Whole City Awards: Masdar City – A Sustainable Community





INTRODUCTION

Masdar

Masdar is a wholly owned subsidiary of the Mubadala Development Company, established in 2006 as a catalyst for the economic diversification of the Emirate of Abu Dhabi. Masdar operates through five integrated units, including an independent, research-driven graduate university, and seeks to become a leader in the field of renewable energy and clean technology.

Traditionally, Abu Dhabi has played a leading role in international energy markets, due to the wealth of natural resources in the country. However, Abu Dhabi has undertaken a two-decade programme to transform the UAE economy from one based on natural resources to one based on knowledge, innovation and the export of cutting-edge technologies. Masdar was established to support the development, commercialisation and adoption of renewable energy and cleantech technologies and systems, both locally and internationally.

Abu Dhabi is committed to playing its part in the global effort to combat climate change. The Emirate's leadership recognises its responsibility to be part of the concerted international efforts to reduce the volume of greenhouse gases released into the atmosphere – by developing renewable energy, reducing demand for power and addressing the carbon produced by industry, utilities and transport.

Masdar was established to support the development, commercialisation and adoption of renewable energy and cleantech technologies and systems, both locally and internationally.



Masdar City location



Masdar City

Masdar City is an emerging global hub for renewable energy and clean technologies established by Masdar. Aspiring to be one of the most sustainable communities on the planet, Masdar City not only embodies Abu Dhabi's commitment to a sustainable future, it is the place where best practice in sustainable urban planning and development is being developed, tested and deployed. It provides an attractive environment for cleantech firms, academic institutions, research facilities, financial firms and other organisations to collaborate and develop new technologies and solutions.

It goes far beyond reducing the environmental impact of an individual building, it addresses housing, education, work, transport and infrastructure, energy, water, and issues of density.

Masdar City view



We are living through a period of unprecedented population growth and urbanisation. While 100 years ago just ten per cent of the world's population lived in cities, today it is more than half – and these cities currently consume around 75 per cent of the world's diminishing natural resources.

In the industrialised world, buildings and the activities within them consume roughly one third of the energy we generate and produce one third of the carbon dioxide we emit. Together, the combination of buildings and infrastructure accounts for almost three quarters of the energy consumed in industrialised societies. Hence, to effectively reduce our carbon footprint today, we need a holistic approach that looks at infrastructure and buildings in an integrated way. There is a need for wellplanned, sustainable new cities, alongside the development of renewable sources of energy.

Masdar Institute 1B – Under Construction



Siemens ME Headquarters – Under Construction





Masdar City in the United Arab Emirates addresses both of these imperatives as a new 6-squarekilometre city for 40,000 residents, located to the southeast of Abu Dhabi Island. The project is an opportunity to start from scratch in order to actively minimise energy demand through the planning and orientation of the urban grid. In this way, it goes far beyond reducing the environmental impact of an individual building. Working at the scale of the integrated city, it addresses housing, education, work, transport and infrastructure, energy, water, and issues of density, together with the aim of achieving a low-carbon, sustainable community.

Masdar City demonstrates both. It is a prototypical sustainable city that actively reduces its impact on the environment, while providing a base for the development of new forms of renewable energy.

AN OVERVIEW OF THE PROJECT:

Project: Masdar City

Total Site Area: 590 hectares.

Total Gross Floor Area: 3.8 million square metres

Total Population: 90,000 (40,000 residents and 50,000 commuters)

Land Use: Mixed land use (residential, commercial, institutional, light industrial)

Masdar Institute 1A - Completed





The following details will demonstrate how the Masdar City planning addresses each award criteria

1. Enhancement of the Natural and Built Landscape



1. ENHANCEMENT OF THE NATURAL AND BUILT LANDSCAPE:

Masdar City has been conceived as a modern Arabian city that incorporates a focus on developing the sustainable technologies of the future. As such, the urban form resonates with a strong sense of place and tradition. The first cities in the Middle East, founded approximately 7,000 years ago, were models of sustainable development and were largely self sufficient. Their city fabric, orientation and surrounding landscape were dictated by the climate and locally available materials. Perhaps most significantly, they were walking cities and typically very dense, with an accommodated population density of approximately 200 people per hectare. Masdar City is inspired by these centuries-old cities and rejects the more recent model of urban planning that centres on the car. Its population density is approximately 180 people per hectare.

The goal of Masdar City is to provide residents with the highest quality of life with the lowest environmental footprint. To achieve this goal the City is based on the principles of sustainable urban design:

- Low-rise high-density accommodation.
- Sustainable transportation.
- Dense neighbourhoods.
- Balanced distribution of community facilities, including open spaces.

To be successful, a sustainable initiative must deliver a place where people want to live, work and visit. In Masdar City, there is a focus on the public realm – on transport, streets and squares – everyday places that often are taken for granted but have a real impact on the quality of life. The master plan incorporates a variety of community spaces, all contained within a safe, primarily fossil fuel-free development. Integrated with its surroundings, the city will offer something for everyone, from intimate courtyards and gardens, to sports fields and shopping streets.

Masdar City – Urban Fabric & Public Realm







Masdar Institute 1A - Courtyard

Providing comfort in a desert climate is a principal concern. Carefully planned landscape and water features will aid in reducing ambient temperatures, while enhancing the quality of the streets.

> The starting point for Masdar City's landscaping strategy is the history of open spaces in the traditional Arab city. Balancing the desire for shade and green with the limited water resources forms the basis for a sustainable landscape scheme in Masdar City.

> Masdar City's footprint is characterised by two Urban Squares - one large and one small, surrounded by open field landscape. The public realm of the Urban Squares is characterised by a hierarchy of open spaces: the linear green parks - two in the large square and one in the small square - public squares, public plazas, laneways and semi-public courtyards. The linear green parks, which form the lungs of the city fabric, are oriented in the direction of wind flow through the city squares. The linear green parks separate the built-up areas, capturing and directing cool breezes, while providing cool, pleasant spaces throughout the city. The linear green parks bleed into the urban fabric, expanding into urban spaces and semi-public courtyards.

> Providing comfort in a desert climate is a principal concern. Carefully planned landscape





and water features will aid in reducing ambient temperatures, while enhancing the quality of the streets. A number of devices – such as colonnades, whose shadowy recesses offer respite from the sun – have been shown to bring the radiant temperature down by 20 degrees Celsius compared to the open desert. Planting, green canopies and water not only help to lift the spirits, but also contribute to further reductions in temperature. Other vernacular devices, such as wind towers, which encourage cooling air currents, can also help to modify the microclimate.

The use of semi-public courtyards for enhanced quality of outdoor living is aptly demonstrated in the Masdar Institute neighbourhood. The large urban square at the base of the wind tower in the Masdar Institute neighbourhood – a civic landmark as well as a cooling device – is animated by café seating, and shaded by the buildings and mature trees. The square offers a place of recreation and social interaction – a counterpoint to the intense research environment of the nearby laboratories.





2. Arts, Culture and Heritage



2. ARTS, CULTURE AND HERITAGE:

In traditional Arab communities, art, culture and heritage are an integral part of the city fabric and are used to enhance the urban landscape in one form or another. Compact urban form, narrow streets, shaded pathways and courtyards are part of the rich architectural culture and heritage of the region. Living and working in such close proximity requires consideration to preserve a sense of privacy. This is achieved through careful positioning of openings, the use of balconies and the use of shading screens that evoke the region's traditional mashrabiyas.

Masdar City has been conceived as a modern Arabian city that incorporates a focus on developing the sustainable technologies of the future. As such, the urban form resonates with a strong sense of place and tradition. The master plan design is inspired by settlements that pre-date electricity and relied on passive environmental controls. Similarly, Masdar City uses building orientation and its compact urban form to reduce energy demand naturally. In keeping with the form of traditional Arab communities, Masdar City incorporates narrow streets, shaded pathways and courtyards, balconies and shading screens.

The first cities founded in the Middle East around 7,000 years ago were models of sustainable development and largely self-sufficient. Their fabric and orientation were dictated by locally available materials and the climate. Perhaps most significantly, they were walking cities.

In keeping with the form of traditional Arab communities, Masdar City incorporates narrow streets, shaded pathways and courtyards, balconies and shading screens. These are part of



North/South North-South orientation of streets allows sunlight penetration of the urban structure with a subsequent increase in cooling loads requirements



East/West An East/West alignment also results in an increase in cooling load requirement due to the street exposure of external walls to sunlight.



Northeast/Southwest The diagonal grid provides optimal shading



Northeast/Southwest Northeast/Southwest orientation of the city fabric provides optimal shading







Masdar City's architectural guidelines, which are prescriptive but provide enough flexibility to achieve the envisaged built-form character. Traditional art and architecture, which explore light, shade, shadow, texture and layering, provide a rich palette of architectural ideological possibilities and are often distinguished by ordered repetition, radiating structures, and rhythmic patterns. Columns, piers and arches are other recognisable elements, organised and interwoven with sequences of niches and cloister spaces, which generate internal courtyard spaces and provide an open interior for private housing, as well as screening from the public streets. Interpretations of these basic traditional elements lay the foundations for a community based on traditional culture and customs, while also allowing for the integration of modern infrastructure and lifestyles. The resulting architecture is rich in traditional elements, but driven by futuristic advancements in energy-efficient and sustainable materials.

Columns, piers and arches are organised and interwoven with sequences of niches and cloister spaces, which generate internal courtyard spaces and provide an open interior for private housing, as well as screening from the public streets.

Masdar Institute Facades











3. Environmental Best Practices



3. ENVIRONMENTAL BEST PRACTICES:

Energy

Energy conservation through demand reduction, appropriate generation from renewable sources and efficient distribution is fundamental to the Masdar City vision. Strategies for producing energy and reducing consumption are at the core of the development of the Masdar City Master Plan. The optimal orientation of the City Squares was determined through wind and solar analysis.

Both now, and at full build out, Masdar City will be entirely powered by renewable energy on a net basis, generated onsite and offsite. Solar power will satisfy most of the city's energy demand. The city's power needs are substantially lower than conventional cities in the region through a range of strategies designed to promote a sustainable way of life. The orientation of the city and streets was set in order to minimise heat gain and maximise cooling breezes. This has provided some of the biggest energy savings to the city – at no cost.

A 10MW solar photovoltaic plant is operational within Masdar City. Occupying 22 hectares within the outer boundary of Masdar City, it is the largest grid-connected solar plant in the Middle East and was connected to the Abu Dhabi power grid in April 2009. The plant provides clean energy to the Masdar Institute campus, as well as to some of the other ongoing activities within Masdar City. The roof-mounted photovoltaic panels installed on Masdar Institute's laboratories and residential apartments, not only generate electricity, but they also help to provide additional shading to the streets and courtyards, and reduce the amount of direct solar gain absorbed by the roofs. In addition to solar energy, Masdar City is exploring the viability of geothermal and solar thermal cooling technologies that use heat to run airconditioning units.

The 10MW solar photovoltaic plant



Masdar City also minimises energy consumption through stringent building efficiency guidelines in areas such as insulation, low-energy lighting, low glazing-to-wall ratios, optimising natural light, and installing smart appliances, smart metres, smart building management systems, an integrated distribution management system, and a citywide energy management system that interacts to manage the electrical load on the grid and all along the system, from the utility to the consumer.

To achieve the ultimate goal for Masdar to derive 100 per cent of its energy requirements from renewable sources, it is paramount that buildings are designed to use the minimum amount of energy, without sacrificing occupant comfort. Hence, the Masdar Energy Design Guidelines (MEDG) have been developed and implemented in Masdar City specifically to serve as a mandatory framework for designing energy-efficient buildings.

Water

As an increasingly precious resource, balancing water supply and demand within Masdar City is fundamental to achieving the sustainability goals of this pioneering development. To facilitate sustainable design and water use, a Water Balance Model was prepared early on, at the concept design stage. This assisted in determining the optimal strategy for supplying potable water, dealing with the wastewater and supplying Treated Sewage Effluent (TSE).

Masdar City proposes to reduce its water needs by more than half that of conventional cities in the region. This will be achieved through increased environmental awareness among residents over time. The city employs a broad array of technologies to reduce water consumption, including highefficiency appliances, smart water meters and highly efficient irrigation systems. Water-use reduction technologies in buildings include highefficiency appliances, low-flow showers, highly efficient laundry systems, real-time monitoring, smart water meters that inform consumers of their consumption, and high-efficiency irrigation and low-water use landscaping, particularly through use of indigenous desert flora. The current wastewater system combines grey water and black water for processing and treatment at the membrane bioreactor (MBR) plant, which is installed within the boundaries of Masdar City. The treated sewage effluent produced at the MBR will be used for landscaping. Wastewater will be treated and recycled for irrigation. The bio solids resulting from the wastewater treatment can be reused for compositing and in any future wasteto-energy plant.



Masdar City plans to divert at least 50% of operational waste from landfill at the completion of Phase 1 and 90% of construction waste during the development period.

Waste:

The Waste Strategy for Masdar City was developed based on the waste hierarchy principle. This starts with the most desired options of prevention, minimisation, reuse, recycling, and energy recovery, and ends with disposal as the option of least preference. Masdar City will significantly reduce waste, encouraging a low-waste lifestyle through the reduction, reuse, recycling and recovery of waste materials. Masdar City plans to divert at least 50% of operational waste from landfill at the completion of Phase 1 and 90% of construction waste during the development period.

Each person living and working in Masdar will be expected to separate their waste into three main streams; dry recyclables, wet recyclables and residual. The dry recyclables, containing materials such as paper and plastic, will be separated into constituent materials at a Material Recycling Facility (MRF) so that they can be reprocessed for further use. The wet recyclables, the organic waste, will be composted to produce a high-value material that can be used in Masdar City as fertilizer. This will be done in the Resource Recovery Centre to be developed by Masdar City.

Comprehensive construction waste management and recycling has been implemented at Masdar City and has achieved a 96% diversion of construction waste from landfill. The management of construction waste is undertaken via an onsite Materials Recycling Centre (MRC) that allows for the separation and processing of all major construction waste. Separate storage areas for waste concrete, wood, metal and other materials make it easy for contractors to reuse these materials onsite, and recycle offsite.

Materials Recycling Centre



Materials Supply Chain:

While Masdar City's supply chain was put in place to ensure the city met its sustainability goals, a secondary objective was to support the development of a local and regional sustainable construction materials industry and to provide information and expertise to help suppliers improve the sustainability of their products and their production processes. From timber, steel and aluminium to paint, cement and beyond, Masdar City's engagement with its local and international suppliers has led to the development of new or improved green products or to their new availability locally. Product lifecycle assessments have helped suppliers to identify ways to make their products even more sustainable.

Furthering its efforts in supply chain, Masdar City has launched the first portal of its kind to originate in the Arab world, www.thefuturebuild.com. The Future Build is being used by specifiers and contractors working on projects in Masdar City and across the region. The Future Build assists architects, engineers and contractors in identifying and sourcing building products and materials that have been independently assessed to ensure they deliver the environmental benefits claimed. The Future Build also offers a platform for suppliers of green building products to bring their products and materials to the attention of all elements of the construction industry, particularly in the United Arab Emirates and wider Arab world, concerned with sustainable construction.

The portal reflects the vital need of Masdar City – as with any project that seeks to accurately manage its environmental footprint – to understand and manage the embodied carbon and other environmental implications of products and materials used to construct and operate the city.



4. Community Participation and Empowerment

4. COMMUNITY PARTICIPATION AND EMPOWERMENT:

Masdar City is already fulfilling its strategic goal to become a centre for the development of new sustainable technologies. A range of pilot projects are underway at Masdar Institute and elsewhere across the city, exploring alternative forms of transport, cooling devices such as wind towers, and new potential sources of power, including solar thermal cooling.

Part of Masdar City's vision is to be a sustainable development model for the region and beyond. Masdar City is progressing toward this realisation by taking a holistic approach to development, with all aspects of design, planning, delivery, management, construction and operation constantly being considered and improved upon to produce the optimum development methodology and, ultimately, a sustainable city.

Masdar City has welcomed and embraced the implementation of the Estidama Pearl Rating System - a sustainability rating system implemented by the Abu Dhabi Urban Planning Council - as a model initiative and framework to further support sustainable urbanisation in the region. The system's design and development model has been developed holistically to solve systemic challenges and to support the overall direction of the Estidama initiative and Plan Abu Dhabi 2030. Masdar City's Key Performance Indicators have a systemic focus, including critical resources, carbon reduction, pollution control, waste reduction, and social and economic targets, as well as minimum Estidama certification in both its Communities and Buildings categories. We anticipate that 3 to 4 Pearls (out of a maximum of 5 Pearls) are likely to be achieved for both Buildings and Communities categories, using the city's current integrated development model.

Masdar, the parent company of Masdar City, has undertaken a number of initiatives at the international and local levels to promote the concept of sustainable development and technologies:

World Future Energy Summit (WFES):

One of Masdar's major international initiatives is the World Future Energy Summit (WFES), launched in 2007 and first held in 2008. WFES brings together global leaders in policy, technology and business to discuss state-of-theart technologies, develop new ways of thinking and shape the future of renewable energy.

A second key international initiative, and an important feature of the World Future Energy

Summit, is the Zayed Future Energy Prize (ZFEP), launched in 2008 and first awarded in 2009. The Prize is an annual award that celebrates achievements that reflect real impact, innovation, long-term vision and leadership in renewable energy and sustainability. The Prize represents the vision of the Late Founding Father Sheikh Zayed Bin Sultan Al Nahyan, who championed environmental stewardship.

Masdar has also announced the International Water Summit to be held in January 2013 in conjunction with the World Future Energy Summit. The International Water Summit is the only global event that focuses specifically on the water-energy nexus and its associated challenges in arid environments.

IRENA:

The International Renewable Energy Agency (IRENA) – an intergovernmental organisation dedicated to promoting the widespread adoption and sustainable use of all forms of renewable energy – will locate its headquarters at Masdar City, thereby bringing to the city the latest in renewable energy policymaking, global best practices and state-of-the-art technological expertise. This is the first time an international organisation of such size has selected a Middle East city for its secretariat.

Collaboration with Local Entities:

Many of the lessons learned at Masdar City in the field of sustainable urban development, planning and design are being shared with the Abu Dhabi Urban Planning Council (ADUPC), Department of Transportation (DOT), Department of Municipal Affairs (DMA), Centre of Waste Management and other government regulators and policymakers. This collaboration is valuable, as these entities, with Abu Dhabi-wide responsibility, seek to maximise the sustainability of the Emirate as a whole.

Masdar City experts contributed substantially to the Abu Dhabi Urban Planning Council's Estidama programme, and they have worked with the Abu Dhabi Department of Municipal Affairs (DMA) on their world-class building codes, which will substantially improve building efficiency in water and power consumption across the Emirate.

From smart utility metres and solar panels on buildings to solid waste standards and street widths, Masdar City is a constant partner to Abu Dhabi in the development of its urban planning and energy policies and strategies.





5. Healthy Lifestyle



5. HEALTHY LIFESTYLE:

To be successful, a sustainable initiative must deliver a place where people want to live, work and visit – the city must 'lift the spirits'. First and foremost Masdar City is a pedestrian-friendly and walkable environment based on multi-modal public transportation systems available in the city. Walkability promotes good health. A safe public realm and easy pedestrian movement is the key to the success of a healthy environment. In Masdar City, there is a focus on the public realm – on transport, streets and squares – everyday places that are often taken for granted but have a real impact on the quality of life. The master plan incorporates a variety of community spaces, all contained within a safe, primarily fossil fuel-free development. Integrated with its surroundings, the city will offer something for everyone, from intimate courtyards and gardens, to sports fields and shopping streets.





Providing comfort in a desert climate is a principal concern. Green parks separate the built-up areas, capturing and directing cool breezes, while providing cool, pleasant oases throughout the city. Carefully planned landscape and water features will aid in reducing ambient temperatures, while enhancing the quality of the streets.

A number of devices – such as colonnades, whose shadowy recesses offer respite from the sun – have been shown to bring the radiant temperature down by 11 degrees Celsius, compared to a regular street in Abu Dhabi and 20 degrees Celsius compared to the open desert. Planting, green canopies and water not only help to lift the spirits, but they also contribute to further reductions in temperature. Other vernacular devices, such as wind towers, which encourage cooling air currents, can also help to modify the microclimate. Cumulatively, all of these devices have the effect of prolonging the pleasant, moderate season in the city.

Masdar Institute is a working prototype of a neighbourhood cluster – it is as liveable as it is sustainable. The cluster consists of stateof-the-art laboratory buildings and residences built around two public courtyards. It provides its residents with all the necessary facilities one expects from living as part of a community. The street level is occupied by various service providers, including food and beverage outlets, student lounge, gym, bank, telecommunications provider, courier and travel agency. It is even home to an organic supermarket. The large urban square at the base of the wind tower in the Masdar Institute neighbourhood – a

Masdar Institute Courtyard & Wind Tower



Masdar Institute Streetscape

civic landmark as well as a cooling device – is animated by café seating, and shaded by the buildings and mature trees. The square offers a place of recreation and social interaction – a counterpoint to the intense research environment of the nearby laboratories. Most significantly, the Masdar Institute campus is fully integrated with the city – its social and public spaces are open to all.

Combining its facilities with a walkable car-free environment and you have the basis of a healthy lifestyle.







6. Strategic Planning



6. STRATEGIC PLANNING:

Masdar City is a challenge requiring original thinking and advanced technological solutions, but it offers a compelling opportunity for change. Most importantly, by embracing this challenge in such an extreme climate, the project has applications for both new and existing cities around the world.

Masdar City keys significantly into the nodal development approach outlined by the Plan Abu Dhabi 2030. It provides Abu Dhabi with a vibrant community located between the Capital District and the Abu Dhabi International Airport. As such, it keys strategically into the existing and planned transport infrastructure systems for this development sector of the city. As a community, through its planned services and amenities, it complements existing and developing communities in the immediate vicinity, including the Khalifa City A quarter to the west and the Al Raha development to the north.

The Masdar City Transport Master Plan has recognised the transport planning initiatives described in the Surface Transport Master Plan (STMP) developed by the DoT for the Emirate of Abu Dhabi. It is intended to key seamlessly into the local municipal and regional transport infrastructure as proposed in the Surface Transport Master Plan for Masdar City. It is based on an Integrated Transport Strategy planning approach that foresees the planned Abu Dhabi Metro and LRT system reaching into the very core of the development; thereby binding this new community into the city of Abu Dhabi and beyond.

Plan Abu Dhabi 2030





Abu Dhabi STMP

Masdar City recognised early on that sustainable goals can only be met by going beyond standard practice. This was the case with the design process for the Masdar Institute.

After defining a high-level brief, a full team was put together to refine the brief and to develop the design. Going beyond standard practice, numerous workshops were held to explore strategies in order to achieve the vision of the project. The many iterations of the design, followed by discussions and workshops, led, in effect, to an integrated design process. Every project in Masdar City goes through a 'Gateway Review Process'. The Gateway Review Process ensures that commentary from all stakeholders is captured and incorporated. Moreover, the process promotes further collaboration, leading to synergies among the owner, the end-users, the architects and the engineers – creating fertile ground for sustainable design.

The experience gained from the Masdar Institute process has since been further refined and formalised, and is now used by Masdar City in all its projects.

Going beyond standard practice, numerous workshops were held to explore strategies in order to achieve the vision of the project.





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