
ENERGY STATEMENT

ON

FORMER WILLIAM FREEMAN FACTORY
WAKEFIELD ROAD
BARNSELEY

AS AT

AUGUST 2009

John R Paley Associates
1 Red Hall Crescent
Paragon Business Village
Wakefield
WF1 3HX

T +44 (0)1924 383322
F +44 (0)1924 384381

- architectural design
- town planning
- landscape architecture



John R Paley Associates

Energy Statement

Wakefield Road, Mapplewell

1. Introduction

This document has been prepared following the request by Barnsley Council, for the outline planning application for residential and commercial development on land off Wakefield Road, Mapplewell to be accompanied by an Energy Statement.

The Government's energy policy, including its policy on renewable energy, is set out in the Energy White Paper. This aims to put the UK on a path to cut its carbon dioxide emissions by some 60% by 2050, with real progress by 2020, and to maintain reliable and competitive energy supplies.

The Government has already set a target to generate 10% of UK electricity from renewable energy sources by 2010. The White Paper set out the Government's aspiration to double that figure to 20% by 2020, and suggests that still more renewable energy will be needed beyond that date. The White Paper sets out policies to stimulate the development of new technologies to provide the basis for continuing growth of renewable in the longer term, to assist the UK renewable industry to become competitive in home and export markets and in doing so, provide employment.

The purpose of this report is to provide an initial assessment of the overall energy requirements and associated CO² emissions for the proposed development with an overview of feasible renewable energy options and the potential energy and CO² savings likely to result from their implementation.

2. Planning Policy

Planning Policy Statement 1

The Government's aim is a set of policies that provides clarity about the framework for achieving zero carbon development. This will provide greater certainty for the development industry and other related businesses, and support cost-effective solutions without over-regulating the sector. *Planning Policy Statement 1 (PPS1): Delivering Sustainable Development* sets out the overarching planning policies on the delivery of sustainable development through the planning system. Planning Policy Statement: Planning and Climate Change Supplement to Planning Policy Statement 1 was produced in December 2007. *Planning and Climate Change* sets out "how spatial planning, in providing for the new homes, jobs and infrastructure needed by communities, should help shape places with lower carbon emissions and resilient to the climate change now accepted as inevitable. Spatial planning, regionally and locally, provides the framework for integrating new development with other programmes that influence the nature of places and how they function."

Planning Policy Statement 22

PPS22 defines renewable energy as that which covers those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass. Policies in this statement therefore cover technologies such as onshore wind generation, hydro, photo-voltaics, passive solar, biomass and energy crops, energy from waste (but not energy from mass incineration of domestic waste), and landfill and sewage gas.

POLICY ENV5: Energy

The Region will maximise improvements to energy efficiency and increases in renewable energy capacity. Plans, strategies, investment decisions and programmes should:

A Reduce greenhouse gas emissions, improve energy efficiency and maximise the efficient use of power sources by:

1. Requiring the orientation and layout of development to maximise passive solar heating
2. Ensuring that publicly funded housing, and Yorkshire Forward supported development, meet high energy efficiency standards
3. Maximising the use of combined heat and power, particularly for developments with energy demands over 2MW, and incorporating renewable sources of energy where possible
4. Ensuring that development takes advantage of community heating opportunities wherever they arise in the region, including at Immingham and near Selby
5. Providing for new efficient energy generation and transmission infrastructure in keeping with local amenity and areas of demand
6. Supporting the use of clean coal technologies and abatement measures

B Maximise renewable energy capacity by:

1. Delivering at least the following Regional and Sub-Regional targets for installed grid connected renewable energy capacity:

2010 2021

Humber 124MW 350MW

North Yorkshire 209MW 428MW

South Yorkshire 47MW 160MW

West Yorkshire 88MW 295MW

Offshore 240MW 630MW

Total 708MW 1862MW

2. Monitoring annually planning permissions and developments against the indicative local authority targets for 2010 and 2021 set out in Table 10.2 and taking action accordingly in order to ensure the regional and sub regional targets are exceeded
3. Promoting and securing greater use of decentralised and renewable or low-carbon energy in new development, including through Development Plan Documents setting ambitious but viable proportions of the energy supply for new development to be required to come from such sources. In advance of local targets being set in DPDs, new developments of more than 10 dwellings or 1000m² of non-residential floorspace should secure at least 10% of their energy from decentralised and renewable or low-carbon sources, unless, having regard to the type of development involved and its design, this is not feasible or viable.

Local Policy

At a local level the Barnsley Unitary Development Plan (adopted 2000) seeks to: provide land use, development and transportation policies aimed at:

i) Reducing the need to travel by car, especially by:

- Promoting development within urban areas at locations highly accessible by means other than the private car
- Locate major generators of travel demand such as shopping, in existing centers and other highly accessible locations, especially for public transport
- Strengthen existing local centres in urban and rural areas, protecting and enhancing their viability and vitality
- Encouraging public transport, cycling and walking between home and facilities people visit regularly
- Limit parking provision to discourage reliance on use of cars for work and other journeys.

ii) Using land in urban areas as fully and effectively as possible without 'town cramming'

iii) Providing enough land for all needs - homes, jobs, shops, food, transport, fuel, building materials and reclamation

- iv) Protecting and enhancing high quality environments and wildlife habitats, and improving poor environments
- v) Recycling land for development
- vi) Conserving non-renewable resources and maximising energy generation from renewable resources
- vii) Minimising pollution of land, air and water and reduction of the impact of waste disposal.
- b) Complementary Transport measures aimed at :
 - i) Promoting modal choice by increasing the relative advantages of travelling by public transport, cycling and walking
 - ii) Reducing dependence on the private car
 - iii) Increasing the competitiveness and attractiveness of urban centres against peripheral development.
- c) Provision of transport infrastructure to:
 - i) Support the locational policies and objectives of the Plan
 - ii) Protect and improve the environment
 - iii) Reduce accidents.

The emerging Local Development Framework, Core Strategy produced in 2005 contains Policy EN2: Including renewable energy in developments, this states: -

New buildings above the following sizes, including conversions of existing buildings to new uses, must include equipment for producing renewable energy to provide at least 10% of predicted energy needs from renewable energy sources.

a Housing development of over 20 homes

b Business development of over 1000 square metres floor space

c Community development of over 1000 square metres floor space

We will refuse planning applications that do not meet these conditions.

Although the Core Strategy carries no weight in the determination of planning applications, the revised Core Strategy, which is due for public consultation in March 2009, will contain policies relating to renewable energy.

3. Site Description

The site is irregular in shape and comprises of approximately 4.4 hectares situated off Wakefield Road, Mapplewell, Barnsley. The site contains a redundant rubber factory with buildings covering half the site and areas of scrub and grassland covering the rest of the site.

The site currently provides existing buildings totalling circa 94,000 sq ft, with expansion land to the rear of circa 2.35 hectares.

The site can be divided into three distinct areas, which are:

- The factory area;
- Associated areas of hardstanding; and
- Rough scrubland, which is of no conservation value; and has been previously used for licensed landfill.

The site is brownfield in its entirety.

4. Sustainability Assessment

In support of the planning application a Sustainability Statement has been produced and is annexed in the Design and Access Statement, to provide information on various issues relating to the sustainability of the site and justification for residential development.

5. Assessment of Energy Demand & Carbon Emissions

5.1 Residential Development

SAP Calculations for energy use and carbon emissions have not yet been completed for the site specific house types, therefore the base line calculations in this energy statement use existing SAP calculations for a typical 4 bedroom semi-detached house of 1190 sq ft and a typical apartment of 732 sq ft. From these SAP calculations (see Appendix 1a and 1b) an energy demand per square foot of total floor area was calculated (Tables 1 & 2) and forms the basis of the predicted baseline energy demand calculations in this report (the energy use per square foot for the typical house and apartment multiplied by the total floor area for houses and apartments on the proposed development to give a predicted energy demand as shown in Tables 3 and 4).

The following energy demand and associated CO2 emissions have been derived from the SAP calculation for a typical house (Appendix 1a).

Energy demand and associated emissions of typical 1190 sq ft 4-bed semi House				
	Energy Demand(kWh/yr)	Emissions (KgCO2/yr)	Energy Demand per sq ft (kWh/yr/foot ²)	Emissions per sq ft (KgCO2/yr/foot ²)
Space Heating (Gas)	5248	1018	4.41	0.855
Water Heating (Gas)	3518	682	2.96	0.573
Lighting & Pumps/Fans (Electric)	871	368	0.73	0.309

Table 1

The following energy demand and associated CO2 emissions have been derived from the SAP calculation for a typical apartment (Appendix 1b).

Energy demand and associated emissions of typical 732 sq ft Apartment				
	Energy Demand(kWh/yr)	Emissions (KgCO2/yr)	Energy Demand per sq ft (kWh/yr/foot ²)	Emissions per sq ft (KgCO2/yr/foot ²)
Space Heating (Gas)	2284	443	3.12	0.605
Water Heating (Gas)	2790	541	3.81	0.739
Secondary Heating, Lighting & Pumps/Fans (Electric)	1022	431	1.40	0.588

Table 2

The Energy demand figures derived from the SAP calculations are divided into Space Heating from a Gas Condensing Boiler, Water Heating from a Gas Condensing Boiler and Electricity usage from Secondary Heating (Apartments only), pump operation and lighting and appliances. Carbon Dioxide emissions have been calculated from the 3 types of energy demand according to the differing carbon outputs for the differing energy types used. The results for Total Residential Energy Demand are shown in Table 5.

Predicted Baseline (Part L) Energy Demand for 67 Houses - 69,400 sq ft Total floor area		
	Energy Demand(kWh/yr)	Emissions (KgCO2/yr)
Space Heating (Gas)	306054	59337
Water Heating (Gas)	205424	39766
Lighting & Pumps/Fans (Electric)	50662	21444
Totals	562,140 kWh/yr	120,547 KgCO2/yr

Table 3

Predicted Baseline (Part L) Energy Demand for 16 Apartments - 9,800 sq ft Total floor area		
	Energy Demand(kWh/yr)	Emissions (KgCO2/yr)
Space Heating (Gas)	30576	5929
Water Heating (Gas)	37338	7242
Lights & Appliances (Electric)	13720	5762
Totals	81,634 kWh/yr	18,933 KgCO2/yr

Table 4

Total Predicted Base-line Energy Demand for Residential Development		
	Energy Demand(kWh/yr)	Emissions (KgCO2/yr)
Total Energy Demand - Houses	562,140 kWh/yr	120,547 KgCO2/yr
Total Energy Demand - Apartments	81,634 kWh/yr	18,933 KgCO2/yr
Total Residential Energy Demand	613,774 kWh/yr	139,480 KgCO2/yr

Table 5

5.2 Commercial Development

In accordance with approved document Part L2A, (Regulations 17A, 17B, 17C and 17E) the energy performance of all commercial buildings shall be in excess of the minimum standards required, based on a Target Emission Rate (TER) calculated by the Simplified Building Energy Model (SBEM). SBEM calculations shall be performed to detail the total energy demand of each building and the associated carbon dioxide emissions. When completed, these calculations shall be used to inform the selection of renewable energy technologies, which will be specified to provide a minimum of 10% of the total energy demand of the commercial buildings, as calculated by SBEM.

6. Proposed Energy Efficiency Measures

6.1 Residential Development

Insulation

To improve the energy efficiency and consequent carbon dioxide emission of the development, it is proposed that the insulation standard of the housing could be increased to a level above those currently required for Part L (2006) compliance. Wall insulation values could be improved through the specification of high thermal performance aerated concrete inner leaf blockwork and increasing the cavity width to accommodate a minimum of 75mm high performance foil-faced polyisocyanurate foam insulation in a partial fill cavity situation. This will improve wall U-values from 0.28 to 0.23 W/m²K. Additional improvements could be made by increasing the thickness of mineral wool roof insulation from 300mm to 400mm to improve roof U-values from 0.14 to 0.10 W/m²K and specifying a ground floor construction with an improved thermal insulation value of 0.21W/m²K over the Part L compliant value of 0.27 W/m²K. The improved thermal efficiency could be achieved with a 75mm thickness high performance foil-faced polyisocyanurate foam insulation above a beam and block floor or insitu concrete slab floor.

Air Tightness

Additional energy efficiency improvements can be gained through a commitment to using Accredited Construction Details, which will minimise the effects of cold bridging and air leakage.

Energy Efficient Lighting and Appliances

The energy demand calculations (Tables 1 - 3) are based on the provision of Dedicated Energy Efficient Lighting for 30% of the total lighting in each house type. With the provision of Energy Efficient Lighting to all light fittings and the specification of 'A-rated' appliances a further improvement in electrical energy demand and associated carbon dioxide emissions could be achieved.

Summary

It is anticipated that with the above suggested energy efficiency measures an improvement of 10 to 15% on the total residential development energy demand could be achieved. This would equate to an energy saving of between 61,377 and 92,065 kWh/yr and a Carbon Dioxide emission saving of between 13,948 and 20,922 KgCO₂/yr.

6.2 Commercial Development

Offices and industrial units will be designed to achieve high levels of energy efficiency in use and provide a healthy work environment. The commercial buildings will be designed to maximise daylight to provide a healthy work environment and reduce the energy demand for lighting. It is anticipated that a masonry construction to a similar specification to the

residential development will be specified and thus provide high levels of insulation and air tightness. The masonry construction will also provide thermal mass to absorb excess heat gain and help to regulate internal temperatures.

Energy demand for cooling will be minimised by incorporating solar shading devices on south-facing elevations to minimise unwanted solar gains. Energy efficient alternatives to conventional air-conditioning units, such as chilled ceiling cassettes will also be investigated.

The Health and Wellbeing of building users will be prioritised with adequate daylight levels, anti-glare measures and suitable artificial lighting levels with zone control.

Appropriate ventilation and thermal comfort will be provided with local control for temperature. Ambient Internal noise levels will be below specified levels. The Energy requirements and subsequent Carbon Dioxide emissions of all buildings will be minimised through high efficiency building services, high performance building fabric and focus on building services whole life performance.

A feasibility study will be carried out to consider renewable and low emission energy sources and where possible a minimum of 10% of total energy demand will be supplied through renewable energy. Carbon Dioxide emissions from energy in use will be substantially below those required for compliance with building regulations.

7. On-Site Renewable Energy Generation

Solar Hot Water Heating

The site layout has been designed to ensure that the majority of housing has a front or rear elevation and roof orientated within 35 degrees of due south. The site also features generous spacing between housing blocks, which ensures that overshadowing does not compromise available solar gains.

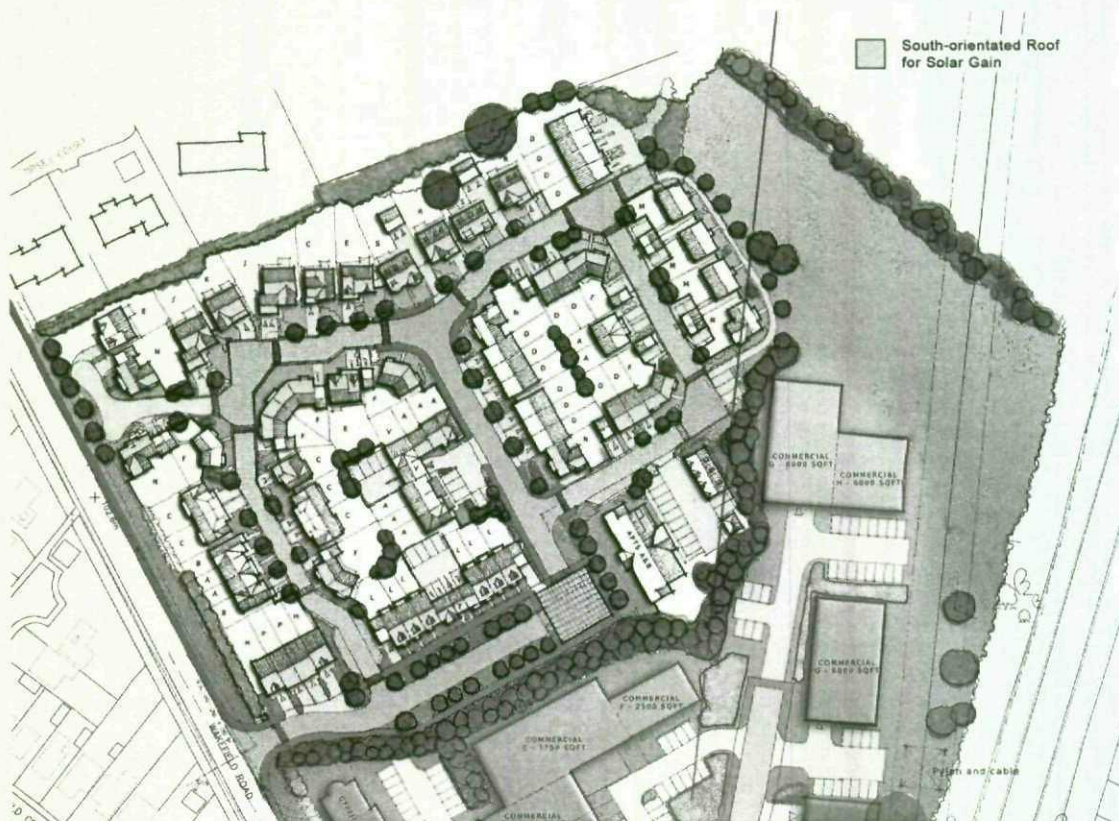


Fig1: Residential south orientation for Solar Gain

A south-facing orientation provides increased solar gain through glazing which reduces energy consumption for space heating as well as providing a suitable roof mounting space for a solar hot water heating system or Photo-Voltaic panels.

Solar Hot Water heating is considered to be a proven and robust renewable technology that can provide around a third of the average house's hot water needs, reducing the average domestic CO₂ emissions by around 325kg per year (online: www.energysavingtrust.org.uk).

As can be seen from Fig 1, a total of 40 houses have a roof orientation suitable for the installation of Solar Hot Water Heating Technology. Assuming the provision of evacuated tube solar water heating panels with a panel area of 3 m² and an effective output of 2000 kWh/yr for all 40 suitable houses, a total output of 80,000 kWh/yr will be achieved. This saving equates to 10.2% of the total energy demand of the residential section of the development.

Photovoltaic Panels

The cost of Photovoltaic panel systems is still prohibitively expensive with suggested payback periods on investment being a minimum of 50 years. As such, is not recommended as a source of renewable energy for the development.

Wind Turbines

The site has a large number of mature trees on its boundary. In addition to these disadvantages, the inland location of the development site suggests that the available wind resource is unlikely to be sufficient to viably support wind energy installations. Another factor to consider is the potential noise pollution from wind turbines that could affect residents. For these reason, wind turbines are not deemed to be a feasible source of renewable energy for this development.

Heat Pump Technology

Heat pumps extract the heat from solar energy stored in the ground or in the air and concentrate it for use in heating systems. Using conventional refrigeration technology heat is absorbed from the air or the ground into a refrigerant, which is then compressed to raise its temperature. A heat exchanger then takes out the heat and uses it in the heating system to provide warmth and hot water. A summer cooling mode can be incorporated into the system where the compression and expansion circuit is bypassed and the heat pump system is used to cool the building by absorbing heat from the building and releasing it back into the ground or the air. This is especially useful for commercial development, which are typically heat gain and consequently have a significant energy demand for cooling.

8. Summary

Evacuated tube solar hot water systems with a collector area of 3m², when installed on the 40 houses with a suitable south-facing roof will provide approximately 80,000 kWh/yr of renewable energy. This equates to 10.2% of the total energy requirement of the residential development (as calculated in Table 3) and a reduction in CO₂ emissions of 16,326 KgCO₂/yr.

It is anticipated that solar hot water systems will also contribute to the required 10% of energy demand for the commercial development. As commercial development has a lower demand for hot water and an increased energy requirement for space and cooling, it is anticipated that additional renewable technologies will be required to provide 10% of the total energy requirement through renewable energy sources. Heat pump technologies are likely to be utilised on the commercial development, in the form of Air Source or Ground source heat pumps, depending on ground conditions and feasibility studies.

Appendix 1a:

CALCULATION DETAILS for survey reference no 'Gtype_Semi_PartL' DER calculation (Existing Dwelling as Designed)

1. Overall house dimensions

Ground floor 39.900×2.320 92.57

First floor 39.900×2.620 104.54

Second floor 30.800×2.160 66.53

Total floor area 110.600 (5)

Total house volume 263.63 (6)

2. Ventilation rate

Number of chimneys 0×40 0

Number of flues 0×20 0

Number of fans 4×10 40

Flueless gas fire 0×40 0

Infiltration 0.15 (10)

Pressure test value 15.00 (q50)

Infiltration rate 0.90 (19)

Sides sheltered 1 (20)

Shelter factor 0.93 (21)

Adjusted infiltration rate 0.83 (22)

Air change natural ventilation 0.85 (24)

Effective air change rate 0.85 (25)

3. Heat losses

Doors ED1 1.970×3.050 6.01

Doors ED2 2.520×2.450 6.17

Doors Heat Loss total 12.18 (26)

Windows GW1 - Lounge $1.860 \times 1/[(1/1.480)+0.04]$ 2.60

Windows GW2 - Kitchen $1.260 \times 1/[(1/1.480)+0.04]$ 1.76

Windows FW1 - Bed 2 $1.620 \times 1/[(1/1.480)+0.04]$ 2.26

Windows FW2 - Bed 3 $1.260 \times 1/[(1/1.480)+0.04]$ 1.76

Windows FW3 - Bed 4 $1.100 \times 1/[(1/1.480)+0.04]$ 1.54

Windows FW4 - Stair Landing $1.240 \times 1/[(1/1.480)+0.04]$ 1.73

Windows SW1 - Master Bed $2.120 \times 1/[(1/1.480)+0.04]$ 2.96

Windows SW2 - 3- Master Bed - En Suite $1.220 \times 1/[(1/1.480)+0.04]$ 1.70

Windows Heat Loss total 16.32 (27)

Roof Lights Heat Loss total 0.00 (27)

Ground floor type 1 39.900×0.100 3.99

Ground floor Heat Loss total 3.99 (28)

Main External wall type 109.840×0.210 23.07 (29)

Secondary walls Loss total 0.00 (29a)

Roof type 1 $17.000 \times 1/[(1/0.100)+0.50]$ 1.62 (30)

Roof type 3 22.900×0.210 4.81 (30)

Roof Loss total 6.43 (30)

Total area of elements 205.81 (32)

Fabric heat loss 61.99 (33)

Appendix K: Thermal bridging 0.08 (y)

Effect of thermal bridges 16.46 (34)

Total fabric heat loss 78.45 (35)

Ventilation heat loss 73.76 (36)

Heat loss coefficient 152.22 (37)

Heat loss parameter (HLP) 1.38 (38)

4. Water heating energy requirements

Energy of heated water 2232.13 (39)

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CALCULATION DETAILS for survey reference no 'Gtype_Semi_PartL' Page: 7

Distribution loss 393.91 (40)

Tank volume 110.00 (43)

Hot Water storage loss factor 0.0086 (44)

Volume factor 1.029 (44a)

Temperature factor T 0.54 (44b)

Energy lost from tank 191.31 (45)

Energy lost from tank 191.31 (46)
 If cyl contains solar storage 191.31 (47)
 Primary circuit loss 360.00 (48)
 Output from water heater 3177.35 (51)
 Gains from water heating 1314.20 (52)
 5. Internal gains
 Lighting, appliances, cooking and metabolic (Table 5) 625.36 (53)
 Reduction of internal gains due to LE lighting (Appendix L)
 Correction factor for low-energy outlets 0.85 (C1)
 Window 1 $0.9 * 1.860 * 0.80 * 0.7 * 0.83 / 110.600$ 0.01
 Window 2 $0.9 * 1.260 * 0.80 * 0.7 * 0.83 / 110.600$ 0.00
 Window 3 $0.9 * 1.620 * 0.80 * 0.7 * 0.83 / 110.600$ 0.01
 Window 4 $0.9 * 1.260 * 0.80 * 0.7 * 0.83 / 110.600$ 0.00
 Window 5 $0.9 * 1.100 * 0.80 * 0.7 * 0.83 / 110.600$ 0.00
 Window 6 $0.9 * 1.240 * 0.80 * 0.7 * 0.83 / 110.600$ 0.00
 Window 7 $0.9 * 2.120 * 0.80 * 0.7 * 0.83 / 110.600$ 0.01
 Window 8 $0.9 * 1.220 * 0.80 * 0.7 * 0.83 / 110.600$ 0.00
 Ratio of glass area to floor area 0.04 (GL)
 Correction factor for daylighting 1.10 (C2)
 Annual energy used for lighting in the house 958.01 (EL)
 Reduction in lighting use due to low energy lights 169.06 (deltaEL)
 Low energy lighting -25.36 (53a)
 Central heating pump 10.00 (53b)
 Water heating 150.02 (54)
 Total internal gains 760.03 (55)

6. Solar gains

Access Area Flux g FF Gains

Factor (m2) (W)

Windows 'W' $0.770 * 1.860 * 48.000 * 0.9 * 0.780(G) * 0.7$ 33.78 (62)
 Windows1 'E' $0.770 * 1.260 * 48.000 * 0.9 * 0.780(G) * 0.7$ 22.88 (58)
 Windows2 'W' $0.770 * 1.620 * 48.000 * 0.9 * 0.780(G) * 0.7$ 29.42 (62)
 Windows3 'E' $0.770 * 1.260 * 48.000 * 0.9 * 0.780(G) * 0.7$ 22.88 (58)
 Windows4 'E' $0.770 * 1.100 * 48.000 * 0.9 * 0.780(G) * 0.7$ 19.98 (58)
 Windows5 'W' $0.770 * 1.240 * 48.000 * 0.9 * 0.780(G) * 0.7$ 22.52 (62)
 Windows6 'W' $0.770 * 2.120 * 48.000 * 0.9 * 0.780(G) * 0.7$ 38.50 (62)
 Windows7 'E' $0.770 * 1.220 * 48.000 * 0.9 * 0.780(G) * 0.7$ 22.16 (58)

Manufacturer supplied factors:

(G) = factor g for 'Glazing Only'.

(W) = factor g for 'Whole window', includes FF.

(B) = factor g taken from 'BFRC Data', includes 0.9 and FF.

Total solar gains 212.13 (65)

Total gains, W 972.16 (66)

Gains/loss ratio (GLR) 6.39 (67)

Utilisation factor 0.940 (68)

Useful gains, W 914.12 (69)

7. Mean internal temperature

Mean internal temperature of living zone (heating type = 1) 18.88 (70)

Temperature adjustment 0.00 (71)

Adjustment for gains 0.40 (72)

Adjusted room temperature 19.28 (73)

Temperature difference between zones 1.88 (74)

Living area fraction 0.114 (75)

Rest of house floor fraction 0.886 (76)

Mean internal temperature 17.62 (77)

8. Degree days

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CALCULATION DETAILS for survey reference no 'Gtype_Semi_PartL' Page: 8

Temperature raise from gains 6.01 (78)

Base temperature 11.61 (79)

Degree days 1263.45 (80)

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

Space heating requirement (useful) 4615.59 (81)
Fraction of heat from secondary system 0.10 (82)
Database boiler reference number : 10459
Model name : Greenstar Cdi
Manufacturer: Worcester Bosch Group
MHS efficiency 90.3
Main system efficiency 90.3 (83)
Secondary system efficiency 100.0 (84)
Space heating fuel - main HS 4600.25 (85)
Space heating fuel - secondary HS 461.56 (85a)
Efficiency of water heater 90.30 (86) (from SEDBUK database)
Energy required for water heating 3177.35
Energy used for water heating 3518.66 (86a)
For each central heating pump 130.00 (87a)
For each boiler with F.A.F 45.00 (87b)
Electricity for pumps, fans, ... 175.00 (87)

10a. Fuel costs - individual heating systems

MHS heating cost [$4600.25 * 1.6300 * 0.01$] 74.98 (88)
SHS heating cost [$461.56 * 7.1200 * 0.01$] 32.86 (89)
Water heating cost [$3518.66 * 1.6300 * 0.01$] 57.35 (91)
Pump/fan energy [$175.00 * 7.1200 * 0.01$] 12.46 (92)
Lighting energy [$958.01 * 7.1200 * 0.01$] 68.21 (93)
Additional standing charges 34.00 (94)
Total energy cost 279.87 (97)
Total energy cost using Sedbuk db prices 453.05

12a. Carbon dioxide emissions

MHS heating CO2 [$4600.25 * 0.1940$] 892.45 (101)
SHS heating CO2 [$461.56 * 0.4220$] 194.78 (102)
WHS heating CO2 [$3518.66 * 0.1940$] 682.62 (103)
Space and water heating CO2 1769.85 (107)
Pumps and fans CO2 [$175.00 * 0.4220$] 73.85 (108)
Lighting CO2 [$958.01 * 0.4220$] 404.28 (109)
Total CO2 emissions in kg/year 2247.98 (112)
Dwelling's Carbon Emission Rate (DER) 20.33 (113)
Dwelling's Carbon Factor 14.45 (CF)
Environmental Impact Rating 80.64
Environmental Impact Rating rounded 81
Environmental Impact Rating band B

Appendix 1b:

CALCULATION DETAILS for survey reference no '07 3934 - FLAT 17' Page: 1

SAP calculation (Existing Dwelling as Designed)

1. Overall house dimensions

Ground floor $68.000 * 2.350$ 159.80

Total floor area (5): 68.000

Total house volume 159.80 (6)

2. Ventilation rate

Number of chimneys $0 * 40$ 0

Number of flues $1 * 20$ 20

Number of fans $3 * 10$ 30

Flueless gas fire $0 * 40$ 0

Infiltration 0.31 (10)

Pressure test value 7.00 (q50)

Infiltration rate 0.66 (19)

Sides sheltered 2 (20)

Shelter factor 0.85 (21)

Adjusted infiltration rate 0.56 (22)

Air change natural ventilation 0.66 (24)

Effective air change rate 0.66 (25)

3. Heat losses

Doors type 1 $1.960 * 1.600$ 3.14

Doors type 2 $4.410 * 1.600$ 7.06

Doors Heat Loss total 10.19 (26)

Windows type 1 $2.880 * 1/[(1/1.600)+0.04]$ 4.33

Windows type 2 $2.880 * 1/[(1/1.600)+0.04]$ 4.33

Windows Heat Loss total 8.66 (27)

Roof Lights Heat Loss total 0.00 (27)

Ground floor type 1 $68.000 * 0.000$ 0.00

Ground floor Heat Loss total 0.00 (28)

Main External wall type $29.550 * 0.270$ 7.98 (29)

Secondary walls Loss total 0.00 (29a)

Plane Roofs type 1 $68.000 * 0.100$ 6.80 (30)

Roof Loss total 6.80 (30,30a,30b)

Total area of elements 109.68 (32)

Fabric heat loss 33.63 (33)

Appendix K: Thermal bridging 0.08 (y)

Effect of thermal bridges 8.77 (34)

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CALCULATION DETAILS for survey reference no '07 3934 - FLAT 17' Page: 2

Total fabric heat loss 42.41 (35)

Ventilation heat loss 34.74 (36)

Heat loss coefficient 77.14 (37)

Heat loss parameter (HLP) 1.13 (38)

4. Water heating energy requirements

Energy of heated water 1686.23 (39)

Distribution loss 297.57 (40)

Hot Water storage loss factor 0.00 (44)

Volume factor 0.00 (44a)

Temperature factor T 1.00 (44b)

Energy lost from tank 0.00 (45)

Energy lost from tank 0.00 (46)

If cyl contains solar storage 0.00 (47)

Primary circuit loss 0.00 (48)

Combi loss from Table 3a 558.64 (49)

Output from water heater 2542.45 (51)

Gains from water heating 799.28 (52)

5. Internal gains

Lighting, appliances, cooking and metabolic (Table 5) 421.30 (53)

Reduction of internal gains due to LE lighting (Appendix L)

Correction factor for low-energy outlets 0.50 (C1)

Window 1 $0.9 * 2.880 * 0.80 * 0.7 * 0.83 / 68.000$ 0.02

Window 2 $0.9 * 2.880 * 0.80 * 0.7 * 0.83 / 68.000$ 0.02

Ratio of glass area to floor area 0.04 (GL)
Correction factor for daylighting 1.15 (C2)
Annual energy used for lighting in the house 362.47 (EL)
Reduction in lighting use due to low energy lights 362.47 (deltaEL)
Low energy lighting -54.37 (53a)
Central heating pump 10.00 (53b)
Water heating 91.24 (54)
Total internal gains 468.18 (55)

6. Solar gains

Access Area Flux g FF Gains

Factor (m2) (W)

Windows 'S' $0.770 * 2.880 * 72.000 * 0.9 * 0.630 * 0.7$ 63.37 (60)
Windows1 'W' $0.770 * 2.880 * 48.000 * 0.9 * 0.630 * 0.7$ 42.25 (62)
Total solar gains 105.62 (65)
Total gains, W 573.79 (66)
Gains/loss ratio (GLR) 7.44 (67)

Utilisation factor 0.91 (68)

Useful gains, W 522.77 (69)

7. Mean internal temperature

Mean internal temperature of living zone 18.88 (70)

Temperature adjustment 0.00 (71)

Adjustment for gains 0.56 (72)

Adjusted room temperature 19.44 (73)

Temperature difference between zones 1.43 (74)

Living area fraction 0.41 (75)

Rest of house floor fraction 0.59 (76)

Mean internal temperature 18.59 (77)

8. Degree days

Temperature raise from gains 6.78 (78)

Base temperature 11.81 (79)

Degree days 1305.18 (80)

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

Space heating requirement (useful) 2416.51 (81)

Model name : Greenstar High Flow 440

Manufacturer: Worcester Heat Systems

MHS efficiency 91.1

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CALCULATION DETAILS for survey reference no '07 3934 - FLAT 17' Page: 3

MHS efficiency adjustment for controls 0.0

Main system efficiency 91.1 (83)

Secondary system efficiency 0.0 (84)

Space heating fuel - main HS 2652.59 (85)

Space heating fuel - secondary HS 0.00 (85a)

Efficiency of water heater 91.10 (86)

Energy required for water heating 2542.45

Energy used for water heating 2790.83 (86a)

For each central heating pump 130.00 (87a)

For each boiler with F.A.F 45.00 (87b)

Electricity for pumps, fans, ... 175.00 (87)

10a. Fuel costs - individual heating systems

MHS heating cost [$2652.59 * 1.6300 * 0.01$] 43.24 (88)

SHS heating cost [$0.00 * 0.0000 * 0.01$] 0.00 (89)

Water heating cost [$2790.83 * 1.6300 * 0.01$] 45.49 (91)

Pump/fan energy [$175.00 * 7.1200 * 0.01$] 12.46 (92)

Lighting energy [$362.47 * 7.1200 * 0.01$] 25.81 (93)

Additional standing charges 34.00 (94)

Total energy cost 161.00 (97)

11. SAP rating

Energy cost deflator 0.91 (98)

Energy cost factor 1.03 (99)
SAP value 85.61
SAP Energy rating 86 (100)
SAP Energy rating band B

12a. Carbon dioxide emissions

MHS heating CO2 [$2652.59 * 0.1940$] 514.60 (101)
WHS heating CO2 [$2790.83 * 0.1940$] 541.42 (103)
Space and water heating CO2 1056.02 (107)
Pumps and fans CO2 [$175.00 * 0.4220$] 73.85 (108)
Lighting CO2 [$362.47 * 0.4220$] 152.96 (109)
Total CO2 emissions in kg/year 1282.83 (112)
Dwelling's Carbon Factor 11.35 (CF)
Environmental Impact Rating 84.79
Environmental Impact Rating rounded 85
Environmental Impact Rating band B

13a. Primary energy

MHS heating P.E. [$2652.59 * 1.1500$] 3050.47
WHS heating P.E. [$2790.83 * 1.1500$] 3209.46
Space and water heating P.E. 6259.93
Pumps and fans P.E. [$175.00 * 2.8000$] 490.00 (104)
Lighting P.E. [$362.47 * 2.8000$] 1014.91 (104a)
Primary energy kWh/year 7764.84
Primary energy kWh/m2/year 114.19 (105)

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