Energy Statement Exercise Part 2 - ANSWERS
Happy Daze Care Home

Hotchester Council has an Energy SPD which states:

"The development must achieve a 10% reduction in CO2 emissions through the installation of low or zero carbon (LZC) energy supplies, compared to the Buildings Emissions Rate without the LZC technologies, where this BER at least achieves the Target Emissions Rate (TER) specified in the current Building Regulations. This policy will remain in force until the Building Regulations require a TER of at least 50% less than the 2006 Building Regulations. "

This development is subject to the Building Regulations Part L 2010.

Heating and hot water for Happy Daze Care Home will be provided from a centrally gas-fired boiler system, with an average efficiency of 95%. Electricity will be drawn from the grid.

The baseline Part L energy demand and related CO2 emissions for the proposed development, before the introduction of renewable technologies, is shown below, compared to the Target Emissions Rate for this type of development.

Floor area 2000 m2

	Energy Demand	
	kWh/m2	kWh
Heat	76	152,000
Electricity	20	40,000
		192,000

Note: Heat Demand (how much heat the building needs) is only 95% of the gas demand, due the boiler efficiency.

	Energy consumption		**Annual CO2 Emissions**	
	kWh/m2	kWh	CO2 kg/kWh	kg CO2
Gas	80	160,000	0.206	32,960
Electricity	20	40,000	0.591	23,640
Total		200,000		56,600
Target CO2 reduction from LZC energy				**5,660**

To meet the requirements of Hotchester BC, **5,660 kg CO2** savings would need to be generated from renewable energy sources.

The Target Emissions Rate (TER) for this development is **30 kg CO2/m2.**

Question 1:

Calculate the Part L Building Emissions Rate from the data.

Data	**Calculation**	**Result**
Building Emissions Rate kg CO2/m2		

Does the building comply with Part L before the addition of any LZC technologies?

Question 2:

The CO2 Emissions conversion factors used shown below.

Fuel	**kgCO2/kWh**
Mains Gas	0.206
Wood Pellets	0.037
Grid Electricity	0.591

Calculate the CO2 emissions reduction from the following technologies

A: 11kW$_e$ Wind Turbine

Rating	11	kW
Capital Cost	£50,000	
Annual Output	25,000	kWh
Annual CO2 Savings	14,775	kg CO2 = 25,000 x 0.591
% of Building Emissions	26%	= 14,775 / 56,600
		kWh output per kW Capacity (rating)
Output Factor	2,273	= 25,000 / 11
		£ per kg CO2 saved
Capital Cost Factor	£3.38	= £50,000 / 14,775

B: 5kW$_e$ PV system

Rating	5	kWp
Area	40	m2
Capital Cost	£20,000	
Annual Output	4,000	kWh
Annual CO2 Savings	2,364	kg CO2 = 4,000 x 0.591
% of Building Emissions	4%	= 2,364/ 56,600
		kWh output per kW Capacity (rating)
Output Factor	800	= 4,000 / 5
		£ per kg CO2 saved
Cost Factor	£8.46	= £20,000 / 2,364

C: 30 kW_{th} Solar Hot Water System

Rating	30	kWth	
Area	30	m2	
Capital Cost	£30,000		
Annual Output	15,000	kWh	
Gas Boiler efficiency	95%		
			= Heat provided / Boiler Efficiency
Annual Gas savings	15,789	kWh	= 15,000 / 0.95
Annual CO2 Savings	3,253	kg CO2	= 15,789 x .206
% Building Emissions	6%		= 3,253 / 56,600
			Solar should not provide more than 50% of hot water demand i.e. 25% of heating demand if hot water is 50% of total heating.
% of Heating demand	10%		= 15,000 / 152,000
			£ per kg CO2 saved
Capital Cost Factor	£9.22		= £30,000 / 3,253

D: Air Source Heat Pump designed to supply all the heat for the building

Heat Output	152,000	kWh	
Coefficient of Performance	2.4		
Electricity Consumption	63333	kWh	= Heat Output/ COP
Gas Saved	160,000	kWh	
CO2 Emissions of Electricity used	37,430	kg CO2	= 63,333 x .591
CO2 Emissions of Gas Saved	32,960	kg CO2	= 160,000 x .206
Annual CO2 Savings	-4470	kg CO2	= 32,960 – 37,430
% of Building Emissions	-8%		

E: Biomass Boiler designed to supply two-thirds of the heat demand.

Boiler Rating	50	kW	
Heat output	100,000	kWh	
% of heat demand supplied	66%		
Biomass Boiler efficiency	90%		
Gas Boiler efficiency	95%		
Capital Cost over gas boiler	£15,000		
Annual biomass energy	111,111	kWh	= Heat / Biomass Efficiency
Annual gas energy replaced	105,263	kWh	= Heat / Gas Efficiency
Annual CO2 emissions biomass	4,111	kg CO2	= 111,111 x .037 (Wood pellet CO2 factor)
Annual CO2 emissions of gas saved	21,684	kg CO2	= 105, 263 x .206 (Gas CO2 factor)
Annual CO2 Savings	17,573	kg CO2	= 21,684 – 4,111
% of Building Emissions	31%		= 17,573 / 56,600
		£ per kg CO2 saved	
Cost Factor	£0.85	= 15,000 / 17,573	

Question 3

What would be the main issues with each technology for this development?

Question 4

The total energy bill for the development is expected to be £11,200 before any renewable energy options are installed.

Energy prices and incentives for the development are expected to be:

Energy Price	p/kWh
Electricity price	12
Gas price	4
Feed In Tariff	
Wind	28
PV (5kW)	37.8
Exported electricity	3.1
Renewable Heat Incentive	
Solar	8.5
Biomass to 65,700 kWh (Tier 1)	7.6
Biomass over 65,700 kWh (Tier 2)	1.9

So the annual costs savings for each technology are as shown below.

	Energy Saving	Export	FIT	Total Saving	Maintenance	Net Saving
Wind (using 80%)	2,400	155	7,000	9,555	500	9,055
PV (using 100%)	480	0	1,512	1,992	100	1,892
Solar Hot Water	632	0	1,275	1,907	100	1,807
	Energy Saving	RHI Tier 1	RHI Tier 2	Total Saving	Maintenance	Net Saving
Biomass Boiler	-1,600	4,993	652	4,045	2,000	2,045

Financial Summary

	Capital Cost	Annual Saving
Wind Turbine	£50,000	£9,055
PV	£20,000	£1,892
Solar Hot Water	£30,000	£1,807
Biomass Boiler	£15,000	£2,045

As the developer, which technology might you prefer?

As the building owner/occupant, which technology might you prefer?

Which technology or combination of technologies might you propose?