

# GM: 2021 FAQs

## Section A: Timeline or Process related

1. What is the cut-off application date of GM2015/2016/2017 and what is the grace period to finish the assessment for projects which applied under GM2015/2016/2017?

The effective date of GM: 2021 is 1 Nov 2021. Projects (New Non-Residential Buildings (NRB), Existing Non-Residential Buildings (ENRB), Residential Buildings (RB), Existing Residential Buildings (ERB)) applying for Green Mark certification on or after 1 Nov 2021, will be assessed under GM: 2021. For re-certification, simplified re-cert will be replaced by GM: 2021 In Operation.

Projects which have applied for Green Mark application before 1 Nov 2021 and assessed under GM2015 or GM2016 or GM2017, must complete the assessment and receive Green Mark Letter of Award (LOA) by end of 2022. If the assessment is not completed by then, they will be assessed under GM: 2021 on 1 Jan 2023.

In short, from 1 Jan 2023 onwards, all projects (NRB, ENRB, RB and ERB) are to be assessed under GM: 2021.

2. Can you tell me more about the GM certification process under GM: 2021?

To start the certification process, the Building owners or the Green Mark consultant need to submit an application via Green Mark online at <https://www.bca.gov.sg/GreenMarkOnline>.

Upon system acceptance of the application fee payable, a BCA Green Mark Assessor will be assigned to the project. Assessment will be conducted after the full submission of required supporting documents. After completion of the assessment, a Letter of Award (LOA) will be issued.

Upon the completion of the project, BCA may select the project for verification on site.

3. For pilot projects, is Green Mark online application required as normal projects and does the GM application fee apply?

Yes, pilot projects are subject to the same Green Mark online application process and the application fees.

#### 4. Could you define “legacy project”?

Legacy projects refer to all previously certified GM projects under previous GM criteria such as GMv4.1, GM2015, GMENRB ver2.1, GMENRB ver.3, GM2017 etc. These projects can be re-certified under GM: 2021 In Operation if there are no major energy use change, such as change of chillers.

#### 5. I have a mixed development with 60% of GFA for commercial, 10% GFA for Hotel and another 30% GFA for Residential, can I apply for one Green Mark Certification for the entire development, or must I apply for two certifications under GM: 2021?

GM: 2021 criteria replace GM: 2015 for NRB, GM: 2016 for RB and GM: 2017 for ENRB. It provides the flexibility to certify the mixed development under one single certification. For energy efficiency for NRB and RB, they must comply with the respective NRB and RB requirements. However, the developers have the choice to apply for two certifications as well.

#### 6. Can I use GM: 2021 for overseas project?

As of now, GM:2021 is only available for local projects but we are working on GM:2021 (International) version to assist our local firms to export their green services overseas. More details would be released when available.

#### 7. There are two phases with two BP submissions for our project with two TOPs. The phase-1 TOP and phase-2 TOP is 3 to 4 years apart. The development will be using one centralised chiller plant to serve 2 phases, can we opt for one GM submission?

If the gap between the two TOP is more than 3 years, it should be separated into two GM applications. The certification of non-residential building is only valid for 3 years from TOP date, and the verification should be completed within the validity of the certification.

## Section B: EE requirement in GM: 2021 full certification

8. I am doing a major retrofitting project which comprises an extension of 2 new floors to the existing building, which EE standard in GM:2021 should I refer to?

EE standards in GM: 2021 have been standardised regardless whether the building is a new or existing building. Please refer to the details on the EE section in GM: 2021.

Additional information: As the building comprises an extension of 2 new floors, you may also need to check on the [legislation on Environmental Sustainability for Buildings](#).

9. What are the key differences between GM: 2021 and GM2015(NRB), GM2017(ENRB)?

The table below shows a simple summary of the key differences:

<b>GM 2015(NRB), 2017(ENRB)</b>	<b>GM: 2021</b>
Pre-requisites in all sections	Only EE as a pre-requisite
Energy efficiency is measured based on a point system and energy savings (for new development)	3 parallel performance-based pathways to energy efficiency compliance instead of a point system  Energy efficiency has moved up in performance level required, about 5% for each tier compared with Green Mark 2015.
Qualification is based on a point system, with mandatory scoring in many sections	More focused criteria allowing projects to focus on key areas that have the most value and meaning to their projects through the modular sections
Some points can be scored for meeting industry norms and building code requirements	Many criteria based on industry norms are removed as they are considered BAU. New areas are developed, such as: <ul style="list-style-type: none"> <li>• Design for Maintainability</li> <li>• Nature based solutions (within resilience section)</li> <li>• Whole-life carbon and refined embodied carbon calculation with reduction from baseline</li> </ul>

	<ul style="list-style-type: none"> <li>• Zero carbon transition plan for the building (how the project would be net zero carbon by 2030)</li> <li>• Resilience strategy for the building (based on TCFD scenario planning)</li> <li>• Enhanced Health and wellbeing criteria – building on GM 2015 and GM 2017 – so greater focus on active mobility (the interior layout and finish to encourage activity), areas of respite, space for outsourced workers</li> <li>• Digital Twins, data ethics, BIM to ISO 19650</li> </ul>
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Some areas under GM: 2021 are similar to those of GM2015/2017 but with a higher standard:

- Sustainable construction (CUI, products and fitout – including green lease)
- IAQ and IEQ
- Sustainable operations and procurement (from Existing Buildings)
- Water fittings
- Environmental Impact Assessment
- Acoustic performance
- Biophilic design/ access to nature
- Energy modelling approach (pathway 3 for demonstrating energy performance).

Lastly, for GM: 2021 full certification, the minimum rating is GoldPLUS. Gold rating has been removed. However, Gold rating is still available under GM: 2021 In Operation for re-certification.

10. For VRF system, should we obtain the value of TSE through calculation based on NEA formula or through measurement by permanent M&V?

During design stage, the TSE for VRF system can be calculated based on NEA formula for CU efficiency plus air side efficiency. However, during operation stage, the TSE must be measured by permanent M&V.

11. My project is an office building with a small data centre, which Energy Efficiency (EE) pathways are applicable for my project? Is there any requirement for the data centre energy efficiency?

There are three EE pathways in GM: 2021: EUI, Fixed metrics and Energy Savings based on simulation. Please refer to more information below:

Pathway 1 – EUI: The energy consumption from Data Centre must be included. EUI is computed based on total building energy consumption.

Pathway 2 – Fixed metrics: This is the most suitable pathway and includes the cooling system efficiency for data centres.

Pathway 3 – Energy Savings: Under this pathway, the data centre will be treated as plug load. However, no energy savings from data centre will be accounted. If the data centre applies for GMDC certification (see details below), its energy consumption and M&E system will be excluded from the main building's assessment. Please refer to the Energy Modelling guideline [here](#).

- For new building, a) if the IT capacity of the data centre  $\geq 1\text{MW}$ , it is required to obtain GMDC certification with the same award rating as the main building. b) If the IT capacity  $< 1\text{MW}$ , it is required to meet the PUE requirement stated in GMDC criteria based on the same rating as the main building, at 25%, 50% and 75% IT load respectively. In this case, it is not a requirement to obtain GMDC certification and is treated as plug load in EM.
- If the data centre is located in an existing building, a) when the IT capacity  $\geq 1\text{MW}$ , it is required to get the same GM Data Centre award rating as the main building; b) when the IT capacity  $< 1\text{MW}$ , it is required to meet the operating PUE requirement stated in the GMDC rating as the main building, but it's not a requirement to obtain GMDC award.
- However, for data centres with IT capacity  $< 1\text{MW}$ , if they apply for GMDC certification voluntarily, its energy consumption and M&E system will be excluded from the main buildings' assessment.

For example, if there is a data centre with 2MW IT capacity located in an office building and the office building received a Green Mark platinum rating, this data centre must achieve Platinum rating under Green Mark for data centre criteria.

## 12. We have a central chiller plant to supply to different buildings located in the school's campus, can this plant be treated as a DCS\* plant?

Please refer to the definition of DCS in the main document. DCS\* plants refer to corporations that have operational control of a business activity that involves the supply of chilled water for air-conditioning. Thus, if the cooling plant is under the same ownership and operational control as the cluster of buildings connecting to it, the DCS plant will not be required to comply with ECA and MEES as this does not fall under the category of a business activity that supplies chilled water for air-conditioning.

13. What is the Energy Efficiency requirement for buildings with chilled water supplied by DCS\*?

Pathway 1 – EUI. The energy consumption of the chilled water supplied by DCS is excluded from EUI. Refer to the table, Energy Use Intensity (EUI) – With District Cooling Supply. Also, projects must comply with its Airside efficiency requirement.

Pathway 2 – Fixed metrics. Energy efficiency of the DCS shall be excluded, project shall meet the Air side efficiency requirements in Fixed metrics.

Pathway 3 – Energy Savings. The same energy savings requirement in Pathway 3 applies to both building with in-building chilled water plant and buildings with chilled water supplied by DCS plant. Energy consumption of the chilled water supplied by DCS plant shall be excluded from the energy modelling. Also, projects must comply with its Airside efficiency requirement. Cooling load savings in GM NRB 2015 is not required in GM: 2021, refer to [Energy Modelling guideline](#).

14. In GM: 2021 SLE EE Fixed Matrix, what is the definition of non-ac space? Does it include the circulation and transit areas, or only occupied space? Could we have a list of applicable spaces in office and retail buildings for reference?

The spaces here take reference to URA's GFA guidelines, the percentage of non-air-conditioning spaces is the non-air-conditioned space (GFA definition) divided by the total GFA. If the space is counted as GFA as per URA's GFA guidelines, it will be included in the calculation. For example, carparks in the recent development are not counted as GFA, but staircases and corridors are counted, therefore the former will not be included in the calculation, but the latter will be included.

15. What happens if the standardised operation schedules used for EE Pathway 1 and 3 used in energy modelling differ from the actual operation schedule during the verification stage? For example, for commercial offices, some developments have longer operating hours, depending on the tenants' make-up.

For Pathway 1, the EUI calculated for new development: 1) shall be based on estimated operation hours (as close to actual as possible); 2) if the actual operation hours are not known, the fixed hours as indicated in Pathway 3 can be used.

For verification of Pathway 1, if occupancy is low, e.g. 20%, the measured consumption must be extrapolated to 80% occupancy to compute the EUI. In scenario 2) above, if the actual operation hours are used during the design stage, adjustment of operational hours is not required during the verification stage. If the standardised operational hours are used during the design stage, it should be adjusted to actual operational hours during the verification stage.

For Pathway 3, the operational hours used for EM is fixed (say 10hr). At stage 2 verification, if the actual operational hours is 15hr and the utility consumption is 1,000,000kwh, the value of  $1,000,000 \times \frac{15hr}{10hr}$  can be calculated and the requirement is considered to be met if it is less than the proposed model consumption.

If the occupancy is low, e.g. only 30%, it needs to be extrapolated to at least 80% occupancy, see example below.

An example is provided:

A small office building	Results	
	1) based on EM proposed model for new buildings; or 2) based on projected data for existing building undergoing retrofit)	
Annual Total Building Energy Consumption: <u>At 30% occupancy</u>	115,489.3	kWh/year
GFA	2,584	m <sup>2</sup>
EUI	44.7	kWh/m <sup>2</sup> /year
TBEC Adjusted to 80% occupancy	= $115,489.3 \div 0.3 \times 0.8$ = 307971.4	kWh/year
EUI after adjustment	119.2	kWh/m <sup>2</sup> /year

With adjusted EUI of 119.2, the project can pass the verification requirement for Platinum rating.

16. For project that make use of on-site renewable energy to make up energy shortfall in order to comply with energy efficiency requirements in the fixed matrix, how do we determine the amount of energy that needs to be offset or how does the safety factor for no-site renewable work?

If a project cannot meet the system efficiency requirement, the energy delta due to that shortfall should be calculated and annualised. For example, if the TSE is 0.72kW/RT rather than 0.68kW/RT (requirement), then there would be an efficiency shortfall of 0.72-0.68=0.04kW/RT. This would be multiplied by the annual RThrs to get the kWh/yr. The

calculated shortfall, say 1000kWh/yr, will be multiplied by the safety factor, e.g.  $1000 \times 1.1$  for office buildings or  $1000 \times 1.5$  for schools, etc. to obtain the onsite replacement yield needed.

17. Among the 3 pathways, there seems to be slight inconsistency in terms of the minimum ACMV TSE required (i.e. Pathway 1&3 requires minimum of 0.8 kW/RT(New) 0.9kW/RT(EB), Pathway 2- 0.8kW/RT). What is the rationale for this?

Pathway 1 is purely outcome based (consumption reduction), so the performance requirements are more relaxed as a low EUI (with majority occupation) clearly means that the building is energy efficient. Pathway 2 is deemed to comply and so it uses conservative figures including AC TSE to ensure equivalent energy savings compared with other pathways. The TSE reflects the requirements for minimum standards for Periodic Energy Audits (PEA), a project will retain its certification if it meets the relevant requirements.

18. In GM: 2021 main document, it is mentioned that projects attempting EE Pathway 1 using EUI shall adopt the standardized schedules for computation if operational schedules of the building are unavailable at design stage. For projects attempting pathway 2 and 3, should the standardized schedules be applied as well?

The standardized schedules are applicable for pathway 1 and 3. For pathway 2, there is an established schedule which is mentioned in the technical guide.

19. Will the electrical consumption of EV charging stations installed in the development affect the compliance with requirements for SLEB or ZEB?

The electricity consumption of the EV charging points needs to be metered separately, and it will be excluded from the EUI calculations for the building. Hence, it will not affect pathway 1 - EUI.

20. Can carbon credit in any form be used to meet the EE requirement for GM: 2021?

No, local REC can only be used to meet requirements beyond SLE, meaning the first 60% energy savings must be achieved through EE and on-site RE. Beyond SLE, projects can use local REC to meet ZEB requirements. GM recognises carbon credit by awarding points in other sustainable sections, but it cannot be used to make up any shortfall of EE savings. In short, Green Mark 2021 seeks to: 1) energise the local RE market place and help reduce the BE emissions (local REC's) and 2) support the decarbonisation of the economy and the BE sector through recognition of positive actions to offset carbon in the global market place.



21. Under GM: 2021 pathway 2, do retail buildings need to meet the lighting power budget requirement in the tenanted spaces or just those areas within landlord's control?

If the retail mall is a new building, it must comply with pathway 2 table 2A requirement if they choose to use pathway2, and the landlord must impose [Green Lease](#) before new tenants move in.

If the mall is an existing mall, the landlord needs to impose [Green Lease](#) upon lease renewal or the next interior retrofit.

22. For an existing building targeting GM Platinum SLE, can it go for pathway 3 – Energy savings via energy modelling, i.e., demonstrating 60% energy saving based on actual building's energy consumption BEFORE and AFTER the EE retrofits?

Yes, existing building projects **can** choose pathway3 - energy saving. However, they should not use before retrofit as baseline. Instead, they should build the reference model based on EM guideline, and use the post retrofit data to compare to the reference model.

23. To get prepared for pandemic situation at a nursing home, where many occupants (elderly) are at higher risk, MERV 14 may be provided at the return air to FCU. MERV 14 adds friction loss, and there is difficulty to find FCU that can cater for friction loss from MERV14. As a result, a booster fan is added. Can the booster fan efficiency will be considered as MV category in term of EE efficiency pathway2?

MERV14 can be used for chilled water FCUs, but the booster fan must be included in the TSE calculation in pathway2 instead of being considered as MV category.

In addition, GM2021 Hw section does not recognize MERV14 for point scoring. It should be ePM1 =>75% or at least MERV14A.

24. I am going to submit GM for a new building, understand there is a cap of receptacle load when I do Energy Modelling to calculate energy saving. Can I apply the cap of receptacle load if I choose pathway 1 - EUI?

For any new buildings using Energy Modelling to calculate EUI under pathway1, **all** energy consumption within the building has to be included without applying the cap of receptacle load; however, if the same project chooses to use EM to calculate energy saving under pathway3, cap for receptacle load is allowed. In short, to calculate EUI, all energy consumption on site including receptacle load, process load or production/manufacturing load must be counted.

25. Can I buy off-site renewable energy to meet SLE requirement?

No, to make it simple, the first 60% energy saving up to SLE level, must be from on-site energy saving measures, or on-site renewable generated from PV owned by the building owners. After the buildings meet the first 60% energy saving, they can purchase off-site renewable to meet ZE requirement.

26. For buildings with space cooling by Passive displacement with fresh and outdoor air cooling PAHU, is the total airside efficiency based on:

(a) PAHU power and load: i.e.  $\text{PAHU power} / \text{PAHU cooling load}$  OR

(b) Total Airside power and building load: i.e.  $\text{Total PAHU} + \text{PDV electrical power} / \text{Total building cooling load}$

Answer is (b)

27. I have an existing building project first time applying for GM: 2021 certification, there is no major retrofit for air side, can I use 3<sup>rd</sup> party energy audit for air side efficiency?

No, 3rd party energy audit is not acceptable for GM: 2021 full certification. It is stated in GM: 2021 full certification technical guide page 13, footnote3. [https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/20211206\\_energy-technical-guide\\_r1.pdf?sfvrsn=4bdbcb84\\_0](https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/20211206_energy-technical-guide_r1.pdf?sfvrsn=4bdbcb84_0)

28. For Table 2A- Lighting power budget under GM: 2021 EE section, is there any consideration given to the cavity ration of rooms, i.e., high volume?

Yes, LPB baseline can be adjusted based on the Room Cavity Ration (RCR) stated in SS530. For example, spaces with high ceiling, the LPB baseline can be adjusted.

## Section C: GM: 2021 In Operation related

29. For an existing building that has been previously certified GM Gold<sup>PLUS</sup> but is able to meet the operation efficiency requirement of GM: 2021 Platinum standard, can the award rating be upgraded to Platinum under GM: 2021 In Operation?

Yes, for projects coming in for re-certification without major retrofitting, if they can demonstrate the EE saving meeting the higher rating requirement, their rating can be upgraded to Platinum without going through GM: 2021 full certification.

30. My project was previously certified under GM ENRB ver3 and I am applying for re-certification under GM: 2021 In Operation, do I need to have permanent M&V for air side in order to submit TSE?

For projects certified under legacy criteria, air side efficiency can be done through third party energy audit if permanent M&V for air side was not a requirement during the previous certification.

31. For a project that was previously certified Green Mark Platinum and is currently applying for re-certification, can the project be certified with the badges under GM: 2021 In Operation, if the operation performance meets the relevant criteria?

Yes, it is optional for previously certified projects to top up to get a badge or a few badges during re-certification under GM: 2021 In Operation, based on the building's performance.

32. For re-certification purposes, is there any circumstance in which the project must go through a full certification under GM: 2021 instead of GM: 2021 In Operation?

If there are any major changes in energy use, such as change of chillers or major retrofit, the project must be assessed under GM: 2021 full certification instead of GM: 2021 In Operation.

33. For existing building coming in for re-certification, should the EUI be based on the previous one year or the average of the past 3 years?

For existing building under GM: 2021 full certification under pathway 1 – EUI, the EUI should be based on the immediate prior year, provided the occupancy rate is at least 60%. Please exclude Circuit Breaker (CB) or COVID period with occupancy rate less than 60%. Past three years EUI data should also be provided for consistency check.

34. For GM: 2021 full certification, it states any shortfall in EE performance can be made up with the use of onsite renewables, subject to the building typology multiplication factor. Would like to check whether this can be applied to GM 2021 In Operation?

No, onsite PV generation is not allowed to offset the EE performance shortfall under GM: 2021 In Operation.

This brings another question, however, if building was certified under GM: 2021 previously and they did offset the TSE. E.g., 0.68 kW/RT (SLE) and the design TSE is 0.72 kW/RT, the shortfall was offset by onsite RE (say X kWh). When this building comes for recert under GM: 2021 In Operation, then the 0.72 kW/RT should be acceptable with the verification of the actual amount of PV annual generation of X kWh.

## Section D: Other Sustainability Sections related

35. Under GM: 2021, only EE is a pre-requisite. Are there any mandatory sustainability requirements for projects that are not pursuing the Green Mark or SLE certification?

Yes, the only pre-requisite in GM: 2021 is EE. However, all projects must comply with other regulation requirements from BCA and other Government agencies, but these are not GM: 2021 requirement. There is a summary of regulatory requirements in the Annex of GM: 2021 main document. ([hyperlink](#)). Note that requirements change as agencies update their regulations, thus project teams are expected to stay abreast of development control, building plan and other statutory requirements.

36. Under Green Mark SLE RB, should the RETV be calculated with the latest ETTV coefficients?

For both RETV and ETTV, the coefficients used will be based on the prevailing Code on Envelope Thermal Performance for Buildings, as shown below. Please note the coefficients used for envelope heat transfer for RETV and ETTV are different.

SLE RBs are required to achieve RETV of 20 w/sqm or below

$$RTTV = 12.5(1 - SKR)U_f + 4.8(SK R)U_s + 485(SK R)(CF)(SC)$$

$$ETTV = 12(1 - WWR)U_w + 3.4(WWR)U_f + 211(WWR)(CF)(SC)$$

37. For private condominiums, if the main entrance door is a fire rated door, is there any contravention to the fire code if a gate is provided for the entrance door?

For residential buildings, the provision of grilles or gates for the main entrance is allowed provided:

- The gate swing does not obstruct public escape

- Units situated along a common corridor must allow a minimum clearance of 1 m from the gate to the wall when gates are opened perpendicularly
- Gates must not obstruct or hit neighbouring apartments windows or doors

The main door should be fire rated and complete with a self-closing device.

This is true for HDB and private residential projects, as such, provided the unit design provides adequate space for the grilles/gates as above. The QP should consult SCDF as the fire code is a live document and subject to amendments.

### 38. Will the requirements on ventilation affect compliance with NEA's acoustics requirements?

Natural ventilation does not necessarily pose challenge to indoor noise level unless the development is sited in immediate proximity/facing noise sources. We encourage to design openings away from the noise sources and to consider acoustic parameters/treatments during the design stage to provide peaceful environment for the occupants without compromising on the minimum ventilation required for the dwelling unit.

### 39. I have an RB project certified based on RB2016 and received LOA in 2020, can I top up to get a Hw badge now?

The project must apply for GM: 2021 full certification or GM: 2021 In Operation in order to get any badge. Badges are only available for GM: 2021 family. Without GM: 2021 certification, there is no badge to be awarded alone. It is a top up for GM: 2021 certification.

### 40. In Cn2.2 Sustainable products and finishes, why cost (\$) is used as one of the measurement unit in GM2021? Is the installation fee and delivery fee to be included in the calculation for cost?

Based on industry's feedback, cost (\$) is the available data in cost plan/Bill of quantities (BoQ) in any projects. Cost usually plays as a key deciding factor in the selection of sustainable products & finishes for a project.

The cost is solely based on Bill of Quantities (BoQ) which typically encompasses the products, systems, installation and delivery costs.

41. In Cn2.2 Sustainable products and finishes, is prorating of GM point allowed?

No pro-rating of points is allowed as carbon badge is a badge for high-performance; GM points are only given when the criteria are met.

42. In Cn2.2 Sustainable products and finishes, when I am doing retrofitting work for my existing building and I only need to change three MEP systems and interior work, in this case, am I able to score for CN 2.2.1 and CN 2.2.2?

You can score full 3 points under Cn 2.2.2 if these three newly changed MEP systems are certified by approved local certification bodies. For interior work, you can score under CN3.2 fit out if they fulfil the requirements stated in the criteria.

43. Under RE1.1b, could you advise whether the 90% relevant water fittings including landscape water fittings?

No, landscape water fittings are not included.

44. If my client were to use paints to claim for CN3.2 Fit Out Products as it was used for exterior and interior façade painting, can the same paints be used to claim for HW1.2 Material Emissions for TVOC specs?

Paints (internal) which are SGBP 2 ticks or equivalent and fulfils  $\geq 80\%$  (by value or by area) of the fit-out materials used (construction and finishes) for common areas (i.e. non-tenanted spaces) or used (construction and finishes) for tenanted spaces/ dwelling units shall be conserved are eligible to be scored under CN.3.2.

Internal paints with SGBC 4 ticks are counted under HW1.2.

45. RE2.3 Resilience Strategy: Would client be able to use Portfolio document such as MAS environmental Risk Assessment to claim points here?

No, whilst the portfolio risk assessment helps, the strategy must be building specific, what are the risks to that building and what is the strategy for that building to reduce those risks. GM is not about corporate or portfolio level strategy or commitment, we dive into the project, so how do the corporate strategies get implemented on that particular asset.

46. For CN2.2 Sustainable Products & Finishes, I would like to clarify the 2 options for scoring under sustainable products and finishes – coverage by cost and area, for products – thermal break and warm edge solutions. Curtain wall typically comprises of several components such as glazing, framing, sealants, spacers etc. As such, I would like to know if we are able to consider thermally broken framing members & insulating glass with warm edge solutions (using SGBP 2 ticks and above) as a base category under architectural product?

Yes, it is acceptable for the applications on top of the curtain wall as long as the products are 2 ticks SGBP products. To recap, the key is still the total BoQ, the base shall include all items that used.

## Section E: Life Cycle Cost Analysis for Green Mark projects

### 47. What is the objective of conducting the Life Cycle Cost Analysis (LCCA) for BCA Green Mark projects?

The objective of LCCA is to determine the holistic cost of greening and identify the cost benefits of a BCA Green Mark Building over its lifecycle. LCCA helps projects to understand how the net positive savings achieved during the building operation over its life span outweigh the upfront investment cost.

### 48. What are the components considered in this LCCA?

The LCCA provides a holistic approach of GM cost over the building's lifecycle and takes into consideration the following:

- **Initial Capital Expenditure (Capex)** – this refers to the cost of investment
- **Operating Expenditure - Utilities (Opex)** – this refers to the utility consumption
- **Maintenance Cost** – this is projected using standard equipment life span commonly adopted in the industry, and the comprehensive maintenance rate.
- **Replacement Cost** during the building's lifecycle period – this shall include estimated cost of dismantling, removal from site, supply and installation of brand-new equipment at the end of their useful lifespan. The year of replacement varies according to the equipment and their economic life spans.
- **End-of-Life (Salvage) Value** – this refers to the estimated resale value of the green features (equipment/materials) at the end of its useful lifespan.
- **Escalation Rate** of 1.5% p.a. is applied to account for the anticipated annual change in percentage for price levels of the goods/materials and services.
- **Net Present Value (NPV) method** is used to determine the current value of all future cash flows generated by the project over the 30-years period. To account future cash flows for time value of money, the Study adopts a Discount rate of 5%.

### 49. How to calculate the Net Present Value Savings per GFA in the analysis?

The NPV savings calculated as follows:

$$\text{NPV Savings} = \text{NPV of Baseline Building (lifecycle cost of a non-Green Mark building)} - \text{NPV of GM Building (lifecycle cost of a Green Mark rating building)}$$

As the NPV savings (i.e. in terms of total absolute costs) vary from project to project depending on the size of the projects, the NPV savings are then divided by their respective project's Gross Floor Area (GFA) so that the data are normalised for comparison across the various Green Mark rated projects.

$$\text{NPV Savings per GFA} = \frac{\text{NPV Savings}}{\text{GFA}}$$



50. For air conditioning saving and payback calculation, should I just consider the equipment saving with same capacity?

No, it should take the reduction of the size of the air-conditioning equipment into account when you calculate the saving and the payback which may have been achieved due to a more efficient design thus reduction in cooling load when compared to the baseline design.