

## Supplementary Information

# Life Cycle Assessment of Wheat Straw Pyrolysis with Volatile Fractions Chemical Looping Combustion

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**Table S1.** Numerical values of the EIIs for the processes of the Case I.

	<b>Wheat Straw production</b>	<b>CO2 biochar secuestration</b>	<b>Syngas combustion</b>	<b>Bio-oil combustion</b>	<b>CH4 thermal energy equivalence</b>	<b>TOTAL</b>
<b>GWP</b>	1.65E-01	-8.22E-01	9.55E-01	1.62E-01	-6.34E-01	-1.76E-01
<b>ODP</b>	2.44E-13	0.00E+00	1.16E-11	1.50E-12	-1.97E-14	1.33E-11
<b>RI</b>	1.09E-08	0.00E+00	1.32E-08	2.25E-09	-4.40E-09	2.19E-08
<b>IR</b>	4.68E-03	0.00E+00	1.78E-04	2.32E-05	-4.62E-04	4.42E-03
<b>POF</b>	1.91E-04	0.00E+00	8.07E-03	1.38E-03	-5.70E-04	9.07E-03
<b>AC</b>	1.22E-03	0.00E+00	5.98E-03	1.02E-03	-4.57E-04	7.77E-03
<b>EUT</b>	5.49E-03	0.00E+00	3.44E-02	5.88E-03	-2.06E-03	4.37E-02
<b>EUF</b>	4.25E-05	0.00E+00	7.73E-09	1.01E-09	-2.29E-08	4.25E-05
<b>EUM</b>	5.78E-03	0.00E+00	3.14E-03	5.37E-04	-1.86E-04	9.27E-03
<b>HTC</b>	7.83E-10	0.00E+00	3.55E-11	4.61E-12	-5.90E-11	7.64E-10
<b>HTNC</b>	3.73E-08	0.00E+00	1.55E-10	2.01E-11	-1.12E-09	3.63E-08
<b>ECFW</b>	1.06E+00	0.00E+00	1.54E-02	2.01E-03	-1.78E-01	8.98E-01
<b>LU</b>	8.70E+01	0.00E+00	1.98E-02	2.58E-03	-1.88E-02	8.70E+01
<b>RDM</b>	1.20E-08	0.00E+00	6.76E-08	8.80E-09	-7.60E-09	8.08E-08
<b>WU</b>	1.74E+01	0.00E+00	1.48E-01	1.93E-02	-1.69E-03	1.76E+01
<b>RU</b>	1.09E+00	0.00E+00	4.99E-02	6.49E-03	-1.02E+01	-9.01E+00

**Table S2.** Numerical values of the EIIs for the processes of the case II.

	Wheat Straw production	CO2 biochar sequestration	Syngas CLC combustion	Bio-oil combustion	CH4 thermal energy equivalence	CO2 transport and injection	TOTAL
<b>GWP</b>	1.65E-01	-8.22E-01	4.11E-03	1.62E-01	-6.03E-01	-9.42E-01	-2.04E+00
<b>ODP</b>	2.44E-13	0.00E+00	1.01E-11	1.50E-12	-1.87E-14	1.72E-16	1.18E-11
<b>RI</b>	1.09E-08	0.00E+00	2.72E-10	2.25E-09	-4.18E-09	4.13E-11	9.24E-09
<b>IR</b>	4.68E-03	0.00E+00	1.58E-04	2.32E-05	-4.39E-04	4.27E-06	4.42E-03
<b>POF</b>	1.91E-04	0.00E+00	2.06E-05	1.38E-03	-5.42E-04	5.36E-06	1.06E-03
<b>AC</b>	1.22E-03	0.00E+00	2.34E-05	1.02E-03	-4.34E-04	4.29E-06	1.84E-03
<b>EUT</b>	5.49E-03	0.00E+00	8.03E-05	5.88E-03	-1.95E-03	1.93E-05	9.52E-03
<b>EUF</b>	4.25E-05	0.00E+00	6.80E-09	1.01E-09	-2.18E-08	2.12E-10	4.25E-05
<b>EUM</b>	5.78E-03	0.00E+00	7.42E-06	5.37E-04	-1.77E-04	1.74E-06	6.15E-03
<b>HTC</b>	7.83E-10	0.00E+00	3.10E-11	4.61E-12	-5.61E-11	5.54E-13	7.63E-10
<b>HTNC</b>	3.73E-08	0.00E+00	1.36E-10	2.01E-11	-1.07E-09	1.05E-11	3.64E-08
<b>ECFW</b>	1.06E+00	0.00E+00	1.36E-02	2.01E-03	-1.69E-01	1.67E-03	9.07E-01
<b>LU</b>	8.70E+01	0.00E+00	1.74E-02	2.58E-03	-1.79E-02	1.72E-04	8.70E+01
<b>RDM</b>	1.20E-08	0.00E+00	6.54E-08	8.80E-09	-7.23E-09	7.11E-11	7.90E-08
<b>WU</b>	1.74E+01	0.00E+00	1.30E-01	1.93E-02	-1.61E-03	8.06E-04	1.75E+01
<b>RU</b>	1.09E+00	0.00E+00	4.48E-02	6.49E-03	-9.66E+00	9.55E-02	-8.43E+00

**Table S3.** Numerical values of the EIIs for the processes of the case III.

	<b>Wheat Straw production</b>	<b>CO2 biochar sequestration</b>	<b>Volatiles CLC combustion</b>	<b>CH4 thermal energy equivalence</b>	<b>CO2 transport and injection</b>	<b>TOTAL</b>
<b>GWP</b>	1.65E-01	-8.22E-01	4.64E-03	-6.00E-01	-1.09E+00	-2.34E+00
<b>ODP</b>	2.44E-13	0.00E+00	1.14E-11	-1.86E-14	1.99E-16	1.16E-11
<b>RI</b>	1.09E-08	0.00E+00	3.06E-10	-4.15E-09	4.78E-11	7.06E-09
<b>IR</b>	4.68E-03	0.00E+00	1.78E-04	-4.36E-04	4.95E-06	4.42E-03
<b>POF</b>	1.91E-04	0.00E+00	2.29E-05	-5.39E-04	6.20E-06	-3.19E-04
<b>AC</b>	1.22E-03	0.00E+00	2.62E-05	-4.32E-04	4.97E-06	8.22E-04
<b>EUT</b>	5.49E-03	0.00E+00	8.92E-05	-1.94E-03	2.24E-05	3.66E-03
<b>EUf</b>	4.25E-05	0.00E+00	7.68E-09	-2.16E-08	2.45E-10	4.25E-05
<b>EUM</b>	5.78E-03	0.00E+00	8.24E-06	-1.76E-04	2.02E-06	5.62E-03
<b>HTC</b>	7.83E-10	0.00E+00	3.50E-11	-5.58E-11	6.42E-13	7.63E-10
<b>HTNC</b>	3.73E-08	0.00E+00	1.53E-10	-1.06E-09	1.22E-11	3.64E-08
<b>ECFW</b>	1.06E+00	0.00E+00	1.54E-02	-1.68E-01	1.93E-03	9.08E-01
<b>LU</b>	8.70E+01	0.00E+00	1.97E-02	-1.78E-02	2.00E-04	8.70E+01
<b>RDM</b>	1.20E-08	0.00E+00	7.37E-08	-7.19E-09	8.24E-11	7.85E-08
<b>WU</b>	1.74E+01	0.00E+00	1.46E-01	-1.60E-03	9.33E-04	1.75E+01
<b>RU</b>	1.09E+00	0.00E+00	5.05E-02	-9.60E+00	1.11E-01	-8.35E+00