ENERGY STATEMENT
FOR THE
PROPOSED RESIDENTIAL SCHEME
QUEENS ROAD, RICHMOND

Wakefield

Manchester

Birmingham

London

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ENERGY EFFICIENCY STATEMENT
FOR THE
PROPOSED RESIDENTIAL SCHEME
QUEENS ROAD, RICHMOND

CONTENTS

1.0 Introduction

This energy efficiency statement has been prepared in support of the Planning Application for the residential development situated at Queens Road, Richmond which comprises of 4 apartments and 1 new build detached dwelling including a self contained studio apartment.

The statement has been prepared in accordance and with reference to the Richmond City Council document “Energy Statement Guidelines for developers” in compliance with policy CP1, and the “London Plan” policy 4A.7.

This energy efficiency statement is intended to show the predicted energy demand and carbon emissions of the proposed development and the degree to which the development meets current energy efficiency standards and follows the hierarchy of The London Plan in terms of: use less energy, supply energy efficiently and utilise renewable energy.

Richmond Council planning policy requirements include for the reduction in $C0^2$ emissions by some 25% above target emissions. This improvement is in line with the current energy reduction requirements of the Code for Sustainable Homes, to achieve Level 3 compliance. In addition, a further 20% reduction shall also be made from dedicated renewable technologies (where feasible).

This report provides an energy assessment for the proposed development showing predicted annual demands for heating, hot water, ventilation, lighting and power together with the carbon emissions resulting from this energy consumption.

The new build residential element will need to comply with building regulations part L1A and sample SAP calculations are included at the rear of this document and have been used to establish the likely energy consumption and carbon emissions.

2.0 Executive Summary

Richmond Council Planning Services require, in support of a planning application, an energy assessment based on the guidance contained within their document “Energy Statement Guidelines for developers” which has the aim of reducing energy demand for any development over the baseline case by reducing the emissions by 25% and then to further introduce on site renewable energy generation based on a 20% ratio of total energy demand.

This report demonstrates by what method 20% of the demand could be generated on site by renewable means.

The SAP calculations appended to this report are based on the proposed use of gas fired heating and hot water generation but coupled with good thermal design and air leakage rates. U values of 0.23 W/m2.k for external walls, 1.4 W/m2.k for glazing and 0.18 W/m2.k for the roof have been adopted together with an air leakage rate of 6 m3/hr.m2 @ 50 Pa.

The report demonstrates that 20% of the energy demand can be generated by a number of renewable technologies however the use of a mixture of ground source heat pumps and solar PV will generate in excess of the 20% baseline figures required for the necessary CO2 reductions.

The incorporation of the solar PV panels to the conversion of the existing property has been based on available roof area. It is considered that only rear facing roof areas will be given approval for the installation of this technology, therefore the number and size of unit has been limited. Whilst it is noted that a 20% reduction in $C0^2$ emissions from dedicated renewable technology is still achieved, the requirements for an additional 25% reduction is considered unfeasible for the conversion element of the project. It is noted that this building, which is considered of Architectural Merit, would not allow the feasible incorporation of any further renewable features without a major change to the external aesthetics of the property. It is however confirmed that the total $C0^2$ reductions, from this incorporation, is achieving the minimum 25% reductions to achieve Code for Sustainable Homes level 3 compliance.

In summary therefore this report will illustrate that the carbon dioxide emissions related to energy consumption within this development have been reduced overall by >25% in relation to Building Regulations.

The tables at the rear of this report highlight how this inclusion has been implemented.

3.0 Base Energy Demand

The starting point for the determination of energy improvements or indeed renewable integration must be the establishment of the base load. In this instance the base load has been established by use of SAP software.

At this early stage of the design development sample SAP calculations have been carried out for all of the proposed dwellings. These will need to be revisited at the next stage of the project by a suitably qualified representative of the design team.

The summary of the results of these SAP calculations are contained within Table 1 of this report at the rear of this document. The SAP calculations themselves are included in Section 13.

4.0 Reduction of Energy Demand

The document “Energy Statement Guidelines for developers” suggests a statement should be made as to how the energy demand for the proposed development will be reduced relative to the baseline through improvements in energy efficiency standards. This is allied to the hierarchy of the London Plan in terms of “use less” (energy) and in particular section 4A.3 which states “reduce carbon dioxide and other emissions that contribute to climate change” and “minimise energy use, including by passive solar design, natural ventilation, and vegetation on buildings” as well as “supply energy efficiently and incorporate decentralised energy systems” (Policy 4A.6), and “use renewable energy where feasible” (Policy 4A.7)

The proposed scheme therefore incorporates a number of alternative design solutions for the development in order to reduce the energy demand. Firstly the thermal elements have improved U values such as: walls 0.23 W/m2K, Glazing 1.4 W/m2K and roof 0.18 W/m2K and secondly reduced air leakage rates of 6 M3/hr.m2 @ 50Pa have been adopted. These represent a substantial improvement upon Building Regulations.

Table 1 at the rear of this report illustrates the energy demand in kWhrs/m2/annum for heating, hot water, lighting and power and the consequent CO2 emissions.

The tables show the combined effect of improved thermal performance of the building shell together with careful selection of building services systems have contributed to a carbon dioxide emission reduction.

5.0 Options for Incorporating Sustainability and Renewable Energy Technology

The document "Development Control Advice Note 1" requires consideration to be given to the inclusion of onsite renewable energy generation by a target of 20%.

Having taken the appropriate steps to ensure the building is designed to minimise baseline carbon emissions it is then necessary to consider renewable energy technologies which may be relevant to the project.

Initially we have considered all technologies. The tables at the rear of this report also highlight the 20% requirement.

The following were therefore considered: -

5.1 Wind Turbine

The efficiency of wind turbines increases with size (and cost) and given the required load for this scheme it would be possible to provide a single turbine to the scheme at 25kWe depending upon the local wind speed.

The dimensions of the turbine are detailed within the table at the rear of this report. The turbine and tower requires a 'footprint' on the ground to allow the installation to be erected and provide maintenance access.

Costs

The Clear Skies Programme gives a cost range of £2,500 - £5,000 per kWh installed.

Suitability for the Development

Not considered suitable as no real suitable location on the site and not competitive on a cost comparative basis. It is unknown whether turbines would receive acceptance from the Planning Authority at this stage.

5.2 Solar Water Heating

Solar water heating systems use the energy from the sun to heat water, most commonly in the UK for hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building. For this project

it is anticipated that the solar thermal panels could feed storage cylinders and pre-heat the domestic hot water cold feed thereby reducing the load requirements of the electric immersion heater. The systems work very successfully in all parts of the UK, as they can work in diffuse light conditions.

There are two types of collectors used for solar water heating applications - flat plate collectors and evacuated tube collectors. The flat plate collector is the predominant type used in domestic systems as they tend to be cheaper. Evacuated tube collectors are generally more expensive due to a more complex manufacturing process (to achieve the vacuum) but manufacturers generally claim better winter performance.

Ideally the collectors should be mounted on a south-facing roof, although south-east/south-west will also function successfully, at an elevation of between 10 and 60°. The panels can be bolted onto the roof or integrated into the roof with lead flashings. They look similar to roof-lights. Solar water heating systems are suitable for any building type that has sufficient year round hot water needs (ideally during the day). The solar water heating system has been analysed based upon occupancy and hence hot water usage. Due to the fact that this type of system utilises solar gain from the sun to heat water, the ideal orientation of the roof mounted solar panels is between south-east and south-west.

Costs

There can be a large variation in the costs of installation labour, pipe-work, fittings etc that depend on site-specific issues. Probably the most important issues are the relative locations of the solar collectors and the hot water storage (obviously the closer together they are the shorter the pipe-runs), the degree of complication in running the pipe-runs from the collectors to the hot water storage (i.e. is there an obvious route for the pipes) and the ease (and costs) of establishing safe working access on the roof area where the collectors are to be mounted. The interface between the solar suppliers/installers and the main contractor can also be a significant factor in determining cost (where the main contractors can add a significant fee for their role in co-ordinating works).

Suitability for the Development

The installation of Solar Thermal collection is entirely suitable for the domestic development. Further consideration is to be given to its incorporation.

5.3 Photovoltaics

Photovoltaic panels utilise energy in the form of rays of light from the Sun and are therefore required to be mounted on either a south facing roof or wall to ensure energy output is maximised.

Photovoltaic systems convert energy from the sun into electricity through semi conductor cells. Systems consist of semi-conductor cells connected together and mounted into modules. Modules are connected to an inverter to turn their direct current (DC) output into alternating current (AC) electricity for use in buildings. Photovoltaics supply electricity to the building they are attached to or to any other load connected to the electricity grid. Excess electricity can be sold to the National Grid when the generated power exceeds the local need. PV systems require only daylight, not sunlight to generate electricity (although more electricity is produced with more sunlight), so energy can still be produced in overcast or cloudy conditions. Photovoltaics are generally blue/grey in colour and can be used successfully in all parts of the UK.

Photovoltaic panels come in modular panels which can be fitted to the top of roofs (looking similar to a roof light) and in slates or shingles which are an integral part of the roof covering (looking similar to normal roof tiles). Photovoltaic cells can be incorporated into glass for atria walls and roofs or used as cladding or rain screen on a building wall.

Photovoltaic systems can be discreet through being designed as an integral part of the roof. An ‘invisible’ design using slates or shingles as opposed to an architectural statement is likely to be preferable if in a sensitive area.

Ideally photovoltaics should face between south-east and south-west, at an elevation of about 30-40°. However, in the UK even flat roofs receive 90% of the energy of an optimum system. They are particularly suited to buildings that use electricity during the day - offices, retail and schools.

Costs

Budget costs for photovoltaic arrays are £5,000 - £8,000 per kWp (the Energy Saving Trust suggest an average of £6,000 per kWp for roof mounted systems and £10,000 to £15,000 for façade systems). kWp is peak kW output. The area required to generate 1 kWp will vary depending upon the type of panel from 8m^2 to 20m^2.

Payback periods are likely to exceed 25 years however each kWp installed is likely to save 360kg of carbon per year.

The annual cost saving brought about by incorporating this technology is detailed within the Tables at the rear of this report for specific areas of photovoltaics (based on the nominal

energy demands to meet the percentage requirements) this also takes into account the maintenance costs associated with cleaning to ensure maximum performance.

Suitability for the Development

Despite the poor payback figures, due to domestic feed in tariffs currently being available, the incorporation of Solar PV is considered appropriate for the development. The inclusion of which is highlighted in the anticipated summary $C0^2$ emissions tables at the end of this report.

5.4 Ground Source Heat Pumps

Ground source heat pumps are used to extract heat from the ground to provide space and water heating to both individual houses and any type of non-domestic building. Heat pumps take in heat at a certain temperature and release it at a higher temperature, using the same process as a refrigerator. As the ground stays at a fairly constant temperature throughout the year heat pumps can use the ground as the source of heat.

The ground temperature is not necessarily higher than ambient air temperature in winter but it is more stable whereas air has a vast temperature range. This makes system design more robust.

Water (or another fluid) is circulated through pipes buried in the ground and passes through a heat exchanger in the heat pump that extracts heat from the fluid. The heat pump then raises the temperature of the fluid via the compression cycle to supply hot water to the building as from a normal boiler.

Most heat pumps are electrically driven but other systems can use waste heat or burn fossil fuel such as gas. The measure of efficiency of a heat pump is given by the Coefficient of Performance (CoP), which is defined as the ratio of the heat output, divided by quantity of energy put in. CoPs of 3 or more should be achievable with ground sourced heat pump systems, and CoPs of up to 4.5 can be achieved with air source giving good energy and running cost savings.

The heat pump can replace the boiler in a single house but in larger non-domestic buildings it is likely to be one of a number of modular condensing units, depending on what proportion of the heat demand it is designed to satisfy. The optimal use of the heat pump system is with under floor heating as this is run at lower temperatures making the operation of the heat pump more efficient. Electrically driven heat pumps should be very reliable but require maintenance to keep to full CoPs.

The ground pipe system can be horizontal or vertical. For horizontal systems, a coiled pipe network is buried at around two metres depth below ground level, thus requiring a large area of open space depending on the size of the system.

For vertical systems, the pipes are placed in holes bored straight into the ground to a depth of 15 to 150 metres depending on ground conditions and size of system. Vertical systems thus require very little ground space but do require access for the drilling rig at the construction stage, though this is unlikely to be greater than for normal construction vehicles.

Whilst a ground source heat pump is clearly not a wholly renewable energy source as it uses electricity, the renewable component is considered as the heat (and coolth) extracted from the ground and air, measured as the difference between heat output, less the primary electrical energy input.

Ground source heat pump systems can be used in almost any size of domestic building. A particular use is where natural gas is not available making the ground and air source heat pump more economic. Ground source heat pumps cannot be seen from the outside of the building, so aesthetic design is not an issue.

Costs

The main additional cost in a ground source heat pump system is the installation of the pipes in the ground, which depends on the ground conditions and length or depth needed to be installed.

Suitability for the Development

The heat pump technology generates low grade heat which would be particularly suitable for under floor heating demand and domestic hot water production.

It is therefore considered that the use of ground source heat pumps for this provision be considered in more details as a practical form of heating for the detached dwelling.

5.5 Conclusions

Table 1 at the rear of this report shows the estimated total annual energy requirement for the proposed scheme as assessed by the SAP calculations. Copies of the TER outputs from the SAP calculations are also appended to the rear of the report.

Given the nature of the site it is unlikely a suitable location could be agreed for the siting of a wind turbine. Solar hot water collection is not considered at this stage either. The current calculations appended to the rear of this report highlight a total of 20% (or more) improvement over the target emissions provided from the incorporation of solar PV to the apartments, and a mixture of solar PV and Ground Source heat pump to the new detached dwelling.

In the case of solar PV these would be roof mounted panels and would be largely unobtrusive and given the nature of the site probably represent a viable solution. The incorporation of the solar PV panels to the conversion of the existing property has been based on available roof area. It is considered that only rear facing roof areas will be given approval for the installation of this technology, therefore the number and size of unit has been limited. Whilst it is noted that a 20% reduction in $C0^2$ emissions from dedicated renewable technology is still achieved, the requirements for an additional 25% reduction is considered unfeasible for the conversion element of the project. It is noted that this building, which is considered of Architectural Merit, would not allow the feasible incorporation of any further renewable features without a major change to the external aesthetics of the property. It is however confirmed that the total $C0^2$ reductions, from this incorporation, is the minimum 25% reductions to achieve Code for Sustainable Homes level 3 compliance.

The ground source heat pump installation considered for the detached dwelling and associated self contained studio apartment, could be utilised for heating, hot water production, and potentially used to heat the proposed swimming pool.

The calculations for the lower ground studio apartment are included within that of the detached dwelling to which it is incorporated within. The main plant (and energy use) for these two elements are combined, therefore the total energy use (and $C0^2$ emissions) are combined.

Current renewable technology inclusion;

Apartment 01	1kWp PV installation
Apartment 02	1kWp PV installation
Apartment 03	1kWp PV installation

Apartment 04	1.5kWp PV installation
Detached House	4kWp PV installation + 30kW Ground Source heat pump (including self contained studio apartment)

Table 1 – Summary Baseline and Emission reductions

RESIDENTIAL ENERGY STATEMENT
IN SUPPORT OF PLANNING APPLICATION

Project:	Queens Road, Richmond
Reference Number:	40155
Revision:	1
Date:	Apr-10

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SUMMARY BASELINE ENERGY DEMAND

Plot Number		Total Energy Demand (kWh/yr)	Associated Total CO^2 ($kgCO^2$/annum)
Apartment 01	Hot Water	2479	480.93
	Space Heating	1702	330.19
	Fixed Electrical	870.5	367.35
	Appliances	695	293.29
	Any other energy consumption	0	0.00
	Total		1471.76

SUMMARY of $C0^2$ EMISSION REDUCTIONS (PROPOSED)

Plot Number		Total $C0^2$ emissions ($kgC0^2$/annum)	
Apartment 01	Baseline Emissions	1471.76	
	Improved emissions (after application of energy efficiency)	1324.58	
	Improved emissions (after incorporation of efficiency energy supply)	0.00	Not considered appropriate
	Improved emissions (after incorporation of renewable technology)	1017.76	1kW PV added
	% $C0^2$ displaced in total	30.85	
	% $C0^2$ displaced by renewable energy	23.16	

SUMMARY BASELINE ENERGY DEMAND

Plot Number		Total Energy Demand (kWh/yr)	Associated Total CO^2 ($kgCO^2$/annum)
Apartment 02	Hot Water	3022.6	586.38
	Space Heating	2990	580.06
	Fixed Electrical	1367	576.87
	Appliances	695	293.29
	Any other energy consumption	0	0.00
	Total		2036.61

SUMMARY of $C0^2$ EMISSION REDUCTIONS (PROPOSED)

Plot Number		Total $C0^2$ emissions ($kgC0^2$/annum)	
Apartment 02	Baseline Emissions	2036.61	
	Improved emissions (after application of energy efficiency)	1995.88	
	Improved emissions (after incorporation of efficiency energy supply)	0.00	Not considered appropriate
	Improved emissions (after incorporation of renewable technology)	1354.61	1.5kW PV added
	% $C0^2$ displaced in total	33.49	
	% $C0^2$ displaced by renewable energy	32.13	

SUMMARY BASELINE ENERGY DEMAND

Plot Number		Total Energy Demand (kWh/yr)	Associated Total CO^2 ($kgCO^2$/annum)
Apartment 03	Hot Water	2581.5	500.81
	Space Heating	2084.9	404.47
	Fixed Electrical	963	406.39
	Appliances	695	293.29
	Any other energy consumption	0	0.00
	Total		1604.96

SUMMARY of C0² EMISSION REDUCTIONS (PROPOSED)

Plot Number		Total C0² emissions (kgC0²/annum)	
Apartment 03	Baseline Emissions	1604.96	
	Improved emissions (after application of energy efficiency)	1524.71	
	Improved emissions (after incorporation of efficiency energy supply)	0.00	Not considered appropriate
	Improved emissions (after incorporation of renewable technology)	1150.96	1kW PV added
	% C0² displaced in total	28.29	
	% C0² displaced by renewable energy	24.51	

SUMMARY BASELINE ENERGY DEMAND

Plot Number		Total Energy Demand (kWh/yr)	Associated Total CO² (kgCO²/annum)
Apartment 04	Hot Water	3022	586.27
	Space Heating	3034.5	588.69
	Fixed Electrical	1367	576.87
	Appliances	695	293.29
	Any other energy consumption	0	0.00
	Total		2045.13

SUMMARY of C0² EMISSION REDUCTIONS (PROPOSED)

Plot Number		Total C0² emissions (kgC0²/annum)	
Apartment 04	Baseline Emissions	2045.13	
	Improved emissions (after application of energy efficiency)	1942.87	
	Improved emissions (after incorporation of efficiency energy supply)	0.00	Not considered appropriate
	Improved emissions (after incorporation of renewable technology)	1363.13	1.5kW PV added
	% C0² displaced in total	33.35	
	% C0² displaced by renewable energy	29.84	

SUMMARY BASELINE ENERGY DEMAND

Plot Number		Total Energy Demand (kWh/yr)	Associated Total CO^2 ($kgCO^2$/annum)
Detached House	Hot Water	6378	1237.33
	Space Heating	71952	13958.69
	Fixed Electrical	17955	7577.01
	Appliances	1280	540.16
	Any other energy consumption	18000	7596.00
	Total		30909.19

SUMMARY of $C0^2$ EMISSION REDUCTIONS (PROPOSED)

Plot Number		Total $C0^2$ emissions ($kgC0^2$/annum)	
Detached House	Baseline Emissions	30909.19	
	Improved emissions (after application of energy efficiency)	29363.73	
	Improved emissions (after incorporation of efficiency energy supply)	0.00	Not considered appropriate
	Improved emissions (after incorporation of renewable technology)	14694.19	4kW PV and 30kW Ground Source added
	% $C0^2$ displaced in total	52.46	
	% $C0^2$ displaced by renewable energy	49.96	

6.0 Table 2.0 – Photovoltaic Panels

TABLE 2 - PHOTOVOLTAICS

kWp	kWp	Area of PV m2	kWhrs / Annum generated	Annual energy cost saving	Annual CO2 saving kg	Installation Cost	Payback Nett 40% grant		energy costs saved in 15 years
Residential	1	5	800	£80.00	454	£10,000.00			
Residential	2	9	1,600	£160.00	909	£12,000.00			
Residential	2.5	11	2,000	£200.00	1,136	£15,000.00			
Residential	4.0	18	3,200	£320.00	1,818	£24,000.00			
Total			7,600		4,317				

7.0 Table 3.0 – Ground Source Heat Pumps

TABLE 3 - GROUND SOURCE HEAT PUMP (VERTICAL)

Ground Source Heat Pump (Vertical)											
	kW Rating	No. Bore holes*	Installed Cost	Annual energy usage kWhr	Annual kWHrs Generated	Annual kWhrs saving	Annual cost saving	Annual CO2 saving kg	Payback Nett (years) excl. grant		energy costs saved in 15 years
Grd Source	25	4	£29,167	6,971	53,625	34,036	£1,322	14,397	16		£57,075

* 80-100m deep and spaced at 3.5 m centres min.
Note. Payback costs do not include annual Government feed-in tariffs for Micorgeneration systems.

Note. Payback costs exclude maintenance of the installed equipment.

Note. 15 year energy cost payback includes for a 5% increase in energy costs.

8.0 SAP Calculations

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Project Information

Building type	Ground-floor flat		
Plot number	01		
Reference	40155 01		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 01
	Carnegie House		Queens Road
	Library Road		Richmond
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SAP Rating Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
Ground floor (1)	42.00	3.00	126.00	(1)
Total floor area	42.00			(5)
Dwelling volume (m^3)			126.00	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	0	x 10	0.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(10)
Pressure test, result q50		6.00		
Infiltration rate			0.30	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.26	(22)
Ventilation : balanced whole house mechanical without heat recovery				
air throughput (air changes per hour)	0.30			
Effective air change rate			0.55	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	**3.60**	**1.68 (1.80)**	**6.04**	(27)
Front Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	**5.76**	**1.33 (1.40)**	**7.64**	(27)
Rear Windows				
Walls	45.84	0.23	10.54	(29)
Ground floors	42.00	0.18	7.56	(28)
Total area of elements Sigma A, m^2	97.20			(32)
Fabric heat loss, W/K			31.78	(33)
Effect of thermal bridges (0.0800 x total area)			7.78	(34)
Total fabric heat loss			39.56	(35)
Ventilation heat loss			23.08	(36)
Heat loss coefficient, W/K			62.64	(37)
Heat loss parameter (HLP), W/m^2K			1.49	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1322.27	(39)
Distribution loss			233.34	(40)
Manufacturer's declared cylinder loss factor (kWh/day)	1.65			(41)
Temperature Factor	0.5400			(41a)
Energy lost from hot water cylinder (160.0) (kWh/year)			325.21	(47)
Primary circuit loss			360.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			2240.82	(51)
Heat gains from water heating			1065.41	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	291.64	(53)
Reduction of internal gains due to low energy lighting	21.09	(53a)
Additional gains from Table 5a	25.12	(53b)
Water heating	121.62	(54)
Total internal gains	417.29	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	0.77 x 5.76	64.0 x 0.9	0.63 x 0.80	128.76
Rear Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.77 x 3.60	34.0 x 0.9	0.63 x 0.80	42.75
Front Windows				

Lighting calculations

	Area	g	FF x Shading

7. Mean internal temperature

	ºC	
Mean internal temperature of the living area	18.8800	(70)
Temperature adjustment from Table 4e, where appropriate	0.0000	(71)
Adjustment for gains	0.8030	(72)
Adjusted living room temperature	19.6830	(73)
Temperature difference between zones	1.4886	(74)
Living area fraction	0.5238	(75)
Rest-of-house area fraction	0.4762	(76)
Mean internal temperature	18.9741	(77)

8. Degree-days

Temperature rise from gains	8.01	(78)
Base temperature	10.96	(79)
Degree days	1132.25	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			1702.10	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		90.40%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			1694.57	(85)
Space heating fuel (secondary)			170.21	(85a)
Water heating requirement	2240.82			
Efficiency of water heater		90.40%		(86)
Water heating fuel			2478.79	(86a)
Electricity for pumps and fans			636.16	(87)
Electricity for lighting (75.00% fixed LEL)			234.36	(87a)
Energy saving/generation technologies				
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):			300.000	(87k)
Energy used (Standard tariff):			0.000	(87l)

10a. Fuel costs

	kWh/year	**Fuel price p/kWh**	**£/year**	
Space heating - main system	1694.566	1.630	27.62	(88)
Space heating - secondary system	170.210	7.120	12.12	(89)
Water heating				
Water heating cost	2478.789	1.630	40.40	(91b)
Pump/fan energy cost	636.160	7.120	45.29	(92)
Energy for lighting	234.360	7.120	16.69	(93)
Additional standing charges			34.00	(94)
PVs 0.75 x 0.000 x 968.000 x 0.800	0.000	0.000	0.00	(95a)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	300.000	7.120	-21.36	(95a)
Energy used (Standard tariff):	0.000	0.000	0.00	(96a)
Total energy cost			154.77	

11a. SAP rating

Energy cost deflator	0.91	(98)
Energy cost factor (ECF)	1.27	(99)
SAP value	82.22	(99a)
SAP rating	82	(100)
SAP band	B	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	1694.57	0.194	328.75	(101)
Space heating, secondary	170.21	0.422	71.83	(102)
Water heating	2478.79	0.194	480.89	(103)
Space and water heating			881.46	(107)
Electricity for pumps and fans	636.16	0.422	268.46	(108)
Electricity for lighting	234.36	0.422	98.90	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	0.422	-126.60	(110)
Energy used (Standard tariff):	0.00	0.422	0.00	(111)
Total CO2, kg/year			1122.22	(112)
			kg/m²/year	
CO2 emissions per m²			**26.72**	(113)
EI value			82.72	(113a)
EI rating			**83**	(114)
EI band			**B**	

13a. Primary energy

	Energy kWh/year	Primary factor	P. Energy (kWh/year)	
Space heating, main	1694.57	1.150	1948.75	(101)
Space heating, secondary	170.21	2.800	476.59	(102)
Water heating	2478.79	1.150	2850.61	(103)
Space and water heating			5275.94	(107)
Electricity for pumps/fans	636.16	2.800	1781.25	(108)
Electricity for lighting	234.36	2.800	656.21	(109)
Energy produced or saved in dwelling	0.00	2.800	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
Electricity generated - wind	0.00	2.800	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	2.800	840.00	(110)
Energy used (Standard tariff):	0.00	2.800	0.00	(111)
Primary energy kWh/year			6873.40	(112)
Primary energy kWh/m²/year			163.65	(113)

Project Information

Building type	Ground-floor flat		
Plot number	01		
Reference	40155 01		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 01
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

TER Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
Ground floor (1)	42.00	3.00	126.00	(1)
Total floor area	42.00			(5)
Dwelling volume (m^3)			126.00	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	2	x 10	20.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)
			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.16	(10)
Pressure test, result q50		10.00		
Infiltration rate			0.66	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.56	(22)
Ventilation : natural ventilation, intermittent extract fans				
Effective air change rate			0.66	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**8.65**	**1.85 (2.00)**	**16.02**	(27)
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**1.85**	**2.00**	**3.70**	(26)
Reference Door				
Walls	44.70	0.35	15.65	(29)
Ground floors	42.00	0.25	10.50	(28)
Total area of elements Sigma A, m^2	97.20			(32)
Fabric heat loss, W/K			45.86	(33)
Effect of thermal bridges (0.0800 x total area)			10.69	(34)
Total fabric heat loss			56.56	(35)
Ventilation heat loss			27.31	(36)
Heat loss coefficient, W/K			83.86	(37)
Heat loss parameter (HLP), W/m^2K			2.00	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1322.27	(39)
Distribution loss			233.34	(40)
Hot water storage volume (litres)	150.00			(43)
Hot water cylinder loss factor (kWh/day)	0.0191			(44)
Volume factor	0.9283			(44a)
Temperature factor	0.5400			(44b)
Energy lost from hot water cylinder (150.0) (kWh/year)			524.28	(47)
Primary circuit loss			610.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			2689.89	(51)
Heat gains from water heating			1424.67	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	291.64	(53)
Reduction of internal gains due to low energy lighting	8.47	(53a)
Additional gains from Table 5a	10.00	(53b)
Water heating	162.63	(54)
Total internal gains	455.80	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 8.65	48.0 x 0.9	0.72 x 0.70	145.02
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 1.85	0.0 x 0.9	0.72 x 0.70	0.00
Reference Door				

Lighting calculations

	Area	g	FF x Shading

7. Mean internal temperature

			ºC	
Mean internal temperature of the living area			18.8502	(70)
Temperature adjustment from Table 4e, where appropriate			0.0000	(71)
Adjustment for gains			0.5167	(72)
Adjusted living room temperature			19.3669	(73)
Temperature difference between zones			1.5695	(74)
Living area fraction			0.5238	(75)
Rest-of-house area fraction			0.4762	(76)
Mean internal temperature			18.6195	(77)

8. Degree-days

Temperature rise from gains			6.58	(78)
Base temperature			12.04	(79)
Degree days			1352.57	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			2722.34	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		78.00%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			3141.16	(85)
Space heating fuel (secondary)			272.23	(85a)
Water heating requirement	2689.89			
Efficiency of water heater		78.00%		(86)
Water heating fuel			3448.58	(86a)
Electricity for pumps and fans			175.00	(87)
Electricity for lighting (30.00% fixed LEL)			320.09	(87a)
Energy saving/generation technologies				
New energy-saving technology :				
Energy saved ():			0.000	(87k)
Energy used ():			0.000	(87l)

10a. Does not apply

11a. Does not apply

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	3141.16	0.194	609.39	(101)
Space heating, secondary	272.23	0.422	114.88	(102)
Water heating	3448.58	0.194	669.02	(103)
Space and water heating			1393.29	(107)
Electricity for pumps and fans	175.00	0.422	73.85	(108)
Electricity for lighting	320.09	0.422	135.08	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology :				
Energy saved ():	0.00	0.000	0.00	(110)
Energy used ():	0.00	0.000	0.00	(111)
Total CO2, kg/year			1602.22	(112)

	kg/m²/year
Emissions per m² for space and water heating	**34.93**
Emissions per m² for lighting	**3.22**
Target Carbon Dioxide Emission Rate (TER)	**30.52**

= [(34.93 x 1.00) + 3.22] x 0.80

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Project Information

Building type	Ground-floor flat		
Plot number	02		
Reference	40155 02		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 02
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

SAP Rating Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
Ground floor (1)	72.00	3.00	216.00	(1)
Total floor area	72.00			(5)
Dwelling volume (m^3)			216.00	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	0	x 10	0.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(10)
Pressure test, result q50		6.00		
Infiltration rate			0.30	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.26	(22)
Ventilation : balanced whole house mechanical without heat recovery				
air throughput (air changes per hour)	0.30			
Effective air change rate			0.55	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	**3.24**	**1.33 (1.40)**	**4.30**	(27)
Front Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	**5.40**	**1.33 (1.40)**	**7.16**	(27)
Rear Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	**6.48**	**1.33 (1.40)**	**8.59**	(27)
Front Windows				
Walls	55.08	0.23	12.67	(29)
Ground floors	72.00	0.18	12.96	(28)
Total area of elements Sigma A, m^2	142.20			(32)
Fabric heat loss, W/K			45.67	(33)
Effect of thermal bridges (0.0800 x total area)			11.38	(34)
Total fabric heat loss			57.05	(35)
Ventilation heat loss			39.56	(36)
Heat loss coefficient, W/K			96.61	(37)
Heat loss parameter (HLP), W/m^2K			1.34	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1740.16	(39)
Distribution loss			307.09	(40)
Manufacturer's declared cylinder loss factor (kWh/day)	1.65			(41)
Temperature Factor	0.5400			(41a)
Energy lost from hot water cylinder (160.0) (kWh/year)			325.21	(47)
Primary circuit loss			360.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			2732.46	(51)
Heat gains from water heating			1228.88	(52)

5. Internal gains

		Watts	
Lights, appliances, cooking and metabolic		440.91	(53)
Reduction of internal gains due to low energy lighting		36.16	(53a)
Additional gains from Table 5a		35.92	(53b)
Water heating		140.28	(54)
Total internal gains		580.95	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) Front Windows	0.77 x 3.24	34.0 x 0.9	0.63 x 0.80	38.48	
Solar gains (UK average)				236.14	(65)
Total gains (W)				817.09	(66)
Gains/loss ratio (GLR)				8.46	(67)
Utilisation factor (G/L)				0.88	(68)
Useful gains (W)				719.82	(69)

Lighting calculations

	Area	g	FF x Shading		
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) Front Windows	0.9 x 6.48	0.80	0.80 x 0.83	3.10	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) Rear Windows	0.9 x 5.40	0.80	0.80 x 0.83	2.58	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) Front Windows	0.9 x 3.24	0.80	0.80 x 0.83	1.55	

GL = 7.23 / 72.00 = 0.100
C1 = 0.625
C2 = 0.960
El = 402

7. Mean internal temperature

	°C	
Mean internal temperature of the living area	18.8800	(70)
Temperature adjustment from Table 4e, where appropriate	0.0000	(71)
Adjustment for gains	0.6902	(72)
Adjusted living room temperature	19.5702	(73)
Temperature difference between zones	1.4647	(74)
Living area fraction	0.3625	(75)
Rest-of-house area fraction	0.6375	(76)
Mean internal temperature	18.6364	(77)

8. Degree-days

Temperature rise from gains	7.45	(78)
Base temperature	11.19	(79)
Degree days	1177.13	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			2729.35	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		90.40%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			2717.27	(85)
Space heating fuel (secondary)			272.94	(85a)
Water heating requirement	2732.46			
Efficiency of water heater		90.40%		(86)
Water heating fuel			3022.63	(86a)
Electricity for pumps and fans			965.56	(87)
Electricity for lighting (75.00% fixed LEL)			401.76	(87a)
Energy saving/generation technologies				
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):			300.000	(87k)
Energy used (Standard tariff):			0.000	(87l)

10a. Fuel costs

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system	2717.275	1.630	44.29	(88)
Space heating - secondary system	272.935	7.120	19.43	(89)
Water heating				
Water heating cost	3022.630	1.630	49.27	(91b)
Pump/fan energy cost	965.560	7.120	68.75	(92)
Energy for lighting	401.760	7.120	28.61	(93)
Additional standing charges			34.00	(94)
PVs 0.75 x 0.000 x 968.000 x 0.800	0.000	0.000	0.00	(95a)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	300.000	7.120	-21.36	(95a)
Energy used (Standard tariff):	0.000	0.000	0.00	(96a)
Total energy cost			222.99	

11a. SAP rating

Energy cost deflator	0.91	(98)
Energy cost factor (ECF)	1.48	(99)
SAP value	79.37	(99a)
SAP rating	79	(100)
SAP band	C	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	2717.27	0.194	527.15	(101)
Space heating, secondary	272.94	0.422	115.18	(102)
Water heating	3022.63	0.194	586.39	(103)
Space and water heating			1228.72	(107)
Electricity for pumps and fans	965.56	0.422	407.47	(108)
Electricity for lighting	401.76	0.422	169.54	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	0.422	-126.60	(110)
Energy used (Standard tariff):	0.00	0.422	0.00	(111)
Total CO2, kg/year			1679.13	(112)
			kg/m²/year	
CO2 emissions per m²			**23.32**	(113)
EI value			80.77	(113a)
EI rating			**81**	(114)
EI band			**B**	

13a. Primary energy

	Energy kWh/year	Primary factor	P. Energy (kWh/year)	
Space heating, main	2717.27	1.150	3124.87	(101)
Space heating, secondary	272.94	2.800	764.22	(102)
Water heating	3022.63	1.150	3476.02	(103)
Space and water heating			7365.11	(107)
Electricity for pumps/fans	965.56	2.800	2703.57	(108)
Electricity for lighting	401.76	2.800	1124.93	(109)
Energy produced or saved in dwelling	0.00	2.800	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
Electricity generated - wind	0.00	2.800	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	2.800	840.00	(110)
Energy used (Standard tariff):	0.00	2.800	0.00	(111)
Primary energy kWh/year			10353.60	(112)
Primary energy kWh/m²/year			143.80	(113)

Project Information

Building type	Ground-floor flat		
Plot number	02		
Reference	40155 02		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 02
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

TER Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
Ground floor (1)	72.00	3.00	216.00	(1)
Total floor area	72.00			(5)
Dwelling volume (m^3)			216.00	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	2	x 10	20.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)
			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.09	(10)
Pressure test, result q50		10.00		
Infiltration rate			0.59	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.50	(22)
Ventilation : natural ventilation, intermittent extract fans				
Effective air change rate			0.63	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**16.15**	**1.85 (2.00)**	**29.91**	(27)
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**1.85**	**2.00**	**3.70**	(26)
Reference Door				
Walls	52.20	0.35	18.27	(29)
Ground floors	72.00	0.25	18.00	(28)
Total area of elements Sigma A, m^2	142.20			(32)
Fabric heat loss, W/K			69.88	(33)
Effect of thermal bridges (0.0800 x total area)			15.64	(34)
Total fabric heat loss			85.52	(35)
Ventilation heat loss			44.68	(36)
Heat loss coefficient, W/K			130.20	(37)
Heat loss parameter (HLP), W/m^2K			1.81	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1740.16	(39)
Distribution loss			307.09	(40)
Hot water storage volume (litres)	150.00			(43)
Hot water cylinder loss factor (kWh/day)	0.0191			(44)
Volume factor	0.9283			(44a)
Temperature factor	0.5400			(44b)
Energy lost from hot water cylinder (150.0) (kWh/year)			524.28	(47)
Primary circuit loss			610.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			3181.53	(51)
Heat gains from water heating			1588.13	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	440.91	(53)
Reduction of internal gains due to low energy lighting	14.46	(53a)
Additional gains from Table 5a	10.00	(53b)
Water heating	181.29	(54)
Total internal gains	617.74	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 16.15	48.0 x 0.9	0.72 x 0.70	270.76
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 1.85	0.0 x 0.9	0.72 x 0.70	0.00
Reference Door				

Lighting calculations

	Area	g	FF x Shading

7. Mean internal temperature

			°C	
Mean internal temperature of the living area			18.8615	(70)
Temperature adjustment from Table 4e, where appropriate			0.0000	(71)
Adjustment for gains			0.4672	(72)
Adjusted living room temperature			19.3287	(73)
Temperature difference between zones			1.5393	(74)
Living area fraction			0.3625	(75)
Rest-of-house area fraction			0.6375	(76)
Mean internal temperature			18.3474	(77)

8. Degree-days

Temperature rise from gains			6.34	(78)
Base temperature			12.01	(79)
Degree days			1347.40	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			4210.42	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		78.00%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			4858.18	(85)
Space heating fuel (secondary)			421.04	(85a)
Water heating requirement	3181.53			
Efficiency of water heater		78.00%		(86)
Water heating fuel			4078.88	(86a)
Electricity for pumps and fans			175.00	(87)
Electricity for lighting (30.00% fixed LEL)			546.34	(87a)
Energy saving/generation technologies				
New energy-saving technology :				
Energy saved ():			0.000	(87k)
Energy used ():			0.000	(87l)

10a. Does not apply

11a. Does not apply

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	4858.18	0.194	942.49	(101)
Space heating, secondary	421.04	0.422	177.68	(102)
Water heating	4078.88	0.194	791.30	(103)
Space and water heating			1911.47	(107)
Electricity for pumps and fans	175.00	0.422	73.85	(108)
Electricity for lighting	546.34	0.422	230.55	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology :				
Energy saved ():	0.00	0.000	0.00	(110)
Energy used ():	0.00	0.000	0.00	(111)
Total CO2, kg/year			2215.87	(112)

	kg/m²/year
Emissions per m² for space and water heating	**27.57**
Emissions per m² for lighting	**3.20**
Target Carbon Dioxide Emission Rate (TER)	**24.62**

= [(27.57 x 1.00) + 3.20] x 0.80

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Project Information

Building type	Top-floor flat		
Plot number	03		
Reference	40155 03		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 03
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

SAP Rating Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
First floor	47.50	3.00	142.50	(2)
Total floor area	47.50			(5)
Dwelling volume (m^3)			142.50	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	0	x 10	0.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(10)
Pressure test, result q50		6.00		
Infiltration rate			0.30	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.26	(22)
Ventilation : balanced whole house mechanical without heat recovery				
air throughput (air changes per hour)	0.30			
Effective air change rate			0.55	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	**2.88**	**1.33 (1.40)**	**3.82**	(27)
Rear Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	**5.58**	**1.33 (1.40)**	**7.40**	(27)
Front Windows				
Walls	53.34	0.23	12.27	(29)
Pitched roofs insulated between rafters	47.50	0.18	8.55	(30)
Total area of elements Sigma A, m^2	109.30			(32)
Fabric heat loss, W/K			32.03	(33)
Effect of thermal bridges (0.0800 x total area)			8.74	(34)
Total fabric heat loss			40.78	(35)
Ventilation heat loss			26.10	(36)
Heat loss coefficient, W/K			66.88	(37)
Heat loss parameter (HLP), W/m^2K			1.41	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1401.21	(39)
Distribution loss			247.27	(40)
Manufacturer's declared cylinder loss factor (kWh/day)	1.65			(41)
Temperature Factor	0.5400			(41a)
Energy lost from hot water cylinder (160.0) (kWh/year)			325.21	(47)
Primary circuit loss			360.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			2333.69	(51)
Heat gains from water heating			1096.29	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	319.40	(53)
Reduction of internal gains due to low energy lighting	23.98	(53a)
Additional gains from Table 5a	27.10	(53b)
Water heating	125.15	(54)
Total internal gains	447.66	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	0.77 x 5.58	34.0 x 0.9	0.63 x 0.80	66.26
Front Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	0.77 x 2.88	64.0 x 0.9	0.63 x 0.80	64.38
Rear Windows				

Lighting calculations

	Area	g	FF x Shading

7. Mean internal temperature

		ºC	
Mean internal temperature of the living area		18.8800	(70)
Temperature adjustment from Table 4e, where appropriate		0.0000	(71)
Adjustment for gains		0.7137	(72)
Adjusted living room temperature		19.5937	(73)
Temperature difference between zones		1.4753	(74)
Living area fraction		0.4600	(75)
Rest-of-house area fraction		0.5400	(76)
Mean internal temperature		18.7971	(77)

8. Degree-days

Temperature rise from gains		7.57	(78)
Base temperature		11.23	(79)
Degree days		1185.68	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			1903.08	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		90.40%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			1894.66	(85)
Space heating fuel (secondary)			190.31	(85a)
Water heating requirement	2333.69			
Efficiency of water heater		90.40%		(86)
Water heating fuel			2581.52	(86a)
Electricity for pumps and fans			696.55	(87)
Electricity for lighting (75.00% fixed LEL)			266.45	(87a)
Energy saving/generation technologies				
PVs 0.75 x 2.000 x 968.000 x 0.800			1239.040	(87h)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):			300.000	(87k)
Energy used (Standard tariff):			0.000	(87l)

10a. Fuel costs

	kWh/year	**Fuel price p/kWh**	**£/year**	
Space heating - main system	1894.657	1.630	30.88	(88)
Space heating - secondary system	190.308	7.120	13.55	(89)
Water heating				
Water heating cost	2581.520	1.630	42.08	(91b)
Pump/fan energy cost	696.550	7.120	49.59	(92)
Energy for lighting	266.455	7.120	18.97	(93)
Additional standing charges			34.00	(94)
PVs 0.75 x 2.000 x 968.000 x 0.800	1239.040	6.410	-79.42	(95a)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	300.000	7.120	-21.36	(95a)
Energy used (Standard tariff):	0.000	0.000	0.00	(96a)
Total energy cost			88.30	

11a. SAP rating

Energy cost deflator	0.91	(98)
Energy cost factor (ECF)	0.54	(99)
SAP value	92.40	(99a)
SAP rating	92	(100)
SAP band	A	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	1894.66	0.194	367.56	(101)
Space heating, secondary	190.31	0.422	80.31	(102)
Water heating	2581.52	0.194	500.81	(103)
Space and water heating			948.69	(107)
Electricity for pumps and fans	696.55	0.422	293.94	(108)
Electricity for lighting	266.45	0.422	112.44	(109)
Electricity generated - PVs	-1239.04	0.568	-703.77	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	0.422	-126.60	(110)
Energy used (Standard tariff):	0.00	0.422	0.00	(111)
Total CO2, kg/year			524.70	(112)

	kg/m²/year	
CO2 emissions per m²	**11.05**	(113)
EI value	92.40	(113a)
EI rating	**92**	(114)
EI band	**A**	

13a. Primary energy

	Energy kWh/year	Primary factor	P. Energy (kWh/year)	
Space heating, main	1894.66	1.150	2178.85	(101)
Space heating, secondary	190.31	2.800	532.86	(102)
Water heating	2581.52	1.150	2968.75	(103)
Space and water heating			5680.46	(107)
Electricity for pumps/fans	696.55	2.800	1950.34	(108)
Electricity for lighting	266.45	2.800	746.07	(109)
Energy produced or saved in dwelling	-1239.04	2.800	-3469.31	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
Electricity generated - wind	0.00	2.800	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	2.800	840.00	(110)
Energy used (Standard tariff):	0.00	2.800	0.00	(111)
Primary energy kWh/year			4067.57	(112)
Primary energy kWh/m²/year			85.63	(113)

n/a

Project Information

Building type	Top-floor flat		
Plot number	03		
Reference	40155 03		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 03
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

TER Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
First floor	47.50	3.00	142.50	(2)
Total floor area	47.50			(5)
Dwelling volume (m^3)			142.50	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	2	x 10	20.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)
			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.14	(10)
Pressure test, result q50		10.00		
Infiltration rate			0.64	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.54	(22)
Ventilation : natural ventilation, intermittent extract fans				
Effective air change rate			0.65	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**10.03**	**1.85 (2.00)**	**18.56**	(27)
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**1.85**	**2.00**	**3.70**	(26)
Reference Door				
Walls	49.93	0.35	17.47	(29)
Pitched roofs insulated between rafters	47.50	0.16	7.60	(30)
Total area of elements Sigma A, m^2	109.30			(32)
Fabric heat loss, W/K			47.34	(33)
Effect of thermal bridges (0.0800 x total area)			12.02	(34)
Total fabric heat loss			59.36	(35)
Ventilation heat loss			30.48	(36)
Heat loss coefficient, W/K			89.84	(37)
Heat loss parameter (HLP), W/m^2K			1.89	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1401.21	(39)
Distribution loss			247.27	(40)
Hot water storage volume (litres)	150.00			(43)
Hot water cylinder loss factor (kWh/day)	0.0191			(44)
Volume factor	0.9283			(44a)
Temperature factor	0.5400			(44b)
Energy lost from hot water cylinder (150.0) (kWh/year)			524.28	(47)
Primary circuit loss			610.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			2782.76	(51)
Heat gains from water heating			1455.55	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	319.40	(53)
Reduction of internal gains due to low energy lighting	9.56	(53a)
Additional gains from Table 5a	10.00	(53b)
Water heating	166.16	(54)
Total internal gains	485.99	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 10.03	48.0 x 0.9	0.72 x 0.70	168.07
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 1.85	0.0 x 0.9	0.72 x 0.70	0.00
Reference Door				

Lighting calculations

	Area	g	FF x Shading

7. Mean internal temperature

			ºC	
Mean internal temperature of the living area			18.8565	(70)
Temperature adjustment from Table 4e, where appropriate			0.0000	(71)
Adjustment for gains			0.5332	(72)
Adjusted living room temperature			19.3897	(73)
Temperature difference between zones			1.5526	(74)
Living area fraction			0.4600	(75)
Rest-of-house area fraction			0.5400	(76)
Mean internal temperature			18.5513	(77)

8. Degree-days

Temperature rise from gains			6.67	(78)
Base temperature			11.89	(79)
Degree days			1320.92	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			2848.11	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		78.00%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			3286.28	(85)
Space heating fuel (secondary)			284.81	(85a)
Water heating requirement	2782.76			
Efficiency of water heater		78.00%		(86)
Water heating fuel			3567.64	(86a)
Electricity for pumps and fans			175.00	(87)
Electricity for lighting (30.00% fixed LEL)			361.33	(87a)
Energy saving/generation technologies				
New energy-saving technology :				
Energy saved ():			0.000	(87k)
Energy used ():			0.000	(87l)

10a. Does not apply

11a. Does not apply

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	3286.28	0.194	637.54	(101)
Space heating, secondary	284.81	0.422	120.19	(102)
Water heating	3567.64	0.194	692.12	(103)
Space and water heating			1449.85	(107)
Electricity for pumps and fans	175.00	0.422	73.85	(108)
Electricity for lighting	361.33	0.422	152.48	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology :				
Energy saved ():	0.00	0.000	0.00	(110)
Energy used ():	0.00	0.000	0.00	(111)
Total CO2, kg/year			1676.18	(112)

	kg/m²/year
Emissions per m² for space and water heating	**32.08**
Emissions per m² for lighting	**3.21**
Target Carbon Dioxide Emission Rate (TER)	**28.23**

= [(32.08 x 1.00) + 3.21] x 0.80

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Project Information

Building type	Top-floor flat		
Plot number	04		
Reference	40155 04		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 04
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

SAP Rating Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
First floor	72.00	3.00	216.00	(2)
Total floor area	72.00			(5)
Dwelling volume (m^3)			216.00	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	0	x 10	0.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(10)
Pressure test, result q50		6.00		
Infiltration rate			0.30	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.26	(22)
Ventilation : balanced whole house mechanical without heat recovery				
air throughput (air changes per hour)	0.30			
Effective air change rate			0.55	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	**5.40**	**1.33 (1.40)**	**7.16**	(27)
Rear Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	**3.42**	**1.33 (1.40)**	**4.53**	(27)
Front Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	**6.12**	**1.33 (1.40)**	**8.11**	(27)
Rear Windows				
Walls	58.26	0.23	13.40	(29)
Pitched roofs insulated between rafters	72.00	0.18	12.96	(30)
Total area of elements Sigma A, m^2	145.20			(32)
Fabric heat loss, W/K			46.17	(33)
Effect of thermal bridges (0.0800 x total area)			11.62	(34)
Total fabric heat loss			57.78	(35)
Ventilation heat loss			39.56	(36)
Heat loss coefficient, W/K			97.34	(37)
Heat loss parameter (HLP), W/m^2K			1.35	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1740.16	(39)
Distribution loss			307.09	(40)
Manufacturer's declared cylinder loss factor (kWh/day)	1.65			(41)
Temperature Factor	0.5400			(41a)
Energy lost from hot water cylinder (160.0) (kWh/year)			325.21	(47)
Primary circuit loss			360.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			2732.46	(51)
Heat gains from water heating			1228.88	(52)

5. Internal gains

		Watts	
Lights, appliances, cooking and metabolic		440.91	(53)
Reduction of internal gains due to low energy lighting		36.16	(53a)
Additional gains from Table 5a		35.92	(53b)
Water heating		140.28	(54)
Total internal gains		580.95	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) Rear Windows	0.77 x 5.40	64.0 x 0.9	0.63 x 0.80	120.71	
Solar gains (UK average)				234.00	(65)
Total gains (W)				814.95	(66)
Gains/loss ratio (GLR)				8.37	(67)
Utilisation factor (G/L)				0.88	(68)
Useful gains (W)				720.03	(69)

Lighting calculations

	Area	g	FF x Shading		
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) Rear Windows	0.9 x 6.12	0.80	0.80 x 0.83	2.93	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) Front Windows	0.9 x 3.42	0.80	0.80 x 0.83	1.64	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) Rear Windows	0.9 x 5.40	0.80	0.80 x 0.83	2.58	

GL = 7.14 / 72.00 = 0.099
C1 = 0.625
C2 = 0.960
EI = 402

7. Mean internal temperature

	°C	
Mean internal temperature of the living area	18.8800	(70)
Temperature adjustment from Table 4e, where appropriate	0.0000	(71)
Adjustment for gains	0.6794	(72)
Adjusted living room temperature	19.5594	(73)
Temperature difference between zones	1.4663	(74)
Living area fraction	0.3625	(75)
Rest-of-house area fraction	0.6375	(76)
Mean internal temperature	18.6246	(77)

8. Degree-days

Temperature rise from gains	7.40	(78)
Base temperature	11.23	(79)
Degree days	1185.56	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			2769.74	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		90.40%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			2757.49	(85)
Space heating fuel (secondary)			276.97	(85a)
Water heating requirement	2732.46			
Efficiency of water heater		90.40%		(86)
Water heating fuel			3022.63	(86a)
Electricity for pumps and fans			965.56	(87)
Electricity for lighting (75.00% fixed LEL)			401.76	(87a)
Energy saving/generation technologies				
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):			300.000	(87k)
Energy used (Standard tariff):			0.000	(87l)

10a. Fuel costs

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system	2757.487	1.630	44.95	(88)
Space heating - secondary system	276.974	7.120	19.72	(89)
Water heating				
Water heating cost	3022.630	1.630	49.27	(91b)
Pump/fan energy cost	965.560	7.120	68.75	(92)
Energy for lighting	401.760	7.120	28.61	(93)
Additional standing charges			34.00	(94)
PVs 0.75 x 0.000 x 968.000 x 0.800	0.000	0.000	0.00	(95a)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	300.000	7.120	-21.36	(95a)
Energy used (Standard tariff):	0.000	0.000	0.00	(96a)
Total energy cost			223.93	

11a. SAP rating

Energy cost deflator	0.91	(98)
Energy cost factor (ECF)	1.49	(99)
SAP value	79.27	(99a)
SAP rating	79	(100)
SAP band	C	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	2757.49	0.194	534.95	(101)
Space heating, secondary	276.97	0.422	116.88	(102)
Water heating	3022.63	0.194	586.39	(103)
Space and water heating			1238.23	(107)
Electricity for pumps and fans	965.56	0.422	407.47	(108)
Electricity for lighting	401.76	0.422	169.54	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	0.422	-126.60	(110)
Energy used (Standard tariff):	0.00	0.422	0.00	(111)
Total CO2, kg/year			1688.63	(112)
			kg/m²/year	
CO2 emissions per m²			**23.45**	(113)
EI value			80.66	(113a)
EI rating			**81**	(114)
EI band			**B**	

13a. Primary energy

	Energy kWh/year	Primary factor	P. Energy (kWh/year)	
Space heating, main	2757.49	1.150	3171.11	(101)
Space heating, secondary	276.97	2.800	775.53	(102)
Water heating	3022.63	1.150	3476.02	(103)
Space and water heating			7422.66	(107)
Electricity for pumps/fans	965.56	2.800	2703.57	(108)
Electricity for lighting	401.76	2.800	1124.93	(109)
Energy produced or saved in dwelling	0.00	2.800	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
Electricity generated - wind	0.00	2.800	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-300.00	2.800	840.00	(110)
Energy used (Standard tariff):	0.00	2.800	0.00	(111)
Primary energy kWh/year			10411.16	(112)
Primary energy kWh/m²/year			144.60	(113)

Project Information

Building type	Top-floor flat		
Plot number	04		
Reference	40155 04		
Date	22 April 2010		
Client	TPE Consulting	Project	Apartment 04
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

TER Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
First floor	72.00	3.00	216.00	(2)
Total floor area	72.00			(5)
Dwelling volume (m^3)			216.00	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	2	x 10	20.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)
			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.09	(10)
Pressure test, result q50		10.00		
Infiltration rate			0.59	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.50	(22)
Ventilation : natural ventilation, intermittent extract fans				
Effective air change rate			0.63	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**16.15**	**1.85 (2.00)**	**29.91**	(27)
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**1.85**	**2.00**	**3.70**	(26)
Reference Door				
Walls	55.20	0.35	19.32	(29)
Pitched roofs insulated between rafters	72.00	0.16	11.52	(30)
Total area of elements Sigma A, m^2	145.20			(32)
Fabric heat loss, W/K			64.45	(33)
Effect of thermal bridges (0.0800 x total area)			15.97	(34)
Total fabric heat loss			80.42	(35)
Ventilation heat loss			44.68	(36)
Heat loss coefficient, W/K			125.10	(37)
Heat loss parameter (HLP), W/m^2K			1.74	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			1740.16	(39)
Distribution loss			307.09	(40)
Hot water storage volume (litres)	150.00			(43)
Hot water cylinder loss factor (kWh/day)	0.0191			(44)
Volume factor	0.9283			(44a)
Temperature factor	0.5400			(44b)
Energy lost from hot water cylinder (150.0) (kWh/year)			524.28	(47)
Primary circuit loss			610.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			3181.53	(51)
Heat gains from water heating			1588.13	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	440.91	(53)
Reduction of internal gains due to low energy lighting	14.46	(53a)
Additional gains from Table 5a	10.00	(53b)
Water heating	181.29	(54)
Total internal gains	617.74	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 16.15	48.0 x 0.9	0.72 x 0.70	270.76
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 1.85	0.0 x 0.9	0.72 x 0.70	0.00
Reference Door				

Lighting calculations

	Area	g	FF x Shading

7. Mean internal temperature

			ºC	
Mean internal temperature of the living area			18.8657	(70)
Temperature adjustment from Table 4e, where appropriate			0.0000	(71)
Adjustment for gains			0.5078	(72)
Adjusted living room temperature			19.3735	(73)
Temperature difference between zones			1.5280	(74)
Living area fraction			0.3625	(75)
Rest-of-house area fraction			0.6375	(76)
Mean internal temperature			18.3994	(77)

8. Degree-days

Temperature rise from gains			6.54	(78)
Base temperature			11.86	(79)
Degree days			1315.71	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			3950.34	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		78.00%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			4558.08	(85)
Space heating fuel (secondary)			395.03	(85a)
Water heating requirement	3181.53			
Efficiency of water heater		78.00%		(86)
Water heating fuel			4078.88	(86a)
Electricity for pumps and fans			175.00	(87)
Electricity for lighting (30.00% fixed LEL)			546.34	(87a)
Energy saving/generation technologies				
New energy-saving technology :				
Energy saved ():			0.000	(87k)
Energy used ():			0.000	(87l)

10a. Does not apply

11a. Does not apply

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	4558.08	0.194	884.27	(101)
Space heating, secondary	395.03	0.422	166.70	(102)
Water heating	4078.88	0.194	791.30	(103)
Space and water heating			1842.27	(107)
Electricity for pumps and fans	175.00	0.422	73.85	(108)
Electricity for lighting	546.34	0.422	230.55	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology :				
Energy saved ():	0.00	0.000	0.00	(110)
Energy used ():	0.00	0.000	0.00	(111)
Total CO2, kg/year			2146.68	(112)

	kg/m²/year
Emissions per m² for space and water heating	**26.61**
Emissions per m² for lighting	**3.20**
Target Carbon Dioxide Emission Rate (TER)	**23.85**

= [(26.61 x 1.00) + 3.20] x 0.80

n/a

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Project Information

Building type	Detached house		
Plot number	05		
Reference	40155 05		
Date	22 April 2010		
Client	TPE Consulting	Project	Detached House
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

SAP Rating Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
Basement floor	459.90	2.80	1287.72	(1)
Ground floor (1)	360.00	3.00	1080.00	(1)
First floor	154.50	3.00	463.50	(2)
Total floor area	974.40			(5)
Dwelling volume (m^3)			2831.22	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	0	x 10	0.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)

			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.00	(10)
Pressure test, result q50		6.00		
Infiltration rate			0.30	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.26	(22)
Ventilation : balanced whole house mechanical without heat recovery				
air throughput (air changes per hour)	0.35			
Effective air change rate			0.61	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast)	**28.00**	**1.33 (1.40)**	**37.12**	(27)
Rear Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest)	**58.00**	**1.33 (1.40)**	**76.89**	(27)
Front Windows				
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast)	**48.20**	**1.33 (1.40)**	**63.90**	(27)
Rear Windows				
Walls	1305.80	0.23	300.33	(29)
Ground floors	459.90	0.18	82.78	(28)
Pitched roofs insulated between rafters	459.90	0.18	82.78	(30)
Total area of elements Sigma A, m^2	2359.80			(32)
Fabric heat loss, W/K			643.81	(33)
Effect of thermal bridges (0.0800 x total area)			188.78	(34)
Total fabric heat loss			832.60	(35)
Ventilation heat loss			565.25	(36)
Heat loss coefficient, W/K			1397.85	(37)
Heat loss parameter (HLP), W/m^2K			1.43	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			4318.68	(39)
Distribution loss			762.12	(40)
Manufacturer's declared cylinder loss factor (kWh/day)	1.65			(41)
Temperature Factor	0.5400			(41a)
Energy lost from hot water cylinder (210.0) (kWh/year)			325.21	(47)
Primary circuit loss			360.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			5766.02	(51)
Heat gains from water heating			2237.54	(52)

5. Internal gains

		Watts	
Lights, appliances, cooking and metabolic		1428.00	(53)
Reduction of internal gains due to low energy lighting		512.19	(53a)
Additional gains from Table 5a		349.75	(53b)
Water heating		255.43	(54)
Total internal gains		1520.98	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) Rear Windows	0.77 x 28.00	34.0 x 0.9	0.63 x 0.80	332.51	
Solar gains (UK average)				2098.71	(65)
Total gains (W)				3619.69	(66)
Gains/loss ratio (GLR)				2.59	(67)
Utilisation factor (G/L)				1.00	(68)
Useful gains (W)				3616.22	(69)

Lighting calculations

	Area	g	FF x Shading		
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) Rear Windows	0.9 x 48.20	0.80	0.80 x 0.83	23.04	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) Front Windows	0.9 x 58.00	0.80	0.80 x 0.83	27.73	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) Rear Windows	0.9 x 28.00	0.80	0.80 x 0.83	13.39	

GL = 64.16 / 974.40 = 0.066
C1 = 0.625
C2 = 1.005
El = 5691

7. Mean internal temperature

	°C	
Mean internal temperature of the living area	18.8800	(70)
Temperature adjustment from Table 4e, where appropriate	0.0000	(71)
Adjustment for gains	-0.2826	(72)
Adjusted living room temperature	18.5974	(73)
Temperature difference between zones	1.4795	(74)
Living area fraction	0.1485	(75)
Rest-of-house area fraction	0.8515	(76)
Mean internal temperature	17.3376	(77)

8. Degree-days

Temperature rise from gains	2.59	(78)
Base temperature	14.75	(79)
Degree days	1957.64	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			65675.64	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		90.40%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			65385.04	(85)
Space heating fuel (secondary)			6567.56	(85a)
Water heating requirement	5766.02			
Efficiency of water heater		90.40%		(86)
Water heating fuel			6378.34	(86a)
Electricity for pumps and fans			12264.31	(87)
Electricity for lighting (75.00% fixed LEL)			5691.00	(87a)
Energy saving/generation technologies				
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):			1500.000	(87k)
Energy used (Standard tariff):			0.000	(87l)

10a. Fuel costs

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system	65385.041	1.630	1065.78	(88)
Space heating - secondary system	6567.564	7.120	467.61	(89)
Water heating				
Water heating cost	6378.335	1.630	103.97	(91b)
Pump/fan energy cost	12264.309	7.120	873.22	(92)
Energy for lighting	5691.001	7.120	405.20	(93)
Additional standing charges			34.00	(94)
PVs 0.75 x 0.000 x 968.000 x 0.800	0.000	0.000	0.00	(95a)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	1500.000	7.120	-106.80	(95a)
Energy used (Standard tariff):	0.000	0.000	0.00	(96a)
Total energy cost			2842.97	

11a. SAP rating

Energy cost deflator	0.91	(98)
Energy cost factor (ECF)	2.51	(99)
SAP value	64.98	(99a)
SAP rating	65	(100)
SAP band	D	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	65385.04	0.194	12684.70	(101)
Space heating, secondary	6567.56	0.422	2771.51	(102)
Water heating	6378.34	0.194	1237.40	(103)
Space and water heating			16693.61	(107)
Electricity for pumps and fans	12264.31	0.422	5175.54	(108)
Electricity for lighting	5691.00	0.422	2401.60	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-1500.00	0.422	-633.00	(110)
Energy used (Standard tariff):	0.00	0.422	0.00	(111)
Total CO2, kg/year			23637.75	(112)

	kg/m²/year	
CO2 emissions per m²	**24.26**	(113)
EI value	68.93	(113a)
EI rating	**69**	(114)
EI band	**C**	

13a. Primary energy

	Energy kWh/year	Primary factor	P. Energy (kWh/year)	
Space heating, main	65385.04	1.150	75192.80	(101)
Space heating, secondary	6567.56	2.800	18389.18	(102)
Water heating	6378.34	1.150	7335.09	(103)
Space and water heating			100917.06	(107)
Electricity for pumps/fans	12264.31	2.800	34340.07	(108)
Electricity for lighting	5691.00	2.800	15934.80	(109)
Energy produced or saved in dwelling	0.00	2.800	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
Electricity generated - wind	0.00	2.800	0.00	(110)
New energy-saving technology : SAP Appendix Q energy saving				
Energy saved (Standard tariff):	-1500.00	2.800	4200.00	(110)
Energy used (Standard tariff):	0.00	2.800	0.00	(111)
Primary energy kWh/year			146991.93	(112)
Primary energy kWh/m²/year			150.85	(113)

Project Information

Building type	Detached house		
Plot number	05		
Reference	40155 05		
Date	22 April 2010		
Client	TPE Consulting	Project	Detached House
	Carnegie House		Queens Road
	Library Road		Richmond
	Dun Laoghaire		Surrey
	Dublin		TW10 6JJ
Tel:	+35312352980		
Fax:	+35312352985		
Email:	rburke@tpe.ie		

TER Worksheet

1. Overall dwelling dimensions

	Area (m^2)	Av. Room height (m)	Volume (m^3)	
Basement floor	459.90	2.80	1287.72	(1)
Ground floor (1)	360.00	3.00	1080.00	(1)
First floor	154.50	3.00	463.50	(2)
Total floor area	974.40			(5)
Dwelling volume (m^3)			2831.22	(6)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40	0.00	(7)
Number of flues	0	x 20	0.00	(8)
Number of fans and passive vents	3	x 10	30.00	(9)
Number of flueless gas fires	0	x 40	0.00	(9a)
			Air changes per hour	
Infiltration due to chimneys, fans and flues			0.01	(10)
Pressure test, result q50		10.00		
Infiltration rate			0.51	(19)
Number of sides on which sheltered	2.00			(20)
Shelter factor	0.85			(21)
Adjusted infiltration rate			0.43	(22)
Ventilation : natural ventilation, intermittent extract fans				
Effective air change rate			0.59	(25)

3. Heat losses and heat loss parameter

	Area (m^2)	U-value (W/m^2K)	A x U (W/K)	
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**241.75**	**1.85 (2.00)**	**447.69**	(27)
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	**1.85**	**2.00**	**3.70**	(26)
Reference Door				
Walls	1196.40	0.35	418.74	(29)
Ground floors	459.90	0.25	114.98	(28)
Pitched roofs insulated between rafters	459.90	0.16	73.58	(30)
Total area of elements Sigma A, m^2	2359.80			(32)
Fabric heat loss, W/K			1058.68	(33)
Effect of thermal bridges (0.0800 x total area)			259.58	(34)
Total fabric heat loss			1318.26	(35)
Ventilation heat loss			555.14	(36)
Heat loss coefficient, W/K			1873.41	(37)
Heat loss parameter (HLP), W/m^2K			1.92	(38)

4. Water heating energy requirements

			kWh/year	
Energy content of required heated water			4318.68	(39)
Distribution loss			762.12	(40)
Hot water storage volume (litres)	150.00			(43)
Hot water cylinder loss factor (kWh/day)	0.0191			(44)
Volume factor	0.9283			(44a)
Temperature factor	0.5400			(44b)
Energy lost from hot water cylinder (150.0) (kWh/year)			524.28	(47)
Primary circuit loss			610.00	(48)
Combi loss			0.00	(49)
Solar input		0.0000		(50)
Output from water heater (kWh/year)			6215.08	(51)
Heat gains from water heating			2596.79	(52)

5. Internal gains

	Watts	
Lights, appliances, cooking and metabolic	1428.00	(53)
Reduction of internal gains due to low energy lighting	195.74	(53a)
Additional gains from Table 5a	10.00	(53b)
Water heating	296.44	(54)
Total internal gains	1538.70	(55)

6. Solar gains

	Access factor & Area (m^2)	Flux (W/m^2)	g & FF	Gains (W)
Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 241.75	48.0 x 0.9	0.72 x 0.70	4052.95
Reference Glazing				
Solid door - Double-glazed, air-filled, low-E, En=0.2, hard coat (East/West)	0.77 x 1.85	0.0 x 0.9	0.72 x 0.70	0.00
Reference Door				

7. Mean internal temperature

			°C	
Mean internal temperature of the living area			18.8546	(70)
Temperature adjustment from Table 4e, where appropriate			0.0000	(71)
Adjustment for gains			-0.2045	(72)
Adjusted living room temperature			18.6502	(73)
Temperature difference between zones			1.5576	(74)
Living area fraction			0.1485	(75)
Rest-of-house area fraction			0.8515	(76)
Mean internal temperature			17.3238	(77)

8. Degree-days

Temperature rise from gains			2.98	(78)
Base temperature			14.35	(79)
Degree days			1863.11	(80)

9a. Energy requirements

			kWh/year	
Space heating requirement (useful)			83768.50	(81)
Fraction of heat from secondary system		0.1000		(82)
Efficiency of main heating system		78.00%		(83)
Efficiency of secondary heating system		100.00%		(84)
Space heating fuel (main)			96655.96	(85)
Space heating fuel (secondary)			8376.85	(85a)
Water heating requirement	6215.08			
Efficiency of water heater		78.00%		(86)
Water heating fuel			7968.06	(86a)
Electricity for pumps and fans			175.00	(87)
Electricity for lighting (30.00% fixed LEL)			7394.53	(87a)
Energy saving/generation technologies				
New energy-saving technology :				
Energy saved ():			0.000	(87k)
Energy used ():			0.000	(87l)

10a. Does not apply

11a. Does not apply

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main	96655.96	0.194	18751.26	(101)
Space heating, secondary	8376.85	0.422	3535.03	(102)
Water heating	7968.06	0.194	1545.80	(103)
Space and water heating			23832.09	(107)
Electricity for pumps and fans	175.00	0.422	73.85	(108)
Electricity for lighting	7394.53	0.422	3120.49	(109)
Electricity generated - PVs	0.00	0.568	0.00	(110)
Electricity generated - µCHP	0.00	0.000	0.00	(110)
New energy-saving technology :				
Energy saved ():	0.00	0.000	0.00	(110)
Energy used ():	0.00	0.000	0.00	(111)
Total CO2, kg/year			27026.43	(112)

	kg/m²/year
Emissions per m² for space and water heating	**24.53**
Emissions per m² for lighting	**3.20**
Target Carbon Dioxide Emission Rate (TER)	**22.19**

= [(24.53 x 1.00) + 3.20] x 0.80