

**CLOSING THE RESOURCE LOOP (CTRL)
FUNDING INITIATIVE (FI)**

**REQUEST FOR PROPOSAL (RFP) ON
BEYOND INCINERATION: PLASTIC WASTE RECYCLING AND PACKAGING
SOLUTIONS**

Research Area	Beyond incineration: Plastic waste recycling and packaging solutions
Publication Date	Wed, 18 Oct 2023, 11 am
Closing Date and Time	Wed, 31 Jan 2024, 11 am
Proposal Submission	<p>Applications shall be made via:</p> <p>Integrated Grants Management System (IGMS) at https://researchgrant.gov.sg by the closing date and time</p> <p>Note: Proposal submitted after the closing date and time will not be considered</p>
Instructions and Format of Submission	<p>Please refer to the following websites:</p> <p>NEA's webpage at https://www.nea.gov.sg/programmes-grants/grants-and-awards/research-innovation-and-enterprise-funding-initiatives/closing-the-resource-loop-funding-initiative</p> <p>or</p> <p>via IGMS at https://researchgrant.gov.sg</p>

REQUEST FOR PROPOSAL (RFP) ON BEYOND INCINERATION: PLASTIC WASTE RECYCLING AND FOOD PACKAGING SOLUTIONS

BACKGROUND

1. Singapore, being a city-state, is faced with an increasingly carbon- and resource-constrained future as well as limited land for waste disposal. To guide the transition to a more sustainable and circular economy, the National Environment Agency (NEA) has developed the Zero Waste Masterplan with the vision of moving towards a Zero Waste Nation. Packaging waste, including plastics, was identified as one of the priority waste streams that Singapore will need to better manage.

2. Plastic recycling rates have remained low in Singapore, ranging between 4% and 6% from 2017 to 2022. To reduce waste generation and improve recycling rates of packaging waste, NEA has introduced various initiatives such as the National Recycling Programme (NRP), Packaging Partnership Programme, the Mandatory Packaging Reporting scheme, and the disposable carrier bag charge. Under the NRP, mixed recyclables are collected by dedicated recycling trucks and sent to Materials Recovery Facilities (MRFs) where the different types of recyclables are sorted, baled and sent to local and overseas recycling plants for further processing. NEA has announced that a beverage container return scheme will commence from 1 Apr 2025.

3. Plastic waste such as polyethylene Terephthalate (PET) from the industrial and commercial sector as well as PET beverage containers collected under the beverage container return scheme can be mechanically recycled into pellets or flakes for manufacturing new bottles or other products. This reduces the amount of plastic incinerated, and correspondingly the amount of carbon emitted from incineration plants in Singapore. Refer to [Appendix 1](#) for the initiatives that NEA has implemented/planned to implement on plastic waste management.

4. To enhance Singapore's plastics recycling efforts, NEA is pursuing chemical recycling solutions to close the plastic waste loop in Singapore. Chemical recycling can process plastics that cannot be mechanically recycled, such as contaminated single-use plastics, and convert these into higher-value products such as new plastics and chemicals. While there is currently no local facility that recovers contaminated plastics from domestic waste, NEA is studying the feasibility of a Plastic Recovery Facility which will take in domestic waste collected from households and trade premises, and recover various plastic polymer types (e.g. polyethylene and polypropylene). These recovered plastics can then be further treated in chemical recycling plants.

5. Beyond NEA's existing and planned plastics recycling initiatives, there is a need to develop novel solutions to address the resource sustainability challenges relating to plastics. These include extracting value from other types of plastics present in mixed plastic waste, as well as developing sustainable plastic food packaging materials that utilise recycled plastic materials that are easy to recycle.

SCOPE OF RFP

6. This RFP is an open call for research and development (R&D) proposals to develop novel solutions to complement NEA's existing and planned plastics recycling and recovery efforts. The desired outcomes for this open call are below. Applicants may submit one or more proposal(s) addressing one or more of these Outcome(s).

Desired Outcome A: Treatment and resource recovery of mixed plastic wastes not covered under NEA's mechanical and chemical recycling plans.

7. While NEA's existing and planned recycling and recovery efforts will target the main types of plastics present in the blue recycling bins and domestic waste, there remains a sizeable amount of other types of plastic wastes that would not be recovered/removed from mixed waste stream and would still be directed to the incineration plants. Recycling and recovery of these non-targeted and rejected plastic waste streams could provide opportunities for resource recovery and diversion from the incineration plants. These include the following types of plastics:

- a) **Plastic types not targeted under NEA's current and planned recycling and recovery efforts** such as polyurethane (PU), polycarbonate (PC), acrylonitrile butadiene styrene (ABS), poly(methyl methacrylate) (PMMA) and multi-layer plastics
- b) **Contaminated¹ mixed plastic waste** such as from MRF and rejected PET, PP, PE and other residual plastic waste from PRF

8. The primary objectives of the research proposal are as follows:

- a) Develop innovative solutions to recycle and convert any of the plastic waste types listed in para 7 (a) and (b) into marketable product(s) of demand in Singapore and/or overseas.
- b) Assess the lifecycle cost and benefits of the solution, recyclability of the end product, potential environmental impact such as leakage of microplastic into the environment during processing and in application or usage of the end product, net carbon emissions/abatement, generation of by-product, and usage of energy, water for the developed solution(s).

9. Proposal(s) shall include:

- Assessment of the tonnage of plastic waste that can potentially be diverted from incineration plants and estimated percentage contribution to nation's plastic recycling rate if the solution is successful.
- An informed cost target of the solution the project aims to achieve.

¹ Contamination refers to dirty plastic found with food (e.g. used and unwashed takeaway plastic food containers) or liquid residues such as food remnants, cooking oil, milk, liquid detergent, etc.

- Assessment of the economic and other sustainability impacts to be derived through the proposed solution(s).
- Industry partners willing to adopt/license the technology developed by putting resources and funding into the project and finding off-takers for the end-products.
- Substantiate the demand for the processed products and the amount of plastics waste that would be utilised in the end-product.

10. Proposal(s) shall exclude:

- Mass-burn solutions i.e. incineration
- Sorting, segregation, and/or processing of plastic waste for recycling, sale, or export
- Incorporation of plastic waste in construction applications like asphalt roads, concrete, and pavements
- Engineering modifications of commercially available solution(s) without any research and development such as reducing the thickness of material or replacing one material with a different material

Desired Outcome B: Address emerging packaging trends to develop sustainable plastic food packaging materials that utilise recycled plastic materials and are easy to recycle.

11. In response to the global shift towards achieving higher recycling rates, governments worldwide are implementing strategies to move towards upstream sustainable practices. For example, the European Union (EU) commission proposed that all packaging within the EU market should be economically viable for recycling and should contain a minimum percentage of recycled content (i.e., between 10% and 35% by 2030) recovered from post-consumer plastic waste, per unit of packaging.² Concurrently, fast moving consumer goods companies and brand owners are demonstrating their commitment by pledging to use recycled packaging materials for their products. This has led to the increased trend of making plastic packaging materials made from recycled plastic, which also can be easily recycled, such as use of mono-layer polyolefin materials as replacement for hard to recycle multi-layered films.

12. Today the use of mono-layer polyolefin packaging has already been introduced locally for both food and non-food products. It is anticipated that such streams will become more common as products with mono-layer polyolefin packaging would be imported into Singapore. This RFP looks for solution(s) to address the emerging trends for sustainable packaging and easy to recycle solutions. The primary objectives of this proposal are as follows:

² Refer to "Regulation of the European Parliament and of the Council on packaging and packaging waste". <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022PC0677>

- a) Develop solutions to enable the circularity of recycling mono-layer polyolefin packaging materials preferably back to food grade quality, while maintaining the necessary functionality, durability and aesthetic appeal required for food packaging and ensure new packaging materials are made from recycled material with reference to minimum recycled content in plastic packaging set by EU.³ The developed solution should also meet the food safety standard/regulation (i.e. all food contact articles must not transfer harmful substances to the food coming into contact with them), be able to retain the freshness and quality of food over extended periods, and provide a cost competitive option to commercial packaging options. While there are no internationally harmonised standards/guidelines for the use of recycled plastics in food contact articles at the moment, applicants could refer to the United States Food and Drug Administration (US FDA) - Use of Recycled Plastics in Food Packaging (Chemistry Considerations): Guidance for Industry⁴ or the relevant EU regulations (e.g. EU 2022/1616⁵ or EU 10/2011⁶) as a guide.
- b) Assess the recyclability of the newly developed packaging materials, as well as the environmental impact, lifecycle cost and waste reduction potential resulting from adopting the developed packaging materials at scale.

13. Proposal(s) shall include:

- Industry partners contributing resources and funding into the project and to pilot and implement developed packaging materials or adopt/license the technology developed
- Justifications to showcase the substantial demand for the products
- An informed cost target of the packaging material to be developed.

14. Proposal(s) shall exclude:

- substitution of plastic with other material(s)

³ 10% for contact sensitive packaging made from plastic materials other than PET, except single use plastic beverage bottles; 30 % for contact sensitive packaging made from PET as the major component / for single use plastic beverage bottles; and 35% for non-contact sensitive plastic packaging.

⁴ <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-use-recycled-plastics-food-packaging-chemistry-considerations>

⁵ Refer to “Commission Regulation (EU) 2022/1616 of 15 September 2022 on recycled plastic materials and articles intended to come into contact with foods, and repealing Regulation (EC) No 282/2008”. <https://eur-lex.europa.eu/eli/reg/2022/1616/oj>

⁶ Refer to “Commission Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food”. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32011R0010>

- the use of bio-degradable⁷ materials, oxo-degradable⁸ materials; and compostable⁹ materials
- improvement of cost-efficiency of commercially available solution(s) without any research and development

PROPOSAL REQUIREMENTS AND SUBMISSION

15. All Proposals shall be submitted through the IGMS before closing date and time. Applicants are to refer to the “Instructions and Templates for Applicants” for guidelines prior to submission of the proposal.

16. Proposal(s) should strive to achieve a Technology Readiness Level (TRL) 6 or above at the end of the project (refer to TRL definition in Section 8 of Research Proposal Template). The Proposal(s) shall include but shall not be limited to the following information:

- a) Detailed description of the research objective, scope and proposed methodologies to achieve the desired outcomes. Where applicable, it should cover the advantages of proposed methodologies over other available methods.
- b) Detailed description of technologies /methods to be used for achieving the desired outcomes. This should include references to prior studies done and/or literatures, where applicable.
- c) Project deliverables and timeline showing the research and technical milestones to be achieved and how the achievement of these milestones is determined. The deliverables should be quantifiable, e.g., % reduction in cost compared to existing solutions, or target to achieve certain performance level or standard.
- d) Detailed description of the quantitative and qualitative impact of the project outcomes and environmental impact of the solution should be provided.

⁷ Biodegradable plastic is a plastic that can be broken down into its constituent monomers and metabolised through the action of naturally occurring micro-organisms, such as bacteria and fungi, over a period of time. Biodegradation refers to biochemical processes during which naturally occurring micro-organisms in the environment, convert the polymer into substances such as water, carbon dioxide and biomass.

⁸ Oxo-degradable plastics are made of conventional petroleum-based polymers (such as PE, PET, PP, PS PET and sometimes also polyvinylchloride, or PVC) to which an additive has been added (usually a transition metal compound), that accelerates their degradation when exposed to heat and/or light. The ‘oxo-biodegradable’ additives are typically incorporated into these conventional plastics as at the moment of conversion into final products.

⁹ Compostable plastic is one that is ‘capable of undergoing biological decomposition in a compost site, such that the plastic is not visually distinguishable and breaks down to carbon dioxide, water, inorganic compounds, and biomass, at a rate consistent with known compostable materials (e.g. cellulose), and leaves no toxic residue.

- e) Proposed budget with justifications.
- f) Research team, their capabilities and relevance of project team members.
- g) Indication of all commitment, in-kind services, funding, and tangible contributions by industry partners, host institute or any other partners towards the proposed project. In-kind services include labour, materials, and other services such as loaning of facilities and space. Any Letter of Support or agreements signed should be attached as supporting documents.

17. Requests for any data from Public Sector Agencies are to be submitted in the proposal (Research Proposal Template Section 4. Research Proposal - Data Requirements.). The Research Proposal Template may be found under section 1.7 of the IGMS project application form.

18. The applicant shall recommend at least three (3) independent international expert reviewers in the proposal submission in IGMS proposal section 8 - Reviewers. The peer review process forms part of the project evaluation process to evaluate the scientific merits and international competitiveness of the proposals.

PROJECT DURATION AND SCHEDULE

19. The project duration shall not exceed three (3) years, from initiation through to the completion of the project for each of the problem statement.

20. The proposed project schedule shall include major milestones and phases. The Proposal shall also explain how the achievement of the major milestones and phases are to be evaluated and determined.

ELIGIBILITY AND FUNDING SUPPORT

21. This RFP is extended to all Institutes of Higher Learning (IHLs), research institutes, and private entities. The RFP is to support R&D work carried out in Singapore.

22. The funding support for successful proposers is indicated below:

Applicant – Nature of Organisation	Funding Support
Institutes of Higher Learning/Research Institutes	Up to 100% of qualifying project cost
Singapore Small and Medium Enterprises (SMEs) Singapore Start-ups Singapore Not-for-profits	Up to 50% of qualifying project cost

Large Local Enterprises (LLEs)	Up to 30% of qualifying project cost
Non-Singapore private sector entities (including not-for-profits)	Up to 30% of qualifying project cost

23. Indirect costs will not be supported for all private sector entities (i.e. 0% of indirect costs will be provided).

24. Funding of private entities for research projects (of total project budget >\$500,000) and test-bedding/demonstration/scale-up projects (of total project budget >\$2M) is conditional on collaboration with public sector performer. Funding for non-Singapore entities is conditional on the appointment of a Singapore Technology Licensing Officer (STLO). More details are in “Guidelines on Funding Private Sector Entities” (refer to **Annex D** of “Instructions and Templates for Applicants” document).

25. Private sector entities are to fill in the ‘Declaration form for Private Sector Applicant(s)’ in **Annex E** of “Instructions and Templates for Applicants” document and submit them via IGMS.

EVALUATION CRITERIA

26. Proposals will be evaluated against the following criteria:

S/N	Evaluation Criterion	Weightage (%)
1	Effectiveness in achieving desired outcomes ¹⁰ <ul style="list-style-type: none"> Relevance of proposed scope Innovativeness and technical feasibility of the proposed methodologies Environmental impact 	50
2	Technical competencies of the research team <ul style="list-style-type: none"> Track record of Principal Investigator(s) and collaborators Relevant R&D capabilities and expertise of the Principal Investigator and team members 	15
3	Project management and cost relative to scope of study	15

¹⁰ Desired Outcome A and B will be ranked independently.

	<ul style="list-style-type: none"> • Clarity of proposed milestones, deliverables, and implementation schedule • Reasonableness of proposed budget 	
4	Quality and extent of industry partners' involvement	20
Total Score		100

CONTACT

27. Please contact the Secretariat at CTRL_Grant_Secretariat@nea.gov.sg, should you have any query.

28. Applicants shall refer to the Instructions and Templates for Applicants document on the Integrated Grants Management System (IGMS) at <https://researchgrant.gov.sg> as the primary source of information. Information is also available at <https://www.nea.gov.sg/programmes-grants/grants-and-awards/research-innovation-and-enterprise-funding-initiatives/closing-the-resource-loop-funding-initiative>.

29. For companies that do not have company accounts in IGMS, please provide the details and information per “IGMS Account Creation” (refer to **Annex F** of “Instructions and Templates for Applicants” document) to the above contact point for account registration early. Account creation may take 5 to 10 working days and late applications due to account registration will not be entertained.

30. Applicants may refer to “Check-List Of Documents To Prepare” **Annex G** of “Instructions and Templates for Applicants” document for a check-list of documents to prepare

31. Successful proposals will be notified in writing.

Appendix 1: Summary of the initiatives implemented/to be implemented on plastic waste management.

A) National Recycling Programme

Under the NRP, Public Waste Collectors (PWCs) licensed by NEA are required to provide recycling bins and recycling collection services to all HDB estates, private landed properties and condominiums/private apartments opted into the public waste collection scheme.

The NRP adopts a collection system in which paper, plastic, glass and metal recyclables are deposited into the same blue recycling bin for collection by the PWCs. The mixed recyclables are collected by dedicated recycling trucks and sent to Materials Recovery Facilities (MRF) where the different types of recyclables are sorted, baled and sent to local/overseas recycling plants for further processing.

As part of Recycle Right Campaign and to support Singapore's ongoing efforts to make recycling convenient for households, the Bloobox (recycling box) initiative was launched in March 2023. From 19 March to 30 April 2023, all residential households in Singapore could collect a Bloobox from vending machines located islandwide to encourage the habit of recycling and set up a recycling corner at home. Labels are featured on the Bloobox to help households identify recyclable items.

B) Packaging Partnership Programme

The Singapore Manufacturing Federation partnered NEA to introduce an industry-led programme called the Packaging Partnership Programme (PPP) in 2020. The objectives are to:

- a. Raise industry and community awareness on reuse, reduce and recycle (3R) of packaging waste; and
- b. Build up industry capability to reduce, recover and recycle packaging waste; introduce supply chain initiatives that foster the sustainable use of resources in packaging.

C) Mandatory Packaging Reporting (MPR) scheme

Mandatory reporting of packaging data and 3R plans for packaging commenced in Jan 2021 and companies were required to submit their packaging reports by 31 March 2022. Producers of packaged products such as brand owners, manufacturers, and importers, as well as retailers such as supermarkets, are required to report data on the packaging that they introduce into Singapore annually. They also need to develop and submit plans to reduce, reuse or recycle packaging in Singapore. For a start, the requirements apply to companies with an annual turnover of more than \$10 million. The MPR scheme aims to bring greater

awareness to companies on the potential benefits for packaging reduction within their business operations and to spur companies to reduce packaging and packaging waste including plastic. It also lays the foundation for an Extended Producer Responsibility scheme for packaging waste.

D) Disposable Carrier Bag Charge at Supermarkets

A disposable carrier bag charge was implemented on 3 Jul 2023 where large supermarket operators are required to charge a minimum of five cents for each disposable carrier bag provided for purchases at physical stores, and to publish information on the number of bags issued, amount of proceeds received from the bag charge, and how the proceeds are used. The requirements apply to operators of SFA-licensed supermarkets with an annual turnover of more than S\$100 million.

E) Beverage Container Return Scheme

The beverage container return scheme is the first phase of an Extended Producer Responsibility approach to manage packaging waste, including plastics. Under the scheme, pre-packaged beverages in plastic and metal containers ranging from 150 millilitres to 3 litres will have a refundable deposit of 10 cents. Consumers can claim a full refund of the deposit by returning their empty beverage containers at designated return points. The scheme aims to increase the recycling rate of beverage containers, reduce the amount of waste disposed of, and reduce carbon emissions. The scheme also seeks to raise consumer awareness on the importance of the 3Rs and encourage good recycling practices.

F) Plastic Recovery Facility (PRF)

PRF is critical in anchoring the chemical recycling value chain in Singapore as it will recover the suitable plastic (e.g., Polypropylene (PP) and Polyethylene (PE)) from domestic waste to be used as feedstock for chemical recycling.