

MARINE CLIMATE CHANGE SCIENCE (MCCS) PROGRAMME
FIRST GRANT CALL

1. Definitions

1.1 In this Call for Proposal, unless the contrary intention appears: -

- (a) “Collaborator” means any company, institution, incorporated body or other industry or academic collaborator, which is not an Institution or an Investigator but is to be engaged in the Research in collaboration with the Institutions or any of them;
- (b) “Host Institution” means the body or institution or administering organisation named in the Letter of Award as the “Host Institution” as the body responsible for undertaking and managing the Research;
- (c) “Institutions” means collectively the Host Institution and the Partner Institutions and “Institution” shall mean any one of them;
- (d) “Investigators” means collectively, the Lead Principal Investigator, Team Principal Investigators and Co-Investigators; and
- (e) “Partner Institutions” means the bodies or institutions named in the Letter of Award as the “Partner Institutions” as the bodies responsible for working together with the Host Institution to undertake the Research

2. Introduction

2.1 Climate change is recognised as an existential threat, and its effects are currently felt by countries around the world, especially low-lying small island nations like Singapore, where retreat from impact frontlines is not an option. There is urgent need to conduct marine climate change-related research not only to understand the complex mechanisms that drive sea-level rise and destabilise ecosystems, but to also understand processes and responses at the ecosystem, habitat and organismal levels, in order to future-proof the marine environment to sustain the health and productivity of our coastal waters. Combined outcomes from such applied and baseline research should be geared towards enabling translational interventions and programmes that practitioners across the public and private sectors – in Singapore and elsewhere – can adopt, apply and implement, to realise greater resilience in environment, society and economy that will evolve and adapt in tandem with a changing climate.

2.2 The Marine Climate Change Science (MCCS) programme serves as a national focal point for multi-disciplinary marine climate change research, to help address the challenges faced by our coastal and marine environment arising from climate change. Led by NParks, the MCCS programme is part of overall efforts to transform Singapore into a City in Nature, as well as contribute towards a nationwide effort to build climate resilience.

2.3 With an emphasis on multi-disciplinary and translational research, the MCCS programme seeks to advance the core sciences of marine climate change, and inform the development of evidence-based interventions and solutions to safeguard our coastal and marine ecosystems against the effects of climate change, such as sea level rise, increasing sea surface temperatures, and extreme storm events. This will be achieved through the integrated research efforts in 3 core research verticals and 2 enabling horizontals:

- Vertical 1: Blue Carbon Science
- Vertical 2: Eco-Engineering
- Vertical 3: Ecological Resilience
- Horizontal 1: Marine Climate Impact
- Horizontal 2: Community-Driven Climate Resilience Planning

[Please see Annex A for further details on each of the verticals and horizontals]

2.4 A total of S\$25 million has been approved to fund the MCCS programme, under Urban Solutions and Sustainability (USS) domain of Research, Innovation and Enterprise 2025 (RIE 2025). More details on USS can be found at: <https://www.nrf.gov.sg/rie2025-plan/urban-solutions-and-sustainability>.

3. Call Topic

3.1 For this Grant Call, there are 6 Call Topics under Verticals 1-3 and Horizontal 1. Please refer to Annex B for the details of these Call Topics.

4. Eligibility

4.1 Principal Investigators (PIs) from all Singapore-based public research institutes (RIs) (e.g., Institutions of Higher Learning (IHLs) and A*STAR RIs) and Singapore-based private sector entities (including not-for-profit organisations), are eligible to apply.

4.2 The Lead PI who leads the Research must be based in Singapore¹. Collaboration with researchers and other experts from Singapore-based or overseas organisations (as described above) in the capacity of Co-Investigator (Co-I), or as Collaborator is allowed, and strongly encouraged in line with the MCCS programme's emphasis on multi-disciplinary and translational research. This is especially so for areas with potential for introduction of new research capabilities and transfer of technical expertise into Singapore.

4.3 Grant applicants are also strongly encouraged to collaborate with industry partners to develop innovative solutions that can address the call objectives and demonstrate strong potential for real-world application within and beyond Singapore.

¹ Lead PIs must have a minimum of 9 months employment with the Host Institution, starting 3 months from the closing date of the Grant Call.

- 4.4 Funding of private sector Lead PIs for (i) research projects with a total project budget more than S\$500,000 or (ii) test-bedding/demonstration/scale-up projects with a total project budget more than S\$2.0mil, will be conditional on collaboration with a public research performer. Nonetheless, below these quanta, private sector Lead PIs are also strongly encouraged to collaborate with public research performers as far as possible.
- 4.5 A Science Technology Licensing Office (STLO) must be appointed in projects that fund non-Singapore entities².
- 4.6 All funding awarded must be used to carry out the research work in Singapore, and should not be carried out overseas unless expressly approved by the grantor. In addition, contracting out the whole or substantial part of the research work is not permitted.
- 4.7 R&D proposals already funded by other government agencies will not be considered under MCCS. In addition, R&D proposals with similar scope, which are currently under evaluation by other funding initiatives, will not be considered until the results from the other funding initiatives are finalised. Lead PIs and Co-Is will need to declare their other funding sources as well as participation in other funding initiatives during application.

5. Funding Support

- 5.1 When budgeting for funding under MCCS, the total cost of the project should include all approved direct costs³ and indirect costs⁴. All expenditure should be budgeted inclusive of any applicable Goods and Services Taxes (GST) at the prevailing rates.
- 5.2 Direct costs are incremental cost required to execute the programme. Supportable direct costs can be classified into the following cost categories:-
- (a)** Expenditure on manpower (EOM);
 - (b)** Equipment;
 - (c)** Other Operating Expenses (OOE);
 - (d)** Overseas Travel; and
 - (e)** Research Scholarship

² Non-Singapore entities are defined as companies registered in Singapore with less than 30% local shareholding, determined by the ultimate individual ownership.

³ More information on the non-fundable direct costs of research can be found in [Annex C](#).

⁴ Indirect costs in research are those costs that are incurred for common or joint objectives and therefore cannot be identified readily and specifically with a particular sponsored research project, but contribute to the ability of the Institutions to support such research projects (e.g., providing research space, research administration, utilities), and not through the actual performance of activities under the sponsored research projects.

- 5.3 For all direct cost items proposed for the project, please note that:
- (a)** Host Institutions must strictly comply with their own procurement practices;
 - (b)** Host Institutions must ensure that all cost items are reasonable and are incurred under formally established, consistently applied policies and prevailing practices of the Host Institution; and
 - (c)** All items/ services/ manpower purchased/ engaged must be necessary for the R&D work.
- 5.4 The Lead PI should exercise due diligence and ensure that the proposed budget is correct and free from error.
- 5.5 For proposed Equipment to be purchased, please ensure that they are currently unavailable in the Host Institution. In the event where the Lead PI is aware that a similar Equipment is available in the Host Institution, but has still proposed to purchase such Equipment, the Lead PI has to provide the necessary justifications for the MCCS Programme Office's approval. Please also note that there is a requirement to share Equipment purchased using NRF funds with other researchers in Singapore.
- 5.6 At the end of the Research, the MCCS Programme Office may enter a negotiation with the Host Institution to transfer ownership of any of the Assets to the MCCS Programme Office or any other person or body at no cost. Please note that data collected in the Research may be required to be shared with other NRF-funded projects, unless they are commercial data or bounded by non-disclosure agreements (NDAs), to maximise synergies across projects and minimise duplicative works.
- 5.7 MCCS will support 100% of the approved qualifying direct costs of a project for Singapore-based public RIs. Singapore-based private sector entities⁵ will qualify for tiered funding support of up to 70%⁶ of the approved qualifying direct costs of a project:
- (a)** 30% for all non-Singapore entities (including non-Singapore not-for-profits);
 - (b)** 50% for Singapore Large Local Enterprises; and
 - (c)** 70% for Singapore Small Medium Enterprises, start-ups and not-for-profits.
- 5.8 Support for indirect costs, in the form of overheads, will only be provided for Singapore-based public RIs. Funding support of 30% of the total qualifying approved direct costs (i.e., Total direct costs less exceptional items) will be allowed. Host Institutions will be responsible for administering and managing the support provided by MCCS for the indirect costs of research. Indirect costs must be specifically provided for in the grant, and approved by the Grantor based on the nature of the research.

⁵ Definitions of the different private sector entity types can be found in [Annex D](#).

⁶ Exemption: Temasek Life Sciences Laboratory will qualify for 100% of the approved qualifying direct costs of a project.

- 5.9 Collaborators are not permitted to receive, directly or indirectly, any part of the funding, whether in cash or in the form of assets acquired using the funding or otherwise. All assets acquired using the funding must be located in Singapore and maintained within the control of the grantees.
- 5.10 Please refer to the document “Guidelines for the Management of Research Grants” for information on Disbursement of funds, Variation requests, Audit and Progress reports and List of Non-Fundable Direct Costs for Research Projects.
- 5.11 The MCCS Programme Office’s decision on the funding support to be awarded for each project is final.

6. Intellectual Property Rights

- 6.1 The Institutions shall keep and maintain a full, comprehensive and updated list of all Research IP, which shall be made available to MCCS Programme Office for inspection at any time.
- 6.2 The parties shall use best efforts to ensure that Research IP is properly managed and wherever feasible, fully exploited and commercialized. When required to do so by MCCS Programme Office, the Institutions shall attend such meetings as MCCS Programme Office may direct to discuss the potential for exploitation and commercialization of Research IP.
- 6.3 The Government and public sector agencies shall reserve a non-exclusive, non-transferable, perpetual, irrevocable, worldwide, royalty-free right and license to use, modify, reproduce and distribute the Research IP for non-commercial, R&D and/or educational purposes.

7. Research Integrity Policy

- 7.1 The Host Institution shall ensure that all necessary approvals for the research, including all ethics approvals, have been granted prior to the commencement of any research activities.
- 7.2 The Host Institution is responsible for establishing a research ethics and integrity policy and enforcing its compliance. In carrying out any Research, the Host Institution shall agree to:-
- (a)** Comply with the provisions of any relevant laws of the Republic of Singapore, statutes, regulations, by-laws, rules, guidelines and requirements applicable to it, as well as all applicable policies and procedures adopted by MCCS as the same may be amended or varied from time to time;
 - (b)** Have in place a research integrity policy which sets out the principles for the responsible conduct of research and procedures for investigating and responding to accusations of misconduct;
 - (c)** Provide training in responsible conduct of researchers, for all researchers;

- (d) Be held responsible for the conduct of research and researchers; and
- (e) Ensure compliance with best practice, as well as the ethical, legal and professional standards relevant to the research.

7.3 All PIs, research personnel and all other persons involved in the Research must comply with the research ethics and integrity policy, and other approval requirements needed to carry out the research programme. The PIs should undertake the following declaration:

- (a) In carrying out Research, agree to comply with the provisions of any relevant laws of the Republic of Singapore, statutes, regulations, by-laws, rules, guidelines and requirements applicable to it, as well as all applicable policies and procedures adopted by MCCS programme as the same may be amended or varied from time to time;
- (b) Agree to hold primary responsibility for the responsible conduct of research, and shall abide and comply with the ethical, legal and professional standards relevant to research, in accordance to the research integrity policy of the Host Institution; and
- (c) Declare any potential conflict of interest that may arise from the purchase of equipment/ physical items or engagement of manpower/ services in the course of carrying out Research.

8. **Evaluation Process**

8.1 Proposals will be evaluated based on the following criteria:

- (a) **Research Excellence (30%)**
 - Significance of proposed research, including novelty, extent to which project deliverables address/answer key research gaps/questions in the research area, and the potential for breakthrough/innovation.
 - Clarity of plans for proposed research project, including proposed deliverables, milestones, timelines, and budget.
- (b) **Innovation and Enterprise Potential (20%)**
 - Potential for application of research project outcomes/solutions to address important challenges/needs in Singapore, as well as globally.
 - Extent that anticipated project output can be expected to meet significant policy, operational, or commercial needs in Singapore, as well as globally.
- (c) **Strength of Research Team (30%)**
 - Relevance and quality of expertise and experience of the Lead PI, Co-Is and key project team members.
 - Time commitment of Lead PI, Co-Is and Collaborators in proposed project.
- (d) **Contribution to MCCS Objectives (20%)**
 - Relevance and degree of contribution of proposed research to the stated objectives, outcomes and targets for the Call Topic.
 - Value for money in relation to deliverables expected and budget required.

9. Letter of Award & Acceptance

- 9.1 The MCCS Programme Office is under no obligation to award research grant in whole or in part to any proposal. The MCCS Programme Office may require proposals to be revised as it sees fit to enhance research outcomes, facilitate integration of research concepts and technologies, and optimise funding resources. **The MCCS Programme Office's decision on project and funding support will be final** and shall be abided by the applicants.
- 9.2 Successful applicants will be informed by the MCCS Programme Office of the award of the grant in the form of a Letter of Award, which will be sent to the Director of Research for the respective Lead PI's Host Institution, and copied to the Lead PI.
- 9.3 The Letter of Award will include the following:
- (a) Statement of Acceptance;
 - (b) Terms and Conditions of the Grant;
 - (c) Guidelines on Grant Management;
 - (d) Performance Indicators and Milestones; and
 - (e) Schedule and Budget Details.
- 9.4 The Acceptance Form must be acknowledged by all of the following:
- (a) The Director of Research (or equivalent);
 - (b) The PI; and
 - (c) The Co-Investigators (Co-Is).
- 9.5 Upon acceptance of the MCCS grant, the PI, Co-Is and Host Institution are bound by these clauses and all other terms as specified in the Letter of Award.
- 9.6 The PI or Co-Is cannot also be the authorised officer representing the Institution (i.e. DOR). In such cases, another officer duly authorised by the management of the Institution shall approve on its behalf.
- 9.7 The Acceptance Form and Annexes (if applicable) should be returned to MCCS Programme Office within a pre-determined time frame from the date of the Letter of Award. The date on which the Statement of Acceptance is signed shall be taken as the date of acceptance of the Award.
- 9.8 After the acceptance of the Award, the Host Institution, Partner Institutions, and the Collaborators shall enter into a written agreement that is consistent with the obligations assumed under this Research and that includes conditions about: -
- (a) the role of each party in the Research;
 - (b) the provision of cash or in-kind contributions to the Research by each party;
 - (c) the work to be undertaken by each party and its technical/scientific contributions;
 - (d) terms relating to Intellectual Property ownership and commercialization; and
 - (e) any other obligations to be fulfilled as laid out in this set of guidelines.

9.9 The Investigators are responsible for putting in place research collaboration agreements where and when applicable.

10. **Submission Instructions**

10.1 This call for proposals is a single full proposal stage.

10.2 Please download the Integrated Grant Management System (IGMS) User Guide from the IGMS system at <https://researchgrant.gov.sg/> for all instructions and guidelines on the submission process and information relating to the Grant Call.

10.3 Lead PI and Co-Is from organisations that are not registered in the IGMS are advised to contact MCCS@nparks.gov.sg as soon as possible. Applicants are advised to allow sufficient time (at least 2 weeks) for their respective organisation to be registered, including registering their respective researcher profiles in the IGMS prior to submitting proposals. Refer to **Appendix 1** for further information.

10.4 The Lead PI is required to submit an online application, with all supporting documents, for the MCCS 1st Grant Call through IGMS at <https://researchgrant.gov.sg/>. Separate submissions outside of IGMS will not be considered. Once PIs have submitted their documents online, their applications will be routed to the Director of Research (or equivalent) of their respective Host Institution for online endorsement.

10.5 Please note that it is mandatory for applications to be lodged in the IGMS system and endorsed by **16 February 2022, 2:00pm, Singapore time (UTC +08:00)**. **Late submissions or submissions from individual applicants without endorsement from the Host Institution will not be entertained.**

10.6 For enquiries on the Grant Call, please email to MCCS@nparks.gov.sg. For other enquiries pertaining to IGMS system, please email IGMS helpdesk at Helpdesk@researchgrant.gov.sg.

10.7 Applications are considered to be successful only if all relevant documents are submitted. The Research Administrative Office from IHLs or equivalent outfits in companies are required to ensure information submitted by their researchers for the grant call are compiled according to the requirements set out. Incomplete submissions may be rejected.

10.8 The application documents required for the submission can be downloaded from, and should be uploaded onto the 'Research Proposal' section under "Research Details" after the applicant login to IGMS. A soft copy of the application documents should also be sent by email to the MCCS Programme Office at MCCS@nparks.gov.sg.

10.9 The documents required to be submitted are:

- (a) Full Proposal Template (Form A);
- (b) Budget Template (Form B); and
- (c) Capability Indicators Template (Form C)

It is advised to restrict each attachment to be less than 4MB.

10.10 Please follow the naming convention and format for labelling of softcopy attachments:

Attachment	Naming Convention	Format of attachment
Full Proposal	<i>[Topic Code] FP_ Proposal title</i>	MS Word
Budget	<i>[Topic Code] Budget_ Proposal title</i>	MS Excel
Capability Indicators	<i>[Topic Code] Indicators_ Proposal title</i>	MS Excel
CVs	<i>[Topic Code] CV_ Proposal title</i>	MS Word
References (optional)	<i>[Topic Code] References_ Proposal title</i>	MS Word

Important: Where relevant privileged or confidential information is needed to help convey a better understanding of the project, such information should be disclosed and must be clearly marked in the proposal.

10.11 In case of discrepancy between the information in the IGMS application form and the attachments uploaded, the information in the attachments shall be taken as final.

10.12 As part of the MCCS programme evaluation process, project submissions will be subjected to a round of peer review by domain experts, followed by evaluation by a Project Evaluation Panel. Research teams applying for the grant call are required to recommend peer reviewers for the MCCS Programme Office's consideration in the Full Proposal Template (Form A) under Section 3 on "Suggested names of Technical Peer Reviewers".

10.13 The final decision on the peer reviewers will be decided by the MCCS Programme Office. Please refer to the following guidelines when recommending peer reviewers:

- (a) Potential reviewers should not have a real or perceived conflict of interest to any members of the research team (e.g., from the same institution as the research team; recently published work with members of the research team; have personal connections with the members of the research team etc.)
- (b) Potential reviewers should be experts in the related field. Researchers cited in the reference list may be recommended as potential peer reviewers.

Appendix 1 – SOP for Creation of New Companies/Institutions in IGMS

Before you begin, please familiarise yourself with the various training guides on navigating the IGMS system.

The various guides and manuals will help you understand the roles of various users in the IGMS and the application process. These documents can be downloaded from: <https://researchgrant.gov.sg/Pages/TrainingGuides.aspx>

Please be informed that companies or institutions who wish to apply for grants in IGMS will need to be registered in the system for first time application. The registration of the company or institution within IGMS is mandatory as part of the proposal submission workflow.

Please refer to the SOP below for the creation of a new company/institution within IGMS.

CREATION OF ACCOUNT FOR LOCAL USERS

Step 1:

To register a new entry in IGMS, companies/institutions will need to send an e-mail to MCCS@nparks.gov.sg with the following details:

Subject: Creation of new Company/Institution in IGMS for MCCS 1st Grant Call

Details of the New Company/Institution to be Created in IGMS

- Full Name of Company:
- Indicate Local Company or Foreign Company:
- Indicate Public Company or Private Company:
- UEN (for local company) or Unique Identifier (for foreign Company):

Step 2 (For Co-Is):

For Co-Is, please proceed to register an account on IGMS using CorpPass after the company/institution has been registered on IGMS. Thereafter, the Lead PI will be able to add the Co-Is' name in the IGMS when he/she fills up the application form.

An Open Researcher and Contributor ID (ORCID) is also necessary to complete the application. Please register for a ORCID at: <https://orcid.org> and update the user profile on the IGMS system with the ORCID.

Step 2 (For Lead PI):

For Lead PI who will be submitting the application under their company/institution, the role of HI Admin is necessary for the assignment of relevant roles ("ORE" and "DOR") to other IGMS users in the company/institution. The grant application is only considered to be submitted after the PI had submitted the proposal on IGMS for ORE's endorsement and DOR's approval.

After the company/institution has been created in IGMS, the MCCS Programme Office will inform them to nominate an HI Admin. The following steps will apply:

- (1) The company/institution will need to nominate a HI Admin. The HI Admin (including all other intended IGMS users) will need to ensure that his/her CorpPass account and ORCID account has been setup. An Open Researcher and Contributor ID (ORCID) is necessary to complete the application. Please register for a ORCID at: <https://orcid.org> and update the user profile on the IGMS system with the ORCID. To set up a CorpPass account, please visit www.CorpPass.gov.sg.
- (2) The HI Admin will need to login to IGMS using his/her CorpPass account to register/update his/her profile inside IGMS. Please note that the IGMS would grant him/her the Principal Investigator (PI) role by default.
- (3) After the HI Admin has been successfully registered in IGMS, the HI Admin will notify the MCCS Programme Office with the information below:
 - Full Name of HI Admin:
 - E-mail Address of HI Admin:
 - Designation of HI Admin in his/her company:

The MCCS Programme Office will arrange with IGMS to change the role of the person from a Principal Investigator (PI) to a HI Admin.

Step 3 (For Lead PI):

- (1) After the role has been updated from Principal Investigator (PI) to HI Admin in IGMS, the MCCS Programme Office will inform the company/institution.
- (2) Once granted the role as a HI Admin, he/she can proceed to assign the relevant roles (e.g. "DOR", "ORE", etc.) to the various users within his/her organisation.

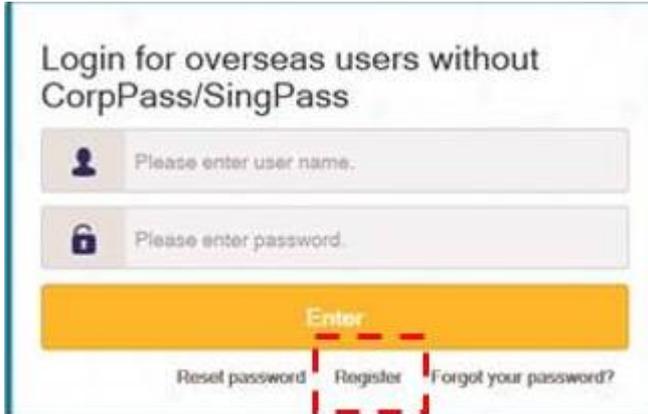
Note:

- (1) To complete a proposal submission, **3 distinct roles** are required from any company or institution to endorse the proposal, namely: Lead Principal Investigator (PI), Office of Research (ORE) and Director of Research (DOR).
- (2) The HI Admin will manage the roles of the users in their company or institution. A HI Admin can concurrently hold the role of Lead PI. He/She will be able to select different profiles upon login to IGMS:
 - (a) Login as HI Admin – to maintain institution & user profiles
 - (b) Login as PI – to apply for grant call.

CREATION OF ACCOUNT FOR FOREIGN USERS

For local companies/institutions with foreign staffs without access to CorpPass/SingPass. The following steps apply:

- (1) All foreign users from the company (i.e. **HI Admin, DOR, ORE, PI**) will “**Register**” themselves in IGMS via “**Login for overseas users without CorpPass/SingPass**”.



- (2) After all the foreign users have been successfully registered in IGMS, the **HI Admin** will notify the MCCS Programme Office with the information below:
 - (a) Full Name of HI Admin:
 - (b) E-mail Address of HI Admin:
 - (c) Designation of HI Admin in his/her company:
 - (d) Full Name of DOR (if DOR is foreign user):
 - (e) E-mail Address of DOR (if DOR is foreign user):
 - (f) Designation of DOR in his/her company (if DOR is foreign user):
 - (g) Full Name of ORE (if ORE is foreign user):
 - (h) E-mail Address of ORE (if ORE is foreign user):
 - (i) Full Name of Foreign PI/Co-I(s)*:
 - (j) E-mail Address of Foreign PI/Co-I(s)*:

**list down all the foreign users that requires tagging to a company/institution*

- (3) The MCCS Programme Office will follow up with IGMS to tag the foreign user to your company.

Note: The **HI Admin** cannot add a new foreign user. However, the **HI Admin** can change the role of a user, or, delete an existing user in his/her company.

Annex A: Overview of the MCCS programme, and its Verticals and Horizontals

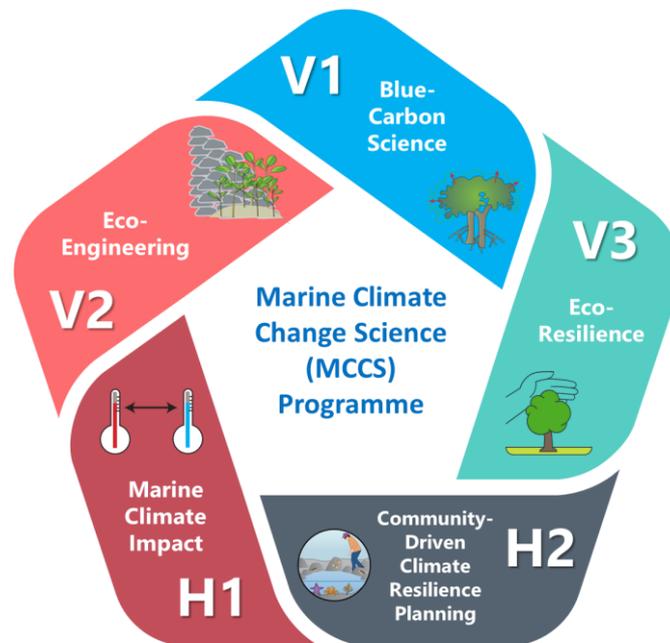
The Marine Climate Change Science (MCCS) programme, developed under RIE2025, will serve as a national focal point for multi-disciplinary marine climate change research in order to advance the core sciences of marine climate change, and develop solutions to help address the challenges faced by our coastal and marine environment arising from climate change, such as sea level rise, increasing sea surface temperatures, and extreme storm events. This is part of overall efforts to transform Singapore into a City in Nature, as well as contribute towards a nationwide effort to build climate resilience.

Led by the National Parks Board (NParks), the MCCS programme aims to address current knowledge gaps that have been identified in the area of marine climate change. The programme also places an emphasis on multi-disciplinary and translational research, and seeks to inform the development of evidence-based interventions and solutions to safeguard our coastal and marine ecosystems against climate change, including leveraging on our existing natural capital in our blue spaces. This is part of overall efforts to transform Singapore into a City in Nature, as well as contribute towards a nationwide effort to build climate resilience under the Singapore Green Plan 2030.

The MCCS programme looks to draw from the foundational science developed under various past and ongoing programmes, such as the ASEAN-Australia Living Coastal Resources Program (1987-1994), TMSI foundational research (1998-2015), the Technical Committee for the Coastal and Marine Environment (TCCME) (2008 to present) and the Marine Science Research and Development Programme (MSRDP) (2016-2021). The programme also seeks to leverage on existing marine science infrastructure in Singapore, such as the St John's Island National Marine Lab and the Marine Environment Sensing Network.

In line with the programme's emphasis on multi-disciplinary and translational research, the MCCS programme also provides upstream identification of potential pilot test-bedding sites for its various projects, where research teams can work to test ideas and solutions that are being developed under the programme. By focusing research within discrete sites, the programme hopes to encourage research teams to test the range of functions, services, and benefits produced by coastal projects, as part of a systems approach to coastal risk reduction and resilience. This will facilitate realistic understanding of the holistic and multi-dimensional considerations in climate change adaptation, with knock-on benefits beyond single-objective, localised coastal protection from sea level rise and extreme weather storm surges.

The MCCS programme is centred around **3 Core Research Verticals** and **2 Enabling Horizontals**, based on various key strategic research areas identified through dialogue and consultation with domain experts, statutory boards and government agencies.



Core domains and enablers of the MCCS programme

Vertical 1 – Blue Carbon Science

Objective: To provide solutions that will reduce Singapore’s carbon footprint while conserving our coastal and marine ecosystems, through building a foundational science for developing a marine carbon credits economy in Singapore.

Vertical 2 – Eco-Engineering

Objective: To protect our coasts against sea level rise and extreme storm events via sustainable engineering measures, while incorporating nature-based solutions which will also enhance our marine environment and create new habitats, thereby providing a sound basis for the sustainable development of Singapore’s islands and coasts.

Vertical 3 – Ecological Resilience

Objective: To better understand the impact of climate change on marine species, habitats, ecosystems and connectivity, so as to inform measures to enhance marine ecosystem resilience against climate change-induced disturbances, and safeguard our natural marine capital through science-based management approaches.

Horizontal 1 – Marine Climate Impact

Objective: To develop predictive models for projecting how climate change may alter existing biogeochemical processes in Singapore’s marine environment, so as to inform the formulation of interventions and strategies that are relevant to the anticipated changes in our local marine environment.

Horizontal 2 – Community-driven Climate Resilience Planning

Objective: To explore how the social sciences can add important methods and perspectives towards climate change mitigation and adaptation efforts in our marine environment.

Annex B: Grant Call Topics

Grant Call ID/ Topic Code: MCCS_V1_2021-1_T1

Call Topic: Assessing the carbon storage and sequestration potential of blue carbon resources in Singapore

Relevant MCCS Verticals/Horizontal: Vertical 1 – Blue Carbon Science (main/ primary)

1. Background

- 1.1 Carbon sequestered and stored within coastal mangrove ecosystems is estimated to be up to three times that of terrestrial forest ecosystems, and this has triggered questions on the potential ability of other coastal and marine resources including seagrass beds, coral reefs, macroalgae communities and seafloor habitats in sequestering and storing carbon.
- 1.2 The research under this topic aims to improve fundamental blue carbon science, establish baselines (e.g., information on stocks potential and sequestration potential) and develop cost-effective carbon accounting and monitoring methodologies to inform the potential use of blue carbon resources for climate change mitigation. This has the potential to support businesses locally and beyond in becoming carbon-light/carbon neutral in their operations or investment options, and to reduce Singapore's carbon footprint while mitigating climate change effects on coastal habitats and infrastructure.

2. Objectives and Scope of Call for Proposals

2.1 Key Research Questions

Proposed projects should seek to address, but are not limited to the following key research questions:

- (a)** What are the carbon storage and sequestration potentials of mangroves, mudflats, and seagrass meadows, as well as coral reefs, macroalgal beds, seafloor and the water column, as potential blue carbon resources?
- (b)** How can we improve the cost-effectiveness of carbon accounting and monitoring methodologies for blue carbon resources?

2.2 Objectives

Proposed projects should include, but are not limited to the following research objectives:

- (a)** To effectively quantify above- and below-ground (e.g., soil and root systems) carbon stocks and sequestration rates within mangroves, mudflats, seagrass meadows, coral reefs, macroalgal beds, seafloor, and water column in Singapore.
- (b)** To develop cost-effective carbon accounting and monitoring methodologies for blue carbon resources.
- (c)** To model the spatial and temporal blue carbon fluxes in Singapore.

Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.

2.3 Project Deliverables

Proposed projects should address, but are not limited to the following project deliverables:

- (a)** Assessment (e.g., spatial representation) of the standing stock of blue carbon above- and below-ground (baseline) and sequestration (including historical, current and future) rates within mangroves, mudflats, seagrass meadows, as well as coral reefs, macroalgal beds, seafloor and the water column as potential blue carbon resources in Singapore.
- (b)** Development of peer-reviewed blue carbon accounting and monitoring methodologies. Possible to also combine with the current carbon accounting framework for terrestrial systems.
- (c)** Spatial and temporal (past, present and future) blue carbon stock and flux maps for Singapore.

Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.

2.4 Impact Outcomes and Pathway to Impact

In relation to the key programme-level deliverables of this vertical, this project should look towards contributing to the following impact outcomes:

- (a)** Quantify the carbon storage and sequestration potential of blue carbon resources in Singapore so as to subsequently look to increasing the total carbon stock of Singapore.
- (b)** Contribute to carbon offset programmes through the development of blue carbon accounting and monitoring methodologies and subsequently, enhancement of carbon offset methodologies. This can support the generation of quality, credible blue carbon credits for carbon market activities in the region, downstream of this project. Outputs from this can eventually contribute to various guidelines and be adopted at international platforms e.g., climate change COP.
- (c)** Development of a database, that incorporates above- and below-ground carbon stocks, monitored and updated regularly by relevant agencies or carbon accounting entities to be used to record historical and current greenhouse gas (GHG) stocks and fluxes from the blue carbon ecosystems etc.
- (d)** Identifying key carbon stock areas of the Singapore “carbon capital” for conservation or restoration in the future.
- (e)** Promoting Singapore as one of the knowledge centres in blue carbon stock and blue carbon stock management.
- (f)** Developing mechanisms and protocols to enhance or promote Singapore efforts in net zero emissions future.
- (g)** Data on spatial and temporal blue carbon stock and fluxes can support the Singapore Green Plan 2030 by helping to guide policy to support Singapore’s long-term net zero emissions aspiration as soon as viable.
- (h)** Data on blue carbon can support Singapore’s reporting commitments under various Multilateral Environmental Agreements (MEAs) like the UN’s 2030 Sustainable Development Agenda and the Paris Agreement.
- (i)** Scientific quantification of blue carbon sinks will allow Singapore to implement more robust evaluation of future coastal developments, taking into account the impacts (both positive and negative) on the blue carbon habitats and its associated carbon capital. For example, associate blue carbon stock with relevant monetary value that can then be applied in the cost-benefit analysis of the proposed coastal development.

2.5 Proposed Study/Pilot Testbed Site(s)

Proposed projects may consider the following coastal and marine areas (industrial and non-industrial) in Singapore for study and pilot test-bedding, including, but not limited to:

Sungei Buloh Wetland Reserve and Mandai Mangrove and Mudflats, Pulau Ubin, Changi creek, Coney Island, Berlayer Creek, Labrador Nature Reserve, Sentosa, and the southern islands of Kusu, St John’s, Lazarus, Sister’s, Hantu and Semakau.

3. Funding Support

- 3.1 The Call for Proposals offers funding support up to S\$2 million (including all direct and indirect costs) (i.e., for meeting all objectives/ deliverables).
- 3.2 This Call for Proposals offers funding support for a period up to 4 years.

4. Agencies Involved

- 4.1 The following agencies will be involved in the project to provide technical direction to ensure that the project meets the objectives and scope of the Call Topic, as well as to provide test-bedding sites for the project.

(a) JTC Corporation (Lead Agency)

(b) National Parks Board (Member Agency)

- 4.2 Agencies involved will not receive any form of the project funding.
- 4.3 Further clarifications before the project award should surround the stated Call Topic requirements and test-bedding sites. All clarifications and queries should be submitted directly to the MCCS Programme Office at MCCS@nparks.gov.sg during the open grant call process, i.e., research teams should not contact agencies directly. MCCS Programme Office will respond to the clarifications and queries, by periodically updating the Grant Call FAQs document with the relevant answers, on the [MCCS programme 1st Grant Call website](#) and [IGMS website](#) to ensure equal accessibility to all additional information. Please refer to these websites for the latest version of the FAQs. Agencies involved will work with research teams to provide further technical advice and discuss test-bedding sites during the proposal scrubbing stage.

Grant Call ID/ Topic Code: MCCS_V2_2021-1_T2

Call Topic: Coastal nature-based solutions for climate change mitigation and adaptation

Relevant MCCS Verticals/Horizontal: V2 – Eco-Engineering (main/ primary), V1 – Blue Carbon Science, V3 – Ecological Resilience

1. Background

- 1.1 Singapore's coastal and marine ecosystems exist as slivers distributed around Singapore's coastlines and offshore islands. Although literature highlights the important role ecosystems like coastal forests, mangroves, seagrass meadows and coral reefs can play in mitigating various climate change impacts like storm surges, wave over-topping and coastal erosion, we do not know if Singapore's contemporary coastal and marine ecosystems can serve similar functions now, and under different climate scenarios. Many of the earlier studies were conducted in lab and flume experiments, which have yet to be validated in real world conditions.
- 1.2 This project will address these knowledge gaps and will increase our understanding of the coastal protection potential of our contemporary coastal and marine ecosystems as nature-based solutions, as well as identify the unique characteristics and attributes of these ecosystems in conferring coastal protection within an urban setting.
- 1.3 This project will develop important ecological and functional baselines and identify ecosystem attributes that confer coastal protection functions. To harness and maximise the potential coastal protection benefits, contemporary baselines that will be used in parameterising predictive ecological and functional models need to be established. This project will generate the necessary baselines for the development of predictive models. We can then understand the environmental conditions and land-use contexts necessary for these ecosystems to play an effective role in providing multi-functional coastal protection. The outputs from this project will support and contribute towards other MCCS research projects within this and other verticals and horizontals, serve as an ecological palette for developing the science and technologies that will underpin the future of eco-engineering infrastructure, and provide a sound basis for the framework for ongoing and future development in Singapore.

2. Objectives and Scope of Call for Proposals

2.1 Key Research Questions

Proposed projects should seek to address, but are not limited to the following key research questions:

- (a)** What are the key functional attributes/indicators of our coastal and marine ecosystems like coral reefs, seagrass meadows, mangrove and coastal forests that contribute to their effectiveness in adapting to climate change related (i) increases in sea level rise, (ii) intensity/frequency of storms and mitigating erosion?
- (b)** How can we enhance the effectiveness of contemporary coastal and marine ecosystems in reducing wave energy, run-up, storm surges and erosion and in increasing contribution to sediment accumulation?
- (c)** What interventions, including nature-based solutions, are required to (i) enhance their functional attributes, and (ii) ensure their persistence over time and under different climate change scenarios (Shared Socioeconomic Pathways* (SSP))?

* IPCC AR6

2.2 Objectives

Proposed projects should include, but are not limited to the following research objectives:

- (a)** Assess and quantify the functionality and effectiveness of Singapore's contemporary coastal and marine ecosystems under various climate change scenarios in:
 - a. Attenuating wave energy,
 - b. Reducing wave run-up and wave overtopping,
 - c. Reducing propagation of storm surges to coastline,
 - d. Reducing erosion, and
 - e. Accumulating sediments to buffer coastlines against sea level rise.
- (b)** Determine environmental conditions and ecosystem attributes (e.g., density, stiffness, porosity, configuration, consolidation, habitat complexity, habitat area, slope, etc.) required to ensure the persistence of Singapore's contemporary coastal and marine ecosystems over time and under different climate change scenarios
- (c)** Develop design guidelines, including nature-based solutions for coastal protection taking into account research outputs from (b).
- (d)** Identify coastal and marine areas around Singapore (including regional, where relevant) that may benefit from the introduction or persistence of nature-based solutions that incorporate enhanced ecosystem functionality.

Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.

2.3 Project Deliverables

Proposed projects should address, but are not limited to the following project deliverables:

- (a)** Assessment on Singapore's contemporary coastal and marine ecosystem attributes and the synergies between these ecosystems that contribute to their functionality and effectiveness in conferring coastal protection.
- (b)** Models (calibrated by e.g., numerical modelling, field experiments) and projections on the functionality and effectiveness of Singapore's contemporary coastal and marine ecosystems, especially involving the following processes under various climate change scenarios:
 - a. Wave attenuation
 - b. Reducing wave-overtopping/wave run-up,
 - c. Erosion reduction
 - d. Surge propagation
 - e. Sediment accumulation
- (c)** Assessment on the environmental conditions and ecosystem attributes required to ensure coastal and marine ecosystems persistence over time and under different climate change scenarios.
- (d)** Design guidelines for incorporating coastal and marine ecosystem attributes into nature-based solutions for coastal protection, taking into account functionality, persistence, cost-effectiveness, local environmental conditions and land-use contexts.
- (e)** A map highlighting potential areas where nature-based solutions may mitigate/ adapt to climate change impacts (a "Nature-Based Solutions potential map" for Singapore's coastal and marine environment) including recommended implementation timeline.

Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.

2.4 Impact Outcomes and Pathway to Impact

In relation to the key programme-level deliverables of this vertical, this project should look towards contributing to the following impact outcomes:

- (a)** Identify the conditions and contexts in which coastal ecosystem restoration is appropriate for achieving multi-functional coastal protection and contribute to the City in Nature, Sustainable Living and Resilient Future pillars of the Singapore Green Plan 2030.
- (b)** Provide effective multi-functional coastal protection, by identifying the conditions/situations in which coastal ecosystem restoration should be considered and hence, inform architectural design and develop technological solutions based on ecosystem attributes to mitigate the impacts of urbanisation on coastal and marine ecosystems, and to provide the ecosystem services implicit in resilient ecosystems.

- (c) Contribute towards the development of design guidelines for incorporating coastal protection attributes into nature-based solutions for coastal protection. This includes informing the design of full scale, science-based and future-ready coastal protection strategies and/or infrastructure that can host a diverse array of native species, contribute to carbon capture, and provide cultural and recreational value through increasing knowledge on ecological and functional baselines and coastal protection attributes of Singapore's contemporary coastal and marine ecosystems.
- (d) Inform urban and coastal planners on strategies to promote coastal marine ecosystem health and human well-being, and contribute towards crafting climate policy and investment decisions by government and corporate sector stakeholders.
- (e) Create opportunities for achieving blue carbon and ecological resilience outcomes, by promoting diverse marine and coastal ecosystems with enhanced potential to sequester carbon from seawater and air.

2.5 Proposed Study/Pilot Testbed Site(s)

Proposed projects may consider the following ecosystems from both the Johor Straits and Singapore Straits for study and pilot test-bedding, including, but not limited to:

- (a) Mangroves at Pulau Tekong, Pulau Ubin, Sungei Buloh Wetland Reserve, Kranji, Mandai and Pulau Semakau
- (b) Seagrass meadows at Chek Jawa, Changi, Labrador, and Pulau Semakau
- (c) Fringing coral reefs at the Sisters' Islands Marine Park, Sentosa, St John's Island, Lazarus Island, Pulau Jong, Pulau Tekukor, Kusu Island, Pulau Semakau, Pulau Hantu and Pulau Satumu
- (d) Coastal forests at Pulau Ubin, Coney Island, Pulau Seletar, Southern Islands

3. **Funding Support**

- 3.1 The Call for Proposals offers funding support up to S\$3 million (including all direct and indirect costs) (i.e., for meeting all objectives/ deliverables).
- 3.2 This Call for Proposals offers funding support for a period up to 4 years.

4. **Agencies Involved**

- 4.1 The following agencies will be involved in the project to provide technical direction to ensure that the project meets the objectives and scope of the Call Topic, as well as to provide test-bedding sites for the project.
 - (a) PUB (Lead Agency)
 - (b) National Parks Board (Lead Agency)
 - (c) Sentosa Development Corporation (Member Agency)

- 4.2 Agencies involved will not receive any form of the project funding.
- 4.3 Further clarifications before the project award should surround the stated Call Topic requirements and test-bedding sites. All clarifications and queries should be submitted directly to the MCCS Programme Office at MCCS@nparks.gov.sg during the open grant call process, i.e., research teams should not contact agencies directly. MCCS Programme Office will respond to the clarifications and queries, by periodically updating the Grant Call FAQs document with the relevant answers, on the [MCCS programme 1st Grant Call website](#) and [IGMS website](#) to ensure equal accessibility to all additional information. Please refer to these websites for the latest version of the FAQs. Agencies involved will work with research teams to provide further technical advice and discuss test-bedding sites during the proposal scrubbing stage.

Project Code: MCCS_V2_2021-1_T3

Grant Call ID/ Topic Code: Integrating green and grey infrastructure as multi-functional coastal protection systems for climate change adaptation

Relevant MCCS Verticals/Horizontal: V2 – Eco-Engineering (main/ primary), V1 – Blue Carbon Science, V3 – Ecological Resilience, H2 – Community-Driven Climate Resilience Planning

1. Background

- 1.1 This project will develop cost-effective and eco-friendly solutions for enhancing natural capital and ecosystem services in the built marine environment through the development of multi-dimensional and multi-functional design elements. In doing so, the project will integrate nature-based solutions through surface-treatment to mitigate against wave run-up and overtopping exacerbated by sea-level rise and extreme storm events, while enhancing and restoring marine environments and creating new habitats. The range of solutions will be applicable to existing as well as future built coastal protection infrastructure.
- 1.2 There are several past and ongoing research projects on developing eco-engineering solutions, but they were and are primarily focussed on biodiversity enhancement and have not included considerations for the climate change drivers mentioned above, which is the focus of this project. In addition, this project will also study the importance of biofilms and other factors essential for priming surfaces and making them suitable for biodiversity to settle and colonise.
- 1.3 Land, and in particular land with shore access, is scarce in Singapore, making it essential to maximise its utility. At the same time, maintaining Singapore's physical, social, and ecological resilience amidst climate change and continued urbanisation requires coastal land uses to meet multiple needs such as coastal protection, recreational spaces, and habitat for biodiversity. This project will help achieve these objectives by developing design parameters for cost-effective multi-functional hybrid solutions with nature-based elements.

2. Objectives and Scope of Call for Proposals

2.1 Key Research Questions

Proposed projects should seek to address, but are not limited to the following key research questions:

- (a)** How can we develop coastal protection systems that integrate green (multi-functional nature-based elements) and grey infrastructure that (i) promotes biodiversity, (ii) increases ecological resilience in terms of long-term efficacy, maintainability, disamenity, adaptability, (iii) provides recreation, and (iv) promotes education, (v) reduces cost?
- (b)** How can existing and emerging systems be enhanced to meet the requirements described in (a)?

2.2 Objectives

Proposed projects should include, but are not limited to the following research objectives:

- (a)** To develop a comprehensive assessment of the ecological, physical and engineering requirements for multi-functional coastal protection systems with nature-based elements under a combination of climate change and land use considerations.
- (b)** To assess and quantify factors (e.g., biofilms) that influence the settlement, colonisation and succession of biodiversity on these multi-functional nature-based elements.
- (c)** To develop novel innovative integrated coastal infrastructure with multi-functional nature-based elements (e.g., eco-armour and biodiversity enhancement tiles) that meet the desired requirements at one or more sites* in Singapore, and quantify their effectiveness in coastal protection, ecological and societal functions, and enhancing natural capital in both the existing and future built marine environment.
- (d)** To determine the long-term efficacy, maintainability, disamenity (e.g., compromise structural integrity), adaptability (including re-deployability) and the cost-effectiveness of the integrated coastal infrastructure with nature-based elements in creating coastal protection, social, and ecological value.
- (e)** To inform the development of guidelines for the application of the spectrum of eco-engineered solutions for enhancing natural capital in the built marine environment.

* Proposed project budget should be reasonably estimated and reflective of the number of proposed pilot sites.

Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.

2.3 Project Deliverables

Proposed projects should address, but are not limited to the following project deliverables:

- (a)** Documentation of innovative coastal protection infrastructure with multi-functional nature-based elements developed and tested at one or more sites*, including measures suitable for retrofitting existing built coastal infrastructure.
- (b)** Description and quantification of the factors that influence the settlement, colonisation and succession of biodiversity on the various nature-based elements.
- (c)** Description and quantification (e.g., through numerical modelling, laboratory tests and field surveys) of the effectiveness of the proposed multi-functional nature-based elements in enhancing natural capital of the built marine environment at the study sites without compromising the integrity of coastal protection measures.
- (d)** Description and quantification on the long-term resilience, efficacy, disamenity, maintainability, and the cost-effectiveness of the proposed multi-functional nature-based elements across different aspects of coastal protection (including but not limited to wave run-up and overtopping), social, and ecological value.
- (e)** Preparation of technical guidelines (including design parameters) for hybrid solutions that integrate multi-functional nature-based and human engineered infrastructure. The guidelines may also be incorporated into a decision-making tool for implementing nature-based solutions to enhance natural capital and coastal protection in the built marine environment in Singapore and other tropical coastal cities.

* Proposed project budget should be reasonably estimated and reflective of the number of proposed pilot sites.

Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.

2.4 Impact Outcomes and Pathway to Impact

In relation to the key-programme level deliverables of this vertical, this project should look towards contributing to the following impact outcomes:

- (a)** Inform the design of full scale, science-based and future-ready living coastal protection infrastructure that can host a diverse array of native species, contribute to carbon capture, and provide cultural and recreational value, and hence contribute to the City in Nature, Sustainable Living and Resilient Future pillars of the Singapore Green Plan 2030.
- (b)** Inform architectural design and develop technological solutions based on ecosystem attributes to mitigate the impacts of urbanisation on coastal and marine ecosystems, provide the ecosystem services implicit in resilient ecosystems, and ultimately contribute towards coastal risk reduction and increase ecosystem and community resilience when these solutions are adopted by government and corporate sector stakeholders.

- (c) Test-bedding of new eco-design typologies will be generated to inform urban and coastal planners on methodologies to promote coastal marine ecosystem health and human well-being.
- (d) Create opportunities for achieving blue carbon and ecological resilience outcomes, by promoting diverse marine and coastal communities with enhanced potential to sequester carbon from seawater and air.

2.5 Proposed Study/Pilot Testbed Site(s)

Proposed projects may consider the following sites for study and pilot test-bedding, including, but not limited to:

- (a) Vertical concrete seawalls along East Coast Park, Berlayer Creek, Sentosa, Singapore Cruise Centre, etc.
- (b) Granite rip rap revetments at East Coast Park, Sentosa, St John's Island, the Sisters' Islands, Kusu Island, Pulau Hantu and Pulau Satumu, etc.
- (c) Jetties and floating pontoons at Sentosa, St John's Island, the Sisters' Islands, Labrador, boating marinas, etc.
- (d) Intertidal and subtidal lagoons at East Coast Park, Sentosa, St John's Island and Small Sister's Island, etc.
- (e) Mudflats from Sungei Buloh to Kranji coastal walk.
- (f) Changi beach.
- (g) Sentosa island.
- (h) South-eastern/ South-western coasts under MPA's jurisdiction.
- (i) Coastal reservoir dams.

Note: Researchers are encouraged to explore different typologies in Singapore.

3. **Funding Support**

- 3.1 The Call for Proposals offers funding support up to S\$3 million (including all direct and indirect costs) (i.e., for meeting all objectives/ deliverables).
- 3.2 This Call for Proposals offers funding support for a period up to 4 years.

4. **Agencies Involved**

- 4.1 The following agencies will be involved in the project to provide technical direction to ensure that the project meets the objectives and scope of the Call Topic, as well as to provide test-bedding sites for the project.

- (a) PUB (Lead Agency)
- (b) National Parks Board (Lead Agency)
- (c) Sentosa Development Corporation (Member Agency)
- (d) Maritime and Port Authority of Singapore (Member Agency)

- 4.2 Agencies involved will not receive any form of the project funding.
- 4.3 Further clarifications before the project award should surround the stated Call Topic requirements and test-bedding sites. All clarifications and queries should be submitted directly to the MCCS Programme Office at MCCS@nparks.gov.sg during the open grant call process, i.e., research teams should not contact agencies directly. MCCS Programme Office will respond to the clarifications and queries, by periodically updating the Grant Call FAQs document with the relevant answers, on the [MCCS programme 1st Grant Call website](#) and [IGMS website](#) to ensure equal accessibility to all additional information. Please refer to these websites for the latest version of the FAQs. Agencies involved will work with research teams to provide further technical advice and discuss test-bedding sites during the proposal scrubbing stage.

Grant Call ID/ Topic Code: MCCS_V3H1_2021-1_T4

Call Topic: Thresholds and tipping points: Understanding responses of Singapore's coastal and marine ecosystems to anthropogenic and climate change impacts

Relevant MCCS Verticals/Horizontal: V3 – Ecological Resilience (main/ primary), H1 – Marine Climate Impacts (main/ primary), V1 – Blue Carbon Science, V2 – Eco-Engineering

1. Background

- 1.1 Climate change will impact coastal areas that are already stressed by human activities. Warmer and more acidic oceans can disrupt physiological processes and biogeochemical cycles while rising sea levels can erode and inundate coastal ecosystems and eliminate low-lying habitats that are unable to keep pace with it.
- 1.2 While earlier works studying the influence of environmental pressures on our coastal and marine ecosystems have generated significant knowledge gains, there has been limited focus on assessing and understanding responses to climate change impacts like sea level rise, elevated sea surface temperatures and ocean acidification, and the interactions between them and anthropogenic impacts.
- 1.3 Projects under this topic will provide the opportunity for multi-disciplinary research that incorporates basic marine biogeochemical modelling as well as both anthropogenic and climate drivers to establish the conditions that affect the physical and biological processes within individual habitats and across entire ecosystems, and to integrate our overall understanding of how ecosystem health and resilience can be promoted in face of long-term climate change. Knowledge generated from the research would support our efforts in conservation of key habitats, a thrust under National Parks Board's Nature Conservation Masterplan, by guiding management strategies to ensure that the functionality and persistence of our coastal and marine ecosystems are not negatively altered.

2. Objectives and Scope of Call for Proposals

2.1 Key Research Questions

Proposed projects should seek to address, but are not limited to the following key research questions:

- (a)** How are the key marine biogeochemical parameters* changing under different climate change scenarios (Shared Socioeconomic Pathways** (SSP)) in Singapore's coastal regions?
- (b)** How will anthropogenic activities and climate change* affect ecological patterns, processes, and the functioning of Singapore's coastal and marine ecosystems under different climate change scenarios (SSP**)?
- (c)** What are the thresholds of climate change* that when exceeded could lead to extreme and potentially irreversible ecological impacts?

* E.g., sea surface temperature, acidification, sea level rise etc.

** IPCC AR6

2.2 Objectives

Proposed projects should include, but are not limited to the following research objectives:

- (a)** To simulate/model a broad set of marine biogeochemical parameters* for the different Shared Socioeconomic Pathways** (SSP) scenarios supporting marine climate change impacts research for Singapore.
- (b)** To evaluate the impacts of anthropogenic activities and climate change* on ecological patterns, processes and the functioning of Singapore's coastal and marine ecosystems under different climate change scenarios (SSP**).
- (c)** To identify the thresholds of climate change* that when exceeded could lead to exceptionally large and potentially irreversible ecological impacts and to model the trajectory of these ecological impacts.

* E.g., sea surface temperature, acidification, sea level rise etc.

** IPCC AR6

Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.

2.3 Project Deliverables

Proposed projects should address, but are not limited to the following project deliverables:

- (a)** A broad set of marine biogeochemical parameters* for the different Shared Socioeconomic Pathways** (SSP) scenarios supporting marine climate change impacts research for Singapore.
- (b)** Evaluate the effects of anthropogenic activities and climate change* on ecological patterns, processes and functioning of Singapore's coastal and marine ecosystems under different climate change scenarios (SSP**).
Examples of impacts include microbial composition, genetic predisposition (e.g., to elevated temperature resilience), larval connectivity, bioerosion, herbivory, and coastal water quality.
- (c)** Create models and datasets that predict the trajectory of exceptionally large and potentially irreversible ecological impacts that result from climate change*, hence determining the ecological thresholds and tipping points of Singapore's coastal and marine ecosystems.

* E.g., sea surface temperature, acidification, sea level rise etc.

** IPCC AR6

Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.

2.4 Impact Outcomes and Pathway to Impact

In relation to the key programme-level deliverables of this vertical and horizontal, this project should look towards contributing to the following impact outcomes:

- (a)** Contribute to the City in Nature, Sustainable Living and Resilient Future pillars of the Singapore Green Plan 2030 through identifying thresholds of our coastal and marine ecosystems through human-induced climate change impacts.
 - a. Understand the anthropogenic and climate change impacts on local marine ecosystems across a range of key parameters, such as temperature, salinity, acidity, coastal weather disturbances and turbidity.
 - b. Identify threats to marine community resilience across Singapore's natural and built coastal environments and incorporate this knowledge into adaptive environmental management and urban planning processes.
- (b)** Contribute towards crafting climate policy and investment decisions by government and corporate sector stakeholders especially in the face of long-term climate change.
- (c)** Knowledge derived from this vertical will also provide the basis and context for the development of project solutions under the Blue Carbon and Eco-Engineering verticals.

2.5 Proposed Study/Pilot Testbed Site(s)

Proposed projects may consider the following sites for study and pilot test-bedding, including, but not limited to:

- (a)** Mangroves: Sungei Buloh Wetland Reserve, Pulau Ubin, Changi Creek, Berlayer Creek, Pulau Semakau
- (b)** Intertidal areas (including mudflats and seagrass beds): Mandai Mudflats, Changi Beach, Sisters' Islands, St John's Island, Lazarus Island, Pulau Semakau, Pulau Hantu, Pulau Jong, Pulau Satumu, Cyrene Reefs, Terumbu Reefs, Raya Reefs
- (c)** Coral reefs: Sisters' Islands, Kusu Island, St John's Island, Lazarus Island, Pulau Semakau, Pulau Hantu, Pulau Jong, Pulau Satumu

3. **Funding Support**

- 3.1 The Call for Proposals offers funding support up to S\$3.5 million (including all direct and indirect costs) (i.e., for meeting all objectives/ deliverables).
- 3.2 This Call for Proposals offers funding support for a period up to 4 years.

4. **Agencies Involved**

- 4.1 The following agencies will be involved in the project to provide technical direction to ensure that the project meets the objectives and scope of the Call Topic, as well as to provide test-bedding sites for the project.
 - (a)** National Parks Board (Lead Agency)
 - (b)** National Environment Agency (Lead Agency)
- 4.2 Agencies involved will not receive any form of the project funding.
- 4.3 Further clarifications before the project award should surround the stated Call Topic requirements and test-bedding sites. All clarifications and queries should be submitted directly to the MCCS Programme Office at MCCS@nparks.gov.sg during the open grant call process, i.e., research teams should not contact agencies directly. MCCS Programme Office will respond to the clarifications and queries, by periodically updating the Grant Call FAQs document with the relevant answers, on the [MCCS programme 1st Grant Call website](#) and [IGMS website](#) to ensure equal accessibility to all additional information. Please refer to these websites for the latest version of the FAQs. Agencies involved will work with research teams to provide further technical advice and discuss test-bedding sites during the proposal scrubbing stage.

Grant Call ID/ Topic Code: MCCS_V3H1_2021-1_T5

Call Topic: Enhancing the ecological resilience of coral reefs in response to climate change stressors

Relevant MCCS Verticals/Horizontal: V3 – Ecological Resilience (main/ primary), H1 – Marine Climate Impacts (main/ primary)

1. Background

- 1.1 Climate change will impact coastal areas that are already stressed by human activities. Warmer and more acidic oceans can disrupt physiological processes and biogeochemical cycles while rising sea levels can erode and inundate coral reef ecosystems and eliminate low-lying habitats that are unable to keep pace with it.
- 1.2 Mangroves, seagrasses, and other marine ecosystems can thrive on a wider range of temperature changes while coral reefs can only withstand a smaller threshold. The study of how different climate change stressors, including heat stress, is therefore more urgent for coral reefs as a vulnerable marine ecosystem. Modelling of marine biogeochemical parameters (such as acidification and intensified heat) and their changes under climate change is key to understand future impact to Singapore's coastal coral reef systems.
- 1.3 Research into the consequences of heat stresses on our coral reef ecosystems is not new to science. However, most research in the past was largely focused on the effects of heat stresses on single coral reef species. Hence, there is a need to deepen our knowledge on how various climate change stressors (e.g., the effect of acidification and intensified heat) can synergistically affect reef organisms from populations to communities. This will enable the development of strategies to deliver ecological resilience of our coral reefs, in response to climate change, at multiple trophic levels.

Projects under this topic will improve our overall understanding of coral reef health and resilience towards climate change stressors (e.g., elevated sea surface temperatures, ocean acidification, etc.) and identify interventions that can be integrated into adaptive conservation and management strategies to tackle climate change impacts in the near and long-term.

2. Objectives and Scope of Call for Proposals

2.1 Key Research Questions

Proposed projects should seek to address, but are not limited to the following key research questions:

- (a)** How are the changing marine biogeochemical parameters* impacting the ecological resilience of coral reef ecosystems?
- (b)** How can we ensure ecological resilience of coral reef ecosystems, through natural or assisted adaptation strategies at multiple trophic levels, in response to climate change stressors under different climate change scenarios (Shared Socioeconomic Pathways** (SSP)), and thereby maintain coral reef health and resilience and prevent unwanted ecological shifts?

* E.g., sea surface temperature, acidification, sea level rise etc.

** IPCC AR6

2.2 Objectives

Proposed projects should include, but are not limited to the following research objectives:

- (a)** To identify and evaluate the factors that influence (promote, inhibit, prevent) the resilience of coral ecosystems*.
- (b)** To conduct model simulations to understand how these factors change under climate change (Shared Socioeconomic Pathways** (SSP)).
- (c)** To develop tools and datasets for implementing adaptation strategies (natural or assisted) to increase resilience of coral reef ecosystems at multiple trophic levels in response to climate change stressors under different climate change scenarios (SSP**).

* Knowledge is therefore also required on the composition and function of the microbiome community associated with the coral host.

** IPCC AR6

Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.

2.3 Project Deliverables

Proposed projects should address, but are not limited to the following project deliverables:

- (a)** Description and quantification of the factors that influence resilience within coral reef ecosystems.
- (b)** Model simulations of how these factors change under climate change (Shared Socioeconomic Pathways* (SSP)).
- (c)** Tools, datasets, technical guidelines, and recommendations that can be incorporated into management strategies to maintain, sustain, and enhance the health and resilience of coral reef ecosystems in response to climate change stressors and under different climate change scenarios (SSP*).

* IPCC AR6

Projects are encouraged to further build upon the above- mentioned deliverables, and/or propose additional deliverables.

2.4 Impact Outcomes and Pathway to Impact

In relation to the key programme-level deliverables of this vertical and horizontal, this project should look towards contributing to the following impact outcomes:

- (a)** Contribute to the City in Nature, Sustainable Living and Resilient Future pillars of the Singapore Green Plan 2030 through strategies that can maintain, sustain, and enhance health and resilience of coral reef ecosystems in the face of long-term climate change. The outcomes from this research can generate comprehensive understanding of the underlying basis for maintaining, sustaining, and enhancing ecosystem resilience within Singapore’s coral reef ecosystems. This can also inform the formulation and implementation of management tools and plans required to investigate and mitigate the effect of local and global environmental pressures.
- (b)** Contribute to coastal risk reduction and increase ecosystem and community resilience locally and regionally. Benchmarks for ecologically resilient coastal cities in the tropics can be established by identifying key ecosystem services involved in sustaining resilience. Threats to coral reef resilience across Singapore’s natural and built coastal environments can be identified and incorporated into adaptive environmental management and urban planning processes.
- (c)** Contribute to crafting climate policy and investment decisions by government and corporate sector stakeholders. Management interventions, natural or assisted, to maintain, sustain, and enhance the health and resilience of Singapore’s coral reef ecosystems can be recommended, while coastal activities (e.g., marine aquaculture, shipping, coastal industries, recreation) within our urban coastal environment can be supported and sustained.
- (d)** Knowledge derived from this vertical can also provide the basis and context for the development of project solutions under the Blue Carbon and Eco-Engineering verticals.

2.5 Proposed Study/Pilot Testbed Site(s)

Proposed projects may consider the following sites for study and pilot test-bedding, including, but not limited to:

(a) Coral reefs: Sisters' Islands, Kusu Island, St John's Island, Lazarus Island, Pulau Semakau, Pulau Hantu, Pulau Jong, Pulau Satumu

3. **Funding Support**

3.1 The Call for Proposals offers funding support up to S\$2.5 million (including all direct and indirect costs) (i.e., for meeting all objectives/ deliverables).

3.2 This Call for Proposals offers funding support for a period up to 4 years.

4. **Agencies Involved**

4.1 The following agencies will be involved in the project to provide technical direction to ensure that the project meets the objectives and scope of the Call Topic, as well as to provide test-bedding sites for the project.

(a) National Parks Board (Lead Agency)

(b) National Environment Agency (Lead Agency)

4.2 Agencies involved will not receive any form of the project funding.

4.3 Further clarifications before the project award should surround the stated Call Topic requirements and test-bedding sites. All clarifications and queries should be submitted directly to the MCCS Programme Office at MCCS@nparks.gov.sg during the open grant call process, i.e., research teams should not contact agencies directly. MCCS Programme Office will respond to the clarifications and queries, by periodically updating the Grant Call FAQs document with the relevant answers, on the [MCCS programme 1st Grant Call website](#) and [IGMS website](#) to ensure equal accessibility to all additional information. Please refer to these websites for the latest version of the FAQs. Agencies involved will work with research teams to provide further technical advice and discuss test-bedding sites during the proposal scrubbing stage.

Grant Call ID/ Topic Code: MCCS_V3_2021-1_T6

Call Topic: Developing modular mangrove and seagrass planters for habitat restoration, carbon sequestration, and bioremediation

Relevant MCCS Verticals/Horizontal: V3 – Ecological Resilience (main/ primary), V1 – Blue Carbon Science, V2 – Eco-Engineering

1. Background

1.1 Traditional marine habitat restoration efforts often do not extend to highly urbanised environments such as coastal promenades, marinas, storm drains, or residential estates. As with many tropical coastal cities, Singapore’s coastal ecosystems have been highly impacted by habitat loss and anthropogenic sedimentation, and the remaining natural habitats are expected to be further impacted by climate change and continued urbanisation. Ensuring the resilience of biodiversity and the overall health of the marine environment will require making use of the urban environment as space for co-locating natural habitats. Given that city residents spend much of their time in the urban environment, the lack of urban coastal and marine habitats is also a missed opportunity to provide social value such as urban heat mitigation and recreation. Similarly, the blue carbon sequestration potential of urbanised shorelines is thus far unexplored.

1.2 This project plans to address these gaps by developing modular mangrove and seagrass planter units that can be deployed along existing and future seawalls. Such units are useful for space-constrained, high-density urban environments that do not allow for the gentle, shallow seabed profiles that are otherwise necessary for such habitats. In addition to providing habitats for biodiversity and enabling carbon sequestration, they may also serve a bioremediation function to improve water quality, especially in hydrologically stagnant areas such as enclosed marinas, lagoons, and basins.

2. Objectives and Scope of Call for Proposals

2.1 Key Research Questions

Proposed projects should seek to address, but are not limited to the following key research questions:

- (a)** How can coastal ecosystems such as mangroves and seagrasses be integrated into hard coastal defences along highly urbanised shorelines with space constraints?
- (b)** What biodiversity can mangroves and seagrasses support if joined onto hard coastal defences
- (c)** How much ecosystem service value (carbon sequestration, water quality, social/recreational value) can such ecosystems provide in the context of hard urbanised shorelines?

2.2 Objectives

Proposed projects should include, but are not limited to the following research objectives:

- (a)** Develop novel modular and low maintenance mangrove and seagrass habitat planter units that can be deployed along highly urbanised, space-constrained shorelines and semi enclosed coastal water bodies across a range of bathymetries
- (b)** Develop suitable planter unit designs that allow for the incorporation or modular add on of water quality monitoring sensors/ systems and possibly, wave gauges sensors to monitor waves on site
- (c)** Create a novel technique to increase carbon sequestration and storage potential along highly urbanised shorelines
- (d)** Investigate the biodiversity benefits of such planter units
- (e)** Investigate the bioremediation benefits of such planter units on water quality
- (f)** Investigate the social and recreational value of such planter units

Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.

2.3 Project Deliverables

Proposed projects should address, but are not limited to the following project deliverables:

- (a)** Design specifications for mangrove planter units that can be deployed along seawall structures and/or floating platforms and support the growth of at least three species of mangrove
- (b)** Design specifications for seagrass planter units that can be deployed along seawall structures and/or floating platforms and support at least two species of seagrass
- (c)** Report on the quantifiable biodiversity and bioremediation benefits of such planter units
- (d)** Report on the carbon sequestration rate and storage capacity per unit area of such planter units
- (e)** Report on the social ecosystem services created by such planter units

Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.

2.4 Impact Outcomes and Pathway to Impact

In relation to the key programme-level deliverables of this vertical, this project should look towards contributing to the following impact outcomes:

- (a)** Develop first of its kind modular mangrove and seagrass planter units for Southeast Asian species.
- (b)** Increase carbon sequestration and storage along highly urbanised
- (c)** Create the foundation for bioremediation of hydrodynamically stagnant urban coastal water bodies.
- (d)** Increase access to nature and biodiversity for recreation along highly urbanised shorelines.
- (e)** The modular units developed by this project can then be scaled up by implementing them throughout coastal urban areas with high footfall and constrained spaces. This will support National Parks Board's (NParks') habitat restoration efforts under the Nature Conservation Masterplan as well as the City in Nature pillar under Singapore's Green Plan 2025.

2.5 Proposed Study/Pilot Testbed Site(s)

Proposed projects may consider the following sites for study and pilot test-bedding, including, but not limited to:

Sentosa Cove and other sites managed by Sentosa Development Corporation (SDC), Bendera Bay (managed by NParks on St John's Island) or private entities with suitable coastal shorelines or water bodies.

3. Funding Support

- 3.1 The Call for Proposals offers funding support up to S\$0.8 million (including all direct and indirect costs) (i.e., for meeting all objectives/ deliverables).
- 3.2 This Call for Proposals offers funding support for a period up to 5 years.

4. Agencies Involved

- 4.1 The following agencies will be involved in the project to provide technical direction to ensure that the project meets the objectives and scope of the Call Topic, as well as to provide test-bedding sites for the project.
 - (a)** National Parks Board (Lead Agency)
 - (b)** Sentosa Development Corporation (Lead Agency)
 - (c)** Housing & Development Board (Member Agency)
 - (d)** PUB (Member Agency)
 - (e)** JTC Corporation (Member Agency)

- 4.2 Agencies involved will not receive any form of the project funding.
- 4.3 Further clarifications before the project award should surround the stated Call Topic requirements and test-bedding sites. All clarifications and queries should be submitted directly to the MCCS Programme Office at MCCS@nparks.gov.sg during the open grant call process, i.e., research teams should not contact agencies directly. MCCS Programme Office will respond to the clarifications and queries, by periodically updating the Grant Call FAQs document with the relevant answers, on the [MCCS programme 1st Grant Call website](#) and [IGMS website](#) to ensure equal accessibility to all additional information. Please refer to these websites for the latest version of the FAQs. Agencies involved will work with research teams to provide further technical advice and discuss test-bedding sites during the proposal scrubbing stage.

Annex C: Non-Fundable Direct Costs for NRF-Funded Projects

This list may be subject to revision.

Type of Expenses	Description
Salaries of Lead PIs / Investigators / Project Leads	Not allowable, to ensure no double-funding of salaries and related costs, as the salaries are already supported from other sources (e.g. faculty salaries are supported separately by the IHL as it is in support of the IHLs' core mission).
Salaries of teaching staff / teaching substitutes	Not allowable, as this is already being supported from capitation grants.
Undergraduate tuition support	Not allowable, as this should be supported under the respective scholarship grants and bursary schemes.
Salaries of general administrative support staff	Not allowable, as this is an indirect cost*.
Costs related to general administration and management	Not allowable, as this is an indirect cost*. This includes common office equipment, such as furniture and fittings, office software, photocopiers, scanners and office supplies.
Costs of office or laboratory space	Not allowable, as this is an indirect cost*. This includes renovation/outfitting costs, rent, depreciation of buildings and equipment, and related expenditures such as water, electricity, general waste disposal and building/facilities maintenance charges.
Personal productivity tools & communication expenses	Not allowable, unless the use of mobile phones and other form of smart devices were indicated in the methodology for the Research/I&E Project. All other costs under this expense type is an indirect cost*.
Entertainment	Not allowable, as this is an indirect cost*.
Refreshment	Not allowable, unless this is related to a hosted conference or workshop for the Research/I&E Project. All other costs under this expense type is an indirect cost*.
Audit fees (Internal and external audit) and Legal fees	Not allowable, as this is an indirect cost*.
Fines and Penalties	
Professional Membership Fees	
Staff retreat and team-building activities	
Patent Application	Not allowable, as this should be supported from overheads given to I&E Office (IEO)*. This includes patent application filing, maintenance and other related costs.

* Note: Indirect cost items should be supported from overheads or other funding sources.

Annex D: Definitions of Different Private Sector Entity Types

S/N	Type	Criteria
1	Non-Singapore entities	<ul style="list-style-type: none"> • <30% local shareholding , determined by the ultimate individual ownership
2	Large Local Enterprises (LLEs)	<ul style="list-style-type: none"> • ≥30% local shareholding; and • More than \$100M in annual turnover
3	Small Medium Enterprises (SMEs)	<ul style="list-style-type: none"> • Have Group Annual Sales Turnover of not more than \$100M, or maximum employment of 200 employees • To qualify as an SG entity, the entity must also have at least 30% local shareholding, i.e. local equity held directly or indirectly by Singaporean(s) and/or Singapore PR(s)
4	Start-ups	<ul style="list-style-type: none"> • Registered for less than 5 years at time of grant application • Has individual ownership of more than 50% at reference year; and • Employs at least 1 worker • To qualify as an SG entity, the entity must also have at least 30% local shareholding
5	Not-for-profits	<ul style="list-style-type: none"> • Registered as a public Company Limited by guarantee, society or charity trust • Main purpose is to support or engage in activities of public or private interest without any commercial or monetary profit, and are prohibited from distributing monetary residual to their own members • To qualify as an SG not for profit, the entity must meet all 3 of the following criteria: <ol style="list-style-type: none"> (1) Registered and physically present in Singapore; (2) Core funding (i.e. excl. competitive grant funding) is derived entirely/mostly from SG entities; (3) Managed by a Board, which is at least half appointed by SG entities