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Table 1. FIT rates in Sterling pence per kWh.

AD plant capacity [2]	CHP technologies	FIT rate in 2010/11 [2]	FIT rate in 2012/13 [2]
$\leq 250 \text{ kWe}$	Proton exchange membrane fuel cell.	12.70	14.70
$250 \text{ kWe} < ;$ $\leq 500 \text{ kWe}$	Micro gas turbine; Solid oxide fuel cell; Solid oxide fuel cell and gas turbine.	12.70	13.60
$500 \text{ kWe} <$	Solid oxide fuel cell; Solid oxide fuel cell and gas turbine. Ignition; Stirling; Gas engines.	9.90	9.90

Table 2. Atmospheric emissions in kg from the CHP processes converting 1 MJ of biogas into electricity and heat.

	PEM FC	SOFC	SOFC-GT	Micro GT	Engine	Ignition
Carbon dioxide (biotic)	0.05	0.05	0.05	0.05	0.08	0.09
Carbon monoxide (biotic)	0.0000017	0.0000017	0.0000017	0.0000280	0.000048	0.000013
Methane (biotic)	0.0000040	0.0000040	0.000004	0.0000054	0.000023	0.000080
Nitrogen oxides	0.0000013	0.0000020	0.000011	0.0000320	0.000015	0.000128
Sulphur dioxide	0.0000006	0.0000006	5.50E-07	0.0000006	0.000021	0.000037
Dust particulate <2.5 micro m	2.00E-10			0.0000005		0.000001
Nitrous oxide				0.0000010	0.000003	0.000005

Table 3. Primary impact characterisations from the AD plant infrastructure for processing 1 t of sewage sludge. CFC: Chlorofluorocarbon; DCB: 1,4 Dichlorobenzene.

Acidification potential kg SO ₂ equivalent	0.0061
Eutrophication Potential kg phosphate equivalent	0.0011
Freshwater aquatic ecotoxicity potential kg DCB equivalent	0.4930
Global warming potential (GWP 100 years) kg CO ₂ equivalent	1.9939
Human toxicity potential kg DCB equivalent	1.9504
Marine aquatic ecotoxicity potential kg DCB equivalent	666.0934
Ozone layer depletion potential kg CFC equivalent	1.0324×10^{-7}
Photochemical ozone creation potential kg ethylene equivalent	0.0009
Terrestrial ecotoxicity potential kg DCB equivalent	0.0728

Table 4. Primary impact characterisations from 315 Nm³ or 11340 MJ biogas (per t of sewage sludge processing) conversion into CHP generation systems.

	Engine	Ignition	Micro GT	PEM FC	SOFC	SOFC-GT
Acidification potential kg SO ₂ equivalent	0.2256	0.9588	0.2603	0.0166	0.0221	0.0936
Eutrophication Potential kg phosphate equivalent	0.0188	0.1362	0.0502	0.0019	0.0029	0.0162
Freshwater aquatic ecotoxicity potential kg DCB equivalent	0.0007	0.0038	0.0003	0.0002	0.0004	0.0004
Global warming potential (GWP 100 years) kg CO ₂ equivalent	607.3865	699.1812	637.4327	634.1782	634.1668	634.1668
Human toxicity potential kg DCB equivalent	0.1442	1.2024	0.4411	0.0185	0.0283	0.1508
Marine aquatic ecotoxicity potential kg DCB equivalent	0.0001	0.0008	0.0001	0.0000	0.0001	0.0001
Photochemical ozone creation potential kg ethene equivalent	0.0257	0.1078	0.0219	0.0027	0.0046	0.0075
Terrestrial ecotoxicity potential kg DCB equivalent	0.0001	0.0004	0.0000	0.0000	0.0000	0.0000

Table 5. Emissions from biogas and natural gas based systems and avoided emissions per MJ of output energy generation.

	GWP	AP	POCP
	kg CO ₂ -Equivalent/MJ	kg SO ₂ -Equivalent/MJ	kg Ethylene-Equivalent/MJ
Biogas to grid system	-0.0737	6.70×10^{-6}	6.36×10^{-7}
Natural gas to grid system	0.0056	5.14×10^{-5}	7.23×10^{-6}
Avoided emissions (grid system)	0.0793	4.47×10^{-5}	6.59×10^{-6}
Biogas- Micro generation (PEM FC based)	-0.0205	9.22×10^{-6}	1.01×10^{-5}
Natural gas- Micro generation (PEM FC based)	0.0995	8.49×10^{-5}	1.21×10^{-5}
Avoided emissions (PEM FC based microgen)	0.1200	7.57×10^{-5}	1.11×10^{-5}
Biogas- Distributed generation (SOFC based)	-0.0223	1.08×10^{-5}	1.30×10^{-6}
Natural gas- Distributed generation (SOFC based)	0.0728	6.26×10^{-5}	8.95×10^{-6}
Avoided emissions (SOFC based distributed gen)	0.0951	5.18×10^{-5}	7.65×10^{-6}
Biogas- Distributed generation (SOFC-GT based)	-0.0223	1.87×10^{-5}	1.62×10^{-6}
Natural gas- Distributed generation (SOFC-GT based)	0.0693	6.46×10^{-5}	8.82×10^{-6}
Avoided emissions (SOFC-GT based distributed gen)	0.0916	4.59×10^{-5}	7.20×10^{-6}
Biogas- Distributed generation (Micro GT based)	-0.0234	3.95×10^{-5}	3.42×10^{-6}
Natural gas- Distributed generation (Micro GT based)	0.0748	8.21×10^{-5}	1.11×10^{-5}
Avoided emissions (Micro GT based distributed gen)	0.0982	4.26×10^{-5}	7.64×10^{-6}

Table 6. Characteristics of the probability distribution curves of the impact potentials obtained using MCLCA in GaBi 6.0.

	Base value	Mean	Standard deviation as a percentage of mean value	10 Percentile	25 Percentile	Median	75 Percentile	90 Percentile
AP kg SO ₂ equivalent	0.25478	0.25476	7.32%	0.23035	0.24219	0.25508	0.26738	0.27877
EP kg phosphate equivalent	0.038818	0.03882	2.87%	0.037362	0.038067	0.038836	0.039569	0.040249
FAETP kg DCB equivalent	19.21	19.212	6.91%	17.503	18.315	19.189	20.108	20.949
GWP kg CO ₂ equivalent	-99.19	-99.27	10.20%	-187.13	-144.52	-98.11	-53.84	-12.8
HTP kg DCB equivalent	105.78	105.78	6.67%	96.703	101.02	105.67	110.55	115.02
MAETP kg DCB equivalent	23549	23549	1.22%	23172	23355	23554	23744	23920
POCP kg ethene equivalent	0.034321	0.03431	19.10%	0.02573	0.029893	0.034427	0.038752	0.042761
TETP kg DCB equivalent	24.911	24.914	9.29%	21.934	23.35	24.875	26.476	27.944

Table 7. Chances or likelihoods of occurrence in percentages of each impact potential (rows) with respect to standard deviations from its mean value (columns).

	(25-19)%	(19-14)%	(14-8)%	(8-3)%	(3-(-3))%	((-3)-(-8))%	((-8)-(-14))%	((-14)-(-19))%	((-19)-(-25))%
AP kg SO ₂ equivalent	0.20%	2.78%	9.78%	22.50%	29.20%	22.40%	10.40%	2.32%	0.00%
EP kg phosphate equivalent	0%	0%	0%	16%	66%	17%	0%	0%	0%
FAETP kg DCB equivalent	0.12%	1.84%	9.68%	23.00%	30.80%	22.90%	9.44%	2.06%	0.00%
GWP kg CO ₂ equivalent	5.50%	7.31%	9.91%	11.05%	12.12%	11.54%	9.74%	7.84%	0.00%
HTP kg DCB equivalent	0.08%	1.52%	9.10%	23.30%	32.00%	23.20%	8.88%	1.72%	0.00%
MAETP kg DCB equivalent	0%	0%	0%	1%	98%	1%	0%	0%	0%
POCP kg ethene equivalent	5.52%	7.80%	10.00%	10.60%	11.60%	11.10%	9.92%	7.54%	0.00%
TETP kg DCB equivalent	1.32%	5.14%	12.30%	19.50%	22.80%	19.90%	11.90%	5.06%	0.00%