

DEPARTMENT OF TRADE & INDUSTRY

*Review of the Economic Case for
Energy Crops in the UK*

29 January 2004

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Background and Scope

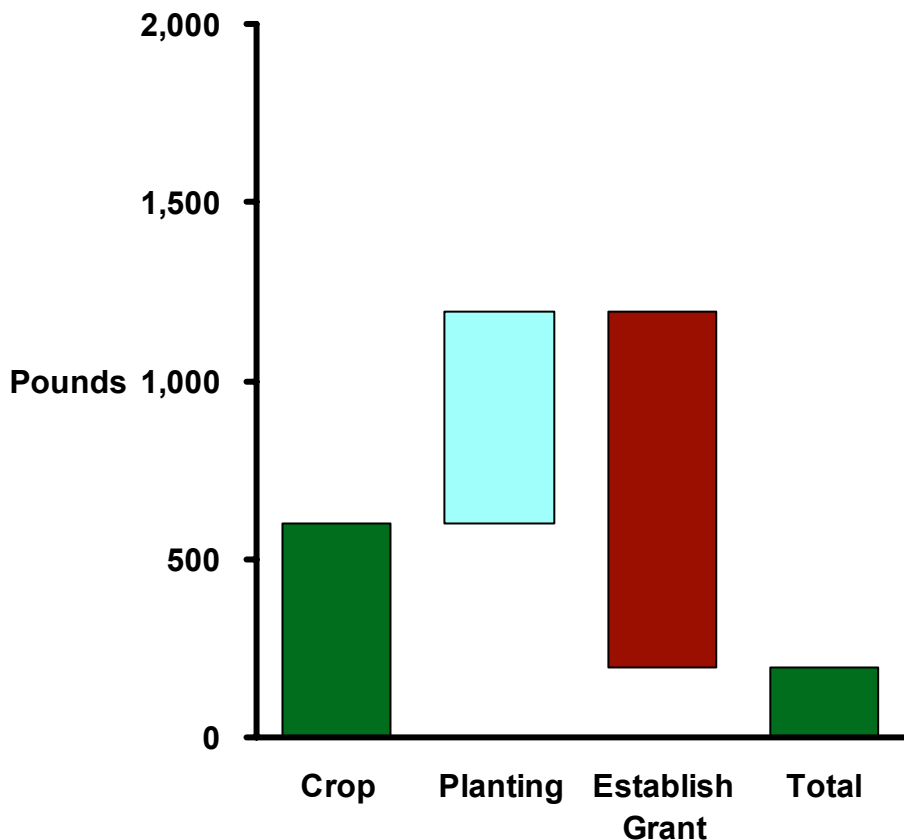
- **L.E.K. was asked to conduct a short review of E4Tech's work to address the following issues:**
 - **how far from economic viability is biomass in the UK today and what is required to break even?**
 - **what are the issues facing the fuel supply chain?**
 - **how could the development of the industry be catalysed?**

- **We focused specifically on energy crops (willow and miscanthus) and traditional combustion technology for electricity generation, carrying out:**
 - **an evaluation of the value chain and, in particular, the fuel source economics**
 - **interviews with 25 industry practitioners and financiers in both the UK and Continental Europe**
 - **a categorisation of the issues and discussion of potential solutions**

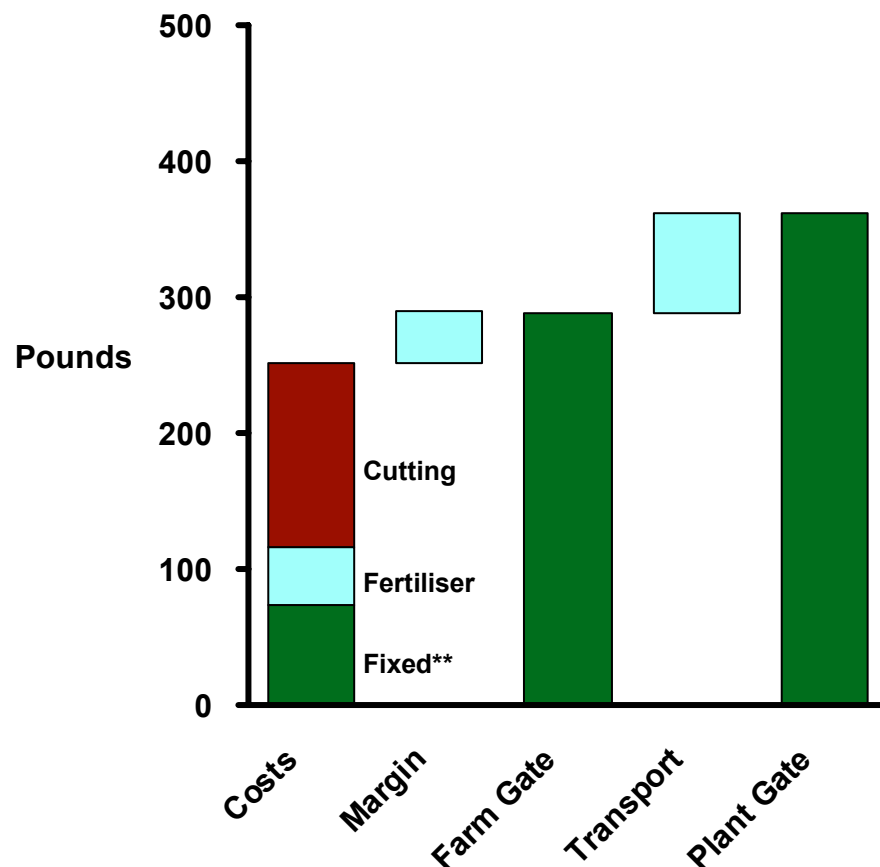
- **Our work was focused on addressing specific issues and augmenting the E4Tech work. It was not intended to be a comprehensive report on the whole of the biomass industry**

An evaluation of the farmers' economics for willow suggests that a margin of 15% would be possible at a "delivered price" of £40/odt

Farmer's Establishment Costs per Hectare - Willow



Typical Farmer Annual Costs per Hectare - Willow*



Note: * Harvested every 3 years at yield of 27.5 tonnes per Hectare; **Annual fixed costs consist of establishment costs for crop plus depreciation charge for farmer's share of harvesting equipment (on basis of machine cost of £200,000, 7 year life, harvesting 30 days per year and 5 ha/day)

Source : MAFF, E4Tech, DEFRA, L.E.K. analysis

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Based on E4Tech's original assumptions of flat ROCs at £35 / MWh and current energy crop yields, a 10MW willow combustion plant is uneconomic

Cashflow Profile of a 10MW Combustion Plant - Willow

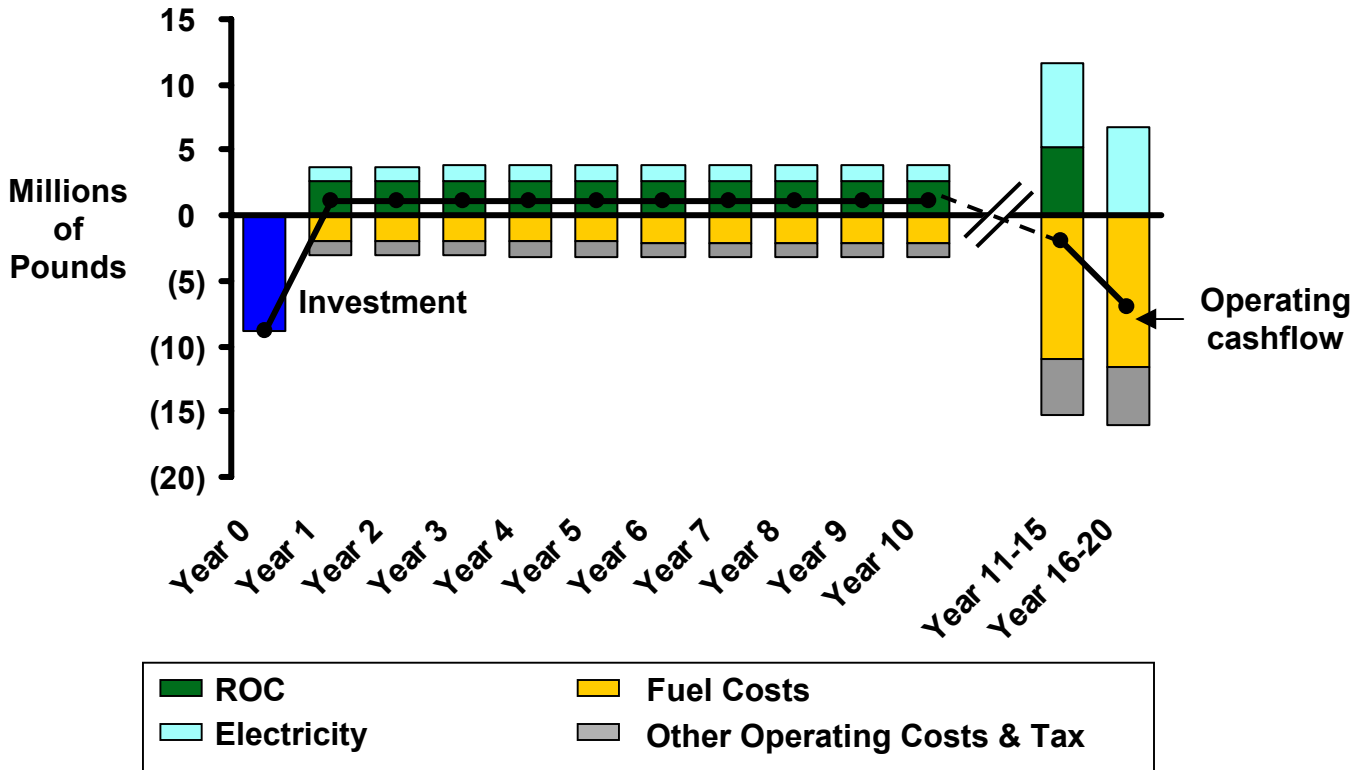
NPV until 2011:
(£2,463k)

NPV post 2011:
(£1,281k)

Total NPV:
(£3,744k)

35 35 35 35 35 35 35 35 35 35 35 7 0

E4Tech's view of ROC value*



Key Assumptions of "typical" case

● Investment		
- total Capex**	£/kW	880
- project length	Years	20
- discount rate	%	8
● Revenue		
- ROC		
- until 2011	£/MWh	35
- post 2011	£/MWh	35-0
- electricity	£/MWh	15
- CCL (constant)	£/MWh	-
● Operation		
- availability	%	85
- efficiency	%	30
- opex / revenue	%	3
- fuel price	£/odt	40
- average cost	p/kWh	4.03

Note : * as per E4tech assumptions with ROC retaining value until 2016; ** net of bio-energy capital grant;

Source : L.E.K. analysis

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However, by assuming market estimates of future ROC values and a 30% uplift in crop yield the 10MW willow combustion plant could become viable

ROC Values

- In the short / medium term, renewable energy supply is expected to fall short of the ROC targets hence causing market ROC values to be higher than £35M / MWh
- Oxera estimates of ROC values have been used, i.e. £48 - 20 /MWh 2005 - 2016

Crop Yield

- Interviewees expect significant yield improvements (e.g., double) to be possible
- A 30% uplift from the current yield has been used

“... New varieties could potentially double the yields seen from present crops...”

Defra

“... Significant yield improvements have already arisen from better husbandry, also, better yielding varieties of willow have been developed which we believe will further improve yields by 30% in the near future at a conservative estimate...”

Willow Crop Breeder

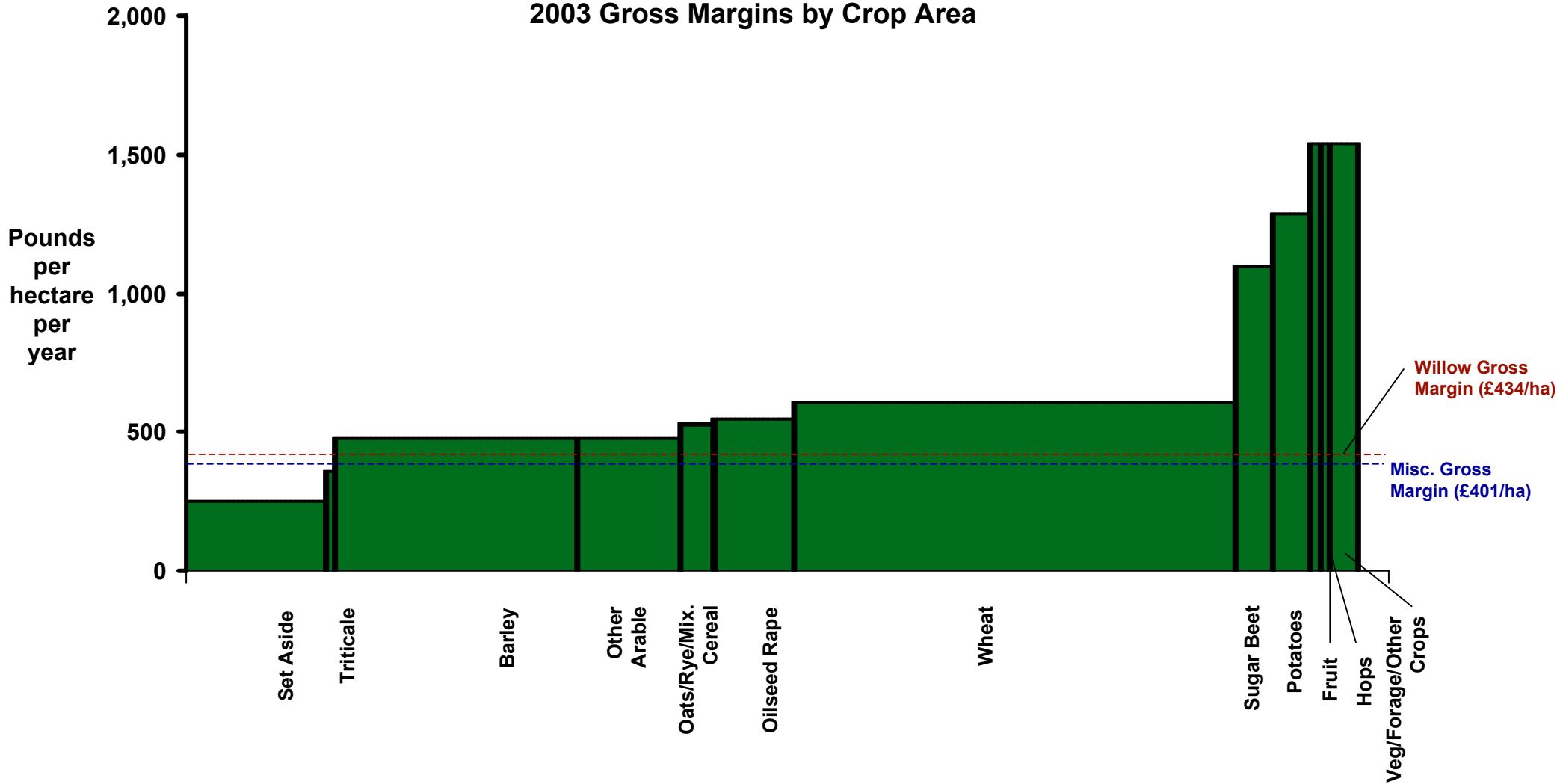
These assumptions create a positive value of £860k*

Note : * NPV of a 10MW willow combustion plant
Source : L.E.K. analysis

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Based on current yields, our estimates of the gross margin for the farmer suggest that energy crop production is only attractive using set aside land

2003 Gross Margins by Crop Area



Note: Total arable land in the UK equals 5,166k hectares
 Source: The Agricultural Budget and Costings Book (Nov 2003)

However, a 30% yield improvement improves the economics to a level that could potentially make willow an attractive alternative to barley

With Crop Yield Improvement

		Willow	Barley	Oats	Winter Wheat
Gross Output					
Yield/ha	[ODT/ha]	9	6	7	8
Assumed Price	[£/ODT]	39	69	65	80
Yield	[£/ha]	362	407	436	620
Area Payment	[£/ha]	250	250	250	250
Gross Output	[£/ha]	612	657	686	870
Variable Costs	[£/ha]	(178)	(184)	(160)	(265)
Gross Margin	[£/ha]	434	473	526	605

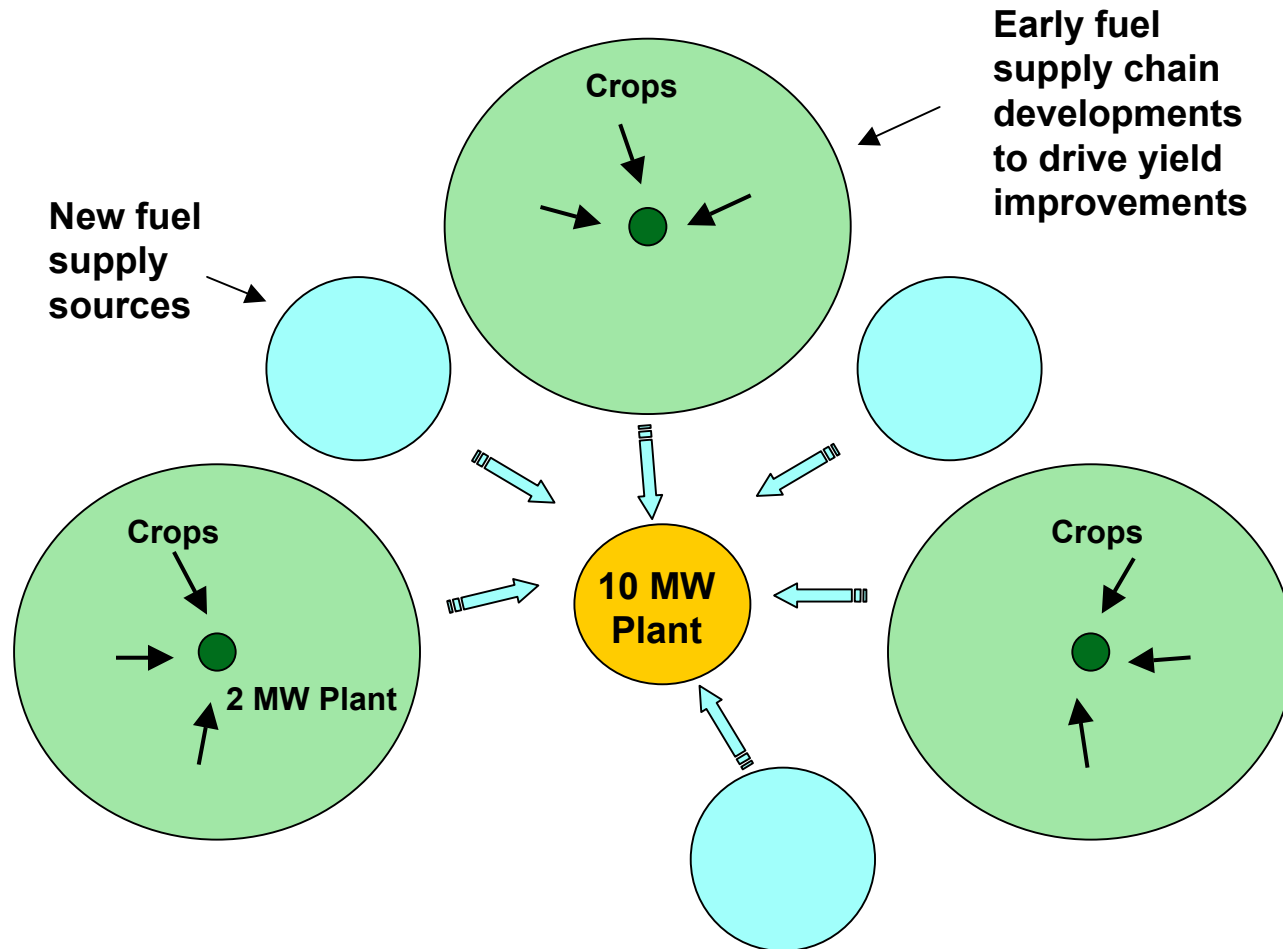
With Energy Crop Yield Improvement

Gross Margin	[£/ha]	500	473	526	605
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Barriers limiting crop yield improvements, as perceived by interviewees

- **Farmers have shown a real interest in developing energy crops (at £40/odt for willow) but are unwilling to take the risk without a bankable long-term contract**
- **At the same time, plant developers are unwilling to take the risk of building plant without the security of feedstock supply**
- **At present there is no intermediary to assist with risk sharing to create a market between the farmers and the plant developers and volumes and margins are not high enough to encourage them**
- **There are limited alternative uses for energy crops, although miscanthus is beginning to be used as horse bedding**
- **The failure of the Abre project has highlighted the risks associated with biomass projects and reduced confidence**

The encouragement of low capacity (2MW) plants might be an effective mechanism to develop the supply base and improve yields over time



Our assessment of the land requirement for energy crop production suggests that most locations in the UK could support up to 20-30MW of generating capacity fuelled by willow

		Proportion of Arable Land Available				
		40%	30%	20%	10%	5%
		Radius of Required Land (km)				
Plant Size (MW)	2	6	6	8	11	16
	5	9	10	12	18	25
	10	12	14	18	25	35
	20	18	20	25	35	50
	30	21	25	30	43	61

Implications of this energy crop development process

- **An additional subsidy of £2-3 per MWh over the life of the plant would create a positive NPV for a willow combustion electricity plant at today's yields**
- **50 2MW plants would require an additional subsidy of c.£2m per annum**
- **Each 2MW plant requires c.1000ha of land to deliver sufficient feedstock**
- **The total subsidy (including ROC) of £491 million would abate 87,321 tonnes of carbon per annum**
- **This equates to a cost of carbon abatement of £281 per tonne of carbon**