CHAPTER 3

ADDRESSING NEW BUILDINGS

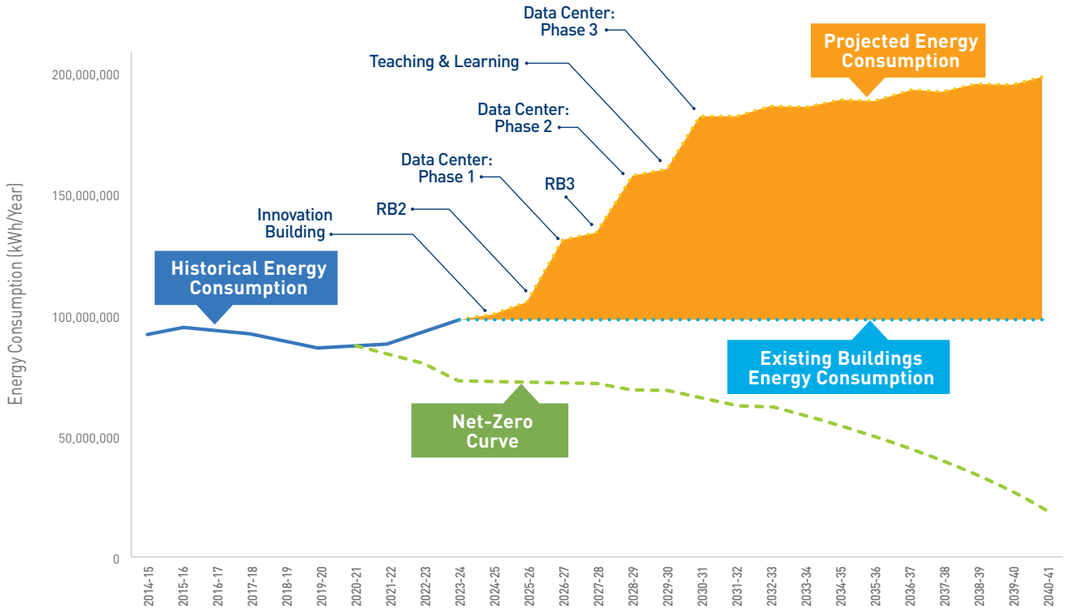
Overview

As a growing campus there is a need to address all of the emissions that will come from the new buildings as they come online. Recognizing that as soon as a new building is completed it becomes part of the existing building inventory, this Action Plan creates a separate strategy for new buildings so that we can address their impacts right from the beginning of the design stage.

The plan for existing buildings is in Chapter 4.

As seen in Figure 3.1, the expected growth of new construction will drive a corresponding increase in electricity consumption over the next two decades. Since electricity is the predominant source of greenhouse gas emissions for the campus, we can estimate the impact of growth on the carbon footprint over time.

Figure 3.1: Understanding the Role of New Buildings in Electricity Impacts

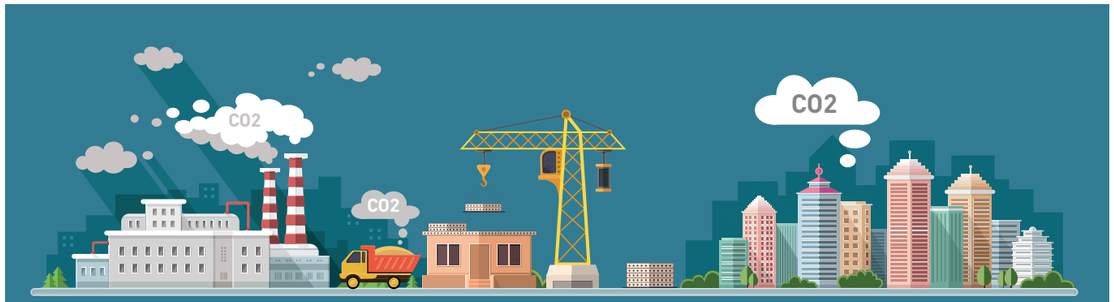


New buildings have two carbon challenges: (1) how they can be constructed in ways that minimize the amount of carbon released during the construction process (also known as "embodied carbon"), and (2) how to design the buildings so that the minimize additional carbon emissions over the life of the building.

Both of these challenges increase the footprint of the campus and make it more difficult to reach the targets. This roadmap contains specific strategies for minimizing these emissions within the HKUST Net-Zero Carbon Building Standards (see Appendix 1). These strategies include a combination of high standards and requirements plus incentives for design teams to act aggressively in reducing carbon in new buildings.

Operational carbon results from the day-to-day use of the building, manly in the form of electricity consumption. Embodied carbon represents the life-cycle emissions released throughout the different phases of construction – from the production of the materials, transportation to the job site, and physical work by contractors to build the structures. Figure 3.2 illustrates the types of emissions that result from the design and construction process.

Figure 3.2: Carbon Emissions from the Construction and Operations Phases



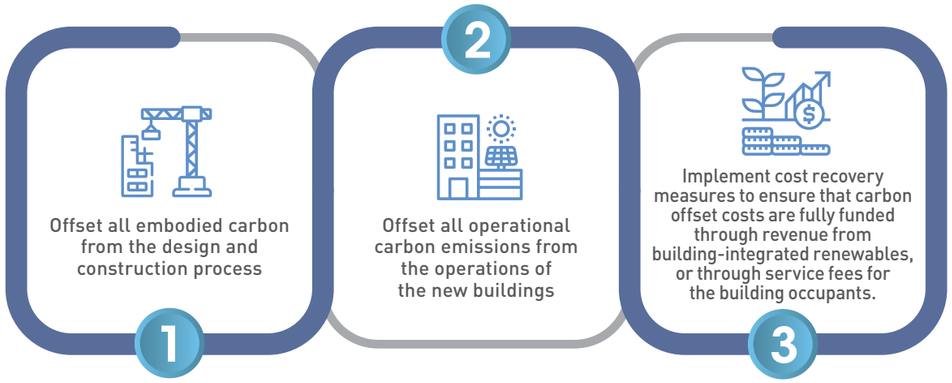
NEED Source

Embodied carbon represents all of the climate impacts that take place before the occupant moves into the building. Today, because buildings are significantly more energy efficient than in the past, the embodied carbon can represent up to half of the associated carbon emissions for a new building over its lifespan.[12] These emissions are categorised as Scope 3 emissions since the third party contractors are responsible for the materials and construction impacts. However, since HKUST has control over the site, the budget, selection of design teams, and approval of all elements within the process, the university is fundamentally accountable for the emissions.

With these considerations in mind, the overarching strategy for new buildings is: **All New Buildings Must Be Designed and Operated as Net-Zero Carbon Buildings**

Three Pronged Approach

To ensure that all new buildings on the HKUST campus are carbon net zero throughout their lifespan, this Action Plan includes 3 action items:



Offset Embodied Carbon from Construction

Throughout the tendering process, from the initial development of the project briefs to the selection of lead design consultants (LDCs), the focus on net-zero carbon shall be infused into the processes. Utilizing the HKUST Net-Zero Building Standards (see Appendix 1), all stakeholders will be accountable for finding the least carbon intensive designs and material selections for the new building.

During the construction stage, it is likely that new buildings will result in embodied carbon that must be counted and addressed as offsets. In these cases, overall amount of embodied carbon can be converted to cost using the carbon cost data table (see Chapter 2). These costs must be included in the capital budget and paid as a project fee. This provides an additional incentive for designers to reduce the embodied carbon as much as possible in order to preserve more funds for building features.

The Net-Zero building requirement comprises two elements (refer to Figure 3.3):

Figure 3.3: Understanding the Role of New Buildings in Electricity Impacts

1. **Performance-based targets**, including embodied carbon in the construction process, and operational targets for energy and water post-occupancy.
2. **Comply-or-explain requirements** containing sustainability design strategies that shall be evaluated for each project. Non-compliance will require justification in the form of a technical feasibility study containing calculations, drawings etc.

HKUST's strategy is to invest in the reduction of greenhouse gas emissions in all capital projects so that both embodied carbon and emissions from future operations are brought to zero, or as close as possible.

Embodied Carbon Performance Target:

The maximum amount of embodied carbon shall be 500 kg CO2e/m2 of Construction Floor Area for the superstructure portion (stages A1 to A3) as well asthe construction process (stages A4 to A5). This is aligned with the latest new construction at HKUST.

Embodied carbon includes both (1) the carbon from the life cycle of product materials and equipment (e.g., concrete, steel), and (2) the emissions resulting from the construction process (e.g., use of large machinery). The emissions from the construction process must be included in the embodied carbon calculations. However, recognizing the limited nature of LCA databases and available information on building supplies, embodied carbon from the life cycle of materials will be calculated by including the following elements over time:

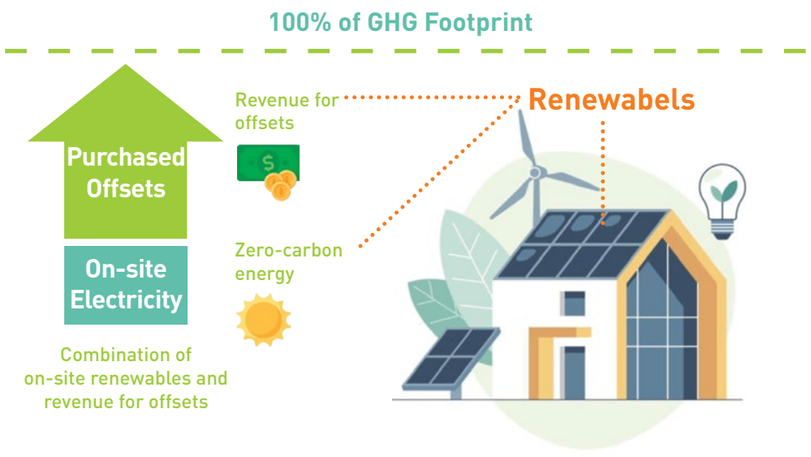
2023-2030	Core building and shell (superstructure, glazing, cladding, and wiring)
2031-2035	Core building and shell, plus MEC equipment, selected finishes
2035 onward	All building elements, including interior and exterior furnishing

Offset all Operational Carbon

The moment HKUST students and staff move into the new building, the emissions become operational. For the new building to be net-zero carbon over time, two things must happen; (1) the building should be generating as much carbon-free electricity as possible through the installation of renewable resources, and (2) any revenue generated by the renewable resources must be sufficient to cover the costs of purchasing approved carbon removal offsets. Ideally, these two measures will cover 100% of the carbon emissions, making the building a sustainable net-zero building over time.

Operational Performance Target:
GHG emissions from energy consumption must be offset by the revenue/avoided costs from building integrated zero carbon renewable energy production.

Figure 3.4: Net-Zero Carbon New Building



Cost Recovery to Ensure Net-zero Buildings

There may be special cases where buildings may not be able to cover the entire GHG burden with integrated renewables plus renewable-generated revenue. Large lab buildings or data centers are examples. In these cases, the buildings must be designed with cost recovery measures that charge the users for the services within the building, including carbon fees as part of the overhead cost recovery fee.

For example, in order to maximize the efficiencies of new data centers, the designs focus on a centralization model where the university purchases all of the equipment, pays for the electricity, and covers the costs of the maintenance. Researchers will no longer need to purchase their own servers or computing equipment, bit rather will utilize the data centers through a fee-based model that recovers all overhead. In this case, the carbon fees will be one of the line items in the overhead charges.

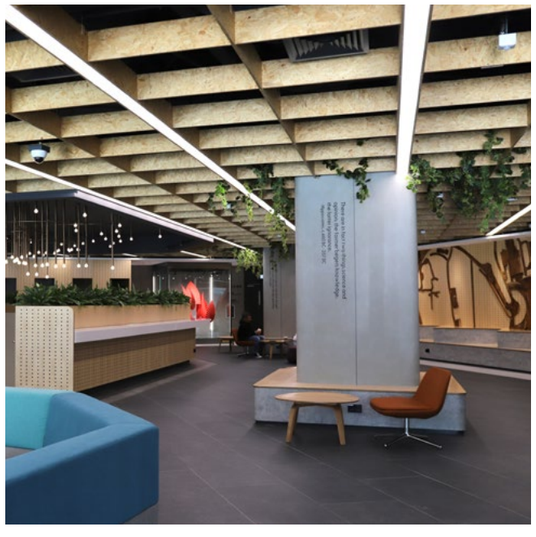
Note on Carbon Fees from New Buildings and Purchase of Offsets

As noted in Chapter 2, the self-assessed carbon fees will be used to pay for high quality carbon offsets as aligned with the Oxford Principles for Net Zero Aligned Carbon Offsetting. Unfortunately, the current state of global offsetting markets is relatively immature, making it absolutely imperative that any offsets purchased by HKUST must be of the highest quality and veracity.

Verifying offsets ensures that the emission reduction or carbon removal actually takes place, and that all forms of double-counting, including double-claiming of the emission reduction benefit, are avoided.[13]

The purchase of verified offsets should be completed by the completion of the construction phase, and sufficient to cover the embodied carbon released in all stages from A1 through A5. Thereafter, the revenue from on-site renewables will go to the purchase of verified offsets at the end of each academic year based on the carbon footprint of the building. The calculations will be determined by the Campus Management Office and verified by the Sustainability / Net-Zero Office. After confirmation by the Sustainable Operations Executive Committee (OpCo), the purchase of the offsets will be completed by either the Finance Office, or the Sustainability / Net-Zero Office on behalf of the FO. More information on the governance structure is included in Chapter 9.

Buildings as Carbon "Sinks"



One of the exciting developments in the building industry is a focus on utilizing buildings themselves as ways of absorbing carbon dioxide and trapping it for the duration of the life of the building. New research is focusing on specific building materials like bricks and masonry where the materials can be manufactured in ways that carbon dioxide is absorbed during the curing process. Structural timber is another promising avenue whereby steel and concrete is replaced by engineered timber panels that replicate the same strength and functionality while simultaneously reducing overall carbon. As this research progresses, we anticipate that newer buildings may have additional opportunities to reduce or even eliminate embodied carbon over time. HKUST has strength in many of these research fields, and this road map anticipates active participation from our research initiatives that can contribute positively to future new low carbon buildings. More details on stimulating low-carbon research in Chapter 5.

Appendix 1

HKUST Net-Zero Building Standards

These standards form part of all Consultants' briefs and the benchmarks shall be included in all contracts and subcontracts.

Application

These standards set benchmarks for the minimum **performance** for all new capital projects and major existing building alterations and additions over 5000 square meters. They shall be included in all Requests for Proposals issued and form an integral part of contracts for design consultants and contractors. The benchmarks shall be included in all contracts and sub-contracts where applicable.

First Created: 2015 (formerly known as HKUST Design Principles and High Performance Building Standards

Last Reviewed: January 2024

Table of Contents

1 HKUST Sustainability Objectives

1.1 Mission and Vision

The Hong Kong University of Science and Technology (HKUST) strives to be a leader in sustainability, as articulated by the following sustainability mission statement:

HKUST will become a global leader in sustainability education by transforming the Clear Water Bay campus into a carbon-neutral, zero waste, and net-positive environmental impact living laboratory for experiential learning, demonstrating cutting-edge research and sustainable operations within a vibrant and engaged community.

To work towards this vision, HKUST embraces the concept of becoming a "Smart and Sustainable Campus," where our buildings and surroundings are complements to the learning environment, and where cutting-edge technologies, data, and building system information form a bridge between campus operations and learning priorities. HKUST's Smart and Sustainable Campus principles are:

1. Emphasize flexibility in spaces;
2. Anticipate future energy needs and opportunities;
3. Maximize potential for metering, monitoring, and sensors;
4. Embrace the benefits of the surroundings;
5. Design for social interaction; and
6. Integrate potential for student experimentation, research and exploration.

1.2 Net-Zero Carbon Timeline

Recognizing HKUST's net-zero commitment (See HKUST Net-Zero by 2045 Action Plan) and support of the 2015 Paris Agreement and Hong Kong's Climate Action Plan, HKUST has made a commitment to:

- Reach a level of net-zero carbon emissions by 2045 by adopting decarbonization strategies that prioritize aggressive energy reductions, development of campus renewable energy installations, and elimination of climate-warming tracer gases and refrigerants.
- Maximize the generation of renewable energy on campus by looking to extend existing renewable energy methods and by piloting, with an aim to deploy, new types of renewable energy resources.
- Identify carbon capture and sequestration solutions to pilot with an aim towards deployment on campus.
- Use the platform, visibility, and research capacity of HKUST to support efforts of the greater Hong Kong community to reach the same this goal.
- Utilize our unique Sustainable Smart Campus as a Living Lab (SSC) framework for supporting university researchers, faculty, and staff to test innovative ideas and decarbonization measures on site for developing proof-of-concept climate solutions.

Each of these commitments are relevant to the design approaches to new construction on the HKUST campus. These HKUST Net-Zero Building Standards are intended to help design teams and contractors understand how to operationalize HKUST's Net-Zero commitments.

2 Scope of Application

These Standards apply to all new construction and major renovations that impact a space of over 5,000 square meters. For smaller renovations or fit outs, please refer to the HKUST Net-Zero Building Standards. This document represents the requirements of the University and expects all contractors, designers, and consultants to abide by the provisions herein.

These standards identify a minimum level of design and requirements and should be included in all Requests for Proposals issued for new projects and referenced in contracts for design consultants and construction managers. These Standards will be periodically updated and revised.

2.1 Net-Zero New Construction

Recognizing the need to support campus growth while maintaining an achievable path to net-zero, HKUST Net-Zero Carbon by 2045 Action Plan requires all new buildings to be net-zero carbon from construction stages through the end of the operational life of the building. Design consultants are expected to achieve net-zero carbon through the following four strategies:

1. Designers are required to **provide embodied carbon assessments** for new construction. While initial embodied carbon calculations may focus on the superstructure structural elements, these requirements will be refreshed and tightened over time to reduce embodied carbon in new construction.
2. Design consultants and construction contractors must account for **carbon emissions created during the construction process** so they can also be included in the overall embodied carbon footprint.
3. All **embodied carbon emissions must be offset** by purchasing an equal number of carbon removal credits. The purchase of offsets must come from the capital budget.
4. New buildings must reduce energy consumption to the greatest extent possible while simultaneously maximizing renewable energy potential on-site. The **building will reach net-zero emissions** when (1) the renewable generation replaces as much grid-powered electricity as possible, and (2) the revenue generated from the on-site renewables is sufficient to pay for the costs of carbon removal offsets for the remaining emissions.

2.2 Procurement and Life Cycle Cost Analysis

To achieve the best value for money from a net-zero aligned perspective and recognizing the vital importance of procurement in influencing key purchasing decisions, HKUST has adopted a Life Cycle Cost Analysis (LCCA) approach to evaluating costs and benefits over time. This means:

- All energy-consuming and water-consuming purchases and investments must use **Life-Cycle Cost Analysis (LCCA)** to ensure all associated costs of ownership, operation, and end-of-life costs are included in cost-benefit analyses.
- Utilizing an **internal carbon pricing** (ICP) to assign a cost to each ton of carbon emissions, allowing carbon considerations more central to university decision making, de-risking against the future carbon prices, and encouraging the adoption of low-carbon innovations.
- Utilizing **HKUST LCCA and internal carbon pricing spreadsheets and calculators** for decision-making.

3 Reference to Other HKUST Policy Documents

This document shall be read in conjunction with other HKUST policy documents as per table below.

Applicability of HKUST Policy Documents for Different Building Related Procurement

HKUST Policy Documents to be Referenced	Type 1: New Building Construction	Type 2: Existing Building Major Renovations & Interior Fit-outs	Type 3: Minor Renovations & Fit-outs	Normal Departmental Purchases inside Buildings
HKUST Net-Zero Building Standards (this document)	Yes	-	-	-
HKUST Net-Zero Renewal Standards	-	Yes	-	-
HKUST Sustainable Purchasing Requirements For Suppliers and Contractors	Yes	Yes	-	-
HKUST Sustainable Office Standards & Guidelines[1]	-	-	Yes	-
HKUST Operation Guidelines on Sustainable Purchasing[2]	-	-	-	Yes

4 Net-Zero Building Requirements

4.1 Elements

This section outlines the performance-based requirements relating to embodied and operational carbon, renewable energy as well as water consumption. The Net-Zero building requirement comprises two elements:

1. **Performance-based targets**, including embodied carbon in the construction process, and operational targets for energy and water post-occupancy.
2. **Comply-or-explain requirements** containing sustainability design strategies that shall be evaluated for each project. Non-compliance will require justification in the form of a technical feasibility study containing calculations, drawings etc.

Key Elements of Net-Zero Building Requirements

4.2 Performance-Based Requirements for Embodied Carbon

4.2.1 Approach for Embodied Carbon

HKUST's strategy is to invest in the reduction of greenhouse gas emissions in all capital projects so that both embodied carbon and emissions from future operations are brought to zero, or as close as possible.

Embodied Carbon Performance Target:

The maximum amount of embodied carbon shall be 500 kg CO2e/m2 of Construction Floor Area for the superstructure portion (stages A1 to A3) as well as the construction process (stages A4 to A5). This is aligned with the latest new construction at HKUST. By 2031, this maximum amount shall include building services equipment and selected finishes, and by 2035, this will be expanded to include all interior finishes as well.

Embodied Carbon Included in Emissions Calculations

Recognizing limitations of available data, the materials required for inclusion in embodied carbon calculations will increase over time, reflecting the anticipation that LCA databases will become more robust and complete.

2023-2030	Core building and shell (superstructure including glazing, cladding, external doors and internal walls)
2031-2035	Core building and shell (superstructure), plus building services equipment, and selected finishes
2035 onward	All building elements, including interior and exterior furnishing

4.2.2 Life Cycle Analysis for Embodied Carbon

HKUST has adopted a life cycle approach to analyze the long-term costs and benefits of capital project decision-making. Assessing the embodied carbon relies on life cycle analysis to determine the overall climate impacts of building materials.

- **Software:** HKUST uses One-Click LCA and the HK Construction Industry Council Carbon Assessment Tool. Although our performance requirements only relate to stages A1 to A3 (raw material extraction and supply, transport to manufacturing plant, manufacturing and fabrication), data for stages A4 to A5 (transport to project site, construction and installation process) shall be tracked and disclosed.
- **Area:** The definition of "area" shall refer to construction floor area and "superstructure" shall include frame, upper floors, roofs, stairs and ramps, external walls (façade), windows and external doors, internal walls (structural and non-structural) and partitions and internal doors. Refer to RICS Whole Life carbon assessment for the built environment for further breakdown of building elements to be included.
- **Quantities:** Material quantities shall follow the project cost plan / bill of quantities, the BIM model, be estimated from drawings, or delivery receipts.
- **Carbon emission factors:** Carbon emission factors shall refer to database from these sources in order of priority - 1) actual product data such as from Environmental Product Declarations or CIC Green Product Certification from suppliers where available, or other local generic data from 2) CIC Carbon Assessment Tool, or 3) OneClick LCA (use

local generic data where available or next closest overseas generic data).

- **Submission schedule**: At the end of each design stage, calculations for embodied carbon stages A1 to A3 shall be submitted. During the construction stage, calculations for stages A1 to A5 shall be submitted every 3 months. A final as-built embodied carbon report for stages A1 to A5 shall be submitted after Occupation Permit stage.

4.2.3 Training Resources

HKUST has developed a series of training resources for practitioners in the building sector to help build skills and awareness of using life cycle analysis software, life cycle costing calculators, and other relevant materials. These resources, developed by HKUST's Life Cycle Lab[3], are available for free, and all contractors are strongly encouraged to become familiar with them so that they can provide the life cycle information as expected by HKUST for capital projects.

4.3 Performance-Based Targets for Operational Carbon

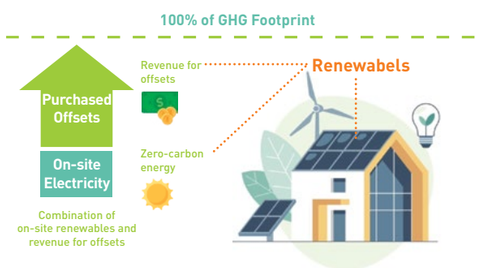
4.3.1 Approach for Operational Carbon

With new buildings expected to last for many decades past our 2045 net-zero target, all new buildings must be designed to the highest efficiency level possible to reduce the carbon burden on the larger campus footprint. Since each building is unique, the performance target for new buildings is simple:

Operational Performance Target:

GHG emissions from energy consumption must be offset by the revenue / avoided costs from building integrated zero carbon renewable energy production.

Making New Buildings Net-Zero Carbon



All greenhouse gas emissions from the operations of the building over time must be offset through either the purchase of high-quality carbon offsets (in alignment with The Oxford Principles for Net Zero Aligned Carbon Offsetting) or by contributing an equal amount into an HKUST carbon reduction fund. To limit carbon offset costs, designers should maximize the amount of on-site renewables while simultaneously employing aggressive energy reduction strategies.

When the revenue from renewables equals the costs of buying offsets, HKUST considers the building to be net-zero carbon.

- **Types of carbon offsets:** Renewable energy shall be creatively placed to maximize the outputs using means such as solar panels on paving / roof trellis / car park roofs, and/or micro-turbines harvesting wind / kinetic / wave energy. Carbon sequestration such as biochar, algae, and/or carbon scrubber shall also be explored. Sub-metering shall be in place to track the renewable energy generated and carbon dioxide sequestered.
- **Costing assumptions:** Shadow cost of carbon offsets, earnings from renewable generation, efficiency gains, derating of equipment, feed-in-tariff rate and building life span shall be based on latest HKUST calculator.

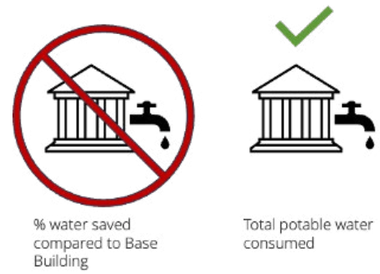
4.3.2 Energy Modelling for Operational Carbon

- **Software:** To estimate the operation carbon, energy modelling using an ASHRAE recognized software shall be used.
- **Occupancy rate:** Occupancy rates shall be based on operating hours of the space type, reduced occupancy during school holidays, and diversity based on typical usage.
- **Weather file:** Weather file (eg. epw) used shall be based on a moderate future climate change scenario for RCP4.5 (2.7°C). This shall include temperature, humidity and solar irradiation.
- **System:** The entire building services system shall be modelled using equipment efficiency from tender and as-built stages.
- **Submission schedule:** At the end of each design stage, calculations for operational carbon shall be submitted. A final as-built operation carbon report based on as-built equipment shall be submitted after Occupation Permit stage.

4.4 Performance-Based Targets for Potable Water

The performance goal for potable water consumption shall be measured against an overall target of net-zero potable water for the building measured on an annual basis (instead of a comparison to a base building).

Focus on Actual Water Consumption



Designers should consider how alternative sources of water (such grey water, rainwater, A/C condensation water, filtration-reject water, and water from other reuse strategies) can be used within the building as well as outside of the building (using the campus) so that potable water consumption is offset.

Net-zero water is achieved when the total amount of alternative water produced from the building and used on campus offsets the amount of potable water consumed by the building.

4.5 Independently Verified Green Building Standards (BEAM Plus)

BEAM Plus Platinum: The Platinum Standard of performance for BEAM Plus shall apply. BEAM Plus[4] is Hong Kong's green building tools developed by Hong Kong Green Building Council. The tool covers sustainability performance criteria relating to planning, design, construction, commissioning, fitting out, management, operation and maintenance of a building, and is aligned with local regulations, standards and codes of practice. A pre-requisite of BEAM Plus requires the project demonstrate performance improvement or at least compliance based on the latest edition of Building Energy Code[5].

4.6 Comply-or-explain Requirements

4.6.1 Approach for Comply-or-explain Requirements

Based on the pain points faced by the users of our existing buildings, these requirements encapsulate our challenges beyond carbon. These are specific built elements that go beyond standard building specifications and will become the best practice standards tailored to HKUST's needs and operational policies. They shall be evaluated for each project. Non-compliance will require justification in the form of a technical feasibility study containing calculations, drawings etc.

To align with BEAM Plus Platinum requirement and based on university priorities, the following sections reference specific BEAM Plus credits that must be met, **PLUS additional criteria to address HKUST's specific needs.**

4.6.2 Integrated Design and Construction Management

a) IDCM 3 Integrated Design Process

(a), (b), (c) Early consideration of integrated building design, buildability / constructability, operation and maintenance: Achieve 4 BEAM Plus credits for integrated design process, multi-disciplinary design charrette, early-stage consideration of buildability / constructability and design consideration for operation and maintenance.

Comply with additional criteria below:

Integrated design charrettes: At least 3 integrated design charrettes are required, the first of which should happen at the time of project kickoff and prior to the end of Schematic Design. Charrettes should include tracking of project goals and analyzing the life cycle cost impacts of potential design options. Charrettes should include representation of major stakeholders including occupants and operations staff. Project stage review reporting should include sustainability components to ensure that issues can be addressed early in the design process. It should provide an update on all elements of the standards and focus on how sustainability aspirations will be addressed through next stage review.

b) IDCM 4 Life Cycle Costing

Life cycle costing: Achieve 1 BEAM Plus credit for conducting life cycle costing for active systems.

Comply with additional criteria below:

Energy and water consuming systems: Include all energy-consuming and water consuming products and systems. Calculator resources and templates will be available on the HKUST Life Cycle Lab[6] website.

c) IDCM 5 Commissioning

(a), (b), (c), (d) Commissioning authority, review report and reports: Achieve 4 BEAM Plus credits through appointing independent commissioning authority (independent from design consultant or contractor), providing commissioning plan and commissioning review report.

Comply with additional criteria below:

Involvement throughout project: A HKUST-appointed commissioning agent is required during design, construction and occupancy for all building projects, and must be present from the very beginning of the design process.

d) IDCM 7. Measures to Reduce Site Emissions (SDG 14: Life below Water) (SDG 15: Life on Land)

(a), (b), (c), (d) Minimization of air / noise / water / light pollution (excluding bonus credits): Achieve 4

BEAM Plus credits for providing adequate mitigation measures during construction.

Comply with additional criteria below:

Low carbon power supply: Where non-grid power supply is used, adopt low carbon alternatives to reduce on-site emissions and environmental impact.

e) IDCM 8 Construction and Demolition Waste Recycling (SDG 12: Responsible Consumption and Production) (SDG 14: Life below Water) (SDG 15: Life on Land)

(a), (b), (c), (d) Construction and demolition waste recycling (including bonus credits): Achieve 1, plus 2 additional bonus BEAM Plus credits for 60% recycling level for construction waste and another 1, plus 2 additional bonus BEAM Plus credits for demolition waste where applicable.

Comply with additional criteria below:

Site waste management plan: Provide a Site Waste Management Plan how to minimize waste and valuable resources so they are not disposed of in landfills and most waste is sorted at all stages during a construction project.

f) IDCM 13 Digital Facility Management Interface

Digital interface: Achieve 1 bonus BEAM Plus credit for providing digital interface with energy use breakdown such as energy use intensity, HVAC equipment, lifts and escalators.

g) IDCM 14 Occupant Engagement Platform

Digital platform: Achieve 1 bonus BEAM Plus credit for providing a digital platform to engage building occupants.

h) IDCM 16 BIM Integration

(a), (b) Coordinated use of BIM within design and construction teams: Achieve 1 plus 1 additional bonus BEAM Plus credit for coordinated use of BIM within Design and Construction Teams.

Comply with additional criteria below:

Use of BIM for sustainability data: Use BIM to assist with life cycle costing, embodied carbon calculations, estimate greenhouse gas (GHG) emissions, and facilitate future measurement and verification.

i) DCM 17 Design for Engagement and Education on Green Buildings

Education elements (including bonus credit): 1 additional Bonus BEAM Plus credit for providing four (4) education elements on strategies and solutions applied to the green buildings.

Comply with additional criteria below:

Access for research: Designers should examine the feasibility of including demonstration of embedded systems and technologies as educational projects – such as low-level renewables easily visible and accessible for students as learning tools, and available/real-time data for students to conduct analysis and study – and research projects from HKUST scholars, who can also have their projects prominently displayed to explain the theories and applications of their work.

4.6.3 Sustainable Site (SDG 13: Climate Action)

a) SS 6 Light Pollution Control

(a) Control of obtrusive artificial light: Achieve 1 BEAM Plus credit for demonstrating that the obtrusive artificial light from exterior lighting meets the specified performance for the environmental zone in which the building development is located.

(b) Control of external light reflection from building: Achieve 1 BEAM Plus credit for demonstrating that the sunlight reflection from external surfaces of the buildings is controlled by using materials with acceptable external light reflectance.

b) SS 8 Urban Heat Island Mitigation

(a) Shade and high-albedo materials: Achieve 1 BEAM Plus 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 colored high-albedo materials (albedo of at least 0.4).

(b) Tree coverage: Achieve 2 bonus BEAM Plus credits for at least 10% of the total site area is provided with tree coverage.

(c) Air Ventilation Assessment: Achieve 2 BEAM Plus credits for demonstrating that better or equivalent ventilation performances compared to the baseline case under annual and summer wind condition.

(d) Intra urban heat island study: Achieve 2 bonus BEAM Plus credits for conducting an Intra Urban Heat Island Study demonstrating that a maximum Intra-Urban Heat Index in summer is less than 0.8°C.

c) SS 9 Immediate Neighbourhood Wind Environment

Wind amplification: Achieve 1 BEAM Plus 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.

d) SS 10 Outdoor Thermal Comfort

(a) Shaded or covered routes: Achieve 1 BEAM Plus credit for providing at least one shaded or covered route connecting the site with nearby amenities / site main entrance / transport hub.

(b) Passive open spaces with thermal comfort: Achieve 1 BEAM Plus credit where 50% or more of the passive open spaces and pedestrian zones achieve thermal comfort on a typical summer day at 3pm in Hong Kong.

Comply with additional criteria below:

Shelters minimizing direct solar radiation: Shelters shall minimize direct solar heat gain eg. Opaque. Designs shall prioritize the use of these shelters for solar energy generation.

e) SS 11 Stormwater Management

Stormwater management (including bonus credit): Achieve 2 BEAM Plus credits, plus 1 additional bonus BEAM Plus credit for demonstrating that adequate stormwater management design measures have been provided to cater the total volume of runoff for one hour corresponding to a design rainfall of at least 40mm/ event for the site in its post-developed conditions.

f) SS 12 Design for Climate Change Adaptation

Design for climate change adaptation (including bonus credits): Achieve 1 bonus BEAM Plus credit 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. Achieve 1 additional bonus credit for including quantitative calculation to support the resilience design which is technically eligible and cost effective.

Comply with additional criteria below:

Extreme weather events: Other than temperature, rainfall and water level rise / storm surge, to include forest fire, typhoons.

Mosquito control: Provide mosquitoes screens for operable windows. Ensure there is well drained soil / roofs / paved surfaces to prevent water ponding during large rainfalls. If water bodies are provided, ensure no standing water. Plants chosen shall not allow water ponding on its surfaces.

Underground facilities: Ensure that underground facilities are not fully enclosed to reduce risk to occupants and staff.

4.6.4 Materials and Waste (SDG 12: Responsible Consumption and Production)

a) MW4 Design for Durability and Resilience

a) Building material selection appraisal: Achieve 1 BEAM Plus credit for appraisal report to evaluate durability of at least 3 building materials.

(b) Protecting vulnerable parts of the building from damage: Achieve 1 bonus BEAM Plus credit for providing suitable protective measures to prevent damage to vulnerable parts.

(c) Protecting exposed parts of the building from material degradation: Achieve 1 bonus BEAM Plus credit for incorporating appropriate design and specification measures to limit material degradation due to environmental factors.

b) MW 5 Sustainable Forest Product

Sustainable timber (including bonus credits): Achieve 1, plus 1 additional bonus BEAM Plus credit for 100% timber and composite timber products from sustainable sources / recycled timber.

c) MW 6 Recycled Materials

(a) Outside surface works and structures: 1 BEAM Plus credit where at least 10% of all materials used for site exterior surface works, structures and features with recycled content.

(b) Building façade and structural components (excluding bonus credits): 1 BEAM Plus 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%.

(c) Interior non-structural components (excluding bonus credits): 1 BEAM Plus credit where at least 10% of all materials used for interior non-structural components are materials with recycled content.

d) MW 7 Ozone Depleting Substances

(a) (b) Refrigerants and ozone depleting materials: Achieve 2 BEAM Plus credits through selecting refrigerant with ozone depletion and global warming potentials within threshold, and products in building fabric and services without ozone depleting substances.

e) MW 8 Regional Materials

Regional materials (including bonus credits): Achieve 1, plus 2 additional bonus BEAM Plus credits for using 50% or above of all building materials used in the project.

f) MW 9 Certified Green Products

(a) Certified green products (excluding bonus credits): Achieve 2 BEAM Plus credits 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).

Comply with additional criteria below:

HKUST sustainable purchasing policies: In compliance with HKUST Sustainable Purchasing Requirements for Suppliers and Contractors and HKUST Operation Guidelines on Sustainable Purchasing[7].

g) MW 10 Life Cycle Assessment

Life cycle assessment: 1 BEAM Plus credit for demonstrating the embodied energy in the major elements of the building structure of the building has been studied and optimized through a Life Cycle Assessment (LCA).

Refer to Section 4.2.

h) MW 11 Adaptability and Deconstruction

(a) (b) Spatial adaptability and flexible engineering services (excluding bonus credits): Meet BEAM Plus credit requirements for designs providing both spatial flexibility and flexible design of services that can adapt to changes of layout and use.

Comply with additional criteria below:

Daylight and views: Consider natural sunlight and views in layout of spaces, and ensure that partitions can be shifted and adjusted to maximize the views, sunlight, and natural ventilation.

4.6.5 Energy Use (SDG 7: Affordable and Clean Energy) (SDG 13: Climate Action)

a) EU 1 Low Carbon Passive Design

HVAC load reduction, natural ventilation and daylight: Achieve 4 BEAM Plus credits either using prescriptive or performance path to optimize built form orientation and spatial planning, providing external shading devices, and space layout for daylighting provision.

Comply with additional criteria below:

Other surfaces: To create thermal breaks, provide heat gain mitigation for roofs, cooling tower, window / door frame, chilled water pipes, metal roofs, tanks on roofs, solar panel frames.

b) EU 2 Reduction of CO2 Emissions

Residential Buildings

Building envelope: Achieve 1 BEAM Plus credit for residential buildings which requires RTTV wall to be reduced by at least 10%, RTTV roof to be reduced by at least 50%, OTTV RRF, lower (if applicable) to be reduced by at least 10%, OTTV RRF, podium (if applicable) to be reduced by at least 40%.

Natural ventilation: Achieve 2 BEAM Plus credits for at least 40% of normally occupied space (habitable space) to satisfy the ventilation requirements.

Non-Residential Buildings

Building envelope: Achieve 1 BEAM Plus credit for OTTV non-residential tower to be reduced by at least 10%, OTTV non-residential podium to be reduced by at least 40%.

Refer to Sections 4.3.

c) EU 3 Peak Electricity Demand Reduction

Reduction of peak electricity: Achieve 3 BEAM Plus credits for at least 15% reduction of peak electricity demand.

Comply with additional criteria below:

Reduction of peak electricity demand charge: Adopt low carbon solutions (e.g. energy storage) to reduce peak electricity demand charge. Consider battery back-up power options instead of gensets to allow for more flexibility in utilizing load shifting strategies.

Refer to Sections 4.3.

d) EU 4 Metering and Monitoring

(a), (b) Fundamental metering and monitoring / metering for tenanted areas (including bonus credits): Achieve 1 plus 2 bonus BEAM Plus credits for providing energy monitoring system and performance auditing monitoring system for equipment and systems in spaces, and allowing monitoring provision of tenants' energy consumption.

Comply with additional criteria below:

Energy consumption monitoring: Sub-meters for major energy consuming equipment e.g. lab fridges and equipment, and renewable systems shall be provided.

Function and location: Demonstrate meter placement by occupancy and tenancy. Sub-metering and zone demarcation shall facilitate occupancy controls and user charging schemes in relation to energy and water use and waste generation.

Access for research: Ensure meters are in place, pipework is accessible, and data and dashboard are open source to facilitate research by researchers and students. Data shall have the ability to be seen and downloaded by all interested users (students, faculty, and FMO staff).

Usage pattern: Design for sensors and people counters so that the building can track the flow of people coming and going at different times of the days, and integrate the data into building management, security, and space optimization strategies.

e) EU 8 Energy Efficient Appliances

Certified electrical appliances: Achieve 2 BEAM Plus credits for having more than 80% total rated power of appliances certified Grade 1 under Mandatory and Voluntary Energy Efficiency Labelling Scheme for residential buildings.

Comply with additional criteria below:

For all buildings, have 100% of appliances certified Grade 1 under Mandatory and Voluntary Energy Efficiency Labelling Scheme, or most energy efficient rating of an equivalent certification scheme for electrical equipment.

Refer to HKUST Sustainable Purchasing Requirements for Suppliers and Contractors and HKUST Operation Guidelines on Sustainable Purchasing .

4.6.6 Water Use (SDG 6: Clean Water and Sanitation)

a) WU 1 Annual Water Use, WU 3 Water Efficient Appliances and WU 7 Effluent Discharge to Foul Sewers

(a) (b) Potable water reduction: (including bonus credits) Achieve 3 plus 1 additional bonus BEAM Plus credit for at least 40% annual water savings.

Water efficient appliances: Achieve at least 1 BEAM Plus credit for washing machines provided in all residential units to be at least Grade 1 under WELS standard.

Sewerage volume reduction: Achieve 1 BEAM Plus credit for reduction in annual sewage volumes by 20% or more.

Comply with additional criteria below:

Toilets: All facilities should meet Hong Kong Water Efficiency Labelling Scheme (WELS) Grade 1 standard for equipment, or US-EPA WaterSense[10] criteria if there is no WELS standard.

Water use monitoring: Water consumption sub-metering for potable water use shall be provided.

Refer to HKUST Sustainable Purchasing Requirements for Suppliers and Contractors and HKUST Operation Guidelines on Sustainable Purchasing .

b) WU 2 Water Efficient Irrigation

No potable water for irrigation (including bonus credit): Achieve 2 plus 1 additional bonus BEAM Plus credit for 100% reduction in potable water consumption for irrigation.

Comply with additional criteria below:

Water efficient planting: No potable or well water should be used for landscaping purposes (except within first 2 years to help establish the plantings). Native species and/or drought-tolerant plants shall be adopted to minimize water use.

Water use monitoring: Water consumption sub-metering for irrigation shall be provided.

c) WU 3 Water Efficient Appliances

Water efficient appliances: Achieve 1 BEAM Plus credit for installing water efficient appliances that achieve Grade 1 under the WSD's Water Efficiency Labelling Scheme for residential buildings.

Comply with additional criteria below:

For all buildings, have 100% of appliances certified Grade 1 under WSD's Water Efficiency Labelling Scheme, or most water efficient rating of an equivalent certification scheme for water consuming equipment.

Refer to HKUST Sustainable Purchasing Requirements for Suppliers and Contractors and HKUST Operation Guidelines on Sustainable Purchasing .

d) WU 6 Cooling Tower Water

Cooling tower water use: Achieve 1 BEAM Plus credit for achieving 7 or more cycles of concentration with acceptable water quality.

Comply with additional criteria below:

Water use monitoring: Water consumption sub-metering for cooling tower including makeup and blowdown lines shall be provided.

Water loss controls: Measures to eliminate water loss from drift.

Water usage controls: Sensors and automated controls to control water use based on actual requirements.

e) WU 8 Water Harvesting and Recycling

(a), (b) Water reuse (including bonus credit): Achieve 2 BEAM Plus credits, plus 1 bonus BEAM Plus credit for harvested rainwater and recycled grey water to achieve at least 10% or more potable water reduction.

Comply with additional criteria below:

Air conditioning condensate water reuse: Condensate water from air conditioning systems is not allowed to go into the sewer or wastewater piping. Water derived from air conditioning condensation can be used for irrigation, toilet flushing, or other grey water purposes. Further, since the temperature of the water is generally colder than general potable water, effort should be made to recycle the water into cooling towers or other means for exchanging heat. Sub-metering shall be in place to track water reuse.

Other water reuse: Rainwater and cooling tower bleed-off reuse shall be maximized wherever possible. Sub-metering shall be in place to track water reuse.

Refer to Section 4.4.

4.6.7 Health and Wellbeing

a) HWB 1 Healthy and Active Living

Healthy and active elements (including bonus credit): Achieve 1 bonus BEAM Plus credit for at least 3 items of all applicable design measures for healthy and active living.

4.6.8 Landscaping and Biodiversity (SDG 15: Life on Land)

- **Site ecology:** Demonstrate how to enhance the ecological value of the site. Adopt measures such as use of surface water, native and edible planting, avoidance of polluting treatments and materials, avoid need for irrigation. The design team must show evidence of how plants and trees are used as part of

a wider ecological strategy including solar shading and water processing and retention for "sponge city" benefits. There are a range of opportunities to integrate natural environment with overall building ecology providing amenity and environmental benefits.

- **Existing plant protection:** For plants on existing sites, identify, monitor and protect plant species listed in the IUCN Red List, Forestry Regulations Cap. 96A[13], and Protection of Endangered Species of Animals and Plants Ordinance Cap. 586 (Schedule 1)[14] to ensure their preservation and promote species recovery, particularly Diospyros vaccinioides.
- **Land conservation and restoration:** Use land sustainably through conservation and restoration. Implement compensatory planting proposal of a ratio not less than 1:1 in terms of number as per Lands Department mandatory requirements for preparing Tree Preservation and Removal Proposal[15], preferably within the existing site boundary. If constraint by space, compensatory planting shall be in a suitable location within HKUST boundary. Consider height of compensatory trees in ways that maximize their value on campus *e.g., small trees should be used where we want to preserve sight lines to the waterfron, and larger shade trees around pathways and roadways.
- **Native species:** Prioritize native species (more than 50%) in planting and landscaping to maximize the local biodiversity included in planning and development projects through enhancing ecological value of the landscape and providing habitat and food sources for local wildlife.
- **Invasive species:** Control the impact of alien species, especially avoiding invasive ones, to prevent disruptions to ecosystems and maintain the natural balance.
- **Plants with dual purpose:** New plants have more purposes than one. Investigate areas of planting and landscaping for productive uses. Certain plants are useful for absorbing VOCs and other airborne contaminants, while others are exceptional at releasing oxygen at specific times of the day. Vertical planting on south-facing walls and trees with dense canopies can absorb solar heat during summer months. Bamboo with its high growth rates is good for biochar, carbon sequestration and furniture.
- **Existing saplings:** Where available, existing saplings of native species and exotic species with value shall be transplanted to a suitable site in HKUST.
- **Wood utilization:** Consider the value of trees at the end of their lifespan for lumber use in HKUST projects. Trees felled shall not be in good health and have good amenity value, and shall be cut and sorted for maximum reuse. Tree felling contracts shall meet the below requirements:
  - A crane should be provided to transport 2m long tree trunk / branches to the road, for ease of delivery off-site to HKUST's designated recycler. This allows maximum reuse into timber furniture and interiors.
  - The tree felling contractor should have some experience with tree felling for purposes of manufacturing timber planks for reuse into timber furniture or interior works.
  - Requirements of size of tree logs
    - Cut lines shall be as close to the bottom of trunk as possible, around 100mm from the ground level.
    - The form of the tree fork shall be kept.
    - Wood logs shall be kept not less than 1.5 meters long, preferably over 2m.
    - Curved part shall be cut through to keep the wood log straight.
    - The length of the wood log should not exceed the container length of the grab lorry / crane lorry.
  - All other smaller diameter tree branches (under 200mm diameter) should be sent to Y-Park for recycling.
- **Exposed services:** Pipework shall always be buried to maximize ground area for other usage.

4.6.9 Occupancy Controls and Thermal Comfort (SDG 7: Affordable and Clean Energy)

Opportunities for further energy savings are presented at HKUST owning to its variability of usage during term time and term break. Flexibility in building services controls also needs to be ensured due to frequent changes in space usage during the lifespan of the building, as well as operation hours. The campus is also prone to condensation due to its high humidity, strong winds and infiltration as a result of its public nature.

- **Control logic:** Occupancy controls for ventilation, cooling and lighting shall have overwrite function for always on during occupancy, and facilitating partial use of the space, and reduced occupancy during school holidays.
- **Variable equipment:** Equipment shall be variable air volume or flow to allow occupancy controls.
- **Enhanced ventilation:** For air-conditioned spaces, enhanced ventilation shall be provided to increase temperature set points for energy savings, reduce condensation risk and cater to varying user requirements to enhance thermal comfort satisfaction (e.g. through mechanical or ceilings fans).
- **Infiltration control:** At entryways, balconies, lift shafts, and staircases, adopt infiltration control and/or airlocks to prevent humid air entering and cooled air escaping.
- **Mold growth and condensation prevention:** Introduce adequate ventilation for staircases, lobbies, corridors to prevent mold growth and condensation.

4.6.10 Sustainable Smart Campus as a Living Laboratory (SDG 7: Affordable and Clean Energy)

HKUST's campus as a "Living Lab" helps to facilitate home-grown novel solutions and proofs of concept for net-zero approaches and technologies. The Living Lab approach will transform our campus into a testing ground for ambitious solutions that will support

our Net-Zero goal. The near-term deliverables will be the development of a framework for HKUST researchers, faculty, and staff to test innovative ideas and decarbonization measures focused on energy conservation measures, renewable energy generation, and carbon removal and sequestration.

It is HKUST's expectation that design consultants will, from time to time and when requested, work with HKUST research teams to explore how new research approaches can be integrated into new building designs.

Examples of HKUST research that may be relevant in the design process:

- **Decarbonization research and development:** HKUST has teams working on the development and application of decarbonization through small scale introduction of the following technologies:
  - Carbon storage in materials eg. biochar blocks, carbon dioxide embedded pavers / blocks / reinforced concrete, bamboo or other timber;
  - Carbon dioxide scrubber;
  - Carbon sequestration eg. biochar, algae, bamboo;
  - Direct air capture.
- **Future renewable provision:** Anticipating that all exterior surfaces (including vertical surfaces, windows, and doors) that have solar exposure will be utilized in the future for energy generation, HKUST researchers are actively exploring new techniques. Design consultants should incorporate in conduit channels and other means for making it easy to access these areas for electrical wiring, and ensure structural loading is sufficient for future solar panel additions.
- **Lower current power systems for renewables:** Considering an emerging area of research looking at how buildings may be converted to be DC powered for greater efficiency, design consultants shall consider how to isolate certain systems (e.g., lighting) so that they can be served by lower current power systems (e.g. direct current) as renewables are added to the building.

5 Deliverables

Checks are in place throughout the building project stages to ensure that the minimum standards can be met. Refer to table below. This facilitates the building of a database to allow future sustainability performance to be benchmarked and targets to be set.

Submission of Sustainability Data Throughout Building Project Stages

Building Project Stages	Submission Deliverables
Request for Fee Proposal (By Consultants)	• Approach and strategy on how performance requirements for operational carbon and renewable energy can be met • Approach and strategy on how performance requirements for stages A1 to A3 embodied carbon can be met • Approach and strategy on how net-zero water use can be met
Schematic Design **Detail Design** **Tender Documentation (By Consultants)**	**At the end of each design stage** • Design calculations with supporting documentation to demonstrate compliance to performance-based requirements. To include operational carbon, stages A1 to A3 embodied carbon, and net-zero water use. (At the end of each design stage) • Design checklists to explain how the requirements are incorporated in the design • Life cycle costing for energy-consuming & water-consuming products & systems
Construction Stage (By Main Contractor)	**Monthly** • Electricity consumption and renewable energy per month (kWh per month) • Water consumption and water reused per month (m3 per month) • Waste generation and waste recycled per month (tonnes or kg per month for each type of waste) **Every quarterly** • Stages A1 and A5 embodied carbon calculations
Occupation Permit (By Main Contractor)	**Within 3 months of obtaining Occupation Permit** • As-built calculations with supporting documentation to demonstrate compliance to performance-based requirements. To include operational carbon, stages A1 to A5 embodied carbon and net-water use • As-built checklists to explain how the requirements are incorporated in the as-built design

Appendix: Net-Zero Buildings Minimum Standards Checklist

The requirements presented in this document is summarized in the form of a checklist for ease of reference by the consultant and construction teams, as well as for compliance checks by HKUST.

A completed checklist shall be submitted at the end of each design stage and within 3 months of obtaining Occupation Permit.

No	Requirement	Ref. Section in Doc	Adopted (Y/N/NA)	Remarks
Performance-Based Targets *Achieves performance goals listed below*				
1	Max. embodied carbon 500 kg CO2e/m2 of CFA for superstructure (stages A1 to A3)	4.2		
2	≥7.5% renewable energy to generate revenue to offset cost of carbon	4.3		
3	Annual alterative water source offsets annual potable water consumption	4.4		
4	BEAM Plus Platinum standard	4.5		
Comply-or-Explain Requirements *Comply with the requirements listed below.* *If not adopted, justification shall be given using technical feasibility study containing life cycle calculations, drawings etc.*				
Integrated Design and Construction Management				
5	BEAM Plus credit IDCM 3 (a), (b), (c), plus additional criteria for integrated design charrettes	4.6.2 (a)		
6	BEAM Plus credit IDCM 4, plus additional criteria for energy and water consuming systems.	4.6.2 (b)		
7	BEAM Plus credit IDCM 5 (a), (b), (c), (d), plus additional criteria for commissioning agent involved throughout project.	4.6.2 (c)		
8	BEAM Plus credit IDCM 7 (a), (b), (c), (d) (excluding bonus credits), plus additional criteria for low carbon power supply.	4.6.2 (d)		
9	BEAM Plus credit IDCM 8 (a), (b), (c), (d) (including bonus credits), plus additional criteria for site waste management plan.	4.6.2 (e)		
10	BEAM Plus credit IDCM 13.	4.6.2 (f)		
11	BEAM Plus credit IDCM 14.	4.6.2 (g)		
12	BEAM Plus credit IDCM 16 (a), (b), plus additional criteria for use of BIM for sustainability data.	4.6.2 (h)		
13	BEAM Plus credit IDCM 17 (including bonus credit), plus additional criteria for access for research.	4.6.2 (i)		

No	Requirement	Ref. Section in Doc	Adopted (Y/N/NA)	Remarks
Sustainable Sites				
14	BEAM Plus credit SS 6 (a), (b)	4.6.3 (a)		
15	BEAM Plus credit SS 8 (a), (b), (c), (d) (including bonus credits)	4.6.3 (b)		
16	BEAM Plus credit SS 9.	4.6.3 (c)		
17	BEAM Plus credit SS 10 (a), (b), plus additional criteria for shelters minimizing direct solar radiation.	4.6.3 (d)		
18	BEAM Plus credit SS 11 (including bonus credit).	4.6.3 (e)		
19	BEAM Plus credit SS 12 (including bonus credits), plus additional criteria to extreme weather events, mosquito control, and underground facilities.	4.6.3 (f)		
Materials & Waste				
20	BEAM Plus credit MW 4 (a), (b), (c) (including bonus credits).	4.6.4 (a)		
21	BEAM Plus credit MW 5 (including bonus credit).	4.6.4 (b)		
22	BEAM Plus credit MW 6 (a), (b), (c) (excluding bonus credits).	4.6.4 (c)		
23	BEAM Plus credit MW 7 (a), (b).	4.6.4 (d)		
24	BEAM Plus credit MW 8 (including bonus credits).	4.6.4 (e)		
25	BEAM Plus credit MW 9 (excluding bonus credits), plus additional criteria for HKUST sustainable purchasing policies.	4.6.4 (f)		
26	BEAM Plus credit MW 10.	4.6.4 (g)		
27	BEAM Plus credit MW 11 (a), (b) (excluding bonus credits), plus additional criteria for daylight and views.	4.6.4 (h)		

No	Requirement	Ref. Section in Doc	Adopted (Y/N/NA)	Remarks
Energy Use				
28	BEAM Plus credit EU 1 (HVAC load reduction, natural ventilation and daylight), plus additional criteria for other surfaces.	4.6.5 (a)		
29	BEAM Plus credit EU 2 (building envelope for residential and non-residential buildings, and natural ventilation for residential building only).	4.6.5 (b)		
30	BEAM Plus credit EU 3, plus additional criteria for reduction of peak electricity demand charge.	4.6.5 (c)		
31	BEAM Plus credit EU 4 (a), (b) (including bonus credits), plus additional criteria for energy consumption monitoring, function and location, access for research, and usage pattern.	4.6.5 (d)		
32	BEAM Plus credit EU 8 (2 credits), plus additional criteria for 100% of appliances to be certified Grade 1.	4.6.5 (e)		
Water Use				
33	BEAM Plus credit WU 1, WU 3, WU 7 (including bonus credit), plus additional criteria for toilets and water use monitoring.	4.6.6 (a)		
34	BEAM Plus credit WU 2 (including bonus credit), plus additional criteria for water-efficient planting and water use monitoring.	4.6.6 (b)		
35	BEAM Plus credit WU 3, plus additional criteria for 100% of appliances to be certified Grade 1.	4.6.6 (c)		
36	BEAM Plus credit WU 6, plus additional criteria for water use monitoring, water loss, and water use controls.	4.6.6 (d)		
37	BEAM Plus credit WU 8 (a), (b), (including bonus credit), plus additional criteria for air-conditioning condensate water reuse and other water reuse.	4.6.6 (e)		
Health and Wellbeing				
38	BEAM Plus credit HWB 1 (including bonus credit).	4.6.7 (a)		
Landscaping and Biodiversity				
39	Site ecology	4.6.8		
40	Existing plant protection			
41	Land conservation and restoration			
42	Native species			
43	Invasive species			
44	Plants with dual purpose			
45	Existing saplings			
46	Wood utilization			
47	Exposed services			
Occupancy Controls and Thermal Comfort				
48	Control logic	4.6.9		
49	Variable equipment			
50	Enhanced ventilation			
51	Infiltration control			
52	Mold growth and condensation prevention			
Sustainable Smart Campus as a Living Laboratory				
53	Decarbonization research and development	4.6.10		
54	Future renewable provision			
55	Lower current power systems for renewables			

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