Development of BEAM Plus Data Centres and Green Data Centre Practice Guide 2nd Stakeholder Engagement and Industry Consultation Background Reading Materials

1 Introduction

The Building Environmental Assessment Method ('BEAM') is a green building labelling scheme and the BEAM Plus assessment is a leading initiative in Hong Kong to offer independent assessments of building sustainability performance.

BEAM Plus is tailor-made for the high-rise, high-density built environment of sub-tropical climate in Hong Kong, which embraces a range of good practices in planning, design, construction, management, operation and maintenance of building, and is aligned with local regulations, standards and codes of practice. Being one of the most widely used voluntary green building labelling schemes, BEAM Plus, covering the series of BEAM Plus Neighbourhood (ND), BEAM Plus New Buildings (NB), BEAM Plus Existing Buildings (EB) and BEAM Plus Interiors (BI), caters to the diverse needs of stakeholders and provides a fair and objective assessment of a building's overall performance throughout its life cycle.

Data Centre (DC) is a key IT infrastructure for both the Government and the private sector in positioning Hong Kong as a data centre hub. While global actions are calling for energy saving and environmental protection, it is imminent that during the planning, design, construction and subsequent management and operation of DCs to take into consideration the appropriate green practices and measures to help energy saving and environmental protection. BEAM Plus DCs aims to reduce the environmental impacts of both new and existing DCs whilst improving quality and user satisfaction, by adoption of the best practices.

2 Objectives of the Project

The objectives of the Project are: -

i. to add a building type for DCs (including new and existing DCs) under BEAM Plus with the relevant assessment methodology and procedures manuals ("BEAM Plus DCs"); and

ii. to develop a Green Data Centre Practice Guide (hereafter referred to as 'Practice Guide'); and

iii. to solicit input, and hence support, from stakeholders on the BEAM Plus DCs and Practice Guide development and promotion.

3 Proposed Assessment Framework

Unlike BEAM Plus New Buildings and Existing Buildings assessments, BEAM Plus New DCs and Existing DCs rating tools are specifically designed for local DCs to recognise DCs owners / building management companies as forerunner of green building management practices, achievable performance and continuous improvement. To encourage more DCs to join the scheme, the design philosophy of the rating tools is tailored to the local ecosystems and the rating mechanism is kept simple and performance oriented to cover most green measures commonly found in data centres. Other than the data centre itself, the building that houses the data centre is also assessed to encourage data centre stakeholders to take a holistic view in green implementation.

3.1 Performance Categories

The proposed performance categories for BEAM Plus DCs are summarised at the following table: -

Table 1 *Summary of the Proposed Performance Categories of BEAM Plus DCs*

BEAM Plus New DCs	BEAM Plus Existing DCs
Integrated Design and Management, IDCM	Management, MAN
Sustainable Site, SS	Site Aspects, SA
Materials and Waste, MW	Materials and Waste Aspects, MWA
Energy Use, EU	Energy Use, EU
Water Use, WU	Water Use, WU
Health and Wellbeing, HWB	Indoor Environmental Quality, IEQ
Innovations and Addition, IA	Innovations and Addition, IA

3.2 Extent of Applications, Pre-requisites and Bonus Credits

i. Extent of Applications
Extent of Applications specify the applicability for each individual credit to particular types of DC installation, i.e. Whole building DCs or DCs installed in part of the building.

ii. Pre-requisites
For some of the environmental aspects, applicant should demonstrate that performance is over and above statutory requirement as prerequisite requirement, i.e. EU P1 - Minimum Energy Performance, to demonstrate performance improvement against the latest edition of Building Energy Code (BEC). Consequently, when an assessed issue becomes subject to legislation, it will no longer count for the award of credits, and will be amended or deleted in any future revisions of BEAM.

iii. Bonus credits
Bonus credits of corresponding categories would not count towards the total number of credits available but would count towards the total number of credits achieved.

3.3 Grading System

i. Four (4) grades, i.e. Platinum, Gold, Silver and Bronze, for BEAM Plus DCs are proposed which aligning with the BEAM Plus family.

ii. BEAM Plus New DCs and Existing DCs

The proposed final grading for all projects rated with BEAM Plus New DCs is conditional upon the following:
a) Meeting all specified pre-requisites;
b) Category weighting will be applied;
c) Meeting specified overall percentage (%) of credits; and

d) Obtaining the minimum percentage (%) of credits for individual categories, i.e. EU (for BEAM Plus New DCs) and MAN & EU (for BEAM Plus Existing DCs).

Table 2 *Grading System for BEAM Plus New DCs Certificate*

Grade	Overall	EU
Platinum	75%	70%
Gold	65%	60%
Silver	55%	50%
Bronze	40%	40%

Table 3 *Grading System for BEAM Plus Existing DCs Certificate*

Grade	Overall	MAN	EU
Platinum	75%	70%	70%
Gold	65%	60%	60%
Silver	55%	50%	50%
Bronze	40%	40%	40%

iii. BEAM Plus Existing DCs (Individual Category)

BEAM Plus Existing DCs (Individual Category) is an individual aspect assessment approach, and certificate will be issued for each individual assessed aspect. For BEAM Plus Existing DCs (Individual Category Certificate), it is proposed the final grading is conditional upon the following:

a) Meeting specified prerequisites of the assessed category; and
b) Meeting specified overall percentage (%) of credits achieved in the assessed category.

Table 4 *Grading System for BEAM Plus Existing DCs (Individual Category Certificate)*

Grade	Overall percentage (%) of credits achieved in the assessed category
Platinum	70%
Gold	60%
Silver	50%
Bronze	40%

iv. The proposed grading system will be finalised subject to the results from feedback from stakeholder engagement exercise.

3.4 Assessment Processes

i. BEAM Plus New DCs

Applicant shall make the submission with templates and the supporting documentations for all categories to BSL for review and approval. Aligning

with BEAM Plus New Building V2.0, both Provisional and Final assessment shall be conducted in BEAM Plus New DCs Scheme.

ii. BEAM Plus Existing DCs

a) BEAM Plus Existing DCs (Comprehensive Assessment)

Applicant shall make the submission with templates and the supporting documentations for all categories to BSL for review and approval.

b) BEAM Plus Existing DCs (Stepwise Assessment)

Applicant shall make the submission with templates and the supporting documentations for MAN and EU first. Applicant with BEAM Plus Existing DCs (Intermediate) Certificate can upgrade to BEAM Plus Existing DCs Certificate by making the submission with templates and the supporting documentations of remaining categories to BSL for review and approval within 2 years after the date of issuance of intermediate certificate. Aligning with BEAM Plus Existing Building V2.0 Comprehensive scheme B, only Final assessment will be conducted.

iii. BEAM Plus Existing DCs (Individual Category)
Applicant shall make the submission with templates and the supporting documentations for any individual category, i.e. EU, to BSL for review and approval. Aligning with BEAM Plus Existing Building V2.0 selective scheme, only Final assessment will be conducted.

3.5 Certificate Validity

i. BEAM Plus New and Existing DCs Certificate:

a) Provisional Assessment Certificate: Upon the issuance of FA result or 6 years, whichever is earlier; and
b) Final Assessment Certificate: 5 years

ii. BEAM Plus Existing DCs (Intermediate) Certificate:

a) Valid for 2 years for the first intermediate certificate; and
b) Upon the completion of the assessment for all aspects, the validity of the final assessment certificate is 5 years.

iii. BEAM Plus Existing DCs (Individual Category) Certificate:

a) Final Assessment Certificate: 5 years

4 Proposed BEAM Plus DCs Rating Tools

The proposed credits for BEAM Plus New and Existing DCs are developed on the basis of BEAM Plus New Buildings (NB) V2.0 and BEAM Plus Existing (EB) V2.0, respectively, and specific attention is made according to the following areas:

i. Proposed revised credits;
ii. Proposed removed credits;
iii. Proposed new credits; and
iv. Proposed revised allocation of credits.

Apart from referencing latest BEAM Plus Rating tools, gap analysis exercise was also performed on current Green Building (DCs) Assessment Standards, and other relevant guidelines, standards, award schemes and campaigns, BEAM Circular Letters and FAQs. Together with the findings collected from the 1st stakeholder engagement exercise and sensitivity analysis at earlier stages, draft version of the BEAM Plus DCs covering the credit allocation and credit requirement are formulated. Tables 4 and 5 summarised the total number of credits and Figures 1 and 2 depicts the credit allocation for BEAM Plus New and Existing DCs, respectively.

The credit summary of the proposed BEAM Plus DCs Rating Tools is included in **Appendix A** and **B** for reference.

Table 5 *Summary of total number of credits for proposed BEAM Plus New DCs*

Category	BEAM Plus New Building Version 2.0	Proposed BEAM Plus New DCs (Draft Version)
IDCM	25 + 12B	23 + 10B
SS	20 + 15B	16 + 8B
MW	14 + 32B	10 + 12B
EU	31 + 8B	41 + 4B
WU	12 + 3B	11 + 2B
HWB	21 + 9B	18 + 5B
IA	10B	10B
Total	**123 + 89B**	**119 + 51B**

Table 6 *Summary of total number of credits for proposed BEAM Plus Existing DCs*

Category	BEAM Plus New Building Version 2.0	Proposed BEAM Plus Existing DCs (Draft Version)
MAN	23 + 6B	19 + 4B
SA	22 + 3B	11 + 3B
MWA	17 + 7B	7 + 3B
EU	39 + 9B	34 + 9B
WU	23 + 8B	12 + 5B
IEQ	26 + 5B	11 + 2B
IA	12B (Max. 10B)	6B (Max. 6B)
Total	**150 + Max. 48B**	**94 + Max. 32B**

Note: B = Bonus credit

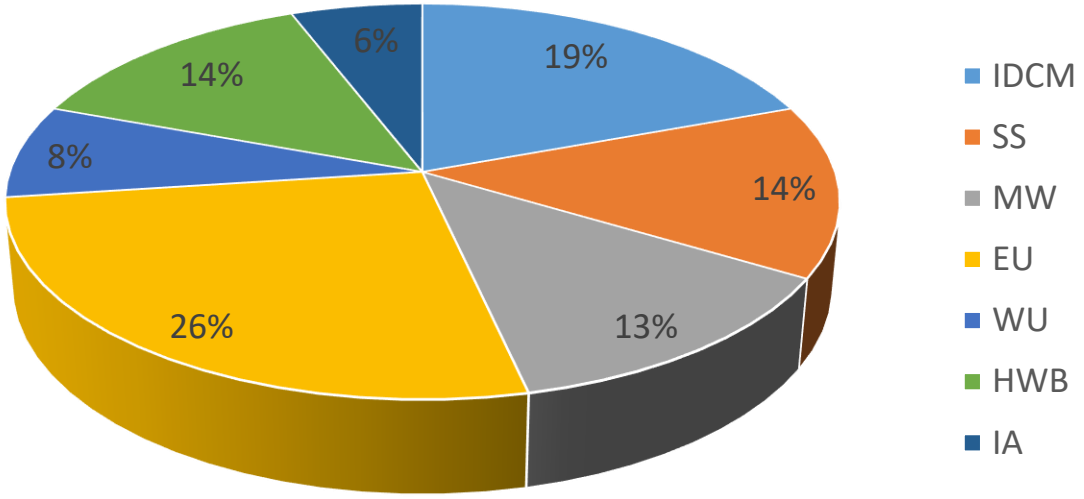

Figure 1 *Credit Allocation (Normal and Bonus credits) for BEAM Plus New DCs*

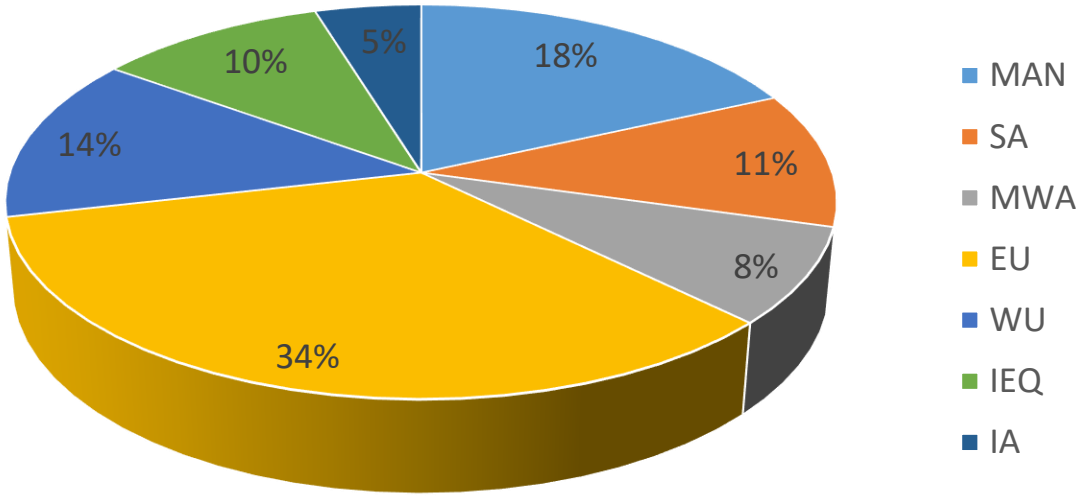

Figure 2 *Credit Allocation (Normal and Bonus credits) for BEAM Plus Existing DCs*

5 Proposed Green Data Centre Practice Guide

The Green Data Centre Practice Guide is developed together with the BEAM Plus DCs Rating Tools / Manuals. Cross references between the two documents are made wherever appropriate to facilitate readers to look for relevant details between the documents. The Practice Guide is designed with intention to assist DCs designers and operators in identifying and implementing measures to improve the energy efficiency of their DCs.

The Proposed Practice Guides are applicable to all types of DCs, including both existing and newly purpose-built DCs and the proposed best practices and measures introduced below cover the whole life cycle of the DCs including:

i. General Practices;
ii. Design & Construction;
iii. Procurement;
iv. Operation & Maintenance; and
v. Disposal.

Among the whole life cycle of the DCs, five (5) common areas of concern in data centre facilities are covered including:

i. HVAC system and Air Flow Management;
ii. Power System;
iii. Metric and Benchmarking;
iv. IT System; and
v. Lighting System.

It is understood that not all DCs users will be able to implement every proposed practices and measures due to the business needs and background of the data centres, and in particular the roles and responsibilities of the users concerned, e.g. a colocation provider (user of the Practice Guide) is difficult to influence his clients the type of green IT equipment to be used. To address this issue, users of the Practice Guide are classified into different types depending on their extents in controlling the development and operation of the data centres. The applicable user type will be tagged to each practice in the guide.

Table 7 *Types of Operators*

User Type	Description
Developer	User with the responsibility to design and/or build the data centre including the building service systems to accommodate the IT equipment and deliver the data centre services.
Data Centre Owner	Engage Developer to build the data centre.
Operator	Operates the entire data centre.
Colocation Provider	Operates the data centre for the primary purpose of selling/renting space/rack together with the data centre supporting facilities such as power, cooling, etc. to customers who will install and manage their own IT hardware and services.

Colocation Customer	Owns and manages IT equipment located in a data centre within which they purchase/rent the space/rack together with the data centre supporting facilities such as power, cooling, etc.
Managed Service Provider	A data centre owner or a third-party team who operates and manages the data centre space, power, cooling, IT equipment and some level of software for the purpose of delivering IT services to customers.
Managed Service Customer	Uses the IT services provided by the Manged Service Provider

The Proposed Green Data Centre Practice Guide is included in **Appendix C** for reference.

Appendix A

Credit Summary of Proposed BEAM Plus New DCs

Disclaimers

The draft serves to offer readers a preliminary view. The draft credit summary is subject to change in due course.

This draft is restricted for limited circulation to reader with needs only.

In no circumstances shall a reader rely on this draft for any purpose other than taking this as a consultative document.

BEAM Society Limited and its commissioned consultants for this development accept no liability for any loss or damage howsoever arising from any use or misuse of or reliance on any information in this draft.

Table 4 Proposed Credit Summaries in Integrative Design and Management (IDCM)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INTEGRATIVE DESIGN AND MANAGEMENT (IDCM)			**23 + 10B**	
IDCM P1	**SUSTAINABILITY CHAMPIONS - PROJECT**	Prerequisite achieved for demonstrating that an accredited BEAM Professional (BEAM Pro) with a valid credential for BEAM Plus DCs is engaged as the project BEAM Pro of the consultant team. The project BEAM Pro shall: 1) Act as the point of contact with Hong Kong Green Building Council and BEAM Society Limited for administrative matters relating to BEAM Plus certification; 2) Participate as one of the key project team members in the design and construction stages, with assistance of Construction BEAM Pro defined under IDCM 5 if any, to oversee the submission materials are in the compliance with relevant requirements of the BEAM Plus Manual. The project BEAM Pro may also assume other roles in the consultant team of the project; 3) Create a BEAM Plus New Data Centres Certification Checklist including project goals, performance and BEAM Plus target; 4) Provide guidance to the project and construction teams regarding BEAM Plus principles, structure, timing, certification process and requirements of credits; and 5) Advise the Client on relevant professionals or parties on respective tasks to address relevant BEAM Plus New Data Centres certification requirements.	All Data Centres.	Required	1. The accredited BEAM Professional (BEAM Pro) should be with a valid credential for BEAM Plus Data Centres.
IDCM P2	**TIMBER USED FOR TEMPORARY WORKS**	Prerequisite achieved for demonstrating that no virgin forest products are used for temporary works.	All Data Centres.	Required	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INTEGRATIVE DESIGN AND MANAGEMENT (IDCM)			**23 + 10B**	
IDCM 1	**SUSTAINABILITY CHAMPIONS - DESIGN**	1 credit for at least two (2) members from at least two (2) applicable core design disciplines shall be accredited BEAM Professionals (BEAM Pro DCs); for the Project achieves a Bronze rating or above. 1 additional BONUS credit for at least one (1) additional member, from an applicable core design discipline different from the disciplines counted in the above credit, shall be an accredited BEAM Professional (BEAM Pro DCs); alternatively, 1 additional BONUS credit for at least two (2) additional members, of an applicable core design discipline different from the disciplines counted in the above credit, shall be accredited BEAM Affiliates.	All Data Centres.	1 + 1B	1. Credit requirement is changed. The accredited BEAM Professionals should have a valid credentials for BEAM Plus DC.
IDCM 2	**INTEGRATIVE DESIGN PROCESS**	(a) Early consideration of integrative building design process 1 credit for early consideration of the integrative design process regarding whole-systems thinking to explore the interrelationships among green building design strategies and systems in the conceptual design stage. 1 additional credit for organizing at least one multi-disciplinary design charrette to formulate passive and active design strategies in the conceptual/schematic design stages. (b) Early design consideration of buildability / constructability 1 credit for early design consideration of buildability to ease construction and save on-site materials/labour before completion of the design development stage. (c) Design consideration of operation and maintenance	All Data Centres	4	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INTEGRATIVE DESIGN AND MANAGEMENT (IDCM)			**23 + 10B**	
		1 credit for design consideration of the long-term operation and maintenance needs of the building and its engineering services.			
IDCM 3	**LIFE CYCLE COSTING**	1 credit for conducting life cycle costing for active systems.	All Active Systems Servicing the Assessed Data Centre.	1	1. Extent of Application is changed.
IDCM 4	**COMMISSIONING**	4 credits for demonstrating the appointment of commissioning authority (CxA) before tender stage and provide a commissioning plan and commissioning reports.	All Data Centres.	4	Remain unchanged.
IDCM 5	**SUSTAINABILITY CHAMPIONS - CONSTRUCTION**	1 credit for at least two (2) accredited BEAM Professionals with valid credentials for BEAM Plus DCs are engaged by the main/lead contractor of the project; for the project achieves a Bronze rating or above. alternatively, 1 credit for at least one (1) accredited BEAM Professional and two (2) accredited BEAM Affiliates, with valid credentials for BEAM Plus DCs are engaged by the main/lead contractor of the project; for the project achieves a Bronze rating or above.	All Data Centres.	1	1. Credit requirement is changed. The accredited BEAM Professionals should have a valid credentials for BEAM Plus DCs.
IDCM 6	**ENVIRONMENTAL MANAGEMENT PLAN AND MONITORING**	(a) Environmental Management Plan 1 credit for demonstrating that an Environmental Management Plan has been properly prepared; (b) Minimisation of air pollution 1 credit for providing adequate monitoring and mitigation measures to minimize air pion during construction (demolition and foundation are included, if any). (c) Minimisation of noise pollution	All Data Centres (expect Data Centres only involve Interior Fit out work).	4+1B	1. The credit is suggested to be combined with IDCM P2 – Environmental Management Plan. 2. Suggested to change IDCM 6d - Minimisation of light pollution to BONUS.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INTEGRATIVE DESIGN AND MANAGEMENT (IDCM)			**23 + 10B**	
		1 credit for providing adequate monitoring and mitigation measures to minimize noise pollution during construction (demolition and foundation are included, if any). (d) Minimisation of water pollution 1 credit for providing adequate monitoring and mitigation measures to minimize water pollution during construction (demolition and foundation are included, if any). (e) Minimisation of light pollution 1 BONUS credit for providing adequate monitoring and mitigation measures to minimize water pollution during construction (demolition and foundation are included, if any).			
IDCM 7	**CONSTRUCTION AND DEMOLITION WASTE RECYCLING**	(a) Demolition waste recycling 1 credit for demonstrating compliance with the Waste Management Plan and the application of proactive waste management provisions during demolition; and recycling at least 15% of demolition waste. 1 additional BONUS credit for demonstrating recycling of at least 30% of demolition waste. For exemplary performance, additional BONUS credit for demonstrating recycling of at least 60% of demolition waste. (b) Construction waste recycling 1 credit for demonstrating compliance with the Waste Management Plan and the application of proactive waste management provisions during construction (foundation to be included, if any); and recycling of at least 15% of construction waste (foundation waste to be included, if any).	All Data Centres requiring demolition which are under the Client's control for IDCM 7a. All Data Centres for IDCM 7b.	2 + 4B	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INTEGRATIVE DESIGN AND MANAGEMENT (IDCM)			**23 + 10B**	
		1 additional BONUS credit for demonstrating recycling of at least 30% of construction waste (foundation waste to be included, if any). For exemplary performance, additional BONUS credit for demonstrating recycling of at least 60% of demolition waste (foundation waste to be included, if any).			
IDCM 8	**CONSTRUCTION IAQ MANAGEMENT**	1 credit for implementing a Construction IAQ Management Plan, undertaking a building 'flush out' or 'bake out', and replacement of all filters prior to occupancy.	All Data Centres areas for implementing a Construction IAQ Management Plan. All areas with central air-conditioning and ventilation systems for undertaking a building "flush out" or "bake out" and replacement of all filters prior to occupancy.	1	Remain unchanged.
IDCM 9	**BUILDING MANAGEMENT MANUALS**	1 credit for providing a fully documented Operations and Maintenance Manual and Energy Management Manual.	All Data Centres.	1	Remain unchanged.
IDCM 10	**OPERATOR TRAINING PLUS CHEMICAL STORAGE AND MIXING ROOM**	1 credit for providing training for operations and maintenance staff to the minimum specified; and demonstrating that adequate maintenance facilities are provided for operations and maintenance work.	All Data Centres for providing training for operations and maintenance staff. Data Centres that are under the control by landlord should further demonstrating that adequate maintenance facilities are provided for operations and maintenance work.	1	1. Extent of Application is changed.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INTEGRATIVE DESIGN AND MANAGEMENT (IDCM)			**23 + 10B**	
IDCM 11	**DIGITAL FACILITY MANAGEMENT INTERFACE**	1 credit for providing a digital interface in addition to the project design metering provision for future facility management team to review the building operation performance	All Data Centres.	1	Remain unchanged.
IDCM 12	**DOCUMENT MANAGEMENT SYSTEM**	(a) Project Team Document Management 1 credit for demonstrating the use of document management systems within the design team. (b) Facility Management Team Document Management 1 BONUS for demonstrating the use of document management systems to hand over to the facility management team.	All Data Centres.	1 + 1B	1. 2nd item of this credit changed to BONUS as suggested by SC member.
IDCM 13	**BIM INTEGRATION**	(a) Coordinated use of BIM within design teams 1 credit for the coordinated use of BIM amongst the design team. (b) Coordinated use of BIM within design and construction teams 1 BONUS for coordinated use of BIM amongst the design team and the contractors. (c) BIM for time 1 BONUS for using the BIM model for scheduling, cost and quantity, schedules preparation and tracking the project budget. (d) BIM for facility management use 1 BONUS for updating the BIM model to as-built condition.	All Data Centres.	1 + 3B	Remain unchanged.

Table 5 Proposed Credit Summaries in Sustainable Site (SS)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	SUSTAINABLE SITE (SS)			**16 + 8B**	
SS 1	**GREEN BUILDING ATTRIBUTES**	One credit (1) is awarded for each of the listed characteristics, up to a maximum of 5 credits. Suggested: i. Minimum planting provisions in terms of viability and site coverage of greenery of at least 20% of the site; ii. Achieving Accessibility Index of 15 or more for all buildings of a development; iii. Achieving 60% or more of the applicable pedestrian-oriented transport planning measures; iv. Providing cycling facilities within the Site and integrating with the public cycling network if a public cycling network exists or has been planned nearby; v. Providing EV charging facilities for at least half of the carparking spaces (including visitor car parks) vi. At least 10 different basic services are located within 500m walking distance from building main entrance; vii. At least 2 different recreational facilities are located within 500m walking distance from building main entrance; viii. Preparing a site design appraisal report demonstrating a proactive approach to achieve a people-oriented and place-making approach for sustainable site planning, and at least 60% of applicable sustainable urbanism measures are achieved. ix. Demonstrating that a proper heritage impact assessment mechanism and its recommendations have been implemented. x. Demonstrating that designs for which the access to daylight of neighbouring sensitive buildings is maintained to the prescribed levels.	All Data Centres.	5	1. One credit (1) is awarded for each of the listed characteristics, up to a maximum of 5 credits. 10 different green building attributes relating to building performance is proposed: i. Minimum planting provisions in terms of viability and site coverage of greenery of at least 20% of the site; ii. Achieving Accessibility Index of 15 or more for all buildings of a development; iii. Achieving 60% or more of the applicable pedestrian-oriented transport planning measures; iv. Providing cycling facilities within the Site and integrating with the public cycling network if a public cycling network exists or has been planned nearby; v. Providing EV charging facilities for at least half of the carparking spaces (including visitor car parks) vi. At least 10 different basic services are located within 500m walking distance from building main entrance; vii. At least 2 different recreational facilities are located within 500m walking distance from building main entrance;

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	SUSTAINABLE SITE (SS)			**16 + 8B**	
					viii. Preparing a site design appraisal report demonstrating a proactive approach to achieve a people-oriented and place-making approach for sustainable site planning, and at least 60% of applicable sustainable urbanism measures are achieved. ix. Demonstrating that a proper heritage impact assessment mechanism and its recommendations have been implemented. x. Demonstrating that designs for which the access to daylight of neighbouring sensitive buildings is maintained to the prescribed levels.
SS 2	**NOISE CONTROL FOR BUILDING EQUIPMENT**	1 credit for demonstrating that the level of the intruding noise at the facade of potential noise sensitive receivers is in compliance with the criteria recommended in the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites.	All Building Equipment servicing the Assessed Data Centre.	1	1. Extent of application is changed.
SS 3	**LIGHT POLLUTION CONTROL**	1 credit for demonstrating that obtrusive light from exterior lighting meets the specified performance for the environmental zone in which the building development is located.	All exterior lighting specified as part of the Assessed Data Centres.	1	1. Extent of application is changed. 2. Suggested to remove credit SS 6b – Control of external light reflection from building. Rationale: It is expected that the majority of applicable DC in Hong Kong is partially installed in building, i.e. whole floor or part of floor. Control of external surface material outside a particular floor level is thus not feasible and practical.
SS 4	**ECOLOGICAL PRESERVATION/ ENHANCEMENT**	(a) Preservation and/ or enhancement of ecological impact	Whole Building Data Centres Development.	2B	New BONUS credit.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	SUSTAINABLE SITE (SS)			**16 + 8B**	
		1 BONUS credit for demonstrating that ecological values of the Site are preserved where existing habitat types of medium or high ecological values are identified on the Site, or; demonstrating that ecological values of the Site are enhanced where existing habitat types of medium ecological values are identified on the Site, or; demonstrating that ecological values of all identified existing habitat types on the Site are low and habitat types of medium ecological values are introduced on the Site, or; demonstrating that ecological values of all identified existing habitat types on the Site are low and habitat types of high ecological values are introduced on the Site. (b) Tree retention 1 BONUS credit for demonstrating that existing trees are retained in situ such that the combined girth of the retained trees, with individual girth of at least 150mm, is at least 20% of the total girth of all existing trees on site.			
SS 5	**URBAN HEAT ISLAND MITIGATION**	For Site area <1000m2 (a) Urban Design Guidelines Chapter 11 1 credit for implementing at least 2 site level strategies under Section 11 of Hong Kong Planning Standards and Guidelines Chapter 11 Urban Design Guidelines. For Site area ≥ 1000m2 (a) Sustainable Building Design Measures 1 credit for providing shade on at least 5% of the site area and at least 50% of non-roof impervious surfaces on the site (parking, walkways, plazas) using light coloured high-albedo materials (albedo of at least 0.4).	Whole Building Data Centre Development.	5+4B	1. Extent of application is changed. Suggested only applicable to whole building DCs.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	SUSTAINABLE SITE (SS)			**16 + 8B**	
		1 credit for demonstrating compliance with prescribed requirements of the SBD Guidelines as promulgated in the PNAP APP-152. 1 additional BONUS credit for demonstrating compliance with prescribed requirements and relevant prescriptive requirements of the SBD Guidelines as promulgated in the PNAP APP-152 with enhanced performances. (b) Tree Coverage 1 BONUS credit for demonstrating that at least 10% of the total Site Area is provided with tree coverage. For exemplary performance, ADDITIONAL BONUS credit where 20% or more of the site is provided with tree coverage. (c) Air Ventilation Assessment (AVA) For conducting an AVA by wind tunnel or Computer Fluid Dynamics (CFD) according to the prevailing AVA methodology introduced by the Government demonstrating that better or equivalent ventilation performances than a baseline case: 1 Credit for demonstrating annual wind condition. 1 Credit for demonstrating summer wind condition. (d) Intra Urban Heat Island Study 1 BONUS credit for conducting an Intra Urban Heat Island Study demonstrating that a maximum Intra-Urban Heat Index (difference between T_{urban} and T_{met}) in summer is less than 0.8 °C.			
SS 6	**IMMEDIATE NEIGHBOURHOOD WIND ENVIRONMENT**	1 credit for demonstrating that no pedestrian areas will be subject to excessive wind velocities caused by amplification due to the site layout design and/or building design.	Whole Building Data Centre Development.	1	1. Extent of application is changed. Suggested only applicable to whole building DCs.
SS 7	**OUTDOOR THERMAL COMFORT**	(a) Shaded or covered routes 1 credit is awarded where at least one shaded or covered route, connects the site with nearby amenities/site main entrance/transport hub.	Whole Building Data Centre Development with site area of 1,000 m^2 or more.	2	1. Extent of application is changed. Suggested only applicable to whole building DCs development with site area of 1,000 m^2 or more.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	SUSTAINABLE SITE (SS)			**16 + 8B**	
		(b) Passive open spaces with thermal comfort 1 credit is awarded where 50% or more of the passive open spaces and pedestrian zones achieve thermal comfort. This is demonstrated on a typical summer day at 3:00 pm in Hong Kong.			
SS 8	**STORMWATER MANAGEMENT**	1 credit for demonstrating that adequate stormwater management design measures have been provided to manage the total volume of runoff corresponding to a design rainfall of at least 30mm/day for the site in its post-developed conditions. 1 additional BONUS credit for demonstrating that adequate stormwater management measures have been provided to manage the total volume of runoff corresponding to a design rainfall of at least 40mm/day for the site in its post-developed conditions.	Whole Building Data Centre Development with site area of 1,000 m^2 or more.	1+1B	1. Extent of application is changed. Suggested only applicable to whole building DCs development with site area of 1,000 m^2 or more.
SS 9	**DESIGN FOR CLIMATE CHANGE ADAPTATION**	1 BONUS for studying the projected variation in temperature and rainfall and water level rise/storm surge of adjacent water bodies due to climate change and its impact on the development, and prepare mitigation proposal to improve the climate resilience of the building.	Whole Building Data Centre Development.	1B	1. Extent of application is changed. Suggested only applicable to whole building DC development.

Table 6 Proposed Credit Summaries in Materials and Waste (MW)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	MATERIALS AND WASTE (MW)			**10 + 12B**	
MW P1	**MINIMUM WASTE HANDLING FACILITIES**	For Whole Buildings Data Centre Development: Prerequisite achieved for meeting minimum provisions of waste recycle facilities for the collection, sorting, storage, recycling (recovered material) and disposal (waste). For Data Centre Development installed in host building: Prerequisite achieved for providing storage facilities at prominent location for the collection, sorting, storage, recycling (recovered material) and disposal (waste).	All Data Centres	Required	1. Credit requirement is revised.
MW 1	**BUILDING RE-USE**	Compliance method 1 1 BONUS credit for the reuse of 20% or more (by mass or volume) of existing structures (sub-structure and superstructure). 2 BONUS credits for the reuse of 40% or more (by mass or volume) of existing structures (sub-structure and superstructure). For exemplary performance, additional BONUS credit for the reuse of 90% or more (by mass or volume) of existing structures (sub-structure and superstructure). alternatively, Compliance method 2 1 BONUS credit for the reuse of 25% or more (by surface area) of superstructure elements (including at least floor, roof decking) & enclosure materials (including at least skin, framing). 2 BONUS credits for the reuse of 50% or more (by surface area) of superstructure elements (including at least floor, roof decking) & enclosure materials (including at least skin, framing). For exemplary performance, additional BONUS credit for the reuse of 90% or more (by surface area) of superstructure elements (including at least floor, roof decking) & enclosure materials (including at least skin, framing).	All Data Centres	3B	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	MATERIALS AND WASTE (MW)			**10 + 12B**	
MW 2	**SUSTAINABLE FOREST PRODUCTS**	1 credit for demonstrating at least 50% for Data Centres development of all timber and composite timber products used in the project are from sustainable sources/ recycled timber. For exemplary performance, additional BONUS for demonstrating 90% or more of all timber and composite timber products used in the project are from sustainable sources/ recycled timber.	All Data Centres	1+1B	1. Removed the requirement for residential development and adjusted the requirement for Data Centres.
MW 3	**RECYCLED MATERIALS**	(a) Outside surface works and structures 1 credit where at least 10% of all materials used for site exterior surface works, structures and features with recycled content. alternatively, (b) Building façade and structural components 1 credit where at least 10% of all materials used for facade and structural components are materials with recycled content; OR the use of Pulverised Fuel Ash (PFA) as a partial cement replacement in concrete that the PFA content is not less than 25%; OR the use of Ground Granulated Blast Furnace Slag (GGBS) as a partial cement replacement in concrete that the GGBS content is not less than 40%. alternatively, (c) Interior non-structural components 1 credit where at least 10% of all materials used for interior non-structural components are materials with recycled content. 1 additional BONUS credit for compliance with requirements listed in sub-item (a), (b) and (c). For exemplary performance, additional BONUS credit where 50% or more of all materials used for sub-item (a) or (b) or (c) are materials with recycled content.	All Data Centres	1+2B	Remain unchanged.
MW 4	**OZONE DEPLETING SUBSTANCES**	(a) Refrigerants	All Building Equipment & insulation servicing the Assessed Data Centre.	2	1. Extent of application is changed.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	MATERIALS AND WASTE (MW)			**10 + 12B**	
		1 credit for the use of refrigerants with a value less than or equal to the threshold of the combined contribution to ozone depletion and global warming potentials using the specified equation. (b) Ozone depleting materials 1 credit for the use of products in the building fabric and services that avoid using ozone depleting substances in their manufacture, composition or use.			
MW 5	**REGIONAL MATERIALS**	1 credit for the use of regional materials meeting prescribed requirement, which contribute at least 10% of all building materials used in the project. 1 additional BONUS credits for the use of regional materials meeting prescribed requirement, which contribute at least 20% of all building materials used in the project. For exemplary performance, additional BONUS credit for the use of regional materials meeting prescribed requirement, which contribute 50% or above of all building materials used in the project.	All Data Centres	1+2B	Remain unchanged.
MW 6	**USE OF GREEN PRODUCTS**	(a) Certified green products 1 credit for having at least 5% certified green products in one (1) of the listed categories (outside surface works, building façade and structures, interior non-structural components, and building services components). 2 credit for having at least 5% certified green products in two (2) of the listed categories (outside surface works, building façade and structures, interior non-structural components, and building services components). 1 additional BONUS credit for having at least 5% of certified green products under Construction Industry Council (CIC) Carbon Labelling Scheme/ HKGBC Green Product Accreditation and Standards (HK G-PASS) in one (1) of the listed categories (outside surface works, building façade and structures, interior non-structural components, and building services components). For exemplary performance, additional BONUS credit for having at least 25% of certified green products under CIC Carbon Labelling Scheme/ HK G-PASS in one (1) of the listed categories (outside	All Data Centres	2+4B	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	MATERIALS AND WASTE (MW)			**10 + 12B**	
		surface works, building façade and structures, interior non-structural components, and building services components). (b) Rapidly renewable materials 1 BONUS credit for demonstrating 5% of all building materials/ products of interior non-structural components in the project is rapidly renewable materials. For exemplary performance, additional BONUS credit for demonstrating 25% of all building materials/ products of interior non-structural components in the project is rapidly renewable materials			
MW 7	**LIFE CYCLE ASSESSMENT**	1 credit for demonstrating the embodied energy in the major elements of the building structure of the building has been studied and optimised through a Life Cycle Assessment (LCA).	Whole Building Data Centre Development	1	1. Extent of application is changed.
MW 8	**EFFICIENT USE OF MATERIALS**	2 credits for demonstrating the adoption of at least two best practices relating to the efficient use of materials as mentioned in the Green Data Centre Practice Guide.	All Data Centres	2	1. New Credits.

Table 7 Proposed Credit Summaries in Energy Use (EU)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	ENERGY USE (EU)			**41 + 4B**	
EU P1	**MINIMUM ENERGY PERFORMANCE**	Demonstrate (a) performance improvement against the Building Energy Code (BEC) 2018 edition and (b) Maximum Power Usage Effectiveness (PUE) (a) Performance improvement against the latest edition of BEC <u>For BEC Governing Building Types:</u> Refer to the BEC 2018 edition to demonstrate that performance improvement is achieved in both of the following building services systems provided by the project owner: Improve 2% of code specified minimum coefficient of performance (COP) for Air-conditioning equipment unit; and Reduce 3% of code specified maximum allowable lighting power density for lighting installation. <u>For Non-BEC Governing Building Types:</u> All Non-BEC governing building types and spaces are required to demonstrate their compliance with the BEC 2018 edition on: Air-conditioning equipment efficiency (full load COP); and Lighting power density for listed space type in the code <u>For building consist of BEC and non-BEC Governing Building or Space type:</u> All requirements of compliance listed in this credit are required. (b) Maximum PUE The data centre must have a design PUE at full load condition of no more than 2.0	All Data Centres	Required	1. Credit requirement is revised by introducing the criteria of Maximum Power Usage Effectiveness (PUE)
EU 1	**LOW CARBON PASSIVE DESIGN**	Passive designs that can reduce building HVAC load, facilitate natural ventilation and maximise daylight will be rewarded in this credit under either prescriptive path or performance path. Option 1: Prescriptive Path	All Data Centres	3	1. Kept as normal credits as per SC member's comment.

Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
ENERGY USE (EU)			**41 + 4B**	
	3 Credits for incorporating any 4 of the passive design strategies listed below: 1) Optimum Spatial Planning 2) External overhang (fix/ movable) 3) Vegetated building envelope 4) Cross Ventilation Provision 5) Daylighting Provision Option 2: Performance Path 3 Credits for incorporating any 3 of the passive design strategies listed below: HVAC Load Reduction 1) Built Form and orientation 1 credit for reducing building envelope load from a hypothetic case with at least 22.5° difference in orientation with justification by simulation. 2) Optimum spatial planning 1 credit for demonstrating consideration of optimum spatial planning to enhance energy conservation with justification by simulation. 3) External shading devices 1 credit for the provision of fixed or movable external shading devices, in the form of vertical or horizontal sun shading feature with justification by simulation. 4) Vegetated building envelope 1 credit for the provision of vegetated building envelope with justification by calculation. Natural Ventilation 5) Space layout for natural ventilation 1 credit for demonstrating that space layout is designed to facilitate the utilisation of natural ventilation with justification by simulation. Daylight 6) Space layout for daylight penetration			

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	ENERGY USE (EU)			**41 + 4B**	
		1 credit for demonstrating that the space is well-lit by daylight and reduce occupants' dependency on artificial lighting with justification by simulation method.			
EU 2	**REDUCTION OF CO2 EMISSIONS**	Predicted Power Usage Effectiveness (PUE) (1-15 Credits + 2 Bonus) Demonstrate a percentage of reduction on PUE of the proposed data centre performance compared with the baseline performance (i.e. PUE = 2.0). 1 to 15 credits for design PUE reduction from 5% to 30%, compared with baseline PUE value of 2.0. (Equivalent to design PUE value of 1.95 to 1.4.) Additional of 2 BONUS credits for design PUE value lower than 1.4.	All Data Centres.	15+2B	1. Suggested to remove Option 2 – Prescriptive Path since Data Centre is unlikely to adopt Passive Building Design. 2. The number of credits achieved is determined by comparing the proposed DC's PUE with the baseline performance (i.e. PUE = 2.0).
EU 3	**COOLING SYSTEM EFFICIENCY**	Encourage the use of high efficiency cooling system to minimise the energy consumption. Refer to the BEC 2018 edition to demonstrate that performance improvement is achieved in both of the following building services systems provided by the project owner: 1 credit for demonstrating the improvement of 4% of code specified minimum coefficient of performance (COP) for Air-conditioning equipment unit. 2 credits for demonstrating the improvement of 6% of code specified minimum coefficient of performance (COP) for Air-conditioning equipment unit.	All Data Centres.	2	New credit.
EU 4	**AIR MANAGEMENT SYSTEM**	Encourage the use of high efficiency Computer Room Air-Conditioning Unit (CRACs) to minimise the energy consumption 2 credits for demonstrating the Fan power limitation in CRAC of 0.9 $kW/m^3/s$	All Data Centres.	2	New credit.
EU 5	**METERING AND MONITORING**	(a) Fundamental metering and monitoring 1 credit for providing energy sub-metering system for equipment and systems in spaces.	All Data Centres.	2+2B	1. Credit requirement is revised.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	ENERGY USE (EU)			**41 + 4B**	
		(b) Metering and monitoring for Data Centres Halls 1 credit for energy metering to provide total facility power and energy usage and total IT equipment power and energy for determining instantaneous and average PUE data. (c) Metering for tenanted area 1 BONUS for providing metering that allows monitoring of tenants' electricity consumption. (d) Metering for individual racks 1 BONUS for providing metering that allows monitoring of individual racks electricity consumption.			
EU 6	**RENEWABLE AND ALTERNATIVE ENERGY SYSTEMS**	(a) Solar energy feasibility study 1 credit for evaluating the building roof's potential in harnessing solar energy. (b) Renewable energy application Path 1: 1 to 3 credits for using on-/ off-site renewable energy systems to offset annual building energy consumption for Non-data centre subsystem, i.e. Building Service systems servicing non-data hall areas, plant rooms, personal office areas and personal office loads, etc. to offset 0.4% to 0.8% energy consumption. Path 2: 1 to 3 credits where the minimum percentage of 40% to 80% of the building footprint is being covered/ used by PV panels respectively and/or other renewable power facility generation with equivalent renewable power output.	All Data Centres.	4	1. Credit requirement is revised, i.e. the maximum attainable credit for EU 6b is reduced. 2. Credit requirement is revised.
EU 7	**SUSTAINABLE IT EQUIPMENT**	(a) Policy for Procurement of IT Equipment 1 credit for having policies that require the procurement and use of the most efficient IT equipment which meet the demand, while providing the required level of redundancy (b) Use of Sustainable IT Equipment	All Data Centres. Data Centres with IT equipments provided by owner	3	New credit

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	ENERGY USE (EU)			**41 + 4B**	
		2 credits for demonstrating that IT Equipment, including servers, storage devices and network systems, that are Energy STAR rated where available.			
EU 8	**BEST PRACTICE ON ENERGY USE**	(a) Best Practice on Design of HVAC system 2 credits for demonstrating the adoption of at least two best practices relating to the design of HVAC system as mentioned in the Green Data Centre Practice Guide. (b) Best Practice on Design of Air Flow Management 2 credits for demonstrating the adoption of at least two best practices relating to the design of air flow management as mentioned in the Green Data Centre Practice Guide. (c) Best Practice on Design of Power system 2 credits for demonstrating the adoption of at least two best practices relating to the design of Power system as mentioned in the Green Data Centre Practice Guide. (d) Best Practice on Design of IT system 2 credits for demonstrating the adoption of at least two best practices relating to the design of IT system as mentioned in the Green Data Centre Practice Guide. (e) Best Practice on Design of Resilience 2 credits for demonstrating the adoption of at least two best practices relating to the planning and design of data centre to maintain balance between efficiency and resilience of data centre as mentioned in the Green Data Centre Practice Guide.	All Data Centres	10	New credit

Table 8 Proposed Credit Summaries in Water Use (WU)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	WATER USE (WU)			**11 + 2B**	
WU 1	**ANNUAL WATER USE**	Potable water saving 1 to 3 credits for demonstrating that the use of water efficient flow devices leads to an estimated annual saving from 20% to 30%.	All Data Centres.	3	Remain unchanged.
WU 2	**WATER EFFICIENT IRRIGATION**	1 to 2 credits for reducing potable water consumption for irrigation from 25% to 50%. 1 additional BONUS for reducing potable water consumption for irrigation by 100% in comparison with the baseline.	Data Centres with permanent greenery and permanent irrigation system within the control of Applicants	2+1B	Remain unchanged.
WU 3	**WATER LEAKAGE DETECTION**	1 credit for installing water leakage detection systems in all municipal potable water tank rooms and Computer Server Room.	All Data Centres	1	Remain unchanged
WU 4	**COOLING TOWER WATER**	1 credit for achieving 7 or more cycles of concentration with acceptable water quality.	All Cooling tower using potable water as makeup water servicing the Assessed Data Centre.	1	1. Extent of application is changed.
WU 5	**EFFLUENT DISCHARGE TO FOUL SEWERS**	1 credit for demonstrating a reduction in annual sewage volumes by 20% or more.	All Data Centres	1	Remain unchanged
WU 6	**WATER HARVESTING AND RECYCLING**	(a) Harvested rainwater 1 BONUS credit for harvesting of rainwater that achieve a reduction of 5% or more in the consumption of potable water. (b) Recycled grey water 1 BONUS credit for recycled grey water that achieve a reduction of 5% or more in the consumption of potable water. (c) Exemplary water recycling 1 BONUS credit where harvested rainwater, recycled grey water or a combination of both leads to a reduction of 10% or more in the consumption of potable water.	All Data Centres	2+1B	1. Suggested to change the first two credits to BONUS credits.
WU 7	**WATER METERING**	1 credit for demonstrating provision of permanent water meters for major water subsystems, e.g. cooling towers.	All Data Centres	1	New credit

Table 9 Proposed Credit Summaries in Health and Wellbeing (HWB)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	HEALTH AND WELLBEING (HWB)			**18 + 4B**	
HWB P1	**MINIMUM VENTILATION PERFORMANCE**	(a) Measure outdoor air pollutants on-site prior to building design to understand the site conditions. (b) Demonstrate the project is in compliance with the minimum ventilation quantity with respective to its designed ventilation mode.	All Data Centres	Required	Remain unchanged
HWB 1	**INCLUSIVE DESIGN**	(a) Universal Accessibility 1 credit for providing at least five (5) applicable enhanced provisions as stipulated in the "Recommended Design Requirements" of BFA 2008. (b) Weather protection and family friendly features 1 BONUS credit for providing prescribed weather protection and at least two (2) family friendly facilities features.	All Data Centres	1+1B	1. Suggested to reduce the applicable enhanced provision from ten (10) to (5) as stipulated in the "Recommended Design Requirements" of BFA 2008.
HWB2	**ENHANCED VENTILATION**	(a) Fresh air provision 1) Fresh air provision in normally occupied spaces 1 credit for demonstrating that all normally occupied spaces in the building are provided with increased ventilation. 2) Fresh air provision in not normally occupied spaces 1 credit for demonstrating that all not normally occupied spaces in the building are provided with adequate ventilation. 3) On-site measurements 1 BONUS credit for conducting on-site measurements to verify the ventilation performance for all normally occupied spaces. (b) Exhaust air 1 credit for the provision of an effective ventilation system for spaces where significant indoor pollution sources are generated	All Data Centres	3+1B	Remain unchanged

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	HEALTH AND WELLBEING (HWB)			**18 + 4B**	
HWB 3	**ACOUSTICS AND NOISE**	(a) Room Acoustics 1) 1 credit for demonstrating that mid-frequency reverberation time in applicable spaces of landlord's controlled area meets the prescribed criteria of different types of premises. 2) 1 credit for demonstrating that the mid-frequency reverberation time in applicable rooms of tenanted area meets the prescribed criteria of different types ofpremises. (b) Noise Isolation 1) 1 credit for demonstrating airborne noise isolation between, spaces fulfils the prescribed criteria. (c) Background Noise 1 credit for demonstrating background noise levels from both external sources and building services equipment are within the prescribed criteria.	All Data Centres	4	1. Removed the BONUS for demonstrating impact noise isolation between floors fulfils the prescribed criteria under Part (b) 2 which is only applicable to Residential buildings.
HWB 4	**INDOOR VIBRATION**	1 credit for demonstrating vibration levels not exceeding the prescribed criteria.	All Data Centres	1	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	HEALTH AND WELLBEING (HWB)			**18 + 4B**	
HWB 5	**INDOOR AIR QUALITY**	(a) Indoor air quality in occupied spaces 1.1 Path 1 1 credit for demonstrating compliance with the prescribed limits for Carbon monoxide (CO), Nitrogen dioxide (NO2), Ozone (O3) in the sampled occupied spaces. 1 credit for demonstrating compliance with the prescribed limits for Carbon dioxide (CO2), Total volatile organic compounds (VOCs), Formaldehyde (HCHO) and Radon (Rn) in the sampled occupied spaces. 1 credit for demonstrating compliance with the prescribed limits for Airborne bacteria in the sampled occupied spaces. 1.2 Path 2 3 credits for submitting a valid IAQ Certification Scheme (Good Class) certificate issued by the Environmental Protection Department (EPD) covering the whole building. 1.3 Path 3 3 credits and 1 BONUS credit for submitting a valid IAQ Certification Scheme (Excellent Class) certificate issued by the Environmental Protection Department (EPD) covering the whole building. (b) Air quality in car park 1 credit for demonstrating compliance with the pollutant concentration limits specified in ProPECC PN 2/96. (c) Mould prevention and control 1 BONUS for adopting mould prevention and control strategies.	All Data Centres for parts (a) and (c) All Data Centres with enclosed and/or semi-enclosed car park of areas more than 10% Construction Floor Area for part (b).	4+2B	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	HEALTH AND WELLBEING (HWB)			**18 + 4B**	
HWB 6	**THERMAL COMFORT**	(a) Thermal Comfort Analysis 1 credit for conducting thermal comfort analysis and demonstrate that normally occupied spaces can fulfil the thermal comfort requirements. (b) Thermal Comfort Measurement 1 BONUS credit for conducting on-site measurements to verify the thermal comfort performance. (c) Thermal Comfort Analysis in Data Centre Hall 1 credit for sustaining the air temperature at the design value within ± 1.5 °C when the air-conditioning unit is operating at steady state.	All Data Centres	2+1B	1. Credit requirement is revised.
HWB 7	**ARTIFICIAL LIGHTING**	(a) Artificial lighting in normally occupied spaces 1 credit for achieving the prescribed lighting performance in normally occupied spaces. (b) Artificial lighting in not normally occupied spaces and unoccupied spaces 1 credit for achieving the prescribed lighting performance in not normally occupied spaces and unoccupied spaces.	All Data Centres	2	Remain unchanged.
HWB 8	**BIOLOGICAL CONTAMINATION**	1 credit for complying with the recommendations given in the Code of Practice for Prevention of Legionnaires' Disease 2016 Edition in respect of Water Supply Systems, HVAC Systems and other Water Features.	The systems are controlled by Landlord	1	Remain unchanged.

Table 10 Proposed Credit Summaries in Innovations and Additions (IA)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	INNOVATIONS AND ADDITIONS (IA)			**10B**	**Max 10 Bonus credits in this Section.**
IA 1	**INNOVATIONS AND ADDITIONS**	Present evidence of the application of new practices, technologies and techniques and the associated benefits in addressing sustainability objectives for green data centres.	All Data Centres		Remain unchanged.

Appendix B

Credit Summary of Proposed BEAM Plus Existing DCs

Disclaimers

The draft serves to offer readers a preliminary view. The draft credit summary is subject to change in due course.

This draft is restricted for limited circulation to reader with needs only.

In no circumstances shall a reader rely on this draft for any purpose other than taking this as a consultative document.

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Table 5 Proposed Credit Summaries in Management (MAN)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Management (MAN)			**19 + 4B**	
MAN P1	Green Purchasing Plan	Demonstrate that green purchasing plan and procedures (including both materials and services) either follow their internal company guideline or other international standards, shall be in place.	All Data Centres.	Required	Remain unchanged.
MAN 1	EHS and Energy Management System	1 credit where the DC management operates an Environmental Management System (EMS) certified to ISO 14001.	All Data Centres.	1	Remain unchanged.
		1 credit where the DC management operates an Occupational Health and Safety System (OHSAS).		1	
		1 credit where the DC management operates an Energy Management System (EnMS).		1	
		1 Bonus credit where DC management operates an OHSAS certified to BS OHSAS 18001.		1B	
		1 Bonus credit where the DC management operates an EnMS certified to ISO 50001.		1B	
MAN 2	Environmental, Social and Governance (ESG) Disclosure	1 credit where the DC Owner/ DC Management Company discloses sustainability policy and targets to the public.	All Data Centres.	1	The Bonus credit is maintained after discussion on 9 July 2019 DCSC meeting.
		1 Bonus credit where the Building Owner/ Building Management Company follows Global Reporting Initiative™ (GRI) Sustainability Reporting Guidelines and discloses the G4 sustainability report to the public.		1B	

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Management (MAN)			**19 + 4B**	
MAN 3	BEAM Professional	1 credit for at least 2 members from the DC Management Company are certified BEAM Professional with DC credential. ***Alternatively*** 1 credit for at least 1 key member from the DC Management Company is a certified BEAM Professional with DC credential and at least 1 member is a certified BEAM Affiliate. 1 additional credit for the building-in-charge being a certified BEAM Professional with DC credential and with at least 1 professional corporate membership qualification (e.g. HKIH, HKIA, HKIE, HKIS (BS/PFM), RICS (BS/FM), IFMA, HKIFM, BSOMES, or equivalent).	All Data Centres.	1 1	Remain unchanged.
MAN 4	Staff Training and Resources	a) Staff and Technical Resources 1 credit for having adequate staff and technical resources to meet the O&M requirements of the building. b) Staff Training 1 credit for providing adequate and periodic training for the staff responsible for the O&M of the building.	All Data Centres.	1 1	Remain unchanged.
MAN 5	Building and Site Operation and Maintenance	a) Building Maintenance 1 credit for demonstrating the operation of a planned programme of regular inspection, cleaning and maintenance of the building's fabric and structure under the control of the Applicant. b) External Areas and Facilities 1 credit for demonstrating the operation of a planned programme of regular inspection, cleaning and maintenance of external areas and facilities.	Except Data Centres not under control of Applicants. All Data Centres with external areas and facilities	1 1	Included exclusion for DCs without external areas and facilities.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Management (MAN)			**19 + 4B**	
MAN 6	Building Services Operation and Maintenance	a) Central Heating Ventilation and Air-Conditioning (HVAC) Plant 2 credits for demonstrating the operation of a planned programme of regular inspection and maintenance of the central HVAC plant.	Except Building does not have a central HVAC plant, or the HVAC plant not controlled by the applicant	2	Included exclusion for systems not controlled by the applicant.
		b) Other Engineering Systems Maximum 4 credits for demonstrating the operation of a planned programme of regular inspection and maintenance of the following listed systems. i. Air-conditioning system except central HVAC plant; ii. Electrical system; iii. Lighting system; and iv. Plumbing and Drainage system.	Except system(s) that is(are) not controlled by the applicant All Data Centres.	4	
		c) Assessment of Operation & Maintenance Practice 1 credit for having undertaken an audit of the effectiveness of the O&M practices for all building services engineering systems.		1	
MAN 7	Electronic Operation and Maintenance Platform	1 Bonus credit for operating an electronic O&M platform by the DC Owner/ DC Management Company.	All Data Centres.	1B	Remain unchanged.
MAN 8	IAQ Management for Renovation	1 credit for providing a Construction Indoor Air Quality (IAQ) Management Plan.	All Data Centres.	1	Specified the requirement to include protection of IT equipment in Construction IAQ Management Plan.
		1 credit for providing records that the Construction IAQ Management Plan has been implemented by the DC Owner/ DC Management Company/ tenants during renovation.		1	

Table 6 Proposed Credit Summaries in Site Aspects (SA)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Site Aspects (SA)			**11 + 3B**	
SA 1	Green Building Attributes	Maximum 5 credits for the host building that has been certified under BEAM Plus / BEAM certification: i. 5 credits for Platinum grade; ii. 4 credits for Gold grade; and iii. 3 credits for any other grade. ***Alternatively*** Maximum 3 credits for an uncertified building that meets the listed performance characteristics. i. Parking capacity must not exceed the minimum requirement from Government; ii. Public transport shall be within 500m walking distance from building main entrance(s); iii. At least 10 different basic services shall be located within 500m walking distance from building main entrance(s); iv. At least 2 different recreational facilities shall be located within 500m walking distance from building main entrance(s); v. Provision of sitting facilities which are open to public during building operation period; vi. Using pervious materials for a minimum of 50% of hard landscaped areas; vii. Enhancement of the biodiversity within the site boundary when compared with the time of building completion; viii. Ensuring the vertical daylight factor is above 12% for neighbouring sensitive buildings; ix. Provision of adequate active and passive security measures to suit the operation need; and x. Provision of standard charger(s) for electric vehicles in the car park for 50% of the total parking capacity of the site.	All Data Centres.	5	Specified the host building that has been certified under BEAM Plus / BEAM certification. (BEAM Plus New Buildings (Version 1.1 or 1.2)/ BEAM Plus Existing Buildings (Version 2.0)/ BEAM 4/04 or 5/04) (As per comment on 9 July 2019 DCSC meeting.) Reduced the maximum number of credits from 7 to 5, in view of the less importance of the attributes for DCs

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Site Aspects (SA)			**11 + 3B**	
SA 2	Noise Pollution	a) Provision of Acoustic Treatment 1 credit for providing adequate acoustic treatment to the following building services equipment: chillers, cooling towers, ventilation fans with Sound Power Level (SWL) higher than 80 dB(A). b) Demonstration of Compliance with HKPSG Criteria 1 credit for demonstrating that the level of the intruding noise at the façade of the potential Noise Sensitive Receivers (NSRs) is in compliance with the criteria recommended in the Hong Kong Planning Standards and Guidelines (HKPSG).	Except the listed building services equipment not controlled by the applicant	2	Included exclusion for BS equipment not controlled by the applicant.
SA 3	Light Pollution	2 credits if there are no external lightings installed for the building. ***Alternatively*** 2 credits for switching off the DC Owner/ DC Management Company's/ tenants' (if any) external lightings from 23:00 to 07:00.	All Data Centres.	2	Remain unchanged. (For the alternative path, the second alternative criteria is combined with the first alternative criteria as per comment from DCSC.)
SA 4	Heat Island Reduction	1 Bonus credit for demonstrating the implementation of any combination of the following strategies for a minimum of 10% of the external non-roof area (i.e. ground floor and podium with less than 15m in height): i. Greenery; ii. Water feature; iii. Green wall or vertical greening; iv. Shading device; and/or v. Paving materials with solar reflectance (SR) of 0.33. 2 Bonus credit(s) for more than 20% of the external non-roof area covered with the aforesaid features. 1 Bonus credit for providing green roof and/or organic farm for at least 20% of the available main roof area.	Whole Building Data Centre Development..	3B	Changed the credit to Bonus credit. Combined the credit requirements with SA 5 Green roof (As per comment on 9 July 2019 DCSC meeting.)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Site Aspects (SA)			**11 + 3B**	
SA 5	Amenities for Operation and Maintenance	Maximum 1 credit for providing 3 of the following listed amenities that improve the operation and maintenance of the building and its engineering services: i. Aerial working platform; ii. Building Management System (BMS); iii. Cat ladder; iv. Davit arm system; v. External pipe duct; vi. Fall arrest system; vii. Gondola system; viii. Guard room; ix. Maintenance platform; x. Maintenance workshop; xi. Movable platform, and xii. Others to be proposed by the Applicant.	All Data Centres.	1	Changed from 3 credits to 1 credit for 3 provisions, in view of the less importance of the amenities for DCs
SA 6	Barrier Free Access	Maximum 1 credit for providing 3 enhanced barrier free access provisions as per the latest version of the Design Manual of Barrier Free Access.	All Data Centres.	1	Changed from 3 credits to 1 credit for 3 provisions, in view of the less importance of the BFA for DCs

Table 7 Proposed Credit Summaries in Materials and Waste Aspects (MWA)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Materials and Waste Aspects (MWA)			**7 + 3B**	
MWA P1	Waste Recycling Facilities	For Whole Data Centre: Providing spaces for collection, sorting, storage and disposal of waste and recovered materials. For Data Centre installed in host building: Providing storage facilities at prominent location for the collection of paper, plastic and metal waste.	All Data Centres.	Required	Changed the requirement of providing spaces to providing storage facilities for DCs installed in host building.
MWA P2	Materials Purchasing Plan	Demonstrating that the plan of material procurement (sub-section under MAN P1 Green Purchasing Plan) and its procedures for both on-going consumables and durable goods either following the internal company guideline or other international standards are in place.	All Data Centres.	Required	Remain unchanged
MWA 1	Materials Purchasing Practices	1 credit for demonstrating at least 50% of purchased on-going consumables are environmentally friendly products for the past 12 months as minimum. 1 credit for demonstrating at least 50% of purchased durable goods are environmentally friendly products for the past 12 months as minimum. 1 credit for demonstrating at least 70% of purchased both on-going consumables and durable goods are environmentally friendly products for the past 12 months. 1 Bonus credit for demonstrating at least 70% of purchased both on-going consumables and durable goods are environmentally friendly products for the past 24 months.	All Data Centres.	1 1 1 1B	Reduced the number of credits from 2 credits to 1 credit for at least 70% of purchased both on-going consumables and durable goods are environmentally friendly products for the past 12 months. Changed the Bonus credit requirement from 36 months to 24 months. The changes are made in view of the less importance for DCs.
MWA 2	Use of Certified Green Products	Maximum 2 Bonus credits for purchasing green products certified by Construction Industry Council (CIC) Carbon Labelling Scheme/	All Data Centres.	2B	Remain unchanged

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Materials and Waste Aspects (MWA)			**7 + 3B**	
		HKGBC Green Product Accreditation and Standards (HK G-PASS) or other internationally recognised schemes.			
MWA 3	Ozone Depleting Substances	a) Newly and Existing Installed Equipment using Refrigerants 1 credit for all the equipment (both newly purchased and existing) using the refrigerants with Global Warming Potential (GWP) less than 1,900. Alternatively, for equipment with refrigerant GWP value > 1,900, credit can be achieved when the Applicant can demonstrate a phased programme of refrigerant replacement. 1 credit for using refrigerants with a combined value less than or equal to the threshold for the combined contributions to ozone depletion and global warming potentials for all new and existing HVAC&R equipment that under the control of Applicant. b) Fire Suppression and Other Materials 1 credit for using the fire suppression and other materials that avoids the use of ozone depleting substances in their manufacture, composition or use.	Except the installed equipment using refrigerants, and fire suppression and other materials not controlled by the applicant	1 1 1	Included exclusion for equipment and materials not controlled by the applicant.
MWA 4	Waste Management Plan	1 credit for developing a waste management plan.	All Data Centres.	1	Specify the requirement on IT related waste such as, electronic equipment.

Table 8 Proposed Credit Summaries in Energy Use (EU)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Energy Use (EU)			**34 + 9B**	
EU P1	Minimum Energy Performance	Conducting energy audit in accordance with the Buildings Energy Efficiency Ordinance (Cap 610) requirements for existing buildings.	All Data Centres.	Required	Removed the exclusion.
EU 1	Energy Management	a) Energy Management Policy 1 credit for an energy management policy endorsed by top management.	All Data Centres.	1	Remain unchanged.
		b) Energy Management Plan 1 credit for energy management plan covering less than 3 years. 2 credits for energy management plan covering 3 years or more.	All Data Centres.	2	
		c) Appointment of Energy Warden 1 credit for appointing an Energy Warden in the DC Management Company.	All Data Centres.	1	
EU 2	Energy Analysis	a) Data Collection Facilities 1 credit for sub-metering systems for the following electrical loads where applicable: i. Water Side; ii. Air Side; iii. Lighting; and 1 credit for having Building Management System (BMS) to log operation data (e.g. pressure, temperature, flow rate, on/off status) for monitoring operation and function of the system including the following as a minimum: i. Air side; ii. Water side; iii. Cooling load; and iv. Lighting control.	Except Building to compulsorily comply with BEC 2012 or later version	3	For the 1st credit, removed the requirement on sub-metering for lift, escalator, plumbing & drainage systems, as these systems contribute less energy consumption in DCs, and not controlled by DCs installed in host building. Added the 3rd credit for energy metering to determine instantaneous and average PUE.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Energy Use (EU)			**34 + 9B**	
		1 credit for energy metering to provide total facility power and energy usage and total IT equipment power and energy for determining instantaneous and average PUE data. b) Data Collection Record 1 credit for providing energy consumption data record of at least 1 year for major electrical loads. 2 credits for providing energy consumption data record of more than 3 years for major electrical loads.	All Data Centres.	2	
		c) Data Analysis 1 credit for calculating the EUI of the following services in data analysis: i. Air-conditioning system; and ii. Lighting. 1 credit for calculating and recording the PUE for 1 year.	All Data Centres.	2	For the 1st credit, only include the requirement of calculating the EUI of AC system and lighting system. As the other systems contribute less energy consumption in DCs, and not controlled by DCs installed in host building. Added the 2nd credit for calculating and recording the PUE.
		d) Energy Audit Report 2 credits for filling up the entire Template 1 on Additional Information to Executive Summary of Energy Audit Report to EMSD.	All Data Centres.	2	Removed the first 3 credits.
		e) Carbon Audit Report 1 credit for conducting carbon audit in accordance with the requirements as stipulated in the guideline issued by the Authority.	All Data Centre.	1	Remain unchanged.
EU 3	Commissioning	a) Action Plan 1 credit for action plan covering less than 3 years. 2 credits for action plan covering 3 years or more.	All Data Centres.	2	Remain unchanged.
		b) Commissioning 1 credit for providing original/ retro-commissioning (RetroCx) for electrical services systems.	Except Electrical system / HVAC system not controlled by the	Max. 3	Removed the credits and requirement on original/ retro-commissioning for lift, escalator, plumbing & drainage. As

Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
Energy Use (EU)			**34 + 9B**	
		applicant		these systems contribute less energy consumption in DCs, and not controlled by DCs installed in host building.
	For buildings with chiller system: 1 credit for providing original/ retro-commissioning (RetroCx) for water side equipment of central air-conditioning system. 1 credit for providing original/ retro-commissioning (RetroCx) for air side equipment of central air-conditioning system. For buildings without chiller system: 1 credit for providing original/ retro-commissioning (RetroCx) for air-conditioning system.			
	c) On-going Commissioning 1 credit for providing an ongoing commissioning plan detailing the works and person-in-charge for electrical services if on-going commissioning have been conducted for electrical system and/or for Heating, Ventilating, and Air-Conditioning (HVAC) system if on-going commissioning have been conducted for HVAC system. 1 credit for the execution of any 2 of the following measures for power quality management regularly. 2 credits for the execution of any 4 of the following measures for power quality management regularly. i. Power factor monitoring & correction; ii. 3-phase Load Balancing; iii. Maximum demand monitoring; iv. Demand Side Management (DSM); v. Total Harmonic Distortion (THD); and vi. Thermal Scan on electrical distribution system. For buildings with chiller system: 1 credit for ongoing commissioning for water side equipment of central air-conditioning system.	Except Electrical system / HVAC system not controlled by the applicant	Max. 5	

<table>
<tr><th></th><th>Section</th><th>Credit Requirement</th><th>Extent of Application</th><th>Credit</th><th>Proposed Changes</th></tr>
<tr><td></td><td>Energy Use (EU)</td><td></td><td></td><td>34 + 9B</td><td></td></tr>
<tr><td></td><td></td><td>1 credit for ongoing commissioning for air side equipment of central air-conditioning system.

For buildings without chiller system:
1 credit for ongoing commissioning for all HVAC equipment.</td><td></td><td></td><td></td></tr>
<tr><td>EU 4</td><td>Energy Benchmarking and Management</td><td>a) Benchmarking

Credit(s) can be achieved based on the PUE

<table><tr><th>No. of Credit(s)</th><th>1</th><th>2</th><th>4</th><th>6</th><th>8</th><th>1 Bonus</th><th>2 Bonus</th></tr><tr><td>PUE</td><td>2.0</td><td>1.9</td><td>1.8</td><td>1.7</td><td>1.6</td><td>1.5</td><td>1.4 and below</td></tr></table></td><td>All Data Centres.</td><td>8 + 2B</td><td>Use PUE as the benchmarking parameter.

The credit requirements regarding the scale for PUE is revised (As per comment on 9 July 2019 DCSC meeting.)</td></tr>
<tr><td></td><td></td><td>b) Air Management System
Encourage the use of high efficiency Computer Room Air-Conditioning Unit (CRACs) to minimise the energy consumption

1 credit for demonstrating the Fan power limitation in CRAC of 0.9 kW/m^3/s

Encourage the operation of the data centre at the high end of the recommended ambient temperature range
1 credit for demonstrating the ambient temperature for 24 °C and above</td><td>All Data Centres.</td><td>1

1</td><td>Combined the percentage saving requirement into one scale only for all Data Centres.

Part (b) Self-Improvement removed. (As per comment on 9 July 2019 DCSC meeting.)

Part (c) Peak Electricity Demand Reduction removed.

The ambient temperature shall be based on the mean rack inlet temperature, which shall be measured at 2 or more points along the cold aisles so that it can appropriately represent the supply air</td></tr>
</table>

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Energy Use (EU)			**34 + 9B**	
					temperature to the servers. (In accordance with ASHRAE 2011 Thermal Guidelines for Data Centres.)
EU 5	Enhancement	Maximum of 1 Bonus credit for each energy conservation approach is allowed but the award of credit is subject to the final approval of BEAM Society Limited (BSL)'s Technical Review Committee (TRC) based on the estimated energy reduction, justification and/or the innovation of the proposed approaches. Note: Energy saving measures that rely on building user's behaviour or manual control (such as, turning up the set temperature manually for air-conditioning; turning off lighting by hand in accordance to staff energy management manual) will not be considered energy saving features in this section. Some of the prescriptive approaches include: a) Research and Development in Energy 1 Bonus credit for conducting research and development or participating in competition with published paper related to energy aspects. b) Compliance with the BEC Maximum 4 Bonus credits for compliance with the latest version of the following listed BEC (This bonus credit does not apply to those buildings that are required to comply with the latest version of the BEC): Energy Efficiency Requirements for Air-Conditioning Installations; Energy Efficiency Requirements for Electrical Installations; Energy Efficiency Requirements for Lighting Installations; and/or Energy Efficiency Requirements for Lift and Escalator Installations. c) Renewable Energy System	All Data Centres.	7B	

Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
Energy Use (EU)			**34 + 9B**	
	1 Bonus credit where at least 0.2% of building energy consumption in communal area is obtained from renewable energy sources. d) Separate Energy Charges 1 Bonus credit where separate charges are made for energy use. e) Other Approaches Maximum 7 Bonus credits for adopting other energy conservation approach not prescribed above.			

Table 9 Proposed Credit Summaries in Water Use (WU)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Water Use (WU)			**12 + 5B**	
WU 1	Water Efficient Devices	Credit(s) can be achieved based on the estimated aggregate annual saving by the use of water efficient devices. No. of Credit(s): 1 | 2 | 3 | 4 Estimated aggregate annual fresh water saving: 10% | 15% | 20% | 25%	Except Water devices not under the control of applicant can be excluded from the assessment.	4	Revised the requirement for exclusion.
WU 2	Cooling Tower Water	1 credit for reducing fresh water consumption by installing water treatment system which can achieve 6 cycles of concentration with acceptable water quality. 1 Bonus credit for achieving 7 or more cycles of concentration with acceptable water quality.	Except Buildings without cooling tower or cooling tower with salt water.	1 + 1B	Remain unchanged.
WU 3	Water Recycling	1 Bonus credit for harvesting rainwater and/or recycling grey water that leads to a reduction of at least 2.5% in the consumption of fresh water. 1 additional Bonus credit if the reduction can achieve 5% or above	All Data Centres.	1B 1B	Remain unchanged.
WU 4	Water Saving Performance	Credit(s) can be achieved based on the reduction percentage by comparing water bill/ metering data. (Reference year can be any year in the past 5 years). No. of Credit(s): 1 | 2 | 3 | 4 | Bonus Annual fresh water use reduction: 3% | 6% | 9% | 12% | 15%	All Data Centres.	4 + 1B	Remain unchanged.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Water Use (WU)			**12 + 5B**	
WU 5	Water Metering	1 credit for permanently installation of water meters for at least 2 of the following water sub-systems: i. Irrigation; ii. Indoor plumbing fixtures and fittings; iii. Cooling towers; iv. Water features/ pools; and v. Other process water. 1 Bonus credit for installation of devices for detecting water leakage at the communal water supply system within the building lot, i.e. underground buried pipes, all server rooms and all fresh water pump rooms.	Except Less than 2 water sub-systems are under the control of applicant.	1 1B	Included exclusion for the credit.
WU 6	Water Efficient Flushing System	1 credit for installing dual flush for the water closets under the control of the Applicant. 1 credit for installing urinal with WELS Grade 2 or above.	Except Flushing system not under the control of applicant can be excluded from the assessment.	1 1	Revised the requirement for exclusion.

Table 10 Proposed Credit Summaries in Indoor Environmental Quality (IEQ)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Indoor Environmental Quality (IEQ)			**11 + 2B**	
IEQ P1	Minimum Ventilation Performance	Demonstrating that the project is in compliance with the minimum requirements of ANSI/ASHRAE 62.1-2013 in respect of Outdoor Air Quality and Minimum Ventilation Rate. ***Alternatively*** In case of the minimum ventilation rate of ANSI/ASHRAE 62.1-2013 is not complied due to the physical constraints of the existing ventilation system, demonstrate that the system is operated at maximum outdoor air delivery rate and provide not less than 5 l/s per person of combined outdoor air rate.	Except Naturally ventilated spaces.	Required	Remain unchanged.
IEQ 1	Ventilation in Common Areas	1 credit for providing adequate ventilation for 90% of mechanically ventilated common areas in a building. ***Alternatively*** For naturally ventilated premises, 1 credit for demonstrating 80% of the common areas in a building are provided by natural ventilation.	All Data Centres.	1	Remain unchanged.
IEQ 2	Localised Ventilation	1 credit for providing adequate ventilation for rooms/ areas with significant indoor pollution sources.	All Data Centres.	1	Remain unchanged.
IEQ 3	Thermal Comfort in Air-Conditioned Premises	1 credit for sustaining the air temperature at the design value within ±1.5°C when the air side system is operating at steady state under normal operation periods. 1 credit for demonstrating an appropriate temperature (i.e. <25.5°C), relative humidity (i.e. <70%) and air velocity (<0.3 m/s) in normally occupied area.	All Data Centres.	1 1	Specified the application area.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Indoor Environmental Quality (IEQ)			**11 + 2B**	
IEQ 4	Biological Contamination	1 credit for complying with the recommendations given in the Code of Practice - Prevention of Legionnaires Disease, in respect of air-conditioning and ventilation systems, and water systems.	Except the systems are not controlled by Landlord.	1	
IEQ 5	IAQ Monitoring	1 credit for the whole building is certified by the Good Class of 'Indoor Air Quality Certification Scheme for Office and Public Place'. 2 credits for the whole building is certified by the Excellent Class of 'Indoor Air Quality Certification Scheme for Office and Public Place'.	All Data Centres.	2	Removed the two Bonus credits, in view of the less importance of IAQ for DCs The credit requirements are combined and changed from 7 credits to 2 credits (As per comment on 9 July 2019 DCSC meeting.)
IEQ 6	Interior Lighting in Normally Occupied Areas	1 credit for achieving the prescribed lighting performance in each type of premises, regarding the illuminance and lighting quality as listed below: i. Maintained illuminance; ii. Achieving the limiting unified glare rating; and iii. Light sources with an appropriate colour rendering index. 1 Bonus credit for fulfilling the above requirement in tenant's areas with at least 50% coverage.	All Data Centres. All Data Centres.	1 1B	Removed the exclusions. The credit requirement on uniformity is removed and changed from 3 credits to 1 credit (As per comment on 9 July 2019 DCSC meeting.)
IEQ 7	Interior Lighting in Areas Not Normally Occupied	1 credit for achieving the prescribed lighting performance in each type of not normally occupied areas, regarding the illuminance and lighting quality as listed below: i. Maintained illuminance; ii. Achieving the limiting unified glare rating; and iii. Light sources with an appropriate colour rendering index.	All Data Centres.	1	The credit requirement on uniformity is removed and changed from 3 credits to 1 credit (As per comment on 9 July 2019 DCSC meeting.)
IEQ 8	Room Acoustics	1 credit for demonstrating that the mid-frequency reverberation time in applicable rooms meets the prescribed criteria of different types of premises. Based on the nature of the building, relaxation shall be allowed in	Except the Buildings/ premises in which speech intelligibility is not important, and rooms of special	1	Specify the requirement suitable for Data Centres only.

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Indoor Environmental Quality (IEQ)			**11 + 2B**	
		considering the acceptance of this credit. The Applicant shall submit both the design and calculation to justify such relaxation.	acoustical nature.		
IEQ 9	Noise Isolation	1 credit for demonstrating airborne noise isolation between rooms, spaces and premises fulfils the prescribed criteria. Based on the nature of the building, relaxation shall be allowed in considering the acceptance of this credit. The Applicant shall submit both the design and calculation to justify such relaxation.	Except Buildings/ premises which are inherently noisy and unaffected by noise.	1	Specify the requirement suitable for Data Centres only.
IEQ 10	Vibration	1 Bonus credit for vibration levels not exceeding the prescribed criteria.	All Data Centres.	1B	

Table 11 Proposed Credit Summaries in Innovations and Additions (IA)

	Section	Credit Requirement	Extent of Application	Credit	Proposed Changes
	Innovations and Additions (IA)			**6B**	
IA 1	Innovative Techniques	Maximum 5 Bonus credits for implementation of each innovative technique which provides environmental benefits in addition to those already covered in this Manual.	All Data Centres.	5B	Remain unchanged.
IA 2	Performance Enhancements	Maximum 5 Bonus credits for having exemplary performance of the requirement stipulated in this Manual.	All Data Centres.		
IA 3	Provision of Electrical Vehicle Charging Stations	1 Bonus credit for providing quick charger(s) for Electric Vehicles for 50% of the total parking capacity of the site.	Whole building Data Centre Development.	1B	Remain unchanged.

Appendix C

Proposed Green Data Centre Practice Guide

Disclaimers

The draft serves to offer readers a preliminary view. The draft practice guide is subject to change in due course.

This draft is restricted for limited circulation to reader with needs only.

In no circumstances shall a reader rely on this draft for any purpose other than taking this as a consultative document.

BEAM Society Limited and its commissioned consultants for this development accept no liability for any loss or damage howsoever arising from any use or misuse of or reliance on any information in this draft.

Proposed Framework for Green Data Centres Practice Guides

(Final version of 2nd Draft)

Management Summary

This is the 2nd draft version of the Green Data Centres (GDCs) Practice Guides (PG). The purpose of the document is to present to SC members for review and endorsement of the final proposal on the structure and content of the GDC PG. The proposed final version of the Green DCs Practice Guides were developed as a sequel to reviewing the fifteen international green data practice guides (**Appendix A**) in stage one, Review and Research. Earlier comments from SC member, results and findings from Stage 2 - 1st stakeholder engagement workshop and industry consultation were also incorporated as appropriate.

The full content of GDC PG is provided in **Appendix B, the focus of this document**. It will be noted that crossing referencing between each proposed practice and the corresponding items in BEAM Plus DCs is provided to facilitate interested users to find out more technical details of the practices. In addition, each of the best practices in this version is further enhanced with two guidance notes, namely the "Implementation Effort" and "Effectiveness", respectively, to offer supplementary guidance to the user on choosing the suitable best practices for their individual DC.

It should be noted the purpose of the GDC PG is not to go into the implementation details of each practice. Decision on implementation is left to the users, as it will depend on many factors, the discussion of which is outside the scope of this document.

1 Introduction

This practice guide is developed in conjunction with the BEAM Plus DCs Rating Tool and is intended to assist Data Centre designers and operators in identifying and implementing measures to improve the energy efficiency of their data centres.

1.1 Scope of Application

i. The practice guides in general are applicable to all types of data centres, including both existing and newly purpose-built data centres.

ii. However, the practices as discussed may not be applicable to all data centre users. For example, a colocation provider (as discussed below) to a large extent is unable to control the type of IT equipment to be procured and/or installed in the data centre.

iii. The best practices and measures introduced below cover the whole life cycle of the data centre including: Design & Construction, Procurement, Management, Operation & Maintenance and Disposal.

1.2 Applicability of Expected Practices

Adoption of each practice should take into account the extent that the user can exercise control on the data centre. Based on the extent of control, different user types are defined below (Table 1). Users should determine the applicability of each practice to them before implementation.

Table 1 Types of Operators

User Type	Description
Developer	User with the responsibility to design and/or build the data centre including the building service systems to accommodate the IT equipment and deliver the data centre services.
Data Centre Owner	Engage Developer to build the data centre.
Operator	Operates the entire data centre.
Colocation Provider	Operates the data centre for the primary purpose of selling/renting space/rack together with the data centre supporting facilities such as power, cooling, etc. to customers who will install and manage their own IT hardware and services.
Colocation Customer	Owns and manages IT equipment located in a data centre within which they purchase/rent the space/rack together with the data centre supporting facilities such as power, cooling, etc.
Managed Service Provider	A data centre owner or a third-party team who operates and manages the data centre space, power, cooling, IT equipment and some level of software for the purpose of delivering IT services to customers.
Managed Service Customer	Uses the IT services provided by the Manged Service Provider

1.3 Major Areas of Concern

The proposed green data centre practice covers five (5) major areas and are grouped as such, including Cooling system & Air Flow Management, Power system, Lighting System, Monitoring & Managing Energy Efficiency. The coverage in each major area is further discussed in the next section.

2 Proposed Contents of the Practice Guides

2.1 General Practises

Under this section, general guidance and proposed practices are described. These proposed best practices are applicable to all green data centres.

2.2 Cooling System

Best practices are focused on the design, procurement, operation, on-going commissioning, optimisation and management of Cooling system in data centre, including, but not limited to, cooling plant, computer room air conditioners & air handlers (CRAC/ CRAH), air flow management, cooling management, environmental zoning and temperature & humidity design.

2.3 Power System

Best practices are focused on the design, procurement, operation, on-going commissioning and management of Power system of the data centre, including, but

not limited to, uninterruptible power supplies (UPS), power quality management, demand response, design for part load operation, lighting system and its control.

2.4 Monitoring and Managing Energy Efficiency

Best practices are focused on the design, operation, on-going management of the data centre through the usage of data collection, as well as energy usage analysing systems and reporting. In addition, metrics, including both commonly and emerging ones are also included with an aim to provide a comprehensive source to users in handling the overall operational and on-going management processes relating to monitoring, analysing, quantifying and reporting of data centre energy usage and environmental performance.

2.5 IT Equipment Deployment

Best practices are focused on the specification, procurement and on-going management of IT System and Equipment to enhance data centre energy efficiency, and the impacts of the IT equipment to energy efficiency of the power and cooling systems.

2.6 IT Application System and IT Service Deployment

Best practices are focused on the specification, procurement and on-going management of IT software and application to enhance data centre energy efficiency, including virtualisation technology, efficient software and data management policy.

2.7 Telecommunications & Network Cabling

Best practices are focused on the design, planning, selection and management of cable installation. A reliable, scalable and manageable cabling infrastructure and good cable management practices can help improving cooling efficiency, performance and flexibility.

2.8 Green Construction

Best practices are focused on the site planning and management and construction of new data centres development, and existing data centres undergo alterations and additions (A&A works) or retrofitting works. Construction site activities can be the significant source of environmental degradation, unless appropriate steps are taken for example to reduce the emissions of pollutants to air, land and water, and to reduce annoyance from construction related noise. In addition, practical considerations and opportunities of using environmentally-sustainable natural resources in construction and fitting-out of data centres will also be addressed under this section.

2.9 Management and Maintenance

An effective management of building operations and maintenance is the key factor for better environmental performance of the data centres, ensuring the data centres are operating in their maximum sustainable potential. Under this section, policies, procedures and strategies that enable data centres to be operated efficiently in a sustainable manner are discussed.

2.10 Green Disposal

Discussion of the waste management issue in Hong Kong is more critical than before. Apart from general refuse, disposal of obsolete electronic equipment and data centre facilities, are expected to have huge environmental impacts.

Process to handling waste disposal on IT equipment within data centre is one of the key focus. Best practices shall therefore cover the overall life cycle of data centre. At the design stage, best practices on the development of green disposal policy for IT equipment and facilities will be addressed. At the Operational and Maintenance stage, measures on monitoring and auditing of the waste policy and performance will be addressed. It is expected that the proposed best practices and measures shall echo the government policy on Proper Recycling of Regulated Electrical Equipment Turning Waste into Resources

3 Metric of Energy Use and Environmental Performance of Data Centre

In this document, the list of metrics that data centre users can adopt to measure the data centre performance is presented and discussed, as highlighted below. Detailed description of the metric is presented in **Appendix B** under Monitoring and Managing Energy Efficiency.

Table 2 Highlights of Metric for Green Data Centre performance

Metric	Definition
Common Metric to Monitor Energy Efficiency	
Power Usage Effectiveness, PUE	This metric provides an overall measure of the infrastructure efficiency and it is defined as the ratio of the total DC facility power/energy to the total IT equipment power/energy: $PUE = \frac{Total\ Facility\ Power/Energy}{IT\ Equipment\ Power/Energy}$ Units: Dimensionless
Cooling System Efficiency	The most common metric used to measure the efficiency of an HVAC system is the ratio of average cooling system power usage (kW) to the average data centre cooling load (tons): $Cooling\ Efficiency = \frac{Average\ Cooling\ System\ Power\ (kW)}{Average\ Cooling\ Load\ (kW)}$ Units: Dimensionless
Water Usage Effectiveness WUE	Water Usage Effectiveness (WUE) is the ratio of annual water usage to total energy consumption by IT equipment and servers (L/kWh) $WUE = \frac{Annual\ Water\ Usage}{IT\ Equipment\ Energy}$ Units: L/kWh
Other Useful Metric to Monitor Energy Efficiency	

Metric	Definition
Data Centre Infrastructure Efficiency, DCiE	DCiE is defined as the ratio of the total power/energy drawn by all IT equipment to the total power/energy to run the DC facility, or the inverse of the PUE: $$DCiE = \frac{1}{PUE} = \frac{IT\ Equipment\ Power/Energy}{Total\ Facility\ Power/Energy}$$ Units: Dimensionless
Source PUE by Energy Star	$$Source\ PUE = \frac{Total\ Facility\ Energy\ (kWh)}{UPS\ Energy\ (kWh)}$$ Units: Dimensionless
Energy Reuse Effectiveness, ERE	ERE is defined as the ratio of the total energy to run the DC facility minus the reuse energy to the total energy drawn by all IT equipment: $$ERE = \frac{Cooling + Power + Lighting + IT - Ruse\ Energy}{Total\ Facility\ Energy}$$ Units: Dimensionless
Heating, Ventilation and Air-Conditioning (HVAC) System Effectiveness	This metric is defined as the ratio of the annual IT equipment energy to the annual HVAC system energy: $$HVAC\ System\ Effectiveness = \frac{Total\ IT\ Equipment\ Energy\ (kWh/yr)}{Total\ HVAC\ Energy\ (kwh/yr)}$$ Units: Dimensionless
Airflow Efficiency	This metric characterizes overall airflow efficiency in terms of the total fan power required per unit of airflow. This metric provides an overall measure of how efficiently air is moved through the data centre, from the supply to the return, and considers low pressure drop design as well as fan system efficiency: $$Airflow\ Efficiency = \frac{Total\ Fan\ Power\ (kW)}{Total\ Fan\ Airflow\ (L/s)}$$ Units: kW/L/s

Return Temperature Index, RTI	This metric evaluates the energy performance of the air management system: $RTI = \frac{\Delta T_{AHU}}{\Delta T_{IT\ EQUIP}} \times 100\%$ where, ΔT_{AHU} is the typical (airflow weighted) air handler temperature drop and $\Delta T_{IT\ EQUIP}$ is the typical (airflow weighted) IT equipment temperature rise.
Ambient Relative Humidity, RH	$RH_{Ambient} = (RH_1 + RH_2 + \cdots + RH_n)/n$ where RH_1 and RH_2 is the Relative humidity at measurement points 1 & 2 and n is the number of representative measurement points.
Uninterruptible Power Supply (UPS) Load Factor	This metric is the ratio of the peak load of the uninterruptible power supply (UPS) to the design value of its capacity. This metric provides a measure of the UPS system over-sizing and redundancy: $UPS\ Load\ Factor = \frac{UPS\ Peak\ Load\ (kW)}{UPS\ Load\ Capacity\ (kW)}$ Units: Dimensionless
Carbon Usage Effectiveness CUE	Carbon Usage Effectiveness (CUE) is the ratio of total carbon emissions from energy consumption to the total energy consumption (kgCO2/kWH) $\mathrm{CUE} = \mathrm{Carbon\ Emission\ Factor} \times \mathrm{Power\ Usage\ Effectiveness}$

Prepared by:

Business Environment Council Limited

October 2019

Appendix A

Reference - International green data practice guides

i. 2019 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency by *Joint Research Centre, European Commission (2019)*

ii. Australian Government Data Centre Strategy 2010-2025 Better Practice Guide: Data Centre Cooling by *Department of Finance, Australian Government (2014)*

iii. Australian Government Data Centre Strategy 2010-2025 Better Practice Guide: Data Centre Power by *Department of Finance, Australian Government 2014)*

iv. Best Practices Guide for Energy-Efficient Data Center Design, Federal Energy Management Program, Office of Energy Efficiency and Renewable Energy by *Department of Energy, United States of America (2011)*

v. Code of Practice for Energy Efficiency of Building Services Installation 2018 by *Electrical and Mechanical Services Department, The Government of HKSAR*

vi. Code of Conduct on Energy Efficiency and Quality of AC Unintenuptible Power Systems by *Joint Research Centre, European Commission*

vii. ENERGY STAR Low Carbon IT Campaign guidelines such as "6 Ways to Reduce IT Energy Costs" and "12 Ways to Save Energy in Data Centers and Server Rooms" by *United States of America*

viii. Four Metrics Define Data Center "Greenness" by *Uptime Institute (2007)*

ix. Green Data Centre Practices, OGCIO by *The Government of HKSAR (2016)*

x. Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings in Hong Kong by *Electrical and Mechanical Services Department and Environmental Protection Department, The Government of HKSAR (2010)*

xi. ISO 50001: Energy management systems *(2018)*

xii. L.1300 Best practices for green data centres, Telecommunication Standardization Section by *International Telecommunication Union (2014)*

xiii. PUE™: A Comprehensive Examination of the Metric by *Green Grid (2012)*

xiv. Technical Guidelines on Code of Practice for Energy Efficiency of Building Services Installation 2015 by *Electrical and Mechanical Services Department, The Government of HKSAR (2015)*

xv. Thermal Guidelines for Data Processing Environments, Fourth Edition by *American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) (2015)*

Appendix B

Proposed Green Data Centre Best Practices

This appendix lists the proposed best practices for green data centre. Crossing referencing between each proposed practice and BEAM Plus DCs is provided to facilitate users to look for more technical details in the BEAM Plus rating tools/manuals. Subject to finalisation of the BEAM Plus DCs manuals, the related credit items in the manuals are included in some of the best practice to help users make choice among similar practices. In addition, each of the best practices is supplemented with two guidance notes, namely the "Implementation Effort" and "Effectiveness" to offer further supplementary guidance to users for making choice applicable to the data centre. "Implementation Effort" refers to the relative complexities including cost and effort of implementation, and "Effectiveness" the relative benefit of the best practice. For simplicity, the two items are rated into "Low", Medium" and "High". It has to be borne in mind the rating stated is meant to be a reference only and not absolute. The perceived rating can be different among users depending on their experience and background and the business needs of the data centre.

BEAM Plus DCs aspects:

Integrated Design and Construction Management	IDCM
Management	MAN
Sustainable Site	SS
Site Aspect	SA
Materials and Waste	MW
Materials and Waste Aspect	MWA
Energy Use	EU
Water Use	WU
Health and Wellbeing	HWB
Indoor Environmental Quality	IEQ

1. Green Data Centre Best Practices – General Aspect

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
The practices described under this section are relevant to all aspects of the data centre in general.				
General	**Mechanical and electrical equipment selection** The selection and deployment of mechanical and electrical equipment should consider with priority, among others, the ones that *do not require or use relatively less cooling in normal operations*	Medium	Medium	-
	Life Cycle Assessment Introduce a Life Cycle Assessment in accordance with international standards, such as ISO 14040, ISO 15656-5:2008, etc The use of life cycle assessment, including cost assessment, is to facilitate investigation of potential requirements/specifications and design options. One of the main objectives is to determine the Total Cost of Ownership for each of the available options, covering the stages of design, build, operate and maintenance. Without the Life Cycle Assessment, it is difficult to determine the best option for green implementation and the monitoring that follows.	High	High	IDCM & MW
	Monitoring and manage air quality in data hall Ensure that air quality is monitored and managed to ensure that critical equipment is not damaged by particulates or corrosive elements which might impact both IT equipment and data centre facilities such as power and cooling equipment. Poor air quality will degrade performance, energy efficiency and reliability. Implementation of this practice should include the choice of filters and the planned replacement schedule as well as the frequency of routine technical cleaning programme (including underfloor and ceiling void areas if applicable). Note: More information on this topic can be found in Environmental Protection Department (EPD) Indoor Air Quality (IAQ) Certification Scheme and ASHRAE	Low	High	HWB & IEQ

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	white paper on "Gaseous and Particulate Contamination Guidelines for Data Centres"			
	Service Charging Model User awareness of energy efficiency can be raised by charging the amount of data centre facilities they consumed.	Low	High	-
General	**Don't Treat Data Centre as Office** Data centre space should not be compromised as office space and should be designed and operated for high availability and energy efficiency. For example, data centre designed with comfort cooling for office will lead to energy inefficiency in particular the cooling system.	Low	High	-
	Site Documentation A comprehensive documentation of the data centre, whether new-built or retrofit, should be prepared and maintained. Accurate documentation and records of the infrastructure and systems built are essential to correct operation and use of energy efficient functions. Initial documentation should include information on operation, maintenance, as-built records (including appropriate drawings, design specification and product specifications) and commissioning records. The documentation should be updated whenever changes are made to the data centre.	Medium	High	-
	Alternative/Sustainable Energy Usage Consider the use of alternative and sustainable energy sources, e.g. solar hot water systems, building integrated photovoltaic panels, etc. for substituting part of electricity or fuel consumption by renewable energy (for some areas in the data centres). This Practice help reduce overall carbon footprint rather than provide direct energy efficiency. In Hong Kong, data centres can talk to the power utility companies on the procurement of alternative / sustainable energy.	High	Low	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Integrative Design Process Early consideration of the integrated building design process, buildability and operational issues to support holistic and cost-effective outcomes of building performance, human health and environmental benefits. For example, take into account whole-system thinking to explore the interrelationships among green building design strategies and systems in the conceptual design stage and to consider long-term operation and maintenance needs of the data centres and its engineering services.	Medium	High	IDCM
To optimise utilisation of data centre space and energy efficiency of power, cooling and similar supporting facilities				
Resilience Level Provisioning	**Build resilience in line with business requirement** Level of resilience should match business requirement and not over provisioned. For example, 2N resilience may not be necessary and can probably be replaced by N+1 or application resilience over multiple sites.	Low	High	-
	Consider multiple levels of resilience Multi-level resiliency in a single data centre can be considered by providing multiple levels of power and cooling resilience at different floor levels. In this way, resilience can be shared across floors.	Medium	Medium	-
	Scalable Data Centre Unnecessary provisioning of excess power and cooling capacity over the actual IT load leads to wastage of energy. Planning a data centre for scalable expansion with not excessive provisioning of power and cooling capacity at the beginning increases energy efficiency and allows the site to respond quickly to business needs and technological advancements.	Medium	High	EU
	Design infrastructure to maximise part load efficiency	Medium	High	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Infrastructure should be designed to respond dynamically to variable and partial IT loads so that the right amount of resources are consumed to support the actual IT load without wastages. Examples include the use of variable speed drive for pumps, fans and compressors in the cooling system.			
Encourage the use of low energy intensity water sources to reduce the effective energy consumption of the data centre				
Water Use/ Sources	**Water recycling** Both the capture and storage of rain water and grey water for evaporative cooling and other non-potable purposes will help reduce overall energy consumption.	Medium	Low	WU
	Potable water usage monitoring Data collected from the metering of water consumption from all sources will help manage and reduce overall water consumption.	Low	Low	WU
	Water leakage system Install water leakage detection systems in all potable water sources to reduce water wastage.	Low	Low	WU
	Cooling tower water Reduce the fresh water consumption for cooling tower makeup by installing water treatment systems which can increase the cycles of concentration with acceptable water quality and save vast amount of water. Note: Further details can be found in EMSD (of HKSARG) guideline on installation and operation of water tower system: https://www.emsd.gov.hk/en/other_regulatory_services/cooling_towers/	Medium	High	WU
A sustainable site location and physical layout of the data centre building are important in achieving flexibility and efficiency and will enhance the effectiveness of the green data centre best practices.				
Sustainable Site &	**Layout of data hall**	Low	High	SS & SA

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
Building Physical Layout	Data Hall area should be designed and located at the centre of the building and surrounding by other associated areas, i.e. corridor, plant rooms, etc. wherever possible to minimise space heat gain through solar radiation, infiltration, conductive heat gains and to prevent leakage of cooling air.			
	Minimise direct solar heating Roof materials with Solar Reflectance Index (SRI) of not less than 78 are recommended with an aim to increase the reflectivity of the building which in turn minimise solar heating of the cooled areas of the data centres. Effective insulation can be provided by using suitable wall and roof coverings. Green roof system is also another potential measure to minimise direct solar heating.	Medium	Medium	SS & SA
	Power system plant location Better design of power system location, such as plant room location, to shorten cable path with an aim to reduce power loss during transmission.	Medium	High	-
	Cooling system location Explore the opportunities to bring cooling systems closer to the heat source which could reduce the amount of energy to spend on air movement.	Medium	High	-

2. Green Data Centre Best Practices – Cooling System

Data centre is a dynamic environment. The cooling system should be designed, managed and operated to respond quickly to changes in IT load, temperature and humidity within the data centre and external seasonal changes. Expert advice such as from the design consultant, facility engineers and maintenance agents should be sought wherever needs are required on the practices described.

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
Energy optimization through the designing, tuning and operating of cooling systems to respond to changes in thermal load				
Cooling System	**Power-off Unnecessary Cooling Equipment** If the data hall is not fully occupied, the unnecessary cooling equipment should be powered off.	Low	High	-
	Review Cooling System Operation before IT Equipment Changes The cooling environment, in particular in the cold aisle (with or without containment as described below) should be reviewed before accommodating new IT equipment, especially IT equipment with high power density.	Low	High	-
	Dynamic Control of Cooling system Consider a design that allow the operation and control systems of the cooling system to take into the account of different factors and components, e.g. using systems such as Central Control and Management System or Building Management System to synchronise the operation and control of data centre facility equipment and systems.	High	High	EU
	Cooling System to Operate Efficiently at Partial Load Data centres are mostly operated at partial load rather than maximum load. The cooling system should be tuned to operate efficiently in variable partial load and not only at maximum load. Chiller plant can be mixed with large and small plant to address part load condition.	Medium	High	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Use Variable Speed Drives Use variable speed control to reduce energy consumption for compressors, pumps and fans to respond automatically to part load and change of load condition. Consider using Electrically Commutated (EC) motors which are more energy efficient than traditional AC motors	Medium	High	EU
	Optimise Chilled Water Pump Operation Chilled water systems configured with dual pumps, one active and one on standby, can be reviewed for improved energy efficiency, e.g. whether to run the two pumps at low speed will reduce the overall energy consumption instead of keeping one idle.	Medium	High	EU
Cooling System	**Segregation of chilled water system with comfort cooling** Data Centre designs should ensure that chilled water systems are separate from comfort cooling (dedicated to office areas). This is to address the differences in operation mode and energy use between data centre and comfort cooling chillers. One single cooling system serving both IT load and comfort should always be avoided. For data centre installed in part of buildings where implementation of independent cooling system for data centre is not practical, use of water flow control or thermostat control to address the variations of operation mode or temperature requirement. In this case, provision of adequate sensors and sub-metering system should be considered to monitor and measure the system condition and energy usage.	Medium	High	EU
	Reuse of waste heat	Medium	Low	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Data centres can be designed to make use of the residual heat from the facility plants and/or IT equipment, to heat up, for example, office space and other areas where extra energy will need to be consumed otherwise. This practice will not enhance the energy efficiency of the data centre parts of the building (such as the data halls), but the overall energy use of the building can be reduced.			
	Chillers with high COP Where a separate cooling system is installed for the data centre parts in a building, the chiller systems should be designed with a high chilled water leaving temperature in order to achieve a high coefficient of performance. Note: Minimum COP requirement for Chillers at Full Load as stated under Code of Practice for Energy Efficiency of Building Services Installation by Hong Kong EMSD can be referenced at the following. https://www.emsd.gov.hk/beeo/en/pee/BEC_2018.pdf	Medium	High	EU
	Thermal tank Thermal tank for the chilled water developed during non-peak hours should be considered.			
	Computer room air conditioners/ air handlers (CRAC/CRAH) CRAC/CRAH should comply with the Code of Practice for Energy Efficiency of Building Services Installation issued by Hong Kong EMSD. Procuring CRAC/CRAH with a high Coefficient of Performance is encouraged. CRAC/CRAH unit sizing should be chosen with regard to the IT load (kW) on the data centre. Undersized CRAC/CRAH units will have airflow management problems while oversized units are inefficient and can cause condensation and static discharges.	Low	High	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Variable speed fan at CRAC/CRAH is recommended to allow more precise cooling in respect of temperature reading at each zone of racks.			
Cooling System	**Review CRAC / CRAH Settings** Ensure all the CRAC/CRAH are operated in tandem and at consistent and appropriate temperature and relative humidity settings to avoid working against each other.	Low	High	EU
	Modular Cooling Plant Cooling plant should be installed in a modular arrangement, which can enhance resilience and allows maintenance without shutting down the whole cooling system.	Medium	High	EU
	Thermal imaging camera Procuring thermal imaging camera is encouraged as it is useful in capturing small temperature gradients. This information can be used to identify easily and quickly hot spots and provide the basis for improving cooling efficiency and removing causes of faults.	Low	Medium	EU
	Proactive Management – HVAC system The cooling system after commissioning and during operation should be monitored continuously for efficiency, e.g. to ensure the settings are in line with the IT load, alarms are analysed for potential needs of replacing parts, etc.	Low	High	EU
Airflow management is about assuring the right amount of air and at the right temperature is circulated to remove heat generated by IT equipment at any time within the data halls. A well designed and managed airflow management system will not let air returns to the cooling system without absorbing heat and no air circulates more than once through IT equipment. An inefficient airflow management system risks IT equipment being overheat and wasting energy.				
Airflow Management	**Adequate Perforations area on rack doors**	Low	High	-

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Rack doors should be provided with adequate perforations to improve airflow. ISO/IEC 14763 recommends a minimum of at least 66% perforated areas.			
	Minimise Obstructions under raised floor The space under the raised floor should be as free as possible. Structures such as cable trays should not obstruct airflow. An alternative is to use overhead cabling trays (Structured Cabling System for example)	Medium	High	-
	IT Equipment Segregation Where the racks have different power density (and hence different cooling requirements), consider grouping them in areas with different environmental control areas, e.g. putting legacy equipment requiring lower temperature into separate areas. The objective is to avoid the need to operate the cooling system with the most restrictive environmental requirements (e.g. legacy equipment) and therefore compromise the efficiency of the entire data centre.	Medium	High	-
	Hot/Cold aisle design Equipment shall be installed in the racks in such a manner to draw cold air from the “cold” aisle and exhaust hot air to the “hot” aisle. This will minimise the mixing of cold and hot air, which in turn result in energy saving.	Medium	High	-
	Airflow management in racks Unused slots in racks should be installed with proper blanking panels to avoid short circuit of hot and cold air. Other openings in the racks including at the base of the racks not designed for air circulation should be similarly covered to avoid short circuit of hot and cold air. Equipment should be installed in the racks in such a manner to draw cold air from the “cold” aisle and exhaust hot air to the “hot” aisle. Where necessary, airflow management accessories should be provided for IT equipment that	Low	High	-

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	draws cold air and exhausts hot air in a side-to-side manner (e.g. network switches).			
	Cabinet air flow management – Other openings Apertures not for airflow in the raised floor should be closed. There should be no gaps along the rows of racks, especially in the case of hot/cold aisle environment. If necessary, fill in the gaps along the rows to prevent air leakage.	Low	High	-
	Hot/Cold air containment design Aisle containment is an extension of the hot/cold air aisle design. Containment, commonly in form of either cold/hot containment, can reduce the amount of conditioned air required and increase the effectiveness of the cooling system. Containment in the simplest form can be retrofitted using materials such as heavy plastic sheet and/or plywood.	Medium	High	-
	Review before Changing Rack Arrangement Deploy IT equipment at the designed rack power density to avoid creating cooling and airflow problems. The cooling capacity and airflow in an aisle, as well as the rack arrangement, should be reviewed for possibility of hot spots, for example, if new racks to be moved in are above the designed rack power density.	Medium	High	-
	Use of Fan Wall Consider using modular fan wall system to improve the airflow efficiency in data hall. Comparing with air distribution system at raised floor, static pressure drop can be avoided which in turn in energy saving. Modular design allows easy transportation, assembly and high flexibility.	Medium	Medium	-
	Opportunity of using hard floors Small data centres or server rooms of less than 50 racks can consider a hard floor design since many cooling technologies are available for smaller rooms	Medium	Medium	-

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	that do not use or require a raised floor, such as the popular approach of row-based cooling with overhead piping, or refrigerant based systems. Rooms that have low headroom, such as small data centres installed in part of buildings in Hong Kong, can be difficult to fit with a raised floor sufficient to achieve the power density required, and can consider the use of a hard floor design.			
Data centre should not be operated below the necessary range of temperature and humidity to minimise waste of energy. Most IT equipment nowadays are able to tolerate higher temperature and humidity, and therefore offer more opportunities to increase energy efficiency. The following practices can be considered:				
Operating at Higher Temperature and Humidity	**Consider Raising Target IT Equipment Intake Temperature** Data centres in the past are mostly designed to operate at temperature range of 20ºC to 26ºC and humidity of 50% to 60%. Opportunities should be taken, e.g. in procuring new IT equipment, to operate the data centres at higher range as specified in the ASHRAE Thermal Guideline, e.g. beyond 26ºC within the Class A2 range or above, instead of A1, to reduce energy usage. Practices mentioned earlier to segregate IT equipment with different temperature and humidity requirement into different areas can be considered together with this one.	Medium	High	EU
	Consider Raising the Working Humidity Range Similar consideration should be made, e.g. in procuring new IT equipment, to raise the operating humidity range in data centres as per ASHRAE Class A2 range or above to reduce humidification and dehumidification loads and hence energy consumption.	Medium	High	EU
	Optimise Chilled Water Temperature Explore opportunities to increase the chilled water temperature differences to reduce water flow and hence the pump (due to lower pump speed) and overall cooling system energy consumption.	Medium	High	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	However, keep the following in mind before adopting the strategies: • Ensure your chillers are capable of operating at higher chilled water temperatures without impacting their reliability. • Ensure the cooling capacity of indoor CRAC/CRAH coils can provide your desired IT supply setpoint at higher chilled water temperatures.			
To ensure that cooling systems are tuned in response to changes in the facility thermal load or external ambient conditions such as seasonal variation				
Cooling Management	**Free cooling/ economised cooling design** Despite the tropical weather in Hong Kong, explore the opportunity of making use free cooling where the data centre sites and/or seasons permit. Free cooling reduces the overall energy cost. Free cooling/economised cooling design makes use of low external air temperatures to meet part of the data centres cooling requirements. In Hong Kong, free cooling can be considered during the winter months between November and March. Designs such as the direct air free cooling, indirect air free cooling, indirect water free cooling with CRAH and dry cooler and indirect water free cooling with CRAC with integrated free cooling coil can be considered for use in Hong Kong.	High	Low	EU
	Fresh Water-Cooling Towers Scheme (FWCT Scheme) The Hong Kong government's FWCT scheme encourages the wider use of fresh water in cooling towers for energy efficient air conditioning systems for non-domestic buildings. Data Centre designs located within the designated area of the FWCT scheme are encouraged to apply. Note: EMSD reference: https://www.emsd.gov.hk/en/energy_efficiency/fwct_scheme/	High	High	EU & WU

3. Green Data Centre Best Practices – Power System

Power System is another major part of the facility infrastructure. It is about the power supply and distribution.

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
To ensure that the design, selection and operation of power equipments will ensure substantial savings throughout the life time of the facility				
Power System	**Modular uninterruptible power supplies (UPS)** Conventionally, data centres have been using high capacity UPS. Smaller modular UPS are now available that can be scaled with load demand. In terms of energy efficiency, modular UPS can offer the following benefits: • Ability to grow capacity on an as-needed basis preventing initial oversizing. • UPS run at greatest efficiency when they are close to the maximum rated capacity. Without oversizing, modular UPS is more likely to operate close to the maximum rated capacity.	High	High	EU
	High Efficiency UPS High efficiency rated UPS, in the range of 92% to 95%, should be selected. Reference can be made at time of procurement to U.S. EPA ENERGY STAR specifications for UPS	High	High	EU
	Use of lithium battery for UPS Explore the opportunities of using lithium battery for UPS system. Lithium battery offers four main benefits: • Reduced UPS footprint and weight to allow for a more effective, flexible use of space • Reduced cooling requirement • Increased energy storage availability and UPS reliability • Extended UPS life and reduced maintenance overhead	All DCs	Medium	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	It has to be noted the initial investment for lithium battery is higher than the conventional lead acid battery. However, considering the whole life cycle including the longer life of lithium battery, maintenance, etc. the Total Ownership Cost can be lower.			
	Power management design Power system should remain energy efficient under partial load and variable IT loads. The ongoing needs of supplying additional computer power using less energy and smaller spaces should be addressed by designing power management solutions that are flexible and adaptable. Power management solutions such as those that incorporate overhead busway systems, intelligent PDUs, power management software will provide the lowest long-term cost of ownership. Examples of power management software for energy efficiency include Power Quality Management and Building Energy Management systems.	Medium to High	Medium to High	EU
Power System	**High Load Factor** Aim to design a power system with a high load factor, which is measured by (Average Load / Maximum Design Load). A high load factor indicates that the power load in the data centre is using the power system efficiently, meaning with less wastage. The practice essentially implies that do not oversize the power system.	Medium	High	-
	Prioritise DC power system designs While it is uncommon, opportunities can be taken to explore converting AC power to DC power for use by IT system equipment. DC power systems require fewer connection steps from power grid to chip which leads to a reduction in cost and an increase efficiency.	High	High	-
	Power quality management	Medium	Medium	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	To establish action plan to monitor the quality, and hence the efficiency, of the power system, on items such as the following: • Power factor monitoring & correction; • 3-phase Load Balancing; • Maximum demand monitoring; • Demand Side Management (DSM); • Total Harmonic Distortion (THD); and • Thermal Scan on electrical distribution system			
Energy saving opportunities on lighting systems				
Lighting systems	**Low energy lighting systems** Low energy lighting systems should be used in data centres. LED lighting is an example. • ANSI TIA -952-A standard recommends LED lighting over fluorescent options as LED fixtures generate less heat, use less electricity and are 100% dimmable. • When selecting fluorescent lighting, T5 fluorescent lamps are recommended for their higher luminous efficacy (lm/W) in comparison to T8 and T12 lamps. Electric ballasts, if needed, should be used over electromagnetic ballasts as they are more energy efficient and generate less heat.	Low	Low	EU, HWB & IEQ
	Optimising the lighting platform Designs should incorporate sensor networks to adjust lighting levels based on occupancy, and motion sensors to reduce wasted lighting energy. LED lighting should be powered with low voltage DC that are less costly in comparison to the traditional AC mains power.	Low	Low	EU
	Pale coloured fixtures and fittings	Low	Low	HWB & IEQ

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Pale coloured cabinets, walls and floors reflect more light than dark coloured fixtures and fittings and has the effect of making the data centre seem brighter. Therefore, the amount of lighting needed to illuminate a data centre and the energy consumed for lighting will be reduced.			
	Maintaining illuminance Illuminance levels decline with age. Lamps/luminaires need be kept clean and replaced when necessary. The frequency of maintenance and replacement will depend on environmental conditions as well as type of luminaire. The Lighting Maintenance Factor should also be referenced to maintain illuminance. Further details on the maintenance of illuminance levels can be obtained from CIBSE *Code for lighting*.	Low	Low	HWB & IEQ

4. Green Data Centre Best Practices – Monitoring and Managing Energy Efficiency

Measuring energy use and factors that impact energy use is a pre-requisite to implement and sustain energy efficiency programs successfully. Tracking of energy usages can also help discover potential problems of the equipment and improve maintenance effectiveness. This section discusses the best practices and metrics generally adopted to achieving the goal.

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
To ensure that the chosen monitoring methods and tools will help facilitate energy conservation and efficiency in the Operations & Maintenance stage.				
Monitoring & Energy Reporting	**Monitoring system** Data centres have to determine the requirements of the monitoring system based on organisation needs such as the need to adopting charging and the charging model, reporting frequency and the means (e.g. report to be compiled automatically or manually), maintenance procedures, adoption of common metrics, etc.	Low	High	EU
	Energy reporting hardware Select mechanical and electrical equipment, including power supply and distribution and cooling systems, with metering functions and features to meet the metering system requirements as far as possible. The metered data should be downloadable in open standard format to systems such as Building Energy Management or DCIM (Data Centre Infrastructure Management) for further analysis. Common metered data to be collected and analysed includes: power and energy usage of facility equipment and power usage at rack level, trending of usage, energy usage at different areas of data centre and at different timing, airflow monitoring, PUE (Power Usage Effectiveness), etc.	Medium	High	EU
	Metering for User Awareness	Low	Medium	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Whereas the metered data collected by installed equipment is unable to meet the total needs, consider supplementing data collection with other means, such as collecting power consumption of racks through intelligent power bars installed in the racks. Energy meter down to server rack level enables the cooling to be more concise and to avoid energy wastage. Power consumption reported at rack level to users will raise their awareness of energy efficiency particularly if it is supported by appropriate charging models.			
Monitoring & Energy Reporting	**Row Level Monitoring** Operation of cooling system in data hall can be monitored with the help of temperature and humidity sensors installed in racks along the cold and hot aisles, as discussed earlier and in the Thermal Guidelines for Data Centres from ASHRAE. Aisle sensors is particularly useful to monitor the temperature of newly installed high power density racks and/or to identify hot spots in an aisle. Data inconsistency between those reported by the installed equipment and aisle sensors can highlight advanced warning of potential problems with the cooling system and/or insufficient cooling capacity.	Medium	High	EU
	Building Management System (BMS) BMS are prominent in their use to ensure that a data centre (and the building service) is safe, secure energy efficient and reliable. Data centres have to decide the scope and requirements before choosing the appropriate BMS, include ease of integration with other monitoring systems.	Medium	High	EU
	Data Centre Infrastructure Management (DCIM) DCIM is a new breed of BMS, specifically design to manage data centre holistically including the facility infrastructures. It includes additional functions such as big data system, asset management, capacity management, cable management, modelling, integrated control with systems such as Fire Alarm, Physical Security, Computational Fluid Analysis, etc.	High	High	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	DCIM is still at early stage of adoption by data centre, due to high investment cost and implementation effort, but should be considered wherever the needs arise.			
Monitoring & Energy Reporting	**Advancement of Monitoring Systems** Data centre users should take note the development trend of monitoring systems such as the availability of digital remote monitoring architectures, emergence of cloud service and mobile computing functions and features and the use of big data analytics and machine learning, all of which can increase energy efficiency and facilitate energy management and maintenance.	Low	Medium	EU
	PUE (Power Usage Effectiveness) PUE is the most common metric adopted by data centres to track energy efficiency. It is defined as: PUE = Total Facility Power / IT Equipment Power Total Facility Power includes everything that support IT equipment load including power delivery components such as UPS, switching gear, gensets, cooling systems, lighting, etc. IT Equipment Power includes the power load for all IT equipment such as server, storage, network equipment, etc. It should be noted PUE varies with changes in IT load, and hence the total facility load, e.g. PUE for partial load can be different from the full load situation. Trending of PUE is a good measure of how energy efficiency is improved over time. According to global survey conducted by Uptime Institute in 2018/19, the average PUE reported is around 1.6, a figure that is targeted by many high tier data centres in Hong Kong.	Medium	High	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	For implementation details, papers from the following Green Grid website can be referred. Note: PUE: A Comprehensive Examination of the Metric https://www.thegreengrid.org/en/resources/library-and-tools/ 20-PUE%3A-A-Comprehensive-Examination-of-the-Metric			
Monitoring & Energy Reporting	**Cooling System Efficiency** Cooling system is one of the most important infrastructure facility. Its efficiency can be measured by dividing the total power consumed by the cooling system to remove a given amount of heat generated by the IT equipment as follows: Cooling efficiency = Average Cooling System Power Consumed (kW) / Average Cooling Load (kW) In terms of efficiency, the lower the percentage the better, meaning less power is required to remove the designated amount of heat. For example, a 50% efficiency means the amount of heat (measured in kW) generated required only half of the power (measured in kW) to remove it. The efficiency of cooling system depends on many factors including for example how tolerant is the IT equipment to the heat generated, investment made to cooling system equipment, etc. In essence, the cooling efficiency should not be approaching 100% or over, and the efficiency figure over time should be reduced.	Medium	High	EU
Monitoring & Energy Reporting	**Water Usage Effectiveness** Power consumed to support the IT load is measured by PUE. Similarly, the amount of water required to support the removal of heat generated by IT load is measured by Water Usage Effectiveness (WUE). Given water is a scarce economic means, the adoption of WUE is getting popular. It is defined as: WUE = Annual Water Usage (in litre) / IT Equipment Power	Medium	Low	EU & WU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Similar to PUE and Cooling Efficiency, WUE depends on many factors. The less is the figure the better, and it is important that the figure is trending less over time, meaning less amount of water is needed to support the IT load. Data centres interested with WUE can study the details from papers in the Green Grid website. Note: Water usage effectiveness (WUE): A Green Grid Data Centre Sustainability Metric https://www.thegreengrid.org/en/resources/library-and-tools/238-Water-Usage-Effectiveness-%28WUE%29%3A-A-Green-Grid-Data-Center-Sustainability-Metric-			
Monitoring & Energy Reporting	**Other Useful Metrics** New metrics are coming up for monitoring energy efficiency. The less popular ones are listed below for reference. Interested data centres can visit Internet for more details. **Data Centre Infrastructure Efficiency, DCiE,** DCiE is defined as the ratio of the total power/energy drawn by all IT equipment to the total power/energy to run the DC facility, or the inverse of the PUE: $DCiE = \frac{1}{PUE} = \frac{IT\ Equipment\ Power/Energy}{Total\ Facility\ Power/Energy}$ Units: Dimensionless **Source PUE,** $Source\ PUE = \frac{Total\ Facility\ Energy\ (kWh)}{UPS\ Energy\ (kWh)}$	Medium	Low	EU

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Units: Dimensionless **Energy Reuse Effectiveness, ERE,** ERE is defined as the ratio of the total energy to run the DC facility minus the reuse energy to the total energy drawn by all IT equipment: $ERE = \frac{Cooling + Power + Lighting + IT - Ruse\ Energy}{Total\ Facility\ Energy}$ Units: Dimensionless **Heating, Ventilation and Air-Conditioning (HVAC) System Effectiveness** This metric is defined as the ratio of the annual IT equipment energy to the annual HVAC system energy: $HVAC\ System\ Effectiveness = \frac{Total\ IT\ Equipment\ Energy\ (kWh/yr)}{Total\ HVAC\ Energy\ (kwh/yr)}$ Units: Dimensionless **Airflow Efficiency** This metric characterizes overall airflow efficiency in terms of the total fan power required per unit of airflow. This metric provides an overall measure of how efficiently air is moved through the data centre, from the supply to the return, and considers low pressure drop design as well as fan system efficiency: $Airflow\ Efficiency = \frac{Total\ Fan\ Power\ (kW)}{Total\ Fan\ Airflow\ (L/s)}$			

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Units: kW/L/s			
Monitoring & Energy Reporting	**Return Temperature Index, RTI** This metric evaluates the energy performance of the air management system: $RTI = \frac{\Delta T_{AHU}}{\Delta T_{IT\ EQUIP}} \times 100\%$ where, ΔT_{AHU} is the typical (airflow weighted) air handler temperature drop and $\Delta T_{IT\ EQUIP}$ is the typical (airflow weighted) IT equipment temperature rise. **Ambient Relative Humidity, RH** $RH_{Ambient} = (RH_1 + RH_2 + \cdots + RH_n)/n$ where RH1 and RH2 is the Relative humidity at measurement points 1 & 2 and n is the number of representative measurement points. **Uninterruptible Power Supply (UPS) Load Factor** This metric is the ratio of the peak load of the uninterruptible power supply (UPS) to the design value of its capacity. This metric provides a measure of over-sizing and redundancy of the installed UPS: $UPS\ Load\ Factor = \frac{UPS\ Peak\ Load\ (kW)}{UPS\ Load\ Capacity\ (kW)}$			

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Units: Dimensionless			

5. Green Data Centre Best Practices – IT Equipment Deployment

The demand for power in data centres and hence cooling comes from IT equipment. An energy efficient facility infrastructure goes hand-in-hand with energy efficient IT equipment. Data centres should use IT equipment that are energy efficient as discussed in the below practices:

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
Reduction in power and cooling used by IT equipment will have a magnified effect on utility energy consumption				
Selection of New IT Equipment	**Energy Efficient Equipment** Use energy efficiency IT equipment, including server and storage, such as the ones labelled with Energy Star, SERT or similar metrics.	Low	High	-
	A2 or above Class Equipment Use ASHRAE Class A2 equipment (or even higher classes such as A3 and/or A4) as long as the processing and performance capability of the equipment meets the business application requirements. A2 or higher classes of equipment is more temperature and humidity tolerant than A1 Class (which is classified as Enterprise Class Servers including tape and mainframe). A summary of ASHRAE environmental guidelines can be found at: https://www.ashrae.org/File%20Library/Technical%20Resources/Publication%20Errata%20and%20Updates/Errata_DataProcessing4thED.pdf The Environment Bureau Circular Memorandum No. 6/2015 from the HKSARG can also be referred together with the above.	Medium	High	-
	Equipment Power Management Turn on the equipment power management features, include BIOS, operating system and driver settings for better power management of the IT equipment and to monitor power usage, hence to save energy.	Low	High	-
	Segregate IT Equipment IT equipment with stringent environmental requirement should be located in separate areas in data hall in order not to compromise the energy efficiency of the cooling systems. Equipment requiring stringent environmental	Medium	High	-

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	requirements should be considered for replacement over the long term with better energy efficient ones with priority.			
Selection of New IT Equipment	**Efficient AC/DC Conversion** Select IT equipment containing high efficiency AC/DC power converters. These should be rated at 90% power efficiency or better across the range of loads expected for the equipment to be installed. Product specifications of the equipment provide the details.	Low	High	-
	Not Going over Rack Power Density Deploy IT equipment at the designed rack power density to avoid creating cooling and airflow problems in the cooling system. The cooling capacity and airflow in an aisle, as well as the rack arrangement, should be reviewed if incoming new racks are above the designed rack power density.	Medium	High	-
	Right Rack Airflow Positioning IT equipment in the rack at the direction that matches the airflow design, which is commonly from front to rear. Equipment (such as switches) use a different airflow direction should only be placed with a correction airflow device.	Low	High	-
	Airflow of Custom Rack Equipment which is housed in custom racks should be positioned at the right direction that matches the air flow design and/or the hot / cold aisle layout.	Low	Medium	-

6. Green Data Centre Best Practices – IT Application System and IT Service Deployment

IT equipment are installed for the delivery of IT services. Inefficient software can waste a lot of useful energy. Best practices in this area include:

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
Reduction in power and cooling used by IT application systems will have a magnified effect on utility energy supply				
Selection of New IT Application	**Decommission Equipment Not Supporting IT Service** Completely decommission and remove any equipment that is not required to support services no longer in use to save energy use. Installed hardware should be regularly examined to ensure that it is still required and is supporting active services. Unused IT equipment to support operation should also be decommissioned and removed.	Medium	High	-
	Optimum Hardware Resilience Determine the business impact due to downtime of IT service and deploy only the level of resilience commensurate to business needs, such as cold standby instead of hot standby.	Low	High	-
	Select Efficient Software Include performance as one of the evaluation criteria for software acquisition and not simply functions and features. In-house developed software likewise should pay attention to software performance.	Low	High	-
	Deploy Virtualisation Technology Virtualisation should be employed to make better use of IT equipment, hence reducing the amount of IT equipment and reducing energy consumption. This applies to servers, storage and networking in the data centres.	Medium	High	-
	Data Management Policy for IT Service Develop a data management policy to define which data should be kept, for how long and at what level of protection with a view to reduce the amount of storage required for each IT service.	Medium	Medium	-

7. Green Data Centre Best Practices – Telecommunications & Network Cabling

Good cable management can help improving cooling efficiency.

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
Reduction in power and cooling used by data centre cabling systems will have a magnified effect on utility energy consumption				
Cable Management	**Overhead Cabling** Where ceiling height permits, consider using overhead instead of under floor cabling to improve cooling efficiency.	Medium	Medium	-
	Underfloor Cabling Consider the following best practices if underfloor cabling has to be adopted: • Use network and cabling design (e.g. top-of-rack switching) to reduce the amount of cabling. • Select cables with smaller diameters to minimise the volume of underfloor cabling. • Use higher strand count optical fiber cables instead of several lower count optical fiber cables to minimise the volume of underfloor cabling. • Route cable pathways in hot aisles so as not to block airflow to ventilated tiles on cold aisle. • Properly sizing pathways and spaces to accommodate cables with minimal obstruction (e.g. shallower and wider trays).	Medium	High	-
	Cabling Management Planning of cable management should make reference to TIA-942 and TIA/EIA-568 industry guidelines.	Medium	Medium	-

8. Green Data Centre Best Practices – Green Construction

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
To implement green construction practice for new data centre development or Alterations and Additions works(A&A).				
Green Construction	**No usage of virgin forest products** No virgin forest products are used for temporary works	Medium	Medium	IDCM
	Local sourcing of materials Use of locally sourced materials will help reduce the environmental impacts of transportation.	High	Low	MWA
	Recycle materials usage Use recycled materials in order to reduce the consumption of virgin resources.	Medium	Low	MWA
	Timber usage Timber should be sourced from well-managed forests i.e. FSCTM certification.	High	Medium	MWA
	Construction Indoor Air Quality (IAQ) Management Plan Implement a Construction IAQ Management Plan to ensure that ventilation systems are not contaminated from construction activities.	Medium	Medium	IDCM & MAN
	Document Management System Implement a Document Management System to encourage tidy and digital documentation throughout the design and construction process. This will ensure the ease of transition over to facility management teams.	Medium	High	IDCM & MAN
	Building Information Modelling (BIM) Encourage the design team to discuss and work through the design platform and deliver holistic solution using Building Information Modelling (BIM)	High	High	IDCM & MAN

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Usage of modular and standardised components Increase the usage of modular and standardised components in building designs to enhance buildability and reduce construction waste. For example, site footprint in Hong Kong is usually small, using modular and standardised components can shorten the construction time, in addition to reducing environmental impacts.	Medium	High	MWA
Green Construction	**Integrative Design Process** Early consideration of the integrated building design process, buildability and operational issues to support holistic and cost-effective outcomes of building performance, human health and environmental benefits.	Medium	High	IDCM
Green Construction	**Prefabrication of building elements** Consider prefabrication of building elements in order to reduce material wastage and the amount of on-site waste.	Medium	High	MWA
A&A Works & Revitalisation of Industrial Building to Data Centres	**Reuse of existing building structures** Reuse major elements of existing building structures to help reduce demolition waste, conserve resources and lower the environmental impacts of construction work. For example, this practice is worth applying in converting industrial buildings to data centres, a common development approach in Hong Kong.	New DCs	Medium	MWA

9. Green Data Centre Best Practices – Management and Maintenance

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
An effective management of building and data centre operations and maintenance is the key factor for better environmental performance of the data centres, ensuring the data centres are operating in their maximum sustainable potential.				
Management	**Auditing of existing equipment** An audit of existing equipment should be carried out to maximise any unused existing capability by ensuring that all areas of optimisation, consolidation and aggregation are identified before considering new investments on equipment.	Medium	Medium	MAN
	Environmental Management System Introduce an environmental management system in accordance with international standards, i.e. ISO 14001.	High	Medium	MAN
	Energy Management System Introduce an energy management system in accordance with international standards, such as ISO 50001. Introduce an energy management system to manage the expectations of implementing the green measures, including apportioning energy cost to users. Standards such as ISO50001 and software such as Building Energy Management, DCIM, etc. are good examples of energy management system.	High	Medium	MAN & EU
	Staff training and resources Operation and maintenance staff are encouraged to have sufficient training to acquire updated knowledge and uphold latest requirements on environmental related and energy efficiency best practices.	Medium	Medium	MAN

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
	Staff skills and experience are important factors in successful implementation of energy efficient programs. The qualifications and experience of the management, operation and maintenance staff should be commensurate with the engineering systems, size and complexity of the buildings/data centres.			
	Data Centre building and site operation and maintenance Planned inspection, maintenance and repairing of the building fabric, structure, and external areas are encouraged, in order to enhance safety and reduce environmental impacts, as well as to retain asset value of the data centre and maintain the performance requirements.	Medium	Low	MAN
	Data Centre building services operation and maintenance Proper and efficient operation of the facility infrastructure by operation and maintenance staff are encouraged. A well-planned operation and effective maintenance would maintain higher operation efficiencies, reduce breakdown rate, prolong the operation life of the systems while the system can still meet with the comfort, health, and safety requirements of the building/data centre users.	Medium	Medium	MAN
	Green Cleaning Environmentally friendly cleaning products and procedures should be adopted to protect human health and environmental quality. Using less hazardous cleaning products (e.g. biodegradable, low toxicity, lower VOC emission, reduced packaging, etc.) can minimise harmful effect on cleaning staff and occupants and equipment and help maintaining a good indoor air quality. Furthermore, putting environmental consideration in the first priority when making choice in purchasing cleaning materials and products can reduce related water, waste, and ambient air pollution.	Low	Medium	MAN

10. Green Data Centre Best Practices – Green Disposal

Aspect	Proposed Green Data Centre Practices Proposed Green Data Centre Practices	Implementation Effort	Effectiveness	BEAM Plus DCs Section
Apart from general refuse, disposal of electronic equipment, i.e. obsolete IT equipment and data centre facilities, are expected to have huge environmental impact and should be handled with reference to the following practices				
Green Disposal	**WEEE Scheme** The Producer Responsibility Scheme on Waste Electrical and Electronic Equipment (WPRS) covers regulated electrical equipment (REE). The removal of computers and monitors from the data centre should make use of the Hong Kong government's WEEE scheme.	Low	High	-
	Environmental legislations The removal of equipment including unused UPS battery should comply with relevant environmental legislations such as the Waste Disposal Ordinance CAP 354, ISO 14001	Low	High	-
	Green disposal, policy, practice, plan Providing spaces for collection, storage, sorting and disposal of waste and recovered materials (whole data centre) at prominent locations.	Low	Medium	MWA