

# WASTE UTILISATION IN THE UK

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# SUMMARY

In 2008, the UK produced some 120 million tonnes of Household (MSW), Commercial and Industrial (C&I), and Agricultural Waste.

Of the 120 million tonnes, approximately 60 million tonnes (50%) was diverted for composting or recycling – leaving the remaining (or residual) 60 million tonnes (50%) to go to landfill or incineration. The energy content of the residual waste is approximately 571,000 TJ.

Given the potentially high value of waste as a source of energy, it is worth considering diverting the waste stream away from composting and into energy conversion. This additional stream of waste amounts to approximately 9.6 million tonnes, or an additional 134,000 TJ.

The total energy content of the residual and un-composted waste is approximately 705,000 TJ, and has a notional substitutional value of between £1.3 and £7.2 billion per year (based upon the current cost of common sources of energy).

	BASE CASE	STRETCH
total energy content of the waste stream	571,000 TJ	705,000 TJ
<b>annual value of the energy from the waste stream</b>	<b>£1.1 to £5.8 billion pa</b>	<b>£1.3 to £7.2 billion pa</b>
ethanol demand for substitution in transportation fuels	all	all
% of UK's electricity demand	4% to 14%	5% to 18%
% of UK's electricity demand after meeting all ethanol demand	3% to 13%	4% to 16%

# HOUSEHOLD WASTE

In 2008, the UK produced some 31.5 million tonnes of household waste (or MSW)<sup>1</sup>.

Approximately 9.4 million tonnes (30%) was diverted for composting or recycling – leaving the remaining (or residual) 22.1 tonnes (70%) to go to landfill or incineration.

**The energy content of the residual waste is approximately 228,999 TJ (or 10.32 TJ per each kilo-tonne of waste).**

WASTE TYPE <sup>2</sup>	TOTAL MSW in 2008		MSW RECYCLED or COMPOSTED		MSW RESIDUAL		CALORIFIC VALUE OF RESIDUAL MSW		
	kt	%	kt	%	kt	%	TJ / kt	TJ	%
Paper / Card	6,165	20%	2,256	24%	3,908	18%	17.23	67,343	29%
Putrescible	12,534	40%	4,351	46%	8,183	37%	6.55	53,599	23%
Textiles	959	3%	296	3%	663	3%	16.12	10,691	5%
Fines	1,114	4%	-	0%	1,114	5%	7.39	8,232	4%
Misc. Combustible	2,776	9%	207	2%	2,570	12%	9.25	23,768	10%
Misc. non-Combustible	1,196	4%	70	1%	1,127	5%	-	-	0%
Metals	2,175	7%	739	8%	1,436	6%	-	-	0%
Glass	2,259	7%	999	11%	1,261	6%	-	-	0%
Plastics	2,361	7%	479	5%	1,882	9%	34.51	64,961	28%
<b>Total</b>	<b>31,539</b>		<b>9,395</b>		<b>22,144</b>			<b>228,594</b>	
<b>Average</b>							<b>10.32</b>		

# COMMERCIAL & INDUSTRIAL WASTE

In 2008, the UK produced some 67.3 million tonnes of Commercial and Industrial (C&I) waste<sup>1</sup>.

Approximately 30.2 million tonnes (45%) was diverted for composting or recycling – leaving the remaining (or residual) 37.1 tonnes (55%) to go to landfill or incineration.

**The energy content of the residual waste is approximately 334,224 TJ (or 9.00 TJ per each kilo-tonne of waste).**

WASTE TYPE <sup>2</sup>	TOTAL C&I in 2008		RECYCLED or COMPOSTED		RESIDUAL C&I		CALORIFIC VALUE OF RESIDUAL		
	kt	%	kt	%	kt	%	TJ / kt	TJ	%
Inert / C&D	2,138	3%	867	3%	1,271	3%	-	-	0%
Paper & Card	4,714	7%	4,478	15%	236	1%	16.50	3,889	1%
Food	2,327	3%	1,831	6%	495	1%	6.50	3,220	1%
General C&I	25,480	38%	2,169	7%	23,311	63%	12.75	297,216	89%
Other General & Biodegr.	7,894	12%	4,747	16%	3,147	8%	9.50	29,899	9%
Metals & Scrap Equip	4,305	6%	4,090	14%	215	1%	-	-	0%
Contaminated General	3,606	5%	1,489	5%	2,117	6%	-	-	0%
Mineral Waste & Residue	11,507	17%	9,144	30%	2,363	6%	-	-	0%
Chemical & Other	5,335	8%	1,337	4%	3,998	11%	-	-	0%
<b>Total</b>	<b>67,305</b>		<b>30,152</b>		<b>37,153</b>			<b>334,224</b>	
<b>Average</b>							<b>9.00</b>		

# AGRICULTURAL WASTE

UK's generation of Agricultural Waste is remarkably difficult to quantify. This is largely due to much of the Agricultural Waste being reused as either compost or silage. Estimates range 12 to 30 million tonnes per year – with up to 0.5 million tonnes showing up in the official DEFRA statistics.

Assuming that the residual 0.5 million tonnes per annum quoted in DEFRA statistics goes to landfill or incineration as residual waste, then it is reasonable to assume that the remainder of the 12 to 30 million tonnes is utilised for compost or silage.

**The energy content of the residual waste is approximately 8,615 TJ (or 17.23 TJ per each kilo-tonne of waste).**

WASTE TYPE	TOTAL AGWASTE in 2008		RECYCLED or COMPOSTED		RESIDUAL		CALORIFIC VALUE OF RESIDUAL		
	kt	%	kt	%	kt	%	TJ / kt	TJ	%
Low estimate	12,000	-	19,500	96%	500	4%	17.23	8,615	-
High estimate	30,000	-	29,500	98%	500	2%	17.23	8,615	-
<b>Average</b>	<b>21,000</b>		<b>20,500</b>		<b>500</b>		<b>17.23</b>	<b>8,615</b>	

# UK ENERGY PRODUCTION

In 2008, the UK produced some 389,366 GWh of electricity – 2,871 GWh (10,335 TJ) or 0.7% was produced from waste<sup>3</sup>.

In the same period the UK consumed some 16.6 million tonnes of oil for transportation<sup>3</sup>. Substituting 5% of this quantity with ethanol (as already happens in some parts of the UK, and will be mandated from 2013) requires approximately 0.83 million tonnes of ethanol per year (or 22,244 TJ).

**The total energy content of the residual waste is 571,434 TJ. Full utilisation of waste can supply 4% to 14% of UK's electricity needs, or all of its ethanol needs for transportation fuels.**

TECHNOLOGY	CONVERSION EFFICIENCY	POTENTIAL ENERGY PRODUCTION		POTENTIAL SHARE OF CURRENT ENERGY
	%	TJ	GWh	%
<b>Power Generation</b>				
Anaerobic Digestion	15%	87,315	24,256	6%
Pyrolysis / Gasification	30%	169,266	47,022	12%
Incineration	27%	153,176	42,552	11%
LFG to Energy	9%	53,419	14,840	4%
MBT-derived RDT	35%	199,086	55,306	14%
<b>Bio Ethanol</b>				
Bio Ethanol only	39%	224,113	NA	1004%
Bio Ethanol + Power (WHR)	45%	255,832	NA	

# WASTE UTILISATION – *Stretch Scenario*

The waste that is diverted to recycling or composting represents some 50% of the total waste stream. While recycling is an important step in the life cycle of a raw material, it is arguable whether composting waste is the best use of a potentially valuable resource.

A recent study into the UK Organics Recycling Industry<sup>2</sup> found that some 4.5 million tonnes of waste was composted in 2007/08 – of which 3.9 million tonnes (87%) was from the household sector. An additional 20.5 million tonnes of agricultural waste is unproductively utilised. **Diverting this waste stream away from composting to energy conversion would result in an additional 134,000 TJ of energy.**

WASTE STREAM	RAW WASTE DATA			ANALYSIS OF WASTE DATA				
	TOTAL	REUSED OR COMPOSTED	RESIDUAL	WASTE COMPOSTED	WASTE AVAILABLE FOR ENERGY	AVERAGE ENERGY CONTENT	ENERGY IN COMPOST	TOTAL ENERGY
	kt	kt	kt	kt	kt	TJ / kt	TJ	TJ
MSW	31,539	9,395	22,144	3,900	26,044	10.32	40,260	268,854
C&I	67,305	30,152	37,153	600	37,753	9.00	5,398	339,622
Ag Waste	21,000	20,500	500	5,125	5,625	17.23	88,304	96,919
	<b>119,845</b>	<b>60,047</b>	<b>59,797</b>	<b>9,625</b>	<b>69,422</b>	<b>10.16</b>	<b>133,961</b>	<b>705,394</b>

# POTENTIAL VALUE OF ENERGY FROM WASTE

The value of the 571,000 to 705,000 TJ in energy derived from the UK waste streams can be estimated by looking at the cost of mainstream sources of energy it could substitute (ie. oil, natural gas, etc).

A review of the cost of mainstream energy in August 2011 suggests that **the substitutional value of the waste stream is between £1.08 and £7.17 billion per year.**

COMMODITY	UNIT COST OF ENERGY		SUBSTITUTIONAL VALUE OF UK WASTE	
	NON-STANDARDISED	STANDARDISED	BASE CASE	STRETCH CASE
Crude Oil (Brent spot)	\$ 101.84 / bbl	£ 10.17 / GJ	£ 5.81 billion	£ 7.17 billion
Natural Gas	£ 0.71 / therm	£ 6.69 / GJ	£ 3.82 billion	£ 4.72 billion
Thermal Coal	\$ 130 / tonne	£ 2.87 / GJ	£ 1.64 billion	£ 2.02 billion
Biomass (wood pellets & chips)	£80 / tonne	£ 6.91 / GJ	£ 3.95 billion	£ 4.87 billion
Ethanol	\$ 4 / hl	£ 1.90 / GJ	£ 1.08 billion	£ 1.34 billion

# REFERENCES

1. **DEFRA Waste Statistics 2004 – 2008.**
2. **Quantification of the Potential Energy from Residuals in the UK** – Renewable Power Association & Institution of Civil Engineers, March 2005.
3. **International Energy Agency** – online database, UK country page, 2008 statistics.
4. **Market survey of the UK organics recycling industry - 2007/08** – Association for Organics Recycling, March 2009.