THE UK WASTE CRISIS

A GENZ perspective

350PPM

Capitalist Solutions to Climate Change

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Document created on 10/07/2024.

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Whitechapel, London

The Crisis

The waste crisis in the United Kingdom is escalating, with landfills emitting foul odours and toxic emissions from waste incineration polluting the air. Illegal dumping, with over one million incidents reported in 2023 alone, is cluttering streets and homes. Inadequate disposal practices contribute to pollution, health risks, and climate change, potentially costing USD 640.3 billion globally by 2050. The situation is dire, with the environmental and health impacts of waste mismanagement becoming increasingly unmanageable. Robust policies and sustainable practices are urgently needed to address these issues and protect our generation and generations to come. Immediate action is critical to mitigate these escalating threats and ensure a sustainable future.

"We are playing Russian roulette with features of the planet's atmosphere that will profoundly impact generations to come. How long are we willing to gamble?"

- David Suzuki

An Introduction to Waste

Waste is a byproduct of human activities, encompassing a wide range of materials discarded by households, industries, and businesses. As both global and UK populations increase, the rate and types of waste generated also rise. Municipal solid waste (MSW) includes everyday items such as food scraps, packaging, and household items, while industrial waste consists of chemicals, metals, and byproducts from manufacturing processes. Hazardous waste, which poses significant health and environmental risks, contains toxic, chemical, medical, and radioactive materials. Electronic waste, for example discarded electronic devices like computers and smartphones, comprises of valuable metals and hazardous substances. Construction and demolition waste comes from building activities and includes concrete, wood, and metals, whereas organic waste, such as food waste and garden waste, is biodegradable and can be composted or used for energy production. This diversity of waste poses an obstacle in of itself regarding its management.

Effective waste management is crucial to reducing environmental impact, conserving resources, and protecting public health. Proper waste management practices, such as recycling and safe disposal, prevent pollution, preserve resources, and slow climate change. Recycling and reusing materials reduce the need for new resources, saving energy and lowering environmental footprints. Waste management also creates jobs in recycling, composting, and waste treatment industries and can reduce costs for businesses and municipalities. Moreover, compliance with waste management regulations ensures adherence to environmental standards, contributing to overall sustainability. As waste generation continues to grow, adopting sustainable waste management practices is essential to addressing these challenges and ensuring a green future.

- In 2018, the UK generated **222.2 million tonnes of waste**, equating to 3 tonnes per capita.
- Waste generation is projected **to grow by 13% by 2050.**
- Global waste is expected to increase by 70% to 3.8 billion tonnes by 2050.
- In 2021, UK households generated 27.6 million tonnes of waste, a 2.3% increase from the previous year.

Figure 1 – General Waste Statistics

Waste Generation by Source

Waste generation in the UK varies significantly by source, with construction, demolition, and excavation activities contributing the largest share. In 2020, these sectors generated 59.1 million tonnes of waste, accounting for 62% of the total. Commercial and industrial operations produced 28 million tonnes, representing 19% of the total, with industrial operations alone contributing 12.4 million tonnes. Household waste accounted for 12% of the total, with a recycling rate of 44.6%.

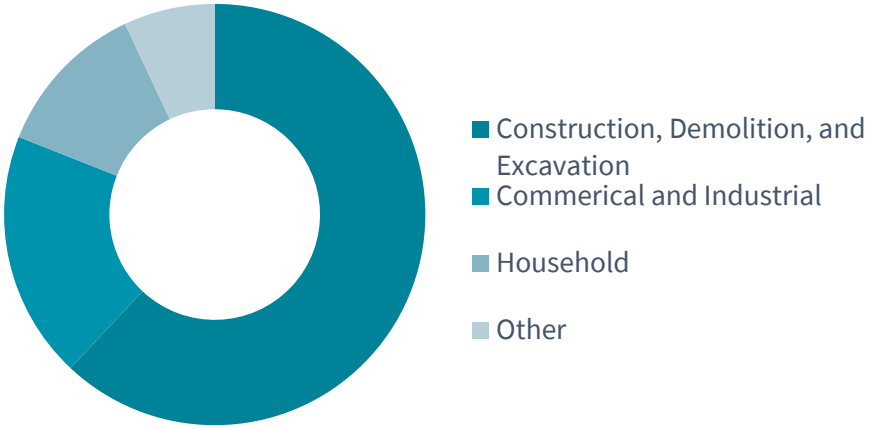

Figure 2 – United Kingdom waste generation by source (2020).

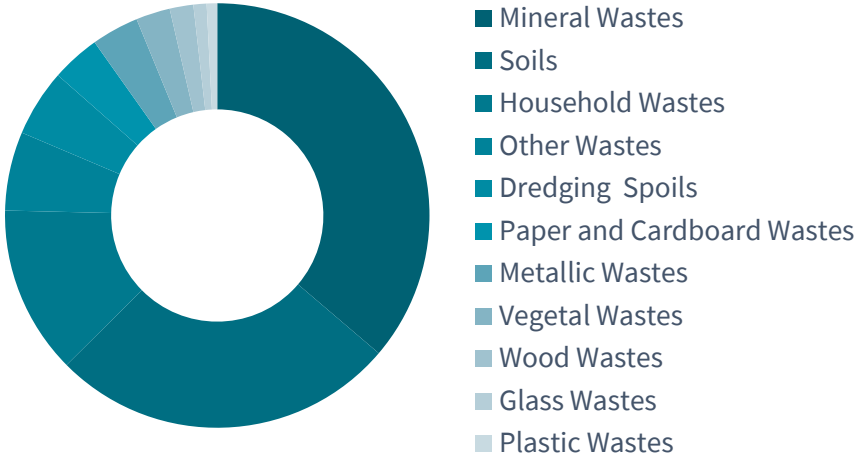

Figure 3 – United Kingdom Waste Generation by Material (2020)

Waste Generation by Material

Waste generation can also be categorised by material type, with significant implications for recycling and waste management strategies. Mineral wastes, primarily from construction and demolition, accounted for 36.2% of the UK's total waste in 2020. This category includes materials recycled and used in the aggregate market, representing 28% of the total aggregate market share. Soils made up 26.3% of the waste, often generated from construction and landscaping activities. Household waste, arising from daily domestic activities, and dredging spoils from waterway maintenance, further contribute to the overall waste generation. Understanding these material-specific categories helps in developing targeted waste management practices to enhance resource recovery efforts.

Existing Waste Management

The UK's existing waste management system employs various methods to handle their waste. **Figure 3** shows the distribution of these methods, including recycling, landfill, incineration with and without energy recovery, backfilling, and land treatment. Landfill and incineration are currently the main methods in place to manage solid waste. This is not sustainable practice and does not indicate movement towards a circular economy.

In contrast, Scandinavian countries have some of the lowest landfill rates in Europe, often less than 1% of total waste. This success is driven by stringent waste management policies, high recycling rates, and innovative approaches to waste treatment, policies and attitudes that must be adopted by the UK's government.

Waste management by method (million tonnes)

Method	2016	2018	Change
Recycling and other recovery	92.4	95.6	4.4%
Landfill	44.7	44.1	-1.4%
Incineration with energy recovery (R1)	6.2	7.4	18.5%
Incineration (excl. R1)	5.4	7.0	28.8%
Backfilling	13.3	11.1	-16.6%
Land Treatment and release into water bodies	17.9	16.8	-6.0%
Total	**179.9**	**182.8**	**1.6%**

Figure 4 –Current Waste Management by Process

Recycling

A recent study by Greenpeace and Everyday Plastic revealed that UK households dispose of 1.7 billion pieces of plastic waste weekly, making the UK one of the highest per capita producers of plastic waste globally, second only to the US. Alarmingly, only 17% of this plastic waste is recycled, while 58% is incinerated. This highlights the urgent need for improved recycling infrastructure and policies to reduce reliance on incineration and landfilling.

Landfill

The current landfilling system in the UK is deeply flawed, plagued by criminal activities and insufficient government regulation. Landfilling manages 24.12% of waste, but the system's inefficiency is highlighted by significant financial losses due to tax fraud and illegal waste disposal, despite increasing landfill tax rates to a standard rate of £98.60 per tonne as of April 2022 to incentivise recycling.

Social and Environmental Costs

Landfills have significant social and environmental costs that must be managed effectively to mitigate their negative impacts. Produced during the anaerobic decomposition of organic matter, landfill gas contains a split combination of CH_4 and CO_2, both of which contribute to greenhouse gas emissions. Leachates, formed by precipitation percolating through waste, contain nutrients, volatile organic compounds, heavy metals, and toxic organics. Landfill fires are common and environmentally harmful, emitting toxic gases and particulates. Risk factors for landfill fires include the type of waste and geographical location, impacting human health, particularly among vulnerable populations.

Incineration

The incineration system in the UK, like landfilling, is defective and presents significant challenges. Incineration manages 7.88% of the waste, with the process releasing substantial amounts of CO_2 and other pollutants. Despite being used as a method to reduce landfill dependency, incineration often fails to address the environmental and health impacts effectively.

Social and Environmental Costs

Incineration releases harmful chemicals and pollutants, including dioxins, mercury, lead, and particulate matter, which pose serious health risks. The UK's 55 incinerators released a combined total of around 14 million tonnes of CO_2 in 2020, with 6.4 million tonnes from fossil sources such as plastic. This resulted in an unpaid societal cost of over £1.5 billion based on the UK Government's central abatement cost. Air pollution from incineration contributes to respiratory problems, cardiovascular diseases, and other adverse health impacts.

Incineration does not eliminate the need for landfills, as ash residues still requires disposal, and discourages recycling and waste reduction, undermining sustainable waste management efforts. A Greenpeace investigation found that 79% of the UK's waste incinerators are in areas with above-average levels of deprivation. This places a disproportionate environmental burden on low-income communities, exposing them to higher pollution levels.

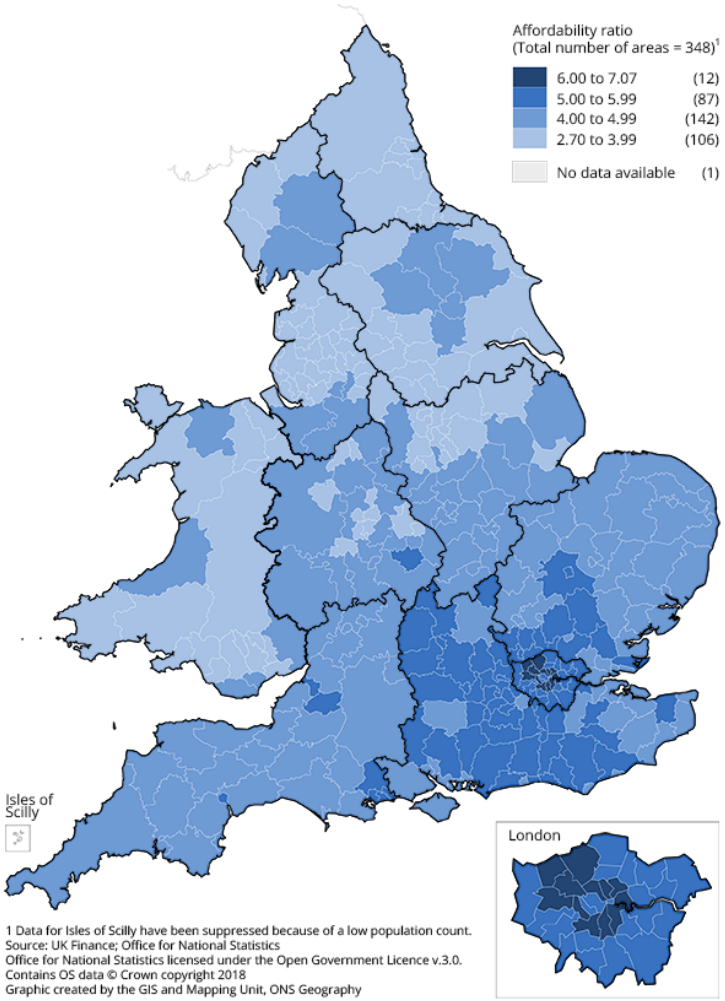

Figure 7 –First-time buyer purchase affordability ratios from UK Finance, by local authority (source)

The effect on emerging generations

The flawed systems of both landfilling and incineration in the UK disproportionately affect Gen Z. Rising living costs push young adults further from city centres, as depicted in **figures 6/7**, placing them closer to landfill and incineration sites where they face significant environmental and health risks, and decreased living conditions. This generation endures substantial financial pressures, with 57% of young adults aged 22-24 are financially insecure, with many young renters and those in full-time work being particularly vulnerable. Financial insecurity hinders further education and career advancement, while environmental degradation from poor waste management practices jeopardizes their future health and well-being. The overarching environmental and social effects of inadequate waste management will impact Gem Z and future generations as climate change intensifies and waste accumulates.

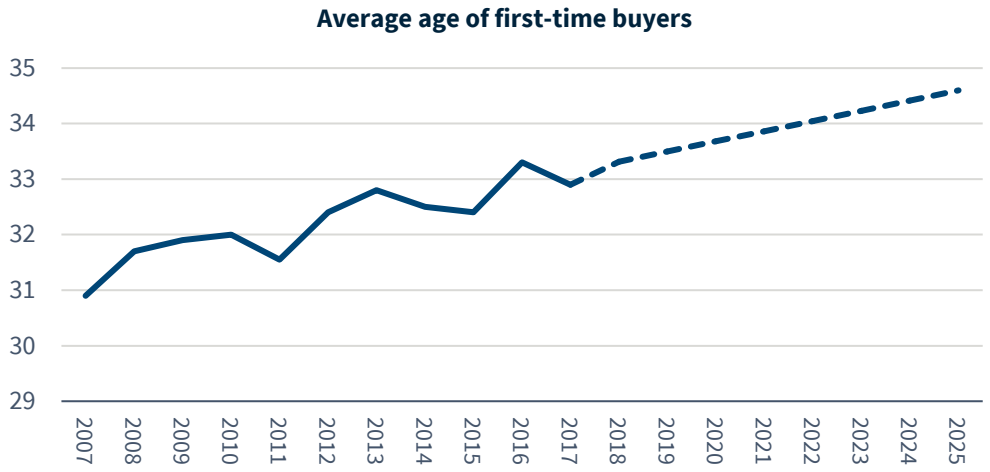

Figure 6 –Rising age of first-time home buyers UK

The Problem

The previous assessment of the UK's existing waste management system reveals the necessity for a technological overhaul and systemic transformation. The EfW sector holds immense potential, and the required technologies to implement a circular economy are available. The question arises: **why not harness them?**

The United Kingdom is often described to embody "one of the most extreme forms of capitalism in the world" (BBC, 2019). Therefore, the only viable path to nationwide environmental reform is through financial incentives. Currently, waste management conglomerates have substantial financial interests in maintaining the status quo.

Why Change?

Biffa and Veolia, two leading waste management firms in the UK, lack sufficient financial incentives to transition towards environmentally sustainable technologies. Biffa, with revenues of £1.68 billion and significant investments in existing waste management infrastructure, is already highly profitable. Their substantial financial commitments to current technologies imply that adopting new, unproven technologies could disrupt their revenue streams and involve considerable risk without guaranteed returns. The high costs of transitioning to new waste management technologies, coupled with current regulatory and market frameworks, reduce the urgency for radical technological changes.

These companies benefit from economies of scale and established customer bases, making the financial risk of transitioning to new technologies a significant deterrent. The current regulatory environment and market demand do not necessitate drastic changes, allowing Biffa and Veolia to maintain their profitability with existing operations.

Without compelling financial incentives, the status quo prevails, stifling innovation and progress in waste management technologies. Environmental reform is hindered by economic structures prioritizing immediate profit over long-term sustainability.

Unsuccessful Firms

Revolutionary technologies face significant capital costs, and many UK contractors underestimate the complexity of EfW projects, treating them like conventional construction schemes. This miscalculation leads to delays, cost overruns, and technical failures, as evidenced by the Tees Valley Gasification Projects by Air Products. These projects aimed to convert 700,000 tonnes of non-recyclable waste annually into syngas, generating electricity for 100,000 homes. However, design and

operational challenges resulted in a nearly $1 billion write-off and abandonment of the projects. EfW plants must meet strict EU emission control limits, adding complexity and risk. The varied composition of waste feedstocks posed additional technical challenges, necessitating costly post-construction modifications and further delays.

These failures underscore the significant risks and complexities of EfW technologies, indicating the need for a supportive environment to implement innovative waste management solutions effectively. The environment necessary for these technologies to flourish **must be cultivated by the government.**

Government Support

The UK government's waste plans aim to develop EfW plants and introduce extended producer responsibility schemes but lack the necessary financial mechanisms for high initial investments. As discussed, companies like Biffa and Veolia dominate the industry, maintaining profitability without transitioning to sustainable technologies. Analysis of DEFRA's waste trajectories highlights the urgent need for action to prevent significant increases in waste generation and associated environmental impacts. For instance, under Trajectory A, waste generation could increase by 26% between 2007 and 2050, with only a slow decline in landfill use. Comparatively, Trajectory D shows a potential reduction in overall waste arisings by 33% in the same period, emphasising the importance of adopting strong environmental policies and practices.

To adhere to the UN's 12th Sustainable Development Goal for sustainable consumption and production, government support is essential. Effective waste management reduces environmental impact and conserves resources, achievable through substantial support such as subsidies, tax reliefs, and grants. These incentives lessen the economic burden on companies, encouraging investment in new technologies. Additionally, government-backed research and development can spur innovation and the adoption of sustainable practices.

The success of the UK's waste management transformation hinges on comprehensive government intervention. Addressing financial challenges with targeted support fosters an environment conducive to adopting advanced waste management technologies, ensuring the achievement of recycling and landfill reduction targets while aligning with global sustainability goals.

Figure 9 – Potential government support process

Leveraging Carbon Credits for Waste Management Technologies in the UK

Carbon credits have historically been used as a market-based mechanism to incentivise the reduction of greenhouse gas emissions. Each carbon credit represents the reduction or removal of one metric tonne of CO_2 or its equivalent. The Cap-and-Trade System, a prominent approach within this mechanism, allows governments or regulatory bodies to set a cap on the total amount of greenhouse gases that can be emitted. Companies are then allocated or can purchase a limited number of allowances (credits) that permit them to emit a specified amount of CO_2.

Despite its potential, the past use of carbon credits has faced several shortcomings. Significant systemic issues, particularly with forestry credits, have been highlighted, with studies showing that 90% of these credits did not result in actual emissions reductions. Additionally, the voluntary trade of carbon credits has been plagued by inconsistent standards, leading to doubts about the credits' efficacy in achieving real environmental benefits. Nevertheless, the carbon credit market has shown promise, with analysts predicting its market size could reach $250 billion by 2050. Structured initiatives like the Clean Development Mechanism, which issues 25 carbon credits for every tonne of CH_4 reduced, illustrate how a targeted approach can incentivise emissions reductions effectively.

To harness the potential of carbon credits for waste management technologies in the UK, several strategic improvements are necessary. Establishing a regulatory body for rigorous oversight of carbon credit markets is essential to ensure the credibility and environmental integrity of the credits. Aligning credit standards globally will prevent discrepancies and enhance trust in the system.

By focusing on suggested actions **(figure 10),** the UK government can effectively use carbon credits to drive investments in waste management technologies. This approach addresses the high capital costs and risks associated with new technologies, promoting their adoption and helping to achieve a circular economy.

Set Clear Standards and Oversight	Establish a robust regulatory framework to monitor and verify the authenticity and impact of carbon credits. This will ensure that credits represent real and additional emissions reductions.
Targeted Carbon Credits for Waste Management	Introduce carbon credits specifically for waste management technologies. By linking credits to measurable emissions reductions in waste management, the government can directly incentivise investment in innovative technologies that address the sector's challenges.
Financial Incentives Through Carbon Credits	Utilise carbon credits as a financial tool to reduce the economic burden on companies investing in new waste management technologies.
Promote Market Participation	Encourage widespread participation in the carbon credit market by making it accessible and appealing to waste management companies. Simplifying the process for earning and trading credits can boost involvement and investment in sustainable practices.

Figure 10 –Potential adoption of carbon credits system by UK government

Government Intervention through Investigation

An investigation and monitoring of the waste management sector in the UK are essential as criminal activities frequently undermine environmental efforts. The government must improve its supervision over the weighing of lorries and the management of waste. Financial incentives for the government include tax collection and fines from penalised firms and individuals. In 2021, the UK government raised £667 million from landfill tax receipts, a notable decrease from the peak of £1.2 billion in 2014.

Criminal activities within the waste sector have serious environmental and economic impacts. The Environment Agency reported that waste crime costs the UK economy approximately £600 million annually. In 2023, the Environment Agency brought forward 52 prosecutions for waste crimes, securing over £400,000 in fines, and inspected nearly 1,100 locations, closing 585 illegal waste sites. This highlights the scale of illegal activities such as fly-tipping, illegal waste exports, and the operation of unauthorized waste sites, which are often linked to organized crime networks.

These criminal activities not only result in financial losses but also contribute to environmental degradation and public health risks. Illegal dumping and mismanagement of waste can lead to pollution and contamination of water sources, impacting local communities and ecosystems. Despite ongoing efforts and coordinated operations with various agencies, the persistent issue of waste crime demonstrates the need for vigorous enforcement and stricter regulations to ensure compliance and protect the environment.

"The men were caught red-handed dumping large piles of rubbish on Packington Estate's Maxstoke Lane near Meriden. Locals used their cars to barricade the vans and called the police.

The incident, described by Warwickshire Police as "some of the worst fly-tipping we had seen in a long time," happened last Wednesday, 7th February. The men were detained and ordered to reload their vehicles with rubbish. Their vehicles were then seized under the Environmental Act. "
source

The Importance of Social Media in Pushing Government Change

Gen Z's extensive use of social media makes it an incredibly powerful tool for driving government change. This generation's online presence on platforms like YouTube, Instagram, and TikTok is not just for entertainment but is also a primary source of information and interaction. By leveraging these platforms, the UK government can effectively communicate the importance of innovative waste management technologies and the financial incentives being implemented. Social media campaigns can highlight success stories, provide transparent updates on policy developments, and engage young generations in environmental advocacy. The visual and interactive nature of these platforms aligns perfectly with Gen Z's preferences, making them more likely to engage with and support governmental initiatives. Furthermore, the authenticity and transparency that Gen Z values can be showcased through regular updates and real impacts of waste management projects.

Collaborating with influencers who resonate with this demographic can amplify the message and extend its reach. Interactive features like polls, Q&A sessions, and live streams can be used to gather feedback and involve young generations in the conversation, fostering a sense of ownership and responsibility towards environmental sustainability. Additionally, the public can use social media to put pressure on the government to enact these changes by creating viral campaigns that highlight the urgency and importance of sustainable waste management practices. By harnessing the power of social media, the government can not only increase awareness but also mobilise Gen Z to actively participate in shaping a sustainable future and be influenced by the public demand for environmental action.

85% of Gen Z say social media impacts their purchasing decisions.

77% of Gen Z prefer to shop from brands they follow on social media.

Over 80% of Gen Z individuals aged 15 to 26 use platforms like YouTube, Instagram, and TikTok monthly.

56% of Gen Z users use social media primarily for communication.

Gen Z uses an average of five social media networks daily.

Figure 11 –Key GENZ social media figures

EfW Technologies

The waste crisis necessitates the adoption of advanced waste management technologies to mitigate environmental impacts and promote sustainability. EfW technologies have emerged as a crucial component in modern waste management strategies, offering solutions that not only reduce the volume of waste but also convert it into valuable energy. UK EfW facilities currently generate 3.2% of the total power across the nation and emit 3.5% of net annual GHG emissions (2022). EfW technologies encompass various processes that transform waste materials into electricity, heat, or fuel, thereby contributing to the reduction of landfill use and the global reliance on fossil fuels. The implementation of these technologies is vital for achieving higher recycling rates, minimising greenhouse gas emissions, working towards a circular economy. As countries strive to meet stringent environmental regulations and sustainability goals, the integration of EfW technologies into waste management systems represents a significant step forward in addressing the global waste crisis. These innovations hold the potential to revolutionise how waste is managed, ensuring a cleaner and sustainable future.

Waste Sorting

Effective waste sorting is crucial for achieving efficient waste management, especially in the UK. Misclassification of waste types results in an estimated £120 million annual loss. Properly sorted waste ensures that recyclable materials are separated from non-recyclable ones, significantly reducing the volume of waste sent to landfills. This not only conserves resources but also reduces greenhouse gas emissions associated with waste decomposition. In the UK, where waste production is substantial, efficient sorting systems are essential to meet environmental targets and promote sustainability. Advanced sorting technologies can handle large volumes of waste with high accuracy, ensuring that valuable materials are recovered and reused, thus supporting movement towards a circular economy.

Grey Parrot

The Grey Parrot system is a cutting-edge solution in waste sorting technology, designed to address the inefficiencies and challenges of traditional waste management practices. This advanced system offers an impressive 98% effectiveness in accurately sorting waste materials, ensuring that almost all recyclable items are recovered. Unlike manual sorting, which covers only 1% of materials, the Grey Parrot system processes 99% of materials passed through it, vastly improving the efficiency and thoroughness of waste sorting operations.

In a UK-based Materials Recovery Facility (MRF), it was found that less than 7% of the materials sorted by the Grey Parrot system were non-recyclable. This high level of accuracy significantly reduces contamination in recyclable streams, thereby increasing the quality and market value of the recycled materials. The system also offers remarkable time and cost savings. For example, manual sampling of 30 PET bales requires 375 hours and costs £4,500. In stark contrast, the Grey Parrot system completes the same task in just 6 hours at a minimal cost of £17. This efficiency not only reduces labour costs but also accelerates the sorting process, allowing facilities to handle larger volumes of waste more quickly and economically.

Clients such as Veolia and SUEZ have adopted the Grey Parrot system, demonstrating its reliability and effectiveness in real-world applications. By integrating such advanced technology, these companies can enhance their waste management operations, achieve better sorting outcomes, and contribute to a more sustainable future.

Bubbling Fluidized Bed Gasification

Bubbling Fluidized Bed (BFB) technology is globally used for waste management, converting municipal solid waste (MSW), industrial waste, and biomass into syngas for electricity generation, heating, or chemical feedstock and minimizes tar and other impurities, offering higher energy efficiency than incineration.

BFB gasification requires significant initial capital investment for construction and technology implementation. Operations are complex, needing skilled personnel and continuous monitoring. Feedstock often requires pre-treatment, adding to cost and complexity, with variability in feedstock composition affecting efficiency and stability.

Environmental concerns include emissions and byproducts. BFB gasification can reduce certain emissions compared to incineration but still produces pollutants like tar, particulates, and harmful gases. The process generates byproducts such as ash and tar, necessitating proper disposal or further treatment.

Efficiency challenges involve energy conversion and heat loss. While generally efficient, BFB gasification's overall energy conversion efficiency can be lower compared to other technologies. Maintaining high temperatures can lead to significant heat loss. Technical issues like clinker formation and bed material degradation further complicate operations, requiring periodic replacement and adding to costs.

Economic viability is influenced by market fluctuations in energy and feedstock prices. BFB gasification faces competition from other EfW technologies like direct incineration, anaerobic digestion, and pyrolysis, which may be more cost-effective in certain scenarios.

Valmet (Finland)	Converts biomass and waste into syngas
EQTec (Ireland)	Provides technology for various waste streams.
Outotec (Finland)	Converts biomass, industrial waste, and MSW into syngas.

Figure 12 – Global Leading BFB firms

Plasma Gasification

Plasma gasification is an advanced waste treatment method that uses high-temperature plasma to convert waste into syngas and vitrified slag. This process involves shredding and homogenizing feedstock like municipal solid waste, hazardous waste, and biomass. Plasma torches generate a plasma arc up to 10,000°C to decompose waste in a reactor, breaking down organic materials into and inorganic materials into vitrified slag. The syngas is then cooled and cleaned to remove particulates, acid gases, and sulphur compounds, making it suitable for electricity generation, chemical production, or heating. The non-toxic slag can be used in construction, and metals can be recovered and recycled.

InEnTec

InEnTec is a pioneering company in EfW technology, utilising advanced plasma gasification to transform a wide range of waste materials into valuable chemical products and clean fuels. Their technology is designed to handle complex waste streams, including hazardous and medical waste, converting them into syngas, which can be further processed into ethanol, methanol, and hydrogen. InEnTec's process is highly efficient, producing minimal emissions and turning waste into high-value products, making it an excellent fit for the UK's sustainability goals.

- **High Energy Costs:** The substantial energy requirements for plasma gasification are particularly significant in the UK, where energy costs are high, potentially making the process less economically viable.
- **Technical Expertise Shortage:** There is a limited availability of highly skilled personnel in the UK to operate and maintain advanced plasma gasification systems, which can increase labour costs and operational risks.
- **Feedstock Supply Chain Issues:** The variability in the quality and consistency of feedstock in the UK can affect the efficiency of plasma gasification systems, requiring robust supply chain management and pre-treatment processes.
- **Regulatory Compliance for Emissions:** The stringent UK environmental regulations necessitate advanced and costly gas cleaning systems to manage emissions from plasma gasification, adding to operational expenses.
- **Capital Investment Challenges:** Securing the high capital investment needed for plasma gasification plants can be difficult in the UK, especially given the current economic climate and competition for funding in the renewable energy sector.

Figure 13 – Plasma gasification limitations

Anaerobic Digestion

Anaerobic digestion (AD) is a process where bacteria break down organic matter such as animal manure, wastewater biosolids, and food wastes in the absence of oxygen, producing biogas and digestate. Biogas, primarily composed of CH_4 and CO_2, can be used similarly to natural gas for heating, electricity generation, and cooling. Upgraded biogas (RNG) can be injected into natural gas grids, used as compressed vehicle fuel, or processed into alternative fuels and biochemicals. Digestate, the residual material from AD, is split into solid and liquid fractions, used for animal bedding, bio-based products, compost, and soil amendments, or as nutrient-rich fertilizer. Both biogas and digestate generate revenue or cost savings, enhancing the financial and environmental benefits of AD projects, supporting renewable energy production and agricultural sustainability. However, the effectiveness of AD is limited by the availability of feedstock, necessitating efficient waste collection systems and diverse organic waste sources.

Thames Water as Feedstock

The potential nationalisation of Thames Water is being considered by the UK government due to the company's severe financial difficulties, including a debt of over £13 billion. Thames Water, with appropriate investment and technology, could leverage its sewage resources for methane farming. This would involve capturing methane emissions from sewage treatment processes and utilising them as a feedstock for biogas production. By investing in AD technology, Thames Water could transform waste into a valuable energy resource, contributing to environmental goals and potentially generating significant financial returns. Nationalisation could ensure a stable and consistent supply of feedstock for AD, streamlining and optimising the collection and processing of sewage to support AD facilities, thus securing necessary organic waste for continuous biogas production and enhancing waste management practices.

Greenlane Biogas

Greenlane Biogas is a global leader in upgrading biogas to RNG. Their advanced technology efficiently converts raw biogas into high-purity RNG, meeting stringent standards for grid injection or vehicle fuel use. By deploying Greenlane's systems, the UK can reduce reliance on fossil fuels, provide a sustainable source of natural gas, and meet renewable energy targets while reducing greenhouse gas emissions. Greenlane's technology supports processing various organic waste streams, including food waste, agricultural residues, and municipal solid waste, alleviating pressure on UK landfills. Their scalable systems are suitable for large-scale municipal projects and smaller community-based initiatives. Greenlane Biogas has a strong market position due to its technological innovation and extensive experience, allowing the company to secure projects and expand its market reach.

Pyrolysis

Waste pyrolysis is a process that thermally decomposes organic materials, including plastics, in the absence of oxygen to produce pyrolysis oil, syngas, and char. The process involves heating the waste to high temperatures (typically between 400-800°C), which breaks down the long-chain polymers into smaller, volatile molecules. The volatile gases are condensed to form pyrolysis oil, while the remaining gases constitute syngas, which can be used for energy production. The solid residue, char, can be used for various applications, including as a soil amendment or for carbon sequestration. Pyrolysis is an effective method for converting plastic waste into valuable products, reducing the volume of waste destined for landfills, and contributing to circular economy initiatives.

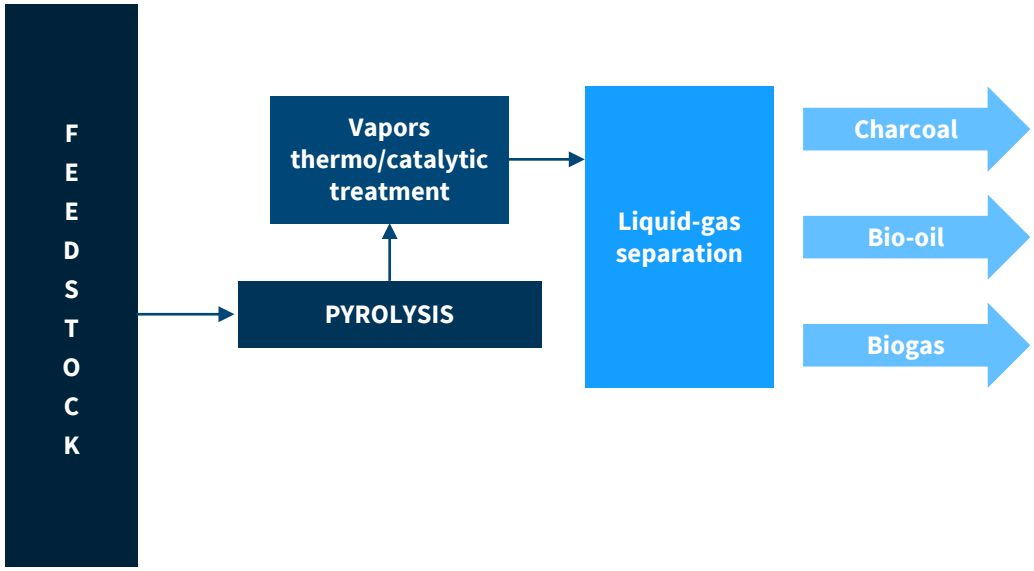

Figure 14 – Waste pyrolysis Process

- **High Capital and Operational Expenses:** The high initial setup costs and ongoing operational expenses for pyrolysis systems are a significant barrier in the UK, where funding for new technologies is competitive.
- **Inconsistent Waste Stream:** The variability and inconsistency of the UK's waste stream, particularly plastics, can impact the efficiency and quality of pyrolysis outputs, requiring stringent sorting and pre-treatment.
- **Energy Source Concerns:** The energy-intensive nature of pyrolysis is a limitation in the UK, where sourcing renewable energy to power these systems can be challenging and costly.
- **Infrastructure Integration:** Integrating pyrolysis systems into the existing UK waste management infrastructure is complex and may require significant modifications, which can be a logistical and financial hurdle.
- **Market Demand for Byproducts:** The economic viability of pyrolysis in the UK is heavily dependent on the fluctuating market demand for byproducts such as pyrolysis oil and char, which can affect profitability and investment returns.

Figure 15 – Limitations of waste pyrolysis implementation in the UK

Pyrolysis cont.

Plastic Energy

Plastic Energy is a pioneering company specialising in the conversion of plastic waste into usable fuels through advanced pyrolysis technology. Their process transforms end-of-life plastics into TACOIL, a valuable feedstock to produce new plastics or as a substitute for fossil fuels.

Plastic Energy's potential in the UK EfW sector is substantial. Their technology can be integrated into existing waste management infrastructure, providing a scalable solution for the country's plastic waste problem. By converting plastic waste into TACOIL, Plastic Energy helps create a closed-loop system, reducing the reliance on virgin fossil fuels and enhancing the sustainability of the plastics industry. Their established track record and successful operations in other regions position them well to contribute to the UK's circular economy and waste management goals.

Agilyx

Agilyx is another leader in the field of EfW technology, focusing on converting difficult-to-recycle plastics into valuable products using pyrolysis. Their technology efficiently transforms mixed and contaminated plastic waste into synthetic crude oil, which can be further refined into fuels and chemicals. Agilyx's systems can process a wide variety of plastic types, including those that are traditionally challenging to recycle.

Agilyx's potential in the UK lies in its ability to handle diverse and complex plastic waste streams. By converting these wastes into synthetic crude oil, Agilyx provides a sustainable alternative to landfill disposal and incineration, supporting the UK's efforts to manage plastic waste more effectively. Their innovative approach and proven technology make them a strong candidate for integration into the UK's EfW sector, contributing to both waste reduction and energy production.

Carbonization

Waste carbonization, an extreme form of pyrolysis, is a process that thermally decomposes organic materials in the absence of oxygen to produce bio-oil, syngas, and biochar.

GreenMine

GreenMine is a leading company in waste carbonization, utilising advanced pyrolysis technology to convert various types of waste into valuable products such as bio-oil, syngas, and biochar. Their technology efficiently processes organic waste, reducing landfill use and producing renewable energy and soil-enhancing biochar. By implementing GreenMine's systems, the UK can address its waste management challenges while contributing to renewable energy targets and soil health improvement.

GreenMine's technology is particularly suited to the UK's EfW sector. The scalable nature of their pyrolysis systems allows integration into both large-scale municipal waste management facilities and smaller, community-based projects. This flexibility makes it possible to process a wide range of waste types, including agricultural residues, food waste, and municipal solid waste, providing a sustainable solution to the UK's diverse waste streams.

Jet Fuel from Landfill Methane

Researchers at the University of Sydney have developed a method to convert methane emissions from landfills into sustainable jet fuel using advanced plasma chemistry. This process involves capturing methane, a potent greenhouse gas, and transforming it into a high-value, renewable energy source. This innovation could significantly impact the UK's waste management sector by reducing methane emissions and providing an alternative to fossil fuels. By integrating this technology, the UK can tackle both its waste crisis and aviation industry's carbon footprint, promoting environmental sustainability and energy efficiency.

Figure 15 – University of Sydney's jet fuel production technology

Final Comments

The findings in this report highlight the significant challenges and opportunities within the UK's waste management sector, particularly focusing on the impacts and engagement of Gen Z. The adoption of advanced waste management technologies, such as EfW solutions, is crucial in addressing the escalating waste crisis. However, the transition to these technologies requires substantial financial investments and strong government support. Historical shortcomings of market-based mechanisms like carbon credits demonstrate the need for a more structured and reliable approach to incentivising sustainable practices.

Gen Z, with their strong presence on social media and deep concern for environmental issues, play a pivotal role in driving change. Leveraging social media to engage and mobilise Gen Z can create a powerful force for driving governmental action and accountability. This generation's preference for transparency and authenticity can be harnessed to promote sustainable waste management practices and hold the government and industries accountable.

The report advocates for comprehensive government policies that include financial incentives, regulatory standards, and support for research and development. By implementing these strategies, the UK can not only mitigate the immediate impacts of the waste crisis but also pave the way for a sustainable and environmentally responsible future. The collaborative efforts of the government, industry stakeholders, and the public, especially Gen Z, are essential to achieving these goals and ensuring a healthier, cleaner environment for all.

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