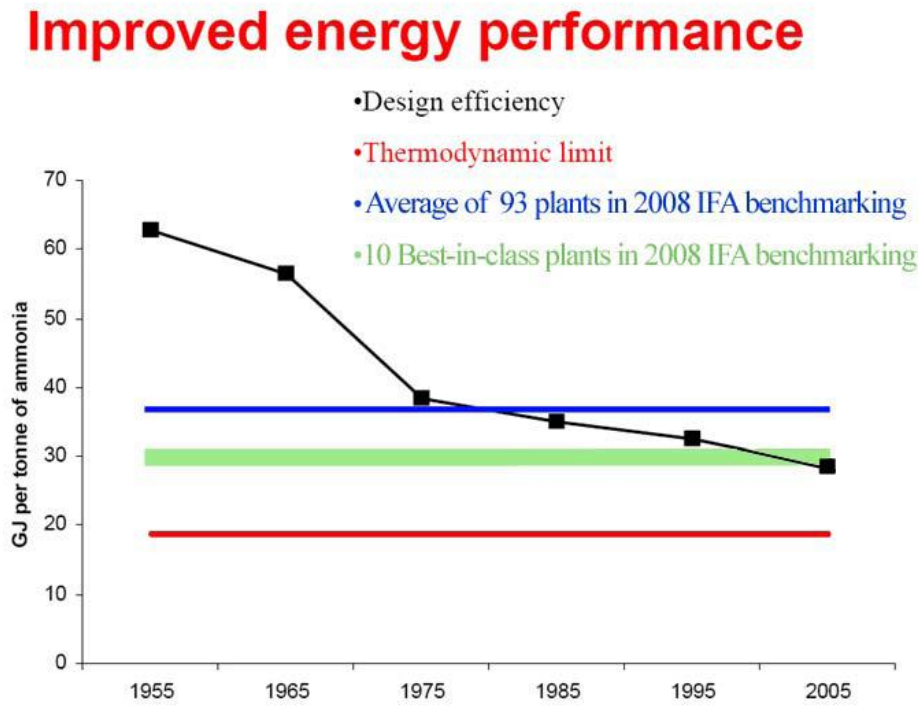
Chemicals in energy analysis

Chemicals to be considered:

- Fertilizers
- Lime
- Pesticides

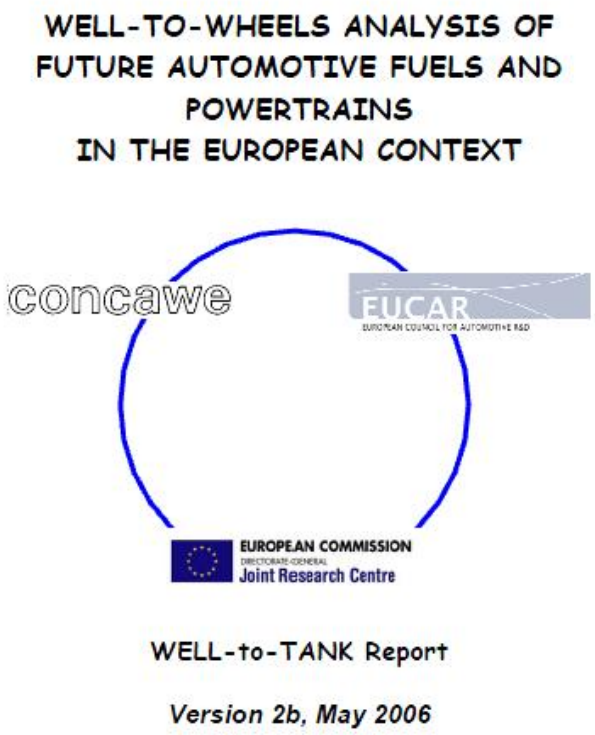
Fertilizers are by far the most important.

Energy consumption in ammonia production



Source:
Energy Efficiency and CO2 Emissions in Ammonia Production *2008-2009 Summary Report. International Fertilizer Industry Association.*

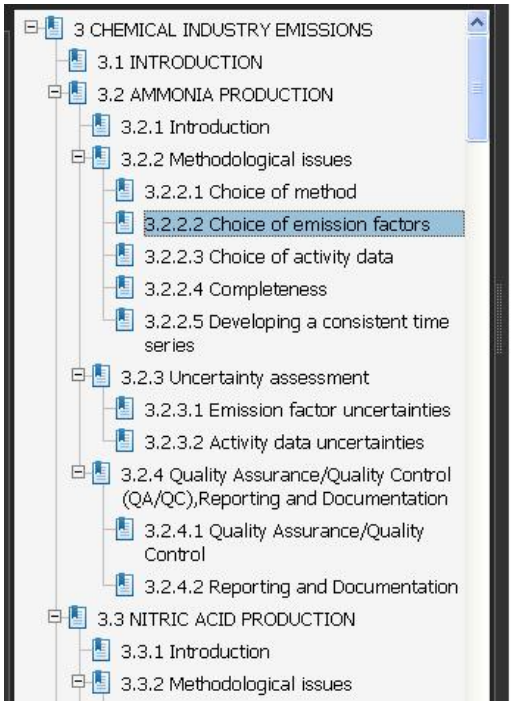
WTT Report uses modified energy costs and emissions of Kaltscmitt & Reinhardt (1997)

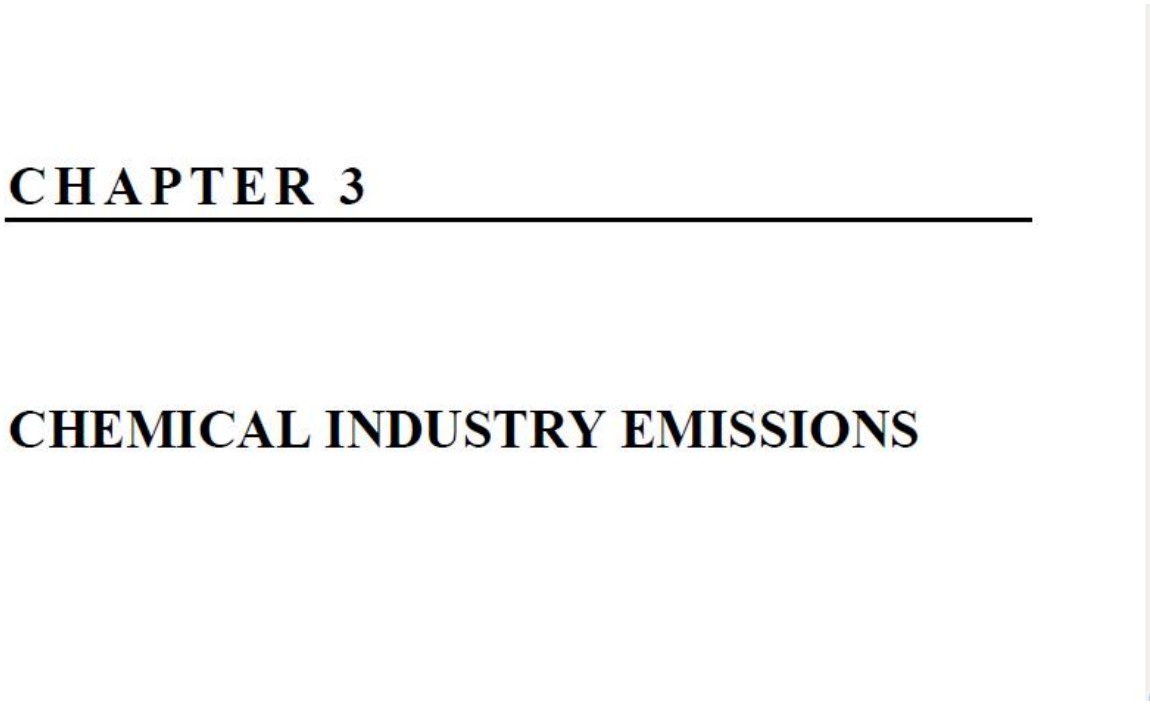


WTT 2006 Report , WTT Appendix 3 p. 41

Code	Process	Assoc. processes	Input: kg/ kg prod.	Expended energy: As used MJ/ kg prod.	Expended energy: MJp/ MJ	Expended energy: Primary MJp/ kg prod.	GHG emissions: g CO_2/ kg prod.	GHG emissions: g CH_4/ kg prod.	GHG emissions: g N_2O/ kg prod.	GHG emissions: g CO_2eq/ kg prod.
AC1	**Nitrogen Fertilizer Provision**									
	Electricity (EU-mix, MV)	Z7a		0.6	2.83	1.78	74.8	0.18	0.0034	80.0
	Hard coal	KO1		3.9	1.09	4.32	405.8	1.51	0.0011	440.8
	Diesel	Z1		0.9	1.16	1.00	75.3	0.00	0.0000	75.3
	Heavy fuel oil	Z3		4.4	1.09	4.77	384.1	0.00	0.0000	384.1
	NG	Z6		33.0	1.13	37.31	2063.0	6.56	0.0008	2234.7
	N2O from process								*0.6300*	
	Primary energy and emissions/kg					***49.17***	*3022.9*	*8.27*	*0.6353*	***6085.3***
AC2	**P fertilizer provision**									
	Electricity (EU-mix, MV)	Z7a		1.6	2.83	4.54	191.2	0.47	0.0086	204.5
	Hard coal	KO1		0.6	1.09	0.62	58.6	0.22	0.0002	63.6
	Diesel	Z1		1.1	1.16	1.30	98.1	0.00	0.0000	98.1
	Heavy fuel oil	Z3		5.0	1.09	5.44	438.3	0.00	0.0000	438.3
	NG	Z6		3.2	1.13	3.56	198.8	0.63	0.0001	213.3
	Primary energy and emissions/kg					***15.47***	*985.0*	*1.31*	*0.0080*	***1017.8***
AC3	**K fertilizer provision**									
	Electricity (EU-mix, MV)	Z7a		0.2	2.83	0.62	26.2	0.06	0.0012	28.0
	Diesel	Z1		0.5	1.16	0.63	47.3	0.00	0.0000	47.3
	NG	Z6		7.5	1.13	8.48	473.4	1.50	0.0002	507.8
	Primary energy and emissions/kg					***9.73***	*546.9*	*1.56*	*0.0014*	***583.2***
AC4	**CaO fertilizer provision (85%CaCO3+15%CaO,Ca(OH)2)**									
	Electricity (EU-mix, MV)	Z7a		0.4	2.83	1.13	47.7	0.12	0.0022	51.0
	Coal	KO1		0.3	1.09	0.35	33.3	0.12	0.0001	36.2
	Diesel	Z1		0.2	1.16	0.21	16.2	0.00	0.0000	16.2
	NG	Z6		0.3	1.13	0.34	18.9	0.06	0.0000	20.3
	Primary energy and emissions/kg					***2.04***	*116.1*	*0.30*	*0.0023*	***123.7***
AC5	**Pesticides (etc) provision**									
	Electricity (EU-mix, MV)	Z7a		28.5	2.83	80.72	3398.9	8.29	0.1535	3635.0
	Hard coal	KO1		7.6	1.09	8.35	784.2	2.91	0.0021	851.9
	Diesel	Z1		58.1	1.16	67.40	5086.9	0.00	0.0000	5086.9
	Heavy fuel oil	Z3		32.5	1.09	35.37	2849.9	0.00	0.0000	2849.9
	NG	Z6		71.4	1.13	80.71	4505.9	14.24	0.0018	4834.0
	Primary energy and emissions/kg					***272.55***	*16025.8*	*25.45*	*0.1573*	***17257.6***

IPCC Reports could be used to define emissions from chemical industry





Yara has succeeded to cut emissions of ammonia production

- 2003 6.8 kg CO2-eq/kg fertilizer-N (Jenssen and Kongshaug, 2003).
- 2.9 kg CO2-eq/kg fertilizer-N based ondata from Yara (Erlingsson, 2009).

Source: Ahlgren et al. 2009. Greenhouse gas emissions from cultivation of agricultural crops for biofuels and production of biogas from manure. SLU

Conclusions

- Energy costs and GHG emission are available in a wide range for Agricultural Chemicals.
- It is hard to evaluate which values are updated and reliable.
- Do we use the energy cost for production only or added with chemical energy content?