

**Assessing the feasibility and impact of energy
projects resulting from waste recycling during
Ziyarat Al-Arabaeen**

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Abstract:

The aim of this study is to study effects of capabilities resulting from waste recycling in Iraq. Finding sustainable solutions is essential because society has dangerous issues in waste production and energy production by rotating this waste. This study is specifically focused in Iraq and the technical, financial and environmental aspects of a number of waste recycling techniques, such as anaerobic digestion, combustion and reinforcement. In addition, the employment of these technologies may increase economic opportunities, increase energy security, and greenhouse gas emissions. The results will help decision -makers, investors and stakeholders in developing plans to increase the effectiveness of renewable energy and waste management in Iraq.

The current study is looking for waste recycling projects to energy in Iraq and exploring the feasibility of applying these projects to address the waste problem and energy lack. The current research takes into account the financial, technical, organizational and social aspects of such projects and proposes a framework to successfully implement them. The study also sheds light on the potential benefits of energy projects resulting from waste recycling, such as reducing greenhouse gas emissions, generating renewable energy, and creating jobs. The results of this study can help decision makers to make accurate decisions about waste management and renewable energy strategies in Iraq.

Keywords: feasibility assessment ; energy initiatives ; waste recycling ; renewable energy ; waste transformation ; environment and sustainable development

Introduction

Waste management and energy production is very important for all countries in the world. Iraq is considered one of the ricing countries facing many challenges in finding solutions for sustainable development with regard to waste and energy production (1). The increase in the population, the expansion of the urban area, and the industrial growth in Iraq lead to an increase in the quantities of waste (2). In addition, many religious events are held in Iraq, and visitors from all parts of the world flock to attend them, the most important of which is the Arba'een Ziarat in the city of Kerbala, and during this event, large amounts of waste are generated that are supposed to be treated immediately through modern global technologies, as they are used, for example, in energy production (3). These issues lead to the consumption of the waste management infrastructure.

After international reports showed that Iraq is the tenth in environmental pollution, and a statistic by the Iraqi Ministry of Planning that more than a third of the country's population is not covered by the waste collection and transport service during the year 2020-2021 the percentage of the population served by the waste collection service at the level of Iraq amounted to 65.7%, while

the percentage of served at the urban level reached 90.7% in urban areas, and in rural areas was 12.5%, as the usual amount of waste raised amounted to 11.8 million tons per year)the average amount of waste generated per capita amounted to 1.3 kg per day(and the percentages according to the usual waste disposal methods showed the highest percentage of disposal by landfill in sites that did not have environmental approval and constituted (93.8%), followed by the method of landfill in sites that obtained environmental approval by (81.3%), then the method of throwing in empty yards by (37.5%), while the method of recycling or reuse is followed by (12.5%) noting the lack of use of methods (burning, composting, convert it to energy). The number of waste sorting and recycling plants in Iraq is only one private plant in Baghdad (4), operating at a rate of 1,045.2 tons per year. And another factory in Thi Qar is not working. Also, the Municipality of Baghdad announced on Thursday 04-13-2023 the sorting of 9 thousand tons of waste per day, confirming 65% of it as leftovers, while indicating the preparation of intensive awareness programs during the last two years for waste management, revealing It needs more than two million surveillance cameras to keep the capital, Baghdad, clean.

In the last decade, the interest in energy production projects has increased from waste recycling in order to meet the problems of waste management and energy production (5). The goal of these projects is to convert waste into environmentally friendly energy with various operations such as burning, anaerobic digestion and the

processing process (6).

In order to be able to evaluate the energy projects caused by the recycling of solid waste, it requires research for many different factors (7). The goal of this study is to implement these projects in Iraq today and appreciate the economic feasibility and their environmental impacts. We will analyze data through the statistics of specialized institutions, infrastructure, policies and legislation in order to determine obstacles and opportunities to implement such projects (8).

This study will address the methods used to produce energy from non-recyclable waste, taking into account the extent of their suitability for investment in Iraq. Through the availability of waste, raw materials, infrastructure requirements, and local energy to allocate the most appropriate methods used for implementation.

In addition to the foregoing, the economic feasibility of producing environmentally friendly, low-carbon energy will be assessed, by referring to project costs, operating budget, revenues, and financing methods. This study will also indicate, in addition to the material return that can be obtained from waste recycling, the environmental and social return is much higher, and this is represented in reducing environmental pollution instead of burying and burning waste, including air emissions, water pollution, and waste management. Solutions will be presented to reduce and mitigate these impacts, ensuring the effective participation of projects in environmental sustainability, as well as preserving natural materials, benefiting

from raw materials, providing new job opportunities, in addition to providing energy alternatives (3).

Energy waste recycling initiatives in Iraq hold great potential for addressing waste management and energy problems. Where Iraq can create a sustainable waste management law, produce environmentally friendly energy, and participate in environmental protection and social and economic development (9).

In the end, the study will provide important insights and proposals for officials, relevant government agencies, and investors in waste and energy management in Iraq. The results of this study will also help in offering sustainable solutions for waste management, and reduce dependence on common energy sources, as it is one of the innovative climate solutions to convert non-recyclable waste into electricity to provide clean, low-carbon energy, which is reflected in raising the level of sustainable quality of life in Iraq (10).

Obstacles or Constraints

1. Iraq is one of the countries that lag behind in the waste management process, as there are few and not serious projects in the field of waste.
2. The culture of recycling and its environmental and economic impact is low in society, and this may constitute an obstacle in the absorption of electricity production projects by the public.
3. The few technical and engineering expertise specialized in the field of design and operation of waste-to-electricity plants

4. Stable political conflicts affect the country's economy and thus affect investment in waste-to-electricity projects.
5. Random collection and sorting of waste in the country This affects the regulatory framework for waste management and makes it unstable, which may cause problems in the implementation of projects to produce electricity from waste.

In general, facing these challenges requires joint efforts by individuals and officials to build the necessary foundation for such projects, develop technical and engineering expertise, legislate supportive laws, and spread the culture of recycling to raise awareness and accept waste-to-energy.³ Lack of technical and engineering expertise through which waste-to-electricity stations can be designed and operated.

4. Iraq is exposed to financial confrontations due to ongoing political conflicts and insecurity, and this may affect investment in waste-to-electricity projects.

5. The random collection and sorting of waste in Iraq makes the regulatory framework for waste management unstable, which may cause problems in the implementation of electricity production projects from waste.

In general, facing these challenges requires organized efforts from individuals and officials to build the necessary infrastructure for such projects, develop technical and engineering expertise, enact supportive laws, and spread a culture of recycling to raise awareness and accept the conversion of waste into energy.

Waste recycling technologies to produce energy

The literature shows that there are advanced tools and techniques for Municipal solid waste (MSW) treatment, and each of the techniques may have advantages and disadvantages, see Figure (1). These tools or techniques may range from source reduction to recycling and waste-to energy (WtE) technologies although open dumping of MSW is prevalent particularly in the most developing countries as mentioned earlier (6,11).

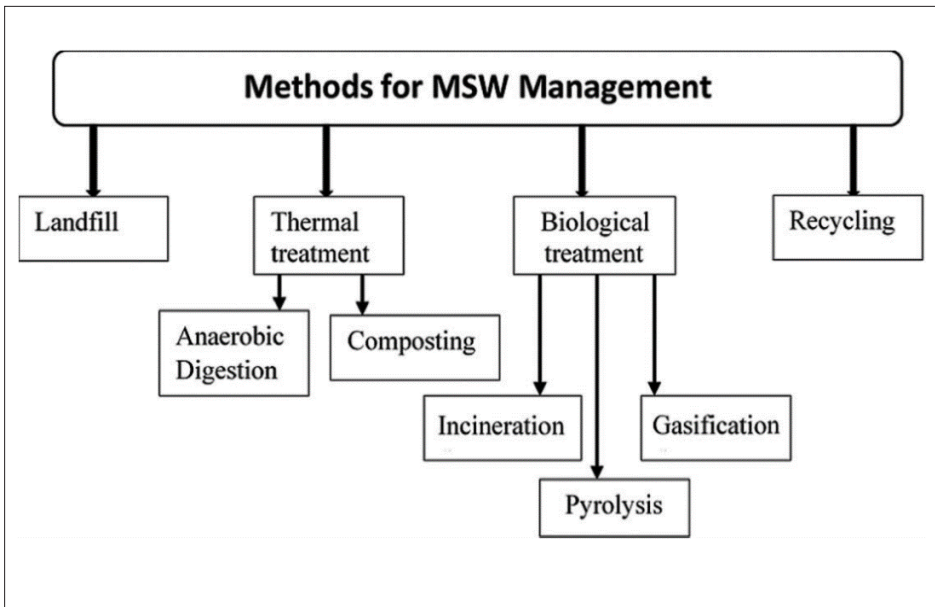


Figure (1): A schematic view of methods for MSW treatment (6).

The most important social effects of waste recycling plants for energy production

1. Employing manpower and contributing to solving the problem of unemployment, as the percentage of workers in recycling is six times more than workers in traditional methods of waste disposal.
2. Low costs of therapeutic expenditure for community members as a result of the decrease in environmental pollution, as biological treatment of waste reduces its accumulation, and thus the decrease in the transmission and spread of infection with infectious diseases, and the low spread of insects and animals that transmit diseases.
3. Waste recycling and energy production plants contribute to improving the community lifestyle through the establishment of centers specialized in waste collection and treatment.
4. It can raise the cultural level of individuals through safe waste disposal methods and thus maintain a clean environment
5. Providing large areas of land to be used as dumping dumps that can be directed to other uses, as well as increasing investment in tourism as a result of improving the aesthetic appearance of the country.

Proposed projects underway for waste recycling and energy production in Iraq

Waste recycling and energy production plants provide great social benefits through sustainable development, and raise the level of health, educational and economic reality of the country and that the most important stations in Iraq are:

Station Name	Location	Amount of Waste	Treated Production
Basra (Figure 2)	Basra Governorate	1200 tons of solid waste	electricity generation
Baghdad	Baghdad province	1500 tons of solid waste	electricity generation
Erbil	Erbil Governorate	450 tons of solid waste	Production of fertilizer and recyclable materials
Sulaymaniyah	Sulaymaniyah province	600 tons of solid waste	Production of fertilizer and recyclable materials
Kirkuk	Kirkuk Governorate	600 tons of solid waste	Production of fertilizer and recyclable materials



Figure 2: University of Basrah Waste Recycling Initiative

Proposed projects for waste recycling and energy production

A good example of waste recycling and energy production plants in the Middle East is the Sharjah Solid Waste Recycling and Power Plant in the United Arab Emirates (12), as the main objective of this plant is to reduce greenhouse gas emissions, achieve carbon neutrality and reduce the effects of climate change to preserve the environment. The plant treats 300,000 tons of solid waste per year, generating 30 megawatts of energy per year, enough to power 28,000 homes. This, in turn, contributes to the displacement of 450,000 tons of harmful carbon dioxide emissions (13), which leads to raising and improving the sustainable quality of life in the Emirate of Sharjah figure 3.



Figure 3: Sharjah Waste-to-Energy Plant

Proposals to increase investment in waste recycling and energy production projects

Increasing investment in this type of project is done by several different policies carried out by the government, and the following is a set of policies:

- 1- Financial facilities provided by the government to investors in this field represented in granting loans with reduced interest or tax exemption, for example.
- 2- Benefiting from the experiences of other countries to be able to develop the recycling industry, especially those countries that have reached a high level to achieve a competitive advantage over neighboring countries by sending specialists to these countries for training.
- 3- Holding many workshops and seminars in order to spread the culture of collecting and recycling waste, starting from kindergartens to schools and universities and even all state institutions. It is also possible to use religious events to spread the culture of waste recycling, for example, in the Arba'een ziarat, processions are provided with containers used for waste sorting, and special leaflets are used to raise awareness.
- 4- Establishing special centers for research and development in the field of waste recycling in order to carry out continuous improvement in quality and reduce costs. And to achieve the cooperation of these centers with the relevant scientific departments in the universities of Iraq, which leads in the future to the opening of scientific branches specialized in the manufacture and recycling of waste.

5- Enacting strict laws, as found in most countries, on those who pollute the environment, and using an escalating mechanism of penalties in case of repeated violations, so that caring for the environment becomes a social habit that does not need deterrent laws.

6- Preventing the export of waste of all kinds, by the government outside Iraq, and recycling it locally, because of the returns it achieves that far exceed what can be obtained from exporting it raw.

7- Increasing waste collection and sorting centers in the country, in order to facilitate the task and include it in the various areas of the city.

By committing to implementing these proposals, the government will be able to create an environment that encourages investment in these projects, which have great benefits, as detailed at the beginning of the research.

Some important points that the government must adhere to in waste conversion plants for sustainable and safe energy for the community

1- Setting special laws for the design and operation of waste transfer stations to produce energy.

2- Requesting permits and licenses from recycling stations before starting their work and under special conditions to ensure environmental sustainability and security for the community.

3- Trying to address the concerns of the community surrounding these projects through the formation of councils for consultations, meetings and community consultations.

4- Setting international technological specifications for the establishment of such stations.

5- The government should regularly monitor the compliance of these stations with laws and permits, such as monitoring water and air quality.

By implementing these points, the government can ensure the community's confidence in the environmental safety of these projects and thus endorse waste transfer plants, which will help local and foreign investment.

Discussion

A country like Iraq contains a huge amount of waste according to the statistics of the Ministry of Planning and thus a polluted environment, and on the other hand, a severe shortage in the production of electrical energy needs real efforts represented by the executive authority and cooperation by society to solve these two problems in one way, which is the projects of waste recycling stations and the production of electric power through the imposition of legislation and laws necessary for the establishment and operation of these stations according to international standards and spreading the culture of collecting and sorting waste from inside homes and then Transported to stations for recycling and energy production.

As well as encouraging the private sector to invest in such projects by giving facilities for loans, reducing interest and protecting them from financial risk, as these projects need huge capital. In addition,

to benefit from the experiences of the countries of the world that have taken great strides in this field, such as China and Germany. Establishing a waste bank, as exists in most developed countries, to urge citizens to collect waste in an orderly manner to facilitate the sorting process.

Such projects have an economic, environmental and social impact, as waste recycling contributes to preserving the environment, reducing environmental pollution and improving the health of individuals. Moreover, the economic effects through creating jobs and reducing the costs of generating sustainable electricity by traditional methods in order to facilitate access to raw materials (waste). As for the social impact, it is through raising the standard of living by providing electrical energy and raising the health level of individuals due to the purity of air and water, as well as creating job opportunities in a country suffering from unemployment.

Last but not least, the initiative to assess the feasibility and impact of energy projects arising from waste recycling in Iraq is critical and necessary to enhance the environment and the health of people nearby, create new jobs, and produce sustainable energy. To determine the social, environmental and economic impacts of the proposed projects and ensure their success and expected benefits, this assessment must be carried out clearly and comprehensively in collaboration with all stakeholders. The best solutions and approaches to reduce environmental pollution and raise the standard of living in the area can also be found using this assessment.

References

1. Musheb JM. The economics of waste recycling in Iraq: Wasted resources and lost opportunities. *Eur J Econ Bus Stud.* 2021;
2. Musahinib JM. Waste recycling in Iraq, wasted resources, and lost opportunity. *J Adm Econ.* 2020;(123).
3. Abdulredha M, Kot P, Al Khaddar R, Jordan D, Abdulridha A. Investigating municipal solid waste management system performance during the Arba'een event in the city of Kerbala, Iraq. *Environ Dev Sustain.* 2020;22:1431–54.
4. Rasool Nma, Mohammed Aj. Factory Of Sorting And Recycling Of Waste In The District Of Al-Mahmoudiyah Between The Economic And Environmental Impact. *Iraq J Mark Res Consum Prot.* 2020;12(1).
5. Al-Kayiem HH, Mohammad ST. Potential of renewable energy resources with an emphasis on solar power in Iraq: An outlook. *Resources.* 2019;8(1):42.
6. Gupta RK, Nguyen TA. *Energy from Waste: Production and Storage.* CRC Press; 2022.
7. عبدالله فم، هحوذبص، الإدريسي هس. دراسة الجدوى الفنية والاقتصادية لإنشاء مشروع إعادة تدوير نفايات الورق والكرتون في مدينة أربيل.
8. Al-Anbar Univ *J Econ Adm Sci.* 2016;8(15).
9. Anssari OM, Alkaldy EA, Almudhaffar N, AlTae AN, Ali NS. A feasibility study of electrical energy generation from municipal solid waste in Iraq: Najaf case study. *Int J Electr Comput Eng.* 2020;10(4).

10. Hamza AA. Municipal Solid Waste Quantity, Ingredients, and Site Disposal Problems in Pshdar District in Sulaimanyah: Iraqi Kurdistan Region, Iraq. *Kufa J Eng.* 2020;11(4).
11. Kadhim ZR, Ali SH, Barbaz DS, Alnagar AS. The Economic and Environmental Effects of Recycling Plant Agricultural Wastes in Iraq (Yellow Maize Production Farms in Babil Province-A Case Study). In: *IOP Conference Series: Earth and Environmental Science.* IOP Publishing; 2022. p. 12145.
12. Serag S, Echhelh A. Technical and Economic Evaluation of Electricity Generation and Storage Using Renewable Energy Sources on Socotra Island, Yemen. *Iraqi J Sci.* 2023;2809–42.
13. Al-Ruzouq R, Abdallah M, Shanableh A, Alani S, Obaid L, Gibril MBA. Waste to energy spatial suitability analysis using hybrid multi-criteria machine learning approach. *Environ Sci Pollut Res.* 2022;29:2613–28.
14. Al Dhaheri MM, Ahmad SZ, Mfarrej MFB. *Emirates Waste to Energy Company: Sustainable, Renewable Energy From Waste.* SAGE Publications: SAGE Business Cases Originals; 2022.

