

Table S1. Techno-economic analysis for bioCNG in Ghana and Uganda.

Key assumptions and outcomes	Units	Smallest system		Medium-scale system		Largest system	
		Uganda	Ghana	Uganda	Ghana	Uganda	Ghana
Plant capacity	Nm3/h raw biogas output	3.00	3.00	10.00	10.00	25.00	25.00
LPG cylinder capacity	kg	14.50	14.50	14.50	14.50	14.50	14.50
LPG refill price	USD/kg	2.60	1.08	2.60	1.08	2.60	1.08
LPG refill price (14.5 kg cylinder)	USD/cylinder	37.70	15.66	37.70	15.66	37.70	15.66
LPG energy density	kWh/kg LPG	13.60	13.60	13.60	13.60	13.60	13.60
LPG total Energy per cylinder	kWh/cylinder LPG	197.20	197.20	197.20	197.20	197.20	197.20
LPG price on kWh basis	USD/kWh LPG	0.19	0.08	0.19	0.08	0.19	0.08
BioCNG at 97% CH ₄ purity	kWh/Nm ³ Bio CNG	9.67	9.67	9.67	9.67	9.67	9.67
BioCNG density	kg/Nm ³ Bio CNG	0.75	0.75	0.75	0.75	0.75	0.75
BioCNG energy density	kWh/kg Bio CNG	12.89	12.89	12.89	12.89	12.89	12.89
Price bioCNG (equiv. energy content basis)	USD/kWh BioCNG	0.19	0.08	0.19	0.08	0.19	0.08
Price bioCNG (equiv. energy content basis)	USD/kg BioCNG	2.46	1.02	2.46	1.02	2.46	1.02
Cylinder volume	litre	35.00	35.00	35.00	35.00	35.00	35.00
BioCNG Cylinder pressure	bar	248.00	248.00	248.00	248.00	248.00	248.00
BioCNG gas volume under pressure	Nm ³	8.68	8.68	8.68	8.68	8.68	8.68
BioCNG weight under pressure/cylinder	kg	6.51	6.51	6.51	6.51	6.51	6.51
Stored BioCNG energy/cylinder	kWh	83.94	83.94	83.94	83.94	83.94	83.94
Equivalent price of each bioCNG refill	USD/cylinder CNG	16.05	6.67	16.05	6.67	16.05	6.67
Volume of agro-waste @12kg waste/Nm3 raw biogas	kg/day	864.00	864.00	2,880.00	2,880.00	7,200.00	7,200.00
Price of feedstock	USD/ kg	0.00	0.00	0.00	0.00	0.00	0.00
Cost of feedstock used	£/day	0.00	0.00	0.00	0.00	0.00	0.00
Volume of raw biogas output from digester	Nm3/day raw biogas	72.00	72.00	240.00	240.00	600.00	600.00
Volume of clean bioCNG (57% net yield)	Nm ³ /day bio CNG clean	41.04	41.04	136.80	136.80	342.00	342.00
Gas upgrader output capacity	Nm3/h, clean bioCNG	1.71	1.71	5.70	5.70	14.25	14.25
Gas upgrader output capacity	kg/h	1.28	1.28	4.28	4.28	10.69	10.69
Gas upgrader output capacity	kg/day	30.78	30.78	102.60	102.60	256.50	256.50
Total CNG production per day	kWh/day	396.86	396.86	1,322.86	1,322.86	3,307.14	3,307.14
Number of bioCNG cylinders produced	cylinders/day	4.73	4.73	15.76	15.76	39.40	39.40
Equiv. 14.5 LPG cylinders replaced by bioCNG	cylinders/day	2.01	2.01	6.71	6.71	16.77	16.77
Income from sale of bioCNG	USD/day	75.87	31.52	252.90	105.05	632.25	262.63
Compost produced assuming 10% solid	kg/day compost	86.40	86.40	288.00	288.00	720.00	720.00
Market price of compost (semi dry)	USD/kg compost	0.06	0.06	0.06	0.06	0.06	0.06
Income from compost sales	USD/day compost	4.80	4.80	16.00	16.00	40.00	40.00
Total income (BioCNG + fertiliser)	USD/day	80.67	36.32	268.90	121.05	672.25	302.63
Total income (BioCNG + fertiliser)	USD/year	26,554	11,030	88,515	36,768	221,287	91,919
Capex of AD plant	USD	16,667	16,667	30,556	30,556	58,333	58,333
Capex of bioCNG upgrader and compressor	USD	25,000	25,000	35,000	35,000	60,000	60,000
Capex of single gas cylinder	USD	663	663	663	663	663	663
Capex gas cylinders for 3 days gas storage	USD	9,397	9,397	31,324	31,324	78,309	78,309
Total capital cost	USD	51,064	51,064	96,879	96,879	196,643	196,643
Farm owner—operator wage, £833/month	USD/year	0	0	10,000	10,000	10,000	10,000
Labour cost: £150/month × 12 months × no. people	USD/year	5,000	5,000	7,500	7,500	10,000	10,000
Land lease cost	USD/year	0	0	6,944	6,944	13,889	13,889
Total labour and land costs	USD/year	5,000	5,000	24,444	24,444	33,889	33,889
Electricity rate (Uganda)	USD/kWh	0.21	0.21	0.21	0.21	0.21	0.21
Energy consumption by biogas upgrader + compressor	kWh/Nm3 raw biogas	0.50	0.50	0.50	0.50	0.50	0.50
Power consumption by biogas upgrader + compressor	kW	1.50	1.50	5.00	5.00	12.50	12.50
Cost of electricity for bioCNG + compressor	USD/day	7.50	7.50	25.00	25.00	62.50	62.50
Servicing and maintenance cost @10% of capex	USD/year	5,106	5,106	9,688	9,688	19,664	19,664
Total overhead & operating cost	USD/ year	12,731	12,731	42,882	42,882	75,428	75,428
Net operating profit	USD /year	13,823	-1,701	45,632	-6,115	145,858	16,491
Payback period	years	3.69	-30.02	2.12	-15.84	1.35	11.92