ENERGY STATEMENT REPORT

FOR

OAKWOOD LODGE

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ENERGY STATEMENT REPORT FOR
OAKWOOD LODGE

EXECUTIVE SUMMARY

This report has been compiled to identify strategies for the reduction of energy consumption and carbon emissions at a proposed new development at Oakwood Lodge, Wythenshawe.

A benchmarking exercise has been undertaken to establish anticipated energy demand and how this can be minimised via the following sustainable measures:

- Building envelope optimisation
- The implementation of low and zero carbon energy systems

The report identifies opportunities for significant energy and carbon reductions, as well as reduction in fossil fuel reliance, via the use of heat pump technology for heating and hot water generation.

A final summary model has been produced based on the most beneficial measures for the site, these being:

- Enhanced thermal envelope
- Photovoltaics to building roofs (assumed 15m^2 per dwelling)
- Air source heat pumps generating heating and hot water

Combining these measures achieved site-wide energy and carbon savings as recorded in *Table 4.0*, below.

Whole Site Model	Annual Energy Demand kWh/year	% Saving	Annual Carbon Emissions $kgCO_2$/year	% Saving
Base Model	119280	N/A	29581	N/A
Combined Model	32206	73%	15087	49%

Table 4.0: Combined Model Results

The findings and recommendations in this report are indicative only, and careful design consideration is required to establish the implications of implementing these measures on project cost, servicing of the internal environment and the operational and maintenance requirements of the site.

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ENERGY STATEMENT REPORT FOR
OAKWOOD LODGE

1.0 INTRODUCTION

1.1 Brief

Parker Wilson Sustain LLP were approached to undertake an energy study for a proposed new residential development at Oakwood Lodge, Wythenshawe.

Outline design information has been provided by Arcus Consulting LLP, including a proposed site plan and plans of the proposed dwelling types.

This report has been compiled to identify strategies for the reduction of energy consumption and carbon emissions at the proposed site.

A benchmarking exercise has been undertaken to establish anticipated energy demand and how this can be minimised via the following sustainable measures:

- Building envelope optimisation
- The implementation of low and zero carbon energy systems
- District energy provision

The report finds that likely targets for renewable energy generation and carbon reduction can be met through implementation of various passive measures and low and zero carbon technologies.

1.2 Proposed Development

The proposed development comprises 6No 3-bed (5 person) and 2-bed (4 person) dwellings forming a new residential development in Wythenshawe. An extract from Arcus Consulting LLP's proposed site plan (5415-P-01 Rev A) is provided in *Figure 1.*2, below. 2-bed units are shown in orange and 3-bed units in red.

An initial breakdown of likely accommodation types and associated floor areas has been generated for use in the calculation of likely energy demand across the site (see *Table 1.2*). The report considers the likely energy usage of each type of accommodation, giving consideration to the varying energy use based on size and configuration i.e. apartment, terraced, semi-detached or detached.

Unit Type	Unit Area (m^2)	Unit Beds	Unit Occupants	No. Units	TFA (m^2)	Total Beds	Total Occupants
2-Bed	86	2	4	14	1,204	28	56
3-Bed	98	3	5	6	588	18	30
Site Total				**20**	**1,792**	**46**	**86**

Table 1.2: Schedule of Accommodation



Figure 1.2: Extract From Proposed Site Plan

2.0 ENVIRONMENTAL STANDARDS

2.1 General

Sustainability will form a key consideration in the development of the architectural and engineering design of the scheme. Initial calculations have been undertaken to assess the likely opportunities for energy saving available through the application of various passive measures and low and zero carbon technologies.

In accordance with the National Energy Hierarchy, it is acknowledged that there is first a need to reduce energy use, then supply energy efficiently and finally to utilise renewable energy where feasible.

2.2 Local Planning Requirements

The development is required to comply with Manchester City Council's Local Development Framework Core Strategy Development Plan Document. As this report considers energy use and carbon emissions relating to the proposed dwellings, it is concerned with the following elements of the Core Strategy:

Policy EN4

All development must follow the principle of the Energy Hierarchy, being designed:

- To reduce the need for energy through design features that provide passive heating, natural lighting and cooling.
- To reduce the need for energy through energy efficient features such as improved insulation and glazing.
- To meet residual energy requirements through the use of low and zero carbon energy generating technologies.

Policy EN6

As the development comprises more than 10No individual units it is expected to meet the requirements set out in Table 12.1 of the Core Strategy (unless it can be shown that this is not viable).

For this development the requirement is to achieve a 15% reduction in carbon emissions over Part L 2010 requirements.

Appendix A of the Core Strategy provides guidance and explanatory notes for demonstrating compliance with EN6. This report has been compiled in accordance with this guidance.

3.0 ENERGY EFFICIENCY & SUSTAINABILITY

Government guidance for carbon performance suggests a hierarchy of good practice in low carbon design. *Figure 3.0* illustrates this hierarchy.

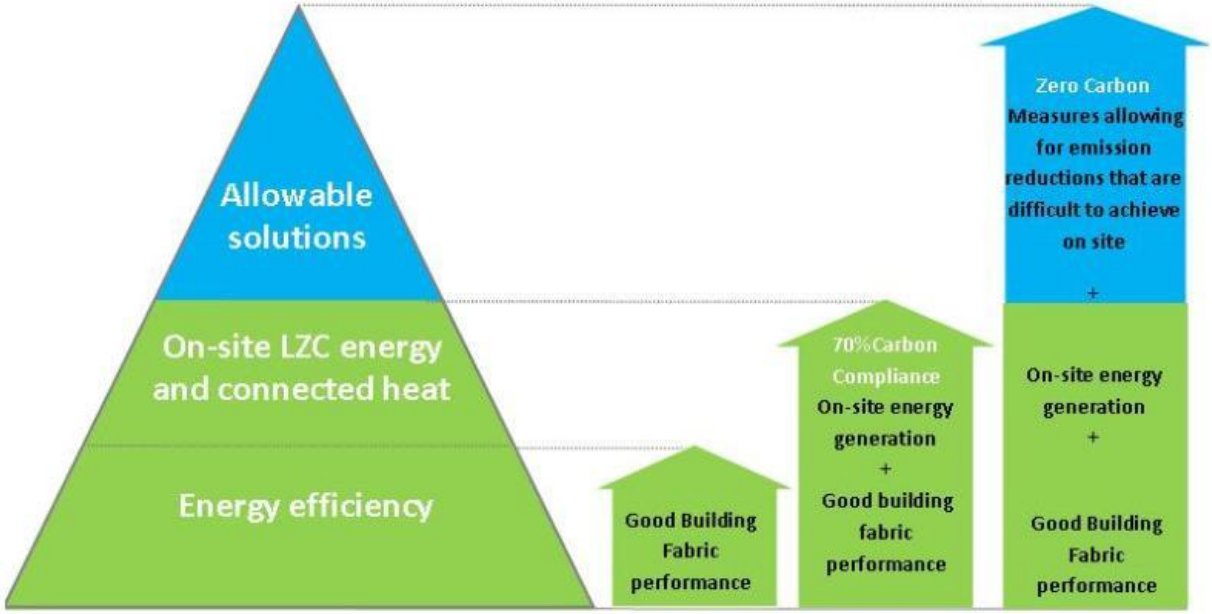


Figure 3.0: Low Carbon Design Hierarchy

Energy efficiency is achieved through the use of high performance building materials to ensure thermal efficiency of the building envelope. This, along with the implementation of efficient fixed services design and low and zero carbon technologies, should allow designers to meet most carbon compliance requirements.

The last element of the hierarchy is the use of renewable energy solutions to generate the energy used on site. Ideally, these renewable energy sources should be installed locally. However, if this is not possible then 'Allowable Solutions' can be used to provide off-site renewable energy sources to offset carbon emissions from the site.

The development will be designed in line with the hierarchy illustrated above. Passive design measures and envelope efficiency will be maximised with on site generation utilised to further offset carbon emissions where necessary.

3.1 Passive Measures

3.1.1 Minimum Standards

Where possible, steps will be taken to maximise the performance of the building fabric and other passive measures to minimise energy consumption and associated carbon emissions.

U-values and air tightness exceeding the minimum standards of Approved Document L1A will be employed to minimise heat loss within the buildings. The minimum performance standards are indicated below.

1. External walls 0.35 W/m^2K
2. Roofs 0.25 W/m^2K
3. Floors 0.25 W/m^2K
4. Air tightness 10 m^3/m^2/hr at 50Pa

3.1.2 Proposed Measures

To minimise building energy demand the following thermal performance criteria have been modelled to identify likely improvements in thermal performance:

1. External walls 0.25 W/m^2K
2. Roofs 0.20 W/m^2K
3. Floors 0.20 W/m^2K
4. Air tightness 5 m3/m2/hr at 50Pa

At this early stage in design, it is important to ensure that proposed insulation levels are practically and commercially feasible for the development type. Further opportunities are likely to be available as the scheme designs are developed. A review of each accommodation type and the feasibility of enhancing the envelope design should be undertaken as the scheme progresses.

3.2 Low and Zero Carbon Technologies

3.2.1 General

There are various low and zero carbon technologies, such as photovoltaic panels, wind turbines and CHP etc available on the market. However, not all are feasible due to capital expenditure, pay-back periods, availability, logistics and respective CO_2 emission reduction. It is often not feasible to outlay significant capital expenditure which has high payback periods and will save limited energy and CO_2 emissions.

Condensing Boilers

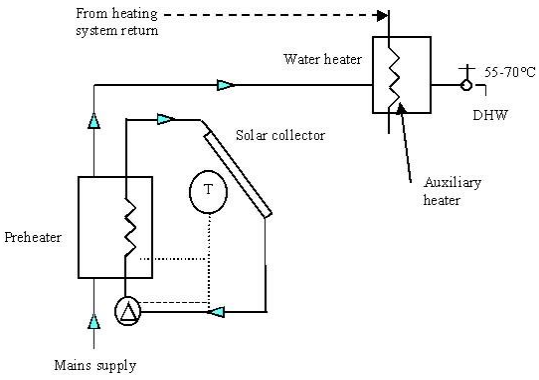
A high efficiency condensing boiler works on the principle of recovering as much as possible of the waste heat which is normally rejected to the atmosphere from the flue of a conventional (non-condensing) boiler.

This is accomplished by using two heat exchangers within the boiler which maximises heat transfer from the burner as well as recovering useful heat which would normally be lost with the flue gases. When in condensing mode (condensing boilers do not condense all the time) the flue gases give up their 'latent heat' which is then recovered by the heat exchanger within the boiler. As a result the temperature of the gases exiting the flue of a condensing boiler is typically 50-60°C compared with 120-180°C in a non-condensing boiler. At the same time an amount of water or 'condensate' is produced.

The result of recovering heat from the exhaust flue gas means less primary gas demand. This subsequently reduces CO_2 emission

Solar Collectors

Solar collectors, collect both direct and diffuse solar radiation. Heat is transferred to the circulating liquid via heat exchange pipes that run through the solar collector. The circulating fluid in the solar collector is a mixture of water and antifreeze. This is to enable operation in winter and maximises efficiency similar to run around coils in a ventilation system which use the same water and antifreeze mix. The water and antifreeze mixture is used to cool the panels, so increasing the temperature of the water/circulating fluid. The water is then used to pre-heat the building domestic hot water as shown in the diagram above. The preheated water is then heated through a condensing boiler prior to delivery to the building.



Heat Pumps

There are a multitude of air and ground source heat pumps available in the construction industry, each installed differently and subsequently perform differently, however the principle of operation is fundamentally the same.

Air source heat pumps remove residual, low grade heat from ambient air and, via the

vapour compression cycle, transfer this to high grade heat for use within the building. Air source heat pumps typically output heat at 45^{o}C, but can output up to 65^{o}C.

Exhaust air heat pumps operate in the same manner as air source heat pumps, but utilise extracted air from within the property to generate heat, rather than ambient external air.

A GSHP removes heat from the earth or ground water in cold weather and transfers it to the building through an underground piping system. The process reverses in warm weather as heat is transferred to the ground. GSHP's work by circulating water or a water/antifreeze solution, generally through a closed loop of pipe that is buried in the ground or set beneath water. The refrigerant cycle within a GSHP system can comprises a two phase process, operating in the vapour and liquid phases. A GSHP can be categorised as having closed or open loops and these loops can be installed in three ways:

- horizontally,
- vertically,
- in a river / pond or lake.

The selection process for a GSHP depends on the area of the site / land, soil and rock type at the project. These factors will help determine the most economical choice for installation of the ground loop.

Wind Catchers



The windcatcher principle, of encapsulating any prevailing wind, originated some 2,000 years ago in the Middle East, where " Wind Towers " were often a common sight. The modern windcatcher is an extension of this principle but is also a development of the Vertical Balanced-flue system.

A windcatcher system is an effective method of providing natural ventilation to a building, by encapsulating the prevailing wind from any direction. Clean, fresh air, relatively free from contamination or traffic pollution, is entrained at roof level and is carried down to the rooms below through a controlled damper arrangement.

Heat Recovery Ventilation Systems

There are various methods of recovering heat from a mechanical ventilation installation. This varies from thermal wheels, heat recuperators and run around coils etc. The recovered heat is then utilised back into the installation and thus reduces the primary energy demand for the building and subsequent CO_2 emissions. On a smaller scale fresh air/extract ventilator units with heat recovery coils will pre-heat or pre-cool the fresh air.

Demand Controlled Ventilation

This type of system is best suited to a central ventilation system serving a number of

rooms. Demand controlled ventilation basically operates through a series of passive infra red detectors which control the ventilation installation in the building. If the space is unoccupied then the ventilation would not operate. However, once the space is occupied the ventilation operates. This reduces the primary energy demand and subsequently reduces the building CO_2 emission rate

Biomass Boilers

Biomass is all non-fossil organic materials that have intrinsic chemical energy content. This includes all water and land-based vegetation and trees or virgin biomass, such as log wood or thinning from local forests, prunings from roadsides or parks, grasses and energy crops and in some countries residues from agriculture or food processing e.g. nutshells or olive pits, wood chips, recycled untreated wood or palletising residues from wood processing. Also all waste biomass such as municipal solid waste, municipal bio solids (sewage) and animal wastes (manures), forestry and agricultural residues, and certain types of industrial wastes. Through using these resources a possible disposal problem can be turned into a high quality fuel and local suppliers of wood fuels will gain extra income and enhance local economic turnover.

Biomass can be used on a domestic or industrial scale. For a biomass power plant, the chipped, shredded and dried fuel is fed into a boiler or gasifier, from where the gas is collected and used.

The boilers could operate via biofuel. Biofuel is any fuel that derives from biomass - recently living organisms or their metabolic byproducts, such as manure from cows. It is a renewable energy, unlike other natural resources such as petroleum, coal and nuclear fuels. The carbon in biofuels was recently extracted from atmospheric carbon dioxide by growing plants, so burning it does not result in a net increase of carbon dioxide in the Earth's atmosphere.

The use of biofuel would mean the requirement for a biofuel storage tank and regular deliveries. A hard standing is therefore required for the delivery truck.

In urban environments careful consideration must be given to local restrictions on the use of biomass such as smoke control zones, clean air requirements and interaction with surrounding buildings.

Biomass flues are normally required to terminate above the roof line of the property being served, as well as any nearby buildings which could be affected by exhaust fumes. This can be a particular concern for tall, multi-storey buildings.

Lighting Control

Presence Detection

A presence detector is a switching device which detects persons within an area, thus switching electrical loads as a result, i.e. switching lighting and extract fans etc.

Presence detection utilises a motion detector, typically a passive infra red or microwave technology to detect the presence of persons in a given area.

Upon detection of persons the presence detector acts as a switch enabling the lighting to switch “on” for a pre determined duration i.e. 15 minutes. After this predetermined duration the lighting will be switched “off”.

Absence Detection

Absence detection utilises the same principles of operation as presence detection, however rather than the detector switching lighting circuits on automatically a manual switch has to be engaged. For example upon walking to a room with a presence detector installed a person has to physically switch on a switch to enable the lighting to switch “on”. As with presence detection, after a pre-determined duration of no presence in an area the lighting will switch off.

A typical Passive Infra Red detector when mounted at 2.7m above finished floor level will give coverage of circular diameter 6.5m. Microwave detectors generally provide greater coverage then Passive Infra Red Detectors. However, they are sensitive and may cause nuisance switching if installed in areas of heavy traffic.

District Energy Systems

A district energy network would generally consist of an energy centre where heat and electricity can be generated via various means (combined heat and power, solar generation etc.) and distributed to building users via a network of pipework and cabling.

Consideration could be given to the provision of a new district energy system to serve the site and potential wider developments, or to connection to any existing local district energy network.

3.2.2 Sustainable Element Feasibility

The following section of this report aims to identify potential technologies for more detailed analysis and justify and technologies being excluded at this stage. A traffic light system has been adopted to represent the anticipated feasibility of these measures prior to undertaking modelling of the site.

The traffic light system should be interpreted as follows:

Red Technology not suitable.

Amber Technology may be suitable depending on building energy demands.

Green Technology are likely to be suitable subject to payback and operational constraints.

No.	SUSTAINABLE ELEMENT	FEASIBILITY COMMENT	FEASIBLE Yes/No/
1	Wind Turbines	Wind Turbines generate electrical power for the earth's natural wind resource. The location of any wind turbines would need to be carefully considered as there are a number of buildings within the vicinity of this building which could prevent/block wind potential. Planning could also be a consideration. It is generally considered that wind turbines do not operate well in urban environments unless they are tall enough to be unaffected by the deflection of wind by surrounding buildings. Given that the scheme comprises dwellings it would not be viable to provide either a significant number of small turbines or a smaller number of large scale turbines to meet a significant proportion of the development's energy demand.	No
2	Photovoltaic Panels	Photovoltaic (PV) panels could be installed however capital expenditure is high for relatively low out outputs and therefore the equipment has long pay-back periods. It would be feasible to provide PV panels to each individual dwelling.	Yes
3	High Efficiency/ Condensing Boilers	Any new boiler installed could be of high efficiency condensing type. As there is no existing gas infrastructure to the site, this could be a limiting factor. In consideration of national drivers to move away from fossil fuels there are more beneficial systems avaialable. The majority of the site could easily	No

		derive heat from more sustainable sources.	
4	Solar Collectors	Solar collectors provide a mechanism to collect heat energy from the sun and transfer this to the water supply to the building, thus reducing the primary domestic hot water demand and subsequent energy consumption. The solar collectors could be mounted on the roof of the building. Individual dwellings could easily accommodate stand-alone solar hot water systems. This would reduce space for any potential PV panels, so the benefit of each system type would need to be considered.	Possible
5	CHP	Combined Heat and Power (CHP) installations require careful sizing against the base loads of the building they are to serve. In order to operate efficiently it is preferable to have a steady base load. As the building's energy demand is unlikely to be steady, CHP will not be viable.	No
6	ASHP	Air source or exhaust air heat pump systems offer a more practical alternative to GSHP's in that, generally, they offer much greater flexibility with regards to their installation and do not require the prior geological work needed by GSHP's. With a seasonal efficiency of 300% or more, they are not quite as efficient as GSHP's. They do, however, offer a renewable energy source to provide low grade hot water for suitable for domestic hot water or heating installations. Air source heating could provide heating and/or hot water to individual dwellings.	Yes
7	GSHP	The installation of a ground source heat pump (GSHP) needs to be carefully considered. The building's location and the size of the site could require that boreholes be dug rather than a more traditional slinky arrangement. This could significantly increase the cost thus potentially making the installation economically prohibitive. Given the setting of the site, available space for individual ground loops to each dwelling and likely ground works required, it is unlikely that ground source heating would be viable.	No
8	Wind Catchers	These lend themselves well to single storey constructions and cannot provide a regulated ventilation rate to sanitary accommodation, as would be required for the dwellings.	No

9	Biomass Boilers	Biomass boilers could be installed to provide the necessary energy for heating and domestic hot water. Given the nature of the site and the proposed development, there are likely to be planning restrictions on the use of biomass systems for residential units. Storage requirements would be difficult to accommodate given the close proximity of surrounding buildings and public areas within the development. In this case the use of biomass unlikely to be viable.	No
10	Heat Recovery Ventilation Units	Heat recovery systems allow energy from extracted air to be transferred to incoming air before it is supplied to the occupied space. For a heat recovery system to be effective, the building in question should have a good level of air tightness, as will be the case for this scheme. Consideration should be given to the inclusion of heat recovery within ventilation systems where it is practical to install these.	Possible
11	High Efficiency Lighting & Lighting Control	Modern low energy LED light fittings should be utilised. Consideration should be given to high efficiency fittings where possible. Lighting control in residential applications would normally be limited to low usage store rooms and external / security lighting.	Yes
12	District Energy Systems	There are no existing district heating networks in close proximity to the site. Given the scale of the proposed development and the availability of space for an energy centre, it would not be cost effective to provide a new district energy system to serve this development and any wider local energy demand.	No

3.3 Initial Modelling

3.3.1 Overview

A benchmarking exercise has been undertaken to establish anticipated energy demand and how this can be minimised via the use of sustainable measures.

The models included within this report have been constructed using CIBSE and DECC approved benchmark data.

Results are presented to follow the energy hierarchy detailed in section 2 and section 3. A base model is first identified to establish building performance to meet minimum Building Regulations 2010 standards. These models will generally allow for gas fired heating via low temperature hot water (LTHW) heating systems.

The thermally enhanced model allows for the upgrade of thermal elements to the U-values detailed in section 3.1.

3.3.2 Passive Sustainable Measures

The passive measures considered in this report relate to the implementation of high performance building fabric. *Figure 2.1* illustrates the mechanisms of heat loss for a typical domestic property. These will vary depending on the property type (e.g. terraced houses suffer less heat loss through walls; flats suffer less through separating ceilings and floors).

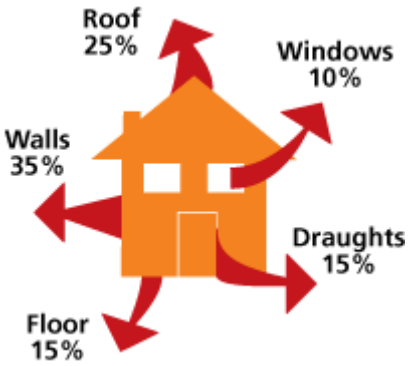


Figure 2.1: Domestic Heat Loss Proportions

Potential energy and carbon savings via passive measures for the development as a whole are presented in *Table 3.1* and the accompanying bar chart.

A breakdown of measures by building type is provided in *Table 3.2*.

Whole Site Model	Annual Energy Demand kWh/year	% Saving	Annual Carbon Emissions $kgCO_2$/year	% Saving
Base Model	119,280	N/A	29,581	N/A
Improved External Walls	113,912	5%	28,615	3%
Improved Roof	115,415	3%	28,886	2%
Improved Ground Floor	117,786	1%	29,312	1%
All Measures	108,553	9%	27,651	7%

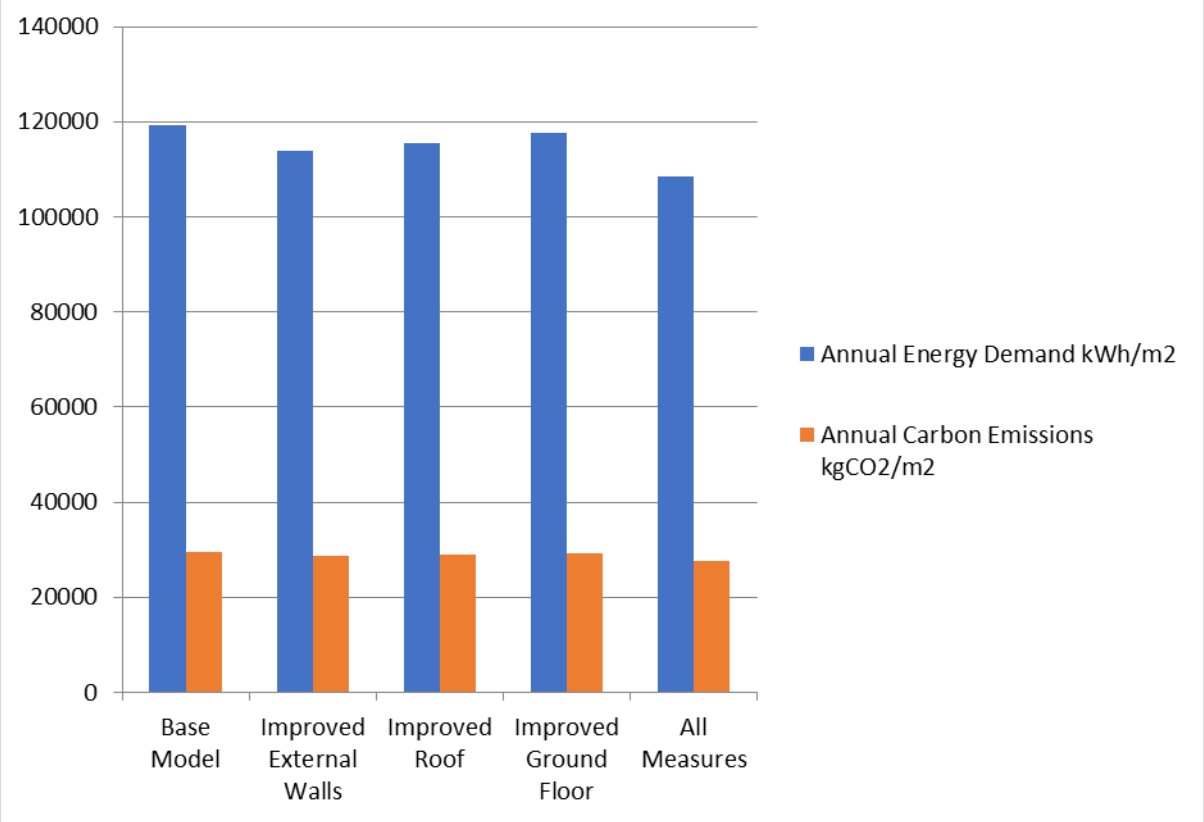


Table 3.1: Passive Energy and Carbon Reduction for Whole Site

2-Bed Model	Annual Energy Demand kWh/year	Annual Carbon Emissions $kgCO_2$/year
Base Model	5,726	1,420
Improved External Walls	5,467	1,373
Improved Roof	5,539	1,386
Improved Ground Floor	5,653	1,407
All Measures	5,210	1,327
3-Bed Model	**Annual Energy Demand kWh/year**	**Annual Carbon Emissions $kgCO_2$/year**
Base Model	6,523	1,618
Improved External Walls	6,230	1,565
Improved Roof	6,312	1,580
Improved Ground Floor	6,441	1,603
All Measures	5,937	1,512

Table 3.2: Passive Energy and Carbon Reduction by Building Type

3.3.3 Low & Zero Carbon Technologies

Based on the technologies identified for further study in section 3.2.2 of this report, the following models have been generated:

- Base model utilising gas fired boilers and LED lighting
- Photovoltaics to building roofs (assumed 15m^2 per dwelling)
- Solar hot water generation
- Air source heat pumps generating heating and hot water

Potential energy and carbon savings for the development as a whole are presented in *Table 3.3* and the accompanying bar chart.

A breakdown of measures by building type is provided in *Table 3.4*.

Whole Site Model	Annual Energy Demand kWh/year	% Saving	Annual Carbon Emissions $kgCO_2$/year	% Saving
Base Model	119,280	N/A	29,581	N/A
PV	99,280	17%	19,181	35%
SHW	104,668	12%	26,951	9%
MVHR (3-Bed only)	115,254	3%	28,857	2%
Air Source Heat Pump	51,120	57%	26,582	10%

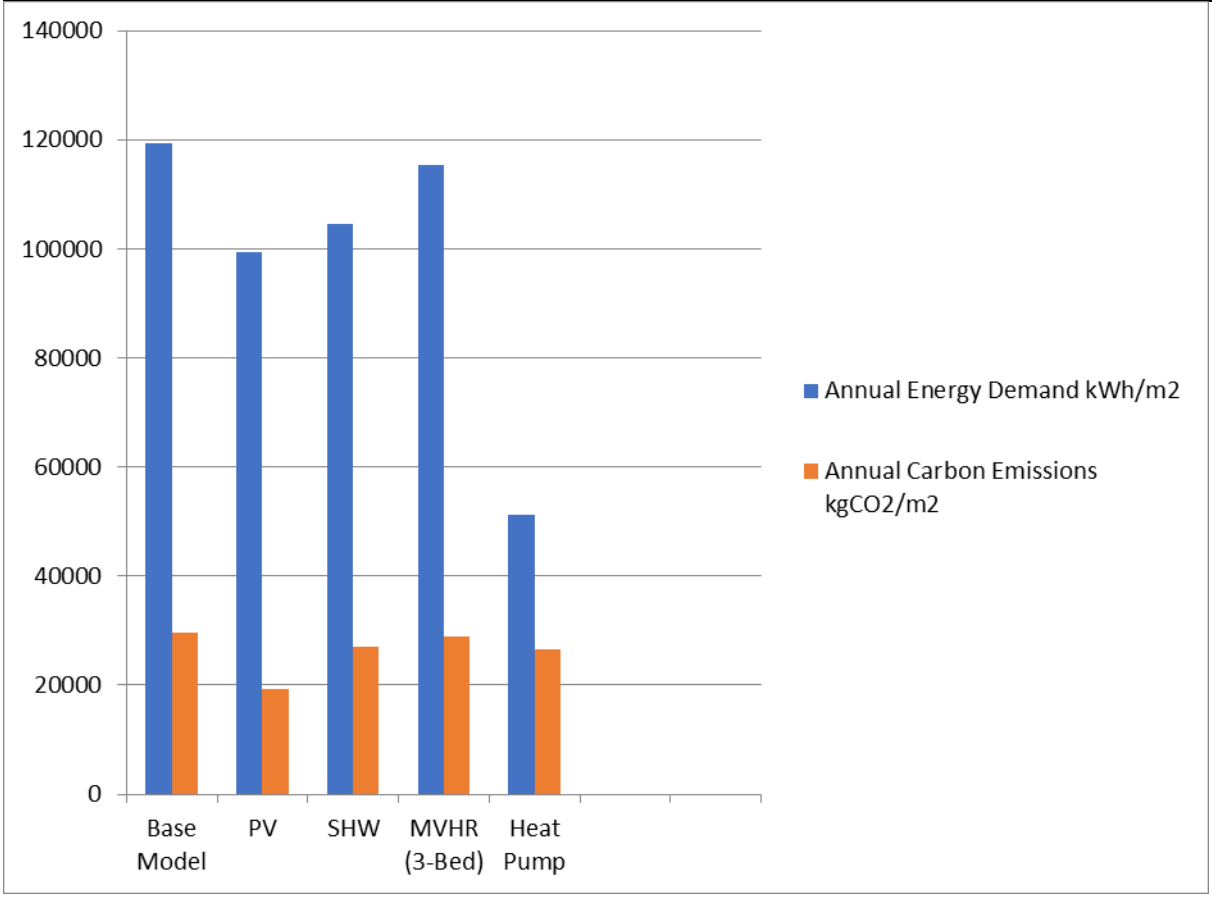


Table 3.3: LZC Energy and Carbon Reduction for Whole Site

2-Bed Model	Annual Energy Demand kWh/year	Annual Carbon Emissions $kgCO_2$/year
Base Model	5,724	1,420
PV	4,724	900
SHW	5,023	1,293
Air Source Heat Pump	2,453	1,276
3-Bed Model	**Annual Energy Demand kWh/year**	**Annual Carbon Emissions $kgCO_2$/year**
Base Model	6,523	1,618
PV	5,523	1,098
SHW	5,724	1,474
MVHR	6,083	1,538
Air Source Heat Pump	2,796	1,454

Table 3.4: LZC Energy and Carbon Reduction by Building Type

4.0 Conclusions

The modelling demonstrated that all units could achieve energy and carbon savings respectively via the use of enhanced building fabric. This would provide a significant reduction in the carbon footprint and energy infrastructure demands across the site as a whole, as well as reducing building running costs for building users.

Similar thought must be given to the impact of building usage on the selection of LZC technologies. Solar hot water, for example, could easily be applied to dwellings but would limit available roof space for photovoltaics. Overall, photovoltaic panels offer a greater opportunity to save energy and carbon and also provide a simpler solution for building occupiers/operators to maintain.

MVHR offers a relatively low saving and would introduce additional cost and complication to the build. As such, it is not recommended for inclusion in the final design solution.

Air source heating could offer a significant energy and carbon saving across the site.

The use of heat pump technologies could eliminate the requirement for natural gas to the site entirely, reducing reliance on fossil fuels.

A final summary model has been produced based on the most beneficial measures for the site, these being:

- Enhanced thermal envelope
- Photovoltaics to building roofs (assumed 15m^2 per dwelling)
- Air source heat pumps generating heating and hot water

Combining these measures achieved site-wide energy and carbon savings as recorded in *Table 4.0*, below.

Whole Site Model	Annual Energy Demand kWh/year	% Saving	Annual Carbon Emissions $kgCO_2$/year	% Saving
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