C40 CITIES Reinventing Cities

Reinventing Cities

A global competition for zero-carbon and resilient urban projects

Guidance to Design a Zero-Carbon, Sustainable & Resilient Project

Contents

Introduction

This document provides guidance on 10 Climate Challenges defined by the competition and presents questions for bidding teams to consider in their proposal. It also outlines the main principles to conduct a carbon assessment.

In the expression of interest phase, bidding teams must provide a general approach to their project; however, teams are not required to provide a carbon assessment or include key performance indicators (KPIs) for this phase. Therefore, the expression of interest submission should include a brief description of the proposed solutions.

In the second phase, finalists are encouraged to include a carbon assessment of their project and provide quantitative details, including several KPIs detailed within this document.

Questions and examples listed within this document have been included to provide guidance and are therefore not exhaustive. Bidding teams are encouraged to propose new and innovative methods for addressing the challenges where appropriate. Bidding teams are not required to answer every question set within this document; instead, teams are encouraged to use these questions as a guide for their response.

The main guiding principles teams should follow are:

Responding to the challenges: Although the first two challenges are mandatory, bidding teams are invited to consider all 10 climate challenges within their proposal. However, it is important for bidding teams to focus on the challenges that are most appropriate for the site, i.e. emphasising those which will enable the city and local communities to catalyse decarbonisation and sustainable and resilient urban development.

Going beyond 'Business-As-Usual'[1]: The bidding teams are expected to demonstrate how their proposed project performs better than a 'Business-As-Usual' (BAU) approach and demonstrate best practices of environmental/social/architectural standards.

Local regulations and sustainability standards: Bidding teams should ensure that their proposed approaches to addressing climate challenges comply with local and national building and environmental regulations, policies, and standards. Where possible, bidding teams are highly encouraged to use approved national or international sustainability standards from design to operation, for example, LEED, BREEAM, Bilan Carbone, Estidama, Mostadam, WELL, GHG Protocol, QualiVerde,

[1] See Glossary for more details.

Référentiel E+,C-, European Energy Performance of Buildings Directive, EDGE, ISO standards, etc.

Regarding the evaluation of proposals, we recognise that bidding teams may not address all 10 challenges within their project proposals. Only the relevant challenges, which are chosen and addressed by the bidding teams, will be assessed as well as the carbon strategy and the two mandatory challenges. To evaluate the proposed solutions and the response to the challenges, the solutions will be assessed according to:

- their ambition and objectives in terms of carbon reduction and environmental performance;
- the coherence between these objectives and the proposed solutions; and,
- the project implementation approach.

The evaluation methodology will award credit to the projects that show consistent, comprehensive, direct, and relevant evidence and justifications for the chosen solutions. Solutions substantiated by independent sources, previous successful projects and credible calculations will be evaluated favourably, as well as projects that can easily be replicable.

1 - Green buildings and energy efficiency

Overview of the challenge: This is a mandatory challenge. The objective of this challenge is to reduce greenhouse gas (GHG) emissions and the environmental impact of energy production and consumption.

The proposed development should go beyond current 'Business-As-Usual' energy standards to demonstrate exemplary energy efficiency, clean energy usage, and should aspire to achieve net-zero energy or 'positive energy' status[2]. The energy strategy developed by the bidding teams should strive to include the following: (i) passive design and efficient building form and fabric; (ii) energy-efficient appliances/equipment; (iii) occupant control, monitoring and evaluation of energy consumption; (iv) on-site and off-site production and consumption of renewable energy; (v) energy storage; and, (vi) social benefits related to sustainable energy.

Energy efficiency is a high priority in the design and operation of buildings and public spaces. This means minimising the amount of energy a building uses for heating, cooling, hot water, lighting, ventilation, electrical services, etc.

In Phase 2, finalists are encouraged to provide the following KPIs for this challenge:

- Energy consumption of the project in kWh/m^2/year broken down by energy source (e.g. electricity, gas, etc.) and by usage (e.g. heat, hot water, ventilation, etc).
- Carbon footprint of the energy consumption in $kgCO_2e/m^2$/year (with a clear distinction made between energy consumption from activities and from normal building use).
- Share of low-carbon energy consumption in % (a distinction should be made between off-site low-carbon energy production and on-site low-carbon energy production).

Questions to consider in your response:

Energy-efficient design:

1. **How will your project reduce energy consumption on-site through passive design/efficient form and fabric?**

[2] Positive energy status refers to a project that produces more energy than it consumes.

E.g. enhanced building fabric specification, bioclimatic design, solar shading optimisation, optimised thermal mass, optimised air tightness levels, reduced thermal bridging, maximised use of daylight, passive/natural ventilation, Passivhaus or equivalent design standards, etc.

Energy-efficient HVAC, lighting, and appliances:

2. **How does your project consider energy efficiency during its occupancy and usage? What type of energy-efficient equipment and appliances are intended to be integrated for the following usages: (i) heating/cooling, (ii) hot water, (iii) lighting (iv) ventilation, and (v) significant other energy usages[4]?**
    a. **What type of energy is expected to be consumed per usage?**
    b. **How much energy is expected to be consumed per usage in kWh/m²/year and kWh/year.**

    E.g. highly efficient heating/cooling, efficient electrical appliances and mechanical equipment, advanced building controls, etc.

Clean energy usage:

3. **How will your project use clean energy?**
    a. **How does your project reduce its external energy purchases thanks to on-site consumption of installed renewable energy produced on-site? Please include capacities installed in kW.**

    E.g. consumed solar photovoltaic and solar thermal, air source heat pumps (ASHPs), ground source heat pumps (GSHPs), biogas, combined heat and power (CHP), (micro) hydropower, waste to energy, wind turbines, etc.

    b. **What types of renewable or low-carbon energy could be produced off-site and consumed on-site? How could the site purchase this energy (e.g. Power Purchase Agreement (PPA), guarantees of origin)?**
    c. **What is the total expected renewable energy consumption in kWh and in % of total energy consumption?**
    d. **What is the expected carbon footprint for the energy consumption of your project (per usage) in $kgCO_2e/m^2$/year or tCO_2e/year? Please specify the carbon intensity breakdown in the appendix of your proposal.**

Energy-efficient control and monitoring:

4. **How will occupants be able to control, monitor, and evaluate their energy consumption?**

   E.g. use of Building Information Modelling, use of Virtual Reality tools to communicate on resource management, data collection, and usage to engage with stakeholders and inform behaviour, monitoring through installed devices such as motion sensor lighting, connected appliances, for HVAC: use of natural ventilation when outdoor temperatures permit. Monitoring devices for future appliances such as centralised systems for power outlets, monitoring systems to enable charging of electric vehicles or shifting of other energy demand during off-peak/low-carbon hours, building handover material for management towards optimisation; such as training materials, videos, manuals, logbooks, etc.

Energy storage:

5. **How and why is energy storage considered in your project?**

   E.g. Energy storage systems such as batteries instead of fossil fuel-based generators, energy storage systems to increase on-site renewable energy consumption, energy storage systems in order to shift energy consumption to off-peak hours (including thermal mass and energy storage descriptions), etc.

Energy social benefits:

6. **How will your project create social benefits related to low-carbon design (including carbon off-setting)?**

   E.g. renewable electricity exports such as export of photovoltaic electricity, heat exports such as district heating, biogas production through methanisation for transport systems, the support given to offsetting projects in the local area to lower the overall carbon footprint of the project, purchase of carbon offsetting credits, etc.

2 - Clean construction and building life cycle

Overview of the challenge: This is a mandatory challenge. The objective of this challenge is to reduce the embodied carbon of the project, which refers to the lifecycle greenhouse gas (GHG) emissions that occur during the manufacture and transport of construction materials, as well as the construction process itself and end-of-life aspects of the building.

The project should prioritise retrofitting buildings over demolishing old buildings or building new ones. Teams should seek to use materials efficiently and consider construction materials with lower emissions from the extraction, manufacturing, transportation, and end-of-life phase (for example, timber and low-carbon concrete). Using modularity/flexible design to enable future adaptation of the building and expand its lifespan, as well as reusing and recycling construction materials are also of great importance.

In Phase 2, finalists are encouraged to provide the following KPIs for this challenge:

- Carbon footprint of the construction phase in tCO_2e or tCO_2e/m^2
- Quantity of low-carbon construction material used for building (e.g. wood or low-carbon concrete) in m^3 / m^2.
- Quantity of each main construction material and tCO_2e associated with each material.

Questions to consider in your response:

Carbon assessment with Life Cycle Assessment (LCA)[3]:

1. **How has a Life Cycle Assessment approach been used in order to make low-carbon decisions in project design and the use of materials in the project? Please refer to all stages of the lifecycle and include a relevant comparison with the environmental impact of a baseline reference situation.**
    a. **Sustainable materials type/nature: How have low-carbon and ecological thinking been considered for the type of material used for your project?**

       E.g. using recycled materials/wood instead of carbon and energy-intensive materials (such as virgin steel or cement).

[3] See the *Key Definitions and Meanings* section for more details.

*Example comparison with a BAU situation: Use of a Cross Laminated Timber (CLT) wooden exterior façade instead of concrete; the methodology used E+/C-, explanation for why using concrete is the BAU reference scenario, project lifetime of 50 years, project lifetime in accordance with local E+C- Regulation, calculation of emissions per m^2 for CLT wood 20 cm and emission factor of 105 $kgCO_2e/m^2$ (e.g. calculation 105 * 0,2 = 21 $kgCO_2e/m^2$), emission reduction over the lifetime of the project = [BAU emissions] – [Chosen solution emission]. Use of local specific regulations/methodologies, etc.*

b. **Sustainable material origin: How does your choice of the geographic origin of your procured materials take into account low-carbon and environmental issues? As mentioned above, if relevant, include tCO_2e emissions related to the logistics of procured materials.**

   E.g. choosing construction materials that minimise greenhouse gas emissions thanks to their local origin (reducing transport emissions), etc.

c. **Sustainable materials manufacturing: How have low-carbon and ecological thinking been considered for the manufacturing of materials used for your project? As mentioned above, if relevant, include tCO_2e emissions related to the manufacturing of materials.**

   E.g. choosing construction processes that minimise greenhouse gas emissions and use a limited amount of energy in order to be produced, choosing suppliers that use biomass or waste in order to generate the energy required for the production of materials, etc.

Sustainable building and infrastructure design:

1. **How does your project's infrastructure consider modularity/flexible design for future uses/extensions? If so, how?**

   E.g. enabling future adaptation of the building through improved modularity, a building space that can serve multiple purposes, ease of maintenance, opportunities for dismantling at the end of the life cycle, etc.

2. **If you have given preference to retrofits over a new build for your project, please specify the surface in m^2 that is to undergo renovation and the volume in m^3 of the material (e.g. concrete) that would otherwise have been required in the case of a new build.**

3. **Has the building or development been designed to minimise the number of materials needed over BAU while ensuring good building performance?**

   E.g. designing lightweight yet well-insulated building fabric, use of aerated materials, good space management to minimise required m^2 of building space, minimisation of storage space (including parking lots, equipment, and appliance storage areas), etc.

4. **How does your project reduce the generation of demolition waste at the end of its lifecycle?**

   E.g. using materials with a potential to be dismantled at the end of lifecycle for re-use, transforming discarded resources back into raw materials, limiting construction waste, recycling waste, etc.

3 - Low-carbon mobility

Overview of the challenge: The objective of this challenge is to foster sustainable mobility options. The bidding teams should design their projects to facilitate and encourage walking, cycling, public transport, shared vehicles, and electric and other low-emission vehicles and to de-incentivize the use of fossil fuel transport.

The proposed development should go beyond 'Business-As-Usual' to demonstrate exemplary standards of green mobility to reduce energy consumption related to transport and contribute towards clean air standards.

In Phase 2, finalists are encouraged to provide the following KPIs for this challenge:

- Number of parking plots broken down by type of transport (classic car, EV, bike, electric bike, scooter, etc.) in comparison to the BAU (e.g. a similar project in the area).
- % of space dedicated to pedestrians and cyclists.

Questions to consider in your response:

Low-carbon transport incentives:

1. **How will the project encourage walking?**

   E.g. urban greening and shading strategies, pedestrian-centric layout, new links to existing walking routes, accessibility for users of all mobility types, accessible walkways to existing communal transport hubs, provision of outdoor seating/rest areas, provision of drinking water, financial incentives for pedestrians, etc.

2. **How will the project encourage cycling?**

   E.g. number of covered/secure cycle storage (total or per occupant), new cycle hire scheme or a new link to the existing scheme, showers, changing facilities and lockers, new cycle route or a new link to the existing cycle route, provision of drinking water, financial incentives for cyclists, etc.

3. **How will the project encourage increased use of existing transport systems?**

   E.g. new links to existing transport stops/stations, live transport updates, use of smart technology, electronic/integrated payment systems, journey planning services, financial incentives for communal transport users, etc.

4. **How will the project encourage the use of electric or low-carbon vehicles?**

   E.g. number of electric vehicle parking and charging points (total or per occupant), new electric vehicle hire scheme or link to existing car hire scheme, localised solar-powered carports, financial and other incentives for electric/low-emission vehicles, emissions standards for vehicles, etc.

5. **How will your project monitor and manage the efficient usage of transport systems?**

   E.g. data collection and usage in order to keep track of mobility emissions, energy use, distance travelled, occupant usage, etc, use of Virtual Reality tools to communicate with occupants on the most efficient and low-carbon routes for travel, smartphone technology to engage with occupants, partnerships with companies that specialise in systems management.

Minimising overall transport emissions:

6. **How will the project minimise the use of diesel and petrol vehicles?**

   E.g. no/limited parking for diesel and petrol vehicles, right of way for pedestrians and cyclists, speed restrictions, no-idling policy, financial incentives for alternative transport methods, etc.

7. **How will transportation emissions be minimised during the construction phase and during occupancy (post-completion)?**

   E.g. procurement planning to minimise deliveries, route optimisation, coordinating deliveries with local sites, telematic controls for construction vehicles, no-idling policy, eco-driver training for operators, use of clean fleet vehicles, monitoring mileage and emissions, incentive scheme, etc.

4 - Climate resilience and adaptation

Overview of the challenge: The objective of this challenge is to develop a project that is resilient to current and future climate hazards specific to the location of the site.

Bidding teams should integrate climate resilience measures throughout the project. The project should be resilient to climate hazards such as temperature rise, increase in intensity and frequency of winds and storms, flooding, sea-level rise and droughts. This means that the project should include a climate change risk assessment, including the climate hazards that the specific site is exposed to and under which climate change scenarios/what time horizon. With this assessment as a starting point, projects should seek to implement adaptation measures. Resilience should cover two aspects: (i) Occupant resilience, such as tree planting or shading devices to protect residents from the heat island effect. (ii) Building resilience, such as a reinforced foundation in locations where strong winds could cause damage, consideration of how droughts could affect building material stability or modular design. Other examples include water evacuation mechanisms in flood-prone areas such as water retention basins and significant permeable areas.

NB: All measures regarding rainwater (e.g. capture and storage, water-saving, run-off, treatment) can be addressed in Challenge 6.

Questions to consider in your response:

Risk assessment:

1. **What are the main climate change hazards the neighbourhood faces / will face?**

   E.g. The assessment can take into account the five main climate change hazards cities have to face: heatwaves, flooding, storms, drought, and sea-level rise; but also, a broader analysis of extreme cold events, wildfires, landslides, chemical or biological hazards. It can also consider the existing infrastructures and risk management measures in the neighbourhood.

Resilient design:

1. **How is the design of the outdoor space adapted to local (location-specific) future climate change risks?**

   E.g. Replacement of asphalt and concrete which absorb and release heat into the surrounding environment, widespread use of green and blue surfaces on roofs, walls and ground will help to reduce local urban heat

island impacts, well-positioned trees to provide shading where needed, both in the public realm and around buildings; cool zones near buildings to reduce the need for air-conditioning, natural solutions for stormwater management associated with future extremes of precipitation, including sustainable urban drainage solutions (SuDS) such as rain gardens, ponds, and retention basins; use of hardy grasses in places such as bike parking, exercise trails, and electric vehicle charging points to replace impermeable materials, heat and drought-resistant species planting, etc.

2. **How are your infrastructure and building design adapted to local (location-specific) future climate change risks?**

   E.g. Optimising solar gains to mitigate the risk of overheating via orientation, solar shading strategies, shadow analysis in summer (especially over the pedestrian and cycling areas), passive cooling, design adapted to increased wind speeds (requires an analysis of neighbourhood morphology), raised crawl space, light impact foundations, earth coupled structures, mechanisms to resist natural disaster (landslides, flooding), resilient structural design adapted to water impacts, driving wind and temperature changes; the presence of courtyard or inner garden within the building, green or blue roofs, sustainable urban drainage solutions (SuDS), etc.

3. **How do the façades in your project take into account the physical risks of climate change? (If relevant, include the surface in m² related to the protected area).**

   a. **For vertical façades:**

   E.g. External removable or fixed shading strategies for solar protection, suitable glazing specification for daylight exposure, minimum heat gain and visible light transmission; UV coatings, good thermal performance, seals, internal glare provision for occupants, increased peak temperatures, use of white paint or reflective materials for façades, presence of vegetated façades, presence of "photovoltaic cladding" on façade, etc.

   b. **For the roof infrastructure:**

   E.g. Presence of a biodiverse roof, (specify surface in m^2) for flat roofs; the presence of white paint/gravel or reflective coatings, presence of a rainwater storage/buffer system, presence of energy producing equipment, etc.

4. **Have complementary actions been taken in order to cope with other indirect climate-induced hazards?**

   E.g. for wildfires or landslides depending on the city and location-specific climate analysis.

Resilient occupancy:

5. **How does your project integrate location-specific climate change adapted mechanical and electrical systems?**
   a. **How has your project considered in its design future heating and cooling needs?**
   b. **How has your project integrated these heating and cooling needs into the energy capacity scaling of equipment (in terms of the power required)?**

      E.g. for heating/cooling, ventilation, air conditioning.

      Protected electrical systems raised above the possible level of flooding (transformers, electrical cabinets), provision of secondary secure supply such as a generator or sufficient battery back up in the event of power outages, provision of energy-efficient appliances in the case of energy poverty, etc.

6. **How does your project encourage people to adapt their behaviour in case of an extreme weather event?**

   E.g. Manual solar protection (as opposed to smart solar protections), fountains in public space, presence of cool areas (tree canopy, or shadow in winter), community awareness of vulnerable people, and solidarity systems.

5 - Sustainable lifestyle and green jobs

Overview of the challenge: The objective of this challenge is to use the site to develop new green services for the neighbourhood that will help foster sustainable lifestyle and consumption habits, thus reducing the overall environmental footprint of the communities, whilst creating green jobs in the city.

Bidding teams should consider using the site as a catalyst to leverage existing green services or to develop new urban services for the neighbourhood that help to reduce the city's environmental impact. Strategies include supply and export of clean energy, new services for waste collection, development of sustainable freight and urban logistics, creation of pooled and shared services, creation of new public parks, etc.

Bidding teams should also implement initiatives to promote a greener, sustainable lifestyle to help equip and empower individuals to make conscious choices on the way they live and consume goods and services. This includes promoting sustainable food choices and integrating methods of producing and trading goods that foster sustainable consumption habits such as encouraging local production and urban agriculture, embracing a circular economy approach with 'Fab-labs', zero-waste stores, and shared spaces that allow retailers and craftspeople to experiment and pool their resources.

Finally, bidding teams should also consider hosting and incubating green start-up companies onsite, providing jobs in ecological sectors, and stimulating green job development.

Questions to consider in your response:

Sustainable living:

1. **How does your project foster a sustainable lifestyle?**

   E.g.; carpool apps and services that replace individually owned goods i.e. lending libraries, clothes swapping stores; upcycling stores; hubs for sharing goods such as sewing machines, sports equipment, baby gear, and DIY equipment; Zerowaste stores or restaurants; 'refillable' retail where customers bring their own containers when purchasing groceries etc.

2. **How does your project promote sustainable food?**

   E.g. source food locally, supply seasonal produce, procure produce that meets a credible certified standard, adopt a 'farm-to-fork' strategy, promote a vegetarian/vegan diet; community kitchens/food hubs, food co-ops, farmers markets, circular food supply chains, waste audits to track

and monitor food waste, low-waste and adaptive menus, collection of extra food for donation, etc.

Environmental benefits:

1. **What types of new green services will your project provide for the city?**

   E.g. supply and export of clean energy, sustainable waste management services, shared economy services, new or improved public space, green transport, urban agriculture, sustainability education, ecosystem services, services and stores that foster sustainable consumption habits, etc.

2. **What environmental value will the new green services provide to the city?** Where possible quantify the expected impact of the new green services i.e. the reduction in tons of CO_2e or landfill waste, based on examples of previous projects.

   E.g. reduced carbon emissions, reduced air pollution, reduced waste and pollution, using biochemical means to depollute a former industrial site, etc.

3. **How will your proposed business model sustain the expected environmental and social benefits over the long run?** Where possible provide examples of previous successful sustainable enterprise models and the quantified social and economic value of past projects.

   E.g. regular consultations and check-ups on impacts of the social return on investment.

Green growth:

1. **How will your project and final site foster innovative green start-up companies?**

   E.g. provide co-working/flexible/affordable/green workspace, shared equipment/workshops/'fab-labs', start-up investment, incubator programs, networking opportunities, fast-tracked private and public procurement opportunities, etc.

2. **How will your project foster the creation of green jobs and innovation in green growth?**

   E.g. fair pay and working conditions, the proportion of low-skilled vs. highly skilled workers, shared economy/industrial symbiosis opportunities with local industries (i.e. use of waste product from one industry as raw material for activities on-site), use of smart technology/digital applications, integrated public services, etc.

6 - Sustainable water management

Overview of the challenge: The objective of this challenge is to develop sustainable water management systems.

In order to address the impacts of water shortage or droughts, bidding teams should seek to lower water demand (e.g. low-flow fixtures and appliances, smart metering) and manage water usage sustainably (e.g. provide wastewater treatment solutions, collect rainwater). In order to address the impacts of flooding or rain/storm damage, bidding teams should include systems to evacuate water efficiently and increase permeable areas to avoid flooded areas.

Bidding teams should consider both potable and non-potable water management in the design of their project and should prioritise water-saving where possible. Consider your current and future (i.e. 2050) climate impacts on water resources for your location, in particular for expected increased rainfall and/or droughts. Describe how your project takes into account this analysis.

Please state your major sources of water consumption for your project. Indicate for each what water management measures have been used in order to save this resource.

In Phase 2, finalists are encouraged to provide the following KPI for this challenge:

- If water-saving measures have been implemented: quantity of water saved per year in m^3 or m^3/per occupant or m^3/m^2.

Questions to consider in your response:

Water scarcity management:

1. **In the case of water scarcity for your site, how has your project incorporated municipal water-saving measures?** Please specify the projected quantity of litres saved per year (unit: litres/year). Please compare the litres of saved water, with the litres consumed directly from the municipal system.

   E.g. (i) Water efficient equipment in order to limit water usage, such as low-flow fixtures and appliances, water-efficient plumbing, smart-metering solutions for users to track and adapt their water usage. (ii) Rainwater capture and storage for potable use, such as the presence of water capture and storage basins/roof reservoirs. (iii) Purple pipe system for re-use of wastewater, such as use of wastewater instead of drinking water for

non-potable uses (e.g. irrigation) or wastewater recycling services for potable uses. (iv) Use of an external water source (separate from the municipal system), such as water desalination plants, the use of river water, and integrated wells on-site (in the case of local water treatment for potable usage, a detailed energy and carbon assessment is required), etc.

2. **How does your project raise inhabitants' awareness about water scarcity risks and is the project for the site adaptable to droughts?**

   E.g. Soft social measures by the city on water saving, public information on water resources, water plazas that turn into recreational areas when dry, etc.

Excess water management:

3. **In the case of excess water supply, how does your project consider water evacuation management measures?**

   E.g. Run-off water infrastructure, scaling of plumbing and sewerage pipe systems to prepare for extreme rainfall conditions, sizing of gutters to prepare for extreme rainfall conditions, sustainable urban drainage (SuDS), etc.

4. **How does your project consider water storage or buffering in order to avoid flooding the city water system?**

   E.g. Water tanks, water plazas, ponds, green or blue roofs, presence of green space or permeable surfaces, analysis of the neighbourhood surface water absorption, permeable roads or parks nearby, etc.

5. **How does the project raise the inhabitants' awareness of the flood risk (in case of a high probability event) and is the project for the site adaptable to flooding?**

   E.g. Soft social measures by the city on flooding events, public information on what to do in the event of a flood, etc. Multiple-use areas depending on the water levels, elevated entrance, power production equipment elevated, etc.

Water treatment:

6. **If relevant, how does your project consider measures to depollute and treat water before sewage dispatch?**

   E.g. Presence of wastewater treatment solution that is integrated with biomass systems, drainage systems (SuDS), etc.

7 - Circular resources and sustainable waste management

Overview of the challenge: The objective of this challenge is to accelerate the transition toward a zero-waste city and to develop sustainable waste management during the project's operational phase, in order to reduce greenhouse gas emissions while providing co-benefits such as reduction in scarce resources extraction and fossil fuel consumption.

Bidding teams should consider developing services, actions, and tools that help decrease solid waste generation on the site, specifically by reducing single-use and non-recyclable plastics and surplus food, and by fostering goods repairability and recyclability. Bidding teams should also consider implementing source-separated collection, specifically for food scraps and other organics.

In Phase 2, finalists are encouraged to provide the following KPIs for this challenge:

- % of estimated recycled waste out of the total waste produced.
- Quantity of expected waste per year and quantity of saved waste compared to a similar project.

Questions to consider in your response:

Limit the amount of waste on-site, promote a circular economy approach, and organise sustainable waste management (If relevant, include tCO_2e emissions related to waste management of materials):

1. **How does your project help occupants reduce waste generation?**

   E.g. support occupants to purchase less and to use "zero waste" goods thanks to specific suppliers, support a circular economy approach through the development of Fab Labs, reparation services and education programs, etc.

2. **How does your project organise sustainable waste management during the operational phase (occupation)?**

   E.g. design physical spaces for separated waste collection within buildings in order to manage waste effectively, reduce treating organic waste via dehydrators, composting, and on-site anaerobic digestion; on-site gardens and vegetable patches for on-site consumption, etc.

8 - Green space, urban nature, and biodiversity

Overview of the challenge: The objective of this challenge is to preserve biodiversity, and develop greenery and urban agriculture to mitigate climate risks and foster a sustainable environment.

Bidding teams should consider developing green and blue infrastructure to maintain and promote urban biodiversity, provide important ecosystem services such as pollination and climate resilience, mitigate the heat island effect, and reduce the energy needed to cool and heat buildings (e.g. eco-roofs and wall gardens). This could also include the development of local and sustainable food systems (urban agriculture) in order to decrease food miles and to raise awareness of the benefits of fresh, seasonal food and local production.

In Phase 2, finalists are encouraged to provide the following KPIs for this challenge:

- Surface area dedicated to planted area in m^2
- Surface area dedicated to permeable surface in m^2
- Surface area dedicated to urban agriculture (if relevant) in m^2

Questions to consider in your response:

Biodiversity protection and preservation:

1. **How will local ecological species and habitats be protected and maintained?**

   E.g. formal ecological assessment is undertaken, an official statement of site's ecological importance, long-term protection of endangered/mature species/nesting grounds/habitats, presence of a blue/green grid at a large scale, etc.

2. **How will the site foster and improve biodiversity?**

   E.g. increase in green space, increase in waterways, increase in the number of species, pollinator-friendly planting, indigenous/native species planting, wildflower and companion planting, introduction of wildlife habitats, creation of/link to wildlife corridors, retention of mature species, biodiverse/green/brown roofs, walls, container planting, etc.

3. **How will the project increase citizen education and awareness on themes of nature and biodiversity?**

E.g. visitor centres, educational programs or activities, etc.

Local agriculture:

4. **How will the site promote local food/crop production?**

   E.g. promote regenerative urban agriculture, land/space dedicated to food production via community gardens or allotments, value-added food production activities on site (turning raw food material into a refined product), supplying on site or local communities with food products, policy for procuring locally sourced food for the site, etc.

Urban re-vegetation:

5. **What is the change in green space area of the site (%)?**

   E.g. calculate the area of green/blue space before and after the development: has the proportion increased or decreased, if so by how much? This could include green roofs, green walls, planters/containers, ponds, waterways, as well as land areas, etc.

   a. **What percentage is accessible by the public?**

      E.g. Non-accessible roof compared to a public park, etc.

   b. **What percentage is to be maintained by the public?**

      E.g. Community or shared garden compared to inhabitants' private gardens, city space compared to green areas owned by private companies, etc.

9 - Social inclusion and community engagement

Overview of the challenge: The objective of this challenge is to develop inclusive services and actions to serve the needs of the local population, and to involve the local community and stakeholders in the development of the project.

Bidding teams must ensure that the project strives to serve the needs of the residents and the neighbourhood where it is located. An emphasis should be placed on understanding the existing neighbourhood context so that the project is responsive to major needs, challenges, and issues of the local residents and businesses (both those in the formal and informal economy). Examples include developing projects that will be accessible to different parts of the population (social background, age, gender, origin, economic status, etc.), prioritising mixed-use development, and promoting projects and activities that support citizen health and wellness.

Moreover, the bidding teams are required to involve local stakeholders and surrounding neighbourhoods in the project design and future management; effective community engagement is important to ensure that the proposed project is relevant and appropriate for those living and working in the area.

Questions to consider in your response:

1. **How do you propose to engage and involve the local community in the decision-making process?**

   E.g. stakeholder mapping, methods to ensure your project planning, design and implementation is inclusive and accessible to all stakeholders: different formats of roundtables and public meetings, local app or radio, emphasis on culture as a way to bring interest to the site (through street-art, forums, workshops, etc.), events (for the launch of the project, disseminated through the timeframe of the program), exploratory walks with local stakeholders to experience, and reflect upon the potential of the site collectively, transitory occupation of the site fostering the development of new uses, etc.

2. **How will your engagement strategy develop through all phases of the project (construction, installation, operation, etc.)?**

   E.g. a wide set of actions for every phase of the project, including co-conception roundtables and local participation before construction on-site, participative building on-site, setting up resident management associations, providing training to occupants, etc.

3. **How will your project meet the social needs of the local community?**

E.g. creation of participatory processes (app, workshops, review of existing local research/projects, etc.) that will identify the needs of the local community and will adapt the solutions proposed to those needs (i.e. social and affordable housing, inclusion of services such as kindergarten, local shops, flexible use of space), etc.

4. **How will your project create spaces dedicated to public/collective use and needs?**

   E.g. shared gardens, communal places dedicated to community use and shared services, etc.

5. **How will your project promote innovative/alternative living arrangements that take into consideration all genders, ages, and social backgrounds?**

   E.g. mixed-use development, intergenerational living arrangement, social housing, student housing, cooperative and participative housing, etc.

6. **How does the design of your project support health and wellness and foster activity and connectedness?**

   E.g. design of public space, fostering sport and leisure activities, preventing and protecting from air, noise, and light pollution, etc.

10 - High-quality architecture and urban design

Overview of the challenge: The objective of this challenge is to combine environmental performance with high-quality urban design and architecture.

Bidding teams should propose high-quality architecture through spatial design, building form, choice of materials, and use of natural light among others. Projects must upgrade the site whilst integrating it into the urban environment and the wider neighbourhood in which the site is located. The project should promote a 'complete neighbourhood' model that is compact and mixed-use, and where people can access everything they need within a short walk or bike ride of their home following the 15-minute city concept. Instead of single-purpose areas and buildings, the project should support a balanced diversity of 'human-scale' activities. It may also activate new places such as 'underutilised' spaces (e.g. rooftops or basements), propose new types of services for local communities, and design a public realm that will provide a vibrant, safe and friendly environment for all. Besides upgrading the site itself, proposals must therefore also contribute to improving the wider precinct or neighbourhood in which it is located.

Questions to consider in your response:

1. **How is your project integrated into the surrounding area? How does it interface with the rest of the neighbourhood?**

   E.g. respect for cultural heritage, continuity of walking and cycling routes and public space across the site itself, etc.

2. **Does your architectural project include the use of pioneering sustainable materials or recycled materials that participate in a creative design?**

   E.g. construction materials such as sustainable wood, rocks, mud/clay bricks, recycled materials, etc.

3. **How does your project promote a 'complete neighbourhoods' model?**

   E.g. high to medium density developments, a mix of land use in the same building/block, active ground floors to create pleasant and safe streets and provide local communities with essential services and amenities, smaller block sizes that facilitate greater interaction between residents, etc.

4. **How does your project promote cultural heritage and contribute to the attractiveness and uniqueness of the city?**

   E.g. use of technologies as part of the design, showcasing the city heritage

while promoting artistic creation and contemporary design, etc.

5. **How does your project design make the best use of all available spaces or propose public space to foster outdoor activities and connectedness?**

   E.g. use of rooftops, basements, attics, lofts, wells, new parks or public space, removal of on-street parking and people-centred public realm, etc.

6. **How does your project reflect upon the adaptability of design and uses, and anticipate new lifestyles?**

   E.g. adaptable and modular floors, partition walls, shared use, anticipate new ways of living and working, temporary activation to support a dynamic, evolving place with a strong identity, etc.

Emission Reduction and Carbon Assessment

A Reinventing Cities project must aspire to be carbon neutral. This is in line with the Paris Agreement's objective of global carbon neutrality before the end of the century.

When striving towards zero carbon, the priority is to minimise the emissions of the project throughout the project lifecycle and achieve net-zero by compensating for any residual emissions in a robust and transparent way through high-quality offsetting.

From Phase 1, teams must showcase solutions to reduce emissions. In Phase 2, finalists must carry out a carbon assessment of their project, quantify their carbon reduction objectives and detail their climate change mitigation strategy.

Categories of emissions and scope of carbon assessment

To significantly minimise carbon emissions, operational and embodied emissions should be calculated.

Operational emissions

Teams should consider emissions associated with the energy used to operate a building and public space that occur throughout the lifetime of the building/site e.g. lighting, heating, cooling, and hot water.

A broader approach especially for larger sites takes into consideration other operational emissions arising from transportation and processing waste. In this case, teams must indicate and specify the scope and limitations of their assessment.

Target:

All new buildings should achieve net-zero operational emissions whilst existing buildings should be retrofitted to minimise emissions as much as possible.

For reference: The Paris agreement requires operational emissions to be reduced by 50% of current levels by 2030 and reduced to net-zero by 2050.

Embodied emissions

These emissions are generated from the materials and construction processes of buildings, including new construction, retrofits, and redevelopment. All embodied emissions should be assessed, through a lifecycle approach; this encompasses emissions created through material extraction, manufacturing, assembly,

maintenance, repairs, refurbishment, replacements, deconstruction, demolition, and any associated transport, waste, and end-of-life aspects.

Unlike operational emissions which occur continually and are measured annually, these emissions are one-off events that only occur at specific points through the development cycle. Historical embodied emissions in existing buildings and infrastructure do not need to be included in the assessment, however, any future ones should be captured.

To measure embodied carbon emissions, a Life Cycle Assessment (LCA) is required. This accounts for emissions at every stage of the entire lifecycle of a building's materials and products. For more details on the LCA, you can refer to the World Green Building Council report.

Target:

All new buildings and major retrofits should reduce embodied emissions by at least 40 to 50% over the BAU approach.

For reference: This is in alignment with World Green Building Council's Net Zero Carbon Buildings Commitment.

Consumption-based emissions

In addition to operational and embodied emissions, there is a third category of emissions that can be considered: consumption-based emissions.

These emissions are associated with the consumption of goods and services by people and future residents (e.g. buying food or clothing). Since this considers a broader set of emissions sources, consumption-based emissions assessments inevitably involve more complex data and detailed calculations. Due to the complexities in tracking consumption-based emissions, teams should not include this category of emissions in their scope but rather focus on delivering tangible and ambitious actions to reduce them through lifestyle and behaviour (challenge 5).

Overall, reducing consumption-based emissions requires significant behavioural changes therefore teams should consider implementing measures that foster a more sustainable lifestyle such as circular economy initiatives, fab labs, urban agriculture projects, sustainability education, etc.

For reference and more information on consumption-based emissions please refer to *The Future of Urban Consumption in a 1.5°C World* report.

Negative emissions

To achieve zero-carbon (or climate positive status), teams should compensate for any residual emissions through a high-quality robust offsetting approach achieving negative emissions. Teams should consider:

- *Avoided emissions*

In addition to minimising its emissions, a project may also reduce emissions outside of the site scope. These are called avoided emissions. For example, if the project contributes to:

  - Lowering the carbon footprint of neighbouring buildings by offering/ selling the surplus green energy produced on-site.
  - Renovating existing neighbouring buildings.
  - Providing a green transport service that lowers emissions compared to the previous fossil-fuel-based transport options for citizens.

- *Sequestered emissions / Offsetting*

Finally, the project could strive to capture emissions within the site and its surrounding environment. . For example, reforestation or tree planting on-site contributes to eliminating carbon from the atmosphere.

The project could also strive to offset emissions outside the site and its surrounding environment[4]. These are sequestered emissions that are related to financing reforestation projects or low-carbon solutions (e.g. a renewable energy plan) in a different country by buying carbon credits.

Please note that all carbon offsetting must comply with internationally accepted carbon offset criteria and should ideally be directly related to the proposed project.

Emissions reduction hierarchy

When developing their project, teams are encouraged to follow the low-carbon hierarchy below, focusing on reducing “at source” carbon emissions before offsetting to compensate. It is essential to design and prioritise low carbon solutions and actions that aim to minimise operational and embodied emissions throughout the development cycle, before developing solutions to convert and compensate.

[4] *Note that this solution is not recommended as bidding teams should prioritise carbon offsetting that occurs locally or is directly related to their project.*

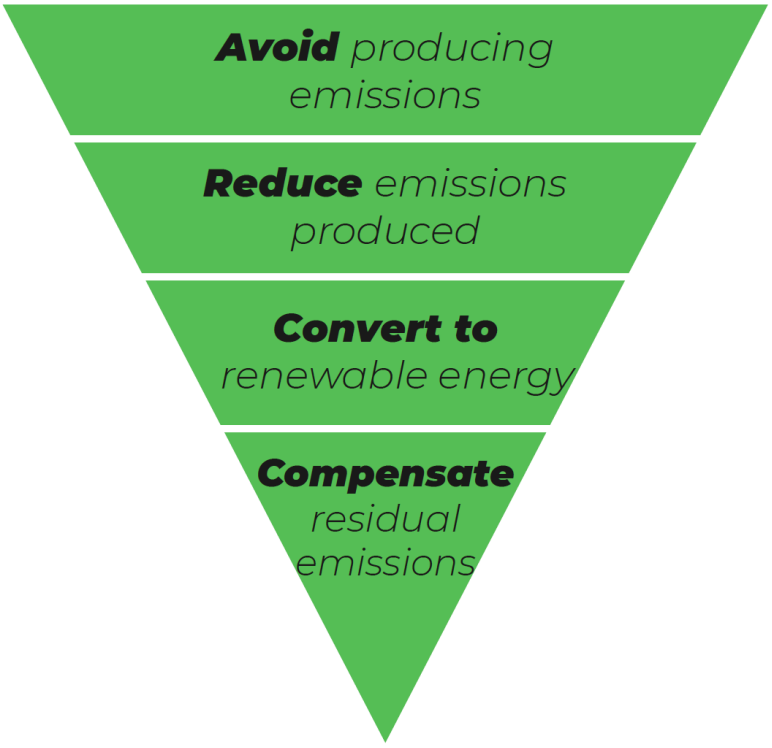

Figure 1: Emissions Reduction Hierarchy

Avoid: Prevent emissions from occurring wherever possible.

For instance, repurposing existing buildings – this will avoid embodied emissions from new foundations and building superstructures – or implementing cycling lanes – will discourage car use.

Reduce: Adopt interventions that reduce emissions, compared to a standard or conventional approach.

For instance, utilising materials from decommissioned sites when undertaking new construction, thus reducing embodied emissions.

Convert: Enable and promote renewable energy and low carbon technologies.

For instance, converting existing buildings with gas-fired heating to low-carbon heating producing clean energy on-site or transforming existing parking into EV parking lots and charging stations.

Compensate: Compensate any residual unavoidable emissions through robust, transparent offsetting or carbon capturing. This directly reduces emissions produced by the project.

For instance, implementing tree planting initiatives such as forest offsets to sequester carbon and act as effective carbon sinks.

Carbon assessment

The carbon assessment is a method used to account for a project's total GHG emissions throughout its lifecycle: from the construction phase (including the building materials used), operational phase (including the energy required to operate the site), and end-of-life phase (e.g. reuse of building materials, the energy required for deconstruction). The exact scope of the analysis should be specified.

If you are unable to perform a detailed carbon assessment for your project, an estimate can be made based on the location, construction area, and existing carbon data on energy consumption.

In Phase 2, finalists are encouraged to provide the following KPIs to define their carbon objectives:

- Carbon footprint of the project in tCO_2e/ m^2 / year or across the lifetime of the project (or tCO_2e /year or across the lifetime of the project). Teams must separately provide the quantitative details for operational and embodied emissions.
- The objective for emissions reduction compared to the carbon footprint of a BAU project in %
- Avoided emissions in tCO_2e *(if relevant)*
- Sequestered emissions/emissions offset tCO_2e *(if relevant)*

Please provide separately the quantitative details for:

1. the project's carbon footprint as well as operational emissions and embodied emissions,
2. avoided emissions, and
3. sequestered emissions.

Measures in order to contribute to carbon neutrality (in order of priority)	**Unit**
1. Justify that your project has a low carbon footprint	• tCO_2e / m^2 / year (intensity indicator) or tCO_2e / m^2 across the lifetime of the project • tCO_2e / year (absolute indicator) or tCO_2e across the lifetime of the project

2. Demonstrate that your project is avoiding emissions	• tCO_2e
3. Prove that your project is capturing/sequestering emissions	• tCO_2e

Please also include:

- The methodology and/or framework used to calculate the carbon footprint. If no official methodology was used, please mention the estimations, calculations, assumptions, and hypotheses made.
- The scope supported by calculations (e.g. energy consumption, construction, passenger transport, transport logistics) and any exclusions accompanied by a justification.

Main principles of a carbon assessment

The following main principles are relevant for conducting a detailed carbon assessment:

Beyond 'Business-As-Usual'

The project should strive to have **minimal emissions generated** and therefore a minimal carbon footprint. To quantify this, the project should compare its carbon footprint to a BAU scenario carbon footprint, demonstrating how the proposed project performs better than a BAU approach. The BAU case refers to a standard building of similar dimensions and uses in the same city; local and national targets and standards can be used in defining this scenario and the appropriate emission difference.

The bidding team should include the difference between the carbon footprint of a BAU compared to the footprint of the proposed project. The difference between the two carbon footprints demonstrates that you are lowering the overall footprint and to what extent. Special recognition will be given to projects that show innovation in greenhouse gas reductions or those which achieve 'carbon negative' status.

Quantifiable data

Providing relevant and quantifiable KPIs and data, for example: tCO_2, tCO_2e/yr, tCO_2e/m^2 and tCO_2e/specific activity, etc.

Recognized standards

Teams should comply with national and local sustainability standards and methodologies, where applicable, for example, LEED, BREEAM, Bilan Carbone

Estidama, Mostadam, WELL, GHG Protocol, QualiVerde, Référentiel E+,C-, European Energy Performance of Buildings Directive, EDGE, ISO standards, etc.

Transparency

Bidding teams will need to ensure that their methodology for the carbon assessment is fully transparent and clearly define the scope of the project. Bidding teams will be required to disclose all relevant methods, data sources, calculations, assumptions, and uncertainties to enable the reviewers to assess the credibility of the results.

Impact and replicability

Special recognition will be given to projects which demonstrate a future-proofing approach to how innovation and GHG emissions reductions could be replicated beyond the selected site in other parts of the city and the world.

Appendix: Glossary

Business-As-Usual reference situation: A BAU scenario for future patterns of activity which assumes that there will be no significant change in people's attitudes and priorities or no major changes in technology, economics, or policies so that normal circumstances can be expected to continue unchanged (*Source: Oxford dictionary*).

Carbon footprint of a project refers to the GHG emissions generated by the project on an annual basis over its lifecycle (construction, operation, end-of-life).

Carbon negative or climate positive: When greenhouse gas sinks are greater than the release of greenhouse gas emissions, or the amount of renewable energy generated on-site is greater than the amount of energy consumed on site.

Consumption-based emissions: are emissions associated with the consumption of goods and services by people (e.g. buying food or clothing).

Embodied carbon emissions: are emissions generated from the materials and construction processes of buildings, and infrastructures, including new construction, retrofits and redevelopment.

Emission reduction: An emissions reduction refers to the difference between the emissions from a theoretical BAU scenario and the emissions related to the low-carbon solution proposed by the project.

Greenhouse gas emissions: the terms 'greenhouse gas' (GHG), carbon, and carbon dioxide emissions are often used interchangeably. For this assessment, we consider all greenhouse gas emissions as carbon dioxide equivalent emissions (CO_2e), as per the Kyoto Protocol convention.

Life Cycle Assessment: An LCA is a technique used to assess the potential environmental impacts associated with a product or service over the lifecycle of this product/service (from the extraction of resources, until the final disposal of materials). An LCA (i) compiles an inventory of relevant inputs and outputs, (ii) evaluates the potential environmental impacts of the associated inputs and outputs, and (iii) interprets the results. For the considered carbon assessment, the LCA is based only on the environmental impact related to climate change by greenhouse gas emissions. For a building, a life cycle GHG assessment would cover the emissions from manufacturing and transporting the building materials, constructing the building, operating and maintaining the building, and disposal of any materials not reused at end-of-life.

Negative emissions

- **Avoided emissions:** refers to the GHG emissions that a project may reduce outside of the site-specific scope.

- **Sequestered emissions/Offsetting:** refers to the GHG emissions that have been captured thanks to an activity such as the planting of trees which biologically stores carbon over their lifetime, or other low-carbon solutions.

Operational carbon emissions: are emissions associated with the energy used to run a building or a public space, that occur throughout the lifetime of the project/site e.g. lighting, heating, cooling, and hot water. For large-scale projects, the scope of operational emissions may also include the energy arising from transportation and processing waste.

Zero carbon or carbon neutral: for this assessment, zero carbon or carbon neutral refers to 'net zero' greenhouse gas emissions. This means that all sources of greenhouse gas emissions are balanced by greenhouse gas emission sinks.