Comparative life cycle assessment of glucose production from maize starch and woody biomass residues as a feedstock

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SUPPORTING INFORMATION

Table S1. Initial composition of the biomass used in the simulation of the woody biomass residues based process.

Fraction proportion	Weight (kg)	Element	Weight (kg)	Proportion (%)
Solid fraction (70%)	1750	Cellulose	875	50
		Lignin	437.5	25
		Hemicellulose	420	24
		Acetate	17.5	1
Liquid fraction (30%)	750	Moisture water		

Table S2. Hemicellulose composition referred to total biomass

Element	Weight (kg)	Proportion (%)
Galactan	17.5	1
Mannan	17.5	1
Xylan	385	22

Table S3. Impacts generated in maize starch based process (MS-bp)

	Uds.	TOTAL	Starch(*) production	Hydrolysis	Transport
CC	kg CO_2-Eq	1.76	1.31	0.43	0.02
FD	kg Oil-Eq	0.45	0.29	0.15	5.62E-3
HT	kg 1,4-DB-Eq	0.41	0.39	0.02	1.83E-3
OD	kg CFC_{11}-Eq	1.72E-07	1.05E-07	6.52E-08	2.57E-09
PMF	kg PM_{10}-Eq	2.07E-03	1.93E-03	1.16E-04	2.15E-05
TA	kg SO_2-Eq	9.80E-03	9.39E-03	3.65E-04	4.83E-05

(*) Indicators values calculated excluding economic allocation reported in Ecoinvent database for starch production process (which assigs to starch 83 % of the overall impacts). Ecoinvent process (with allocation) leads to the following impacts values: CC: 1.09 kg CO_2-Eq; FD: 0.24 kg Oil-Eq; HT: 0.32 kg 1,4-DB-Eq; OD: 8.69E-8 kg CFC_{11}-Eq; PMF: 1.60E-3 kg PM_{10}-Eq; TA: 7.79E-3 kg SO_2-Eq.

Table S4. Impacts generated in woody biomass residues based process (WBR-bp)

	Uds.	TOTAL	Transport	Pretreatment	Conditioning	Hydrolysis
CC	kg CO_2-Eq	0.82	0.03	0.44	0.34	7.08E-04
FD	kg Oil-Eq	0.29	0.01	0.15	0.13	2.39E-04
HT	kg 1,4-DB-Eq	0.06	3.07E-3	0.05	0.01	8.22E-05
OD	kg CFC_{11}-Eq	1.13E-07	4.30E-09	5.86E-08	4.97E-08	9.17E-11
PMF	kg PM_{10}-Eq	5.74E-04	3.60E-05	4.02E-04	1.35E-04	5.70E-07
TA	kg SO_2-Eq	1.78E-03	8.09E-05	1.23E-03	4.68E-04	1.88E-06

Table S5. Impacts during pretreatment within WBR-bp

	Uds.	TOTAL	Deacetylation	Acidification	Purification
CC	kg CO_2-Eq	0.44	0.07	0.09	0.28
FD	kg Oil-Eq	0.15	0.03	0.03	0.10
HT	kg 1,4-DB-Eq	0.05	3.44E-03	0.03	0.01
OD	kg CFC11-Eq	5.86E-08	1.08E-08	6.11E-09	4.18E-08
PMF	kg PM10-Eq	4.02E-04	2.36E-05	2.62E-04	1.17E-04
TA	kg SO_2-Eq	1.23E-03	6.65E-05	8.23E-04	3.43E-04

Table S6. Impacts during conditioning within WBR-bp

	Uds.	TOTAL	Acidification	Alkalinization	Separation
CC	kg CO_2-Eq	0.34	0.14	0.20	1.31E-03

FD	kg Oil-Eq	0.13	0.06	0.07	3.26E-04
HT	kg 1,4-DB-Eq	0.01	6.28E-03	7.14E-03	8.94E-04
OD	kg CFC11-Eq	4.97E-08	2.09E-08	2.87E-08	6.67E-11
PMF	kg PM10-Eq	1.36E-04	6.93E-05	6.42E-05	2.01E-06
TA	kg SO_2-Eq	4.69E-04	2.64E-04	1.99E-04	5.18E-06

Table S7. Comparison between hydrolysis stage of MS-bp and (hydrolysis + conditioning) stages of WBR-bp

	Uds.	**Hydrolysis (MS-bp)**	**Hydrolysis + Conditioning (WBR-bp)**	**Avoided impact**
CC	kg CO_2-Eq	0.43	0.34	0.08
FD	kg Oil-Eq	0.15	0.13	0.03
HT	kg 1,4-DB-Eq	0.02	0.01	3.42E-3
OD	kg CFC11-Eq	6.52E-08	4.98E-08	1.55E-08
PMF	kg PM10-Eq	1.16E-04	1.36E-04	-1.90E-05
TA	kg SO_2-Eq	3.65E-04	4.70E-04	-1.03E-04

Table S.8. Analysis of the human toxicity (HT) indicator of the water production process (water is used for dilution in the hydrolysis stage of both systems).

Input flows of the process "tap water, at user" of Ecoinvent V2.2 database	**Relative contribution to HT indicator (%)**
▪ disposal, wood untreated, 20% water, to municipal incineration	0.1
▪ pump station	1.8
▪ treatment, sewage, unpolluted, to wastewater treatment, class 3	1.1
▪ water storage	2.0
▪ water supply network	6.5
▪ water works	15.3
▪ charcoal, at plant	0.1
▪ aluminium sulphate, powder, at plant	1.0
▪ chlorine, liquid, production mix, at plant	0.1
▪ hydrogen peroxide, 50% in H_2O, at plant	0.2
▪ ozone, liquid, at plant	8.3
▪ transport, freight, rail	0.1
▪ electricity, medium voltage, production UCTE, at grid	63.5