

## **Arun District Council Ford Eco-town Select Committee**

### **Sustainability and Alternative Energy**

#### **CAFÉ Submission by R W Penny - 30 May 2008**

##### **1. INTRODUCTION**

The following analyses are based on an estimate of the domestic requirements of the residents of 5,000 homes. No attempt has been made to estimate the further requirements of commercial, business and social use buildings such as municipal offices, schools, medical, entertainment and religious meeting places, etc. No allowance has been made of the requirement for street lighting. Until more details are known of the proposed infrastructure none of the above can be determined.

The document starts with an estimate of the peak requirement for the 5,000 homes and goes on to review the proposed sources of renewable energy and compares each with the estimated energy requirement. Because of the limited time available it has not been possible to go into great detail of each proposition. Nevertheless, this document extrapolates real data obtained from an up-and-running DTI-funded biomass project in Staffordshire now supplying 1000 homes to examine the Ford Eco-Town proposal.

##### **2. ESTIMATED MINIMUM ELECTRICITY REQUIREMENTS.**

###### **2.1. General.**

Ford Airfield Eco-Town is a proposed development of some 5,000 dwellings. The developers (FAVG and FEH) have proposed a number of alternative energy sources for the Eco-Town that would be environmentally friendly in order to meet the UK Government's Eco-Town criteria. Each of these alternatives will be discussed. However, it is necessary to have reasonable idea of the magnitude of the power required in order to come to meaningful conclusions about the alternatives.

###### **2.2. Assumptions.**

Putting the energy requirements of the Eco-Town into context, the peak electrical power demand of each dwelling will typically be 5 kW. Therefore an available generating supply of 25MW would be required to meet the peak demand of the residential consumers in the town. Generally, users will not all require 5kW all of the time, but at peak times it must be assumed that all users will need servicing simultaneously in order to define the maximum feeder capacity of the grid. It must also be supposed that the national grid must be able to guarantee the supply in the case that other local sources are in default

It is a foregone conclusion that not everyone will agree that this estimate is realistic. Some may think that it is too high, whilst other may take another view. Whatever may be

the case, it is hoped that the figures will be accepted by all as a legitimate starting point to determine the validity of subsequent arguments. Under more normal circumstances it would have been possible to obtain more accurate information from the operators of the National Grid but, because of the limited time available to prepare this report, it has not been possible.

Domestic heating will generally be by gas or another source not requiring significant electrical power.

The domestic apparatus in each home to be: cooker - 4kW, washing machine - 3kW, tumble dryer - 4kW, freezer/refrigerator- 2kW, power-shower - 3kW, computer - 0.5kW, kettle - 2kW, lighting - 0.5kW and other minor and/or occasionally used electrical items.

### 3. REVIEW OF PROPOSED 'GREEN' SOURCES OF ENERGY

#### 3.1. Introduction.

There appear to be two main types of sustainable energy source namely:- Continuous and Discontinuous.

A continuous source is one that can be relied upon to yield a constant source of energy and is not dependent on environmental conditions such as weather, time of day, etc. In the following review, the only source that is found to be continuous is Biomass, and it is therefore to be regarded as the major component of the Eco-Town energy resource.

All the other sustainable energy sources are discontinuous in that they are subject to environmental variations. These are minor components of the energy resource, but are nevertheless important to the concept of an Eco-Town.

#### 3.2. Biomass from Bio-crops.

Substantial useful technical information was found to be available, with many companies offering solutions. A typical website is [www.talbotts.co.uk](http://www.talbotts.co.uk). and the information from here is used to illustrate the principle of gaining significant power from a bio-crop. The company, Talbotts, is a well-established manufacturer of small steam turbine driven generators in the range 2MW to 20MW. They have carried out a successful (DTI funded) pilot study using a 2MW generator to power 1,000 homes in Eccleshaw, near Stoke-on-Trent. From the information given, 52 tonnes per day of miscanthus grass (see picture) are required to produce energy. The waste product, ash, is sold as fertiliser. The crop is supplied by 60 farms located in the 25-mile radius of the 2MW plant, which occupies 1 hectare of land using 8 lorry movements per day. Miscanthus grass can be grown on rough soil

Scaling up for the Ford Eco-Town – what are the problems?

To achieve a similar result for the Ford site, the numbers need to be multiplied by a factor of between 5 and 10.

Problem 1. It is immediately apparent that there is a logistics problem, because 40 to 80 lorry movements per day greatly increases the carbon footprint. So it is clear that the crop, now between 260 and 520 tonnes per day, must be transferred to rail and the mini power station moved to Ford rail-side. The changes to the railway must allow for a siding running into the biomass plant.

Problem 2. Where do the bio-crops come from? For example; crops on this scale are more economically farmed where the fields are very flat and vast. This allows the crop to be machine harvested. This kind of crop can be grown on poor soil and would be waste of good quality arable land. To attempt to supply the crop from farms local to Ford would interfere with the established crops-for-food nature of this part of Sussex. .

Problem 3. In the days of coal-fired power stations, it was usual to site the power station on top of the mine to eliminate transport costs. Nothing has changed.

The right place for the power station is where the crops are farmed, not many miles away!

The eco-generated electricity is easily fed into the grid to transport it to Ford or any of the other proposed Eco-Towns). From the nation's point of view, it is a better solution. Even better, instead of one large power unit, it is logistically more practical to build a number of small units within each farm complex. These can be located anywhere in the UK in areas where the soil is not so valuable as that in West Sussex.

### 3.3. Biomass From Waste and/or the Viridor Waste Management Facility

This is a major part of the FAVG proposal and is similar in all respects to 3.2. (above). As stated above, the biomass furnace must be continuously fed with fuel. Whilst it might be a useful component if confined to consuming local waste, CAFÉ are opposed to Ford Eco-Town becoming a dump for waste from the whole of the South East simply to maintain an eco-illusion.

As part of their PFI contract with WSCC, Viridor Waste Management is constructing the Ford MRF. The facility is due to be commissioned in November 2008, with full operation by February 2009. This facility is designed to sort mixed recycled materials, including paper, cardboard, tins, glass and aluminum foil. The Ford MRF has targets to recycle more than 85% of the waste brought into the site; indeed planning documents suggest about 80% of the material handled by the plant will be paper and cardboard. The segregated streams will then be exported from the site for recycling elsewhere.

If the products of the Ford MRF were to be diverted to produce energy via steam raising, with the steam used either for district heating or for power generation (i.e. Biomass), then this would require the combustion of material that is currently planned to be sent for recycling; presumably the paper and/or cardboard. This would not only reduce the

percentage of waste material that West Sussex recycles, but also produce a negative public reaction when the public learn that material that they are saving and sorting for recycling is “being burned in an incinerator”.

#### 3.4. Energy From Water Treatment Sludge

The existing waste water treatment plant at Ford produces sludge as a by-product of its operation. The quantity of sludge is not known, and it is presumed that it is currently being disposed of by spreading onto agricultural land.

Several technologies have been developed and commercialised for the production of heat and/or power from water treatment sludge. These include direct combustion in a fluidised bed combustor, and gasification of the sludge to produce “biogas” followed by combustion of the biogas in either a boiler or engine. As an example, the ALCOSAN waste water treatment plant in Pittsburgh, USA combusts 193 dry tonnes per day of sludge for the production of 24 tonnes/hr of 29 bar steam. However, the steam raised by this unit is entirely used for process use and electrical power generation for use within the water treatment plant; it does not export power. This will also be the case with the sludge gasification unit planned by the town of Sanford in Florida; the biogas generated will be used in place of natural gas for on-site energy use.

From the above, while the technology is available to generate energy from sludge in the Ford waste water treatment plant, whether this would provide sufficient power for export to residential consumers in the town is open to question.

#### 3.5. Solar Power for Housing

3.5.1. Domestic photo-voltaic (PV) technology is available for households to install to generate power both for their own use and, when their demand is less than the system output, for export into the grid.

The Energy Savings Trust indicates that a typical domestic PV installation has an installed capacity of 1.5 to 3.0 kW. If each home in the Ford Eco-Town had a system installed, then the total installed capacity would be between 7.5MW and 15 MW, i.e. between 30% and 60% of the peak load of the town. However, alternative sources of generation would be required for operation at night, and when the PV units are operating at less than optimum efficiency. Peak output from PV tends not to coincide with peak demand from domestic consumers. The cost of a single domestic PV system, again using data from the Energy Savings Trust, is typically £5,000 to £8,000 per kW. It is anticipated that a developer looking to install 5,000 units would be able to achieve a lower installed cost than an individual household installing a single system. If it is assumed that an installed cost of £4,000 per kW can be achieved, then this translates to £12,000 per home, and £60 million for the whole town.

#### 3.5.2. Solar Heating.

The main problem with Photovoltaic PV technology is that the electrical energy is produced as low voltage dc and needs electronic conversion to 50Hz 230Vac. Further, the efficiency of light to electrical energy conversion is around 20%, so large panels are required. Smaller solar heating panels produce no electricity, but transfer the heat to a domestic hot-water tank. In this case, not only is the efficiency increased to 70%, but the ability to store the heat generated is a better practical and cheaper proposition.

### 3.6 Energy from Water.

#### 3.6.1. Tidal Energy Generators – Micro-Hydro from the River Arun.

The developers estimate that a micro-hydro scheme with a capacity of 30 kW could be installed on the River Arun. Such a facility would only generate the peak power requirement for 6 dwellings, or 0.12% of peak demand, so can only be regarded as a demonstration unit rather than a serious contributor to the power demands of the town. Data from the Energy Savings Trust suggests an installed cost of around £100,000 for this facility or £3,300 per kilowatt.

The sinusoidal nature of the rise and fall is greatest at the mouth of the river. However, in that position it would reduce the navigability of the river, and might promote flooding in Littlehampton. Also, there would be periods between the tides when no power is generated, and the maximum diurnal power would be subject to the phases of the moon.

## 4. CONCLUSIONS.

4.1. The developers' proposals rely heavily on electricity generation by biomass technology. There are serious logistical problems related to the transport of large requirements of fuel to feed the associated steam-turbine generators.

4.2. The developers have proposed that the so-called energy centre be sited in the town centre, whereas the fuel transport terminus would be better incorporated with the rail network. Any atmospheric pollution caused would then be furthest away from residential areas.

4.3. CAFÉ suggests that the best national ecological solution would be to build smaller biomass power stations where the bio-crops are grown, so allowing the National Electricity Grid to transport the energy to where it is needed. This would undermine the town's eco-status somewhat, but is the most logical solution to an otherwise intractable logistic problem.

4.4. The use of solar photo-voltaic (PV) arrays are the least efficient and most costly solution. The use of solar water heating arrays are a more efficient local source of renewable energy.

4.5. Micro-Hydro power from the River Arun is a trivial and uncertain energy source, and may have a disruptive effect on other river amenities.

4.6. Generation of power from sludge locally is of questionable value, especially since the quantity involved is small. It is better used as fertilizer, as at present.

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30 May 2008

Author's Details:

Mr Penny is a Chartered Electrical Engineer having 50 years of experience in the electrical and electronic industries. After graduating BSc in Physics at Southampton University in 1955, he served in the Royal Air Force as a signals officer installing airfield control radar. He then worked on Naval ASDIC with the Plessey Company before joining Rosemount Engineering (Bognor Regis). Subsequently, he was Chief Electronics Engineer at KDG Instruments, (Rustington) but left on appointment as Associate Research Fellow at University College, London (at the Mullard Space-Science Laboratory). He started and ran an industrial electronics manufacturing business in Littlehampton for 10 years. For 9 years he served as an on-site Consultant Design Engineer to many major companies including CEGB (Ferrybridge), CIBA (Sudbury), Honeywell SA (France), Philips (Cambridge), Cambridge Consultants, NEC (Reading), Thales (Crawley), Nokia (Farnborough), and Alcatel Submarine Networks (Greenwich).

He and his wife moved to Arundel in 1973 where they raised 5 children. They are active members of the Clymping Parish Church. He is one-time parent governor of Westergate Community College. Now in retirement, he is a foundation Governor of Clymping CofE Primary School