

UK: Inputs and notes

Table 1. General inputs and inputs for arable system

General			
Country	name	UK	
Currency units		£	
Exchange rate	€£	1.48	a
Single farm payment	£/ha	215.97	b
Land rent	£/ha	143.48	c
Other overheads	£/ha		

Physical production							
		Wheat	Oats	OSR	Sugar beet	Crambe	
Grain	t/ha	7.9	6.0	3.2	56.9	3.5	
Straw	t/ha	5.9	4.5	3.9		4.5	

Commodity output prices (at the "farm gate")								
		Wheat	Oats	OSR	Sugar beet	Crambe		
Grain	£/t	78.75	71.50	150.00	20.3	180.00	a	b
Straw	£/t	22.50	22.50	20.27		20.27	c	d

Input prices : paid by farmers

labour wage rate:	£/hr	11.61	a
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Note: including insurance and other employment costs

Agrichemical prices			
N	£/kg	0.45	b
P	£/kg	0.31	c
K	£/kg	0.24	d
Na	£/kg	0.09	e
S	£/kg	0.35	f

		Wheat	Oats	OSR	Sugar beet	Crambe		
Seeds	£/kg	0.26	0.25	4.98	130.00	6.00	g	h

Note: cost of planting material "units" for sugar beet

		Wheat	Oats	OSR	Sugar beet	Crambe		
Sprays (pesticides, herbicides, etc)	£/application	29.6	15.1	48.0	26.0	25.0	i	j

		Wheat	Oats	OSR	Sugar beet	Crambe		
Straw variable costs (baling string)	£/t	2	1.5	1.5		1.5	k	l

Physical inputs by crop: Quantities/ha

		Wheat	Oats	OSR	Sugar beet	Crambe		
Seeds	kg/ha	175	155	6	1	10	m	n

Note: number of planting material "units" for sugar beet

		Wheat	Oats	OSR	Sugar beet	Crambe		
N	kg/ha	165	110	210	100	130	o	p
P	kg/ha	45	45	40	50	40	q	r
K	kg/ha	45	45	40	90	40	s	t
Na	kg/ha				320		u	v
S	kg/ha					30		

		Wheat	Oats	OSR	Sugar beet	Crambe		
Sprays (pesticides, herbicides, etc)	applications/ha	4	4	2	5	2	w	xx

Table 2. Farm operations costs (machinery and labour assumed) used for developing fixed crop fixed costs (developed assuming data in Nix 2007 and ratios from the EU FADN for 2004)

Assumed ratio of UK to UK operations costs		1.00									
Currency ratio (£/£)		1									
	Cost	Wheat		Oats		OSR		Sugar beet		Crambe	
Cultivations	£/ha	Events	Cost	Events	Cost	Events	Cost	Events	Cost	Events	Cost
Ploughing (light/heavy soils)	43.8	1	43.8	1	43.8		0.0	1	43.8		0.0
Power harrowing	29.0	1	29.0	1	29.0	1	29.0		0.0	1	29.0
Seedbed harrowing	13.2		0.0		0.0	1	13.2	3	39.6	1	13.2
Rolling (flat 3-4 tonne)	22.5		0.0		0.0	1	22.5	1	22.5	1	22.5
Total cultivation costs		Total	72.8		72.8		64.7		105.9		64.7
Fertilizer distributing (including loading and carting):											
Broadcast (500-750 kg/ha)	10.0	1	10.0	1	10.0	1	10.0	1	10.0	1	10.0
Pneumatic (125-375 kg/ha)	14.0	3	42.0	3	42.0	2	28.0		0.0	1	14.0
Total fertiliser application costs		Total	52.0		52.0		38.0		10.0		24.0
Drilling											
Cereals: conventional	20.5	1	20.5	1	20.5	1	20.5		0.0	1	20.5
Sugar Beet - precision drill	36.4		0.0		0.0		0.0	1	36.4		0.0
Total drilling costs		Total	20.5		20.5		20.5		36.4		20.5
Spraying (excluding materials)											
(extra £1-£2 for < 20 ha)			0.0		0.0		0.0		0.0		0.0
Medium volume (200-300 l/ha)	9.0	4	36.0	4	36.0	2	18.0	5	45.0	1	9.0
Total spraying costs		Total	36.0		36.0		18.0		45.0		9.0
Combine harvesting											
200 ha/year	73.0	1	73.0	1	73.0		0.0		0.0		0.0
200 ha/year	80.3		0.0		0.0	1	80.3		0.0	1	80.3
Carting to barn add	15.0	1	15.0	1	15.0		0.0		0.0		0.0
Total combine costs		Total	88.0		88.0		80.3		0.0		80.3
Straw management costs											
Windrowing Oilseed Rape			0.0		0.0	1	43.0		0.0		0.0
Big baling (round) (per bale)	1.8	19	35.0	19	35.0		0.0		0.0		0.0
Total combine costs		Total	35.0		35.0		43.0		0.0		0.0
Crop collection and drying (inc. intake and pre-cleaning) (per tonne)											
Sugar beet complete harvesting (inc cart)	215.0		0.0		0.0		0.0	1	215.0		0.0
Crop collection and drying		Total	0.0		0.0		0.0		215.0		0.0

Table 3. Inputs for perennial systems

Rotations and harvests							
		Willow	Poplar	Miscanthus			
Typical rotation	years	16	16	16			
Typical year of first harvest	years	4	4	1			
Typical interval between harvest	years	3	3	1			
Physical production							
		Willow	Poplar	Miscanthus			
Biomass	t/harvest	27.20	22.40	10.37			
Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus							
Input prices							
		Willow	Poplar	Miscanthus			
Planting material	£/unit	0.045	0.045	0.090			
Note: The "unit" for the "planting material" is "cuttings" for willow and poplar, and "rhizomes" for miscanthus							
Output prices (at the "farm gate")							
		Willow	Poplar	Miscanthus			
Biomass	£/odt	35	35	35			
Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus							
Note: odt = oven dried tonne							
Physical inputs:							
		Willow	Poplar	Miscanthus			
Planting material	units/ha	15000	12000	20000			
Note: The "units" for the "planting material" will be "cuttings" for willow and poplar and "rhizomes" for miscanthus							
		Willow	Poplar	Miscanthus			
N	kg/ha	100	150	100			
P	kg/ha	10	29				
K	kg/ha	40	125				
Na	kg/ha						
S	kg/ha						
		Willow	Poplar	Miscanthus			
sprays (pesticides, herbicides, etc)	£/ha						
Plant protection (rabbit fencing)	£/ha	200	200				
Field operations: costs (labour and machinery):							
		Willow		Poplar		Miscanthus	
		types of machinery used	typical £/ha	types of machinery used	typical £/ha	types of machinery used	typical £/ha
Establishment operations:							
Ploughing							
Harrowing							
Ground preparation			130		130		120
Planting			285		285		300
Spraying			120		120		65
Mechanical weeding							
Fertiliser application							
Cutback			35		35		
Recurring operations:							
Spraying							
Fertiliser application							
Contracting - growing							
Harvesting			311		311		92
Field transport							
Handling and storage			163.2		134.4		41.48
Decommissioning			100		100		100

Notes for UK:**Arable crops:****General**

- a Exchange rate from Ask.com UK: <http://uk.ask.com/?o=0&l=dir#subject:curjpg:2> (March 2007)
- b The per hectare value of the single farm payment was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare crop + livestock payments for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area. (i.e. for all groups of farm sizes 1...n, average ((SE610*SYS02+SE615*SYS02)/(SE025*SYS02))
- c The per hectare value for land rent was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare rent for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average ((SE375*SYS02/SE030*SYS02)/SE025*SYS02))

Physical production

Yields: personal communication (Marcel Toonen, 2007). Straw values assume a ratio of 1.25 to grain and a straw recovery rate of 60%. Rapeseed and crambe straw yields are assumed to be 1.7 to grain yields with 1.5 tons of straw remaining in the field (Personal communication, Anders Carlsson, 2007).

Commodity output prices (at the "farm gate")

- a Wheat grain price given by Nix (2007). Grain prices vary from £75 t-1 (feed wheat) to £82.50 t-1 (milling wheat). The mid value between these two price is used.
- f Wheat straw prices given by Nix (2007). Straw prices typically range from £20 to £25 per tonne, but, can also range from £10 to £50 per tonne depending on season. The mid value between these two prices is used. (Standing straw prices are typically £8.6 t ha-1. But can vary from £0 to £43 per tonne depending on the season)
- b Oat grain prices are given by Nic (2007). Grain prices vary from £65 t-1 (feed oat) to £78.00 t-1 (milling oat). The mid value between these two price is used.
- g Oat straw prices typically range from £25 to £35 per tonne (Agro Buisness Consultants Ltd, 2006), but, can also range from £10 to £50 per tonne (Nix, 2007). The mid value (£30 t-1) is used.
- c Rapeseed prices (£150 t-1) are given by Nix (2007).
- h Rapeseed straw prices are given as €30/t (£20.27/t) by personal communication (Anders Carlsson, 2007)
- d Sugar beet prices, excluding the transport allowance, (£20.25 t-1) is given by Nix (2007) for 2007/08
- e Crambe prices (£180 t-1) are given by Nix (2007)
- i Crambe straw prices are given as €30/t (£20.27/t) by personal communication (Anders Carlsson, 2007)

Input prices : paid by farmers

- a Labour cost, including social security payments and employers liability insurance (£11.61 h-1) are given by Nix (2007, p132)
- b - f Fertiliser costs (N = £0.45 kg-1, P = £0.31 kg-1, K = £0.24 kg-1 are derived from Nix (2007, p222). For Na (£0.09 kg-1) and S (£0.24 kg-1) they are derived from Agro Buisness Consultants Ltd (2006)
- g - k All seed cost (wheat, oats, rapeseed and crambe) are given by Agro Buisness Consultants Ltd (2006). Sugar beet "unit" cost is also given by Agro Buisness Consultants Ltd (2006)
- l - p Crop spray costs (chemicals only) per application are derived from Nix (2007) by taking total cost of chemicals and dividing by number of sprays required (p 134 - 145)
- q - t Wheat and oat straw variable costs, considered to be baling string by Nix (2007) are given by Nix (2007). Rapeseed and crambe variable costs assumed as for oats

Physical inputs by crop: Quantities/ha

- a - e All seed rates (wheat, oats, rapeseed and crambe) are given by Agro Buisness Consultants Ltd (2006). Sugar beet "unit" rate is also given by Agro Buisness Consultants Ltd (2006)
- f - v All fertiliser rates are derived from Agro Buisness Consultants Ltd (2006)
- w - aa Crop spray rates are derived from Nix (2007 p 134 - 145)

Field operation costs (labour and machinery)

- A Field operation costs (labour and machinery) have been developed from Nix 2007 (p 156 - 159). They represent costs for the average farm in the UK.
- B Cost of machine operations include tractor and machinery fuel, repairs, and depreciation
- C The labour cost of these field operations has been derived from the hourly labour requirements given for each crop (p 134 - 145) and the assumed labour rate of £11.61 h-1 (p 133)
- D Field operation costs for crambe have been developed as suggested in Nix (2007), by assuming that they are similar to costs for spring rapeseed.

Perennial crops:**General**

As described for crops

Rotations and harvest

Personal communication (Marcel Toonen, 2007)

Physical production

Biomass values for each harvest derived from personal communication (Marcel Toonen, 2007)

Input prices

Price of planting material for willow and miscanthus is derived from Agro Buisness Consultants Ltd (2006). Price of poplar planting material is assumed to be the same as for willow.

Output prices

Value of crop biomass is given by the Scottish Agricultural College and Cambridge Univerity Report (2005)

Physical inputs

Planting units per hectare given by Marcel Toonen (personal communication, 2007)

Application rates for fertiliser given by Marcel Toonen (personal communication, 2007). Fertiliser application is assumed only for the first year as subsequent applications of sewage sludge after harvesting are reported by farmers to be provided free of cost (Scottish Agricultural College and Cambridge University Report (2005))

Physical plant protection cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Field operations: costs (labour and machinery):**Establishment operations:**

Ground preparation cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Planting cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Spraying cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Cutback cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Recurring operations:

Harvesting cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Handling and storage cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Decommissioning (spraying with glyphosate and harrowing with forestry specification power harrow) cost is given by the Scottish Agricultural College and Cambridge University Report (2005)

Scheduling of field operations is developed from on rotation length, initial harvest, and harvest frequency data provided by Marcel Toonen (personal communication, 2007).

References:

- 1 Nix, J. (2007). Farm Management Pocketbook, 37th edition, September 2006. Imperial College London, Wye Campus, UK
- 2 Agro Business Consultants (2006). The Agricultural Budgeting and Costing Book, 63rd edition, November 2006. Agro Business Consultants Ltd.
- 3 Scottish Agricultural College and University of Cambridge (2005). Farm level economic impacts of energy crop production. Final Report to Defra, (August 2005). Scottish Agricultural College (SAC), West Mains Road, Edinburgh, EH9 3JG. Rural Business Unit, Department of Land Economy, University of Cambridge, 19 Silver Street, Cambridge, CB3 9EP.
- 4 Stott, E. (2003). Straw availability in the UK. BioRegional Development Group. BedZED Centre, 24, Helios Road, Wallington, Surrey. SM6 7BZ. UK

Poland Inputs and notes

Table 1. General inputs and inputs for arable system

General			
Country	name	Poland	
Currency units		PLN	
Exchange rate	€PLN	0.26	a
Single farm payment	PLN/ha	364.00	b
Land rent	PLN/ha	140.00	c
Other overheads	PLN/ha		

Physical production										
		Wheat		Oats		OSR		Sugar beet		Crambe
Grain	t/ha	3.8		2.5		2.4		42.7		3
Straw	t/ha	2.9		1.9		2.6				3.6

Commodity output prices (at the "farm gate")											
		Wheat		Oats		OSR		Sugar beet		Crambe	
Grain	PLN/t	450	a	401	b	1008	c	105.5	d	1210	e
Straw	PLN/t	129	f	126	g	115	h			115	i

Input prices : paid by farmers			
labour wage rate:	PLN/hr	13.00	a

Note: including insurance and other other employment costs

Agrichemical prices			
N	PLN/kg	1.85	b
P	PLN/kg	2.14	c
K	PLN/kg	1.08	d
Na	PLN/kg	0.37	e
S	PLN/kg	1.44	f

		Wheat		Oats		OSR		Sugar beet		Crambe	
Seeds	PLN/kg	2.04	g	1.96	h	39.07	i	1020.00	j	47.08	k

		Wheat		Oats		OSR		Sugar beet		Crambe	
Sprays (pesticides, herbicides, etc)	PLN/application	47	l	24.0	m	76.2	n	41.2	o	39.7	p

		Wheat		Oats		OSR		Sugar beet		Crambe	
Straw variable costs (baling string)	PLN/t	5.36	q	4.02	r	4.02	s			4.02	t

Physical inputs by crop: Quantities/ha

		Wheat		Oats		OSR		Sugar beet		Crambe	
Seeds	kg/ha	125	a	111	b	4	c	1	d	7	e

		Wheat		Oats		OSR		Sugar beet		Crambe	
N	kg/ha	150	f	100	g	191	h	91	i	118	j
P	kg/ha	60	k	60	l	53	m	67	n	53	o
K	kg/ha	84	p	84	q	75	r	168	s	75	t
Na	kg/ha							320	u		
S	kg/ha									30	v

		Wheat		Oats		OSR		Sugar beet		Crambe	
Sprays (pesticides, herbicides, etc)	applications/ha	4	w	4	x	2	y	5	z	2	aa

Table 2. Farm operations costs (machinery and labour assumed) used for developing fixed crop fixed costs (developed assuming data in Nix 2007 and ratios from the EU FADN for 2004)

Assumed ratio of UK to Poland operations costs		0.54									
Currency ratio (PLN/£)		5.70									
	Cost	Wheat		Oats		OSR		Sugar beet		Crambe	
Cultivations	PLN/ha	Events	Cost	Events	Cost	Events	Cost	Events	Cost	Events	Cost
Ploughing (light/heavy soils)	134.7	1	134.7	1	134.7		0.0	1	134.7		0.0
Disk harrowing	47.7	1	47.7	1	47.7		0.0		0.0		0.0
Power harrowing	89.3		0.0		0.0	1	89.3		0.0	1	89.3
Seedbed harrowing	40.6		0.0		0.0	1	40.6	3	121.9	1	40.6
Rolling (flat 3-4 tonne)	69.3		0.0		0.0	1	69.3	1	69.3	1	69.3
Total cultivation costs		Total	182.4		182.4		199.1		325.8		199.1
Fertilizer distributing (including loading and carting):											
Broadcast (500-750 kg/ha)	30.8	1	30.8	1	30.8	1	30.8	1	30.8	1	30.8
Pneumatic (125-375 kg/ha)	43.1	3	129.3	3	129.3	2	86.2		0.0	1	43.1
Total fertiliser application costs		Total	160.1		160.1		117.0		30.8		73.9
Drilling											
Cereals: conventional	63.1	1	63.1	1	63.1	1	63.1		0.0	1	63.1
Sugar Beet - precision drill	112.0		0.0		0.0		0.0	1	112.0		0.0
Total drilling costs		Total	63.1		63.1		63.1		112.0		63.1
Spraying (excluding materials)											
Medium volume (200-300 l/ha)	27.7	4	110.8	4	110.8	2	55.4	5	138.5	1	27.7
Total spraying costs		Total	110.8		110.8		55.4		138.5		27.7
Combine harvesting											
200 ha/year	224.7	1	224.7	1	224.7		0.0		0.0		0.0
200 ha/year	247.2		0.0		0.0	1	247.2		0.0	1	247.2
Carting to barn add	46.2	1	46.2	1	46.2		0.0		0.0		0.0
Total combine costs		Total	270.9		270.9		247.2		0.0		247.2
Straw management costs											
Windrowing Oilseed Rape			0.0		0.0	1	132.4		0.0		0.0
Big baling (round) (per bale)	5.5	19	107.7	19	107.7		0.0		0.0		0.0
Total combine costs		Total	107.7		107.7		132.4		0.0		0.0
Crop collection and drying (inc. intake and pre-cleaning) (per tonne)											
Sugar beet complete harvesting (inc cart)	661.8		0.0		0.0		0.0	1	661.8		0.0
Crop collection and drying		Total	0.0		0.0		0.0		661.8		0.0

Table 3. Inputs for perennial systems**Rotations and harvests**

		Willow	Poplar	Miscanthus
Typical rotation	years	16	16	16
Typical year of first harvest	years	4	4	1
Typical interval between harvest	years	3	3	1

Physical production

		Willow	Poplar	Miscanthus
Biomass	t/harvest	28.80	32.00	16.98

Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus

Input prices

		Willow	Poplar	Miscanthus
Planting material	PLN/unit	0.25	0.25	0.50

Note: The "unit" for the "planting material" is "cuttings" for willow and poplar, and "rhizomes" for miscanthus

Output prices (at the "farm gate")

		Willow	Poplar	Miscanthus
Biomass	PLN/odt	165	165	165

Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus

Note: odt = oven dried tonne

Physical inputs:

		Willow	Poplar	Miscanthus
Planting material	units/ha	15000	12000	20000

Note: The "units" for the "planting material" will be "cuttings" for willow and poplar and "rhizomes" for miscanthus

		Willow	Poplar	Miscanthus
N	kg/ha	100	150	100
P	kg/ha	10	29	
K	kg/ha	40	125	
Na	kg/ha			
S	kg/ha			

		Willow	Poplar	Miscanthus
sprays (pesticides, herbicides, etc)	PLN/ha			
Plant protection (rabbit fencing)	PLN/ha			

Field operations: costs (labour and machinery):

	Willow		Poplar		Miscanthus	
	types of machinery used	typical PLN/ha	types of machinery used	typical PLN/ha	types of machinery used	typical PLN/ha
Establishment operations:						
Ploughing		135		135		135
Harrowing		48		48		48
Ground preparation						
Planting		616		616		648
Spraying		154		154		83
Mechanical weeding		220		220		220
Fertiliser application						
Cutback		88		88		
Recurring operations:						
Spraying		81		81		44
Fertiliser application						
Growing						
Harvesting		852		852		252
Field transport		173		192		102
Drying						
Decommissioning		308		308		308

Notes for Poland:**Arable crops:****General**

- a Exchange rate from Ask.com UK: <http://uk.ask.com/?o=0&l=dir#subject:cur|pg:2> (March 2007)
- b The per hectare value of the single farm payment was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare crop + livestock payments for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area. (i.e. for all groups of farm sizes 1...n, average $((SE610*SYS02+SE615*SYS02)/(SE025*SYS02))$)
- c The per hectare value for land rent was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare rent for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average $((SE375*SYS02/SE030*SYS02)/SE025*SYS02))$)

Physical production

Yields: personal communication (Marcel Toonen, 2007). Straw values assume a ratio of 1.25 to grain and a straw recovery rate of 60%. Rapeseed and crambe straw yields are assumed to be 1.7 to grain yields with 1.5 tons of straw remaining in the field (Personal communication, Anders Carlsson, 2007).

Commodity output prices (at the "farm gate")

- a - e Wheat grain price given by Ericsson et al. (2006). Oat, rapeseed prices are derived from FAO statistics for 2003, using the the ratios of oat and rapeseed prices in comparison with wheat, and the wheat price given by Ericsson et al. (2006). The minimum sugar beet price under the EU Sugar Reform was assumed (<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/05/1473&format=HTML&aged=0&language=EN&guiLanguage=en>). The crambe price is derived by using the ratio of crambe/oilseed prices in the UK and the price of oilseed derived for Poland.
- f - i Wheat straw prices were derived by assuming the wheat/straw price ratio and oat/straw price ratio for the UK. Rapeseed and crambe prices as sourced for UK.

Input prices : paid by farmers

- a Labour cost is from Ericsson et al. (2006).
- b - d Fertiliser costs were derived from Ericsson et al (2007) and Ericsson (2006)
- e - f It is assumed that Na and S will also be applied to sugar beet and crambe in Poland. The ratio of N/Na and N/S cost in the UK is used with the price of N in Poland.
- g - k Wheat seed cost were derived from Ericsson et al (2006). The cost of oat, rapeseed, and crambe seed and sugar beet units were derived by using the ratio of cost for wheat/oat, wheat/rapeseed, wheat/sugar beet and wheat/crambe in the UK and the cost of wheat seed given by Ericsson et al (2006)
- l - p Wheat spray costs were derived from Ericsson et al (2006). The cost of oat, rapeseed, sugar beet and crambe spray costs were derived by using the ratio of wheat/oat, wheat/rapeseed, wheat/sugar beet and wheat/crambe costs in the UK and the cost of wheat spray derived from Ericsson et al (2006)
- q - t Wheat and straw variable costs (given as baling string by Nix (2006)) were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the variable cost of wheat and oat straw in the UK and the ratio of total specific costs (SE281) in the UK and Poland for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE281*SYS02)/((SE035+SE041)*SYS02))$). Rapeseed and crambe variable costs assumed as for UK

Physical inputs by crop: Quantities/ha

- a - e The wheat seed rate was derived from Ericsson et al (2006). The rates for oat, rapeseed, and crambe and sugar beet "units" were derived by using the ratio of rates for wheat/oat, wheat/rapeseed, and wheat/crambe and wheat/sugar beet in the UK and the rate of wheat seed given by Ericsson et al (2006).
- f - v The fertiliser rate for wheat was derived from Ericsson et al (2006). The rates for N, P, and K for oat, rapeseed, and crambe and sugar beet were derived by using the ratio of rates for wheat/oat, wheat/rapeseed, and wheat/crambe and wheat/sugar beet in the UK and the rate of wheat fertilisers given by Ericsson et al (2006). The rate for Na and S was assumed as for the UK.
- w - aa All spray rates are assumed as for the UK and are derived from Nix (2007).

Field operation costs (labour and machinery)

- A Field operation costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the per hectare field operation costs for the UK and the per hectare weighted average ratio of fuel and energy costs (SE345) + contractor costs (SE350) in the UK and Poland for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE345+SE350)*SYS02)/(SE025*SYS02))$)
- B Cost of machine operations include tractor and machinery fuel, repairs, and depreciation
- C The labour cost of these field operations has been derived from the hourly labour requirements given for each crop in Nix (p 134 - 145) and the assumed labour rate of PLN13 h-1 (Ericsson, 2006)
- D Field operation costs for crambe have been developed as suggested in Nix (2007), by assuming that they are similar to costs for spring rapeseed.

Perennial crops:**General**

As described for crops

Rotations and harvest

Personal communication (Marcel Toonen, 2007)

Physical production

Biomass values for each harvest derived from personal communication (Marcel Toonen, 2007)

Input prices

The price of willow planting material (including transport) was derived from the values assumed for Germany with 10% extra assumed

for transport costs. The price of poplar and miscanthus planting material were derived by using the ratio of willow/poplar, and willow/miscanthus in the UK and the cost derived for willow planting material.

Output prices

The "MWh" value of biomass was given in Ericsson et al., (2006). The "MWh" value of biomass was converted to "odt" value for biomass by using an energy value of 18GJ/odt for willow (Ericsson, 2006) and assuming that 1 GJ is equivalent to 0.2778 MWh (<http://www.scotland.gov.uk/Publications/2006/09/22094104/3>), thus giving each tonne of willow an energy value of 5 MWh. The price of poplar and miscanthus biomass were derived by using the ratio of willow/poplar, and willow/miscanthus prices in the UK and the price of willow biomass given in Ericsson et al (2006).

Physical inputs

Planting units per hectare given by Marcel Toonen (personal communication, 2007)

Application rates for fertiliser given by Marcel Toonen (personal communication, 2007). Fertiliser application is assumed according to the schedule given by Ericsson et al (2006)

Field operations: costs (labour and machinery):

Establishment operations:

Ploughing costs are derived as described for arable field operation costs

Harrowing costs are derived as described for arable field operation costs

Planting cost is derived for willow from Ericsson et al (2006). The cost of poplar and miscanthus planting were derived by using the ratio of willow/poplar, and willow/miscanthus planting costs in the UK and the planting cost of willow given by Ericsson et al (2006).

Spraying cost is derived for willow from Ericsson et al (2006). The cost of poplar and miscanthus spraying were derived by using the ratio of willow/poplar, and willow/miscanthus spraying costs in the UK and the spraying cost of willow given by Ericsson et al (2006).

Mechanical weeding cost is for willow derived from Ericsson et al (2006). The cost of poplar and miscanthus mechanical weeding are assumed to be the same as for willow.

Cutback cost is derived for willow from Ericsson et al (2006). The cost of poplar cutback is assumed to be the same as for willow.

Recurring operations:

Spraying cost is derived for willow from Ericsson et al (2006). The cost of poplar and miscanthus spraying were derived by using the ratio of willow/poplar, and willow/miscanthus spraying costs in the UK and the spraying cost of willow given by Ericsson et al (2006).

Harvesting cost is derived for willow from Ericsson et al (2006). The cost of poplar and miscanthus harvesting were derived by using the ratio of willow/poplar, and willow/miscanthus harvesting costs in the UK and the harvesting cost of willow given by Ericsson et al (2006).

Field transport cost is derived per tonne for willow from Ericsson et al (2006). The cost of poplar and miscanthus harvesting is assumed to be the same per tonne as the cost for willow derived from Ericsson et al (2006).

Decommissioning costs are derived as for arable field operation costs

Scheduling of field operations is based on rotation length, initial harvest, and harvest frequency data provided by Marcel Toonen (personal communication, 2007). However, mechanical weeding, recurring spraying, manure and N, P, and K application are scheduled as described for willow in Ericsson et al. (2006). This schedule is assumed to be similar for poplar and miscanthus within the rotation lengths provided by Toonen.

References:

- 1 Ericsson, K., Rosenqvist, H., Ganko, K., Pisarek, M., Nilsson, L. (2000). An agro-economic analysis of willow cultivation in Poland. *Biomass and Bioenergy*, 30: 16 - 24.
- 2 Ericsson, K. (2006). Prospects for Bioenergy in Europe: Supply, Demand and Trade. Thesis submitted for the Degree of Doctor of Philosophy in Engineering. Institute of Technology, Environmental and Energy Systems Studies, Lund University, Lund, Sweden. P.O. Box 118, SE-22100
- 3 Nix, J. (2007). *Farm Management Pocketbook*, 37th edition, September 2006. Imperial College London, Wye Campus, UK
- 4 Agro Business Consultants (2006). *The Agricultural Budgeting and Costing Book*, 63rd edition, November 2006. Agro Business Consultants Ltd.
- 5 Scottish Agricultural College and University of Cambridge (2005). *Farm level economic impacts of energy crop production. Final Report to Defra*, (August 2005). Scottish Agricultural College (SAC), West Mains Road, Edinburgh, EH9 3JG. Rural Business Unit, Department of Land Economy, University of Cambridge, 19 Silver Street, Cambridge, CB3 9EP.

Germany: Inputs and notes

Table 1. General inputs and inputs for arable system

General			
Country	name	Germany	
Currency units		€	
Exchange rate	€/€	1.00	a
Single farm payment	€/ha	316.55	b
Land rent	€/ha	178.32	c
Other overheads	€/ha		

Physical production						
		Wheat	Oats	OSR	Sugar beet	Crambe
Grain	t/ha	7.2	4.7	3.3	57.8	3.0
Straw	t/ha	5.4	3.5	4.1		3.6

Commodity output prices (at the "farm gate")											
		Wheat	Oats	OSR	Sugar beet	Crambe					
Grain	€/t	106.06	86.97	221.67	27.4	266	a	b	c	d	e
Straw	€/t	30	27	30.00		30.00	f	g	h		i

Input prices : paid by farmers			
labour wage rate:	€/hr	13.90	a

Note: including insurance and other employment costs

Agrichemical prices			
N	€/kg	0.58	b
P	€/kg	0.40	c
K	€/kg	0.31	d
Na	€/kg	0.12	e
S	€/kg	0.45	f

		Wheat	Oats	OSR	Sugar beet	Crambe
Seeds	€/kg	0.31	0.30	5.92	154.51	7.13

		Wheat	Oats	OSR	Sugar beet	Crambe
Sprays (pesticides, herbicides, etc)	€/application	33.3	17.0	54.0	29.2	28.1

		Wheat	Oats	OSR	Sugar beet	Crambe
Straw variable costs (baling string)	€/t	2.52	1.89	1.89		1.89

Physical inputs by crop: Quantities/ha										
		Wheat	Oats	OSR	Sugar beet	Crambe				
Seeds	kg/ha	175	155	6	1	10				
N	kg/ha	165	110	210	100	130				
P	kg/ha	45	45	40	50	40				
K	kg/ha	45	45	40	90	40				
Na	kg/ha				320					
S	kg/ha					30				
Sprays (pesticides, herbicides, etc)	applications/ha	4	4	2	5	2				

Table 2. Farm operations costs (machinery and labour assumed) used for developing fixed crop fixed costs (developed assuming data in Nix 2007 and ratios from the EU FADN for 2004)

Assumed ratio of UK to Germany operations costs		1.25									
Currency ratio (€£)		1.48									
	Cost	Wheat		Oats		OSR		Sugar beet		Crambe	
Cultivations	€/ha	Events	Cost	Events	Cost	Events	Cost	Events	Cost	Events	Cost
Ploughing (light/heavy soils)	80.9	1	80.9	1	80.9		0.0	1	80.9		0.0
Power harrowing	53.7	1	53.7	1	53.7	1	53.7		0.0	1	53.7
Seedbed harrowing	24.4		0.0		0.0	1	24.4	3	73.3	1	24.4
Rolling (flat 3-4 tonne)	41.6		0.0		0.0	1	41.6	1	41.6	1	41.6
Total cultivation costs		Total	134.6		134.6		119.7		195.8		119.7
Fertilizer distributing (including loading and carting):											
Broadcast (500-750 kg/ha)	18.5	1	18.5	1	18.5	1	18.5	1	18.5	1	18.5
Pneumatic (125-375 kg/ha)	25.9	3	77.7	3	77.7	2	51.8		0.0	1	25.9
Total fertiliser application costs		Total	96.2		96.2		70.3		18.5		44.4
Drilling											
Cereals: conventional	37.9	1	37.9	1	37.9	1	37.9		0.0	1	37.9
Sugar Beet - precision drill	67.3		0.0		0.0		0.0	1	67.3		0.0
Total drilling costs		Total	37.9		37.9		37.9		67.3		37.9
Spraying (excluding materials)											
Medium volume (200-300 l/ha)	16.7	4	66.6	4	66.6	2	33.3	5	83.3	1	16.7
Total spraying costs		Total	66.6		66.6		33.3		83.3		16.7
Combine harvesting											
200 ha/year	135.1	1	135.1	1	135.1		0.0		0.0		0.0
200 ha/year	148.6		0.0		0.0	1	148.6		0.0	1	148.6
Carting to barn add	27.8	1	27.8	1	27.8		0.0		0.0		0.0
Total combine costs		Total	162.8		162.8		148.6		0.0		148.6
Straw management costs											
Windrowing Oilseed Rape			0.0		0.0	1	79.6		0.0		0.0
Big baling (round) (per bale)	3.3	19	64.8	19	64.8		0.0		0.0		0.0
Total combine costs		Total	64.8		64.8		79.6		0.0		0.0
Crop collection and drying (inc. intake and pre-cleaning) (per tonne)											
Sugar beet complete harvesting (inc cart)	397.8		0.0		0.0		0.0	1	397.8		0.0
Crop collection and drying (inc. intake and pre-cleaning) (per tonne)		Total	0.0		0.0		0.0		397.8		0.0

Table 3. Inputs for perennial systems

Rotations and harvests						
		Willow	Poplar	Miscanthus		
Typical rotation	years	16	16	16		
Typical year of first harvest	years	4	4	1		
Typical interval between harvest	years	3	3	1		

Physical production						
		Willow	Poplar	Miscanthus		
Biomass	t/harvest	25.60	28.80	17.25		

Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus

Input prices						
		Willow	Poplar	Miscanthus		
Planting material	€/unit	0.058	0.058	0.116		
Material transport	€/unit					

Note: The "unit" for the "planting material" is "cuttings" for willow and poplar, and "rhizomes" for miscanthus

Output prices (at the "farm gate")						
		Willow	Poplar	Miscanthus		
Biomass	€/odt	43	43	43		

Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus
 Note: odt = oven dried tonne

Physical inputs:						
		Willow	Poplar	Miscanthus		
Planting material	units/ha	15000	12000	20000		

Note: The "units" for the "planting material" will be "cuttings" for willow and poplar and "rhizomes" for miscanthus

Either:						
		Willow	Poplar	Miscanthus		
N	kg/ha	100	150	100		
P	kg/ha	10	29			
K	kg/ha	40	125			
Na	kg/ha					
S	kg/ha					

		Willow	Poplar	Miscanthus		
sprays (pesticides, herbicides, etc)	€/ha					
Plant protection (rabbit fencing)	€/ha	370	370			

Field operations: costs (labour and machinery):						
	Willow		Poplar		Miscanthus	
	types of machinery used	typical €/ha	types of machinery used	typical €/ha	types of machinery used	typical €/ha
Establishment operations:						
Ploughing						
Harrowing						
Ground preparation		240.5		240.5		222
Planting		527.25		527.25		555
Spraying		222		222		120
Mechanical weeding						
Fertiliser application						
Cutback		64.75		64.75		
Recurring operations:						
Spraying						
Fertiliser application						
Contracting - growing						
Harvesting		575		575		170
Field transport						
Handling and drying		284.16		319.7		128
Decommissioning		185		185		185

Notes for Germany:	
Arable crops:	
General	
a	Exchange rate from Ask.com UK: http://uk.ask.com/?o=0&l=dir#subject:cur pg:2 (March 2007)
b	The per hectare value of the single farm payment was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare crop + livestock payments for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area. (i.e. for all groups of farm sizes 1...n, average $((SE610*SYS02+SE615*SYS02)/(SE025*SYS02))$)
c	The per hectare value for land rent was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare rent for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average $((SE375*SYS02/SE030*SYS02)/SE025*SYS02))$)
Physical production	
Yields: personal communication (Marcel Toonen, 2007). Straw values assume a ratio of 1.25 to grain and a straw recovery rate of 60%. Rapeseed and crambe straw yields are assumed to be 1.7 to grain yields with 1.5 tons of straw remaining in the field (Personal communication, Anders Carlsson, 2007).	
Commodity output prices (at the "farm gate")	
a - e	Wheat grain price derived by taking the ratio of UK to German wheat prices from FAO statistics for 2003 and adjusting this to the wheat price in the UK for 2007 given by Nix (2007). Oat and rapeseed prices are derived from FAO statistics for 2003, using the ratios of oat and rapeseed prices in comparison with wheat prices, and the wheat price derived using the FAO UK/German wheat ratios and the Nix (2007) prices for wheat. The minimum sugar beet price for 2009 under the recent EU Sugar Reform was assumed (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/05/1473&format=HTML&aged=0&language=EN&guiLanguage=en). The crambe price was derived by the ratio of crambe/oilseed prices in the UK and the price of oilseed derived for Germany.
f - i	Wheat straw prices were derived by assuming the wheat/straw price ratio and oat/straw price ratio for the UK. Rapeseed and crambe prices as sourced for UK.
Input prices : paid by farmers	
a	Labour costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using ratio of the total wages paid (SE370) and the total number of paid hours (SE020) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average $((SE370*SYS02)/(SE020*SYS02))/SYS02))$ and the labour wage rate given by Nix (2007) in the UK for 2007.
b - d	Fertiliser costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the fertiliser costs in the UK and the per hectare ratio of total fertiliser costs (SE296) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE296*SYS02)/((SE035+SE041)*SYS02))$)
e - f	It is assumed that Na and S will also be applied to sugar beet and crambe in Germany.
g - k	Seed costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the seed costs in the UK and the per hectare ratio of seed and plant costs (SE285) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE285*SYS02)/((SE035+SE041)*SYS02))$)
l - p	Spray costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the spray costs in the UK and the per hectare ratio of spray costs (SE300) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE300*SYS02)/((SE035+SE041)*SYS02))$)
q - t	Wheat and straw variable costs (given as baling string by Nix (2006)) were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the variable cost of wheat and oat straw in the UK and the per hectare ratio of total specific costs (SE281) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE281*SYS02)/((SE035+SE041)*SYS02))$). Rapeseed and crambe variable costs assumed as for UK
Physical inputs by crop: Quantities/ha	
a - e	All seed rates (wheat, oats, rapeseed and crambe) and sugar beet "unit" rates are assumed as for the UK and are derived from Agro Business Consultants Ltd (2006).
f - v	All fertiliser rates are assumed as for the UK and are derived from Agro Business Consultants Ltd (2006).
w - aa	All spray rates are assumed as for the UK and are derived from Nix (2007).
Field operation costs (labour and machinery)	
A	Field operation costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the per hectare field operation costs for the UK and the per hectare weighted average ratio of fuel and energy costs (SE345) + contractor costs (SE350) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE345+SE350)*SYS02)/(SE025*SYS02))$)
B	Cost of machine operations include tractor and machinery fuel, repairs, and depreciation
C	The labour cost of these field operations has been derived from the hourly labour requirements given for each crop in Nix (p 134 - 145) and the assumed labour rate of €13.9 h-1
D	Field operation costs for crambe have been developed as suggested in Nix (2007), by assuming that they are similar to costs for spring rapeseed.
Perennial crops:	
General	
As described for crops	
Rotations and harvest	
Personal communication (Marcel Toonen, 2007)	

Physical production

Biomass values for each harvest derived from personal communication (Marcel Toonen, 2007)

Input prices

The cost of planting material was derived from the EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rca/dwh/index_en.cfm) using the planting material cost in the UK and the per hectare ratio of seed and plant costs (SE285) in the UK and Germany for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE285 * SYS02) / ((SE035 + SE041) * SYS02))$)

Output prices

The "MWh" value of biomass was given in the Ericsson et al., (2006). The "MWh" value of biomass was converted to "odt" value for biomass by using an energy value of 18GJ/odt for willow (Ericsson, 2006) and assuming that 1 GJ is equivalent to 0.2778 MWh (<http://www.scotland.gov.uk/Publications/2006/09/22094104/3>), thus giving each tonne of willow an energy value of 5 MWh. The price of poplar and miscanthus biomass were derived by using the ratio of willow/poplar, and willow/miscanthus prices in the UK and the price of willow biomass given in Ericsson et al (2006).

Physical inputs

Planting units per hectare given by Marcel Toonen (personal communication, 2007)

Application rates for fertiliser given by Marcel Toonen (personal communication, 2007). Fertiliser application is assumed according to the schedule given by Ericsson et al (2006)

Physical plant protection cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Field operations: costs (labour and machinery):**Establishment operations:**

Ground preparation cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Planting cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Spraying cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Cutback cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Recurring operations:

Harvesting cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Handling and storage cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Decommissioning cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Scheduling of field operations is developed from on rotation length, initial harvest, and harvest frequency data provided by Marcel Tooner (personal communication, 2007).

References:

- 1 Ericsson, K., Rosenqvist, H., Ganko, K., Pisarek, M., Nilsson, L. (2000). An agro-economic analysis of willow cultivation in Poland. *Biomass and Bioenergy*, 30: 16 - 24.
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Italy: Inputs and notes

Table 1. General inputs and inputs for arable system

General			
Country	name	Italy	
Currency units		€	
Exchange rate	€/€	1.00	a
Single farm payment	€/ha	554.23	b
Land rent	€/ha	333.02	c
Other overheads	€/ha		

Physical production						
		Wheat	Oats	OSR	Sugar beet	Crambe
Grain	t/ha	3.2	2.2	1.5	43.6	3.7
Straw	t/ha	2.4	1.7	1.1		4.8

Commodity output prices (at the "farm gate")									
		Wheat	Oats	OSR	Sugar beet	Crambe			
Grain	€/t	181.00	154.00	135.00	27.4	162			
Straw	€/t	65.00	55.00	30.00		30.00			

Input prices : paid by farmers

labour wage rate:	€/hr	13.96	a
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Note: including insurance and other employment costs

Agrichemical prices			
N	€/kg	0.60	b
P	€/kg	0.60	c
K	€/kg	0.60	d
Na	€/kg	0.13	e
S	€/kg	0.50	f

		Wheat	Oats	OSR	Sugar beet	Crambe
Seeds	€/kg	0.56	0.54	10.68	278.83	12.87

		Wheat	Oats	OSR	Sugar beet	Crambe
Sprays (pesticides, herbicides, etc)	€/application	32.0	16.3	51.9	28.1	27.0

		Wheat	Oats	OSR	Sugar beet	Crambe
Straw variable costs (baling string)	€/t	2.34	1.75	1.75		1.75

Physical inputs by crop: Quantities/ha

		Wheat	Oats	OSR	Sugar beet	Crambe
Seeds	kg/ha	180	159	6	1	10

		Wheat	Oats	OSR	Sugar beet	Crambe
N	kg/ha	190	127	242	162	180
P	kg/ha	45	30	57	88	100
K	kg/ha	35	35	31	212	150
Na	kg/ha				320	
S	kg/ha					30

		Wheat	Oats	OSR	Sugar beet	Crambe
Sprays (pesticides, herbicides, etc)	applications/ha	4	4	2	5	2

Table 2. Farm operations costs (machinery and labour assumed) used for developing fixed crop fixed costs (developed assuming data in Nix 2007 and ratios from the EU FADN for 2004)

Assumed ratio of UK to Italy operations costs	1.14										
Currency ratio (€£)	1.48										
	Cost	Wheat		Oats		OSR		Sugar beet		Crambe	
Cultivations	€/ha	Events	Cost	Events	Cost	Events	Cost	Events	Cost	Events	Cost
Ploughing (light/heavy soils)	73.8	1	73.8	1	73.8		0.0	1	73.8		0.0
Power harrowing	48.9	1	48.9	1	48.9	1	48.9		0.0	1	48.9
Seedbed harrowing	22.3		0.0		0.0	1	22.3	3	66.8	1	22.3
Rolling (flat 3-4 tonne)	38.0		0.0		0.0	1	38.0	1	38.0	1	38.0
Total cultivation costs		Total	122.7		122.7		109.2		178.6		109.2
Fertilizer distributing (including loading and carting):											
Broadcast (500-750 kg/ha)	16.9	1	16.9	1	16.9	1	16.9	1	16.9	1	16.9
Pneumatic (125-375 kg/ha)	23.6	3	70.9	3	70.9	2	47.2		0.0	1	23.6
Total fertiliser application costs		Total	87.7		87.7		64.1		16.9		40.5
Drilling											
Cereals: conventional	34.6	1	34.6	1	34.6	1	34.6		0.0	1	34.6
Sugar Beet - precision drill	61.4		0.0		0.0		0.0	1	61.4		0.0
Total drilling costs		Total	34.6		34.6		34.6		61.4		34.6
Spraying (excluding materials)											
Medium volume (200-300 l/ha)	15.2	4	60.7	4	60.7	2	30.4	5	75.9	1	15.2
Total spraying costs		Total	60.7		60.7		30.4		75.9		15.2
Combine harvesting											
200 ha/year	123.2	1	123.2	1	123.2		0.0		0.0		0.0
200 ha/year	135.5		0.0		0.0	1	135.5		0.0	1	135.5
Carting to barn add	25.3	1	25.3	1	25.3		0.0		0.0		0.0
Total combine costs		Total	148.5		148.5		135.5		0.0		135.5
Straw management costs											
Windrowing Oilseed Rape			0.0		0.0	1	72.5		0.0		0.0
Big baling (round) (per bale)	3.0	19	59.1	19	59.1		0.0		0.0		0.0
Total combine costs		Total	59.1		59.1		72.5		0.0		0.0
Crop collection and drying (inc. intake and pre-cleaning) (per tonne)											
Sugar beet complete harvesting (inc cart)	362.7		0.0		0.0		0.0	1	362.7		0.0
Total crop drying cost		Total	0.0		0.0		0.0		362.7		0.0

Table 3. Inputs for perennial systems

Rotations and harvests						
		Willow	Poplar	Miscanthus		
Typical rotation	years	16	16	16		
Typical year of first harvest	years	4	4	1		
Typical interval between harvest	years	3	3	1		

Physical production						
		Willow	Poplar	Miscanthus		
Biomass	t/harvest	28.80	32.00	18.14		

Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus

Input prices						
		Willow	Poplar	Miscanthus		
Planting material	€/unit	0.10	0.105	0.209		
Material transport	€/unit					

Note: The "unit" for the "planting material" is "cuttings" for willow and poplar, and "rhizomes" for miscanthus

Output prices (at the "farm gate")						
		Willow	Poplar	Miscanthus		
Biomass	€/odt	70	70	70		

Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus
 Note: odt = oven dried tonne

Physical inputs:						
		Willow	Poplar	Miscanthus		
Planting material	units/ha	15000	12000	20000		

Note: The "units" for the "planting material" will be "cuttings" for willow and poplar and "rhizomes" for miscanthus

		Willow	Poplar	Miscanthus		
N	kg/ha	100	150	100		
P	kg/ha	10	29			
K	kg/ha	40	125			
Na	kg/ha					
S	kg/ha					

		Willow	Poplar	Miscanthus		
sprays (pesticides, herbicides, etc)	€/ha					
Plant protection (rabbit fencing)	€/ha	337.44	337.44			

Field operations: costs (labour and machinery):						
	Willow		Poplar		Miscanthus	
	types of machinery used	typical €/ha	types of machinery used	typical €/ha	types of machinery used	typical €/ha
Establishment operations:						
Ploughing						
Harrowing						
Ground preparation		219		219		202
Planting		481		481		506
Spraying		202		202		110
Mechanical weeding						
Fertiliser application						
Cutback		59		59		
Recurring operations:						
Spraying						
Fertiliser application						
Contracting - growing						
Harvesting		525		525		155
Field transport						
Handling and drying		292		324		122
Decommissioning		169		169		169

Notes for Italy:	
Arable crops:	
General	
a	Exchange rate from Ask.com UK: http://uk.ask.com/?o=0&l=dir#subject:cur pg:2 (March 2007)
b	The per hectare value of the single farm payment was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare crop + livestock payments for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area. (i.e. for all groups of farm sizes 1...n, average $((SE610*SYS02+SE615*SYS02)/(SE025*SYS02))$)
c	The per hectare value for land rent was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare rent for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average $((SE375*SYS02/SE030*SYS02)/SE025*SYS02))$)
Physical production	
Yields: personal communication (Marcel Toonen, 2007). Straw values assume a ratio of 1.25 to grain and a straw recovery rate of 60%. Rapeseed and crambe straw yields are assumed to be 1.7 to grain yields with 1.5 tons of straw remaining in the field (Personal communication, Anders Carlsson, 2007).	
Commodity output prices (at the "farm gate")	
a - e	Wheat grain and oat grain are from personal communication (David Viaggio, 2007). Rapeseed prices was derived from FAO statistics for 2003, using the the ratio of rapeseed and wheat prices, and the wheat price given for Italy. The minimum sugar beet price for 2009 under the recent EU Sugar Reform was assumed (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/05/1473&format=HTML&aged=0&language=EN&guiLanguage=en). The crambe price was derived by using the ratio of crambe/oilseed prices in the UK and the price of oilseed derived for Italy.
f - i	Wheat straw and oat straw prices were given by personal communication (David Viaggio, 2007). Rapeseed and crambe prices as sourced for UK.
Input prices : paid by farmers	
a	Labour costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using ratio of the total wages paid (SE370) and the total number of paid hours (SE020) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average $((SE370*SYS02)/(SE020*SYS02))/SYS02))$ and the labour wage rate given by Nix (2007) in the UK for 2007.
b - d	Fertiliser costs for N, P, and K were given by personal communication (David Viaggio). Fertiliser cost for Na and S were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the Na and S costs in the UK and the per hectare ratio of total fertiliser costs (SE296) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE296*SYS02)/(SE035+SE041)*SYS02))$)
e - f	It is assumed that Na and S will also be applied to sugar beet and crambe in Italy.
g - k	Seed costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the seed costs in the UK and the per hectare ratio of seed and plant costs (SE285) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE285*SYS02)/(SE035+SE041)*SYS02))$)
l - p	Spray costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the spray costs in the UK and the per hectare ratio of spray costs (SE300) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE300*SYS02)/(SE035+SE041)*SYS02))$)
q - t	Wheat and straw variable costs (given as baling string by Nix (2006)) were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the variable cost of wheat and oat straw in the UK and the per hectare ratio of total specific costs (SE281) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE281*SYS02)/(SE035+SE041)*SYS02))$). Rapeseed and crambe variable costs assumed as for UK
Physical inputs by crop: Quantities/ha	
a - e	The wheat seed rate was given by personal communication (David Viaggio, 2007). The rates for oat, rapeseed, and crambe and sugar beet "units" were derived by using the ratio of rates for wheat/oat, wheat/rapeseed, and wheat/crambe and wheat/sugar beet in the UK and the rate of wheat seed given by personal communication (David Viaggio, 2007).
f - v	The fertiliser rate for wheat was derived by personal communication (David Viaggio, 2007). The rates of N, P, and K for oat, rapeseed, and crambe and sugar beet were derived by using the ratio of rates for wheat/oat, wheat/rapeseed, and wheat/crambe and wheat/sugar beet in the UK and the rate of wheat fertilisers given by personal communication (David Viaggio, 2007). The rate of Na and S was assumed as for the UK.
w - aa	All spray rates are assumed as for the UK and are derived from Nix (2007).
Field operation costs (labour and machinery)	
A	Field operation costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the per hectare field operation costs for the UK and the per hectare weighted average ratio of fuel and energy costs (SE345) + contractor costs (SE350) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE345+SE350)*SYS02)/(SE025*SYS02))$)
B	Cost of machine operations include tractor and machinery fuel, repairs, and depreciation
C	The labour cost of these field operations has been derived from the hourly labour requirements given for each crop in Nix (p 134 - 145) and the assumed labour rate of €13.96 h-1
D	Field operation costs for crambe have been developed as suggested in Nix (2007), by assuming that they are similar to costs for spring rapeseed.
Perennial crops:	
General	
As described for crops	

Rotations and harvest

Personal communication (Marcel Toonen, 2007)

Physical production

Biomass values for each harvest derived from personal communication (Marcel Toonen, 2007)

Input prices

The cost of planting material was derived from the EU Farm Accountancy Data Network for 2004

(http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the planting material cost in the UK and the per hectare ratio of seed and plant costs (SE285) in the UK and Italy for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE285 * SYS02) / ((SE035 + SE041) * SYS02))$)

Output prices

The "MWh" value of biomass was given in the European Bioenergy Network., (2003). The "MWh" value of biomass was converted to "odt" value for biomass by using an energy value of 18GJ/odt for willow (Ericsson, 2006) and assuming that 1 GJ is equivalent to 0.2778 MWh (<http://www.scotland.gov.uk/Publications/2006/09/22094104/3>), thus giving each tonne of willow an energy value of 5 MWh. The price of poplar and miscanthus biomass were derived by using the ratio of willow/poplar, and willow/miscanthus prices in the UK and the price of willow biomass given in European Bioenergy Network., (2003).

Physical inputs

Planting units per hectare given by Marcel Toonen (personal communication, 2007)

Application rates for fertiliser given by Marcel Toonen (personal communication, 2007). Fertiliser application is assumed according to the schedule given by Ericsson et al (2006)

Physical plant protection cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Field operations: costs (labour and machinery):**Establishment operations:**

Ground preparation cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Planting cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Spraying cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Cutback cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Recurring operations:

Harvesting cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Handling and storage cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Decommissioning cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Scheduling of field operations is developed from on rotation length, initial harvest, and harvest frequency data provided by Marcel Toonen (personal communication, 2007).

References:

- 1 Ericsson, K., Rosenqvist, H., Ganko, K., Pisarek, M., Nilsson, L. (2000). An agro-economic analysis of willow cultivation in Poland. *Biomass and Bioenergy*, 30: 16 - 24.
- 2 Ericsson, K. (2006). Prospects for Bioenergy in Europe: Supply, Demand and Trade. Thesis submitted for the Degree of Doctor of Philosophy in Engineering. Institute of Technology, Environmental and Energy Systems Studies, Lund University, Lund, Sweden. P.O. Box 118, SE-22100
- 3 Nix, J. (2007). Farm Management Pocketbook, 37th edition, September 2006. Imperial College London, Wye Campus, UK
- 4 Agro Business Consultants (2006). The Agricultural Budgeting and Costing Book, 63rd edition, November 2006. Agro Business Consultants Ltd.
- 5 Scottish Agricultural College and University of Cambridge (2005). Farm level economic impacts of energy crop production. Final Report to Defra, (August 2005). Scottish Agricultural College (SAC), West Mains Road, Edinburgh, EH9 3JG. Rural Business Unit, Department of Land Economy, University of Cambridge, 19 Silver Street, Cambridge, CB3 9EP.
- 6 European Bioenergy Networks. Fuel prices in Europe 2002/2003. Jyvaskyla, March 2003.

Sweden: Inputs and notes

Table 1. General inputs and inputs for arable system

General			
Country	name	Sweden	
Currency units		SWE	
Exchange rate	€SWE	0.11	a
Single farm payment	SWE/ha	2264.67	b
Land rent	SWE/ha	1117.84	c
Other overheads	SWE/ha		

Physical production										
		Wheat		Oats		OSR		Sugar beet		Crambe
Grain	t/ha	5.9		4		3.1		51		3
Straw	t/ha	4.4		3.0		3.8				3.6

Commodity output prices (at the "farm gate")											
		Wheat		Oats		OSR		Sugar beet		Crambe	
Grain	SWE/t	950	a	970	b	2140	c	305	d	2568	e
Straw	SWE/t	271	f	305	g	273	h			273	i

Input prices : paid by farmers

labour wage rate:	SWE/hr	170.48	a
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Note: including insurance and other other employment costs

Agrichemical prices			
N	SWE/kg	10.68	b
P	SWE/kg	13.05	c
K	SWE/kg	5.36	d
Na	SWE/kg	1.13	e
S	SWE/kg	4.38	f

		Wheat		Oats		OSR		Sugar beet		Crambe	
Seeds	SWE/kg	2.68	g	2.85	h	77.05	i	1436.00	j	61.85	k

		Wheat		Oats		OSR		Sugar beet		Crambe	
Sprays (pesticides, herbicides, etc)	SWE/application	112	l	38.3	m	420.0	n	190.8	o	312.0	p

		Wheat		Oats		OSR		Sugar beet		Crambe	
Straw variable costs (baling string)	SWE/t	23.66	q	17.75	r	17.75	s			17.75	t

Physical inputs by crop: Quantities/ha

		Wheat		Oats		OSR		Sugar beet		Crambe	
Seeds	kg/ha	190	a	170	b	8	c	1.2	d	11	e

		Wheat		Oats		OSR		Sugar beet		Crambe	
N	kg/ha	108	f	44	g	138	h	120	i	95	j
P	kg/ha	15	k	10	l	18	m	24	n	15	o
K	kg/ha	25	p	17	q	26	r	34	s	20	t
Na	kg/ha							320	u		
S	kg/ha									30	v

		Wheat		Oats		OSR		Sugar beet		Crambe	
Sprays (pesticides, herbicides, etc)	applications/ha	4	w	4	x	2	y	5	z	2	aa

Table 2. Farm operations costs (machinery and labour assumed) used for developing fixed crop fixed costs (developed assuming data in Nix 2007 and ratios from the EU FADN for 2004)

Assumed ratio of UK to Sweden operations costs	1.1										
Currency ratio (SWE/£)	13.8										
	Cost	Wheat		Oats		OSR		Sugar beet		Crambe	
Cultivations	SWE/ha	Events	Cost	Events	Cost	Events	Cost	Events	Cost	Events	Cost
Ploughing (light/heavy soils)	644.0	1	644.0	1	644.0		0.0	1	644.0		0.0
Power harrowing	426.9	1	426.9	1	426.9	1	426.9		0.0	1	426.9
Seedbed harrowing	194.3		0.0		0.0	1	194.3	3	582.9	1	194.3
Rolling (flat 3-4 tonne)	331.2		0.0		0.0	1	331.2	1	331.2	1	331.2
Total cultivation costs		Total	1070.9		1070.9		952.4		1558.1		952.4
Fertilizer distributing (including loading and carting):											
Broadcast (500-750 kg/ha)	147.2	1	147.2	1	147.2	1	147.2	1	147.2	1	147.2
Pneumatic (125-375 kg/ha)	206.1	3	618.2	3	618.2	2	412.2		0.0	1	206.1
Total fertiliser application costs		Total	765.4		765.4		559.4		147.2		353.3
Drilling											
Cereals: conventional	301.8	1	301.8	1	301.8	1	301.8		0.0	1	301.8
Sugar Beet - precision drill	535.8		0.0		0.0		0.0	1	535.8		0.0
Total drilling costs		Total	301.8		301.8		301.8		535.8		301.8
Spraying (excluding materials)											
Medium volume (200-300 l/ha)	132.5	4	529.9	4	529.9	2	265.0	5	662.4	1	132.5
Total spraying costs		Total	529.9		529.9		265.0		662.4		132.5
Combine harvesting											
200 ha/year	1074.6	1	1074.6	1	1074.6		0.0		0.0		0.0
200 ha/year	1182.0		0.0		0.0	1	1182.0		0.0	1	1182.0
Total combine costs		Total	1295.4		1295.4		1182.0		0.0		1182.0
Straw management costs											
Windrowing Oilseed Rape			0.0		0.0	1	633.0		0.0		0.0
Big baling (round) (per bale)	26.5	19	515.2	19	515.2		0.0		0.0		0.0
Total combine costs		Total	515.2		515.2		633.0		0.0		0.0
Crop collection and drying (inc. intake and pre-cleaning) (per tonne)											
Sugar beet complete harvesting (inc cart)	3164.8		0.0		0.0		0.0	1	3164.8		0.0
Total crop drying cost		Total	0.0		0.0		0.0		3164.8		0.0

Table 3. Inputs for perennial systems

Rotations and harvests							
		Willow	Poplar	Miscanthus			
Typical rotation	years	16	16	16			
Typical year of first harvest	years	4	4	1			
Typical interval between harvest	years	3	3	1			
Physical production							
		Willow	Poplar	Miscanthus			
Biomass	t/harvest	25.60	21.12	11.71			
Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus							
Input prices							
		Willow	Poplar	Miscanthus			
Planting material	SWE/unit	0.50	0.50	0.99			
Material transport	SWE/unit						
Note: The "unit" for the "planting material" is "cuttings" for willow and poplar, and "rhizomes" for miscanthus							
Output prices (at the "farm gate")							
		Willow	Poplar	Miscanthus			
Biomass	SWE/odt	607	607	607			
Note: Biomass is "woodchips" for willow and poplar, and miscanthus "straw" for miscanthus							
Note: odt = oven dried tonne							
Physical inputs:							
		Willow	Poplar	Miscanthus			
Planting material	units/ha	15000	12000	20000			
Note: The "units" for the "planting material" will be "cuttings" for willow and poplar and "rhizomes" for miscanthus							
		Willow	Poplar	Miscanthus			
N	kg/ha	100	150	100			
P	kg/ha	10	29				
K	kg/ha	40	125				
Na	kg/ha						
S	kg/ha						
		Willow	Poplar	Miscanthus			
sprays (pesticides, herbicides, etc)	SWE/ha						
Plant protection (rabbit fencing)	SWE/ha	2944	2944				
Field operations: costs (labour and machinery):							
		Willow		Poplar		Miscanthus	
		types of machinery used	typical SWE/ha	types of machinery used	typical SWE/ha	types of machinery used	typical SWE/ha
Establishment operations:							
Ploughing							
Harrowing							
Ground preparation			1914		1914		1766
Planting			4195		4195		4416
Spraying			1766		1766		957
Mechanical weeding							
Fertiliser application							
Cutback			515		515		
Recurring operations:							
Spraying							
Fertiliser application							
Growing							
Harvesting			4578		4578		1354
Field transport							
Drying			2261		1865		689
Decommissioning			1472		1472		1472

Notes for Sweden:	
Arable crops:	
General	
a	Exchange rate from Ask.com UK: http://uk.ask.com/?o=0&l=dir#subject:cur pg:2 (March 2007)
b	The per hectare value of the single farm payment was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare crop + livestock payments for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area. (i.e. for all groups of farm sizes 1...n, average $((SE610*SYS02+SE615*SYS02)/(SE025*SYS02))$)
c	The per hectare value for land rent was derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) assuming weighted average per hectare rent for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. for all groups of farm sizes 1...n, average $((SE375*SYS02/SE030*SYS02)/SE025*SYS02))$)
Physical production	
Yields: personal communication (Marcel Toonen, 2007 and Jan Van Beilen, 2007). Straw values assume a ratio of 1.25 to grain and a straw recovery rate of 60%. Rapeseed and crambe straw yields are assumed to be 1.7 to grain yields with 1.5 tons of straw remaining in the field (Personal communication, Anders Carlsson, 2007).	
Commodity output prices (at the "farm gate")	
a - e	Wheat grain, oat grain, rapeseed and sugar beet prices derived from the Agriwise database (Agriwise, 2007). The crambe price was derived by using the ratio of crambe/oilseed prices in the UK and the price of oilseed for Sweden.
f - i	Wheat straw prices were derived by assuming the wheat/straw price ratio and oat/straw price ratio for the UK. Rapeseed and crambe prices as sourced for UK.
Input prices : paid by farmers	
a	Labour cost were given by the the Agriwise database (Agriwise, 2007).
b - d	Fertiliser costs for N (average N cost for the different crops), P, and K were given by the Agriwise database (Agriwise, 2007). Fertiliser cost for Na and S were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the Na and S costs in the UK and the per hectare ratio of total fertiliser costs (SE296) in the UK and Sweden for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE296*SYS02)/((SE035+SE041)*SYS02))$)
e - f	It is assumed that Na and S will also be applied to sugar beet and crambe in Sweden.
g - k	Seed costs are given by the Agriwise database (Agriwise, 2007). The crambe seed cost was derived by using the ratio of crambe/wheat seed cost in the UK and the price of wheat given for Sweden.
l - p	Spray costs per application for wheat, oats, sugar beet and rapeseed were derived from the Agriwise database (Agriwise, 2007) and the total number of sprays assumed as for the UK (Nix, 2007). As per the suggestion in Nix (2007), crambe management was assumed to be similar to spring rapeseed management and cramber spray costs were therefore calculated assuming the spray cost for spring rapeseed
q - t	Wheat and straw variable costs (given as baling string by Nix (2006)) were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the variable cost of wheat and oat straw in the UK and the per hectare ratio of total specific costs (SE281) in the UK and Sweden for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE281*SYS02)/((SE035+SE041)*SYS02))$). Rapeseed and crambe variable costs assumed as for UK
Physical inputs by crop: Quantities/ha	
a - e	All seed rates (wheat, oats, rapeseed and crambe) and sugar beet "unit" rates are given by the Agriwise database (Agriwise, 2007). The crambe seed rate is derived by using the ratio of crambe/wheat seed rates in the UK and the seed rate of wheat given for Sweden.
f - v	The fertiliser rates for N, P, and K are given by the Agriwise database (Agriwise, 2007). The rate of Na and S is assumed as for the UK.
w - aa	All spray rates are assumed as for the UK and are derived from Nix (2007).
Field operation costs (labour and machinery)	
A	Field operation costs were derived from EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the per hectare field operation costs for the UK and the per hectare weighted average ratio of fuel and energy costs (SE345) + contractor costs (SE350) in the UK and Sweden for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE345+SE350)*SYS02)/(SE025*SYS02))$)
B	Cost of machine operations include tractor and machinery fuel, repairs, and depreciation
C	The labour cost of these field operations has been derived from the hourly labour requirements given for each crop in Nix (p 134 - 145) and the assumed labour rate of €168 h-1
D	Field operation costs for crambe have been developed as suggested in Nix (2007), by assuming that they are similar to costs for spring rapeseed.
Perennial crops:	
General	
As described for crops	
Rotations and harvest	
Personal communication (Marcel Toonen, 2007)	
Physical production	
Biomass values for each harvest derived from personal communication (Marcel Toonen, 2007)	
Input prices	
The cost of planting material was derived from the EU Farm Accountancy Data Network for 2004 (http://ec.europa.eu/agriculture/rica/dwh/index_en.cfm) using the planting material cost in the UK and the per hectare ratio of seed and plant costs (SE285) in the UK and Sweden for all "Cereal, oilseed and protein crops" farms greater than 100 ha in area (i.e. in each country, for all groups of farm sizes 1...n, average $((SE285*SYS02)/((SE035+SE041)*SYS02))$)	

Output prices

The "MWh" value of biomass was given in the Ericsson et al., (2006). The "MWh" value of biomass was converted to "odt" value for biomass by using an energy value of 18GJ/odt for willow (Ericsson, 2006) and assuming that 1 GJ is equivalent to 0.2778 MWh (<http://www.scotland.gov.uk/Publications/2006/09/22094104/3>), thus giving each tonne of willow an energy value of 5 MWh. The price of poplar and miscanthus biomass were derived by using the ratio of willow/poplar, and willow/miscanthus prices in the UK and the price of willow biomass given in Ericsson et al (2006).

Physical inputs

Planting units per hectare given by Marcel Toonen (personal communication, 2007)

Application rates for fertiliser given by Marcel Toonen (personal communication, 2007). Fertiliser application is assumed according to the schedule given by Ericsson et al (2006)

Physical plant protection cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Field operations: costs (labour and machinery):**Establishment operations:**

Ground preparation cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Planting cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Spraying cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Cutback cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Recurring operations:

Harvesting cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Handling and storage cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Decommissioning cost is assumed as for the UK and adjusted as for the arable field operation costs (see A)

Scheduling of field operations is developed from on rotation length, initial harvest, and harvest frequency data provided by Marcel Toonen (personal communication, 2007).

References:

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