Devon Miscanthus and Woodfuels Opportunities Statement

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Executive Summary of Report to Devon Wildlife Trust

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EXECUTIVE SUMMARY

Background

With almost universal acceptance of the urgent need to reduce UK CO_2 emissions there is increasing interest in the role that energy crops could play as a renewable energy source. However, there is also a risk that unmanaged large scale cultivation could have negative impacts on the rural environment in terms of biodiversity and ecology, visual appearance and landscape character, the historic environment and archaeology, and agricultural diversity. At the same time, climate change will have (and is already having) increasingly detrimental impacts on rural landscapes and economies in the UK and internationally, and rising demand for low carbon energy sources will make energy crop production an increasingly profitable business, which could have some very positive implications for rural economies, and the agricultural sector in particular.

There is therefore a tension between the immediate need to protect rural landscapes from the potential negative effects of unmanaged land use change, and the need to reduce CO_2 emissions as rapidly as possible so as to minimise climate change. It is in this context that the Devon Wildlife Trust, on behalf on Natural England and the Environment Agency, commissioned the Centre for Sustainable Energy (CSE) in association with Wardell Armstrong, Land Use Consultants, and ADAS, to carry out the Devon Miscanthus and Woodfuels Opportunities Statement.

The aim of the project is to assess geographically the potential for, and constraints on, the cultivation of miscanthus and SRC willow in the county of Devon, along with the opportunities for using arisings from existing woodlands as an energy source. It is hoped that the results will provide the relevant stakeholders with a clearer understanding of the potential scale of energy crop production in Devon, and more detailed knowledge of the geographical distribution of the constraints to cultivation. This should be seen as part of the long term process of Devon's adaptation to the impacts, demands, and opportunities, created by climate change.

Project Outputs

The outputs from this project are (1) a GIS database containing maps of the resources, constraints, and opportunities relevant to the production of biomass from miscanthus, SRC willow, and arisings from existing woodlands across Devon; (2) a non technical user-friendly hyperlinked Adobe PDF version of a set of key output maps from the GIS database, with an associated user help file; and (3) this report.

Policy Context

UK national, regional, and local policy is increasingly taking account of climate change and the need to achieve large reductions in CO_2 emissions over the coming years. As one of the main approaches to reducing emissions, increasing production of renewable energy is a recurring theme: there are challenging national, South West, and Devon targets for renewable energy generation.

In the South West, energy crops and forestry residues are identified as significant contributors to the overall regional targets. For example, REvision 2020 identifies targets for up to 100MW of biomass fired electricity by 2020, along with 247MW of heating, 42MW of CHP, and 39MW of community heating on site in new developments.

Progress is being made in Devon and the South West. According to the RegenSW annual survey, there is now almost 30MW of installed renewable heat capacity in the South West, spread across 419 individual projects. Of this, about 10MW is from biomass thermal projects, 2.2MW of which is in Devon. However these figures do show that despite recent progress, meeting the Revision 2020 targets is likely to require large increases in the cultivation of energy crops and the exploitation of forestry residues in the South West. The situation in Devon reflects this, with the Devon Structure Plan acknowledging national and regional targets, and more locally, the North Devon and Torridge Renewable Energy Action Plan identifying potential for 99GWh of annual energy crop production (equivalent to about 11MW average continuous heat demand).

National and regional policy are therefore increasingly aligned in terms of their commitment to the development of renewables, including energy crops and biomass, as essential components of the UK approach to reducing CO_2 emissions. The existence of local and regional targets and drive, combined with guidance and pressure from the national level, means that there is the support, commitment and necessity to develop energy crops as an important element of the region's renewable energy portfolio.

Environmental Impacts of Energy Crops

In this context it is important to understand the mixture of positive and negative environmental impacts that may result from the cultivation of miscanthus and SRC willow. The negative effects can include visual impacts, soil compaction during harvesting, high water demand relative to arable crops, and the potential to disturb archaeological remains. The positive impacts include potential benefits to biodiversity, and bioremediative effects via the removal of heavy metals from contaminated soil. The extent to which these negative impacts may be barriers to the establishment of energy crops will vary on a case-by-case basis. Careful management practices and the use of landscape sensitivity assessment will often mitigate impacts through following best practice management and landscape guidelines or pragmatic re-siting. Finally, any assessment of the costs and benefits of energy crop cultivation must include the large environmental gain achieved through the reduction of CO_2 emissions.

Sensitivity of the Devon Landscape

As part of this research, Land Use Consultants assessed separately the sensitivity of the 17 Landscape Types (as defined by the Countryside Agency) present in Devon to SRC and miscanthus. The assessment considered the extent to which crops could be integrated without change to landscape character. Acceptance of change was not considered as part of the assessment, and it should be noted that a strategy to change character in a particular area may be acceptable in some cases.

The sensitivity of these 17 Landscape Types was rated from Low (1) to High (5), with the following definitions:

Sensitivity Level	Definition
Low (1)	Greatest opportunity to accommodate biomass crops.
Low-moderate (2)	Some considerable opportunity to accommodate biomass crops – the landscape is not likely to have many features/ characteristics sensitive to growth of these types of crops.
Moderate (3)	Some opportunity to accommodate biomass crops. However, the landscape also contains a number of features/ characteristics sensitive to growth of these types of crops. Care is needed in locating crops so they do not dominate the landscape, or detract from key characteristics of the landscape.

Sensitivity Level	Definition
Moderate-high (4)	Some limited opportunity to accommodate biomass crops. However, only small amounts could be accommodated before landscape character is adversely affected. Great care is needed in locating crops so they do not dominate the landscape, or detract from key characteristics of the landscape.
High (5)	Unsuitable for growth of biomass crops – the presence of even a small amount of crop would change the character of the landscape.

These sensitivity ratings were combined with a map of Devon Landscape Types to generate two new maps showing landscape sensitivity to miscanthus and SRC willow respectively. These are shown below in Figures A and B.

Figure A: Devon Landscape Sensitivity to Miscanthus

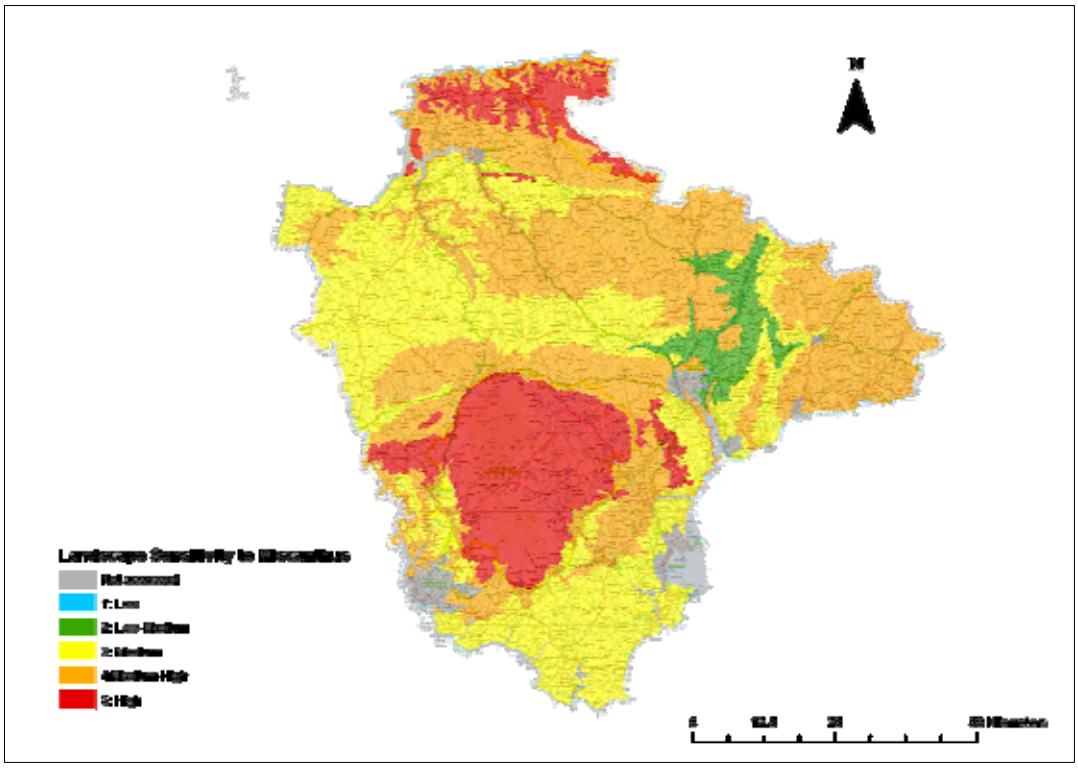
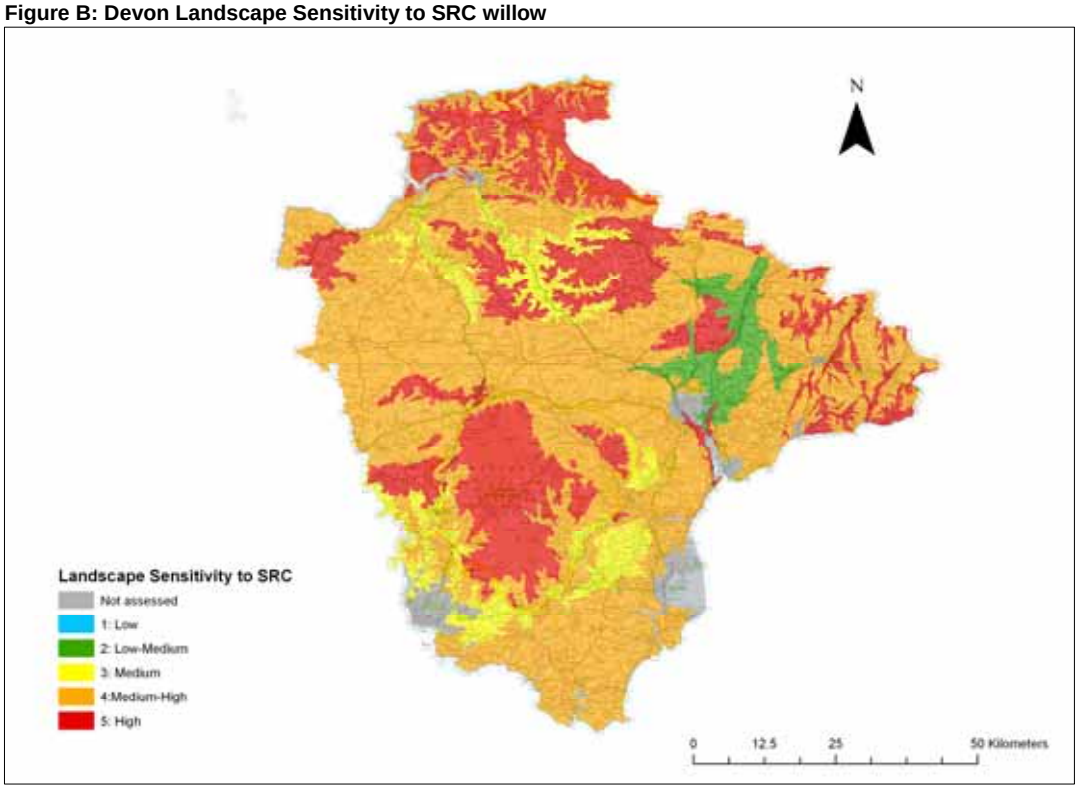


Figure B: Devon Landscape Sensitivity to SRC willow



GIS modelling

Methodology

The approach taken to geographically modelling the opportunities for biomass and woodfuels in Devon was based on combining crop yield models with a set of constraints to cultivation, on a 200m (4 hectare) grid basis. The output of the GIS processing is a grid map showing: i) areas unsuitable for energy crop cultivation due to the presence of one or more constraints, and ii) modelled yields in unconstrained areas.

The model is based on a priority crop order of existing woodland > miscanthus > SRC willow, such that only one crop per grid square will be identified as an opportunity. This means that on a square where there is no existing woodland and no constraints to prevent it, miscanthus would be the identified as the potential crop (due to higher energy yields), followed by SRC willow on squares where miscanthus is constrained – either through landscape sensitivity, or because of high windspeed. Where both crops are constrained, a square would be identified as having no potential for energy crops.

Constraints to energy crop cultivation

Following discussion at the Project Steering Group, it was agreed that areas with high landscape sensitivity would be treated as constrained, and therefore unavailable for energy crop cultivation. In addition, a range of land cover and land designation types were also classified as constrained. These are shown in Table A below.

Table A: Land Cover and Designation Constraints, and GIS data sources.

	Feature	Source
Land Cover	Slope (average slope > 20%) (OS)	Calculated from Ordnance Survey data
	Blanket Bog	Natural England
	Coastal and Floodplain Grazing March	Natural England
	Coastal Sand Dunes	Natural England
	Coastal Vegetated Shingle	Natural England
	Fens	Natural England
	Lowland Calcareous Grassland	Natural England
	Lowland Dry Acid Grassland	Natural England
	Lowland Heathland	Natural England
	Lowland Meadows	Natural England
	Lowland Raised Bogs	Natural England
	Maritime Cliff and Slope	Natural England
	Mudflats	Natural England
	Purple Moor Grass Rush Pastures	Natural England
	Reedbeds	Natural England
	Saline Lagoons	Natural England
	Undetermined Grassland	Natural England
	Upland Calcareous Grassland	Natural England
	Upland Hay Meadow	Natural England
	Upland Heathland	Natural England
	Urban Land (Strategii Dataset)	Natural England, Ordnance Survey
	Urban Land	National Statistics
	Agricultural Land Classifications <> 1,2 or 3	MAGIC
Land Designation	Doorstep Greens	MAGIC
	Historic Parks and Gardens	MAGIC
	Local Nature Reserves	Natural England
	Millennium Greens	MAGIC
	National Nature Reserves	Natural England
	Ramsar sites	Natural England
	Registered Battlefields	MAGIC
	Scheduled Ancient monuments	MAGIC
	Sites of Special Scientific Interest	Natural England
	Special Areas of Conservation	Natural England
	Special Protection Areas	Natural England
	World Heritage Sites	MAGIC

These maps of constrained land were each translated onto the 200 metre x 200 metre grid map of Devon which formed the basis of the GIS model. From this, a new map was produced, indicating the status of each of the 175,000 grid squares making up the county. Figure C below illustrates this process, and Figure D presents a larger scale version of the resulting map.

Figure C: Combining Land Cover, Designation and Sensitivity Constraints

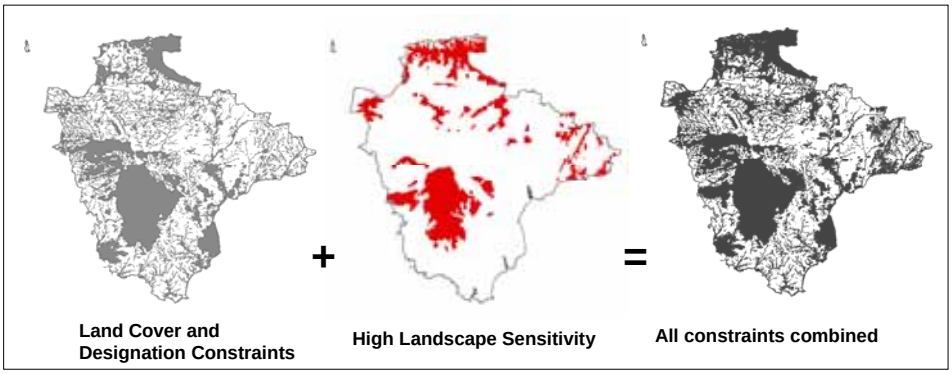
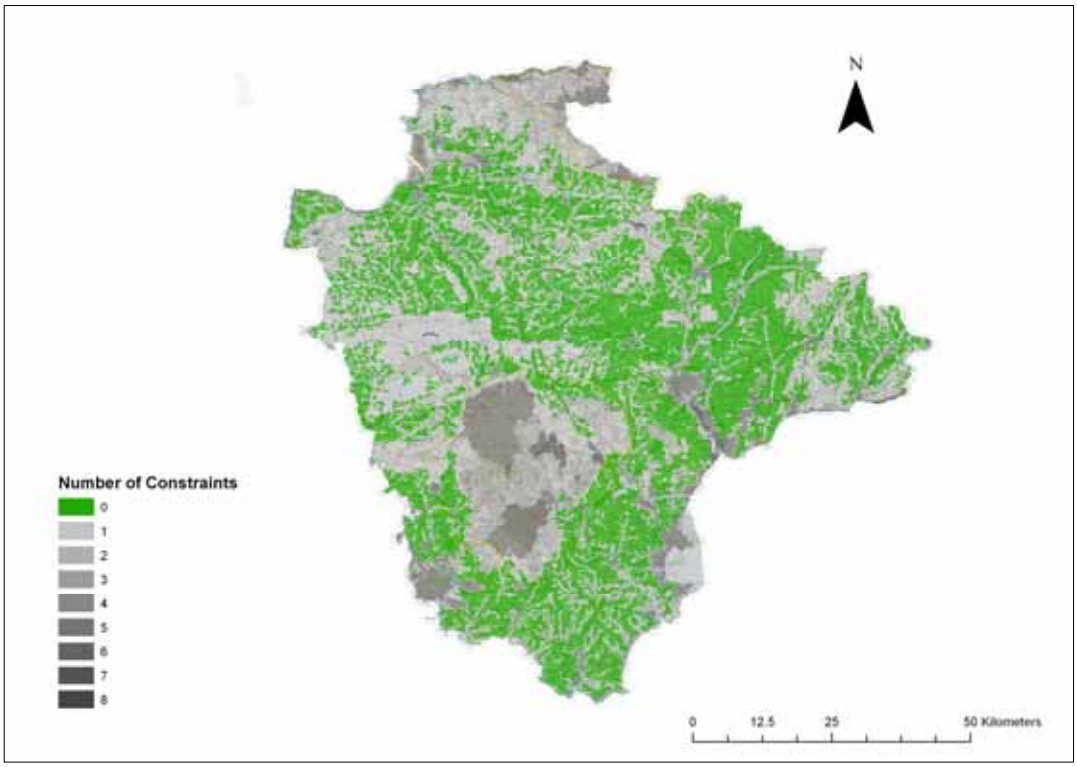


Figure D: Devon wide map of constrained land



These results show that in total, approximately 380,000 hectares (55%) of Devon land is constrained to energy crops, with the remaining 310,000 hectares (45%) theoretically available for cultivation. The precise proportion of the unconstrained land which can be cultivated without unacceptable changes to landscape character has not been assessed, and requires a more detailed landscape assessment than was possible in the scope of this project.

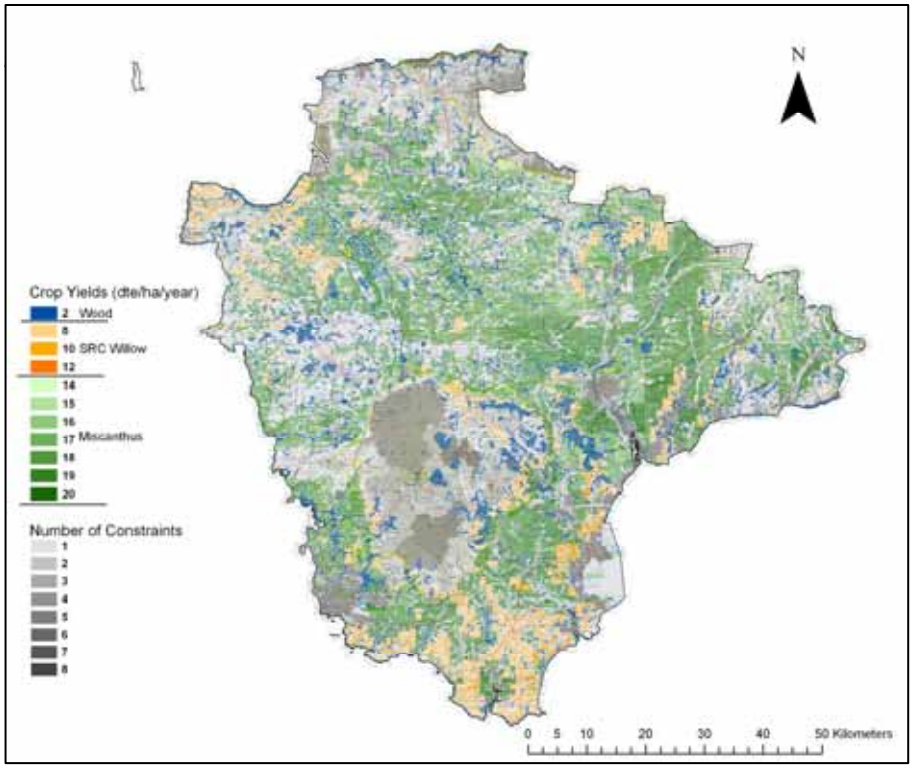
Energy crop yields

Maps showing the expected yields from miscanthus, SRC willow, and existing woodland arisings were combined into a grid based 'biomass resource' map. Following the convention outlined above, this resulted in a grid map of Devon in which each square was assigned to one crop type only. For miscanthus grid squares, yields were derived from a geographic model provided by ADAS. Yields from SRC willow were estimated based on Agricultural Land Classification, and woodland arisings were assumed to be 2 dry tonnes per hectare per year, based on previous work by Wardell Armstrong International.

GIS Results

The result of the GIS modelling is a grid map of Devon indicating, for each grid square, either the type and number of constraints present, or if none are present, the expected yield from the crop identified as appropriate at that location. This was produced by overlaying the final constraints grid map on the biomass resource map, and setting energy crop yields to zero wherever at least one constraint was present. Figure E below is a small scale version of the results map.

Figure E: Final GIS results map



Tables B,C and D below summarise the potential yields for the three energy crops under consideration, along with the energy that could be provided by these yields. The resulting CO_2 reductions are calculated based on the assumption that the crops displace gas for heating, and that net CO_2 emissions from the production and use of energy crops are zero (consistent with the figures in the UK Biomass Strategy 2007).

Table B: Miscanthus yields at different landscape sensitivities

Landscape Sensitivity	Yield (dte/year)	Total Area (ha)	Energy content (GWh)	CO_2 reduction (tonnes)
Low-moderate	300,000	17,000	1,500	300,000
Moderate	1,800,000	100,000	8,600	1,800,000
Moderate-high	1,900,000	110,000	9,200	1,900,000
Total	**4,000,000**	**230,000**	**19,000**	**4,000,000**

Table C: SRC willow yields at different landscape sensitivities

Landscape Sensitivity	Yield (dte/year)	Total Area (ha)	Energy content (GWh)	CO_2 reduction (tonnes)
Low-moderate	80	8	0	85
Moderate	4,300	512	22	4,580
Moderate-high	499,000	61,100	2,580	531,000
Total	**503,000**	**61,600**	**2,600**	**535,000**

Table D: Existing Woodland Arisings

Existing Woodland	Yield (dte/year)	Total Area (ha)	Energy content (GWh)	CO_2 reduction (tonnes)
	146,000	73,000	771	159,000

Discussion and Conclusions

The figures above suggest a potential total saving in CO_2 emissions from energy crops in Devon of nearly 5 million tonnes per year. However, it must be noted that this scenario represents a theoretical maximum, in which just under half of the county would be cultivated for energy crops. In practice this would be both unrealistic and inappropriate.

Nevertheless, the scale of the potential savings is such that if 20% of the unconstrained land in Devon (i.e. around 10% of the Devon's total area) was converted to energy crop production, this could result in a saving of nearly 1 million tonnes of CO_2 annually. To put this in context, in 2004 the county's total CO_2 emissions were around 9 million tonnes. Cultivation of energy crops on 10% of Devon's land area could therefore generate carbon savings equivalent to just over 10% of Devon-wide CO_2 emissions.

These results suggest that there is significant potential for cultivation of energy crops in Devon without compromising the existing landscape character, although further study is required to assess the precise quantity of energy crops that could be accommodated within each specific landscape type without altering its character. Indeed, the greatest challenge in the short term is likely to be the encouragement of landowners and farmers to cultivate energy crops, rather than the protection of the landscape from an uncontrolled and large scale change from existing land uses.

This is because there is as yet no compelling economic case for farmers to switch to energy crops. Farmers are understandably cautious about the risks of experimenting with new crops, and one of the key issues with miscanthus and SRC willow is that they must remain in the ground for a period of 10-20 years for their full economic potential to be realised. This is in contrast with arable crops such as wheat and barley, which are replanted annually, allowing farmers to respond to changes in the market from year to year. From the perspective of a farmer or landowner, the length of the commitment required for energy crops represents a risk that must be compensated for by higher profits relative to lower risk alternatives: at current prices the profits available from miscanthus and SRC willow cultivation are comparable to those from traditional crops such as wheat and barley, which are therefore preferred.

Companies such as Bical, Biojoule and Strawsons Energy are beginning to bridge the gap between suppliers (farmers) and consumers of energy crops, either by acting as agents to the process of matching suppliers and users, or by purchasing the energy crops and processing them into fuels which they then sell on to users. While these activities can increase the rate at which energy crops are cultivated, there remains a long way to go in terms of exploiting the huge potential in agricultural counties like Devon.

For farmers to be persuaded to plant energy crops on a larger scale, there needs to be a more clear cut economic case for their doing so. The obvious route to achieving this is for the government to ensure that an appropriate financial value is placed on CO_2 reductions, for example via the creation of a functional cap-and-trade market for carbon. The creation of such a long term price signal would change the framework within which farmers make decisions regarding which crops to cultivate. However in the absence of such a price signal, farmers are likely to continue to plant crops which generate relatively predictable incomes while allowing the flexibility to adapt to changing market conditions.

Recommendations

1. As part of the process of taking the findings from this work forwards, it is recommended that Natural England establish a Devon stakeholder group, possibly based on the current project Steering Group. This group should by tasked with disseminating the report (and the associated PDF maps) to appropriate representatives of the agriculture, energy, environmental, and landscape interest groups, and establishing a process to develop consensus on the ways in which the GIS tool should be used.

2. One of the main outputs from this project is a GIS database containing the detailed information on the distribution of the opportunities and constraints considered in this report. This can be used to analyse local conditions in more detail than is possible either in this report, or in the PDF maps. It is important that an organisation take responsibility for owning, maintaining, and providing stakeholder access to this database. This will require resources, in particular GIS hardware and software, the skilled staff time to manage it, and the development of an approach to making the detailed data available to third parties at low cost. Although beyond the scope of the current project, it is technically quite feasible to make detailed results available via the internet. This would represent an improvement on the PDF maps created to accompany this report, as users could then specify in detail the geographic scope and data content of the maps they require.

3. In the medium term, consideration should be given to refining the GIS database. In particular, a higher resolution miscanthus yield model would increase its local relevance. A yield model for SRC willow is also needed, since the current yield figures are simply estimates based on Agricultural Land Classification.

4. This report has shown that there is a large potential bioenergy resource in the county of Devon. It has also argued that this resource is unlikely to be developed significantly unless farmers and landowners perceive there to be a compelling economic case for switching from existing agricultural land uses to energy crops. A detailed assessment of the economic and cultural context in which farmers and landowners make decisions regarding land use – with particular reference to energy crops - would therefore be

valuable. Such an assessment could provide additional insight into the reasons why energy crops have so far not 'taken off', as well as identifying possible future problems before they arise.

5. Consideration should be given to extending the analysis of Devon presented here to cover the whole of the South West, and possibly other agricultural regions. This is because similar threats and opportunities exist, and county borders are not particularly meaningful in terms of agricultural land and energy demand patterns. As a result the analysis presented here could be applied equally to Cornwall, Dorset, Gloucestershire, Somerset and Wiltshire. However, more coherent and useful results, along with economies of scale, could be achieved if the analysis was applied at a regional level, rather than being undertaken on a county by county basis with differing methodologies.

Guide to main report

For readers interested in the detailed findings (some of which are not covered in this summary), the main report is structured as follows:

Section 1

Background to the project, summary of the policy context, and review of the environmental impacts of energy crop cultivation.

Section 2

Review of the report 'Energy Crops in Cornwall': an analysis of the constraints and opportunities for energy crop cultivation in Cornwall, published in 2004.

Section 3

Explanation and detail of the GIS methodology and input data sources.

Section 4

Detailed results from the GIS modelling process.

Section 5

Discussion of key findings, conclusions, and recommendations.

Appendix 1

A review of guidance on the cultivation of energy crops.

Appendix 2

A review of literature regarding the environmental impacts of energy crop cultivation.

Appendix 3

Review of relevant policy and research.

Appendix 4

Detailed Landscape Sensitivity guidance for the Devon Landscape Types.