Forest Research

Stakeholder Perceptions of Short-rotation Forestry for energy

Literature Review

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Executive Summary

1. Short-rotation forestry has the potential to deliver considerable quantities of biomass for use in the renewable energy sector. However it is an unfamiliar land-use in Britain. This research was conducted in order to further understanding of the social viability of SRF in the British landscape.
2. A literature review was conducted focused on identifying stakeholder perceptions of SRF in Britain. No published research meeting expected quality standards was found relating directly to these perceptions. However, more than 50 papers and reports on closely associated issues were identified from which conclusions can be drawn about likely stakeholder perceptions of SRF.
3. The literature widely reports low levels of awareness of biomass as a form of renewable energy - especially in relation to solar and wind power. This is perhaps unsurprising given the need to understand sustainable forest management and the carbon-cycle which make biomass renewable and meaningful as a climate-change mitigation strategy. This complexity is worsened by the variety of products and technologies referred to as 'bioenergy'. Evidence suggests that stakeholders are, therefore, unlikely to recognise and understand the connections between SRF plantations and renewable energy.
4. The silvicultural forms and management practices likely to produce greatest economic and biomass returns from SRF are likely to be perceived negatively by stakeholders who view and use plantation areas. Economically and productively sub-optimal planting and management options may be required in order to gain broad stakeholder acceptance.
5. Opposition to the establishment of SRF plantations is perhaps likely to be strongest amongst stakeholders local to them. However, experience of SRF over time may reduce opposition if predicted negative impacts do not emerge.
6. Although this review has identified no research that has been published investigating UK stakeholders' perceptions of *eucalyptus*, the species has been implicated in a number of controversial and socio-economically damaging forestry initiatives internationally. This has resulted in *eucalyptus* becoming a strong symbol which would likely be a useful rhetorical device for stakeholders opposed to SRF. This deserves consideration by advocates of SRF in Britain, where the *eucalyptus* is planned.
7. Actors seeking the establishment of SRF in an area should engage local communities and other stakeholders as early as possible in the process. Innovative engagement methods should be employed (beyond information provision) to create dialogue between stakeholders and, in particular, to address the complexities of biomass as a renewable energy source.
8. SRF establishment should be targeted in areas where it is likely to be socially sustainable along with meeting other ecological and economic criteria, and generate most benefit for local communities.

1. Background

The EU Renewable Energy Directive (2009/28/EC) sets European and National targets for renewable energy use. By 2020 the UK aims to be generating 15% of its energy using renewable sources, and biomass will play a key role as part of the 'energy mix'. The importance and role of biomass is now described in a number of policy documents including the UK Low Carbon Transition Plan, Renewable Energy Strategy and UK Biomass Strategy (DEFRA et al., 2007, HM-Government, 2009a, HM-Government, 2009b). It has been suggested that Short Rotation Forestry (SRF) has the potential to deliver the volumes of biomass required to contribute significantly to this energy goal. The establishment of a strong UK biomass energy sector also has the potential to contribute to overall security of energy supply.

Whilst some trials of appropriate species have been started (e.g. Mitchell, 1999, Purse & Richardson, 2001), experience of SRF in Britain remains very limited and there is a critical need to establish the feasibility, sustainability and appropriateness of its use in Britain. New growth trials comparing native and naturalised broad-leaved species with *eucalyptus* and other fast growing exotic species will assess risks relating to hydrology, carbon balance, economic viability and impacts on landscape, heritage/archaeology and biodiversity.

This literature review explores a previously neglected dimension of short-rotation forestry - its *social viability*. Many factors influence how practicable or workable a land-use is in any given location. These include biophysical conditions (e.g. climate and soil), economics (e.g. equipment costs and market prices), operational practicalities (e.g. availability of skilled workers and suitable machinery), and social factors (e.g. the attitudes of land managers and other stakeholders). This report focuses upon one set of social factors affecting bioenergy production as a land-use, that is stakeholder perceptions of short-rotation forestry. If SRF is to be established as a productive land-use it is recognised that a number of key social challenges will need to be addressed more effectively. In particular these are likely to be meeting criticism and opposition from some public and 'third sector' stakeholders, along with convincing an adequate number of landowners to plant the crops and create a viable resource. A key report on bioenergy to the European Commission stated, for example, that

> ... although most organisations and actors involved in the promotion of bioenergy would agree with the importance of a favourable public opinion on bioenergy there is also wide agreement that this issue has to be dealt with more effectively – although at the same time there often is uncertainty about the strategies to do so. Thus there are good reasons to analyse the public perception of bioenergy, and

> the factors shaping it more systematically and through this provide a better basis for strategies to improve public perception. (Rohracher et al., 2004: 1).

This report goes on to note that

> Most of the interviewees [promoters of biomass energy] felt that improving the public perception of bioenergy is of high importance for the promotion of bioenergy, but often could not tell very much about the situation in their country ... (Rohracher et al., 2004: 2)

It is considered that the adoption of SRF in the Britain may be perceived negatively by some stakeholders, for example, local residents and environmentally focused non-governmental organisations, with opposition perhaps particularly occurring during formal forest planning consultation processes. This view is in part based on a number of problem case studies globally, where large scale SRF practices (particularly using *eucalyptus*) have been directly linked to environmental, socio-political and economic problems (see Section 2.3.1). In addition to these concerns, *eucalyptus* species may be perceived aesthetically as unusual in the British landscape as they have 'non-native' characteristics (trees can have stark white trunks and are evergreen in nature). It has been anticipated that the unfamiliar appearance of these plantations may encourage additional unwanted and negative attention. The attitudes, perceptions and opinions of landowners towards SRF is a critical dimension of the social viability and feasibility of establishing it as part of the UK's renewable energy sector. The Energy Crops Scheme, aimed at promoting and establishing short-rotation coppice, saw only limited uptake of financial incentives. It is thus important to understand any barriers there may be to establishing SRF on private land – which would be vital to the effectiveness of the sector.

The objective of this literature review is to assess the existing published social research 'evidence' relating to UK stakeholder perceptions of short-rotation forestry for energy (particularly using *eucalyptus* species).

1.1 Method

This review has followed standard procedures for literature review, as set out in the methodological literature (Hart, 1998) and summarised within Forest Research Standard Operating Procedure 'Conducting a Literature Review' (SOP0123). The process consists of three basic stages, i) search and identification of relevant literature, ii) review, and iii) synthesis and summary of findings.

The search was conducted through a number of keyword searches utilising literature databases (e.g. IBSS and Web of Science) and internet search engines (e.g. Google),

combined with a subsequent 'snowball' process identifying further literature from the references contained in identified resources. Given the dates of previous *eucalyptus* growth trials, searches were confined to available evidence published since 1980. Literature was tracked and recorded using EndNote software (version X), which was also used to store text extracted from references during analysis.

1.2 Report structure

Following this Introduction, Section 2 of this report describes the literature relating to stakeholder perceptions of biomass energy, eucalyptus, and silvicultural attributes. Section 3 provides a discussion of this literature, interpreting it in the context of short-rotation forestry looking to identify the most likely perceptions of SRF amongst UK stakeholders. Section 4 offers a brief summary conclusion, including a number of recommendations to promote the establishment of SRF in the UK.

2. Results: The Literature

2.1 Stakeholder perceptions of SRF in Britain

In-depth searches identified just **one** published study directly reporting stakeholder perceptions of SRF in Britain. This study (Hardcastle et al., 2006) does include *eucalyptus* as a focus, but the quality of evidence and analysis relating to the perceptions of 'NGOs' (non-governmental organisations) and 'potential SRF Planters' (the only stakeholding groups investigated) is very poor and brief. In this report the perceptions of 'Planters' are assessed through two conversations in which 'general views' were 'canvassed'. This superficial research led the authors to conclude that 'famers are mainly concerned with the magnitude and timing of the cash flow of the investment' (p. 28) - a conclusion that is clearly challenged in the wider literature on farmer and landowner attitudes, (Lawrence et al., 2009). The perceptions of the non-governmental sector were assessed through contacts (of varying extent) with 14 organisations (including English Nature and the Joint Nature Conservation Committee, both, in fact, statutory governmental organisations), reported in an Annex to the report. The authors conclude that 'None of those consulted was opposed to SRF' (p. 28) despite opinions including that 'Large-scale adoption would be detrimental ...' (p. 127) and 'There are many locations where SRF would be unsuitable ...' (p. 128), and recorded responses from those organisations perhaps most likely to offer strong opposition (including for example CPRE, Greenpeace and Friends of the Earth) being very limited and inadequate to form a proper assessment of their position.

No literature was identified directly addressing 'public' perceptions of short-rotation forestry or *eucalyptus* as a species in Britain.

The term 'public' here refers to stakeholders without stated (or otherwise obvious) livelihood or professional connections to land management. This almost total lack of direct evidence requires us to widen the scope of literature assessed here. Below we analyse the literatures relating to perceptions of silvicultural form (Section 2.4), *eucalyptus* (Section 2.3), and biomass energy more generally (Section 2.2) in an attempt to facilitate drawing conclusions across from these to SRF in Britain.

2.2 Perceptions of biomass energy

There is a significant, if not substantial, literature describing stakeholder perceptions of biomass energy - often embedded within wider studies of renewable energy options. A large proportion of published material refers to research conducted in the United States, but a small number of studies have been done in Britain and other European countries (such as Sweden). Having said this, these British studies are centred almost exclusively on controversies surrounding the **siting** of biomass energy plants, rather than on questions relating to biomass energy, and its use, *per se* (van der Horst et al., 2002, Upreti and Horst, 2004, Upreti, 2004, Upham and Shackley, 2006a, Upham and Shackley, 2006b, Upham and Shackley, 2007, van der Horst, 2007). The result of this is an emphasis on local opposition and the planning process. The North American literature offers some insights into more general perception questions, often using questionnaire surveys and/or 'willingness to pay' techniques (Ostermeier et al., 1988, Frankena, 1989, Farhar, 1999, Adams, 2003, Jensen et al., 2004, Caputo et al., 2008, Monroe et al., 2009, Plate et al., 2010). The use of these sorts of quantitative methods, framed within a market research approach, is indicative of the wider literature on 'public' perceptions of renewable energy. Such methods can provide useful descriptions of attitudes, but are of limited explanatory power (see Devine-Wright, 2007: 3).

The literature on perceptions of biomass highlights a number of relevant issues, examined in detail below, including

1. a generally low level of stakeholder awareness and understanding of biomass energy, particularly relative to other forms of renewable energy and the intrinsic variety within the category of 'bioenergy';
2. a number of core concerns that stakeholders have in relation to biomass energy;
3. the character, strength, importance and process of local opposition;
4. the importance of trust between stakeholders involved in debates over biomass energy;

5. some perceived benefits of and levels of support amongst stakeholders for biomass energy, and,
6. some idea of demographic / social factors that affect acceptance of biomass energy.

2.2.1 Awareness of biomass energy amongst stakeholders

The available published evidence suggests that stakeholders in general lack awareness and understanding of biomass as a renewable energy option (Ostermeier et al., 1988, Farhar, 1999, Adams, 2003, Upreti and Horst, 2004, Rohracher et al., 2004, Jensen et al., 2004, Devine-Wright, 2007, Caputo et al., 2008, Monroe et al., 2009, Plate et al., 2010,). This is particularly apparent relative to other renewables, especially perceived 'zero-emission' energy options (i.e. wind and solar power). Having noted this, some evidence suggests this is changing positively. For example, an increase in awareness of 'biomass and bioenergy' (from 45% of respondents in 2006 to 59% in 2008) is reported in a report for the UK government (BERR 2008).

In some studies, biomass is perceived as no better than fossil fuels. In a review of the limited number of UK studies (Devine-Wright, 2007: 4) concludes that

> 'members of the public relate to specific renewable energy resources or technologies more than the general term, and wind, solar and hydro are most widely recognised (e.g. awareness by over 70% of respondents), in contrast to biomass (approximately 20% awareness)

Another study by this same author 'found that many respondents believed "natural gas" to be a form of renewable energy, whilst awareness of "biomass" as a form of renewable energy was low' (Devine-Wright 2003, cited in Devine-Wright, 2007: 4). From her review of utility company market research, Farhar concludes that 'Customers favor renewable energy sources but tend to know very little about them.' (Farhar, 1999: 5). In their discussion of 'Perception and Public Trust' (Caputo et al., 2008) assert that perceptions of biomass energy are generally based on 'confusion' and/or a lack of knowledge ('the widest perception is ignorance'). Surveys in the United States reveal mediocre levels of public awareness of bioenergy, whilst similar studies in Ireland and the Netherlands both identified very low levels of awareness relative to other renewable energy options.

> ... more than half [55.7%, of Florida homeowners surveyed] had not heard of biomass ... (Adams, 2003: 24)
>
> When asked to assess their own level of knowledge about converting wood to electricity, less than 5% considered themselves "Very knowledgeable," while over

> half (54.5%) considered themselves to be "Not at all knowledgeable" (Plate et al., 2010: 4), same survey also reported in (Monroe et al., 2009: 12-13)
>
> ... biomass as a source of power generation comes out last with an awareness of only 2% (compared to e.g. wind with 23% and solar energy with 12%). If only those aware of the term “renewable energy” (53%) are asked to name sources of renewable energy, biomass still only gets 6% and is even behind nuclear, coal or gas, ... Wind energy (69%) and solar power (38%) apparently are the main sources identified with renewable energy. (Landsowne Market Research 2003, cited in (Rohracher et al., 2004: 5-6)
>
> Asked about what they would associate with the consumption of green electricity ... answers were distributed as follows: Wind 60%, Solar 22%, Hydro 15%, Bioenergy 8%. Again we find a very low awareness of bioenergy. (Kalf 2002, cited in (Rohracher et al., 2004:7)

(Ostermeier et al., 1988) found that ‘72 percent [of fossil-fuel using industries surveyed] had a low awareness of wood energy’, and that ‘Thirty three percent of respondents indicated they did not know if wood fuel could meet their low cost fuel need’ (p. 55).

It is clear that not only does biomass energy have a relatively low level of awareness amongst stakeholders in general, but stakeholders are also broadly unaware of the benefits it can have and its potential role in contributing to environmental goals. (Upreti and Horst, 2004: 68), for example, noted that ‘Environmental contributions of biomass are not yet well understood at the local level’. Furthermore, the environmental credentials of biomass relative to other fuels is poorly understood, for example

> Respondents [in Reading] were also asked whether they thought wood fuel could replace fossil fuels and here 68% rejected this view. (Støer and Yang 2003, cited in (Rohracher et al., 2004: 9).

More positive results are reported from the UK Public Opinion of Forestry[1] surveys where in response to the statement “Using wood for fuel is better for climate change than using fuels such as coal and gas” just under half (48%, in 2009) agreed and just 16% disagreed. However, this figure has not changed substantially from the previous survey (in 2007) where 46% agreed, and 15% disagreed, so there is perhaps limited if any improvement in awareness. Similarly low levels of awareness were reported in a US study

[1] See http://www.forestry.gov.uk/forestry/INFD-5ZYL9W

> Respondents were confused about the advantages and disadvantages of wood as opposed to coal or natural gas in relation to climate change and believe that solar energy is a feasible energy source for meeting electricity demands in Florida.' (Monroe et al., 2009: 13)

Of course, the geographical and climatic context of this research (sub-tropical Florida) probably explains much of the (likely well-founded) preference for solar energy. Few studies have attempted to explore this specific lack of understanding, but it is likely that the fact that biomass has to be within a wider sustainable management framework to be renewable is a barrier to developing understanding.

> ... respondents do not seem to consider the carbon-neutral nature of wood and the global carbon cycle. When comparing wood to coal and natural gas in the context of global climate change, only a small fraction of respondents seemed to understand the advantages that wood has over fossil fuels (Plate et al., 2010: 11)

The lack of awareness relating to biomass energy reported in the literature leads some analysts to diagnose opposition to its use as a simple 'knowledge-deficit' problem whereby the 'public' reach baseless prejudiced conclusions about bioenergy which can be mitigated by the provision of 'objective' information.

> People who are not familiar with the opportunities and benefits from the use of biomass for energy and who have only little knowledge about biomass conversion technologies tend to have prejudices. ... To correct these prejudices and to improve the understanding of the use of biomass for energy by the public, the necessary information about the technical background and the benefits, but also about the challenges of the provision of heat and/or electricity from biomass, should be presented in an adequate, objective and fair way. (Rosch and Kaltschmitt, 1999: 352-353)

However, as can be seen from more recent literature reported below, this perception of 'knowledge deficit' falls a long way short of explaining opposition.

Having noted the widespread *lack* of knowledge, it is important to note that, in some communities, high levels of awareness and understanding have been revealed. For example, in a study completed in Sweden, Lofstedt notes:

> In response to the question 'Have you heard of biomass?' 90 respondents answered affirmatively. They were also aware of what constituted biomass.' (Löfstedt, 1996: 40)

This study also revealed that in this community 'Sixty-nine of the respondents *did* see biomass as an environmentally friendly energy source' (p. 41, emphasis added), and the author links this level of understanding and support as a key factor contributing towards the commercial viability of the biomass plant involved.

Further to this it is important to acknowledge Devine-Wright's conclusion that 'a deficit of technical understanding does not equate with an absence of personal meanings or beliefs associated with energy technologies' (2007: 11). It is consequently crucial to recognise that limited technical knowledge does not necessarily mean limited opinions or views about renewable technologies, so that advocates of renewable energy do not treat individuals as neutral blank canvasses waiting to be convinced by technical 'truths'.

2.2.2 Stakeholder concerns in relation to biomass energy

The literature identifies a number of concerns that stakeholders have about biomass energy. These are nearly all 'local' in character, and include impacts on the environment (especially forests and wildlife), emissions resulting in air and water pollution, and various economic issues. Indeed, in addition to this characterisation in the literature (Barnett et al., 2010) note that actors in the renewable energy industry have a strong tendency to define the 'public' as 'concerned', noting the impact of this upon 'engagement' activities.

> Alongside the framing of engagement as a response to "not knowing enough," the construction of the imagined publics as concerned and the framing of engagement (or more specifically of information provision) as a response to concern, was similarly clear. ... Concerns that could be addressed were often seen as understandable concerns. This was contrasted with situations where people were blinkered or would not change their mind or where it was evident that they simply wished the facility could be sited elsewhere. (p. 8)

A large number of studies identify stakeholder concerns regarding **emissions** from the use of biomass (Ostermeier et al., 1988, Frankena, 1989, Upreti and Horst, 2004, Rohracher et al., 2004, Jensen et al., 2004, Upham and Shackley, 2007, Monroe and Plate, 2007, Caputo et al., 2008 Monroe et al., 2009, Plate et al., 2010). These emissions are perceived to potentially cause air pollution (reduced air quality; lack of compliance with air regulations), water pollution, severe mists and fogs (with associated road safety problems (Upreti and Horst, 2004), unpleasant odours, and health risks (Rosch and Kaltschmitt, 1999). Caputo et al., 2008 note that public concerns include air pollution, and this is problematically related to forest fires ("... there is a concern of air pollution in relation to combustion. People equate forest fires to burning wood in a

power plant."; "The perception here in Oregan is that biomass combustion equals emissions from a forest fire instead of a steam plume").

Frankena, 1989, Monroe et al., 2009, Plate et al., 2010, Upreti and Horst, 2004, Jensen et al., 2004 and Hardcastle et al., 2006 all identify the perceived **potential negative impacts on the environment** as important concerns held by stakeholders, commonly associated with opposition to biomass energy use. Biomass is particularly seen as a threat to local forests (Frankena, 1989, Jensen et al., 2004, Monroe and Plate, 2007, Monroe et al., 2009, Plate et al., 2010) and wildlife (Upreti and Horst, 2004). Other potential negative environmental impacts identified included nutrient loss / reduced nutrient cycling, water-cycle damage, and localised weather events.

Closely linked to perceptions of local environmental damage were variously expressed **concerns about scale and 'industrialisation'** (Frankena, 1989, Upreti and Horst, 2004, Rohracher et al., 2004, Caputo et al., 2008). As Upreti and Horst, 2004 note from their study of a biomass plant development controversy in the UK.

> ... the plant was viewed as a factory with smoking chimneys rather than a small, state of the art, environmentally friendly facility to produce green electricity to benefit all. ... Local people see 'industrial-scale' biomass energy plants as a threat to the local environment' (p. 68).

A similar conclusion was reached by Upham and Shackley 2006b elsewhere in the UK.

> The large majority of people in Winkleigh object to the Winkleigh Biomass Gasifier primarily because they see it as an industrial-scale development that they think is likely to damage their quality of life substantially. (p. 61)

Often these concerns over 'industrialisation' are not directed towards biomass energy itself, but rather at what might become of the biomass energy installation, or crop, as it develops. A study in Germany, for example notes that local opposition was motivated at least in part by the 'fear that the plant will later be converted into a waste incinerator' (Köpke & Schmidtferick 2002, cited in Rohracher et al., 2004: 18-19), and this same fear was perceived by the local public in relation to a biomass plant in Devon, England (Upham and Shackley, 2006b, Upham and Shackley, 2007). This same report cites Gray et al. 2001 which notes how interviews revealed that 'local residents feel that developers may 'sell out' to processing other products if the biomass process is not found to be viable' (Rohracher et al., 2004: 21). In his studies of opposition to wood energy installations in the US (Frankena, 1989) notes an 'explicit worry that the plant might eventually burn coal' amongst Californian stakeholders. (Caputo et al., 2008) also characterise public concerns over biomass as largely related to perceptions of unconstrained industrialised forestry in the name of biomass production. The feeling is

that this forest management would consist of 'the same old ways' ('... when the public hears about the utilization of forest biomass for energy, they believe that management will not be different ...'), including clear felling ('... the public will think that all the trees will be cut down'; 'There is a fear that ... the forest will be clear cut as in the 1950s') and prioritise economic goals ('People view that biomass energy is the latest attempt to get timber programs running'; 'The perception was that this is just another way to get into forest to do the same thing in a different manner').

Scale is an important dimension of this concern. Contrasting with unease about 'industrial' scale developments, Rogers et al., 2008 report 'widespread support' for small or medium scale community-based energy generation projects amongst the rural public in the UK.

A variety of **economic concerns** are identified as influential upon stakeholders' perceptions of biomass energy. The creation of local jobs, for example, was identified both as unlikely (Upreti and Horst, 2004) and key to obtaining local support (Monroe et al., 2009). Other concerns included negative impacts on local property prices (Upreti and Horst, 2004), high fuel and/or conversion costs (relative to other energy options) (Ostermeier et al., 1988, Monroe and Plate, 2007, Monroe et al., 2009), long term reliability of supply (Ostermeier et al., 1988, Frankena, 1989, Upham and Shackley, 2006b, Monroe et al., 2009), competition for wood used for other activities (Frankena, 1989, Monroe et al., 2009), the displacement of food crops (Jensen et al., 2004) and benefits accruing to non-local stakeholders (e.g. local stakeholders in Indian River, Michigan, asserted that 'the sole purpose of the project [a wood burning electricity plant] was to provide Primary Power investors with federal tax breaks.' (Frankena, 1989: 20).

Other stakeholder concerns over biomass energy identified by the literature relate to increased local traffic leading to congestion, associated air pollution and road safety issues (Rosch and Kaltschmitt, 1999, Upreti and Horst, 2004, Rohracher et al., 2004, Upham and Shackley, 2006b, Upham and Shackley, 2007, Upham and Speakman, 2007, RELU, 2009), along with aesthetics / visual impact (Upreti and Horst, 2004).

2.2.3 Opposition to bioenergy

An artefact of this literature's focus on opposition to biomass energy installations (Frankena, 1989, Löfstedt, 1996, Upreti, 2004, Upreti and Horst, 2004, Upham and Shackley, 2006a, Upham and Shackley, 2006b, Upham and Shackley, 2007, Upham, 2009) is the characterisation of opposition (and/or support) in almost exclusively local terms. This parallels literature relating to other forms of renewable energy with, for example, Toke (2005) concluding that

> Decisions by local planning authorities in England and Wales to refuse planning permission to wind power schemes are closely associated with high levels of apprehension about such schemes among people living in the immediate vicinity of the proposed sites (p. 1539)

The literature shows that proximity clearly does affect attitudes towards renewable energy projects. For example, Hubner and Meijnders (2004, cited by Devine-Wright, 2007: 9) found that 'those living close to biomass power plants had more negative attitudes towards purchasing biomass electricity.'. However it is equally clear that physical / geographical proximity is by no means the sole explanatory variable.

Very little evidence is published on non-local perceptions of biomass. The result of the literature's local focus is, however, a reasonably detailed analysis of the strength, importance and processes behind opposition. In his review of cases of biomass energy siting controversies in the United States Frankena (1989) asserts that

> In general, recipient communities bear the costs of projects that primarily benefit a different population. Communities increasingly refuse to accept this burden and sacrifice local interests. Citizen groups are forcing administrative agencies to be responsive to local needs and desires. Where mechanisms are lacking for the public to be heard and heeded, the politics of protest have often been effective in challenging development decisions, especially at the local level (p. 18)

Upreti and Horst (2004: 61) note that 'The environmental justification of biomass energy at the national level is not always sufficient to convince the local residents'. It is clear from the evidence that planning processes are a focal point of influence for those in opposition to biomass developments, with van der Horst et al. (2002: 123) for example, noting that 'obtaining local planning permission has proved to be an important obstacle for the developers'. Opposition groups are often very well coordinated and can mobilise substantial action and pressure. For example

> 'There were 439 letters submitted by local people to NWDC opposing the plant whereas only one letter was submitted in support of the development (sent by a willow growing farmer). In addition to the letters of objection, local people also submitted a petition signed by 861 people. Cricklade Town Council and Purton, Blunsdon and Castle Eaton Parish Councils had also objected to the proposal (Upreti and Horst, 2004: 64)

This, once again parallels opposition to wind energy (Toke, 2005). It is apparent that well organised and effective groups often adopt names with easily memorable acronyms, such as 'BLOT' (Upreti and Horst, 2004), 'CRUF' and 'SORE' (Frankena, 1989)!

It is common, both anecdotally and in the literature, to characterise local opposition to renewable energy, including biomass, in terms of NIMBY-ism. For example Rosch and Kaltschmitt (1999) states

> The personal attitude towards a biomass energy plant can change if people are confronted with such a plant in their neighbourhood. This is the so called NIMBY effect - everybody likes the use of renewable sources for the provision of energy but Not In My Back Yard.

However several recent studies challenge this characterisation (Wolsink, 2000, Rohracher et al., 2004, Devine-Wright, 2005, Burningham et al., 2006, Devine-Wright, 2007, van der Horst, 2007). For example

> Analysis of case studies show that blaming all local conflicts and opposition to the 'NIMBY syndrome' is too much of a simplification for the processes and conditions leading to opposition and certainly is not a good basis to find a way out of such conflicts. ... [drawing on Wolsink 2000] Generally NIMBY preferences only explained 4% of the variance of behaviour. By labelling all protests as NIMBY one misses the multitude of underlying motivations and the different roots of opposition. ... Wolsink's survey showed that attitudes are dynamic and influenced by the features of the project, along with the content of the public discussion which also depends on these features and not on a general NIMBY attitude. (Rohracher et al., 2004: 20)

Van der Horst (2007) notes that the term NIMBY is contested and has several operational definitions, making it (and, thus, its impact) very difficult to measure or assess. His main conclusion is that '*On aggregate*, proximity does have a strong influence on public attitudes to *proposed* projects, but the nature, strength and spatial scale of this effect may vary according to local context and 'value' of the land.' (p. 2705, emphasis in original). Who is involved (individuals or groups; 'followers' or 'leaders'), when (i.e. stage of project planning and development), and where (the meaning and value of the landscape) are all identified as key variables in explaining local opposition to bioenergy (and other renewable energy) projects. Of particular importance are perceived **risk**, **experience** of projects and community **culture** and background.

> risk perception of the new and unfamiliar is an important factor in people's dislike of proposed windfarms ... with the actual local experience of the existing windfarm, the reason for this opposition disappears. ... [because] certain feared impacts had failed to materialise (van der Horst, 2007: 2707)

> The area around the ARBRE wood gasification plant (see Upreti 2004) provides perhaps a typical example of an area of low landscape value and industrial

> heritage. A manager at the ARBRE plant described their success in gaining planning permission as the expected outcome of a specific strategy. While careful management of community relations was clearly part of their approach, he also pointed out that their site selection strategy included social sustainability criteria. He stated that (ex-)mining or (ex-)industrial communities understand that electricity does not come 'out of the light switch' but has to be produced in a plant somewhere and that the fuel has to be produced, stored and transported to the plant.' ... 'Ambient Energy proposed identical bioenergy gasifying plants in Eye and Cricklade (see Upreti 2004, Upreti and van der Horst 2004). But while they Cricklade plant was proposed in the rural buffer zone, the proposed site of the Eye plant was in an industrial zone right next to a much larger existing chicken litter combustion plant. While planning permission was heavily contested and rejected (also on appeal) in Cricklade, in Eye public opposition was negligible and planning permission was gained very smoothly (van der Horst, 2007: 2709)

Devine-Wright (2007) develops a classification of potential explanations of opposition to renewable energy technologies, which illustrates the breadth of possible motivations for opposition well beyond localised NIMBYism. **Personal factors** relate to individual demographic characteristics (e.g. age, gender, class, income), **social-psychological** factors include knowledge and direct experience, environmental and political beliefs, and place attachment, and **contextual factors** encompass a range of issues such as technology type and scale, institutional structure (e.g. ownership; distribution of benefits; use of participatory approaches to public engagement - see next section) and spatial factors (regional and local context, proximity and NIMBYism) (Devine-Wright, 2007: 8-9). This author concludes

> that there are important symbolic, affective and discursive aspects of how individuals relate to renewable energy technologies that have been insufficiently captured in the literature thus far, but may play an important role in motivating public responses ... [and] ... that such beliefs are ‘social’ as much as ‘personal’, dynamic rather than static, in that they may be shared across a community or social network, and generated through interpersonal communication, hence the incompleteness of an approach to public understanding based upon a more individualistic and static ‘public attitudes’ perspective.. (p. 11)

2.2.4 The importance of trust within debates about biomass energy

The literature reveals that perceptions of, and attitudes towards, biomass are influenced by levels of trust amongst stakeholders (Frankena, 1989, Löfstedt, 1996, Sinclair and Lofstedt, 2001, Upreti and Horst, 2004, Rohracher et al., 2004, Upham and Shackley,

2006b, Caputo et al., 2008, Plate et al., 2010). Particularly important and problematic has been trust in the developers of biomass installations, for example

> the environmental assurances by the developer were not trusted as the developer was thought to be guided by commercial motives only (Upreti and Horst, 2004: 68)

> local residents feel that developers may 'sell out' to processing other products if the biomass process is not found to be viable (Rohracher et al., 2004: 21)

> the professional credibility of the builders and operators of the plant was also important for local people (Löfstedt, 1996: 38)

Gray et al. 2001 cited in (Rohracher et al., 2004: 21) also pointed out that 'the "lack of trust in the developer caused by suspicion and misunderstanding of the intent of the developer" as a key issue for the success or failure of planning applications'. However, it is not only the private sector who may be mistrusted.

> ... the mistrust is around forest industry and local government. If somebody is going to burn trees and make money from it, the public will not trust them. (Caputo et al., 2008)

Upham and Shackley (2006b: 55) also note substantial distrust of regional government bodies and impact assessment research funded by them. They were viewed by local stakeholders as biased towards the developers and in financial control of the research consultancy.

Having said this, the literature also briefly identifies some positive aspects of trust such as 'Trust in foresters, environmental groups, and Extension agents to provide information about proposed woody biomass facilities' (Plate et al., 2010), and an Austrian study which found that 'the personal endorsement of a trusted public figure increased a community's acceptance of biomass' Austrian Academy of Sciences 1994 cited in (Löfstedt, 1996).

Sinclair and Lofstedt (2001) analyse local residents' levels of trust in relation to five key 'institutions' involved in a planning consultation for a biomass energy plant in Cambridgeshire, UK. They concluded that trust varied according to the perceived localness of institutions, with the parish council and local media being trusted most and nationally-focused institutions, such as the developer, the least.

Closely linked to issues of trust are concerns about **democratic principles and processes** in biomass energy development. Two studies (Frankena, 1989, Upreti and Horst, 2004) note this in relation to biomass, asserting that decisions in cases studied

were 'top down and imposed' on local stakeholders, or represented 'a lack of local autonomy'. The type and effectiveness of public or community 'engagement' is identified as an important contextual factor in the renewable energies sector broadly by (Devine-Wright, 2007). With reference to Haggett (2008), Barnett et al. (2010: 3) state

> Research has noted the value of engagement in facilitating positive public attitudes to the process of siting RETs [renewable energy technologies]. Negative emotions and assessments of the project as well as the triggering of active opposition are invariably associated with being marginalised in decision-making processes and having concerns ignored – even when the engagement options are framed in terms of communication and consultation

Considerable research has been conducted on this subject specifically in relation to wind renewable technology (e.g. Wolsink, 2000, Loring, 2007, Wolsink, 2007, Haggett, 2008, Wolsink, 2010).

Literature suggests that the form of 'engagement' is often key to establishing high levels of trust and understanding stakeholders' perspectives. However, despite the broad range of possibilities, Barnett et al., (2010) show that professional actors in the renewable energy sector technology conceptualise 'engagement' simply as information provision.

> Information provision is almost invariably depicted as the essence of engagement and often seen as key to acceptance of RET. The imagined lay public were primarily envisaged as requiring, and sometimes as requesting, information. Similarly, negative reactions of lay publics were sometimes attributed to the unsatisfactory provision of information, in terms of either its content or its timing. ... Information provision was linked to a model of lay publics where opposition is explicable in terms of knowledge deficiency. There were a range of explicit claims about the nature and extent of low levels of public knowledge attributable to "myth, media and misinformation". (Barnett et al., 2010: 7)

2.2.5 Benefits of and levels of support amongst stakeholders for biomass energy

The literature identifies some benefits of biomass energy use perceived as important by stakeholders (although none of this relates to the UK), and offers a number of assessments of levels of support for it. For example, stakeholders in two studies in the United States identified benefits, including the maintenance of local forests.

> ... making use of a potential waste and maintaining local forests are both perceived as extremely important benefits. Conversely, relatively little importance

> is put on creating new jobs and new markets for local wood (Plate et al., 2010: 6) also reported in (Monroe et al., 2009)

> Megavoltz [the biomass development company] promoted the economic benefits of the facility to both communities - 50 to 75 new jobs, an increase in the local tax base from improved property and salaries, $20 million invested for construction, and improved forest management. (Frankena, 1989: 21)

Stakeholders in a Swedish study also identified benefits.

> The advantages of using biomass in their opinion were its environmentally friendly image and that it provides jobs in economically depressed rural areas (Löfstedt, 1996)

Assessments of levels of support for biomass energy development offer slightly mixed conclusions, but with the general rule being low to medium ('basic') levels of support, although consistently at a level considerably lower than other renewable energy options such as solar and wind power. Löfstedt (1996) identified 'local support for using biomass as an energy source' (p. 41) and refers to other studies which have also revealed general stakeholder support for biomass energy in both Sweden and the United States.

> senior management of local municipal energy companies in central Sweden ... liked biomass as long as it remained competitive compared to other fuels (Hedman 1994, cited in (Löfstedt, 1996)

> Both farmers and landowners expressed an interest in commercial biofuel production. In one study, 88% of Missouri farmers responding to a mail questionnaire were interested in growing switchgrass to produce ethanol, and in another, 60% of the Minnesota landowners surveyed were interested in planting poplar trees for fuel. (Missouri Department of Conservation, 1994 and Loher, 1994 cited in (Löfstedt, 1996: 38)

Plate et al. (2010) show broad general support for using 'waste' wood for energy production, with slightly less support for specifically grown energy forests.

> a large majority of respondents (71%) indicated that they were at least "Fairly supportive" of using ... waste wood ... While the wood grown specifically for energy received relatively less support, even here 61% of respondents indicated that they were at least "Fairly supportive" of this source.' (p. 5).

Various studies have revealed, however, significantly lower levels of support for biomass relative to other renewable energy options, sometime having little more support than fossil fuels. For example

> biomass energy initiatives receive far less public support than zero-emission sources (e.g., solar and wind). In fact, respondents rank woody biomass no better than fossil fuel energy sources ... When respondents were asked to characterize their feelings about building a wood-fueled power plant in Alachua County, 31.6% of them expressed "Negative" or "Highly negative" feelings, and 27.1% expressed "Positive" or "Highly positive" feelings. The remainder, 41.2%, answered Neutral.". (Plate et al., 2010: 2-4) also reported in (Monroe et al., 2009).
>
> Support for wind energy was at 72% with only 2.4% opposing, this was a similar statistic for solar energy at 74.7 with 1% in opposition and to an extent for hydro at 63% in support and 2.6% opposing the technology. However, *biomass received less support at only 16% with 4.8% opposed* Støer and Yang 2003, cited in (Rohracher et al., 2004: 8, emphasis added)
>
> While 69 percent of the study respondents placed “Wind” in their top three choices, *only 26 percent placed “Biomass” in their top three choices of renewable energy* for their utility to develop. ... About 53 percent of the respondents stated that they would be willing to pay at least $4 a month more for electricity generated from biomass. In contrast, 65 percent said they would be willing to pay $6 per month more for wind power. (Jensen et al., 2004: 5, emphasis added)

Jensen et al. (2004: 5) cites Farhar and Coburn (1999) who state that 'only 1.5 percent listed biomass as their top choice, while 33 percent listed solar cells as their top choice'. (Farhar, 1999: 8) presents figures indicating that producing energy from ‘forest waste’ is ranked only 6th out of 8 energy options by US energy consumers (Table1 below).

Energy Resource	Somewhat or strongly favor %	Somewhat or strongly oppose %	Don’t know %
Solar	93	5	2
Wind	91	9	0
Natural gas	83	11	6
Geothermal	71	13	16
Landfill gas	64	18	18
Forest waste	*59*	*29*	*12*
Nuclear	31	63	6
Coal	24	69	7

Table 1

This report also summarises a number of studies of US energy customers' 'willingness to pay' for energy from renewable sources - presented as the graphs below (next page). Once again biomass compares unfavourably with the percentage of consumers willing to pay an additional $12 being c.80% for rooftop photovoltaic, 54% for wind, 53% for geothermal, and just 34% for biomass.

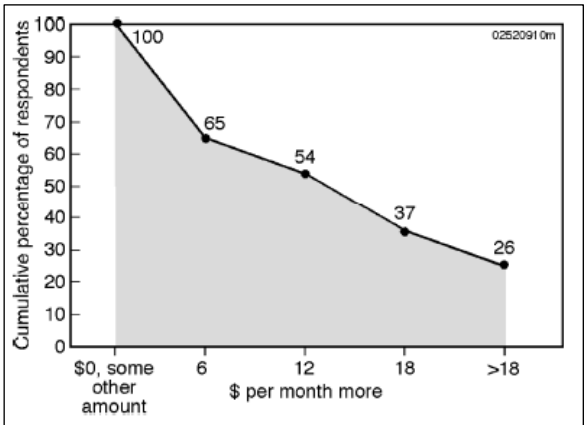
These low levels of support may in part be explained by a lack of confidence in wood as a viable energy option. Plate et al. (2010) notes this lack of confidence.

> 'Nearly half of the respondents (44%) consider solar power to be a very feasible solution to meeting additional local power needs, while *only 18% have that kind of confidence in wood*,' (p. 9, emphasis added).

2.2.6 Demographic / social factors influencing support for or opposition to biomass energy development.

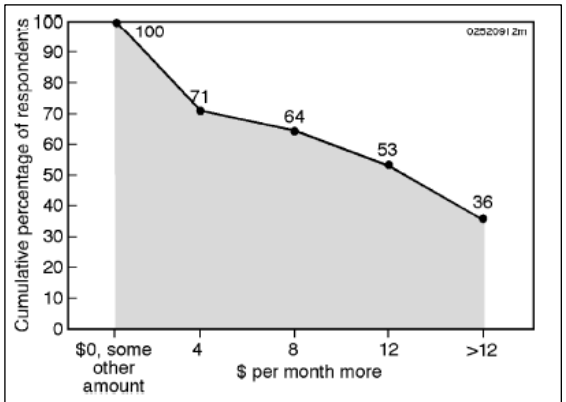
Attempts to identify the demographic or other social factors that influence support for or opposition to biomass energy use have not been a prominent aspect of the published literature. Some evidence is available however (both pertaining to biomass specifically and renewable energy broadly) and suggests a number of important variables including **cultural/historical context** (Rohracher et al., 2004), **levels of education** (Zarnikau 2003 and Roe et al. 2001, both cited in Jensen et al., 2004, Löfstedt, 1996, Jensen et al., 2004, Farhar, 1999), **income** (Zarnikau 2003 and Roe et al. 2001, both cited in Jensen et al., 2004, Adams, 2003), **age** and **gender** (Zarnikau 2003 cited in Jensen et al., 2004, Adams, 2003) **environmental organisation membership** (Roe et al. 2001 cited in Jensen et al., 2004, Jensen et al., 2004), **urban/rural location** (Jensen et al., 2004, Caputo et al., 2008), **ethnicity** (Adams, 2003), **demographic / population change** (Frankena, 1989), and local levels of social organisation (**social capital**) (Frankena, 1989). Evidence presented by both (Frankena, 1989, Löfstedt, 1996) illustrate that biomass development can be controversial even in localities where stakeholders are very familiar with using wood for energy.

Figures extracted from Farhar 1999, illustrating US energy consumers' 'willingness to pay' for renewable energy from various sources.



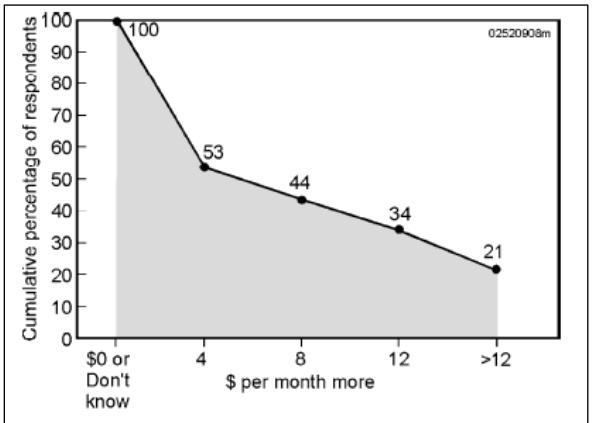
$0 = 31%; Some other amount = 4%

Figure B-7. Incremental Monthly Amounts Respondents Are Voluntarily Willing to Pay for Wind Power



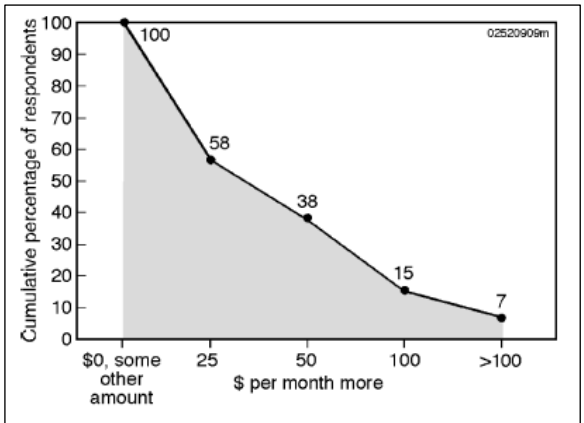
$0 = 27%; Some other amount = 2%

Figure B-8. Incremental Monthly Amounts Respondents Are Voluntarily Willing to Pay for Geothermal Electricity



$0 = 45%; Don't know = 2%

Figure B-9. Incremental Monthly Amounts Respondents Are Voluntarily Willing to Pay for Electricity from Biomass



$0 = 35%; Some other amount = 7%

Figure B-10. Incremental Monthly Amounts Respondents Are Voluntarily Willing to Pay for Home-Based Rooftop PV System

2.3 Perceptions of *eucalyptus*

Given the breadth of literature on perceptions of forestry in general, it is perhaps surprising that only a limited literature exists specifically describing stakeholder perceptions of *eucalyptus*. No literature describes stakeholder perceptions of *eucalyptus* in the UK. Studies in Australia, Ecuador and Pakistan report generally positive perceptions of *eucalyptus*. For example, in their study investigating the relationship between stakeholder preferences for forest landscapes and 'ecological quality', Williams and Cary (2002) identified clear and consistent preferences for native *eucalyptus* in Australia.

> The most striking result of pairwise comparisons indicates that both rural and urban respondents have significantly lower preference for the two noneucalyptus vegetation categories (bull-oak and she-oak) relative to the three eucalyptus vegetation types (Williams and Cary, 2002: 268)

In a study in Pakistan, Nawaz et al. (2004) report a slight majority (56.86%) 'liked' *eucalyptus* dominated roadside vegetation; with stronger majorities amongst highly educated individuals (65%) and passers-by on foot (69%).

Possibly the most informative study of perceptions of *eucalyptus* is that by Carse who studied two communities (Morochos and San Pedro) in Ecuador. The use of qualitative methods, along with quantitative semantic differential scaling facilitates clear comparisons between perceptions of *eucalyptus* and native species. Although this study revealed some negative perceptions of *eucalyptus* regarding its water use and affect on soil, in essence, the communities valued different species for different purposes - with *eucalyptus* particularly being considered 'useful'.

> While many community members recognize the potential ecological risks of monocultures of introduced tree species, they appreciate the trees' accessibility, utility and monetary value. Native trees, in contrast, are perceived to be very important ecologically and to provide economic benefits distinct from those plantation species, but are also considered less accessible due to diminished quantities and reduced geographic distribution.' (Carse, 2006: 103-104)

This study compared community members perceptions in relation to water use, soil damage and tree 'utility'. The scores generated by the semantic scaling are summarised in Table 2 below, and illustrate that 'participants believe that the *eucalyptus* consumes more water more than native trees' (Carse, 2006: 111) and damages the soil, instead of sustaining it (as native trees are perceived to do). '62.5% of participants identify *eucalyptus* as damaging the soil, a mere 2.5% believe that native species damage the soil' and specifically 'negative soil impacts commonly mentioned include: a lack of organic material benefiting soil fertility, high levels of nutrient absorption and soil

desiccation' (Carse, 2006: 113). Having noted this, both *eucalyptus* and native trees are perceived as very useful.

		Morochos	San Pedro	Combined Average	Notes
Water use	*eucalyptus*	4.90	4.26	4.58	1= consumes 'a little' water, 5= consumes 'a lot'
	native	1.40	1.88	1.61	
Soil damage	*eucalyptus*	1.50	2.00	1.78	1= 'damages' the soil, 5= 'sustains' the soil
	native	4.90	4.47	4.69	
Utility	*eucalyptus*	4.95	5.00	4.98	1= 'not useful', 5= 'useful'
	native	4.55	5.00	4.78	

Table 2

Carse also reports species preferences for reforestation.

> When asked which tree varieties they prefer for reforestation, inhabitants ... emphatically favoured native over exotic plantation species. [native 'aliso' (alder)= 73%, Pine= 33%, Arrayan (Eugenia spp)=27%, *eucalyptus* = 24%] ... Many participants mentioned that both *eucalyptus* and native species should be planted in order to receive their distinct benefits. ... 'no significant difference emerged between the reforestation preferences of men and women. ... Gender appears to be of little significance...' (Carse, 2006: 118)

(Phantumvanit et al., 1990) also report Thai farmers' concern about environmental impacts of *eucalyptus*, specifically regarding soil moisture and water supply to neighbouring land and crops.

> Most farmers surveyed, including small-scale eucalyptus planters, complain about the negative environmental impacts of eucalyptus—such as damage to their crops and a reduction in soil moisture and the water supply in the vicinity of eucalyptus plantations. (p. 4)

Whilst each of these studies reported some positive perceptions of *eucalyptus*, the single study found to have investigated perceptions of these species in Europe revealed relatively negative perceptions. González et al. (2001, cited in Edwards et al., 2010: 38) concludes that 'in a study of 200 Galician citizens people preferred the traditional forests (i.e. oak, chestnut and broadleaves) over conifers or *eucalyptus* plantations'.

2.3.1 *Eucalyptus* and the politics of development

Stakeholder perceptions of *eucalyptus* as a species, especially within the third sector, are likely to be affected by a number of political controversies focused around the environmental and social impacts of the species when planted on a large scale for economic development. Such problems have arisen around the globe, but instances in the Iberian peninsula (Spain and Portugal) and south-east Asia (India and Thailand) have perhaps prompted most controversy. In Spain and Portugal controversies have revolved around the environmental damage caused by forest fires ('eucalypts have been the cause of a dramatic increase in forest fires' (López-Cerezo and González-García, 1996: 62) and the substantial social and environmental change associated with the establishment and dominance of *eucalyptus* plantations. Referring to the coastal region of Asturias in northern Spain, (López-Cerezo and González-García, 1996) state that

> Eucalyptus forestation in this area has recently produced a strong social controversy. The Asturian landscape, society, economy, and culture are all undergoing transformations partly derived from the proliferation of eucalyptus plantations. Popular actions such as the one carried out in 1988 by the people of Tazones (a small coastal village in Asturias)—uprooting a private eucalyptus plantation and facing the Spanish federal police (Guardia Civil)—are only the tip of a troublesome iceberg ... (p. 61)

Eucalyptus plantations are considered central to a number of specific problems in Iberia including endemic biodiversity loss, pollution, soil impoverishment and the transformation of traditional landscapes (López-Cerezo and González-García, 1996: 62-63). These authors conceptualise a significant problem as the 'technicization' of what is essentially a social controversy. That is, a technical policy discourse led and controlled by biology and forestry experts has been used to close-down debate about the social dimensions of the problems associated with *eucalyptus* plantations.

> No public participation and no interest groups except that of politicians, private industry (in the shadows), and the experts themselves have been involved in the technocratic policy process. And the technical assessment carried out by these experts, far from sufficient in determining the most adequate political measures, has been mostly a political smokescreen used to transform a social problem into a supposedly technical issue. (López-Cerezo and González-García, 1996: 62)

Eucalyptus plantations have similarly been at the heart of social and ecological problems in India. In particular the government-sponsored expansion of *Eucalyptus* plantations has been established as one of several processes which has opened up long-standing communal economic and social institutions to new industrial markets. The consequent

deterioration of these communal institutions has had a substantial and disproportionate affect on the poorest of India's population. Vandana Shiva et al.'s (1981) seminal critique of this situation is worth quoting at length

> The success of the propagation of the species like *Eucalyptus* through farm forestry is rooted in new and growing markets for the produce as well as the decay in the traditional ties that had provided the social organisation essential for the production of traditional food crops. *Eucalyptus* plantations have provided a way for farmers to make profits from land without the corresponding dependence on the community. This detachment from the community, in turn, leads to insurmountable problems in generating community participation in the utilization of common uncultivated and unforested land for raising village woodlots. The organisational context in which *Eucalyptus* plantations have come up and which they in turn engender and reinforce creates individual motives and actions which undermine the possibility of cooperative motives and actions. When the richer farmers can make large profits by planting *Eucalyptus* on their own land and simultaneously reduce their dependence on poorer people and local resources in the villages, it is utopian to expect them to take part in parallel community activities to raise village woodlots on the commons. With organisational constraints restricting the primary thrust of farm forestry operations to private farmland, the participation of the village community as an integrated unit is excluded, not merely in terms of raising of forests but also in sharing the profit and benefits that occur. (Shiva et al., 1981: 11)

The final point here is crucial. Under communal institutions, not only were intra-community ties strong but whole communities participated in 'the material production and distribution of the tree wealth' (Shiva et al., 1981: 12). Thus once these institutions were lost, and industrialised markets were accessed only by privileged elites, so too were opportunities to obtain any benefits from tree wealth for the majority of rural people.

The fact that these farm forestry initiatives have been heavily supported by central government and international development banks has led to criticism of the phenomenon as 'top-down' and undemocratic. However, Indian state forestry services have made substantial efforts to address and deflect this criticism. In a report for the Food and Agriculture Organisation it was claimed that

> Allegations against *Eucalyptus* that it is ecologically, socially and economically unsuitable to Indian conditions are exaggerations ... [and] ... where farm forestry had been practiced with eucalypt as the main species has shown that planting of eucalypt has not only created substantial employment opportunities for the local

> people ... the standard of living of the people in the area improved. (Palanna, 1996)

Similar issues have been encountered in other areas of South-east Asia such as Thailand. Again state-sponsored *eucalyptus* plantations for economic development have had problematic socio-economic and environmental outcomes. Evidence has shown that opportunities are much more open to relatively wealthy landowners with large land holdings and available capital, whereas small farmers are less able to generate the capital nor have the land available to take advantage. Once again *eucalyptus* plantations have largely occupied land that landowners previously rented to small and landless farmers, consequently restricting opportunities for the poorest members of society. This results in the perception of *eucalyptus* 'as having economic rather than ecological benefits, and they [farmers] complain that such economic benefits go to the companies and to the wealthier farmers.' (Phantumvanit et al., 1990: 4).

Whilst the environmental problems associated with these politically controversial *eucalyptus* plantations are specific to *eucalyptus*, it is important both to acknowledge that these are not uncontested, and to separate them from the perhaps more important socio-economic problems which are not related essentially to *eucalyptus* species (that is, any tree species promoted in a similar way as an industrial economic crop could potentially have the same socio-economic impacts). However, *eucalyptus* has become strongly symbolic of these socio-economic problems, and is consequently vulnerable to being used as a rhetorical device in debates around forestry and economic development *per se*.

2.4 Perceptions of silvicultural attributes

A large body of literature exists relating to individual's preferences for woodland landscapes and scenes, focused upon informing forestry planning and design processes. Having said this, we identified no studies conducted to investigate preferences relating to *eucalyptus* aesthetics or landscapes or short-rotation forestry silvicultural landscapes in the UK - indeed we found almost no studies that address preferences for *eucalyptus* or SRF at all. The more broad studies of perceptions of *eucalyptus* that were identified have been discussed in the previous section. This current section focuses upon the more general aesthetics of silvicultural attributes (such as tree size, stand density and residue presence) of forests and woodlands *per se*, with particular reference to studies of short-rotation woodland management. This section does not provide a detailed review of this literature itself as a recent comprehensive review has been completed ("Public Preferences for Silvicultural Attributes of European Forests" (Edwards et al., 2010), conducted by colleagues at Forest Research in collaboration with others involved in the EFORWOOD research project). This identified the twelve most important dimensions of

silviculture. Whilst these dimensions relate to the recreational benefits provided by forests, the review is an excellent window onto more general aesthetic preferences. Table 3 (next page) details these findings, but in summary, the review reveals preferences for larger, older trees; variation; limited signs of human interference; moderate ground vegetation and visibility; and the appearance of naturalness.

In the absence of research focused on SRF, this section draws upon the limited research investigating stakeholder preferences for short-rotation coppice (SRC) in the landscape. The primary source of evidence here is Sadler (1993), although recent research by the RELU-biomass (www.relu-biomass.org.uk) project promises to offer more up to date evidence when its detailed results are published. Sadler (1993) noted the importance of variation in the landscape, and a preference for smaller, well-placed, SRC plantations.

> It is variety and change that make the scenery in the countryside attractive ... Some people suspect that unrestricted coppicing could damage the countryside - covering favourite views with a single species "over-regimented" crop..." (p. 9)
> Plots of 5 to 10 hectares, carefully integrated into the landscape and adding to its variety, seem likely to be acceptable.' (p. 12)

Initial findings from the RELU-biomass project state similar conclusions

> Most members of the public were not particularly concerned about the appearance of these new crops [SRC] and thought that they would fit in well with the current agricultural landscape. ... Wider margins, smaller, scattered fields (rather than large blocks of planting) and local small-scale end-uses were slightly more favoured than other planting options (RELU, 2009: 3)

Table 3. Key Silvicultural Attributes - From Edwards et al. 2010

1. Size of trees within stand	'as stand age increases ... or as canopy height increases from low to high the recreational value increases' (see pp. 18-21)
2. Variation in tree size within stand	'for Great Britain, Central Europe and Iberia, as variation in tree size within stand increases, from uniform to diverse, or as the number of canopy layers increases from one to many the recreational value increases' (see p. 21)
3. Variation in tree spacing within stand	'for Great Britain, Nordic region and Central Europe, as variation in tree spacing within stand increases from regular to different sized groups of trees and openings, the recreational value increase' (p. 23) 'Structural diversity within stands is a part of what many people consider to be 'naturalness' or 'wildness', which is often highly valued' (p. 24)
4. Extent of tree cover within stand	'in general, as extent of tree cover increases from sparse ... to moderate ... to full, the recreational value increases then decreases. 'Very low or very high tree cover was considered less valuable than a moderate level of tree cover' ... 'it is hard to generalise from the literature about the preferred percentage of forest cover because much depends upon what is between the forests, and the overall layout and context. We can conclude that presence of a significant proportion of open space is positive.' (p. 25)
5. Visual penetration through stand	'in general, very low and very high levels of visual penetration through a stand were considered to be negative compared to moderate levels' (p. 28)
6. Density of ground vegetation cover	'in general, very low and very high levels of ground vegetation were considered to be negative compared to moderate levels. (p. 33)
7. Number of tree species within stand	'in general, as number of species within the stand increases from one to many, the recreational value increases' (p. 34)
8. Size of clear-cuts	'in general, as size of clear-cuts increases from small to large, the recreational value decreases' (p. 39)
9. Residue from harvesting and thinning	'in general, as volume of tree stumps, branches and other visible woody residue increases from low to high, the recreational value decreases' (p.41)
10. Amount of natural deadwood	'in general, a very low and very high volume of deadwood is seen as negative compared to a moderate amount.'
11. Variation *between* stands along a 5 km trail through forest	'in general, as the number of forest stand types encountered increases from one to many, recreational value increases, although a significant proportion of respondents saw very high or very low variation as negative' (pp. 47-47)
12. 'Naturalness' of forest edges	'in general, as the proportion of 'natural' looking (i.e. not straight) edges increases from low to high, the recreational value increases.' (p. 50)

3. Discussion

This review identified very little published evidence directly regarding stakeholder perceptions of SRF in the UK - just one study of limited quality. Despite this the various related literatures described here can contribute to an understanding of what these perceptions are most likely to be. They provide understanding not only of general silvicultural likes and dislikes, but also knowledge of some of the most probable reasons for opposition to (and support for) the establishment of SRF in the British landscape.

This review identified more than 50 papers and reports constituting evidence from which it is possible to draw tentative conclusions about stakeholder perceptions of SRF in the UK (and a further 40 providing contextual information). The literature regarding perceptions of biomass energy, and the contextual literature on renewable energy, is perhaps the most useful in this regard. However it is important to note that very much of this relates to the generation of electricity, and almost completely misses issues relating to heat generation - a sector in which biomass can be applied with great potential. Consequent limitations of the literature are sometimes very obvious. For example, the finding that Floridans, in need of electricity to cool homes and workplaces, have a higher awareness of solar energy and prefer it for electricity generation (Monroe 2009) is of only limited interest in relation to British and other Northern European stakeholders who are in much greater need of heat energy.

In silvicultural terms, SRF plantations are likely to be most productive in terms of biomass and economic if established on a large-scale, planted densely and in well regimented blocks designed for ease of harvest (i.e. clear-fell by heavy machinery). Furthermore, single species monocultures may offer greatest economic return and a means to ensure biomass fuel standards, and SRF, by definition, maintains woodlands at a 'young' stage. Unfortunately each of these silvicultural and management options seem likely to reduce the aesthetic (and recreational) value of the woodland and thus are likely to be unpopular amongst local stakeholders who view and/or use them. It is unclear if the use of exotic (non-native) species would have an effect on stakeholder perceptions.

Scale, or more precisely perceived scale, is likely to be an important factor influencing stakeholder attitudes towards SRF plantations. One of the central features of opposition to the siting of renewable energy installations has been concern regarding the scale of such facilities. Similar concerns are expressed in relation to planting, where the establishment of large areas of single, or similar, species is generally viewed negatively. Closely linked to these concerns is unease relating to '**industrial**' practices, that is extensive human interference with / management of forests. This might include the regular use of heavy harvesting machinery within plantations and high volumes of road freight of forest product to and from the area.

Local ecological impacts will undoubtedly feature within the debates about SRF plantations, and where these are perceived to be negative they will contribute considerably to opposition. These issues are also likely to encompass discussion of 'naturalness', which is a strong dimension of some stakeholders' decisions not only about which silvicultural options look best, but also whether to oppose or support development of any kind (such as SRF plantations).

The existence, or not, of **local socio-economic practices or institutions** in association with the land and/or forests affected by SRF plantations are very likely to impact upon support for or opposition to them. Examples of potentially likely existing practices are the collection of firewood or non-timber forest products, shooting, walking (recreation), or educational activities. Where these practices are disrupted (whether they are desired by the landowner or not) by SRF establishment, opposition is likely. It may also be that affected land and/or forest has management institutions associated with it. These could range from formalised institutions such as designated nature conservation areas or complex tenure arrangements, through voluntary arrangements such as participation in a deer management group, to informal arrangements such as where a landowner has traditionally allowed access to their land for family, friends and/or the wider community to enjoy and discuss management in everyday socialisation. In each of these cases, a change to SRF, either on the land or on land adjacent, may be less likely than where such practices or institutions are absent.

Whilst there are perhaps few, if any, instances in the UK of a subsistence level connection to forests, it is clear that a broad range of **benefits** can flow from local trees, woods and forests to local communities. Where SRF plantations negatively affect this flow, they are very likely to be opposed. Closely linked to the sorts of local practices and institutions described above through which many benefits are captured, reductions in benefits have the potential to materially affect local quality of life. The literature identifies these concerns as central to opposition to siting of renewable energy installations. One important dimension of these benefits is individual and community sense of 'place', and this can be profoundly affected by local **landscapes**. The literature analysing NIMBYism and siting controversies identifies this set of concerns as, once again, fundamental to opposition where a land use is perceived as degrading a valued or meaningful landscape.

Finally, the prominence of issues relating to trust in the bioenergy siting controversy literature identifies the need to **involve local stakeholders in the decision-making process** from the earliest practical point. It is clear that a great deal of opposition is founded upon dissatisfaction with planning and decision processes, rather than bioenergy *per se*. These can be viewed as undemocratic, but perhaps more importantly strong opposition seems to occur if options are presented as well-developed or even

already decided. This illustrates the folly of a reactive approach to stakeholder engagement. Forest management and planning adopts, in general, a more proactive approach than many others and whilst some may perceive this as presenting vulnerabilities it is likely that it has the capacity to avoid more conflict than it creates.

Whilst factors will vary significantly in accordance with local contexts, in summary, SRF plantations are likely to be opposed by local stakeholders if:

1. they are perceived as large-scale,
2. they damage, or might damage, local ecology,
3. they disrupt established social practices or institutions,
4. they reduce the flow of benefits from local trees, woods and forests to local communities,
5. they require and exhibit 'industrial' management
6. they degrade locally valued or meaningful landscapes ('places')
7. communities are excluded from, or don't participate in, decision-making processes.

This literature review has identified a number of additional factors of importance or interest in relation to the potential establishment of SRF in Britain. First, the **acceptability of SRF**, including *eucalyptus*, **may increase as experience of it grows**, it's use is increasingly recognised, and particularly if the expected environmental problems / impacts do not materialise. Second, ***eucalyptus* is a powerful rhetorical device** in forestry and development debates and this might be used by stakeholders opposing its establishment in Britain. Supporters of SRF need to be aware of this and maintain the focus on the UK where the economic development context differs profoundly from those areas of the globe where *eucalyptus* plantations have been most controversial. Third, ***eucalyptus* debates have focused almost exclusively on negative environmental impacts**, but have not so far considered potential broader environmental benefits, for example those associated with the use of wood for fuel.

This last point raises a key research question: does the evidence indicate that perceptions of SRF would be improved if set explicitly in a renewable energy context? Whilst, once again, there is no evidence related directly to this question, the literature on perceptions of bioenergy strongly suggests that, **given current levels of knowledge and awareness, stakeholders are generally unlikely to understand the connections between SRF plantations and renewable energy**. Low levels of understanding of biomass as a renewable energy source are perhaps not surprising given the range of practices involved (such as cutting down trees, burning and emission of smoke) which are highly symbolic of environmental degradation, and the essential need to conceptualise biomass as part of a sustainable forestry process in order for it indeed to be renewable. Solar and wind generated energy, so-called 'zero-emission'

technologies, have none of these complexities. A substantial amount of innovation and work is required to enable stakeholders to deal with this complexity, although efforts are already being made (see 'Wood for Energy' poster, Forestry Commission England at http://www.forestry.gov.uk/pdf/see-wood-for-energy-poster.pdf/$FILE/see-wood-for-energy-poster.pdf)

4. Conclusions

Current government policy goals seek to substantially increase the generation of energy from biomass as part of achieving national targets for renewable energy. Short-rotation forestry (SRF) is considered to have the potential to contribute significantly to the volumes of biomass required to do this. SRF is not a familiar land-use in the British landscape and experience of it is very limited. Thus research is needed to assess its viability - economically, environmentally, operationally and socially. The purpose of this review is to increase knowledge relating to the social viability of SRF in Britain through an assessment of likely stakeholder perceptions of this land-use.

Virtually no evidence is published relating directly to stakeholder perceptions of SRF in the UK, therefore this review has had to draw on three parallel literatures relating to perceptions of biomass energy, perceptions of *eucalyptus*, and preferences for silvicultural attributes. It is therefore clear that if SRF is to be established in the UK, there exists an urgent need for primary social research to investigate and explain stakeholder perceptions and opinions directly. Such research would need to utilise both quantitative and qualitative methods, and capture perceptions over a meaningful length of time to assess any change.

Having said this, the literature reviewed in this report suggests a number of recommendations to facilitate the establishment of SRF, including the importance of considering its social sustainability.

SRF is perhaps most likely to be accepted in areas (landscapes) where communities are familiar with production economic forestry or energy production (such as coal mining areas or near established power facilities). This is because such communities are most likely to attach certain appropriate meanings to their surrounding landscapes, based on a background understanding of productive or working landscapes. Although this raises significant issues of environmental justice and equity, these could be addressed - indeed well designed and managed SRF plantations might increase the value of these landscapes. Further to this, other communities may accept SRF plantations if they can be made a meaningful and valued part of the landscape.

In order to do provide this meaning or value, **SRF needs to deliver both direct and indirect benefits to local communities**. For example, SRF needs not only to mitigate

climate-change at the national and global levels, but also contribute positively to local residents quality of life through providing a 'place' for recreation and/or accessible and affordable fuel for wood-burners. If SRF can bring employment to the local community, this should be emphasised and prioritised. Absolutely central to this issue is the need to **construct meaning and value within the framework of sustainable forestry**, in order to develop understanding of wood as a renewable energy source - which the literature suggests is currently lacking. This is a complex task and requires significant innovation and effort.

Prior to the establishment of SRF, foresters and landowners needs to **be aware of and consider what socio-economic practices and institutions are present in the local landscape**, and ensure that any SRF establishment either maintains or contributes positively to these. If SRF is likely to impact negatively on established socio-economics, its advocates should, at least, consider how these could be replaced.

In terms of silviculture and forest landscape design, SRF plantations are most likely to be accepted if **a mix of species is planted, in 'patches', at a small or perhaps medium scale**. Planting should be done where ecological damage will not occur or is expected to be at a minimal level. SRF should be established and managed with as **few signs of 'industrial' practices** as feasible, **with particular attention being given to how heavy harvesting and haulage traffic**, if and when needed, **will approach and gain access to and from the plantation**.

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