UK Renewable Heat Policy: Lessons from Renewable Electricity Policy

Peter M. Connor
School of Geography, Archaeology and Earth Resources, University of Exeter, Cornwall Campus, Penryn, Cornwall, TR10 9EZ, UK
Email: P.M.Connor@exeter.ac.uk Tel: 01326 371870

Introduction

Figures presented by the UK's Department for Trade and Industry in 2007 suggest demand for heat energy accounts for almost half of all UK energy consumption, and for 79% of non-transport related energy consumption (DTI, 2007). This translates to around 47% of UK CO_2 emissions, making heating a major contributor to the UK's climate change emissions. Despite this, there has been little attention paid to the more sustainable supply of heat and on policy relating to renewable energy sources of heat (RES-H). Heat from renewables sources accounted for only 0.6% of UK heat demand in 2006 and this fraction has been in decline for over a decade (BERR, 2008a). Recently emerging discussion seems centred around the associated costs and contribution of a target in the range of 11-14% of total UK heat demand to be met by 2020 (BERR, 2008b; BERR, 2008c). The UK, in common with the large majority of other nations which have developed renewable energy policy, has tended to focus, often exclusively, on electrical generation. While there may be a number of explanations for this, a switch to more sustainable sources of heat offers many of the same advantages with regard to reduced environmental impact, increased security of supply and all he other benefits that go with renewable electrical generation.

This paper considers the particular needs of RES-H technologies in terms of the policy instruments which might best suit their growth. It considers what lessons might be learned from the policy experience with renewable energy sources of electricity (RES-E) whilst also emphasising the key differences which have the potential to undermine the application of instruments from one category to the other. The diverse needs of different RES-H technologies are considered, with particular attention to the often conflicting nature of their requirements for support. Critical assessment of the problems of transferring mechanisms wholesale from employment in support of RES-E to efforts to support RES-H is carried out.

The Goals of Renewable Heat Policy

There is no real distinction between the goals of renewable electricity policy and those of renewable heat policy. In the UK, these are:

- Displacement of climate change emissions from fossil fuel energy sources;
- Reduction in dependence on fossil fuel imports and increased security of energy supply;
- Increased diversity of energy sources;
- To assist in development of new technology;
- Stimulation of growth of new industries and capture of attendant benefits.

As with RES-E, most of these goals can be addressed by stimulation of capacity, though as with RES-E, capture of industrial opportunity may require additional consideration (Johnson and Jacobsson, 2003). It also seems likely that some policy instruments will be better suited to stimulating different technologies at different stages in their maturation (Foxon, Gross et al., 2005).

The Current State of Renewable Heat Policy

While some European nations, including the UK, have amassed decades of experience in stimulating renewable electricity policy, many less have established national policies to support renewable heat technologies which go beyond the use of grants; a mechanism which has come to be increasingly seen as inefficient, and which may, in some circumstances, act to retard deployment[1].

There is a clear need to consider what policies might best – and most efficiently – enable the growth of significant renewable heat deployment in the UK, while at the same time maximising the capture of the full range of potential benefits.

The UK currently has no overarching policy for driving forward the sector. What policy initiatives there have been relevant to the sector have been small-scale and have tended to be technology specific. These include (IEA, 2007):

- Community Energy Programme (grant, biomass, 2001-2007)
- Bio-energy Capital Grants Scheme (grants, biomass, 2002-)
- Community Renewables Initiative (small-scale, limited funds, 2002-2007)
- Clear Skies Initiative (grants, biomass & solar, 2003-2006)
- Biomass Heat Acceleration Project (biomass heat, 2005-)
- Bioenergy Infrastructure Scheme (wood and straw supply chain, 2005-8)
- Low Carbon Buildings Programme (replaced Clear Skies), (grants, small scale RE inc. RES-H., oversubscribed, 2006-)
- Climate Change Programme Review (biomass, grants)

Policies which impact on prices for other energy sources also provide some stimulation for RES-H, these include the EU Emissions Trading Scheme, the Climate Change Levy and the Carbon Reduction Commitment (BERR/NERA, 2008), though it is suggested that their combined impact is not sufficient to drive significant deployment. While efforts so far betray the absence of overall strategy, the government has seemingly come to acknowledge this recently. Two DEFRA/BERR commissioned reports in the latter half of 2007 investigated the business case for RES-H and then the potential for the application of various support mechanisms (DEFRA/BERR, 2007a; DEFRA/BERR, 2007b). This was followed by BERR's Heat Call for Evidence in January 2008 (BERR, 2008a) and a chapter in the latest Renewable Energy Strategy consultation document. It seems likely that the UK will move to adopt more far reaching policy in the coming years. But what form should this policy take? What should inform it and how wide should its reach be?

Most other nations are little more advanced in regard of supporting RES-H. The EU Renewables Directive, proposed at the beginning of 2008, made a point of noting that "the development of renewable energy in this sector is nearly stagnant." (European Commission, 2008) Some regions of EU Member States have made efforts to expand, but at the national level only a few have begun to adopt and apply instruments to stimulate growth. National level mechanisms seem confined to Spain's 2006 adoption of a 'Use Obligation', followed this year by a similar mechanism in Germany, both compelling the use of various RE technologies including RES-H in new build housing. Germany is currently considering a heat related tariff mechanism.

Efforts in the UK and elsewhere seem likely to be driven by the commitment of the various Member States in March 2007 to strive towards a 20% target for renewables as a fraction of

[1] Notably, by creating an expectation of availability amongst consumers which leads them to delay purchases.

all energy use. Given the high fraction of energy used for heat and the problems hindering high levels of renewable penetration in the transport sector, the ambition of the target seems likely to require heat make a significant contribution in many, if not all, Member States.

Renewable Heat Technologies

There are a diverse range of renewable energy technologies that can act as sources of heat. When compared with RES-E technologies, it is apparent that as a group they are more heterogeneous, with a more diverse set of applications and a greater disparity in their applicability to different situations. Policies aiming to stimulate the full breadth of renewable heat applications will need to take this into account.

RES-H technologies include, but are not limited to;

- Wood fuel heating systems: using logs or chipped wood. Applicable at all scales from single home to commercial process heat user.
- Solar water heating: mainly for domestic use and pre-heating for industrial processes.
- Passive solar design: designing buildings to maximise the heating effect of the sun.
- Anaerobic digestion of animal waste: where animal waste from livestock farms is used to produce gas.
- Geothermal heat use.
- Heat pumps: Employing differences between temperatures above and below ground for heating or cooling purposes.
- Substitution of fossil fuels with renewable biofuels in multiple heating applications.

- Additionally, given the huge amount of waste or 'surplus' heat currently discarded by society, a more holistic policy might usefully include consideration of the contribution this might make to greater sustainability of energy supply, as well as improved energy security and other benefits. BERR's Heat Call for Evidence drew particular attention to this issue.

RES-H technologies are notably diverse in many characteristics, including in their scale, quality of output and appropriate application and method of delivery. The uses to which each might be put seems likely to mean that any sensible policy will need to consider the differences in order to draw conclusion as to how each might best be supported.

What lessons can we learn from experience with RES-E?

There are various options for adoption of instruments to support RES-H, many of which are already familiar from application to RES-E, though consideration needs to be given to their specific application to RES-H given the differences between electrical and heat infrastructures, modes of delivery, trading and regulatory regimes and many other factors. Instruments such as R&D support, grants, green labelling, government procurement, purchase obligations and others may all have their part to play; recent adoption in Spain and Germany suggests the adoption of use obligations may have a significant contribution to make and are coming to be seen as a good way to begin to stimulate demand into the supported commercial phase. It seems increasingly likely however that choosing between quotas and tariffs will form a substantial part of the debate regarding RES-H as it has in regard of RES-E. This certainly seems to be how the debate in the UK is already being framed.

Various commentators have detailed some of the key lessons that can be drawn upon from the collective experience with RES-E and which can jointly inform successful future policy (Haas, Eichhammer et al., 2004; Mallon, 2006; Lipp, 2007). Many of these can usefully be applied to RES-H policy providing proper consideration is given to the different

characteristics pertinent to RES-H technology and the context in which it will have to be developed.

Haas *et al* (Haas, Eichhammer et al., 2004) provide eighteen general conclusions as to the successful promotion of renewable energy systems. These will not be replicated in full but it is possible to draw out key elements from their list and consider their applicability in regard of promoting RES-H technologies.

- *Sufficiently large and stable price subsidies, available for a suitably long period.*[2] These are also likely to be key to stimulating sustainable growth in renewable heat. Easy grid access is seen as essential for RES-E, without direct equivalent for RES-H, clarity and innovation in building codes seem likely to address key impediments and to allow much easier consideration of retro fitting of heat systems, including potential connection to district heating systems. It is noteworthy that while Haas *et al* drew their conclusions with regard to policy relating to deployment, Johnson and Jacobsson draw similar conclusions as to the desirable qualities of policy aiming to stimulate new industrial opportunities within the RE sector (Johnson and Jacobsson, 2003).
- *No assumptions should be made concerning the best choice of mechanisms. However, it would be unwise not to consider the relative performance of mechanisms which have so far been deployed elsewhere.* Further consideration is given to this later in this paper.
- *The usefulness of any mechanism is dependent on the appropriateness of its initial design and ongoing oversight, particularly with regard to functionality, stability and continuity.* Implicitly, this suggests a body be charged with responsibility for oversight, in the case of UK RES-H this body, along with its responsibilities, would have to be devised from scratch as part of the legal process to initiate policy.
- *Different instruments are more appropriate to technologies dependent on their respective stage of development.* This is a point that Foxon *et al* (2005) develop in more depth, and is an element that is particularly appropriate to RES-H given the considerable variations in maturity, levels of penetration and differing scopes of the various RES-H technologies. Particular care must be applied to ensure that instruments are reduced such that the burden to taxpayers or consumers is minimised.
- *A promotional system should differentiate between new capacity and existing (depreciated) capacity.* This may apply to RES-H technologies which have already received significant grants when other systems are introduced.
- *Support should be time (or otherwise) limited.*
- *The process for authorisation of projects generally needs consideration to ensure a harmonised process.* This is perhaps easier for some, especially smaller scale RES-H technologies in comparison with RES-E, but may become as significant at higher levels. The overall regulatory situation regarding RES-H will be addressed shortly. The considerably less advanced state of the general heat sector in terms of the achievement of a regulatory framework and regulatory institutions to allow the application of proper support for RES-H may mean there are opportunities to be seized which will allow easier international harmonisation than has been the case as regards RES-E.
- *The major goals for policies should be the finding of strategies to minimise public cost.* While this may seem obvious, it is worth reiterating. It may perhaps be one of the most important points on this list in terms of the nascent debate over what form UK RES-H support should take. If the debate over policy instruments to support RES-H is to feature the argument over quota and tariff mechanisms that has characterised the last decade of RES-E policy debate then this must inform it. The

[2] The points made in Haas *et al* (2004) are summarised in italics.

evidence as to their comparative performance must be appropriately assessed and must inform the choice of which – if either – mechanism should be the choice as the UK's primary instrument. We have already seen the addition to the debate of another metric, 'cultural compatibility' (DEFRA/BERR, 2007b), which in one analysis appeared to be weighted as more significant than cost and used to justify the adoption of a quota mechanism which was otherwise rated as more expensive than the alternative.

- *Changing between systems is likely to be inefficient; moving from a mechanism with demonstrated efficiency is likely to be unwise.* With regards to heat, the lack of established policy means this is unlikely to be a significant issue.
- *Switching systems has the potential to create regulatory uncertainty and increase investor risk.* Transparent planning, properly in advance of change should be employed to mitigate this. Again, the general absence of an established RES-H policy strategy means this is less significant. However, this and the previous point taken together emphasise the need to get policy strategies right in the first instance. Failure to do so means costly inefficiencies resulting from poor choices with the possibility that these will extend considerably over time. Poor strategy choices might include a failure to properly consider potential negative outcomes, failure to consider and address wider issues such as regulatory frameworks and failure to avoid perverse incentives which drive undesired market behaviours. (It could be argued various national biofuels strategies exemplify this.)
- *That economic modelling of the advantages of quota mechanisms in terms of technological price reductions versus tariff systems may not be as significant as once believed.*
- *Incentive based mechanisms alone are not sufficient to create sustainable RES-E market development.* While fiscal incentives can assist in overcoming various barriers to sustainable RE growth, the example of RES-E has clearly shown the need to identify the full range of barriers and to adequately address all of these. Additional areas for consideration include education and training of key stakeholders; the need for innovative approaches to regulation, for innovation in relation to institutional interaction and many other factors.
- *Proper comparison of support mechanisms has to include consideration of administration and transaction costs.* The UK's Renewables Obligation (RO) has seen administration costs rise from £600,000 to £900,000 per annum between 2004 and 2006 (Ofgem, 2008). More significantly, transactions costs for the UK companies involved are more substantial, estimated to be in the region of £54 million across the projected operational period of the RO, 2002-2027 (Oxera, 2005), representing 0.4% of the total investment represented by the mechanism. While oversight has been classified as efficient by the relevant auditing body it must be borne in mind that the RO impacts on a relatively small number of generators and supply companies. Quota mechanisms are regarded as the most costly to administrate and this seems likely to remain true in application to supporting RES-H. However the wide range of scales of RES-H technologies mean that if all RES-H technologies are to be included as able to be supported, the potential for the number of installations included within the support framework could easily slip into the hundreds of thousands (Woods, Gross et al., 2003). This level of inclusion seems likely to mean high transaction costs in relation the application of either a quota or tariff mechanism. However, if either applied only to larger scale applications of renewable heat then the overall costs seem likely to remain a relatively low fraction of the total costs of support. This tends to suggest a separate mechanism might best serve the needs of smaller scale RES-H technologies.
- *Empirical evidence shows that carefully designed, stepped tariff mechanisms are the preferable instrument for mature technologies.* This is perhaps one of the most significant conclusions drawn by Haas *et al*. Proper attention must be paid to the codicils, that the technologies must be at the more mature phases of development and

that the mechanism must be properly designed and (as in an earlier point) should not be open ended. Accepting the earlier point that the major driver of policy choice should be cost, the considerable evidence (Butler and Neuhoff, 2005; Mitchell, Bauknecht et al., 2006; DEFRA/BERR, 2007b) that tariffs are superior at delivering renewable energy capacity cost effectively – due to their effectiveness at risk and thus cost reduction – must place this in the lead as a choice for driving large-scale mature RES-H technology development in the UK and elsewhere. Nevertheless, it must be borne in mind that other instruments will be more appropriate to less mature technologies, and this must be judged on a case by case basis.

Small-scale RES-H and 'Production vs. capacity'

One lesson that emerged from early Danish efforts to drive the wind sector was the need to provide subsidies that subsidised technologies based on energy production rather than on the stated capacity of the generator. The latter subsidies tend to undermine innovation since they do not reward efficient technology and incentivise improvements. This represented an important early lesson and one that has informed policy choices since.

It has already been noted that inclusion of smaller scale RES-H development might lead to significant transactions costs relating to either a quota or tariff mechanism. This suggests there may be wisdom in separating smaller and larger scale technologies. But what are the alternatives? A 'Use Obligation' mechanism may be one solution. While slow turnover of housing stock seems likely to prevent this mechanism from achieving high levels of RES-H penetration with any rapidity, it may create niche demand for technology and thus stimulate market growth. This may flatten once widely applied in relation to turnover of housing production after a certain point and it may be necessary to maintain a grant or similar system for smaller RES-H technologies, effectively maintaining a system which does not reward output. While this will again threaten innovation and product quality this could be addressed to some extent by application of government standards for technologies to be eligible for support. While this is not an ideal solution, as Haas *et al* note, it is important to consider the best available mechanism, and to take into account the particular characteristics of the technologies and their level of maturity in drawing appropriate conclusions as to the best policy. All policy options must be considered, with minimising cost central to the final choice (rather than, for example, maintaining faith in a mechanism which is only cheapest in theory). The problem is further complicated – perhaps even dominated – by the high cost of installing heat metering equipment. Heat meters are available but their cost is such that their use will outweigh any benefits of fiscal support that a small project might receive.

What are the Key Differences that may Impact on RES-H Policy Framework Design?

While many of the lessons learned from the RES-E policy experience seem likely to be capable of fruitful application to RES-H there are key differences that need to inform the development of the holistic strategy that will have to be developed if RES-H policy is to be effective.

Perhaps the single element of heat supply that differs most significantly from electrical supply is in the delivery. The UK's national grid for electrical transmission and distribution fulfils a number of roles. It provides a single delivery network, with clear technical regulation outlining the connection process; it facilitates a trading process based around delivery aligning supply and demand and provides the mechanism for assessing costs to stakeholders; it allows easy metering of inputs and consumption for generators and consumers, and it comes with a system of regulatory oversight.

The absence of a similar network for heat seems likely to have implications for the effective design of a RES-H policy framework.

The lack of a single network seems likely to be a complicating factor. Heat delivery can be networked but obviously this is not well established in the UK[3]. Networked fuel delivery is more common, ~85% of domestic heat is sourced from networked gas, but inclusion of all fuels – necessary in the interests of equity and to avoid giving competitive advantage to some energy providers – will mean added complexity with each additional supply mode. Further, the absence of an easy and universal system of measurement of heat and fuel supply is likely to add both complication and cost to applying any system of support.

The absence of a single delivery mechanism also effectively means a more diverse market place for heat. This will bring a number of implications. On the supply side, supply companies will not have the same flexibility to shift between modes of generation as exists in the electricity sector. Similarly, consumers may also find it more difficult to switch between supply companies; they are much more likely to have large capital investments attached to their current mode of heat supply. (For example, via the installation of boilers burning only one kind of fuel type, be it wood, gas or any other alternative.) Different forms of technology will have greater ability to adapt to new inputs of heat or heat related than others. The ability of companies to substitute RES-H technologies into their energy delivery is something that government may wish to take into account in adopting policy. The assertion of a quota type mechanism to support RES-H seems likely to leave some heat and heating fuel providers with much easier tasks of adding alternatives while others will be restricted to purchases of tradable green certificates. This may not be a disadvantage in terms of economic delivery of RES-H though may lead to opposition from some elements of the current heat market.

The absence of a single market for heat energy provision may also to some extent undermine another justification that applied in relation to the UK's choice of the RO. A keen desire on the part of the UK Government and the UK energy regulator not to interfere with the electricity market was a key argument in favour of a quota over a tariff mechanism. While the argument concerning interference with the operation of the market still holds to some extent, there may be less imperative where delivery is not as time constrained as in the electricity sector and prioritisation of particular sources is less of an issue.

Regulation

The issue of regulation presents a key lesson for RES-H from the RES-E experience but at the same time throws up a significant difference between RES-E and RES-H, and potentially adding both complexity and an opportunity.

The RES-E policy experience has made it very apparent that adequate and fair regulation is a hugely important element in overcoming technical, institutional, financial and other barriers to deployment of renewable energy technology (Mitchell, 2000; Haas, Eichhammer et al., 2004). Left unaddressed, regulatory barriers can make renewables less economic or even totally uneconomic. Employed proactively, proper regulation, taking into account the exigencies of the current system and the needs of the desired future state can provide greater consumer choice and allow more effective and more innovative competitive practices.

As already noted, supply of heat in the UK comes primarily via delivery of fuels to the home, in various forms and via various mechanisms. There is no single mechanism as with the electricity grid and no overarching system of regulation. This seems likely to mean that any substantial instrument will have to take into account a wider architecture than is the case with electricity. More positively, this may mean that regulation for RES-H does not have to be as bounded by the existing situation as was the case with RES-E, although this remains to be

[3] Only 1-2% of UK homes are connected to district heating schemes, virtually all of them supplied via fossil fuels.

seen. It is important that that UK government, or any government approaching the development of policy relating to RES-H, properly considers the regulatory environment, as well as the other conditions of the various heat supply markets before rushing to adopt policy instruments on a piecemeal basis.

The current lack of regulatory oversight will also have to be addressed. If any significant mechanism is to be introduced it will need to be transparent, to be applied centrally and its regulator will need to earn the trust of stakeholders. A further lesson from RES-E policy reflects the need to consider the wider context. Ofgem has needed to consider many aspects of the issue of stimulating increased deployment of RES-E beyond operation of the RO. While some of these will be specific to electricity, we are not currently in a position that allows us to know what else will need to be considered to facilitate more sustainable heat energy provision. In the absence of a heat equivalent to Ofgem it may be that the Government will have to more proactively address issues as they arise, or to devolve them to a body which has responsibility sufficient to address them. It is not enough to assume that responsibility for a fiscal mechanism can be assigned to any government agency and that that will be the end of the matter.

Conclusions

There are a multiplicity of lessons arising from the experience of both the UK and other nations with renewable electricity policy, which, if drawn upon at this early stage in the process to develop RES-H policy can fruitfully accelerate the process without repeating mistakes costly in both capital and time.

Central to the development of policy is that it must be viewed as a wide ranging framework with multiple elements, all of which are important, many of which are essential. Adopting some policy instruments without proper understanding and consideration of the full picture will, experience tends to suggest, fail to address a sufficiently wide section of the barriers to enhanced deployment and industrial development, may well lead to additional barriers, and will lead to the UK failing to seize all the benefits of same: economic, social and environmental.

While one key debate seems destined to be a replication of that between quota and tariff mechanisms, ('Renewable Heat Obligation' and 'Renewable Heat Incentive' as they are currently respectively styled in the UK policy milieu) it seems impossible, and indeed unwise, to try to come to meaningful conclusions until there is a greater understanding of a great many factors which will complicate their adoption and usefulness. These include the functionality, trading and regulatory architecture of current heat supply and the nature of the potential interaction of RES-H with the existing market. It is also important not to think that these policy instrument options represent the only ones available. The potential for wide distribution of small scale technologies such as solar water heating and heat pumps may make an alternative to either economically attractive The use obligation adopted in Spain and Germany offers a 'stick' option which can bring enhanced niche market opportunities for small and large scale RES-H technologies, and the chance to widen public knowledge of what are elsewhere regarded as relatively mature technologies. It can be applied either alongside a tariff or quota or completely separate of either. Changes to building regulations offer the chance to ease integration and widen choice in the long term. Changes to planning permission could result in the need for thermal electrical generation to consider better use of waste heat. There are many options and the choice of any needs to be properly informed by familiarity with the sector and by thorough and ongoing consultation with the sector and its stakeholders.

In the absence of a regulator with equivalent powers and levels of responsibility for all elements of market regulation, it may be that the government will have to take a much more proactive role in driving forward the process by which changing sectoral needs are brought to

the fore. It will certainly need to consider the overall regulatory picture and how it might be most effectively amended to drive forward renewable heat.

References

BERR (2008a). Heat Call for Evidence. London.

BERR (2008b). Impact Assessment of Proposals for a UK Renewable Energy Strategy - Renewable Heat. London.

BERR (2008c). UK Renewable Energy Strategy - Consultation. London.

BERR/NERA (2008). Qualitative Evaluation of Financial Instruments for Renewable Heat. London, BERR.

Butler, L. and K. Neuhoff (2005). "Comparison of Feed in Tariff, Quota and Auction Mechanisms to Support Wind Power Development." Cambridge Working Papers in Economics **CWPE 0503**.

DEFRA/BERR (2007a). Renewable Heat Initial Business Case. London.

DEFRA/BERR (2007b). Renewable Heat Support Mechanisms. London.

DTI (2007). Energy Trends. London.

European Commission (2008). Proposal for a Directive on the use of energy from renewable sources. Brussels.

Foxon, T. J., R. Gross, et al. (2005). "UK innovation systems for new and renewable energy technologies: drivers, barriers and systems failures." Energy Policy **33**(16): 2123-2137.

Haas, R., W. Eichhammer, et al. (2004). "How to Promote Renewable Energy Systems Successfully and Effectively." Energy Policy **32**(6): 833-839.

IEA (2007). Renewables for Heating and Cooling: Untapped Potential. Paris, International Energy Agency.

Johnson, A. and S. Jacobsson (2003). The Emergence of a Growth Industry: A Comparative Analysis of the German, Dutch and Swedish Wind Turbine Industries. Change, Transformation and Development. J. S. Metcalfe and U. Cantner, Springer Verlag.

Lipp, J. (2007). "Lessons for Effective Renewable Electricity Policy from Denmark, Germany and the United Kingdom." Energy Policy **35**(11): 5481-5495.

Mallon, K. (2006). Renewable Energy Policy and Politics: A Handbook for Decision-making. London, Earthscan.

Mitchell, C. (2000). "Neutral Regulation - The Vital Ingredient for a Sustainable Energy Future." Energy & Environment **11**(4): 377-389.

Mitchell, C., D. Bauknecht, et al. (2006). "Effectiveness through Risk Reduction: A Comparison of the Renewable Obligation in England and Wales and the feed-in system in Germany." Energy Policy **34**(3): 297-305.

Ofgem (2008). Renewables Obligation Annual Report 2006-2007. London, Ofgem.

Oxera (2005). Economic Analysis of the Design, Cost and Performance of the UK Renewables Obligation and Capital Grants Scheme. London, Oxera/NAO.

Woods, J., R. Gross, et al. (2003). Innovation in the Renewable Heat Sector in the UK: Markets, Opportunities and Barriers. London, ICEPT/DTI.