

Accelerating Singapore's Next Generation Plastic Recycling Value Chain

Insights from a Rapid Plastic Waste Flow Opportunity Assessment

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strategy x economics


CIRCULATE CAPITAL

About the Plastic Waste Opportunity Assessment

The study was commissioned by Circulate Capital with AlphaBeta and Kiverdi to develop an approach to identify and define key plastic waste circularity investment opportunities.

- ▶ Rapid Opportunity Assessment* of Singapore's plastic waste flows and recycling value chain.
- ▶ Identification of potential investment opportunities to increase circularity.
- ▶ Value unlock required to capture those opportunities.

*The Rapid Opportunity Assessment approach incorporates both top-down and bottom-up modelling for prioritized sectors and polymer groups. Breakdown of plastic waste was derived through interviews with companies across Wholesale & Real, Accommodation & Food Services, Transport & Storage, Construction, and Computer, Electronic and Optical Production. The data collectively represent 40% of Singapore's domestic economy and 70% of plastic waste generation in Singapore.

The companies provided the team with information of the volumes of plastic waste generated in daily operations, typical polymers used in these plastics, which was then paired with primary data collected from major plastic recyclers operating in Singapore. The data were then scaled to economic segments and sector level based on market proxies to generate total plastic waste generated.



CIRCULATE CAPITAL

Circulate Capital is a Singapore-based investment management firm dedicated to financing innovation, companies, and infrastructure that prevent the flow of plastic waste into the world's ocean while advancing the circular economy.

αlphaβeta
strategy x economics

AlphaBeta is a strategic economics consultancy that works with governments, businesses, investors, and other institutions to tackle the largest societal challenges we face.

KIVERDI

Kiverdi was founded with a mission to commercialize sustainable resource utilization solutions by transforming carbon to make high-value oils, complete proteins, and other bio-based products.

SINGAPORE IS WELL-POSITIONED TO BE A GLOBAL LEADER IN ADVANCING THE CIRCULAR ECONOMY

Singapore has the ideal conditions to lead part of the shift from linear to circular supply chains as a resilience hub for advanced manufacturing.

- ▶ Individual solutions are strengthened within the context of the whole system improving.
- ▶ Waste management operators are transitioning from slow growth models to entrepreneurial mindsets, supported by the ambitious plans of building Singapore as a digital innovation anchor.
- ▶ Institutional policy framework can be leveraged to demonstrate the role of circular plastics in creating healthy cities.



STRONG
COLLECTION SYSTEM



EXISTING PATHWAYS
TO EDUCATION



GOVERNMENT AND PRIVATE
SECTOR COMMITMENT



TRUSTED ECOSYSTEM

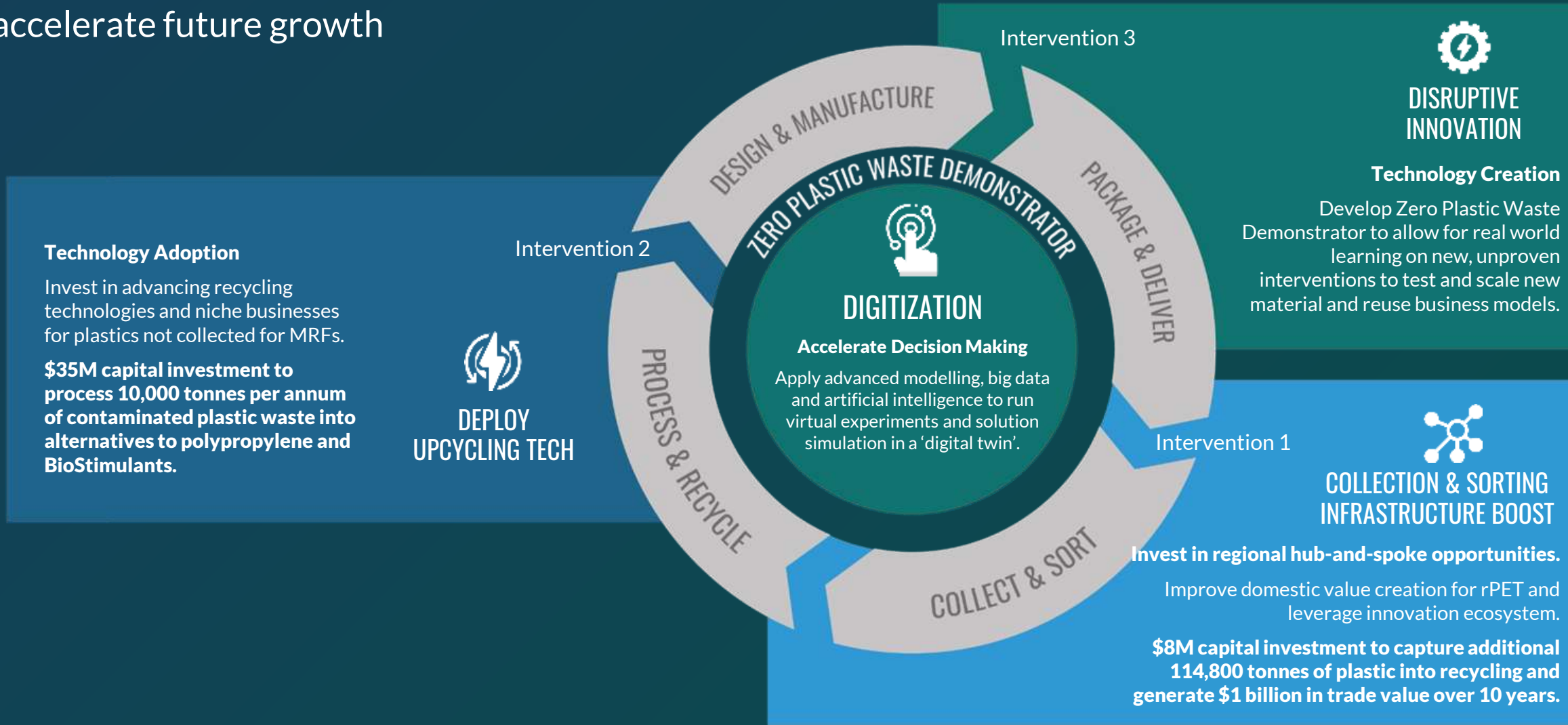


ENABLING POLICY
ENVIRONMENT



EXISTING RESPONSIVE
POPULATION INCENTIVES

Investment interventions in three circularity solutions will accelerate future growth



INSIGHTS INTO ACTION: SCALING SINGAPORE'S PLASTIC WASTE REDUCTION PATHWAY

The 2026 and 2030 Green Plan recycling targets are achievable by pairing investments in Infrastructure and Innovation -- independent interventions are insufficient and inefficient.

Global research¹ has clearly found systems change can only be achieved by combining behavioural interventions to reduce overall consumption alongside keeping products and materials in use. These combined interventions create the economic conditions that scale circular outcomes.

The data indicates that investments to boost existing infrastructure will achieve over half of Singapore's Zero Waste target, but, to achieve the targets, an accelerated year-on-year reduction of 0.5% annual plastic packaging consumption is required.

Singapore Plastic Waste Not Kept in Circular Systems

(tonnes not reused or recycled)



Pre-Intervention Scenario
(EXCLUDES Green Plan, EPR and DRS Policy interventions)

Zero Waste Plan Plastic Reduction Target

Intervention 1 - Infrastructure Boost
(Mechanical Recycling Capacity Boost)

Intervention 3 - Disruptive Innovation
(Innovative materials and reuse models, assumed minimum 0.5% year-on year reduced plastic consumption)



Intervention 1, 2 and 3 - Infrastructure Boost, Upcycling Technology, Disruptive Innovation
(mechanical recycling capacity boost, 0.5% reduction consumption, ramp up to reverse plastics gasification)

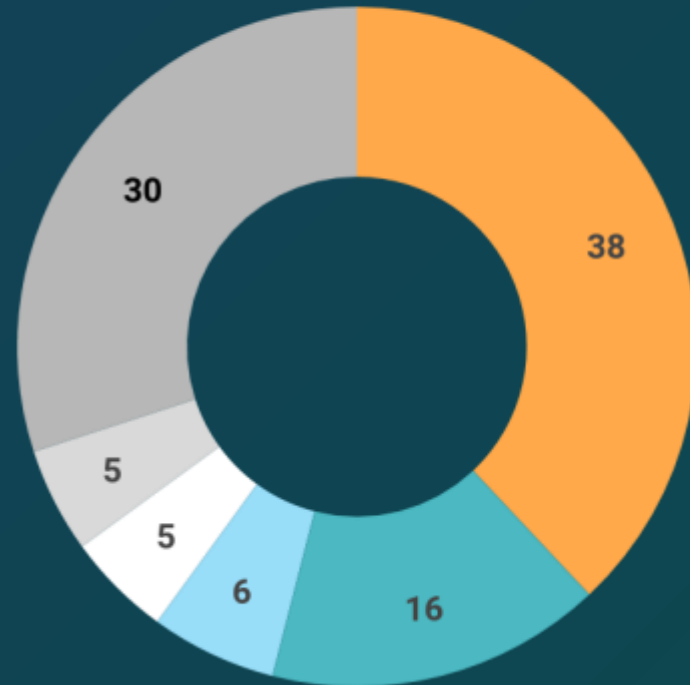
¹Sources: The Ellen Macarthur Foundation and Pew Charitable Trusts

The wholesale and retail sector contributed over 350,000 tonnes of total plastic waste generation. Packaging was 83% of Singapore's total plastic waste, and the majority of plastic waste generated across each industry sector.

Plastic Waste Generated by Industry Sector

(percentage)

- Wholesale & Retail
- Accommodation & Food Services
- Transport & Storage
- Construction
- Electronics
- Other (Education, Government Services, Banking etc)



WHOLESALE AND RETAIL

93% OF PLASTIC WASTE IN THE SECTOR IS PACKAGING.

62% of plastic waste is made up of primary packaging (containers, refill pack, bottles, wrappers, tubs and bottle caps).



ACCOMMODATION AND FOOD SERVICES

71% OF PLASTIC WASTE IN THE SECTOR IS PACKAGING.

29% of plastic waste is attributed to plastic consumables (gloves for food preparation hotel slippers) and **32%** to primary packaging (food containers, cups).



ELECTRONICS

74% OF PLASTIC WASTE IS ATTRIBUTED TO THE OUTER CASING OF ELECTRONIC UNITS (i.e., when a computer is thrown away, the metals are extracted for recycling but plastic casing of computer is thrown away).

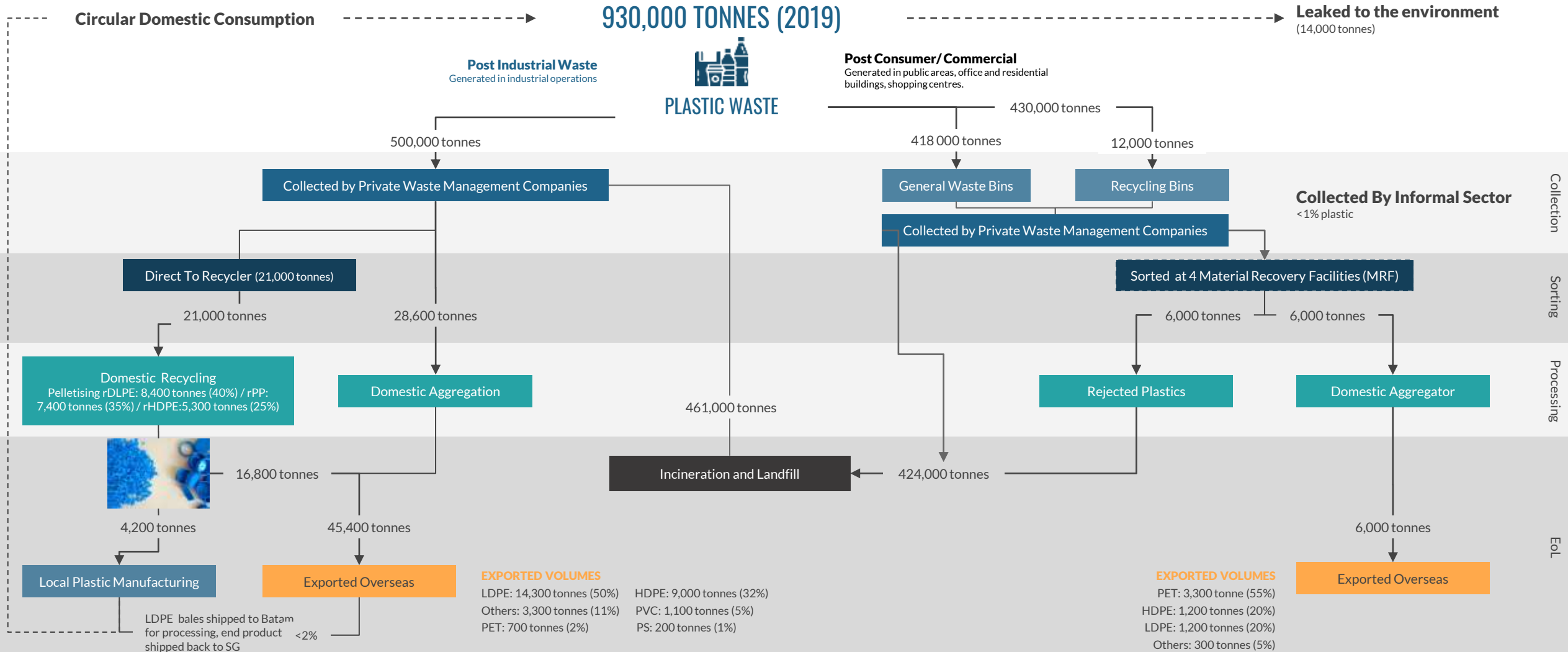


TRANSPORT AND STORAGE

79% OF PLASTIC WASTE IN THE SECTOR IS PACKAGING

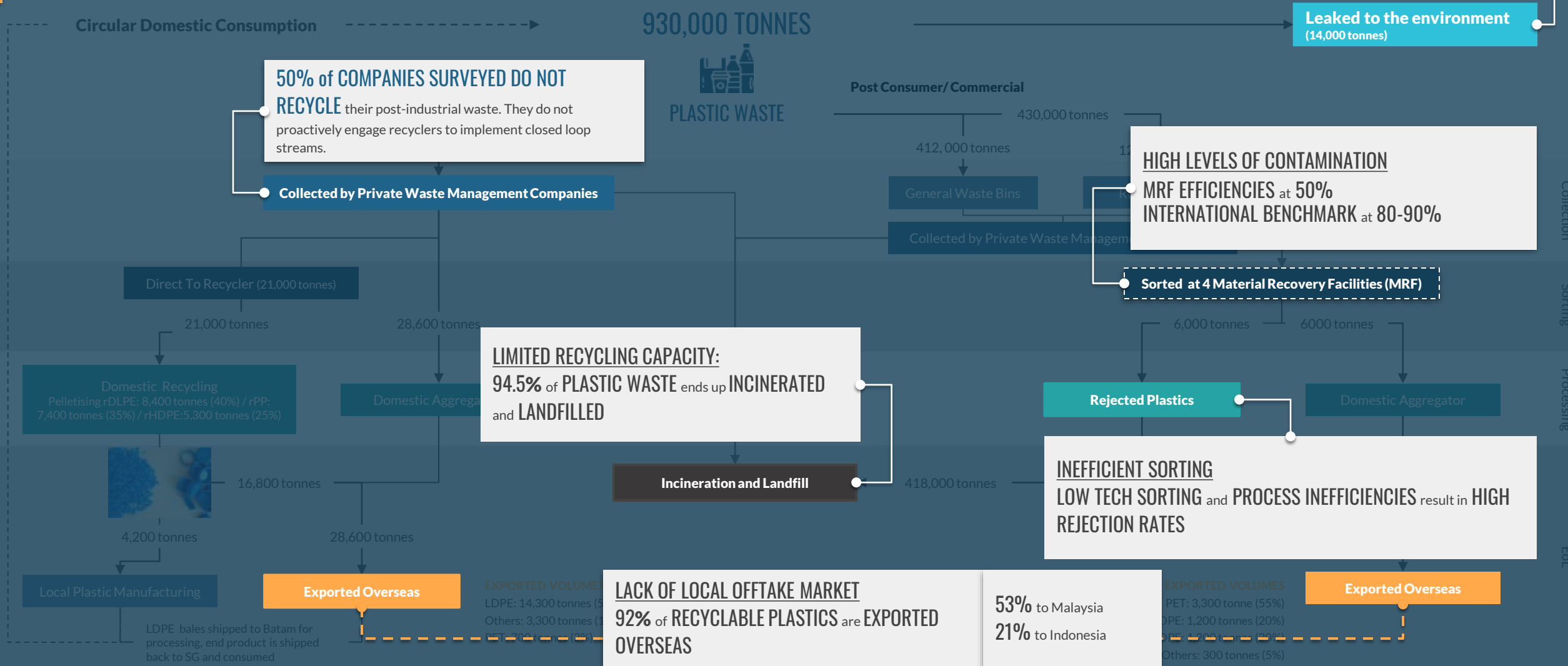
62% plastic waste from **tertiary packaging** used to facilitate transport of goods (i.e., LDPE shrink wrap).

How plastic gets recycled in Singapore



How Plastic gets recycled in Singapore

14,000 TONNES OF PLASTIC WASTE ENTERS THE ENVIRONMENT
 Primary pathway through littering. Gross pollutant traps become overfilled and blocked contributing to flash flooding.



Limited transparency on what happens to plastic waste once exported. As of 1 January 2021, Basel Convention Plastic Waste amendments requires that all transboundary plastic waste must be demonstrated to be destined for recycling in an 'environmentally sound manner and almost free from contamination'. Certain plastic waste (e.g. ABS) are subject to Prior Informed Consent Procedure.

Opportunities can be targeted by resin volumes and market prices

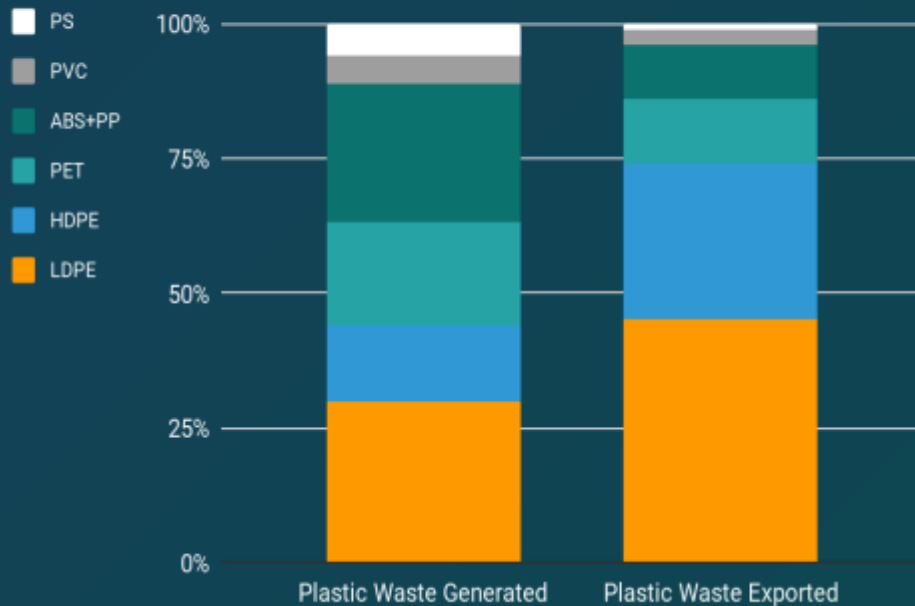
LDPE represents the largest post-industrial plastic waste volume generated while polystyrene has one of the highest recycling value for both post-industrial and post-commercial waste generated

Baled prices from Singapore are competitive with neighbouring ASEAN countries, however mechanical recycling in Singapore could be up to 2.6x that of the cost for other countries in ASEAN due to the higher costs of labour, rental and water for recycling operations.

Export plastic waste trade value
SG\$17.3M
 annually

Plastic Waste Generated and Exported

(percentage)



Value
 (2019) ~SGD700/tonne

Value
 (2019) ~SGD50/tonne

PS - Polystyrene | Take-away containers, foam cups

PVC - Polyvinyl chloride | Piping, cables, health care applications

ABS - Acrylonitrile Butadiene Styrene | Piping, electronic casings, LEGO®

PP - Polypropylene | Bottle caps, Straws, Beauty care, Yoghurt pots, 3D printing

PET - Polyethylene terephthalate | Water bottles, clam shell packaging, Polyester yarn

HDPE - High Density Polyethylene | Milk jugs, cleaning/hygiene bottles

LDPE - Low Density Polyethylene | Shrink wrap, bubble wrap

The value of the plastics will decrease by up to 20% if it is:

1. Contaminated and
2. Coloured

Unsorted plastic waste

Feedback on the study from the industry

FEEDBACK

- ▶ Increased collaboration between plastics recycler with domestic recycling operations since study launch has increased feedstock utilisation rates.
- ▶ Participating companies are exploring greater opportunities to collect granular recycling data from recyclers to improve their waste management practices.
- ▶ Cross-industry interest to ‘continue the conversation’ and create a forum to collaborate, problem solve and share best practice.

RECOMMENDED NEXT STEPS

1. Share Study Insights at Industry Convenings
2. Launch Circular Materials Lab
3. Develop and Launch Zero Plastic Waste Demonstrator

“THIS IS THE STUDY INDUSTRY HAS BEEN NEEDING TO MAKE INFORMED DECISIONS.”

- Industry Association

“INSIGHTS FROM THE STUDY ENABLED US TO DEVELOP THE CIRCULAR MATERIAL LAB AND THE ZERO WASTE DIGITAL TWIN DEMONSTRATOR WHICH WE WILL BE USING TO SUPPORT OUR GLOBAL PACKAGING DECISIONS.”

- Global FMCG

“WE SIGNED A NEW CLOSED LOOP AGREEMENT AFTER FINDING OUT RECYCLERS IN SINGAPORE ARE WELL ADEPT AT SUPPORTING LOGISTICS COMPANIES MANAGE LDPE, THIS HAS DOUBLED OUR RECYCLING RATE.”

- E-commerce Company

“WE DIDN’T PARTICIPATE IN THE INITIAL SURVEY BUT HEARD OF IT THROUGH WORD OF MOUTH, AFTER REACHING OUT FOUND IT TO BE EFFECTIVE MATCHMAKING TO IDENTIFY RECYCLING SOLUTIONS AND INDUSTRY COLLABORATION.”

- Pharmaceutical Company