GREEN BUILDINGS INNOVATION CLUSTER (GBIC)

REQUEST FOR PROPOSALS (RFP)

Research Challenge Areas	**Innovation Challenge Call for Advancing Super Low Energy (SLE) through Alternative Cooling Technologies for the Tropics**
RFP Number	GBIC-R&D RFP 03
Category	GBIC Innovation Challenge Call
Open Date for Proposal	**3 October 2019**
Close Date for Proposal	Proposals must be submitted via Integrated Grant Management System (IGMS) by **18 November 2019** at 2355 hours (Singapore time).
Enquiries	For enquiries on the Grant Call, please send your enquiries to: BCA_Challenge_Call@bca.gov.sg. For enquiries pertaining to IGMS system, please email IGMS helpdesk at: Helpdesk@researchgrant.gov.sg.

Background

1. Buildings account for approximately 40% of energy consumption globally, and contribute up to a quarter of greenhouse gas (GHG) emissions in Singapore. In response to climate change, Zero Energy Buildings (ZEBs) represent a transformative shift in the building sector, with an astonishing momentum gained over the past years. According to Navigant Research, the global ZEB market is projected to grow from less than USD 100 billion in 2016 to USD 1.4 trillion by 2035. The trend, notably, is led by rapid advancements of technologies and governments' sustainability agenda.

2. BCA launched the Super Low Energy (SLE) Programme in September 2018 to push the envelope of environmental sustainability in Singapore. It includes a suite of initiatives such as the SLE Buildings Technology Roadmap and the Green Mark SLE to encourage the development of energy-efficient and cost-effective SLE buildings.

3. Due to the hot tropical climate of Singapore, there is a high demand for cooling and dehumidification in order to maintain occupant comfort. As air-conditioning is the largest contributor of energy consumption in buildings (i.e. 40--60% for a typical office building), it is imperative to look at ways to improve the energy efficiency of the air-conditioning system and to innovate the ways to cool buildings.

4. While the existing efforts had led to development of several energy-efficient cooling solutions, e.g. decoupling of latent and sensible cooling; passive displacement cooling, hybrid cooling with elevated temperature and increased air movement, there is room for technology improvement, especially towards achieving greater performance and market adoption in the tropics.

5. Recent technological advancements on materials, equipment, digital technologies and understanding of user preferences had provided new opportunities to further advance cooling strategies and their potential applications to buildings in the tropics. In addition, with integration of multiple technologies and innovative designs, there is a potential to unlock greater energy efficiency to support the government's vision to achieve super low energy buildings.

Objectives of Challenge Call

6. In collaboration with the Cooling Energy Science and Technology Singapore (CoolestSG)[1] consortium, BCA launched the **Innovation Challenge Call for Alternative Cooling Technologies (ACT) for the Tropics**. This call aims to encourage technology providers, researchers and potential adopters to co-create innovative cooling technologies to enable a paradigm shift for cooling the buildings in urban, high density, tropical environment.

[1] CoolestSG is a national cooling consortium aims to create a synergistic platform to *accelerate* cooling integrated design and technology development, and promote technology transfer by *bridging the gap* to commercialisation.

Scope of Challenge Call

7. This call aims to develop **Alternative Cooling Technologies (ACT)** for new and existing buildings in the tropics.

8. Proposal shall involve developing highly energy-efficient and cost-effective innovative air-conditioning solutions suitable for the tropics, including but not limited to:

a) Review of the existing ACT solutions;

b) Development or enhancement of ACT solution(s) to address the current challenges. Please refer to Annex A for examples of the Challenge Statement;

c) The solution(s) should be close-to-market, addressing issues on durability, cost effectiveness and maintenance; and

d) Evaluation of the effectiveness of the solution on indoor air quality (IAQ) and thermal comfort.

9. The project team is expected to work together with building owner, consultants, technology providers and researchers for the demonstration in a suitable building space.

10. The project will be split into two phases:

a) Phase 1: Development

i. Development of ACT for office and/or other building types;
ii. Development of a working prototype. The technologies proposed should attain a Technology Readiness Level (TRL) of 6 when completed. (Please refer to Annex B for TRL classification)

b) Phase 2: Performance Validation

i. The developed prototypes should be tested in a high-fidelity testbed environment, such as the BCA SkyLab, and/or
ii. The developed solutions should be demonstrated in an operational environment in an actual building as part of the deliverables (TRL 8).

Project duration should not be more than 2 years for both the development and performance validation phases.

11. Proposals should also show clear evidence of commercial viability to scale up for wider adoption in the market. This should be indicated clearly in the submitted proposals.

Eligibility

12. This call is open to all public and private entities. I**ndustry driven proposals will be assessed more favourably.** Institutes of Higher Learning (IHLs), Research Institutes, research

start-ups, and not-for-profit organisations, are strongly encouraged to co-create innovative solutions with the industry.

Evaluation Criteria

13. The following criteria will be used for the evaluation of proposals:

a) High-technical-merit research and innovation that is novel, internationally competitive, directly addresses identified industry-challenge(s), and can lead to breakthrough results;

b) Economic benefits to Singapore in terms of potential scale up for mass adoption, capabilities and manpower development.

c) Excellent execution plan by an experienced project team with a good trackrecord; members with relevant and complementary expertise; close collaboration and partnership with the industry; and a clear business model for the proposed innovation – are vital considerations for award.

Funding Support

14. Private sector companies will qualify for up to 70% of funding support of the approved direct qualifying costs[2] of a project. IHLs, research institutes, public sector agencies and not-for-profit organisations will qualify for up to 100% funding support of approved direct qualifying costs of a project. Only IHLs and not-for-profit entities would be allowed support for indirect costs. These include up to 20% of qualifying costs for overhead costs.

15. Proposals should not be funded or be currently considered for funding by other agencies. Funding awarded cannot be used to support overseas R&D activities. All funding awarded must be used to carry out the research and innovation activities in Singapore unless approved in the grant.

16. We expect each project to range in total project cost of up to S$1 Mil, although we may consider projects outside this range.

17. Projects would be considered for further funding support for a larger scale demonstration in a real building environment if they show potential at the end of the technology innovation phase.

Application and Evaluation Process

Submission Instructions

18. Interested applicants are required to submit proposal through the Integrated Grant Management System (IGMS) at https://researchgrant.gov.sg/ with the supporting documents by **18 Nov 2019, 2355 hours** (Singapore time). Separate submissions outside of IGMS will not

[2] Direct and indirect qualifying cost items shall base on National Research (NR) Fund Guide.

be considered. **Late submissions or submissions from individual applicants without endorsement from the Host Institution will not be entertained.**

19. 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.

20. Lead PI and Co-PIs from organisations that are not registered in the IGMS are advised to contact BCA_Challenge_Call@bca.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 **Annex D** for further information.

21. For enquiries on the Grant Call, please email to BCA_Challenge_Call@bca.gov.sg. For other enquiries pertaining to IGMS system, please email IGMS helpdesk at Helpdesk@researchgrant.gov.sg.

22. Applications are considered to be successful only if all relevant documents are submitted. The application documents can be downloaded from the "Research proposal" section under "Research Details" after the applicant login to IGMS. The documents required to be submitted are:

a) Form A – Full Proposal;
b) Form B – Budget; and
c) Form C – Capability Indicators

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

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

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

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.

24. 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.

25. Shortlisted applicants may be invited to present their proposals to the Project Evaluation Panel (PEP). Successful shortlisted project teams will be invited to proceed to develop Full Proposal. This will be followed by the final selection of proposals for award.

Indicative Timeline

26. Indicative timeline is as below:

Activities	**Timeline**
Launch of Innovation Challenge Call	3 Oct 2019
Close of Innovation Challenge Call	18 Nov 2019
Peer Review of Proposals	Dec 2019
Project Evaluation Review	Jan 2020
Award of Innovation Challenge Call	Feb 2020

Rights of Awarding

27. BCA reserves the right to select proposals to be awarded. For the avoidance of doubt, BCA reserves the right not to award any proposal.

Annex A: Challenge Call Statement

Challenge Statement for Advancing SLE through Alternative Cooling Technologies	
Current Situations	In line with the national sustainability targets, developing innovative solutions to make our buildings greener, smarter and healthier is imperative for our industry and research community. While the existing R&D efforts had led to development of several advanced cooling technologies e.g. decoupling of latent & sensible cooling; hybrid cooling systems with elevated temperature; indirect evaporative coolers, passive displacement cooling systems and/or others, there is room for further improvement and continued efforts to drive R&D towards market-ready solutions. Some of the challenges (non-exhaustive) are listed below: • Air momentum control with heat-source interaction (for passive displacement cooling/radiant cooling) • Complex and costly condensation control (for radiant cooling) • Limited cooling capacity (for indirect-evaporative cooling) • Humidity control and Indoor air quality challenges (for hybrid cooling) • Maintenance and operation issues due to extending the chilled water pipes into tenant spaces (for passive displacement cooling/radiant coiling) • Lack of understanding of concept, design, installation and operation requirements from the industry.
Challenge Statement	The challenge is to develop innovative alternative cooling technologies / solutions that can be scaled up for market adoption that are cost effective, easily deployable and simple to operate & control. Besides pushing the boundaries of novelty and building research and innovation (R&I) capabilities, the technologies proposed should be industry relevant and state-of-the-art.
Possible solutions	Some of the possible solutions (non-exhaustive) are listed below: • High efficiency dehumidification systems to control indoor humidity • High performance materials/equipment for passive displacement coil/heat exchanger with better heat transfer properties and improved thermal comfort • Optimisation of airflow delivery and distribution with minimum energy • Responsive cooling that can self-adapt to part-load conditions • Industry best practices on the design of the proposed innovative AC system

Desired outcomes	• The energy savings should be at least 20% better than current best-in-class conventional air-conditioning system. Please see table below for indicative targets. • The energy potentials need to be clearly validated and demonstrated in operational environment settings. • Enhanced indoor thermal comfort and environmental quality.

Indicative targets:

Aspects	**GM Platinum Pre-requisite** (for reference)	**SLE Challenge Call Targets**
Total AC System Efficiency (air distribution + chiller + pumps + condenser + cooling tower)	≤ 0.90 kW/ton	**< 0.6 kW/ton**
Chiller Plant System efficiency (excluding air distribution system)	≤ 0.65 kW/ton	**< 0.5 kW/ton**
Air distribution system	≤ 0.25 kW/ton	**< 0.1 kW/ton**

Annex B: Technology Readiness Level Descriptions

Technology Readiness Level (TRL) is widely used indictor of degree of development or a technology toward deployment on a scale of 1-9.

Level	Definition	Description
TRL 1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties or experimental work that consists mainly of observations of the physical world.
TRL 2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be formulated. Applications are speculative and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.
TRL 3	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative tested with simulants.
TRL 4	Component and/or system validation in laboratory environment	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system.
TRL 5	Laboratory scale, similar system validation in relevant environment	The basic technological components are integrated so that the system configuration is similar to (matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory scale system in a simulated environment.
TRL 6	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in simulated operational environment.
TRL 7	Full-scale, similar (prototypical) system demonstrated in relevant environment	Prototype near or at planned operational system – Represents a major step up from TRL 6, requiring demonstration of an actual system prototype in an operational environment.
TRL 8	Actual system completed and qualified through test and demonstration.	The technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development.
TRL 9	Actual system operated over the full range of expected conditions.	The technology is in its final form and operated under the full range of operating conditions.

Annex C: Format for CVs

All CVs submitted for GBIC application must not exceed 2 pages and should use the following format (in terms of sections required and the order of the sections), to highlight key information relevant for the evaluation of proposal.

A. EDUCATIONAL QUALIFICATIONS
B. PROFESSIONAL EXPERIENCE
C. SELECTED PUBLICATIONS MOST CLOSELY RELATED TO THE PROPOSAL
D. SELECTED OTHER PUBLICATIONS (THAT THE REVIEW PANELS SHOULD NOTE)
E. PREVIOUS AND CURRENT RESEARCH GRANTS IN RELATED AREAS
F. LIST OF RECENT COLLABORATORS

Annex D: 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

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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 BCA_Challenge_Call@bca.gov.sg with the following details:

Subject: Creation of new Company/Institution in IGMS for GBIC Innovation Challenge Call for Alternative Cooling Technologies

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-PIs):

For Co-PIs, 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-PIs' 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, BCA 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 BCA with the information below:
- Full Name of HI Admin:
- E-mail Address of HI Admin:
- Designation of HI Admin in his/her company:

BCA 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, BCA 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.

<u>CREATION OF ACCOUNT FOR FOREIGN USERS</u>

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 BCA 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-PI(s)*:
(j) E-mail Address of Foreign PI/Co-PI(s)*:

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

(3) BCA 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.

Appendix 1 of Annex C – Frequently Asked Questions (FAQs)

Q: I am a local PI with access to CorpPass. How do I register an account on IGMS?

A:

(1) Go to the URL: https://researchgrant.gov.sg/eservices/account/login

(2) Click on "**Login for PI / ORE / DOR**"

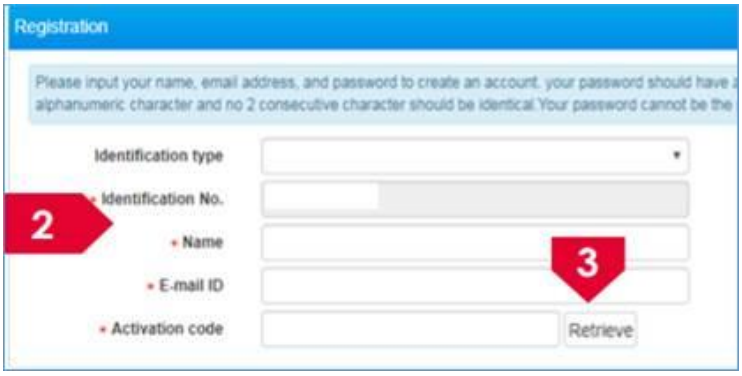
(3) Enter CorpPass login credentials

(4) For first time login, user will be directed to IGMS registration page.

(5) Fill in all necessary details.

(6) Click on "**Retrieve**" button to receive an activation code (the code is valid for 10 minutes and will be sent to the e-mail registered)

(7) Key in the activation code and click on **"Next"** to complete the registration



Q: Does the Co-PIs need to register an IGMS account?

A: The Lead Principle Investigator (Lead PI) will submit the online application in IGMS but he/she will need to add the relevant Co-PI(s) as research team member in IGMS. All Co-PI(s) must be registered in IGMS before they can be added as a research team member.

Q: Is the proposal, budget and capability indicators templates available on IGMS for download? Is there any specific format for CV to be submitted?

A: To download the Full Proposal, Budget and Capability Indicator templates, applicants will need to click "Apply" and login to IGMS, under the "Research Details" tab, look for "Research proposal" section to download the templates from "Please click here".

The instruction to prepare CV can be found under the "Research Team, Collaborators, Referees" tab, at the "Research team" section, click "Add" to download the document from "Please click here".

Q: Is signatory on the Budget template necessary before submitting it on IGMS?

A: Yes. It is necessary for Form B to be endorsed before submission on IGMS. E-signature is acceptable.