GREEN BUILDINGS INNOVATION CLUSTER (GBIC) 2.0
2ND THEMATIC CHALLENGE CALL
FOR HEALTHCARE, RETAIL, MIXED DEVELOPMENT AND HOTEL BUILDINGS

Introduction

1. The Green Buildings Innovation Cluster (GBIC) Programme (Green Buildings Innovation Cluster (GBIC) Programme | Building and Construction Authority (BCA)), is an integrated research, development and demonstration (RD&D) hub set up under the National Research Foundation, Singapore (NRF)'s Urban Solutions and Sustainability (USS) domain. To further push the boundaries of energy efficiency in buildings, NRF has allocated an additional $45 million to BCA to enhance the GBIC programme (GBIC 2.0) in 2022 to support the research, prototyping and demonstration of green building technologies.

Objective

2. Under the Singapore Green Building Masterplan (SGBMP), BCA will work with stakeholders to deliver three outcomes; (a) green 80% of Singapore's buildings (by gross floor area) by 2030, (b) 80% of new developments to be Super Low Energy (SLE) buildings from 2030 and (c) for best-in-class buildings to achieve 80% improvement in energy efficiency over 2005 levels by 2030. This will require building owners and project teams to look at innovations and various ways to push the boundaries and improve their buildings' energy efficiency.

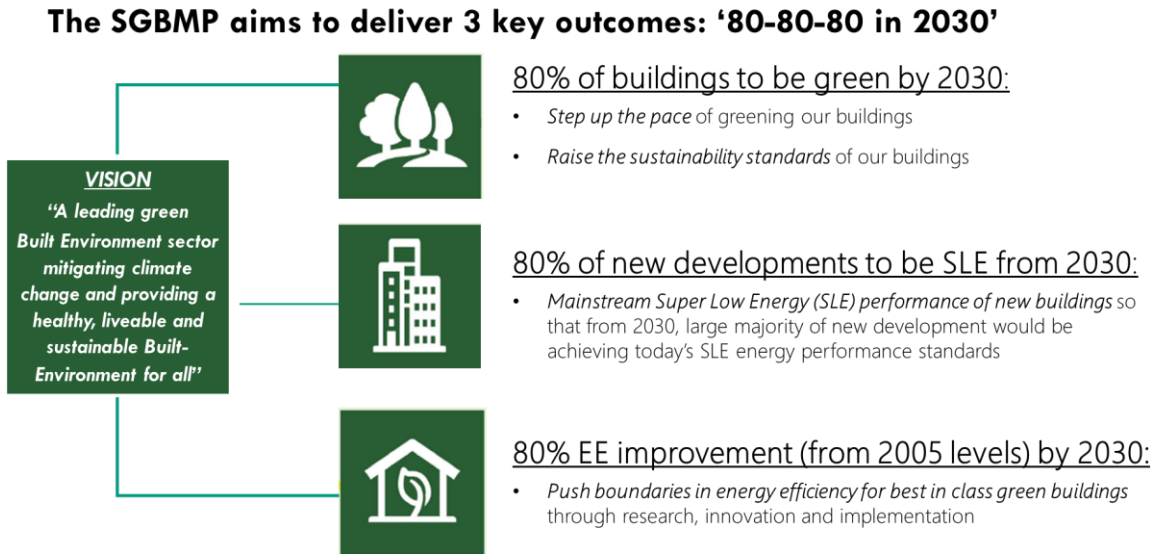


Figure 1: SGBMP 80-80-80 Targets

Scope of Challenge Call

3. The 2nd Thematic Challenge Call will focus on energy intensive buildings in the **healthcare, retail, mixed development and hotel sectors**, with the aim to encourage building owners to demonstrate that **75% energy efficiency improvement from 2005 baseline** is achievable and for technology firms and solutions providers to develop solutions to address the challenges for the healthcare sector.

4. This call reaches out to local and global technology firms, solution providers, environmental sustainability design (ESD) consultants and local research institutes that have relevant technology or innovative solutions to address building owners' and developers' challenges.

5. This call covers three schemes (i.e. Research and Development (R&D), Product Prototyping and Demonstration), depending on the Technology Readiness Level (TRL) of the proposed solutions and scope of the proposals. For detailed information about the schemes and challenge statements, please refer to Annexes A and B.

Data Management

6. To safeguard against data leaks/breaches, depending on the nature of the Research, the Host Institution, Partner Institutions and/or Collaborators may be required by BCA to

(a) Attain one of the data and/or cybersecurity standards certifications listed below (hyperlinked) as a pre-requisite to start the project, receive data requested or execute the data collection (e.g. survey) for the Research.

(b) Conduct an independent exit external audit assessment[1] upon completion or termination of the Research

Exact requirements will be determined after evaluation[2] and BCA will officially inform the applicants selected for award in writing[3]. Failure to obtain the required certifications may affect project progress leading to delays in payment milestones, and potentially termination of the award.

Cyber Security Agency (CSA) Cybersecurity Standards[4] [5]	**Infocomm Media Development Authority (IMDA) Data Security Standards**
Cyber Essentials Mark (CEM)	Data Protection Essentials (DPE)

[1] The independent assessment is to be conducted by an external auditor unless directed otherwise by the BCA, and the report shall confirm that all classified information provided by the Government or generated during the project has been securely disposed of in accordance with Singapore's data protection laws, contractual obligations, and industry best practices.

[2] To ensure accurate evaluation of Institutions' cybersecurity posture, Institutions are required to submit internet-facing sites relevant to the delivery of the project in the proposal.

[3] Should there be new data request or new data collection works identified later over the course of the project, BCA reserves the right to require additional certifications to be attained during the project's progress (i.e. after project is awarded).

[4] Applicants with ISO/IEC 27001:2022 certification may use that to meet CEM and all tiers of CTM.

[5] A list of CSA-certified service providers for CSA's CEM and CTM can be found here - https://www.csa.gov.sg/our-programmes/support-for-enterprises/sg-cyber-safe-programme/cybersecurity-certification-for-organisations/how-to-get-certified/

Cyber Trust Mark (CTM) *Note – there are a few tiers under CTM, Institutions will only have to attain certification for one tier for the project, if required.*	Data Protection Trust Mark (DPTM)

7. Any datasets shared by agencies may be aggregated, anonymised and desensitised, where feasible, to lower the data classification/sensitivity. In the same vein, where feasible, any proposed data collection from human subjects (e.g. survey) by the Investigators should be anonymised as well. These efforts would help to reduce the inherent data/cybersecurity risks of the Research and minimise the need for data/cybersecurity standards certifications.

8. To facilitate data sharing, Host institutions are required to submit cleaned data that is collected or generated in the Research as identified by the GBIC Directorate. Please note that data may be shared with other NRF-funded projects in the future through the metadata catalogue, unless they are commercial data or bounded by non-disclosure agreements (NDAs), to maximise synergies across projects and minimise duplicative works.

Indicative Timeline

9. Indicative timeline is as below:

Activities	**Timeline**
Launch of 2nd Thematic Challenge Call	30 June 2025
Briefing on 2nd Thematic Challenge Call	7 July 2025
Close of 2nd Thematic Challenge Call	14 August 2025
Notification of shortlisted proposals to present to Project Evaluation Panel *(for GBIC R&I proposals only)*	September 2025
Project Evaluation Panel meeting *(for GBIC R&I proposals only)*	October 2025
Notification of award of proposals	By 31st March 2025

Briefing to Interested Parties

10. Interested parties are encouraged to attend the post-launch virtual briefing on 7 July 2025 (Mon), 2:00 PM. Please register your attendance by 4 July 2025 via the link: https://go.gov.sg/gbic-2nd-thematic-challenge-call. The meeting link will be sent to you once we have received your registration.

Rights of Awarding

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

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

Enclosed Annexes:

Annex A: GBIC Demonstration Challenge

Annex B: GBIC R&I Challenge

Annex C: SOP for Creation of New Companies/Institutions in IGMS

Annex A: GBIC Demonstration Challenge

Introduction

1. The 2nd Thematic Challenge Call will focus on energy intensive buildings in the **healthcare, retail, mixed development and hotel sectors**, with the aim to encourage building owners to demonstrate that 75% energy efficiency improvement from 2005 baseline is achievable and for technology firms and solutions providers to develop solutions to address the challenges for the healthcare sector.

Scope of Challenge Call

2. The Demonstration Scheme focuses on **healthcare, retail, mixed development and hotel buildings**.

3. This challenge call is open to building owners, developers, Environmental Sustainability Design (ESD) consultants, technology/solution providers, Institutes of Higher Learning (IHLs), and Research Institutes (RIs). Applicants may either respond to the predefined Buildings or submit proposals for the buildings of their choice[6].

GBIC Demonstration Scheme Details

4. The GBIC-Demo provides building owners and developers the opportunity to strive for greater energy savings by demonstrating innovative energy efficient technologies that have not been widely implemented locally in upcoming projects or existing buildings. The programme brings together developers and building owners with research performers, technology providers and system integrators to establish platforms where industry can test and showcase these technologies to generate local performance data for verification by a 3rd party.

	Demonstration
Intent	To encourage building owners/developers to demonstrate innovative energy efficient technologies and solutions to achieve best-in-class building energy efficiency improvement in the healthcare, retail, mixed development and hotel sector.
Target Group	Building owners/developers Submit GBIC-Demo application with proposals from consortiums led by ESD Consultants together with technology and solution providers.
Technology Readiness Level	Start TRL: 7; End TRL: 9 (See Table 2 for TRL descriptions)
Funding	Up to 70% depending on the profile of the entities, capped at $3m.

[6] Demonstration should be carried out for the whole building. In cases where there are difficulties in doing so, the demonstration area can be limited to one floor.

Desired Outcomes	1) Energy Efficiency Improvement • **75%** building energy efficiency improvement from 2005 levels - Target Energy Use Index (EUI) kWh/m²/year: 2) Solutions Open to local and overseas technology companies with the following criteria: • Solutions must be technically feasible and commercially viable, • Ready to scale up for mass market adoption

5. For this challenge call, proposals are required to achieve 75% energy efficiency improvement compared to 2005 baseline for the respective building typology as per Table 1 below.

Table 1. Target Energy Use Index (EUI) for various building typologies

Building Typologies	Baseline EUI (kWh/m²/year)	Target EUI (kWh/m²/year)
Healthcare facilities - **Hospitals** - **Polyclinics** - **Community hospitals** - **Nursing homes**	 750 300 462.5 175	 187.5 75 115.6 43.7
Retail buildings	480	120
Mixed Development	Calculated by GFA mix	Calculated by GFA mix
Hotel	476	119

Eligibility

6. This call is open to open to building owners, developers, Environmental Sustainability Design (ESD) consultants, technology/solution providers, Institutes of Higher Learning (IHLs), and Research Institutes (RIs), with the building owner/ developers as the lead applicant.

Evaluation Criteria

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

a) Energy efficiency (Evaluation weightage: 20%)

- Proposals submitted must achieve more than 75% energy efficiency improvement over 2005 level at the building level.

b) Scalability (Evaluation weightage: 30%)

- Plans of scaling up of solution by technology suppliers/solution providers.
- Plans of building owners/ developers to replicate in building owner's portfolio.

c) Commercial viability and cost effectiveness (Evaluation weightage: 30%)

- Potential for commercialisation, which includes technology transfer to industry, partnerships with established organizations with global outreach.
- Solutions developed are cost effective such as reasonable payback period and lower operating cost such as reducing the frequency of maintenance and replacement of parts.

d) Novelty and Innovation (Evaluation weightage: 20%)

- New or improved product, service, process, method that enhance current practices or industry standards.

Funding Support

8. Singapore-based building owners and developers are eligible to apply for up to 70% funding support or SG$3 million (whichever is lower) for the demonstration project.

9. Qualifying cost will cover:
   a) Design and consultancy services,
   b) Energy performance modelling and simulation work,
   c) Equipment and Installation,
   d) Testing and commissioning,
   e) Consultancy and instruments for measurement and verification,
   f) Dashboard and graphic user interface, and
   g) Documentation work such as M&V Report and Final Report

10. Proposals should not be funded or be currently considered for funding by other agencies.

Application Process

11. Interested applicants are required to submit the GBIC Demonstration Application Form together with necessary supporting documents via email to BCA_Challenge_Call@bca.gov.sg **by 14 August 2025, 5:00 PM (Singapore Time).**

Building 1: Raffles Hospital

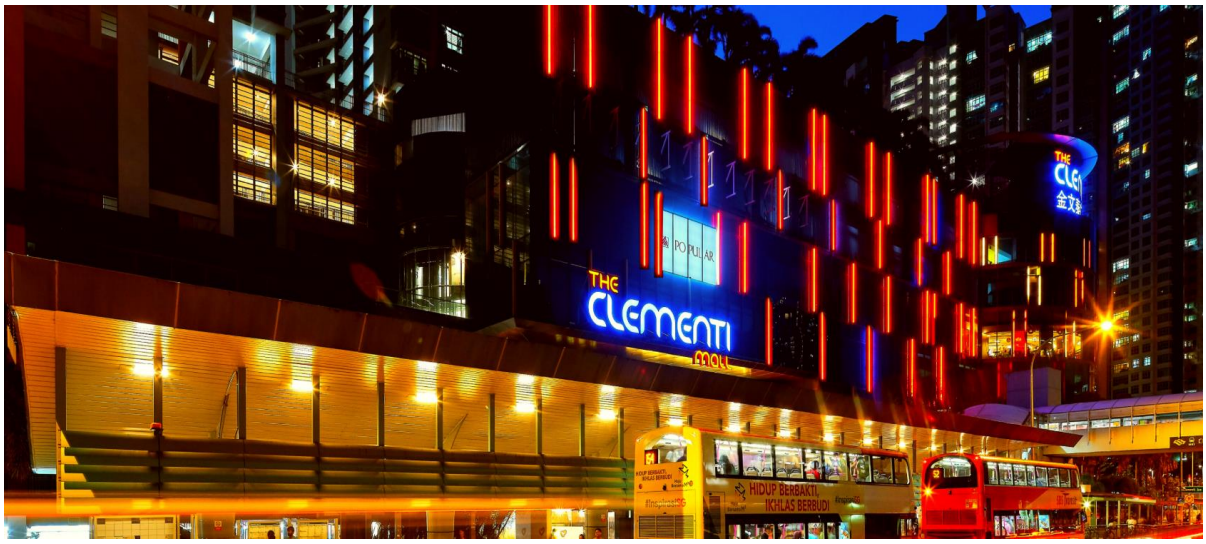
Building Information

Building Name	Raffles Hospital & Raffles Specialist
Building Address	585 North Bridge Road S(188770)
Building Typology	Hospital & Specialist Centre
Number of Floors	13-storey Hospital & 23-storey Specialist Centre
Gross Floor Area (sqm)	49,272
Current Annual Energy Consumption (kWh/year)	15,059,433
Current Energy Use Index (kWh/m²/year)	306
Current Green Mark Certification	No
Demonstration Area	Entire building
Contact Person's Details	Heng Wee Khim Weekhim_heng@rafflesmedical.com

Building 2: The Clementi Mall

Building Information

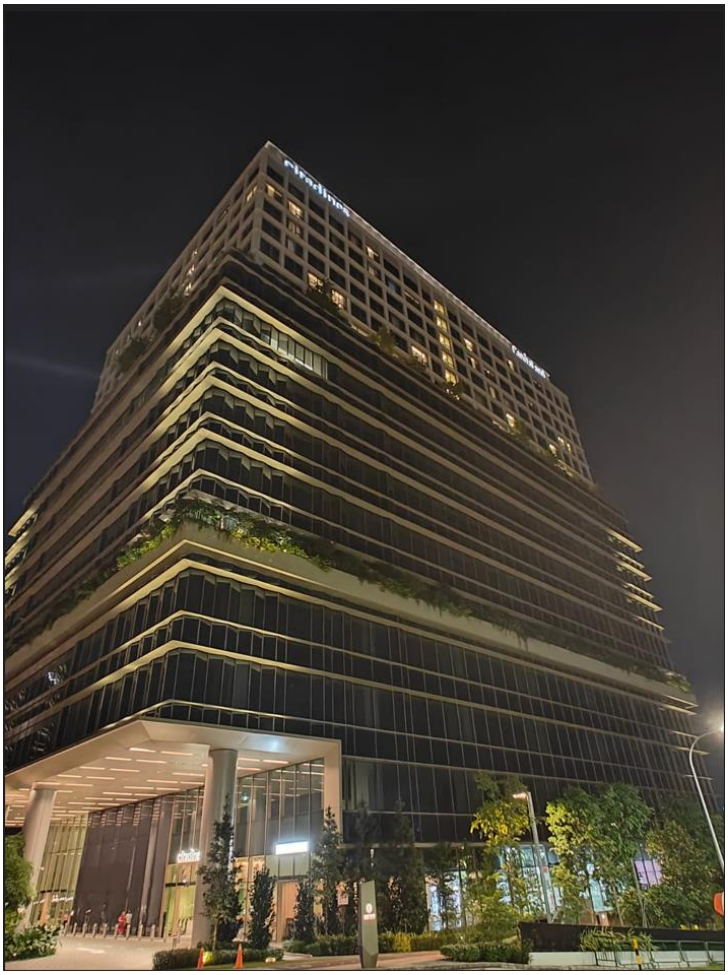
Building Name	The Clementi Mall
Building Address	3155 Commonwealth Avenue West, S(129588)
Building Typology	Retail (Shopping Mall)
Number of Floors	6-storey building
Gross Floor Area (sqm)	26,973.71
Current Annual Energy Consumption (kWh/year)	16,259,943
Current Energy Use Index (kWh/m²/year)	602.81
Current Green Mark Certification	Gold
Demonstration Area	Entire building
Contact Person's Details	Cristal Fm_Tcm_Trm@straitsproperties.com.sg Fm_grp@straitsproperties.com.sg



Building 3: 7 Science Park (GENEO)

Building Information

Building Name	7 Science Park Drive
Building Address	7 Science Park Drive, S(119316)
Building Typology	Mixed Development
Number of Floors	1 Block of 15-storey business park and hotel with 2 levels of basement carparks Breakdown: 2 levels of basement carpark 10 levels of business park 5 levels of service residence
Gross Floor Area (sqm)	38,818.36 Breakdown: Business Park: 28,818.36 Business Park (white) – Service apartment: 10,000
Current Annual Energy Consumption (kWh/year)	2,058,906
Current Energy Use Index (kWh/m²/year)	53.04
Current Green Mark Certification	Platinum SLE
Demonstration Area	Entire building
Contact Person's Details	Derrick Lim: derrick.lim@capitaland.com Lim Wee Boon: lim.weeboon@capitaland.com Lee Shun Hao: lee.shunhao@capitaland.com



Building 4: Paragon

Building Information

Building Name	Paragon
Building Address	290 Orchard Road, S(238859)
Building Typology	Mixed Development (Retail & office)
Number of Floors	6-storey retail podium, 1 level of basement with 14-storey tower and another 3-storey tower on top of retail podium
Gross Floor Area (sqm)	94,393
Current Annual Energy Consumption (kWh/year)	34,338,710
Current Energy Use Index (kWh/m²/year)	363.78
Current Green Mark Certification	Gold
Demonstration Area	Entire building
Contact Person's Details	Cristal Fm_Tcm_Trm@straitsproperties.com.sg Fm_grp@straitsproperties.com.sg

Building 5: Grantral Mall Macpherson

Building Information

Building Name	Grantral Mall Macpherson
Building Address	601 Macpherson Road, S(368242)
Building Typology	Mixed Development (Retail and offices)
Number of Floors	8-storey
Gross Floor Area (sqm)	45,441.46
Current Annual Energy Consumption (kWh/year)	11,000,000
Current Energy Use Index (kWh/m²/year)	To be confirmed
Current Green Mark Certification	No
Demonstration Area	Entire building
Contact Person's Details	David Cheong David.cheong@theelegantgroup.com

Building 6: SingHealth Tower/ Outram Community Hospital

Building Information

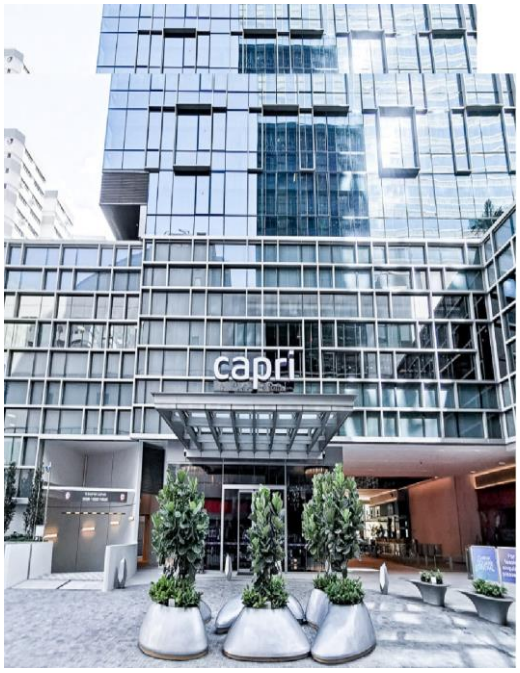
Building Name	SingHealth Tower/ Outram Community Hospital
Building Address	10 Hospital Boulevard, S(168582)
Building Typology	Mixed Development (Community Hospital, Offices and Logistics Hub)
Number of Floors	21-storey above ground, 4 levels of basement
Gross Floor Area (sqm)	149,000
Current Annual Energy Consumption (kWh/year)	35,968,159
Current Energy Use Index (kWh/m²/year)	241.4
Current Green Mark Certification	Platinum
Demonstration Area	Dedicated area The demonstration space allocated will be at a service lobby (AGV). The AGV lobby contains three service lifts and is served by a single FCU for its ventilation. It has two side exits at opposite ends. One opens to an AC corridor and another open to a separate corridor served by fresh air. This lobby also has a door access to the wastehold room served by aircon and exhaust air which is also prone to serious mould conditions.
Contact Person's Details	Foo Seck Sen: foo.seck.sen@singhealth.com.sg Lim Kian Giap: lim.kian.giap@singhealth.com.sg Ryan Thio: ryan.thio.t.j@singhealth.com.sg

Demonstration area:

Building 7: Capri by Frasers, China Square

Building Information

Building Name	Capri by Frasers, China Square
Building Address	181 South Bridge Road, #02-01, S(058743)
Building Typology	Hotel
Number of Floors	16-storey
Gross Floor Area (sqm)	15,354
Current Annual Energy Consumption (kWh/year)	2,639,400
Current Energy Use Index (kWh/m²/year)	172
Current Green Mark Certification	GoldPlus SLE
Demonstration Area	Entire building
Contact Person's Details	Alex Chua Alex.chua@fraserspropery.com



Annex B: GBIC R&I Challenge

Research Challenge Areas	**GBIC 2.0 2nd Thematic Challenge Call**
RFP Number	GBIC-R&I RFP 07
Category	GBIC R&I Challenge Call
Open Date for Proposal	**30 June 2025**
Close Date for Proposal	Proposals must be submitted via the Integrated Grant Management System (IGMS) at https://www.researchgrant.gov.sg **by 14 August 2025, 5:00 PM (Singapore time).**
Enquiries	For enquiries on the Challenge 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.

Introduction

1. As the key support measure for the BE sector to meet the Singapore Green Building Masterplan (SGBMP)'s 80% energy efficiency improvement target, GBIC 2.0's efforts will be focusing on novel solutions with significant impact on energy savings without compromising thermal comfort and indoor air quality. GBIC 2.0 is pushing the next bound of decarbonisation through passive and active strategies. The 2nd Thematic Challenge Call (R&I) will focus on two broad areas for the **Healthcare sector**: Innovative Cooling Technologies and Advanced Building Ventilation Solutions for further deep dive.

Scope of challenge call

2. The GBIC R&I Scheme focuses on **healthcare sector solutions**. Innovative solutions for other building typologies may be considered on a case-by-case basis.

3. Eligible applicants for this challenge call include technology/solution providers, Institutes of Higher Learning (IHLs), and Research Institutes (RIs). Applicants may submit proposals that address either the Challenge Statements or Focus Area Topics, or both.

GBIC R&I Scheme Details

4. GBIC Research & Innovation (R&I) covers two schemes (i.e. Research and Development (R&D) and Product Prototyping). Please see the following attributes for Research and Development (R&D) and Product Prototyping proposals:

	R&D	Product Prototyping
Intent	Support development of high impact solution to be ready for piloting upon completion.	Support enhancement of existing innovation to be ready for piloting upon completion.
Target Group	Solution provider from private sector or research institute as lead with building owner/developer as collaborator.	Solution provider from private sector as lead with research institute as collaborator, building owner/developer as collaborator.
Technology Readiness Level	Start TRL: 3; End TRL: 7/8 (See Table 2 for TRL descriptions)	Start TRL: 5; End TRL: 8 (See Table 2 for TRL descriptions)
Funding	Up to 70% for private sector, 100% for IHL/RI Funding size to be reviewed on case-by-case basis	Up to 70% for private sector, 100% for IHL/RI Cap at S$500,000 per project
Project Duration	Up to two years	Up to one year
Desired Outcomes	Technologies achieve at least 30% better than current GM2021 Platinum standard or existing best-in-class solutions, whichever is better. (See Table 3 for targets) Commercially viable solutions with good Return of Investment (i.e. potential payback of 3-5 years)	Technologies achieve at least 25% better than current GM2021 Platinum standard) or existing best-in-class solutions, whichever is better. (See Table 3 for targets) Commercially viable solutions with good Return of Investment (i.e. potential payback of 3-5 years).

5. The project will consist of two phases:

Phase 1: Development

- Development of a working prototype of the proposed solution.

Phase 2: Performance Validation

- The developed solution must undergo testbedded in an operational healthcare facility, to validate energy saving performance targets, occupant thermal comfort and indoor air quality.

Note:
Applicants could still submit their proposals before the closing date if they have not identified the building spaces for testbedding. Applicants can update BCA on the

identified building spaces for testbedding, before the commencement of the Project Evaluation Panel meeting tentatively scheduled in October 2025.

Eligibility

6. This call is open to local and global technology firms and Singapore-based Institutes of Higher Learning (IHLs), and research institution (RI).

7. Industry-led proposals will be assessed more favourably. IHLs and RIs are strongly encouraged to co-create innovative solutions with the industry to drive further commercialisation and market adoption.

Evaluation Criteria

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

a) Energy efficiency (Evaluation weightage: 20%)

- Proposals submitted must meet the targets set by the respective building owners in their challenge call and achieve at least 25-30% better than GM 2021 Platinum standards or current best-in-class technologies, whichever is better.

b) Scalability (Evaluation weightage: 30%)

- Plans of scaling up of solutions by technology suppliers/solution providers.
- Ability to ramp up production of technologies and provide after-sale support with partners.
- Potential application of technologies across wider building typologies.

c) Commercial viability and cost effectiveness (Evaluation weightage: 30%)

- Potential for commercialisation, which includes technology transfer to industry, partnerships with established organizations with global outreach.
- Solutions developed are cost effective such as reasonable payback period and lower operating cost such as reducing the frequency of maintenance and replacement of parts.

d) Novelty and Innovation (Evaluation weightage: 20%)

- New or improved product, service, process, method that enhance current practices or industry standards.

Funding Support

9. Private sector entities are eligible for **funding support of up to 70%**[7] of approved direct qualifying costs of a project. However, funding for private sector entities for R&D projects

[7] Tiered funding support levels would apply for private sector entities (up to 30% for all non-Singapore entities; up to 50% for Singapore Large Local Enterprises (LLEs); up to 70% for Singapore Small and Medium-sized Enterprises (SMEs), start-ups and not-for-profits entities).

with a total project budget exceeding S$0.5M is subject to the condition of collaboration with a public research performer from an IHL or RI. For Product Prototyping projects, this condition applies to projects with a total project budget exceeding S$2M.

10. Singapore-based IHLs are eligible for up to 100% funding support of approved direct qualifying costs for a project. Only Singapore-based IHLs are allowed support for indirect costs of up to 30% of qualifying costs for overhead costs.

11. Total project cost capped for Product Prototyping project at S$0.5M (including indirect costs) with project period of not more than 1 year. R&D projects would be considered for higher funding support for more extensive proposals that show potential with project period of not more 2 years.

12. Proposals should not be funded or be currently considered for funding by other agencies.

13. Funding awarded cannot be used to support overseas R&I activities. All funding awarded must be used to carry out the testbedding activities in Singapore unless approved in the grant.

Application Process

14. Interested applicants are required to submit proposal through the Integrated Grant Management System (IGMS) at https://www.researchgrant.gov.sg with the supporting documents by **14 August 2025, 5:00 PM (Singapore Time). Late submissions or submissions from individual applicants without endorsement from the Host Institution will not be considered.**

15. Lead PI/Co-PIs from organisations that are not registered in the IGMS must register an IGMS account **for their first-time application** as part of the proposal submission workflow. Please refer to **Annex C** for further registration information**. 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.** Guides for IGMS application process are available at: https://www.researchgrant.gov.sg/Pages/TrainingGuides.aspx

16. Applications will only be considered as successfully received 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;
c) Form C – Capability Indicators; and
d) PI and co-PI's CVs

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

17. 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
PI and co-PI's 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.

18. Shortlisted applicants will be invited to present their proposals to the appointed Project Evaluation Panel (PEP) for recommendation for award.

Challenge Statement 1: Sengkang General Hospital

Challenge statement

a) To implement an innovative dynamic setpoint control system that adjusts operational parameters in real-time based on current conditions, thereby optimizing energy use and improving overall system performance.

Current situation

b) The chiller plant operates under a traditional model that relies on fixed setpoints for temperature and cooling load controls.

1. Fixed setpoints often lead to overcooling or undercooling, resulting in wasted energy. Chillers may run at full capacity even when the demand is low, leading to unnecessary energy consumption.

2. Fixed setpoints do not account for fluctuations in external temperatures, occupancy levels, or equipment loads. This lack of adaptability can result in discomfort for building occupants and increased operational costs.

Gaps to be addressed

c) The reliance on fixed setpoints prevents the system from adapting to variations in external conditions, leading to inefficiencies and discomfort for occupants. There may be difficulties in integrating dynamic control systems with existing building management systems (BMS), hindering the overall efficiency of operations.

Scope of Call for Proposals

d) The project should achieve 25 – 30% more energy savings than existing best-in-class technologies for air-conditioning systems commonly used by Green Mark Platinum buildings, with satisfactory thermal comfort and IAQ.

Building details

Building Name:	Sengkang General Hospital
Building Address:	110 Sengkang East Way, Singapore 544886
Test bedding location:	Chiller plant room
Contact Person's Details:	Edward Reuben Roch.edward.reuben@skh.com.sg Sustainability.office@skh.com.sg

Challenge Statement 2: SingHealth Tower/ Outram Community Hospital

Challenge statement

a) To find ways to inhibit the growth of moulds in the L4 floor areas without going into the option of operating the AC for 24 hours just to maintain the RH levels, as this will be a very expensive and energy intensive way to address the issue. Other than cost efficient solutions, the solution must be able to meet the hospital's infection control requirements in order for implementation within the hospital premises.

Current situation

b) Mould has been present in the facility. Treatment measures taken were repainting with anti-mould paints and replacement of ceiling board actively when signs of mould appear. In addition, active measures such as adjustment to airflow and placement of dehumidifier were utilised for air treatment. For context, the rehab gym area is air-conditioned during operating hours and a/c is switch off during non-operating hours. In addition, any facility management activities need to get approval from infection control.

Gaps to be addressed

c) Current floor air-conditioning (AC) operation hours are only during office hours, and the RH level will tend to spike to sky high levels and promote mould growth in areas especially after the AC is switched. The floor layout is also in such a way that there are a lot of small compartments to form many pockets of poor ventilation dead corners and further promote mould growth.

Scope of Call for Proposals

d) The project should achieve 25 – 30% more energy savings than existing best-in-class technologies for air-conditioning systems commonly used by Green Mark Platinum buildings, with satisfactory thermal comfort and IAQ.

Building details

Building Name:	SingHealth Tower/ Outram Community Hospital
Building Address:	10 Hospital Boulevard, S(168582)
Test bedding location:	L4 Rehab Area
Contact Person's Details:	Foo Seck Sen: foo.seck.sen@singhealth.com.sg
	Lim Kian Giap: lim.kian.giap@singhealth.com.sg
	Ryan Thio: ryan.thio.t.j@singhealth.com.sg

Focus Area 1: Innovative Cooling Technologies

Challenges Faced

a) In Singapore's tropical climate, Air-Conditioning and Mechanical Ventilation (ACMV) plays an important role in ensuring building occupants' thermal comfort. As air-conditioning is energy intensive, typically responsible for 40 to 60% of the commercial building electricity consumption, it is imperative to drive energy efficiency (EE) and sustainability to support the SGBMP to achieve 80% improvement in energy efficiency for best-in-class building (over 2005 levels) by 2030. With the increased frequency of hot spells due to climate change, the usage of air conditioning is expected to increase, especially in the healthcare facilities. This poses challenges of more heat rejected from buildings to ambient environment causing urban heat island effect.

b) Typical building ACMV systems are designed to cater to the most unfavourable days or hours of the year under the full occupancy condition. This has posed challenges and potentially caused inefficiencies in operation as most of the time buildings are operated under part-load conditions with rigid setting of space condition. To achieve energy efficiency, an adaptive air-conditioning system that can monitor the occupancy conditions and adjust its operation accordingly would be necessary.

c) Non-compressor air-conditioning (e.g. using water as a refrigerant) has great potential in reducing carbon emissions of ACMV as it does away with conventional hydrofluorocarbon (HFC) based refrigerant. However, the current non-compressor air-conditioning technology faces several challenges such as high cost, small cooling capacity and humidity control for tropical environment conditions.

d) Current hybrid air-conditioning (AC) system applying elevated temperature with increased air movement via direct current fan has shown great potential to improve the energy savings. There are opportunities for further enhancement such as different hybrid modes of cooling to achieve optimal energy efficiency and thermal comfort and develop design/operating/maintenance guidelines for these solutions to promote wider adoption.

Scope of Call for Proposals

a) The scope of the proposals should cover:

- Develop cost-effective, compact non-vapour compression cooling system and evaporative cooling system (using water as refrigerant) with good dehumidification control suitable for large building indoor applications for tropical climate environment conditions.
- Review various possible combination of multiple modes of hybrid AC and natural ventilation systems that could address air momentum, condensation, low cooling capacity and humidity control challenges.

- Solutions developed are required to be compact, durable, cost effective and low maintenance with high energy efficiency, Indoor Air Quality (IAQ), and thermal comfort performance.

b) Some of the possible solutions (non-exhaustive) are listed below:

- Hybrid coupled AC systems with various possible combination of multiple modes of air-conditioning, natural ventilation, assisted ventilation system, to achieve optimal energy efficiency, thermal comfort and IAQ.
- Integrated advanced dehumidification system with evaporative cooling.
- Advanced energy recovery technologies for building applications.
- Innovation in mechanical components that can take quick action for flexible adjustments of cooling power and broader high-efficiency band under part load condition.
- ACMV solutions to allow for raised indoor temperature set point without compromising cooling and dehumidification efficacy and be able to take quick adaption to variation of occupancy pattern and weather condition.
- Non-vapour compression technologies that provide cooling without the use of hydrofluorocarbon (HFC) refrigerants

c) The project should achieve 25 – 30% more energy savings than existing best-in-class technologies for air-conditioning systems commonly used by Green Mark Platinum buildings, with satisfactory thermal comfort and IAQ.

Focus Area 2: Advanced Building Ventilation Solutions

Challenges Faced

a) With the emphasis to provide adequate outdoor air and effective air movement in premises to better protect building occupants, the anticipated trend of increased energy consumption in air-conditioning and mechanical ventilation system in buildings will pose a challenge. This is primarily due to the energy-intensive process of treating outdoor air for indoor air condition spaces.

b) While advanced shading and façade systems have been the key to reduce heat load and drive natural ventilation for healthcare facilities, integrating effective outdoor air intake into façade systems in tropics remains a challenge. There is little understanding and lack of cost-effective solutions to incorporate outdoor air intake into façade systems that will help to reduce cooling load while maintaining good humidity control.

c) While current occupant-level cooling and ventilation systems can reduce energy consumption and provide good indoor air quality, they have encountered limited adoption due to challenges such as integrating with existing ACMV systems, sensor deployment, accuracy and control systems to detect occupancy and IAQ. Moreover, long payback period may deter building owners from investing in such systems.

Scope of Call for Proposals

a) The scope of proposals should cover:

- Develop novel, cost effective materials and designs, such as permeable facade and breathing facades which will reduce indoor humidity within the building using porous materials.
- Study the integration between the façade as a building skin with other building systems e.g. ACMV, building management system, to achieve greater energy savings.
- Study the occupant ventilation system relying on improved monitoring of occupancy conditions (i.e. presence, comfort, and adaptive behaviour) and incorporation of these parameters into control strategies in a timely fashion to reduce unnecessary energy usage.
- Review and identify the key factors of aerodynamic fans combining with natural ventilation (NV) and evaluate the effectiveness of the solutions including energy efficiency and ventilation effectiveness.

b) Some of the possible solutions (non-exhaustive) are listed below:

- Hybrid solutions combining aerodynamic fans with natural ventilation to reduce energy consumption of traditional mechanical ventilation systems without compromising thermal comfort and occupant satisfaction.

- Occupant ventilation systems integrated with smartness and AI to provide adaptive cooling and ventilation to reduce the energy consumption of air-conditioning systems based on occupancy conditions, outdoor weather and real time health parameters (e.g. using wearable devices to monitor occupant's vital signs).
- Building envelope systems have been the key to reduce heat load and drive natural ventilation spaces for non-residential buildings. With advanced façade systems, there is potential to reduce heat transfer and incorporate fresh air intake into façade systems which will help reducing cooling load and improving humidity control.
- High energy efficient air filtration system capable of removing indoor air impurities which can lead to reduction of ventilation rate to improve energy efficiency, prevention of microbial growth in the filter, with less frequent service.
- Air cleaning technology for ACMV load reduction by removing carbon dioxide, ozone, formaldehyde, and a wide range of volatile organic compounds from indoor air so that ventilation rates can be optimised to improve energy efficiency and IAQ, which can lead to reduction in ACMV equipment costs, operating costs, and buildings' carbon emissions.

c) The project should achieve 25 – 30% more energy savings than existing best-in-class technologies for building ventilation systems commonly used by Green Mark Platinum buildings, with satisfactory thermal comfort and IAQ.

Table 2: Technology Readiness Level Descriptions

The Technology Readiness Level (TRL) is widely used indictor of the degree of development or a technology toward deployment, measured 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.

Table 3: R&I Challenge Call Targets

	GM 2021 Platinum Standard	**Product Prototyping Target** *(25% better the GM Platinum standard or existing best-in-class solutions, whichever is better)*	**R&D Target** *(30% better the GM Platinum standard or existing best-in-class solutions, whichever is better)*
Chiller plant system efficiency (kW/RT)	0.56	0.420	0.392
Air side efficiency (kW/RT)	0.18	0.135	0.126
Total AC system efficiency (including water side and air side) (kW/RT)	0.74	0.555	0.518
Lighting (W/m²)			
- Office/Meeting Room	5.5	4.125	3.85
- Hotel Guest Room	7.0	5.250	4.90
Mechanical Ventilation (W/CMH)			
> 4kW	0.28	0.210	0.196
< 4kW	0.17	0.128	0.119
Reduced Heat Gain (ETTV) (W/m²)			
- Office Building	38	28.5	26.6
- Hotel	40	30.0	28.0

Annex C: SOP for Creation of New Companies/Institutions in IGMS

As part of the proposal submission workflow, companies or institutions who wish to apply for NRF grants **for the first time as lead Principal Investigator (PI) or co-PI** will need to create a IGMS account to allow them to submit proposals. Please refer to the SOP below for the creation of a new company/institution within IGMS. The guides for IGMS application process are available at: https://www.researchgrant.gov.sg/Pages/TrainingGuides.aspx

---

CREATION OF NEW IGMS ACCOUNT

Step 1: Registering the Host Institution (HI)

For the creation of **new** Host Institution (HI) in IGMS, please provide the following details and in email to BCA_Challenge_Call@bca.gov.sg:

"Subject: Creation of new Company/Institution in IGMS for GBIC 2.0 2nd Thematic Challenge Call"

Details of the New HI:

- *Full Name of Company:*
- *Indicate Local Company or Foreign Company:*
- *Indicate Public Company or Private Company:*
- *UEN (for local company) or Entity ID (for foreign Company):*

For Foreign Company, please provide the screenshot from Corppass profile page indicating the Entity ID (for Foreign Company), for verification purpose. Refer to Appendix A.

For foreign company users who have an existing IGMS account via "For overseas users without Singpass", please refer to the Notes below.

Step 2: Creation of users under HI

i) The company will need to nominate a HI Admin.

ii) The **HI Admin** will need to have their Corppass account setup. Please refer to Corppass website for more info (www.corppass.gov.sg) on Corppass account matters.

iii) The **HI Admin** will need to log in to IGMS via "**For Business Users**" to register an account and update their profile in IGMS. Please note that the IGMS would grant them the **Principal Investigator (PI)** role by default.

*For foreign company users who have an **existing IGMS** account via "**For overseas users without Singpass**", please refer to the Notes below.

iv) After the **HI Admin** has been successfully registered in IGMS, the **HI Admin** will notify BCA in email with the information below, to change the role of the person from a **PI** to a **HI Admin**:

- *Full Name of HI Admin:*

- *E-mail Address of HI Admin:*

- *Designation of HI Admin in the company:*

v) Once granted the role as a **HI Admin**, companies can proceed to assign the relevant roles (e.g. Office of Research (ORE), Director of Research (DOR), PI, etc) to the various users within the organisation.

Notes:

For **existing** foreign company users who have an IGMS account registered via "**For overseas users without Singpass**" route.

• Users should contact Corppass to register for and obtain a Corppass account. Please refer to Corppass website (www.corppass.gov.sg) and their FAQ section (go.gov.sg/corporate-login) for more info.

• Since the company had registered in IGMS before, once the Corppass account has been obtained, please follow Step 1 (Registering the Host Institution) above, to **update** your company with the **newly issued Entity ID (for Foreign Company)** in IGMS, before proceeding further.

• After Step 1 is completed, when registering in IGMS via "**For Business Users**", ensure to register using the **same email address** that was used for the existing IGMS account.

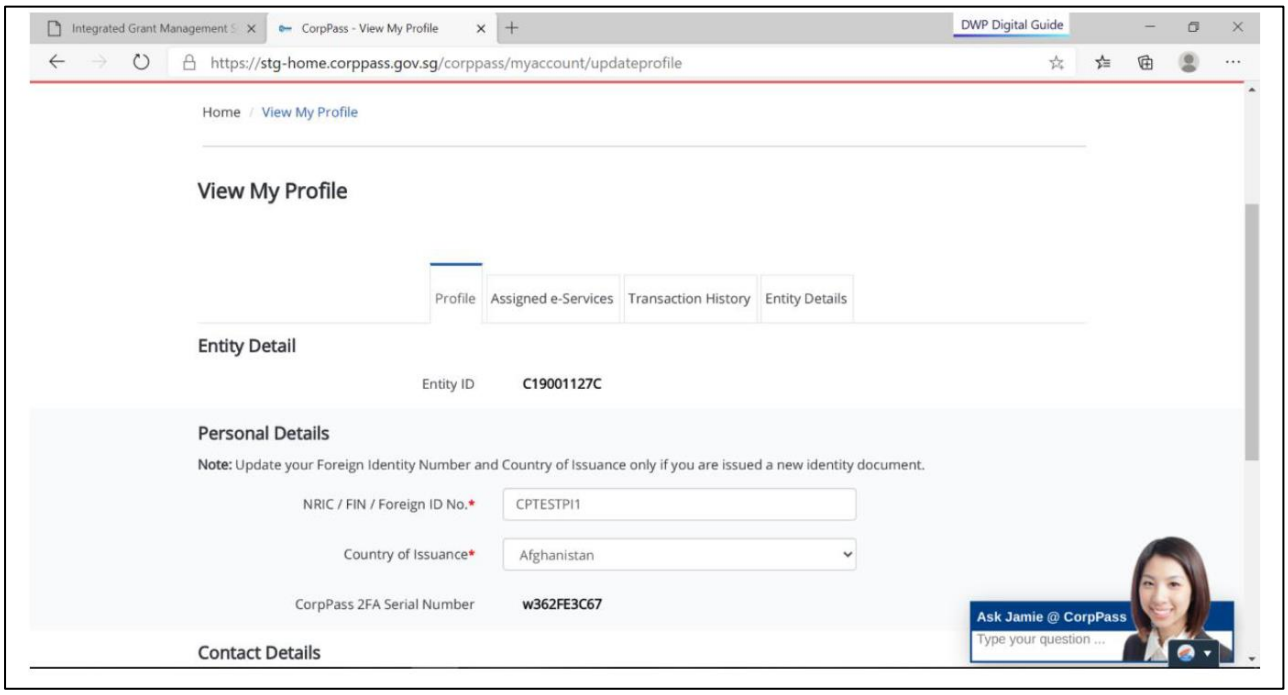
[Important!] In order to continue accessing past transactions in IGMS, it is important the above steps are done to (i) update the new Entity ID in IGMS, and (ii) to register via "**For Business Users**" with the same email address.

• The rest of the steps under Step 2 (Creation of users under HI) remains the same.

Appendix A

Screenshots for verification – samples

(i) Corppass profile page



(ii) Email from Corppass