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## Supporting Information

2 **Life cycle assessment in wastewater treatment: Influence of site-oriented normalization**  
3 **factors, life cycle impact assessment methods, and weighting methods**

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14 **Table S1- Inputs and outputs of different scenarios**

	Parameter	Unit	Scenario-1	Scenario-2	Scenario-3	Scenario-4
Inputs from the background system of different scenarios	Electricity	kWh	4380	3420	3120	480
	Inorganic Chemicals	t	0.858	0.658	0.508	—
	Chemical transport	t.km	1716	1316	1016	—
	PAM- acrylonitrile	kg	7.35	7.35	6.5	—
Outputs to the environment of different scenarios	Tertiary and phosphorus precipitation solid waste	t, water 60 %	0.923	0.113	—	—
	Bio-sludge	(t, water 80 %)	8.45	7.35	6.5	—
	CO <sub>2</sub>	(t)	1.76	1.76	1.41	—
	N <sub>2</sub> O	(kg)	1.02	0.68	0.18	0.22
	COD	(kg)	298	426	800	2592
	TN	(kg)	128	142	226	287
	TP	(kg)	5	7.8	22	34
SST	(kg)	82	163	240	1874	

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17 **Table S2- Normalization factors**

Impact category	Unit	Ch <sub>NF</sub>	EU <sub>25+3</sub>	NF <sub>World</sub>	Ch <sub>NF</sub> (of World)
ADE	kg antimony eq.	1.44E+07	7.24E+07	2.09E+08	6.86%
ADF	MJ	1.44E+13	7.24E+13	3.80E+14	3.79%
GW	kg CO <sub>2</sub> eq.	6.35E+12	6.57E+12	4.18E+13	15.21%
OD	kg CFC-11 eq.	6.62E+06	6.79E+06	2.26E+08	2.93%
HT	kg 1,4-DCB eq.	2.27E+12	2.27E+12	3.63E+13	6.25%
FAET	kg 1,4-DCB eq.	6.03E+09	6.03E+09	3.47E+12	0.17%
PO	kg ethylene eq.	2.80E+10	2.80E+10	4.01E+11	6.98%
A	kg SO <sub>2</sub> eq.	3.16E+10	2.23E+10	2.39E+11	13.23%
E	kg PO <sub>4</sub> eq.	1.68E+09	5.89E+09	1.58E+11	1.06%

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38 **Table S3- Characterization results and Normalization results**

Characterization Results from CML				
Impact categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4
ADE (kg antimony eq.)	0.0151	0.0109	0.00705	0.00039
ADF (MJ)	117000	86300	76600	8860
GW (kg CO <sub>2</sub> eq.)	15700	12200	10500	787
OD (kg CFC-11 eq.)	0.00089	0.00067	0.00039	0.00001
HT (kg 1,4-DCB eq.)	2860	2080	1740	441
FAET (kg 1,4-DCB eq.)	2140	1530	1300	739
PO (kg ethylene eq.)	4.21	3.11	2.77	0.271
A (kg SO <sub>2</sub> eq.)	84.1	60.5	54.3	7.14
E (kg PO <sub>4</sub> eq.)	97.2	104	189	282
□ Normalization Results from NF <sub>World</sub>				
Impact categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4
ADE	7.21E-11	5.23E-11	3.37E-11	1.86E-12
ADF	3.08E-10	2.27E-10	2.02E-10	2.33E-11
GW	3.76E-10	2.91E-10	2.51E-10	1.88E-11
OD	3.94E-12	2.93E-12	1.73E-12	2E-14
HT	7.88E-11	5.75E-11	4.79E-11	1.22E-11
FAET	6.16E-10	4.42E-10	3.76E-10	2.13E-10
PO	1.05E-10	7.77E-11	6.91E-11	6.77E-12
A	3.52E-10	2.53E-10	2.27E-10	2.99E-11
E	6.14E-10	6.58E-10	1.2E-09	1.78E-09
□ Normalization Results from Ch <sub>NF</sub>				
Impact categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4
ADE	1.60E-10	1.21E-10	7.81E-11	4.32E-12
ADF	8.13E-09	5.99E-09	5.32E-09	6.15E-10
GW	2.47E-09	1.92E-09	1.65E-09	1.23E-10
OD	1.31E-10	9.86E-11	5.74E-11	1.47E-12
HT	1.25E-09	9.16E-10	7.66E-10	1.94E-10
FAET	3.54E-07	2.53E-07	2.15E-07	1.22E-07
PO	1.50E-10	1.11E-10	9.89E-11	9.67E-12
A	2.66E-09	1.91E-09	1.71E-09	2.25E-10
E	5.78E-08	6.18E-08	1.12E-07	1.67E-07

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41 **Table S4- weighting results from methods of EPA, BEES, and EDIP**

CML	Normalization results from EPA				Contribution of each impact category			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Impact categories								
ADF	1.54E+03	1.14E+03	1.01E+03	1.17E+02	7.26%	6.80%	5.77%	0.96%
GW	6.02E+03	4.66E+03	4.02E+03	3.01E+02	28.38%	27.88%	22.95%	2.49%
OD	1.97E+01	1.47E+01	8.65E+00	1.00E-01	0.09%	0.09%	0.05%	0.00%
HT	1.34E+03	9.78E+02	8.14E+02	2.07E+02	6.32%	5.85%	4.65%	1.71%
FAET	6.78E+03	4.86E+03	4.14E+03	2.34E+03	31.96%	29.11%	23.63%	19.36%
PO	6.30E+02	4.66E+02	4.15E+02	4.06E+01	2.97%	2.79%	2.37%	0.34%
A	1.76E+03	1.27E+03	1.14E+03	1.50E+02	8.30%	7.57%	6.49%	1.24%
E	3.07E+03	3.29E+03	6.00E+03	8.90E+03	14.48%	19.70%	34.29%	73.55%
Overall results	2.12E+04	1.67E+04	1.75E+04	1.21E+04				
	Normalization results from BEES				Contribution of each impact category			
Impact categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
ADF	3.08E+03	2.27E+03	2.02E+03	2.33E+02	12.22%	11.29%	9.57%	1.75%
GW	1.09E+04	8.44E+03	7.28E+03	5.45E+02	43.27%	41.99%	34.50%	4.10%
OD	7.88E+00	5.86E+00	3.46E+00	4.00E-02	0.03%	0.03%	0.02%	0.00%
HT	1.73E+03	1.27E+03	1.05E+03	2.68E+02	6.88%	6.29%	4.99%	2.02%
FAET	4.31E+03	3.09E+03	2.63E+03	1.49E+03	17.11%	15.39%	12.47%	11.21%
PO	4.20E+02	3.11E+02	2.76E+02	2.71E+01	1.67%	1.55%	1.31%	0.20%
A	1.06E+03	7.59E+02	6.81E+02	8.97E+01	4.19%	3.78%	3.23%	0.67%
E	3.68E+03	3.95E+03	7.20E+03	1.07E+04	14.62%	19.64%	34.12%	80.30%
Overall results	2.52E+04	2.01E+04	2.11E+04	1.33E+04				
	Normalization results from EDIP				Contribution of each impact category			
Impact categories	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
GW	4.89E+02	3.78E+02	3.26E+02	2.44E+01	25.73%	22.79%	14.97%	1.11%
OD	9.06E+01	6.74E+01	3.98E+01	4.60E-01	4.77%	4.06%	1.83%	0.02%
PO	1.26E+02	9.32E+01	8.29E+01	8.12E+00	6.63%	5.62%	3.80%	0.37%
A	4.58E+02	3.29E+02	2.95E+02	3.89E+01	24.08%	19.81%	13.54%	1.76%
E	7.37E+02	7.90E+02	1.44E+03	2.14E+03	38.78%	47.57%	66.06%	96.65%
Overall results	1.90E+03	1.66E+03	2.18E+03	2.21E+03				

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47 **Table S5- weighting results from methods of ECER-115, ECER-125, and ISCP-2009**

CML	Normalization results from ECER-115				Contribution of each impact category			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Impact categories								
ADF	1.54E+03	1.14E+03	1.01E+03	1.17E+02	28.36%	24.15%	18.57%	1.41%
GW	2.21E+03	1.71E+03	1.48E+03	1.11E+02	40.73%	36.42%	27.14%	1.34%
A	7.66E+02	5.51E+02	4.94E+02	6.51E+01	14.11%	11.72%	9.08%	0.79%
COD	9.14E+02	1.31E+03	2.46E+03	7.95E+03	16.84%	27.79%	45.14%	96.42%
Overall results	5.43E+03	4.70E+03	5.44E+03	8.25E+03				

  

CML	Normalization results from ECER-125				Contribution of each impact category			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Impact categories								
ADF	1.93E+03	1.42E+03	1.26E+03	1.46E+02	30.17%	25.29%	18.90%	1.32%
GW	2.21E+03	1.71E+03	1.48E+03	1.11E+02	34.67%	30.51%	22.10%	1.01%
A	1.02E+03	7.35E+02	6.60E+02	8.69E+01	16.04%	13.11%	9.88%	0.79%
COD	1.22E+03	1.74E+03	3.28E+03	1.06E+04	19.14%	31.09%	49.09%	96.57%
Overall results	6.38E+03	5.61E+03	6.68E+03	1.10E+04				

  

CML	Normalization results from ISCP-2009				Contribution of each impact category			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Impact categories								
ADF	6.25E+01	4.61E+01	4.10E+01	4.73E+00	23.51%	18.89%	12.35%	0.95%
GW	6.54E+01	5.06E+01	4.37E+01	3.27E+00	24.60%	20.75%	13.15%	0.66%
A	3.63E+01	2.61E+01	2.34E+01	3.08E+00	13.63%	10.68%	7.04%	0.62%
E	6.88E+01	7.37E+01	1.34E+02	1.99E+02	25.85%	30.20%	40.48%	39.95%
COD	3.32E+01	4.74E+01	8.91E+01	2.89E+02	12.47%	19.43%	26.84%	57.85%
Overall results	2.66E+02	2.44E+02	3.32E+02	4.99E+02				

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