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Islamic Environmental Ethics and Waste-to-Energy Innovation: Insights from the Quran

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ABSTRACT

Angelika Neuwirth's intertextuality opens new insights into the Qur'an's relationship with Environmental sustainability, a fundamental concern in modern society, and Islam provides ethical guidelines for responsible environmental stewardship. This study explores the principles of Islamic ecological ethics derived from the Quran and their relevance to waste-to-energy (WTE) innovation as a sustainable waste management strategy. The Quran emphasizes khalifah (stewardship), mizan (balance), and israf (avoidance of wastefulness) as key ethical foundations for environmental conservation. From an Islamic perspective, the transformation of waste into energy aligns with the maqasid shariah (higher objectives of Islamic law) by promoting ecological protection a nd public welfare. This research also examines WTE initiatives in Muslim-majority countries, highlighting challenges and opportunities in integrating Islamic values into technological advancements. The findings suggest that Islamic teachings can serve as a moral and spiritual foundation for promoting WTE solutions, encouraging policymakers, religious scholars, and communities to adopt environmentally responsible practices. This study contributes to the discourse on Islamic environmental ethics and provides policy recommendations for sustainable waste management in Muslim societies.

Keywords: : Islamic Environmental Ethics, Waste-to-Energy, Quran, Sustainability

ABSTRAK

Keberlanjutan lingkungan merupakan isu penting dalam masyarakat modern, dan Islam memberikan pedoman etika untuk pengelolaan lingkungan yang bertanggung jawab. Penelitian ini mengeksplorasi etika lingkungan Islam berdasarkan Al-Qur'an serta relevansinya dengan inovasi pengubahan sampah menjadi energi (Waste-to-Energy/WTE) sebagai strategi pengelolaan limbah yang berkelanjutan. Al-Qur'an menekankan konsep khalifah (pengelolaan), mizan (keseimbangan), dan israf (larangan pemborosan) sebagai prinsip utama dalam konservasi lingkungan. Dari perspektif Islam, konversi limbah menjadi energi sejalan dengan maqasid shariah (tujuan utama syariah) karena mendukung perlindungan lingkungan dan kesejahteraan masyarakat. Studi ini juga meninjau implementasi WTE di negara-negara mayoritas Muslim, mengidentifikasi tantangan serta peluang dalam mengintegrasikan nilai-nilai Islam ke dalam inovasi teknologi. Hasil penelitian menunjukkan bahwa ajaran Islam dapat menjadi landasan moral dan spiritual dalam mendukung solusi WTE, serta mendorong pemangku kebijakan, ulama, dan masyarakat untuk menerapkan praktik ramah lingkungan. Penelitian ini berkontribusi pada diskusi mengenai etika lingkungan Islam serta memberikan rekomendasi kebijakan dalam pengelolaan limbah berkelanjutan di negara-negara Muslim.

Kata Kunci: Etika Lingkungan Islam, Pengubahan Sampah menjadi Energi, Al-Qur'an, Keberlanjutan.

INTRODUCTION

Climate change, environmental pollution, and increasing amounts of waste are global challenges that require sustainability-based solutions (Putranto, 2023). This environmental crisis is further exacerbated by population growth and uncontrolled urbanization, causing an increase in waste production that negatively affects the ecosystem. In this context, Islam has principles of environmental ethics that emphasize balance, wise management, and prohibition against waste (Gulzar et al., 2021). Islam teaches that humans are khalifah (managers) on earth with the responsibility to maintain ecological balance and avoid environmental damage. This Islamic perspective explains that any form of overexploitation of resources and poor waste management not only impacts nature but also goes against the spiritual and ethical principles taught in the Qur'an (Djuned, 2016). Islam highlights mizan (balance) in resource-utilization and forbids israf (wastefulness), thus Muslims are expected to efficiently manage resources and discover methods to recycle or reprocess waste, so as not to pollute the environment. In addition, Islam also believes in istishlah (public good) which upholds public good, including sustainable environmental management.

While facing such a challenge, one solution waste-to-energy (WTE) innovation appears as if it can effectively deal with the problem of waste and at the same time, serve as an alternative energy source. With this technology, it is possible to minimize the amount of waste sent to landfills and produce reusable electricity or fuel (Vukovic & Makogon, 2022). The greatest benefit offered by WTE is its capacity to transform non-recyclable waste into useful energy, which helps reduce the consumption of fossil fuels and lessens the adverse effects of waste disposal (Fetanat, Abdolvahhab, 2019). In addition, this methodology could assist developing nations with limited infrastructure for managing waste and producing energy by making it easier to protect the environment and promote sustainability. On the other hand, the use of this technology still has some hurdles to clear, such as policy, public opinion, and adequate facilities.

Prior research has analyzed the relevance of environmental ethics within Islam, looking into how Islam as a religion supports sustainability efforts Gulzar et al. (2021). observe that Islam possesses a theocentric view regarding the safeguarding of the environment, which implies that caring for the environment is considered a social responsibility, as well as worship unto God (Gulzar et al., 2021). On the other hand, Sharma et al. (2020) emphasized the need to exercise ‘circular economy’ principles in sustainability regarding the management and conversion of waste to renewable energy (Sharma et al., 2020). Nevertheless, there is limited

literature that incorporates Islamic principles within approaches to WTE technology, particularly focusing on how Islam can enable its use in the Muslim world. Thus, this research seeks to address this gap by demonstrating how Islamic principles can inform the discourse on the adoption of this technology in Muslim societies.

The aim of this research is to analyze environmental ethics with the inspiration of Qur'anic ethical precepts and to connect it with sustainability approaches in waste management. Also, this study aims to examine how Islamic sustainability principles can be integrated into waste treatment methods, especially through WTE technology. By understanding the Islamic principles in managing the environment, it is hoped that Muslim communities can better accept and apply this technology as part of their moral and religious responsibilities. This research will also explore the potential and challenges in the implementation of WTE technology in Muslim countries and provide Islamic value-based recommendations to support sustainable and environmentally-friendly technological innovation. With this approach, it is hoped that this research can contribute to the academic discourse on Islamic environmental ethics and innovative solutions in sharia-compliant waste management, so that it can serve as a reference for policy makers, academics, and the wider community in facing increasingly complex environmental challenges (Derysmono et al, 2024).

METHOD

This study employs a qualitative library research approach with descriptive-critical analysis to explore the connection between Islamic environmental ethics derived from the Qur'an and the innovation of Waste-to-Energy (WTE) technology. Primary sources include selected Qur'anic verses that emphasize the concepts of *khalifah* (stewardship), *mizan* (balance), *israf* (avoidance of waste), and *tazkiyah* (purification), while secondary sources consist of scholarly journals, books, fatwas, and policy reports from Muslim-majority countries.

The analysis is conducted through a thematic hermeneutic approach (tafsir maudhū'i), which involves identifying relevant Qur'anic themes related to environmental responsibility and interpreting them in light of contemporary challenges, particularly in relation to the objectives of Islamic law (*maqāṣid al-sharī'ah*) and sustainable development principles. The study also examines real-world WTE practices and policies in selected Muslim countries to provide contextual and empirical insights that complement the normative-theological analysis. This methodology is chosen for its suitability in uncovering the ethical and spiritual dimensions of Islamic teachings, while also addressing the socio-technological realities of waste

management. The goal is to formulate value-based recommendations that align Islamic principles with sustainable environmental innovations such as WTE.

RESULTS and DISCUSSION

Environmental Ethics in Islam: A Qur'anic Perspective

Islam has environmental ethics principles that emphasize human responsibility towards nature as part of worshiping Allah. The Qur'an teaches balance in resource utilization, rejects waste, and emphasizes the importance of cleanliness and sustainability (Syakur, 2025). Islamic scholars and academics argue that the current environmental degradation is caused by human negligence in applying the ecological principles taught by Islam (Gulzar et al., 2021). Islam, as a comprehensive religion, has established principles of environmental ethics that reflect human responsibility towards the earth. Some of the main concepts in Islamic environmental ethics include :

1. Khilafah (Human Leadership over the Earth)

Humans in Islam are given the responsibility of being khalifah (leader) on earth, which means that they should take care of and preserve the environment, not exploit or destroy it (Kahfi, 2024). One of the main concepts in Islamic environmental ethics is khalifah, which is the duty of humans as leaders on earth to maintain the balance of nature and not destroy it (Ipin Tajul Aripin, 2024). This concept is stated in QS. Al-Baqarah [2:30] which states that humans have been appointed as khalifah on earth with the mandate to manage and care for the environment. In QS. Al-A'raf [7:31], Allah also reminds humans not to be excessive in utilizing natural resources, because any form of abuse can lead to environmental damage. As caliphs, humans have a moral responsibility to use resources wisely and avoid excessive exploitation that can damage ecological balance (Muhamad et al., 2020). Related Verses:

QS. Al-Baqarah [2:30)

وَاِذْ قَالَ رَبُّكَ لِلْمَلٰۤىِٕكَةِ اِنِّيْ جَاعِلٌ فِى الْاَرْضِ خَلِيْفَةً ۗ قَالُوْٓا اَتَجْعَلُ فِيْهَا مَنْ يُّفْسِدُ فِيْهَا وَيَسْفِكُ الدِّمَآءَ ۚ وَنَحْنُ نُسَبِّحُ بِحَمْدِكَ وَنُقَدِّسُ لَكَ ۗ قَالَ اِنِّيْٓ اَعْلَمُ مَا لَا تَعْلَمُوْنَ ۝٣٠

"And (remember) when your Lord said to the angels, 'Surely I want to make a caliph on the earth.' They said, 'Do you want to make one who will cause corruption therein and shed blood, while we praise you and sanctify your name?' He said, 'Surely I know what you do not know.'"

This verse emphasizes that humans are given a great responsibility as stewards of the earth. In the context of the environment, this means that humans should not damage the ecosystem that Allah has created in perfect balance. Islam emphasizes that overexploitation of natural resources is contrary to humanity's duty as khalifah (Muhamad et al., 2020).

QS. Al-A'raf [7:31]

يٰبَنِيْٓ اٰدَمَ خُذُوْا زِيْنَتَكُمْ عِنْدَ كُلِّ مَسْجِدٍ وَّكُلُوْا وَاشْرَبُوْا وَلَا تُسْرِفُوْٓا اِنَّهٗ لَا يُحِبُّ الْمُسْرِفِيْنَ ۚ ٣١

"O children of Adam! Wear your beautiful garments at every entrance to the mosque, eat and drink, but do not overdo it. Verily, Allah dislikes those who are excessive."

Islam prohibits excessive consumption and irresponsible exploitation of resources. In the context of the environment, this means humans should use natural resources wisely and not cause damage to the ecosystem (Nasir et al, 2021).

2. Mizan (Ecological Balance and Simplicity)

Allah created nature with the perfect balance, and He prohibits humans from its disruption. Mizan or ecological balance is also an important concept in Islamic teachings on the environment (Suhendra, 2013). QS. Ar-Rahman [55:7-9] thus states that Allah created nature in a very accurate balance, and humans should not break limits in the management of the environment. This principle, therefore, teaches us that every form of irresponsible exploitation of the natural resource could lead to disruption in the balance, which has been created by Allah himself. If that balance is disturbed, the result could be ecological-disaster events such as climate change, environmental pollution, or the extinction of biodiversity. Islam, indeed, believes, that maintaining the environmental balance is part of worship and forms an obedience to Allah (Nasir et al, 2021).

QS. Ar-Rahman [55:7-9]

وَٱلسَّمَآءَ رَفَعَهَا وَوَضَعَ ٱلْمِيزَانَ ٧ أَلَّا تَطْغَوْا۟ فِى ٱلْمِيزَانِ ٨ وَأَقِيمُوا۟ ٱلْوَزْنَ بِٱلْقِسْطِ وَلَا تُخْسِرُوا۟ ٱلْمِيزَانَ ٩

"And the heavens He has exalted, and He has created a balance, so that you may not break the balance. And establish the balance with justice and do not diminish the balance."

This verse confirms that everything in the universe was created in a state of balance. Over-exploitation of natural resources can upset this balance, resulting in climate change, species extinction and pollution. Islam requires humans to maintain this balance as part of their obedience to Allah (Blankinship et al., 2025).

3. Israf dan Tabzir (Prohibition of Waste and Pollution)

Islam also prohibits israf (extravagance) and tabzir (waste of resources) as part of environmental ethics. In QS. Al-Isra' [17:26-27], Allah forbids humans to waste resources, and describes wasteful behavior as the actions of the devil (Nur Laini Br Limbong, 2025). This wastefulness is not only in the form of food or drink, but also in the use of energy, water, and other natural resources. In the modern context, overconsumption behavior and uncontrolled waste production are among the main causes of environmental damage. Therefore, Islamic teachings emphasize the importance of efficiency in the use of resources and support sustainability practices such as recycling and waste reduction (Sarah Schmidt, 2020). Waste and squandering of resources is prohibited in Islam as it can lead to environmental damage.

QS. Al-Isra' [17:26-27]

وَءَاتِ ذَا ٱلْقُرْبَىٰ حَقَّهُۥ وَٱلْمِسْكِينَ وَٱبْنَ ٱلسَّبِيلِ وَلَا تُبَذِّرْ تَبْذِيرًا ٢٦ إِنَّ ٱلْمُبَذِّرِينَ كَانُوٓا۟ إِخْوَٰنَ ٱلشَّيَٰطِينِ ۖ وَكَانَ ٱلشَّيْطَٰنُ لِرَبِّهِۦ كَفُورًا ٢٧

"And give their due to near relatives, as well as to the poor and those on a journey, and do not squander (your wealth) extravagantly. Verily, the spendthrift is the brother of Satan, and Satan denies his Lord."

Islam teaches that wastefulness is a satanic trait. In the context of the environment, this means that any form of irresponsible consumption, such as excessive food waste and the use of single-use plastics that pollute the environment, contradicts Islamic principles (Nur Laini Br Limbong, 2025).

4. Tazkiyah (Environmental Purification and Hygiene)

Islam strongly emphasizes cleanliness as part of faith. Cleanliness includes oneself, places of worship, and the environment. The concept of tazkiyah, or purification and environmental cleanliness, is also an important part of Islamic environmental ethics (Jamaluddin, 2018). QS. Al-Baqarah [2:222] and QS. At-Taubah [9:108] teach that cleanliness is part of faith and is an obligation for every Muslim. Islam emphasizes the importance of maintaining personal and environmental hygiene as part of worship. In the context of waste management, Islamic teachings encourage people not to dispose of waste carelessly, and to find ways to recycle and manage waste properly so as not to pollute the environment. This principle is very relevant in

dealing with the increasing problem of environmental pollution due to plastic waste and domestic waste (Subhasish, 2019).

QS. Al-Baqarah [2:222]

اِنَّ اللّٰهَ يُحِبُّ التَّوَّابِيْنَ وَيُحِبُّ الْمُتَطَهِّرِيْنَ ﴿٢٢٢﴾

"Verily, Allah loves those who repent and loves those who purify themselves."

Islam teaches that cleanliness is part of faith. In the context of the environment, maintaining cleanliness means not littering, managing waste properly, and adopting a sustainable lifestyle.(Gulzar et al., 2021)

QS. At-Taubah [9:108]

لَا تَقُمْ فِيْهِ اَبَدًاۗ لَمَسْجِدٌ اُسِّسَ عَلَى التَّقْوٰى مِنْ اَوَّلِ يَوْمٍ اَحَقُّ اَنْ تَقُوْمَ فِيْهِۗ فِيْهِ رِجَالٌ يُّحِبُّوْنَ اَنْ يَّتَطَهَّرُوْاۗ وَاللّٰهُ يُحِبُّ الْمُطَّهِّرِيْنَ ﴿١٠٨﴾

"Do not pray in that mosque forever. Verily, the mosque founded on piety (Quba Mosque) from the first day is more worthy of your prayers. Therein are those who wish to cleanse themselves. And Allah loves those who are clean."

This verse shows how cleanliness is part of worship. In daily practice, Muslims are encouraged to keep the environment clean as part of their moral and religious responsibilities (Begum et al., 2021).

Thus, Islamic teachings provide a very comprehensive framework for environmental ethics. Principles such as khalifah, mizan, israf, and tazkiyah can be the basis for building better environmental awareness among Muslims. In the face of the current global environmental crisis, the application of Islamic environmental ethics can be a solution to encourage a more sustainable and responsible lifestyle. Therefore, it is important for Muslims to understand and apply this teaching in their daily lives, both on an individual and public policy scale, in order to create a healthier and more sustainable environment for future generations. Islamic environmental ethics teach humankind to be responsible in wisely and sustainably managing natural resources. These environmentalists lived in the 7th century AD, based on the principles of khilafah, balance, non-wastage, cleanliness, and non-damage; principles relevant to approaching modern environmental concerns. Muslim action values of the Qur'an could inspire an Islamic eco-friendly solution toward possibly saving the earth or generating green innovation as waste-to-energy based on Qur'an value. Hence, learning and practicing these principles will enable Muslims to perform their role, such as conservation of wildlife through so-called

undervisiting practices, etc., as part of worship in Allah-aligned embattling sustainment of our environment.

Waste-to-Energy Innovation in Islam

The Waste-to-Energy (WTE) technology refers to the transformation of waste into energy through diverse scientific and technological methods. (Jo Van Caneghema,*, Karel Van Ackerb & Wautersd, 1850) This became a remedy for two urgent problems: one, the worsening situation of waste production and its improper management, and the second, the need to seek alternative energy sources that are more environmentally beneficial (Adellea, 2018). WTE technology has been operated in the development of some countries under a circular economy strategy since wastes are construed not only as something to get rid of but also resources that humans can work with for the benefit of environmental sustainability.

The main principle of Waste-to-Energy technology is the conversion of energy from the waste into a usable form of energy: electricity, heat, or fuel (Widyawidura & Pongoh, 2018). This process is founded on the concept of waste minimization, followed by recovery and reuse of waste with the aim of reducing reliance on fossil resources and diminishing adverse impact on the environment due to waste accumulation. This technology, in addition, helps to reduce the greenhouse gas emissions due to methane, which is generated from the decomposition of organic wastes in landfills (Fadilah, 2014). In the long term, the application of WTE technology can help countries meet sustainability targets and transition to cleaner energy that is more environmentally friendly.

There are several main methods used in Waste-to-Energy technology. One of them is incineration, where waste is burned at high temperatures to generate heat which is then used to heat water in a boiler, creating steam that can drive turbines to generate electricity. This method is widely used in developed countries such as Japan, Germany, and Sweden due to its efficiency in reducing waste volume by up to 90%. In addition, this method is also equipped with a strict flue gas filtration system to reduce air pollution (Fahmi Hermawan, 2017). However, the main challenge of this method is the carbon emissions and combustion ash that must be managed properly so as not to pollute the environment.

Another method is gasification, which is a thermochemical process that converts waste into a synthetic gas (syngas) consisting of hydrogen, carbon monoxide, and methane. This gas can be utilized as fuel for power generation or further processed into liquid fuel. Gasification is considered more environmentally friendly than incineration because it reduces the formation of

dioxins and furans that are harmful to human health. It also offers higher energy efficiency as well as flexibility in the type of waste that can be processed (Vukovic & Makogon, 2022).

In addition, there is the pyrolysis method, which is the process of heating waste at high temperatures under minimal oxygen conditions to produce pyrolysis oil that can be used as biofuel. Pyrolysis has the advantage of producing reusable by-products, such as carbon black and synthetic gas. This technology is particularly suitable for the treatment of plastic and biomass waste, which would otherwise pollute the environment for a very long time. However, the main challenges in pyrolysis are the high initial investment and the need for specialized infrastructure to ensure the process runs efficiently (Agus Eko Setyono, 2021).

Anaerobic fermentation technology is also an important part of Waste-to-Energy, especially for organic waste. In this process, microorganisms decompose waste under oxygenless conditions, producing biogas containing methane that can be used as an energy source (Nurhayati, 2025). The application of this technique is strong for developing countries as it generates energy at a relatively lower cost from the household waste, food waste, and, agrarian waste. Anaerobic fermentation also gives organic fertilizer besides producing energy, which can find its place in agricultural applications; hence, it overall delivers a multi-fold benefit to society.

From the point of view of sustainability, it thus becomes part of a circular economy input-output strategy, whereby waste is treated and then put back into production via energy. This is a clear extension of the reduce, reuse, recycle, and recover principles that are transforming most environmental policies into an international phenomenon. WTE has also ensured the economy does not depend on fossil fuel resources, optimizes waste management, and has created cleaner, more sustainable systems for producing energi (Zueva et al., 2024).

Many countries worldwide have policies in place that encourage the introduction of Waste-to-Energy technology as part of green energy transitioning. "The European Union has set targets to reduce the amount of waste going to landfill or otherwise increase the proportion of waste turned into energy." Examples of countries that have effectively included WTE in their national waste management systems are Japan and South Korea. In many developing countries, however, this technology faces many challenges, such as lack of investment, unsupportive regulations, and the public that has not yet been totally brought over in terms of long-term benefits of such technology.

In the Islamic context, Waste-to-Energy can be seen as an effort to carry out the human mandate as khalifah on earth in maintaining environmental balance (Yaqub, 2022). Islam

teaches that all forms of resources should be utilized wisely and should not be wasted. This is in line with the concept of israf (wastefulness) which is prohibited in Islam, as mentioned in the Qur'an: "And do not be extravagant. Verily, Allah dislikes those who exaggerate" (QS. Al-A'raf [7]: 31). This principle encourages Muslims to be wiser in managing resources, including in waste management and the utilization of renewable energy. In addition, the concept of mizan (balance) in Islam is also the basis for the application of Waste-to-Energy technology. The Qur'an in QS. Ar-Rahman [55]: 7-9 states that Allah created everything in balance, and humans are commanded to maintain this balance so that no damage occurs. Therefore, innovations in waste management that are oriented towards sustainability are in line with Islamic teachings that emphasize human responsibility in protecting the environment (Munir, 2021).

Waste-to-Energy technology can also be related to the principle of istishlah (public good), where everything that brings benefits to society and does not conflict with Islamic values is allowed (Darmalaksana, 2019). In this case, waste processing that produces clean energy can provide great benefits to humanity, both in economic, social, and environmental aspects. In fact, several scholars and fatwa institutions have stated that this technology-based waste management is in line with Islamic values and can be part of efforts to achieve better sustainability.

In general, Waste-to-Energy is not only a technological innovation, but also part of a sustainable solution in addressing waste problems and energy crisis. With principles that support resource efficiency, emission reduction, and environmental quality improvement, this technology has great potential to be widely adopted, especially in Muslim countries that want to develop better waste management systems (Rachman et al, 2024). The implementation of this technology must be supported by clear regulations, adequate investment, and education to the community so that the benefits can be felt optimally. Thus, WTE technology can be part of a long-term solution in creating a cleaner, healthier and more sustainable environment (Festaria, 2023).

The Urgency of Waste-to-Energy in the Context of Sustainability in Islam

The worsening environmental crisis due to increased waste and uncontrolled exploitation of natural resources has become a global concern (Baiquni, 2009). Waste-to-Energy (WTE) technology comes as a solution that integrates waste management and sustainable energy production (Shanty, 2024). From an Islamic perspective, environmental sustainability is not only an ecological necessity but also part of the spiritual responsibility of humans as khalifah on earth (Novanda, 2023). The focus of this ideology is on the proper

management and non-wasteful use of every natural resource bestowed by Allah. Hence the development of WTE technologies corresponds with the Islamic teachings of balance (mizan), prohibition of wastage (israf), and the utilization of resources for the public good (istishlah).

Under the notion of energy sustainability, the WTE technologies offer many strategic advantages. Firstly, landfill waste reduction would mitigate land and water pollution hazards due to the WTE operation Sharma et al. (2020). Have noted that the WTE method, based on the 5R principles-reduce, reuse, recycle, recovery, and restore-is extremely beneficial to remedy waste problems while producing energy that can be reused (Sharma et al., 2020). This concept in Islam conforms to the teachings of the maintenance of the balance of nature and not to disregard anything that still holds some useful value. The Prophet showed in his action, as in the hadith narrated by Muslim, that water should not be wasted even for ablution while using a river with strong water flow.

Secondly, WTEs help to reduce the production of greenhouse gases (Wahyudi, 2019). Organic waste left to decompose in landfills produces methane, a greenhouse gas that has greater global warming potential than carbon dioxide. By converting waste into energy, methane emissions can be significantly reduced. This is very relevant in the context of Islam, which emphasizes human responsibility in protecting the environment. As explained in the research of Gulzar et al. (2021), Islam views the environment as an integral part of the balance of life, where human actions that damage the balance are contrary to Islamic teachings on sustainability (Gulzar et al., 2021). Therefore, innovations such as WTE that are able to reduce environmental impacts can be seen as part of an effort to carry out the mandate in protecting the earth

Third, WTE technology supports the transition to a circular economy, where waste is not only viewed as waste but as a resource with economic value (Erwinsyah, 2021). In Islam, this concept can be linked to the principle of istishlah, which emphasizes that everything that brings benefits to society is allowed and supported by sharia. In a study conducted by Yilmaz (2024), Islamic economics has a different perspective than capitalist economics in understanding waste. If in the capitalist system waste is often considered a worthless by-product, in Islamic economics, waste can be categorized as a resource that must be optimized for the benefit of the people (Yilmaz, 2024). However, the implementation of WTE also faces several challenges, especially in the aspects of regulation, investment, and public acceptance. One of the main obstacles is the lack of awareness and education on the importance of sustainability-based waste management.

These days, a lot of communities have not advanced from the ancient style of waste disposal where refuse is dumped at designated points without any further treatment. Hence, there is a need to have an active role played by religious scholars and institutions to enlighten the people about the environmental issues in Islamic perspective and where it comes to using technology in an environmentally cohesive manner. Moreover, both the support of government and Islamic financial institutions are also supposed to be vital considerations for the development of WTE technology. Innovative mechanization like green sukuk or energy waqf can be an alternative in supporting investments in sustainable energy that fund Shariah-based financing schemes. As per the study of Jan and Marimuthu (2019), sustainable practices in the Islamic financial system hold a great promise and potential in improving the economic and social performance when they are very well managed (Jan et al., 2019).

Therefore, the collaboration between the Islamic financial sector, government, and academic institutions would be very much appropriate to fast track the adoption of such technology in Muslim countries. In conclusion, the necessity for implementing Waste to Energy in the context of sustainability in Islam is determined by three main aspects: environmental protection, efficiency in resource utilization, and community welfare. Such is the claim since, under such a reality, Islam states that it is human kind's responsibility to preserve nature as part of being its khalifah on earth; thus WTE can be one of the solutions in realizing this principle. Reducing waste and greenhouse gas emissions, as well as promoting a circular economy, WTE can be a part of the grand strategy for achieving a cleaner and more sustainable energy system. Therefore, there is a need for collective efforts by all segments of society along with the government, scholars, academicians, and the private sector to bring this innovation to sustainability for future generations.

Fatwas and Scholars' Views on Modern Waste Management

It not simply refers to the cleaning up physically, but also goes ahead to show the responsibility of mankind as khalifah on earth. Waste poorly managed is very contaminative, leads to disease, and destructs the ecological balance that Allah has created (Budiman & Objantoro, 2022). Therefore various fatwa institutions and scholars gave the view of waste management according to Islamic perspective including the implementation of Waste-to-Energy (WTE) technology to part of sustainable intervention. Fatwas on waste management by Muslim countries, including Indonesia, Egypt, Malaysia, and Saudi Arabia have now been further developed. In its fatwa, the Indonesian Ulema Council (MUI) explains the importance of keeping cleanness of the environment as part of Islamic teachings that every Muslim must

conduct. MUI highlights, littering is against Islam, and one may categorize it as oppression against environment and society (Mangunjaya & Praharawati, 2019). Further, for MUI, innovation in waste management, including application Waste-to-Energy, is encouraged as long as it will not cause more adverse impacts on environment and society (Badgett et al., 2019).

In Egypt, Al-Azhar scholars have stated that waste management is a collective responsibility that must be carried out by the government and society. They asserted that Islam teaches the concept of mizan (balance) in resource utilization, and any human action that causes imbalance, such as environmental pollution due to unmanaged waste, is against the teachings of Islam (Abdallah et al., 2019). Therefore, Al-Azhar supports the application of WTE technology as long as the process does no harm to human beings and nature. Meanwhile, in Malaysia, the National Fatwa Council has issued a view that modern waste management should take into consideration the aspects of sustainability and public benefit. The approaches such as Waste-to-Energy are viewed as a kind of solution which meets Islamic commandments in reducing the adverse effect of waste on environment. The National Fatwa Council emphasizes that innovativeness on waste management must be guided by sharia principles that bestow more harms than benefits.

Hence, in Saudi Arabia, a discussion on responsible waste management in holy cities such as Mecca and Medina, which experience increased waste during the Hajj and Umrah seasons, has also commenced among scholars, suggesting the use of eco-friendly technologies in waste management, including the conversion of organic waste into energy via anaerobic fermentation methods (Hadidi et al., 2020). This adheres to the Islamic principle that encourages the efficient utilization of resources while minimizing wastage (israf). Overall, fatwas and views of scholarly opinions on modern waste management stress that every Muslim must keep the environment clean and sustainable. Waste-to-Energy is one of the technologies that can prove useful in this regard.

In Malaysia, the National Fatwa Council has also emphasized that modern waste management should consider the aspects of sustainability and public benefit. Studies by. Underlining that using Waste-to-Energy technology can help achieve sustainability in waste and energy management, while adhering to the Sharia principle, which is not to cause greater harm than benefit (Aldhafeeri & Alhazmi, 2022). Thus, fatwas and the views of scholars from various Muslim countries further emphasize that responsible waste management is part of Islamic teachings. The implementation of Waste-to-Energy technology can be a solution that

Islam supports as long as it still pays attention to ecological balance and the principle of the benefit of the people.

Waste-to-Energy as an Implementation of Maqasid Shariah Principles

Maqasid Shariah is the main objective of sharia which includes the protection of five fundamental aspects: religion (hifz al-din), soul (hifz al-nafs), intellect (hifz al-aql), offspring (hifz al-nasl), and property (hifz al-mal). Waste-to-Energy technology can be seen as an implementation of Maqasid Shariah because it supports environmental sustainability and human welfare (Ashari, 2023). First, hifz al-din or protecting religion, emphasizing that Islam teaches its people to maintain cleanliness and the environment. In QS. Al-Baqarah [2]:222, Allah says: “Verily, Allah loves those who repent and loves those who purify themselves.” This verse underlines that maintaining cleanliness is part of faith. By applying Waste-to-Energy technology, Muslims can be more responsible in managing waste and keeping the environment clean, which is part of Islamic teachings.

Hifz al-nafs or the protection of human life comes next; poorly managed waste would pollute the environment and consequently increase the chances for diseases. Waste-to-Energy means this technology would help reduce waste and greenhouse gas emissions that may harm human health. According to the study carried out by Atstāja et al. (2024), waste reduction via WTE technology would reduce air pollution, and improve the quality of life for people (Atstāja et al., 2024). Although hifz al-aql means protecting human health, the first principle is nonetheless hifz al-din or protecting religion, which insinuates cleanliness and environmental care as taught by Islam. Thus, Allah states in QS. Al-Baqarah [2]:222, "Verily, Allah loves those who repent and loves those who purify themselves." This verse tells that one of the tenets of belief is taking care of cleanliness. In support of our environment, Waste-to-Energy technology may help Muslims manage waste and create a clean environment, two important aspects taught by Islam. Al-Baqarah [2]:222): "Verily, Allah loves those who repent and loves those who purify themselves." This verse emphasizes that one of the fundamental tenets of faith is to maintain cleanliness. Thus, by helping with Waste-to-Energy technology, Muslims would be able to contribute to the cleaner management of waste and the cleaner habitat, which are two very important aspects taught in Islam.

The second is hifz al-nafs or protecting the soul and this clenches the case of protection of human life. Poor management of waste leads to environmental pollution and a greater risk for disease. In this case, the application of the Waste-to-Energy technology will help in the reduction of waste and greenhouse gas emissions, which are detrimental to human health.

According to Atstāja et al. (2024), waste reduction through WTE technology will improve air quality and increase the quality of life of the community in general (Satyakti, 2023). Thirdly, hifz al-aql or protecting human health. The study by Satyakti carries out an additional striking revelation: that the application of Maqasid Shariah principles, hifz al-nafs, hifz al-nasl, and hifz al-mal, contributes toward the advancement of sustainability in the Islamic economic system. The present study confirms that Islamic sustainability principles in the context of Waste-to-Energy (WTE) technology would act as a pillar of innovation in economic and environmental systems. Besides, research by Muhamad et al. (2020) affirmed that Islam greatly advocates environmental sustainability by the teachings of Maqasid Shariah, which balances between human beings and nature. This study puts forth how Islam establishes the concept of collective responsibility to protect the environment as part of the greater mandate of man as the khalifah on earth. WTE technology provides an avenue for Muslims to mitigate the ill effects of environmental pollution and thereby enhance the sustainability of the energy system for generations to come.

In their research (Güney, 2024), the authors from an Islamic economic perspective discuss the applications of the principle of hifz al-mal in efficient resource management. WTE technology diminishes waste, while at the same time generating its value in terms of reusable energy. This facilitates the Muslim countries in reducing their dependence on fossil fuels and improving economic efficiency in the utilization of natural resources.

Integrating Islamic Environmental Ethics with Waste-to-Energy Innovation

Islam has strong principles in environmental and waste management. The concept of cleanliness and sustainability in Islam is not just a recommendation, but part of the spiritual obligations that Muslims must carry out. The Qur'an emphasizes that humans are caliphs on earth who have the responsibility to maintain and not damage the balance of the ecosystem. In QS. Al-A'raf [7]:31, Allah says: “Eat and drink, but do not overdo it. Verily, Allah dislikes those who exaggerate.”. This verse emphasizes that any form of wastefulness, including in waste management, is against Islamic values. Therefore, Islam guides its followers to adopt an efficient waste management system, one of which is through Waste-to-Energy (WTE) innovation. Islam prohibits israf (extravagance) and fasad (environmental damage) behavior, which is the basis for the application of the circular economy concept in Islam. As explained in the research of Gulzar et al. (2021), uncontrolled resource exploitation and wastefulness are a form of violation of the ecological balance established by Allah (Gulzar et al., 2021). In the

context of waste management, innovations such as WTE can help Muslims carry out this responsibility more effectively

1. The Concept of Zero Waste in Islam: Reducing, Recycling, and Utilizing Waste

Islam teaches the principle of zero waste, which focuses on reducing waste production, recycling and reusing waste. This concept is in line with Islamic teachings that emphasize efficiency in resource utilization. In QS. Ar-Rum [30]:41, Allah says: "There is corruption on land and in the sea because of the deeds of men, that Allah may taste to them some of the consequences of their deeds, that they may return (to the right path)." Hadiths of the Prophet (SAW) also emphasize the importance of waste management. The Prophet said: "Cleanliness is part of faith." (HR. Muslim). Islamic history shows that since the time of Prophet Muhammad SAW, waste management practices have been implemented, such as organic waste treatment for agriculture and sanitation policies in early Islamic cities. Majorly, Waste-to-Energy is the implementation of this concept of converting waste into energy so that the evils of that waste can be neutralized to some extent under the environmental impact issue. The study of Rohmatulloh et al. (2023) enlightens on the way Islamic values will be combined with sustainable energy education in the Islamic boarding schools since Islam has already taught sustainability principles long ago (Rohmatulloh et al., 2023).

2. Insights from Islamic History on Waste Management and Urban Hygiene

Such systems are also recorded in Islamic history in regard to the world's greatest cities like Baghdad, Cairo, and Cordoba. The drainage and sanitation systems during the Abbasid Caliphate era already existed and demonstrated the Muslims' awareness of environmental hygiene. The same practice is that of the effective waste management strategy that is Islamic - clean faith. Besides, Islamic civilization has also exercised recycling practices since time immemorial. Al-Kindi and Al-Razi, for example, researched the means by which organic or inorganic materials may be reused in order to reduce waste. It is similar to the modern Waste-to-Energy system: waste translates into energy and benefits society.

3. Harmonizing Technology with Islamic Principles

In view of the modern environmental challenges, WTE technology can be an answer in harmony with Islamic principles. Nevertheless, the application of this technology must be implemented following ethical considerations concerning the balance between technological innovation and environmental sustainability. This study by Fetanat et al. (2019) suggested that in choosing WTE technology, the consideration of energy justice, social welfare, and ecological

impacts should maximize social welfare on the basis of energy justice and ecological considerations. Islam, therefore, teaches the importance of maintaining balance (mizan).

4. Using Waste-to-Energy Technology with an Ethical Approach according to Qur'anic Principles

The above factors indicate the application of WTE technology in the Islamic context on sharia grounds. This is according to what Islam teaches regarding istishlah (public good), where policies should be for the benefit of the larger community. The application of WTE technology fully satisfies this because it promotes environmental pollution reduction, energy efficiency enhancement, and economic solutions to waste management. Also, Waste-to-Energy is in accordance with the concept of hifz al-mal (meaning safeguarding wealth) within Maqasid Shariah which underscores making efficient usage of economic resources. This study by Atstāja et al. (2024) indicates that the WTE technology can support in developing cleaner, more sustainable energy systems consistent with the rule of Islamic teachings related to the environment (Atstāja et al., 2024) However, it must also consider the tenets of social justice and environmental welfare under such a premise. Islam generalizes the balance between innovation and ecological impact within the study of Phillips (2024) where the implementation of waste-based energy in developing countries must consider social and political aspects for the acceptance of human beings within the society (Phillips, 2024).

Seething application of WTE technology within the Islamic environment would demand: sharia values, as God has delivered the principles of istishlah (public good) which enjoin that a policy be for wider communities. The source is stating that this policy shall be fulfilled in WTE technology as environmental pollution would decline, energy efficiency would increase, and it would also give an economical solution to waste management. In addition, Waste-to-Energy is relevant to the concept of hifz al-mal in Maqasid Shariah that accentuates efficient use of resources of economics. According to Atstāja et al., 2024, WTE technology creates a cleaner and more sustainable energy system in accordance with the Islamic view of responsibility towards the environment (Atstāja et al., 2024). Nevertheless, they must always keep in mind the perspectives of social justice and environmental welfare. Islam emphasizes equilibrium between the innovation and the ecological impact as seen in Phillips' (2024) study, which elaborates on how it is necessary for the implementation of waste-based energy in developing countries to consider social and political aspects in order to satisfy acceptance by the wider community (Phillips, 2024).

KESIMPULAN

Here, the research affirms that Islamic environmental ethics derive great moral and spiritual support to Waste-to-Energy (WTE) technological innovation as a sustainable pathway in waste management. The guiding principles of khalifah (stewardship), mizan (balance), and israf (prohibition of waste) compel Muslims to keep ecological balance and to use the resources wisely. Weaving energy out of waste does, however, not only apply the concept of maqasid shariah (the main objective in Shari'ah), which includes environmental protection and public welfare, but also offers a modern solution to the waste crisis and energy needs.

The application of WTE technology in Muslim countries indicates that there is great potential in the Islamic aspect of waste management; however, it still faces challenges regarding the absence of sharia-law on running construction codes, technological limitations, and lack of public awareness. Therefore, political support, intently Islamic value education, and involvement of the scholars and stakeholders towards the integration of Islamic principles in environmental sustainability are needed. This research recommends a collaborative effort involving the government, academia, industry, and religious institutions to develop waste management policies and practices in congruence with Islamic teachings.

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