UK Data Archive

Study Number 6615

Social, economic and environmental implications of increasing rural land under energy crops, 2006-2009

USER GUIDE

RELU street surveys, 2007

Key for inputting collected questionnaire data

Researcher

1 = Jenny
2 = Marie
3 = Alex
4 = Will
5 = Alicia
6 = Sarah
7 = Andrew
8 = Trudie

Date (Write in)

Place

1 = Taunton
2 = Bridgewater
3 = Lincoln
4 = Retford

1) To what extent do you approve of each of these sources being used for electricity production?

a) Biomass
b) Coal
c) Natural Gas
d) Hydroelectric Power
e) Nuclear Power
f) Oil
g) Sun/Solar Power
h) Tidal Power
i) Wind Power

1 = Strong Approval
2 = Slight Approval
3 = No Opinion
4 = Slight Opposition
5 = Strong Opposition
6 = Don't Know

2) Which of these possible sources of energy would you regard as renewable?

a) Biomass
b) Coal
c) Natural Gas
d) Hydroelectric Power
e) Nuclear Power
f) Oil
g) Sun/Solar Power
h) Tidal Power
i) Wind Power

1 = Renewable
2 = Non-renewable
3 = Don't know

3) Which three of these factors are the most important for deciding which methods of electricity production should be used in Britain in the future?

a) First choice
b) Second choice
c) Third choice

1 = Cost to the consumer
2 = Effects on the economy
3 = Effects on the environment
4 = Effects on human health
5 = Effects on the landscape
6 = Helping to prevent climate change
7 = Level of pollution
8 = Reliability of supplies
9 = Safety
10 = None of these
11 = Don't know

4) Have you noticed either of these crops being grown around here?

a) SRC
b) Misc.

1 = Yes
2 = No
3 = Don't Know

5) To what extent do you think SRC would fit into the landscape in this area?

1 = Very Well
2 = Reasonably Well
3 = No Concerns
4 = Some Concerns
5 = Major Concerns
5 = Don't Know

6) To what extent do you think Miscanthus would fit into the landscape in this area?

1 = Very Well
2 = Reasonably Well
3 = No Concerns
4 = Some Concerns
5 = Major Concerns
5 = Don't Know

7) How close to your home would you mind if these crops were grown?

a) SRC
b) Misc.

1= Within the view from your home
2 = On the outskirts of your town/village
3 = >1mile but <5miles form your home
4 = > 5miles but < 10miles form your home
5 = Further away than 10 miles
6 = Should not be grown at all

8) Do you have a favourite local walk in the countryside?

1 = Yes
2 = No

9) How close to your favourite walk do you mind if these crops were being grown?

a) SRC
b) Misc.

1= Alongside the footpath
2 = Within the view you can see
3 = Should not be seen at all
99 =no response (answered no to question 8)

10) How close to your home would you mind if these crops were grown?

a) SRC
b) Misc.

1= Within the view from your home
2 = On the outskirts of your town/village
3 = >1mile but <5miles form your home
4 = > 5miles but < 10miles form your home
5 = Further away than 10 miles
6 = Should not be grown at all

Respondent Characteristics…

Male/female?

1 = Male
2 = Female

How many low energy light bulbs do you have in your home at the moment?

1 = None
2 = 1 - 2
3 = 3 - 5
4 = 6 or more
5 = All lights

Occupation

(Write in)

Home Postcode

(Write in)
99 = missing/respondent would not say

Age group

1 = A: 16 – 19
2 = B: 20 – 24
3 = C: 25 – 34
4 = D: 35 – 44
5 = E: 45 – 54
6 = F: 55 – 64
7 = G: 65 – 74
8 = H: 75 +

RURAL ECONOMY AND LAND USE

University of East Anglia

Public attitudes to biomass energy crops and their visual impacts

Trudie Dockerty, Andrew Lovett, Katy Appleton & Gilla Sünnenberg

RELU BIOMASS SUB-PROJECT REPORT

December 2009

Zuckerman Institute
School of Environmental Sciences
University of East Anglia
Norwich NR4 7TJ

Contact: a.lovett@uea.ac.uk or t.dockerty@uea.ac.uk

PREFACE

This report describes work undertaken to assess public attitudes towards two dedicated biomass crops – *Miscanthus* and Short Rotation Coppice (SRC), particularly regarding their visual impacts in the landscape. The research forms part of the RELU-Biomass project (http://www.relu-biomass.org.uk) which was funded by the Rural Economy and Land Use Programme (RELU) of the UK Research Councils to provide a holistic assessment of the potential impacts of increasing rural land use under energy crops at spatial scales ranging from the site to the region. RELU-Biomass was led by Rothamsted Research and also involved partners at the Centre for Ecology & Hydrology, University of Exeter and The Game and Wildlife Conservation Trust.

The work undertaken within RELU-BIOMASS has included measurements of water use and biodiversity in fields of the crops, as well as farm surveys, and assessments of public acceptability. The results are being used to develop an integrated framework for a Sustainability Appraisal (SA) of conversion of land to perennial energy crops and to provide input into best practice guidance for planting of SRC and *Miscanthus*. RELU-Biomass ran from 2006 - 2009 and focused on two contrasting regions of the UK where SRC and *Miscanthus* are currently being grown – the East Midlands and South West.

This analysis of public attitudes is based upon a public questionnaire survey, focus group meetings with community groups, insights from stakeholder meetings, and interviews with key industry and local government officers. In total the views of over 550 people contribute to the findings.

We are very grateful to all those involved for their time and contribution to this study. Particular thanks are due to Jenny Morley, William Ashley-Cantello, Alicia Gailliez, Sarah Gregg, Alex Jones and Marie Prebble for their contributions to the implementation of the questionnaire survey. We greatly appreciated their hard work, perseverance and cheerfulness during the very wet summer of 2007.

EXECUTIVE SUMMARY

- This report describes work undertaken between 2006 – 2009 in the East Midlands and South West to assess public attitudes towards two dedicated biomass crops – *Miscanthus* and Short Rotation Coppice (SRC), particularly regarding their visual impacts in the landscape.

- This analysis of public attitudes is based upon a public questionnaire survey, focus group meetings with community groups, insights from stakeholder meetings, and interviews with key industry and local government officers. In total the views of over 550 people contribute to the findings.

- The questionnaire survey sought to ascertain the general level of knowledge and approval of various renewable energy sources, understanding of the term 'biomass', and specific knowledge of *Miscanthus* and SRC. Photographs of the crops were used as a visual aid and to gather views on the acceptability of introducing *Miscanthus* and SRC into the local landscape setting.

- The questionnaire survey found that contrary to earlier studies, most members of the public were able to correctly differentiate between renewable and non-renewable fuel sources (though there was some confusion over nuclear power). 68% recognised biomass as a renewable fuel.

- Effect on the environment was the highest ranked factor cited by respondents for deciding which method of electricity production should be used in Britain in the future. (Helping to prevent climate change was ranked third). Impact on the landscape was the least mentioned of nine specific factors.

- From the photographs shown, most survey respondents (>75%) felt that both *Miscanthus* and SRC would fit into the landscape 'very well' or 'reasonably well'. Less than 10% had any concerns at all about SRC but 18% disapproved of *Miscanthus*.

- However few people had direct experience of the crops. Only 32% of respondents were familiar with SRC and only 17% were familiar with *Miscanthus.*

- Despite this, over 60% said they would not mind seeing the crops within the view from their home. However, this percentage halved, when respondents were shown a photograph of a biomass power station and it was explained that for economic reasons biomass would need to be processed and utilised within about a 25 mile radius of where the crops were grown. This indicates that the infrastructure rather than the crops *per se* are likely to attract more public concern.

- Overall, the questionnaire results showed very little difference in support for SRC compared to *Miscanthus* and no significant differences in attitudes to the crops between people from different regions.

- With the small number of photographs included in the questionnaire survey it was difficult to be certain that respondents (most of whom had no direct experience of the crops) could properly appreciate the full visual and landscape characteristics of the biomass crops which are much taller, grown densely and harvested at a different time of year to conventional crops.

- With the aim of providing a broader representation of possible visual impacts, GIS-based computer generated real-time landscape models and other computer generated static images were produced and used alongside photographs in more in-depth interviews and focus groups.

- Some difficulty was encountered in recruiting participants for focus group meetings, particularly in the East Midlands, perhaps reflecting the low level of concern for potential landscape impacts, as indicated by the questionnaire survey.

- Meetings attendees were shown crop photographs plus computer generated images including above-ground views of different planting patterns and areas, and ground-level visualisations along footpaths and illustrating different widths of field margin. In addition, they were shown photographs and given information about the infrastructure associated with different potential end uses for the crop (co-firing in coal fired power stations; dedicated biomass power stations, and small-scale biomass boiler units) and a local example was presented showing the land-take needed to produce sufficient crop yield to supply a power station capable of meeting the needs of the local community.

- Both concerns and positive comments were recorded during the meetings. Overall, most people declined to express a view, indicating perhaps, limited knowledge of and exposure to the crops (as found in the questionnaire survey). The most commonly expressed concerns related to increased lorry movements, loss of view and the 'food versus fuel' land-take issue. The sole benefit expressed was that in some circumstances, the new crops might improve diversity within the landscape.

- In terms of landscape management, dispersed or random planting patterns of small fields were preferred to planting of large blocks in adjacent fields. The 10 m margin was more popular than the 4 m margin. In terms of end use, of the views expressed, most were in favour of small-scale boilers and CHP units over the other end uses. However, these views were expressed by only a small number of participants and so cannot be regarded as statistically meaningful.

- Overall, although the visualisations were welcomed and undoubtedly helpful, the majority of people interviewed in this study had little personal experience of either crop. More work would therefore be beneficial to evaluate whether the visualisations provide an accurate reflection of the true nature of the crops.

- Based on the evidence from this study, and given the caveat that there was limited personal experience of the crops, it appears unlikely that wide-scale planting of biomass crops will give rise to any substantial public concern in relation to their visual impact in the landscape.

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1. INTRODUCTION

1.1 Background

Perennial biomass crops such as Short Rotation Coppice Willow (SRC) and *Miscanthus* grass can be used as a fuel to generate heat or electricity. They represent a form of renewable energy generation and have been identified as one of a range of measures to meet national and international targets for reduced greenhouse gas emissions (Royal Commission on Environmental Pollution, 2004; UN-Energy, 2007; HM Government, 2009). The UK Biomass Strategy in 2007 estimated that there were up to 15,500 ha of SRC and *Miscanthus* planted in the country and suggested that there was the potential for the area of perennial energy crops to expand to 350,000 ha by 2020 (Defra, DTI and DfT, 2007). This latter total could translate to planting on around 10 % of arable land in some regions. However, crops such as SRC and *Miscanthus* are physically different to most current rural land uses; they are in place for 7-25 years, harvest is normally early spring (February-March) and they are dense and tall (3-4 m). These factors mean that expansion in planting has the potential to modify the rural landscape, with particular implications for visual appearance, cultural heritage, tourism, farm incomes, hydrology and biodiversity (Upreti, 2004; Rowe et al., 2009; Haughton et al., 2009). Such issues are of interest to a range of government agencies and NGOs, and have stimulated discussion regarding the development of planning policies and tools to maximise the benefits of planting (e.g. English Heritage, 2006; Defra, 2004, 2007).

Previous studies in the UK have often found that there is a poor public understanding of terms such as 'renewable energy' or 'biomass'. For instance, a MORI (2004) poll for Regen SW of 218 residents of Devon found that 52 % had never heard of biomass power. The DTI (2003a, 2003b) funded two studies, each with a considerable sample size, to assess knowledge and awareness. The first study collated data from 20 discussion groups across England, Scotland and Wales, held both near renewable energy schemes and in locations without renewable energy. The second study involved face-to-face home-based interviews of 1,279 people, again across England, Scotland and Wales, with a further 'boost' sample of 528 people living within 5 km of a renewable energy scheme. Both studies found low awareness of 'renewable energy' in their samples and even less understanding of the term 'biomass'. The first study (DTI, 2003a) found that even people living in proximity to biomass plants were unfamiliar with the term and suggested that participants found it difficult to distinguish between biomass and incineration. More generally, there was a strong tendency for greater knowledge of a renewable energy technology to be associated with a higher opinion of it. Solar power was rated highest of nine generation technologies on both scales, while biomass was placed lowest in each case (DTI, 2003a, p.44).

Several proposals to construct biomass power plants have attracted strong local opposition (Upreti, 2004; Upham and Shackley, 2006; Devine-Wright, 2007) and issues of public acceptability will clearly be important if energy generation from crops such as SRC and *Miscanthus* is to become more common in the UK.

1.2 Aims

The overall aim of the studies described in this report was to provide data on the public acceptability of the two biomass crops that could be used in the Sustainability Appraisal that is a key integrative output of the overall RELU-BIOMASS project.

In addition, the UEA researchers undertaking the work were interested in increasing their understanding of public reactions to photographic and computer-generated visualisations of potential landscape changes. The past decade or so has seen considerable developments in the technical capability to generate such visualisations (Lovett, Appleton and Jones 2009), but there are substantial gaps in understanding of how best to use them in different communication and decision-making contexts.

1.3 Output

The project proposal specified the following outputs:

"The production of landscape visualisations showing the impact of different planting scenarios and assessment of the public acceptability of such activities". (W.5.iv)

The production of the visualisations is described in Chapter 3. The broader assessment of public acceptability is provided by this report as a whole.

2. THE QUESTIONNAIRE SURVEY

2.1 Aim

The project proposal stated:

"In the first year of the project the current awareness and opinions of the general public regarding energy crops will be elicited via an initial street survey in a variety of city or market town locations in each region. We will aim to obtain the views of a stratified cross-section of at least 100 respondents in each region. The questionnaire will probe attitudes towards renewable energy, include views on photos of energy crops and ask about whether such planting would change resident's satisfaction with their neighbourhood as a place to live".

The questionnaire survey took place in town centres within the East Midlands and South West where SRC and *Miscanthus* are grown in the surrounding areas.

The particular objectives of this work were to:

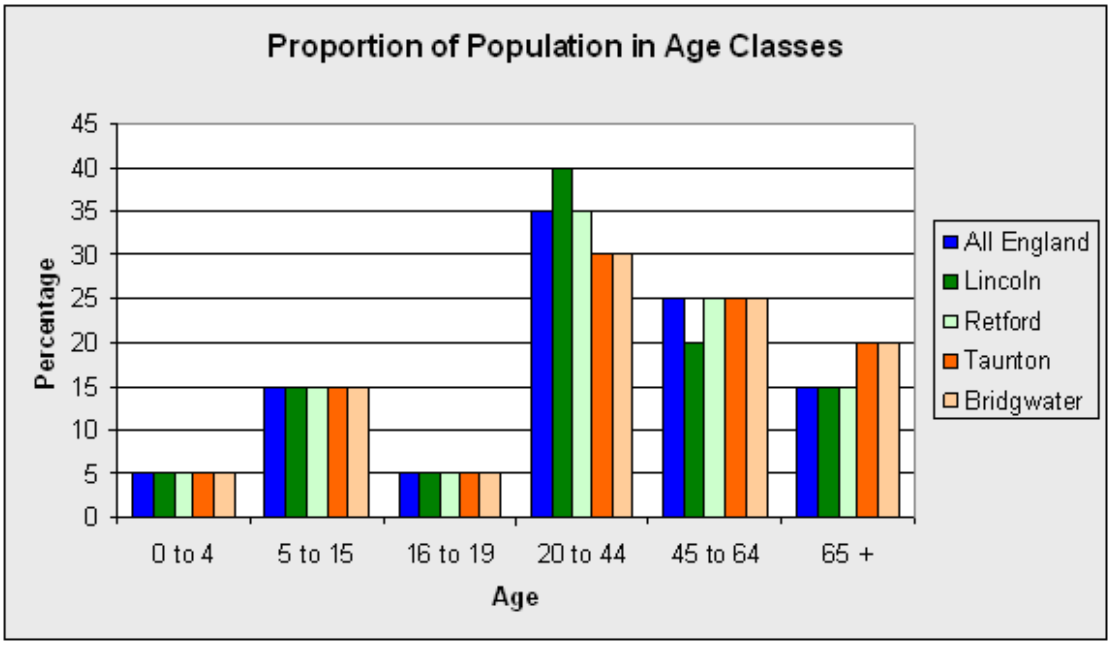
- Compare knowledge and attitudes regarding different methods of energy generation in these localities with previous results from national surveys
- Assess the extent of public awareness of biomass crop planting in the surrounding areas and attitudes towards the visual appearance of SRC and *Miscanthus*
- Examine whether attitudes towards the crops changed when a link with the presence of a nearby biomass power station was made more explicit.

2.2 Method

The content of the questionnaire was devised in consultation with our RELU-Biomass project colleagues and Advisory Group members. It included certain questions that had been asked in a national 2005 UEA/MORI survey on energy options in Britain (MORI, 2005; Poortinga et al., 2006) in order to allow a comparison with that study. The survey was designed to be conducted in the street and therefore needed to take no more than about 5 minutes. Most of the questions involved selection from a set of possible responses and sets of photographs were used to show the appearance of SRC, *Miscanthus* and a biomass power station. The answer choices and photographs were contained in a booklet with plastic-covered sheets which was given to respondents while the survey was conducted. The questions and booklet layout were street tested in a pilot exercise in advance of the main survey.

Two urban centres (one larger and one smaller in size) were selected for survey in each region. These were Lincoln and Retford in the East Midlands and Taunton and Bridgwater in the South West. Figure 1 compares the population age classes in the survey locations against the average for England in 2001. All the locations were reasonably representative of the national average; Lincoln had a slightly higher than average proportion of young adults (20 – 44) and the South West centres had a higher than average proportion of older people.

FIGURE 1: POPULATION COMPOSITION OF SURVEY LOCATIONS



Source: 2001 Census statistics, (http://neighbourhood.statistics.gov.uk).

A target was set to survey a cross-section of 100 respondents in each urban centre. Local authority statistics were examined prior to the survey to derive target numbers of survey respondents in eight age/gender categories.

In accordance with good survey practice, advance notice was given to Town Centre Managers and local Police authorities of the nature, duration and location of the survey. Six undergraduate students at UEA were recruited to assist two members of the RELU-Biomass project team with the survey. These student assistants took part in a training session prior to the survey where they practiced asking and answering the questionnaire, which helped to further refine the final format of the survey documents. They were also given a personal safety briefing. As there are representatives from so many different organisations in town centres trying to extract information, and often money, from members of the public, the survey team members all wore hi-viz jackets clearly printed with 'university survey', to reassure and encourage people to participate.

The surveys took place in June 2007. Each centre was surveyed for two days with the team members locating themselves at different points in the main shopping streets from around 9.30 am to 4.30 pm. Members of the public were asked to participate in the survey as they walked past and once a person had agreed to do so they were handed the booklet containing photographs and answer cards. The survey team member then led them through the questions and recorded their answers (see Figure 2). As the survey progressed in each location efforts were made to target sections of the population that were under-represented in the sample, though it was inevitably difficult to achieve the exact proportions calculated from the census data.

FIGURE 2: QUESTIONNAIRE SURVEY IN PROGRESS

A full copy of the questionnaire, photographs and answer cards is given in Appendix 1 of his report. An initial screening question was asked to eliminate those people who did not live within 25 miles of the survey location as the objective was to assess local opinion. The questions posed and response categories are listed in Table 1. A minimal number of questions were asked at the end of the questionnaire to record respondent characteristics. These are shown in Table 2. We wanted to include a question to help gauge the level of environmental awareness of respondents and decided on a measure of 'energy awareness' represented by the number/proportion of low energy light bulbs in the home (none, some, or all).

TABLE 1: CONTENTS OF THE QUESTIONNAIRE

Q1: These are all sources of electricity generation in Britain. To what extent do you approve of each of these sources being used for electricity production?

Biomass (e.g. wood, energy crops, straw, chicken litter)	Coal	Natural Gas	Hydroelectric Power (generated from flowing water	Oil	Sun/Solar Power	Tidal Power (generated from the movement of the tides)	Wind Power

Strong Approval	Slight Approval	No Opinion	Slight Opposition	Strong Opposition	Don't Know

Q2: Renewable energy comes from sources that are regenerated naturally more quickly than they are being consumed. Which of these possible sources of electricity would you regard as renewable?

Biomass (e.g. wood, energy crops, straw, chicken litter)	Coal	Natural Gas	Hydroelectric Power (generated from flowing water	Oil	Sun/Solar Power	Tidal Power (generated from the movement of the tides)	Wind Power

Renewable	Non-Renewable	Don't Know

Q3: Government, industry and environmental groups are currently thinking about how Britain should generate electricity in the future. In your opinion, which THREE of these factors, are the most important for deciding which methods of electricity production should be used in Britain in the future? Please read out the letters which apply to your 1st, 2nd and 3rd choices.

A	Cost to the consumer	G	Level of pollution
B	Effects on the economy	H	Reliability of supplies
C	Effects on the environment	I	Safety
D	Effects on human health	J	None of these
E	Effects on the landscape	K	Don't know
F	Helping to prevent climate change		

Q4: Here are some pictures of two new energy crops - Short Rotation Coppice and *Miscanthus*. These can be cut and processed into fuel pellets and used for heat or electricity generation. They are now being grown in several parts of Britain. Have you noticed either of these crops being grown around here?

	Yes	No	Don't Know
Short Rotation Coppice			
Miscanthus			

Q5: Here are some photos of Short Rotation Coppice in a landscape setting. To what extent do you think Short Rotation Coppice would fit into the landscape in this area?

Q6: Here are some photos of *Miscanthus* in a landscape setting. To what extent do you think *Miscanthus* would fit into the landscape in this area?

Very Well	Reasonably Well	No Concerns	Some Concerns	Major Concerns	Don't Know

Q7: How close to your home would you mind if these crops were grown? (7a) SRC (7b) *MISCANTHUS*

a) within the view from your home		d) more than 5 miles away but less than 10 miles from your home
b) on the outskirts of your town or village		e) further away than 10 miles
c) more than 1 mile away but less than 5 miles from your home		f) should not be grown at all

Q8: Do you have a favourite local walk in the countryside? Yes / No if yes -

Q9: How close to your favourite walk would you mind these crops being grown? (9a) SRC (9b) *MISCANTHUS*

a) alongside the footpath
b) within the view you can see
c) should not be seen at all

Q10: This is a biomass power station [show picture]. To make it cost effective to produce electricity from biomass crops, the crops can only be transported up to 25 miles - so the power station would need to be situated within the area where the crops are grown. How close to your home would you mind if these crops were grown?
(10b) SRC (10a) *MISCANTHUS*

a) within the view from your home		d) more than 5 miles away but less than 10 miles from your home
b) on the outskirts of your town or village		e) further away than 10 miles
c) more than 1 mile away but less than 5 miles from your home		f) should not be grown at all

TABLE 2: RESPONDENT CHARACTERISTICS RECORDED

Q: Gender: Male / Female

Q: "Energy Awareness": (Derived from number of low energy light bulbs in the home)

None	1 or 2	3 to 5	6 or more	all lights

Q: Occupation: (SOC classes)

Higher managerial and professional occupations	Routine occupations
Lower managerial and professional occupations	Never worked/long-term unemployed
Intermediate occupations	Student
Small employers and own account workers	Housewife/parent
Lower supervisory and technical occupations	Retired
Semi-routine occupations	

Q: Home postcode [quality control check]

Q: Age Class

16 - 19	20 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 - 74	75+

2.2.1 Sample Characteristics

No methodological problems were reported during the conduct of the survey. In total, 490 complete questionnaires were obtained, exceeding our target of 100 respondents from each location. The data were entered into an Excel spreadsheet and SPSS software was subsequently used to produce tabulations and conduct statistical analyses.

Table 3 shows that we did not entirely match our age-class targets. In all locations the 16-19 and 45-64 age groups were over-represented, while the 20-44 and over 65 age groups were under-represented. Nevertheless, the overall age distribution pattern is generally preserved. The gender balance of respondents was 49.2 % male 50.8 % female.

TABLE 3: TARGET AND ACTUAL AGE CLASSES OF RESPONDENTS IN EACH SURVEY AREA

Age	Lincoln Target %	Lincoln Actual % (n=117)	Retford Target %	Retford Actual % (n=130)	Taunton Target %	Taunton Actual % (n=126)	Bridgwater Target %	Bridgwater Actual % (n=117)
16 to 19	6	11	6	8	6	12	6	12
20 to 44	50	41	44	38	40	36	40	33
45 to 64	24	31	30	36	30	33	30	36
65 +	20	17	20	19	24	19	24	20
Total	100	100	100	100	100	100	100	100

The occupational information from respondents was classified according to the National Statistics Socio-economic Classification (ONS, 2005). Occupation classes and a comparison with regional data from the 2001 Census data and a recent National Labour Force Survey (Hall, 2006) are shown in Table 4. Perhaps unsurprisingly for a day-time street-based survey, our respondents included a slightly higher proportion of non-working people than are represented in the general population and a lower proportion of working people. However, the details in Tables 3 and 4 do suggest that a reasonable cross-section of the population was surveyed in each location.

TABLE 4: OCCUPATIONAL CLASSIFICATION OF SURVEY RESPONDENTS

Occupation Category	This Survey	East Midlands 2001 Census	South West 2001 Census	National Labour Force Survey 2005
	%	%	%	%
1. Higher managerial and professional occupations	8.4	7.4	7.7	11.1
2. Lower managerial and professional occupations	12.2	17.2	18.7	22.4
3. Intermediate occupations	8.6	8.6	9.1	10.0
4. Small employers and own account workers	5.7	6.9	8.8	7.6
5. Lower supervisory and technical occupations	1.4	8.1	7.6	9.1
6. Semi-routine occupations	11.0	12.5	12.3	12.8
7. Routine occupations	5.1	11.6	8.9	9.3
8. Never worked/long-term unemployed	6.3	3.1	2.2	3.8
9. Student	14.1 }	}	}	}
10. Housewife/parent	4.1 } 41.3	} 24.7 *	} 24.8 *	} 13.7 *
11. Retired	23.1 }	}	}	}

* Full-time students and unclassified (including retired, people looking after the home, long-term sick and disabled).

2.3 Results

Chi-square statistics were calculated (e.g. see Lovett, 2005) to assess whether answers to individual question varied according to respondent characteristics such as gender, age group, occupation, location and energy awareness (i.e. number of low-energy light bulbs). In the presentation of results that follows such variations are only mentioned when the chi-square test indicated a difference in responses that was statistically significant at the 95 % confidence level.

2.3.1 Approval of Electricity Sources

Table 5 shows the level of approval for each source of electricity generation across all locations. It indicates a high level of support for biomass and other renewable fuels. Those people who knew biomass is renewable were mostly likely to strongly or slightly approve of using it as a fuel, whereas respondents who thought it was not renewable were most likely to be opposed to using it. Men and those in the 45-64 age group were most likely to approve of biomass, as were full-time students and those in lower managerial and professional occupations.

TABLE 5: RESPONSES TO Q1: THESE ARE ALL SOURCES OF ELECTRICITY GENERATION IN BRITAIN. TO WHAT EXTENT DO YOU APPROVE OF EACH OF THESE SOURCES BEING USED FOR ELECTRICITY PRODUCTION?

	Strong Approval	Slight Approval	No Opinion	Slight Opposition	Strong Opposition	Don't Know	Missing Values	Total %
A) Biomass	38.0 (18)	28.0 (36)	9.2 (17)	7.2 (6)	5.9 (2)	11.7 (19)		100
B) Coal	12.7 (7)	27.8 (31)	8.2 (24)	27.2 (25)	22.3 (8)	1.8 (3)		100
C) Natural Gas	22.9 (10)	35.2 (45)	12.7 (21)	20.2 (14)	7.2 (4)	1.8 (3)		100
D) Hydro Power	77.3 (36)	13.7 (40)	2.2 (11)	3.1 (2)	1.6 (1)	2.0 (10)		100
E) Nuclear	19.4 (9)	17.0 (27)	7.4 (22)	15.1 (20)	36.8 (17)	4.3 (7)		100
F) Oil	7.0 (6)	20.7 (33)	11.2 (22)	32.3 (25)	26.6 (8)	2.2 (4)		100
G) Sun/Solar	80.4 (55)	13.5 (32)	2.4 (6)	2.0 (2)	0.8 (1)	0.6 (2)	0.2	100
H) Tidal Power	75.3 (n/a)	16.8 (n/a)	3.5 (n/a)	1.8 (n/a)	1.0 (n/a)	1.6 (n/a)		100
I) Wind Power	69.1 (50)	18.6 (31)	3.1 (8)	3.9 (5)	4.3 (2)	1.0 (2)		100

Note: Values are percentages. Figures in brackets are from Q3 in the 2005 UEA/MORI survey. Categories in this survey were: very favourable, mainly favourable, neither favourable nor unfavourable, mainly unfavourable, very unfavourable, never heard of it/no opinion/don't know.

2.3.2 Renewable Sources of Electricity

Contrary to earlier studies (e.g. DTI, 2003a; 2003b) the great majority of respondents were able to correctly differentiate between renewable and non-renewable fuel sources. The easiest to identify were sun/solar, tidal, wind and hydroelectric power; more than 88 % of respondents correctly identified each of these as renewable. Biomass was correctly identified as renewable by 68 %, with men more likely to know this than women, as were those in the 45-64 age group. Over 75 % of respondents categorised the three fossil-fuel sources as non-renewable. The most confusion surrounded nuclear power with 28 % thinking it renewable, 46 % non-renewable, and 26 % saying they didn't know – the largest undecided proportion in all of the choices presented.

2.3.3 Methods of Electricity Generation

The factors that people selected as most important for deciding which methods of electricity production should be used in Britain in the future are summarised in Table 6. Findings from the 2005 UEA/MORI survey are also given for comparison.

TABLE 6: RESPONSES TO Q3: WHICH THREE FACTORS ARE MOST IMPORTANT FOR DECIDING WHICH METHODS OF ELECTRICITY PRODUCTION SHOULD BE USED IN BRITAIN IN THE FUTURE?

	Factor	1ST choice	2nd choice	3rd choice	Total Mentions	Percentage of all mentions	Rank	UEA/MORI Survey Rank *
A	Cost to the consumer	79	29	55	163	11.1	4	5
B	Effects on the economy	14	27	28	69	4.7		
C	Effects on the environment	164	114	69	347	23.6	1	2
D	Effects on human health	71	114	75	260	17.7	2	1
E	Effects on the landscape	4	17	33	54	3.7		
F	Helping to prevent climate change	60	58	69	187	12.7	3	3
G	Level of pollution	30	50	79	159	10.8	5	4
H	Reliability of supplies	29	38	34	101	6.9	7	7
I	Safety	34	36	40	110	7.5	6	6
J	None of these	3	1	1	5	0.3		
K	Don't know	1	1	0	2	0.1		
	Missing Values	1	5	7	13	0.9		
	Total	490	490	490	1470	100.0		

Note: * Q6 in the UEA/ MORI survey.

Effect on the environment was the most mentioned factor (by women slightly more than men and particularly those in the 25-44 age group). This was followed by effects on health, helping to prevent climate change and then cost to the consumer. However, in terms of first choices, cost was mentioned more often than effects on health or climate change prevention. More women than men and those in the 45-64 age group thought that helping to prevent climate change was important, whereas men were more concerned about reliability of supply. Cost was a bigger concern than other issues for those in the over 65 age group. Interestingly, in relation to biomass crops, impact on the landscape was the least mentioned of the nine specific factors.

2.3.4 Public Responses to SRC and Miscanthus

Awareness of Short Rotation Coppice or *Miscanthus* being grown in the areas around the survey locations was generally low. The majority of people questioned were not aware of either crop growing in the vicinity, although more had noticed SRC (32.2 %) than *Miscanthus* (17.6 %). Men, those aged over 45 or those in lower managerial and professional occupations were more likely to have noticed the crops than women or those under 45. Respondents in the East Midlands were more likely to have seen SRC, whilst those in the South West were more likely to have noticed *Miscanthus*, reflecting regional differences in the relative abundances of the crops. A significantly

higher than expected number of people living in Retford had seen SRC, and similarly more respondents in Taunton were aware of *Miscanthus* in the area. Whether a crop had been previously noticed or not had no statistically significant influence on approval of biomass as an energy source in responses to Question 1 in the survey.

Table 7 indicates that when shown pictures of the biomass crops in landscape settings, most people (particularly women) thought that they would fit into the local landscape very well or reasonably well. (SRC 86.7 %: *Miscanthus* 75.1 %). Those who were in favour of biomass for electricity production, and middle age groups were most approving, whilst those over 65 had a higher than expected level of concern. Those classed as 'energy aware' (defined as having all or nearly-all low energy light bulbs in their homes) were more likely to express the opinion that they thought *Miscanthus* would fit into the landscape very or reasonably well.

TABLE 7: RESPONSES TO Q5 AND Q6: TO WHAT EXTENT WOULD SRC OR MISCANTHUS FIT INTO THE LOCAL LANDSCAPE?

	Very Well %	Reasonably Well %	No Concerns %	Some Concerns %	Major Concerns %	Don't Know %
Short Rotation Coppice	55.5	31.2	5.1	4.5	3.1	0.6
Miscanthus	42.2	32.9	5.9	15.5	2.9	0.6

There were some differences in responses depending on whether people had noticed the crops growing locally. Those who had noticed SRC were significantly more likely to say that it fitted into the landscape very well. A similar trend was apparent for *Miscanthus*, but the difference in response was not statistically significant at 95 % confidence.

When presented with the landscape views showing the crops, the majority of respondents said they would not mind seeing SRC and *Miscanthus* (68.2 % and 64.9 % respectively), within the view from their home. Another 19.6 % (SRC) and 20.4 % (*Miscanthus*) approved of the crops being visible on the outskirts of their town or village. Again, approval was greatest from those who supported biomass as an energy source and the 25 – 44 and 45 – 64 age groups.

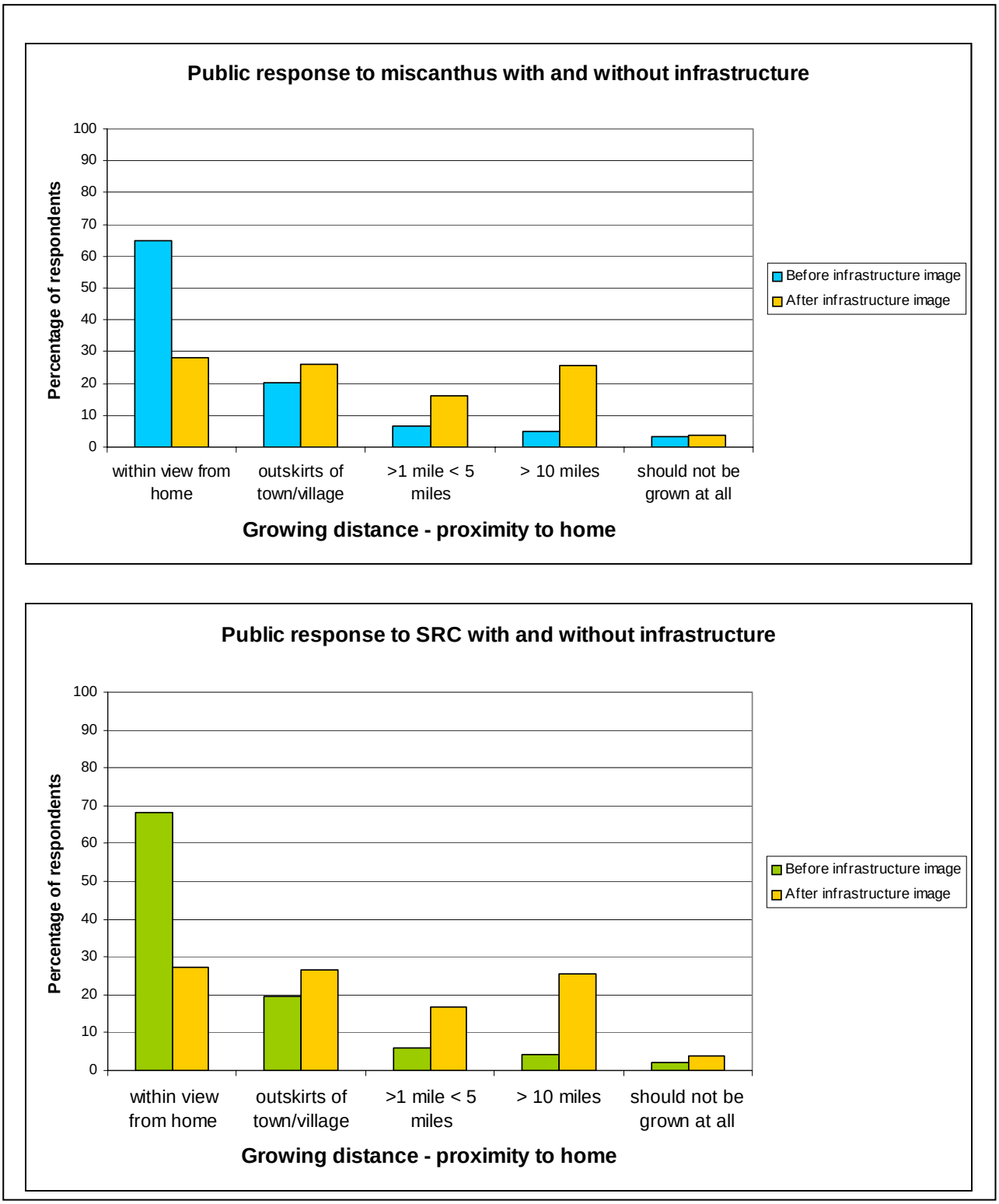
Respondents were asked if they had a favourite local walk, and those that did (70.4 % of survey participants) were asked to picture SRC and *Miscanthus* in its vicinity. Again, the majority (and particularly biomass supporters) said they would not mind if SRC or *Miscanthus* were grown alongside the footpath (60.4 %; 56.0 %) or within the view (31.3 %; 33.7 %).

2.3.5 Responses to Power Generation Infrastructure

Following presentation of a photograph showing a biomass power station (see Appendix) and explanation that for economic reasons biomass would need to be processed and utilised within about a 25 mile radius of where the crops are grown, respondents were again asked how close to their homes they would mind if SRC and *Miscanthus* were grown. The answers indicated that rather fewer people were willing to have SRC and *Miscanthus* within the view from their home (27.4 %; 28.3 %), or on the outskirts of their town or village (26.6 %; 26.0 %).

Figure 3 illustrates the distribution of responses before and after presentation of the power station view. Those that thought that the crops should be grown more than 10 miles away from their homes increased from 4.1 % to 24.8 % for SRC and 4.9 % to 25.8 % for *Miscanthus*. Over 45 % of those who originally said they wouldn't mind biomass crops within the view of their home were in the highest 'energy awareness' class, but even these people exhibited a similar degree of negative response towards power generation infrastructure, as did those who supported biomass as an energy source (strong approval and slight approval classes).

FIGURE 3: CHANGES IN RESPONSES FOLLOWING PRESENTATION OF POWER STATION INFRASTRUCTURE



2.4 Discussion

The survey respondents were encouragingly 'energy aware'. Nearly 24 % said they only used low energy bulbs in their homes, 59.8 % had some low energy bulbs and only 16.3 % had none. Contrary to the findings of earlier studies (DTI 2003b, McGowan and Sauter 2005) respondents were also knowledgeable in distinguishing renewable from non-renewable fuel sources, suggesting a growing awareness of energy issues in recent years. Participants in the survey were also

generally supportive of biomass crops as a fuel source with 66 % showing strong or slight approval (Table 5). In the 2005 UEA/MORI national survey based on 1,491 interviews only 54 % of respondents considered energy production from biomass crops 'very favourable' or 'mainly favourable' (Table 5).

Our survey results were, however, similar to the UEA/MORI poll in terms of the most important factors to consider when deciding which future methods of electricity production should be used in Britain. In our study effect on the environment received the highest number of mentions followed by the effect on human health. These top two were reversed in the UEA/MORI poll. Helping to prevent climate change was ranked third in both studies. Cost to the consumer and pollution were fourth and fifth but in opposite order, whilst safety and reliability of supply were ranked 6th and 7th.

Overall, the questionnaire results showed very little difference in support for SRC compared to *Miscanthus* and no significant differences in attitudes to the crops between people from different regions. Although relatively few people had direct experience of either crop, of those that did, respondents in the East Midlands were more familiar with SRC and those in the South West with *Miscanthus*, reflecting where these crops are more common.

The overwhelming positive response of those who said they would not mind if SRC or *Miscanthus* were grown within the view, or along the footpath, of their favourite local walk, might actually raise concerns that respondents may not have fully appreciated the visual impact these tall and densely grown crops can have at ground level. We took considerable care over the selection of photographs used in the survey (e.g. including views with people or vehicles to give a sense of scale), but it was difficult to evaluate whether respondents were able to accurately assess the potential impact of these crops on landscape and views from the images presented.

Potential limitations in understanding could also have influenced the initially strong level of support for growing SRC or *Miscanthus* within view of home or on the outskirts of respondents' villages or towns. However, response to the power-generating infrastructure that could accompany the crops was striking with a distinct shift in preference towards planting in more distant locations, even from those who strongly approved of biomass as an energy source. We did not have the opportunity in the questionnaire to examine responses to small-scale, more localised combined heat/power plants such as farm-scale generating units, and therefore made this one focus of the follow-up interviews and focus group meetings.

2.5 Conclusions

The results of this questionnaire survey indicate that there were many positive public attitudes towards planting of biomass crops as a renewable source of energy. It needs to be acknowledged that it is difficult to ascertain if the photographs shown to respondents were sufficient for them to fully appreciate the characteristics of the crops concerned, and whether other visualisation methods or indeed props such as a potted-up, full-height, real example of each plant would have produced alternative opinions. It is also relevant to note that there might be some change in opinions if the survey was repeated now, given recent public debate concerning the potential conflict between land use for food crops versus biofuel production, and the fact that questions relating to this were not included in the survey. Nevertheless, response to a single image of the potential large-scale power generation infrastructure that could accompany the widespread planting of biomass crops was unmistakably negative and it is likely to be this, rather than landscape or other concerns, which will need to be addressed if public support for biomass crops is to be developed. Attitudes towards other generation options, such as smaller combined heat/power units, were examined through the focus groups (see chapter 4).

3. PRODUCTION AND USE OF LANDSCAPE VISUALISATIONS

3.1 Reasons for using visualisations

Information presented in a visual form is processed and absorbed by the human brain much more efficiently than textual, numerical or even diagrammatic data (Tufte 1992) and offers great potential for facilitating stakeholder participation in decision-making processes (Bishop and Lange, 2005; Lovett and Appleton, 2008). Developments in computer software and graphics capabilities mean that it is now possible to generate static images and real-time models (so-called because the user can change their viewpoint at will) representing real and geographically accurate places and portray them as they are now, as they were in the past, or as they might be in the future. One use of such is to depict 'scenarios' that visualise the various possible outcomes of future policy options, acting as a focus to help stakeholders and decision makers better understand and evaluate the potential consequences of policy choices.

The overall objective of the RELU-BIOMASS project was to provide a holistic assessment of the potential impacts of increasing rural land use under energy crops at spatial scales ranging from the site to the region. Achieving this objective required the development of an integrated framework for Sustainability Appraisal (SA). The SA itself involved stakeholders in both study regions, who set the objectives and indicators used to assess sustainability for a set of theoretical 'scenarios' concerning various degrees of expansion in the planting of biomass crops. These scenarios and listed in Table 8 and form the basis for a number of the visualisations produced and used in the research. A full account of the development of the SA is given in Dockerty et al. (2009). See Bond et al. (2009) for the SA itself.

TABLE 8: SCENARIOS USED FOR ASSESSING SUSTAINABILITY APPRAISAL

EAST MIDLANDS SCENARIOS	**SOUTH WEST SCENARIOS**
1: TOTAL LAND COVER: 50/50 SRC/*Miscanthus*	**1: TOTAL LAND COVER: Monocrop *Miscanthus***
1a) "Suitable" 72,000 Ha of SRC and *Miscanthus* planting	1a) "Suitable" 43,000 Ha of *Miscanthus* planting
1b) "Minimum" 18,000 Ha of SRC and *Miscanthus* planting	1b) "Minimum" 18,000 Ha of *Miscanthus* planting
1c) "Extreme" 200,000 Ha of SRC and *Miscanthus* planting	1c) "Extreme" 130,000 Ha of *Miscanthus* planting
2: BIOMASS END USE	**2: BIOMASS END USE**
2a) Small-scale CHP	2a) Small-scale CHP
2b) Large-scale co-firing	2b) Large-scale co-firing
2c) Dedicated Biomass	2c) Dedicated Biomass
3: CROP MANAGEMENT/FIELD DISTRIBUTION PATTERN: (no mixing of SRC/*Miscanthus* on any individual farm)	**3: CROP MANAGEMENT/FIELD DISTRIBUTION PATTERN:**
i) Heavily aggregated	i) Heavily aggregated
ii) Realistic scenario (based on current pattern)	ii) Realistic scenario (based on current pattern)
iii) Evenly spread across the landscape	iii) Evenly spread across the landscape
4: CROP MANAGEMENT: HEADLAND USE	**4: CROP MANAGEMENT: HEADLAND USE**
a) 4m field margins	a) 4m field margins
b) 10m field margins	b) 10m field margins

The questionnaire survey (discussed in Chapter 2), interviews and focus group meetings (discussed in the following chapter) were all designed to elicit views that would enable us to evaluate the public acceptability of the various elements of these scenarios and help inform the SA. Specifically, views were sought on the level of planting that would be acceptable, how it is distributed in the landscape and at field scale, and how the crops are eventually used.

In the questionnaire survey we included photographs of the crops in various settings for people to comment on. For the focus group meetings and interviews, a number of different visualisations were produced, including panoramic photographs of the crops at different times of year (Figure 4), GIS–based 'real-time' landscape models showing *Miscanthus* planting scenarios for areas in the South West and East Midlands, and computer generated still images views representing airborne views of different planting scenarios and ground level illustrations of different field margin widths for both *Miscanthus* and SRC in the East Midlands. The methods used to produce these visualisations are described in the next section.

FIGURE 4: VIEWS OF MISCANTHUS FIELD IN THE SOUTH WEST IN JUNE AND NOVEMBER

June

November

3.2 Methods used to construct visualisations

The preliminary stage of the work involved assessing different means of generating visualisations. Three main software tools that can produce real-time landscape models were compared. These were 1) the 3D Analyst extension of ArcGIS, 2) Visual Nature Studio (VNS) with Scene Express extension and the NatureView Express (NVE) and Virtual Terrain Project (VTP) Enviro viewers and 3) the Lenné3D Player (see Table 9 for further details). This selection represented a range from a general-purpose GIS, through a commercial landscape visualisation product capable of generating a wide variety of outputs, to research software designed specifically for real-time capabilities. The following section describes the selection of a pilot area, together with the data sources and methods used to produce visualisations. This is followed by presentation of some example views and an evaluation of the outputs achieved.

3.2.1 Selection of pilot area for visualisations

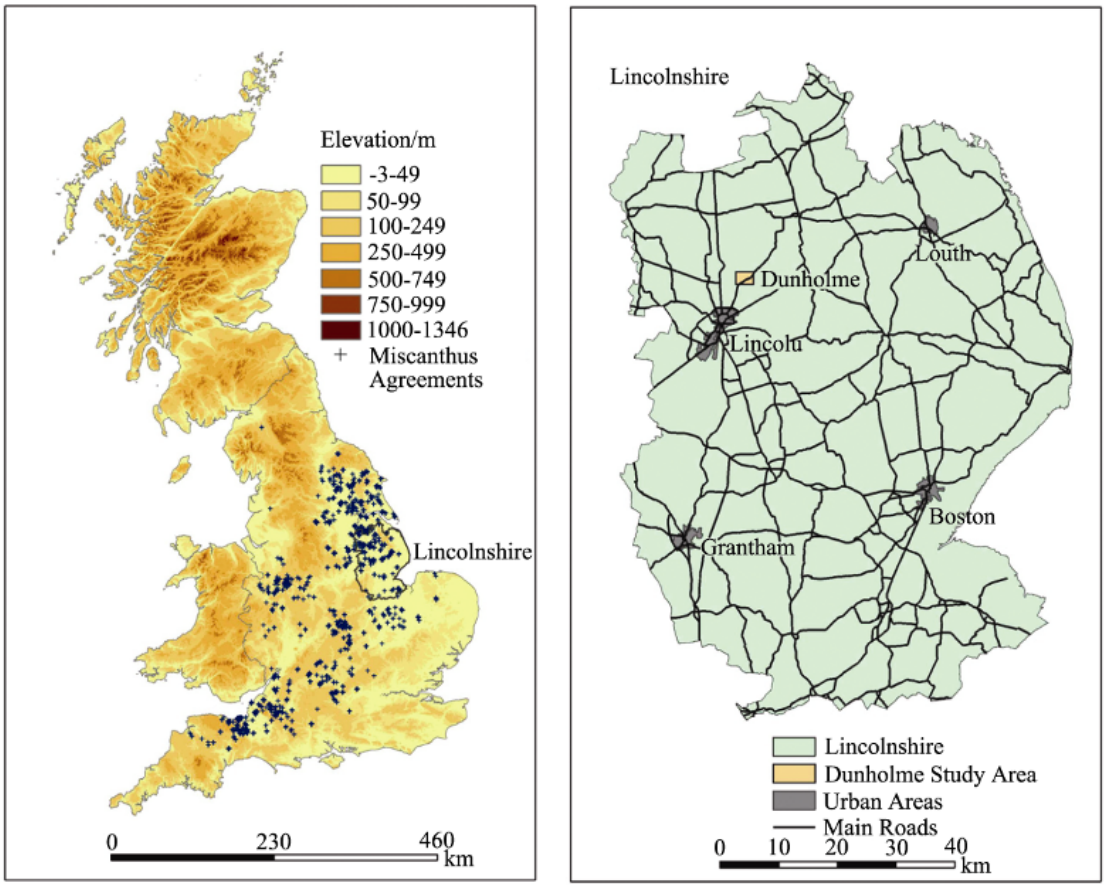
In order to evaluate the capabilities of different visualisation tools it was decided to generate a range of example outputs for a pilot area. Information on *Miscanthus* planting grants approved under the Energy Crops Scheme (Natural England 2007) from 2001 to mid 2006 was used to identify a number of possible locations for visualisation and these were then visited. As a result of this exercise a site near the village of Dunholme in Lincolnshire (see Figure 5) was selected for visualisation. Under the grant scheme, applications were approved to establish over 160 hectares of *Miscanthus* during 2007 which would have covered many of the fields to the south and west of the village. In the event, site visits in July and November 2007 indicated that no planting had taken place (probably due to increases in prices for conventional arable crops) so there was an opportunity to collect information on the existing land uses and visualise how the area would change with different amounts of *Miscanthus* being grown.

TABLE 9: URLS FOR DATA SOURCES AND SOFTWARE

Data	URL
Bluesky Imagery	http://www.bluesky-world.com/
Flora3D plant models	http://www.lenne3d.com
NEXTMap Britain DEM	http://www.bluesky-world.com/dem-nextmap.html
OS MasterMap	http://www.ordnancesurvey.co.uk/osmastermap/

Software	URL
ArcGIS 9.2	http://www.esri.com/software/arcgis/index.html
ArcGIS 3D Analyst 9.2	http://www.esri.com/software/arcgis/extensions/3danalyst/index.html
Deep Exploration	http://www.righthemisphere.com/products/dexp/de_std.html
Hawth's Analysis Tools	http://www.spatialecology.com/htools/index.php
Lenné3D Player	http://www.lenne3d.com
ModelBuilder3D	http://www.presagis.com/products/multigen_paradigm/details/creator/
NatureView Express	http://3dnature.com/nv.html
oikPC	http://www.lenne3d.com
Polytrans	http://www.okino.com/conv
Scene Express	http://3dnature.com/scene.html
Visual Nature Studio	http://3dnature.com/vnsinfo.html
VTP Enviro	http://www.vterrain.org/
Xfrog	http://www.xfrog.com

FIGURE 5: LOCATION OF *MISCANTHUS* PLANTING AGREEMENTS AND THE DUNHOLME STUDY AREA



3.2.2 Data sources

An initial 3 by 2 km study area was defined to cover the village and fields extending to the south and west. Digital data assembled for this area included a 5 m resolution NEXTMap Britain DEM, a 25 cm Bluesky orthophoto (taken on 15th June 2003) and Ordnance Survey MasterMap vector mapping. Attributes from the MasterMap data were combined in ArcGIS 9.2 to produce a polygon land cover layer and information on the specific crops being grown in 2007 was added to this. Details of tree positions and hedgerows were digitized from the orthophoto and photos taken during site visits were used to create billboard and texture images for relevant vegetation. Other visits were made to sites where *Miscanthus* is already grown to obtain photos of the crop.
A variety of 3D building models for the area were created by combining polygon footprints extracted from the MasterMap data with textures and height details from photos taken during field visits. The building models were generated in ModelBuilder3D (a subset of MultiGen-Paradigm Creator) and then converted from OpenFlight to 3D Studio format using Deep Exploration and Polytrans. Further details of the source data and software used are available via the URLs in Table 9.

For the purposes of comparing the software tools it was decided to focus on creating visualisations for a smaller area covering 1,400 m by 1,400 m on the western side of Dunholme. Figure 6 shows this square against a background of the 2003 orthophoto. A hatched area represents a potential 10 ha field of *Miscanthus*. It is common to establish *Miscanthus* at a density of two plants per m^2 so a 10 ha field would be equivalent to 200,000 plants. Three viewpoints are also marked and these were used to generate sets of comparative images.

FIGURE 6: THE DUNHOLME VISUALISATION AREA AND VIEWPOINTS

3.2.3 Visualisation results

The visualisations were all created on PCs with at least a 1 GHz processor, 1 Gb RAM and a graphics card with 256 Mb memory. There are trade-offs between the different types of software used, particularly regarding the realism with which vegetation is represented, the amount of detail

that can be shown and scope for real-time navigation around a landscape (see Lovett et al., 2009a and Lovett, Appleton and Jones 2009 for further details).

Figures 7 to 10 show a series of photos and visualisations of the study area. An aerial overview looking towards Dunholme is shown in Figure 7 and illustrates the relatively flat and open nature of the landscape. Figure 8 contains a panoramic ground level photo (approximately 135 degrees) looking from VP1 towards Dunholme. The photos constituting this panorama were taken in July 2007 and show a field of wheat between the viewpoint and the village. Under the visualized planting scenario the *Miscanthus* would be grown at the far end of this field.

FIGURE 7: AERIAL VIEW OF THE DUNHOLME AREA PRODUCED USING THE 3D-PLAYER

FIGURE 8: PANORAMIC PHOTO LOOKING NORTH EAST TOWARDS DUNHOLME FROM VIEW POINT 1, JULY 2007

A set of example visualisations looking north from VP3 across the *Miscanthus* crop is shown in Figure 9. The top left-hand image is a still rendered with VNS and was produced as a reference to illustrate the highest levels of feature detail that could be anticipated. Each of the other four images is a screenshot or rendered view from a real-time model and so allows comparison of their capabilities. Overall the results indicate significant contrasts in visual appearance, highlighting the differences between the systems and the subjectivities involved in creating the visualisations.

Close-up visualisations of the *Miscanthus* crop are presented in Figure 10. As with Figure 9, the top-left image is a still rendered from VNS and the remaining four are from the real-time models. With respect to the representation of vegetation, one clear difference is that the 3D-Player model is the only one that could display plants in the buffer strip around the *Miscanthus* with similar detail to the still render. In the other three models this area has a rather bare appearance which varies according to how the ground texture image is handled. Further discussion of the differences between these visualisation systems and outputs is given in Lovett et al. (2009a).

FIGURE 9: EXAMPLE VISUALISATIONS FROM VIEW POINT 3

Left: Reference still image (Visual Nature Studio)

Below left: 3D-Player

Below right: ArcGlobe

Bottom left: VTP Enviro

Bottom right: Nature View Express

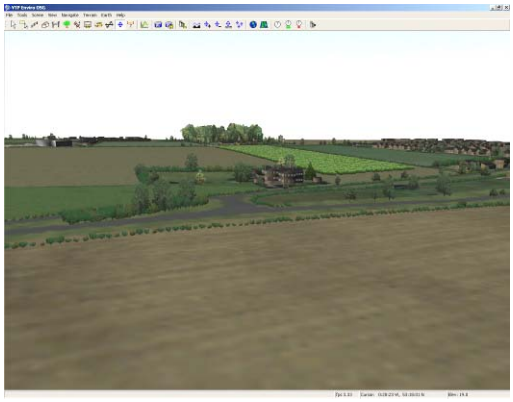


FIGURE 10: EXAMPLE VISUALISATIONS FROM VP2

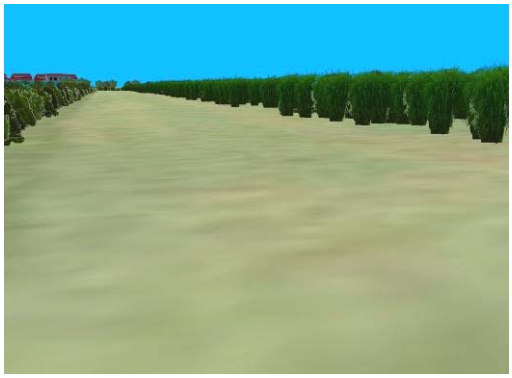
Left: Reference still image (Visual Nature Studio)

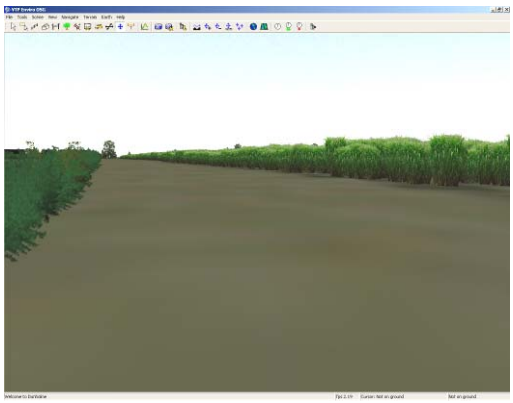
Below left: 3D-Player

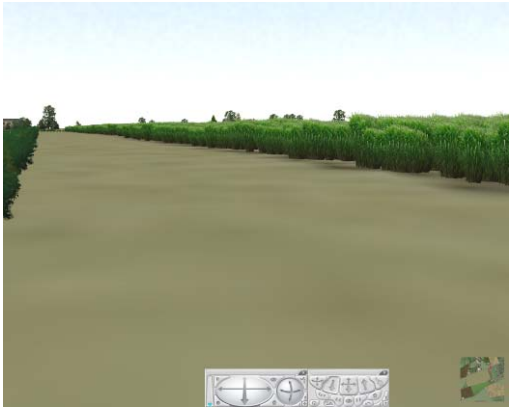
Below right: ArcGlobe

Bottom left: VTP Enviro

Bottom right: Nature View Express







3.2.4 Conclusions from the pilot exercise

The experience gained in the pilot exercise suggested that there would be advantages in using several types of computer-generated visualisations in subsequent stages of the research. Real-time models have the benefit that they can provide an overview of a landscape which people can navigate around and this degree of interactivity is particularly valuable for public displays (e.g. it attracts interest from a passing potential audience). On the other hand, it is difficult with most systems to include large amounts of ground detail and given the focus of the research on biomass crops this was an important consideration. Rendered still images do not have the same constraint on detail and can be readily used to depict different scenarios from the same viewpoint. Switching between scenarios is quite possible in real-time models, but invariably involves some pause in display while new data are loaded and also requires more in the way of computing resources to run effectively. For many of the interviews and public events images it was concluded that it would be necessary to have output that could be displayed from a laptop, so primary reliance was placed on sets of rendered still images, with use of real-time models limited to either displays of the general landscape context or public events where it was practical to transport specialised equipment from

UEA. One example of the latter was at the British Association Festival of Science in York during September 2007 where a real-time model based on a subset of the Dunholme data was shown on an Elumens VisionStation as part of a wider display on the RELU-Biomass project. Figure 11 shows the setup used, which attracted considerable public and media interest during the event.

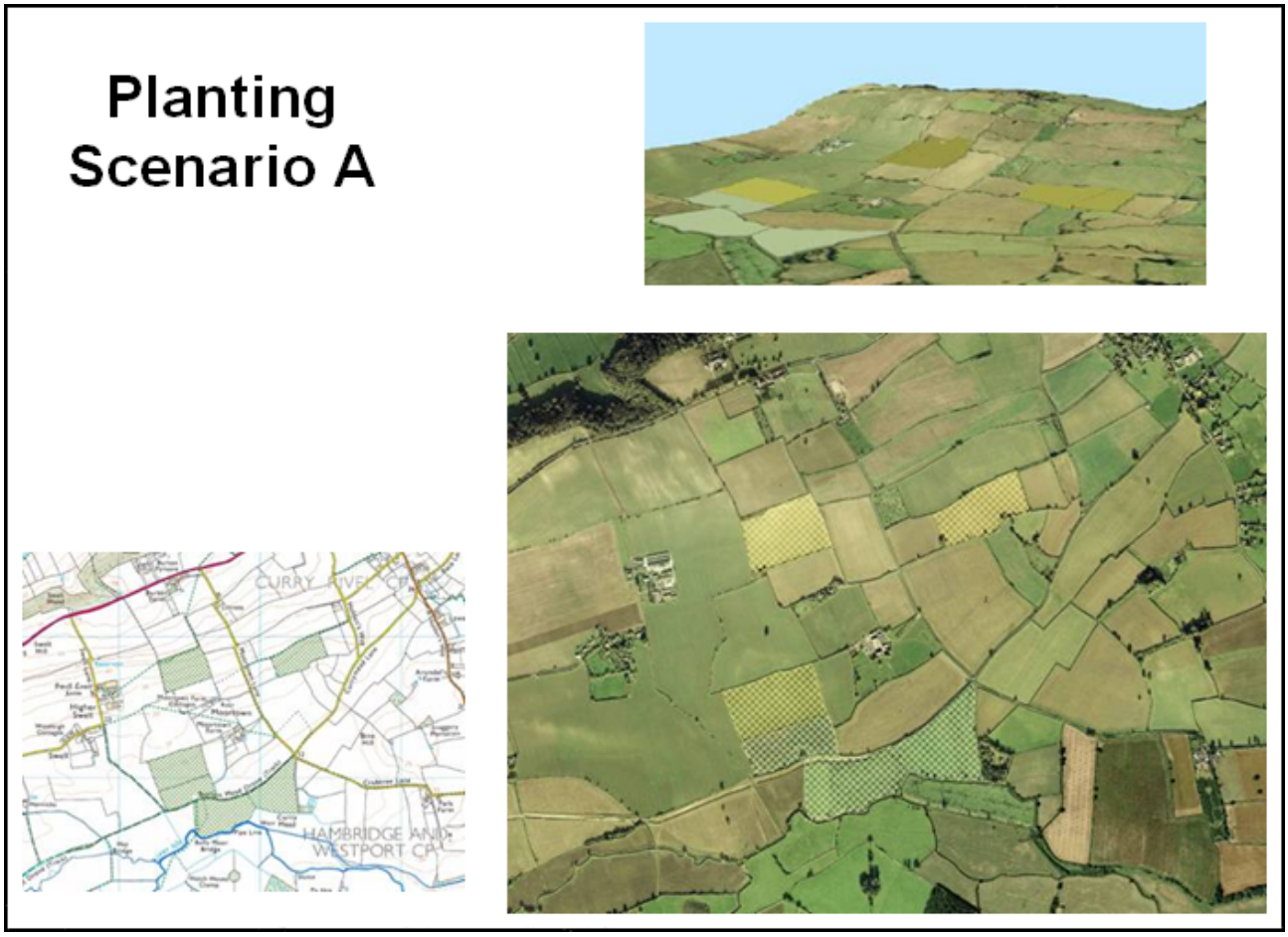
FIGURE 11: REAL-TIME LANDSCAPE MODEL AS PART OF DISPLAY AT THE BRITISH ASSOCIATION FESTIVAL OF SCIENCE, YORK, SEPTEMBER 2007

3.3 Visualisations used in the interviews and focus groups

Visualisations of biomass crops were created for three study sites. In addition to Dunholme, these were of *Miscanthus* at Moortown, Somerset and SRC at Laneham, Nottinghamshire. In both of the latter two sites some planting already existed nearby, but information from approved Energy Crop Scheme grants indicated where further expansion might take place so there was at least a potential basis for the scenarios depicted.

GIS databases were created for Moortown and Laneham using similar data sources and techniques to those described for Dunholme in Section 3.2.2. The visualisation products generated varied between sites. For Moortown they included maps and simple 'image drape' 3D views of planting scenarios that could be displayed on Powerpoint slides (see example in Figure 12). The range of outputs from Dunholme was more extensive and included VNS-generated still images providing 'bird's eye' and ground level views of planting scenarios, as well as a NatureView Express real-time model with Miscanthus in part of one field close to the village. Visualisations for Laneham concentrated on ground-level views and showed how the existing view along a public footpath might change as new SRC planting matured. Examples of a number of these visualisation outputs are included in the next chapter.

FIGURE 12: EXAMPLE OF MAP AND 3D VIEW OUTPUT USED TO REPRESENT MOORTOWN PLANTING SCENARIOS



3.4 Summary

This chapter has described and evaluated some of the different techniques used to produce computer-generated visualisations of biomass crops. Examples of different types of visualisations have been presented and the approach adopted in different study areas has been outlined. The following chapter explains in more detail how the visualisation outputs were used in interview and focus group settings.

4. FOCUS GROUPS AND INTERVIEWS

4.1 Aim

The project proposal stated:

"During the second year of the research we intend to carry out baseline focus groups with residents in areas where planting is planned but has not yet happened (one per region). These sessions will explore current knowledge and attitudes regarding energy crops, as well as perceptions regarding the prospective visual impacts. Preparatory fieldwork (e.g. obtaining vegetation and landscape photos) for the production of GIS-based 3D visualisations of planting scenarios will also be carried out during this period".

"The third year of the project will see a return, post-planting, focus group in each of the communities who were visited pre-planting. These sessions will concentrate on comparing current attitudes and perceptions with those expressed previously (particularly as landscape change is most marked during the establishment phase of energy crops). In addition, four further focus groups (two in each region) will be carried out in parishes where farmers are (1) currently growing or (ii) have land potentially suitable for growing energy crops. These discussions will consider local planting scenarios and include interactive displays of the visual appearance as well as information on economic, biodiversity and hydrological factors (based on findings from other parts of the overall project). The aim will be to identify thresholds in the extent and nature of planting considered publically acceptable, evaluate the tradeoffs that residents make between visual and other factors, and to assess the merits and limitations of using interactive visualisations to present information on energy crop planting schemes".

In actuality, these original ideals were constrained by real world events. As mentioned in the previous chapter, preliminary investigations had revealed a good level of applications for planting grants through the Energy Crop Scheme (Natural England 2007), and access to data on planting applications allowed us to gain an insight into where planting of biomass crops might take place (Figure 5). It was envisaged that this knowledge would allow us to identify suitable study areas and communities for this part of the public acceptability work.

However, many of the approved planting grants were never taken up as farmers chose instead to take advantage of record prices for wheat in 2007. This made it much more difficult to identify suitable 'pre' and 'post' planting study areas in the way originally envisaged. In addition to high wheat prices, the focus group exercise also took place during a time where oil prices reached record highs, with economic knock-on effects forcing food shortages in some parts of the developing world and a general questioning of the sustainability of using crops and land for fuel production giving rise to considerable heated 'food versus fuel' debate in the press. Concerns were raised by some of the organisations we spoke to, that given this setting, public meetings discussing the acceptability of biomass crops, (even though in relation to landscape issues and not food crop displacement) might undermine their efforts to promote local renewable energy projects. Due to such issues and sensitivities, we decided to modify our aims and undertake more general meetings and interviews not linked to specific locations that might prove inflammatory, but which would still add to overall understanding regarding the public acceptability of biomass crops in the landscape.

4.2 Approach

Our approach to identifying individuals and organisations that might be willing to facilitate and help organise a series of public meetings was necessarily undertaken by first approaching local government officers and other agencies for contacts, rather than making direct invitations through the media to the public.

Email requests for help in targeting potential communities or groups (e.g. Parish Councils and other rural community groups) were made to initial contacts in local government or other relevant agencies and, in a number of cases, circulated onward to a variety of community groups. Unfortunately, this was not met with a great deal of enthusiasm (particularly in the East Midlands).

We nevertheless managed to instigate meetings with representatives of 5 organisations with an interest in biomass crops and landscape in the East Midlands and 6 organisations (including two community groups) in the South West. The number of people interviewed or entering into discussion via focus groups totalled 11 in the East Midlands and 44 in the South West. (Appendix 2 Table A, gives a summary of meetings held and Table B gives a list of other organisations approached directly but does not include recipients of forwarded requests which increased the total number of individuals and organisations approached considerably).

Attendees of the meetings were shown a Powerpoint presentation introducing the project, including images of the two biomass crops (*Miscanthus* and Short-Rotation Coppice) in close-up and in a landscape setting (the same images used in the street-based questionnaire survey that took place the previous summer to ensure comparability), and in winter and summer. They were asked similar questions about the acceptability of the crops in these settings. (Figure 13).

FIGURE 13: MEETING HELD WITH SOUTH PETHERTON TRANSITION TOWN GROUP

The main findings of the street survey undertaken in 2007 were that people in general made very few negative comments about the possible introduction of *Miscanthus* and SRC into the landscape. However, as noted previously, relatively few people had direct experience of either crop and there was some uncertainty that respondents fully appreciated the visual impact these tall and densely grown crops can have at ground level.

In the follow-up series of meetings, in addition to the photographs used in the questionnaire survey, participants were shown 'bird's eye' computer-generated visualisations of landscapes within the relevant region depicting different scales and distributions of biomass crops to try to convey the landscape change that would be brought about by increased areas of planting. Figure 14 shows a set of five examples for Dunholme starting with a baseline (Summer 2007) view, then three different configuration with 40 ha of *Miscanthus* and finally one with 100 ha of biomass. These images were accompanied by maps (as in Figure 12) showing a plan view of each planting scheme

Participants were also shown visualisations along a public footpath (Figure 15 shows an example for SRC planting) and further ground-level images representing the impact of changing field margin widths (as might possibly occur under future agri-environment schemes, see Figure 16).

Photographs and descriptions of the infrastructure associated with different potential end uses for the biomass crops (co-firing in coal fired power stations; dedicated biomass power stations, and small-scale biomass boiler units) were also shown and in each region a local example was presented showing the land-take needed to produce sufficient crop yield to supply a power station capable of meeting the needs of the local community (see example in Figure 17). These latter results were based on analysis in Lovett et al. (2009b), a GIS-based constraints mapping exercise to identify suitable land for growing *Miscanthus*.

4.3 Findings

Tables 10 and 11 summarise the key issues encountered during the discussions, listing concerns raised in relation to each crop, also positive comments, and preferences in relation to planting scenarios, field margin width and method of power generation. The values are the number of times each issue was mentioned; only a single time in the majority of cases. In general, most people appeared to have very little to say on the issue, reflecting perhaps, limited exposure to and knowledge of the crops (as found in the previous questionnaire survey). *Miscanthus* produced a wider range of concerns than SRC (26 issues raised with a total of 46 mentions), but we spoke to more people about this crop. (Particularly in the two focus groups held in the South West).

Only four concerns were raised about SRC, and three of these were also raised in relation to the production of *Miscanthus*: - increased lorry movements, loss of view and the 'food versus fuel' land-take issue.

The sole benefit mentioned in relation to SRC in the East Midlands was that it might enhance landscape and this was also raised with regard to *Miscanthus* in the South West. Only in the South West were comments made about the potential contribution of energy crops to renewable energy targets, with one person saying "*The landscape issues shouldn't get in the way of the positive renewable energy aspects".*

In Somerset (where the focus of our study had been on increased planting of *Miscanthus* as an energy crop) the most frequently raised issue was why *Miscanthus* was being considered as a crop for this area, when it had a historical link with willow production (formerly for basket making, fencing etc). It was suggested that SRC might be more appropriate or that local focus should be on utilising existing wood fuel through better woodland management where there would be little or no implications for landscape change. In addition, there was some concern that wide-scale planting of *Miscanthus* would lead to a reduction in soil fertility.

FIGURE 14: VNS IMAGES USED TO REPRESENT DIFFERENT PLANTING DISTRIBUTIONS

FIGURE 15: VNS IMAGES OF VIEWS ALONG A PUBLIC BYWAY AT LANEHAM, EAST MIDLANDS

Present view (NB: SRC > 1 year old)

View with mature SRC and 10m field margins

View with mature SRC and 4m field margins

FIGURE 16: VNS IMAGES DEPICTING CHANGES IN FIELD MARGIN WIDTH

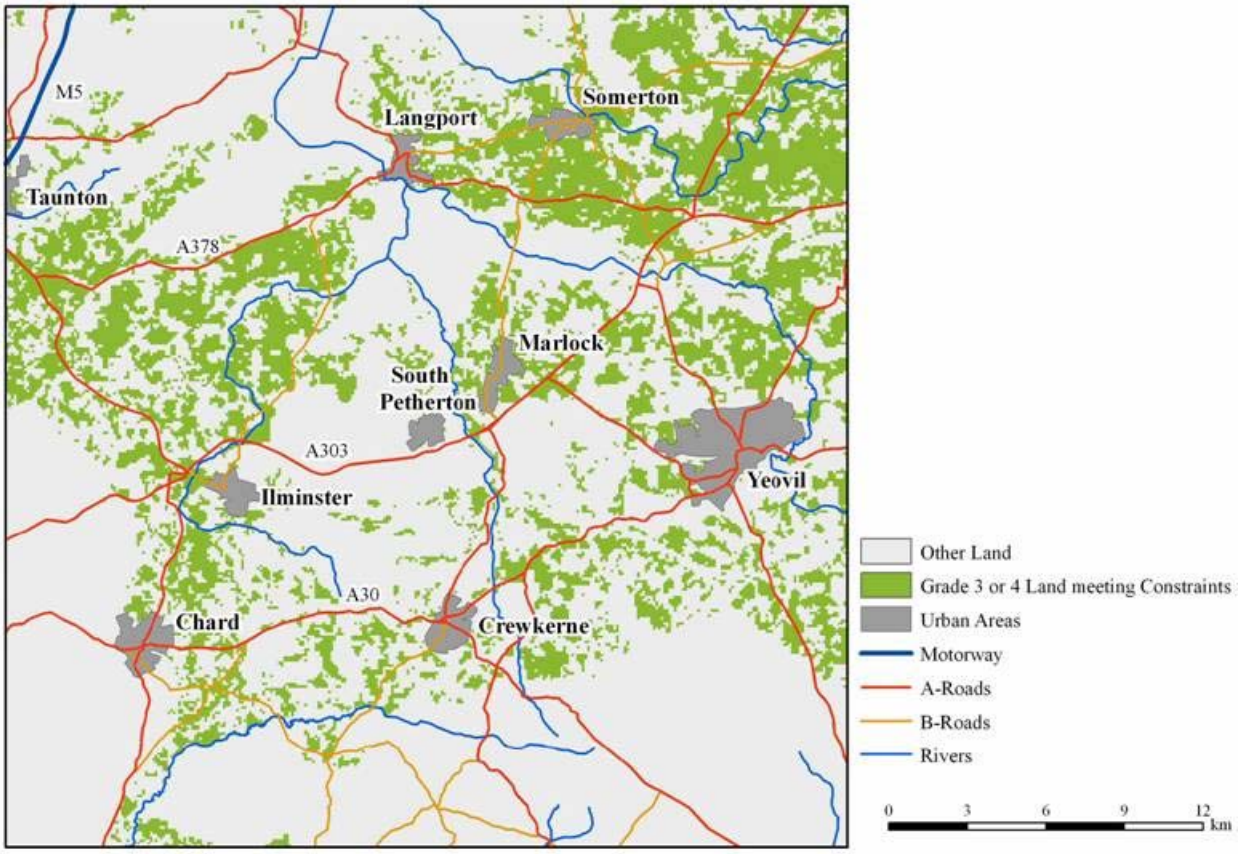
10m field margin -

4m field margin -

10m field margin –

4m field margin

FIGURE 17: EXAMPLE OF LAND SUITABLE FOR BIOMASS CROPS COMPARED WITH ENERGY NEEDS



Implications for Ilminster:
Approximately 18,000 ha of potential land within 10 miles.
To provide combined heat and power for 2,100 households would need ~ 2,000 ha of Miscanthus.
For heat alone ~1,200 ha of Miscanthus (but also requires boilers in individual houses).

Implications for South Petherton:
Approximately 24,000 ha of potential land within 10 miles.
To provide combined heat and power for 1,400 households would need ~ 1,300 ha of Miscanthus.
For heat alone ~750 ha of Miscanthus (but also requires boilers in individual houses).

In terms of landscape management, dispersed or random planting patterns of small fields were preferred to planting in large blocks of adjacent fields. The 10 m field margin received the highest voiced support (mostly in relation to possible biodiversity benefits), though there were some who thought that margins were unnecessary – "*If you've lost the long view it doesn't matter much about the width of the margin*" and other comments that wide margins next to roads might be a hazard for wildlife or encourage unwanted use e.g. by gypsies.

In terms of end use, of the few views expressed, most were in favour of small-scale boilers and CHP units. One said *"In the East Midlands co-firing will prevail but there is a lot of interest in small scale boilers for schools and communities"*. Another said *"people will like the idea of crops grown locally being used locally".* However, a more sceptical view from the South West was "*If it's expensive to install and not a lot cheaper to run we wouldn't want it. It wouldn't be worth ruining the landscape for*".

TABLE 10: *MISCANTHUS*: KEY POINTS RAISED IN INTERVIEW AND FOCUS GROUP DISCUSSIONS

SA	MISCANTHUS	NUMBER OF MENTIONS										
Objective	Region	East Midlands				South West						
	Meeting Reference	A	B	C	D	E	F	G	H	I	J	TOTAL
	CONCERN RAISED											
N	Increased number of lorry movements					1			1		1	3
N	Mud on roads during harvest								2			2
J	Water runoff on roads/ in watercourses during harvest								2			2
	Rustling noise from crop								1			1
	'Alien' appearance							1	1			2
	Winter appearance looks like an abandoned crop									1		1
	Conspicuous in landscape								1	2		3
	Wind blown crop debris (sharp leaves and stems)								1			1
F	No local energy production scheme						1		1			2
N	Unsuitability of transport distance to nearest co-firing facility (Aberthaw = 100 miles)						1		1			2
	Local focus should be on utilising existing wood fuel through better woodland management (no landscape change implications)							1	1	2		4
	Instead of planting Miscanthus make use of biomass from other crops – why isn't Somerset growing traditional willow? (for fuel)							1		2		3
D	Potential for interference with Rights of Way								1			1
A	Potential for roots to damage archaeological remains								1			1
H	*Miscanthus* should not be planted in areas of high landscape sensitivity / value e.g. some areas of National Parks and AONBs.								1			1
S	Loss of best/most versatile agricultural land and its use for food production (Food v Fuel)							1	1		1	3
	"It is a strategic mistake to use land for this purpose"											
D/H/R	From footpath level it obscures the view							2		1		3
D/R	You would not want it near footpaths or houses (obscures the view)							1		1		2
D/R	There wouldn't be any pleasure in walking along a footpath through it									1		1
L	Soil depletion							1		2		3
	"*Growing Miscanthus year on year with no fertilisers will progressively strip potash, nitrogen, phosphate from the soil. How long can you continue mining your land in this way without depleting the soils? Don't want to end up with barren land*"											
K	Depletion of water tables										1	1
	End-user concern regarding reliability of supplies of biomass and securing a long-term fuel supply (how sensitive is land use to price fluctuations for different crops)					1						1
	End-user concern about what local people will think of large-scale planting					1						1
	On poorer soils it may not produce the yields					1						1

	promised in trials											
	Large-scale infrastructure associated with production		1									1
	BENEFIT RAISED											
F	Could make a modest contribution to renewable energy								1	1		2
H	Better than having oilseed rape in the landscape							1	1			2
H	Enhances landscape diversity							1				1
H	Enhances winter landscape diversity and appearance *"it looks like a reed bed"*							1		1		2
	"The landscape issues shouldn't get in the way of the positive renewable energy aspects"									1		1
	PREFERRED PLANTING SCENARIO											
	A – random						1					1
	B – concentrated											
	C – dispersed						1		1			2
	Small fields/blocks would be best							1		1		2
	D – random 2 x area of A											
	"It would depend on the region it's in – big blocks would probably be OK in East Anglia – a more mosaic like spread is needed in Somerset"											
	PREFERRED MARGINS											
	A – No margin							1		1		2
	"If you've lost the long view it doesn't matter much about the width of the margin"											
	B – 4m Margin											
	C – 10m Margin						2		1	1		4
	PREFERRED END USE											
	C0-firing											
	Dedicated biomass											
	CHP						1					1
	Small-scale Boilers						1					1
	"If it's expensive to install and not a lot cheaper to run we wouldn't want it. It wouldn't be worth ruining the landscape for it".											

TABLE 11: SHORT ROTATION COPPICE: KEY POINTS RAISED IN INTERVIEW AND FOCUS GROUP DISCUSSIONS

SA	SHORT ROTATION COPPICE	NUMBER OF MENTIONS									
Objective	Region	East Midllands				South West					
	Meeting Reference	A	B	C	D	E	F	G	H	I	TOTAL
	CONCERN RAISED										
B	Impact of harvesting in Jan/Feb on birds that are using SRC for roosting/shelter.			1							1
D/H/R	Loss of view			1							1
S	Food vs fuel				1						1
N	Lorry movements				1						1
	"people are only alarmed when it gets cut down as it's seen as trees"										
	"In terms of environmental impact much depends on what the energy crop replaces"										
	BENEFIT RAISED										
H	This landscape was really bleak before SRC – so it is an improvement			1							1
	PREFERRED PLANTING SCENARIO										
	A – random			1							1
	B – concentrated										
	C – dispersed			1							1
	D – random 2 x area of A										
	"Scenarios A & B add interest to the landscape but with C the landscape becomes simplified again" [NB: the higher proportion of biomass in the landscape the more simplified it will become regardless of layout]										
	PREFERRED MARGINS										
	A – No margin										
	B – 4m Margin			1							1
	C – 10m Margin										
	"It's the landscape features that define the landscape, not the crop. 4m stand-off is sufficient".										
	PREFERRED END USE										
	COF			1							1
	"In the East Midlands co-firing will prevail but there is a lot of interest in small scale boilers from schools and communities"										
	BIO										
	CHP										
	Small-scale boilers			1					1		2
	"People will like the idea of crops grown locally being used locally".										

4.4 Discussion

It is interesting to note that many of the issues raised in the interviews and meetings coincided with those identified by stakeholders in the development of the Sustainability Appraisal. Table 12 gives the list of objectives drawn together at stakeholder meetings and with further input from project researchers and Advisory Group members. The first column of Tables 10 and 11 indicates to

which objective a particular comment relates. The affirmation of issues of importance arising from these meetings and interviews provides further confidence that the scope of the Sustainability Appraisal has been appropriately specified.

TABLE 12: OBJECTIVES FOR SUSTAINABILITY APPRAISAL OF BIOMASS PLANTING IDENTIFIED IN RELU-BIOMASS STAKEHOLDER MEETINGS

Objective:-
A SAFEGUARD THE HISTORIC ENVIRONMENT
B PROTECT AND ENHANCE BIODIVERSITY
C REDUCE GREENHOUSE GAS EMISSIONS
D IMPROVE PUBLIC CONNECTION WITH THE COUNTRYSIDE
E ENHANCE RURAL EMPLOYMENT
F INCREASE AMOUNT OF ENERGY PRODUCED AND USED LOCALLY
G REDUCE ENERGY COSTS
H ENHANCE LOCAL LANDSCAPE CHARACTER
I ENHANCE RURAL QUALITY OF LIFE
J IMPROVE WATER QUALITY
K MAINTAIN WATER AVAILABILITY
L PROTECT AND IMPROVE SOIL RESOURCES
M IMPROVE AIR QUALITY
N MINIMISE ADDITIONAL VEHICLE MOVEMENTS
O MAXIMISE WASTE MANAGEMENT OPPORTUNITIES
P INCREASE THE VIABILITY OF LOCAL ECONOMIES
Q ENHANCE VIABILITY OF FARMING
R MAINTAIN TOURISM RESOURCE
S MAINTAIN FOOD SECURITY

Overall, the meetings provided some additional insights into attitudes towards the two crops under study. Although a considerable number of concerns were raised, these were generally only by one, or at most, a few individuals, indicating no strong majority objection on any issue. Only a few people chose to express a preference on planting scenarios, margin widths or end uses. Again, this may be due to lack of personal experience of the crops, or an indication that it was really of no great importance or interest.

In response to the visualisations included in the presentations, one person expressed the view that it would have been helpful to have seen a ‘before’ visualisation i.e. with a traditional crop rotation to contrast against the landscape images that included biomass crops. This was included in subsequent meetings (e.g. see baseline example in Figure 14). Another felt that the sequence of images showing different planting configurations (e.g. Figure 14) was useful but still not tangible enough to give people the full impression of the crop, though this was addressed to some extent by providing footpath level visualisations (e.g. Figure 15).

In terms of the experience gained in using visualisations it became apparent that there were advantages in using a mixture of display types. Real-time models proved very effective as an engagement or demonstration tool at public events, but sequences of rendered still images were a more straightforward way of depicting sets of scenarios or before/after views. The still images also had benefits in terms of the higher level of feature detail that could be incorporated and were easy to include in Powerpoint slides alongside maps that depicted the overall landscape setting (or change), as well as the viewpoint shown in the 3D visualisation. Linking such slides through transitions, and being able to switch back and forward between them as necessary, was the best understood method we identified for communicating different scenarios or planting options in meetings, though as noted above there were a few reservations expressed as to whether such visualisations gave people a sufficiently full impression of the crops.

4.5 Conclusions

The difficulty we found in engaging organisations and community groups to participate in meetings on the topic of biomass crops leads us to believe that there is currently a fairly low level of general interest in the landscape issues associated with increased planting, outside of organisations directly involved in the promotion, production or use of biomass energy. It may be that a further study targeting people who have had direct experience of the crops (either living close to them or using recreational facilities - such as footpaths - near them) would provide additional useful insights. However, this may need to wait until a greater number of farmers and landowners decide to grow biomass crops. Otherwise, based on the evidence of this study, it appears unlikely at present that wide-scale planting of biomass crops will give rise to any substantial public concern in relation to their visual impact in the landscape.

5. REVIEW OF RESULTS: CONCLUSIONS

Due to a number of practical constraints (e.g. reduced uptake of the Energy Crop Scheme; limited interest in engaging with the project by some local authorities and other agencies; concern about jeopardising developing relationships relating to renewable energy scheme implementation) the original work plan was slightly modified and it was not possible to compare and contrast attitudes to the biomass crops 'pre' and 'post' planting in nearby rural communities as initially intended.

The relatively small acreage and quite widely scattered distribution of crops currently in the ground probably contributed to the lack of interest encountered when trying to enlist help in organising focus group meetings, as currently, outside of specific interest groups, there are relatively few people with experience of these crops. 'Landscape impact' received the lowest score of nine factors presented in the questionnaire survey in relation to factors to be taken into account when choosing how electricity should be produced in Britain in the future and there were only a few, varied, concerns about either crop raised by either the questionnaire or focus group meetings.

One of the most striking findings from the public survey was the reduction in support for the crops, when faced with the prospect of attendant infrastructure. When presented with end-use options, communities were most accepting of small-scale CHP projects that were seen as bringing direct benefits to the local area.

The visualisations did help provide a focal point in meetings and were valuable for illustrating different scenarios or land management options. Participants expressed a general preference for a 'patchwork' crop pattern to increase landscape diversity with wide margins to offset visual intrusion and enhance biodiversity. However, there were too few participants at time-limited meetings to undertake a more detailed academic evaluation of the benefits of the visualisations and we felt that with the level of interest shown it was not possible to ask more of the people that attended. Consequently, although some useful lessons can be identified based on the experience of using the visualisations, they primarily derive from the perceptions of the researchers.

One issue raised by the results presented in this study is that it was difficult to ascertain whether any of the visualisations used – photographs, static computer-generated images or real-time models, were really able to convey the true nature of the crops to people who hadn't seen them firsthand. This question of validity is becoming an increasingly important focus of research in many applications of visual simulation techniques (e.g. Wergles and Muhar, 2009). If the planting of biomass crops continues to increase then it could be worthwhile to undertaken a further study with a sample of people who have no experience of either crop, first exposing them to all the various visual media this study has produced, and then taking them out into the field and assessing to what degree their experience of the real crop is matched by their expectations from the visualisations. This could help to obtain more informed views of potential landscape-visual impacts.

Nevertheless, it is reassuring that the issues raised in these public acceptability studies reflected those raised by stakeholders contributing to the development of the Sustainability Appraisal framework which forms the key integrative output of this RELU study. Based on the findings obtained, it appears unlikely that wide-scale planting of biomass crops will give rise to substantial public concerns regarding visual impacts on the landscape and the affirmation of issues of importance provides confidence that the scope of the Sustainability Appraisal has been appropriately specified.

REFERENCES

Bishop I and Lange E (Eds) (2005) *Visualisation in Landscape and Environmental Planning*. London: Taylor & Francis.

Bond, A; Dockerty, T and Lovett, A (2009) *Relu-Biomass Sustainability Appraisal (SA).* Relu-Biomass Sub-Project Report. Norwich: University of East Anglia.

Defra (2004) *Growing Short Rotation Coppice: Best Practice Guidelines for Applicants to Defra's Energy Crops Scheme*. London: Department for Environment, Food and Rural Affairs.

Defra (2007) *Planting and Growing Miscanthus: Best Practice Guidelines for Applicants to Defra's Energy Crops Scheme*. London: Department for Environment, Food and Rural Affairs.

Defra, DTI and DfT (2007) *UK Biomass Strategy*. London: Department for Environment, Food and Rural Affairs.

Devine-Wright, P (2007) *Reconsidering public attitudes and public acceptance of renewable energy technologies: a critical review*. Manchester: School of Environment and Development, University of Manchester. Available at http://www.sed.manchester.ac.uk/research/beyond_nimbyism/.

Dockerty, T; Bond, A and Lovett, A (2009) *Relu-Biomass Sustainability Appraisal (SA): Explanation of Approach*. Relu-Biomass Sub-Project Report. Norwich: University of East Anglia.

DTI (2003a) *Attitudes and Knowledge of Renewable Energy amongst the General Public – Report of Findings,* London: Taylor Nelson Sofres plc . Prepared for Central Office of Information.

DTI (2003b) *Attitudes to Renewable Energy. Final Report.* London: Department of Trade and Industry. Prepared for COI Communications.

English Heritage (2006) *Biomass Energy and the Historic Environment.* London: English Heritage.

Hall (2006) *National Labour Force Survey 2005.* London: Office for National Statistics.

Haughton, A J; Bond, A J; Lovett, A A; Dockerty, T L; Sünnenberg, G; Clark, S J; Bohan, D A; Sage, R B; Mallott, M D; Mallott, V E; Cunningham, M D; Riche, A B; Shield, I F; Finch, J W; Turner, M M and Karp, A. (2009) "A novel, integrated approach to assessing social, economic and environmental implications of changing rural land-use: a case study of perennial biomass crops". *Journal of Applied Ecology* Vol. 46, Issue 2, p.315-322. DOI 10.1111/j.1365-2664.2009.01623.x

HM Government (2009) *The UK Renewable Energy Strategy*. Surrey: Office of Public Information. http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/res/res.aspx

Lovett, A; Appleton, K and Jones A (2009) "GIS-based Landscape Visualisation – The State of the Art", p.287-309 in: Mount, N J; Harvey G; Aplin P and Priestnall G (Eds) *Representing, Modeling and Visualizing the Natural Environment*. London: Taylor and Francis.

Lovett, A; Appleton, K; Paar, P and Ross, L (2009a) "Evaluating real-time landscape visualisation techniques for public communication of energy crop planting scenarios", p.103-116 in: Lin, H and Batty M (Eds) *Virtual Geographic Environments*. Beijing, China: Science Press.

Lovett, A A; Sünnenberg, G M; Richter, G M; Dailey, A G; Riche, A B and Karp A (2009b) "Land use implications of increased biomass production identified by GIS-based suitability and yield mapping for *Miscanthus* in England". *Bioenergy Research*. Vol. 2, No 1-2, June 2009, p.17-28.

Lovett A and Appleton K (Eds) (2008). *GIS for Environmental Decision-Making*. Boca Raton, FL: CRC Press.

Lovett, A.A. (2005) “Analysing categorical data”, p.207-217 in Flowerdew, R and Martin, D (Eds.) *Methods in Human Geography*, Second Edition. Harlow: Pearson.

McGowan, F. and Sauter, R (2005) *Public Opinion on Energy Research: A Desk Study for the Research Councils.* Brighton: SPRU – Science and Technology Policy Research, University of Sussex.

MORI (2004) *Attitudes to Renewable Energy in Devon: Summary Report*, Research Study Conducted for Regen SW. London: MORI Social Research Institute.

MORI (2005) *Views of the British Nation Topline Findings (21/11/05.* London: MORI Social Research Institute.

Natural England (2007) *Energy Crops Scheme-Establishment Grants Handbook*. Sheffield, UK: Natural England.

Office for National Statistics (2005) *The National Statistics Socio-economic Classification User Manual.* Basingstoke: Palgrave MacMillan.

Poortinga, W; Pidgeon, N F and Lorenzoni, I (2006) *Public Perceptions of Nuclear Power, Climate Change and Energy Options in Britain: Summary Findings of a Survey Conducted during October and November 2005. Technical Report*, Understanding Risk Working Paper 06-02, Centre for Environmental Risk. Norwich: University of East Anglia.

Rowe, R; Street, N and Taylor, G (2009) “Identifying potential environmental impacts of large-scale deployment of dedicated energy crops in the UK”. *Renewable and Sustainable Energy Reviews.* Vol. 13, Issue 1, January 2009, p.271-290.

Royal Commission on Environmental Pollution (2004) *Biomass as a Renewable Energy Resource*, London: Royal Commission on Environmental Pollution.

Tufte, E R (1992) *The Visual Display of Quantitative Information*. Graphics Press.

UN-Energy (2007) *Sustainable Bioenergy: A Framework for Decision Makers*. New York: United Nations.

Upham, P and Shackley, S (2006) “Stakeholder opinion of a proposed 21.5 MWe biomass gasifier in Winkleigh, Devon: Implications for bioenergy planning and policy”, *Journal of Environmental Policy and Planning*, Vol. 8, p.45-66.

Upreti, B R (2004) “Conflict over biomass energy development in the United Kingdom: some observations and lessons from England and Wales”, *Energy Policy*, Vol. 32, p.785-800.

Wergles, N and Muhar A (2009) “The role of computer visualization in the communication of urban design – a comparison of viewer responses to visualizations versus on-site visits”. *Landscape and Urban Planning* Vol. 91, p.171-182.

APPENDIX 1

Questionnaire & Answer Selection Cards

Surveyor name:	Date:	Location:

STREET SURVEY QUESTIONNAIRE

READ OUT

Hello. I'm [your name] from the University of East Anglia. Would you be willing to take part in our survey on renewable energy?

IF YES: Do you mind telling me if you live within 25 miles of here?

IF NO: We are actually looking to record the opinions of people who live in the area, so thank you for stopping but as you don't live here I don't have any other questions.

IF YES: The survey will take around 5 minutes. Your answers will be treated confidentially and used only for this research.

READ OUT: I'd like to start by asking about different sources of electricity

1. HAND OVER CARD BOOKLET - TURN TO CARD A: READ OUT: These are all sources of electricity generation in Britain. To what extent do you approve of each of these sources being used for electricity production?

	Strong Approval	Slight Approval	No Opinion	Slight Opposition	Strong Opposition	Don't Know
Biomass						
Coal						
Natural Gas						
Hydroelectric Power						
Nuclear Power						
Oil						
Sun/Solar Power						
Tidal Power						
Wind Power						

2. STILL WITH CARD A: READ OUT: Renewable energy comes from sources that are regenerated naturally more quickly than they are being consumed. Which of these possible sources of electricity would you regard as renewable?

	Renewable	Non-Renewable	Don't Know
Biomass			
Coal			
Natural Gas			
Hydroelectric Power			
Nuclear Power			
Oil			
Sun/Solar Power			
Tidal Power			
Wind Power			

3. TURN TO CARD B: READ OUT: Government, industry and environmental groups are currently thinking about how Britain should generate electricity in the future. In your opinion, which THREE of these factors, are the most important for deciding which methods of electricity production should be used in Britain in the future? Please read out the letters which apply to your 1st, 2nd and 3rd choices. [surveyor – please note 1,2,3]

A	Cost to the consumer	G	Level of pollution
B	Effects on the economy	H	Reliability of supplies
C	Effects on the environment	I	Safety
D	Effects on human health	J	None of these
E	Effects on the landscape	K	Don't know
F	Helping to prevent climate change		

READ OUT: Now I'd like to go on to some questions about energy crops.

4. TURN TO CARD C: READ OUT: Here are some pictures of two new energy crops - Short Rotation Coppice and *Miscanthus*. These can be cut and processed into fuel pellets and used for heat or electricity generation. They are now being grown in several parts of Britain.

[explain the main features of the crops as described on the card]

READ OUT: Have you noticed either of these crops being grown around here?

	Yes	No	Don't Know
Short Rotation Coppice			
Miscanthus			

If Yes, READ OUT: Could you tell me whereabouts please?

……..

5. TURN TO CARD D. READ OUT: Here are some photos of Short Rotation Coppice in a landscape setting. To what extent do you think Short Rotation Coppice would fit into the landscape in this area?

	Very Well	Reasonably Well	No Concerns	Some Concerns	Major Concerns	Don't Know
Short Rotation Coppice						

6. TURN TO CARD E. READ OUT: Here are some photos of *Miscanthus* in a landscape setting. To what extent do you think *Miscanthus* would fit into the landscape in this area?

	Very Well	Reasonably Well	No Concerns	Some Concerns	Major Concerns	Don't Know
Miscanthus						

7. TURN TO CARD F: READ OUT: How close to your home would you mind if these crops were grown?

	SRC	*MISCANTHUS*
a) within the view from your home		
b) on the outskirts of your town or village		
c) more than 1 mile away but less than 5 miles from your home		
d) more than 5 miles away but less than 10 miles from your home		
e) further away than 10 miles		
f) should not be grown at all		

8. READ OUT: Do you have a favourite local walk in the countryside?

YES (go to Q9) ***/*** **NO** (go to Q10)

9. TURN TO CARD G: READ OUT: Where is this walk? Name: _____

READ OUT: How close to your favourite walk would you mind these crops being grown?

	SRC	*MISCANTHUS*
a) alongside the footpath		
b) within the view you can see		
c) should not be seen at all		

10. TURN TO CARD H: READ OUT: This is a biomass power station. To make it cost effective to produce electricity from biomass crops, the crops can only be transported up to 25 miles - so the power station would need to be situated within the area where the crops are grown. How close to your home would you mind if these crops were grown?

	MISCANTHUS	SRC
a) within the view from your home		
b) on the outskirts of your town or village		
c) more than 1 mile away but less than 5 miles from your home		
d) more than 5 miles away but less than 10 miles from your home		
e) further away than 10 miles		
f) should not be grown at all		

RESPONDENT CHARACTERISTICS: Male Female

READ OUT: May I ask a couple of questions about you and your household?

A. How many low energy light bulbs to you have in your home at the moment

None 1 or 2 3 to 5 6 or more all lights

B. Your Occupation: _____ **C.** Your Home Postcode: _____

D. TURN TO CARD I: READ OUT: Please would you tell me which letter covers your age group?

A	B	C	D	E	F	G	H
16 – 19	20 – 24	25 – 34	35 – 44	45 – 54	55 – 64	65 – 74	75+

READ OUT: Thank you very much for your time.

CARD A (Q1 & 2)

- **Biomass (e.g. wood, energy crops, straw, chicken litter)**
- **Coal**
- **Natural Gas**
- **Hydroelectric Power (generated from flowing water)**
- **Nuclear Power**
- **Oil**
- **Sun/Solar Power**
- **Tidal Power (generated from the movement of the tides)**
- **Wind Power**

Strong Approval	Slight Approval	No Opinion	Slight Opposition	Strong Opposition	Don't Know

Renewable	Non-Renewable	Don't Know

CARD B (Q3): THREE MOST IMPORTANT FACTORS

A. Cost to the consumer

B. Effects on the economy

C. Effects on the environment

D. Effects on human health

E. Effects on the landscape

F. Helping to prevent climate change

G. Level of pollution

H. Reliability of supplies

I. Safety

J. None of these

K. Don't know

1st Choice	2nd Choice	3rd Choice

CARD C (Q4)

SHORT ROTATION COPPICE:

- Is a tree (most usually willow)
- It is tall – growing to about 5m in height.
- It is cut to ground level once every few years.
- The stems re-grow and can be cut over and over again.
- It usually replaces arable crops e.g. wheat.

MISCANTHUS:

- It is a grass (related to sugar cane)
- It is tall – growing to around 4m in height.
- It is cut each year in winter.
- Once planted it remains in the ground for about 10 – 12 years.
- It usually replaces arable crops e.g. wheat.

CARD D (Q5)

SHORT ROTATION COPPICE

Very Well	Reasonably Well	No Concerns	Some Concerns	Major Concerns	Don't Know

CARD E **(Q5)** **MISCANTHUS**

Very Well	Reasonably Well	No Concerns	Some Concerns	Major Concerns	Don't Know

CARD F (Q7) GROWN NEAR WHERE YOU LIVE

a) within the view from your home

b) on the outskirts of your town or village

c) more than 1 mile away but less than 5 miles from your home

d) more than 5 miles away but less than 10 miles from your home

e) further away than 10 miles

f) should not be grown at all

PLEASE CHOOSE ONE OF THE ABOVE	
Short Rotation Coppice	*Miscanthus*

CARD G (Q9) GROWN NEAR YOUR FAVOURITE WALK

a) alongside the footpath

b) within the view you can see

c) should not be seen at all

PLEASE CHOOSE ONE OF THE ABOVE	
Short Rotation Coppice	*Miscanthus*

CARD H (Q10)

a) within the view from your home

b) on the outskirts of your town or village

c) more than 1 mile away but less than 5 miles from your home

d) more than 5 miles away but less than 10 miles from your home

e) further away than 10 miles

f) should not be grown at all

PLEASE CHOOSE ONE OF THE ABOVE	
Short Rotation Coppice	*Miscanthus*

CARD – AGE GROUP

A. 16 – 19

B. 20 – 24

C. 25 - 34

D. 35 – 44

E. 45 – 54

F. 55 – 64

G. 65 – 74

H. 75 – 94

I. 95 – 104

j. 105 +

APPENDIX 2

Summary of Participation

Table A: Summary of Meetings Held

Mtg Ref	Date	Organisation	Representatives
		EAST MIDLANDS	
A	13/05/08	Strawsons Energy	John Strawson, M D
B	16/05/08	Rural Community Action, Nottinghamshire	Rob Crowder, Chief Executive
B	16/05/08	Renewable Nottinghamshire Facilities Ltd, Dunham on Trent	Chris Fitzpatrick, Chief Executive
C	09/10/08	Government Office for the East Midlands	Alex Bowness, GOEM Natural Environment Team Lesley Eddleston, Senior Landscape Architect, Leicester County Council Peter Hayman, ECS Manager, Natural England
D	18/11/08	Natural England	Rachel Bathurst, Energy Senior Specialist, Policy Team, Natural England, Crewe Richard Cooke, Nation Manager of ESC and Agri-Env schemes Amanada Naylor, Administrator of ESC and Agri-Env schemes Karen Davenport, Senior Specialist, Regional Spatial Planning & Landscape Martin Banham, Regional Landscape Specialist Nancy Stedman (RELU Steering Group)
		SOUTH WEST	
E	27/06/08	NPower, Swindon	Sophie Hartfield Emma Wilson Paul Duncan
F	29/10/08	Somerset County Council	Ian Bright Jenny Barnett, Renewable Energy Officer Phil Stone, Manager, Countryside Team Nick Fackrell, Countryside Team Ben Thorne, FWAG Not at meeting but lunch discussion with Jane Hillier, freelance consultant to SCC
G	29/10/08	Somerset Climate Action Group	Joe & Wendy (group leaders) plus 11 other participants.
H	30/10/08	Exmoor National Park Authority	Graham Wills, Head of Conservation and Land Management Sarah Bryan, Exmoor National Park (telephone interview 5/11/09)
I	30/10/08	South Petherton Transition Town Group	Becky (Organiser) plus 18 other participants
J	03/11/08	CPRE South West (by email)	Wendy Lutley, Roger Martin

Table B: Other organisations approached but either not interested / no response / not available

Date	Organisation
	EAST MIDLANDS
17/04/08	Lincolnshire Community Council
03/04/08	Lincolnshire Association of Local Councils
24/04/08	East Midlands Development Agency
24/04/08	Lincolnshire County Council
24/04/08	Notts County Council
19/06/08	East Bridgford Parish Council
19/06/08	Rural Community Action Nottinghamshire
19/06/08	Langar cum Barnstone Parish Council
07/08/08	Transition Nottingham
18/08/08	East Midlands Landscape Institute
	SOUTH WEST
17/04/07	BICAL
03/04/08	Somerset Association of Local Councils
03/04/08	Sedgemoor Rural Community Development Project
03/04/08	South West ACRE Network of Rural Community Councils
03/04/08	Community Council for Somerset
18/04/08	Heritage & Landscape Team, Taunton Deane Borough Council
18/04/08	Sedgemoor District Council
18/04/08	Sedgemoor Action Group for the Environment
18/08/08	South West Landscape Institute

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Welcome to RELU-Biomass

Future policies are likely to encourage more land use under energy crops: principally willow, grown as short rotation coppice, and the tall grass miscanthus. These crops will make an important contribution to the UK's commitment to reducing CO2 emissions and are grown under low input agriculture. However, they are quite different from the arable crops that we are used to and it is not clear how planning decisions based on climate, soil and water should be balanced against impacts on the landscape, social acceptance, biodiversity and rural economy. RELU-Biomass will provide a holistic assessment of the potential impacts of increasing rural land use under miscanthus and SRC willow, focusing on two study regions – the South-West and the East Midlands.

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Summary

Renewable energies are crucial for meeting the UK Government's energy and environmental objectives, particularly energy security and reduction of greenhouse gas emissions. Perennial crops grown for biomass production, such as Short Rotation Coppice (SRC) willow and the exotic grass, miscanthus, are a renewable energy source which is carbon neutral, because the quantities of carbon dioxide released to the atmosphere on combusting the crop are equal to those absorbed by photosynthesis during crop growth. Future policies are likely to encourage plantings of biomass crops, particularly as they provide new opportunities for farmers. Biomass crops differ from the annual arable crops and grassland they are likely to replace, in the habitat they provide, in their life cycle, growth characteristics and general appearance. It is important to understand the impacts of changing land use to biomass crops in order to optimise the gains and minimise any potential downsides. RELU-Biomass will use an interdisciplinary approach to make a holistic assessment of the main social, economic and environmental impacts of energy crops.

RELU-Biomass will examine the sustainability of SRC willow and miscanthus in comparison with arable crops and grassland by comparing rural economics, social acceptability, landscape character, water use and biodiversity. In addition to using data that have already been collected, we will be carrying out experimental studies concentrating on two areas of the UK as contrasting study regions – the South West and East Midlands. These include: measurements of water use, biodiversity and landscape impacts and conducting farm surveys, social surveys and focus groups.

The results will be used to:

- Develop an integrated scientific framework for Sustainability Appraisal (SA) of conversion of land to energy crops
- Evaluate the implementation of the SA framework
- Update Best Practice Guides for planting short rotation coppice (SRC) willow and miscanthus
- Provide the scientific tools for Environmental Impact Assessments (EIAs) of projects, and for Strategic Environmental Assessments (SEAs) or SAs of plans or programmes, involving increased planting of energy crops

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Research Activities

This project brings together experts from the fields of crop science, biodiversity and ecology, hydrology, social science and geography and rural economics, and will provide an integrated, interdisciplinary scientific evaluation of the implications of land conversion to energy crops, focussing on short rotation coppice (SRC) willow (Figure 1a) and miscanthus grass (Figure 1b).

The proposal reflects the range of disciplines needed to undertake a comprehensive evaluation and will ensure that the consequences of any major changes in land use towards biomass production are properly and fully understood in advance. These outputs will be used to update DEFRA Best Practice Guides for SRC and miscanthus, and to provide the scientific tools to underpin the conduct of EIAs, SEAs or SAs involving projects, policies or programmes where increased planting of energy crops is proposed or anticipated. The innovative research approach taken here also allows for greater stakeholder involvement in defining options for energy crops.

We will use existing data and generate new data, where there are gaps in existing knowledge, by specific research activities in the disciplines outlined above.

We have chosen two contrasting farming systems typical of different regions of the UK as study areas (i) The arable cropping dominated system of the Midlands and Eastern Counties of England and; (ii) A grassland-dominated system more typical of the South West of England. Both have been classified as being within contrasting geographic, farming and Environmental Zones. They also contain some of the greater densities of existing energy crop plantings and are likely to see new plantings in the near future.

This project is funded by
the Research Councils UK,
through the RELU program.

Figure 1a. SRC willow landscape

Figure 1b. Planted fields of miscanthus

We aim to study biodiversity and hydrology in established sites. Given the length of time crops are in the ground, more land use will be under established crops cf. establishment phase. The establishment phase is also a period of change, and this will ensure that plant and insect species associated with the new crop, rather than a previous land-use are monitored. In contrast, for social acceptance, the greater landscape change will occur in the establishing phase (years 1 – 4) and this will therefore be the focus for these studies. The economic appraisal will encompass all phases of the crop, from the pre-planting decision making process through to the long term financial viability and will look at the effects on the whole rural economy. To maintain credibility within the agricultural context for all studies and to avoid edge effects in the biodiversity and hydrology studies, actual field sites chosen will have a minimum size of 3 ha.

To assess the public acceptability of landscape impacts we will use GIS-based 3D landscape visualisations within a framework of stakeholder consultations and focus groups. These visualisations have considerable advantages over conventional 2D maps or photomontages as means of representing landscape change, not least the ability to combine feature detail with an interactivity where viewpoints can be changed at will. UEA researchers have used these techniques in several recent studies of landscape change scenarios and have specialist display equipment (including a portable Elumens VisionStation) (Figure 2) that will be utilised in the research (see http://www.uea.ac.uk/zicer/ssevrel/).

Figure 2. Portable Elumens VisionStation

The research on hydrology will take measurements in SRC willow and miscanthus fields (Figure 3) for use in a physically-based, numerical model, the Joint UK Land Environment Simulator (JULES), which is an initiative of CEH and the Meteorological Office, to predict the impact of land cover change resulting from planting energy crops on river flows. The model is spatially distributed and incorporates an integrated description of the energy, water and carbon balances of the land surface with a rainfall-runoff model. The land surface description is based on previous work. JULES is grid-based, with mosaicing of the vegetation cover within each grid cell, and runoff represented by a probability distribution model and flow routing. A feature of this model, essential for this project, is the description of the land surface which is physically-based and fully integrated so that the vegetation growth and therefore its structure, e.g. leaf area index, canopy height etc., are dynamically calculated by the model. The model is also generic and consistent in how it handles the different land cover types; an important feature for predicting the impacts of land use change.

Figure 3. Instrumentation for hydrological measurements

Research on impacts on farmland biodiversity will be evaluated using the approach developed for the Farm Scale Evaluations (FSE) of genetically modified, herbicide-tolerant crops. The FSEs developed techniques that can be applied in a wide variety of cropping situations using repeatable sampling protocols. Employing these sampling protocols in this study will allow direct comparison of measures of biodiversity (Figure 4), associated with energy crops, with arable crops for the first time, which is a major benefit of the proposed study since it will be possible to start to explore how different mixtures and rates of adoption of these crops might influence biodiversity across farms or regions.

Figure 4. Invertebrate (a) and weed (b) abundance and diversity in the two energycrops will be studied using the protocols developed for the farm-scale evaluations

The economic assessment will encompass both farm-level and wider rural economy impacts, and will be closely integrated with other areas of the research programme through being informed by and, in turn, informing work modules in other disciplines. The initial construction of farm economic models will utilise information from the GIS, bio-diversity and hydrology areas to build case-specific models; these will later be validated and augmented by the extended dataset derived from the farm survey work. The models will compare baseline and alternative scenarios to estimate the implications of change on the wider rural economy, the outcomes for which will be used in completing the scientific conclusions.

A Sustainability Appraisal (SA) approach will be used to provide an integrated assessment of the implications of greater energy crop planting. SA is an environmental assessment methodology that systematically examines the extent to which the implementation of a plan or strategy would achieve sustainable development. Under the Planning and Compulsory Purchase Act of 2004 SAs are mandatory for several types of land use plans (e.g. Regional Spatial Strategies) in the UK. The ODPM has recently issued a consultation document which outlines how SAs can be conducted to meet the requirements of both the EU SEA Directive (2001/42/EC) and the 2004 Act. Several recent SAs of RSSs have included consideration of the extent and location of energy crop planting. The SA approach has been chosen here because it: (i) encompasses social, economic and environmental objectives (ii) is suitable for landscape scale evaluations (iii) can be adapted to compare the implications of different planting scenarios (iv) is currently being used in a range of regional and local planning frameworks (v) utilises much existing work on sustainability indicators (e.g. see http://www.sustainable-development.gov.uk) but permits some flexibility in the measures employed.

Although we have selected the East Midlands and South West regions as a focus of our research, elements of the project will take a national level into account. Information from existing data sets will be reviewed and based on these a scoping exercise will be conducted to identify objectives, targets and indicators for the SA. GIS will be used to identify potentially suitable land for energy crops and a number of planting scenarios will be defined. These scenarios will supply the basis for first pass surveying and modelling studies on social acceptance, landscape sensitivity, hydrological and economic impacts. Biodiversity and hydrological measurements will be conducted at field sites on farms in these regions where energy crops are already established. These farms will be included in the economic modelling and visualisations of the sites used in the social acceptance surveys. Information from these different research activities will be used to refine the land suitability maps and to assess likely changes in indicators for the different scenarios. Subsequently, the scenarios will be compared on sustainability indicators (e.g. rivers classed as good or fair quality, trends in bird populations or plant biodiversity) and the most appropriate outcome (relative to sustainability objectives) identified. Scientifically-based recommendations will be drawn up and discussed with stakeholders, planners and those involved in

conducting environmental assessments. The direct involvement of the Regional Development Agencies for the two selected areas and inputs from DEFRA will add important strength to our capacity to carry out this approach.

RELU-Biomass provides a comprehensive platform upon which to assess the implications of increasing land use under energy crops. However, whilst RELU-Biomass embraces the main priority areas in need of consideration, it was not possible to cover all aspects under the funding resources available. Biodiversity assessments using the FSE protocols are particularly resource-intensive and, with the resources available, focus was placed on a comparison of miscanthus and SRC willow with arable and, to a lesser extent, grassland, for established crops at the smaller field scale. It was also not possible to include bird studies within the RELU-Biomass budget, although the intention was to model impacts of weed and invertebrate abundance in SRC on some farmland bird species, based on the bird data available so far, and to use a similar approach for miscanthus, should bird data become available during the life time of the project.

Subsequent to RELU-Biomass starting, Defra have provided additional support to compliment the biodiversity research covered by the RELU biomass project so that some of the areas we were not able to study can now be investigated. Click here for more information.

Biodiversity research in the farmscale evaluations (FSE) of genetically modified herbicide tolerant crops has shown that the management systems employed can affect changes in biodiversity, and that these management systems should be optimised to assure the highest biodiversity attainable. For biomass crops, management systems that will affect biodiversity include the scales of growing, within a landscape, and temporal effects including the crop age, time in the cutting cycle and timing of cutting. Presently there is only limited evidence upon which to draw up guidelines on these management systems and, given the rate at which plantings are increasing, it is clear that such data are urgently required. The Defra project extension to RELU-Biomass aims to expand the evidence base on biodiversity in energy crops for policy development by determining how the biodiversity of miscanthus and SRC willow is affected by the spatial scale, structuring and management of the plantings. This will be done by extending the sampling for abundance and diversity of weeds and invertebrates using FSE-standard methods to cover these aspects. The suitability of SRC willow and miscanthus crops for birdlife will also depend on the size of a continuous planted area and the structure of the crop, and the Defra project extension we also enable us to investigate the use of both biomass crops by birds in relation to cropping scale.

More information on stakeholder engagement in RELU-Biomass can be found here

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Partners

Partner teams and their roles

Team	Roles	Organisation
Angela Karp Ian Shield Andrew Riche David Bohan Alison Haughton	• Coordination • Energy crops • Biodiversity	Plant and Invertebrate Ecology Department Rothamsted Research West Common Harpenden, AL5 2JQ **Tel:** 01582 763133 **Fax:** 01582 760981
Alan Bond Andrew Lovett Trudie Dockerty Katy Appleton Gilla Sünnenberg	• Sustainability appraisal • Social acceptance • Landscape futures • Landscape visualisation • GIS suitability mapping	School of Environmental Sciences University of East Anglia Norwich NR4 7TJ **Tel:** 01603 593126 **Fax:** 01603 591327
Jon Finch Paul Rosier	• Hydrology	Centre for Ecology and Hydrology, Wallingford Process Hydrology Section Maclean Building Crowmarsh Gifford Wallingford OX10 8BB **Tel:** 01491 838800 **Fax:** 01491 692424

This project is funded by the Research Councils UK, through the RELU program.

Martin Turner
Allan Butler

- Economics
- Sustainability Appraisal

Department of Geography
University of Exeter
Amory Building
Rennes Drive
EXETER EX4 4RJ
Tel: 01392 263833
Fax: 01392 263342

Rufus Sage
Mark Cunningham

- Biodiversity

The Game Conservancy Trust
Fordingbridge
Hampshire
SP6 1EF
Tel: 01425 652381

Who to contact on specific issues

RELU-Biomass Coordinator

Dr Angela Karp	Rothamsted Research	Tel: (0)1582 763133 Ex 2855	Email: angela.karp@bbsrc.ac.uk

Energy crops

Dr Ian Shield	Rothamsted Research	Tel: (0)1582 763133 Ex 2630	Email: ian.shield@bbsrc.ac.uk
Dr Andrew Riche	Rothamsted Research	Tel: (0)1582 763133 Ex 2476	Email: andrew.riche@bbsrc.ac.uk

Sustainability appraisal

Dr Alan Bond	University of East Anglia	Tel: (0) 1603 593402	Email: alan.bond@uea.ac.uk

Social research

Dr Andrew Lovett	University of East Anglia	Tel: (0)1603 593126	Email: A.Lovett@uea.ac.uk

Rural economic research

Dr Martin Turner	University of Exeter	Tel: (0)1392 263833	Email: M.M.Turner@exeter.ac.uk

Hydrology research

Dr Jon Finch	Centre for Ecology and Hydrology	Tel: (0)1491 838800	Email: jon@ceh.ac.uk

Biodiversity research

Dr David Bohan	Rothamsted Research		
Dr Dr Rufus Sage	The Game Conservancy Trust	Tel: (0)1452 652381	Email: rsage@gct.org.uk

A collaborative effort between Rothamsted Research, The Centre for Ecology and Hydrology, The Game Conservancy Trust and the universities of East Anglia and Exeter. A collaborative effort between Rothamsted Research, The Centre for Ecology and Hydrology, The Game Conservancy Trust and the universities of East Anglia and Exeter.

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Stakeholder engagement

Stakeholder engagement is an essential part of RELU-Biomass. Representatives of the South West of England Regional Development Agency (SWRDA), East Midlands Development Agency (EDMA), DEFRA (Sustainable Farming Food and Fisheries) and the energy crop industry (Bical and Coppice Resources Ltd) have already participated in supporting and advising us during the development of the proposal and their continued inputs are extremely important to us. In addition Bical and Coppice Resources are also liaising with growers to provide RELU-Biomass staff with access to sites for research and we are grateful to growers who have responded positively to these requests.

In addition, RELU Biomass has an increasing number of stakeholders who have expressed interest in the project. Engagement with this community is particularly important to us as the project develops, especially for the sustainability appraisal. We have already started the process of inviting stakeholders to attend special workshops to discuss objectives, targets and indicators for the sustainability appraisal. A first meeting was organised this year in each of our two study regions on March 9th (SW) and March 20th (E-Midlands) 2006 to hear views on objectives, targets and indicators so that the framework for the sustainability appraisal can be developed with their inputs. The outputs of these meetings will be circulated and any stakeholders who could not attend can have inputs during this consultation phase. We will then test biomass planting scenarios against the objectives and this will also involve consultation with stakeholders, either by again inviting them to meetings or though a paper-based consultation. This stage is likely to involve several iterations where new options are developed and tested until only a few preferred ones will be left. In the final stages of the sustainability appraisal there will be further consultation on the preferred options identified and the report that we have prepared of the sustainability appraisal.

In addition to the engaging in a continued dialogue with stakeholders, RELU-biomass will be carrying out social and economic surveys, which will include hearing views from farmers and other stakeholders in the agricultural sector, rural interest groups, regulatory bodies and residents in areas where energy crop plantings are either present or planned. In these instances, engagement will be via questionnaires, interviews and focus groups.

Stakeholders

Dr Guy Anderson	RSPB

This project is funded by the Research Councils UK, through the RELU program.

Graham Ayling	South West Biofuels Forum
Mrs Joanna Bagnall	High Peak Borough Council
Paul Baker	Devon Association for Renewable Energy
CAA Barnes	
Roger A Barton	Peninsular Power
Dr Robert Bewley	English Heritage
Dr Richard Blanchard	Department of Electronic & Electrical Engineering, Loughborough University
Eric Boultbee	East Midlands Development Agency
Tanya Burdett	ODPM Zone 3/H4 Eland House
Rupert Burr	
David Calderbank	Water demand management. Environment Agency
Dr Paul Carver	Bical
Richard Collins	John Amos & Co
Nick Collinson	Woodland Trust
Steve Dunkley	Rural Development Service
Lesley Eddleston	Leicestershire County Council
Matt Georges	Climate Change Unit, Environment Agency
Pete Grigorey	Environment Agency
Melanie Hall	National Farmers Union, Southwest region
R Halliday	Duchy of Cornwall
Alison Hepworth	
Keith Hill	North East Derbyshire District Council
Barbara Hilton	Coppice Resources Ltd
Anna Hope	English Nature
Jo Hughes	National Farmers' Union
Rudie Humphrey	Forestry Commission
Rob Jackson	Agricultural Development. Taunton Deane Borough Council
Jane James	Environment Agency
Lynne Kenderdine	Devon Wildlife Trust
Catherine Le Grice Mack	SW Regional Assembly
Rachel Leighton	Defra, Sustainable Farming and Food
Kevin Lindegaard	Dorset County Council
Andy Mason	Forestry Commission
Yve Metcalfe-Tyrrell	South West RDA
Diana Mompoloki	South West of England Regional Development Agency
John Mortimer	Country Land and Business Association
Donal Murphy-Bokern	Defra, Agriculture and Climate Change

Andy Neale	Countryside Agency
Susan O'Brien	FES
Dave Parker	The Countryside Agency
N & N Parish	
Mark Paulson	Coppice Resources Limited
Matthew Pitts	Environment Agency
Linda Pooley	SEERAD
Malcolm Price	North Cornwall District Council
Adele Rhodes	Bolsover District Council
Douglas Robinson	Lincolnshire County Council
Will Rolls	Forestry Commission
Jim Skelton	South West Forest
Richard Smithers	The Woodland Trust
Vanessa Straker	English Heritage SW Region
John Strawson	Strawson Energy
Peter Strutton	EMDA
Natasha Styles	Salisbury District Council
Sian Thomas	Woodland Trust
Charles H Willmer	
Paul Wilson	Derbyshire Dales District Council
Julian Wright	Environment Agency (East Anglia)
Ian Woodhurst	CPRE
Peter Udy	Boston Borough Council
Ian Tubby	Forest Research
Ray Tucker	Switch to Switch Ltd
Dominic Vincent	South West Regional Development Agency
Steve Williams	South Holland District Council

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