

Quantitative Analysis of Municipal Solid Waste: Energy Potential Recovery Prediction in Yola, Adamawa State

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Abstract- This research has been done to determine the energy content via the physical composition of MSW and to determine the percentages of the individual components (waste type) in Yola. This study presents an analysis of the physical properties of MSW in Yola with the aim of evaluating its energy potential. Key physical parameters such as percentage waste composition, and calorific value were examined to determine their suitability for waste-to-energy conversion. Primary and secondary data findings indicate that MSW in Yola is predominantly composed of combustible materials, plastics, paper, and textiles, with varying moisture content that influences its combustion efficiency. From the outcome of the result, it showed that Plastic waste (63 %) had the highest percentage among other waste type (from the total weight of the waste types). The effective net calorific value of MSW in Yola was found to be approx. 13.647MJ/kg and an electrical energy recovery of about 758.17kWh/kg, suggesting moderate energy recovery potential suitable for thermal conversion technologies such as incineration. The study further highlights that effective segregation and pre-treatment of waste can significantly enhance its heating value and overall energy yield. Estimates from the data show that waste-to-energy systems in Yola could generate several megawatts of electricity if properly harnessed, contributing to the mitigation of energy shortages in the region. In conclusion, the physical characteristics of MSW in Yola demonstrate considerable potential as a renewable energy resource. However, optimizing this potential requires improved waste management practices, investment in modern conversion technologies, and policy support to ensure sustainable energy recovery and environmental protection in Adamawa State.

Keywords: Municipal Solid Waste, Moisture Content, Energy Recovery, Power Generation

I. INTRODUCTION

Municipal solid waste (MSW) management has become a serious environmental and energy concern in many developing countries, including Adamawa State. Makinta *et al.*, 2025; Malgwi & Abdulkadir 2020. Rapid population growth, urbanization, and changing consumption patterns have significantly increased the volume and complexity of waste generated in urban centers such as Yola. This growing waste streams presents serious problem in terms of collection, disposal, and environmental sustainability, while also ushering an opportunity for energy potential recovery, particularly in the form of energy generation.

Municipal solid waste (MSW) is a kind of low quality fuel containing high amounts of moisture, combustible, non-combustibles, and miscellaneous pollution sources. (Rominiyi & Adaramola, 2020; Luo & Xiao, 2010; Liang,*et al.*, 2008). MSW consists of wastes that are gotten from municipal services and operations such as street waste, dead animals, market waste and abandoned automobiles. (Valavanidis, 2023; Ghanbarzadeh *et al.*, 2024). It often contains various substances such as heavy metals, persistent organic pollutants, sulphates, chlorides, polycyclic aromatic hydrocarbons from batteries, treated wood discards, and discarded electronic devices. (Dabrowska *et al.*, 2023, Yin, *et al.*, 2017). They are mostly, household or domestic waste such as food refuse, paper, plastics, and yard clipping.

In Nigeria, MSW is typically characterized by a high proportion of organic (biodegradable) waste, often exceeding 50%, along with varying fractions of

recyclables and inert materials (Ogwueleka, 2009). Studies have shown that the calorific value of MSW in Nigerian cities ranges widely depending on composition and seasonal variations, generally falling between 6–18 MJ/kg (Akinbami *et al.*, 2001). This variation underscores the need for localized studies, as waste characteristics differ significantly across regions due to socio-economic and cultural factors.

The management of MSW is among the serious problems in developing countries (Kumari & Raghubanshi 2023; Ferronato & Torretta 2019) including Yola, Adamawa State in the northeast. According to Abubakar, 2018, the uncontrolled influx of people to the urban areas has brought about increase in the demand on electricity and increases the waste dumped in the municipality. Similarly, the increasing family size (population) which also increases the rate of consumption and rate of waste generation (Liu *et al.* 2019; Suthann4r & Singh 2015, Xiao *et al.*, 2015, Noufal *et al.*, 2020; Herdiansyah 2020). This could possibly bring about an increased energy potential if the energy is harness using the appropriate waste to energy (WtE) technology (Opoku *et al.*, 2022; Adeleke *et al.*, 2021; Paz *et al.*, 2020). In yola just like other places in the North east a lot of people still throws their waste anyhow, even if there are trash bins available, only a few are following the waste segregation at source.

The physical composition of MSW and calorific value are crucial in determining its suitability for waste-to-energy (WtE) technologies. These properties determine the efficiency of thermal processes like incineration, gasification, and pyrolysis. It had being established by other researchers that, high moisture content reduce heating value or calorific value of waste, whereas a higher proportion of combustible materials such as plastics, paper, and textiles enhances or promotes its heating value or calorific value of waste. Therefore, the knowledge of the physical characteristics of MSW is essential for evaluating its tendency as a renewable energy source (Khu *et al.*, 2021)

Yola metropolis, the capital of Adamawa state, has an average waste generation rate estimated between 0.5–0.7 kg per capita per day, the waste generated comprises of both the environmental burden waste

which causes blockages to our water ways and in turn becoming a breeding house of mosquitoes and rodent, others causes gully erosion and even flood in some cases while some of the accumulated waste remains energy resources that are yet to be tap. Therefore, harnessing this potential could contribute to addressing Nigeria's persistent energy deficit while improving waste management practices

There is need to explore waste to energy potential in Yola, so as to reduce over dependence on fossil fuel power generation which produces greenhouse gases and in turn depletes the ozone layer leading to global warming which is gaining greater acceptance in the scientific community (Alkasin *et al.*, 2018). This will reduce or minimise adverse environmental and health impacts among others in yola., Basavaraju, *et al.*, 2025. There are other negative environmet impact which are associated with MSW types such as food waste and other hazardous waste which can affect Land, air and water, Anayet, *et al.*, 2024.

This accumulation of waste in dumpsites and improper waste management requires more work on the environmental impact of waste-to-energy. The average calorific value of MSW in Yola has been reported at approximately 1,515.67 kcal/kg (6.34 MJ/kg) by Mshelia *et al.*, 2022 suggesting moderate energy recovery potential suitable for thermal conversion technologies such as incineration This research is therefore motivated by the need to fill the gaps by determining the energy potentials that may be generated from MSW by considering the Physical composition and categorizing the waste type as the key factors for energy generation and their usage towards reducing the over-dependency on the national grid.

There is serious need to study the physical composition of the waste stream, beside energy recovery. The research is birth from the idea that the physical constituent of the waste stream can determine the amount of energy potential that can be generated from a particular waste stream or the physical composition is the main factor to be considered when evaluation the energy harnessing potentials of a MSW.

This study therefore focuses on analyzing the physical properties of MSW in Yola and assessing its potential for energy generation. By examining key parameters such as waste composition and calorific value, the research aims to provide data-driven

insights that can support the development of sustainable waste-to-energy systems in Adamawa State.

Table 1: Different MSW categories and their respective treatment methods

Waste Category	Waste types	Energy Potential	Conversion Method
Biodegradable	Food, leaves	Low–Medium	Composting, biogas
Combustible	Plastics, paper	High	Incineration, RDF
Recyclable	Glass, metal, plastic	Indirect	Recycling
Inert	Sand, concrete	None	Landfill, construction reuse
Hazardous	Batteries, chemicals	Variable	Special disposal
Non-combustible	Glass, ceramics	None	Recycling/landfill

II. METHODOLOGY

This study used a quantitative approach to determine the energy harnessing potential of municipal solid (MSW) in Yola, Adamawa State, based on its physical composition and typical or standard Lower Heating Value

The study area

Adamawa state is one of the 36 states of the federation with Head quarter in Yola. It is situated between latitudes 9°11'59"N and longitudes 12°28'59"E and rising to a height of around 192m. The area is distinguished by generally flat scenery with modest valleys and mountainous elevations. The area has an estimated population of roughly 271,818 according to Ishaku *et al.*, (2015). The principal profession of the residents is farming. Local metallurgical operations, several water packet businesses and historic textile companies are operating in the area. The waste disposal carried out in the locality is by open dumping mainly solid wastes. A rise in human populations has altered the land usage pattern, which finally resulted in more waste than can be managed.

Sample collection and sorting

A random sampling method was employed in MSW sample collections from five (5) the various dumpsites Yola metropolis, Adamawa State. Collected waste samples were transported to a

designated sorting site, where manual separation and physical analysis were carried out. Dubeli Junction, Yola- Fufure road, Runde baru, Jimeta and Jambutu dumps in Yola, Adamawa state were chosen as the sample site because the municipality largely represents the variety of socioeconomic and indicators of demographics prevailing in different locations in the municipality which are important to this research. several waste component such as paper, nylon, plastic bottles, glass, metals, soft drink cans, soiled textiles, etc. were separated and categorized under biodegradable (food waste, paper, wood etc.) and non-biodegradable (Iron, plastic/rubber, Leather/Nylon) the wastes were further classified into combustible (paper, wood, textile, plastic/rubber, Nylon/Leather and Grass) and non-combustible (Iron and glass).

MSW Physical Composition

The MSW samples collected were sorted into different waste types or components based on standard classification methods (ASTM D5231). Each component was weighed using a digital scale and the percentage weights was determined using equation 1 as suggested by (Miguel *et al.* 2016, Ngohayon & Tulaga, 2022):

$$\%type\ of\ waste = \frac{mass\ of\ type\ of\ waste}{total\ mass\ of\ MSW} \times 100.$$

The average percentage composition was then calculated using the various percentage compositions for the individual waste types considered.

MSW categorization

This analysis provides insight into the proportion of combustible and non-combustible materials, which is essential for energy evaluation.

Determination of Lower Heating Value (LHV)

The Lower Heating Value (LHV) of the MSW was estimated based on its physical composition using standard calorific values of individual waste components obtained from literature. The overall LHV of the mixed waste was calculated as a weighted average:

$$LHV_{MSW} = \sum_i^n (W_i \times LHV_i)$$

W_i is the fraction (by weight) of waste type i , LHV_i is the lower heating value of waste type i (MJ/kg) and n is the number of waste types

Analysis of Electrical Energy generation in Yola

Estimation of Energy Potential: the total energy potential of MSW generated in Yola was calculated using the estimated LHV and the quantity of waste generated per day. The energy content was determined as:

Equation (2) was used to calculate the thermal energy (Ibitoye *et al.*, 2021)

$$E_{thermal} = LHV_{MJ/kg} \times M_{kg}, \quad 2$$

where: $E_{thermal}$ = thermal energy (MJ).

$LHV_{MJ/kg}$ = Low heating value {MJ/Kg}

M_{kg} = Mass (Kg)

Next, the thermal energy in MJ was converted to kwh by using equation (3) (Hofstrand, 2007).

$$E_{kwh} = \frac{E_{thermal(MJ)}}{3.6} \quad 3$$

where: E_{kwh} = thermal energy (kwh)

$$E_{thermal(MJ)} = \text{thermal energy(MJ)}$$

3.6= 1 kWh = 3.6 MJ

Finally, equation (4) was used to calculate the electrical energy from MSW in kwh (Ibitoye *et al.*, 2021)

$$E_{thermal} = E_{kwh} \times \eta, \quad 4$$

where: $E_{thermal}$ = thermal energy(kwh)

E_{kwh} = thermal energy (kwh)

η =efficiency in decimal (0.20 for 20%)

III. RESULTS AND DISCUSSION

The results were presented in tables and percentages to show the distribution of waste components and their contributions to the overall energy potential. Comparative analysis was also performed with existing studies in similar regions to validate findings.

The physical composition of the seven dumpsites investigated in Yola is as shown in Table 1

Table 1: Physical composition by percentages of different waste types in Yola.

WASTE TYPES	HANYAN GADDA%	JAMBUTU %	JIMETA %	RUNDE			AVERAG E
				BARU %	YOLA FUFURE%		
PAPER	10.040	7.028	9.036	7.429	9.839	8.674	
FOOD	38.152	20.481	40.763	NA	NA	19.879	
PL/RB	10.843	33.132	15.662	40.160	37.148	27.389	

NY/LEA	26.104	16.064	10.040	10.040	30.120	18.473
GRASS	5.020	11.646	10.040	21.887	9.638	11.646
GLASS	0.803	2.409	3.012	6.425	4.819	3.493
WOOD	3.212	0.401	5.020	0.401	0.200	1.847
IRON	NA	0.903	NA	0.702	0.602	0.441
TEXT	5.020	6.626	5.020	11.686	4.618	6.594
MISCE	0.803	1.104	1.506	1.606	3.012	1.606

Note: PL/RB means Pla+stic/Rubber, NY/LE means Nylon/Leather, TEXT mean Textile, MISCE mean Miscellaneous and NA means not available

The Physical composition by percentages of different waste types in Yola is seen in Table 1, indicates that Plastic/rubber waste is the most dominant waste type found in most of the dumpsites with average percentage of 27.38 % followed by food waste with average percentage of 19.879 % and Nylon/Leather waste(18.473 %) the next is Grass (11.646 %). The least percentages are: glass, paper, textile and Iron and miscellaneous with average percentages ranging from 1.606 -8 %. The lower average percentage of

food waste is due to the economy situation of the nation, these days most people hardly eat and remain. It can also be attributed to the activities of domestic animals on the site where disposal are being made, they rum about in search of feed like food remnants, vegetable straw, market wastes, yam peels, bad fruits etc and the incessant presence of waste pickers at the disposal sites in the case of iron waste.

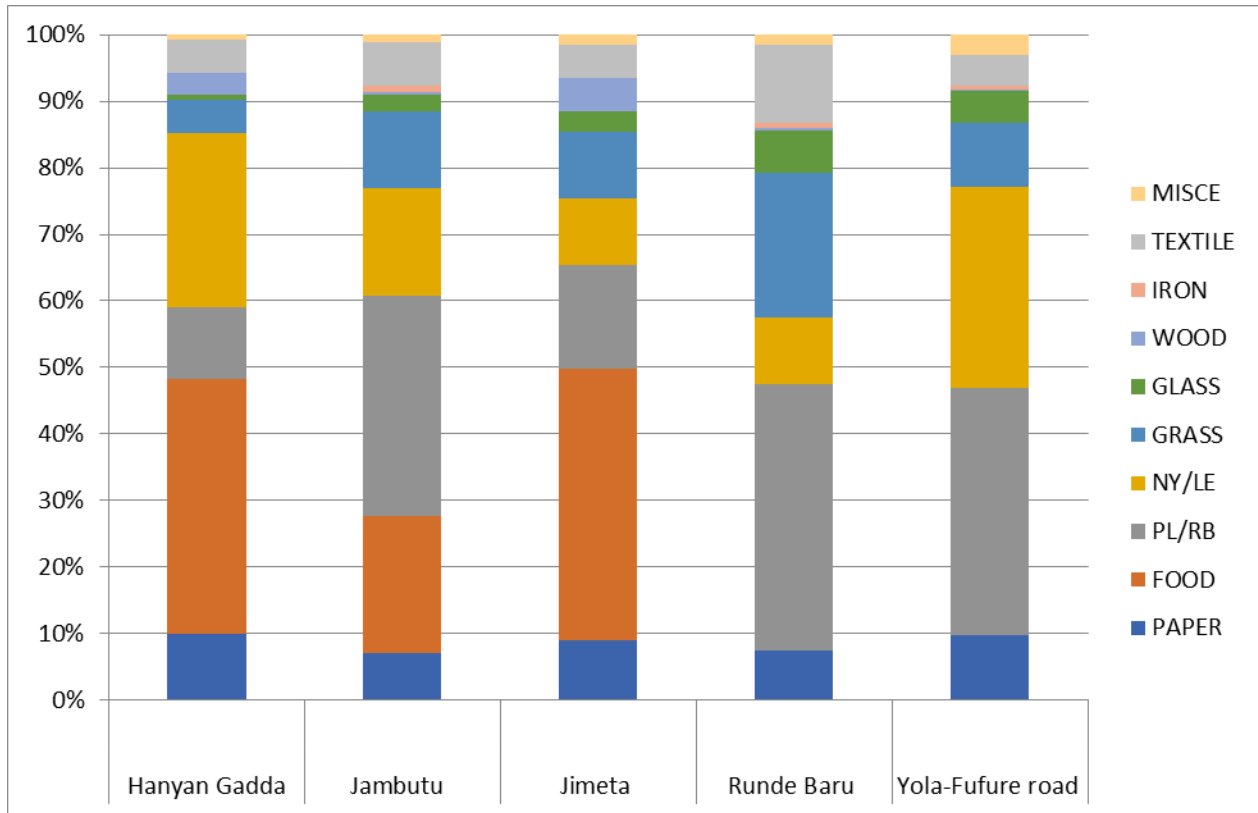


Figure 1: Stacked bar chart showing the percentage composition of different waste types in Yola dumpsites.

From the stacked bar chart represented in Figure 1, it is clear that plastic/rubber waste is the most dominant waste type contain in waste streams collected from Yola. The highest percentage was found in Runde Baru (40.16%) followed by Yola fufure (37.14 %) and closely followed by Jambutu (33.13 %) and the lowest are 15.66 % and 10.84% from Jimeta and Hanyan Gadda respectively. The second dominant waste type is Food waste with a very high percentage observed in Jimeta (40.76 %), this is followed by Hanyan gadda (38.15 %). The lowest percentages were seen in Jambutu (20.48 %). The unavailability of food waste in Runde Baru and Yola Fufure could be attributed to the activities of waste pickers and the animal that feed on the food remnant right from home before the final disposal at the site.

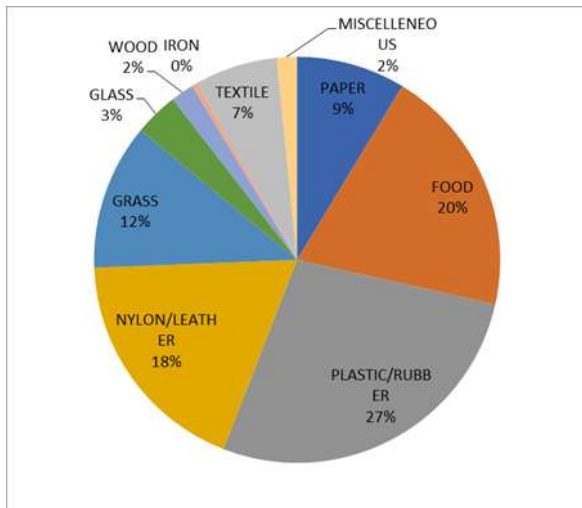


Figure 2: Pie chart showing the total percentage of different waste types in the Yola dumpsites

Figure 2 pie chart shows that, plastic/rubber waste (27%) is the dominant waste type in the yola dumpsites which is followed by food waste (20%), and then Nylon/leather (18%), paper (9 %), grass (12%), all other waste types comprising of glass, wood, iron and textile account for (15%) of the total waste.

Table 2: MSW categorization in Yola

Waste Category	Waste types	Average % wt	Treatment Method
Biodegradable	Food, Grass	32	Composting, biogas
Combustible	Pl/Ru, pp,Ny/Leather, text, wood	63	Incineration, RDF
Recy/Non Com	Glass, metal	3	Recycling
Others	Misce	2	Recycling/landfill

Note:RDF mean Refuse derived fuel, Recy/Non-Com. means Recyclable/non-combustible, %wt means weight in percentage and Misce means Miscellaneous.

The MSW stream in Yola, shows a good balance between biodegradable (32 %) materials and combustible (63 %) waste type which are high energy synthetic and are suitable for thermal WTE applications. This categorization helps determine the most appropriate waste management or waste-to-energy strategy. Biodegradable waste constitutes the organic matter which decays naturally by the activity of microorganisms such as bacteria and fungi. These wastes contain carbon dioxide, methane, water and compost; therefore it is suitable for anaerobic digestion or composting.

The Combustible waste represents the category of materials that can burn and release energy in the form of heat. These wastes can either undergo incineration, pyrolysis, or gasification. These wastes contain carbon, hydrogen, and other volatile compounds. These make them making them suitable for energy recovery. From the percentage of combustible waste in Yola, the waste to energy technological option that should be adopted is incineration and Refuse Derived fuel (RDF)

Inert wastes are materials that do not transform either physically, chemically and biologically. They constitute the non-combustible and non-biodegradable; therefore they reduce the energy

efficiency of MSW because they do not burn and cannot produce heat. This categorization helps determine the most appropriate waste management or waste-to-energy strategy (Tan *et al.*, 2015).

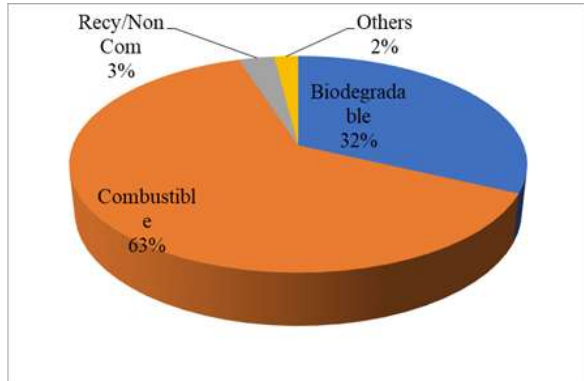


Figure 3: Municipal solid Waste Categorization in Yola

Figure 3: shows a pie chart in which the waste types were categorized into biodegradable, combustible, inert and miscellaneous. In which biodegradable were about 32 %, combustible amount 63 %, Recyclable/Non-combustible 3% and others (miscellaneous) 2%. It is clear that combustible is the most abundant waste type in the study area, closely followed by biodegradable, recyclable/Non-combustible (3 %) and the least is others also known as miscellaneous in this study. The very low percentage is due to the fact that inert or recyclable/non-combustibles material in the study area comprises mainly glass and iron (Non-combustible). Iron pieces are collected by scavengers who sell them to industries that recycle them.

The waste stream are made up of high percentage of combustible and also a substantial proportion of food waste materials as can be seen in the pie chart presented in Figure 3. The combustible waste type

has the highest proportions about 63 % which comprises of plastic/rubber, paper, nylon/leather, text and wood. The biodegradable fraction comprises of the food waste and grass making up about 32% of the total waste stream. This presents a moderate percentage of organic content which initiates a possibility of using biochemical conversion processes such as anaerobic digestion (AD) and land fill gas (LFG) energy recovery being considered for the site. However, the successful implementation of AD is dependent on proper source separation and presence of moisture. The fraction of biodegradable materials in the dumpsite is sufficient for biogas production but is not sufficient to build the entire WTE plant.

The main potential of the waste stream as it relates to WTE conversion lies in its high combustible synthetic content which is made up of 27 % plastic/rubber, 18 % Nylon, 7 % textile and a 2 % wood, making a total percentage for combustible materials (63 %). These waste types have very high calorific values. The textile materials are mostly the synthetic type and they enhance the heating value of the waste stream while at the same time enhancing its combustion stability. The amount of combustible fraction in the waste stream strongly favors thermal waste to energy technologies such as mass burn incineration with energy recovery, refuse derived fuel RDF production, pyrolysis and gasification. The miscellaneous fraction which makes up 2 % is constituted by mixed media and dirt contaminated materials and non-recyclable fragments. Glass and Iron which are 3 % and 0.14% respectively in the waste samples collected make up 3.02% of the composition of the waste in the dumpsite and are regarded as inert materials and are non-combustible components that make no contribution to the calorific value.

Table 3: Standard net caloric values/low heating value of different waste types (Usman and Evans, 2023; Abel *et al.*, 2025; Solomon, 2025)

S/N	Waste Type	NCV/LHV Range (MJ/kg)	Mass (%)	Comment
1	PAPER	12-14	8.674	Good combustible Material
2	FOOD	3-6	19.879	High moisture content

3	PL/RB	25-30	27.389	Highest calorific Value
4	NY/LE	18-22	18.474	High energy content
5	GRASS	6-10	11.646	Moisture affect energy
6	GLASS	0-0	3.494	Non- combustible
7	WOOD	14-17	1.847	High Volatile matter
8	IRON	0-0	0.442	Similar to glass
9	TEXT	15-18	6.594	The fiber determines the energy
10	MISCE	7-10	1.606	Depends on the composition

Note: PL/RB means Plastic/Rubber, NY/LE means Nylon/Leather, TEXT mean Textile, MISCE mean Miscellaneous and NA means not available.

The net caloric value or the lower calorific value of different waste types as seen in Table 3. According to literatures different waste type has differences in the energy content as a result, from physical examination one can infer how much of energy a certain content of MSW can generate owing to the quantity in a specific location. Also, the waste type that has highest calorific value is Plastic/Rubber waste followed by Nylon/leather and next is Textile while

the one with lowest calorific value is food waste and grass due to the high moisture content they possess. Glass and iron(metal) are said to have Zero (0) calorific value due to their non-combustible nature of properties they possess, which means that, they do not burnt at all, they contain high ash content which makes the calorific value reduces to zero.

Table 4: Electrical energy generation of MSW in Yola per waste type in Kg.

Waste type	Average LHV/N CV	Mass (kg)	Mass (%)	waste fraction	Total energy (MJ/kg)	Thermal energy (kwh/tonnes)	Electrical energy (kwh/tonnes)
PAPER	12	0.43	8.674	0.086	1.032	286.66	57.33
FOOD	3	0.99	19.879	0.198	0.594	165.00	33.00
PL/RB	25	1.36	27.389	0.273	6.825	1895.83	379.17
NY/LE	18	0.92	18.474	0.184	3.312	920.00	184
GRASS	6	0.58	11.646	0.116	0.696	193.33	38.67
GLASS	0	0.17	3.494	0.034	0.00	0.00	0.00
WOOD	14	0.09	1.847	0.018	0.252	70.00	14.00
IRON	0	0.02	0.442	0.004	0.00	0.00	0
TEXT	14	0.32	6.594	0.06	0.84	233.33	46.67
MISCE	6	0.08	1.606	0.016	0.096	26.67	5.33
Total					13.647	3790.83	758.17

Note: PL/RB means Plastic/Rubber, NY/LE means Nylon/Leather, TEXT mean Textile and MISCE mean Miscellaneous

The obtained Lower Heating Value (LHV) of 13.647MJ/kg for MSW in Yola as seen in Table 4 shows a moderate to high calorific value, suggesting strong potential for energy recovery through WtE technologies such as incineration and refuse-derived fuel (RDF) production. This value is in line when compare to global standard which fall within the typical range 7-14 MJ/kg for a mixed MSW in a developing countries as reported by World bank, 2018 while high income countries falls within 10-15 due to increased percentages of plastic and paper as reported by IEA, 2020. Within Nigeria, similar studies have reported varying calorific values depending on location and waste composition. For example, Ibadan has an LHV of approximately 12.6 MJ/kg, while Abuja reports values as high as 17–18 MJ/kg under dry conditions (Adewumi et al., 2020; Oketola & Osibanjo, 2007).Therefore the calorific value is slightly higher than the report for other studies due to increased presence of combustible waste such as paper, Nylon/leather, plastic/rubber and also the sample was taken in dry season with reduce moisture content. This align with UNEP, 2015 finding that moisture content and waste compositions are the key determinant of LHV

The electricity generation potential per tonnes of MSW in Yola as seen in Table 4 shows that, the effective lower heating value is 13.647MJ/kg with an

electrical energy potential of 758.17kWh/tonne. This means that, one (tonne) of MSW was processed in an assumed waste to energy system (either through incineration or gasification). The result is in line with the research by Laaye *et al.*, 2025: Amuleh *et al.*, 2022 who reported 734.9381kwh/tonnes as the potential electricity generation Yola, which also a part of northeast and had a border with Adamawa state. The relative high lower heating value or net calorific value is attributed to high percentage or proportion of plastic/rubber, waste types which has a high lower heating value due to low values of moisture or lesser moisture content found in most of the combustible waste type as indicated in this report which is in line with other literatures. The differences between this result and other literature values could be attributed to other factors such as waste composition, calorific value, moisture content, and conversion efficiency. The difference can also be the seasonal variations which take into account the amount of moisture content. Also, the biodegradable waste percentage had been reported by other researcher to be higher in rainy season and very low in dry season. And the combustible waste type like plastic waste and nylon/ leather has very high lower heating value (net calorific value) percentages said to be increased in dry season as more demand for water and soft drinks in dry season. This is supported by

Table 5: Comparison of MSW Energy Potential in Selected Nigerian Major Cities

City	NCV/LHV (MJ/kg)	ElectricalEnergy (kWh/tonne)	Authors
Yola	13.67	840–1050	This study
Maiduguri	6.8–15	500–900	Mshelia et al. (2017)
Gombe	9–12	600–850	Abdullahi et al. (2018)
Jalingo	8–11	500–800	Yakubu (2019)
Ibadan	12.6	700–900	Oketola & Osibanjo (2007)
Abuja	17–18	900–1200	Adewumi et al. (2020)

IV. CONCLUSION

According to the research findings in Yola, there is a significant proportion of combustible waste kinds, primarily plastic garbage. The community's generated MSW has a comparatively high flammable proportion, which is consistent with findings from Adeleke *et al.* (2021). Additionally, the percentage of

combustible garbage is sufficient to use incineration as a waste-to-energy method. This suggests that anaerobic digestion in Yola has the capacity to produce power from 32% of the MSW stream. 63% of the waste stream can be burnt to produce power. The remaining component of the waste stream can be used for land filling, with 3.02% of the MSW being recycled or reused. Yola's MSW has a comparatively

high energy potential, matching both national and international benchmarks, as evidenced by the obtained LHV of 13.67 MJ/kg. This demonstrates that it is suitable for sustainable energy recovery using waste-to-energy technology, especially when combined with efficient waste management techniques like moisture control and segregation. When compared to other research on waste to energy, Table 4's electrical generating potential value of 804 kwh/tonne of MSW is reasonable (Laaye *et al.*, 2025). According to other researches, it ranges from 400 to 800 kwh/tonne for an incinerator. Consequently, this figure shows that a sizable portion of the waste stream is combustible and has a high calorific value. The outcome therefore showed that MSW produced in Yola, Taraba State, Nigeria, has a promising potential for producing waste-to-energy electricity. Therefore, Yola, Adamawa State State can work toward effective and efficient waste management and sustainable development by putting specific measures into place such recycling promotion and waste reduction initiatives. Additionally, it can assist planners or waste policy makers as well as possible investors in constructing a waste-to-energy facility in Yola.

V. SUMMARY

Unsanitary conditions brought on by improper MSW disposal may pollute the ecosystem. Waste management is crucial for sustainable development since it is the primary cause of environmental deterioration that harms people and even the environment overall. The impact of poor waste management cannot be overstated. Additionally, this research emphasises the significance of MSW composition and classification since it provides a framework for waste reduction from the source and controls the technologies that lessen the adverse consequences of waste-to-energy operations. This finding supports the viability of waste-to-energy technology as a sustainable waste management option by demonstrating that MSW in the research region has a respectable potential for producing power. Unsanitary conditions brought on by improper MSW disposal may pollute the ecosystem. Waste management is crucial for sustainable development since it is the primary cause of environmental deterioration that harms people and even the

environment overall. The impact of poor waste management cannot be overstated. Additionally, this research emphasises the significance of MSW composition and classification since it provides a framework for waste reduction from the source and controls the technologies that lessen the adverse consequences of waste-to-energy operations. This finding supports the viability of waste-to-energy technology as a sustainable waste management option by demonstrating that MSW in the research region has a respectable potential for producing power.

VI. RECOMMENDATION

From the study the following recommendations are very important to further enhances WtE generation which mitigate waste accumulation in Yola, adamawa,

- [1] Waste segregation and categorization should be encourage as it helps in enhancing the LHV which in turn increase the the amount of electrical energy generated.
- [2] There is need for WtE plant adoption , the gotten LHV is greater than 10 (>10), therefore, it is technically suitable for WtE plant
- [3] Moisture content reduction strategies which includes: pre-drying and seasonal collections these improve combustion efficiency.
- [4] Government should invest in WtE infrastructure and also encourage private sector partisipation
- [5] Seasonal variation should be given consideration in further research.

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