Supplementary material of "Energetic, exergetic and techno-economic analysis of a bioenergy with carbon capture and utilization process via integrated torrefaction-CLC-methanation"

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Table S1. Energy, mass, and exergy flows for each unit of the integrated process treating OS.

Process Unit	Flow direction	Energy flow [kW]	Exergy flow [kW]	Flow Composition	Mass Flow [kg h^{-1}]
Torrefaction	In	93.2	98.0	Wet Biomass	18.4
	Out with	92.1	93.5	Torrefied Biomass	10.0
				Water (l)	2.2
	w/o torgas	65.9	67.0	Torgas	6.1
MFB-CLC	In	64.4	66.4	Torrefied Biomass	10.0
	Out	64.2	40.3	Water (l)	3.9
				CO_2	20.8
Electrolysis	In	177.2	177.2	Water (l)	34.0
	Out	149.9	128.9	O_2	30.2
				H_2	3.8
Methanation	In	151.0	130.0	CO_2	20.8
				H2	3.8
	Out	142.7	124.9	Methanation gas	8.1
				Water (l)	16.7

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Table S2. Energy, mass, and exergy flows for each unit of the integrated process treating GM.

Process Unit	Flow direction	Energy flow [kW]	Exergy flow [kW]	Flow Composition	Mass Flow [kg h^{-1}]
Torrefaction	In	160.6	164.4	Wet Biomass	57.4
	Out with torgas	154.0	140.5	Torrefied Biomass	10
				Water (l)	36.5
	w/o torgas	107.7	93.8	Torgas	9.5
MFB-CLC	In	82.7	84.1	Torrefied Biomass	10.0
	Out	82.5	56.3	Water (l)	3.1
				CO_2	26.0
Electrolysis	In	220.1	220.1	Water (l)	42.5
	Out	187.6	161.4	O_2	37.8
				H_2	4.8
Methanation	In	189.0	162.7	CO_2	26.0
				H2	4.8
	Out	177.3	155.2	Methanation gas	10.0
				Water (l)	20.7

Table S3. Energy, mass, and exergy flows for each unit of the integrated process treating HH.

Process Unit	Flow direction	Energy flow [kW]	Exergy flow [kW]	Flow Composition	Mass Flow [kg h^{-1}]
Torrefaction	In	228.7	240.8	Wet Biomass	46.9
	Out with torgas	226.2	227.4	Torrefied Biomass	10.0
				Water (l)	5.3
	w/o torgas	81.4	81.2	Torgas	31.1
MFB-CLC	In	77.8	79.8	Torrefied Biomass	10.0
	Out	77.6	52.3	Water (l)	2.0
				CO_2	26.3
Electrolysis	In	222.8	222.8	Water (l)	43.0
	Out	189.6	163.1	O_2	38.2
				H_2	4.8
Methanation	In	191.0	164.5	CO_2	26.3
				H2	4.8
	Out	179.7	157.3	Methanation gas	10.2
				Water (l)	21.0

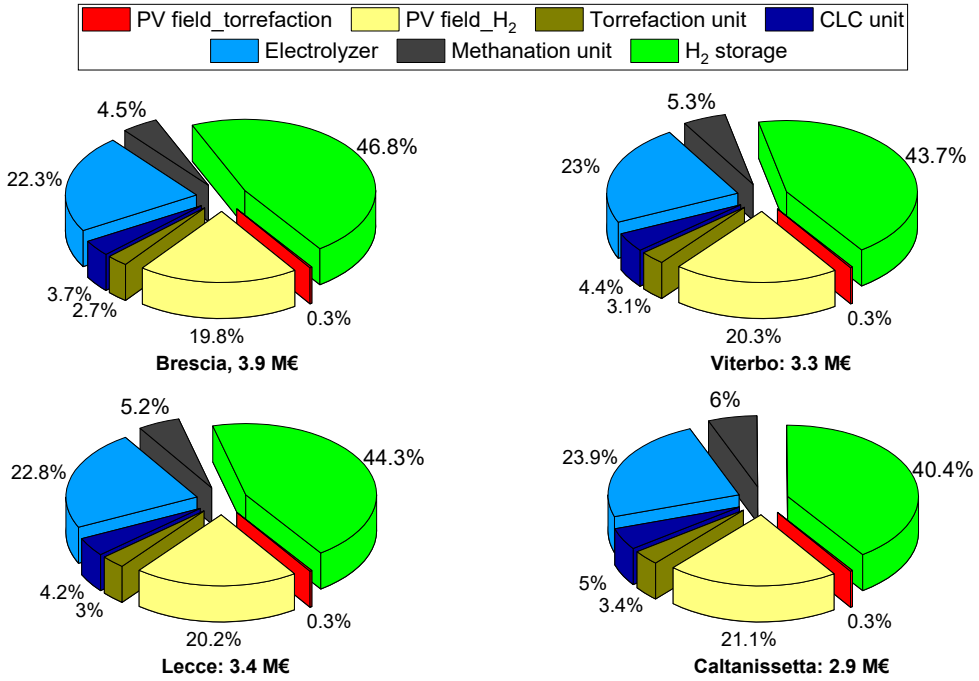

Figure S1. Total plant cost (and its breakdown) for the four site locations, olive stones.

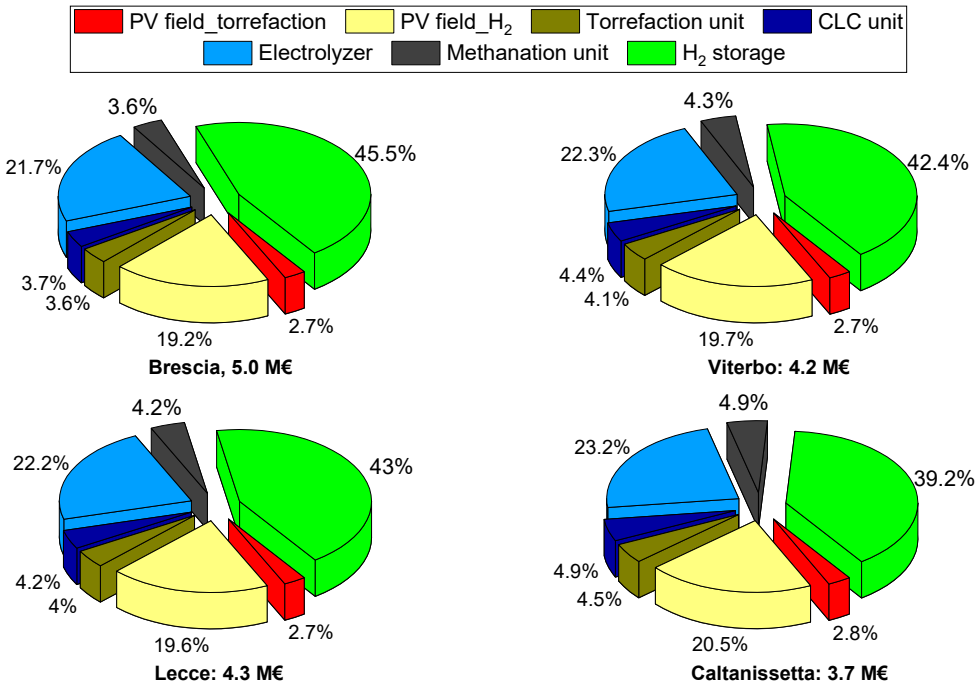

Figure S2. Total plant cost (and its breakdown) for the four site locations, grape marc.

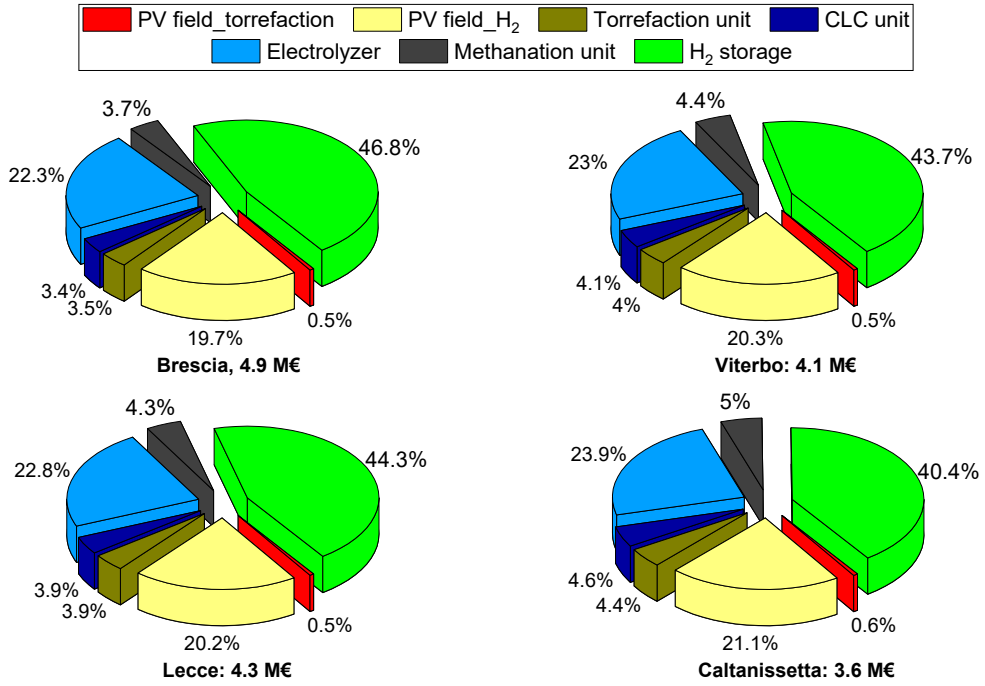

Figure S3. Total plant cost (and its breakdown) for the four site locations, hemp hurd.