Breaking Down Waste: A Comparative Analysis of Laws Regarding Separation of Waste at Source in Malaysia, Japan, and Australia

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ABSTRACT

Separation of waste at source is one of the crucial methods in boosting recycling rate and reducing the amount of waste which end up at the landfills. As at 2022, Malaysia already has 165 landfills, eight sanitary landfills, and three inert landfills hence the local environmental experts have forecasted that no space will be available by 2050 if nothing is done to reduce waste. This comparative study examines the legal and practical aspects of waste separation at source in Malaysia, Japan, and Australia. The findings showed that Japan practices advanced waste management laws and technologies, such as incineration to cater to its limited land space as well as a strict separation of waste at source regulations. Australia's robust system emphasizes waste minimization and recycling through comprehensive legislation and public collaboration. Malaysia, still developing its infrastructure, can learn from these countries to enhance its waste management practices. Key findings include Japan's detailed waste categories and Australia's focus on organic waste composting. Malaysia can benefit from adopting stricter legislation, clear division of responsibilities, and public awareness initiatives to improve its waste management system and align with the United Nations Sustainable Development Goals.

Keywords*:* separation of waste, recycling, minimising waste, sustainable solid waste management practices, waste management

INTRODUCTION

The world generates 2.01 billion tonnes of municipal solid waste annually, with at least 33 percent of it not managed in an environmentally safe manner. Waste generated per person per day averages 0.74 kilograms but ranges widely among countries, from 0.11 to 4.54 kilograms (World Bank, 2018). It is a global issue with huge environmental impact as it pollutes the air, contaminates the water, endangers public health, and hastens climate change (International Finance Corporation, 2024). Its importance is proven when sustainable cities and communities as well as responsible consumption and production are two out of seventeen's goals of United Nations Sustainable Development Goal (SDG), a "shared blueprint for peace and prosperity for people and the planet, now and in the future". Target 11.6 of SDG's 11th goal explicitly calls for a reduction in the adverse environmental impact of cities, which includes paying attention to municipal and other waste management. Adding to that, Target 12.1, 12.3, 12.4, 12.5, and 12.8 of SDG's 12th goal aim to reduce waste generation through policies and public behaviour change campaigns that promote sustainable consumption and production as well as improved waste segregation practices (UN Towards Zero Waste, 2023).

It is undeniable that solid waste management is a critical issue for many countries, including Malaysia. According to Solid Waste Management and Public Cleansing Corporation (SWCorp), Malaysia disposes of more than 39,078 tons of municipal solid waste daily, equivalent to about 1.17kg per person. 30% of them are food waste, followed by plastic (21.9%), paper (15.3%), disposable diapers (8.2%) and hazardous household waste (4.2%) (The Star, 2 January 2024).

Landfilling is the most popular method of disposing of solid waste in Malaysia. As at 2022, Malaysia has 165 landfills, 8 sanitary landfills, and 3 inert landfills (New Straits Times, 19 July 2022). While sanitary landfills have pits which are protected from leakage, most of the landfills are non-sanitary landfills which release methane gas and leachate into the air and soil without proper treatment (Greenpeace, 2024). This is one of the

reasons why separation of waste at source is important. The organic portion of household solid waste is the main source of pollution in a landfill (Fadhullah, *et. al*. 2022) and by separating the waste at source, it increases waste diversion and provides raw materials for recycling (Tang, *et al.,* 2023). Food waste which is the biggest component of domestic waste can also be composted and used as fertilisers (UN Towards Zero Waste, 2023).

The aim of this study is to compare the legal and practical aspects of household separation of waste at source as well as collection systems and recycling practices implemented by Malaysia, Japan and Australia. This study also aims to determine if there is any lesson that can be learned from both countries in making Malaysia's household waste separation at source efforts more efficient.

LITERATURE REVIEW

Waste management is an important aspect of sustainable development. Studies have been conducted in all three countries regarding various aspects of solid waste management and recycling practices. A study by Johari *et. al.* (2014) discussed the solid waste management in Malaysia and estimated the economic potentials of recyclables. It was concluded that since the greater part of solid waste is organic in nature, composting was a better option followed by the intensification of recycling for Malaysia in order to reduce the disposal of solid waste in the landfills. Fadhullah *et. al.* (2022) discussed the household's practices and perceptions on solid waste management among residents in the East Coast of Malaysia. Razali *et. al.* (2018) and Shakil *et. al.* (2023) also reviewed the solid waste management policies in Malaysia and concluded that the Malaysian government has implemented several measures to enhance solid waste management throughout the nation. However, the household in Malaysia is still far behind compared to other countries in engaging waste separation behaviour and recycling practice due to ignorance about the importance of waste minimization, recycling, and appropriate waste disposal techniques. Razi *et. al.* (2022)'s study revealed that lack of enforcement, facilities, awareness and incentives as some of the barriers for the public to participate in separation of waste at source.

Japan is well known as an environmentally advanced nation with a reliable system for waste management in the world (Mekonnen & Tokai, 2020). A study by Mekonnen & Tokai (2020) comprehensively discussed the history of municipal solid waste management and recycling systems in Japan which started from the early 20th century. Moshkal *et. al.* (2023) explored the impact of environmental awareness and education to solve solid waste management in Japan and found that as the Japanese culture encourages individuals, organizations, and communities to respect the environment, it increases the awareness of its people on the importance of conserving the environment. The study also highlighted the need for educational programs that can promote responsible behaviour in order to protect the environment through proper solid waste management practices. A study by Jakimiuk *et. al.* (2022) discussed the strict requirement by the Japan government when it comes to disposal of solid waste through landfills which resulted in extremely low disposal of waste rate in landfills compared to other developing and developed countries. Fujioka (2019) wrote an overview of waste management policies in Japan and examined the pro and cons of the special collection method compared to the self-declaration method.

Australia has a more established framework for waste management, where each state implements their own policies. In Australia, waste management is primarily governed by the National Waste Policy (National Waste Policy, n.d.), which provides a cohesive framework for responsible waste management, resource recovery and waste disposal (Abila & Kantola, 2019). It highlights the significance of waste separation, where both individual households and business are encouraged to uphold. The government has made several strides in managing waste in the country via implementation of laws, policies and several initiatives. Halving current food waste in Australia by 2030 is one of the government's goals in effective waste management (Bird et al., 2022), where legislation plays a vital role. The Australian government is of the opinion that waste need not be created in the first place, which could be recovered and reused (Bates, G. 2013). Waste management laws in Australia are primarily governed by State and Local Governments, with each state having its own legislative and administrative systems, often resulting in complex and overlapping regulations (Zhao et al., 2021).

In Australia, the largest components of the Construction and Demolition (C&D) waste stream include materials such as concrete, bricks, asphalt, soil, and timber, which are also the most commonly recycled materials. The National Waste Report 2022 shows that 75.8 million tons (Mt) of waste was generated in 2020-21, with Building & Demolition and Organics the largest waste categories by 25.2 Mt and 14.4 Mt respectively (National Waste Report 2022). To solve this issue, the Australian government has implemented different policies to avoid waste and encourage recycling (Du et al., 2023). Quite many policies and practices on solid waste management have been implemented at both local and national scale. Their approach reflects a strong adherence to international laws in both national legislation and international commitments (Bradford & Grice, 2022).

Due to technology and industry development, electronic waste (E-waste) has become a concern in Australia (Islam & Huda, 2020). The Australian government faces a new challenge to address this growing concern. Australia's National Television and Computer Recycling Scheme is limited to computers and televisions only, whereas other electronic waste is not properly addressed (Islam & Huda, 2020). Its current practice has a great effect on the economy, where subsidies and financial support from the government plays a vital role in making recycling among domestic households capable (Jayasiri et al., 2023). Currently, there is no ongoing deliberation on electronic waste regulation, and any potential national policy would probably be based on voluntary participation.

The State and Local Governments in New South Wales (NSW) are principally responsible for the legislation and administration of garbage disposal. This implies that these levels of government are in charge of creating and enforcing the rules and regulations regarding trash management. The concept of Sustainability Management System (SMS) is very relevant to handling landfills in New South Wales, which combines sustainability and environment protection into waste management (Mildren, 2013). Different states in Australia, like South Australia, Victoria and New South Wales have a different approach compared to metropolis states like Adelaide, Melbourne and Sydney (Du, Zuo, et al., 2023). Overall, the waste management policies in Australia have shifted to include more recycling practices and reduce the need of landfills. In Victoria state, they have their own set of laws specifically addressing recycling and landfills. A landfill levy was imposed on the landfills in Victoria, aiming to make it less economically attractive in hopes to reduce waste and protect the environment (Council, M. C., 2020). The Environment Protection Act 2017 is the primary legislation which sets the structure to manage trash and provide regulations for waste reduction, resource recovery and landfill operations. (Ong, 2021) The Recycling and Waste Reduction Act 2020 emphasizes on a comprehensive approach on recovering resources and minimizing contamination in the processing of recyclable materials.

The National Waste Policy Action Plan 2019 by the Australian government focuses on improving recyclable/ environmental-friendly designs on products, designing a framework that provides practical steps for waste management in various sectors across different industries (National Waste Policy Action Plan 2019). Legislation has historically shaped Australian waste management in a sequence. For example, the Waste Avoidance and Resource Recovery Act 2001 (NSW Legislation, n.d.) and the Product Stewardship Act 2011 introduced ideas of extended producer responsibility and waste minimization, therefore laying the foundation for the present policies. It enables the establishment of various product stewardship activities and programs, as well as the accreditation of current schemes and initiatives. The diverse range of operations anticipated to be conducted under this Act will effectively diminish waste and reclaim valuable resources in a manner that ensures safety and environmental responsibility (National Waste Policy n.d.).

The effectiveness of waste management in Australia's legislative framework in achieving its objectives in waste reduction and environment preservation has advanced significantly, thus making it a relevant reference to other developing countries when it comes to waste management. Nevertheless, continuous efforts and adaptations are still needed to cater to the ever-enveloping environmental goals and challenges.

There are also existing literatures which discussed various aspects of waste management and recycling methods practiced in different countries. Dahalan *et. al.* (2016) made a comparison between the household waste recycling between Malaysia and Singapore which highlight the similarities and differences between the two countries. Singapore has limited landfill capacity hence the emphasis on waste minimization and recycling compared to Malaysia where landfill is the most preferred method of waste disposal. Both countries also have

legislations to govern solid waste management but there is no law on mandatory recycling and separation of waste in Singapore.

Khan *et. al.* (2020) compared and contrasted between Malaysia and Australia with regards to legislations on solid waste minimisation. When it comes to solid waste minimisation, it is said that Australia's priority is on resource recovery, recycling, and waste reduction while Malaysia's priority is still on basic solid waste management issues which include collection, disposal and infrastructure necessities. Australia also has a variety of legislations and subsidiary legislations which cover various aspects of solid waste management compared to Malaysia that only have Solid Waste and Public Cleansing Management Act 2007 (Act 672). However, the legislation regarding recycling in Australia and Malaysia is not discussed in the paper.

Watanabe (2014) discussed the operational efficiency of centralised and decentralised municipal waste management systems by making a comparison between the household waste management in Japan and Malaysia. The paper discussed the rationale and constraints of decentralised solid waste management in Japan with smaller facilities serving smaller municipalities. In contrast, Malaysia is moving towards a centralised solid waste management system through the federalisation of solid waste management under Act 672. Mahajan (2015) also made a comparative study of municipal solid waste management in India and Japan and concluded that the difference in waste composition of the two countries and presence of a widespread informal recycling sector in India made it difficult to implement the solid waste management system as practiced in Japan. Japan also incorporated technologies like incineration which is relatively expensive and not suitable for weaker economies such as India.

METHODOLOGY

This study employed doctrinal legal research to evaluate the legal and practical aspects of the implementation of household separation of waste at source as well as collection systems and recycling practices in Malaysia. Doctrinal legal research is primarily concerned with understanding the existing legal framework, including statutes, judicial decisions, and other authoritative legal materials, to address legal problems, predict future legal developments, and provide solutions (Majeed *et al.*, 2023).

In conducting the study, both primary and secondary sources of law were examined. Primary sources of law such as statutes, regulations and government policies on waste management were rigorously analysed. The study examined the legal statutes relating to waste management in Malaysia, Japan and Australia. The study also covered relevant official government policies and guidelines relating to waste management in all the countries.

The analysis of the primary sources of laws is supported by secondary sources of law including journal articles, newspaper articles, reports and other periodicals. These studies discussed the journal articles, newspaper articles and online websites relating to waste management practices and policies in all three countries, providing insights into the current waste management issues. A comparative law method is also used to achieve the objective of the study. Comparative law method involves assessing various legal systems from different jurisdictions to identify commonalities and differences to enhance the understanding of global legal structures, promotes uniformity in implementing model laws and conventions, and aids in identifying areas for improvement (Al Abiad & Masadeh, 2024).

In order to identify gaps in the existing regulations as well as propose recommendation to enhance the current legal framework on separation of waste at source as well as collection systems and recycling practices in Malaysia, two jurisdictions have been chosen namely Japan and Australia. The reasons these jurisdictions are selected is because Japan is known for its strict waste management laws (Olmsted, 2007) and also invests heavily in waste management technologies (Mekonnen & Tokai, 2020) while Australia seems to focus more on waste minimisation and its policy is to regard waste as something that need not be created in the first place. Data collected for each country were categorised into themes such as legislations, waste management authorities, key policies, waste categories, separation at source practices, disposal methods, recycling rate, public awareness initiatives and challenges encountered.

Hence, a comparative law study with these countries seems to be indispensable. The strengths and weaknesses of the approaches adopted by these jurisdictions are appraised and recommendations are made based on the approaches considered as the most viable with the existing framework in Malaysia.

RESULT AND DISCUSSION

Malaysia

Law on Solid Waste Management in Malaysia

In Malaysia, solid waste management is under the jurisdiction of both the federal government and the state government. It falls under the term 'sanitation' as provided in item 7 of the Concurrent List (List III) of the Federal Constitution. Before the Solid Waste and Public Cleansing Management Act 2007 (Act 672) came into force in 2011, solid waste management was the responsibility of local governments and state governments according to the Local Government Act 1976 (Act 171) (Khan *et al.*, 2020). S. 73 of the Local Authorities Act 1976 grant the power to local authorities to "…make, amend or revoke by-laws…" in order "…to establish, maintain and compel the use of any service for dealing with effluent and to require the owners or occupiers of any premises to effect such dealing and to regulate and control the manner thereof…"[s. 73(1)(a)(i)].

By virtue of this section, all local authorities in Malaysia have enacted their own respective subsidiary legislation commonly called Undang-Undang Kecil Pemungutan, Pembuangan dan Pelupusan Sampah (Refuse Collection, Removal and Disposal By-Laws). The subsidiary legislations contain provisions regarding the requirement for local authority to collect, remove and dispose waste materials in their respective local authority. The provisions in the subsidiary legislations are slightly different for each local authority but from looking at a number of them i.e. Majlis Daerah Manjung, Majlis Perbandaran Johor Bahru, Majlis Daerah Pekan as well Majlis Bandaraya Subang Jaya's respective by-laws, it can be summarised as follows: -

All household refuse shall be put into plastic bags and securely fastened before being put into the refuse bins;

1. Any broken glass, cans and other objects with cutting edges shall be safely wrapped and put in a separate disposable receptacle and placed close to the refuse bin for collection;

2. The refuse bins may be placed on the edge of the arcade or verandah, outside the gate, on a back-lane or at any convenient place within the compound of the house to facilitate the emptying of the bins by the local authority;

3. For multi-storey building, the Management Corporation or the occupier of the building shall provide and maintain a refuse bin which is to be placed in the refuse chamber

The By-Laws clearly spelt out the requirement to put household waste inside plastic bags and securely fastened them before putting them inside a rubbish bag to be collected by the local authority. It also requires any objects with cutting edges to be put in a separate plastic bag for collection. However, the By-Laws did not contain any provisions regarding separation of waste at source or the requirement for recycling.

To ensure the uniformity of law relating to the management of solid waste throughout Peninsular Malaysia and the Federal Territories of Kuala Lumpur, Putrajaya and Labuan, the Solid Waste and Public Cleansing Management Act 2007 (Act 672) was gazetted on 30th August 2007 and enforced on 1st September 2011 (The Star, 4 January 2024). However, as solid waste management falls under Concurrent List in the Federal Constitution i.e. subjects matters that both Federal Government and State Government may make laws on, the federal government can only take over solid waste management from state governments who have surrendered their executive powers on it (Khan *et. al.* 2018). As at May 2024, seven states have adopted Act 672; Kedah, Pahang, Negeri Sembilan, Melaka, Johor, Perlis and the Federal Territory of Kuala Lumpur and Putrajaya while Selangor has sent Letter of Intent (LoI) to the Ministry of Housing and Local Government (KPKT) regarding the adoption of Act 672 (Malay Mail, 15 March 2024). On the other hand, Sabah and Sarawak have different sets of laws governing solid waste management as Act 672 covers only Peninsular

Malaysia and the federal territories (Khan, *et. al.*, 2020). Perak, Penang, Kelantan and Terengganu have yet to adopt Act 672 hence solid waste management is still under the purview of its local authorities.

Act 672 have a wide definition of 'controlled solid waste' which includes any solid waste falling within any of the following categories: commercial solid waste; construction solid waste; household solid waste; industrial solid waste; institutional solid waste; imported solid waste; public solid waste; or other solid waste which may be prescribed from time to time. Household solid waste is further defined as any solid waste generated by a household, a dwelling house and includes garden waste while recyclable solid waste means controlled solid waste which is suitable for recycling as may be prescribed by the Act (Section 2, Act 672).

The Solid Waste and Public Cleansing Management (Scheme for Household Solid Waste and Solid Waste Similar to Household Solid Waste) Regulations 2011 (2011 Regulation) has categorised household solid waste as residual waste; recyclable waste; bulky waste; and garden waste (Regulation 3, 2011 Regulation). Residual waste is household solid waste which are not reused, recycled or composted; recyclable waste is household solid waste which are separated for recycling, and includes paper, cardboard, glass, plastic, metal and food waste; bulky waste is oversized household solid waste which cannot be placed in a receptacle, and includes appliances, furniture, tree trunks, branches and stumps; and garden waste means plants, leaves, creepers, grass or roots with attached soil and any other similar waste from the garden or compound of any premise (Regulation 2, 2011 Regulation).

Separation of Waste at Source in Malaysia

In accordance to Section 74 of Act 672, it is mandatory for household residents in the states that applied the Act to separate its waste into recyclables and non-recyclables. A fine of RM1000 will be imposed on those who disregard this (Razali et al, 2018). Only residual waste can be placed in a waste receptacle to be collected by the licensee appointed by SWCorp under Act 672 (Regulation 8, 9, and 10 of 2011 Regulation). Recyclable waste may be sorted by the owner or occupier of landed premises and brought to the nearest recycling centre or be put into bags or containers, and placed at the collection point before the time of collection as specified in the collection schedule if a collection schedule for recyclable waste is provided for that area (Regulation 14, 2011 Regulation). Bulky waste shall be placed at the collection point before or on the date and time of collection as specified in the collection schedule (Regulation 15, 2011 Regulation) while garden waste shall be put in bags or containers and placed at the collection point before the time of collection as specified in the collection schedule (Regulation 16, 2011 Regulation). Failure to adhere to any of the above will result in a fine not exceeding RM1000.

Recycling Practices in Malaysia

Act 672 also promotes 3R i.e. reduce, reuse and recycle. Section 101 of the Act empowers the Minister of Housing and Local Development by order published in the Gazette to require:

1. any solid waste generator to reduce the generation of controlled solid waste in any manner or method;
2. any person to use environmental friendly material;
3. any person to use specified amount of recycled materials for specified products;
4. any person to limit the generation, import, use, discharge or disposal of specified products or material;
5. the implementation of coding and labelling systems for any product or material to promote recycling;
6. the use of any method or manner for the purpose of reducing the adverse impact of the controlled solid waste on the environment; and
7. the use of any method or manner for the purpose of reduction, reuse and recycling of the controlled solid waste.

SWCorp has taken a number of initiatives in implementing Acts 672 and its regulations. For example, 242,100 landed premises were inspected to ensure that separation of waste at source are being practiced which resulted in 113 offence notices (Notis Pemberitahuan Kesalahan) as at 31st December 2021. According to the SWCorp

website, for the first offence, the landed premise owner was fined RM50.00, RM100.00 for 2nd offence and RM500.00 for each consequent offence. On the other hand, for strata housing, the fine for first offence is RM100.00, RM200.00 for 2nd offence and RM500.00 for consequent offences. If the premise owner failed to settle the fine within the allocated period, the Ministry of Housing and Local Government will bring the case to the court where the offender can be fined up to RM1000.00 upon conviction (SWCorp website). Besides that, the amount of recyclable waste collected by SWCorp in 2021 is also 41% higher than what was collected in 2020. In 2021, SWCorp managed to collect 4,354.3 tonnes of recyclable waste from states that had implemented Act 672 compared to 3088.9 tonnes collected in 2020 (SWCorp 2021 Annual Report).

Other than the law on solid waste management, the government of Malaysia has also introduced the National Cleanliness Policy 2020 which aimed to achieve four objectives by 2030 namely;

1. Increasing The Awareness And Cultivating The Practice Of Cleanliness Among The General Public;
2. Increasing The Cleanliness As Well As The Sustainability Of The Environment;
3. Encouraging Waste To Money Initiative Towards Circular Economy; And
4. Strengthening The Governance And Enforcement Of Law To Be More Efficient, Effective And With Integrity.

In order to achieve the objectives, 14 strategies are proposed which are divided into 5 clusters. Cluster 2 which is about environmental sustainability aimed at improving the mechanism for solid waste management as one of its strategies. 7 action plans were proposed, namely;

1. Encouraging the industry, commercial and institutions to develop a Workplace Cleanliness Rules at organisational level;
2. Strengthening the implementation of separation at source initiative at the household, industrial, commercial as well institutions level;
3. Implementing a more comprehensive compliance regulation for solid waste management;
4. Ensuring proper solid waste management facilities is provided for construction building sites;
5. Increasing the cooperation between government agencies and NGO to reduce food waste;
6. Improving the managerial and procedural aspect of imported plastic waste; and
7. Strengthening the monitoring and law enforcement regulations regarding imported solid waste including plastic waste

(Malaysia National Cleanliness Policy, Ministry of Housing and Local Development, 2020).

The policy reflects the government's aim to shift towards a circular economy as well as practicing an efficient use of resources, reduction of waste and minimising environmental impact in order to achieve sustainability goals of make cities and human settlements inclusive, safe, resilient and sustainable (SDG 11) and ensuring sustainable consumption and production patterns (SDG 12)(The Star, 31 October 2023).

Among the challenges faced by Malaysia in implementing the separation of waste at source is the absence of legal repercussion for non-adherence to law relating to recycling. A study by Rodzi et. al. (2023) revealed that individuals perceived little value in expending additional effort towards recycling when there are no repercussions for non-compliance. The implementation of penalty for failure to practice separation of waste at source are only enforced by SWCorp and limited to the States which have adopted Act 672. As there is a lack of repercussions for abstaining from recycling practices especially for States that does not adopt Act 672, it encouraged the belief that the activity lacks value and is not worth their time and energy.

In addition, studies by Khan & Nopiah (2018) and Rodzi et. al. (2023) also cites the lack of infrastructure for proper solid waste management especially equipment to collect sorted waste as an obstacle in separation of waste at source. The lack of access to recycling facilities and services may decrease individuals' motivation and incentives to engage in recycling practices. Irregular recycling collection timetables could potentially worsen the issue, thereby increasing the challenge of recycling for individuals.

Furthermore, a study on the household solid waste management practices and perceptions among residents in East Coast of Malaysia revealed another challenge on behaviours related to waste segregation. It shows that while majority (95.9%) are aware of the health risks brought by improper waste segregation, only 50.3% of them practice proper waste segregation at home. The prevalent attitude of "Not In My Backyard" (NIMBY) attitude is the main challenge among the residents as it hinders active participation in waste separation practices (Fadhullah et al. 2021). Furthermore, the lack of advanced technology and logistic support for waste separation and recycling increases the complications of the current situation. The lack of inconsistency in the demand for recyclables is inconsistent, discouraging investments in waste separation and recycling infrastructure.

Japan

Law on Solid Waste Management in Japan

Solid waste management is a serious issue in Japan due to its dense population and high-level of development. The country is the world's second-highest generator of plastic packaging waste as the island nation rapidly industrialised (Moshkal, *et al.,* 2023). The main law which deals with solid waste management in Japan is the Waste Management and Public Cleansing Law (Law No. 137 of 1970). Article 1 of Law No. 137 stated that the law is enacted for the purpose of preserving the living environment and improving public health through the restriction of waste discharge, appropriate sorting, storage, collection, transport, recycling, disposal, or the like of waste and conservation of a clean-living environment. Waste is defined in the Act as "garbage, oversized garbage, ashes, sludge, faeces and urine, waste oil, waste acid, waste alkali, animal carcasses, and other filth or unwanted matter, both solid or liquid". It is broadly categorised as industrial waste and municipal waste. Industrial waste is defined as "ashes, sludge, waste oil, waste acid, waste alkali, waste plastic, and other waste determined by government ordinance that are generated during business activities" which is a wide concept that includes schools, hospitals, and government other than commercial businesses. On the other hand, municipal waste includes domestic waste such as kitchen refuse and over-sized garbage as well as business-related non-industrial waste such as paper and kitchen refuse similar to domestic garbage (Fujioka, 2019).

Municipal waste management is the responsibility of municipalities (Article 2.3, Article 4 of Law No. 137), while industrial waste management is the responsibility of the waste-generating businesses (Article 3 of Law No. 137). Municipal waste is collected and transported by municipalities or contractors commissioned by municipalities and processed by public cleaning facilities operated either by a single municipality or jointly by multiple municipalities. Industrial waste must be processed by waste-generating businesses themselves hence they will either process the solid waste themselves in accordance with the standard stipulated by the law or contract licensed private companies to process the waste (Fujioka, 2019).

Waste separation at source in Japan

Waste separation at source in Japan is mainly based on the manual provided by each municipality. The instruction and number of sorted items differ between cities, but the waste is generally segregated into four major categories i.e. combustible, non-combustible, recyclables and bulky items (Mekonnen & Tokai, 2020). Examples of combustible waste are greasy plastic containers or packaging, kitchen refuse, disposable diapers, wooden furniture, tree branches, rubber products, clothes, paper, and packaging with aluminium-coated film that cannot be recycled. Non-combustible waste are ceramics, glass, mirror, light bulbs, electric blankets, cosmetic/disinfectant bottles, and luggage bags. PET bottles, metal cans, large wooden furniture, newspapers, magazines, clothes as well as some electrical appliances fall under the recyclable category (Waste Sorting Guidebook, Tsu City 2024), while bulky items have their own separate disposal rules which can vary by region. The combustibles and non-combustibles waste will go through incineration and disposal processes, whereas recyclables and bulky items will be considered for recycling and reprocessing (Mekonnen & Tokai, 2020).

Unlike Malaysia that used landfills to dispose of solid waste, Japan disposes of about 75% of its waste using industrial incinerators (Moshkal, *et al.,* 2023). This is due to the fact that Japan's population is extremely dense, and its land resources are scarce (Ishimura & Takeuchi, 2019). The final waste disposal rate in landfills is extremely low, occupying less than 5% of the waste generated (Jakimiuk, *et. al.,* 2022). The incineration plants

in Japan were also innovated to reduce dioxin emission, remove acidic gas, recycle ash and enable power generation to ensure it becomes a safe and sound technology. The number of incineration plants was also reduced by upgrading smaller facilities as the priority in setting up waste incineration plants has changed from waste volume reduction to efficiency of energy recovery (Mekonnen & Tokai, 2020). However, incineration is a difficult option for developing countries due to lack of financial and technological resources, the high moisture content of the wastes, low quantity of combustible material as well as the high cost of processing and difficulties in maintaining the required operating conditions (Mahajan, 2015).

Recycling Practices in Japan

Japan has also enacted a number of Acts to promote recycling. Basic Act on Establishing a Sound Material-Cycle Society (Law No. 110 of 2000) stipulates that there is a need to establish a sound material-cycle society (Article 1 of the Law No. 110 of 2000), a society in which products, etc., are prevented or reduced from becoming wastes, generated waste is utilized as resource as much as possible, and burden on environment is minimized (Article 2 of the Law No. 110 of 2000). The target of this law is all considered "waste" regardless of whether it is valuable, and the priority of the policy on waste was set in the following order: reduce; reuse; recycle; heat recovery; and proper disposal (Fujioka, 2019).

The Act also incorporates Extended Producer Responsibility (EPR) which shifts the responsibility of processing general household waste from local governments to producers of products. For example, the Home Appliance Recycle Law 2001 requires the makers of products to take back and recycle four home appliances waste i.e. fridges, washing machines, televisions and air conditioners enabling the process for recovery and recycling of iron, copper, aluminium and glass from these products. Retailers are obligated to take them back from consumers and deliver them to the appropriate producers or recycling agents and the consumers have an obligation to pay for waste processing (Mahajan, 2015). Other laws on recycling also includes Containers and Packaging Recycling Law 1997, the Food Recycling Law 2001, the Construction Material Recycling Law (2002), and the End-of-Life Vehicles Recycling Law 2005 were enacted or revised based on the concept of the Basic Act on Establishing a Sound Material-Cycle Society (Fujioka, 2019).

Australia

Sustainable waste management is essential for the environment, a nation's economy and overall social well-being. (Khan et al., 2018). In addressing the complexities of waste management, Australia has made significant impacts by emphasizing waste separation. This is because improper and inadequate waste management can be detrimental to public health and the environment. Many countries, including Australia, have adopted a less rigid waste management system, stressing on the 3Rs concept, namely reduce, reuse and recycle. (Yaacob et al., 2019). Waste separation has become the focus of the Australian government, where the government and local government cooperate to promote effectiveness in hopes of higher recycling rates and high-quality products. This contributes to the sustainable material management principle, which is to reuse resources and decrease harm to the environment. (Anshassi et al., 2019)

However, there are challenges in implementing effective waste management throughout the country. The challenge of collecting recyclable materials, transporting them to recycling plants and managing electronic waste requires further attention. (Khaliq et al., 2014) These issues need collaboration between the government, industry and the public. The necessary infrastructure and regulatory framework to support waste segregation should be developed by policy makers. Australia aims to create more sustainable and specialized waste processing technologies. By addressing these issues and challenges, Australia could be the leader in transforming the waste management system into a model for environment and economic sustainability.

Waste separation at source in Australia

The fundamental principle behind the Australian approach on waste separation is to encourage business and individuals to separate waste into different categories; namely recyclables, organics, and non-recyclables, before it is collected and processed. The method of separation of waste involves a comprehensive and multi-stages approach that incorporates technologies and systematic management. There have been many efforts by

the government to raise public awareness about the importance of waste separation. Public knowledge and awareness are critical factors in the adoption of sustainable waste management strategies.

There are three main categories of waste, namely general waste, recyclable waste, and food and garden organic wastes. Waste is categorised from their 'source', for example waste from local households would fall under 'domestic waste'. The general makeup of the waste, for example paper boards are recyclable waste is also used to categorise waste into their category.

General waste typically refers to non-recyclable waste that are typically sent to be buried in landfills. (Zaman, 2014) The common examples of general waste include non-recyclable plastics and organic waste that decomposes over time. In Adelaide, general waste is collected from households via kerbside waste collection systems and taken to transfer stations for further processing before being sent to landfill.

Next, there are recyclable waste, which are materials that could be processed and made into new products for the same or different purposes. Beside the common materials like paper, glass and metal materials, it also includes electronic and electrical products. (Herat & Panikkar, 2019) This category of waste is collected separately from general waste, where there is a robust system, for example the Container Deposit Legislation (CDL) program that incentivizes recycling through refunds. (Nashfa, H., 2016).

Food and garden organics waste includes biodegradable waste that can be composted. This category is essential for reducing landfill waste and producing valuable compost for agricultural and gardening use. This category includes food scraps, garden clippings, and other organic materials that decompose naturally. In Adelaide, organic waste is collected separately and sent to composting facilities. The city has been increasing its composting efforts, and by 2015, the amount of waste composted was projected to be higher than that going to landfill. This highlights the importance of biological waste treatment infrastructure in the city's zero waste strategy. (Zaman, 2014)

By putting waste into different categories, it is more convenient for the local government to manage them effectively and achieve Australia's zero waste goals.

Household waste separation practice varies across different states. In Victoria, household waste is collected through a kerbside system, where separate bins are available for general waste, recyclables and organic waste, which adds to the effectiveness of waste management in Victoria (Dejan, 2023). Recycling bins are provided to households, where residents can dispose of recyclable waste which would be then collected and processed. Organic waste is also collected to be made into compost, promoting sustainable practices.

In Great Sydney, household waste separation is also processed in a similar way in Victoria. Kerbside bins are provided where residents dispose of their household waste. Waste management trucks transferred the waste to processing stations or landfill facilities. The public is continuously educated about the importance of effective waste separation at the household level.

Law and Policies on Solid Waste Management in Australia

There are many legislations enacted by the State governments in Australia to manage various environmental aspects and challenges (Khan et al., 2020). The Australian government hopes to reduce waste for disposal and to manage waste as a resource that can possibly generate profit besides preserving the environment. They regard waste as something that need not be produced in the first place (Bates, 2013).

The National Waste Policy Action Plan 2019 (NWPAP) was developed to implement the 2018 National Waste Policy, which was agreed to by Australia’s environment ministers and the Australian Local Government Association. It aims to provide a comprehensive and strategic framework to address Australia's waste management challenges effectively. It establishes a open-source dataset to address gaps in the National Website data on managing waste, enhancing transparency and accessibility of waste data, contributing to a more effective management system (Jacob F., 2021) The five key principles in this policy are:

1. Avoid Waste;
2. Improve resource recovery;
3. Increase use of recycled material and build demand and market for recycled products;
4. Better manage material flows to benefit human health, the environment and the economy; and;
5. Improve information to support innovation, guide investment and enable informed consumer decisions

This policy also emphasizes on the importance of cooperation among businesses, government, the community and individuals, where each party has their respective roles and responsibilities to achieve the aims and goals set in this plan. It is important to work together in implementing the seven ambitious targets, namely:

1. Regulate waste exports
2. Reduce total waste generated by 10% per person by 2030
3. Recover 80% of all waste by 2030
4. Significantly increase the use of recycled content by governments and industry
5. Phase out problematic and unnecessary plastics by 2025
6. Halve the amount of organic waste sent to landfill by 2030
7. Provide data to support better decisions

Recycling Practices in Australia

The Recycling and Waste Reduction Act 2020 is a pivotal piece of legislation in Australia aimed at addressing the country's escalating waste management challenges. This Act is part of a broader federal strategy that includes the National Plastic Plan and the Australian Investment Recycling Fund, all designed to enhance recycling efforts and reduce waste generation (Nagtzaam et al., 2023). It supports development of the National Waste Database, which is extremely essential for informed decision-making and effective policy implementation.

Besides managing waste at a National level, it also regulates waste export, ensuring that waste is processed in an appropriate manner both domestically and internationally. This Act also emphasizes on product stewardship, which means that industries and businesses are also responsible for the disposal of waste from manufacturing their products. This Act encourages producing goods which are 'recycling-friendly', reducing the amount of waste that eventually ends up in landfills due to their non-recyclable nature.

Overall, the Recycling and Waste Reduction Act 2020 is a component of a wider nationwide endeavour to tackle plastic pollution and waste, in conjunction with other programs like the National Plastic Plan and the Recycling Modernisation Fund.

The Waste Avoidance and Resource Recovery Act in New South Wales (NSW) is a crucial law designed to encourage waste avoidance, resource recovery, and the decrease of trash disposed in landfills. This Act is a component of a comprehensive policy framework that encompasses a range of strategies and plans aimed at improving recycling and re-use. Its purpose is to ensure that energy recovery technologies do not compromise or weaken more advanced waste valorisation processes (Madden, 2016).

In Queensland, the statute directly related and applicable is the Waste Reduction and Recycling Act 2011 No. 31. It provides detailed provisions on waste management which includes 3R and share responsibilities between the government, business and industry on waste management and resource recovery.

The Environment Protection (Beverage Containers and Plastic Bags) Act 2011 and the Waste Management and Pollution Control Act are the relevant laws in Northern Territory (Environment Protection (Beverage Containers and Plastic Bags) Act 2011, n.d.). This Act aims to mitigate the environmental impact of plastic bags and beverage containers by promoting the use of environmentally friendly alternatives and enhancing recycling efforts. In order to tackle these problems, novel materials and production techniques have been devised. For example, plastic bags designed for environmental protection use components like low-density polyethylene, vinyl trimethoxy silane, and polyvinyl alcohol resin (Wei, 2015).

Comparison Between Separation of Waste at Source in Malaysia Compared to Australia and Japan

It is evident that Malaysia, Japan and Australia have their own unique approaches suited to their environment and community. Each country has tailored waste management practices to cater to different needs. Japan focuses on advanced technologies, like incineration due to its limited land space. Australia focuses on a robust system and collaborations between the government and the society. Meanwhile, Malaysia is in the process of developing its waste management infrastructure, in hopes of complying more to the United Nations Sustainable Development Goals. This table offers insights on the differences and similarities on waste management between these three countries, together with analysis on how Malaysia can perhaps adopt practices from Japan and Australia to have a more sustainable and efficient waste management framework and strategy.

	Malaysia	**Japan**	**Australia**	**Analysis & Suggestions for Malaysia**
Legislation	Solid Waste and Public Cleansing Management Act 2007 (Act 672), Local Government Act 1976 (Act 171) and its subsidiary legislations	Waste Management and Public Cleansing Law (Law No. 137 of 1970), Basic Act on Establishing a Sound Material-Cycle Society (Law No. 110 of 2000) etc.	National Waste Policy and Action Plan 2019, Recycling and Waste Reduction Act 2020	Both Japan and Australia have comprehensive and proactive legislation that promotes sustainability. Malaysia can benefit from strengthening and enforcing stricter waste separation and recycling requirements.
Waste Management Authorities	Shared between federal and state governments; local authorities have significant roles for states that has not adopted Act 672	Municipal waste managed by municipalities; industrial waste by businesses.	Federal and state governments collaborate; local governments manage collection and disposal	Japan has a clear delineation on the responsibilities of each party, particularly municipal and industrial waste. This ensures accountability and that each party will carry out their duties. Australia relies on cooperation between the government and the people, with some municipalities requiring payment for collecting waste from households. Malaysia can adopt the clear division of responsibilities like Japan to improve efficiency.
Key Policies	National Cleanliness Policy 2020, 3R (Reduce, Reuse, Recycle)	Extended Producer Responsibility (EPR), focus on reducing waste and promoting recycling	3R principles, phasing out problematic plastics, product stewardship, and resource recovery	Japan's EPR and Australia's focus on phasing out problematic plastics are proactive measures. Both countries mandate that producers are responsible for the entire lifecycle of their products, including the take-back, recycling, and final disposal of the products. Malaysia can adopt this

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				approach to encourage sustainable practices.
Waste Categories	Residual waste, recyclable waste, bulky waste, garden waste	Combustible, non-combustible, recyclables, bulky items	General waste, recyclable waste, food and garden organics	As both Japan and Australia have more detailed waste categories which makes it easier and more effective in facilitating sorting and recycling, Malaysia could also refine its waste categorization, for example including organic waste to promote compost and reduce reliance on landfills.
Separation at source	Mandatory in states adopting Act 672; fines for non-compliance	Detailed manual provided by municipalities; categories differ by region	Mandatory in most areas; varies by state, but generally includes separation of recyclables, organics, and general waste	Standardization of waste separation practices should be adopted. Households and businesses should be provided clear and complete guidelines on waste separation.
Disposal Methods	Mainly landfills, some recycling efforts	Predominantly incineration with energy recovery, minimal landfill usage	Mix of landfills, recycling, and composting; export to other countries, incineration less common	Malaysia could explore and expand Australia's composting efforts to reduce organic waste and landfill reliance. This waste-to-energy technology might be an effective way to manage waste.
Recycling rate	Increasing, with initiatives from government bodies like SWCorp	High, with extensive laws supporting recycling	Target of 80% waste recovery by 2030, strong focus on increasing recycled material use, and encouraging industry to design more recyclable products.	Due to strong policies and public participation, recycling rates in Japan and Australia are considered high. To boost recycling rates, there is a need for Malaysia to enhance its recycling infrastructure.
Public Awareness Initiatives	Campaigns to increase cleanliness and recycling awareness	Educational efforts on waste sorting and recycling	Public campaigns, Container Deposit Legislation (CDL) for incentivizing recycling	Public awareness campaigns are quite successful in Japan and Australia. Malaysia should increase public education on waste management.
Challenges	Inconsistent adoption of Act 672 across states, reliance on landfills	Limited land space, high costs of waste management, need for efficient incineration	Challenges in electronic waste management, infrastructure for waste segregation, varying state regulations	While each country has its own unique challenge, Malaysia's focus is on improving technology use in waste processing and regulating frameworks across the country.

Figure 1

Legislative Framework

Waste management legislation in Japan and Australia are more comprehensive and proactive than the system in Malaysia. Japan's Waste Management and Public Cleansing Law and the Basic Act on Establishing a Sound Material-Cycle Society emphasize sustainability and recycling. In

Australia, the National Waste Policy and Action Plan 2019 and Recycling and Waste Reduction Act 2020 focuses on waste reduction and recycling. Meanwhile, the laws in Malaysia are still evolving. The stricter waste separation and recycling rules could benefit Malaysia.

Waste Management Authorities

In Japan, there is clear division of responsibilities, where municipalities manage municipal waste and business handle their industrial waste. Australia's federal and state government collaborates in managing collection and disposal of waste. Malaysia could adopt a concept of clear division of responsibilities like Japan to improve efficiency.

Key Policies and Waste Categories

Both Japan and Australia puts the responsibility of the entire lifecycle of products on its producers. It includes including the take-back, recycling, and final disposal of the products. Malaysia could benefit by refining waste categorisation to encourage sustainable practice.

Separation at Source and Disposal Methods

Waste separation guidelines in Japan Australia are quite detailed, including separation of recyclables, organics and general waste. Malaysia could standardise its waste separation practices by implementing clear guidelines to households and businesses. Malaysia could explore Japan's waste-to-energy technologies to manage waste more effectively.

Recycling Rates and Public Awareness

The strong policies and public participation in both Japan and Australia contribute to the high recycling rates. Malaysia needs to improve on its recycling infrastructure and increase public awareness so that there are more participation from the people.

Challenges and Recommendations

In Malaysia, the primary challenge is the inconsistency in adopting Act 672 and the dominant reliance on landfills. Implementing technology use in waste processing and regulating frameworks across the country could solve these issues efficiently.

CONCLUSION

Malaysia is currently in a transition period from solid waste management system led by the State governments through local authorities towards a more centralised approach by adopting Act 672 in order to standardise waste management practices across the whole country. The adoption of Act 672 introduces mandatory waste separation at source as well as promoting recycling through legal channels which would assist greatly in the government’s effort to reduce the volume of waste that ends up in the landfills though challenges remain in achieving consistent compliance by the public and effective enforcement by the legal authorities. The National Cleanliness Policy 2020 is also part of the government’s initiative to make Malaysia a clean country and to create a society that adopts the practice of cleanliness in order to guarantee the well-being of the people and sustainability of the environment. On the other hand, Japan’s solid waste management is highly advanced with stringent laws and regulations that govern its solid waste management system and recycling practices. It has a well-established system for waste separation and recycling, supported by detailed municipal guidelines provided by each cities’ municipal councils and advanced incineration technologies to dispose of waste that

cannot be recycled or reprocessed. The Waste Management and Public Cleansing Law and the Basic Act on Establishing a Sound Material-Cycle Society serves as a guideline for the country. Australia's solid waste management strategy emphasises the 3Rs (reduce, reuse and recycle) with the National Waste Policy Action Plan 2019 and the Recycling and Waste Reduction Act 2020 illustrate Australia's strategic framework to manage solid waste more efficiently and increase recycling rates. Australia's approach is multifaceted, involving cooperation between government, industry, and the public to address waste management challenges and promote sustainability. The collaborative approach between various stakeholders highlights Australia's commitment towards a sustainable solid waste management system.

In summary, while Malaysia, Japan, and Australia each have distinct approaches to waste management, they share common goals of reducing waste, promoting recycling, and protecting the environment. The effectiveness of these strategies depends on robust regulatory frameworks, public compliance, and the ability to address evolving challenges in waste management. Japan's efficient use of incineration technology and Australia's solid recycling and compost system are strategies Malaysia can learn from. Japan has detailed waste categories, aided by advanced incineration technologies. In Australia, strong public collaboration and the focus on waste composting shows promising results. By strengthening its law and policies as well as enforcing them more effectively to ensure compliance and at the same time increasing public awareness on the importance of conserving the environment, Malaysia can improve its solid waste management system and be more aligned with the United Nations sustainable development goals. Strengthening laws, improving public awareness and investment in advanced technology are crucial steps towards a cleaner and more sustainable environment.

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