Table 1 **UK Carbon Emissions Targets**

Label	Date Year	Emissions MtC/y
Actual	1990	164
Actual	2000	152
UK Govt.	2010	132
Kyoto	2012	144
RCEP	2050	62
RCEP	2100	31

Table 3 - Carbon Savings for Various Options Supplying Useful Heat of 229 TWh/y v Gas Boilers at 0.65, and Gas or Mix Electricity

Heating by Energy Carrier		**Boiler** Nat. Gas	**Micro-CHP** Nat. Gas	**Boiler** Hydrogen	**Micro-CHP** Hydrogen	**Fuel Cell** Hydrogen	**DH-CHP** Hot Water
Domestic Heat (useful) Net	TWh/y	228.8	228.8	228.8	228.8	228.8	228.8
Carbon Emissions for Gas Boilers	MtC/y	19.2	19.2	19.2	19.2	19.2	19.2
Carbon Savings v Gas Heat and Electricity	MtC/y	0.0	7.3	-8.2	-1.1	1.2	14.5
Carbon Savings v Gas Heat and Electricity	%	0.0	37.9	-42.9	-5.5	6.2	75.4
Specific Carbon Savings v Gas Heat and Electricity	gC/kWh th	0.0	31.8	-35.9	-4.6	5.2	63.2
Carbon Savings v Gas Heat & Mix Electricity	MtC/y	0.0	8.2	-8.2	0.0	5.4	24.5
Carbon Savings v Gas Heat & Mix Electricity	%	0.0	42.9	-42.9	-0.2	28.3	127.9
Specific Carbon Savings v Gas Heat & Mix Electricity	gC/kWh th	0.0	36.0	-35.9	-0.2	23.8	107.2

Table 6 **Energy Crops for the UK**

Attribute	Unit	Wheat (whole)	Miscanthus	SRC Willow
Grassy or Woody	none	Grassy	Grassy	Woody
C3 or C4	none	C3	C4	C3
Time to first crop	years	1	2	4
Crop interval	years	1	1	3
Yield	ODT/ha,y		up to 13, or 20	7 to 12
Net Calorific Value, dry	MJ/kg		17	17
Net Calorific Value, dry	toe/t		0.41	0.41
Gross Yield	toe/ha,y	4.1	up to 5.3, or 8.1	2.8 to 4.9
Inputs	toe/ha,y	0.42		
Net Yield	toe/ha,y	3.68	up to 8.12	
Net Solar Conversion Effy	%	0.52	0.67 to 1.0	

Table 7 - Transport Fuel Properties

Fuel	GCV MJ/kg	GCV MJ/l	NCV MJ/kg	NCV MJ/l	Mol. Wt.	C atoms Number	C Intensity kg C/kg	C Index g C/MJ	Boiling Pt. C	State
Hydrogen (gas)	136.8	0.01	120.0	0.0106	2.02	0	0.000	0.00	-253.0	Gas
Methane (gas)	53.4	0.04	48.1	0.035	16.04	1	0.748	15.55	-161.5	Gas
Propane (liquid)	50.2	25.4	46.1	23.6	44.09	3	0.817	17.71	-42.3	Gas
Methanol	22.7	17.9	19.9	15.8	32.04	1	0.375	18.82	64.7	Liquid
Ethanol	29.7	23.4	26.7	21.2	46.07	2	0.521	19.51	78.5	Liquid
Petrol	43.7-47.4	34.8	41.8-44.2	32.0	mixture	5 to 10	0.865	20.12	range	Liquid
Diesel	44.6-46.5	38.7	41.8-44.2	35.8	mixture	15 to 25	0.855	19.88	range	Liquid

Table 8 - Crops for Biofuels for Transport

		Oil Seed Rape	Winter Wheat	Wheat	Sugar Beet
Author		I.R. Richards		Bekers & Viesteurs	
Ref.		Levington study		icibs paper	
Item	Units				
Product fuel		R. M. E.	Ethanol	Ethanol	Ethanol
Yield of fuel	l/ha	1776	3130	2081	4755
Yield of fuel	MJ/ha	54346	74189		
Input Energy Cost	MJ/ha	31162	68257		
Output fuel/Input Cost	ratio	1.74	1.09	1.14	1.63
Fuel + Straw - Cost	MJ/ha	84500	103432		
(Fuel + Straw - Cost)/Input Cost	ratio	3.67	2.52		

Table 9 - Possible Tradable Fuels

Attribute	Unit	Coal	Pet. Oil	Nat. Gas	Bioethanol home	Bioethanol imported	Hydrogen	Hydrogen
Produced with		Heat, Pressure and Time			Sunlight	Sunlight	Nat. Gas	Ren. En.
Carbon Intensity	tC/toe	1.03-1.06	0.86	0.63	-0.34	0	~0.9	0
Gross Calorific Value	toe/t	~0.73	1	1.27	0.71	0.71	3.27	3.27
Gross Calorific Value	toe/m3	voids	0.8	gaseous	0.56	0.56	gaseous	gaseous
Internal Combustion		No	Yes	Yes	Yes	Yes	Yes	Yes

Table 10 - Energy Storage Options

Energy Form	Heat	Fuel	Fuel	Fuel	Electricity	Electricity
Means	Hot Water	Hydrogen	Hydrogen	Ethanol	Pumped Storage	Regen. Fuel Cell
State		Compressed	Liquefied	Liquid		
Energy Density	Varies	Very Low	Low	High	Varies	?
Charge Efficiency	High	High	Medium	Medium	High	High
Standing losses	Low	Low	High	Very low	Very low	Very Low ?
Discharge Efficiency	High	Low	Low	Low	High	High
Charge/Discharge Efficiency	High	Low	Very Low	Low	High	High

Table 12 - UK Energy Trade-offs, Gordon Taylor, 18 November 2003

Model 15 (with changes to Final Elec and Net gas for Ethanol Synthesis)

Oil ratio	Gas ratio	Land fraction	Renewable Electricity TWh/y	Imported Ethanol mtoe/y	Elec. Htg. fraction	DH Extent fraction	Primary mtoe/y	F/P fraction	Renew. mtoe/y	R/P fraction	Deplet. mtoe/y	D/P fraction
0.17	0.828	0	0	30.6	1	0.28	126.2	0.8	34.4	0.273	91.8	0.727
0.17	0.828	0.1	0	22.8	1	0.28	126	0.8	34.2	0.271	91.8	0.729
0.17	0.828	0.2	0	17.8	1	0.28	126	0.8	34.2	0.271	91.8	0.729
0.17	0.828	0	50	25.8	1	0.35	125.7	0.8	34	0.270	91.7	0.730
0.17	0.828	0.1	50	21.2	0.79	0.46	127.1	0.79	35.4	0.278	91.7	0.721
0.17	0.828	0.2	50	16.7	0	0.51	128.6	0.78	36.8	0.286	91.8	0.714
0.17	0.828	0	100	25	0	0.59	129.2	0.78	37.4	0.290	91.8	0.711
0.17	0.828	0.1	100	20.5	0	0.66	130.7	0.77	39	0.298	91.7	0.702
0.17	0.828	0.2	100	16	0	0.73	132.3	0.76	40.5	0.306	91.8	0.694
0.17	0.823	0	185.3	23.7	0	1.00	136.1	0.74	44.8	0.329	91.3	0.671
0.17	0.804	0.1	200	19.4	0	1.00	136	0.74	46.5	0.342	89.5	0.658
0.17	0.785	0.2	200	15.1	0	1.00	135.9	0.74	48.2	0.354	87.7	0.645