Guide to the Establishment of a Co-operatively Managed Biodiesel Production Facility Recycling Used Vegetable Oil

Jan Cliff, Molly Scott Cato, Len Arthur, Tom Keenoy, Russell Smith

Background

The two main underpinnings of the argument in favour of biodiesel are becoming increasingly pressing: the need to reduce emissions of carbon dioxide to avert the catastrophe of climate change; the importance of finding alternative fuels in a framework of declining oil production and an increasingly unstable international oil market.

The discussion about oil and gas depletion is now hedged in terms of 'peak oil', with most analysts concluding that we are reaching the peak of oil production and that the future trend will be downwards. Figure 1 indicates the trends in oil availability. The prediction is that production will be only half its 2010 level by 2050. This will lead to an increase in prices during the next decade or so and increasingly bitter conflict over remaining supplies (FEASTA, 2004; Douthwaite, 2004).

Around 20 per cent of CO2 emissions are transport-related (Hansard, 2004), and this is the fastest growing part of total emissions. The UK government has set a target for CO2 reduction of 60 per cent on 1990 levels by 2050. It is legally bound to reduce annual emissions of greenhouse gases to 12.5 per cent below 1990 levels during the period 2008-2012. Biodiesel can play a significant role in achieving these reductions, since biodiesel made from transesterifying used vegetable oil reduces life-cycle CO2 emissions by 90 per cent (latest DTI figures).

Biodiesel produced from recycling is thus a product with a guaranteed future market. Its slow development is the result of an unsupportive fiscal environment, as discussed below. In the future biodiesel can anticipate a lower rate of duty, and rising mineral diesel prices as oil runs out can only improve its prospects. Since it is a recycled product it can also expect to gain support from the future increase in the Landfill Levy. The Sundance recycling plant - which is the pilot on which this report is based - has the capacity to produce approximately 250,000 litres of

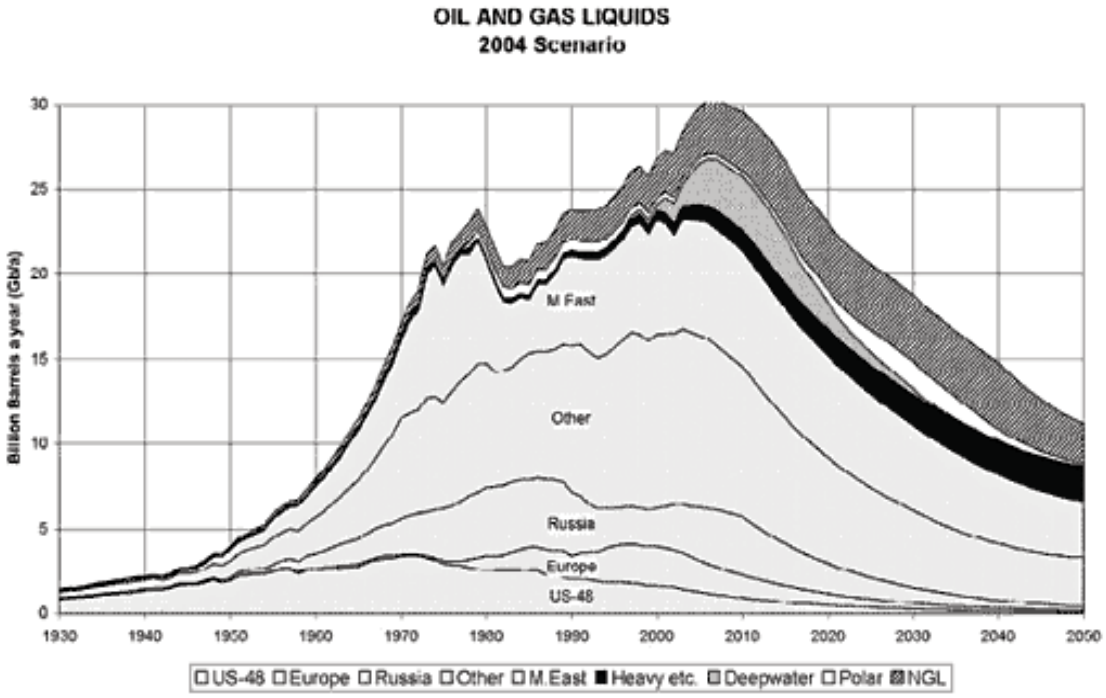

Figure 1. Projected availability of oil and gas, 1930-2050
Source: Association for the Study of Peak Oil and Gas

biodiesel a year, saving 875 tonnes of carbon dioxide. It is thus an efficient way of achieving reduction targets compared with other forms of renewable energy. A system of photo-voltaic cells producing 18Kw of electricity, by comparison, would offset 18 tonnes of carbon dioxide but would cost £100,000 to install.

In this paper we propose the development of the market for vegetable-oil biodiesel as a system of community-based cooperatives. In a recent paper we have argued that there is an intrinsic link between sustainable businesses and co-operative organisation (Cato et al, 2005). The link operates through the concepts of responsibility and accountability. Mutual organisations are an empowered response to a shared problem, and are therefore entirely suited to responding to the challenge of climate change. The mutual response which is precisely the sort of motivation required for the biodiesel market to be established in Wales.

Recycling used vegetable oil into usable fuel

The input: used vegetable oil

While there has been increasingly attention paid to the negative health consequences of our love affair with fried food, the disposal problems caused by the creation of large quantities of waste oil have received less publicity. Traditionally, this used oil has had three main disposal routes (Wyecycle, 2004):

- Landfill, where it has acted as a catalyst for the production of methane (a much more powerful greenhouse gas than CO2).
- Sewers, where it has encouraged the growth in urban vermin populations as well as reducing the efficiency of waste water systems.
- Animal feed, especially pig feed, although new regulations passed in 2003 have banned this use.

So we have a widely available feedstock that is presently part of a growing problem of waste management.

But it can also be the input to a new cycle of use, in a simple chemical process. The process, known as 'transesterification', removes the glycerol from the vegetable oil leaving only methyl esters which can be burned in any compression-ignition engine. The process involves heating vegetable oil to 60 degrees C and adding a mixture of methanol and sodium (or potassium) hydroxide, which will cause a reaction that will separate the glycerol from which methanol can be recovered. The remaining fatty acid methyl esters are washed and further processed before being ready for use. The Sundance pilot plant uses a 1,500 litre batch processor, a capacity that they are seeking to increase to a 5,000 litre batch process, should funding become available. The plant produces one batch per day.

The scale of the operation will also need consideration, since plants of various sizes can be constructed, depending on the size of the number of customers, the availability of used vegetable oil to recycle. Source of supply of the feedstock needs to be considered at an early stage. The best sources are chip-shops and pubs that serve food; local businesses are easier to deal with than chains where decisions will need to be referred up a hierarchy. The used vegetable oil is inert and so can be stored in plastic cans to await collection and before the recycling takes place at the plant.

Legal requirements

The main legal consideration for a community group considering setting up a biodiesel recycling plant is the need to obtain a licence from the Environment Agency. The system of Integrated Pollution Prevention and Control (IPPC) is administered by the Environment Agency on behalf of the Department of Environment, Food and Rural Affairs: 'Operators of installations under IPPC have to apply for a permit from the Regulator (the Environment Agency or Local Authority) prior to operation. The applicant must consider all the environmental impacts associated with the installation when preparing the application' (Defra website). The granting of the permit is a lengthy process, so four to six months will need to be allowed.

All usable fuel is subject to excise duty (for more about the rates see a later section) and so co-operative recycling groups will need to register with Customs & Excise before they can sell any biodiesel. You are likely to be inspected, and once registered will have to

Box 1. The Benefits of Biodiesel as a Fuel

- Used in the same way as fossil diesel.
- Can be mixed with fossil diesel in any proportion.
- No need to modify car engine.
- Zero net carbon emissions.
- A renewable fuel.
- Security of supply.

send a monthly return and pay the duty at the appropriate rate, currently 27.1p. In order to begin this process you need to request and complete form EX103. Once you are registered, Customs and Excise will send a form HO930 each month, which must be returned, with payment due by fifteenth of the following month. Full details are available in a publication from HM Customs and Excise called *Biodiesel and Bioblend* (Notice 179E, October 2002).

The site chosen for the plant will also need to have appropriate planning permission and there may be the need to liaise with the local planning authority to ensure that the chemical processes involved do not contravene local planning law.

The market for biodiesel

Viability

Biodiesel is suffering from a failure of market confidence because it is a new product and therefore a new market. Customers are not sure that their vehicles will run on the new fuel and are concerned about possible damage to their engines. There have also been false rumours spread by mineral fuel manufacturers that vehicle warranties may be invalidated by using biodiesel. In fact that product is safer than mineral diesel and better for car engines.

The diesel engine was originally designed to be run on vegetable-based diesel oil and was only converted under pressure from the growing mineral diesel industry. The use of biodiesel will not automatically invalidate warranties – warranties do not cover fuel anyway, they are to cover workmanship and unless a problem can be directly attributed to the fuel, the warranty should not be affected. Nevertheless, talk of warranties being invalidated has proved sufficient caution for many would be biodiesel users.

Since the environmental costs of the procedure are internalised within the process, and because of the small scale of the recycling operations when based on co-operative community organisation, the price of the fuel has until recently been slightly higher than standard diesel. The Table shows the costs and revenues achieved by Sundance Renewables. The rising price of mineral diesel this year has made biodiesel competitive, and this is likely to continue to be the case as growing demand for petroleum from China in particular causing world prices to remain high.

Item	Cost/revenue
Feedstock	15-20p
Chemicals	9p
Utilities	2p
Overheads (staff, plant, etc)	15-30p
Excise duty	27.1p
Price charged per litre	74p ex VAT
VAT @ 17.5 %	13p
Total price to consumer	87p

Table 1. Costs and revenues per litre of biodiesel

Tax regime

In spite of the need to encourage the expansion of the market for biodiesel the fiscal environment is not supportive. Biodiesel is currently taxed at a rate of 27.1p per litre, compared to a rate of only 6p for LPG (liquid petroleum gas, which is a fossil fuel)

The situation is quite different in other countries where tax regimes are fixed to encourage the development of biodiesel. In Australia the effective rate of excise duty on biodiesel is set at zero until 2011. EU legislation allows the total exemption of biodiesel from duty and Germany has passed legislation removing duty until 2008. The UK government has not followed suit yet, but may be forced to do so if it continues to struggle to reach its Kyoto targets. This extremely slanted playing-field leads to the absurd situation where much waste vegetable oil in the UK is exported to Germany to be processed into biodiesel which is sometimes then reimported, making a mockery of policies to reduce transport-related carbon emissions.

Sources of revenue

In spite of the enormous contribution recycling vegetable oil makes to the sustainable development espoused by the Welsh Assembly government and the UK government, no grants are available. Sundance has to survive entirely on the basis of the sale price of the fuel. They cannot even charge for waste oil collection, since they cannot afford to compete with the larger collectors.

It might be expected that recycling grants would be available but the experience of Sundance has been otherwise. The Strategic Recycling Scheme was based on an average £1.5m grant awarded to each local authority for a joint application in partnership with local community recycling groups. Sundance were involved in Swansea and Carmarthenshire's applications and worked together for 9 months putting the bid together. After they were submitted, they received a response from WAG that their project was not eligible - it was deemed to be an Energy-from-Waste project, not a recycling project.

Community recycling projects could supplement the income made from selling biodiesel by charging for collection of other compostable materials while they collect their waste oil. They may also be able to receive payments from local authorities to undertake this sort of collection, in conjunction with unitary authority compost schemes - however, this facility has not been forthcoming so far in Wales.

Economic regeneration

We see the community biodiesel model as being particularly relevant to the South Wales Valleys, where we have a constellation of the three basic requirements: a dense level of population requiring fuel for vehicles; a concentrated agglomeration of businesses using vegetable oil; a large number of economically inactive people seeking employment. Recycling biodiesel provides relatively skilled employment and knowledge of processes and materials that may be relevant in other jobs. The Valleys also has a large number of suitable business development sites which could provide premises for biodiesel recycling projects. Social enterprises are being proposed as an important plank in regenerating local economies, and have seen particular successes in the recycling sector.

Co-operative organisation and community focus

At the Welsh Institute for Research into Co-operatives we have argued for the recognition of the concept of 'capital

Box 2. Targets for biodiesel usage

- EU Member States require that by 2005 a minimum share of 2% of transport fuel sold on their territory is biofuels.
- Rising to 5.75% by 2010 and 20% by 2020.
- Over 80% of all biofuels is biodiesel.
- Production of biofuels in EU rose by 26% last year to 1.7m tonnes.
- Germany produced 1,088,000 tonnes.

anchoring', the phrase we use to describe the way that cooperatives prevent the draining of value out of the local economy because of their particular ownership structure. There are three reasons for this. First, a co-operative enterprise automatically, through its practice, broadens and localises the ownership of capital. This ensures that any wealth creation and value added, as well as any multiplier effects, benefit the local economy. Secondly, it challenges the conventional idea of ownership and the employment relationship. This is because members of a co-operative are, conjointly, both owners and employees within the organisation. Thirdly, it considers the reality of the operation of co-operatives where the ownership operates in a social manner. This involves decision-making based on democratic structures within and strong ties with the local community without. Biodiesel is a market with tremendous potential and we would argue that its production and distribution should be organised along co-operatives lines, thus keeping the value in the local economy.

Elsewhere we have also argued that in areas like the South Wales Valleys, which have a strong tradition of radical socialism, the conventional model of regeneration based on the individualist entrepreneur are unlikely to succeed. The idea of 'associative entrepreneurship' was developed as an alternative. This refers to a way of revitalising the local economy that is based on achieving a better life for the community as a whole, rather than wealth for a single or a small group of individuals. This has proved a better source of motivation in the case of, for example, Tower Colliery, the only worker-owned colliery in the world, which has successfully returned a surplus in the nine years since it was founded. We suggest that the biodiesel market should be developed along the same lines, as a system of small-scale worker co-operatives.

Supporting the development of a system of community co-operatives producing and selling biodiesel would also increase the range of funding options available. For example, the co-operatives could apply for loans from the co-operative development bank ICOF, of for support in grant of loan form from the New Ventures panel of Co-operative Action, the business development arm of the co-operative movement.

Appendix: Costs of establishing a community recycling plant for biodiesel

Set-up costs

Building of plant (cost depends on size)

Costs based on 5,000 litre batch system. Output of 25,000 litres per week or £1.25m. litres per year, when operating at maximum efficiency.

Basic production equipment

Pre-treatment vessel	£8,000
Reactor vessel	£10,000
Methanol mixing vessel	£2,000
Water wash tank	£8,000
Methanol recovery unit	£15,000
Pumps, pipes and filters	£2,000
Post-treatment equipment	£2,000
Biodiesel store	£3,000
Vegetable oil store	£2,000
Weight-and-measures-compliant pump	£3,500
Methanol store	£3,000
Process water container units	£1,000
TOTAL	£86,500

Ancillary equipment

Forklift truck	£5,000
Steam cleaners	£1,500
Health and safety equipment	£2,000
Fire and smoke detection equipment	£1,500
Collection vehicle	£10,000
Tanker delivery vehicle (optional)	£20,000

Consultancy

Project planning and management	7 days @ £300 per day	£2,100
Permit application process	10 days @ £300 per day	£3,000
Design and installation of plant	20 days @ £300 per day	£6,000
Training and advice	10 days @ £300 per day	£3,000

Running costs

Fixed overheads (Sundance used as an example):

Rent of plant	£9,600
Insurance	£6,500
Staff	£33,600
Administration	£6,000
TOTAL	£55,700

These are projected figures for a plant operating at peak efficiency. At 150,000 litres of production per year the cost per litre is 37p; at 250,000 litres it is 22p. As a pilot plant Sundance is achieving only 100,000 litres, which equates to a cost per litre of 55.7p. Equates to 37p/litre @ 150,000 litre production

Variable production costs (per litre of fuel produced):

Chemicals (methanol, sodium hydroxide)	8p
Utilities	2p

Next steps

1. Attend a training course on the intricacies of the production process
2. Undertake a feasibility study
3. Produce a business plan
4. Establish a suitable site
5. Collect vegetable oil
6. Begin process for PPC permit application from EA

Timetable

Month	
1	Attend training course: seek funding for feasibility study
2	Commission feasibility study; establish local support group
3	Results of feasibility study arrive; draw up business plan
4	Seek suitable site; begin process of seeking funding
5	Site chosen and business plan completed and accepted by funders
6	Decision to proceed: consultants begin design of plant and permit application procedure
7-11	Plant under construction
12	Permit arrives and plant begins production

The authors of this article are Jan Cliff, of Sundance Renewables and Molly Scott Cato, Len Arthur, Tom Keenoy, Russell Smith of the Welsh Institute for Research into Co-operatives

References

Douthwaite, R (2004) (ed), *Before the Wells Run Dry: Ireland's Transition to Renewable Energy.* Dublin: Feasta.
Feasta (2004), *Curing Global Crises: Let's Treat the Disease, not the Symptoms.*
Hansard (2004), 16 Sept 2004: Column 1718W, answer by the Secretary of State for Transport to a parliamentary question by Adam Price MP.
Wyecycle (2004), *Cheap as Chips? A Practical Guide to Biodiesel Production for Community Waste Projects*. Wye: Wyecycle.