



Energy Demand Reduction Study

Pound Nursery, Angmering

Client: Barratt Homes Southampton

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Thermal House

8 Cardiff Road

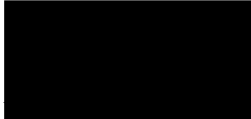
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1. Project Overview

1.1. Introduction

This energy demand reduction study was prepared by Environmental Economics Ltd on behalf of Barratt Homes Southampton (BHS) to support a planning application for a proposed development in Angmering. The report assesses measures to reduce the energy demand from the domestic housing on site through the use of Low and Zero Carbon (LZC) technologies.

1.2. Description of Site

The Pound Nursery site consists of 46 detached, semi-detached, and terraced dwellings.

The site location is shown in Appendix A. The proposed site layout/design is shown in Appendix B.

This energy demand reduction study addresses a domestic development being undertaken by BHS, and does not include any further proposals for subsequent developments or non-residential parcels.

1.3. Local Planning Requirements

The development has been designed to achieve a 10% reduction in energy demand through the use of Low and Zero Carbon (LZC) technologies

The development is set to comply with the targets set by the Arun District Council. Policy ECC SP2 states:

'All major developments must produce 10% of the total predicted energy requirements from renewables or low carbon energy generation on site unless it can be demonstrated that this is unviable.'

2. Improvement Measures

2.1. Assessment Methodology

Environmental Economics have modelled the proposed dwellings using NHER Plan Assessor software. The software provides a number of outputs which can be used to assess and compare the improvements from any number of build specifications in terms of:

- *Building regulations compliance*
- *Energy usage per year (kWh/annum)*
- *Carbon emissions as a measure of building regulations compliance (kg CO₂/m²/year)*
- *Energy costs per year (£/annum)*
- *More detailed breakdowns by end use (space heating, water heating, cooking, lighting, appliances)*
- *Code for Sustainable Homes compliance*
- *Effective air change rate*

Each of these outputs can be used in different ways to analyse the performance of the dwelling. For this project the requirement as set out in the previous section relates to a reduction in energy demand.

The analysis, therefore, evaluated the energy usage per year for each of the properties on site. The total energy demand for each property is based upon:

- *Space heating*
- *Water heating*
- *Electricity for pumps and fans*
- *Electricity for lighting*

Two models were created in order to calculate the difference in energy demand from the fabric improvements and addition of renewables. The total energy demand for the site is calculated for each of the models, and then the difference used to establish the improvement from LZC technology.

The first model without renewable technologies which achieves compliance with current Building Regulations is based upon standard BHEC heating and hot water designs. Depending on total floor area, this will take the form of a mains gas combi or regular condensing boiler.

The energy calculation for the space and water heating, as well as the electricity for pumps, fans and lighting were all assessed using the Standard Assessment Procedure 2012 (SAP) through the Plan Assessor software.

2.2. Design Philosophy

In addition to LZC technology, BHS have improved numerous elements of the build specification in order to improve energy efficiency across the site. The improved site specification is shown on table 1.

BHS have adopted the good design principles endorsed and promoted by The Zero Carbon Hub, the construction industries' key advisors and partners with the Governments Communities and Local Government Department. This guidance follows the general good principles of energy efficiency as the industry moves towards zero carbon. The principles are illustrated in figure 1 below.

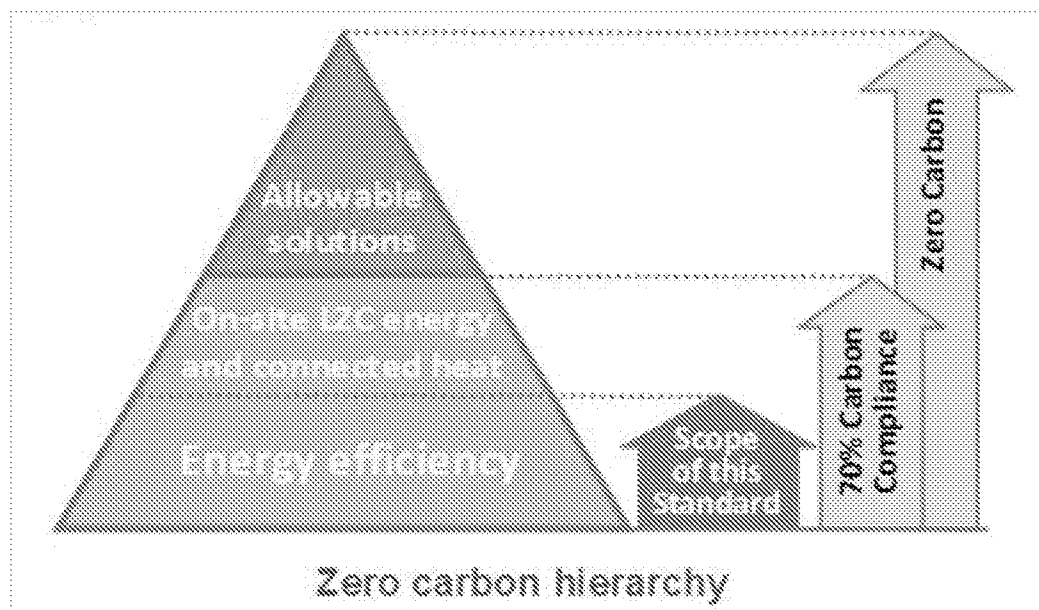


Fig. 1

Element	Proposed Specification	Performance W/m^2k
Roof	400mm Mineral Wool Insulation	0.11
Ground Floors	150mm Alreflex Platinum	0.12 – 0.16
Doors	Insulated Composite Doors	1.00 - 1.70
Glazing	High Performance Double Glazed, Low-E Coated and Argon Filled	1.41
Walls	Cavity Wall with 50mm Alreflex Platinum	0.27
Air Permeability	Air Pressure rate	$5.01m^3/hm^2$ (@50Pa)

Table 1

2.3. LZC Technologies

2.3.1. Photovoltaic (PV) Cells

The efficiency of PV cells has improved rapidly over the last 15 years. This has made a previously uneconomical technology an increasingly viable solution to rising energy costs and demand. The cells can be produced in a variety of formats but are typically manufactured as a panel or a roof tile for domestic housing applications.

The PV system typically produces direct current (DC) which is then sent through an inverter to supply the house with electricity. If a greater amount of electricity is produced than used by the household, this extra can be sold back to the national grid.

A PV cell is assessed on its peak power rating. This is tested by exposing the cell to the equivalent of full solar radiation and measuring the power output. The peak power is input into the NHER software as well as the physical attributes of the installation such as pitch, orientation and over-shading. A total energy saving per year can then be calculated through SAP for the PV installation. This is then offset against the electricity energy demand for the house.

2.3.2. Solar Hot Water (SHW) Systems

SHW systems provide hot water to a household usually in conjunction with a conventional boiler and cylinder system. Because of this they are best suited to houses with a need for a cylinder hot water system rather than a combi boiler.

There are two main SHW systems: evacuated tubes and flat plate collectors. Evacuated tubes are more efficient at transferring solar irradiation to the fluid although flat plate collectors are considered to be better aesthetically and to install.

The final energy contribution to the household, calculated through SAP, is based on a number of factors:

- *Pitch, orientation and over-shading*
- *Heat absorption efficiency for the collector*
- *Average hot water usage of the dwelling*

The majority of the energy savings will be made in the hot water demand for the dwelling however, adding a SHW system will impact upon other energy demands.

2.3.3. Air Source Heat Pumps (ASHP)

ASHP provide heating and hot water to a home through thermal energy gathered from air outside the dwelling. Systems can be designed to work in conjunction with a boiler system but in the case of energy efficient new builds it is possible for an ASHP unit to provide 100% of the heating and hot water demand.

The thermal performance of the unit depends on the outside temperature as well as the unit's Coefficient of Performance. This is the ratio of thermal energy produced to energy used. A typical value for this would be around 3.5, meaning that for every 1kW of electricity consumed the unit would provide 3.5kW of thermal energy to the household. This efficiency leads to large carbon and energy savings for both space and water heating.

ASHP are assessed by their power output and the size of unit chosen depends on the demand from the household. The units with a larger power output can provide a larger amount of hotter water even in colder climates.

2.3.4. Wind Turbines

Wind turbines provide electricity directly to a dwelling. They can be added to a property in two ways: pole mounted or building mounted. The pole mounted systems are free standing and therefore require enough space around them to allow for the construction and maintenance of the structure, as well as to allow for efficient operation. The building mounted systems have a lower power output but do not require additional structures.

The energy produced from a wind turbine is heavily dependent upon the surrounding landscape. The energy saved will be offset against the electricity usage of the dwelling.

2.3.5. Biomass Heating Systems

Biomass heating systems burn fuels, considered carbon neutral, to heat the water required for a dwelling. There are a large variety of systems available and choice depends on the type of fuel to be burned and the level of automation.

The system would offset the energy demand from the hot water and main space heating. However, biomass systems typically require a large amount of maintenance and monitoring.

The savings from such a system, in terms of CO₂ and money, depends upon what it is replacing. The savings are greatest when replacing an electrical hot water system but are considerably less for replacing mains gas.

2.3.6. Ground Source Heat Pumps (GSHP)

GSHP provide heating and hot water to a dwelling through geothermal effects. A GSHP system would offset the energy demand from the main space heating. There is, however, an additional electricity demand for the pump and control system. This would reduce energy savings from the installation.

GSHP are expensive to install and rely on having appropriate ground conditions and suitable space around the dwelling for the pipe looping. Energy savings are dependent upon the type of system being replaced and the way the system is operated by the homeowner.

2.3.7. Comparison

SHW can be easily incorporated into new build house designs and has the potential to reduce the energy demand from hot water considerably. The site layout has taken into account passive solar gains and therefore is suitable to benefit fully from solar technology.

The density of the site is a major restriction on the potential energy that could be generated from wind turbines. Surrounding houses and the inner city location would restrict wind speeds. In order to obtain the energy savings required, larger, more expensive pole mounted systems would be required.

Biomass hot water systems are more suited to the replacement of inefficient, carbon heavy systems such as electrical immersion heaters. The requirement of maintenance and monitoring makes it unsuitable for large scale new build developments

The installation cost and groundwork requirement make GSHP an expensive option. There is also a degree of uncertainty about the energy saving that can be obtained from the system as it requires diligent operation.

The solution of PV panel systems will be used to meet the 10% energy generation requirement.

SAP 20012 provides solar yield for the various combinations of roof pitch, orientation and over shading. The potential annual energy savings per kWp installed, depending on roof pitch and orientation, are shown in the table below.

Energy (kWh)

<i>Pitch</i>	<i>N</i>	<i>NE</i>	<i>E</i>	<i>SE</i>	<i>S</i>	<i>SW</i>	<i>W</i>	<i>NW</i>
0	769	769	769	769	769	769	769	769
30	584	628	730	822	858	822	730	628
45	512	549	683	798	843	798	683	549
60	400	478	621	742	791	742	621	478
90	297	352	466	564	597	564	466	352

Table 1

3. Evaluation

3.1. Potential Solution

The table presented in Appendix C shows the possible schedule of the PV arrays for each house type on the site, based on their proposed orientation. The plots proposed to be installed with a system in order to reach the 10% mark are listed along with their orientation. The table presented in Appendix D, along with Appendix C shows the results of the energy consumption of the site without renewables and the reduction from use of renewables and fabric improvements.

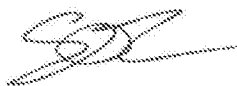
The total energy demand of the housing without any LZC technology is 286.4MWh/Annum. Therefore in order to meet the demand a saving of at least 28.46MWh/Annum needs to be achieved through the addition of renewables.

The installation of the PV schedule as shown in Appendix C would be sufficient for the energy condition. The total energy reduction from the PV schedule shown is 28.74MWh/annum, representing a 10.04% saving across the site.

3.2. Conclusion

Adoption of the illustrated schedule of photovoltaic panel arrays would result in a reduction in energy demand of at least 10% for the development.

Approved for Release



Date 24/04/2015

Appendix A



Appendix B



Appendix C

Plot	Housetype	Format	PV Orientation	PV (kWp)	Energy Reduction (kWh/Annum)
4	Woodvale	SD	S	1.5	1281.69
5	Woodvale	SD	S	1.5	1281.69
6	Finchley	SD	S	1.5	1281.69
7	Finchley	SD	S	1.5	1281.69
8	Barwick	SD	S	1.5	1281.69
9	Barwick	SD	S	1.5	1281.69
10	Finchley	SD	S	1.5	1281.69
11	Finchley	SD	S	1.5	1281.69
12	Tiverton	SD	S	1.5	1295.43
13	Tiverton	SD	S	1.5	1295.43
14	Woodbridge	DET	S	1.5	1295.43
15	Woodbridge	DET	S	1.5	1295.43
16	Alnwick	DET	S	1.5	1281.69
17	Falmouth	DET	s	1.5	1295.43
21	Falmouth	DET	s	1.5	1295.43
30	Alnwick	DET	S	1.5	1281.69
31	Thornbury	DET	S	1.5	1281.69
32	Thornbury	DET	S	1.5	1281.69
34	Barwick	MID	S	1.5	1281.69
33	Barwick	EOT	S	1.5	1281.69
27	Falmouth	DET	S	1.5	1295.43
35	Barwick	EOT	S	1.5	1281.69
29	Tiverton	SD	E	0.75	544.71
40	Farringdon	SD	S	1.5	1234.8
41	Farringdon	SD	SW	1.5	1234.8
Total Base Energy load across site (kWh):			Total Energy Reduction from renewables(kWh):		Percentage Below Base (%):
286435.00			28744.29		10.04

Appendix D

Client:	Barratt Southampton						
Project:	Pound Nursery Angmering						
Report:	Energy Reduction from On-Site Renewable Energy Generation						
House Type/ Plot Number	Space Heating Requirement	Hot Water Requirement	Lighting Requirement	Pumps and Fans Requirement	SAP Floor Area	Number of Plots	Total Energy Demand #1
-	kWh/Annum	kWh/Annum	kWh/Annum	kWh/Annum	m ²	-	kWh/Annum
Data Set 1: Base Case Design (Part L 2010 Compliant)							
Woodvale Mid AC	3991	2201	489	75	127.72	1	6,756
Woodvale EOT AC	4816	2190	489	75	127.72	4	30,279
Woodbridge EOT Cnty	4599	2183	470	75	120.88	2	14,654
Woodbridge DET	5352	2177	470	75	120.88	2	16,147
Tiverton EOT Std	2923	1688	313	75	67.92	7	34,992
Thornbury SD	4283	2054	456	75	111.72	1	6,868
Thornbury Det CB	4881	1923	456	75	111.72	1	7,334
T16 End-Terrace	3260	2038	410	75	86.02	4	23,129
T15 Mid-Terrace	2380	1930	359	75	72.80	1	4,744
T15 End-Terrace	3058	1928	347	75	72.80	4	21,630
Finchley EOT Cnty	2909	1970	358	75	77.20	4	21,248
Faringdon 1 Det AC	4328	2147	420	75	102.02	2	13,941
Falmouth 1 Det Cnty	3991	2029	365	75	84.95	3	19,381
Barwick Mid Cnty	2405	1971	375	75	77.20	1	4,827
Barwick EOT Cnty	2949	1970	360	75	77.20	5	26,769
Alnwick Det	5799	2074	486	75	138.85	4	33,736
Data Set 1 Total Energy Demand (kWh/Annum)							286,435