

Supplementary Information

To calculate the operational expenses, the data in Table S1 was used. Additionally, the amount of labor required was calculated to be 54,664 h/y for a plant with an annual methanol output of 11.8 kt/y following the literature recommendations [1]. The supervision costs were estimated as an additional 15% of the labor costs [1]. The annual mirror renewal was estimated to be 0.2% and the annual water needs for the cleaning of the heliostats, 58.0 L/m²/y [2].

Table S1. Cost data used to determine the operational expenses.

Expense	Category	Cost	Unit
Purified Water	Raw Material	8.20	USD ₂₀₂₁ /m ³
Desalinated Water	Utility	1.64	USD ₂₀₂₁ /m ³
Grid Electricity	Utility	159	USD ₂₀₂₁ /MWh
Natural Gas	Utility	3.80	USD ₂₀₂₁ /GJ
Oxygen	Product/Raw Material	38.1	USD ₂₀₂₁ /t
Workers	Labor	14.4	USD ₂₀₂₁ /h

Table S2. Stream information of the Aspen Plus® simulation of synthetic fuel production (part 1).

[illegible]

Table S2. Stream information of the Aspen Plus® simulation of synthetic fuel production (part 2).

Variable	Units	H2-STO-2	H2-STO-3	H2O-IN-1	H2O-IN-2	H2O-IN-3	H2O-IN-4	H2O-OU-1	H2O-OU-2	H2O-OU-3	H2O-OU-4	H2O-RE-1	H2O-RE-2	MEOH-1	O2-OU-1	O2-OU-2	O2-OU-16	OC-CO2-1	OC-CO2-2	OC-H2O-1
Temperature	°C	107	50	25	25	40	900	900	900	86	50	50	50	49	1500	1500	55	900	1205	900
Pressure	bar	50.0	50.0	1.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	2.0	45.0	1.0	0.0	1.0	1.0	1.0	1.0
Molar Vapor Fraction		1.000	1.000	0.000	0.000	0.000	1.000	0.042	1.000	1.000	0.457	0.000	0.000	0.000	1.000	1.000	1.000	0.000	0.000	0.000
Molar Liquid Fraction		0.000	0.000	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.543	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Molar Solid Fraction		0.000	0.000	0.000	0.000	0.000	0.000	0.958	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000	1.000
Enthalpy Flow	kW	19	6	-3608	-3608	-8985	-6580	-750035	-3620	-4518	-5291	-5377	-5376	-537	545	545	-442	-350406	-341854	-746415
Mole Flows	kmol/h	28.1	28.1	45.4	45.4	113.6	113.6	2679.6	113.6	113.6	113.6	68.2	68.2	8.2	38.7	38.7	44.8	1229.1	1229.1	2566.0
Mole Fractions																				
H ₂		1.000	1.000	0.000	0.000	0.000	0.000	0.017	0.400	0.400	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H ₂ O		0.000	0.000	1.000	1.000	1.000	1.000	0.025	0.600	0.600	0.600	1.000	1.000	0.000	0.000	0.000	0.150	0.000	0.000	0.000
CO ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
O ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000	0.850	0.000	0.000	0.000
CEO ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.923	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.996	0.996	0.964
CE ₂ O ₃		0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.004	0.036
METHANOL		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000

Table S2. Stream information of the Aspen Plus® simulation of synthetic fuel production (part 3).

		OC-H2O-2	PURGE-1	RC-1	RC-2	RC-3	RC-CO2-X	RC-H2O-X	RCO2-1	RCO2-2	RSYN-1	RSYN-2	RSYN-3	SC-1	SC-2	SC-6	SC-7
Variable	Units																
Temperature	°C	1205	62	1500	1500	900	900	900	135	131	49	62	62	600	1222	883	600
Pressure	bar	1.0	50.0	1.0	1.0	1.0	1.0	1.0	9.0	1.0	45.0	50.0	50.0	80.0	80.0	80.0	80.0
Molar Vapor Fraction		0.000	1.000	0.010	0.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Molar Liquid Fraction		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Molar Solid Fraction		1.000	0.000	0.990	1.000	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Enthalpy Flow	kW	-728042	-22	-1034403	-1034947	-1088768	-348066	-741687	-3699	-3699	-435	-432	-411	-562691	-508871	-538811	-562691
Mole Flows	kmol/h	2566.0	1.5	3756.4	3717.7	3717.7	1206.6	2520.6	36.0	36.0	29.8	29.8	28.3	5515.7	5515.7	5515.7	5515.7
Mole Fractions																	
H ₂		0.000	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.667	0.667	0.667	0.000	0.000	0.000	0.000
H ₂ O		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO ₂		0.000	0.058	0.000	0.000	0.000	0.000	0.000	0.931	0.931	0.058	0.058	0.058	1.000	1.000	1.000	1.000
CO		0.000	0.275	0.000	0.000	0.000	0.000	0.000	0.069	0.069	0.275	0.275	0.275	0.000	0.000	0.000	0.000
O ₂		0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CEO ₂		0.964	0.000	0.943	0.953	0.953	0.977	0.945	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CE ₂ O ₃		0.036	0.000	0.046	0.047	0.047	0.023	0.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOLUENE		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
METHANOL		1205	62	1500	1500	900	900	900	135	131	49	62	62	600	1222	883	600

Table S2. Stream information of the Aspen Plus® simulation of synthetic fuel production (part 4).

		SC-CO2-3	SC-CO2-4	SC-CO2-5	SC-H2O-3	SC-H2O-4	SC-H2O-5	SYN-1	SYN-2	SYN-3	SYN-4	SYN-5	SYN-6	SYN-7	SYN-8
Variable	Units														
Temperature	°C	1222	933	912	1222	911	869	361	204	235	250	250	215	50	49
Pressure	bar	80.0	80.0	80.0	80.0	80.0	80.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	45.0
Molar Vapor Fraction		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.781	0.783
Molar Liquid Fraction		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.219	0.217
Molar Solid Fraction		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Enthalpy Flow	kW	-169607	-178159	-178770	-339264	-357637	-360041	-202	-612	-598	-591	-818	-832	-969	-969
Mole Flows	kmol/h	1838.4	1838.4	1838.4	3677.3	3677.3	3677.3	26.1	54.4	54.4	54.4	38.0	38.0	38.0	38.0
Mole Fractions															
H ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.667	0.667	0.667	0.667	0.523	0.523	0.523	0.523
H ₂ O		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO ₂		1.000	1.000	1.000	1.000	1.000	1.000	0.003	0.032	0.032	0.032	0.046	0.046	0.046	0.046
CO		0.000	0.000	0.000	0.000	0.000	0.000	0.330	0.301	0.301	0.301	0.216	0.216	0.216	0.216
O ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CEO ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CE ₂ O ₃		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
METHANOL		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.216	0.216	0.216	0.216

Table S3. Stream information of the Aspen Plus® simulation of the steam Rankine cycle (part 2).

Variable	Units	VS-SJ1-1	VS-SJ1-2	VS-SJ2-1	VS-SJ2-2	VS-SJ3-1	VS-SJ3-2	VS-SJ4-1	VS-SJ4-2
Temperature	°C	55	190	55	190	55	190	55	190
Pressure	bar	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000	12.0000
Molar Vapor Fraction		0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000
Enthalpy Flow	kW	-11208	-9357	-35901	-29972	-26318	-21971	-9785	-8169
Mole Flows	kmol/h	142.3	142.3	455.8	455.8	334.1	334.1	124.2	124.2
Mole Fractions									
H ₂ O		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
O ₂		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

References

1. Peters, M.S.; Timmerhaus, K.D.; West, R.E. *Plant Design and Economics for Chemical Engineers*, 5th ed.; Peters, M.S., Timmerhaus, K.D., West, R.E., Eds.; McGraw-Hill: New York, NY, USA, 2003; ISBN 9780072392661.
2. Falter, C.; Pitz-Paal, R. Water Footprint and Land Requirement of Solar Thermochemical Jet-Fuel Production. *Environ. Sci. Technol.* **2017**, *51*, 12938–12947, doi:10.1021/acs.est.7b02633.