Supplementary Material: Life Cycle Costing

For LCC, there were parameters required to calculate the waste generated, waste collected, energy generated as well as for economic assessment. These parameters are represented in Tables S1-S7 below.

Table S1. The parameters for the projection of the Population and Waste Generated and Collected

City	Year	Population	Population Growth Rate	Waste Generation Rate (kg/capita/day)
Lagos	2022	15387639	0.032	0.72
Abuja	2022	3464000	0.0567	0.66

Days	Conversion Factor (Kg to tonnes)	Collected Fraction
365	1000	0.4

Table S2. The waste fraction for WtE Processes

City	AD Process Fraction	Incineration Fraction	Gasification Fraction	LFGTE Fraction
Lagos	0.46	0.48	0.94	1
Abuja	0.47	0.41	0.88	1

Table S3. The energy generating potential of the WtE Processes.

Energy Generating Potential (kWh/t)	AD	Incineration	Gasification	LFGTE
Lagos	683	549	626	171
Abuja	667	441	639	135

Table S4. The average population, waste generated and wasted collected over a 20-year period.

City	Average Population	Average Waste Generated (t)	Average Waste Collected (t)
Lagos	21470392.43	5642419.131	2256967.652
Abuja	6353994.284	1530677.223	612270.8892

Table S5. The amount of waste processed for the WtE systems.

City	Waste for AD process (tonnes)	Waste for Incineration process (tonnes)	Waste for Gasification process (tonnes)	Waste for LFGTE process (tonnes)
Lagos	1038205.12	1083344.473	1909394.634	2256967.652
Abuja	287767.3179	251031.0646	538798.3825	612270.8892

Table S6. The amount of energy generated from the WtE systems.

Electricity Generated (kWh)	AD	Incineration	Gasification	LFGTE
Lagos	709094097	594756115.8	1195281041	385941468.6
Abuja	191940801.1	110704699.5	344292166.4	82656570.04

Table S7. The plant size/ kW capacity for the WtE systems.

Plant Size (kW)	AD	Incineration	Gasification	LFGTE
Lagos	80946.8	75438.4	136447.6	44057.2
Abuja	21911.1	14041.7	39302.8	9435.7

From the tables, the following sample calculations for waste generated, waste collected, and waste processed, energy generated, plant size and the economic assessment are given below for each of the WtE systems for both cities.

AD (Lagos):

(1) Waste Generated = (P(t) x Wgr x 365)/1000
= (21470392.43 x 0.72 x 365)/1000
= 5642419.13 t

(2) Waste Collected = 5642419.13 x 0.4
= 2256967.652 t

(3) Waste processed for AD = 2256967.652 x 0.47
= 1038205.12 t

(4) Energy Generated from AD = Waste processed from AD x Energy generating Potential
= 1038205.12 t x 683 kWh / t
= 709094097 kWh

(5) Size = Energy Generated /Operating hours
= 709094097kWh ÷ 8760 h
= 80946.8 kWh

(6) Capital Cost = U$4339 / kw x 80946.8 kW
=U$351228229.1

(7) O$M Cost = 0.03 x Capital Cost + U$0.005 / kWh x Energy Generated (kWh)
= 0.03 x U$351228229.1 x U$ 0.005 x 709094097 kWh
= U$14082317.36

(8) Revenue = Electricity Tariff x Electricity Generated
= U$0.1868/kWh x 709094097kWh
= U$132458777.3

(9) Payback Period = Capital Cost / (Revenue – O&M Cost)
= U$ 351228229.1 / (U$132458777.3 – $14082317.36)
= 2.97 years

AD (Abuja):

(1) Waste Generated = (P(t) x Wgr x 365)/1000
= (6353994.28 x 0.66 x 365) /1000
= 1530677 t

(2) Waste Collected = 1530677 x 0.4
= 612270.88 t

(3) Waste processed for AD = 612270.88 x 0.47
= 287767.32 t

(4) Energy Generated from AD = waste processed from AD x Energy generating potential
= 1038205.12 x 667 kWh / t
= 191940801.1 kWh

(5) Size = Energy Generated /Operating hours
= 191940801.1 /8760
= 21911.05 kWh

(6) Capital Cost = $4339 / kW x 21911.05 kW
=U$95072047.46

(7) O$M Cost = 0.03 x capital cost + $0.005 / kwh x Energy Generated (kWh)
= 0.03 x $95072047.46 + U$0.005 x 191940801.1 kWh
= U$3811865.429

(8) Revenue = Electricity Tariff x Electricity Generated
= U$0.1868/kWh x 191940801.1 kWh
= $35854541.6

(9) Payback Period = Capital Cost /(Revenue – O$M Cost)
= U$95072047.46 /(U$35854541.6 – U$3811865.429)
= 2.967 years

Incineration (Lagos)

(1) Waste processed for Incineration = 2256967.652 x 0.48
= 1083344.473 t

(2) Energy Generated = waste processed from incineration x Energy generating potential
= 1083344.4732 x 549 kWh / t
= 594756115.8 kWh

(3) Size = Energy Generated/Operating hours
= 594756115.8 / (0.9 x8760)
= 75438.37 kW
Because incineration plants operate on a 90% basis

(4) Capital Cost = $16587 / kW x $(size)^{0.82}$
= U$16587 / kW x $(75438.37)^{0.82}$
=U$165725601.5

(5) O$M Cost = 0.04 x capital cost

= 0.04 x U$ 594756115.8
= U$6960475

(6) Revenue = Electricity Tariff x Electricity Generated
= $0.1868 x 594756115.8 kWh
= $132458777.3

(7) Payback Period = Capital Cost / (Revenue – O$M Cost)
= U$165725601.5/ (U$132458777.3 – U$6960475)
= 1.59 years

Incineration (Abuja)

(1) Waste processed for Incineration = 612270.88 x 0.41
= 251031.0646 t

(2) Energy Generated = waste processed from incineration x Energy generating potential
= 251031.0646 x 441 kWh / t
= 110704699.5 kWh

(3) Size = Energy Generated ÷ Operating hours
= 110704699.5 kWh /(0.9 x8760) h
= 14041.69 kW
Because incineration plants operate on a 90% basis

(4) Capital Cost = $16587 / kW x $(size)^{0.82}$
= U$16587 / kw x $(14041.69kW)^{0.82}$
= U$41749171.3

(5) O$M Cost = 0.04 x Capital Cost
= 0.04 x U$41749171.3
= U$1753466.195

(6) Revenue = Electricity Tariff x Electricity Generated
= $0.1868 x 110704699.5
= $20679637.86

(7) Payback Period = Capital Cost /(Revenue – O&M Cost)
=U$41749171.3/ (U$20679637.86 –U$1753466.195)
= 2.21 years

Gasification (Lagos)

(1) Waste processed for Gasification = 2256967.652 x 0.94
= 2121549.593 t

(2) Energy Generated = waste processed from gasification x Energy generating potential
= 2121549.593 x 626 kWh / t
= 1328090045 kWh

(3) Size = Energy Generated/Operating hours
= 1328090045 ÷ 8760
= 151608.4527 kW

(4) Capital Cost =U $3925 / kWx size (Kw)
= U$3925 / kW x 151608.4527kW
= U$595063176.7

(5) O$M Cost = 0.04 x Capital Cost + U$0.004 / kWh x Energy Generated (kWh)
= 0.04 x U$595063176.7 + U$0.004/kWh x 1328090045 kWh
= U$29114887.3

(6) Revenue = Electricity Tariff x Electricity Generated
= U$0.1868 x 1328090045 kWh
= U$248087220.5

(7) Payback Period = Capital Cost/ (Revenue – O$M Cost)
= U$595063176.7 ÷ (U$248087220.5 – U$29114887.3)
= 2.71 years

Gasification (Abuja)

(1) Waste processed for Gasification = 612270.882 x 0.88
= 538798.3825 t

(2) Energy Generated = Waste processed from Gasification x Energy Generating potential
= 538798.3825 x 639 kWh / t
= 344292166.4 kWh

(3) Size = Energy Generated/Operating hours
= 344292166.4kWh ÷ 8760 h
= 39302.759 kW

(4) Capital Cost = $3925 / kW x size (kW)
= U$3925 / kw x 39302.759 kW
= U$154263328

(5) O$M Cost = 0.04 x Capital Cost + U$0.004 / kWh x Energy Generated (kWh)
= 0.04 x U$1542633287 + U$0.004/kWh x 344292166.4 kWh
= U$7547702

(6) Revenue = Electricity Tariff x Electricity Generated
= U$0.1868/kWh x 344292166.4 kWh
= U$248087220.5

(7) Payback Period = Capital Cost / (Revenue – O$M Cost)
= U$154263328 ÷ (U$248087220.5 – U$7547702)
= 2.717 years

LFGTE (Lagos)

(1) Waste processed for LFGTE = 2256967.652 t

(2) Energy Generated = Waste processed from LFGTE x Energy generating potential
= 2256967.65 x 171 kWh / t
= 3859141468.6 kWh

(3) Size = Energy Generated / Operating hours
= 1328090045 kWh / 8760h
= 44057.25 kW

(4) Capital Cost = $C_V + C_W + C_{Kout} + C_{eng} + C_{ICE}$
C_V = U$85 x 50 (65-10)
= U$85 / ft x 50 x 55 ft

= U$233750

C_W = U$17000 x 50

=U$ 850000

C_{Kout} = U$4600 x (72.59 m^3 / t x 2256967.652 t)$^{0.6}$

= U$390300502.4

C_{eng} = U$700 x 50

= U$35000

C_{ICE} = U$1100000 + (U$1300 / kw x 44057.25 kw)

= U$58374418.85

Capital Cost = $449793671.3

(5) O$M Cost = U$5100 + (U$2600 x 50) + (U$0.025 / kWh x 3859141468.6 kwh)

= U$9783636.7

(6) Revenue = Electricity Tariff x Electricity Generated

= U$0.1868 / kWh x 3859141468.6 kWh

= U$72093866.3

(7) Payback Period = Capital Cost / (Revenue – O$M Cost)

= U$449793671.3 / (U$72093866.3 –U $9783636.7)

= 7.2 years

LFGTE (Abuja)

(1) Waste processed for LFGTE = 612270.8892 t

(2) Energy Generated = waste processed from LFGTE x Energy generating potential

= 612270.8892 x 135 kWh / t

= 82656570.04 kWh

(3) Size = Energy Generated/ Operating hours

= 82656570.04 kWh ÷ 8760 h

= 9435.68 kW

(4) Capital Cost = C_V + C_W + C_{Kout} + C_{eng} + C_{ICE}

C_V = U$85 x 50 (65-10)

= U$85 / ft x 50 x 55 ft

= U$233750

C_W = U$17000 x 50

=U$ 850000

C_{Kout} = U$4600 x (62.29 m^3 / t x 612270.8892 t)$^{0.6}$

=U$ 162770237.4

C_{eng} = U$700 x 50

= U$35000

C_{ICE} = U$1100000 + (U$1300 / kWh x 82656570.04 kWh)

=U$13366385.97

Capital Cost = $177255373.4

(5) O$M Cost = U$5100 + (U$2600 x 50) + (U$0.025 / kWh x 82656570.04 kWh)

= U$2201514.251

(6) Revenue = Electricity Tariff x Electricity Generated

=U$0.1868 / kWh x 82656570.04 kWh

= U$15440247.3

(7) Payback Period = Capital Cost ÷ (Revenue – O$M Cost)
= U$177255373.4 ÷ (U$15440247.3 – U$2201514.251)
= 13.39 years

The summary of the results from the economic assessment for the WtE systems are given in Tables S 8 –9. This is followed by Tables S 10-11 the results of the economic indicators calculated on a per tonnes basis by dividing with amount of waste processed for each WtE systems. While Tables S12 -13 gives the population and waste projections for Lagos and Abuja.

Table S8. The economic assessment for the WtE systems for Lagos

Economic Indicators	LFGTE	Gasification	Incineration	AD
Capital Cost (U$)	449793671.3	535556859	165725601.5	351228229.1
O&M Cost (U$)	9783636.714	26203398.5	6960475.263	14082317.36
Revenue (U$)	72093866.33	223278498	111100442.4	132458777.3
LCOE (U$/kWh)	0.165220429	0.07712625	0.045807208	0.080372347
LCC (U$)	542870922.6	784844561	231944526.4	485201252.6
NPV (U$)	80688438.94	1142254562	720876644.7	656577305.7
IRR (%)	0.125512937	0.36727582	0.628351345	0.336008916
PBP (Years)	7.218616815	2.71752677	1.591373668	2.967044539

Table S9. The economic assessment for the WtE systems for Abuja

Economic Indicators	LFGTE	Gasification	Incineration	AD
Capital Cost (U$)	177255373	154263328	41749171.3	95072047.46
O&M Cost (U$)	2201514.25	7547701.785	1753465.195	3811865.429
Revenue (U$)	15440247.3	64313776.69	20679637.86	35854541.64
LCOE (U$/kWh)	0.28165278	0.077126253	0.061996181	0.080372347
LCC (U$)	198199619	226068869.9	58430874.16	131336472.1
NPV (U$)	-64546576	329018267.8	119380005.7	177725318.2
IRR (%)	0.04169039	0.367275821	0.453073065	0.336008916
PBP (Years)	13.3891493	2.717526767	2.205896144	2.967044539

Table S10. The economic assessment on a per tonne basis for the WtE systems for Lagos

Economic Indicators	LFGTE	Gasification	Incineration	AD
Capital Cost (U$/t)	199.2911466	280.48516	152.9759053	338.3033105
O&M Cost (U$/t)	4.334859077	13.7234064	6.424988021	13.56409932
Revenue (U$/t)	31.9428	116.9368	102.5532	127.5844
LCOE (U$/kWh)	0.165220429	0.07712625	0.045807208	0.080372347
LCC (U$/t)	240.5311046	411.043661	214.1004382	467.3462336
NPV (U$/t))	35.75081763	598.228643	665.4177527	632.4157847
IRR (%)	12.55129365	36.7275821	62.83513451	33.60089155
PBP (Years)	7.218616815	2.71752677	1.591373668	2.967044539

Table S11. The economic assessment on a per tonne basis for the WtE systems for Abuja

Economic Indicators	LFGTE	Gasification	Incineration	AD
Capital Cost (U$/t)	289.50482	286.3099315	166.3107766	330.3781963
O&M Cost (U$/t)	3.59565397	14.00839726	6.985052618	13.24634589
Revenue (U$/t)	25.218	119.3652	82.3788	124.5956
LCOE (U$/kWh)	0.28165278	0.077126253	0.061996181	0.080372347
LCC (U$/t)	323.712303	419.5797115	232.7635198	456.398152
NPV (U$/t))	-105.4216	610.6519219	475.5586958	617.6007737
IRR (%)	4.16903875	36.72758206	45.30730652	33.60089155
PBP (Years)	13.3891493	2.717526767	2.205896144	2.967044539

Tables S12-13 gives the population and waste projection for Lagos and Abuja for 2022-2042.

Table S12. The projected population for Lagos and Abuja

Year	Projected Population of Lagos	Projected Population of Abuja
2022	15387639	3464000
2023	15880044	3660409
2024	16388205	3867954
2025	16912627	4087267
2026	17453832	4319015
2027	18012354	4563903
2028	18588749	4822677
2029	19183589	5096122
2030	19797464	5385072
2031	20430983	5690406
2032	21084775	6013052
2033	21759487	6353992
2034	22455791	6714263
2035	23174376	7094962
2036	23915956	7497247
2037	24681266	7922340
2038	25471067	8371537
2039	26286141	8846203
2040	27127298	9347783
2041	27995372	9877802
2042	28891224	10437874
Average Population	**21470392**	**6353994**

Table S13 The projected waste generation for Lagos and Abuja

Year	Projected Waste Generated for Lagos (t)	Projected Waste Generated for Abuja (t)
2022	4043871.529	834477.6
2023	4173275.418	881792.4799
2024	4306820.232	931790.1135
2025	4444638.479	984622.613
2026	4586866.91	1040450.715
2027	4733646.651	1099444.271
2028	4885123.344	1161782.761
2029	5041447.291	1227655.843
2030	5202773.605	1297263.93
2031	5369262.36	1370818.794
2032	5541078.755	1448544.22
2033	5718393.276	1530676.677
2034	5901381.86	1617466.045
2035	6090226.08	1709176.37
2036	6285113.315	1806086.67
2037	6486236.941	1908491.784
2038	6693796.523	2016703.268
2039	6907998.011	2131050.344
2040	7129053.948	2251880.898
2041	7357183.674	2379562.545
2042	7592613.552	2514483.741
Average Waste Generated (t)	**5642419.131**	**1530677.223**

Table S14 Sensitivity Analysis: Variation of Capital Cost of WtE systems for Lagos and Abuja.

	Capital Cost							
(%)	**10% Increase AD Lagos**	**10% Decrease AD Lagos**	**10% Increase Incineration Lagos**	**10% Decrease Incineration Lagos**	**10% Increase Gasification Lagos**	**10% Decrease Gasification Lagos**	**10% Increase LFGTE Lagos**	**10% Decrease LFGTE Lagos**
LCOE	9.304823324	-9.304823324	10	-10	9.420451747	-9.420451747	8.285462576	-8.285462576
LCC	9.304823324	-9.304823324	10	-10	9.420451747	-9.420451747	8.285462576	-8.285462576
NPV	-6.715650123	6.715650123	-3.120978503	3.120978503	-6.28526058	6.28526058	-55.74450035	55.74450035
IRR	-10.0850389	12.2560314	-9.704546355	11.85760278	-10.20763283	12.42280074	-12.00922339	14.22271009
PBP	10.98791829	-10.79403422	10.7401617	-10.59754539	11.20885213	-10.96778966	10	-10

(%)	**10% Increase AD Abuja**	**10% Decrease AD Abuja**	**10% Increase Incineration Abuja**	**10% Decrease Incineration Abuja**	**10% Increase Gasification Abuja**	**10% Decrease Gasification Abuja**	**10% Increase LFGTE Abuja**	**10% Decrease LFGTE Abuja**
LCOE	9.304823324	-9.304823324	10	-10	9.420451747	-9.420451747	8.94327516	-8.94327516
LCC	9.304823324	-9.304823324	10	-10	9.420451747	-9.420451747	8.94327516	-8.94327516
NPV	-6.715650123	6.715650123	-4.747646698	4.747646698	-6.28526058	6.28526058	-27.46162291	27.46162291
IRR	-10.0850389	12.2560314	-9.978278178	12.17400182	-10.20763283	12.42280074	-25.41615474	29.52450522
PBP	10.98791829	-10.79403422	11.02865426	-10.82617443	11.20885213	-10.96778966	10	-10

Table S15 Sensitivity Analysis: Variation of O&M Cost of WtE systems for Lagos and Abuja.

	O&M Cost							
(%)	**10% Increase AD Lagos**	**10% Decrease AD Lagos**	**10% Increase Incineration Lagos**	**10% Decrease Incineration Lagos**	**10% Increase Gasification Lagos**	**10% Decrease Gasification Lagos**	**10% Increase LFGTE Lagos**	**10% Decrease LFGTE Lagos**
LCOE	0.047341544	-2.761184617	2.854946653	-2.854946653	3.176268449	-3.176268449	1.714537424	-1.714537424
LCC	0.047341544	-2.761184617	2.854946653	-2.854946653	3.176268449	-3.176268449	1.714537424	-1.714537424
NPV	0.188495092	1.82599528	-0.822033147	0.822033147	-1.953017397	1.953017397	-10.32286851	10.32286851
IRR	0.02474894	1.207821941	-0.66868362	0.668671349	-1.343838048	1.343148326	-2.047775289	2.037672433
PBP	0.019205267	-1.175635814	0.672874277	-0.663939323	1.347531864	-1.312168097	1.595196325	-1.545876785

(%)	**10% Increase AD Abuja**	**10% Decrease AD Abuja**	**10% Increase Incineration Abuja**	**10% Decrease Incineration Abuja**	**10% Increase Gasification Abuja**	**10% Decrease Gasification Abuja**	**10% Increase LFGTE Abuja**	**10% Decrease LFGTE Abuja**
LCOE	2.761184617	-2.761184617	2.854946653	-2.854946653	3.176268449	-3.176268449	1.05672484	-1.05672484
LCC	2.761184617	-2.761184617	2.854946653	-2.854946653	3.176268449	-3.176268449	1.05672484	-1.05672484
NPV	-1.82599528	1.82599528	-1.250480563	1.250480563	-1.953017397	1.953017397	-2.90375307	2.90375307
IRR	-1.208576926	1.207821941	-0.929842087	0.929702036	-1.343838048	1.343148326	-4.557027067	4.518752426
PBP	1.203943803	-1.175635814	0.935140234	-0.91797159	1.347531864	-1.312168097	1.691055383	-1.635733079

Table S16 Sensitivity Analysis: Variation of Discount Rate of WtE systems for Lagos and Abuja.

	Discount Rate							
(%)	10% Increase AD Lagos	10% Decrease AD Lagos	10% Increase Incineration Lagos	10% Decrease Incineration Lagos	10% Increase Gasification Lagos	10% Decrease Gasification Lagos	10% Increase LFGTE Lagos	10% Decrease LFGTE Lagos
LCOE	-4.361556551	5.475272297	-4.414262129	5.538080078	-4.594883751	5.753321877	-3.773214535	4.774161364
LCC	-1.596985237	1.784902849	-1.651214348	1.845513111	-1.837057106	2.053224028	-0.99163632	1.108322389
NPV	-9.920376807	11.08770977	-7.948865868	8.884210701	-9.493307356	10.61038696	-42.49097786	47.49090077
IRR	0	0	0	0	0	0	0	0
PBP	0	0	0	0	0	0	0	0

(%)	10% Increase AD Abuja	10% Decrease AD Abuja	10% Increase Incineration Abuja	10% Decrease Incineration Abuja	10% Increase Gasification Abuja	10% Decrease Gasification Abuja	10% Increase LFGTE Abuja	10% Decrease LFGTE Abuja
LCOE	-4.361556551	5.475272297	-4.414262129	5.538080078	-4.594883751	5.753321877	-3.403444487	4.333516611
LCC	-1.596985237	1.784902849	-1.651214348	1.845513111	-1.837057106	2.053224028	-0.611177521	0.683094917
NPV	-9.920376807	11.08770977	-8.723281558	9.749752058	-9.493307356	10.61038696	-11.2855285	12.61349918
IRR	0	0	0	0	0	0	0	0
PBP	0	0	0	0	0	0	0	0

Table S17 Sensitivity Analysis: Variation of Collection Rate of WtE systems for Lagos and Abuja.

Collection Rate (%)	10% Increase AD Lagos	10% Decrease AD Lagos	10% Increase Incineration Lagos	10% Decrease Incineration Lagos	10% Increase Gasification Lagos	10% Decrease Gasification Lagos	10% Increase LFGTE Lagos	10% Decrease LFGTE Lagos
LCOE	0	0	-1.700950903	1.914586865	0	0	-2.748042397	3.166457275
LCC	10	-10	8.128954006	-8.276871821	10	-10	6.977153363	-7.150188453
NPV	10	-10	10.58394943	-10.5377846	10	-10	30.32093524	-29.15675708
IRR	0	0	1.846823804	-2.0051405	0	0	4.429839537	-4.809137107
PBP	0	0	-1.812577863	2.045170571	0	0	-3.309784811	3.814962523

(%)	10% Increase AD Abuja	10%Decrease AD Abuja	10% Increase Incineration Abuja	10% Decrease Incineration Abuja	10% Increase Gasification Abuja	10% Decrease Gasification Abuja	10% Increase LFGTE Abuja	10% Decrease LFGTE Abuja
LCOE	0	0	-1.700950903	1.914586865	0	0	-3.232706942	3.731471605
LCC	10	-10	8.128954006	-8.276871821	10	-10	6.444022364	-6.641675555
NPV	10	-10	10.88830653	-10.81808038	10	-10	0.898214231	-0.291291451
IRR	0	0	1.897141538	-2.060325114	0	0	10.2061373	-11.13983956
PBP	0	0	-1.855615739	2.095686185	0	0	-3.638157352	4.209971568

Table S18 Sensitivity Analysis: Variation of Energy Generating Efficiency of WtE systems for Lagos and Abuja.

	Energy Generation Efficiency							
(%)	10% Increase AD Lagos	10% Decrease AD Lagos	10% Increase Incineration Lagos	10% Decrease Incineration Lagos	10% Increase Gasification Lagos	10% Decrease Gasification Lagos	10% Increase LFGTE Lagos	10% Decrease LFGTE Lagos
LCOE	0	0	-1.700950903	1.914586865	0	0	-6.594645389	8.060122142
LCC	10	-10	8.128954006	-8.276871821	10	-10	2.745890072	-2.745890072
NPV	10	-10	10.58394943	-10.5377846	10	-10	58.78882775	-58.78882775
IRR	0	0	1.846823804	-2.0051405	0	0	11.09498011	-11.70089287
PBP	0	0	-1.812577863	2.045170571	0	0	-7.951462824	9.722712435

(%)	10% Increase AD Abuja	10% Decrease AD Abuja	10% Increase Incineration Abuja	10% Decrease Incineration Abuja	10% Increase Gasification Abuja	10% Decrease Gasification Abuja	10% Increase LFGTE Abuja	10% Decrease LFGTE Abuja
LCOE	0	0	-1.700950903	1.914586865	0	0	-7.626575043	9.321369497
LCC	10	-10	8.128954006	-8.276871821	10	-10	1.610767453	-1.610767453
NPV	10	-10	10.88830653	-10.81808038	10	-10	15.73942413	-15.73942413
IRR	0	0	1.897141538	-2.060325114	0	0	24.93245075	-26.52043324
PBP	0	0	-1.855615739	2.095686185	0	0	-8.546645045	10.46745918

Development of Scenarios

The scenarios were developed based on the composition of the collected MSW for Lagos and Abuja in Table S 19.

Table S19. The Waste Composition of Lagos and Abuja (after [1] and [2]; complied by the authors).

Waste Components	Lagos (%)	Abuja (%)
Food Waste	46	47
Paper	13	14
Plastics	23	22
Textiles	12	5
Metal	2	7
Glass	4	5
Total	100	100

The food waste was considered as putrescible while paper, textiles, and plastics, were assigned as 'combustibles' and metals and glass as 'recyclables'. Thus, the scenarios for this study were as follows:

AD Scenario: This involves the separation of the food waste (Lagos: 46% and Abuja: 47% by mass for 1 tonne of MSW) from the rest of the MSW and transferring it to AD plants where it is used to produce biogas for combustion for electricity generation and digestate.

Incineration Scenario: In this scenario, the combustibles portion of the Wastes in both cities (Lagos: 48% and Abuja: 41% by mass for 1 tonne of MSW) is sorted and sent to the incineration plant where it is com-busted to produce electricity.

Gasification Scenario: Here, all the waste except the recyclables (Lagos: 94% and Abuja: 88 % by mass for 1 tonne of MSW) is used for energy recovery after the sorting process. Thus, energy via gasification is recovered from the food waste and combustible fractions, the residues from the gasification are assumed to be used as construction material, and the recyclables go to re-cycling.

LFGTE Scenario: This scenario involves the use of all the unsorted MSW transported to the landfill site. From here, landfill gas is collected, treated, and combusted for electricity production.

Overall Assumptions:

The following general assumptions have been made for all the LCC scenarios:

- It is assumed that the waste composition is constant throughout the period study for both cities.
- A constant of population growth of 3.2 and 5.67% was assumed for Lagos and Abuja respectively throughout the period of study.
- A 40% collection rate is assumed for the amount of MSW that was collected and transported to landfill site /WtE plants

- The only source of revenue considered is from the electricity generated from WtE systems for both cities. Other potential sources of revenues such as from the sales of digestate, solid residues and recyclables are not considered.

References

1. LAWMA. *Lagos Waste Management Authority Report*; LAWMA: Lagos, Nigeria, 2019.
2. Amoo, O.M.; Fagbenle, R.L. Renewable municipal solid waste pathways for energy generation and sustainable development in the Nigerian context. *Int. J. Energy Environ. Eng.* **2013**, *4*, 1–17.