Green Land

Green Land Reclamation Ltd,
Porthiddy Farm West,
Berea,
Haverfordwest,
Pembrokeshire,
SA62 6DR.
Telephone 01348-837033
Fax: 01348-837588
Mobile: 07768-726645
E-mail: dr.pike@dial.pipex.com

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Green Heat.

Volume 3.

The trigger-points for support that could lead to rapid development of the market.

by

S.Preddy, B.Prior and Dr D.C.Pike.

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A report to Summerleaze Ltd.

Summary.

Mankind will very soon have to face two serious problems that are increasingly receiving recognition. First, supplies of low-cost fuels (mainly oil) are beginning to diminish; this will have serious effects on the global economy and, unless the transition to the new reality is managed carefully, there could also be damage to political stability.

Secondly, the threat of the damaging effects of climate-change caused by the emissions of gases resulting from the combustion of fossil carbonaceous fuels is now widely accepted. Furthermore, estimates made by reputable scientists of the likely pace and scale of that threat are growing in magnitude. To deal with it, international co-operation is urgently needed on the political front, and the first faltering steps have been taken, such as the Kyoto Protocol.

Most of the uses of fossil fuels can be usefully split into three:

(a) fuels (solids, liquids and gases) for generating electricity;
(b) fuels (mainly liquids) for transport;
(c) fuels (solids, liquids and gases) for heat without associated generation of electricity.

The rate of use of fossil fuels must be greatly reduced, and it is widely agreed that an important part of the strategy to achieve that is the development of both energy-saving measures and "*energy from renewable sources*". In Volume 1 of this report, explanations are given for why, among choices within renewable energy, Green Heat offers the best value for financial support, and why the market for Green Heat has developed very slowly so far in the UK. The position in other European countries is summarised in Volume 2.

In this Volume 3, an examination is made of the trigger-points for support-measures that could lead to rapid development of the market for Green Heat.

Contents.

1. INTRODUCTION.

In Volume 1 of this report, explanations are given for why, among choices within renewable energy, Green Heat offers the best value for financial support, and why the market for Green Heat has developed very slowly so far in the UK. The position in other European countries is summarised in Volume 2.

The basic assumption of this report is that there are at least four elements that must be put in place before real progress can be secured:

(a) the availability of reliable systems for Green Heat;
(b) financial measures to persuade customers to adopt those technologies;
(c) education of several different groups of people; and
(d) sufficient time for these first three elements to take effect.

The first element is already in place – there are systems of several kinds (based on biofuels, solar heating, heat-pumps) already available. It is the second area – the financial measures – where action is urgently required. Such measures need to:

(α) secure real progress towards the growth of Green Heat in the UK;
(β) be seen to be fair and reasonable;
(χ) be simple, secure and low-cost in operation;
(δ) not increase excessively the general burden on taxpayers at large; and
(ε) take account of the sectors of society that need special consideration.

In this Volume 3, an examination is made of the trigger-points for such support-measures that could lead to rapid development of the market for Green Heat. The term “*trigger-points*” is used in this context because it is not to be expected that a simple pattern of outcomes will flow from any given measure, or combination of measures, because of the large number of relevant variables and of the possibility of complex interactions. Indeed, there are several examples from the recent past in which substantial arrangements were made for flows of public money to projects for Green Energy that had very limited results. One of the areas where knowledge is needed is the scale of financial transfers that require to be made at particular points in the pattern of demand and use.

Thus, in Section 2, an examination is made of the comparative costs of heating-systems. In Section 3, an analysis is made of the effectiveness of the various measures that have been suggested for supporting Green Heat.

2. A REVIEW OF THE COMPARATIVE COSTS OF HEATING-SYSTEMS.

In this report the term “*system-costs*” is used to incorporate all of the costs (capital-costs of equipment, fuel-costs, etc.) that are taken into consideration for commercial purposes. In other papers these are sometimes called “*total costs*”, but the authors reserve that term to describe the totality that includes an estimate of externalities (e.g. social and environmental costs that are not drawn into commercial calculations). The authors, together with others, have carried out research on such total costs for various forms of electricity, but that approach is outside the current scope of this study.

2.1 Costs of fuels.

In Table 1, information is given for the costs of heating-fuels in the UK in the third quarter of 2004.

Table 1. Costs of heating-fuels in the third quarter of 2004.

Fuel-type	**Cost – pence/kWh (1),(2)**	
	For residential Customers	**For others**
Natural gas	1.665 to 2.46[4]	0.85 to 1.298
Gas-oil	2.4	2.072 to 2.424
Heavy oil (for industrial use only)	--	1.260 to 1.434
Liquid petroleum gas (LPG) – delivered by road-tanker	c. 3.5 XXX CHECK	2.48
Propane - small bottles	c. 3.6 XXX CHECK	--
Electricity – *Economy-7*	7.93 and 2.81[5]	--
Electricity – *Standard Electric*	7.45 [6]	2.61 to 3.97
Wood-chips – lower grade (3)	1.0	1.0
Wood-chips – higher grade (3)	1.6	1.6
Wood-pellets – 10-kg bags	3.3 to 5.5	--
Wood-pellets – 1-tonne bags, delivered by large lorry	2.8	2.8
Wood-pellets – >50 tonnes/year, delivered by road-tanker	--	2.2

Notes on Table 1:

1. The data has been collected from various sources, including the DTI's digest of quarterly energy prices. The price-data for wood is not available from that source, and is less reliable because the market is not yet well established in the UK.
2. The cost-data includes delivery to the user and the relevant taxes (VAT, CCL, etc.).
*3. Here, "*lower-grade wood-chips*" have moisture-contents above 30 per cent, while "*higher-grade wood-chips*" have moisture-contents below 30 per cent, and are screened or otherwise treated so their particle-size distribution and their ash-content is controlled.*
4. These values are taken from the British Gas web-site, and include a standing charge. The higher rate is for users with low consumption.
5. This does not include the standing charge, which is c. 16 pence/day.
6. This does not include the standing charge, which is c. 13 pence/day.

The first observation to be made about the data in Table 1 is that it shows very clearly why the great majority of residential premises, as well as many commercial and industrial buildings, in the UK are heated with gas. Although gas-prices have recently increased, this pattern seems unlikely to change, unless some substantive action is taken by the Government.

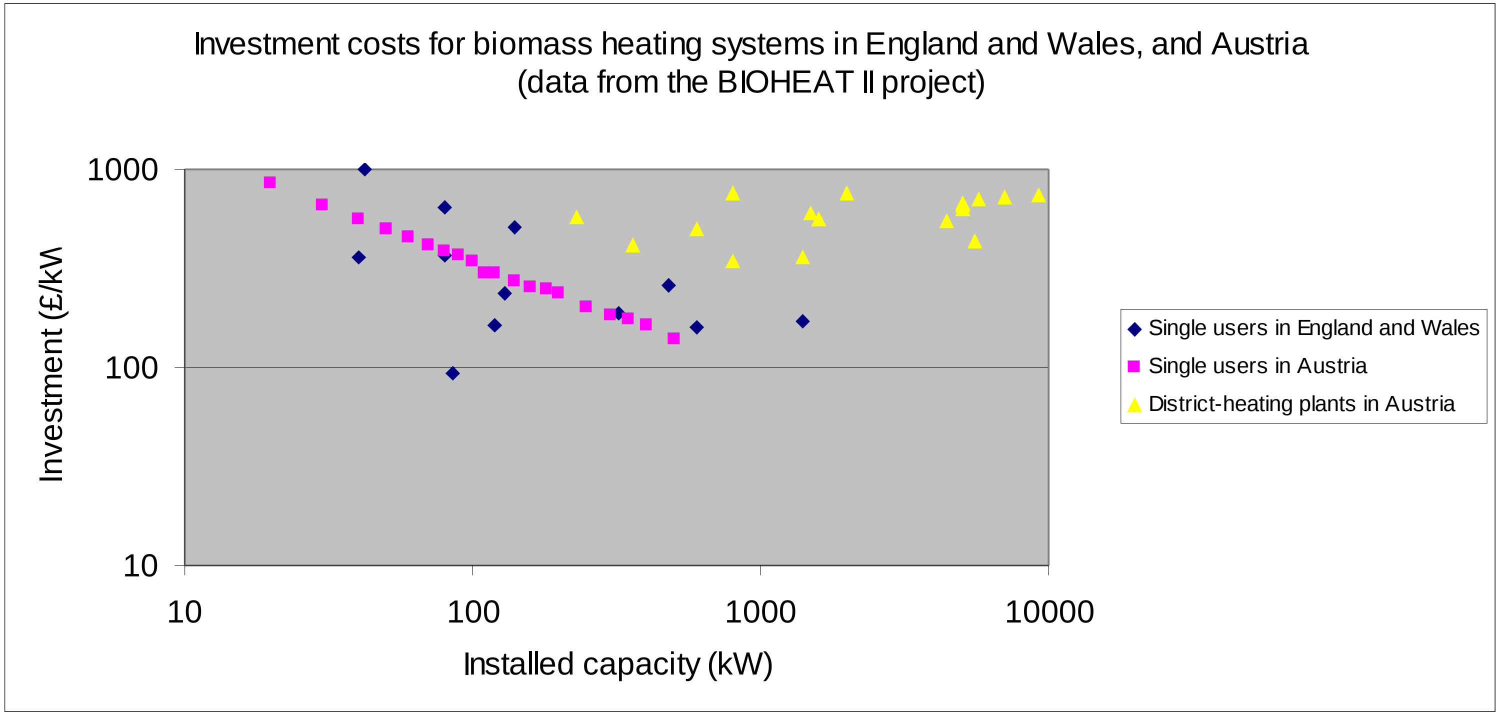
Fuel-costs are obviously important, but they are not the only factor taken into account by customers; other important factors include:

(a) the reliability of the fuel-source(s);
(b) capital cost of the equipment for converting the fuel into useful heat;
(c) how that equipment can be fitted into available space(s);
(d) the life of the equipment and its running costs; and possibly
(e) the sustainability of the process in an environmental sense (although experience shows that this often attracts at best only a small premium).
(f) convenience (how much personal effort is involved in using the fuel).

2.2 Non-fuel costs of wood-fired systems.

Figure 1 on the next page shows data (plotted on log/log axes) on capital costs of wood-fuelled systems that have become available through the BIOHEAT-II Project, which has been completed out within the European Commission's ALTENER Programme. The aim of that project has been to promote wood-heating of public buildings in nine countries; Green Land has led the work that has been carried out in England and Wales.

Figure 1.



Investment costs for biomass heating systems in England and Wales, and Austria
(data from the BIOHEAT II project)
Investment (£/kW)
1000
100
10
10
100
1000
10000
Installed capacity (kW)
Single users in England and Wales
Single users in Austria
District-heating plants in Austria

It is well known that (a) Austria has achieved a high level of penetration of the heating market with wood-fuelled systems, and (b) the unit costs of systems (£/kW of installed capacity) fall with increase in size of installed capacity. The line of small square-shaped points in Figure 1 shows the relation between unit cost and installed capacity found in Austrian conditions (this is based on a large number of projects). The diamond-shaped points scattered about that line are data from feasibility-studies to a standard (Swiss) format carried out by Green Land with the co-operation of developers at nine sites in England and Wales. The data represented by triangle-shaped points are drawn from Austrian district-heating projects. XXX MORE DATA HAS BEEN REQUESTED FROM OTHER PARTNERS IN BIOHEAT-II

This information (together with estimates of maintenance costs where appropriate) can be used to assess the system-costs of wood-fired and heat-pump systems – see Sections 2.3 and 2.4. Similar data on wood-fired systems can be extracted from the work of Bullard *et al.* (2004) - see Section 2.6.

2.3 System-costs for wood-fired heating.

Because there is such a wide range of credible circumstances for the application of wood-fired systems (even without considering CHP), ranging from pellet-fuelled boilers and stoves rated at a few kW, to systems fired with wood-chips rated at 1 or more MW, a sensible way to proceed in seeking system-costs (capital and running costs, including fuel) is to select some cases for study – see Table 2.

Table 2. Six cases selected for study that span most of the applicable size-range for wood-fired heating systems in the UK.

Case (peak load)[1]	Type of fuel	Capital costs of system spread over life of project[4][6] (p/kWh)	Fuel-costs[5] (p/kWh)	Other costs, including maintenance, servicing, etc. (p/kWh)	System-cost of heat over life of project (p/kWh)
Small house or flat – a pellet-fired stove[2] to provide half of the space-heating (5 kW)	Wood-pellet (a)[7]	2.9	5.5	2.1	10.5
	Wood-pellet (b)	2.9	3.3	2.1	8.3
Small house or flat – a pellet-fired boiler[2] to provide all heating (10 kW)	Wood-pellet (a)	5.1	5.5	2.1	12.7
	Wood-pellet (b)	5.1	3.3	2.1	10.5
Large house or small commercial premises – a boiler fired with dry wood-chips or pellets to provide heating (20 kW)	Dry wood-chip	3.3	1.6	0.8	5.7
	Wood-pellet (a)	2.9	5.5	0.7	9.1
	Wood-pellet (b)	2.9	3.3	0.7	6.9
	Wood-pellet (c)	2.9	2.8	0.7	5.5
Medium-sized commercial premises – a boiler fired with dry wood-chips or pellets to provide heating (130 kW)	Dry wood-chip	2.2	1.6	0.4	4.2
	Wood-pellet (c)	2.0	2.8	0.4	5.2
	Wood-pellet (d)	2.0	2.2	0.4	4.6
Medium-sized school - a boiler fired with dry wood-chips or pellets to provide heating (300 kW)[3]	Dry wood-chip	1.5	1.6	0.3	3.4
	Wood-pellet (c)	1.5	2.8	0.3	4.6
	Wood-pellet (d)	1.5	2.2	0.3	4.0
Large public building - a boiler fired with wet or dry wood-chips or pellets to provide heating (600 kW)[3]	Wet wood-chip	1.4	1.1	0.4	2.9
	Dry wood-chip	1.2	1.6	0.3	3.1
	Wood-pellet (c)	1.1	2.8	0.3	4.2
	Wood-pellet (d)	1.1	2.2	0.3	3.6

Notes on Table 2:

1. The peak load of a system has to be selected to suit the combination of factors, including (a) the characteristics of the building(s), (b) the requirements of the users, (c) the climatic conditions, and (d) the existence of other heating facilities in the building.
2. It has been assumed for simplicity that wood-chips are not as attractive as wood-pellets for very small systems, because they require much bulkier storage- and delivery-systems.
3. There are various strategies for sizing wood-fired systems, some of which suggest sizing them below the peak demand with another kind of fuel and boiler for dealing with peaks, and others of which suggest automatic firing coupled with buffer-storage of hot water. These differences can be ignored for the purposes of the calculations herein.
4. It is assumed that capital is borrowed at an interest-rate of 7 per cent and paid back over a period of 15 years. The cost has been spread over 1,500 operating-hours a year at the rated peak load. For simplicity, no account has been taken of the practice used in some systems to run at variable loads. Depreciation is not accounted for.
5. See Table 1.
6. VAT has not been included, but information is given at Section 3.5.
7. There is a substantial price-range for wood-pellets – see Table 1.

2.4 System-costs for heat-pumps and solar installations.

Data for costs of heat-pump systems are shown in Table 3. It is believed that, through the expected 15-year life of projects based on these systems, there are no additional costs for servicing, repairs, etc.

The fuel-cost shown in Table 3 is based on a Coefficient of Performance (COP) of 4. What this means is that for every 1 kWh of electricity consumed by the heat-pump, 4 kWh of heat will be generated.

Table 3. Five cases selected for study that span the size-range for heat-pump systems in the UK.

Peak-load (1)	Electricity tariff	Capital costs of system spread over life of project (p/kWh)	Fuel-costs(2) (p/kWh)	System-costs of heat over life of project (p/kWh)
5 kW	Standard	5.6	1.8	7.4
	Economy 7(9)	5.6	0.7	6.3
10 kW	Standard	3.2	1.8	5.0
	Economy 7	3.2	0.7	3.9
20 kW	Standard	2.6	1.8	4.4
	Economy 7	2.6	0.7	3.3
130 kW	Standard	1.4	1.8	3.2
	Economy 7	1.4	0.7	2.5
200 kW	Standard	1.2	1.8	3.0
	Economy 7	1.2	0.7	2.2

Notes on Table 3.

1. The maximum peak-load for which data is available from the UK manufacturer's published papers is 200 kW.
2. It is assumed that in the case of Economy 7, all the power is consumed during the night, and is charged at the rate for night units.

XXX ADD TEXT ON SOLAR INSTALLATIONS

2.5 Comparison of different systems at various power-ratings.

Data from tables above are used to provide the overall comparison summarised in Table 4.

Table 4. Costs of systems at various power-ratings.

Peak-load	System	Type of fuel	System-costs of heat over life of project (p/kWh)
5 kW	Gas	Mains	3.8
		LPG	5.6
		Bottled propane	5.7
	Oil	35-sec	4.9
	Wood-pellet (see Note 7 under Table 2)	(a)	10.5
		(b)	8.3
	Heat-pump	Standard electricity	7.4
		Economy 7	6.45
10 kW	Gas	Mains	3.0
		LPG	4.8
		Bottled propane	4.9
	Oil	35-sec	3.9
	Wood-pellet	(a)	12.7
		(b)	10.5
	Heat-pump	Standard electricity	5.0
		Economy 7	3.9
20 kW	Gas	Mains	2.9
		LPG	4.7
		Bottle	4.8
	Oil	35-sec	3.6
	Wood-chip	Dry chip	5.7
	Wood-pellet	(a)	9.1
		(b)	6.9
		(c)	5.5
	Heat-pump	Standard electricity	4.4
		Economy 7	3.3

Table 4 - continued.

Peak-load	System	Type of fuel	System-costs of heat over life of project (p/kWh)
130 kW	Gas	Mains	2.5
		LPG	4.3
		Bottle	4.4
	Oil	35-sec	3.4
	Wood-chip	Dry chip	4.2
	Wood-pellet	(c)	5.2
		(d)	4.6
	Heat-pump	Standard electricity	3.2
		Economy 7	2.5
300 kW	Gas	Mains	2.5
		LPG	4.3
	Oil	35-sec	3.4
	Wood-chip	Dry chip	3.4
	Wood-pellet	(c)	4.6
		(d)	4.0
600 kW	Gas	Mains	2.5
		LPG	4.3
	Oil	35-sec	3.3
	Wood-chip	Wet chip	2.9
		Dry chip	3.1
	Wood-pellet	(c)	4.2
		(d)	3.6

2.6 Cost-data from other studies.

In September, 2004, Bio-Renewables Ltd (BRL) published a report *"Small-scale wood-fuel heat and CHP options for South West"* by Bullard, Heaton and Osola, was commissioned by the South West Renewable Energy Agency, Regen SW. In that report, BRL recommended that Regen SW should:

"1. Map off-gas grid areas, estimate the current and future heat demands within them and the likely uptake of wood heat and identify priority areas.
2. Form local strategic alliances around priority areas to oversee the development of wood heating.
3. Apply to the DEFRA Bioenergy Infrastructure Grant for activity around each priority area.
4. Negotiate regional grant funding for the installation of wood fuel heating with the DTI and other partners.
5. Work with local authorities to develop a framework which requires all new developments to consider detailed renewable energy and energy efficiency options (i.e. PPS22).
6. Develop or expand a regional wood fuel supply function to offer, or facilitate long-term contracts to customers.
7. Explore the feasibility of establishing a fuel wood ceiling in the SW with Forest Enterprise.
Establish a regional steering group on wood energy, to oversee the implementation of the high-level work that flows from these recommendations.
9. Review the case for small-scale wood-fuelled CHP, particularly for the built environment, as an alternative to other renewables, in 3 years."

The report includes cost-analyses, based on a financial model. Although some of the assumptions made in that report could be questioned, the results turn out to be broadly similar to those derived in the Sections of this report, above.

As to outcomes, it is interesting to note that Bullard *et al.* conclude that:

(a) small-scale wood-heating (e.g. single dwellings) and district-heating are not feasible, and
(b) a hybrid kind of energy-supply company (ESCO) could be a useful market-actor:

"Our analysis is that for wood heating to achieve a significant level of penetration in the SW, a hydrid between an energy co-operative and an ESCO be established which embodies the best traits of both. Namely, the commercial acumen of the ESCO with the strategic focus and initiative development of the energy agency. It will be essential to include stakeholders from local authorities in which the hybrid body will be active. In reality, this LA support will need to include financial support in order to spread the financial risk of the venture. Key roles:

Supplier group / ESCO	*Facilitating agency*
● *Sourcing and procuring wood fuel to order (chip/raw wood fuel material)* ● ● *Chipper* ● *Delivery of wood-chip/wood pellet to market* ● *Possibly the collection and* ●	● *Identifying and short-listing opportunities* ● *Liaison with regional stakeholders* ● *Providing single point of contact for the market* ● *Providing advice on system specification* ● *Signposting to appropriate technology suppliers* ● *Signposting to grant awarding bodies* ● *Finding external funding assistance to continue support role* ● *Marketing"*

As noted in Volume 1, arrangements of this kind obviously raise issues of governance and fair competition, but these are outside the scope of this report. Another aspect is, however, germane to the main topic considered herein because Bullard *et al.* are suggesting that public money (i.e. money drawn from general taxation) effectively be put at the disposal of such hybrid bodies, and yet are recommending that attention should not be focused on the dwellings of the taxpayers. This recommendation has some features that may be palatable to some politicians, for example it is unlikely to raise an outcry about “*stealth taxes*”; but it will not lead to the scale of change of public behaviour that must be sought if the big issues of climate-change and depletion of lower-cost energy-resources are to be addressed effectively.

XXX ARE THERE OTHER RELEVANT STUDIES?

3. MEASURES THAT HAVE BEEN SUGGESTED FOR SUPPORTING GREEN HEAT.

The data set out above can be used to test the efficacy of various measures to promote Green Heat. It will be pointless to seek mechanisms that do not deliver value for public and private money, and yet it has to be borne in mind that it may be necessary to inject a sizeable amount of money to trigger a change in behaviour by users of fossil fuels. This introduces the concept of "*trigger-points*" an allusion to which is made in the title of this Volume 3.

3.1 The Heat Obligation.

It is assumed that a Heat Obligation would fall on industrial, commercial and domestic use of heat. Significant progress is already being made in reduction of energy consumption in the industrial and commercial sectors, whereas domestic consumption continues to rise. Moreover, the above figures indicate that some forms of Green Heat are already economic at the industrial scale, without the additional incentive of an obligation (e.g. a 130kW heat pump or a 600kW wood-chip boiler). It is therefore most useful to consider how a general Heat Obligation might be a useful incentive for domestic Green Heat.

It is probably safe to assume that, if faced with the Heat Obligation (HO) – see Volume 1 – fuel-suppliers would initially focus on properties where the demand for heat is high. For the purposes of this illustration, it is assumed that "*high*" here means a yearly use of at least 30 MWh per household.

If the arrangements for the HO followed those that are now in place for the Renewables Obligation (RO), there would be two components of the market-value of a Heat Obligation Certificate (HOC):

(a) the buy-out price (1 penny/kWh has been suggested, but perhaps that sum should be discounted a little for the cost of administration); this assumption holds so long as compliance with the HO has not reached a point at which the marginal value of HOCs falls to zero); and
(b) the value of recycled payments from the pot of money accumulated from buy-outs.

The notional value of the recycled payment is given by the formula

$$RP = BOP \times \left(\frac{100 - PC}{PC}\right)$$

where:

RP = recycled payment – pence/kWh or £/MWh*
BOP = the buy-out price – pence/kWh or £/MWh, and
PC = overall compliance with the HO – per cent.

*Note: *1 penny/kWh = 10 £/MWh*

In practice, this might be true if certificates were traded in a short-term market but, where longer-term values are required, they will be significantly discounted because of the uncertainty of future levels of compliance.

So, for example, assuming that (a) fuel-suppliers were able to meet half of the quantum of heat set for the HO, and (b) a BOP were set at £10/MWh, a HOC would be worth £20, i.e. £10 for the avoided buy-out and £10 for the recycled value (traded short). If this level of compliance were predictable throughout the period of a contract of adequate length to interest investors (probably around 15 years) , a supplier could invest on the basis of a HOC being worth £20/MWh but, as this is not the case, the value of a HOC applied in a realistic financial model appropriate for such a contract-period must be increasingly discounted towards £10/MWh over the period.

In this example, a property using 30 MWh/year of heat could produce HOCs worth £600 a year in the first year, but (in a financial model) this value should be discounted towards £300 a year in later years. These discounted numbers are those that a fuel-supplier would have to consider when assessing the viability of a proposed project based on Green Heat, and when calculating whether or not it would be worthwhile to take on (a) the capital cost of installing new equipment at customers' premises, (b) the cost of managing the project, and (c) the difference in cost between Green Heat and systems using fossil fuels. In taking such decisions, the fuel-supplier would be searching for a justifiable return on investments, and allowing a sum to give each householder an incentive to agree to the installation of the equipment.

The cost of natural gas for residential customers is currently about 1.7 pence/kWh; the costs of biofuels range from about 1 to 1.8 pence/kWh for wood-chips and upwards from 2.2 pence/kWh for wood-pellets (these figures are highly dependent on region and scale of use). The equipment for burning solid biofuels is also substantially more than those for burning gas or oil.

Different assumptions naturally change outcomes of model calculations, and it is clear from data in other Sections that:

(a) the residential market for heating fuels is an important user of fossil fuels and emitter of carbon dioxide; and
(b) the system-costs at that scale to produce Green Heat are substantially higher than those at larger-scales.

A simple example (Case A) can be investigated in which the cost of wood-fuel is £34/MWh, i.e. double that of gas, which is currently around £17/MWh So, for the supposed target-property using 30 MWh/year, the supplier would have to allow £510 of the £600/year value of the HOCs, simply to cover the additional fuel-cost of using biomass. Within a model based on discounted costs (even taking no account of capital costs, other operating costs or the possibility of paying an incentive to the householder), it would not be long before the cash-flow was negative.

There are three principal ways to change assumptions in this *scenario* so that the prospects are improved:

(a) a higher buy-out price,
(b) a lower level of compliance, or
(c) changes in both (a) and (b).

As will be shown, to cause significant impacts, a change of at least 50 per cent in one of (a) or (b) would be needed.

If the buy-out price were set at £15/MWh, and if the level of compliance were 50 per cent (Case B), the value of HOCs from the target-property would now be £30/MWh or £900 a year (tending over time towards £450 a year in the financial model). The difference in fuel-cost is still £510 a year, so in this Case B the supplier can start with £390 a year to put towards the capital cost, the management, the incentive to the householder and some sort of return on investment. The return is still going to be very low, even if the capital cost is in the low thousands of pounds, but it may just be feasible over a sufficiently long period of time (if the supplier can justify a long payback for something so uncertain).

If the even lower level of 33 per cent for compliance is tested with the £10/MWh buy-out price (Case C), the value of the HOCs will again be £30/MWh or £900 a year, the effects for the supplier and householder is much the same as if the buy-out price were increased by 50 per cent.

The overall cost and success of the HO will be different, though. Using some of the assumptions that the supporters of the concept of the HO have put forward (starting the HO set at a level of 3 per cent of total heat supplied, and increasing that level at 1 per cent a year for 13 years), in Case B, the proportion of heat generated from renewable sources would rise from 1.5 to 7.5 per cent over the 13-year period of escalation. Also, the cost of fossil-fuels to consumers would increase by 3 to 15 per cent.

In contrast in Case C, the proportion of heat generated from renewable sources would rise from 1 to 5 per cent over the 13-year period of escalation and the cost to consumers of fossil-fuel will rise by around 2 to 10 per cent.

Neither of these options represents good value in terms of delivering reductions in fossil-fuel combustion relative to the cost to consumers.

No doubt it will be argued by some that the market would not, in practice, work by targeting installations in individual households, but through the development of industrial-scale systems or district-heating schemes. But, the domestic consumption of fossil-fuels is roughly four-times that of industry and commerce combined. If the aim is to encourage an increase in the use of renewable heat in industry, there are much cheaper, more targeted ways of doing so than a general obligation on **all** supplies of heat. In effect, a general obligation that favours industrial over domestic applications is a measure whereby domestic consumers pay for changing the patterns of heat-production in industry.

District-heating schemes allow the capital cost of the heat-production equipment to be spread, so should result in significantly lower capital costs per property. However, the total capital cost is increased because of the need for a heat distribution network (see Figure 1 above). The running costs do not vary significantly.

XXX WHAT IS THE PAY-BACK ON THE GAS DISTRIBUTION NETWORK? SEE VOL. 2 – DEVELOPERS IN AT LEAST ONE COUNTRY (HOLLAND?) WILL NOT CONSIDER DISTRICT-HEATING BECAUSE OF RECENT INVESTMENT IN GAS NETWORKS

Unlike gas or electricity distribution networks, the thermal efficiency required from heat-distribution networks makes them very expensive and limited in range. For the extra cost to be justified, the installer needs to be confident that all potential customers will participate in the scheme for a long period, so as to spread the cost of the network as widely as possible. This means that, except in exceptional cases, district-heating schemes are likely to face a lack of investment because there are high fixed costs that need to be set against insecurity in the level of demand (particularly long-term).

Whichever way a supplier tried to encourage domestic use of renewable heat, they would face significant risks to their investments (or costs to ensure long-term commitment) for as long as cheap alternative methods of heating made it conceivable that installed equipment might not be fully utilised throughout and beyond the extent of their payback period.

The examples given above (Cases A, B and C) were based on the assumption that fossil-fuel suppliers would be prepared to make very speculative, low-return, long-term investments in order to satisfy their parts of the HO. In practice, this will not be the case. For instance, suppliers will need to tie householders to ten-year-plus contracts, if they are even to consider investing in the property. How many householders would be prepared (a) to commit to a ten-year plus contract for an unknown fuel supply, and (b) to guarantee that they will still be occupying the property in ten years' time? It will take a significant incentive to make it worthwhile, and any significant incentive will reduce the return to the supplier, thereby extending the payback period, so requiring an even longer contract term – a vicious circle.

And the calculations, which were based on experience of the RO, significantly underestimate the differences between the RO and HO. For example, the baseline for the RO is at least reasonably predictable. Consumption of electricity for many years has been on a slowly rising trend, and even if the trend should flatten, the annual variation from the trend is not significant. Demand for heat, however, varies significantly from year to year, following weather-patterns. Consequently, it will be much harder for fossil-fuel suppliers to judge how many HOCs they should and can forward-contract.

There is a serious tension between the need to make significant short-term adjustments to account for variations in weather/climate, and the long-term investments that are necessary to deliver HOCs. Under the RO, it is rational for suppliers to under-contract for ROCs relative to their obligation, because of (a) the uncertainty over future levels of compliance, (b) the unknown future levels of demand from customers and (c) the low marginal values of ROCs as one approaches 100-per-cent compliance. It is in the nature of the mechanism that the RO will probably never deliver more than 90 per cent of the level of the obligation. Under the HO, this effect would be magnified, because of the significantly greater uncertainty about levels of compliance. For this reason a HO may never reach a level of compliance greater than 70 per cent, even if the economics of individual installations appeared to make higher levels of compliance feasible.

The net effect of the above factors will be to cause investors in renewable-heat projects to discount forward HOC values more heavily than they would forward ROC values. That means that even fewer projects will be built for a given buy-out price and assumed level of compliance. Thus, if it is to make an impact, a HO might have to be predicated either on a buy-out price in excess of £20/MWh or an assumed level of compliance of less than 25 per cent.

Even if the BOP were set at £15/MWh and this caused a level of compliance of 33 per cent (giving a total HOC value of £45/MWh), this would result after 13 years in only a 5-per-cent diversion of heat-generation to renewable sources from fossil fuels at a cost of an additional 15 per cent on gas bills. This would represent very poor value indeed, especially when what might be achieved for that cost through energy-efficiency measures is considered.

Moreover, such high values for HOCs, though necessary to achieve any significant uptake under the HO, bring their own risks. If HOCs are worth more than the **total** fuel-cost (not, as in the examples considered above, the **differential** fuel-cost), then the HO introduces an incentive to supply (and use) heat regardless of demand! All other costs (capital and running) do not vary significantly with utilisation of the equipment, so where HOCs more than cover the cost of the fuel, the return on investment is improved the more HOCs are generated.

Thus, there appears to be a Catch-22 type of paradox in which HOCs below a certain value will not justify investment in equipment to produce renewable heat, whereas HOCs above that value will justify running the equipment not just during winter, but throughout the summer, even though much of the heat will simply be thrown away.

All in all, the HO would be a very inefficient method of reducing carbon emissions. This is only to be expected from a policy that will carry with it such significant bureaucratic and financial inefficiencies. An Obligation may be appropriate to a market where the installations are numbered in the low thousands and the active parties in the low hundreds (as they are for renewable electricity). It does not work where millions of installations and customers have to be involved (as would be the case for heat).

If the main effect of the HO is to drive up the cost of using fossil-fuels for heating, then the Government might as well go for a tax in the first place. And at least a proper energy-tax would allow correct balances to be drawn between direct heating by fossil-fuels and indirect heating *via* electricity. An Obligation that was imposed purely on fossil-fuel suppliers and ignored electricity as an alternative (much simpler, compared to renewable heat) source of heat, would probably have the principal result of encouraging replacement of fossil-fired boilers with electric heating. Given the relative conversion efficiencies, this is hardly a desirable result for the environment.

3.2 Capital grants.

A number of capital grant-schemes have been introduced at a national level, and some smaller schemes have started at the regional level. They can be useful to assist the demonstration of new (in the UK) technologies, but in general terms, they are also associated with several kinds of problems:

(a) there are extra administrative costs for developers, with filling in forms, using accredited consultants, etc.;
(b) grants can be restrictive in terms of (i) eligible parties (domestic, community, etc.), (ii) eligible technologies, and (iii) what are included as eligible costs;
(c) they distort the market; and
(d) when the grant-scheme stops, this can lead to a rapid fall-off in replications.

3.3 An amended Climate Change Levy.

XXX DEVELOP FROM VOL 1.

3.4 Domestic Tradeable Quotas.

XXX INSERT TEXT

3.5 Changes to the rate of Value Added Tax.

In the UK, Value Added Tax (VAT) is levied at three rates:

(a) Standard rate (currently 17.5 per cent).
(b) Reduced rate (currently 5 per cent).
(c) Zero rate.

Certain energy-saving materials, heating equipment, and security goods are charged at the reduced rate. The reduced rate applies to the installation of specified materials in residential accommodation, or a building used solely for a relevant charitable purpose. Any incidental work, such as plastering or painting to make good, is also eligible for the reduced rate. The installation of energy-saving materials in a new building attracts the zero rate. If energy-saving materials are supplied, but installed by somebody else, the supply is standard-rated.

The reduced rate applies to the installation of:

(a) central heating and hot water system controls,
(b) draught stripping,
(c) insulation,
(d) solar panels,
(e) wind turbines, and
(f) water turbines.

3.5 Combinations of measures.

XXX INSERT TEXT

4. CONCLUSIONS.

This Volume 3 sets out estimates of system-costs of Green Heat and then investigates the efficacies of several measures that have been proposed to support the deployment of Green Heat.

The proposed Heat Obligation is shown to offer poor value for money, and the approach of a simple energy-tax is clearly superior.

XXX MORE TEXT

5. REFERENCES.

BULLARD, M., HEATON, REBECCA and OSOLA, M. Small-scale wood-fuel heat and CHP options for south-west England. September, 2004.

HM CUSTOMS AND EXCISE. Notice 701/19. VAT – Fuel and power. January, 2002.

HM CUSTOMS AND EXCISE. Notice 708/06. VAT – Energy-saving materials. June, 2002.

APPENDIX 1. VALUE ADDED TAX.

Most business transactions involve supplies of goods or services. Value Added Tax (VAT) is payable if they are:

(a) supplies made in the United Kingdom (UK) or the Isle of Man
(b) by a taxable person
(c) in the course or furtherance of business, and
(d) are not specifically exempted or zero-rated.

Currently there are three rates of VAT:

(a) a standard rate of 17.5 per cent,
(b) a reduced rate of 5 per cent, and
(c) a zero rate.

At present, the reduced rate applies to, for example,:

(a) domestic fuel or power,
(b) the installation of energy saving materials,
(c) grant funded installation of heating equipment or security goods or the connection of a gas supply,
(d) renovation and alteration of dwellings,
(e) children's car seats.

There is a long list of items that are charged at the zero-rate, or exempt. That list can be found at: www.hmce.gov.uk/channelsPortalWebApp/channelsPortalWebApp.portal?_nfpb=true&_pageLabel=pageVAT_InfoGuides&propertyType=document&id=HMCE_CL_001225

A.1.1 Reduced rate of VAT on fuel and power.

The reduced rate of VAT applies to supplies of fuel and power for qualifying use, and are:

(a) fuel and power for domestic use (see Section XXX below),
(b) fuel and power for charity non-business use,
(c) fuel and power where the amount supplied does not exceed the small quantities *de minimis* limits (see Section XXX below), and
(d) fuel and power partly for qualifying use and partly for other purposes, where 60 per cent or more of the supply is for qualifying use.

A.1.2 Qualifying use.

Supplies of certain small quantities of fuel and power (*de minimis*) are always treated as being made for domestic use, even when the supply is to a business customer. These limits are shown in Section A.1.3.

Supplies of fuel and power that exceed the *de minimis* limits are for domestic use only if they are for use in a dwelling or certain types of residential accommodation (**excluding** hospitals, prisons, hotels or inns or similar establishments).

A.1.3 *De minimis* limits.

Supplies within the *de minimis* limits should be charged at the reduced rate. The limits are shown in Table A1 below.

Table A1. *De minimis* limits for the supply of fuel and power.

Type of fuel or power	*De minimis* limit
Gases, including acetylene, coal gas, methane, natural gas, propylene, butylenes, LPG, producer gas, and water gas.	Average daily rate of not more than 145 kWh of piped gas.
	LPG in cylinders containing less than 50 kg net, provided the total supply is less than 20 cylinders, and that they are not for re-sale.
	Supplies of gases for use as road fuel are always charged at the standard rate.
Electricity	Average daily rate of 33 kWh.
Oil, including fuel-oil, gas-oil, and kerosene	2,300 litres.
The reduced rate applies to the following solid fuels, provided they are *“held out for sale solely as fuel”*: barbecue fuels, briquettes of straw, charcoal, coal, coal dust and coal briquettes, coke, firewood, wood-logs, smokeless fuels, etc.*	One tonne or less.

NOTE: The authors have spoken to HM Customs and Excise, and in the words of their Guidance Notice 701/19, wood-pellets are covered by the term* “compressed or agglutinated sawdust”. *Wood-chips are covered by the reduced rate provided they are sold solely as a fuel (not, for example, as animal bedding).*