

Unlocking Sustainable Packaging Opportunities in Singapore

Study by Singapore Environment Council
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Foreword

Our esteemed partners and friends of the environment,

In today's world, waste management is serious business. Any company worth its salt would have given much thought to how they and their products impact the environment. Millennials and Gen Zs prioritise purpose over profit when making purchasing decisions. They check the environmental track record the brand has in the market. In Singapore, Millennials account for 22 percent of the total population and Gen Z, for 30 percent.

Recently a young woman in her twenties who is known for having a taste for the finer foods in life was asked why she did not choose a particular brand of butter that many considered far superior in taste to the one she uses. Her reply – is that they use plastic packaging.

Clearly, consumers demand much more. They want to know how you package your product, and the material you use, if the brand could minimise packaging, whose responsibility is the packaging material post-purchase.

It is why this report: "Sustainable Packaging in the Circular Economy in Singapore" excites me. Society demands it. Of course, one piece of information in the report is going to hit you between the eyes, as it did, me. Let me put it up here in front to mitigate the shock - Singapore has the highest per capita single-use plastic waste generation in the world and a very low recycling rate. Chew on that. It pains me and my colleagues at the Singapore Environment Council to read that. We can either allow that piece of information to dishearten us or we could pick ourselves up and say – we can do better.

I have been working with so many of you out there who share the same vision and values as the SEC and who will rise to the challenge and say – we will change that fact. I know you can and you will.

The report is the product of tireless, meticulous research. Our researchers compiled statistics from the Singapore authorities, collated figures from experts, and garnered information and feedback from the man on the street.

But waste management is not a new problem, nor is it something peculiar to Singapore so the team went outside Singapore to study how other countries are tackling this problem. The research team looked at the experiences of these countries, what they have tried, what had worked for them and the tweaks they have had to make along the way. Our researchers looked at these before coming to their final recommendations on how and what is best for Singapore as we evolve towards a circular economy.

Take time to pore over the details in the report, these figures and statistics help us to identify the problem areas accurately and to take a surgical approach to tackle the problem. With these findings, we will not be shooting in the dark. We will be acting with more precision and it also means we could shorten the time we take to work out solutions, implement them and see results.

The government is of course working on its end on tackling the whole waste management problem. It involves long-term commitment from them. They need to facilitate it as you will see from the examples in Germany and the Netherlands. But challenges abound. The present lack of recycling infrastructure, increasing waste import restrictions by our traditional sources, and the lack of public awareness and education are obstacles to overcome.

What is clear is this - Singapore's high amount of packaging waste generation and low domestic recycling rate calls for urgent action. But as our economy continues to grow the tug in the other direction is inevitable. We will continue to consume more resources and generate more waste that requires appropriate disposal methods. We need to take stock, embrace new ways of doing things, deploy technology and call on all other resources to strike a balance between economic development and environmental sustainability. Corporate action and innovation can step in to meet these challenges and complement government efforts.

As always, we welcome your feedback. The times we have made the best progress were when we worked closely with our partners and we continue to look forward to working that way with you for your

energy, inspiration and also for so graciously sharing the wealth of knowledge and information you have.

Jen Teo

Executive Director

Singapore Environment Council

Executive Summary

Governments everywhere are at the forefront of waste management moves. They continue to introduce, revise and tweak policies and regulations to facilitate progress towards sustainable packaging and recycling (e.g., improving existing recycling infrastructure, imposing a tax on packaging, introducing cost-sharing schemes and raising consumer awareness). This study examines the state of sustainable packaging in Singapore as we continue our evolution towards a circular economy. For perspective and a clearer idea of the problem, the study also examines schemes and policies countries like Germany and Netherlands have introduced.

The government in Singapore has also taken various promising initiatives to address the packaging waste situation. These include developing regulatory frameworks and organising awareness campaigns to reduce waste and promote recycling. For example, the Singapore Packaging Agreement (SPA) which was launched in 2007 successfully reduced 62,000 tonnes of packaging waste with S\$150 million in savings since its inception¹. The Resource Sustainability Act (RSA) which will be implemented in stages between 2020 and 2025 aims at combatting electronic waste, excess packaging and food waste. The Mandatory Packaging Reporting (MPR) aims to reduce packaging waste and would lay the foundation for the Extended Producer Responsibility (EPR) framework for managing packaging waste. Besides these, the Singapore Manufacturing Federation (SMF) has partnered with the National Environment Agency (NEA) to launch an industry-led initiative to expand industry capacity in managing waste sustainably and help organisations meet the new MPR requirements.

Adopting a circular economy approach will reduce pressures on the environment by decreasing waste that is generated and recovering resources at the end of a product's life cycle and channelling them back into production. In addition, a circular economy is designed to improve resource productivity and deliver a more competitive economy by creating new green industries and jobs. As our economy continues to grow, we will continue to consume more resources and generate more waste that requires appropriate disposal methods and it will be critical for Singapore to capitalise on possibilities that will assist us in striking a balance between economic development and environmental sustainability.

The global packaging industry has experienced significant growth over the past decade and the widespread usage of single-use packaging has proved wasteful and damaging to the earth's ecosystems and environment. Exacerbating this is the low recycling rates for packaging which has resulted in most of the waste going into incineration and landfills². Governments are starting to respond to public concerns about the situation by setting more ambitious goals and initiatives for recyclability and reusability to improve waste management processes³. According to a recent study, the Plastic Waste Makers Index published by the Minderoo Foundation, Singapore had the highest per capita single-use plastic waste generation in the world.

With increasing pressure on the corporate agenda to take the circular economy seriously, organisations and retailers have been proactively committing to fundamentally rethink their packaging practices to improve sustainability⁴. Traditional linear models of product manufacture, ownership and disposal are increasingly being disrupted in the market and replaced with circular models, a trend that is expected to continue.

In Singapore, waste generation has increased six-fold over the past 40 years reaching a total of 5.88 million tonnes in 2020. Data reported in 2020 suggests that Singapore has a high industrial (which includes construction waste etc.) recycling rate; domestic recycling was put on hold due to the COVID-19 pandemic. Waste data in 2018 indicate that packaging waste made up one-third of domestic waste

¹ National Environment Agency, Singapore Packaging Agreement and Packaging Partnership Programme. Retrieved from <https://www.nea.gov.sg/programmes-grants/schemes/singapore-packaging-agreement>

² McKinsey & Company, The drive toward sustainable packaging. Retrieved from <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/the-drive-toward-sustainability-in-packaging-beyond-the-quick-wins>

³ Inside Packaging, A shifting landscape for the politics of waste. Retrieved from https://inside-packaging.nridigital.com/packaging_sep19/a_shifting_landscape_for_the_politics_of_waste

⁴ KPMG, Getting ahead in the circular economy. Retrieved from <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/04/getting-ahead-in-the-circular-economy.pdf>

disposal - of which, 55% is plastic waste, 25% is paper waste and 20% is other materials like glass and metal.

Packaging waste has been identified as one of Singapore's priority waste streams for closing the loop and achieving Singapore's vision of a Zero Waste Nation. To highlight, the plastic recycling rate remains at 4% in recent years despite the high volume of plastic waste generated. Through extensive research and stakeholder insights, this packaging waste study aims to uncover opportunities to build a circular economy for packaging materials in Singapore.

Along its journey toward circularity, Singapore faces several challenges including:

- (i) a lack of recycling infrastructure while being confronted with waste import bans and restrictions by China and Southeast Asian countries,
- (ii) a lack of public awareness and education, as well as,

As seen above, there is potential for improvement in Singapore's development of a closed-loop system. Furthermore, with Singapore's only landfill site set to reach capacity by 2035, waste disposal would be a serious concern for our land-scarce city-state⁵ and slashing the nation's packaging waste will make a significant difference.

Nevertheless, there are plenty of opportunities for Singapore to incorporate a circular economy within its waste management ecosystem. Corporate action by companies and retailers provides an option to reduce these losses and recapture some of the value through reuse and recycling. This is particularly relevant for the large and relatively fast-growing waste streams from the food, fast-moving consumer goods (FMCG) and e-commerce sectors. Furthermore, government mandates and regulatory pressures on industry players are expected to drive sustainability-focused initiatives and innovation around packaging waste management in the coming years.

To achieve a circular economy, this study highlights the following opportunities in Singapore's waste management and certification space:

1. Corporate action
2. Introducing certification
3. Improving public awareness

Working on public awareness can reap significant rewards in Singapore's recycling efforts. Our surveys revealed that majority of consumers found there is insufficient information on eco-friendly packaging and its benefits in Singapore. Other key findings indicate that most Singaporeans are willing to change their consumption habits to reduce the negative impact on the environment, Singapore's low recycling rates may be attributed to a lack of awareness about Singapore's recycling capabilities, proper waste material segregation, as well as a lack of awareness of product labelling.

A separate survey revealed a positive attitude of consumers towards purchasing and recycling packaging and that eco-labels and eco-friendly product design significantly influence consumer purchasing decisions. Also, they held the view that packaging for most products tends to be excessive.

To ensure packaging is clearly and accurately labelled, various international organisations have launched national labelling programs (e.g., the Australian Packaging Covenant Organisation) to help brands design and label packaging for recycling and thus provide consumers with accurate information about recycling. Although the complete elimination of plastic material in packaging may not be possible yet, some supermarkets have started to reduce the use of plastic for their products and have taken initiatives such as plastic packaging-free fruit and vegetable aisles in their grocery stores.

⁵ Channel News Asia, Singapore to reduce Semakau waste by 30% under first Zero Waste Master Plan. Retrieved from <https://www.channelnewsasia.com/news/singapore/semakau-reduce-landfill-zero-waste-master-plan-recycling-bins-11856664>

The evolution to a circular economy and achieving Zero Waste are uphill battles that require immediate and urgent action from industries, businesses, organisations and the community. There is a lot of room to make up and time is not on our side.

1. Packaging and Waste Landscape

According to the United States Environmental Protection Agency (EPA), packaging is defined as products that are assumed to be discarded the same year the products they contain are purchased. Thus, packaging is, by definition, a major contributor to waste streams, and is responsible for nearly half of the waste globally⁶.

In 2020, despite a global pandemic and inflationary pressures, 3.8 trillion retail packaging units were produced⁷. The global packaging market was worth \$1.1 trillion in 2021⁸. The largest segment was the industrial/transit application, accounting for 41.6% of world sales, followed by food and beverages, representing a 29.6% and 13.9% share respectively, in 2020⁹.

The global packaging market is expected to reach \$1.65 trillion by 2027 growing at a compound annual growth rate (CAGR) of 7.5%¹⁰. Most of this growth is likely to occur in the paper and paperboard packaging due to brands' sustainability goals and legislation aiming for a circular economy¹¹.

The total mass of packaging waste generated in the EU in 2019 was estimated at 79.3 million tonnes, (177.4 kg per inhabitant), a 2.4% increase compared with 2018¹². Paper and cardboard were the primary packaging waste material in the EU (32.2 million tonnes in 2019) followed by plastic and glass (15.4 million tonnes for plastic and 15.2 million tonnes for glass waste materials in 2019)¹³. In the US, the EPA estimated that packaging waste makes up a significant portion of municipal solid waste (MSW), amounting to 82.2 million tonnes of generation (28.1 percent of total generation) in 2018, with 30.5 million tonnes landfilled¹⁴.

It was reported that about 1.76 billion plastic items were used each year in Singapore, including 820 million plastic bags from supermarkets, 467 million polyethene terephthalate (PET) bottles and 473 million plastic disposable items¹⁵. According to a recent study, the Plastic Waste Makers Index published by the Minderoo Foundation, Singapore was ranked first on the list of countries per capita single-use plastic waste generation. Out of the 1.56 million tonnes of domestic waste disposed of, one-third was made up of packaging, of which 55% was made up of plastic, 25% made up of paper, and the remaining 20% was made up of other types of packaging materials like glass and metal¹⁶. It was also

⁶ Our World in Data, Plastic Pollution. Retrieved from <https://ourworldindata.org/plastic-pollution>

⁷ Euromonitor, World Performance and Outlook for a 3.8 Trillion Unit Consumer Packaging Industry. Retrieved from <https://www.euromonitor.com/article/world-performance-and-outlook-for-a-3.8-trillion-unit-consumer-packaging-industry>

⁸ Packaging Europe, Smithers predict world packaging demand to surpass \$1 trillion. Retrieved from <https://packagingeurope.com/news/smithers-predict-world-packaging-demand-to-surpass-1-trillion-in-2021/7612.article>

⁹ Smithers analysis. Retrieved from [https://www.smithers.com/resources/2021/november/world-packaging-demand-to-break-\\$1-trillion-mark](https://www.smithers.com/resources/2021/november/world-packaging-demand-to-break-$1-trillion-mark)

¹⁰ Business Wire, Global Packaging Market Outlook to 2027 and the Impact of COVID-19. Retrieved from <https://www.businesswire.com/news/home/20210111005470/en/Global-Packaging-Market-Outlook-to-2027-and-the-Impact-of-COVID-19---ResearchAndMarkets.com>

¹¹ Packaging Europe, Smithers predict world packaging demand to surpass \$1 trillion in 2021. Retrieved from <https://packagingeurope.com/news/smithers-predict-world-packaging-demand-to-surpass-1-trillion-in-2021/7612.article>

¹² Eurostat, Packaging waste statistics. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging_waste_statistics

¹³ Business Wire, Global Packaging Market Outlook to 2027 and the Impact of COVID-19. Retrieved from <https://www.businesswire.com/news/home/20210111005470/en/Global-Packaging-Market-Outlook-to-2027-and-the-Impact-of-COVID-19---ResearchAndMarkets.com>

¹⁴ Eurostat, Packaging waste statistics. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging_waste_statistics

¹⁵ Straits Times, Singapore goes through 1.76 billion plastic items a year, recycles less than 20%. Retrieved from <https://www.straitstimes.com/singapore/singapore-goes-through-167-billion-plastic-items-a-year-recycles-less-than-20-per-cent-of>

¹⁶ Towards Zero Waste, Packaging. Retrieved from <https://www.towardszerowaste.gov.sg/zero-waste-masterplan/chapter3/packaging/>

estimated that Singapore's packaging market was worth \$3.9 billion in 2021 and is expected to grow 8% in value¹⁷.

The recycling rate for plastic and paper waste in Singapore was only 6% and 39%¹⁸ respectively, in 2021. Due to the high volume of waste generation and low recycling rate, packaging waste (including plastics) was identified as one of Singapore's three priority waste streams for closing the resource loop and addressing waste management as we work towards our vision of becoming a Zero Waste Nation¹⁹.

The overall recycling rate improved from 52 per cent in 2020 to 55 per cent in 2021. The recycling rate of the non-domestic sector increased from 68 per cent in 2020 to 70 per cent in 2021, while that of the domestic sector remained unchanged at 13 per cent in 2021.²⁰ The lower recycling rates during the COVID-19 pandemic were due to a temporary halt in the recyclable collection in the first half of 2020 during the Circuit Breaker period. A study from the National University of Singapore reported that households disposed of more packaging waste during the circuit breaker period. An extra 1,334 tonnes of plastic waste were generated from takeaway and delivery meals during the two-month circuit breaker period²¹, even though overall waste generation dropped by 19% in 2020²². This study considers the waste figures from 2020 as anomalies and will use 2021 as the reference year.

The illustration below describes the breakdown of domestic and industrial packaging waste disposed of annually by material:

¹⁷ Containers and Packaging in Singapore - Market Summary, Competitive Analysis and Forecast to 2026. MarketLine, December, 2021. Retrieved from <https://www.marketresearch.com/MarketLine-v3883/Containers-Packaging-Singapore-Summary-Competitive-30854141/>

¹⁸ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>

¹⁹ Towards Zero Waste, Overview. Retrieved from <https://www.towardszerowaste.gov.sg/zero-waste-masterplan/chapter3/>

²⁰ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>

²¹ Business Wire Global Packaging Market Outlook to 2027 and the Impact of COVID-19. Retrieved from <https://www.businesswire.com/news/home/20210111005470/en/Global-Packaging-Market-Outlook-to-2027-and-the-Impact-of-COVID-19---ResearchAndMarkets.com>

²² National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>



Figure 1. Annual domestic and industrial packaging waste in Singapore

1.1 Current material flow in Singapore

In 2021, about 6.94 million tonnes of solid waste was generated, of which 3.83 million tonnes were recycled. Waste generated by the non-domestic and domestic sectors both increased in 2021, from 4.12 million tonnes and 1.77 million tonnes respectively in 2020, to 5.12 million tonnes and 1.82 million tonnes respectively in 2023²³, it was recorded that a total of 3.04 million tonnes of waste was being recycled – approximately 92% of which were industrial waste and the remaining 8% was generated from domestic waste. Singapore's low domestic recycling rate²⁴ could be explained by several factors, most of which are common barriers to recycling such as the contamination of recyclables and incorrect recycling methods by household residents. Given that 34% of Singapore's recyclables are exported, the external market and policies from other countries regarding the import of recyclables could also impact our recycling rates.

We have calculated 2021 data concerning packaging, non-packaging and food waste using 2018 ratios as a proxy as there was no packaging waste data publicly available in 2019²⁵. Based on the calculations,

²³ Ministry of Sustainability and the Environment, Key Environmental Statistics 2020. Retrieved from <https://www.mse.gov.sg/resources/key-environmental-statistics.pdf>

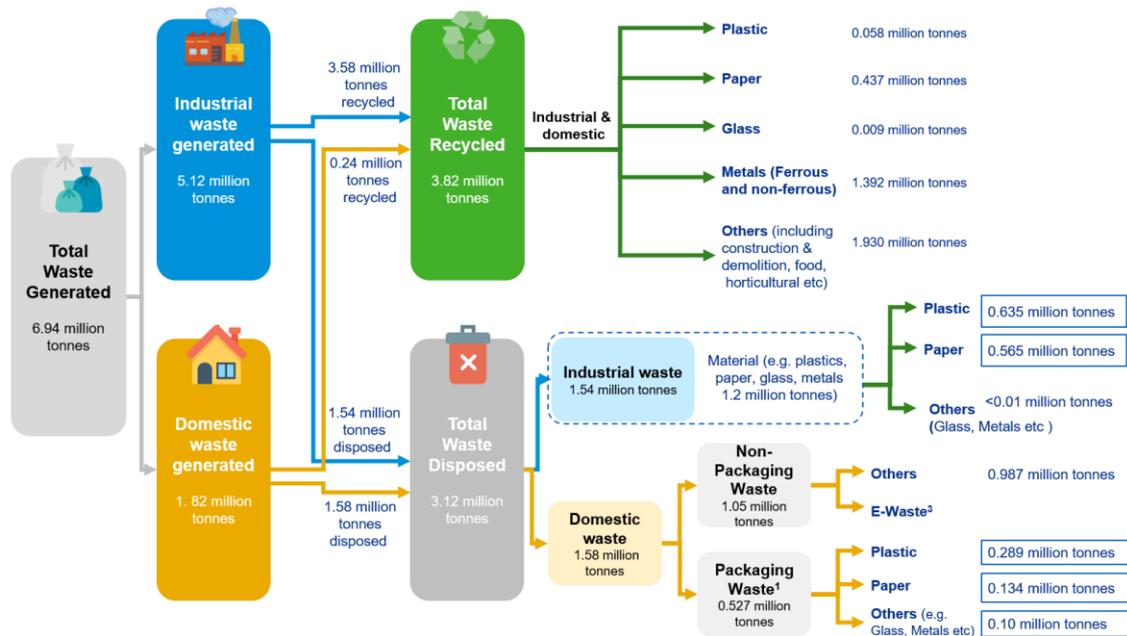
²⁴ Channel News Asia, Contamination of recyclables, incorrect recycling among possible factors for Singapore's low domestic recycling rate: Experts. Retrieved from <https://www.channelnewsasia.com/news/singapore/contamination-of-recyclables-incorrect-recycling-among-possible-12648240>

²⁵ 2018 ratios used as a proxy

there was an estimated total of 0.51 million tonnes of disposed packaging waste, of which 0.28 million tonnes were plastic, 0.13 million tonnes were paper, and 0.10 million tonnes were other materials.

The calculated 2019 data has been shared with relevant Public Waste Collectors (PWCs), industrial players and expert groups in Singapore for a sanity check, returning no remarks.

The diagram below shows the flow of materials for Singapore for key packaging materials (plastic, paper, glass, metals, etc.) in Singapore in 2021²⁶.



¹ Packaging and non-packaging waste is calculated using 2018 as a proxy: (i) Packaging waste is 1/3 of domestic waste disposed, (ii) Plastic is 55% of packaging waste, and (iii) Paper is 25% of packaging waste. National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>
² The domestic and non-domestic food waste disposed is calculated based on the 19% food recycling rate in 2021.
³ OpenGov Asia, NEA study: Singapore produces 60,000 tonnes of e-waste annually, only 6% recycled. Retrieved from <https://opengovasia.com/nea-study-singapore-produces-60000-tonnes-of-e-waste-annually-only-6-recycled/>

Figure 2. Singapore's Material Flow 2021

1. Packaging and non-packaging waste is calculated using 2018 as a proxy: Packaging waste is 1/3 of domestic waste disposed, Plastic is 55% of packaging waste, and Paper is 25% of packaging waste.
2. The domestic and non-domestic food waste disposed is calculated based on the 19% food recycling rate in 2020.
3. OpenGov Asia, NEA study: Singapore produces 60,000 tonnes of e-waste annually, only 6% recycled. Retrieved from <https://opengovasia.com/nea-study-singapore-produces-60000-tonnes-of-e-waste-annually-only-6-recycled/>

²⁶ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>.

1.1.1 Plastics in Singapore

As of 2019, plastic had one of the lowest recycling rates at only 4% overall²⁷. Yet, since plastics make up almost 1 million tonnes or 13% of the total waste amount in Singapore²⁸, the low recycling rate makes it material with the largest potential for improvement in terms of waste management.

As traditional plastics do not biodegrade, they break down into smaller pieces, otherwise known as micro-plastics, that can pollute the environment and lead to greater concentrations of plastic particles entering our food chain²⁹. In contrast, biodegradable plastics are plastics that can be decomposed through natural processes³⁰ by the action of living organisms, usually microbes, into water, carbon dioxide, and biomass, and are much less harmful.

Nevertheless, it is important to note that biodegradable plastics require specific medium (usually water, soil, compost), conditions, and varying amounts of time to biodegrade.³¹ However, as Singapore currently has no dedicated facilities to process the afterlife of biodegradable and compostable plastics³², there is no difference in how these materials are processed as they are all sent to the incineration. As such, the proper recycling of plastics is an opportunity at hand to prevent larger volumes of plastics from entering the environment, retaining as much value as possible from our plastic waste stream.

Due to Singapore's land scarcity, incineration of selected waste (such as food, paper, hazardous and medical waste) helps to reduce the solid waste's volume by around 90%³³. This is typically done through four waste-to-energy plants which are: Tuas, Senoko, Tuas South and Keppel Seghers Tuas Waste-To-Energy Plant. Ferrous scrap metal contained in the ash, from incineration, are recovered and recycled, and the trash is sent to the Tuas Marine Transfer Station for disposal at the offshore Semakau Landfill³⁴. While the materials are lost from the ecosystem, some potential residual value is retained – in Singapore's incineration plants, heat from the combustion generates superheated steam in boilers which drives turbogenerators to produce electricity.

1.2 Mandatory Packaging Reporting (MPR)

Under the RSA, the MPR framework aims to spur companies to reduce the amount of packaging used and packaging waste disposed of³⁵. The MPR lays the foundation for the Extended Producer Responsibility (EPR) framework for managing packaging waste, including plastics.

Under the MPR, producers of packaging products are expected to report packaging data and the development of plans to reduce, reuse or recycle (3R) packaging. These producers include brand owners, manufacturers, importers, and retailers such as supermarkets with an annual turnover of more than \$10 million³⁶. Companies will be required to report the types of packaging material (e.g., plastic, paper, metal, glass), packaging form (e.g., carrier bags, bottles), and the corresponding weights³⁷. The

²⁷ The Straits Times, Just 4% of Singapore's plastic waste recycled last year. Retrieved from <https://www.straitstimes.com/singapore/just-4-of-spores-plastic-waste-recycled-last-year>

²⁸ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>

²⁹ University of Nottingham, The big problem of microplastics. Retrieved from <https://www.nottingham.ac.uk/connectonline/research/2018/the-big-problem-of-microplastics.aspx>

³⁰ Conserve Energy Future, What are Biodegradable Plastics. Retrieved from <https://www.conserve-energy-future.com/advantages-disadvantages-uses-biodegradable-plastics.php>

³¹ European Environment Agency, Biodegradable and compostable plastics - challenges and opportunities. Retrieved from <https://www.eea.europa.eu/publications/biodegradable-and-compostable-plastics/>

³² Ministry of Sustainability and the Environment, Written reply to Parliamentary Question on Biodegradable Plastics by Ms Grace Fu, Minister for Sustainability and the Environment. Retrieved from <https://www.mse.gov.sg/resource-room/category/2020-10-05-parliament-q-&-a-on-biodegradable-plastics/>

³³ iSwitch, Waste Management In Singapore. Retrieved from <https://iswitch.com.sg/waste-management-in-singapore/>

³⁴ National Environment Agency, Waste-To-Energy Incineration Plants. Retrieved from <http://www.packaging-partnership.org.sg/resources/about-rsa-and-mp/>

³⁵ Packaging Partnership Programme, About RSA and MPR. Retrieved from <http://www.packaging-partnership.org.sg/resources/about-rsa-and-mp/>

³⁶ Packaging Partnership Programme, About RSA and MPR. Retrieved from <http://www.packaging-partnership.org.sg/resources/about-rsa-and-mp/>

³⁷ National Environment Agency, Factsheet on Mandatory Packaging Reporting. Retrieved from <https://www.nea.gov.sg/docs/default-source/media-files/news-releases-docs/cos-2019/cos-2019-media-factsheet---mandatory-packaging-reporting.pdf>

reporting of packaging material is key in the labelling and certification of product packaging. As a result, it aims to raise companies' awareness of the benefits of packaging reduction and to spur the reduction of packaging amount used.

Due to the COVID-19 pandemic, the commencement of packaging data collection for the MPR has been revised to 1 January 2021, with the first report to be submitted by 31 March 2022. NEA has also partnered with the Singapore Manufacturing Federation (SMF) to introduce the Packaging Partnership Programme (PPP) to assist companies in fulfilling these obligations by enabling the exchange of best practices in sustainable packaging waste management.

1.2.1 Extended Producer Responsibility (EPR)

Another pillar of the RSA is the EPR framework for managing packaging waste. The EPR scheme will be implemented for electronic waste from 2021 and be extended to packaging waste, including plastics, by 2025³⁸.

Under the EPR, producers are responsible for the collection, treatment and disposal of the materials used in product packaging. The aim is to ensure that companies take greater responsibility for the management of packaging waste from their products. This framework is likely to increase recycling rates downstream and promote innovation upstream, where products are expected to be designed with less packaging and are easily disassembled or recycled.

A Deposit Refund Scheme (DRS) for beverage containers will also be implemented from 2023 as the first phase of the EPR framework³⁹, with industry consultations being conducted by NEA since early 2020 to gather industry feedback on the proposed DRS framework. The scheme will encourage the take-back and recycling of packaging, such as plastic beverage bottles and aluminium drink cans. Under a scheme like DRS, producers would finance the take-back of their used beverage containers with rebates offered to consumers when they intentionally return their cleaned and emptied beverage containers at designated collection points. Similar DRS frameworks have been implemented in several countries such as Norway, Sweden and Germany which have achieved high recycling rates of beverage containers of over 80 per cent. In Singapore, the implementation of this framework is designed with the intent to reduce the amount of waste per capita sent to landfills and meet our 30% by 2030 goal⁴⁰.

As part of the Deposit Refund Scheme (DRS) pilot scheme in Singapore, 50 smart Reverse Vending Machines (RVMs) were deployed across the island. This initiative successfully collected more than 9 million plastic beverage bottles and aluminium drink cans over a 2.25-year period. With an average 330-ml aluminium weighing around 13 grams⁴¹, the RVMs have collected approximately between 40 to 52 tonnes⁴² of beverage containers per year, to be sent for recycling. As NEA will be implementing the DRS for beverage containers by 2023⁴³, along with greater awareness and deployment of additional machines across the island, the recycling rate for beverage containers has the potential to improve greatly over time and facilitate the recovery of beverage packaging.

³⁸ Towards Zero Waste, Zero Waste Masterplan. Retrieved from <https://www.towardszerowaste.gov.sg/files/zero-waste-masterplan.pdf>

³⁹ National Environment Agency, NEA To Implement Deposit Refund Scheme (DRS) By 2022 As First Phase Of Extended Producer Responsibility (EPR) Framework For Packaging Waste Management. Retrieved from <https://www.nea.gov.sg/media/news/news/index/nea-to-implement-deposit-refund-scheme-as-first-phase-of-extended-producer-responsibility-framework>

⁴⁰ National Environment Agency, NEA To Implement Deposit Refund Scheme (DRS) By 2022 As First Phase Of Extended Producer Responsibility (EPR) Framework For Packaging Waste Management. Retrieved from <https://www.nea.gov.sg/media/news/news/index/nea-to-implement-deposit-refund-scheme-as-first-phase-of-extended-producer-responsibility-framework>

⁴¹ The Future Protects with Aluminium, Lightweight. Retrieved from <https://packaging.world-aluminium.org/benefits/lightweight/>

⁴² Calculated the lower and upper bound weights using an average weight of 10g for PET bottles and 13g for aluminium cans for 4,000,000 containers recycled.

⁴³ National Environment Agency, NEA To Implement Deposit Refund Scheme (DRS) By 2022 As First Phase Of Extended Producer Responsibility (EPR) Framework For Packaging Waste Management. Retrieved from <https://www.nea.gov.sg/media/news/news/index/nea-to-implement-deposit-refund-scheme-as-first-phase-of-extended-producer-responsibility-framework>

With the support of Equinix, SEC launched⁴⁴ its first Reverse Vending Machine (RVM) Pilot Project in 1st May 2021 – 30th Sept 2021 to create awareness and encourage recycling of PET bottles and aluminum cans in Republic Polytechnic and Temasek Polytechnic. This project provides students with an easy way to recycle their used plastic beverage bottles and aluminum drink cans. Over a period of 3-month, the RVMs collected a total of 2,918 PET bottles and 1,675 aluminum cans.

1.2.2 Packaging Partnership Programme (PPP)

Launched on 24 March 2021, the Packaging Partnership Programme (PPP) is an industry-led initiative by the Singapore Manufacturing Federation (“SMF”), in partnership with the NEA, designed to build up industry capability in managing packaging waste sustainably⁴⁵. This was set up to support organisations in fulfilling new Mandatory Packaging Reporting (MPR) requirements⁴⁶ in Singapore. As part of the programme, workshops and training sessions will be arranged to share knowledge and facilitate the exchange of industry best practices in the sustainable management of packaging waste. The programme would also introduce supply chain initiatives that promote the sustainable use of resources in packaging and raise awareness on the 3Rs of packaging waste⁴⁷. Furthermore, the members of PPP would be eligible for up to double the funding amount under NEA’s 3R Fund. Some members of the PPP include Starbucks, Toshiba, Procter & Gamble, PepsiCo, Coca Cola, Nestle, Johnson & Johnson, ExxonMobil⁴⁸.

1.2.3 Waste management trends in Singapore

To boost its waste management capabilities, Singapore is planning to complete its Integrated Waste Management Facility (IWMF) by 2025, which will be the world’s first integrated waste and water treatment facility. This facility will be able to effectively process various waste streams, including incinerable waste, household recyclables, source-segregated food waste and sludge from PUB’s Tuas Water Reclamation Plant (TWRP) co-located with it at Tuas, jointly known as Tuas Nexus. The IWMF will be designed to be more efficient in terms of energy and resource recovery so that more electricity and recyclables would be generated for reuse⁴⁹. In addition, advanced technologies will be integrated to the IWMF to ensure clean air emissions and minimise solid residues for disposal at Semakau Landfill. The following waste streams can effectively be processed by the IWMF:

- 5,800 tonnes per day of incinerable waste;
- 250 tonnes per day of household recyclables collected under NRP (National Recycling Programme);
- 400 tonnes per day of source-segregated food waste; and
- 800 tonnes per day of dewatered sludge from TWRP⁵⁰.

In addition, Singapore is pursuing both mechanical and chemical recycling opportunities to further close the plastic waste loop. To that end, NEA has awarded tender for the feasibility study and design of a pilot plastic recovery facility (PRF) to an engineering company HTP GmbH & Co which specialises in

⁴⁴ Singapore Environment Council, Make A Difference. Retrieved from https://sec.org.sg/make-a-difference/?utm_source=website&utm_medium=news&utm_content=RP

⁴⁵ National Environment Agency, Launch Of The Packaging Partnership Programme (PPP) To Develop Industry Capability In Sustainable Packaging Waste Management. Retrieved from [https://www.nea.gov.sg/media/news/news/index/launch-of-the-packaging-partnership-programme-\(ppp\)-to-develop-industry-capability-in-sustainable-packaging-waste-management](https://www.nea.gov.sg/media/news/news/index/launch-of-the-packaging-partnership-programme-(ppp)-to-develop-industry-capability-in-sustainable-packaging-waste-management)

⁴⁶ National Environment Agency, Singapore Packaging Agreement and Packaging Partnership Programme. Retrieved from <https://www.nea.gov.sg/programmes-grants/schemes/singapore-packaging-agreement>

⁴⁷ Packaging Partnership Programme, Overview of the Packaging Partnership Programme (PPP). Retrieved from <http://www.packaging-partnership.org.sg/about-us/overview-packaging-partnership-programme-ppp>

⁴⁸ Packaging Partnership Programme, Members of the PPP. Retrieved from <http://www.packaging-partnership.org.sg/about-us/members-ppp>

⁴⁹ National Environment Agency, Integrated Waste Management Facility. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/waste-management-infrastructure/integrated-waste-management-facility>

⁵⁰ National Environment Agency, Integrated Waste Management Facility. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/waste-management-infrastructure/integrated-waste-management-facility>

the design and planning of the waste management and recycling systems⁵¹. The facility is an essential part of Singapore's long-term plans to build up large scale, advanced plastic waste sorting and recycling capabilities and thus improve its ability to recover more plastic waste. As a result, Singapore's plastic recycling rate and overall waste management capabilities are expected to improve, while lowering the carbon emissions arising from the incineration of plastics.

The feasibility study will propose technologies and infrastructure required to recover up to 72,000 tonnes per year of plastic waste for chemical recycling⁵², and is expected to be finished by the third quarter of 2021. Besides recovering suitable Polyethylene Terephthalate (PET) for mechanical recycling⁵³, the study will also highlight the cost-effectiveness for the PRF to separate and recover non-plastic recyclables (e.g., paper, glass). Given that, the PRF is therefore expected to be a key enabler in closing the waste loop, particularly for plastic waste.

1.3 Common packaging materials

1.3.1 Plastic

In general, plastic refers to polymeric materials that can be molded by applying heat and pressure, thereby allowing the plastic to be shaped into a wide spectrum of products.⁵⁴ Based on their chemical composition, plastics can be divided into two categories:

- (i) plastics made up of polymers with only linear carbon atoms along their backbone (i.e., carbon-chain polymers), and
- (ii) plastics made up of heterochain polymers.

For each polymer type, there can be numerous subtypes, each with different properties and applications.⁵⁵ A common example of heterochain polymers includes recording tape and transparent bottles made up of polyethylene terephthalate (PET). Typical products and applications of carbon-chain polymers include eating utensils made up of polystyrene and food containers comprising polypropylene. The lifespan of plastics can be optimised by reusing and recycling plastic items as many times as possible (e.g., recycling used bottles made up of plastic into new bottles), thereby reducing the amount of solid waste going to landfills and the ocean.⁵⁶

It would be useful to draw a distinction between thermoplastics and thermoset plastics. On one hand, thermoplastics (e.g., polythene) soften and become more fluid when heated which allows it to be easily reshaped and recycled without affecting its physical properties.⁵⁷ Thermoplastics have a wide range of real-world applications (e.g., from plastic containers to plastic bags in retail stores). A common example of a thermoplastic polymer is polyethylene terephthalate (PET) which is one of the most widely recycled plastics.⁵⁸ Although thermoplastic can be recycled, it is not economical or environmentally effective to recycle some forms of plastic. For example, even though polyvinyl chloride (PVC) is a thermoplastic

⁵¹ National Environment Agency, NEA Awards Tender To Conduct A Feasibility Study For A Pilot Plastic Recovery Facility. Retrieved from <https://www.nea.gov.sg/media/news/news/index/nea-awards-tender-to-conduct-a-feasibility-study-for-a-pilot-plastic-recovery-facility>

⁵² Chemical recycling of plastic is any process by which a polymer is chemically reduced to its original monomer form so it can eventually be processed and remade into new plastic materials that go on to become new plastic products.

⁵³ Mechanical recycling of plastic refers to the use of physical processes (e.g., grinding, shredding, melting and/or extrusion) to transform plastic waste into resins, flakes, or pellets for the production of new plastic materials.

⁵⁴ Britannica, Plastic. Retrieved from <https://www.britannica.com/science/plastic>

⁵⁵ Britannica, Plastic. Retrieved from <https://www.britannica.com/science/plastic>

⁵⁶ Recycle Now, Everything you need to know about recycling plastics. Retrieved from <https://www.recyclenow.com/recycling-knowledge/how-is-it-recycled/plastics>

⁵⁷ Modor Plastics, Thermoset vs. Thermoplastics. Retrieved from <https://www.modorplastics.com/plastics-learning-center/thermoset-vs-thermoplastics/>

⁵⁸ Plastics for Change, Which plastics can be recycled? Retrieved from <https://www.plasticsforchange.org/blog/which-plastic-can-be-recycled>

polymer, it is not recyclable in normal collections⁵⁹. Similarly, polypropylene (PP) – one of the most popular packaging materials – is only recycled 1% to 3% of the time in the US due to financial reasons⁶⁰.

On the other hand, thermoset plastics withstand higher temperature and harden when heated, thereby being more durable and not being able to be remolded as thermoplastics.⁶¹ Given that, it is practically impossible to recycle thermoset plastics. Common examples of thermosetting plastics include phenol-formaldehyde (PF), polyethylene terephthalate (polyesters) and polyepoxides (epoxy resins), amongst others⁶².

1.3.2 Paper

Paper is a flat sheet material produced by mechanically or chemically processing cellulose fibres derived from wood, rags, grasses, or other sources of plant fibre. Paper consists of the three kinds of plant polymers: cellulose, hemi-cellulose, lignin, and filler materials such as calcium carbonate, clay, titanium oxide, etc.⁶³.

Due to its material composition, paper can be made into varying thickness and flexibility to fulfill various packaging functions, from heavy corrugated cardboard for shipping transport to thin decorative wrapping. Paper is biodegradable since it is mostly made up of plant matter (>70%) and small non-hazardous components. This makes it an excellent option for packing food products that would contaminate the packaging material. Food-contaminated waste is often unrecyclable.

Various forms of paper-based packaging include cardboard, paperboard, shipping sacks, and paper bags. Paper-based packaging has been touted as a sustainable form of packaging material as it is made from renewable resources, is biodegradable and has a high recycling rate⁶⁴. Since 2009, cardboard recycling in the United States has surpassed 83%⁶⁵. The recycling rate in Singapore has fallen from 50%⁶⁶ to 38%⁶⁷ between 2017 and 2020, which is a cause for concern. The government has made paper recycling a part of a nation-wide recycling effort with other materials, being rolled out in several towns in Singapore⁶⁸.

However, paper fibers break and shorten after each cycle of use and can only be recycled a limited number of times due to its plant origin. As a result, paper recycling is considered downcycling.

1.3.3 Aluminum

Aluminum is a soft, ductile, and highly malleable silvery metal. It can be rolled into flat sheets of varying thickness. It is also lightweight, about one-third as dense as iron or copper and is corrosion resistant. Aluminum is not only the most abundant metal on Earth but also the most widely used metal after steel⁶⁹. The metal is also easily recycled and is estimated to have a recycling rate of 73%, according to

⁵⁹ Plastics for Change, Which plastics can be recycled? Retrieved from <https://www.plasticsforchange.org/blog/which-plastic-can-be-recycled>

⁶⁰ Plastics for Change, Which plastics can be recycled? Retrieved from <https://www.plasticsforchange.org/blog/which-plastic-can-be-recycled>

⁶¹ Thomas, Comparison of Thermoset Versus Thermoplastic Materials. Retrieved from <https://www.thomasnet.com/articles/plastics-rubber/thermoset-vs-thermoplastics/>

⁶² Osborne, The Difference Between Thermoplastic and Thermosetting Plastic. Retrieved from <https://www.osborneindustries.com/news/difference-between-thermoplastic-thermosetting-plastic/>

⁶³ Pulp and Paper Resources on the Web, What is the chemical composition of Paper. Retrieved from <https://paperonweb.com/A1056.htm>

⁶⁴ American Forest and Paper Association, Packaging. Retrieved from <https://www.afandpa.org/paper-wood-products/packaging>

⁶⁵ American Forest and Paper Association, Packaging. Retrieved from <https://www.afandpa.org/paper-wood-products/packaging>

⁶⁶ National Environment Agency, Data and Statistics. Retrieved from <https://www.nea.gov.sg/docs/default-source/our-services/waste-management/waste-recycling-statistics-2016-to-2019.pdf>

⁶⁷ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>

⁶⁸ The Straits Times, Recycling paper to earn cash part of sustainability drive in 15 towns managed by PAP. Retrieved from <https://www.straitstimes.com/singapore/environment/recycle-paper-to-earn-cash-sustainability-drive-in-15-towns-managed-by-pap>

⁶⁹ Britannica, Aluminium. Retrieved from <https://www.britannica.com/science/aluminum>

a 2021 report by The Aluminum Association and the Can Manufacturers Institute (CMI)⁷⁰. As a non-porous, non-toxic metal, it offers full protection against the elements such as oxygen, light, moisture, and other elements⁷¹.

Aluminum can be used as a packaging material because of these properties, primarily in two forms: aluminum cans and aluminum foil.

Aluminum cans are produced from aluminum alloy that is 1% magnesium, 1% manganese, 0.4% iron, 0.2% silicon and 0.15% copper⁷². The typical 330 ml beverage cans weigh about 25 grams with walls no more than 0.08 mm thick. Although aluminum cans are more expensive to produce than a glass bottle, it is estimated that its use in production is 3.5% cheaper than using a glass bottle. This is because aluminum cans are lighter than glass bottles and they do not break when beverages must be transported over long distances⁷³.

Aluminum foil is a thin sheet of aluminum alloy that is between 0.004 and 0.24 mm thick. Although it is thin, it can provide protection against light, liquid, and bacteria. Around a quarter of all foil made is used for technical purposes in industries like transport and construction⁷⁴. Furthermore, the majority of produced foil is used to produce various types of domestic packaging and foil. This includes the packaging of most types of medications (e.g., pills, capsules, powder medications) as well as food containers, bins, bottle caps and soft packages for liquids, to name a few⁷⁵. However, packaging that has been contaminated with food often cannot be recycled.

According to the US EPA, the total recycling rate of aluminum containers and packaging, which includes beverage containers, food containers, foil, and other aluminum packaging in 2018, was 34.9 percent. Within this number, the most recycled category of aluminum was beer and soft drink cans, at 50.4% (0.67 million tons)⁷⁶.

1.3.4 Glass

Glass is an inorganic solid material that is typically transparent or translucent. Natural and abundant raw materials such as sand and soda ash are melted at a high temperature to form glass. At normal temperature levels, glass is a solid, but at high temperature, it is structurally similar to liquid⁷⁷. Given that, glass can be poured, pressed, or molded into a variety of shapes that have widespread applications in the real world (e.g., tableware, windowpanes, and optics). Depending on the desired purpose and the type of glass required, there are numerous production procedures employed to make it. However, all these processes require glass to be melted first which requires two types of raw materials: sand and waste glass from recycling collections.

Glass is sustainable, completely recyclable and there is no limit to how much glass we can recycle without losing out on quality or purity⁷⁸. The recycling process behind glass revolves around sorting glass waste (e.g., glass bottles, containers, and jars) into different colours and crushing them into smaller pieces known as cullets. Next, contaminants (e.g., paper and metal) are removed from cullets which is then melted in a high-temperature furnace and subsequently molded to form new glass products like bottles, containers, and ornaments⁷⁹. It is important to note that colour sorting does make a difference as glass manufacturers are limited in the amount of mixed colour cullets that can be produced to create new containers. Thus, separating glass by colour ensures that new bottles created

⁷⁰ The Aluminum Association, The Aluminum Can Advantage: Sustainability Key Performance Indicator. Retrieved from https://www.aluminum.org/sites/default/files/2021-11/KPI_Report_2021.pdf

⁷¹ All about aluminium, Aluminium in Packaging. Retrieved from <https://aluminiumleader.com/application/packaging/>

⁷² All about aluminium, Aluminium in Packaging. Retrieved from <https://aluminiumleader.com/application/packaging/>

⁷³ All about aluminium, Aluminium in Packaging. Retrieved from <https://aluminiumleader.com/application/packaging/>

⁷⁴ All about aluminium, Aluminium in Packaging. Retrieved from <https://aluminiumleader.com/application/packaging/>

⁷⁵ All about aluminium, Aluminium in Packaging. Retrieved from <https://aluminiumleader.com/application/packaging/>

⁷⁶ United States Environmental Protection Agency, Aluminum: Material-Specific Data. Retrieved from <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/aluminum-material-specific-data>

⁷⁷ Glass Alliance Europe, What is Glass. Retrieved from <https://www.glassallianceeurope.eu/en/what-is-glass>

⁷⁸ Glass Packaging Institute, Glass Recycling Facts. Retrieved from <https://www.gpi.org/glass-recycling-facts/>

⁷⁹ Zero Waste SG, Glass Recycling. Retrieved from <http://www.zerowastesg.com/2008/12/08/glass-recycling/>

from glass waste match the colour standards demanded by glass container customers⁸⁰. Besides that, cullets can also be crushed into a form of powder and used as input materials for bricks, tiles, replacement of sand, and so on. The recycling process has numerous environmental benefits such as reducing the amount of waste glass that needs to be landfilled, preserving raw materials and natural resources⁸¹.

For every tonne of recycled glass utilized, 1.2 tonnes of raw materials are preserved as recycled glass accounts for up to 95% of raw materials. Since recycled glass can be a component for glass⁸², the more recycled glass utilised, the less energy used in the furnace. This not only helps to lower the costs for glass container manufacturers and increase their profits, most importantly, it also benefits the environment.

⁸⁰ Glass Packaging Institute, Glass Recycling Facts. Retrieved from <https://www.gpi.org/glass-recycling-facts/>

⁸¹ Zero Waste SG, Glass Recycling. Retrieved from <http://www.zerowastesg.com/2008/12/08/glass-recycling/>

⁸² Glass Packaging Institute, Glass Recycling Facts. Retrieved from <https://www.gpi.org/glass-recycling-facts/>

1.4 Challenges faced in recycling

1.4.1 Lack of infrastructure and import bans on waste

While the IWMF, which will open in 2025, is encouraging, Singapore still lacks the capacity and technological capability to recycle large volumes of materials. Due to the city-state's land constraints, it is difficult to build new incineration plants, recycling plants, landfills and expand the IWMF for waste processing, which results in the export of paper and plastic waste⁸³. As of 2019, 24% of Singapore's recyclables were exported to countries including Australia, China, India, Indonesia, Malaysia, South Korea and Thailand for processing and recycling⁸⁴.

However, in recent years, countries that import waste from Singapore are starting to ban waste imports which would have a significant impact on Singapore's recycling rate⁸⁵. For instance, the Chinese government is set to ban all imports of solid waste from 2021, in line with the National Sword campaign that was launched in 2017⁸⁶. Following suit, the Malaysian government also announced in 2018 that it would ban the import of plastic waste⁸⁷ due to the immense pollution and adverse health impacts on locals caused by waste mismanagement. Since these countries are the top destinations for Singapore's recyclable exports, there is a pressing need for Singapore to reconsider its waste management practices and promote circularity. As a result, PWCs that may have in the past collected household recyclables, sorted out the plastics and sold them to importing countries are finding it more convenient to directly incinerate the waste. This further exacerbates the problem of insufficient space in our landfills. Most companies that previously collected plastic recyclables have fully ceased operations, while a handful has invested in machinery to process the plastics into pellets⁸⁸.

Therefore, although the lack of capacity and infrastructure for recycling poses challenges, the Packing Partnership Programme (see Section 1.2.2) and Extended Producer Responsibility framework (see Section 1.2.1) are likely to promote the sharing of best practices and upstream innovation, reducing the volume of waste that requires recycling. However, there remains an opportunity for corporate action in areas such as direct elimination, design innovation and reformulation, amongst others (see Section 4.1).

1.4.2 Lack of public awareness and education

Another challenge to overcome in improving Singapore's recycling rates is changing the public's mindset and behaviour through awareness campaigns and education programmes. While Singapore's overall recycling rate was 59% in 2019, the domestic recycling rate was only 17%⁸⁹.

This is due to contamination of recyclables in the blue recycling bins, where food waste and large furniture items are frequently discarded⁹⁰. The likely cause for contaminated waste management could

⁸³ Channel News Asia, IN FOCUS: 'It is not easy, but it can be done' - The challenges of raising Singapore's recycling rate. Retrieved from <https://www.channelnewsasia.com/news/singapore/in-focus-singapore-recycling-sustainability-blue-bins-waste-12972634>

⁸⁴ Ministry of Sustainability and the Environment, Written reply to Parliamentary Question on Exports of Recyclables by Ms Grace Fu, Minister for Sustainability and the Environment. Retrieved from <https://www.mse.gov.sg/resource-room/category/2020-10-05-parliament-q-&-a-on-exports-of-recyclables/#:~:text=1.,2018%20and%2034%25%20in%202019.>

⁸⁵ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>

⁸⁶ Resource, CHINA TO BAN ALL IMPORTS OF SOLID WASTE FROM 2021. Retrieved from [https://resource.co/article/china-ban-all-imports-solid-waste-2021#:~:text=The%20Chinese%20Government%20is%20set,Recycling%20\(BIR\)%20has%20learned.](https://resource.co/article/china-ban-all-imports-solid-waste-2021#:~:text=The%20Chinese%20Government%20is%20set,Recycling%20(BIR)%20has%20learned.)

⁸⁷ CNBC, Malaysia, following in China's footsteps, bans imports of plastic waste. Retrieved from <https://www.cnbc.com/2019/01/25/climate-change-malaysia-following-china-bans-plastic-waste-imports.html>

⁸⁸ Channel News Asia, 'Cannot sell ... so they burn': What's next in the uncertain future for plastic waste in Singapore?. Retrieved from <https://www.channelnewsasia.com/news/singapore/china-bans-plastic-waste-whats-next-for-recycling-in-singapore-10281026>

⁸⁹ National Environment Agency, Waste Statistics and Overall Recycling. Retrieved from <https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling>

⁹⁰ Channel News Asia, Contamination of recyclables, incorrect recycling among possible factors for Singapore's low domestic recycling rate: Experts. Retrieved from <https://www.channelnewsasia.com/news/singapore/contamination-of-recyclables-incorrect-recycling-among-possible-12648240>

be explained by improper recycling methods among household residents, which further reduces the efficiency of the waste management process in Singapore.

Additionally, Singapore households typically prioritise convenience over recycling and choose to dispose of their waste using waste chutes located within the apartments rather than separating domestic waste by material types and placing them in the blue recycling bins⁹¹.

Whilst there appears to be an overall lack of public awareness and education, programmes such as the Deposit Refund Scheme (see Section 1.2.1), consumer awareness is likely to be enhanced over time. However, opportunities exist for further public engagement and education (see Section 4.3). There is also room to encourage and enhance certification, to increase the public's trust towards environmentally-friendly packaging and practices (see Section 4.2).

1.4.3 COVID-19 pandemic

As much of the population worked, studied, and dined at home in 2020 due to COVID-19, the use of single-use packaging and plastics increased exponentially. As a result, the global pandemic has had a significant impact on Singapore's economy, including waste management⁹², as well as the demand, supply, collection, and logistics of plastic and plastic waste.

The surge in waste generated by households and businesses resulted in more packaging and plastic waste, as packaged take-out meals and home-delivered groceries contributed to an additional 1,400 tonnes⁹³ of plastic waste during Singapore's Circuit Breaker period⁹⁴. Furthermore, because plastics continue to play an important role in protecting our frontline workers who are constantly in need of medical and protective equipment, masks, gloves, gowns, and disposable bags are becoming indispensable.

Domestic capacity to manage the growing volume of waste is limited as recycling supply chains have been disrupted due to movement restrictions to and from recycling facilities. In Singapore, fewer plastic recyclables were collected as recyclables collection programmes (e.g., Cash-for-Trash, door-to-door collection, ad-hoc collection drives with schools and Residents' Committee centres) under the PWCs were halted during the Circuit Breaker period⁹⁵, leading to more packaging waste being disposed.

Nevertheless, international pressures are mounting from both governments and stakeholders to increase the percentage of recycled content in the total share of plastics used. Going forward, more regulations on plastics is expected. For example, analysis shows the plastic tax levies will be more costly for companies than paying for recycled plastic content⁹⁶. It is also expected that mechanically recycled plastics will still displace over 1.7 million tonnes of virgin polymer feedstocks by 2030, compared with 688,000 million tonnes in 2020.

Although the commencement for Mandatory Packaging Reporting had been delayed due to the pandemic, this framework for reporting packaging data is likely to encourage businesses to minimise the use of packaging in the long term.

However, there remain several opportunities to address the challenges facing Singapore's plastic and recycling markets. Local governments and businesses will need to collaborate to reduce waste, improve

⁹¹ Channel News Asia, IN FOCUS: 'It is not easy, but it can be done' - The challenges of raising Singapore's recycling rate. Retrieved from <https://www.channelnewsasia.com/news/singapore/in-focus-singapore-recycling-sustainability-blue-bins-waste-12972634>

⁹² Channel News Asia, Less waste generated in Singapore in 2020, recycling rates drop due to impact of COVID-19. Retrieved from <https://www.channelnewsasia.com/news/singapore/less-waste-generated-singapore-recycling-rates-drop-14678238#:~:text=SINGAPORE%3A%20Overall%20waste%20generation%20in,impact%20industries%20and%20collection%20process.&text=Of%20this%2C%203.04%20million%20tonnes%20of%20waste%20was%20recycled>.

^{**} Science, Accumulation of plastic waste during COVID-19. Retrieved from <https://science.sciencemag.org/content/369/6509/1314.full>

⁹⁴ The Circuit Breaker measure was a stay-at-home order implemented as a preventive measure by the Singapore government in response to the COVID-19 pandemic lasting between 7 April 2020 to 1 June 2020.

⁹⁵ Channel News Asia, Less waste generated in Singapore in 2020, recycling rates drop due to impact of COVID-19. Retrieved from <https://www.channelnewsasia.com/news/singapore/less-waste-generated-singapore-recycling-rates-drop-14678238>

⁹⁶ S&P Global Platts, Recycled plastics market becoming more liquid and globalized as demand soars. Retrieved from <https://www.spglobal.com/platts/en/market-insights/blogs/petrochemicals/031121-recycled-plastics-global-market-commoditization-standards-pricing>

waste collection and recycling infrastructure (see Section 1.4.1), raise public awareness (see Section 1.4.2), and improve the viability of domestic recycling and recyclables. Businesses can gain a competitive advantage by reducing costs and differentiating their service offerings, as well as by conducting research and development and reinventing business models to support the circular economy transition, such as product-as-a-service or leasing models to reduce waste or the collection and proper treatment of used packaging.

1.5 Principles for packaging waste reduction

Packaging, as a form of solid waste, should be treated according to the waste management hierarchy.

Actions taken upstream of the consumer can influence prevention, or source reduction, minimisation, reuse, and even recycling. Only upstream actions, such as deliberate product and packaging design, package labelling, and programs and initiatives by corporations using packages and packaging material producers, make source reduction, minimisation, and package reuse possible.

The central principle we are following in this study would be to improve circularity of packaging and packaging materials in the circular economy. Circularity in packaging waste management is depicted in the figure below.

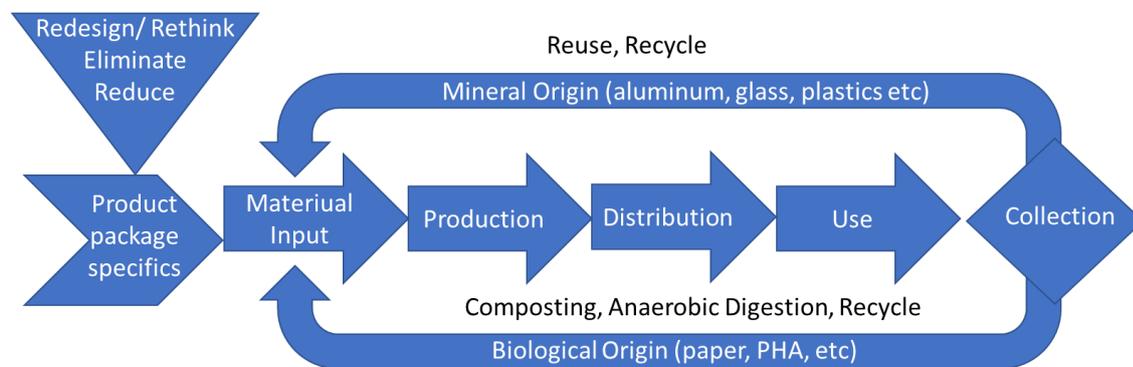


Figure 3: Circularity for packaging waste management

To achieve such circularity in packaging waste management, several conditions must be favourable. Opportunities for circularity must be present and be of interests to companies.

1. Legislation to encourage companies and consumers alike to be more circular. This will be examined in Chapter 2.
2. Market and consumer demand and acceptance. We have conducted consumer surveys and stakeholder interviews in this area. The analysis of the results will be covered in Chapter 3.
3. Packaging waste reduction through upstream actions such as sustainable design and redesign, material reduction and elimination, and 3Rs programs. This will be further elaborated in Chapter 4.

2. Policies and legislation in other countries

The paper also highlights learning points for Singapore based on the current industry practices in Europe. The countries selected include Germany, Spain, and The Netherlands. Legal developments in these respective jurisdictions lend itself to a thematic analysis of key considerations categorised as follows:

1. A general legislative framework regulating packaging and plastic waste
2. Existing or expected measures for single-use plastics
3. Producer responsibility schemes for packaging material
4. Deposit return schemes (“DRS”) for packaging of beverages
5. Taxes on packaging production and/or consumption
6. Measures regarding micro-plastics or the use of microbeads in products; and
7. Recycling or waste reduction targets for packaging or plastics.

Several learning points across these jurisdictions serve to inform how Singapore can and should implement its own legislative framework regulating packaging waste.

Germany	Spain	The Netherlands	Considerations for Singapore
Producer responsibility schemes			
Producers and distributors of sales packaging are obliged to comply with the scheme Obligations are extended to non-packaging materials	Producers must adopt “polluter pays” principles	Producers and importers of beverage containers must comply with legislations	“Polluter pays” requires producers to pay for recycling of packaging and products, incentivising them to establish control mechanisms in design and production of their products to manage waste.
Deposit return schemes			
Mandatory deposit on disposable beverage packaging	Implementation of deposit, return and refund systems for waste is established on a voluntary base	Mandatory deposit on disposable beverage packaging	The success of the German model relies heavily on the cooperation of all stakeholders and a robust ecosystem to support the scheme ⁹⁷ . Government support and collaboration will help to alleviate the huge financial cost for industry players looking to design a circular system.
Tax on packaging or plastics			
Tax on disposable packaging is currently introduced in only one city	A new tax on any non-reusable packaging containing plastic, expressed in the quantity of plastics by kilogram	Producers of packaging material to pay a ‘waste management contribution’ to the government-appointed waste fund; the contribution amount is set by quantity of packaging by kilogram	EU’s Plastic Tax effective January 2021 is driving the demand for recycled plastics. Plastics Tax announcement in July 2020 led to recyclers operating near 100% production rates in December 2020 as buyers rushed to the recycled HDPE market.
Waste reduction targets for packaging or plastics			
Further reduction in lightweight plastic carrier bags Banning of disposable plastic articles	Quantifiable reduction targets set for waste produced and reduction Targets for reuse and recycling of waste	Minimum recycling targets set for different packaging materials including plastics, paper, wood, glass, and metals	Dutch model on having concrete waste reduction targets broken into packaging types, reusability and recyclability provides clarity to producers

⁹⁷ Euractiv, Germany’s pioneering bottle deposit scheme has lessons for the EU. Retrieved from <https://www.euractiv.com/section/circular-materials/news/germanys-pioneering-bottle-deposit-scheme-has-lessons-for-the-eu/>

Limit plastic residues in organic waste			
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2.1 Germany



The revised German Packaging Act dates to 2019⁹⁸ and was amended to assume an important task of regulating packaging licensing for manufacturers on the German market⁹⁹. Regulations for packaging waste in Germany contain obligations such as:

- General requirements on packaging volume and mass, reusability and recyclability, and the use of secondary raw materials;
- Restrictions for lead, cadmium, mercury and chromium VI in packaging and packaging components
- Requirements for the labelling of packaging materials and reporting of packaging materials and quantities to the Central Agency;
- Producers and first distributors of system-relevant packaging filled with goods have to register with the Central Agency Packaging Register to participate in a take-back system - this process fosters producer responsibility, transparency, and legal certainty through data reporting
- Distributors for disposable beverage packaging are required to indicate whether the packaging is disposable or reusable;
- Producers and distributors are obliged to account for ecological criteria when calculating the license fees. Ecological behaviour, such as the use of packaging that can be easily recycled, contains recycled material or renewable raw materials, are rewarded through lower license fees;
- Failure to comply can lead to prohibition of distribution and/ or administrative fees up to EUR 200,000;
- Disposal is governed by the general waste law requirements under the German Circular Economy Act to practise and observe waste separation and collection in accordance with the waste hierarchy.

A range of policies and measures have been put in place to ensure that obligations prescribed by the German Packaging Act are followed through. The policies and measures in place are as such:

1. Measures for single-use plastics

The German ordinance on single-use plastics was adopted and enforced since 3 July 2021¹⁰⁰. This includes the reduction or banning of certain single-use plastic products for which environmentally friendly alternatives already exist.

For example, products such as cotton swabs, disposable cutlery, and plates, drinking straws, stirrers, cotton buds, and balloon wands made of plastic will be banned. This is because products made from oxo-degradable plastic often breaks down into micro-particles which are particularly difficult to dispose of. Food and beverage containers and cups made of foamed expanded polystyrene (also known as Styrofoam) will be banned from the market. Producers and distributors who neglect these measures constitutes a misdemeanour.

2. Producer responsibility schemes

⁹⁸ The new German Packaging Act was established in 2019 and has replaced their previous German Packaging Ordinance. Under this new Act, the regulations and laws around managing packaging waste will apply to e-commerce businesses as well.

⁹⁹ CMS. Plastics and packaging laws in Germany. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/germany>

¹⁰⁰ CMS. Plastics and packaging laws in Germany. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/germany>

Producers can exercise their responsibility, as specified in the German Packaging Act, on a voluntary basis and may, for example, voluntarily take back products after their use.

Since October 2020, the German Circular Economy Act¹⁰¹ was adapted to authorise regulations that promote core elements of the circular and recycling economy. This includes imposing a cost sharing obligation on producers of certain products for cleaning up litter and/ or exercise a duty of care to ensure that products remain usable and do not become waste. However, this obligation is currently limited to the single-use plastic products and concrete regulations around cost sharing obligation and duty of care have yet to be specified in further ordinances.

From 2022, the German Packaging Act would be further amended to consider the following of enhancement.

- **Packaging registry:** Operators of online marketplaces and fulfilment service providers will have to ensure that the producers of packaged goods on their platform are listed and registered under the Central Agency Packaging Register.

3. Deposit return scheme

Germany has one of the largest and most successful DRSs in the world with a 98% total return rate, 99% for metals and 97% for PET in 2018¹⁰².

In Germany, there is a mandatory deposit on disposable beverage packaging. Products excluded from the DRS are beverage packaging with a filling volume of less than 0.1 or more than 3 litres, certain types of packaging and packaging for certain alcoholic beverages, juices, and milk products.

From 2022, the German Packaging Act would be further amended to consider the following of enhancement.

- **Mandatory deposit:** A deposit will be mandatory on all disposable plastic beverage bottles and cans. Only milk or milk products will be subject to a transitional period until 2024.

4. Tax on packaging

In February 2020, the city of Tübingen decided to introduce a packaging tax¹⁰³. The tax will apply from January 2021 to disposable packaging, dishes, and cutlery for food and beverages intended for immediate consumption. The introduction of comparable taxes is being discussed in other municipalities.

5. Waste reduction targets

In Germany, the recycling quotas set at EU level apply to, inter alia, plastic packaging. Following the amendment of the Packaging Act, plastic carrier bags with a wall thickness between 15 – 50 micrometres that are designed and intended to be used at the point of sale will be prohibited in Germany from 1 January 2022. The aim is to achieve a further significant reduction in lightweight plastic carrier bags in Germany and to increase recycling.

From 2023 and 2025 respectively, Germany has rolled out other plans in the following areas:

- **Reusable alternative:** From 2023, restaurants, bistros and cafés selling food and beverages on the go are obliged to offer their products in reusable packaging - which must not cost more than the product packaged in disposable packaging. Exempted are businesses with a total of five employees or less and a shop area of no more than 80 square metres (e.g., small snack bars, late-night shops, and kiosks).
- **Recycling quota:** From 2025, PET beverage bottles will have to consist of at least 25% recycled plastic, and this quota will increase to 30% from 2030 and apply to all single-use plastic bottles, with the exception of one-way plastic beverage bottles where the body of the bottle is made of glass or metal and only the caps, lids, labels, stickers, or wrappers are made of plastic.

Key learning points

¹⁰¹ CMS. Plastics and packaging laws in Germany. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/germany>

¹⁰² Reloop Platform, Global deposit book 2020. An overview of deposit systems for one-way beverage containers. Retrieved from <https://www.reloopplatform.org/wp-content/uploads/2020/12/2020-Global-Deposit-Book-WEB-version-1DEC2020.pdf>

¹⁰³ CMS. Plastics and packaging laws in Germany. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/germany>

1. Governance

Apart from mandating regulations on packaging and plastic waste, Germany enforces the ban, reduction and/ or limitation of certain single-use plastic products for which environmentally friendly alternatives already exist. This incentivises producers and distributors to exercise their responsibility by using packaging materials and packaging components that are reusable, easy to dispose of, and/or separate for waste collection.

2. Cost sharing obligation

Authorising a cost sharing obligation on producers for cleaning up litter or adopting a duty of care incentivises producers to limit overall single-use plastic products and ensure that the products do not become waste. This allows manufacturers and distributors of packaging materials to share the disposal costs, which further promotes participation from consumers to avoid packaging waste whenever possible and use only products that are reusable.

3. Price sensitivity

Recognising that price is often a source of consumer concern, the requirement that food establishments offer their products in reusable containers that do not cost more than the products in disposable containers has been implemented. Mandating the containers (reusable and disposable) to be of the same price would alleviate any consumer concerns; and increase the chances of the consumers bringing back their reusable containers for their food.

2.2 Spain



The Spanish government sets an ambitious legislative framework to regulate packaging and plastic waste in their jurisdiction. Measures were established to regulate waste management through the Acts as follows:

1. Customs Management Act (22/2011) targeted at regulating waste management to prevent the generation of waste and mitigate the associated adverse impacts on human health and the environment;
2. Packaging and Packaging Waste Act (11/1997) to manage the impacts of packaging waste throughout its life cycle on the environment – by preventing packaging waste production and encouraging the reuse of packaging, recycling, and other forms of recovery to avoid packaging waste disposal; and
3. Royal Decree 298/2018 to reduce the consumption and/or abandonment of plastic bags and their dispersion.

A range of policies and measures has been put in place to ensure that obligations prescribed by the Spanish government are followed through. These include:

1. Measures for single-use plastics

As of January 2023, the free distribution of single-use plastics will be prohibited, and a price must be charged for each plastic product given to the consumer. Public administrations are required to adopt measures to reduce the consumption of bottled water on their premises by promoting sources of drinking water in conditions that guarantee hygiene and food safety¹⁰⁴.

2. Producer responsibility schemes

Producers are subject to adopt measures to regulate waste management both through the design and production phase of their products and during the management of the waste deriving from their use, either individually or by means of collective systems. Furthermore, product producers are subject to the “polluter pays” principle to incentivise the prevention and organisation of waste

¹⁰⁴ CMS. Plastics and packaging laws in Spain. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/spain>

management, while promoting management in accordance with the principles inspiring the legislation.

Other obligations that can be imposed by Royal Decree on product producers include the deposit, return, and refund system, the waste-management items to be financed by producers and the control mechanisms for the individual and collective systems.

3. Deposit refund schemes

Currently, the implementation of deposit, return and refund systems for waste is established on a voluntary basis.

4. Tax on packaging

The bill on Waste and Contaminated Soils introduces a new tax on any non-reusable packaging containing plastic. The tax base will be the quantity of plastic, expressed in kilograms. The tax rate will be EUR 0.45 / kg of plastic.

5. Recycling or waste reduction targets

The bill on waste prevention¹⁰⁵ sets out quantifiable reduction targets, such as a reduction in the weight of waste produced of 15% by 2025 in addition to the current target of a 10% reduction from 2020 onwards. It also sets out ambitious targets to prepare for reusing and recycling of municipal waste: an increase of 5% every five years to reach 65% by 2035. The disposal of waste is also regulated, whereby it must be carried out in a safe way, and in the case of landfilling, after prior treatment.

Furthermore, there is an obligation for the competent authority to carry out awareness-raising campaigns on the negative environmental consequences of excessive plastic consumption.

Key learning points

1. “Polluter pays” principle

In Spain, a charge for disposable products is introduced to exercise the “polluter pays” principle in which product manufacturers are obliged to pay in full for the recycling of packaging and other products they put on the market. As such, producers are incentivised to establish control mechanisms in both the design and production phases of their products as well as during the disposal of waste generated by their use.

2.3 The Netherlands



The general aim of the Dutch legislative framework is to reduce litter and to protect the public interest and the environment. There are several laws and decrees that regulate packaging and plastics waste, which include the following:

1. Measures on single-use plastic products

From 3 July 2021, single-use plastic products for which there is a reasonably affordable, sustainable, and less harmful alternative available are prohibited in the market¹⁰⁶. As with the German Packaging Act, cotton swabs, cutlery, plates, straws, stirrers for beverages, and balloon wands are prohibited. Additionally, the marketing of products made of oxo-degradable plastics will also be prohibited.

For certain products such as food containers, bags and wrappers, packages for drinks containing a maximum volume of three litres, drinking cups, light plastic carrier bags, wet wipes, balloons for consumers, tobacco products with filters, the producer or the importer that markets the

¹⁰⁵ Plastics and packaging laws in Spain. CMS. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/spain>

¹⁰⁶ Plastics and packaging laws in The Netherlands. CMS. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/the-netherlands>

abovementioned products in the Netherlands must compensate the costs for cleaning up, transporting, and processing litter that the Dutch government makes.

In addition, the producer must cover the cost of certain measures to raise awareness of the environmental impact of several single-use plastic products. For the tobacco and fish industry, additional costs for waste collection will be charged. Markings should be applied to the packaging of single-use plastics or the products itself to make it clear to the consumer that the product contains plastic and if thrown away, the product will have a negative impact on the environment.

2. Producer responsibility schemes

As of 1 January 2022, a producer or importer who markets beverages in a plastic bottle of three litres or less must ensure that at least 90% of the weight of the total number of the marketed bottles, caps and lids is collected separately during a calendar year. By January 2024, the same legislation would apply for metal containers¹⁰⁷.

Under the Decree packaging 2014, all producers and importers regulations who fall under the scope of the regulation must comply with additional regulations wherein further rules on the minimum levels of deposits on beverage packaging are established.

3. Deposit Refund Schemes

The Netherlands has a deposit return rate of 95% for PET in 2018¹⁰⁸. Every producer or importer who markets water or soda in plastic bottles with a volume of three litres or less must request a deposit for each bottle. When the consumer returns a plastic bottle to a designated place (mainly shops), the consumer receives the deposit back.

As of 31 December 2022, producers and importers who market beverages in metal packaging with a volume of three litres or less must charge the consumer a deposit on the packaging¹⁰⁹.

4. Tax on packaging

Producers of packaging materials who market or import more than 50,000 kg per calendar year must pay a 'waste management contribution' to the government-appointed Packaging Waste Fund. The amount of the contribution depends on the material and the type of packaging. For example, the contribution amount for paper and carton packaging is set at EUR 0.022 per kilogram¹¹⁰.

5. Recycling or waste reduction targets

The producer or importer must ensure that, of all the packaging they import or place on the market and dispose of in a calendar year, at least 75% is reused and at least 70% is recycled. Each year, a minimum recycling percentage is set by the Dutch government¹¹¹. In 2021, the minimum recycling percentages are as follows:

- 51% for plastics;
- 43% for wooden packaging;
- 90% for glass;
- 75% for paper and carton packaging; and
- 85% for metal packaging.

Key learning points

¹⁰⁷ Plastics and packaging laws in The Netherlands. CMS. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/the-netherlands>

¹⁰⁸ Global deposit book 2020. An overview of deposit systems for one-way beverage containers. ReLoop Platform. Retrieved from <https://www.reloopplatform.org/wp-content/uploads/2020/12/2020-Global-Deposit-Book-WEB-version-1DEC2020.pdf>

¹⁰⁹ Plastics and packaging laws in The Netherlands. CMS. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/the-netherlands>

¹¹⁰ Plastics and packaging laws in The Netherlands. CMS. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/the-netherlands>

¹¹¹ Plastics and packaging laws in The Netherlands. CMS. Retrieved from <https://cms.law/en/int/expert-guides/plastics-and-packaging-laws/the-netherlands>

1. Quantitative waste reduction targets

The Dutch model mandates that a minimum recycling percentage is set and apply to all the packaging that is imported or placed on the market. This is further broken down by packaging types and expected reusability and recyclability by percentage. This provides clarity in the expected reduction in each of the material type to the producer.

2. Packaging Waste Fund

The Netherlands instituted a Waste Fund in 2007, financed by a carbon tax on packaging. The Waste Fund helps to pay for the separate collection of household packaging waste, while the tax encourages businesses to move towards the national recycling target. This further promotes companies to address the activity of packaging and packaging waste through the supply chain of packaged products and stimulate continuous improvement in the same regard.

3. Minimum share of reused or recycled content in packaging

Governments can support the development of a differentiated demand for materials from secondary sources, which would increase incentives for separate collection and treatment of plastic and other materials and reduce leakage.

This can be done by:

- a. Introducing recycled content labels
- b. Requiring recycled content in public procurement rules
- c. Requiring recycled content through product standards regulations
- d. Introducing a tax on virgin plastics that reflects the environmental costs of the material

The European Commission is expected to introduce minimum quotas for usage of recycled content in new plastic products by 2022. The Netherlands is a leading example by setting the target in the Plastics Pact for all single-use plastic products to be made of 25% recycled plastic by 2025 and all products and packaging made entirely from recyclable plastic¹¹².

Many countries have introduced public procurement requirements to increase the purchase of recycled-content products (e.g., UK, Italy, France, Norway, the Netherlands, Spain, Belgium, Latvia, Japan, USA). This has the potential to increase economies of scale and demand for supply of recycled content.

The increase in demand for recyclates will present opportunities for waste and recycling companies. Producers and brand owners will need to redesign their products and revise the materials they use in their packaging.

3. Research and Findings

3.1 Design and Methodology

The objectives of the first survey are to understand consumer behaviours around packaging and how to improve Singapore's management of packaging waste. An online survey was selected as the survey approach, and the survey was rolled out using MS Forms. The first survey was live for 3 months from July 2021 to September 2021.

The survey was structured around 3 primary themes:

1. Packaging use habits and trends in Singapore
2. Awareness and receptivity of eco-labelling in Singapore
3. Stakeholder roles and responsibilities

Following this, a second online survey was conducted in November 2021 to gather further analyses on the attitude and behaviour of consumers towards buying and recycling packaging. Besides gender and

¹¹² The Ellen MacArthur Foundation, Meer met minder plastic. Retrieved from <https://ellenmacarthurfoundation.org/the-plastics-pact-nl>

age, the survey demographics additionally factored in the number of people in the household, highest education qualification, occupational status, type of housing and income level.

It should be noted that the sample size for the second survey is relatively small, therefore its results may not be generalised to the wider public which in return could affect the precision and interpretation of the findings. Despite that, findings from the survey still provide valuable information given the inferential goals of the report.

3.2 Findings from First Survey

A total of 1,015 responses were used in the analysis of the first survey¹¹³. The demographic profile of the respondents is as follows:

Category	Count
Gender	
Male	390
Female	584
Prefer not to say	39
Age	
15-25	398
26-40	277
21-60	262
Above 60	53
Prefer not to say	25

Key finding 1: Further education is keenly needed among consumers on the recyclable items in Singapore

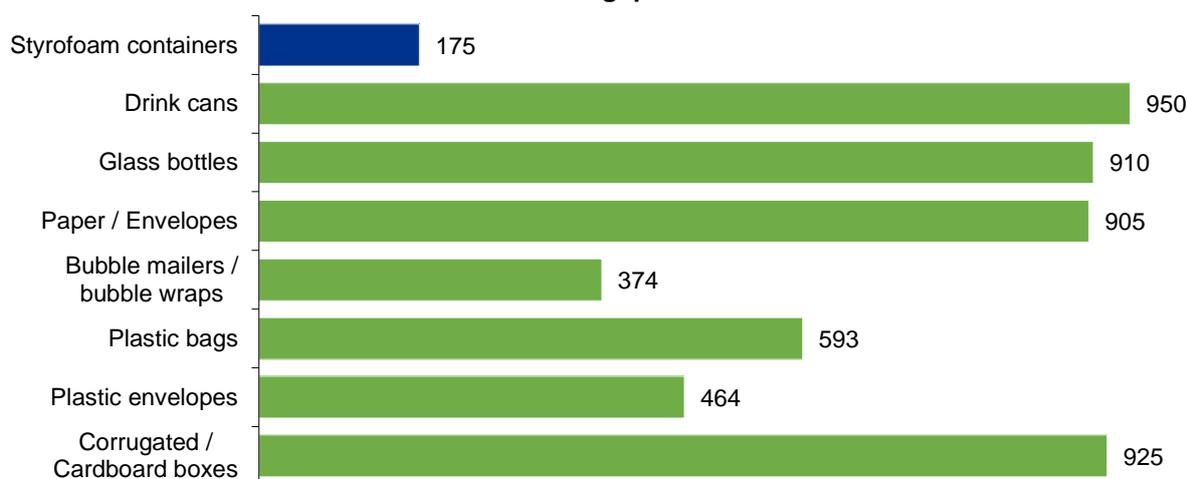
Prior research has shown that consumer behaviour is driven by environmental awareness to reduce the impact on the environment. Our survey findings also find that most Singaporean respondents (95%) would improve their consumption behaviour to reduce the environmental impact of packaging waste, which signals a positive shift in mindset towards sustainable consumption. However, consumers' concern for the environment does not readily translate into the purchase of environmentally friendly products or packaging.

In addition, a significant number of respondents do not display an accurate understanding of the material items that can be recycled in Singapore, indicating their lack of awareness of Singapore's recycling capabilities. For example, a total of 175 responses selected Styrofoam containers are recyclable when it is in fact not recyclable in Singapore. Although Styrofoam is a kind of plastic, it is not readily recyclable¹¹⁴ as it requires specialised equipment to be broken down successfully and therefore the process is not commonplace in most recycling facilities, Singapore or globally. This may explain why it has also contributed to recycling confusion among consumers.

¹¹³ For the full survey results, refer to Appendix F.

¹¹⁴ Green Matters, Why Can't Styrofoam Be Recycled? Retrieved from <https://www.greenmatters.com/p/why-cant-styrofoam-be-recycled>

Respondents' responses on which of the packaging items can be recycled in Singapore



* **Green colour** = recyclable items in Singapore, **blue colour** = not recyclable in Singapore

The survey results that were analysed include:

- Respondents do not have a complete understanding of items that can be recycled. Most respondents are aware of the bulk of items that can be recycled but only 171 respondents (16.8%) have a firm grasp on the full recycling capabilities.

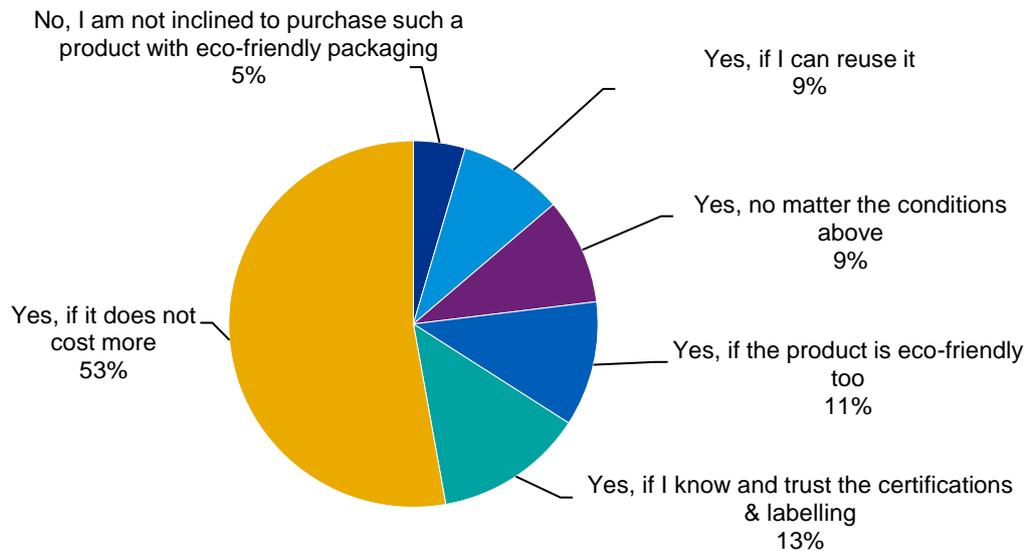
Key finding 2: Respondents are inclined to purchase a product that has eco-friendly packaging only if it did not cost more

Despite positive environmental attitudes toward green packaging, respondents still consider price as a major factor in their inclination for sustainable packaging. While existing commercial studies have indicated that product price is not a significant concern for consumers, their willingness to pay more for sustainable packaging and eco-friendly products is not readily translated. The gap between purchase intentions and behaviours was consistent in our survey findings, with most of the respondents more inclined to purchase a product that has eco-friendly packaging only if it did not cost more.

Actions by FMCG companies and retailers have historically been focused on managing efficiencies to lower packaging costs. At the same time, while these sustainability-focused initiatives around packaging innovation have changed significantly and major brands are starting to curb the use of plastic packaging and changing packaging materials¹¹⁵, it often comes at a cost as initiatives to scale sustainable packaging are at an early stage of research and development, costing more than traditional products overall. As the concept of “eco-packaging” is closely tied to increasing cost, it is undeniable that consumers regard price as a key buying criterion despite a shift in attitudes toward sustainable packaging.

¹¹⁵ McKinsey & Company, The drive toward sustainability in packaging—beyond the quick wins. Retrieved from <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/the-drive-toward-sustainability-in-packaging-beyond-the-quick-wins>

Respondents reasons for inclining to purchase a product that has eco-friendly packaging (certified and labelled)



The survey results that were analysed include:

- Price is a major cause of consideration for respondents to purchase a product that has eco-friendly packaging, as seen by more than half of the respondents (53%).

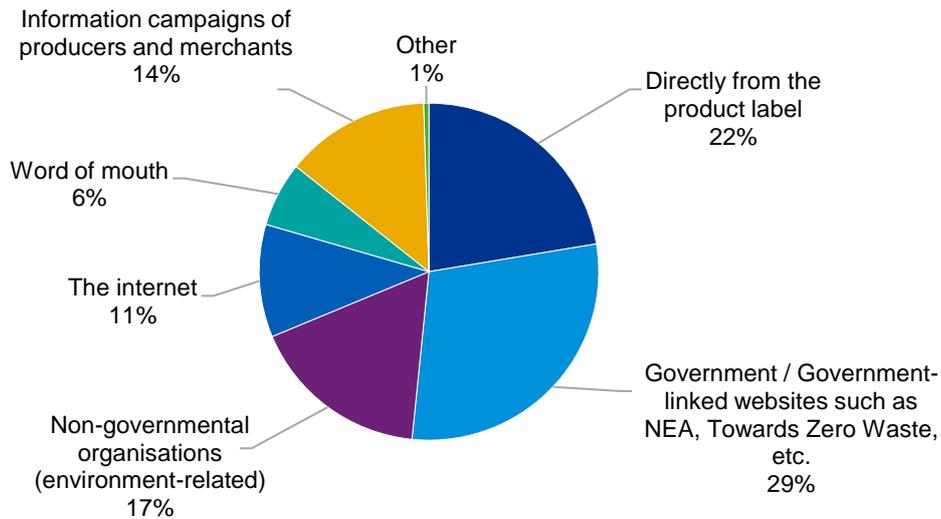
Key finding 3: Producers, governments, and non-governmental governments play important roles in addressing packaging waste

Purchasing decisions based on environmental attitudes have been shown to evolve with market trends and the government’s role in environmental protection. Among the general population, Singapore consumers have displayed more positive attitudes about reducing their consumption of single-use plastic disposables, however, this was not readily translated in our survey results. For example, consumers’ use of disposable packaging did not see an improvement, with 373 respondents using more packaging than in the past year. This could very likely be attributed to the increasing number of consumers stuck at home amid the spread of COVID-19, which has skyrocketed the demand for disposable plastics.

Nonetheless, we can still expect to see an improvement in consumers’ purchase and recycling decisions in years to come as positive environmental attitudes continue to develop. In fact, respondents claim that they can make well-informed decisions on eco-friendly packaging and proper recycling methods through the product labels and educational campaigns endorsed by our governments, shifting the responsibility to governments and FMCG producers.

Key finding 3 (a): The role played by the Singapore government and corporates can help to facilitate positive attitudes by consumers in their purchase and recycling decisions

Respondents' trusted sources of information for information on eco-labels/ eco-labelling

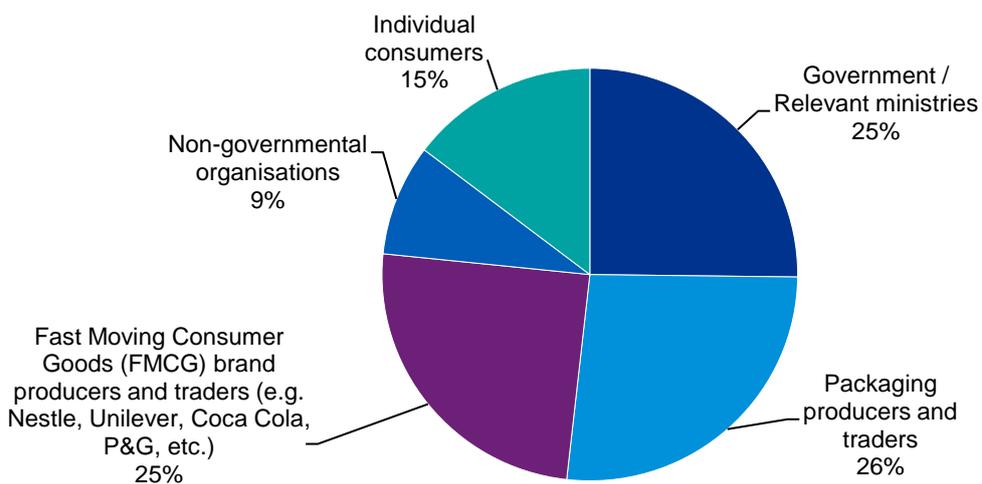


The survey results that were analysed include:

- In addition to the Government (29%), respondents are also relying more on corporates as their source of information (22% from product labels and 14% from information campaigns of producers and merchants)

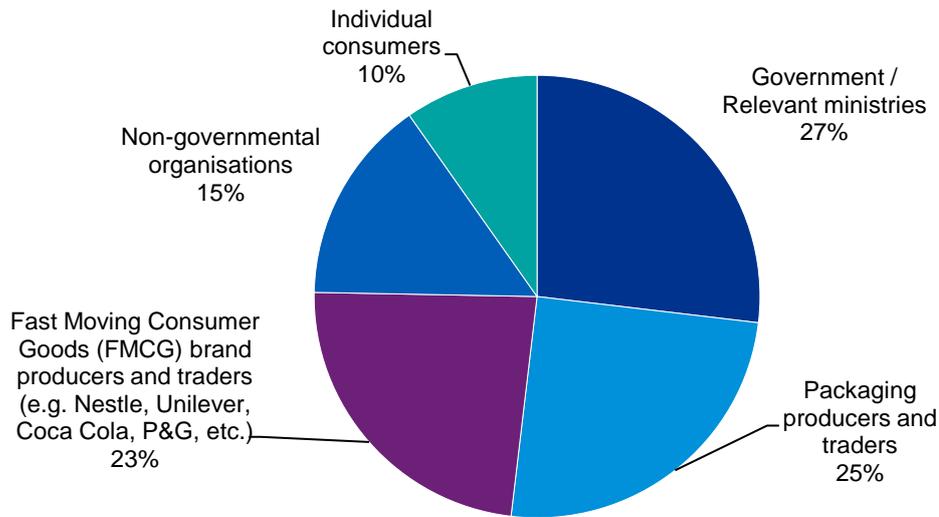
Key finding 3 (b): Consumers have different expectations in terms of which stakeholder is responsible for implementing and informing consumers about eco-friendly packaging

Respondents' opinion on whose responsibility is it to implement eco-friendly packaging



- While it is heartening to see an increase in consumers' interest and awareness of proper recycling methods, many of them still believe that the responsibility lies with packaging producers (26%) and governments (25%) to implement eco-friendly packaging.

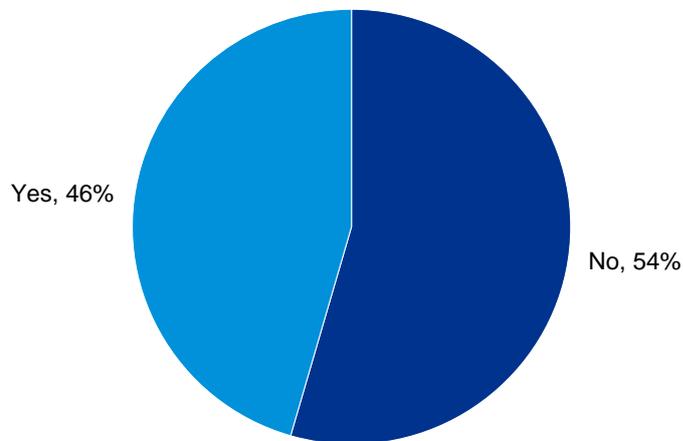
Respondents' opinion on whose responsibility is it to inform consumers about eco-friendly packaging



- Consumers believe that the responsibility for eco-friendly packaging should lie with the governments (26.7%) and packaging producers (24.8%)

Key finding 3 (c): Stakeholders can do more to improve their sustainability initiatives and educate consumers

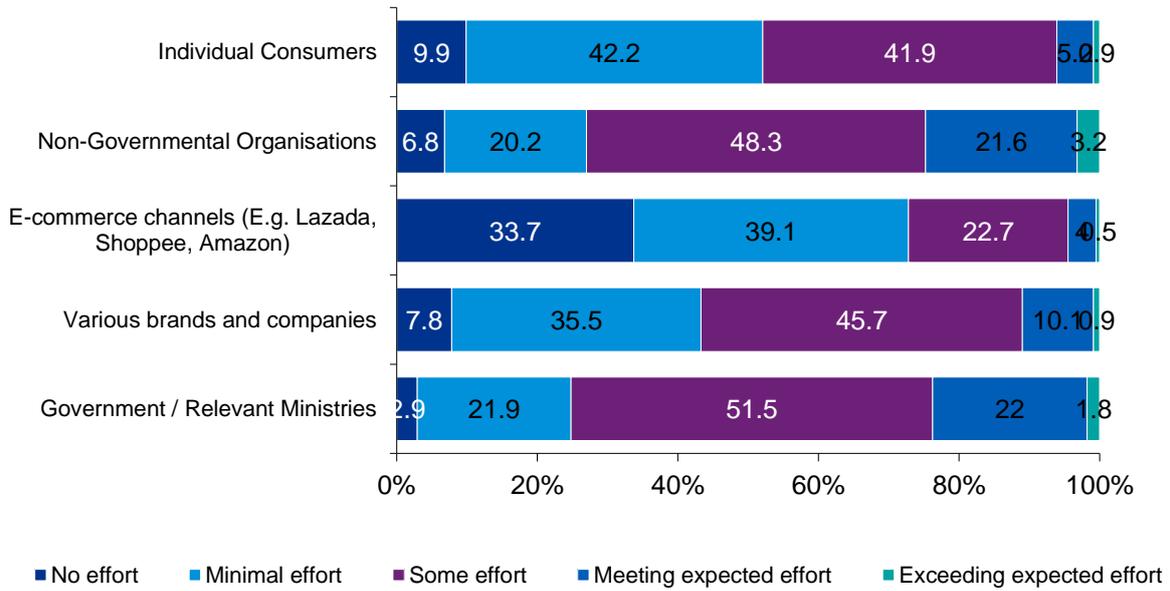
Respondents' opinion on whether there is sufficient information (in Singapore) on eco-friendly packaging and its benefits



The survey results that were analysed include:

- The majority of respondents (54%) indicated that there is insufficient information on eco-friendly packaging and its benefits which could explain challenges to recycling properly.

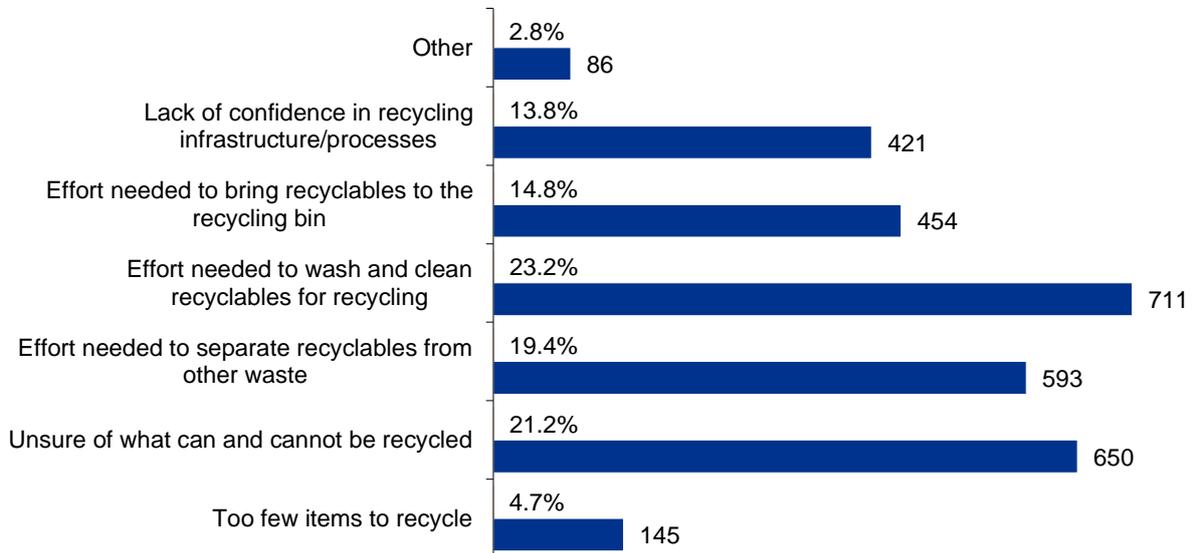
Respondents' opinion on whether the following stakeholders have done enough to reduce packaging waste in Singapore



- The majority of the respondents feel that the government (75.2%) and NGOs (73%) have put in the effort to reduce packaging waste in Singapore.

Key finding 4: Consumers view the effort needed to wash and clean recyclables for recycling as the biggest challenge to recycling

Challenges respondents face in recycling packaging



The survey results that were analysed include:

- The majority of respondents (23.2%) identified the effort needed to wash and clean recyclables for recycling followed by the lack of understanding of what can be recycled or not (21.2%) in terms of the biggest challenge they face in terms of recycling packaging.
- With the top 3 challenges taken together, the effort taken to wash, separate and identify recyclables point to a need for a clear and simple post-consumer recycling system. Corporate action is also needed to reduce the need for post-consumer recycling.

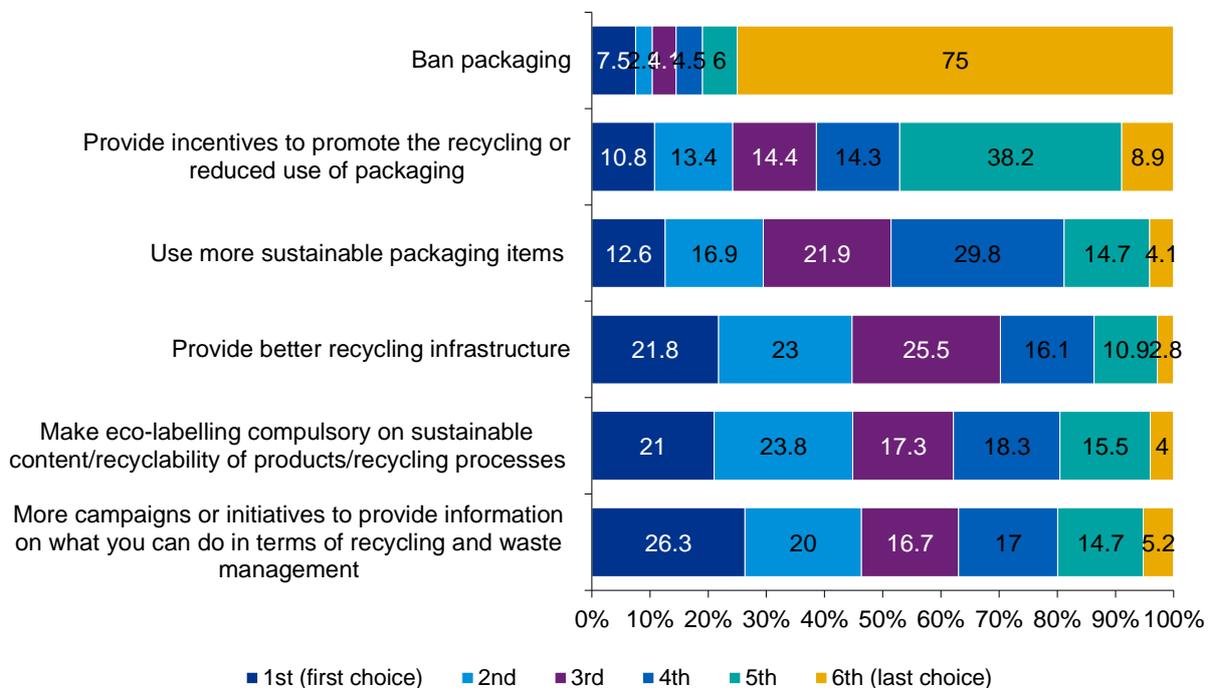
- It is interesting to note that a significant portion of respondents (14.7%) identified the effort to bring recyclables to the bin and the lack of confidence in the recycling infrastructure (13.8%) as challenges they face in recycling packaging as well.

Key finding 5: More campaigns, clearer labels and enhanced infrastructure will support the market maturity relating to packaging

Packaging can influence the consumer’s mindset of the product by its exposure – attracting the consumer’s attention and transferring valuable product knowledge. When a product is labelled as “green”, “eco” or sustainable, it differentiates the product in the consumer’s mindset.

While considering that different types of plastic could improve the product’s sustainability profile, packaging design for easy use and recycling would provide clarity for consumers on how packaging should be collected and sorted at recycling facilities. As survey results show, respondents are not only willing to pay more for sustainable packaging but also to buy products that are clearly and accurately labelled. Moreover, it is the responsibility of both governments and FCMG companies to address them and use clear labelling to help consumers understand the sustainability narrative.

Solutions that may help respondents recycle or manage their packaging waste better



The survey results that were analysed include:

- Top 3 most effective solutions to inform consumers about their recycling and waste management methods:
 - Educational campaigns (26.3%),
 - improved recycling infrastructure (21.8%) and
 - compulsory eco-labelling (21%).
- It is also interesting to note that most respondents indicated that banning packaging (75%) is not the best solution for packaging waste management in Singapore.

3.3 Findings from Second Survey

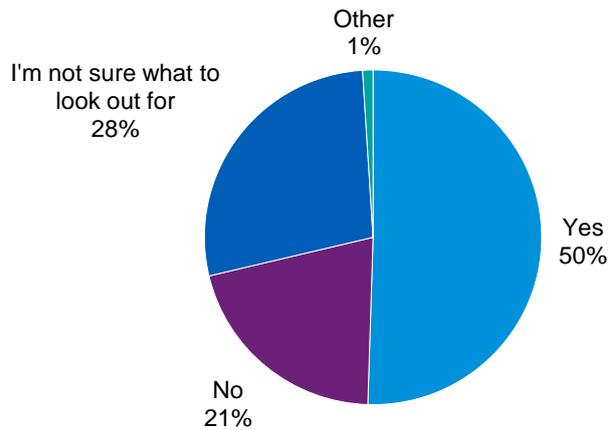
To further investigate some of the results and common themes of the first survey, a second survey was conducted. It was opened in November 2021 for 2 weeks. A total of 101 responses were used in the analysis of the second survey. The demographic profile of the respondents is as follows:

Category	Count
Gender	
Male	61
Female	40
Age	
15-25	39
26-40	36
21-60	23
Above 60	3
Number of people living in your household (Including yourself)	
1 (I live alone)	1
2-3 people	35
4-5 people	55
More than 5 people	10
Highest education qualification	
Primary School	0
Secondary School	1
ITE / Diploma / A levels	11
Degree	59
Post-graduate	29
Other	1
Occupational status	
Student	17
Unemployed	4
Employed	77
Homemaker	2
Other	1
Type of housing	
HDB	59
Condominium / Loft	31
Landed Property	11
Other	0
Monthly Household Income Level (SGD), before CPF	
<\$2,000	9
\$2,000 - \$5,000	27
\$5,001 - \$10,000	33
>\$10,000	32

Key finding 1: Product packaging should be improved to provide sufficient information and ensure that it is comprehensible to consumers

Although more consumers are willing to support sustainable packaging and are showing more interest in their environmental footprint, they are often misinformed about the recyclability of materials and have misconceptions about what makes packaging sustainable. This confusion is also often exacerbated by online misinformation, leaving consumers misguided.

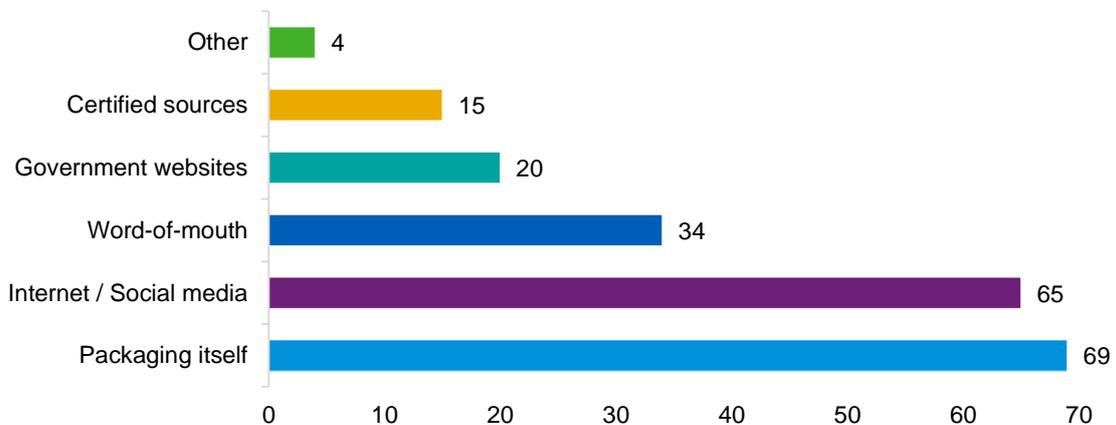
Difficulty for respondents to obtain information on product packaging (e.g., recyclability, reusability, or for disposal)



The survey results that were analysed include:

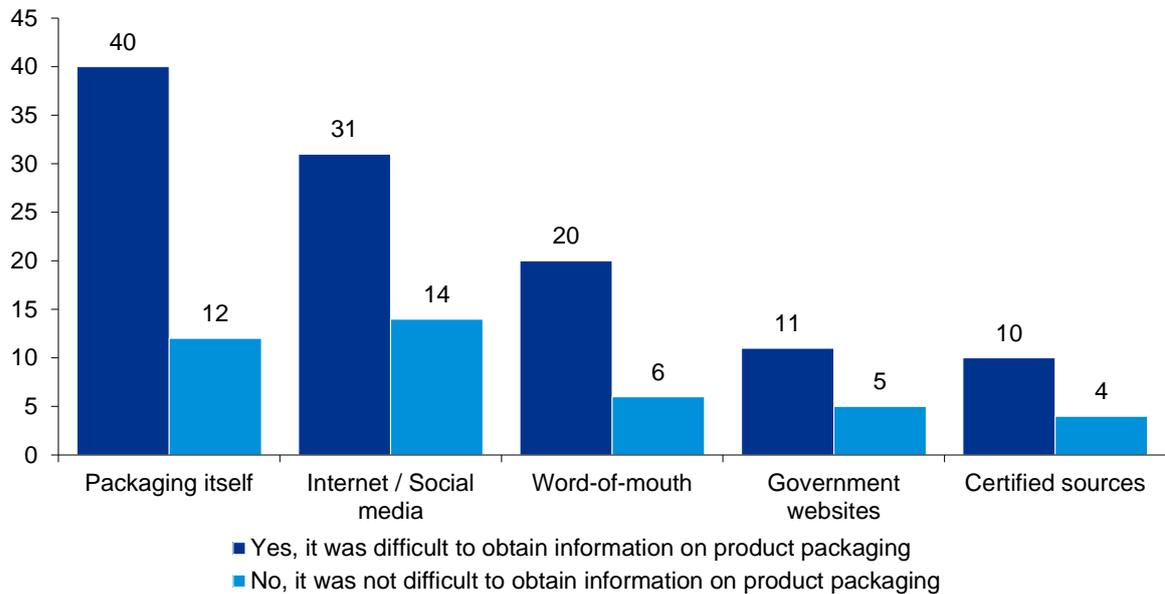
- 50% of respondents found it difficult to obtain information on product packaging and 28% are unsure of the type of information to look for in terms of understanding the product packaging’s recyclability, reusability, or disposal method.

Where respondents derive their source of environmentally friendly information



- Majority of respondents turn to the packaging itself for environmentally friendly information on packaging, followed by the internet/ social media. Brands will have to ensure that they are supplementing sufficient information to their consumers both online and offline.

Where respondents obtain environmentally friendly information and the difficulty level of doing so



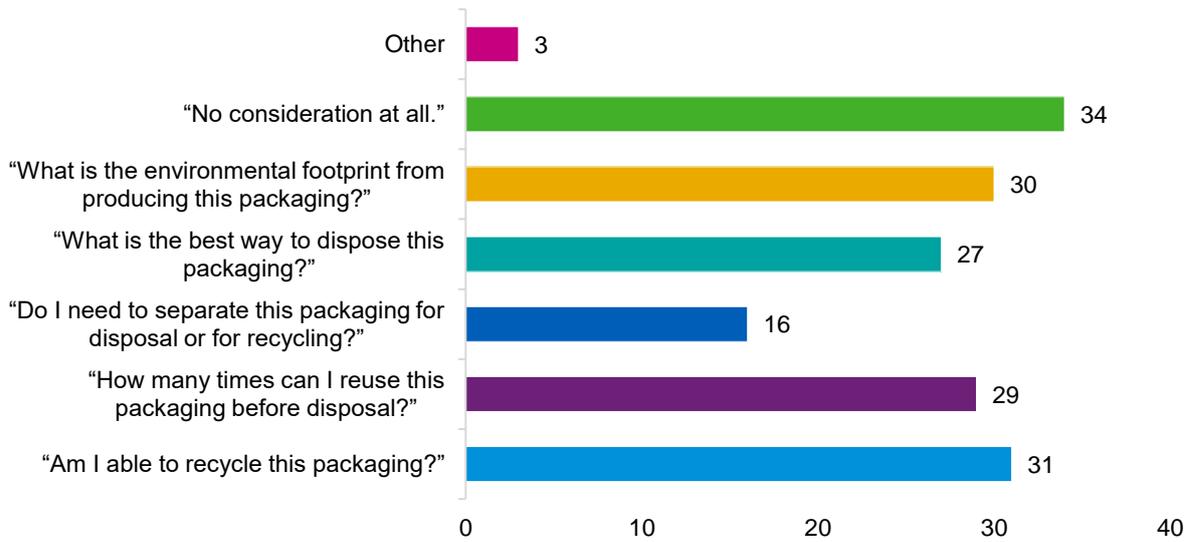
- Out of the respondents who found it difficult to obtain information on product packaging, the typical method would be to turn to the packaging itself followed by the internet/ social media for more information. This highlights the importance of ensuring the information on product packaging provides sufficient information and is properly designed for consumers, as outlined in our recommendation for corporate action.

Key finding 2 (a): Besides pricing, consumers are also concerned about the sustainability of the product’s packaging

As consumers are becoming more environmentally conscious, they are more cognisant of the amount of packaging products are using. It can be seen in everyday items they purchase, such as, individually wrapped cotton buds, oversized box, and excess fillers for a pair of socks¹¹⁶.

¹¹⁶ PackHelp, 13 Bad Packaging Examples That’ll Make You Cry For the Environment. Retrieved from <https://packhelp.com/bad-packaging/>

Besides pricing, these are the other factors that influence the respondents' purchasing decision of a product

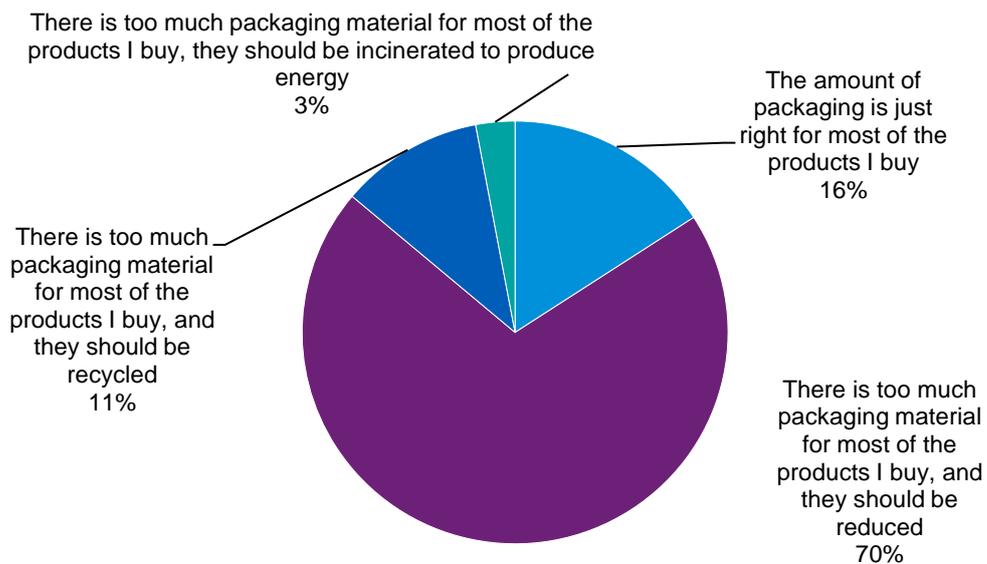


The survey results that were analysed include:

- When purchasing a product, only 30 respondents are primarily concerned about pricing. Besides pricing, the top priorities for respondents are also environmental footprint and the ability to recycle and dispose the packaging.

Key finding 2 (b): There is too much packaging material for most of the products

What consumers think about packaging materials for the products they purchase

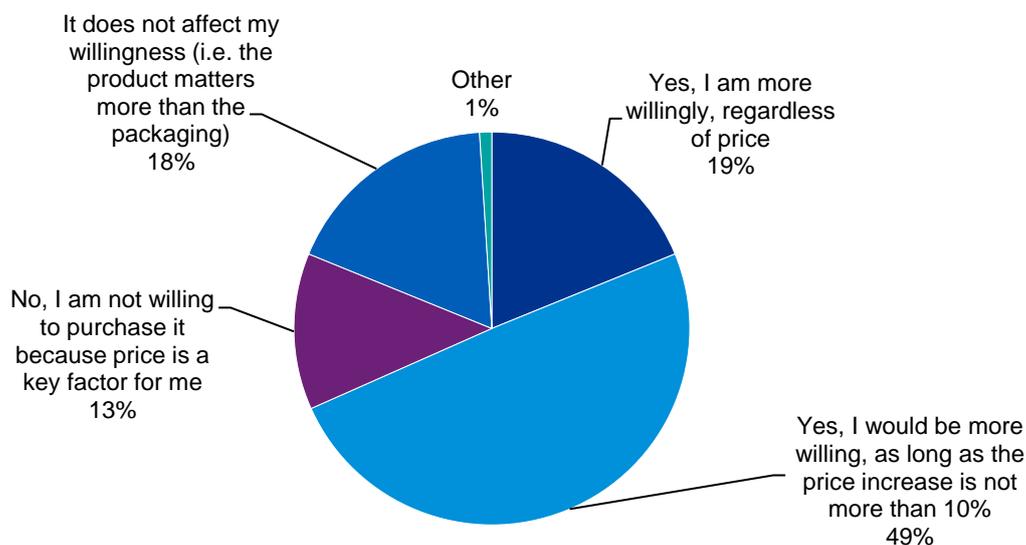


- The vast majority of respondents (70%) agree that there is too much packaging material for the purchased products, and it should be reduced, whereas only 16% see the amount of packaging to be just right for most of the products.

Key finding 2 (c): Eco-labels and eco-friendly design play a significant role in consumer purchasing decisions, however, the ability to recycle the products and their environmental footprint have also emerged as priorities

Today, consumers have started to make changes in their purchasing behaviours by paying more attention to the environmental footprint of products. Product labelling and design are seen as solutions to support the transition towards a circular economy. Eco-labels¹¹⁷ and labelling schemes are used as information-based communication tools to create shifts in consumer choices and guide them towards more environmentally friendly purchase decisions. The main idea behind eco-friendly design¹¹⁸ is that the design phase is the best time to improve the environmental impact of a product. This can be done by integrating environmental aspects into the design stage (e.g., using green materials).

Respondents' willingness to purchase a product if its packaging were designed to be more environmentally friendly



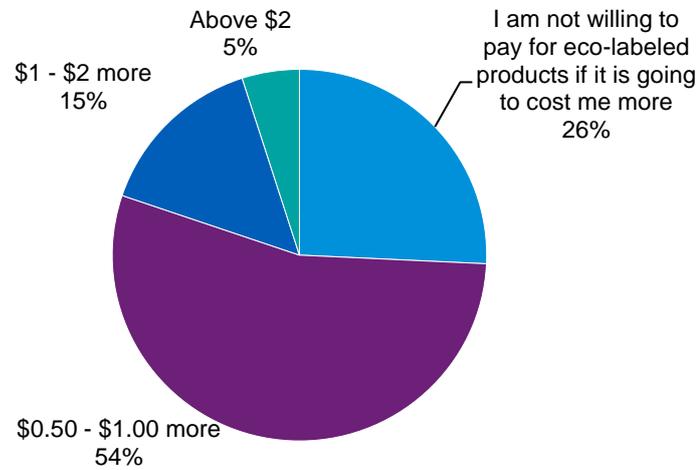
The survey results that were analysed include:

- The majority of respondents (49%) would be more willing to purchase a product if its packaging has an environmentally friendly design and the price increase is no more than 10%, while only 18% claim that it does not affect their willingness to buy a product.

¹¹⁷ ScienceDirect, What is the role of eco-labels for a circular economy? A rapid review of the literature. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0959652621013536#:~:text=Eco%2Dlabelling%20as%20a%20behaviour%20change%20tool&text=Eco%2Dlabels%20are%20thus%20a,the%20environmental%20performance%20of%20products.>

¹¹⁸ Research Gate, Introduction to the Eco-Design Methodology and the Role of Product Carbon Footprint. Retrieved from https://www.researchgate.net/publication/276266304_Introduction_to_the_Eco-Design_Methodology_and_the_Role_of_Product_Carbon_Footprint

Assuming the product cost ten dollars (\$10), how much more would respondents be willing to pay if it were eco-labelled

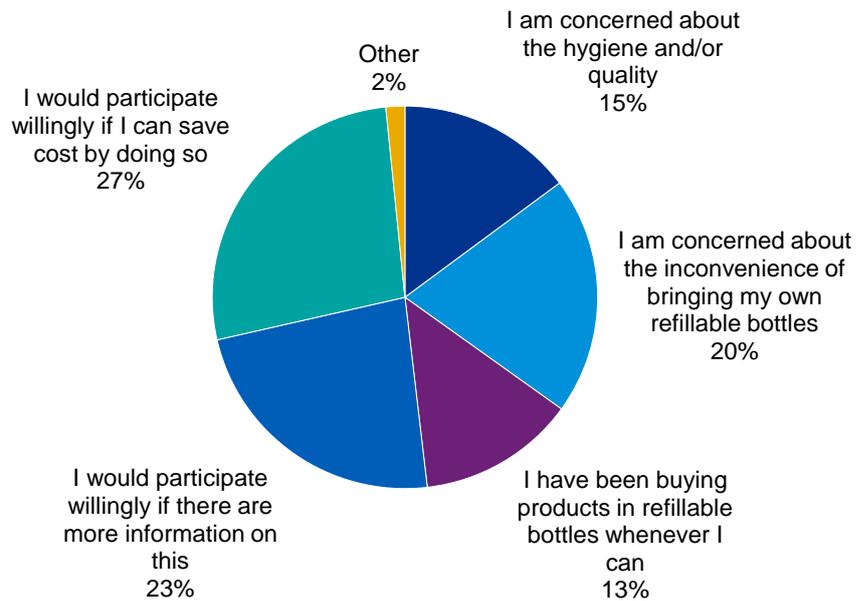


- The majority of respondents (54%) are willing to pay \$0.50 to \$1 more for a \$10 product that is eco-labelled, whereas only 15% are prepared to pay \$1 to \$2 more. This demonstrates that there has been a shift in consumer purchasing decisions, with more consumers being willing to pay extra for environmentally friendly products. Despite that, 26% of the respondents claim that they are not willing to spend more on an eco-labelled product.

Key finding 3: 27% of respondents are willing to buy products in refillable bottles if they can save cost by doing so

Although the average plastic bottle is cheaper per bottle, they are significantly more expensive in the long term, depending on how frequently people purchase them. A reusable bottle, in turn, requires a flat, one-time cost and allow us to get back its value within one week of use, providing a simple money-saving solution.

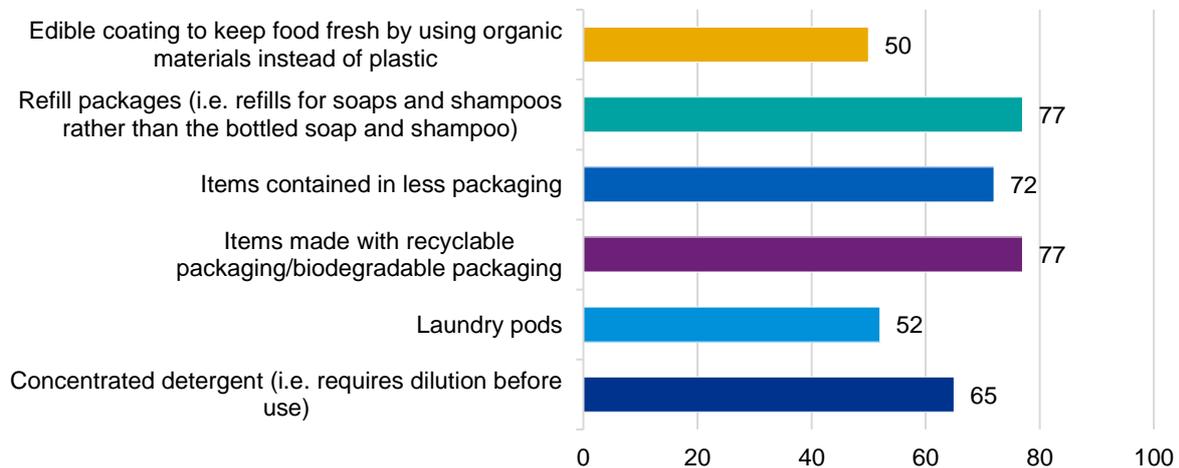
What respondents' think about purchasing products (e.g. food, detergent etc.) in refillable bottles



The survey results that were analysed include:

- 50% of respondents are willing to purchase products in refillable bottles if they can save costs (27%) and have more information on it (23%). However, it is important to also consider the consumers' concerns as some may find it inconvenient to bring their refillable bottles (20%) back to retail stores.

Respondents' willingness to purchase these products if they do not cost more than the conventional product



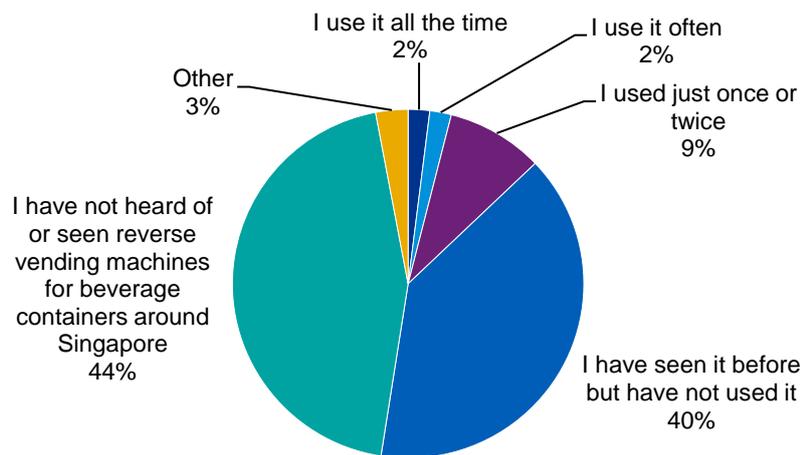
- Majority of respondents would be willing to purchase items made with recyclable or biodegradable packaging as well as refill packages, given that they do not cost more than the conventional product.

Key finding 4: More than half of respondents would participate in a take-back scheme if collection points were made more convenient and accessible across Singapore

Reverse vending machines (RVMs) were designed to encourage the recycling of used plastic bottles and aluminum cans by rewarding users in exchange for depositing used bottles or cans. For example,

the Recycle N Save initiative installed 50 of these machines across Singapore¹¹⁹. This, in effect, brings recycling facilities closer to consumers' homes and businesses and, at the same time, improves recycling rates and raises awareness in the country¹²⁰. However, the survey results indirectly imply that RVMs are placed at inconvenient locations and there may be an insufficient amount of these machines across Singapore.

Respondents' frequency to use reverse vending machines



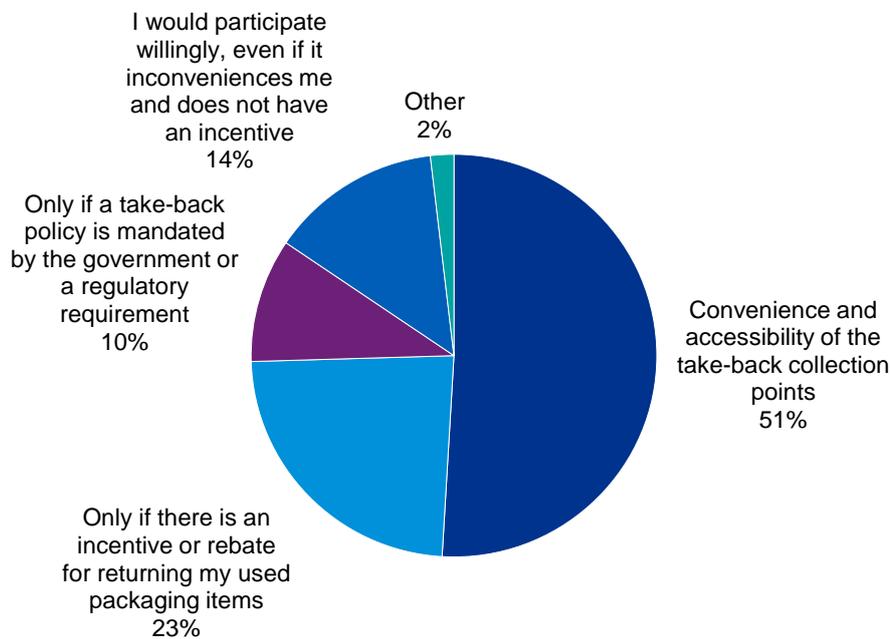
The survey results that were analysed include:

- RVMs have been deployed across Singapore as part of the DRS pilot scheme, yet 44% of respondents claim that they have never seen or heard of RVMs, whilst 40% has never attempted to use them, even though they have seen these machines before. This shows that further education and promotion may be needed to increase Singaporean's awareness and knowledge of RVMs.

¹¹⁹ Recycle N Save, Recycle N Save. Retrieved from <https://recyclensave.sg/>

¹²⁰ The Straits Time, More recycling vending machines for drink containers to be rolled out in Jurong. Retrieved from <https://www.straitstimes.com/singapore/more-recycling-vending-machines-for-drink-containers-to-be-rolled-out-in-jurong>

Conditions whereby respondents would actively participate in a take-back scheme, such as using the reverse vending machines



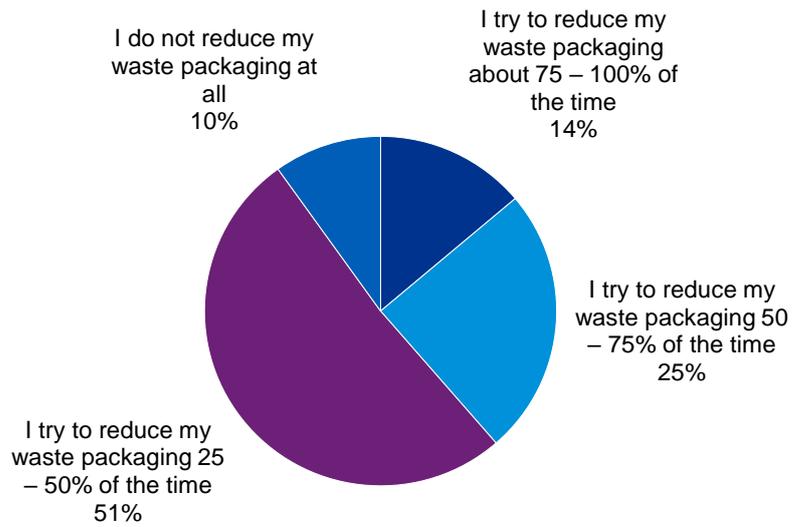
- 51% of respondents would participate in the take-back scheme if take-back collection points would be made more convenient and accessible across Singapore. However, 23% would only do so if there is an incentive or rebate for returning used packaging items.

Key finding 5: Around two-thirds of respondents tend to reuse reusable packaging at least 50% of the time, and more than half of them make an effort to recycle packaging material from purchased products

More and more consumers now focus on reducing plastics and are becoming conscious of the impact of plastic on the environment¹²¹. As consumers demand for alternative packaging solutions (e.g., sustainable packaging), reusable packaging is often seen as a promising solution for replacing single-use products and facilitating the transition towards a circular economy.

¹²¹ Fashion for Good, The Rise of Reusable Packaging. Retrieved from https://reports.fashionforgood.com/wp-content/uploads/2021/04/Reusable_Packaging_Report_April_2021.pdf

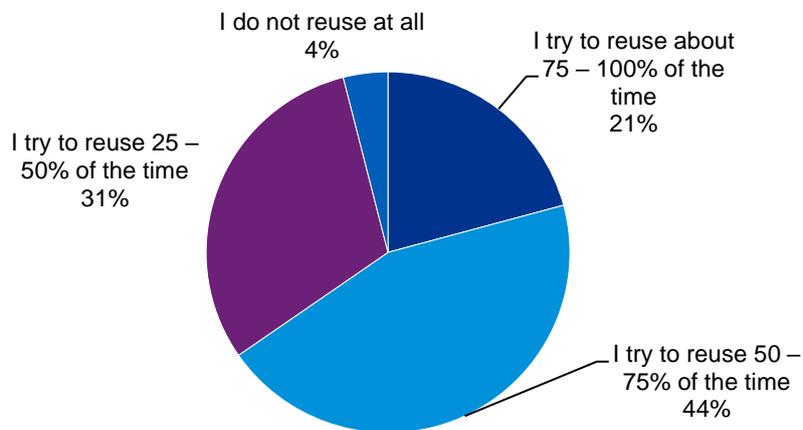
Frequency of respondents reducing the waste packaging they produce



The survey results that were analysed include:

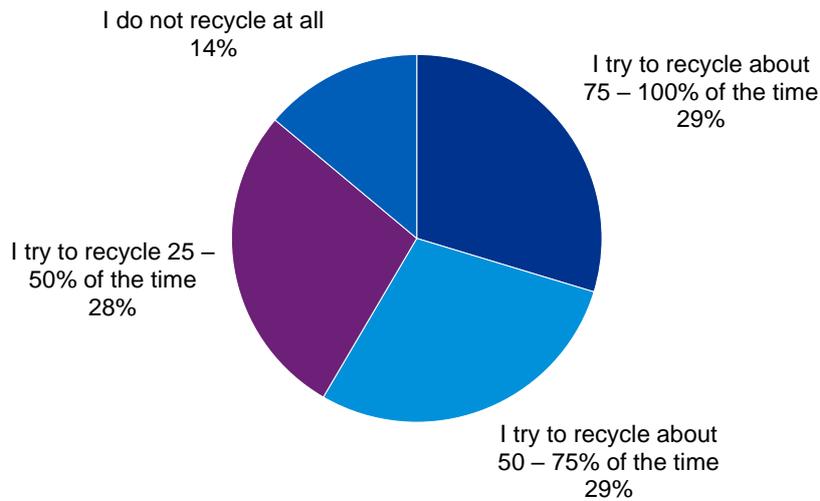
- More than half of the respondents (51%) strive to reduce their waste packaging 25% to 50% of the time, whereas only 14% try to do that 75% to 100% of the time. Besides that, 10% do not make an effort to reduce their waste packaging at all.

Frequency of respondents reusing packaging that can be reused



- Majority of the respondents (96%) strive to reuse packaging that can be reused at least 25% of the time, and 65% reusing packaging at least 50% of the time.

Frequency of respondents recycling the packaging material from the products they purchase (e.g placing in recycling bin)



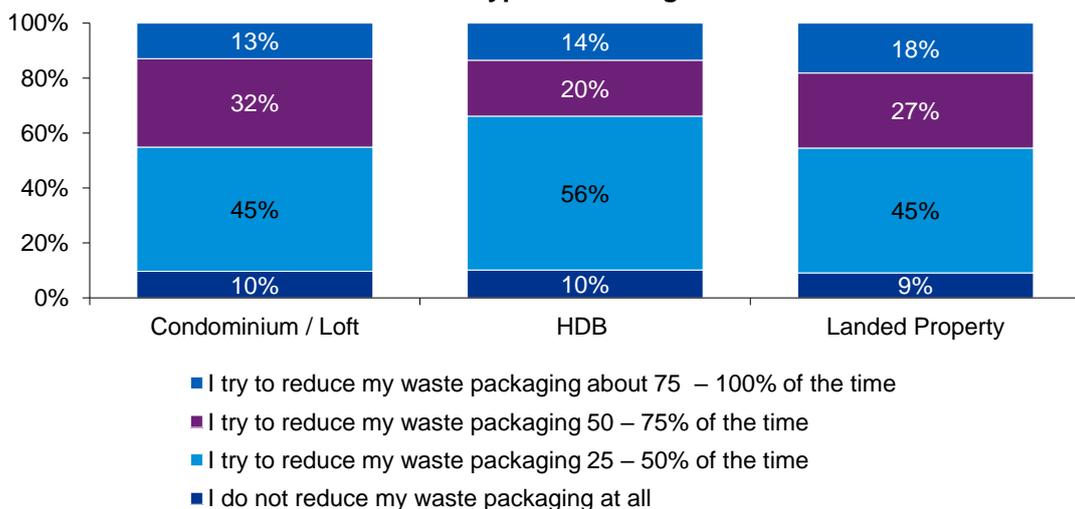
- 29% of respondents try to recycle packaging material from purchased products 75% - 100% of the time, with 58% try to recycle at least 50% of the time and 86% try to recycle at least 25% of the time.

Key finding 6: Regardless of the type of property, most respondents reuse and recycle their waste packaging at least 50%, but only reduce it 25% of the time.

The lack of recycling knowledge may be one contributing factor to poor waste management behaviours in Singapore. The challenge lies in changing the mindset and behaviour of consumers which includes increasing personal responsibility for recycling as well as raising public education and awareness¹²².

Key finding 6 (a): Regardless of the type of housing, the majority of respondents reduce their waste packaging 25 to 50% of the time

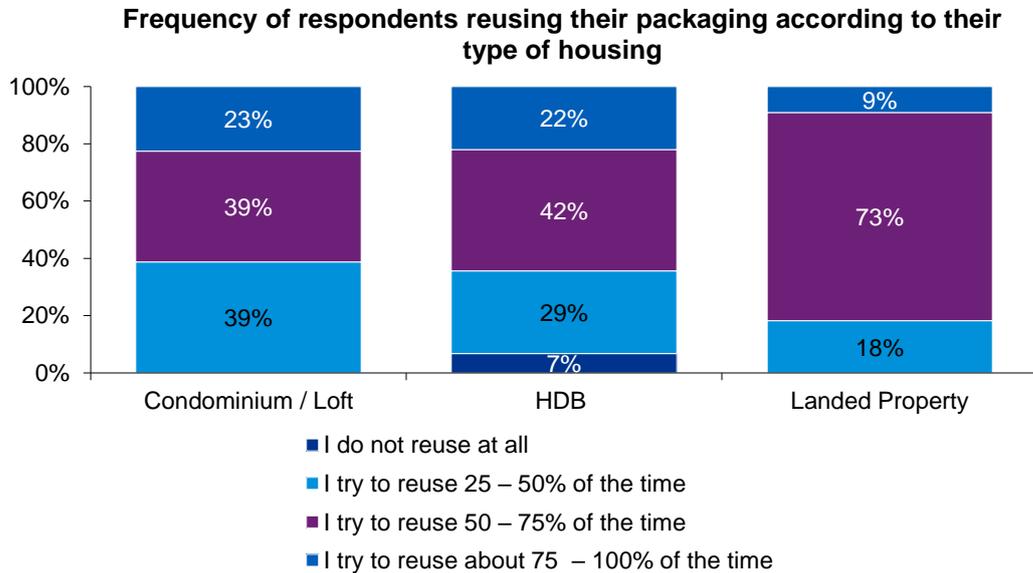
Frequency of respondents reducing their waste packaging according to their type of housing



¹²² Channel News Asia, IN FOCUS: 'It is not easy, but it can be done' - The challenges of raising Singapore's recycling rate. Retrieved from <https://www.channelnewsasia.com/singapore/in-focus-singapore-recycling-sustainability-blue-bins-waste-1339091>

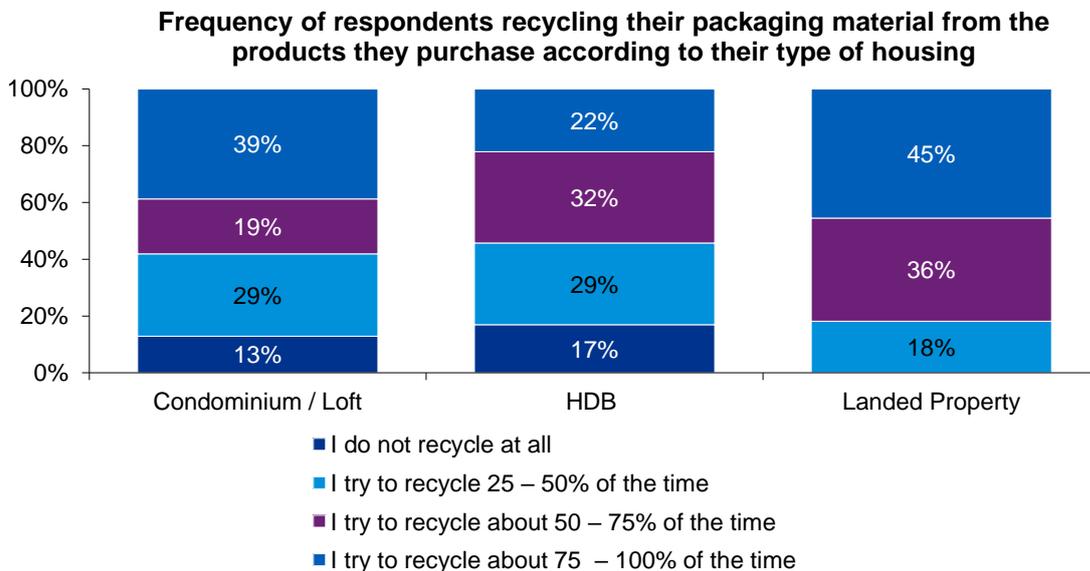
- Regardless of the type of housing, most respondents reduce their waste packaging 25% to 50% of the time. 45% of respondents currently living in a condominium, 56% staying in HDB and 45% staying in landed property reduce their waste packaging 25% to 50% of the time.

Key finding 6 (b): Respondents living in HDB and landed property reuse their waste packaging 50 to 75% of the time whereas those in Condominium reuse at least 25% of the time



- The majority of respondents living in HDB (42%) and landed property (73%) reuse their waste packaging 50 to 75% of the time, while the majority living in a condominium (39%) reuses their packaging either 25% to 50% or 50% to 75% of the time.

Key finding 6 (c): Respondents living in a condominium and landed property recycle their waste packaging 75 to 100% of the time whereas those in HDB recycle only 50 to 75% of the time



- Most respondents living in a condominium (39%) and landed property (45%) recycle their waste packaging 75% to 100% of the time, while the majority of respondents living in HDB (32%) recycle their packaging 50% to 75% of the time.

The tables below summarise the key findings to the two surveys, and the areas of opportunity:

S/N	Key findings from First Survey	Areas of opportunity
-----	--------------------------------	----------------------

1.1	Further education is keenly needed among consumers on the recyclable items in Singapore	<ul style="list-style-type: none"> Improving public awareness
1.2	53% of consumers are inclined to purchase a product that has eco-friendly packaging only if it does not cost more	<ul style="list-style-type: none"> Corporate action – innovative application solutions Certification and labelling of green packaging
1.3a	The role played by the Singapore government and corporates can help to facilitate positive attitudes by consumers in their purchase and recycling decisions	<ul style="list-style-type: none"> Corporate innovation and participation Corporate action-all Government regulation of the market Better education on a simpler recycling system, see 2.1 and 2.2(b)
1.3b	Consumers have different expectations in terms of which stakeholder is responsible for implementing and informing consumers about eco-friendly packaging	
1.3c	Stakeholders can do more to improve their sustainability initiatives and educate consumers	
1.4	Consumers view the effort needed to wash and clean recyclables for recycling as the biggest challenge to recycling; unsure of what can and cannot be recycled	<ul style="list-style-type: none"> Improving public awareness Corporate action – reduce/eliminate composite materials and packaging in general Simple and easily understood labelling system
1.5	More campaigns, clearer labels and enhanced infrastructure will support the market maturity relating to packaging	<ul style="list-style-type: none"> Improving public awareness Corporate action – primary packaging as an information carrier Introducing certification – certification of product packaging

S/N	Key findings from Second Survey	Areas of opportunity
2.1	Product packaging should be improved to provide sufficient information and ensure that it is comprehensible to consumers	<ul style="list-style-type: none"> Corporate action – primary packaging as an information carrier. Educating public on certified source, especially through social media Need for less complex labelling system and easily understood labels
2.2a	Besides pricing, consumers are also concerned about the sustainability of the product's packaging	<ul style="list-style-type: none"> Corporate action - all Corporate action – direct elimination
2.2b	There is too much packaging material for most of the products	<ul style="list-style-type: none"> Corporate action - all Corporate action – direct elimination
2.2c	Eco-labels and eco-friendly design play a significant role in consumer purchasing decisions, however the ability to recycle the products and their environmental footprint also top priorities after pricing	<ul style="list-style-type: none"> Introducing certification – certification of product packaging Label- recyclable and biodegradable
2.2c	53% of consumers are inclined to purchase a product that has eco-friendly packaging only if it does not cost more	<ul style="list-style-type: none"> Corporate action – innovative application solutions

2.3	27% of consumers are willing to buy products in refillable bottles if they can save cost by doing so	<ul style="list-style-type: none"> • Corporate action – reformulation and refills • Improving public awareness on incentives of take-back schemes; simplify RVM's ease of use. Simplify scheme for easy understanding by public. • Label and certification
2.4	More than half of consumers would participate in a take-back scheme if collection points were made more convenient and accessible across Singapore	
2.5	Around two-thirds of consumers tend to reuse reusable packaging at least 50% of the time, and more than half of them make an effort to recycle packaging material from purchased products	
2.6a	Regardless of the type of property, most respondents reuse and recycle their waste packaging at least 50% but reduce it only 25% of the time.	
2.6b	Regardless of the type of housing, most respondents reduce their waste packaging 25 to 50% of the time	
2.6c	Respondents living in HDB and landed property reuse their waste packaging 50 to 75% of the time whereas those in Condominium reuse at least 25% of the time	
2.6d	Respondents living in a condominium and landed property recycle their waste packaging 75 to 100% of the time whereas those in HDB recycle only 50 to 75% of the time	

4. Opportunities for a more circular economy

Inefficient waste management not only can lead to financial losses but are also the main cause of material degradation¹²³. To achieve more sustainable waste management, Singapore must adopt a different perspective on waste reduction and materials recycling and reuse. This can be tackled at the upstream and downstream levels. Upstream reduction of used packaging material would mean less packaging waste is generated. As there will still be some waste generation, procedures that support closed-loop recycling can help waste or by-products become new products. In both cases, businesses

¹²³ Bureau Veritas, Sustainable waste management certification. Retrieved from <https://certification.bureauveritas.com/sustainable-waste-management-certification>

can reduce environmental impacts and achieve cost savings. The following illustration maps out potential opportunities within Singapore's packaging waste management ecosystem:

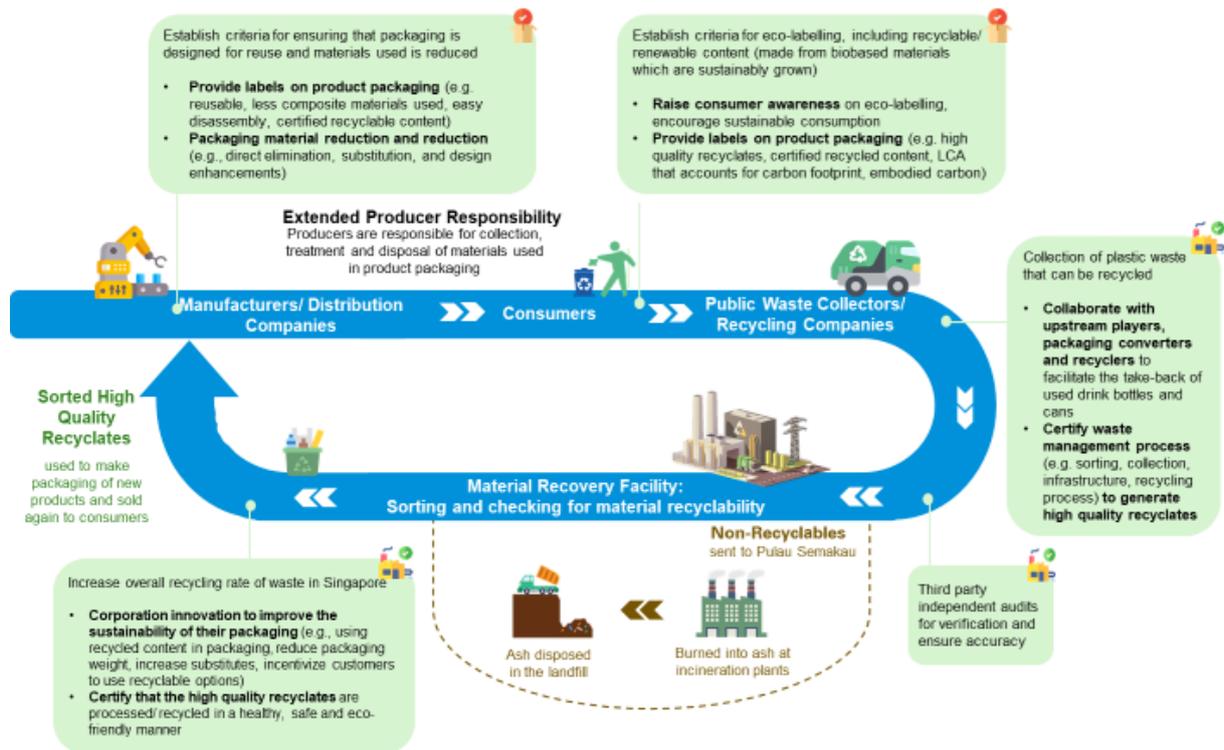


Figure 4: Opportunities in Singapore's packaging waste ecosystem

4.1 Corporate Action

Despite disruptions from the COVID-19 pandemic, waste reduction efforts to reduce, reuse, and recycle remains important in Singapore's vision of becoming a Zero Waste Nation. Companies continue to embrace environmental commitments to curtail virgin plastic use using more environmentally friendly packaging options like biodegradable containers¹²⁴ and extending plastic bag charges to reduce plastic bag consumption.

Notwithstanding that some waste is inevitable, the COVID-19 pandemic has impacted developments in sustainable packaging. Of which, this has signaled an inherent requirement for innovative packaging solutions for the industry today. Beyond “must-haves”, packaging companies must seek to rethink packaging design while retaining reasonable costs, convenience, and performance.

As a result of heightened digital engagement in the wake of “stay-at-home” orders, online grocery shopping is likely to persist even after the pandemic is over. The increased e-commerce penetration is forecasted to have significant implications for packaging design.

In light of the pandemic and the challenges outlined in Section 1.4, the below opportunities for corporate action can help to minimise packaging waste, alleviating the need for local capacity. Additionally, several of the opportunities listed below such as effective utilization of packaging as an information carrier (see Section 4.1.1) and container return schemes (see Section 4.1.8) can help to engage and educate consumers.

4.1.1 Primary packaging as an information carrier

The consumer's perceptions of both the actual product and brand value are highly dependent on the packaging. Survey 1 (key finding 5) and survey 2 (key finding 1) suggest how product packaging serves as an important source of information for consumers and the need to ensure there is sufficient information on the packaging that is clearly and accurately labelled. Therefore, a key component in promoting a sustainability narrative is to educate consumers about the product inside and help them to differentiate between packaging materials and the ways to use or recycle it (i.e., clarity for consumers on how packaging should be collected and sorted at recycling stations).

There are 5 recommendations for effective communications on plastic packaging¹²⁵:

1. The plastic packaging communications of businesses should be consistent with the Guidelines for Providing Product Sustainability Information¹²⁶ (see Figure 5).
2. There needs to be global consistency for definitions relating to the content and reusability of packaging or disposable items.
3. Actual conditions need to be reflected in a better way in standards, labels, and claims.
4. Restricting the use of the ‘chasing arrows’ symbol to indicate recyclability.
5. Adopting informative and verified recycling labels and enforcing their proper use.

¹²⁴ Channel News Asia, Commentary: Here's what months of food deliveries and takeaways have taught us. Retrieved from <https://www.channelnewsasia.com/commentary/plastic-zero-waste-byo-food-delivery-takeaway-resuable-container-651796>

¹²⁵ Consumers International, Key messages and case studies to provide credible sustainability information on plastic packaging. Retrieved from <https://www.consumersinternational.org/news-resources/news/releases/key-messages-and-case-studies-to-provide-credible-sustainability-information-on-plastic-packaging/>

¹²⁶ One Planet Network, Guidelines for Providing Product Sustainability Information. Retrieved from <https://www.oneplanetnetwork.org/knowledge-centre/resources/guidelines-providing-product-sustainability-information>

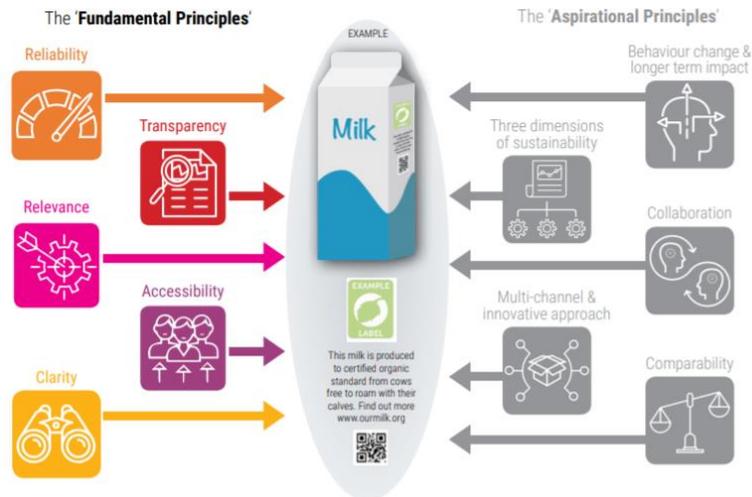


Figure 5: Fundamental principles for providing Product Sustainability Information¹²⁷

An example would be The Australian Packaging Covenant Organisation (APCO) that started a national labelling program for Australia and New Zealand, providing consumers with accurate recycling information and helping brands design and label packaging for recycling. Australasian Recycling Label (ARL) is an on-pack label that provides disposal information to help consumers correctly recycle their packaging. ARL is a voluntary program that is exclusive to APCO members who pay a membership fee¹²⁸ to gain access to Packaging Recyclability Evaluation Portal (PREP) and ARL¹²⁹. ARL provides disposal information for each material, as most packaging has more than one element of composition with different implications for its recyclability. The three main classifications, as seen in the figure below from left to right, include: recyclable, conditionally recyclable (can be recycled if instructions below the symbol are followed) and not recyclable¹³⁰.

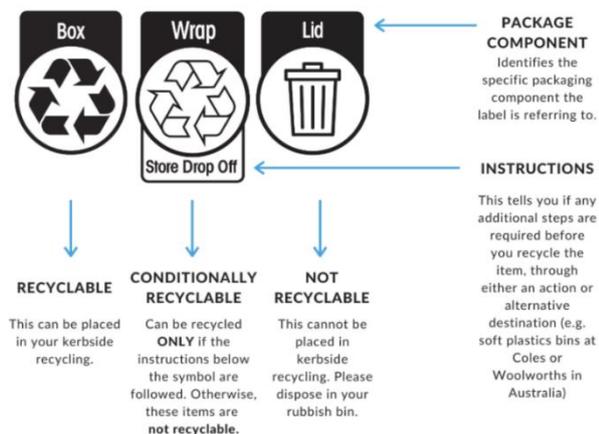


Figure 6: Example of ARL¹³¹

¹²⁷ One Planet Network, Guidelines for Providing Product Sustainability Information. Retrieved from <https://www.oneplanetnetwork.org/knowledge-centre/resources/guidelines-providing-product-sustainability-information>

¹²⁸ APCO, Membership options. Retrieved from <https://apco.org.au/about-membership>

¹²⁹ APCO, Australasian Recycling Label Program. Retrieved from <https://apco.org.au/faqs?category=Australasian+Recycling+Label+Program>

¹³⁰ Consumers International, Australasian Recycling Label (ARL). Retrieved from https://www.consumersinternational.org/media/361469/unep_ci_2021_arl_case_study.pdf

¹³¹ APCO, The Australasian Recycling Label Program. Retrieved from <https://apco.org.au/the-australasian-recycling-label>

Effective communication such as the above would be beneficial in the Singapore context, given the lack of public awareness and education on recycling (see Section 1.4.2).

4.1.2 Direct elimination

Survey 2 (key finding 2) suggests the push for brands to rethink how much packaging is used as consumers find that there is too much packaging material for most of the products. Redesigned formats to improve packaging design need not come with cost pressures and can be carried out with only minimal impact on operating costs and capital expenditures. For instance, some supermarkets like Tesco¹³² in the UK and Walmart¹³³ in Canada have started phasing out the use of unnecessary plastic films for products such as multi-buy tins, yoghurt pots, and wrapping from some vegetables (e.g., broccoli, bell peppers).

Supermarkets such as Sainsbury have also started to trial plastic packaging-free fruit and vegetable aisles in their grocery stores. This will give customers the option of bringing their own containers or buying a reusable drawstring bag for loose produce¹³⁴. A similar move in Singapore is not unlikely, which is already being practiced in NTUC FairPrice and Cold Storage, however complete elimination of plastic packaging at our local supermarkets may not be fully accepted for hygiene and cross-contamination concerns.

Nevertheless, plastic packaging redesign (i.e., by simply eliminating unnecessary packaging where possible) could represent a decrease of up to 20% by 2050 and save as much as 425 metric tons of plastic from entering the waste stream in the forecast period¹³⁵.

Beyond supermarkets, direct elimination approaches could further reduce the global plastic packaging footprint within the e-commerce sector. For example, Amazon introduced their “Frustration Free Packaging (FFP)” concept to help manufacturers reduce packaging waste and develop sustainable alternatives for online fulfilment. By June 2021, Amazon reports having reduced the weight of outbound packaging by over 36% and eliminated more than 1 million tons of packaging material since 2015¹³⁶.



Figure 7: Elimination of plastics¹³⁷

Another way to eliminate packaging of consumer products is to sell solutions and services of the products instead of the products themselves. Such a business model is often known as servitisation¹³⁸.

¹³² BBC News, Tesco to ditch plastic-wrap for multipack tins. Retrieved from <https://www.bbc.com/news/business-51223214>

¹³³ Walmart Canada, Update: Walmart Canada prevents 1.1 million pounds of plastic from entering its supply chain. Retrieved from <https://www.walmartcanada.ca/news/2019/10/24/update-walmart-canada-prevents-11-million-pounds-of-plastic-from-entering-its-supply-chain>

¹³⁴ Channel News Asia, Could more be done to reduce plastic packaging waste in Singapore's supermarkets?. Retrieved from <https://www.channelnewsasia.com/singapore/reduce-plastic-packaging-supermarkets-clingwrap-1319216>

¹³⁵ Wood Mackenzie, Packaging redesign could reduce global plastic demand by 20% by 2050. Retrieved from <https://www.woodmac.com/press-releases/packaging-redesign-could-reduce-global-plastic-demand-by-20-by-2050/>

¹³⁶ <https://sustainability.aboutamazon.com/environment/circular-economy/packaging>

¹³⁷ Walmart, Waste: plastics. Retrieved from <https://corporate.walmart.com/esgreport/esg-issues/waste-plastics>

¹³⁸ Colette Aubertin, From Product to Product-as-a-Service Jul 2, 2019 <https://medium.com/swlh/from-product-to-product-as-a-service-37baed471cd6>

There is an increasing number of companies servitising their offerings instead of consumer-owned products. One example is Philips' initiative to servitise LED lamps through its Lighting-as-a-Service offering. In this business model, clients are not paying for light bulb and equipment, but pays for light availability as a service¹³⁹. No light bulb packaging waste is generated as Philips owns the bulbs and lighting fixtures and recovers them at the end of the service contracts. Computing devices is another example where major device manufacturer like HP¹⁴⁰ and Lenovo¹⁴¹ are offering Device-as-a-service (DaaS)¹⁴². Globally, the DaaS market is expected to reach \$66.1 million by 2023, at a 54.7% compound annual growth rate¹⁴³. In general, many durable consumer products can be leased as a service (aaS), eliminating post-consumer packaging waste. Thus, changing business models from product to service reduces packaging waste tremendously as no products are sold and product packaging is largely unnecessary.

Case Study: Apparel as a Service

Renting products offers new revenue streams for businesses, especially at times of supply chain disruption. Hirestreet's new business, Zoa, allows brands and retailers to reduce their impact on the environment by introducing a complimentary rental option for their customers.

Rental service Hirestreet stocks major brands, including Zara and ASOS. Hirestreet users, mostly 18 to 35-year-old women, can book outfits in advance and hire them for four to 16 days¹⁴⁴.

Users select the size, rental period, and delivery date. They can also choose to add insurance to any of their items before proceeding to checkout, to cover against any accidental damages. Their usual order packaging is resealable and will contain a return label. Once the garment has been worn, it can be returned via Royal Mail to Hirestreet's warehouse in Glasgow.

After several rentals, some garments would start to show signs of wear and unleaseable. Hirestreet is selling some of these items through the Hirestreet Pre-Loved Collection. All the outfits are available to buy at a discounted rate of up to 70% off recommended retail price.

All packaging cardboard, polyethylene and paper are recycled. Hirestreet is seeking to increase clothing use and has saved customers over 2 million pounds by renting instead of buying. With more than one million site users, the firm is working with brands like French Connection, Whistles, Lavish Alice and Ghost, renting affordable outfits to mostly young, working professional women looking to hire outfits for special occasions, including weddings, parties, and holidays.

During the pandemic, the fashion rental firm offered their tech to other businesses, allowing retailers the chance to offer rental as an option for their customers.

Another example is MUD¹⁴⁵, which makes, rents, and recycles organic cotton jeans. MUD lease jeans made from 40% recycled denim and 60% organic cotton for a monthly fee. Free repairs are included during the leasing period.

¹³⁹ National Zero Waste Council, CIRCULAR ECONOMY CASE STUDIES & SNAPSHOTS

<http://www.nzwc.ca/Documents/PhilipsLight.pdf>

¹⁴⁰ HP Commercial PC Services, HP Device as a Service, 2022, <https://www.hp.com/us-en/services/daas.html>

¹⁴¹ Lenovo Device as a Service, Sign up Page, 2022, <https://www.lenovo.com/sg/en/daas>

¹⁴² Ryan LaFlamme, Tech industry Trends, forecasts & research, The Big -aaS List of As-a-Service Offerings, November 3, 2020, <https://www.auvik.com/franklyit/blog/aas-as-a-service-list/>

¹⁴³ Market Research Future, 2022, <https://www.marketresearchfuture.com/reports/device-as-a-service-market-4486>

¹⁴⁴ "Offering accessible clothing rental to users and retailers: Hirestreet", v The Ellen MacArthur Foundation, 23 Nov 2021. <https://ellenmacarthurfoundation.org/circular-examples/hirestreet>

¹⁴⁵ "Organic jeans for rent: MUD jeans" The Ellen MacArthur Foundation, <https://ellenmacarthurfoundation.org/circular-examples/mud-jeans>

Even luxury brands like Ralph Lauren¹⁴⁶ has adapted its business model with a rental subscription service. it has launched a rental subscription service in March 2021 called 'The Lauren Look'. Starting at USD 125 a month for the membership, the rental subscription allows members to rent looks from the most recent Lauren collections. The Lauren Look will include all sizes the Lauren collection offers. The membership includes Lauren, Lauren Woman, and Lauren Petite, and also includes suggestions from expert stylists. The platform more accurately reflects consumer trends, which reduce the amount of unsold inventory while helping subscribers reduce purchasing new clothes. Post-consumer packaging waste reduces as a result.

4.1.3 Packaging-design enhancements

Today, modern flexible plastic packaging often consists of several layers of different plastic types, decorated with bright colour inks, and glued together for the purposes of keeping content fresh and consumable for a sufficiently long time. However, multilayer plastic packaging despite its valuable protective properties is often difficult to recycle and is perceived as an environmental problem. A promising route to increase recycling rates for these materials is delamination, which allows the polymers to be recycled separately¹⁴⁷. By taking advantage of innovative materials and using mono materials¹⁴⁸ in packaging, recycling can be made simpler through new forms of packaging and design elements.

Despite promising environmental impacts and technical feasibility, these techniques of delamination are not common on an industrial scale and currently have not obtained precise numbers to operate at large¹⁴⁹. Nevertheless, delamination could become a key process in the circular economy of packaging plastics as it allows for the recovery of polymers separately. Over time, a fundamental understanding of the delamination mechanism would strongly accelerate the effort for multilayer plastic packaging waste management and significantly reduce the need for new plastic packaging material.



Figure 8: Delamination of multilayer plastic film¹⁵⁰

¹⁴⁶ “ Rental subscription service for timeless products: The Lauren Look by Ralph Lauren”, The Ellen MacArthur Foundation, 23 November 2021, <https://ellenmacarthurfoundation.org/circular-examples/ralph-lauren>

¹⁴⁷ ChemSusChem, Towards a Better Understanding of Delamination of Multilayer Flexible Packaging Films by Carboxylic Acids. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8518906/>

¹⁴⁸ Mono materials are those incorporating only one resin such as polyethylene (PE) or polypropylene (PP) in order to create plastic firms with high recyclability. This is in contrast to multi-layer packaging that uses a combination of different plastic types to create a barrier with high “sealability” and “printability”.

¹⁴⁹ Cleaner Environmental Systems, Sustainability of flexible multilayer packaging: Environmental impacts and recyclability of packaging for bacon in block. Retrieved from <https://www.sciencedirect.com/science/article/pii/S2666789420300015>

¹⁵⁰ The process of delamination be useful in the plastic recycling sector since it can be applied to different types of laminates from plastic waste of both industrial and domestic origin.

4.1.4 Innovative application solutions

Survey 1 (key finding 2) reveals how consumers are inclined to purchase products that have eco-friendly packaging, signaling the growth potential of this market. However, as consumers are still price sensitive and the innovative applications market is nascent, it would take some time before the market matures and become cost competitive.

R&D experts are pushing the technical boundaries in plastic packaging and were able to make progress through downgauging and light-weighting¹⁵¹. Efforts to push major brands such as Nestle, Unilever, and PepsiCo to cut down their use of plastic seems to be bearing fruit. For example, Nestle has reduced the weight of its water bottles by 22% over the last decade and is on track to meet its goal of avoiding 140,000 tonnes of packaging material by 2020.

Apart from light-weighting and downgauging, other companies have started to look at a range of innovative application solutions to support sustainable packaging aspirations. For example, UK-based packaging and paper company Mondi has introduced a high barrier pouch for food and wet pet food products¹⁵². The fully recyclable mono-material retort packaging solution is designed to replace multilayer and unrecyclable packaging while protecting the product and minimising food waste.



Figure 9: Mondri's RetortPouch Recyclable

Some companies such as Dell have created a new supply chain technology that recovers ocean-bound plastics and collects them for reuse to make new parts for new computers and monitors each year. Dell reported a 30-35% closed-loop recycled resins content¹⁵³ because of their technology.



Figure 10: Dell uses recycled ocean plastics in its laptop packaging

¹⁵¹ Light-weighting reduces the overall amount of material to create packaging and has become part of an overall sustainability strategy for many brands.

¹⁵² Packaging Gateway, Mondri introduces RetortPouch Recyclable mono-material packaging. Retrieved from <https://www.packaging-gateway.com/news/mondi-retortpouch-recyclable/>

¹⁵³ Dell Technologies Singapore, Recycled materials. Retrieved from <https://corporate.delltechnologies.com/en-sg/social-impact/advancing-sustainability/sustainable-products-and-services/materials-use/recycled-materials.htm>

While these solutions offer higher recyclability today, they are far from being cost-efficient. Successful applications will need to be at a neutral or affordable cost tradeoff to gain scale; this is partly because research for these development initiatives is at early stages and often use costly materials.

Nevertheless, upstream substrate producers are taking the lead in innovative applications and sustainable packaging solutions. For example, some paper producers are using bio-derived products – most of which are recyclable, compostable, or both – to replace plastics. This can be in the form of flexible paper-based packaging with water-based coatings that act as barriers for vapour, oxygen, and oil. In another example, micro-fibrillated cellulose (MFC)¹⁵⁴ is used in paper board production to create a lighter but stronger packaging board that also uses less virgin material.



Figure 11: Stora Enso has already market tested this fibre derivative in milk cartons for the dairy industry

4.1.5 Use of recycled content

The rise of green consumer and market demand for sustainable packaging alternatives is further driving the market for recycled plastics and major corporations have set sustainability targets that include the use of recycled PET¹⁵⁵. Some major players in the beverage industry have announced that they will be transitioning to using 100% recycled PET bottles in European markets or have quantitative targets such as using 25% recycled content in its packaging by 2025¹⁵⁶. There is also substantial work underway to develop more food-safe-grade plastic films incorporating recycled content.

For example, Danone has established ambitious goals to make its packaging 100% circular. This includes expanding the amount of recycled and bioplastic used in their packaging. By 2025, Danone aims to incorporate 25% of recycled material on average in their plastic packaging; 50% on average for their water and beverage bottles; and 100% for all Evian bottles¹⁵⁷.

¹⁵⁴ Micro-fibrillated cellulose (MFC) is a natural performance enhance for bio-based packaging materials. It is known for creating lighter, stronger packaging that improves material efficiency and delivers high performance. It is also known to potentially replace packaging raw materials containing fossil fuel.

¹⁵⁵ KPMG, Market trends plastics recycling market, 2016

¹⁵⁶ Eco-Business, Cheap virgin plastic is being sold as recycled plastic—it's time for better recycling certification/#:~:text=The%20price%20of%20virgin%20polyethylene,now%20US%241%2C000%20a%20tonne. Retrieved from <https://www.eco-business.com/news/cheap-virgin-plastic-is-being-sold-as-recycled-plastic-its-time-for-better-recycling->

certification/#:~:text=The%20price%20of%20virgin%20polyethylene,now%20US%241%2C000%20a%20tonne.

¹⁵⁷ Danone, Circular economy model. Retrieved from <https://www.danone.com/impact/planet/packaging-positive-circular-economy.html>



Figure 12: All Evian bottles today are 100% recyclable and contain on average 30% recycled plastic (rPET)¹⁵⁸

At the same time, several virgin plastic resin producers have acquired plastics recycling processors to add recycled plastic to their portfolio of resin offerings. Having these products available would make it much easier for converters that aspire to include recycled content in their products.

In another example, global materials solutions provider and manufacturer, Trinseo launched a new portfolio of resins called “PULSE™ ECO” which is composed of 30% recycled content to meet the insatiable demand for its recycled polystyrene (R-PS). Not only is the recycled plastics compound used in consumer electronics applications and safe for use in food applications, but Trinseo is also targeting parts used in the interior of automobiles¹⁵⁹.

4.1.6 Reformulation

Survey 2 (key finding 3) shows that consumers are willing to purchase refillable products if they can save cost while doing so. This is a positive signal for the market and major FMCG manufacturers like Unilever have started offering concentrated versions of products that can be decanted into spray bottles¹⁶⁰ for use at home. In another example, P&G launched its classic liquid detergent in a new packaging designed specifically for online e-commerce orders. The detergent was reformulated to be more concentrated¹⁶¹ and its packaging was designed to reduce overall weight in transit.



Figure 13: Toothpaste tablets are an alternative to traditional plastic tubes

¹⁵⁸ Danone, Evian® Transforms Its Approach To Plastic To Become A 100% Circular Brand By 2025. Retrieved from <https://www.danone.com/stories/articles-list/evian-transforms-approach-to-plastic.html>

¹⁵⁹ ICIS, US Trinseo sees higher margins for sustainable products. Retrieved from <https://www.icis.com/explore/resources/news/2021/02/04/10602995/us-trinseo-sees-higher-margins-for-sustainable-products/>

¹⁶⁰ dezeen, Cif spray bottles can be refilled with ecorefill cleaning concentrate. Retrieved from <https://www.dezeen.com/2019/07/16/cif-ecorefill-spray-bottle-concentrate-cleaning-product-design/>

¹⁶¹ Packaging Europe, Turning the Tide: The Eco-Box eCommerce Rethink. Retrieved from <https://packagingeurope.com/tide-procter-gamble-ecobox-ecommerce-packaging/>



Figure 14: Concentrated refill bottles



Figure 15: Repackaged and concentrated detergent

4.1.7 Refill and reuse

Global beverage giants like Coca-Cola and PepsiCo¹⁶² have started investing in new technologies to improve drink dispensers that will encourage customers to reuse their bottles.



Figure 16: PepsiCo launches drinks dispenser for refillable bottles

Terracycle, the parent company of Loop, has devised its own deposit return scheme, with big players and partners like Nestlé, PepsiCo, Unilever, Mars, Clorox, Coca-Cola, Mondelēz, Danone and Carrefour and UPS. Consumers simply pay a small deposit for a reusable package when ordering goods from the Loop website or that of a partner and have them delivered like traditional products purchased online¹⁶³.

¹⁶² Environmental Leader, PepsiCo Moves Away from Single-Use Plastics, Promotes Reusable Bottles. Retrieved from <https://www.environmentalleader.com/2019/04/pepsico-moves-away-from-single-use-plastics-promotes-reusable-bottles/>

¹⁶³ GreenBiz, Loop's launch brings reusable packaging to the world's biggest brands. Retrieved from <https://www.greenbiz.com/article/loops-launch-brings-reusable-packaging-worlds-biggest-brands>

If the container is empty, then customers would place it in a specially designed tote for pickup or bring it to a retailer. They can choose to either have that product replenished or receive their deposit which will be returned or credited to their account. Subsequently, the empties are dispatched to a facility to be washed and refilled.

Pack has silicone FlexBox and stainless steel KindCup to replace single-use food packaging¹⁶⁴. BarePack partnered with major food delivery platforms in Singapore such as GrabFood, Deliveroo and FoodPanda to allow customers the choice to have their food delivered in these reusable packages. Customers can then choose to return the reusables to any of the 120 drop-off points in Singapore or request a home pick-up service from BarePack, who will then professionally clean and reuse the items. Similar business models have also adopted internationally by other companies such as Canadian company Reusables, Spanish company Bumerang and Norway's Packoorang.¹⁶⁵

The efforts made by companies to reduce packaging waste upstream of the consumer can be seen in three ways: package, product and business model. These three ways are not mutually exclusive and can impact each other (See Case Study: Toothpaste).

Case Study: Toothpaste

Toothpaste tubes are a form of product packaging that has remained largely unchanged since its invention in 1856.¹⁶³ Toothpaste tubes are single-use packaging made of fossil fuels, comprising layers of mixed materials, aluminium and plastic. Thus, they almost never recycled, and do not biodegrade. Globally, about 1 to 1.5 billion toothpaste tubes are discarded annually^{166,167}.

Several companies have been providing low environmental impact (green) packaging for a few years now. The packaging for these toothpaste are either reusable, recyclable or biodegradable. A few are introduced in this text box.

Colgate's recyclable tube

Colgate launched its first-of-its-kind recyclable plastic tube in 2020. The solution is to transform rigid, High-Density Polyethylene (HDPE) into soft, squeezable laminate tubes. Colgate experts worked with recycling associations to help to ensure alignment with existing standards so tubes could be recycled in the existing HDPE bottle stream. HDPE can be a raw material for a variety of things, including construction materials and new packaging. Interestingly, decided to share the technology with other companies and now other brands are developing their own recyclable tubes enabling a huge collective step forward towards sustainability.



Better and Better produces toothpaste that comes in a razor thin pouch that uses 54% less plastic than traditional tubes. The packaging is completely collapsible to reduce landfill waste by 84% and the pliable material makes it easier to get the toothpaste out reducing product waste. It uses a subscription-based business model to offer top-ups and refills, avoiding single-use tubes packaging entirely.

¹⁶⁴ Green Queen, Return & Reuse: 8 Circular Packaging Companies To Watch In The Race To Close The Waste Loop. Retrieved from <https://www.greenqueen.com.hk/return-reuse-8-circular-packaging-companies-to-watch-in-the-race-to-close-the-waste-loop/>

¹⁶⁵ Green Queen, Return & Reuse: 8 Circular Packaging Companies To Watch In The Race To Close The Waste Loop. Retrieved from <https://www.greenqueen.com.hk/return-reuse-8-circular-packaging-companies-to-watch-in-the-race-to-close-the-waste-loop/>

¹⁶⁶ 13 "Zero Waste Toothpaste Brands – Plastic Free Products To Sink Your Teeth Into" Sustainable Jungle, 2019 <https://www.sustainablejungle.com/best-of-sustainable-beauty/zero-waste-toothpaste/>

¹⁶⁷ Bea McMonagle, "Oral Care Companies Finally Tackle Packaging Waste", Forbes, Apr 24, 2021 <https://www.forbes.com/sites/beamcmonagle/2021/04/24/oral-care-companies-finally-tackle-packaging-waste/?sh=67a1dc475ae1>

Toothpaste tablets

Toothpaste tablets work like traditional paste but are formulated without water and glycerin. For example, Bite's pellets are made with nano-hydroxyapatite a non-toxic fluoride alternative to remineralize and strengthen teeth and are housed in reusable glass jars and aluminum lids. Refills are delivered in kraft envelopes padded with post-consumer recycled newspapers.

Another subscription-based toothpaste company, Huppy toothpaste tablets, is entirely plastics free. Their toothpaste tablets are packaged in refillable storage containers that require no toothpaste tubes or unnecessary paperboard packaging. Their refillable pouches are made from biodegradable wood-cellulose, which is fully biodegradable or recyclable, and uses water-based inks. Finally, Huppy toothpaste tablets are pre-measured, preventing excess use and are thus cost-effective and efficient.

Other companies that offer toothpaste tablets with similar reduced packaging include etee Zero Waste Chewpaste, Battle Green Remineralizing Tooth Powder and Nelson Naturals.

4.1.8 Private sector-run container return scheme

All the above-mentioned actions companies can be implemented within a deposit refund scheme, run by the private sector, but supported by the government.

In Europe, 10 countries have already implemented deposit return schemes: Croatia, Denmark, Estonia, Finland, Germany, Iceland, Lithuania, Netherlands, Norway, and Sweden. All of which have achieved significant results. The least successful country is Estonia, with an impressive 82.7% total return rate – including can, PET and glass – which is already higher than many countries in Europe.

The most successful example in Europe is Norway, with an outstanding 97% recycling rate for plastic bottles. Germany also has very high results, as it has the highest population and a broad DRS scope, targeting glass, plastic (mostly PET) and metal (aluminum) with 98.4% total return rate. The system was implemented by the ministry of environment in 2003 with a €0.25 fee per item, whether it is glass, metal or plastic.

The DRS is run by Infinitum AS (former Norsk Resirk AS). The company was established in 1999 and is owned by companies and organizations in beverage industry and food trading (giant chain stores). The company aims to ensure the highest possible return in deposit recycling packaging for beverages at the lowest cost and environmental impact.

The system in Norway has been live since 1996 following 10 years of discussion, development and testing. This system handles PET bottles for beverages (not food or household cleaning) and a small amount of HDPE and aluminum cans. Refunds can be made via one of the 3,500 reverse vending machines, with 93% of the total packaging collected via this channel. The remaining 7% is collected manually by one of 11,500 registered collection points. For products registered with Infinitum, consumers get one Krone (approximately €0.10) back for a 330ml plastic bottle or can and 2.5 Kr (approximately €0.26) for a large 2l plastic bottle. Infinitum has a recycling rate of 97% of all of the packaging that is registered through its system.

4.1.9 Key factors for future success

The table below summarises the factors contingent on future competitive success in the packaging recycling industry. If major FMCG and retail companies are to navigate through these sustainability challenges and innovation application solutions, there are complexities and trade-offs to consider. Businesses can explore identifiable groups of opportunities in their journeys towards adopting sustainable packaging waste management practices.

1. There are critical gaps around waste collection, recycling systems, and technology, limiting significant changes in the packaging value chain over the near term.
2. Government support is likely to lend favourably to systemic level changes; this includes R&D, improving existing recycling infrastructure, recycling technologies, and coordination across the value chain, alongside initiatives to raise consumer awareness around recycling.

3. Leading FMCG companies and retailers remain committed to transforming their portfolios, but large-scale market adoption of innovations is slow, which will require collaboration with upstream and downstream partners.

Category	Key factors for future success
Technology and manufacturing related considerations	<p>Environmental concerns and regulations are strong positive drivers for growth in the plastic recycling industry. Companies are hence showing an interest in new technologies that allow them to use recycled plastics in their consumer products. These solutions are particularly attractive for more problematic waste materials like multilayered plastics.</p> <p>However, the key economic factor that governs the plastic recycling industry concerns the cost and quality competitiveness of recycled resins when compared with virgin materials. As this is often tied to oil and plastic commodity prices, it can be offset by the development of technologies that can maximise the volume, usability, and quality of waste collected.</p> <p>Furthermore, transforming the packaging portfolio has proved to be challenging, with the need to manage complex trade-offs encompassing multiple implications for sustainability – achieving high recyclability while maintaining a low carbon footprint. In light of slim margins and important branding considerations, FMCG manufacturers and retailers will have to carefully consider their options.</p>
Government regulation of market	<p>Recycling and achieving circularity for materials have found their way to the core of the plastics industry. In fact, advanced recycling technologies will play a significant role in facilitating these commitments from consumer goods manufacturers. However, there can be limitations to achieving these commitments as many application innovations are often at infancy in the research process and can be difficult to gain scale.</p> <p>Therefore, to truly achieve significant progress toward sustainable packaging, changes to the broader packaging and recycling system will be required. Individual stakeholders will find it challenging by themselves, thus government’s support to regulate the industry and include positive incentives for businesses looking for tax relief, R&D, and innovative infrastructure will be needed to make it happen.</p>
Collaboration with upstream players, packaging converters, and recyclers	<p>While FMCG companies and retailers have started to make some bold commitments to act on packaging waste management and recyclability, they are entering into new and unfamiliar territory. Successfully addressing the new packaging recyclability and waste challenges are likely to stretch their current capabilities. Consequently, closer collaboration with upstream players, packaging converted, and recyclers will be required. A key focus area will be the need to build infrastructure by employing more closed systems that can manage the high recycling needs of companies.</p> <p>In Singapore, where the deposit refund scheme for beverage containers is soon to be implemented by 2022, infrastructure development to facilitate the take-back and recycling of packaging bottles and cans could address raising concerns relating to the quantity and quality of plastic waste supply collected. For these infrastructures to operate at a scale, take-back schemes such as the DRS will require high sufficient quantities of material and the aggregation of a steady supply of feedstock for recycling. This can potentially drive the demand for plastic recycling in Singapore, helping industry players achieve cost-effectiveness and economics of scale.</p>
Corporate innovation and commitments	<p>Several packaged goods manufacturers and retailers continue to act on their sustainability commitments for packaging. These include improving both the sustainability of their packaging and rethinking packaging systems. The top 100 FMCG companies to embrace these initiatives have seen a higher degree of recyclability and recycled content, accounting for a 26% reduction in total plastics usage and a 14% change in promoting the use of innovative</p>

	<p>packaging¹⁶⁸. This is a clear indication that corporate action will be a key enabler in facilitating innovative solutions to promote sustainable packaging.</p> <p>Apart from incorporating recycled content in the packaging, other commitments by FCMG and consumer packaged goods companies to support sustainability may include direct elimination of packaging on some items; reducing packaging weight where possible; incentivising customers to use recyclable options (e.g., reusable shopping bags); partnering with suppliers to reduce consumption and increase substitutes; and innovation with environmental-advocacy or sustainability-engineering groups.</p> <p>For example, it was reported in 2020 that Unilever became the first major consumer goods company to commit to an absolute plastic reduction across its portfolio; reducing its use of virgin plastic by half, which will save up to 4,500 tonnes of plastic¹⁶⁹. This will fundamentally pave the way for new solutions such as reusable and refillable formats that we can expect to see amongst more FMCG and major consumer goods companies.</p>
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4.2 Introducing Certification

As FMCG companies' source for packaging made from recycled materials from suppliers with food-grade certification, some Asian recyclers have identified this as an opportunity to expand their food-grade recycled PET capacity. The demand for food-grade certified recycled materials will continue to grow with many large FMCG and beverage companies taking a stance to commit to at least 50% recycled content in their packaging by 2030.

With Asia increasing its capacity for recycled food and beverage packaging, the harmonisation of certifications and standards will help drive companies towards achieving their sustainability targets for higher recycled content in bottles and food packaging. These certifications and standards will help to increase the credibility of recycled products, which is critical in overcoming the public's skepticism about environmentally friendly products. This could help alleviate the pressure on current recycling capacity locally. Compliance with international standards (e.g., ISO 14021:2016) on the labelling standards of recycled content used in products is also an effective strategy to boost credibility¹⁷⁰.

The DRS also requires distinct labelling of containers for the return of deposits.

4.2.1 Certification of product packaging

Survey 1 (key finding 5) and survey 2 (key finding 2b) highlight how eco-labels on product packaging plays a crucial role in consumers' purchase decision and elevating the standards of product certification would help to improve consumers' confidence and interest in purchasing eco-friendly products.

Product certification is the process of certifying that a certain packaging has passed performance tests and quality assurance tests, and meets qualification criteria stipulated in contracts, regulations, or specifications¹⁷¹. Most product certification bodies (or product certifiers) are accredited to or aligned with ISO/IEC 17065 Conformity assessment¹⁷². Product certification provides information about the contents, use and/ or recyclability of a product by considering the inflow, use and outflow.

¹⁶⁸ McKinsey & Company, The drive toward sustainability in packaging—beyond the quick wins. Retrieved from <https://www.mckinsey.com/industries/paper-forest-products-and-packaging/our-insights/the-drive-toward-sustainability-in-packaging-beyond-the-quick-wins>

¹⁶⁹ Unilever, Unilever makes progress on its sustainable packaging goals. Retrieved from <https://www.unilever.com/news/press-and-media/press-releases/2020/unilever-makes-progress-on-its-sustainable-packaging-goals/>

¹⁷⁰ ISO, ISO 14021:2016. Retrieved from <https://www.iso.org/obp/ui/#iso:std:iso:14021:ed-2:v1:en>

¹⁷¹ IEEE Xplore, Business process improvement design of Indonesian National Standard (SNI) product certification. Retrieved from <https://ieeexplore.ieee.org/abstract/document/7440173>

¹⁷² InCompliance, ISO/IEC 17065: The Standard for Certification Bodies – A Review of the Key Requirements – In Compliance Magazine. Retrieved from <https://incompliancemag.com/article/isoiec-17065-the-standard-for-certification-bodies-a-review-of-the-key-requirements/>

Enhancing the labels on the packaging of the product would help to establish a circular system of materials and waste management and close the loop on the packaging. According to the Circular Transition Indicators Framework of the World Business Council for Sustainable Development¹⁷³, there are three main levers to increase circularity: (i) Inflow, (ii) Potential recovery and (iii) Actual recovery (see Figure 17):

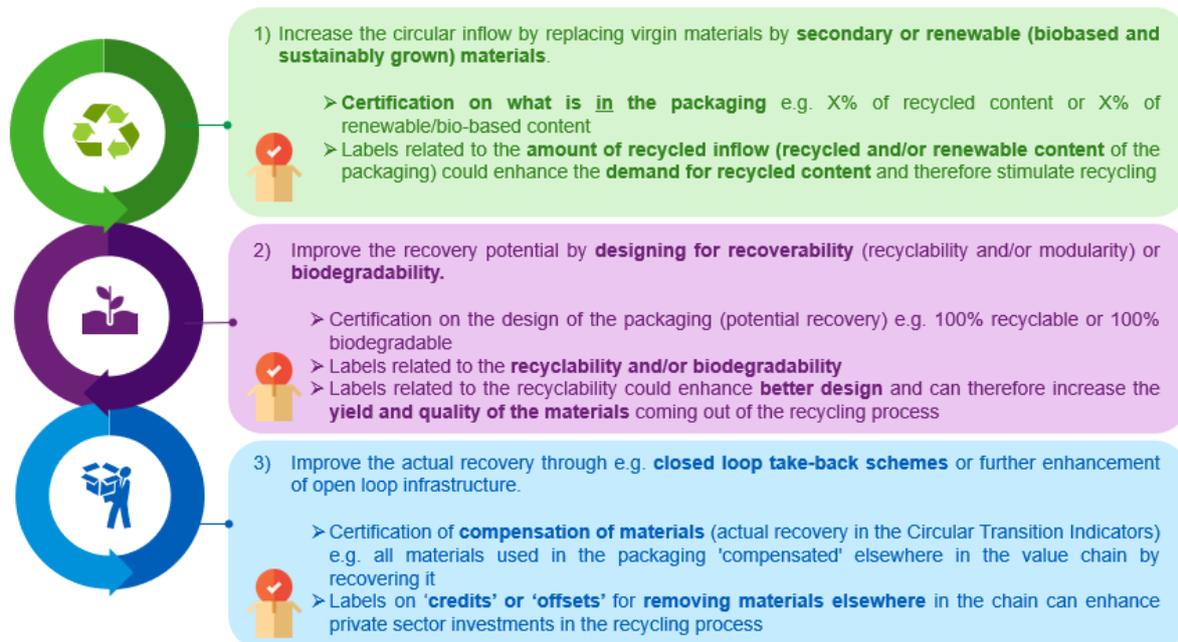


Figure 17: Options to increase circularity on the packaging of the product

4.2.2 Certification of production site

As Singapore is developing more recycling facilities, there is a need for a steady stream of high-quality recyclable waste. One way to achieve this is through the certification of the waste management and collection process.

Site certification verifies that a certain production site meets the criteria for performance, quality and other criteria stipulated in contracts, regulations, or specifications¹⁷⁴. Site certification provides information about the environment in which a product was developed, but not necessarily about the product itself. By verifying that their waste management and collection process are meeting the set standards (which can include health, safety, and environmental criteria), recyclers can improve confidence in the quality of the recycled materials coming out of their facility as exemplified in the illustration below:

¹⁷³ WBCSD, Circular Transition Indicators V1.0 – Metrics for business, by business. Retrieved from <https://www.wbcsd.org/Programs/Circular-Economy/Metrics-Measurement/Resources/Circular-Transition-Indicators-V1.0-Metrics-for-business-by-business>

¹⁷⁴ Federal Office for Information Security, Site Certification. Retrieved from https://www.bsi.bund.de/EN/Topics/Certification/SiteCertification/SiteCertification_node.html

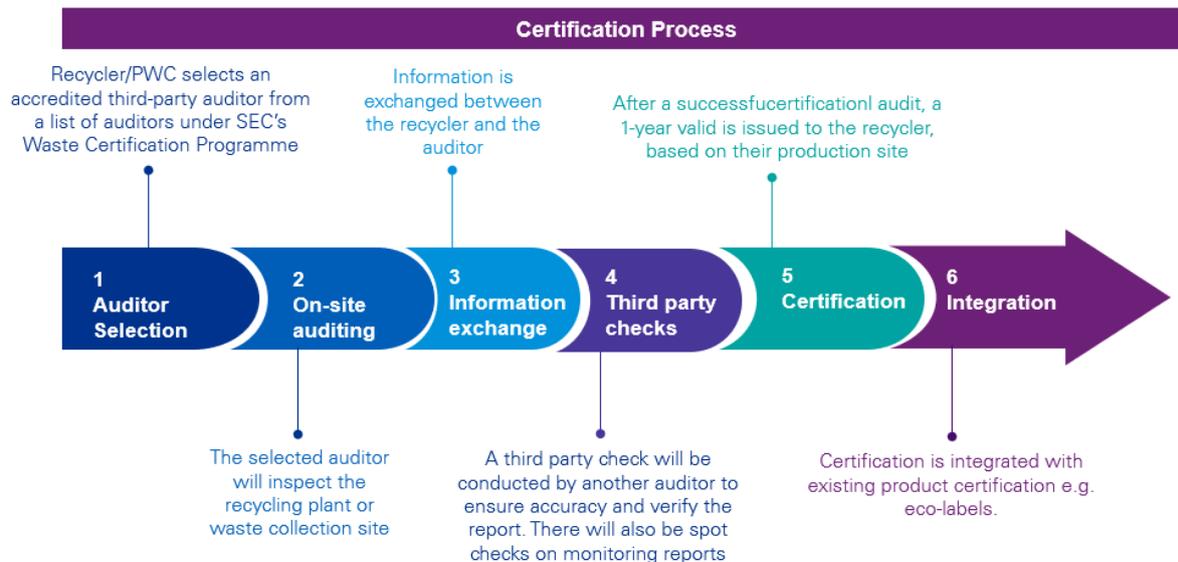


Figure 18: Example of certification process for waste management

For example, in Europe, EUCertPlast¹⁷⁵ is a certification aimed at post-consumer plastic recyclers. The purpose is to recognise plastic recyclers operating at high standards by awarding them a certification. The certification gives confidence to suppliers and customers that any input waste plastic and output produced in a certified facility will be treated according to best practices. It works according to the European Standard EN 15343:2007 and aims at encouraging environmentally friendly recycling of plastics by standardising it, with a focus on traceability in the supply chain, throughout the recycling process and recycled content quality in the end-product.

Certification can increase the transparency of the waste industry by implementing traceability of collected post-consumer waste and setting recycling and trading practices and standards. Furthermore, it can help to avoid contamination and ensure food contact compliance for recyclers.

In addition, many companies identify waste as a key environmental impact, which they address via their Environmental Management System (EMS). EMS such as ISO 14001 is the most widely recognised standard for environmental management and can provide a framework and structured approach to handling waste¹⁷⁶. Through identification and evaluation of environmental aspects, companies can determine the types of waste emerging in their processes, whilst operational controls can define how the waste will be treated. With certifications, recyclers can improve waste management on their sites, encourage awareness among staff and prove their commitment to sustainable business practices.

4.3 Improving public awareness

To ensure the efficiency of Singapore's waste management process, it is integral to develop and improve public education on waste reduction and recycling, which in turn will help to drive sustainable consumption habits. The wider public plays an imperative role in the success of Singapore's waste management strategies; similar observations from Survey 1 (key findings 1, 4 and 5) and survey 2 (key findings 4, 5 and 6) suggest that more can be done to educate our consumers.

While consumers are increasingly concerned about environmental benefits, it is not directly translated into action; with more consumers displaying a lack of understanding of Singapore's recycling capabilities and are unaware of the existing sustainability initiatives. This indicates that government and corporates have a responsibility to educate consumers on the importance of their roles in Singapore's

¹⁷⁵ EUCertPlast, What drives us?. Retrieved from <https://www.eucertplast.eu/about>

¹⁷⁶ 14001 Academy, 7 steps in handling waste according to ISO 14001. Retrieved from <https://advisera.com/14001academy/blog/2016/11/07/7-steps-in-handling-waste-according-to-iso-14001/>

behaviours which would help to promote participation environmentally conscious consumption behaviour.

The Citizens' Workgroup on Reducing the Excessive Consumption Disposables concluded in January 2021. The Workgroup provided a wide range of recommendations from policy interventions which amongst others include mandatory carrier bag charge, to integrating education on sustainability into our students' curricula¹⁷⁷. The Workgroup is a good initiative to gather ideas and feedback from the ground as public education takes efforts from all stakeholders.

The table below maps out the stakeholders, roles, and considerations:

Stakeholder Group	Roles & Responsibilities	Key Considerations
Local government	Local government to plan and implement solid waste management programmes.	<ul style="list-style-type: none"> ● Implement policy measures that increase the demand for recycled plastics and raw materials and thereby stimulate recycling (e.g., taxes on virgin plastics, subsidies for recycled plastics) ● Identify the demand (and therefore the sales market) for recycled raw materials for packaging materials and translate that into output for mechanical and chemical recycling ● Implement public procurement policies that also focus on end-of-life treatment of the goods and services purchased ● Provide consumers with an incentive to recycle (e.g., considering financial rewards for returned packaging)
Recyclers/ Recycling facilities	In charge of the end-of-life treatment of the waste materials.	<ul style="list-style-type: none"> ● Identify the demand (and therefore the sales market) for recycled raw materials for packaging materials and translate that into output for mechanical and chemical recycling ● Increase accessibility of recycling infrastructure by streamlining processes (e.g., cleaning and recycling take place in the same vicinity)
Non-governmental organisations (NGOs)	NGOs can serve an important role in educating the public on different aspects of waste management. They typically understand the local context in decision making.	<ul style="list-style-type: none"> ● Conduct education campaigns to help to educate the public on waste management and recycling ● Play the role of administering the certification on the waste management and collection process ● Play the role of administering the certification of eco-labelling on packaging products
Informal recycling workers	Informal sector workers collect recyclables and reusable materials from communal waste bins and disposal sites and frequently work in unsafe working conditions.	<ul style="list-style-type: none"> ● To upskill them with proper waste segregation knowledge

¹⁷⁷ National Environment Agency, Eight Recommendations From Citizens' Workgroup On Reducing Excessive Consumption Of Disposables Supported And To Be Further Developed. Retrieved from <https://www.nea.gov.sg/media/news/news/index/eight-recommendations-from-citizens-workgroup-on-reducing-excessive-consumption-of-disposables-supported-and-to-be-further-developed>

Consumers/ Residential waste generators	Domestic waste makes up a large portion of the waste stream. Residents can play an important role in improved waste prevention, minimisation, segregation, and collection scheme.	<ul style="list-style-type: none"> ● Education and outreach to residents on new waste programs to support better waste management ● Practice good waste management habits (e.g., disposing and recycling responsibly, segregating waste especially plastic)
Commercial and Industrial waste generators	Commercial and industrial waste contributes to the overall waste stream. Commercial and industrial stakeholders can play an important role in improved waste prevention, minimisation, segregation, and collection scheme.	<ul style="list-style-type: none"> ● Education and outreach to commercial and industrial generators to support better waste management ● Practice good waste management habits (e.g., disposing and recycling responsibly, segregating waste especially plastic) ● Track waste and recycling

5. Conclusion

We propose a packaging waste management scenario that involves all stakeholders in the current waste management system. This includes packaging designers, producers, manufacturers, business owners, retailers, consumers, waste collectors and waste recyclers. The packaging materials flow from producers to consumers before being separated into recyclables and biodegradables. Given that, the change in Singapore’s recycling infrastructure should reflect both material recycling and material biodegradation. This means there should be collection points for biodegradables, in addition to recyclables. Currently, there is only one blue bin for recyclables, resulting in food contamination, as mentioned in Section 1. In addition to collection points, there should also be treatment facilities for biodegradables and recycling plants. The Tuas Nexus, mentioned in Section 1.2.3, is one such facility.

The scenario starts with product and packaging redesigning and rethinking and continues with the flow of packaging materials in a circular manner. It consists of six (6) areas:

1. Redesign, rethink packaging and products

As given in Sections 4.1.2-4.1.4, the use of design thinking can reduce the weight of packaging, increase its recycled content, use mono-material, and replace virgin material with waste materials for packaging. Light-weighting and downgauging of packaging material are an ongoing industrial exercise. Redesigning products to fit into smaller packaging formats, such as formula concentration, solids instead of liquids, is another way of reducing packaging. Design for recyclability includes design for disassembly and using recyclable mono-material. This also involves substituting for recyclable or biodegradable materials, such as from plastics to paper.

These redesigns can dramatically change the packaging forms. From Section 4.1.2, research suggests that direct elimination could potentially reduce packaging waste by 20%, while redesigns are estimated to bring down packaging by another 20%. This would decrease the amount of packaging waste from 510,000 tonnes, as given in Section 1, to 306,000 tonnes. However, this decline is expected to take place mainly for plastic and aluminum packaging materials. Therefore, we can conservatively estimate that plastic packaging waste can be lowered from 280,000 to 168,000 tonnes, while other forms of waste from 100,000 to 60,000 tonnes.

2. Labelling

As given in Section 4.1.1, consumers can be better informed with simpler and clearer labelling. Labels on primary packaging should communicate whether the package is 1) recyclable; 2) biodegradable; 3) neither recyclable nor biodegradable. This would streamline the identification and separation processes and allow consumers to separate waste into only two bins. Therefore, we propose to have two bins to receive post-consumer packaging waste: one for recyclables and one for biodegradables.

However, not all packaging can or should be labelled. Therefore, the labelling must also be done in tandem with certification. This is mentioned in Section 4.2 and helps to improve transparency and process improvements in the short run, while raising consumer awareness in the long run.

3. Reuse and refills

As given in Section 4.1.7, refills and reuse of containers play a big role in packaging reduction. This flow caters to companies that produce packaging that is both durable and long-lasting and has programs and processes for retrieving these packages for reuse. This includes reverse vending machines (Section 1.2.1) and reusable packages (Section 4.1.7).

4. Collection

Technical materials and biodegradables should be separately disposed. In response to NEA's statistic of 40% contamination of food waste in recyclables, food packaging should be biodegradable, and consumers ought to be given another bin for biodegradables. This would provide great convenience to consumers when they return their food containers but are not aware of the fact that contaminated recyclables cannot be recycled and are treated as general waste instead.

The RSA 2019 mandates that all large premises that produce a sizeable amount of food waste must install treatment units to treat food waste before sending it off-premises for disposal. Using biodegradable food packaging saves these premises both labour and time in pre-sorting non-biodegradables and recyclables from food waste. As of now, an integrated waste management facility is also being constructed, termed the Tuas Nexus.

Collection of recyclables can still be done via the blue bin and reverse vending machines (Section 1) currently. The separation of food contaminated material from the blue bin will significantly increase the recycling rate, as 40% of the unrecyclable are now being removed and treated separately instead.

5. Recycling of technical materials (mineral origin)

It is not economically viable to recycle some forms of plastic (e.g., polypropylene and PET), as noted in Section 1.3.1. However, the efforts in recycling can be bolstered by separation of recyclable and biodegradables (Section 1.1.1), mechanical and chemical recycling (Section 1.2.3, Appendix C), improved recovery through labelling (Section 4.1.1), legislation (Section 4.3) and public awareness (Sections 1.4.2, 4.3). With proposed mechanical and chemical recycling plants in Singapore, the amount of plastic packaging waste could be reduced even further.

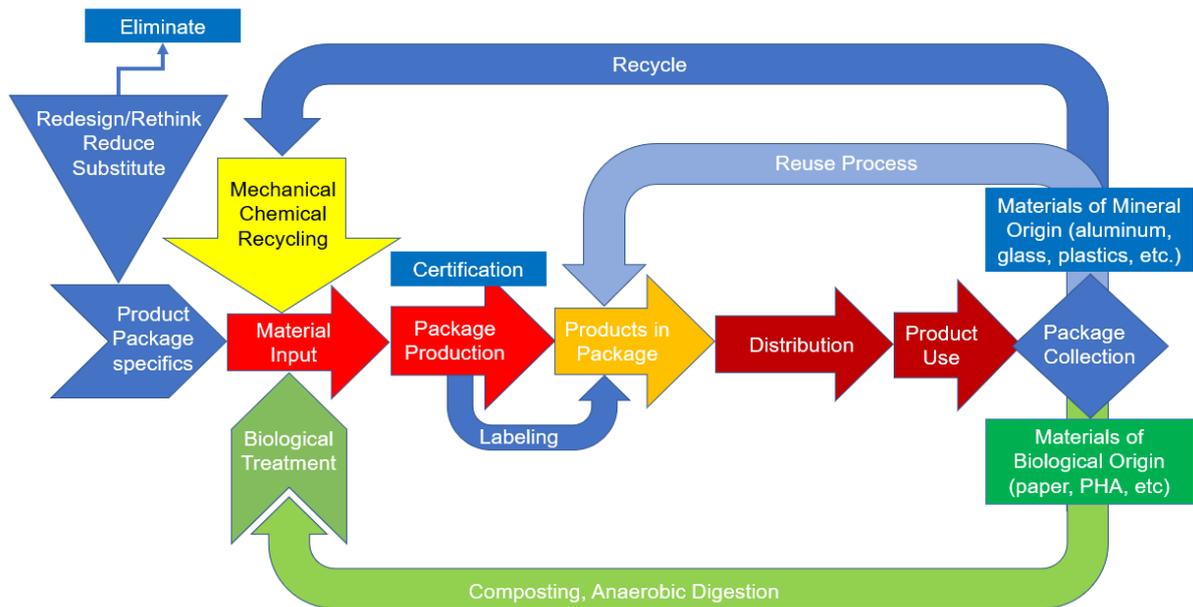


Figure 19: Recycling of technical materials

6. Job Creation and Employability

It was reported that about 200,000 jobs would be created in the EU from sorting and recycling 25 million tonnes of plastic waste¹⁷⁸. If we assume the same potential for employability, the amount of packaging waste (0.51 million tonnes) in Singapore can generate 4,080 jobs. The expansion of the circular packaging economy will thus be beneficial for society and the environment.

There is a myriad of local, regional, and international industries that depend on recyclable materials¹⁷⁹. Hence, when more people recycle, there is a potential for employment opportunities to be created in the following three areas:

1. Collecting, processing and preparing discarded materials at processing facilities;
2. Manufacturing new products from recycled waste at manufacturing facilities, and;
3. Reusing and remanufacturing¹⁸⁰.

According to the National Recycling Coalition, recycling creates four jobs for every one job created in the waste management and disposal industries. Furthermore, these new jobs would primarily be in manufacturing and recycling industries ranging from product manufacturing to materials handling and processing and would employ workers with all levels of skills¹⁸¹. For instance, in the US alone, recycling and reuse activities in 2012 accounted for 680 thousand jobs and almost \$38 billion in wages¹⁸².

There are plenty of products that can be manufactured from recycled materials (e.g., recycling bins, grocery bags, shoes, and furniture). Given that, each of these products can then open a variety of

¹⁷⁸ Climate Action, The European Union releases decisive strategy against plastic waste. Retrieved from <https://www.climateaction.org/news/the-european-union-releases-decisive-strategy-against-plastic-waste>

¹⁷⁹ Eco-Cycle, Zero Waste Creates Jobs. Retrieved from <https://www.ecocycle.org/zerowaste/jobs>

¹⁸⁰ Ecocycle, Zero Waste Creates Jobs. Retrieved from <https://www.ecocycle.org/zerowaste/jobs>

¹⁸¹ United States Environmental Protection Agency, Economic Benefits. Retrieved from <https://archive.epa.gov/wastes/conservation/tools/rmd/web/html/econ.html>

¹⁸² United States Environmental Protection Agency, Recycling Economic Information. Retrieved from <https://www.epa.gov/smm/recycling-economic-information-rei-report>

new jobs in manufacturing companies¹⁸³. These job opportunities can be in areas such as marketing, accounting, sales, engineering, production, just to name a few. Recycling facilities would have to employ sorters, truck drivers to collect recycling waste from each household, as well as managers and supervisors to oversee the entire recycling process. Another example includes stores that re-sell recycled products for purchase. These stores would have to hire cashiers, cleaners, and managers to run the operations. Taken together, the more people recycle, the more employment opportunities arise at recycling facilities and other industries and sectors¹⁸⁴.

In conclusion, Singapore's high amount of packaging waste generation and low domestic recycling rate calls for urgent action to uncover opportunities to build a circular economy for packaging materials in Singapore. A circular economy could potentially generate income from collecting materials for recovery, reduce costs by purchasing less material, conserving natural resources, and reducing carbon emissions. These could be achieved through regulatory measures, corporate innovation, and commitments to improve the sustainability of their packaging, introducing certifications such as eco-labelling, and improving general awareness and public education.

While government initiatives such as the PPP, RSA, MPR and EPR address the waste situation in Singapore by reducing, managing, and promoting recycling of waste; future challenges still stand in the way of the country's path toward a more circular economy. The present lack of recycling infrastructure, increasing waste import restrictions, lack of public awareness and education, as well as the increasing demand for packaging of all forms for hygiene and physical distancing measures because of COVID-19 amongst other factors, will require additional packaging waste management solutions. Corporate action and innovation can step in to meet these challenges and complement government efforts.

As consumer interest in sustainability increases, major FMCG companies and retailers continue to draw up plans to increase their reputation and brand identity. In subsequent years, we can expect the number of plastic manufacturers investing in advanced technology and recycled resins to rise exponentially. Should the acceleration of new technologies scale, we are on track to achieving sustainability in the packaging industry.

¹⁸³ CleanRiver, How Recycling Creates New Jobs – 4 New Job Opportunities. Retrieved from <https://cleanriver.com/bloghow-recycling-creates-new-job-opportunities/>

¹⁸⁴ CleanRiver, How Recycling Creates New Jobs – 4 New Job Opportunities. Retrieved from <https://cleanriver.com/bloghow-recycling-creates-new-job-opportunities/>

6. Appendix

Appendix A: Other Packaging Waste Types by Sector

In this study, we selected the food, FMCG and e-commerce sectors for packaging waste because of (i) expected increasing intensity of use of plastic packaging in these sectors; and (ii) discussions with SEC on the relevant sectors in Singapore, due to their large market that are direct to consumers and utilise a significant amount of packaging.

There are three different packaging types: primary, secondary, and tertiary, which serve different purposes and for different types of products, users, or consumers¹⁸⁵.

1. **Primary packaging** is the branded packaging that is most closely associated with the product e.g. bottle/ can for alcoholic/ soft drinks, cereal box, toothpaste tube
2. **Secondary packaging** is all other packaging for the product, other than its primary packaging e.g., a foil around a box of cookies, or a box around a toothpaste tube
3. **Tertiary packaging** facilitates the protection, handling, and transportation of a series of sales units or secondary packaging to group everything into unit loads during transit¹⁸⁶.

For food and FMCG sectors, the focus would be mainly on primary and secondary packaging. For e-commerce, the focus would be on tertiary packaging.

Material	Food	FMCG	E-commerce	Recycling potential
	Food packaging e.g. for takeaway/ delivery or for food and beverage products	Goods that have a short lifespan and consumed at a rapid or fast pace <ul style="list-style-type: none"> • Product packaging • Warehouse/storage packaging 	Packaging of the product for shipping to customers <ul style="list-style-type: none"> • Warehouse/ storage packaging • Delivery packaging • Product packaging 	
Polystyrene (PS) + Expanded Polystyrene (EPS) (Styrofoam)	✓ e.g., Food packaging (dairy, fishery), takeaway packaging, Styrofoam e.g., desserts/ ice cream containers, Styrofoam boxes for takeaway	✓ e.g., Styrofoam balls for fragile items	✓ e.g., Delivery packaging, Styrofoam balls for fragile items	Challenging to mechanically recycle PS due to its low densities ¹⁸⁷
Low Density Polyethylene (LDPE)	✓ e.g., Trays and containers, food packaging film, reusable bags	✓ e.g., Reusable bags	✓ e.g., Reusable bags, bubble wrap	Often suitable for mechanical recycling

¹⁸⁵ Packaging Definitions, Euromonitor International. Retrieved from <https://www.portal.euromonitor.com/images/miscdocs/PACKAGING%20TYPE%20DEFINITIONS.pdf>

¹⁸⁶ Difference between primary, secondary & tertiary packaging, Saxon Packaging. Retrieved from <https://www.saxonpackaging.co.uk/difference-between-primary-secondary-tertiary-packaging/>

¹⁸⁷ Mechanical recycling of packaging plastics. Retrieved from <https://onlinelibrary.wiley.com/doi/10.1002/marc.202000415>; List of items that are recyclable and not. Retrieved from <https://www.nea.gov.sg/docs/default-source/our-services/waste-management/list-of-items-that-are-recyclable-and-not.pdf>

Polypropylene (PP)	✓ e.g., Containers for yoghurt	✓ e.g., Drug bottles		Suitable for mechanical recycling ¹⁸⁸
High Density Polyethylene (HDPE)/Medium Density Polyethylene (MDPE)	✓ Juice and milk jugs	✓ e.g., Shampoo bottles	✓ e.g., Toys, reusable crates, and pallets	Often suitable for mechanical recycling
Polyethylene Terephthalate (PET)	✓ e.g., Bottles for water, soft drinks, juices	✓ e.g., Bottle for cleaners		Often suitable for mechanical recycling
Paper/Cardboard	✓ e.g., Paper containers, paper bags	✓ e.g., Storage boxes, paper bags, boxes for teacups, tissue box	✓ e.g., Storage/cardboard boxes, envelopes	Different paper grades have different value, based on the quality of fiber, amount that must be de-inked, level of contamination etc. ¹⁸⁹
Glass	✓ e.g., Food bottles (excluding those under DRS)	✓ e.g., Cosmetic bottles	e.g., Reusable bottles/containers (milk-man principle)	Suitable for recycling ¹⁹⁰
Aluminium	✓ e.g., Bottles & cans (excluding those under DRS), aluminium utensils, aluminium trays	✓ e.g., Aerosol cans		Suitable for recycling ¹⁹¹
Wood	✓ e.g., Pallets	✓ e.g., Pallets	e.g., Pallets	Can be reconditioned, processed, and used to make new wood products ¹⁹²
Beverage cartons (plastic-coated paper carton)	✓ e.g., Tetra pak			Recycled locally
Hybrids/multilayer	✓ e.g., Crisp bags			Can be used to make other products

¹⁸⁸ Mechanical recycling. Retrieved from https://docs.european-bioplastics.org/publications/bp/EUBP_BP_Mechanical_recycling.pdf

¹⁸⁹ Information gathered through stakeholder engagement. Retrieved from <https://www.ghs.sg/recyclables/paper-recycling/>

¹⁹⁰ Singapore recycling sustainability blue bins. Retrieved from <https://www.channelnewsasia.com/news/singapore/in-focus-singapore-recycling-sustainability-blue-bins-waste-12972634#:~:text=The%20recyclables%20are%20then%20sorted.can%20be%20found%20in%20Tuas>

¹⁹¹ <https://www.channelnewsasia.com/news/singapore/in-focus-singapore-recycling-sustainability-blue-bins-waste-12972634#:~:text=The%20recyclables%20are%20then%20sorted.can%20be%20found%20in%20Tuas>

¹⁹² <http://www.zerowastesg.com/2008/12/08/wood-and-horticultural-waste-recycling/>