)	=	872.7000 (1b)	- (3b)
First floor	221.3000 (1c)	x	3.0000 (2c)	=	663.9000 (1c)	- (3c)
Second floor	89.2000 (1d)	x	3.0000 (2d)	=	267.6000 (1d)	- (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	844.2000				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	2532.6000	(5)

2. Ventilation rate

	m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	Air changes per hour	
Pressure test	40.0000 / (5) =	0.0158 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		5.0000 (17)
Number of sides sheltered		0.2658 (18)
		0 (19)

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Shelter factor
Infiltration rate adjusted to include shelter factor

$$(20) = 1 - [0.075 \times (19)] = 1.0000 \quad (20)$$
$$(21) = (18) \times (20) = 0.2658 \quad (21)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
Effective ac	0.3389	0.3322	0.3256	0.2924	0.2857	0.2525	0.2525	0.2459	0.2658	0.2857	0.2990	0.3123	(22b)
	0.5574	0.5552	0.5530	0.5427	0.5408	0.5319	0.5319	0.5302	0.5353	0.5408	0.5447	0.5488	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.7000	1.0000	2.7000			(26)
TER Opening Type (Uw = 1.20)			114.5000	1.1450	131.1069			(27)
Opening			4.5000	2.0221	9.0993			(27a)
BASEMENT			242.8000	0.1300	31.5640			(28a)
GF			38.6000	0.1300	5.0180			(28a)
Basement	190.8000	12.2000	178.6000	0.1800	32.1480			(29a)
GF	232.2000	71.4000	160.8000	0.1800	28.9440			(29a)
1ST	211.2000	28.8000	182.4000	0.1800	32.8320			(29a)
2ND	167.7000	4.8000	162.9000	0.1800	29.3220			(29a)
2ND	89.2000	4.5000	84.7000	0.1100	9.3170			(30)
1ST	132.1000		132.1000	0.1100	14.5310			(30)
GF	38.6000		38.6000	0.1100	4.2460			(30)
Total net area of external elements Aum(A, m2)			1343.2000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 330.8281			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

240.1510 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate	64.8000	0.0500	3.2400	
E3 Sill	64.8000	0.0500	3.2400	
E4 Jamb	177.0000	0.0500	8.8500	
E5 Ground floor (normal)	89.2000	0.1600	14.2720	
E6 Intermediate floor within a dwelling	203.7000	0.0000	0.0000	
E10 Baves (insulation at ceiling level)	126.3000	0.0600	7.5780	
E14 Flat roof	25.6000	0.0800	2.0480	
E16 Corner (normal)	126.0000	0.0900	11.3400	
E17 Corner (inverted - internal area greater than external area)	75.0000	-0.0900	-6.7500	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

Point Thermal bridges		(36a) =	43.8180	(36)
Total fabric heat loss	(33) + (36) + (36a) =		374.6461	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	465.8702	464.0066	462.1800	453.6002	451.9950	444.5223	444.5223	443.1385	447.4007	451.9950	455.2424	458.6374	(38)
Heat transfer coeff	840.5163	838.6528	836.8261	828.2464	826.6411	819.1684	819.1684	817.7846	822.0468	826.6411	829.8885	833.2835	(39)
Average = Sum(39)m / 12 =												828.2387	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9956	0.9934	0.9913	0.9811	0.9792	0.9703	0.9703	0.9687	0.9738	0.9792	0.9830	0.9871	(40)
HLP (average)												0.9811	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.8394	(42)
Hot water usage for mixer showers													
88.5941	87.2627	85.3225	81.6105	78.8711	75.8162	74.0797	76.0052	78.1158	81.3959	85.1876	88.2546	(42a)	
Hot water usage for baths													
38.2216	37.6539	36.8545	35.3807	34.2770	33.0533	32.3923	33.1861	34.0503	35.3598	36.8640	38.0923	(42b)	
Hot water usage for other uses													
53.9492	51.9874	50.0256	48.0638	46.1020	44.1402	44.1402	46.1020	48.0638	50.0256	51.9874	53.9492	(42c)	
Average daily hot water use (litres/day)												166.1629	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	180.7648	176.9040	172.2027	165.0550	159.2502	153.0097	150.6123	155.2933	160.2299	166.7813	174.0391	180.2961	(44)
Energy conte	286.2873	251.9089	264.6692	225.9521	214.3814	188.1433	182.1525	192.2855	197.5795	226.3206	247.9505	282.3002	(45)
Energy content (annual)										Total = Sum(45)m =		2759.9309	
Distribution loss (46)m = 0.15 x (45)m													
42.9431	37.7863	39.7004	33.8928	32.1572	28.2215	27.3229	28.8428	29.6369	33.9481	37.1926	42.3450		(46)

Water storage loss:

Store volume													600.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													3.2538	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													1.7571	(55)

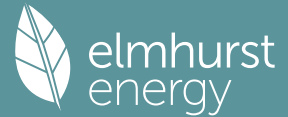
Total storage loss													(56)	
54.4691	49.1979	54.4691	52.7120	54.4691	52.7120	54.4691	54.4691	52.7120	54.4691	52.7120	54.4691	52.7120	54.4691	(56)
If cylinder contains dedicated solar storage														
54.4691	49.1979	54.4691	52.7120	54.4691	52.7120	54.4691	54.4691	52.7120	54.4691	52.7120	54.4691	52.7120	54.4691	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month														
364.0187	322.1180	342.4006	301.1760	292.1128	263.3673	259.8840	270.0170	272.8035	304.0521	323.1745	360.0316			(62)
WWHRS	-40.5015	-35.8199	-37.5085	-31.0585	-28.9454	-24.7688	-23.2168	-24.6887	-25.6268	-30.2111	-34.2255	-39.7515		(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000		(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(63d)

Output from w/h	323.5172	286.2981	304.8921	270.1175	263.1674	238.5985	236.6672	245.3282	247.1768	273.8409	288.9490	320.2802	(64)
12Total per year (kWh/year)												3298.8331	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

$$\text{Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m = 0.0000 (64a)}$$

Heat gains from water heating, kWh/month	157.3757	139.9270	150.1877	135.3082	133.4670	122.7368	122.7509	126.1201	125.8744	137.4368	142.6227	156.0500	(65)
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	191.9695	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	443.1377	490.6167	443.1377	457.9089	443.1377	457.9089	443.1377	443.1377	457.9089	443.1377	457.9089	443.1377	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	821.5292	830.0541	808.5717	762.8380	705.1075	650.8489	614.6009	606.0760	627.5585	673.2921	731.0226	785.2812	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	42.1970	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	-153.5756	(71)
Water heating gains (Table 5)	211.5264	208.2246	201.8651	187.9281	179.3911	170.4678	164.9877	169.5163	174.8255	184.7268	198.0872	209.7446	(72)
Total internal gains	1559.7842	1612.4863	1537.1653	1492.2659	1411.2271	1359.8165	1303.3171	1299.3208	1340.8838	1384.7475	1470.6096	1521.7543	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W

Northeast				16.3000	11.2829		0.6300		0.7000		0.7700		56.2059 (75)
Southeast				24.0000	36.7938		0.6300		0.7000		0.7700		269.8722 (77)
Southwest				21.9000	36.7938		0.6300		0.7000		0.7700		246.2584 (79)
Northwest				52.3000	11.2829		0.6300		0.7000		0.7700		180.3416 (81)
North				4.5000	26.0000		0.6300		0.7000		1.0000		46.4373 (82)

Solar gains	799.1153	1457.1071	2241.8759	3183.0652	3927.4343	4056.2478	3845.3832	3267.3890	2564.9618	1677.9699	974.7830	672.3838	(83)
Total gains	2358.8995	3069.5934	3779.0412	4675.3311	5338.6614	5416.0643	5148.7003	4566.7098	3905.8456	3062.7174	2445.3925	2194.1381	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)

Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	67.0010	67.1499	67.2964	67.9936	68.1256	68.7471	68.7471	68.8634	68.5063	68.1256	67.8590	67.5825	
alpha	5.4667	5.4767	5.4864	5.5329	5.5417	5.5831	5.5831	5.5909	5.5671	5.5417	5.5239	5.5055	
util living area	1.0000	0.9998	0.9989	0.9921	0.9554	0.8340	0.6683	0.7557	0.9573	0.9979	0.9999	1.0000	(86)
MIT	19.4237	19.5911	19.8707	20.2713	20.6497	20.9015	20.9779	20.9578	20.7380	20.2497	19.7700	19.4039	(87)
Th 2	20.0870	20.0888	20.0906	20.0991	20.1007	20.1081	20.1081	20.1095	20.1053	20.1007	20.0975	20.0941	(88)
util rest of house	0.9999	0.9997	0.9984	0.9887	0.9344	0.7614	0.5484	0.6400	0.9278	0.9967	0.9998	1.0000	(89)
MIT 2	18.1972	18.4133	18.7732	19.2909	19.7609	20.0405	20.0994	20.0902	19.8769	19.2665	18.6492	18.1770	(90)
Living area fraction	18.2821	18.4948	18.8491	19.3587	19.8223	20.1001	20.1602	20.1502	19.9365	19.3345	18.7267	18.2619	(91)
MIT	18.2821	18.4948	18.8491	19.3587	19.8223	20.1001	20.1602	20.1502	19.9365	19.3345	18.7267	18.2619	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2821	18.4948	18.8491	19.3587	19.8223	20.1001	20.1602	20.1502	19.9365	19.3345	18.7267	18.2619	(93)

8. Space heating requirement

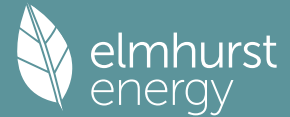
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9994	0.9975	0.9845	0.9260	0.7606	0.5559	0.6459	0.9202	0.9950	0.9996	0.9999	(94)
Useful gains	2358.6092	3067.8954	3769.4171	4603.0914	4943.4358	4119.5601	2862.1707	2949.6063	3594.0186	3047.4421	2444.4625	2193.9621	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	11752.1699	11401.2989	10334.0436	8662.3788	6714.2618	4505.4855	2916.3847	3066.8541	4797.8644	7220.2954	9648.8608	11717.5247	(97)
Space heating kWh	6988.8092	5600.0471	4884.0822	2922.6870	1317.4945	0.0000	0.0000	0.0000	0.0000	3104.6028	5187.1668	7085.5306	(98a)
Space heating requirement - total per year (kWh/year)												37090.4202	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	6988.8092	5600.0471	4884.0822	2922.6870	1317.4945	0.0000	0.0000	0.0000	0.0000	3104.6028	5187.1668	7085.5306	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												37090.4202	
Space heating per m2										(98c) / (4) =		43.9356	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)

Fraction of space heat from main system(s)													0.0000 (201)
Efficiency of main space heating system 1 (in %)													1.0000 (202)
Efficiency of main space heating system 2 (in %)													92.3000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (207)
													0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	6988.8092	5600.0471	4884.0822	2922.6870	1317.4945	0.0000	0.0000	0.0000	0.0000	3104.6028	5187.1668	7085.5306	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	7571.8409	6067.2233	5291.5300	3166.5081	1427.4047	0.0000	0.0000	0.0000	0.0000	3363.6000	5619.8990	7676.6312	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Full SAP Calculation Printout



Water heating												
Water heating requirement												
	323.5172	286.2981	304.8921	270.1175	263.1674	238.5985	236.6672	245.3282	247.1768	273.8409	288.9490	320.2802 (64)
Efficiency of water heater												79.8000 (216)
(217)m	88.3591	88.3155	88.2154	87.9607	87.1633	79.8000	79.8000	79.8000	79.8000	87.9956	88.2747	88.3690 (217)
Fuel for water heating, kWh/month												
	366.1391	324.1763	345.6223	307.0888	301.9245	298.9956	296.5754	307.4288	309.7453	311.1985	327.3294	362.4351 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	92.0753	73.8662	66.5083	48.7268	37.6380	30.7506	34.3347	44.6295	57.9693	76.0588	85.9083	94.6343 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-195.9452	-261.6819	-356.1049	-377.7156	-388.2546	-354.7267	-349.2650	-338.1500	-317.0864	-286.9203	-209.6831	-171.0626 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-159.5619	-328.5759	-640.9268	-946.0373	-1235.9183	-1237.3935	-1223.8090	-1043.8144	-774.6843	-465.4383	-211.4186	-126.8239 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												40184.6373 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												3858.6592 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												743.1001 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-12000.9983 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												32871.3983 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	40184.6373	0.2100	8438.7738 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3858.6592	0.2100	810.3184 (264)
Space and water heating			9249.0923 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	743.1001	0.1443	107.2523 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3606.5963	0.1359	-490.0146
PV Unit electricity exported	-8394.4020	0.1264	-1061.0316
Total			-1551.0462 (269)
Total CO2, kg/year			7817.2276 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.2600 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	40184.6373	1.1300	45408.6402 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3858.6592	1.1300	4360.2849 (278)
Space and water heating			49768.9250 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	743.1001	1.5338	1139.7917 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3606.5963	1.5022	-5417.8632
PV Unit electricity exported	-8394.4020	0.4640	-3894.8889
Total			-9312.7521 (283)
Total Primary energy kWh/year			41726.0654 (286)
Target Primary Energy Rate (TPER)			49.4300 (287)

SECTION 12

12

APPENDIX B – GHA EARLY STAGE OVERHEATING RISK TOOL

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019



This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply.

Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING

KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	
#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	3
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure?

Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context

1

1

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	Day - reasons to keep all windows closed	8	0
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green?

Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme

1

1

#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas?

Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels

1

0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	0
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	0

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation?

Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance

1

1

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future?

Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans

>2.8m and fan installed	2
> 2.8m	1

1

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	0
	>50%	7	
	>35%	4	
#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	0
	Dual aspect	0	

#13 Is there useful external shading?

Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per #6

	Full	Part
>65%	6	3
>50%	4	2
>35%	2	1

0

#14 Do windows & openings support effective ventilation?

Larger, effective and secure openings will help dissipate heat - see guidance

	Openings compared to Part F purge rates	
	= Part F	+50% +100%
Single-aspect	3	4
Dual aspect	2	3

3

TOTAL SCORE

4

= Sum of contributing factors:

11

minus

Sum of mitigating factors:

7

High

12

Medium

8

Low

score >12:

Incorporate design changes to reduce risk factors and increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score between 8 and 12:

Seek design changes to reduce risk factors and/or increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8:

Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)