Energy Statement: Plot A

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For a Living, Working Countryside

This report has been prepared by Zoe Wangler of the Ecological Land Co-operative Ltd. It is written to be read in conjunction with the planning application, plans and other documents accompanying this application.

SUMMARY

This report summarises the projected energy consumption and planned energy sources for one new temporary agricultural worker's dwelling (Plot A) which forms part of a proposal for three new low impact smallholdings for new entrants to ecological agriculture developed by the Ecological Land Co-operative, a co-operative society and social enterprise.

- Monitored electricity data has been used to estimate the electrical energy demand. Anticipated increase in the demand has also been considered.
- Seven low carbon and renewable energy technologies have been reviewed. The preferred options are photovoltaic cells (PV) to provide all of the electrical demand and solid biomass to provide all of the space heating and domestic hot water demand. Solar hot water, and biodiesel fuel to drive the backup electric generator can be retained as options.
- Mr. Boyle will be working with a firm of engineers who have offered the ELC *pro-bono* assistance to design a highly sustainable yet temporary dwelling allowable under PPS7 Annex A. The dwelling will make use of materials with low embodied energy, be highly insulated and make use of energy efficient lighting and other appliances.
- The development will be exemplary for low carbon living, with no projected carbon impact from domestic energy consumption.

INTRODUCTION

According to the Department of Energy Climate Change, from 2005 – 2009 domestic energy use in Mid Devon in heating, electricity and cooking generated ~ 1.01 Mega tonne CO_2 (~ 2.7 tonne CO_2 per year per person)[1]. One of the central principles of the proposed scheme is for all households to be 'low impact' which includes dramatically reduced carbon emissions as a result of onsite renewable energy generation. The proposed development is aiming for a target of ~ 0.2 tonne CO_2 per year per person from domestic energy consumption.

PROJECT DESCRIPTION

The proposal is for a temporary agricultural worker's dwelling for a period of 5 years located at Greenham Reach in Holcombe Rogus. In addition to the dwelling, the proposal includes a shared agricultural barn and a greenhouse.

Although this statement supports an application for a single agricultural worker's dwelling, it forms part of proposal for three smallholdings: Plot A, Plot B, and Plot C.

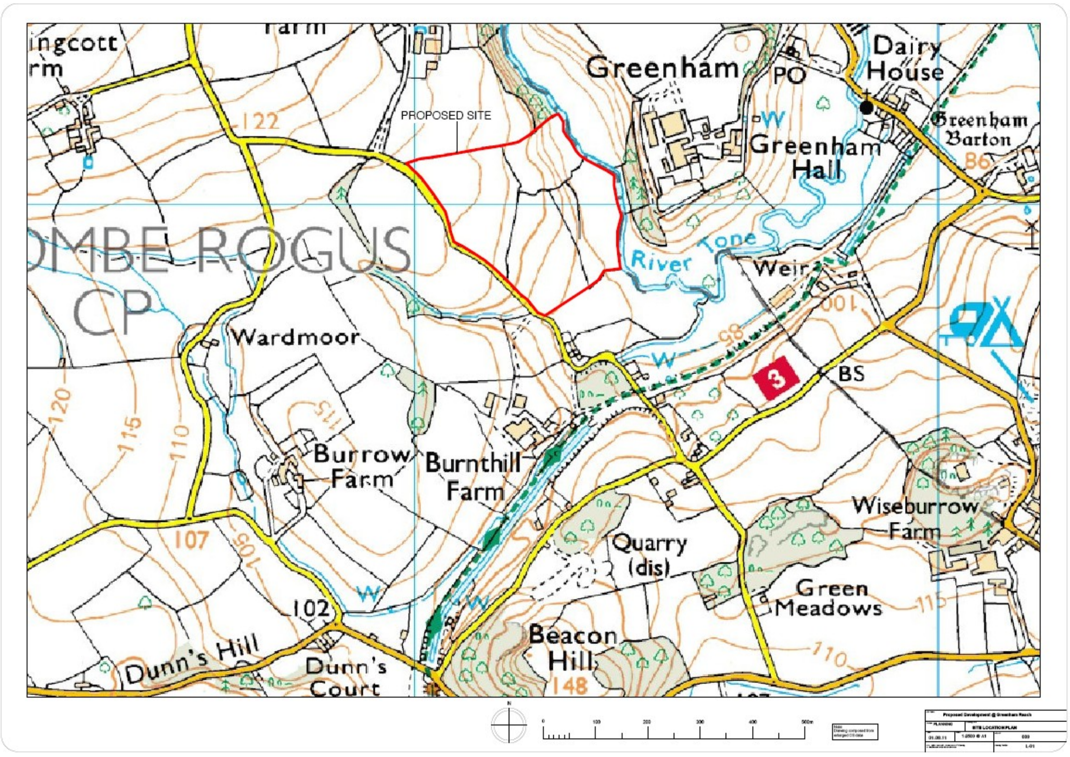

Figure 1: Site location plan

[1] AEA (2011) *Local and Regional CO2 Emissions Estimates for 2005-2009*. Department of Energy & Climate Change.

ENERGY DEMAND

Space heating and hot water energy demand

The temporary dwelling will be positioned to maximise passive solar heating from direct sunlight. Heating and hot water demand calculations are not included in this report as 100% of this demand will be met via carbon neutral energy source using solid biomass heating (woodburning).

Electrical energy demand

Efficient and low energy light bulbs and energy efficient appliances will be used. This will significantly reduce the electrical energy demand.

The electrical energy demand has been estimated using monitored data for electricity consumption provided by three prospective tenants' households. They also provided anticipated changes to the monitored electricity consumption and that has been included in the total demand estimation. Detailed breakdown of the list of appliances that have been monitored (including anticipated changes) are shown in Appendix 1.

The average and peak annual electrical energy demand for Plot A has been estimated as ~ 330 and ~ 618 kWh respectively (see Figure 1).

For the whole development (3 smallholdings), the total average and peak annual electrical energy demand has been estimated as ~ 1,550 and 2,550 kWh respectively.

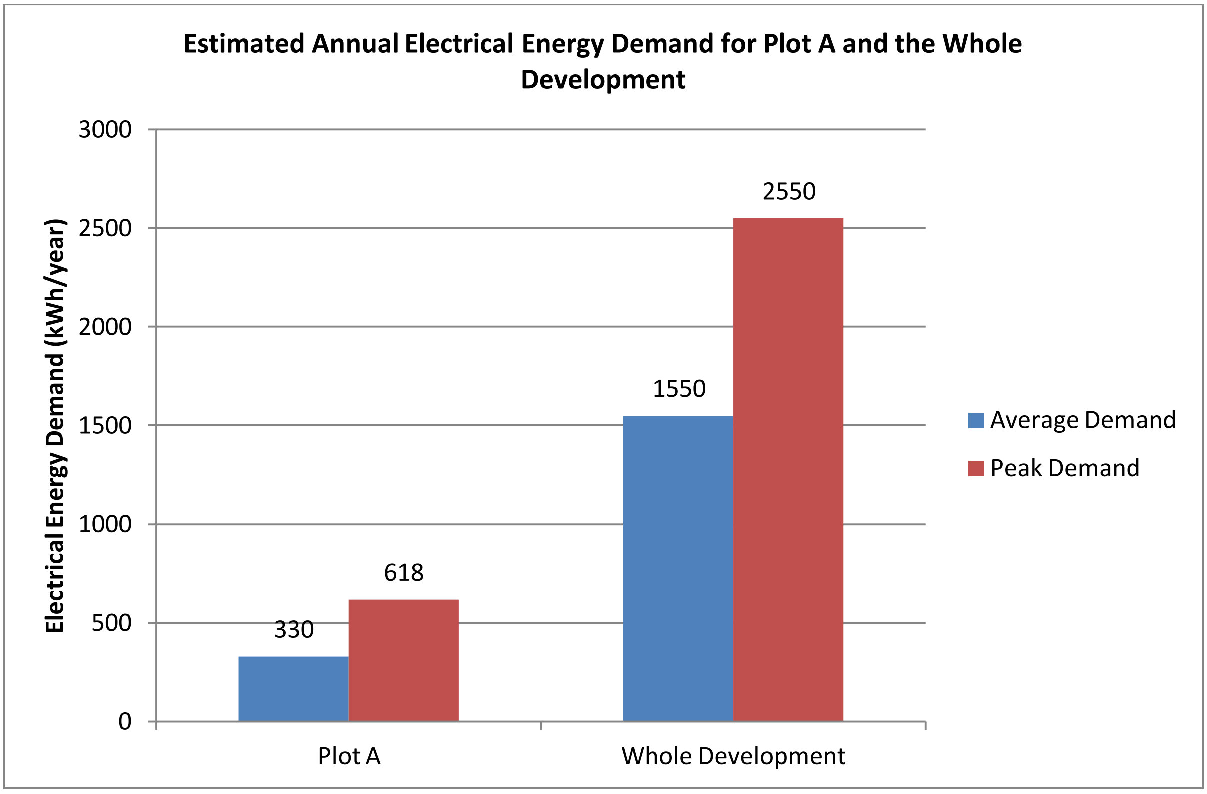

Figure 1: Estimated annual electrical energy demand for Plot A and the whole development

Cooking

It is expected that a 'rocket stove' fuelled by wood will be used for cooking.

Further sustainability features

Water use

In addition to efficient energy use, sustainable measures for water use such as compost toilets, biological waste water treatment system, rainwater harvesting and borehole water abstraction are proposed.

RENEWABLE ENERGY TECHNOLOGIES

Seven low carbon and renewable energy technologies have been reviewed for the development and preferred options have been identified. These technologies are listed below:

- Photovoltaic cells (PV)
- Solar hot water (SHW)

- Solid biomass
- Biodiesel (for power generation)
- Ground source heat pump (GSHP) and air source heat pumps (ASHP)
- Combined heat and Power (CHP)
- Hydro electric power

Preferred renewable energy technologies

Photovoltaic cells (PV)

Preliminary assessment indicates that the ideal size of a PV system for Plot A is ~ 1 kWp. This system should be sufficient to meet the maximum peak demand of ~ 618 kWh as shown in Appendix 1. The PV panels' area is ~ 7.6 m^2. The PV panels are proposed to be installed on the barn's roof. If necessary, besides the barn's roof, there is sufficient unshaded land area that can be used for PV panel installation.

For the whole development, the suggested capacity of the PV system is ~ 3.75 kWp, and the total PV panels' area is ~ 28.5 m^2.

	PV system capacity (kWp)	PV system area (m^2)
Plot A	~ 1	~ 7.6
Whole development	~ 3.75	~ 28.5

Table 1: Summary of suggested PV system for Plot A and the whole development

The proposed PV system is anticipated to meet all of the electrical energy demand. All energy generated will be stored in an electric battery bank.

In addition, the prospective tenants of the scheme are aware that as they are powered by an off-grid system they will have to consider the time of day to use major appliances. They have all made a commitment to work within the limits of this system. Further guiding information and training for the tenants will be provided.

Solid biomass heating

Space heating and domestic hot water demand will be provided by solid biomass heating technology using a woodburning stove. Wood will be sourced locally and in time, some will be sourced from the site itself. With this approach, 100% of the space heating and domestic hot water energy demand will be met via a carbon neutral source.

Technologies that can be retained as an option

The technologies that can be kept as an option for the development are as follows:

Solar hot water (SHW)

Mr. Boyle is likely to include a solar water heater to provide his domestic hot water during summer. For this option, a storage tank would be used with an immersion heater to top-up the hot water temperature as required / when surplus solar energy was available.

Biodiesel power generation

A backup electric generator with a 5 kW capacity is proposed for the development. This generator will be used to replenish the energy generated by the PV system only if required. As a potential option, the electric generator could be fuelled by biodiesel fuel. There are different types of biodiesel fuel available in the market. The backup electric generator is not anticipated to be used frequently. For this reason, a suitable biodiesel fuel with long degradation period should be used.

Technologies considered unsuitable for the development

The following technologies are considered unsuitable for the development:

Ground source heat pump (GSHP) and air source heat pump (ASHP)

GSHP technology utilises ground temperature to provide heat at low grade temperature. It also requires arrangement of pipework to be buried below the ground surface (~ 2 – 4 metre deep). ASHP technology operates similar to the GSHP however it utilises air temperature.

Both GSHP and ASHP systems are driven via electricity. The development's heating demand will be met via solid biomass heating, which is carbon neutral source. GSHP and ASHP are not considered as suitable options.

Combined heat and power (CHP)

CHP technology is suitable for buildings with high hot water demand such as hotels. The technology requires the system to run continuously for long hours to be cost effective (e.g. 15 hours a day). The development's hot water demand will be met via solid biomass heating. For these reasons, CHP is not considered as a feasible option.

Hydroelectric power

Hydroelectric technology utilises water power to generate electricity. The water flow must be sufficient enough to drive the hydroelectric turbines. There is a water stream close to the development. However while it has not yet been established whether the water flow is sufficient for electric power generation, hydroelectric power systems are more complex and require higher running costs compared to PV systems. For this reasons, hydroelectric technology has not been considered further.

Overall CO2 emissions

The development is aimed to be carbon neutral. The anticipated CO_2 emission from domestic energy consumption is ~ 0.0 tonne of CO_2 per year.

CONCLUSION

To minimise space heating energy demand, any temporary dwelling will be sited to maximise solar gain and will be well insulated. The proposal includes a number of sustainability features such as a dry toilet, a biological waste water treatment system, rainwater harvesting and borehole water abstraction for low and efficient water use.

The electrical energy demand has been estimated using monitored electricity provided by prospective tenants with the consideration of anticipated increase in the demand. The expected average electrical demand for Plot A and the whole development is ~ 330 and 1,550 kWh per year respectively. While the peak demand has been estimated as ~ 618 and ~ 2,550 kWh per for Plot A and the whole development respectively.

Seven low carbon and renewable energy technologies have been reviewed. Two technologies have identified as preferred options: (a) solid biomass heating to provide all the space heating and domestic hot water demand, (b) photovoltaic cells (PV) to meet the electrical demand. This preliminary assessed showed the PV system that can be suggested is as in the following Table.

	PV system capacity (kWp)	PV system area (m^2)
Plot A	~ 1	~ 7.6
Whole development	~ 3.75	~ 28.5

Copy of Table 1. Summary of suggested PV system for Plot A and the whole development

Two technologies can be retained as options: (a) solar hot water (SHW) to contribute to the hot water demand particularly in summer, (b) biodiesel to drive the backup electric generator.

There are no projected CO_2 emissions from domestic energy consumption. The proposal is aimed to be exemplary for a sustainable, low carbon, and energy efficient development.

APPENDICES

Appendix 1: Breakdown of electrical energy demand for Plot A

Month		Fridge/freezer	Lights	Music	Television	Phone	Chargers	Computer	Washing machine[2]	**Total**
January	Average	0	0.15	0.02	0.025	0.008	0.01	0.45	0.075	**0.738**
	Peak	0.24	0.3	0.04	0.1	0.028	0.01	0.9	0.15	**1.768**
February	Average	0	0.15	0.02	0.025	0.008	0.01	0.45	0.075	**0.738**
	Peak	0.24	0.3	0.04	0.1	0.028	0.01	0.9	0.15	**1.768**
March	Average	0.24	0.15	0.02	0.025	0.008	0.01	0.45	0.075	**0.978**
	Peak	0.24	0.3	0.04	0.1	0.028	0.01	0.9	0.15	**1.768**
April	Average	0.24	0.15	0.02	0.025	0.008	0.01	0.45	0.075	**0.978**
	Peak	0.24	0.15	0.04	0.1	0.028	0.01	0.9	0.15	**1.618**
May	Average	0.24	0.1	0.02	0.025	0.008	0.01	0.45	0.075	**0.928**
	Peak	0.24	0.15	0.04	0.1	0.028	0.01	0.9	0.15	**1.618**
June	Average	0.24	0.1	0.02	0.025	0.008	0.01	0.45	0.075	**0.928**
	Peak	0.24	0.15	0.04	0.1	0.028	0.01	0.9	0.15	**1.618**
July	Average	0.24	0.1	0.02	0.025	0.008	0.01	0.45	0.075	**0.928**
	Peak	0.24	0.15	0.04	0.1	0.028	0.01	0.9	0.15	**1.618**
August	Average	0.24	0.1	0.02	0.025	0.008	0.01	0.45	0.075	**0.928**
	Peak	0.24	0.15	0.04	0.1	0.028	0.01	0.9	0.15	**1.618**
September	Average	0.24	0.1	0.02	0.025	0.008	0.01	0.45	0.075	**0.928**
	Peak	0.24	0.15	0.04	0.1	0.028	0.01	0.9	0.15	**1.618**
October	Average	0.24	0.15	0.02	0.025	0.008	0.01	0.45	0.075	**0.978**
	Peak	0.24	0.3	0.04	0.1	0.028	0.01	0.9	0.15	**1.768**
November	Average	0.24	0.15	0.02	0.025	0.008	0.01	0.45	0.15	**1.053**
	Peak	0.24	0.3	0.04	0.1	0.028	0.01	0.9	0.15	**1.768**
December	Average	0	0.15	0.02	0.025	0.008	0.01	0.45	0.075	**0.738**
	Peak	0.24	0.3	0.04	0.1	0.028	0.01	0.9	0.15	**1.768**
No days per annum	365									
Annual Electrical Energy Demand (kWh)	Average	66	47	7	9	3	4	164	30	**330**
	Peak	88	82	15	37	10	4	329	55	**618**

[2] [1] The washing machine would not be used every day. Typical consumption is 500 W for 0.3 hours per day. This is considered as the peak demand (~ 0.15 kWh per day). 50% diversity assumed for average use (~ 0.075 kWh per day)