Programme-wide Sustainability Strategy

Sustainability

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Prepared for

Bureau Expo Dubai 2020

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EXPO 2020 إكسبو
دبي، الإمـــارات العربيـة المتحـدة
DUBAI, UNITED ARAB EMIRATES

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Acronyms and Abbreviations

Acronym/Abbreviation	Expansion
ADA	Americans with Disabilities Act
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BIE	Bureau International des Expositions
BMS	Building Management System
CEEQUAL	Civil Engineering Environmental Quality
CFD	Computational Fluid Dynamics
DEWA	Dubai Electricity and Water Authority
DM	Dubai Municipality
EPD	Environment Product Declaration
ESMA	Emirates Authority for Standardization and Metrology
EX20	Bureau Expo Dubai 2020
GDP	Gross Domestic Product
GEP	Green Economy Partnership
GFA	Gross Floor Area
GHG	Greenhouse Gas
GMO	Genetically Modified Organism
HVAC	Heating, Ventilation, and Air Conditioning
IECC	International Energy Conservation Code
IoT	Internet of Things
ISO	International Organization for Standardization
K-12	Primary and Secondary Education
KPI	Key Performance Indicator
LCA	Life Cycle Analysis
LEED	Leadership in Energy and Environmental Design

Acronym/Abbreviation	Expansion
LRV	Light Reflectance Value
SPP	Sustainable Public Procurement
SRI	Solar Reflectance Index
SUDS	Sustainable Urban Drainage Systems
TBC	To Be Confirmed
TBD	To Be Determined
TDM	Transportation Demand Management
TIS	Traffic Impact Study
TSE	Treated Sewage Effluent
UAE	United Arab Emirates
UNEP	United Nations Environmental Programme
USGBC	U.S. Green Building Council
VOC	Volatile Organic Compound

Executive Summary

Dubai's population is expected to rise to 3.4 million people[1] by 2020. This trend in growth will create challenges for the United Arab Emirates (UAE) as they balance development with the ecological limits and natural resource constraints, a changing climate, local pressures on water supplies, the growing need for employment and access to affordable, liveable and enjoyable places.

A sustainable Expo 2020 Dubai® embodies the principles of sustainable development, respecting ecological limits and natural resource constraints, encouraging prosperity and well-being while optimising conditions for human development. It also lays the foundation for a sustainable legacy for future generations.

The overall development will embrace an integrated design approach across all stakeholders and project team members to deliver sustainable outcomes ranging from passive to active and technological solutions.

The sustainability approach will address the pre-defined programme-wide sustainability key areas that address all aspects of environmental sustainability such as energy, water, waste materials, environmental quality, and biodiversity as well as social and economic sustainability. The sustainability key areas identified in this strategy align with the commitments stipulated in EX20's Chapter 4 of the Registration Document to the Bureau International des Expositions (BIE). The key to successful implementation is the sustainable design, construction, management and operation of event facilities and legacy development plan based on the principles of sustainable development.

A project-specific sustainability management plan will be prepared and implemented by all project teams to integrate the Programme-wide Sustainability Strategy into project delivery through design and construction stages as well as providing an assurance framework to verify programme compliance.

[1] Dubai Municipality, Planning and Engineering Department

1 Introduction

1.1 Objective

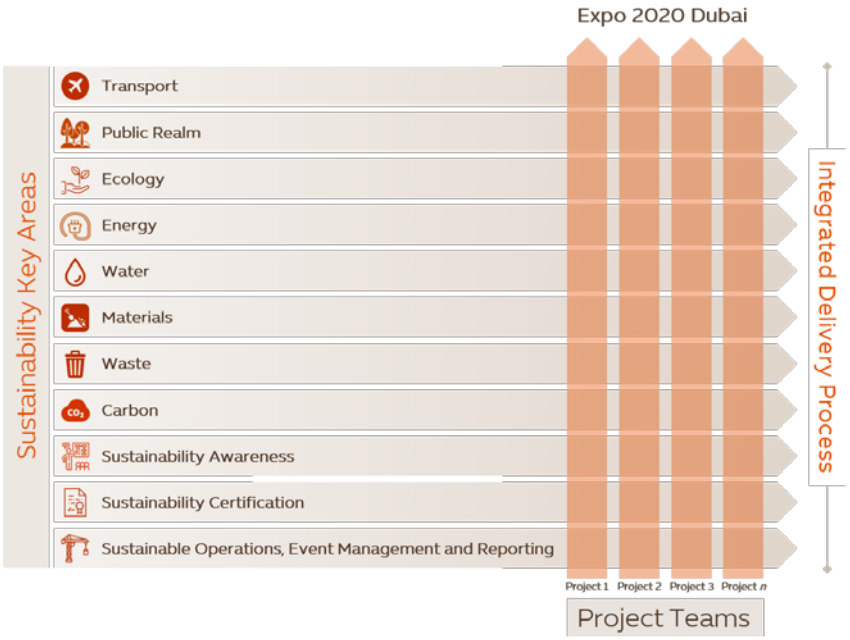
Achieving a sustainable Expo 2020 Dubai requires a coherent cross-cutting programme strategic approach addressing all of the key sustainability key areas. This Programme-wide Sustainability Strategy sets out the overall methodology for the integration of sustainability into the planning, design, construction and operational processes and provides a framework for each of the identified key areas.

This Programme-wide Sustainability Strategy provides the following:

- Programme-wide approach to sustainability, prioritising the delivery of passive solutions
- Programme-wide approach to integrated sustainable design
- Sustainability key areas approach

Sustainability shall be implemented across all elements and disciplines of design and construction through an integrated design process to achieve the best sustainability outcomes for the programme.

Figure 1-1. Integrated Approach



1.2 Expo 2020 Dubai Sustainability Vision and Drivers

The vision for Expo 2020 is to 'host an inspirational, safe, and inclusive Expo event that leaves a sustainable legacy for Dubai and the UAE.' Sustainability is one of the three sub-themes of Expo 2020, along with Mobility and Opportunity, and therefore it needs to be reflected through all elements of the programme. Additionally, EX20 has expressed further high-level drivers, as laid out in the BIE registration document:

- Catalyse sustainability efforts in Dubai and the UAE, creating an Expo event offering substantial legacy value.
- Increase public awareness and educate the society on sustainability principles and sustainable living.
- Develop solutions in sustainability that are scalable and can be rolled out and implemented on a broad level, extending the benefits to the wider economy.

Finally, alignment with the national and sub-national policies, as detailed in Section 1.3, will be required.

1.3 Compliance Requirements and Drivers

Compliance with environmental laws and regulations will be required and details of these can be found in the Programme Environment Management System (doc. ref. 05007-PLN-P990000-EN-000033). Strategic alignment with the following national and subnational initiatives will also be required:

- UAE Vision 2021
- UAE Green Growth Strategy
- UNEP's Sustainable Public Procurement Programme
- Dubai Green Economy Partnership
- 2030 Dubai Integrated Energy Strategy
- Dubai Green Building Regulations and Specifications

1.3.1 UAE Vision 2021

The UAE Vision 2021 outlines future challenges facing the UAE and provides an overarching perspective on mitigation over the coming years. The strategy focuses on economic, social, and environmental factors.

The UAE Vision 2021 identifies several sustainability objectives with which Expo 2020 Dubai will align. Some of these are shown in Table 1-1.

Table 1-1. Expo 2020 Dubai Alignment with UAE Vision 2021

UAE Vision 2021	Expo 2020 Dubai
24% of the nation's energy mix to come from clean energy sources	50% of Expo 2020 Dubai's energy to come from renewable energy
Improvement in water efficiency to reduce the water scarcity index from 12.79 to 4.0	25% reduction in potable water use in buildings, with all water for irrigation and cooling to be recycled water
75% of municipal solid waste to be treated and diverted from landfill	85% of all waste, including municipal solid waste, construction waste, and decommissioning waste, to be segregated to allow for treatment and diversion from landfill
Improvement of the Air Quality Index, covering nitrogen dioxide, carbon monoxide, sulphur dioxide and ozone, from 55% to 90%.	Specifying low emissions for fixed plant such as standby generators. Additionally, Expo 2020 Dubai will be implementing a transport strategy that prioritises low-emission modes of transport, including the metro and the ExpoRider.

1.3.1 UAE Green Growth Strategy

The UAE Green Growth Strategy was launched in January 2012, by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai. This is a long-term initiative that aims to promote sustainability in the economy, in the public and private sectors, to help the UAE become a global hub and a successful model of the new economy. Action has already started in multiple sectors of the economy. The following three pillars of the UAE Green Agenda have been identified, along with their associated programmes of action:

- Green Technology and Market Development
  - National Green Innovation Programme
  - Green Market Development Programme

- Integrated Social and Spatial Development
  - Integrated Green Infrastructure Programme
  - Green Transport Programme
  - National Green Workforce and Talent Programme
- Clean Energy and Sustainable Use of Resources
  - Integrated National Power and Water Programme
  - National Renewable Energy Programme
  - National Resource Efficiency Programme[2]

One of the aims of Expo 2020 Dubai is to collaborate with national stakeholders and explore opportunities to act as an incubator for new, sustainable technologies that can be scaled up and rolled out across the country, thus promoting local industry and sustainability.

1.3.2 Sustainable Public Procurement Programme

The UNEP's Sustainable Public Procurement (SPP) programme is a set of activities to support the implementation of SPP around the world under the mandate of the UNEP's 10-year Framework of Programmes. It has a vision of embedding environmental, economic and social aspects of sustainability into public procurement and associated supply chains. The UAE's Federal Ministry of Environment and Water is a member of the SPP programme.

Government procurement typically accounts for between 15% and 30% of national Gross Domestic Product (GDP), and procurement of sustainable goods and services can:

- Stimulate competition
- Create markets for appropriate technologies
- Expand markets for innovative sustainable solutions
- Encourage early engagement and dialogue with the market
- Enhance dialogue with stakeholders to promote growth in demand for goods supplied by local markets and by making sustainable products purchased by the public sector more readily available to individual consumers[3]

1.3.3 Dubai Green Economy Partnership

Launched in May 2012, by His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai and Chairman of Dubai Executive Council, the Dubai Green Economy Partnership (GEP) is inspired by the UAE Green Growth Strategy. It is a multi-stakeholder and cross-sector partnership to promote green growth in the Middle East and position Dubai as a global gateway for green investment and trade that is leading the worldwide transition to the new economy. The goals of Dubai GEP are:

- To effectively contribute to the sustainable and green growth of Dubai and UAE economies
- To enable growth of green trade and investment in regional markets
- To accelerate the adoption of green technologies, products and services worldwide

1.3.4 2030 Dubai Integrated Energy Strategy

The Dubai Integrated Energy Strategy 2030, outlined by Dubai Supreme Council of Energy, sets an ambitious target of a 30% reduction in energy consumption by 2030. Renewable energy is tapped to satisfy 7% of the city's energy requirements by 2020, increasing to 15% by 2030.

Expo 2020 Dubai is aligned with this strategy. Not only will renewable energy provide 50 percent of the power, but energy consumption for buildings is targeted to be 20% below the latest building energy efficiency standard, which itself is more efficient than current business as usual.

[2] 'UAE State of Green Economy', United Arab Emirates Ministry of Environment and Water, 2014

[3] 'Sustainable Public Procurement Implementation Guidelines: Introducing UNEP's Approach', UNEP, 2012, p11

1.3.5 Dubai Green Building Regulations and Specifications

The ‘green building’ regulations and specifications administered by Dubai Municipality cover the standard elements of ‘green building’ design such as energy, water, healthy buildings, ecology, materials, and waste.

All Expo 2020 Dubai permanent buildings will be compliant with the Dubai Green Building Regulations and Specifications.

2 Programme Strategy

EX20 has prepared this comprehensive strategy to guide the delivery of the buildings and infrastructure that are required to host the Expo 2020 Dubai as well as lay the foundation to achieve a sustainable legacy resulting from the hosting of the Event.

2.1 Sustainability Approach

The programme-wide approach to sustainability is to apply a hierarchical framework as shown in Figure 2-1 and detailed as follows:

- **Passive solutions first**: Using best practices that focus on design-based solutions to achieve the sustainability outcome. Some example strategies include:
  - **Energy**: Use of concepts such as passive cooling, shading and optimised building solar orientation and massing, high albedo materials, strategic thermal massing and designs that maintain natural airflow to reduce heat gain and therefore reduce the cooling load
  - **Water**: Selection of functional landscapes and planting regimes and species that have lower water demands
  - **Design efficiency**: Design to use space and materials in an efficient manner
- **Active solution implementation**: Optimising the design using industry standard solutions to ensure resources are used in an efficient manner. Some example strategies include:
  - **Energy**: Ensure highly efficient lighting design and use highly efficient equipment and heating, ventilation, and air conditioning (HVAC) systems to reduce energy demand
  - **Water**: Use of low-flow fixtures and fittings to reduce water consumption, and condensate capture systems to substitute for potable water where appropriate
- **Technological solution selection:** Using innovative solutions to raise the sustainability standard to a world-class level. Some example strategies include:
  - **Energy**: Use of active shading solutions to dynamically deliver solar shading throughout the day as well as renewable energy solutions to reduce reliance on the national power grid
  - **Water**: Substitution of water with humidity capture, grey water and/or black water management systems to minimise potable water usage

In general, passive solutions deliver the highest sustainability value when the full lifecycle is considered in terms of both cost and carbon emissions. Consequently, designs must aim to maximise the gains that can be achieved through passive solutions before considering active solutions.

Technological solutions provide a level of performance that is required to achieve world-class sustainable outcomes. However, due to their high capital investments and requirement for long-term maintenance, advanced technological solutions may have relatively high lifecycle financial and carbon demands. As such, they should only be utilised where passive and active solutions are insufficient to achieve the desired sustainable outcome.

Figure 2-1. Sustainability Approach

2.2 Integrated Design Approach

To deliver sustainability across the programme, an integrated design process is required. The intent is to optimise the design to benefit from the synergies between the many components and systems of the project. Through implementing this process, strategies shall be investigated, evaluated, and appropriate recommendations shall be made to achieve the minimum KPIs for the project and exceed those targets when financially feasible (refer to Appendix A). This approach requires that a process is implemented to identify sustainability solutions and assess the viability of the solutions in a staged manner that tracks solutions from concept to implementation.

An integrated design process must:

- Allow for sustainable strategy workshops throughout the design process to identify potential sustainable solutions and cross-discipline synergies
- Initiate a preliminary integrated design workshop early in design process to set targets and goals to optimise the integration of sustainability across all aspects of the project
- Identify and engage an integrated project team that comprehensively represents the various design and decision disciplines
- Implement a process and tools that track sustainable design solutions from conceptualisation to either implementation or rejection
- Provide a framework for a staged assessment of each design solution including:
  - A strategy capture and tracking tool that lists sustainability solutions
  - A desktop feasibility study
  - A detailed analysis including performance modelling and cost-benefit analysis considering both financial costs and greenhouse gas (GHG) emissions throughout lifecycle
- Develop a decision framework to justify acceptance and/or rejection at each staged assessment

Table 2-1. Integrated Design Process

Traditional Design Process	Integrated Design Process
Design team generally limited to architects and engineers	Design team includes the owner, architect, engineers, consultants, construction team, facility management team, future users, end users, and similar.
Linear in Nature	Cyclical in nature
Serial collection of Discrete Tasks	Collaborative and conscious effort to integrate design strategies between all disciplines
Thinking of the asset as a collection of separate systems and materials	Holistic approach of the asset as a whole
Cost Decisions driven by Initial Capital Cost	Cost decisions driven by Whole Life Cost/Life Cycle Cost
Solutions yield optimised independent systems	Solutions yield multiple benefits and ‘Synergies’ between systems

3 Project Requirements

A project-specific sustainability management plan shall be prepared and implemented by each project team. The plan must address the following:

- Identification of sustainability performance requirements, key performance indicators (KPIs), where relevant, and other sustainability drivers
- Processes for integrating the Programme-wide Sustainability Strategy requirements into project delivery through design and construction
- Processes for integrating the Programme-wide Certification Strategy (doc. ref. no. 05007-STG-P990000-SU-000035) requirements into the project delivery through design and construction, (these processes should complement and support the requirements set out in the project-specific sustainability management plan)
- Framework, processes and tools for an integrated design process
- Framework, processes and tools for managing delivery of the sustainability requirements by the project delivery team
- Framework, processes and tools for monitoring, measuring and reporting performance against the sustainability KPIs in design and construction stages
- Framework, processes and tools for assuring performance against the sustainability KPIs in design and construction stages
- Framework, processes and tools for project-level sustainability training and awareness

3.1 Design Stage Requirements

During the design stage, the project-specific sustainability management plan must be developed and maintained to ensure that it reflects the current stage of works.

At each design stage review, a sustainability report is required as a component of the design report. The following key aspects must be included as a minimum:

- Integrated design approach to include relevant trackers and study reports
- Thematic summaries of project approaches, progress against selected design solutions, key risks and opportunities
- Delivery of strategy progress, to include key project-specific plans (within the document or as appendices) that meet the specific requirements of the contract and the thematic requirements
- Project performance against identified KPIs (to include projected values with supporting justification in reporting tools where design detail is insufficient)
- Identifiable risks that may impact any aspect of the project delivery in both design and construction stages.

3.2 Construction Stage Requirements

During construction stage, the project-specific sustainability management plan must be updated and maintained to ensure that it reflects the current stage of works. Compliance with the Programme-wide Reporting Strategy is also required as well as any documentation and submission required to achieve the project specific sustainability requirements.

At construction completion, sustainability closeout reports will be required which summarise asset performance against sustainability KPIs. All relevant calculators, certifications, inventories and thematic strategy requirements must be included in the closeout report.

3.3 Assurance Framework

Assurance of the accuracy of data supplied throughout the programme must be achieved. EX20 will implement a sustainability audit programme to assure compliance with the project-specific sustainability management plan, or any other aspect of the project team activities.

3.4 Climate Modelling

Expo 2020 Dubai has developed a prioritised set of climate themes to be utilised by the design teams for Event (2020-2021) and Legacy (2050 and 2100) modes:

- A blended weather file for assessing air conditioning demand for buildings
- Dust haze and sand storm that is a persistent risk particularly during the winter months
- Extreme wind that also has a distinctive seasonality
- Solar radiation that is used for renewable energy modelling
- Heat index for assessing visitor comfort
- Seasonal precipitation and temperature baselines and future change to assess any shifts in seasonality of the future weather of the site
- Extreme precipitation that can be applied in drainage and other site water management design

Project teams are expected to utilise the Climate Modelling Analysis report and data sets (doc. ref. 05046-RPT-X280567-SU-000018 Revision 1) to assess the risks during Event and Legacy from future climatic impacts. Planning, design and implementation shall adopt this climate science and results to ensure adaptation and resilience.

4 Sustainability Key Areas

The Expo 2020 Dubai programme is aligned with national and sub-national drivers (Section 1.3), and designed to help move Dubai and the UAE towards a more sustainable future. The following sustainability key areas are aligned with BIE's Registration Document Chapter 4, and will include programme-wide KPIs:

- Transport
- Public Realm
- Ecology
- Energy
- Water
- Materials
- Waste
- Carbon
- Sustainability Awareness
- Sustainability Certification
- Sustainable Events Operations and Management

4.1 Transport

Well-connected networks enhance access and give people a choice of routes. However, networks need to offer people more than access alone. They must also provide high quality spaces and routes that people find safe and enjoyable to use.

A well-connected Expo 2020 Dubai can do the following:

- Enhance land values
- Make local facilities more viable
- Enhance people's safety and security by supporting crime prevention
- Encourage more walking and cycling, leading to health benefits
- Reduce vehicle emissions through fewer cars being used

Sustainable transport for the Expo 2020 Dubai will be achieved by:

- Encouraging alternative transport methods and practices to reduce vehicle usage and associated carbon emissions
- Providing infrastructure to encourage use of alternative transport systems and promoting the use of alternative fuel sources
- Promoting a healthy, secure and walkable lifestyle by providing comfortable, appealing, unobstructed and safe pathways

As per the BIE's registration document, the strategic objective and KPI is as listed in Table 4-1.

Table 4-1. Strategic Objective and KPI

Objective	Key Performance Indicator	Target
Sustainable, lower carbon public transport	Passenger modal shifts	Significant deviation from baseline

4.1.1 Alternative Transportation

Maximising alternative transportation options will be measured by achieving an overall reduction in vehicle trip demand. Project teams shall demonstrate a significant deviation from baseline in total trip demand generated and percentage reduction in GHG emissions through a comprehensive transportation demand management (TDM) program quantified in a traffic impact study (TIS) and/or transportation demand model. The transport strategies developed shall account for Event and Legacy mode operations.

Examples of techniques to reduce vehicle trip demand are as follows:

- Provide appropriate access to public transportation networks
- Provide priority parking for carpools, alternative fuel vehicles, and priority area loading zones for buses
- Provide frequent transit stops and/or additional public shuttles
- Provide safe and shaded pedestrian public transit access with visible signage
- Provide comfortable public transit waiting areas (e.g. shaded seating and proper light levels)
- Provide safe, comfortable and well-connected pedestrian pathways
- Designate safe and accessible bicycle networks
- Provide adequate bicycle parking and storage areas
- Provide or promote a vehicle or bicycle sharing system
- Other innovative travel demand reduction techniques

Additional strategies that focus on reducing the environmental impact of vehicles shall be incorporated as appropriate, for example:

- Provide vehicle charging stations and/or refuelling stations to supply alternative fuels
- Provide preferred parking for low-emitting and fuel-efficient vehicles
- Provide or promote a Green Fleet vehicle program
- Incorporate other innovative vehicle emission reduction technologies

4.1.2 Walkability

Internal connectivity and circulation within the site should be pedestrian-focused and encourage a healthy, secure and walkable lifestyle. All components of the project streetscape shall be considered to improve the pedestrian experience. Pedestrian pathways shall have good links with existing and planned surrounding neighbourhoods and be comfortable, appealing, unobstructed and safe. The following are examples of strategies to optimise the pedestrian experience:

- Maximised pedestrian pathway access (e.g. eliminate pedestrian barriers and inefficient routes, and maximise pedestrian routes)
- Visible and clear pedestrian signage and other wayfinding indicators
- Adequate lighting to enhance safety and security
- Functional building entries and well positioned building facades (appropriate setbacks)
- Street level amenities (such as retail and basic services)
- Close proximity and adequate access to open spaces
- Limit areas of expansive surface parking
- Reduced vehicular speeds near pedestrian pathways

4.2 Public Realm

Creating a pleasant public realm within the development is an essential component of creating a built environment that is appreciated by visitors and occupants and hence supports the delivery of a sustainable Legacy.

A high quality public realm for the Expo 2020 Dubai will be achieved by the following:

- Minimising the adverse effects to the atmosphere by eliminating the use of pollutants generated by HVAC systems and construction activities
- Eliminating the impact to local watercourses from waste and storm water emissions
- Minimising the impact to the local environment and ecosystems by mitigating negative impacts of excessive lighting and noise pollution
- Protecting open spaces from the hot climate to the fullest extent possible and incorporating shading from landscape or architectural features, and where possible, optimising air movement by site design that captures and utilises prevailing winds
- Improving the effects from urban heat islands to decrease cooling loads and create comfortable outdoor areas without harming flora and fauna by temperature increases
- Avoiding adverse wind conditions and utilising natural airflows to create pleasant public realm and improve building efficiency

Outdoor comfort is being addressed by the objectives, indicators and targets as shown in the BIE's registration document.

Table 4-2. Objectives, Indicators and Targets

Objective	Key Performance Indicator	Target
Create people-centric, comfortable and walkable spaces	Percentage of primary walkways in thematic districts providing shading at 13:00 on the equinox	75%
	Percentage of hard landscaping in self-built pavilion areas and public open spaces providing shade at 13:00 on the equinox	60%
	Percentage of site hardscape and roof with heat island reduction strategies implemented Minimum values of Solar Reflective Index (SRI) and Light Reflectance Value (LRV): 30 for hardscape (SRI) 30 for non-flat roof (SRI) 80 for flat roof (SRI) 45% for walls (LRV)	70%
	Public space complies with Americans with Disabilities Act (ADA) requirements	100%

4.2.1 Outdoor Environmental Quality

To contribute to a comfortable public realm and outdoor environment, considerations must be made with regard to light and noise pollution, outdoor thermal comfort and the urban heat island effect, as well as to airflow and wind speeds.

Light and Noise Pollution

All projects must meet minimum lighting and acoustic requirements as identified by the design brief. Pedestrian pathways as well as public open spaces shall be adequately illuminated for safety, however, not excessively lit where adverse impacts to the surrounding environment or energy demand will occur. Site features associated with the Event will likely produce excessive levels of noise, but the site plan must identify strategies to ensure acoustic quality across the project. Project-specific strategies shall be developed to mitigate negative impact of excessive lighting and noise pollution, such as the following:

- High efficiency public realm lighting systems
- Illuminated pedestrian pathways and wayfinding
- Public open space lighting that incorporate automatic controls, sensors or other energy saving technologies
- Light fixture shields or other strategies to minimise or eliminate light pollution to the night sky
- Orient buildings and/or site features to contain noise, protect specific areas from noise or reduce noise through other mitigation strategies

Urban Heat Island Effect

Urban heat islands result from the use of dark non-reflective materials with low albedo factors for hardscape or roof areas and the rejection of heat from buildings and automobiles. These factors combine to raise ambient temperatures compared with surrounding undeveloped areas by absorbing and re-emitting heat rather than reflecting it. Heat islands not only increase cooling loads, but can also

exacerbate air pollution, create uncomfortable outdoor areas, and harm flora and fauna when temperatures increase.

Site design shall incorporate appropriate material selection and strategies to reduce the heat island effect such as the following:

- Preserve existing tree canopy and vegetation and incorporate new vegetation with high shading capacity
- Utilise architectural shading devices, hardscape materials and roof systems with high albedo rating
- Incorporate open-grid pavement systems
- Incorporate vegetation or vegetated rooftop gardens to reduce the overall footprint of hardscape areas

Adverse Wind Conditions and Airflow

Designs should be developed to capture and utilise natural airflows as a mechanism for increasing comfort, while avoiding adverse wind conditions resulting in wind tunnels or other severe conditions. Appropriate levels of airflow can be encouraged by:

- Identifying prevailing wind flows and daily flow variations
- Distributing buildings to capture and channel airflows through the site
- Considering building surface designs that enable airflows
- Incorporate micro-climatic variables such as water features or vegetated landscapes that enhance thermal comfort by modifying humidity and temperature
- Utilising Computational Fluid Dynamic (CFD) simulations are required at a building and site scale to demonstrate airflows

Conversely, high wind conditions can make public spaces unpleasant and impact on the efficiency of building operation. Many design features within a site plan can impact the development of adverse wind conditions, including building size and mass, building proximity or width of streetscape, building orientation, site topography and landscape features. Building and site design should minimise the creation of harmful wind conditions.

4.2.2 Environmental Management

A robust environmental management system is critical to protecting the local environment from adverse impacts during the construction programme. Environmental management requirements are set out within the following documents:

- Assurance Minimum Standards – Environment (doc. ref. 05007-STD-P990000-EN-000001)

4.3 Ecology

UAE's arid environment offers a unique and diverse ecology. Climate change, overharvesting, invasive species, pollution and habitat change are the main threats to global biodiversity and the UAE is no exception. Rapid development, construction, and increasing industrialisation in UAE threaten the country's biodiversity, notably through habitat loss and pollution.

The focus of this key area is to protect existing ecology both within and outside project areas, and to set requirements for the creation of enhanced biodiversity and ecology as a result of the programme.

The relevant objectives for the site, as per BIE's registration document are listed in Table 4-3.

Table 4-3. Objectives for the Site

Objective	Key Performance Indicator	Target
Enhance the ecological value of the site and	Percentage of landscape plants which are native/adaptive species	50%
	Minimum number of native/adaptive plant species	5

Objective	Key Performance Indicator	Target
promote local species	Number of pest species used	0
	Percentage of landscape area managed without the use of chemical pesticides, herbicides or fertilisers	95%

The following key aspects are considered:

- Measuring, managing, and mitigating the adverse impacts of the Expo 2020 Dubai programme on the ecological systems of the region
- Restoring and creating habitat with a high ecological value
- Protecting natural water systems including groundwater

Developments for Expo 2020 Dubai will offer enhancements to ecosystem management and the natural environment through preservation of existing resources and creation of new urban and non-urban natural areas. By incorporating ecosystem management and biodiversity strategies into the sustainability management programme, EX20 recognises the intrinsic economic, scientific and social values of preserving and enhancing the biodiversity of species through habitat protection and creation.

A systems approach will be applied by the project teams to understand and manage the extent of the project work with respect to the various ecosystems, their surroundings, and natural connections beyond the system boundaries.

By implementing this programme-wide strategy, EX20 will:

- Maximise protection of existing biodiversity and habitats and engage with regulatory and other stakeholders to minimise desertification and degradation of habitat
- Use trees and plant covers/buffers to protect the soil of existing and new landscape from sandstorms and other adverse wind conditions contributing to desertification
- Engage with regulatory and other stakeholders to support an understanding of the importance of protection of biodiversity and urban ecology to minimise risks of extinction of threatened species
- Engage with regulatory and other stakeholders to control invasive species and genetically modified organisms (GMOs) to limit risks to local biodiversity
- Maximise potential for creating efficient and diverse new habitats
- Consider and include various landscape forms and planting themes, including edible landscapes, perennials rather than seasonal landscapes
- Implement a biological landscape maintenance plan, including use of organic/biological soil amendments other than peat that could include local soil amendments (composted horse and camel manure), coconut fibre and other agricultural waste products suitable as soil amendments, biological fertilizer, biological pest control, limited use of pesticides that cause no harm to flora/fauna/human health and have a short shelf life
- Minimise harm of vermin/pest control
- Conduct a water balance audit and implement a water efficiency program that addresses irrigation needs, irrigation methods that minimise water loss through evaporation, collection of irrigation run-off to reduce water use
- Implement a high quality tree service programme with properly trained personnel certified by the International Society of Arboriculture to provide skilled and safe tree care, pruning, and trimming to protect the investment in trees as high value habitat but also to increase the property value.
- Implement an operation and maintenance plan that considers local climate conditions that reflects and includes all above listed items

4.4 Energy

Energy from buildings account for at least 40% of global energy with the opportunity of using proven and commercially available technologies to reduce it by 30% to 80%. However, with one of the fastest growing economies in the world over the past few years, electricity demand in the UAE has risen

significantly. The programme has the opportunity to address the future of energy generation by introducing renewable solutions and processes to enhance economic development and foster partnerships, as well as contributing to the long-term vision of the UAE as identified in the UAE Vision 2021.

To minimise the impact of energy consumption, two strategic objectives have been identified, with associated indicators and targets, as shown in the BIE registration document:

Table 4-4. Strategic Objectives

Objective	Key Performance Indicator	Target
Reduce energy consumption	Outperform the ASHRAE 90.1 standard for building efficiency	Outperform the standard by 20%
	Reduce permanent building energy use intensity against Energy Star Target Finder (ongoing projects excluded)	70%
	Lighting power density that outperforms the IECC Exterior Lighting standard	20% reduction for exterior areas
	Lighting power density that outperforms the IECC Exterior Lighting standard	50% reduction for landscaped features
Produce clean energy	Percentage of total energy requirement to be met with (on-site and off-site) renewable energy during Expo event	50%
	Percentage of total energy requirement to be met with on-site renewable energy during the Expo event	25%

The Key Performance Indicators shall be measured against the following parameters:

- Outperform the ASHRAE 90.1 (2013) standard for building efficiency. The ASHRAE 90.1-2013 can be used with LEED v4, as per official direction from the U.S. Green Building Council (USGBC)
- Outperform the IECC (latest version), Section 505.6.2 standard for exterior and landscape features lighting

Energy efficient Expo 2020 Dubai will be achieved by:

- Measuring the energy consumption associated with hosting the Event
- Taking action to reduce the energy consumption to the extent practicable by using proven and commercially available technologies and processes
- Implementing off-site and on-site renewable energy solutions

Energy reduction as well as on-site and off-site renewable energy production will support delivery of a carbon-neutral event and will be used as the basis to shape aspects of the programme, setting a vision for the achievement of a lower energy outcome. Efficient energy use and sustainable energy production are key aspects of the overall sustainable strategy and include baseline energy use, building form and design, energy efficient technologies and systems, efficient energy supply, and renewable energy generation both on-site and off-site. The objective of the programme-level energy strategy is to ensure cost-effective solutions with a clear use in the Legacy phase based on a viable business case.

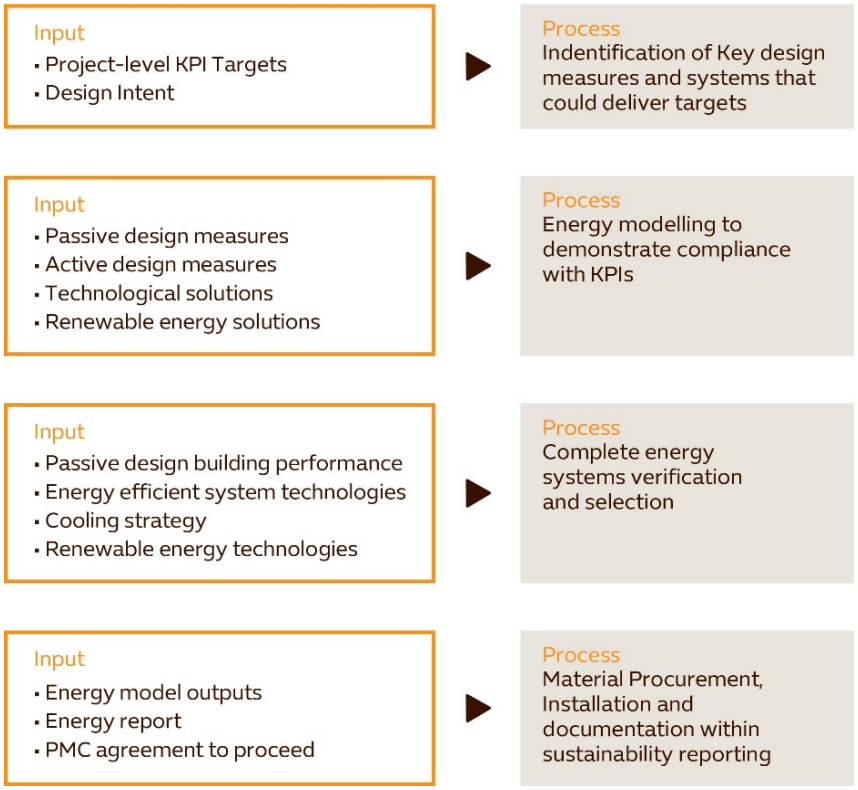
Fundamentally, the energy strategy is based on the sustainability hierarchical framework as shown in Figure 2-1. Passive design solutions will be prioritised and maximised prior to selection of appropriate ‘active’ industry standard solutions and finally innovative technological solutions will be integrated.

Such an approach will result in cost effective environmental outcomes that are realised through comprehensive energy savings. Project teams shall reduce energy demand through:

- Passive solutions, including, but not limited to, massing, shading, thermal mass and insulation, daylighting and orientation
- Implementation of industry standard active solutions, including but not limited to high-efficiency lighting systems, equipment, cooling and ventilation systems
- Implementation of innovative technological solutions, including but not limited to active shading technologies, district systems and other innovative solutions
- Installation of on-site renewable energy to offset operational energy demands through the Event

Each project team shall consider the development of a process to embed these design strategies into the project-specific sustainability management plans. As identified in Figure 4-1, the approach to energy demand reduction shall incorporate key inputs within each design decision making process. This approach must address energy use for both permanent and temporary facilities and development.

Figure 4-1. Energy Reduction Design Process



The project team is required to identify strategies that may present lifecycle cost benefits from an energy performance point of view during design, using an integrated design approach. Lifecycle cost benefit should therefore consider the overall cost for GHG emissions mitigation as well as the price of electricity.

In addition, EX20 will work with key stakeholders to develop agreements and standards for the connection of renewable energy generation systems to the electricity network, considering network efficiency and protection. Once these agreements are reached they will be shared with project teams and applied programme-wide.

The programme-level energy KPIs shall drive the following outcomes:

- Maximise energy demand reduction through passive design, including, but not limited to, building solar orientation, building massing, shading, thermal mass and insulation, daylighting, and material selection.
- Eliminate unnecessary energy consuming systems and spaces through design efficiency

- Maximise building and/or district energy efficiency, including, but not limited to, low energy cooling strategies, low energy lighting and lighting control, and advanced efficient equipment selection
- Efficient energy supply systems to meet building and site demands
- On-site building/site renewable energy generation

4.4.1 Passive Design Solutions

Project teams are required to develop designs that prioritise and maximise the use of passive solutions to reduce building and site energy demands. The project team must provide a plan for the inclusion of passive design strategies to achieve energy efficiency and comfort within the basis of design. All passive strategies will be evaluated as part of the overall energy reduction strategy driven by the Design Review Process.

Passive design approaches that must be considered and are discussed in further detail below include, but are not limited to:

- Optimisation of building orientation and building massing
- Thermal mass and material properties
- Landscaping that provides shading and evaporative cooling
- Mitigation of the urban heat island effect
- Use of natural ventilation and daylighting

4.4.2 Energy Efficient Building Systems

The selection of all energy consuming building systems, such as light fittings, lifts and chillers must consider a high-level of energy demand reduction and maximum efficiency.

The building system technologies used should all consider the following:

- Capacity to carry out full load requirements
- Suitable level of redundancy
- Ability to run at part load efficiently
- Modularity to allow for systems to be demounted post event
- Automatic shut off for periods of low and no use
- Ability to be remotely controlled by Building Management System (BMS)
- Consider their impacts on other sustainability goals
- Lifecycle cost benefit of improved energy performance

4.4.3 On-site Renewable Energy Generation

To meet the BIE commitments and contribute to a GHG emissions reduction and to support the carbon-neutral Expo 2020 Dubai event, all projects will be required to provide a targeted amount of their energy demands through on-site renewable energy generation.

The programme-level BIE commitment to provide 25% energy from on-site generation of renewable energy sources (developed over six months) is a site-wide target. Projects are expected to contribute individually, with liaison with EX20's Renewable Energy Consultant who will track overall contribution from all projects.

The renewable energy generation technologies proposed shall consider the following:

- Ability to meet project-specific KPI on renewable energy (Table 4-4)
- Event and Legacy phase use of the renewable energy system
- System modularity to allow for parts of the system to be demounted post event
- Metering of energy supply of systems
- Consider the systems impacts on other sustainability goals
- Suitable level of system redundancy dependent for periods of no or low energy generation
- Visibility of technology to engage visitors and the local population post event
- Lifecycle cost benefit of improved energy performance

4.4.4 Off-site Renewable Energy Generation

Two commitments will contribute to the need for installation of off-site renewable energy generation capacity by the programme:

- The programme-level BIE commitment to provide 50% energy from generation of renewable energy sources (developed over six months)
- The programme-level commitment to achieve a carbon-neutral Expo 2020 Dubai event

Of these two commitments, the programme-level BIE commitment to provide 50% from generation of renewable energy will fix an absolute minimum requirement for development of renewable energy generation capacity. In addition, to achieve a carbon-neutral event, the framework to mitigate the programme-wide GHG emissions and achieve carbon-neutrality through offsets while minimising the purchase of offsets on the spot market will be defined by EX20.

The large-scale off-site renewable energy generation systems will be managed by a specialist programme-wide consultant and are not the responsibility of individual project teams. However, every decision that affects energy use will affect the magnitude of large-scale renewable energy generation required and must therefore be considered in this way. This means that the cost benefit of these decisions needs to consider that the alternative is not just the purchase of additional electricity generation, but it is also the cost to offset that the programme will have to bear for additional large-scale renewable energy generation.

4.4.5 Electricity Network Connection

There are a number of challenges to be considered in renewable energy as a source of electricity generation and how the resultant power can be used. It is assumed that for the vast majority off-site renewable energy can be used on-site, and project teams should evaluate if any renewable energy generation is likely to be generated at any time that exceeds the instantaneous energy demand. If no excess is likely to be generated, then this would significantly simplify connection.

Discussions of connectivity and electricity export with key stakeholders are being undertaken in accordance with EX20's Stakeholder Management Plan. The project teams will work with key stakeholders to develop standard approaches to renewable energy connectivity.

4.5 Water

The UAE is water resource poor with most of UAE's water being derived from desalination. Desalinating water is energy intensive, and so reducing water demand and consumption results in significant energy savings. The water strategy focuses on reducing demands on potable water systems through applying a hierarchy of water efficiency followed by substitution of potable water with non-potable supplies. Through design and construction, there is the opportunity to deliver water-sensitive sustainable solutions across the programme.

Therefore, there are two strategic objectives centred on water, with associated indicators and targets as shown in the BIE's registration document.

Table 4-5. Strategic Objectives Centred on Water

Objective	Key Performance Indicator	Target
Reduce water consumption	Reduction in water consumption in buildings compared to Dubai Electricity and Water Authority (DEWA) baselines (Applies to permanent building projects controlled and/or delivered by Expo 2020)	40% improvement on baseline
	Percentage of publicly accessible fixtures and fittings with smart controls	100%

Objective	Key Performance Indicator	Target
	Average water consumption in the public realm	10 litres/m²/day (parks) 7 litres/m²/day (streetscapes) 4 litres/m²/day (remaining landscape in aggregate)
	Leak detection on external networks	90%
Minimise potable water consumption through use of recycled water	Percentage of non-potable exterior water uses (e.g. irrigation, cooling) to be met by treated sewage effluent (TSE)	100%
	Percentage of condensate recovered from buildings > 1000 m^2 for on-site reuse	95%

4.5.1 Demand Reduction

Water demand can be reduced through design by addressing all water consuming systems and using techniques such as the following:

- Indoor water demand can be reduced by using efficient or waterless fixtures and fittings such as:
  - Low-flush toilets
  - Low-flow or waterless urinals
  - Low-flow taps (or the use of flow restrictors) fitted with infra-red sensors or percussion style mechanisms that automatically turn off after use
  - Low-flow showers (or the use of flow restrictors)
  - Water efficient appliances (such as washing machines and dishwashers)
- Outdoor water use can be reduced through careful landscaping design considering:
  - Local rainfall patterns
  - Plant selection
  - Soil water retention properties
  - Irrigation equipment and scheduling technologies such as incorporating underground drip irrigation systems to minimise water loss through evapotranspiration
  - Planting schedules and establishment periods

Processed water can be reduced through selection of low water demand process equipment (e.g. closed-circuit cooling systems).

4.5.2 Demand Substitution

Once total water demand has been minimised through the above reduction techniques, reductions in the demand on the municipal potable water distribution networks should be addressed by identifying the use of alternative water sources for the supply of water. The following usages are commonly substituted but other options should also be considered:

- Irrigation
- Water features
- Cooling equipment including district cooling distribution
- Toilet flushing

A water balance model must be prepared for each project to consider the benefits of capture, treatment and reuse of the following potential water streams:

- Black water (discharge from urinals and toilets)

- Grey water (discharge from basins, showers, appliances)
- Air conditioning condensate and humidity capture
- On-site capture of shallow groundwater discharges to drainage systems
- Subsoil capture of surplus irrigation water

A municipal source of high quality TSE is anticipated to be available for the site from the Dubai Municipality (DM). Use of this water should also be considered as a potential source of non-potable water to the site. This supply may become limited as additional demands are placed on the distribution network. Consequently, proposals to use municipal TSE must be discussed with EX20.

Passive treatment systems such as constructed wetland treatment technologies may enable decentralised wastewater treatment providing water suitable for non-potable uses.

Water reuse solutions shall be assessed for the overall impact of providing a source of water for a sustainable environmental, social and human legacy against the following criteria:

- Feasibility (including passive solutions, active treatment technologies, on-site and off-site treatment space requirements)
- Lifecycle energy demand and carbon impact associated with source capture, treatment and water pumping requirements
- Lifecycle operational expenditure and capital expenditure associated with source capture, treatment and water pumping requirements

4.5.3 Water Resource Protection

Protection of water resources is critical to delivery of a sustainable construction project. Key aspects to eliminate waterway contamination and pollution resulting from construction or operational activities for consideration include:

- Design stage – management of storm water and groundwater drainage, management of seasonal and permanent surface water flows
- Construction stage – pollution prevention, construction water (storm water and groundwater) management, and commissioning (flushing of pipe networks)

Water resource protection aspects are addressed by requirements detailed in Assurance Minimum Standards – Environment (doc. ref. 05007-STD-P990000-EN-000001).

During construction, water demands can be high and highly variable. Reducing water demand through construction requires careful planning at both strategic and task-specific levels. Key water demands anticipated through construction include:

- Site management aspects, notably including dust control but also wheel washes and similar aspects
- Concrete water requirements
- Pipework flushing waters
- Worker facilities water demands

4.6 Materials

Materials are a finite resource. The increase on earth's population and demand of goods has a direct effect on the lifecycle of materials. Building construction activities account for approximately 40% of the global material use. The selection of sustainable materials conserves natural resources and preserves biodiversity at the point of extraction, and enhances environmental conditions within the constructed facilities.

Table 4-6 lists the identified strategic objectives, with associated indicators and targets as shown in the BIE registration document.

Table 4-6. Objectives with Associated Indicators and Targets

Objective	Key Performance Indicator	Target
Minimise depletion of natural resources through design for reuse and Legacy	Percentage of materials used in permanent construction retained for Legacy	90%
	Percentage of materials in temporary construction redeployed, taken back or recycled	75%
Promote use of sustainable materials in terms of environmental, social and economic impacts	Percentage of selected materials procured in accordance with Sustainable Materials Guidelines	90%

The programme-wide Sustainable Materials Guidelines (doc. ref. 05007-GDL-P990000-SU-000001) provide guidance on the selection of appropriate materials on the programme.

4.7 Waste

Waste is generally considered in a hierarchical system as follows, with waste avoidance the preferred solution and waste recovery the last option before landfill.

- Avoid/Reduce – review of requirements and specifications to eliminate components that are superfluous and minimise the production of waste through careful design, and good construction practice
- Reuse – identify potential reuse options for wastes on-site and off-site
- Recycle – maximise opportunities for recycling of wastes both during construction and during operation. Designing waste management facilities that support waste segregation and consider end-of-life materials management to facilitate recycling
- Recover – recover the energy from residual waste streams

The strategic objective of minimising waste to landfill, as shown in the BIE registration document is listed in Table 4-7.

Table 4-7. Strategic Objective of Minimising Waste to Landfill

Objective	Key Performance Indicator	Target
Minimise quantity of waste to landfill	Percentage (by weight) of waste segregated into different waste streams, during construction, operation and decommissioning, to allow for diversion from landfill	85%
	Number of non-compliances for waste segregation on-site, in pursuit of overall 85% waste diversion target	Target zero
	Average structural recovery index for temporary buildings. Decommissioning plan is required	60%
	Construction Waste Diversion Rate	TBD
	Operational Waste Diversion Rate	TBD

Project teams will be required to develop and implement strategies to minimise the production of waste during design, construction and operation, and to manage waste in accordance with recognised

international best practice. Project-specific KPIs and targets will be set for the segregation of construction and operational waste to enable diversion from landfill.

The first priority should be to minimise the production of waste and then subsequently to maximise the value of wastes through supporting endeavours to reuse and recycle waste. Waste Management Plans for the construction/demolition and operational modes should be provided to meet this waste strategy within the project-specific sustainability management plan.

4.7.1 Reducing Waste

Waste minimisation is best accomplished with careful planning and consideration for all anticipated waste streams. Successful waste management can only be accomplished when the entire waste stream is fully understood. Strategies for the minimisation of waste production should be considered across all phases of the works from design through construction and into operational decisions.

At design stage, waste minimisation can be achieved through a number of strategies, some of which include:

- Design using prefabrication options, standardisation and modular design concepts
- Design with functional dimensions in mind to minimise cuts and thereby reduce waste generation – cutting of building components to size (e.g. gypsum sheet and concrete blocks) produces waste offcuts. By designing to minimise cutting through actions such as aligning ceiling heights with standardised gypsum sheet sizes, significant reductions in waste can be achieved
- Design components to market-standard specifications to minimise custom manufacturing
- Identify and specify products with reduced packaging requirements or with stewardship schemes in place – work with suppliers to determine what packaging options are available, to optimise packing efficiencies and gain additional unit volume

During construction works, careful planning and site management actions can significantly reduce waste. A key action to be taken prior to the start of construction is to program works in a sequential manner to avoid damage to completed surfaces reducing or eliminating any need for rework. During construction, provision of proper material staging/storage areas can help eliminate potential breakage/damage and thereby reduce waste generation.

Operational decisions in the completed facility can also minimise waste production. Developing food procurement, storage and preparation regimes can help minimise food wastage. Specifying reusable plates, cups and cutlery where appropriate can achieve significant reductions in waste.

4.7.2 Waste Reuse

Reducing waste through material reuse can present challenges relating to reliance on material quality and warranty. However, by establishing a culture of material reuse throughout the programme and taking into account reasonable effort and costs, this strategy can have many positive impacts throughout design and construction.

Opportunities may exist to reuse existing site materials in construction. For example, balancing cut and fill across the project will maximise the opportunity to reuse excavated materials on-site thereby reducing the amount of excavated materials that need to be disposed of. This can be particularly important where there is not a mature framework for the management of recycled aggregates. Demolition products such as crushed concrete may also be incorporated into the project design where the product is of suitable quality and the design usage is compliant with building codes.

Salvaged materials can be incorporated to reduce the demand for new or raw materials. Collaboration with neighbouring projects is another feasible strategy to achieve material reuse and divert functional and usable materials from landfill.

By designing components for easy disassembly, for example by specifying connections or fastening systems that simplify dismantling, planning for the building end-of-life and potential reuse of building elements can be facilitated. Similarly, ensuring that building components are easily adaptable will minimise the waste resulting from future modifications to the building. The modular design components present a significant opportunity to avoid production of waste through reuse.

During construction and operation, temporary use items should, to the extent practicable, to be procured on lease or buyback schemes. Typical items that may be procured for temporary use include site offices, plant including generators and temporary shelters for events. Taking this action reduces the risk that an item procured for temporary use will be discarded before the end of its useful life.

4.7.3 Waste Recycling

The diversion of waste through recycling is the most commonly implemented aspect of the waste hierarchy. Designing buildings to provide facilities for waste recycling is critical to support this aspect. Sufficient facilities for the collection and storage of recyclable materials as well as signage to encourage awareness and mitigate improper sorting, are important factors. Provision of central sorting and storage areas on a facility or neighbourhood scale is necessary, regardless of whether sorting is undertaken by the building user or by a facilities management operation. The design of these areas should account for potential impacts from odour, noise and vehicle movements. Management equipment and strategies may be necessary, including recycling chutes, compactors, balers, etc.

Design phase consideration for end-of-life disassembly can also impact on the ease of recycling building components. Avoiding the use of composite products that reduce the need for processing prior to recycling and so removes an obstacle to the recycling of that product. Avoiding coatings where possible or selecting coatings that do not preclude recycling is also beneficial.

Some straightforward construction site management practices can encourage recycling. Provision of clearly labelled waste segregation storage areas and collaboration with the waste and recycling hauler is necessary. Appointing a construction waste manager and implementing a robust worker education programme is vital to the overall success of construction waste management.

During the Event and ongoing operations, the procurement strategy for disposable items should target recyclable and/or biodegradable plates, cups and cutlery. Attention should be paid to biodegradable claims to ensure that the product is compostable, as many degradable and oxo-degradable items will not degrade in either a composting or a landfill environment. It is also important to identify waste management companies with appropriate facilities to process compostable wastes.

4.8 Carbon

Climate change has been identified as the most pressing global environmental problem with potentially catastrophic consequences for human development. Addressing climate change is the responsibility of all nations and every generation of humankind. Because climate change is a long-term problem with cumulative outcomes, mitigation measures implemented today, no matter how stringent, may not appear beneficial within the lifetime of the present generation. Action must instead be taken on the basis of the longer-term interests of ensuring inter-generational well-being.

EX20 has publicly committed that the Event will be carbon neutral to ensure that the potential adverse climatic impacts of hosting the Event are mitigated.

The carbon neutral goal will be achieved by:

- Estimating the GHG emissions associated with the Event
- Minimising programme GHG emissions to the extent practicable through efficient designs and construction practices
- Offsetting unavoidable emissions

From these objectives, the commitment listed in Table 4-8 to the BIE was made:

Table 4-8. Carbon Neutral Commitment to the BIE

Objective	Key Performance Indicator	Target
Minimise carbon emissions in Expo 2020 Dubai	Implement GHG mitigation and off-setting strategy	Full implementation
	Site-wide carbon emissions reduction compared to a 2015 operational baseline	TBD

The phrase ‘carbon emissions’ is a broadly used term that represents a range of emissions that contribute to global warming or climate change. ‘Greenhouse gas (GHG) emissions’ is a more accurate term that accounts for a number of gases, including carbon dioxide, methane, nitrous oxide, water vapour, ozone and others. GHG emissions are generally categorised as ‘embedded carbon’ and ‘operational carbon’ defined as follows:

- Embedded carbon accounts for the GHG emissions associated with the materials, equipment and processes that go into a finished product, such as a table, a car or a building.
- Operational carbon accounts for the GHG emissions associated with the use of a finished product or system, such as the energy and water used in the operations of a building.

Projects are required to follow the programme hierarchy of reducing GHG emissions associated with construction and operation of the facility during the Event, installing renewable energy and other offset features to further reduce or offset emissions in operation, and finally proposing further alternative and innovative solutions in order to achieve the targeted performance.

Project reductions in GHG emissions will be further supported by application of multiple targets:

- Designing and building to include recycled building materials will reduce embedded carbon, as set out in the Sustainable Materials Guideline
- Designing to achieve defined project targets for reduction of energy consumption and water demand will reduce the GHG emissions associated with operation of the facility through the Event
- Designing building systems to eliminate contribution of harmful substances to the earth’s stratospheric ozone layer and impact to global warming

Project teams shall address embedded carbon impacts in line with the Sustainable Materials Guideline.

An overall carbon strategy to achieve a carbon neutral Event will be developed by EX20.

4.9 Sustainability Awareness

It is envisioned that through programme delivery many new building systems and technologies will be brought to the region and installed projects across the programme. Educational programmes developed shall not only promote public and building occupant sustainability awareness, but also focus on construction personnel and building facility management capacity building.

Education and awareness programmes must consider workers during construction, building occupants, management personnel and visitors. Education and awareness strategies should be integrated into all components of sustainability and visible within each strategy developed.

It is critical that construction personnel have a comprehensive understanding of the sustainability measures required of them while on-site, such as proper construction waste management and sorting. Similarly, training of building and/or facility operators and managers shall ensure an understanding of how the building is intended to function, how it was designed for improved performance and how it needs to be maintained to optimise performance.

Occupant behaviour can have a significant impact on the performance and sustainability of a development, especially in relation to energy and water use. Small occupant behaviours like turning off lights, appliances, and using controls correctly can make a big difference. Awareness and education strategies developed must be legible to all visitors, ensuring cultural sensitivity, language, age, gender, cultural and educational backgrounds. Where appropriate and beneficial, these solutions may draw information directly from building management systems to demonstrate actual performance and drive change.

These objectives will be achieved by:

- Adopting monitoring and verification processes including metering strategies to identify environmental and economic savings
- Encouraging awareness and training practices to enhance the knowledge of end users and building operators for efficient usage of building systems
- Providing publicly accessible installations that encourage awareness and education on sustainability features.

The associated BIE commitments on this topic are listed in Table 4-9.

Table 4-9. Sustainability Awareness

Objective	Key Performance Indicator	Target
Enable visitors to appreciate, understand and contribute to responsible use of resources	Percentage of sustainability features with educational awareness, collaterals or activities	75%
	Sustainability awareness strategy or display for publicly accessible buildings/pavilions	Yes
Enable participants and facility managers to understand and contribute to responsible use of resources	Percentage of pavilions and buildings to have smart metering with digital feedback for energy and water consumption	75%

The sustainability awareness strategy shall address the following as a minimum:

- Energy consumption on a project captured by smart meters shall cover: cooling energy, lighting energy, small power, and process loads
- Water consumption on a project captured by smart meters shall cover: bathrooms, kitchens, irrigation, fountains, and laundries.

4.9.1 Monitoring Systems

Meters and sub-meters are used to track, report and record energy and water consumption rates. Sub-metering by system or component helps to enable quick identification of the source of potential issues. The ability to measure energy and water use at multiple scales and share the information with users in various forms makes energy and water a more readily understood and actionable area of concern and is a key component to building user and visitor sustainability education and awareness. Usage must be measured and monitored in order to effectively manage and improve operation of the building and to provide user and visitor awareness during Event and Legacy phases.

A comprehensive building management and control system can provide further sustainability benefits by providing a coordinated approach to the building systems delivering water, cooling, energy, and similar. By integrating the management of all operational aspects of a building it is possible to deliver a building that increases the quality of the environment for the occupants, for example through dynamic lighting and cooling controls, while reducing peak energy demands. Furthermore, by incorporating the metering strategy with the building control system, performance issues can be identified centrally leading to a potential for more rapid response. Smart systems technology such as smart grid connected applications, cooling systems, peak shut down controls, and similar should be incorporated.

4.10 Sustainability Certification

The objective of the third-party green building and site certification strategy is to demonstrate leadership, innovation, environmental stewardship and social responsibility on a global scale.

Utilising green building and precinct rating systems provides access to the processes and tools needed to effectively measure sustainable design and construction against recognised, reliable and valid standards.

The benefits of certified buildings not only result in direct environmental benefits, but also provide a more comfortable, healthy, and productive environment for the people that use the buildings. Multiple studies have shown that improving the indoor environmental quality of a building increases occupant health and wellbeing, boost productivity, and adds value to the real estate assets as measured in property values and rental rates. Certified buildings provide enhanced thermal comfort, access to daylight, better acoustics, external views, and improved indoor air quality with fewer contaminants in the space.

The objective of sustainability certification is identified in Table 4-10, as per BIE commitments:

Table 4-10. Objectives of Generating Value

Objective	Key Performance Indicator	Target
Demonstrate added value through sustainability certification of both horizontal and vertical infrastructure	Achieve LEED Certification as appropriate for the building projects	LEED Gold,
	Achieve CEEQUAL Certification as appropriate for the infrastructure projects	CEEQUAL Excellent

A programme-wide strategy to address sustainability certification is considered in the Programme-wide Certification Strategy (doc. ref. 05007-STG-P990000-SU-000035).

4.11 Sustainable Operations, Event Management and Reporting

Management and operational considerations are imperative to ensure a lasting sustainable legacy in all programme developments. In addition to system design and specification, how products and systems are installed and operated have a direct impact on performance throughout the life of a building. Systems that do not perform as intended can consume significantly more resources (such as energy, water, and materials) over their lifetime. The goal is to ensure a foundation for maximum operational efficiency and minimal impact on the environment through the design and construction process, providing operational benefits throughout the life of the building.

Improvements to the way in which buildings and sites are operated and maintained will be made. To realise such change, significant effort toward education, occupant and visitor awareness and worker training is required.

These objectives will be achieved by implementing the construction, commissioning, management and operational plans to cover the whole building life cycle.

The associated BIE commitments on this topic are listed in Table 4-11.

Table 4-11. Sustainable Event Operations and Management BIE Commitments

Objective	Key Performance Indicator	Target
Promote sustainable event management and operations	Achieve ISO 20121 Sustainable Event Management certification	Yes
Communicate progress and achievements in respect of sustainability in a transparent and stakeholder responsive way	Sustainability reporting based on internationally recognised guidelines	Yes

4.11.1 Commissioning

Comprehensive building and systems commissioning will be required to ensure that the project is performing as per the design and is meeting all the requirements to achieve the targeted sustainability certification (if required).

The project team shall ensure a streamlined commissioning process is implemented for the project, including documentation and reporting standards and templates to be used from design through construction and operations.

Approval Requested

Title				Reference
Programme-wide Sustainability Strategy Sustainability				05007-STG-P990000-SU-000001 Revision 4
Status				
☒ Approval	☐ Review	☐ Endorsement	☐ Action	☐ Information
EX20 Approval				

Approved by

27 MAR 2017

Dr. Robert Platt
Vice President, Urban Planning and Public Realm

Date

2.4.2017

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03.04.17

Tony Aikenhead
Senior Vice President, Real Estate & Delivery

Date

NOTE: SECTION 4.4.3 IS UNDER REVIEW.

Appendix A

Key Performance Indicators – Expo Mode

Appendix A - Key Performance Indicators – Expo Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
Transport	Sustainable, lower carbon public transport	Achieve passenger modal shift	Significant deviation from baseline
Public Realm & Ecology	Create people-centric, comfortable and walkable spaces	Percentage of primary walkways in Thematic Districts areas providing shading at 13:00 on equinox	75%
		Percentage of hard landscaping in self-built pavilion areas and public open spaces providing shading at 13:00 on equinox	60%
		Percentage of site hardscape and roof with heat island reduction strategies implemented Minimum values of Solar Reflective Index (SRI) and Light Reflectance Value (LRV): ≥30 SRI for hardscape ≥30 SRI for non-flat roofs ≥80 SRI for flat roofs ≥45% LRV for walls	70%
		Public space complies with ADA requirements	100%
	Enhance the ecological value of the site and promote local species	Percentage of landscape plants which are native/adaptive species	50%
		Minimum number of native/adaptive plant species to be used	5-No
		Number of pest species to be used	0
		Percentage of landscape area managed without the use of chemical pesticides, herbicides or fertilizers	95%
Energy	Reduce energy consumption	Outperform the ASHRAE 90.1 standard for building efficiency	20%
		Reduce permanent building energy use intensity against Energy Star Target Finder (ongoing projects excluded)	70%
		Lighting power density that outperforms the IECC Exterior Lighting standard (for exterior areas)	20%
		Lighting power density that outperforms the IECC Exterior Lighting standard (for landscaped features)	50%

Appendix A - Key Performance Indicators – Expo Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
	Produce clean energy	Percentage of total energy requirement to be met with (on-site and off-site) renewable energy during Expo event	50%
		Percentage of total energy requirement to be met with on-site renewable energy during the Expo event	25%
Water	Reduce water consumption	Reduction in water consumption in buildings compared to Dubai Electricity and Water Authority (DEWA) baselines	40%
		Percentage of publicly accessible fixtures and fittings with smart controls	100%
		Percentage of exterior water to be monitored and leak detected	90%
		Average water consumption in the public realm:	10 litres/m²/day (parks) 7 litres/m²/day (streetscapes) 4 litres/m²/day (remaining landscape in aggregate)
		Leak detection on external networks	90%
	Minimise potable water consumption through use of recycled water	Percentage of non-potable exterior water uses (e.g. irrigation and cooling) to be met by treated sewage effluent (TSE)	100%
		Percentage of condensate recovered from buildings > 1000 m² for on-site reuse	95%
Materials	Minimise depletion of natural resources through design for reuse and Legacy	Percentage of materials used in permanent construction retained for Legacy	90%
		Percentage of materials in temporary construction redeployed, taken back or recycled	75%
	Promote use of sustainable materials in terms of environmental, social and economic impact	Percentage of selected materials procured in accordance with Sustainable Materials Guidelines	90%

Appendix A - Key Performance Indicators – Expo Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
Waste	Minimise quantity of waste to landfill	Percentage (by weight) of waste segregated into different waste streams, during construction, operation and decommissioning, to allow for diversion from landfill	85%
		Number of non-compliances for waste segregation on-site, in pursuit of overall 85% waste diversion target	Target zero
		Average structural recovery index for temporary buildings. Decommissioning plan required.	60%
		Construction Waste Diversion Rate	TBD
		Operational Waste Diversion Rate	TBD
Carbon	Minimise carbon emissions in Expo 2020 Dubai	Implement greenhouse gas (GHG) mitigation and off-setting strategy	Full implementation
		Site-wide carbon emissions reductions compared to a 2015 operational baseline	TBD
Sustainability Awareness	Enable visitors to appreciate, understand and contribute to responsible use resources	Percentage of sustainability features with educational awareness, collaterals or activities	75%
		Sustainability awareness strategy or display for publicly accessible buildings/pavilions	Yes
	Enable participants and facility managers to understand and contribute to responsible use of resources	Percentage of pavilions and buildings to have smart metering with digital feedback for energy and water consumption	75%
		Percentage of public realm with free access to wireless high speed internet	TBD
Sustainability Certification	Demonstrate added value through sustainability certification of both horizontal and vertical infrastructure	Achieve LEED Certification as appropriate for the building projects	LEED Gold
		Achieve CEEQUAL Certification as appropriate for the infrastructure projects	CEEQUAL Excellent

Appendix A - Key Performance Indicators – Expo Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
Sustainable Operations, Event Management and Reporting	Promote sustainable event management and operations	Achieve ISO 20121 Sustainable Event Management certification	Yes
	Communicate progress and achievements in respect of sustainability in a transparent and stakeholder responsive way	Sustainability reporting based on internationally recognised guidelines	Yes

Appendix B

Key Performance Indicators – Legacy Mode

Appendix B - Key Performance Indicators – Legacy Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
Live	Mixed-use development	Parcels that are zoned for multiple uses	75% (TBC)
		Provision for housing of different types, sizes and tenures	15% of total (TBC)
	Access to services and amenities	K-12 schools within 5 km	1 School (TBC)
		Percentage of dwelling units within 1 km walking distance from a recreational area	80% (TBC)
		Public, communal and/or private amenity spaces and facilities for children and parents	1-day care facility/500 residents
		Public open spaces that are clearly defined, and open to all	100% (TBC)
	Smart Homes	Living units equipped with home automation technology and smart appliances	90% (TBC)
		Living units that use smart technology to reduce energy consumption	90% (TBC)
Work	Economic Opportunity	Commercial GFA allocation for start-up and managed incubator space	7.5% (TBC)
		Number of institutions engaging in mobility and logistics research or testing and development	10 (TBC)
	Quality Work Environment	Percentage of commercial buildings within 5 minutes' walk of open/green space	85% (TBC)
		Indoor space having a daylight autonomy of 300 lux for 50% of occupied time	75% (TBC)
	Optimized Work Space	Staff to desk ratio	> 1.0 (TBC)
		Informal seating area to formal seating area ratio	25% (TBC)
Wellness	Healthy Food	Residents within 250 m of groceries selling organic food	75% (TBC)
		Organic food certified by Emirates Authority for Standardization and Metrology (ESMA)	100% (TBC)
		Restaurants offering organic food choices on the menu	(TBD)

Appendix B - Key Performance Indicators – Legacy Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
		Restaurants and catering services that provide calorie and nutrition information	(TBD)
		Community greenhouse area available for urban agriculture	8 ha (TBC)
	Fitness	Percentage of dwellings within 400 m walking distance of a gym with smart equipment	TBD
		Residents whose health information can be uploaded and stored in the cloud and monitored by local health facilities	100% (TBC)
		Number of publicly available workout or activity spaces per 500 m of pedestrian pathway	2 (TBC)
		Length of publicly accessible cycling and walking trails	5 km (TBC)
Transport/ Mobility	Sustainable, lower carbon public & private transport options	Percentage of residents within 500 m of public transport	100% (TBC)
		Percentage of workers travelling to the site using public transport: 50%	50% (TBC)
		Percentage of total internal commutes made via cycling or walking	75% (TBC)
		Parking space allocation for green vehicles	20% (TBC)
		Capacity of autonomous car parking lots	1000 vehicles total
		Percentage of deliveries and collections by electric vehicles by 2025	80% (TBC)
		Percentage of public transit stops with real-time transit information	100% (TBC)
		Streets monitored by traffic security and management system	100% (TBC)
		Parking spaces with parking guidance systems	100% (TBC)
Public Realm & Ecology	Create people-centric,	Percentage of public gathering space providing shade at 13:00 on the equinox	60% (TBC)

Appendix B - Key Performance Indicators – Legacy Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
	comfortable and walkable spaces	Percentage of site hardscape and roof with heat island reduction strategies implemented Minimum values of Solar Reflective Index (SRI) and Light Reflectance Value (LRV): ≥30 SRI for hardscape ≥30 SRI for non-flat roofs ≥80 SRI for flat roofs ≥45% LRV for walls	70%
		Density of Green/Open public space	1 public space/ 10 ha (TBC)
		Public space complies with ADA requirements	100% (TBC)
		Maximum block length	250 m (TBC)
		Percentage of rights of way allocated to pedestrians	40% (TBC)
		Streets with protected cycle lanes that are wider than 2 m	90% (TBC)
	Enhance the ecological value of the site and promote local species	Percentage of non-productive landscape plants which are native/adaptive species	95% (TBC)
		Amount of landscape area that is protected/ restored and minimally managed as wildlife refuge	20 ha (TBC)
		Number of pest species to be used	0
		Percentage of landscape area managed without the use of chemical pesticides, herbicides or fertilizers	95%
		Percentage of permanent buildings that have implemented a climate change resilience plan during design	95% (TBC)
Energy	Reduce energy consumption	Reduce permanent building energy use intensity against Energy Star Target Finder	70% (TBC)
		Lighting power density that outperforms the IECC Exterior Lighting standard (for exterior areas)	20%
		Lighting power density that outperforms the IECC Exterior Lighting standard (for landscaped features)	50%
	Produce clean energy	Annual site-wide electrical energy demand being met by on-site renewables	25% (TBC)

Appendix B - Key Performance Indicators – Legacy Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
		The fraction of total electrical load served by real-time pricing, or time-of-use pricing	80% (TBC)
		Percentage of total energy requirement to be met with (on-site and off-site) renewable energy	100% (TBC)
Water	Reduce water consumption	Reduction in potable water consumption in buildings compared to Dubai Electricity and Water Authority (DEWA) baselines	40%
		Percentage of publicly accessible fixtures and fittings with smart controls	100%
		Percentage of exterior water to be monitored and leak detected	90%
		Maximum potable and non-potable water network leakage rate of utilities infrastructure installed post Expo event	5%
		Average water consumption in the public realm:	10 litres/m²/day (parks) 7 litres/m²/day (streetscapes) 4 litres/m²/day (remaining landscape in aggregate)
	Minimise potable water consumption through use of recycled water	Potable water used for non-potable applications	0% (TBC)
		Post-Expo event constructed area with a SUDS strategy in place	100% (TBC)
		Percentage of condensate recovered from buildings > 1000 m^2 for on-site reuse	95%
Materials	Minimise depletion of natural resources through design for reuse and legacy	Percentage of materials used in permanent construction retained for Legacy	90%
		Percentage of materials in temporary construction redeployed, taken back or recycled	75%
	Promote use of sustainable materials in terms of environmental, social and economic impact	Percentage of selected materials procured in accordance with Sustainable Materials Guidelines	90%
		Percentage of core and shell building materials by cost estimate value having an Environment Product Declaration (EPD)	60% (TBC)

Appendix B - Key Performance Indicators – Legacy Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
		Reduction in Building LCA compared to baseline building	25% (TBC)
Waste	Minimise quantity of waste to landfill	Percentage (by weight) of waste segregated into different waste streams, during construction and operation to allow for diversion from landfill	85%
		Number of non-compliances for waste segregation on-site, in pursuit of overall 85% waste diversion target	Target zero
		Average structural recovery index for temporary buildings. Decommissioning plan required.	60%
		Construction Waste Diversion Rate	80% (TBC)
		Operational Waste Diversion Rate	80% (TBC)
		Percentage of commercial and retail space reporting waste generation against a stated target	70% (TBC)
		Reduce carbon emissions from waste collection	50% (TBC)
Carbon	Minimise carbon emissions in Expo 2020 Dubai	Implement GHG mitigation and off-setting strategy	Full implementation
		Site-wide carbon emissions reductions compared to a 2015 operational baseline	40% (TBC)
Sustainability Awareness	Enable visitors to appreciate, understand and contribute to responsible use resources	Percentage of sustainability features with educational awareness, collaterals or activities	75%
		Sustainability awareness strategy or display for publicly accessible buildings	Yes
	Enable participants and facility managers to understand and contribute to responsible use of resources	Percentage of buildings to have smart metering with digital feedback for energy and water consumption	75%
		Percentage of public realm with free access to wireless high speed internet	95% (TBC)
		Percentage of buildings with BMS connected to site-wide Internet of Things (IoT) environment technology	50% (TBC)

Appendix B - Key Performance Indicators – Legacy Mode

Sustainability

Aspect	Objective	Key Performance Indicator	Target
Sustainability Certification	Demonstrate added value through sustainability certification of both horizontal and vertical infrastructure	Achieve LEED Certification as appropriate for the building projects	LEED Gold
		Achieve LEED for Neighbourhood Development (LEED ND)	TBD
		Achieve WELL Certification	TBD
	Communicate progress and achievements in respect of sustainability in a transparent and stakeholder responsive way	Sustainability reporting based on internationally recognised guidelines	Yes

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