Development of a rural biomass cluster on the Isle of Arran: the necessity of co-operation between stakeholders when utilising a limited resource

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Introduction

Darwin noted that competition within a species over resources is one of the main drivers which will keep a population in check [1]. At present the UK finds itself embroiled in a war over resources, in this case over oil in Iraq. Humanity does have a capacity for co-operation which allows us to prevent war, but there are many instances where such co-operation has failed and where nations and groups of nations have gone to war [2].

This competition (or necessary co-operation) over resources is directly linked to population.

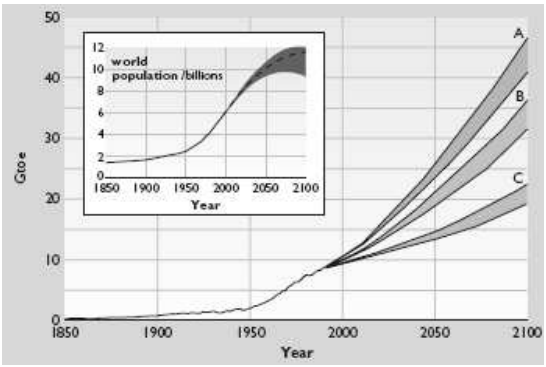

Figure 1. Global population growth [2].

It has been noted that more widespread and more frequent wars could take place as energy reserves shrink. Population is set to increase as is shown above, and if developing economies follow the trend of stabilising population that the developed economies have shown (as is happening in China at the moment) then world population should stabilise at around ten to twelve billion people by the end of the century [2]. This would suggest an energy consumption of between $2x10^{10}$ and $4.5x10^{10}$ tonnes of oil equivalent per year depending on World Energy Council scenario – between two and nearly five times current energy consumption. Given that when world population doubled between 1950 and 2000 energy consumption increased by a factor of six, the statistics are not encouraging [3]. Further, the upper suggested limits of these statistics are the ones which are most likely. People in developing countries want access to the same goods and transport which have made developed countries so intensive in their energy use, and remaining fossil resources will not support this. When fossil reserves are exhausted we not only lose cheap energy and transport, we lose cheap plastics and consumer goods.

In the development of any sustainable energy proposal consultation and public engagement are important; this importance increases when a limited resource is to be utilised. Such an energy resource could be usefully described as one exhibiting characteristics similar to fossil fuels, such as biofuels and biomass. It has been evident that a lack of such consultation and engagement in the biofuel policies of both the US and EU has caused an increase in prices of food/fuel crops, leading to speculation, inflation, and in some cases malnutrition and rioting. Likewise biomass – it is versatile and sustainable, and must be subject to careful and efficient utilisation.

All resources are ultimately limited. This paper looks to take an example on a micro scale, that of an island with a population of 5000, and apply what lessons can be learned from that example to the macro scale. Arran, in the Firth of Clyde, is known as ‘Scotland in Miniature’. It represents a microcosm of Scotland as a whole in population and terrain. Heating on the island is primarily electric, and by means of oil fuel and LPG delivered by ferry. The island’s electricity is supplied by a connection to the mainland. The intention to develop a thermal biomass cluster on the island, utilising its considerable coniferous forestry resource, could offer fuel cost savings of 50%, depending on installation, along with associated CO2 savings.

Methods

In proceeding with this project, sections of a methodology developed at the University of Strathclyde were followed.

Figure 2. Sustainable energy assessment [4].

1	Clarify organisational environment
2	Quantify demand
3	Assess energy resource within local area
4	Match resource to technology
5	Check relevant legislation

This is a 'go/no-go' methodology, designed to prevent unnecessary effort should any of the sequential stages produce a 'no-go' decision. Its main advantages are its simplicity, and that it can be used to assess multiple energy resources, or a preferred resource, with equal success.

Results

In terms of stage 1, the internal organisational environment was suitable for the project; at the time of the 'go' decision, with the information available, the external environment was also suitable.

After quantification of demand – stage 2 – by means of ESP [5], a dynamic building energy modeling program developed by Prof. Joe Clarke, it was determined that at least 100 tonnes per annum of green small round wood at 50% moisture content would be required. This, along with such for external customers, would be stored on site for up to a year and used at a maximum of 30% moisture content as woodchip.

Stage 3 – energy resource – was not difficult, at least initially. Arran has 11k hectares of managed coniferous forestry. This will provide the woodchip resource for business and large domestic installations. For smaller domestic installations wood pellets are preferred; since pelleting is currently uneconomic on this scale these will be imported from the mainland.

High efficiency (c90%) technology was available – stage 4 – and funding had been secured for the project. This technology was fully compliant with legislation such as the EU Integrated Pollution Prevention and Control Directive, Arran is not a smoke free area, and the use of virgin wood exempted the project from the EU Combustion of Waste Directive – stage 5 could and did produce a 'go' decision.

As it looked as if all 'go' decisions had been made, a potential problem came to our attention – there is the intention to build a biomass fuelled power station on the island. It was stated that the station will be steam plant of 5.5MW output, and somewhat more than 30% generating efficiency. Combined Heat and Power (CHP) is planned for the plant, for 20 affordable houses to be built in the vicinity. It became evident that the power station had at least a verbal agreement for the island's entire output of green small round and pallet wood, stated as being circa 60k tonnes p.a. Assuming 35% efficiency, 90% availability of the plant, 50% moisture content of the fuel, and 0.006TJ/tonne energy content of the fuel, brief calculation shows 60 000 tonnes of fuel per year will result in an output of 31.5GWhe/yr and 58.5GWhth/yr. Further assuming an average household thermal requirement of 12MWh per year, the power station will utilise a further 240MWhth/yr in CHP, equating to 0.41% of thermal output. Fuel delivery, assuming the average wagon carries 20 tonnes of green timber, will require a wagon approximately every 15 minutes – Forestry Commission Scotland is planning a new road to service the area. The final consideration is financial – the CHP planned represents 0.41% of thermal output from the plant and could provide an extra 0.5 Certificates/MWhe, worth up to £0.6M per year at present market prices, under the recently proposed banding of the Renewable Obligation.

For thermal biomass and the biomass cluster project to progress on Arran, a meeting with the local community council and with the power station developer became necessary – revisiting stage 1 – the external organisational environment. The meeting recognised the potential benefits of local biomass heating, and a supply – revisiting stage 3 – was secured sufficient to satisfy initial demand. Co-operation in this case benefited all stakeholders; the biomass cluster company was successfully launched in March of this year [6]. It should be noted that this was co-operation between the potential users of the energy resource. Owners and producers of primary energy will naturally look to secure contracts with the largest consumers, and often welcome conflict between consumers as it can enable price increases, although FCS have been very fair. In order to deliver best value for the island any conflict of this kind had to be avoided.

Conclusions

Arran – 'Scotland in Miniature' – is unlikely to be involved in sustainable transport fuel provision; other targets will affect the island and its resources directly. The biomass resource is clearly visible and just as clearly limited. How it is used will be determined in the coming years. Forestry Commission Scotland, as a public body, has an important role to play, yet the public themselves will ultimately define its use; whether they embrace sustainability, and the fuel cost savings this can provide.

Renewable energy is a global issue which must be tackled on a local level. Fossil fuel use has created externalities to the energy market – in terms of pollution and intergenerational equity – that have the potential to create ecological and economic havoc in the coming years.

Scotland finds itself in a position where it has considerable biomass resource. Managing how this resource is used will require care. High conversion efficiency is always desirable, yet not necessarily where it conflicts with local requirements. Local planning will be affected by utilisation. For the first time in two decades a public body – the Forestry Commission – will be involved in primary energy supply and controls slightly more than 40% of the available Scottish resource.

Scotland's and the UK's biomass emphasis has thus far been electricity production. This has been laudable, yet maximum efficiencies are c40% and even large scale CHP in the UK normally raises efficiency by only a few percent. EU targets now require 15% of all UK energy to be sustainable, greatly increasing the overall contribution and scope renewable energy technologies must make; the use of high efficiency thermal biomass and the development of rural clusters must not be ignored in the light of a limited yet extraordinarily versatile resource. The scale of CHP – the thermal aspect – is likewise an immediate concern when, per MWhe, financial incentives under a banded R.O. will increase from 1.5 to 2.0 of reference.

This paper has thus far been 'micro', so what specific lessons can be learned to take forward into the 'macro' scale?

Firstly, it is necessary to inform consumers about choice. This could be applied from the scale of one consumer in the developing world being informed about efficient means of cooking and keeping warm, to an island given the choice of how to use its forestry, up to a scale whereby countries are informed of the choices they face.

Secondly, when such information is provided all points of view should be available where based on scientific fact. This paper has been written from the point of view of a biomass cluster developer and illustrates such, whereas a paper from the developer of biomass power stations would be very different in tone and emphasis.

Finally, co-operation between consumers can be mutually beneficial. This is not a fashionable statement in a 'free market', yet it is necessary to make the point. The reader is invited to consider which area(s) of the global energy economy could be defined as being, in any reasonable economic sense, 'free'.

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