SETAC Europe 26th Annual Meeting, Nantes, 23 May 2016

A model and tool to calculate life cycle inventories of chemicals discharged down the drain

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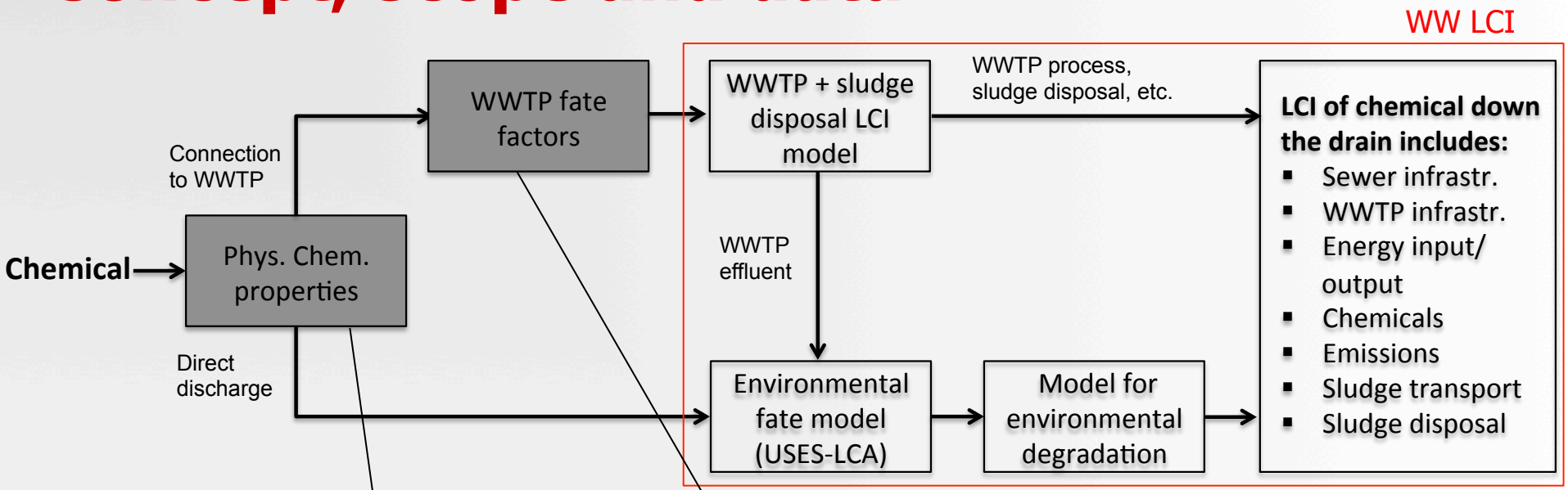
Background and aim

- The fate of household chemicals following use is generally to municipal wastewater treatment plants (WWTP) although in some countries this may be limited
- Current WWTP models in LCA, e.g. Ecoinvent (Doka 2007):
  - Reflect average conditions in WWTPs, rather than the specific fate of particular chemicals (e.g. Degradability)
  - Omit the impact of direct discharges
- Our goal was to develop a model that calculates chemical-specific LCIs of chemicals discharged down the drain or to the environment

Doka, G. (2007) Life Cycle Inventories of Waste Treatment Services. Final report ecoinvent 2000 No. 13, EMPA St. Gallen, Swiss Centre for Life Cycle Inventories, Duebendorf, Switzerland.

Concept, scope and data



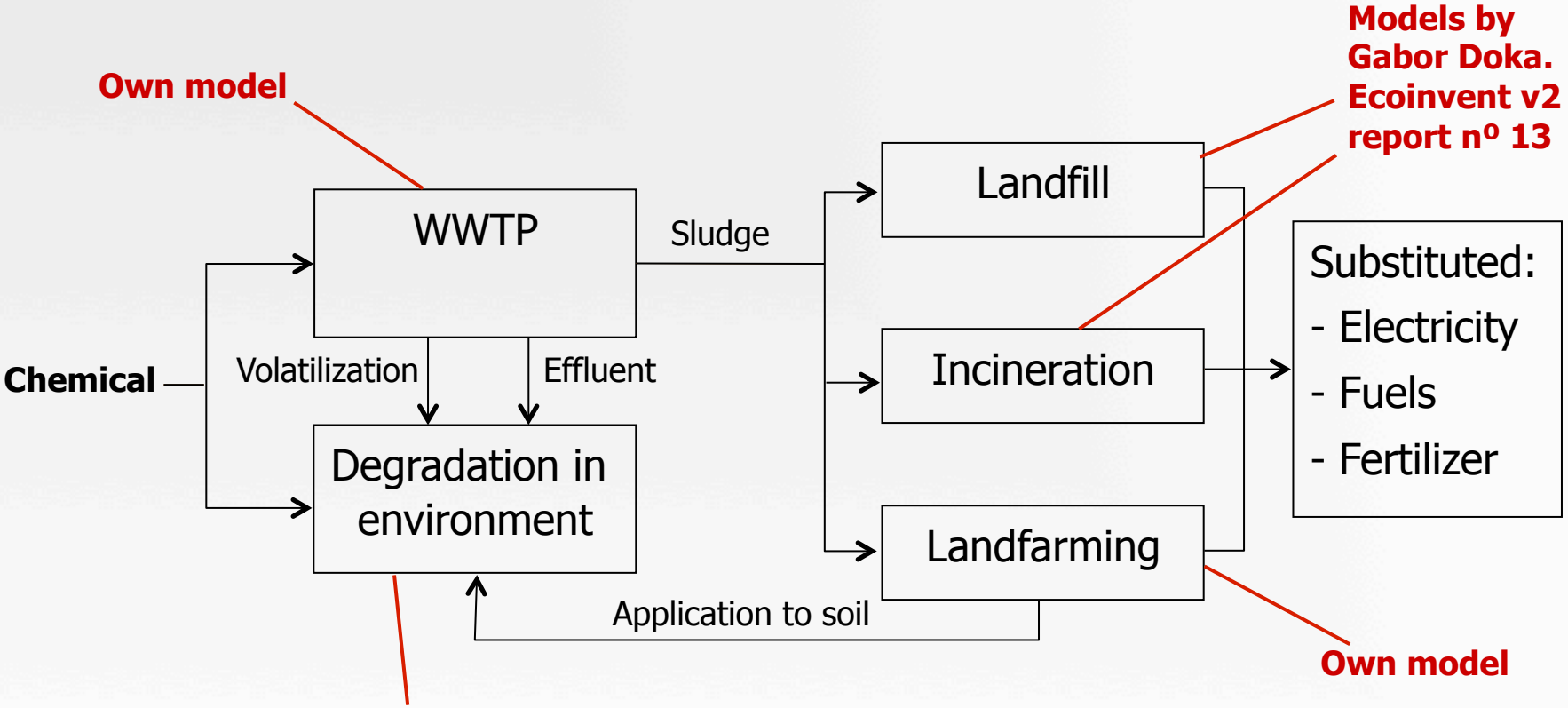
- Organic/inorganic
- Composition (C, H, O, N, S, P, Cl)
- Molecular weight
- Vapour pressure
- Solubility
- Kow
- Half-lives in the environment (soil, water, air)

- Fraction degraded
- Fraction volatilized
- Fraction to sludge
- Anaerobic degradability

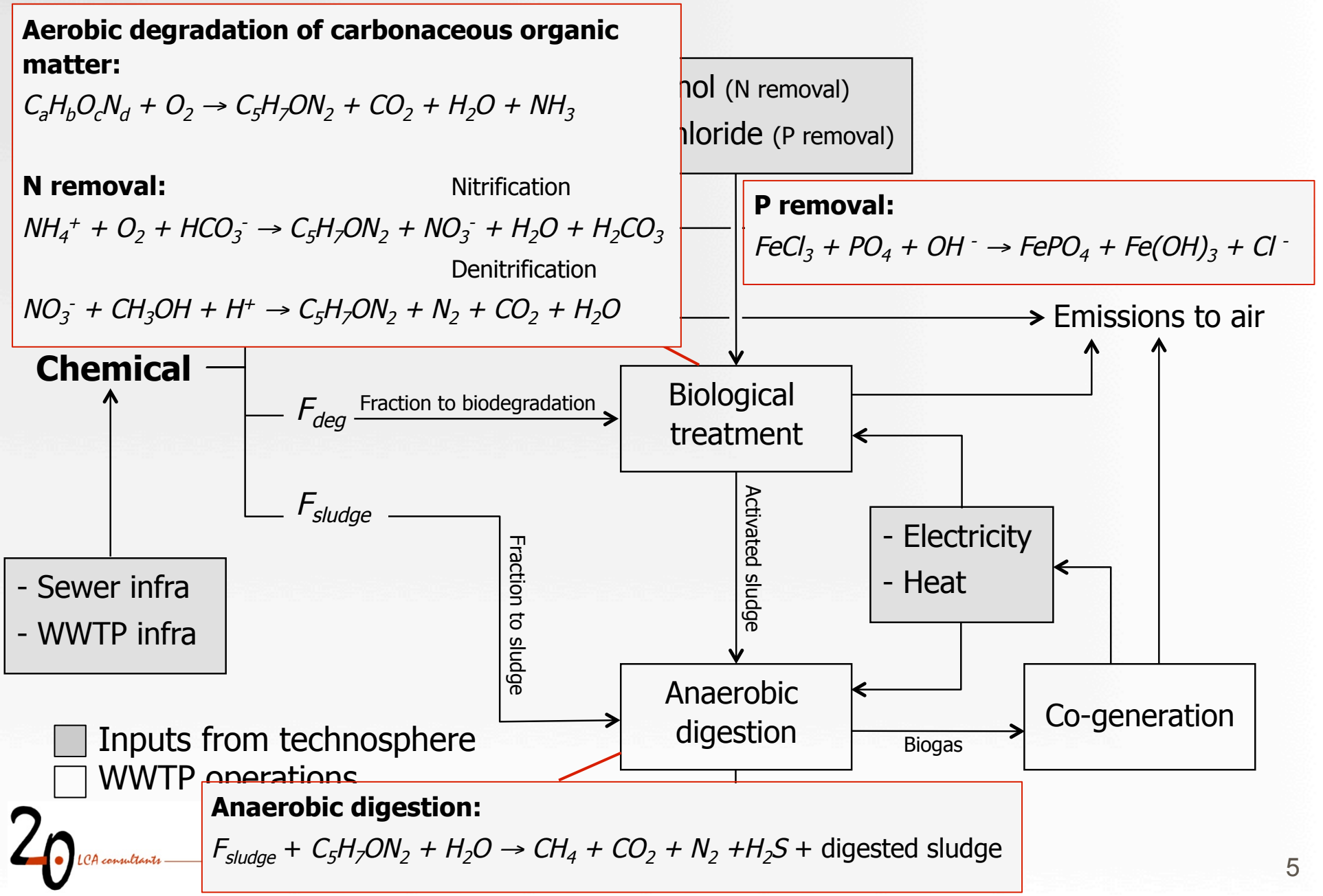
- % population connected to WWTPs
- WWTP includes N and P removal
- Country
- Sludge disposal scenario

Concept, scope and data

- Mass and energy balances
- Functional unit is 1 kg of chemical
- Multifunctionality solved by substitution (credits)



WWTP model


Aerobic degradation of carbonaceous organic matter:
$C_aH_bO_cN_d + O_2 \rightarrow C_5H_7ON_2 + CO_2 + H_2O + NH_3$
N removal:
Nitrification
$NH_4^+ + O_2 + HCO_3^- \rightarrow C_5H_7ON_2 + NO_3^- + H_2O + H_2CO_3$
Denitrification
$NO_3^- + CH_3OH + H^+ \rightarrow C_5H_7ON_2 + N_2 + CO_2 + H_2O$
ol (N removal)
loride (P removal)
P removal:
$FeCl_3 + PO_4 + OH^- \rightarrow FePO_4 + Fe(OH)_3 + Cl^-$
Emissions to air
Chemical
F_{deg}
Fraction to biodegradation
Biological treatment
F_{sludge}
Fraction to sludge
Activated sludge
- Electricity
- Heat
- Sewer infra
- WWTP infra
Anaerobic digestion
Co-generation
Biogas
Inputs from technosphere
WWTP operations
Anaerobic digestion:
$F_{sludge} + C_5H_7ON_2 + H_2O \rightarrow CH_4 + CO_2 + N_2 + H_2S$ + digested sludge

WW LCI: key features

- All calculations in a single Excel file: WW LCI.xlsx
- 30 chemicals can be assessed at a time, separately or as a mixture
- Entirely parameterized, all values can be changed by the user
- Resulting LCIs use ecoinvent 3 nomenclature
- WW LCI does not include impact assessment calculations
- LCIs can be exported as CSV files to LCA software: SimaPro

WW LCI in Excel

Sheet 'WWTP input'

Scenario data			
WWTP	Connection to WWTP (%)		100%
	Nitrogen Removal in WWTP		yes
	Phosphorus removal in WWTP		yes
Sludge	Sludge to landfarming (%)		100%
	Sludge to landfilling (%)		0%
	Sludge to incineration (%)		0%
Country			DE
Chemical mixture			yes

Chemical-specific data

Name	CAS number	Type	Composition (no of atoms in a molecule)							Molecular weight (g/mol)	Biogenic carbon?	Mass in mixture (%)	Fate in WWTP (%)				If emitted to water				
			C	H	O	N	S	P	Cl				Fair	Fdeg	Fsludge	Anaerobic deg?	Deg_a	Deg_w	Deg_{sed}	Deg_s	Deg_a
DTPMP	15827-60-8	Organic	9	28	15	3		5		573	no	100.00%	0.00%	0.00%	85.00%	no	0.00%	53.10%	42.14%	0.00%	0.09%
Sodium carbonate	497-19-8	Inorganic	1		3					106	n.a.		0.00%	0.00%	0.00%	n.a.	0.00%	0.00%	0.00%	0.00%	
Ethanol	64-17-5	Organic	2	6	1					46	yes		0.43%	87.05%	0.01%	yes	13.14%	86.45%	0.05%	0.35%	23.16%
TAED	10543-57-4	Organic	10	16	4	2				228	no		0.00%	97.00%	0.10%	yes	0.00%	99.09%	0.91%	0.00%	0.03%
Zeolite A	1344-00-9	Inorganic		54	75					2190	n.a.		0.00%	0.00%	90.00%	no	0.00%	0.00%	0.00%	0.00%	
STPP	7758-29-4	Inorganic			10			3		368	n.a.		0.00%	0.00%	0.00%	no					
Water		Inorganic		2	1					18	n.a.		0.00%	0.00%	0.40%	n.a.					

Sheet 'USES-LCA input'

Chemical-specific data

Row number	Name	CAS number	Physical chemical properties									
			ChemType	Neutral/Acid/Base	MW (g/mol)	Vapour pressure 25 deg. C (Pa)	Solubility 25 deg (mg/L)	Melting point (deg. C)	Kow	Koc	Henry's Law Constant (Pa·m3/mol)	
1	Ethanol	64-17-5	organic	-	46	7910	1000000	-114	0.48977882	1.04	0.506625	
2	TAED	10543-57-4	organic	-	228	4.80E-06	1500	152	0.83176377	15	1.682E-11	
3	DTPMP	15827-60-8	organic	A	573	1.67E-10	500000	90	0.00039811		7.3967E-13	
4												
5												
6												

WW LCI in Excel

Sheet 'LCI output'

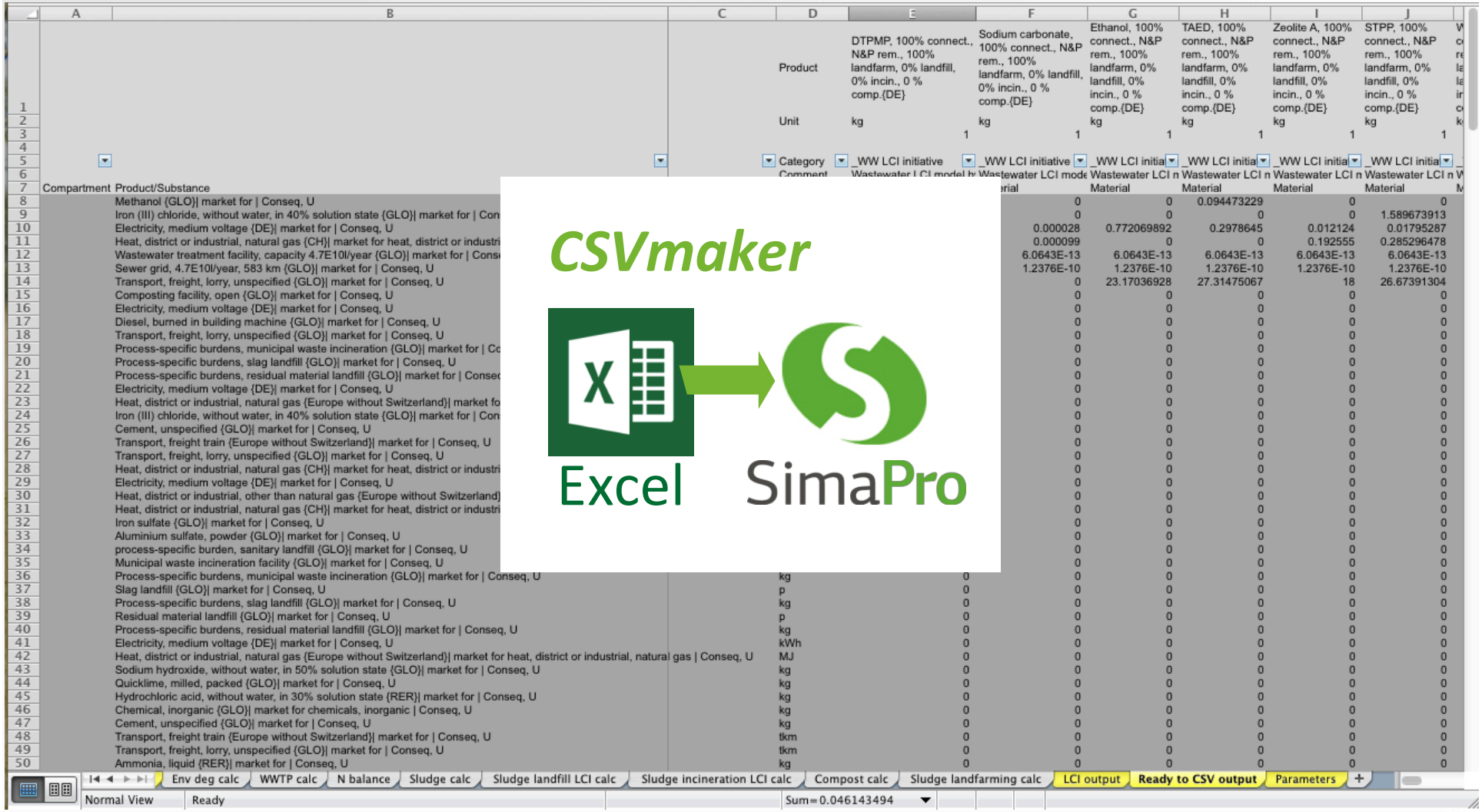
	A	B	C	D	H	I	J	K	L	M	N	O	P
1	LCI for WWTP+sludge disposal+environmental degradation				TAED	Zeolite A	STPP	Water	LAS	Diuron	0	0	0
2	Inputs	From technosphere	Wastewater treatment	Product in wastewater (kg)	1	1	1	1	1	1	0	0	0
3				Methanol (kg)	0.094473229	0	0	0	0	0	0	0	0
4				FeCl3 (kg)	0	0	1.589673913	0	0	0	0	0	0
5				Electricity (kWh)	0.2978645	0.012124	0.01795287	0.00008176	0	0.000597856	0	0	0
6				Heat (MJ)	0	0.192555	0.285296478	0.00095436	0	0.009165816	0	0	0
7				WWTP infrastructure (unit)	6.0643E-13	6.0643E-13	6.0643E-13	6.0643E-13	6.0643E-13	6.0643E-13	0	0	0
8				Sewer infrastructure (km)	1.2376E-10	1.2376E-10	1.2376E-10	1.2376E-10	1.2376E-10	1.2376E-10	0	0	0
9			Sludge transport	transport to sludge disposal facilities, lorry (kgkm)	27.31475067	18	26.67391304	0.005773196	0.609239766	0.848	0	0	0
10			Sludge composting	Compost plant infrastructure (units)	0	0	0	0	0	0	0	0	0
11				Electricity (kWh)	0	0	0	0	0	0	0	0	0
12				Diesel (MJ)	0	0	0	0	0	0	0	0	0
13				Transport to landfarming (kgkm)	0	0	0	0	0	0	0	0	0
14			Sludge landfilling	process-specific burdens, municipal waste incineration (kg)	0	0	0	0	0	0	0	0	0
15				process-specific burdens, slag compartment (kg)	0	0	0	0	0	0	0	0	0
16				process-specific burdens, residual material landfill (kg)	0	0	0	0	0	0	0	0	0
17				electricity from waste, at municipal waste incineration plant (kWh)	0	0	0	0	0	0	0	0	0
18				heat from waste, at municipal waste incineration plant (MJ)	0	0	0	0	0	0	0	0	0
19				iron (III) chloride, 40% in H2O, at plant (kg)	0	0	0	0	0	0	0	0	0
20				cement, unspecified, at plant (kg)	0	0	0	0	0	0	0	0	0
21				disposal, cement, hydrated, 0% water, to residual material landfill	0	0	0	0	0	0	0	0	0
22				transport, freight, rail (tkm)	0	0	0	0	0	0	0	0	0
23				transport, lorry 28t (tkm)	0	0	0	0	0	0	0	0	0
24				natural gas, burned in industrial furnace low-NOx >100kW (MJ)	0	0	0	0	0	0	0	0	0
25				electricity, low voltage, at grid (kWh)	0	0	0	0	0	0	0	0	0
26				light fuel oil, burned in boiler 100kW, non-modulating (MJ)	0	0	0	0	0	0	0	0	0
27				natural gas, burned in boiler modulating >100kW (MJ)	0	0	0	0	0	0	0	0	0
28				iron sulphate, at plant (kg)	0	0	0	0	0	0	0	0	0
29				aluminium sulphate, powder, at plant (kg)	0	0	0	0	0	0	0	0	0
30				process-specific burdens, sanitary landfill (kg)	0	0	0	0	0	0	0	0	0
31			Sludge incineration	municipal waste incineration plant (unit)	0	0	0	0	0	0	0	0	0
32				process-specific burdens, municipal waste incineration (kg)	0	0	0	0	0	0	0	0	0
33				slag compartment (unit)	0	0	0	0	0	0	0	0	0
34				process-specific burdens, slag compartment (kg)	0	0	0	0	0	0	0	0	0
35				residual material landfill facility (unit)	0	0	0	0	0	0	0	0	0
36				process-specific burdens, residual material landfill (kg)	0	0	0	0	0	0	0	0	0
37				electricity from waste, at municipal waste incineration plant (kWh)	0	0	0	0	0	0	0	0	0
38				heat from waste, at municipal waste incineration plant (MJ)	0	0	0	0	0	0	0	0	0
39				sodium hydroxide, 50% in H2O, production mix, at plant (kg)	0	0	0	0	0	0	0	0	0
40				quicklime, milled, packed, at plant (kg)	0	0	0	0	0	0	0	0	0
41				hydrochloric acid, 30% in H2O, at plant (kg)	0	0	0	0	0	0	0	0	0
42				chemicals inorganic, at plant (kg)	0	0	0	0	0	0	0	0	0
43				cement, unspecified, at plant (kg)	0	0	0	0	0	0	0	0	0
44				disposal, cement, hydrated, 0% water, to residual material landfill	0	0	0	0	0	0	0	0	0
45				transport, freight, rail (tkm)	0	0	0	0	0	0	0	0	0
46				transport, lorry 28t (tkm)	0	0	0	0	0	0	0	0	0
47				ammonia, liquid, at regional storehouse (kg)	0	0	0	0	0	0	0	0	0
48				natural gas, burned in industrial furnace low-NOx >100kW (MJ)	0	0	0	0	0	0	0	0	0
49				titanium dioxide, production mix, at plant (kg)	0	0	0	0	0	0	0	0	0
50				chromium oxide, flakes, at plant (kg)	0	0	0	0	0	0	0	0	0
51				Product to air (kg)	0	0	0	0	0	0	0	0	0
52				CO_2 to air, biogenic (kg)	0.008383035	0	0	0	0	0	0	0	0
53				CH_4 to air, biogenic (kg)	8.48738E-06	0	0	0	0	0	0	0	0
54				CO_2 to air, fossil (kg)	1.574951965	0	0	0	1.385615811	0	0	0	0
55				CH_4 to air, fossil (kg)	0.000646717	0	0	0	0.001402863	0	0	0	0

WWTP input | USESLCA input | Env deg calc | WWTP calc | N balance | Sludge calc | Sludge landfill LCI calc | Sludge incineration LCI calc | Compost calc | Sludge landfarming calc | LCI output | Reac

Normal View | Ready | Sum=0.547826087

WW LCI in Excel

Sheet 'Ready to CSV output'



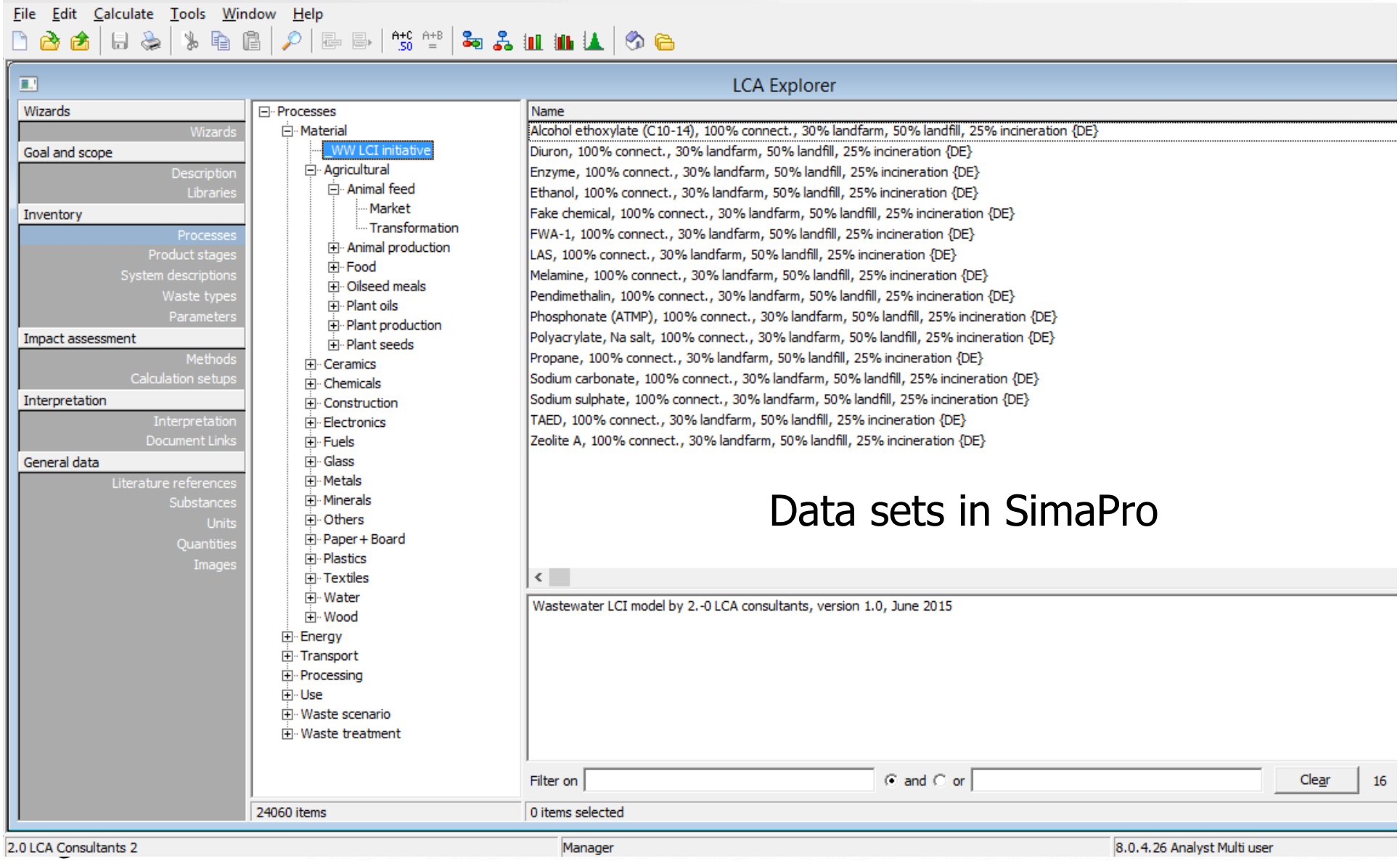
	A	B	C	D	E	F	G	H	I	J
1				Product	DTPMP, 100% connect., N&P rem., 100% landfarm, 0% landfill, 0% incin., 0 % comp.{DE}	Sodium carbonate, 100% connect., N&P rem., 100% landfarm, 0% landfill, 0% incin., 0 % comp.{DE}	Ethanol, 100% connect., N&P rem., 100% landfarm, 0% landfill, 0% incin., 0 % comp.{DE}	TAED, 100% connect., N&P rem., 100% landfarm, 0% landfill, 0% incin., 0 % comp.{DE}	Zeolite A, 100% connect., N&P rem., 100% landfarm, 0% landfill, 0% incin., 0 % comp.{DE}	STPP, 100% connect., N&P rem., 100% landfarm, 0% landfill, 0% incin., 0 % comp.{DE}
2				Unit	kg	kg	kg	kg	kg	kg
3					1	1	1	1	1	1
4										
5				Category	_WW LCI initiative	_WW LCI initiative	_WW LCI initia	_WW LCI initia	_WW LCI initia	_WW LCI initia
6				Comment	Wastewater LCI model by	Wastewater LCI mode	Wastewater LCI n	Wastewater LCI n	Wastewater LCI n	Wastewater LCI n
7	Compartment	Product/Substance				rial	Material	Material	Material	Material
8		Methanol {GLO}| market for | Conseq, U				0	0	0.094473229	0	0
9		Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Con				0	0	0	0	1.589673913
10		Electricity, medium voltage {DE}| market for | Conseq, U				0.000028	0.772069892	0.2978645	0.012124	0.01795287
11		Heat, district or industrial, natural gas {CH}| market for heat, district or industri				0.000099	0	0	0.192555	0.285296478
12		Wastewater treatment facility, capacity 4.7E10l/year {GLO}| market for | Cons				6.0643E-13	6.0643E-13	6.0643E-13	6.0643E-13	6.0643E-13	6.0643E-13
13		Sewer grid, 4.7E10l/year, 583 km {GLO}| market for | Conseq, U				1.2376E-10	1.2376E-10	1.2376E-10	1.2376E-10	1.2376E-10	1.2376E-10
14		Transport, freight, lorry, unspecified {GLO}| market for | Conseq, U				0	23.17036928	27.31475067	18	26.67391304
15		Composting facility, open {GLO}| market for | Conseq, U				0	0	0	0	0
16		Electricity, medium voltage {DE}| market for | Conseq, U				0	0	0	0	0
17		Diesel, burned in building machine {GLO}| market for | Conseq, U				0	0	0	0	0
18		Transport, freight, lorry, unspecified {GLO}| market for | Conseq, U				0	0	0	0	0
19		Process-specific burdens, municipal waste incineration {GLO}| market for | Co				0	0	0	0	0
20		Process-specific burdens, slag landfill {GLO}| market for | Conseq, U				0	0	0	0	0
21		Process-specific burdens, residual material landfill {GLO}| market for | Conse				0	0	0	0	0
22		Electricity, medium voltage {DE}| market for | Conseq, U				0	0	0	0	0
23		Heat, district or industrial, natural gas {Europe without Switzerland}| market fo				0	0	0	0	0
24		Iron (III) chloride, without water, in 40% solution state {GLO}| market for | Con				0	0	0	0	0
25		Cement, unspecified {GLO}| market for | Conseq, U				0	0	0	0	0
26		Transport, freight train {Europe without Switzerland}| market for | Conseq, U				0	0	0	0	0
27		Transport, freight, lorry, unspecified {GLO}| market for | Conseq, U				0	0	0	0	0
28		Heat, district or industrial, natural gas {CH}| market for heat, district or industri				0	0	0	0	0
29		Electricity, medium voltage {DE}| market for | Conseq, U				0	0	0	0	0
30		Heat, district or industrial, other than natural gas {Europe without Switzerland}				0	0	0	0	0
31		Heat, district or industrial, natural gas {CH}| market for heat, district or industri				0	0	0	0	0
32		Iron sulfate {GLO}| market for | Conseq, U				0	0	0	0	0
33		Aluminium sulfate, powder {GLO}| market for | Conseq, U				0	0	0	0	0
34		process-specific burden, sanitary landfill {GLO}| market for | Conseq, U				0	0	0	0	0
35		Municipal waste incineration facility {GLO}| market for | Conseq, U				0	0	0	0	0
36		Process-specific burdens, municipal waste incineration {GLO}| market for | Conseq, U		kg	0	0	0	0	0	0
37		Slag landfill {GLO}| market for | Conseq, U		p	0	0	0	0	0	0
38		Process-specific burdens, slag landfill {GLO}| market for | Conseq, U		kg	0	0	0	0	0	0
39		Residual material landfill {GLO}| market for | Conseq, U		p	0	0	0	0	0	0
40		Process-specific burdens, residual material landfill {GLO}| market for | Conseq, U		kg	0	0	0	0	0	0
41		Electricity, medium voltage {DE}| market for | Conseq, U		kWh	0	0	0	0	0	0
42		Heat, district or industrial, natural gas {Europe without Switzerland}| market for heat, district or industrial, natural gas | Conseq, U		MJ	0	0	0	0	0	0
43		Sodium hydroxide, without water, in 50% solution state {GLO}| market for | Conseq, U		kg	0	0	0	0	0	0
44		Quicklime, milled, packed {GLO}| market for | Conseq, U		kg	0	0	0	0	0	0
45		Hydrochloric acid, without water, in 30% solution state {RER}| market for | Conseq, U		kg	0	0	0	0	0	0
46		Chemical, inorganic {GLO}| market for chemicals, inorganic | Conseq, U		kg	0	0	0	0	0	0
47		Cement, unspecified {GLO}| market for | Conseq, U		kg	0	0	0	0	0	0
48		Transport, freight train {Europe without Switzerland}| market for | Conseq, U		tkm	0	0	0	0	0	0
49		Transport, freight, lorry, unspecified {GLO}| market for | Conseq, U		tkm	0	0	0	0	0	0
50		Ammonia, liquid {RER}| market for | Conseq, U		kg	0	0	0	0	0	0

Env deg calc | WWTP calc | N balance | Sludge calc | Sludge landfill LCI calc | Sludge incineration LCI calc | Compost calc | Sludge landfarming calc | LCI output | **Ready to CSV output** | Parameters

Normal View | Ready | Sum=0.046143494

2.0 LCA consultants

WW LCI: import to SimaPro



WW LCI: import to SimaPro

File Edit Calculate Tools Window Help

Documentation | Input/output | Parameters | System description

Known outputs to technosphere. Products and co-products

Name	Amount	Unit	Quantity	Allocation %	Waste type	Category
TAED, 100% connect., N&P rem., 30% dm, 42% landfarm, 0% landfill, 58% incin. {DE}	1	kg	Mass	100 %	not defined	_WW LCI initiative\Article
(Insert line here)						

Known outputs to technosphere. Avoided products

Name	Amount	Unit	Distribution	SD^2 or 2*SD	Min	Max	Comment
(Insert line here)							

Inputs

Data set in SimaPro

Known inputs from nature (resources)

Name	Sub-compartment	Amount	Unit	Distribution	SD^2 or 2*SD	Min	Max	Comment
(Insert line here)								

Known inputs from technosphere (materials/fuels)

Name	Amount	Unit	Distribution	SD^2 or 2*SD	Min	Max	Comment
Methanol {GLO}| market for | Conseq, U	0.0944732291233778	kg	Undefined				
Electricity, medium voltage {DE}| market for | Conseq, U	0.578145350582864	kWh	Undefined				
Heat, district or industrial, natural gas {CH}| market for heat, district or industrial, natural ga	0.513847686067642	MJ	Undefined				
Wastewater treatment facility, capacity 4.7E10l/year {GLO}| market for | Conseq, U	8.42263888888889E-10	p	Undefined				
Sewer grid, 4.7E10l/year, 583 km {GLO}| market for | Conseq, U	1.71888888888889E-7	km	Undefined				
Transport, freight, lorry, unspecified {GLO}| market for | Conseq, U	18.9447165755555	kgkm	Undefined				
Municipal waste incineration facility {GLO}| market for | Conseq, U	1.37349195172778E-10	p	Undefined				
Process-specific burdens, municipal waste incineration {GLO}| market for | Conseq, U	0.549396780691111	kg	Undefined				
Slag landfill {GLO}| market for | Conseq, U	6.87755137133613E-10	p	Undefined				
Process-specific burdens, slag landfill {GLO}| market for | Conseq, U	0.386862264637657	kg	Undefined				
Residual material landfill {GLO}| market for | Conseq, U	4.91847593725435E-13	p	Undefined				
Process-specific burdens, residual material landfill {GLO}| market for | Conseq, U	0.000236086844988209	kg	Undefined				
Electricity, medium voltage {DE}| market for | Conseq, U	0.289650670353426	kWh	Undefined				
Heat, district or industrial, natural gas {Europe without Switzerland}| market for heat, distric	1.88137608615912	MJ	Undefined				
Sodium hydroxide, without water, in 50% solution state {GLO}| market for | Conseq, U	0.000107415053668396	kg	Undefined				
Quicklime, milled, packed {GLO}| market for | Conseq, U	1.90331937201894E-5	kg	Undefined				
Hydrochloric acid, without water, in 30% solution state {RER}| market for | Conseq, U	1.33647546953005E-7	kg	Undefined				
Chemical, inorganic {GLO}| market for chemicals, inorganic | Conseq, U	2.22745911588341E-7	kg	Undefined				
Cement, unspecified {GLO}| market for | Conseq, U	9.44347379952835E-5	kg	Undefined				
Transport, freight train {Europe without Switzerland}| market for | Conseq, U	0.00507181904027039	tkm	Undefined				
Transport, freight, lorry, unspecified {GLO}| market for | Conseq, U	0.0159156712225795	tkm	Undefined				
Ammonia, liquid {RER}| market for | Conseq, U	0.00201398080284601	kg	Undefined				
Heat, district or industrial, natural gas {CH}| market for heat, district or industrial, natural ga	0.196408038652177	MJ	Undefined				
Titanium dioxide {RER}| market for | Conseq, U	5.76499323496558E-5	kg	Undefined				
Chromium oxide, flakes {GLO}| market for | Conseq, U	1.17652923162563E-6	kg	Undefined				
Nitrogen fertiliser, as N {GLO}| market for | Conseq, U	-0.0115631309551324	kg	Undefined				
(Insert line here)							

Known inputs from technosphere (electricity/heat)

Name	Amount	Unit	Distribution	SD^2 or 2*SD	Min	Max	Comment
(Insert line here)							

Outputs

Emissions to air

Name	Sub-compartment	Amount	Unit	Distribution	SD^2 or 2*SD	Min	Max	Comment
Carbon dioxide, biogenic		0.0083830349	kg	Undefined				
Methane, biogenic		8.4873821127	kg	Undefined				
Carbon dioxide, fossil		1.5749519651	kg	Undefined				
Methane, fossil		0.0006467173	kg	Undefined				
Ammonia		0.0008489087	kg	Undefined				
Dinitrogen monoxide		0.0009871233	kg	Undefined				
Nitrogen oxides		0.0076407501	kg	Undefined				

WW LCI compared to Ecoinvent model

Name	CAS number	Key features
Tetraacetylethylenediamine (TAED)	10543-57-4	Organic, degradable, contains N and fossil C
Ethanol	64-17-5	Organic, degradable, contains biogenic C
Diethylenetriamine penta(methylene phosphonic acid) (DTPMP)	15827-60-8	Organic, poorly degradable, contains N and P, contains fossil C
Sodium carbonate	497-19-8	Inorganic, soluble
Zeolite A	1344-00-9	Inorganic, insoluble
Sodium tripolyphosphate (STPP)	7758-29-4	Inorganic, soluble, contains P

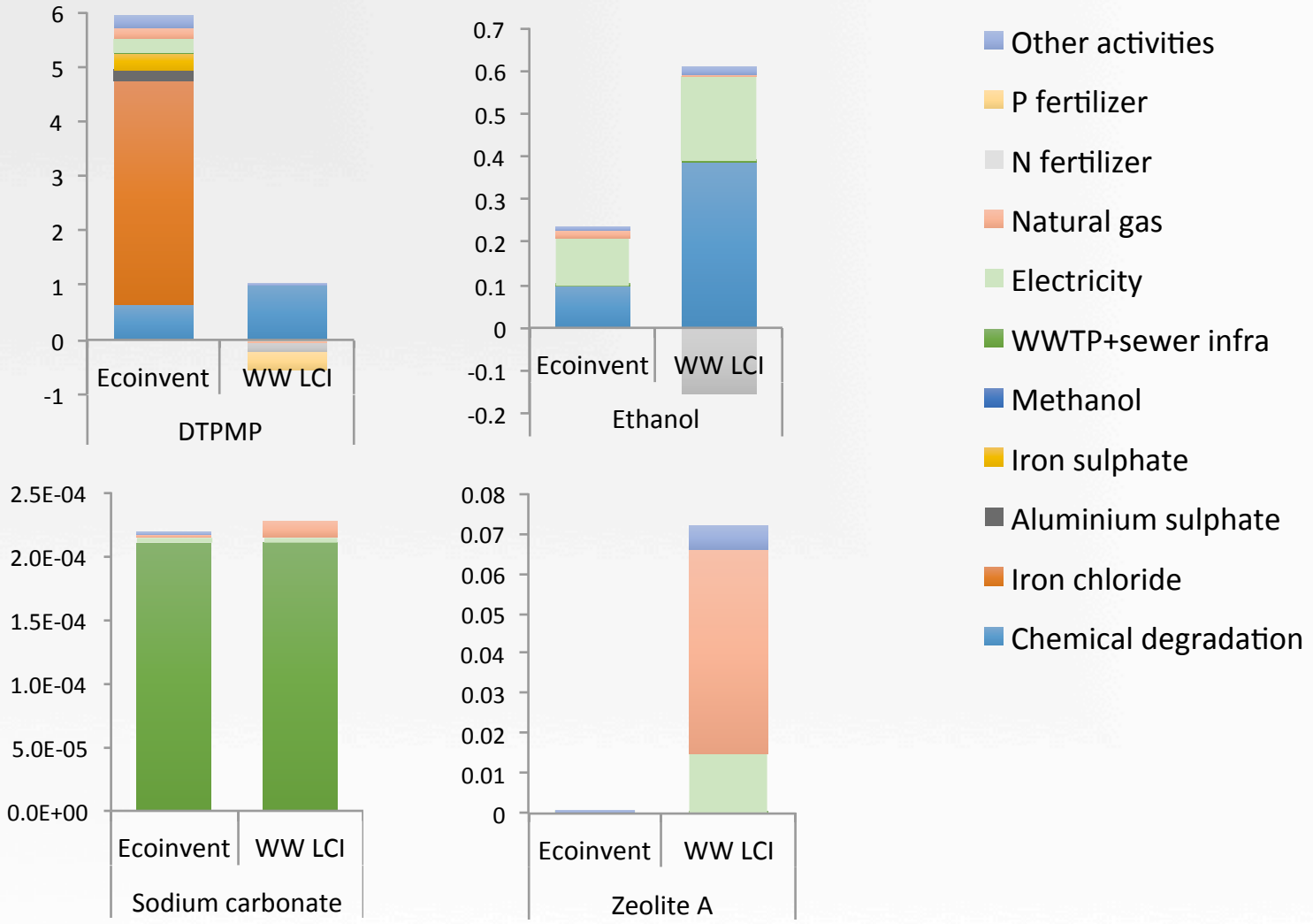
- Same connection level to WWTP: 100%
- Same sludge disposal: 58% incineration, 42% agriculture (DE)
- Same sewer-WWTP size: 4.7E10 L/year
- Same functional unit: 1 kg chemical in wastewater influent

WW LCI compared to Ecoinvent model

GHG emissions, in kg CO_2-eq/kg chemical (IPCC 2013)

(biogenic CO_2 considered neutral)

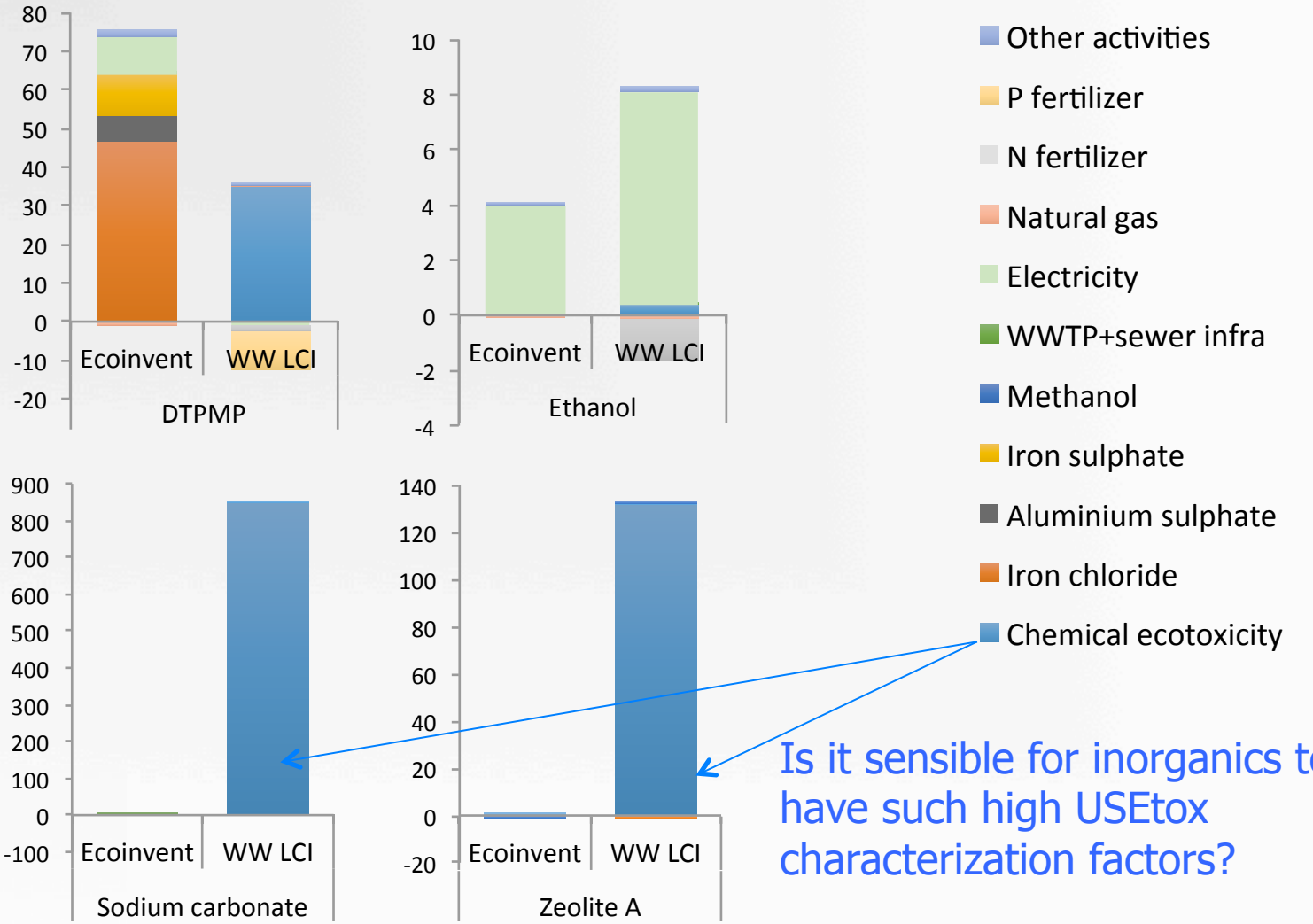
Note different Y axis scale



WW LCI compared to Ecoinvent model

Freshwater ecotoxicity, in CTU-eq/kg chemical (USEtox)

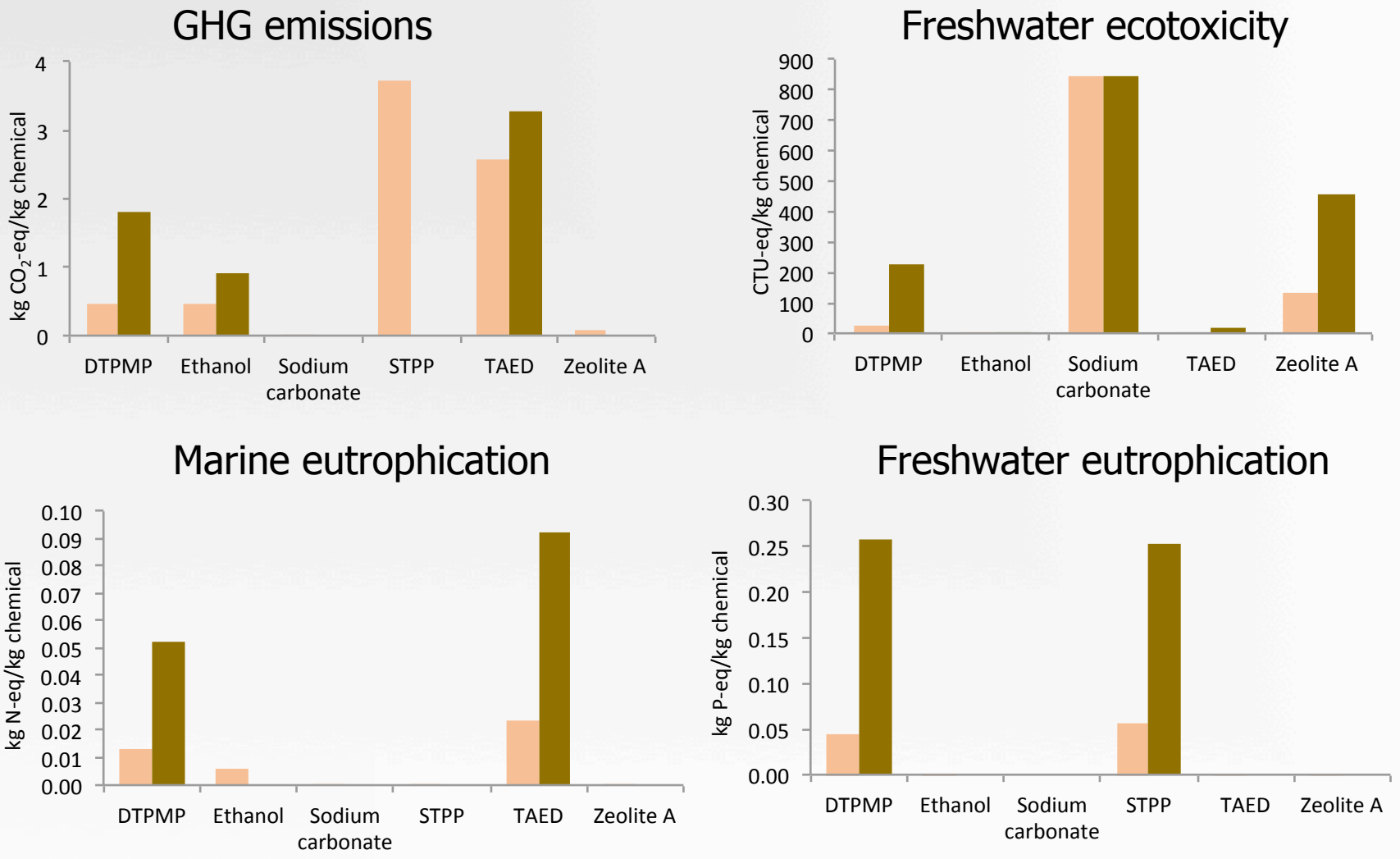
Note different Y axis scale



Is it sensible for inorganics to have such high USEtox characterization factors?

WW LCI: assessing direct discharges

Population connected to WWTP: 100% vs. 0%



Compared to Ecoinvent model…

- WW LCI can handle a complete substance flow analysis for chemicals in wastewater
- WW LCI addresses specific degradability, sorption to sludge, etc. This has substantial influence in the calculation of energy use, sludge production, N and P removal…
- WW LCI accounts for direct discharges, relevant for developing countries
- WW LCI closes the carbon balance when sludge is applied in agriculture
- WW LCI accounts for displaced energy and fertilizers
- WW LCI can represent scenarios other than Switzerland

Conclusions & Outlook

- Improvement in modelling the end of life for chemical substances
- Still some limitations:
  - Data-demanding
  - Complete flow analysis only for C, N, P, S and Cl
  - Metals not yet supported
  - Import of data sets only available for SimaPro so far
- Work in progress with Technical University of Denmark (DTU) on integration of **WW LCI** with **Sewage LCI**:
  - Adding treatment by septic tanks
  - Adding WWTPs with primary treatment only
  - Adding WWTPs with tertiary treatment (sand filter)
  - Sludge composting
  - Built-in country scenarios (% connection, sludge disposal)

Thank you!

More info:
http://lca-net.com/projects/show/wastewater-lci-initiative/

Reference:

Muñoz I, Otte N, Van Hoof G, Rigarlsford G. ***A model and tool to calculate life cycle inventories of chemicals discharged down the drain***. Submitted to the International Journal of Life Cycle Assessment.