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Sustainable Waste Disposal Technology Selection using the WSM Method

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Abstract: *The choice of a sustainable waste disposal option is essential due to the expanding problems with global waste management. In view of rising population and consumption patterns, it is imperative to create environmentally friendly solutions that lessen the detrimental consequences of rubbish on ecosystems and human health. The selection process considers a variety of factors, including waste volume, composition, regional regulations, infrastructure accessibility, and environmental considerations. We may promote waste reduction, resource conservation, and climate change mitigation practices such as composting, recycling, and waste-to-energy conversion by using the appropriate technologies. Effective waste management practices contribute to the development of a circular economy, which not only protects the environment but also views trash as a resource. The decision to choose a sustainable waste disposal method has implications for research since it can solve substantial environmental and social problems associated with waste management. In conclusion, what makes sustainable waste disposal technology selection important for study is its ability to address environmental problems, save resources, slow down climate change, improve public health, guide policy development, and promote economic growth. It provides a path to the development of a circular economy, where garbage is viewed as a valuable resource and waste management practices become more reliable and sustainable over time. In this Research we will be using Weighted sum method, Landfilling, Incineration, Pyrolysis, Plasma, Gasification investment cost, operation cost, energy recovery, technology accessibility, emission, social acceptance Showing sustainable waste disposal technology selection using the analysis method in TOPSIS, where Plasma is the first rank and Landfilling is the last rank. The majority of MDO issues are multi-objective, hence the focus of this study is on creating an efficient multi-objective MDO approach. For the design of massive, intricate technical systems like aero planes, the AWSCSSO approach may be used to produce a regularly spaced, broadly dispersed, and smooth Pareto front. The AWSCSSO approach is validated using two numerical examples and a conceptual design challenge for an aero plane. Following are a few conclusions that may be drawn. First, AWSCSSO is useful and effective for resolving multi-objective MDO issues. It covers the whole Pareto front for test difficulties and conceptual design issues with aero planes. Second, for multi-objective MDO issues, AWSCSSO is a potential method for building a smooth, evenly distributed, and regularly spaced Pareto front. Given that getting uniform, ubiquitous Future work will concentrate on enhancing the quality of the solutions as well as testing it with more practical engineering design challenges employing distributed Pareto points in a bilevel optimization framework.*

Keywords: *Multiobjective optimization, Pareto front, adaptive weighted sum, NBI, and AWS.*

1. INTRODUCTION

Energy systems are crucial to a person's and a society's capacity to live, and they have altered the topography of the planet. The usage of energy resources based on fossil fuels has made life easier by providing light, heat, and simple transportation. However, it has negative effects on the environment, bringing up concerns about human happiness, welfare, freedom, and equality in addition to challenges with climate change, sea level rise, air pollution, desertification, and forced migration (Jones et al., 2015). By contributing to problems like pollution and global warming on the one hand, and energy poverty and underconsumption on the other, energy misuse plays a catalytic role in a number of social and environmental challenges (Wilkinson et al., 2007). The current state of affairs shows how energy systems affect complex social, political, cultural, and moral issues more so than just economic and technical advancements alone (Sovacool et al., 2017). However, it has detrimental impacts on the environment, raising issues with climate change, sea level rise, air pollution, desertification, and forced migration in addition to issues with human happiness, welfare, freedom, and equality (Jones et al., 2015). Energy abuse plays a catalytic role in a variety of social and environmental issues by contributing to issues like pollution and global warming on the one hand, and energy poverty and underconsumption on the other (Wilkinson et al., 2007). The state of the world now demonstrates how energy systems have a greater impact on complex social, political, cultural, and moral concerns than solely economic and technological achievements (Sovacool et al., 2017). According to a rising body of view, the tools and technology needed to create energy (such as fuel, electricity, and other items) are but one part of an energy system. Due to the interdependence of the technological and physical infrastructure of energy systems with user behaviours, organisations, and lifestyles, they are classified as sociotechnical systems. According to (Kern and Smith, 2008; Markard et al., 2012). Significant management and planning difficulties emerge from our improved understanding of energy systems. Currently, more energy is being consumed owing to global population growth and economic growth. Over the next 20 years, an increase in energy consumption of 25–34% is anticipated (BP, 2017). It is crucial to take steps towards a long-term sustainable energy supply and low carbon emissions. According to data and polls, fossil fuels significantly contribute to the world's energy usage. This outstanding contribution won't be significantly reduced any time soon. His predictions state that by 2035, non-clean fuels will supply around 80% of the world's energy needs. (IEA, 2016) "Statistical Review of World Energy | Energy economics | BP," date unknown. Energy is one of the requirements for human life. Decisions and actions done to protect the energy supply and reduce carbon emissions shouldn't imperil people's ability to obtain energy (financially or otherwise The "energy trilemma" is the relationship between energy security, energy poverty, and climate change. Although it is clear that each system component's aims conflict with those of the other components, the issues mentioned above may be resolved if plans are made for each component while taking into consideration its requirements and preferences. Planning must include a range of system elements, including production, distribution, and consumption as a single, integrated system, to address the problems with the energy trilemma. In the management and decision-making of these systems, it would seem that a number of frameworks and criteria, including socioeconomic and environmental norms, are inadequate. According to Markowitz and Hariff (2012), these frameworks are unable to handle the complex relationships between energy-related concerns or give a solution to the conflicting needs of energy security, energy efficiency, and renewable energy. poverty, and climate change. Al-Khateeb et al. (2017) state that "Sustainability is a cornerstone in municipal solid waste management (MSWM) systems to ensure efficient and reliable waste management Environmental managers are motivated to create a sustainable waste management system by the complexity of waste streams with social and environmental problems and the growing amounts of waste generation. A well-organized and supervised system is necessary to preserve a healthy society and the environment in light of the advancement of technology. Municipal solid waste (MSW) has become more significant over the past few decades, especially in developing countries (Zhen-Shan et al., 2009; water, soil, and air. In urban areas, solid waste clogs drains, causing floods during the rainy season and stagnant water where mosquitoes can breed. Untreated leachate and careless dumping have an impact on the area around surface and groundwater sources (Seng et al., 2011; Yildirim, 2012; Arkan et al., 2017). Organic waste decomposes in landfills and emits greenhouse gases (GHGs). The initial cost of building sufficient storage and disposal facilities is further increased by inefficient waste management (Coban et al., 2018). An effective treatment and disposal solution must be created to handle the expanding volume of MSW in such a complex environment. To correctly install MSWM, it is vital to thoroughly consider the various MSWM solutions and select the best one. Choosing an MSW treatment and disposal approach is a challenging procedure that takes both qualitative and quantitative variables into account (Soltani et al., 2015). The main justification for this is because MCDM issues, which comprise technical, economic, environmental, social, and political elements, have an influence on MSWM, treatment, and disposal. A useful tool for choosing the optimal course of action and convincing people in general that MSWM planning is the best is MCDM. The properties of the MSWM issue are very compatible with MCDM approaches, according to Onut and Sonner (2008), Ekmekçiolu et al. (2010), Asefi and Lim (2017), and Coban et al. (2018). Regulating metropolitan solid waste (MSW) is presently a top priority for emerging nations. Choosing an MSW treatment and disposal approach is a challenging procedure that takes both qualitative and quantitative variables into account (Soltani et al., 2015). According to Dewi et al. (2010), the procedure is labor-intensive and requires collection, the position of the transfer station, a treatment plan, the location of the treatment plant, and energy recovery. Because of complicated aspects including cost effectiveness and environmental sustainability, decision-making has become more challenging. There is an alarming quantity of solid waste being created in the main cities of emerging countries as a result of rising urbanization, population expansion, and lifestyle changes. As a result, several nations are having significant issues processing and disposing of their waste. Choosing an MSW treatment and disposal approach is a difficult procedure that takes into consideration both qualitative and quantitative needs (Soltani et al., 2015). The development and implementation of a sustainable plan to manage MSW that contains ideas that will lead to the best workable solution is highly valued by decision-makers today. Making the right choices is challenging due to trade-offs among several stakeholders, each of whom has a unique set of interests and viewpoints. Therefore, it is necessary to take into account relevant technological, economic, environmental, and social problems. These problems can be found using mixed, quantitative, or qualitative techniques. Choosing an MSW treatment and disposal approach is a challenging procedure that takes both qualitative and quantitative variables into account (Soltani et al., 2015). As a result, MCDM may consider MSW management to be a problem. Vermicomposting, aerobic composting, and anaerobic composting are only a few of the several composting methods. The selection of an MSW treatment and disposal strategy is a difficult process that takes into consideration both qualitative and quantitative factors (Soltani et al., 2015). Solid trash can occasionally be disposed of swiftly or securely. Organic wastes, especially sewage sludge, may be one of the resources accessible to meet the rising need for organic matter and renewable energy on a worldwide scale. This substrate is a source of heat and power that may be applied in both conventional and cutting-edge methods. Additionally, sewage sludge may be employed as a substrate for soil restoration and fertilisation, presuming the technique being used enables the development of results of a high calibre. In contrast to waste management and landfilling, such re-uses of sewage sludge are both environmentally beneficial and economically successful. A difficult process that takes into consideration both qualitative and quantitative criteria is choosing an MSW treatment and disposal strategy (Soltani et al., 2015). The environment may be improved through reducing greenhouse gas emissions, improving soil quality, and using fewer fossil fuels. Utilising biogas and biofuels can balance off the expenses of using traditional waste disposal techniques, lower health care costs due to efficient waste management, and lower energy prices. These fuels might reduce the cost of energy and possibly replace some traditional fuels. A difficult process that takes into consideration both qualitative and quantitative criteria is choosing an MSW treatment and disposal strategy (Soltani et al., 2015). Wastewater treatment operations must manage sewage sludge correctly both during and after removal from the treatment plant in order to achieve these aimsfor 50% of all operational costs at the wastewater treatment plant, even though it only constitutes a minor portion of the total volume of wastewater processed (U.S. EPA, 2008 However, it is necessary to collect and manage enormous amounts of sewage sludge from wastewater treatment plants. Usually, 97-98% of this "raw" sludge is made of water. It must thus be carefully handled in order to be used as a viable biosolid. The suggested new/improved technology must provide complete organic matter recycling and a decrease in the possible risk brought on by the presence of contaminants. The expenses related to treating the management techniques for the long-term and economical use of sewage sludge are summarised in this study. Asia is an area that defies classification due to its width and variety. There are emerging economies like South Korea, China, and India in addition to highly established countries like Japan and Indonesia. The majority of solid trash is produced by cities, and each municipality is responsible for processing it. These services are accessible to the steadily growing urban population in the majority of Asian nations. In this case, evaluating the urban environment and anticipating future trends would be acceptable.

2. MATERIALS AND METHOD

Landfilling: Modern landfills are well-managed, well-designed sites for disposing of solid waste. In order to assure that they adhere to According to government regulations, landfills are carefully planned, operated, and monitored. They are designed to protect the environment from any pollutants that may be present in the waste stream as well.

Incineration: Burning potentially harmful substances at levels high enough to eliminate pollutants is known as incinerated. An "incinerator," a kind of furnace built to burn dangerous materials in a combustion chamber, is used for incineration.

Pyrolysis: Organic material that "cracks" or decomposes when exposed to heat can be treated using pyrolysis. This includes poly chlorinated biphenyls (PCBs), dioxins, and the polycyclic aromatic hydrocarbons (PAHs).

Plasma: Blood's liquid component is called plasma. About 55% of human blood is plasma, and the remaining 45% is made up of scattered red, white, mixed white haemoglobin. 92% of plasma is water.

Gasification: Waste plastics are heated by a technique known as gasification to industrial gas mixes known as "synthesis gas" or syngas at temperatures between 700 and 1100 °C with controlled proportions of oxygen, air, oxide-enriched air, and/or steam.

Investment cost: Investments are costs that lead to an improvement or acquisition of finished goods. These costs are often long-term and will pay off in the future. Investment expenditures include planned costs for purchasing goods and building new military facilities.

Operation cost: The regular, ongoing costs that accompany running a business are known as operational expenses. Operating expenses comprise the cost of goods sold (COGS) as well as other ongoing expenses, also referred to as marketing general, and administrative (SG&A) costs.

Energy recovery: Through a number of techniques, Recycling garbage can be transformed into usable heat, electricity, or fuel by processes like incineration, combustion, gasification, anaerobic fermentation, and landfill gas reimbursement. This process is known as "waste to energy" (W).
Technology accessibility: All users of readily available equipment are intended to be able to use it. People who use technology are incredibly diverse, with a vast variety of traits and environments. Nobody can be certain that they use a standard monitor, browser, or keyboard.

Method: A selection theory Weighted sum sampling method WSM is very The well-known MCDM (multi-criteria decision-making) is one of the techniques And primarily some Alternatives based on criteria Easier to evaluate is one. WSM is valid handiest while all information supplied are in the same size or unit [14]. The in each column Rows are compressed, using their respective rank sums Columns are sorted If the rank sum is reduced The column molecule is searched Same as reference form will be others mixtures of rating matrix except summation have been studied. This approach is relevant to tuning parameter choice and different regions in which Subgroup variables of variables must be selected from the set This is when the SRD method is monitored The approach can be considered unsupervised (A goal vector is used) In addition to the SRD approach Can be used in molecular fitting research [15]. Factor weights for robot selection and are A weighted sum model with This model has no institution consensus on those values. In choosing robots, the best and weights and subjectivity Less expert on components Values are removed. The main purpose for getting rid of These values are any capacity at the last stage It is to reduce the impact of distorted desire to explain version and program A numerical example is presented the ranking change while in comparison to a version that does not do away with those excessive values [16]. Using weighted-sum beamforming, the microphone arrangement, which includes the variety and function of the microphones, determines the weight for every microphone signal. To determine the design parameters, diverse simulations had been finished if the listener had a head. To make amends for the and the impact is accounted for using the round head-related transfer function (HRTF). We perform simulations with respect to a round head version [17]. The Weighted Sum Model (GWSM) accounts for multi-year uncertainties with the aid of comparing the enterprise environment in West Africa. The deal with a first-rate problem now not blanketed through DBP, specifically, ranking countries throughout years by considering inside-country uncertainty and investor possibilities as criterion weights. Second, we enlarge the traditional weighted sum model [18]. of weights containing pure gas The sum equals A common way to use calculate the entire emissions by means of making a grey approximation to resolve the spectrally included RTE. An alternative method non-gray or bar formula [19]. To decide the depth of penetration, the sum rule need to be cautiously applied. Our effects display that Normal and superconducting to move the c-axis between positions A within energy There is trade, for a speed-dependent gap; This exchange in kinetic energy ought to be taken under consideration to properly derive the penetration intensity from conductance sum regulation Naïve use of conductivity sum [20]. Important (1) part Determination of sum rule closely related the greater trendy trouble of improving the feature Out of test range is widely recognized the evaluation (holomorphic) of a complicated feature $\sigma(\omega)$ on a given area D can be persevered analytically over the complete domain inclusive of the last boundary from a subset of the boundary of this area [21]. The weight trouble must be solved first. Furthermore, modelling the dynamic shape factor studied with the aid of MNS is extra tricky considering that discrete Sum laws of theoretical models are satisfying. In fact, any theory Notification of serious settlement dynamic structure issue measured in absolute devices should provide an explanation for how the regulation of composition is happy or why it is violated [22]. All like the weight of white fuel a0 The sum of the weights zero = zero; Therefore, εt , calculated by the SNB version, is the sum of the differences among L and by the WSGG version of SQP Extraordinary path with help Calculated for length set of rules [23]. Weighted sum rules for exchange forces A very sensitive test Fourier components optimization measures, roughly speaking, it proved. transfer potential of the two-particle interaction density [24]. Sum (SNNMS) reduces the number of LDPC decoding network Correction factors. A single revision in a single layer by dividing the factors Through the SNNMS LDPC decoding network good performance can be achieved a small increase in computational complexity [25]. The weighted sum model does not require any supported solutions to be pruned with this optional correlation. To the best of our understanding, the priority relation is only implemented to given answers and non-stop multi-objective optimization troubles [26].

3. RESULTS AND DISSCUSSION

TABLE 1. Sustainable Waste Disposal Technology Selection

	Investment cost	**Operation cost**	**Energy recovery**	**Technology accessibility**
Landfilling	31.080	139.530	29.150	35.600
Incineration	53.060	142.970	33.690	30.050
Pyrolysis	38.350	122.580	29.180	23.100
Plasma	44.360	128.280	24.600	38.050
Gasification	33.330	158.360	27.960	28.060

Table1 Showing sustainable waste disposal technology selection using the analysis method in alternative in use Landfilling, Incineration, Pyrolysis, Plasma, Gasification. investment cost, operation cost, Energy Recovery and technology accessibility.

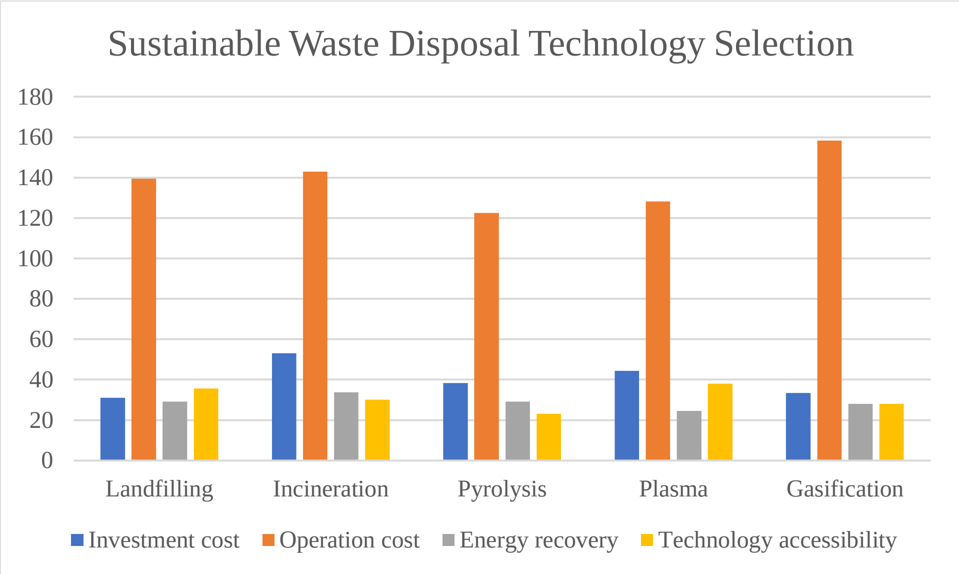

FIGURE 1. Sustainable Waste Disposal Technology Selection

Figure 1 shows sustainable waste disposal technology selection using the analysis method in alternative in use Landfilling, Incineration, Pyrolysis, Plasma, Gasification. investment cost, operation cost, Energy Recovery and technology accessibility.

TABLE 2. Normalized Data

Normalized Data			
0.58575	0.88109	0.84391	0.64888
1	0.90282	0.73019	0.76872
0.72277	0.77406	0.84304	1
0.83603	0.81005	1	0.6071
0.62816	1	0.87983	0.82324

Table 2 shows the Normalized data for sustainable waste disposal technology selection using the analysis method in alternative in use Landfilling, Incineration, Pyrolysis, Plasma, Gasification. investment cost, operation cost, Energy Recovery and technology accessibility it is also the Maximum in Normalized value.

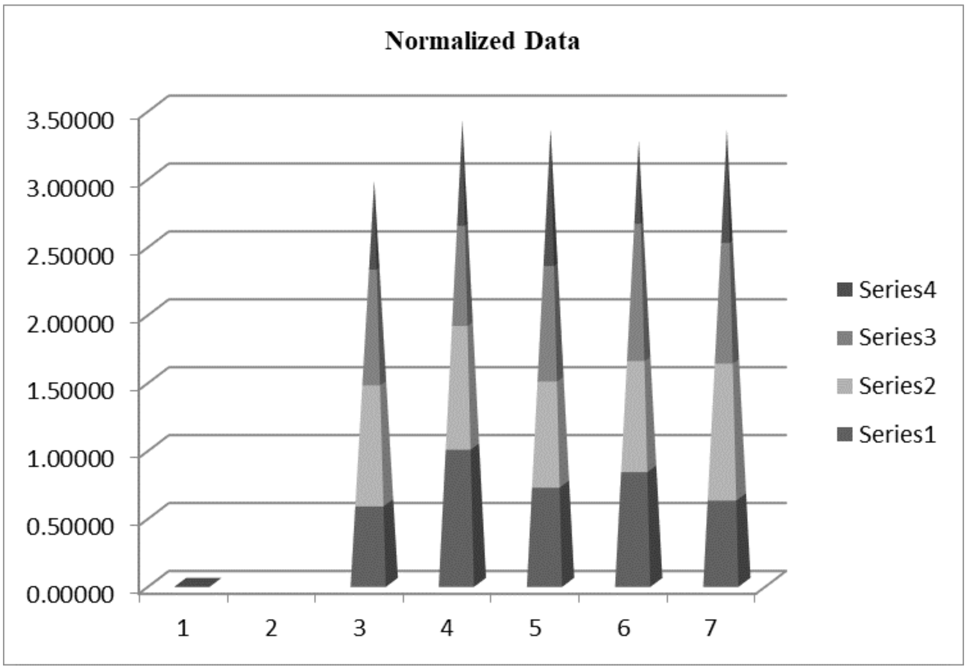

FIGURE 2. Normalized data

Table 2 shows the Normalized data for sustainable waste disposal technology selection using the analysis method in alternative in use Landfilling, Incineration, Pyrolysis, Plasma, Gasification. investment cost, operation cost, Energy Recovery and technology accessibility it is also the Maximum in Normalized value.

TABLE 3. Weightages

Weightages			
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 3 shows Weightages used for the analysis. We take same weights for all the parameters for the analysis

TABLE 4. Weighted normalized decision matrix

Weighted normalized decision matrix			
0.14644	0.22027	0.21098	0.16222
0.25000	0.22570	0.18255	0.19218
0.18069	0.19351	0.21076	0.25000
0.20901	0.20251	0.25000	0.15177
0.15704	0.25000	0.21996	0.20581

Table 4 shows the weighted normalized decision matrix for sustainable waste disposal technology selection using the analysis method in alternative in use Landfilling, Incineration, Pyrolysis, Plasma, Gasification. investment cost, operation cost, Energy Recovery and technology accessibility is also Multiple value.

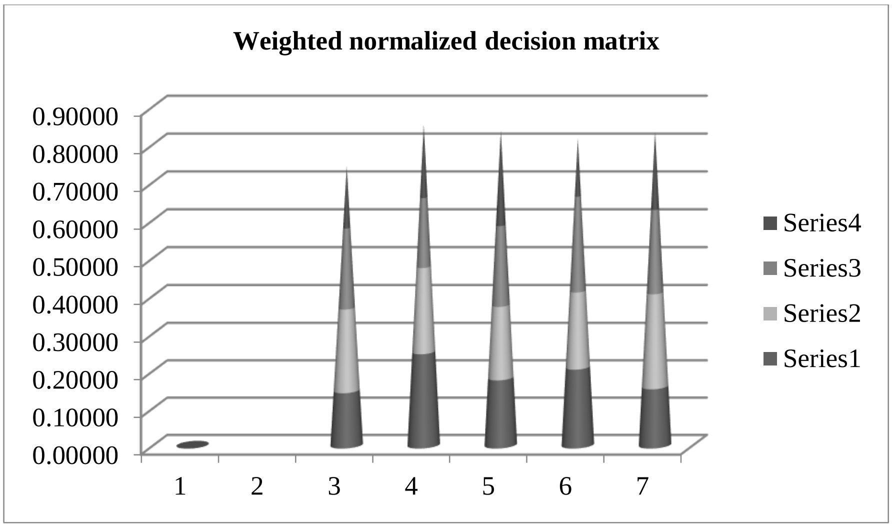

FIGURE 3. Weighted Normalized Decision matrix

Figure 3 shows the weighted normalized decision matrix for sustainable waste disposal technology selection using the analysis method in alternative in use Landfilling, Incineration, Pyrolysis, Plasma, Gasification. investment cost, operation cost, Energy Recovery and technology accessibility is also Multiple value.

TABLE 5. Final Result of Indian Technical Institution

	Preference Score	**Rank**
Landfilling	0.73991	5
Incineration	0.85043	1
Pyrolysis	0.83497	2
Plasma	0.81330	4
Gasification	0.83281	3

Table 5 shows the final result of WSM for Sustainable waste disposal technology selection. Preference Score is calculated using the Incineration is having is Higher Value and Landfilling is having Lower value.

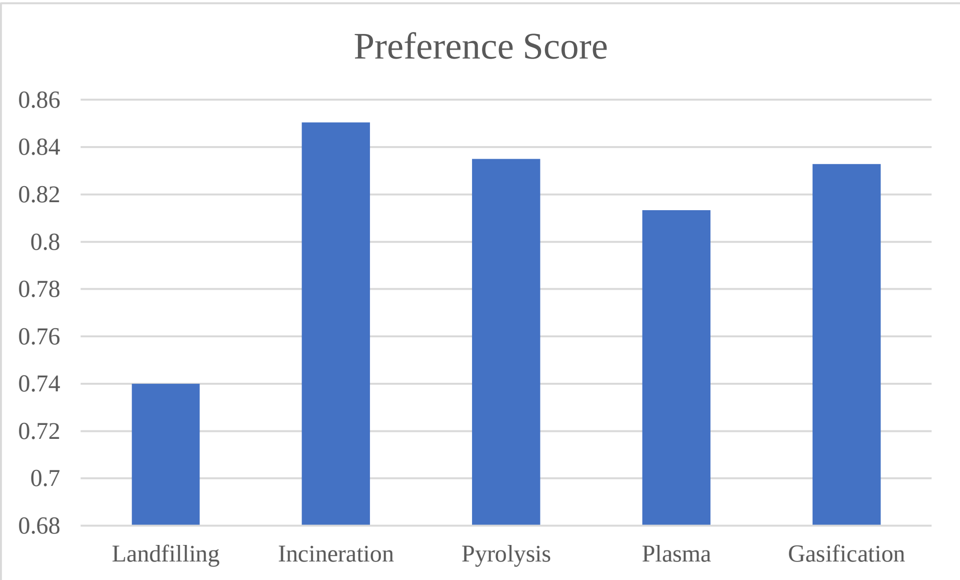

FIGURE 4. Preference Score

Figure 4 shows the preference Score for Sustainable waste disposal technology selection Preference Score is calculated using the Incineration is having is Higher Value and Landfilling is having Lower value.

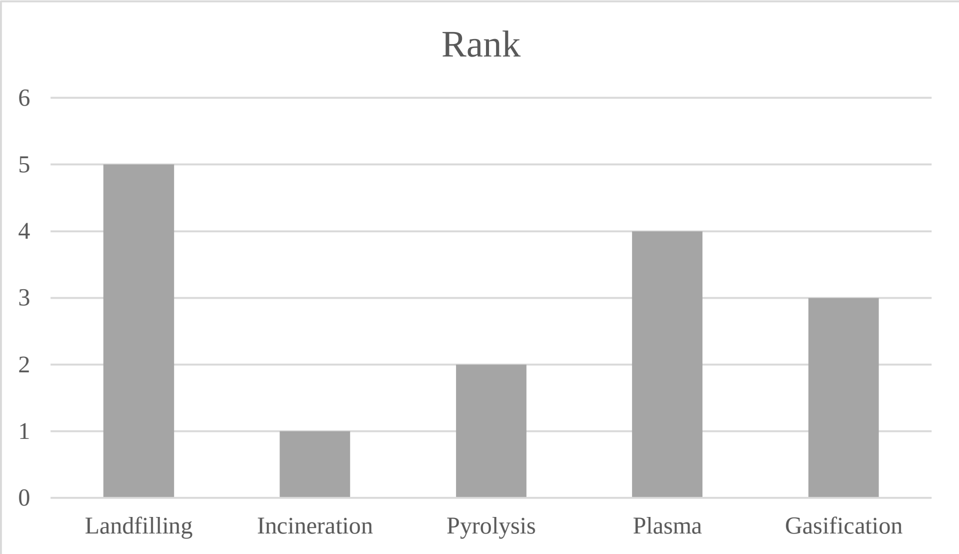

FIGURE 5. Shows the Rank

Figure 5 Shows the Ranking of Sustainable waste disposal technology selection. Incineration is got the first rank whereas is the Landfilling is having the Lowest rank

4. CONCLUSION

After careful analysis and consideration of various sustainable waste disposal technologies, the following conclusion can be drawn: Trash-to-Energy (WtE) Plants: WtE plants are a practical method for disposing of trash in a sustainable manner. They transform garbage into energy using cutting-edge combustion or gasification procedures, usually in the form of heat or electricity. WtE facilities offer the benefit of producing renewable energy and lowering landfill trash. To lessen environmental effects, however, thorough emission monitoring is crucial. Recycling and resource recovery are important parts of sustainable waste management. Comprehensive recycling programmes may drastically cut down on the quantity of garbage dumped in landfills. Sorting and processing waste materials are required to recover useful resources for reusing. Recycling has to be prioritised for items with great potential for recycling, such as paper, plastic, glass, and metal. 3. Composting: Composting is a naturally occurring process that creates nutrient-rich compost from organic waste, including leftover food and yard trash. It is a sustainable technique that lowers greenhouse gas emissions and helps prevent organic waste from ending up in landfills. Composting can be done on a local or big scale at municipal composting facilities or backyard bins.4. Anaerobic Digestion: Organic waste is converted into biogas and nutrient-rich digestate through the biological process of anaerobic digestion. Particularly good for wet organic waste are sewage sludge and food waste. Although the digestate may be utilised as fertiliser, the resulting biogas can also be used to generate heat and electricity. Anaerobic digestion, which also provides a renewable energy source, lowers methane emissions. Ranking of Sustainable waste disposal technology selection. Incineration is got the first rank whereas is the Landfilling is having the Lowest rank

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