

# FOREWORD

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Executive Director, Sustainable  
Real Estate, Masdar



Renewable energy is positively affecting the lives of communities worldwide. It has the potential to mitigate climate change by cutting carbon emissions and advancing the global transition to cleaner forms of energy. It is exciting to think how societies around the world in the future will creatively integrate renewable energy solutions into their landscapes for sustainable development and the alleviation of climate change.

For urban communities to grow in a sustainable manner, society must accept the integration of renewable energy into the public realm. The Land Art Generator Initiative 2019 competition—Return to the Source—provides the perfect opportunity to demonstrate how art and renewable energy can go hand-in-hand to provide aesthetic and community-friendly solutions to the pressing challenge of powering our cities sustainably.

At Masdar, our vision is to make Abu Dhabi the world's reference for knowledge and collaboration in the advancement of renewable energy, clean technologies, and sustainable development. Our partnership with LAGI aims to highlight how renewable energy can be beautiful as well as functional. The competition entries demonstrate how Masdar City can further transform the places where people live, work, and play, energize public spaces, and create new places of interaction with the city's residents, tenants, and visitors, in alignment with the city's master plan.

Masdar is proud to sponsor this special edition of the LAGI competition in the same year that Abu Dhabi has the privilege of hosting the 24th World Energy Congress. It is fitting that the capital's flagship sustainable city is supporting the competition, which complements the holistic approach that Masdar City takes towards urban development based on the three pillars of economic, social, and environmental sustainability.

The launch of this Land Art Generator Initiative book at the Masdar-hosted Abu Dhabi Sustainability Week (ADSW) 2020 reaffirms our company's commitment to and pursuit of truly sustainable urban development.

We hope you enjoy the diverse and multifaceted entries from the competition and take inspiration from their creativity to further the global energy transformation.



*Starlit Stratus*  
Sunggi Park  
See page 46



**“The journey to build Masdar City has been one of understanding the relationship between the three pillars of environmental, economic, and social sustainability. Our experience has shown that rather than one pillar being improved at the expense of the others, all three can be improved simultaneously.”**

— Chris Wan

Head, Design Management, Sustainable Real Estate, Masdar





Aerial rendering of what Masdar City will look like upon completion.  
Image courtesy of Masdar



# SUN FLOWER

*Sun Flower* is a kinetic sculpture that utilizes the potential energy of its own weight to store the energy collected through solar panels in its petals during the day.

The inspiration for *Sun Flower* comes from the 18th-century Scottish engineer, James Watt, who used horses to lift pails of water thus defining horsepower as a unit of energy equal to the energy required to lift a 550-pound pail of water one foot in one second. Instead of horses, *Sun Flower* uses solar energy to drive electric motors and charge a giant kinetic battery.

During daytime, the fully open petals collect energy from the sun through translucent photovoltaic panels, providing comfortable shade for visitors below. At its maximum open state, each structure produces at least 200 kW of power, some of which is sent to the grid and some of which is transferred to electric motors that slowly lift the petals up toward the center of the flower throughout the day. At sunset, the petals will have reached their closed position after which they begin to fall slowly under the force of the earth's gravity. As the flowers open again through the night, the rotation at their central pivot point powers generators at the base to provide the stored energy to the city grid.

Some of the energy generated by the falling petals is used to illuminate the artwork through the night as the entire structure becomes a lantern of translucent solar petals. With this beautiful display of solar and kinetic energy storage, *Sun Flower* heralds a new era in sustainability, where art, energy production, and our built environment can coexist symbiotically.

## TEAM

Ricardo Solar Lezama,  
Viktoriya Kovaleva,  
Armando Solar

## TEAM LOCATION

San Jose (CA), USA

## TECHNOLOGIES

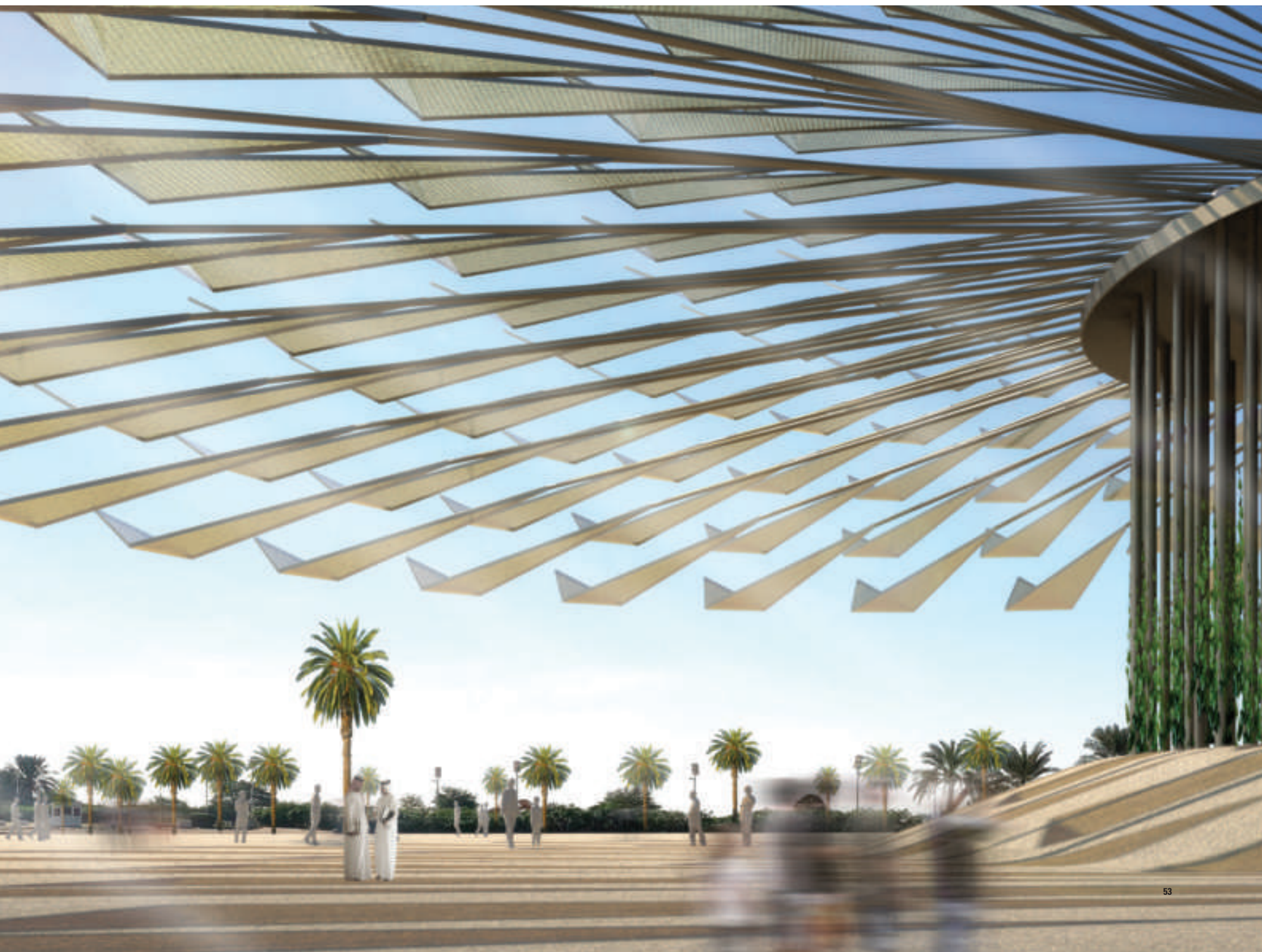
translucent solar photovoltaic,  
gravity storage

## ANNUAL CAPACITY

350 MWh



During the day, the fully open petals collect energy from the sun through translucent photovoltaic panels while providing a comfortable shade for visitors.





# UNEXPECTED SCENARIOS

*Unexpected Scenarios* occurs when nature and technologies collaborate to create new stories.

The desert is a hostile and inhospitable place, where nature alone reigns. For millennia, humans have built an identity out of these places by creating and nurturing oases, using what limited resources nature has provided. The oasis in the middle of a desert represents a miracle, an unexpected event. Travelers through the desert know well the unpredictability of nature, but the idea of the oasis presents a compelling future in which visitors press on and sustain hope. Like the rose of Jericho, which survives by following the rhythms of nature, *Unexpected Scenarios* follows the sun's radiation and decides when to bloom with experiences.

The project includes two plazas, one of desert sand in which large black spheres collect solar energy, and the other surrounded by green space within which a large, white inflatable ETFE sphere hosts public events.

The curious Vantablack® spheres set within the sandscape absorb 99.96% of the sun's energy. The heat collected within the spheres is transmitted to a chemical thermal storage system. The heat is used to separate calcium hydride into its constituent elements and is later recovered by allowing

calcium to recombine with hydrogen in an exothermic reaction used to power a high-efficiency Dual Shell Stirling Engine™ to generate electricity. The entire self-regulating system is provisioned by ADI Solar.

Each evening, as the heat energy is converted into electricity, the sun's energy from the day will give life to a 40-meter diameter sculptural sphere that will rise out of its retracted storage space and become a new landmark for the citizens of Abu Dhabi where residents and visitors will come together to meet and socialize.

## TEAM

Riccardo Daniel, Kei Shiho,  
Francesco Feltrin

## TEAM LOCATION

Tokyo, Japan

## TECHNOLOGIES

solar thermal with Stirling heat  
engine, calcium hydride reactor  
with hydrogen energy storage

## ANNUAL CAPACITY

175 MWh



*Unexpected Scenarios* is an event to attend. The central square is an ETFE sculpture that is inflated by the Stirling engine.



Large black spheres appear as physical anomalies of negative space and time set within a landscape of sand dunes.



# CLOUD FIELD

An abstract representation of a cloud and a rainy sky over Masdar City provides shading for the public park below, prompting us to think differently about solar power plants. Rather than vast and monotonous environments somewhat hostile to people, what if a solar farm could take the shape of the sky? What if constant clouds could provide shade for visitors while generating renewable energy?

New technologies and advancements in the field of organic photovoltaics (OPV) allow for more freedom in the design process and an exploration of complex geometries. It is now possible to conceive of lightweight tensile and pneumatic structures that are covered with flexible OPV cells ranging from transparent to translucent colors in many hues.

The *Clouds* are manufactured with ETFE sheets and inflated under low-pressure. They are supported by slender steel tubes that channel all the services and wiring from the canopy to the underground service room, where the pumps, inverters, distribution boards, transformers, and substations are located out of reach and sight from the park users to ensure a safe environment and uninterrupted landscape.

## TEAM

Nacho Marti

## TEAM LOCATION

London, UK

## TECHNOLOGIES

organic photovoltaic (OPV)

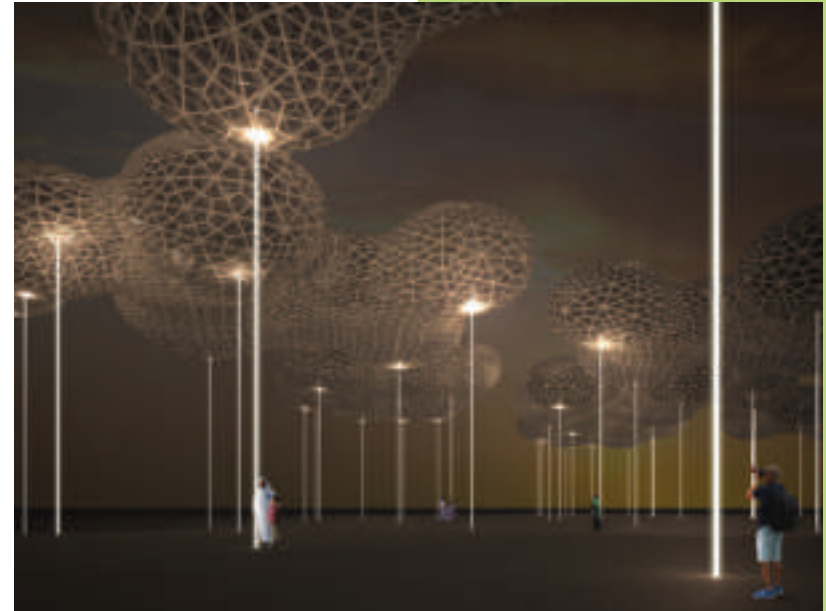
## ANNUAL CAPACITY

1,172 MWh

The design is based on a repeating module that can be rotated to create the perception of the randomness of a natural sky while simplifying the fabrication process. The geometry of the *Cloud* maximizes the surface area for energy production while maintaining a limited footprint over a ground plane of white stained cork, which creates a soft ground with acoustic absorption properties.

Meandering through the park and set 12 meters above grade, the installation allows for continuous views and the establishment of a natural landscape endemic to the UAE. Inspired by the Sheikh Zayed Grand Mosque of Abu Dhabi, an open empty space for reflection and contemplation is juxtaposed against the rich Islamic geometries within the *Clouds*.

During the night, the columns turn into streetlamps that gently illuminate the park, resembling water falling from the clouds.



View at night.



View from the park entrance toward  
the university during the day.



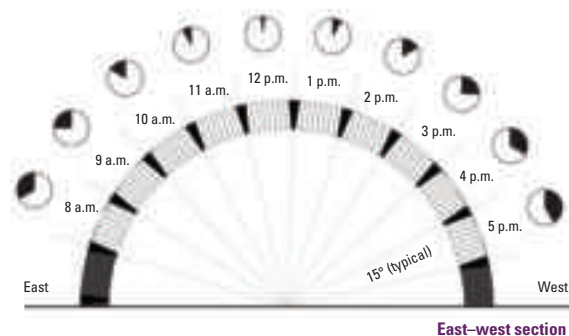
# DIURNAL SHADOW

"Time is the measure of change." —Aristotle, *Physics*

*Diurnal Shadow* celebrates the sun as the primary source of energy on earth. The sun's movements become visible to visitors under a shaded gateway in the park at the entrance to Masdar City.

The design of the artwork is inspired by the sundial—the oldest known device used to measure time by the apparent position of the sun in the sky. In this case, the traditional configuration is reversed. Rather than a gnomon casting shadows, the time of the day is indicated by sunlight projected through a series of openings within a surface of photovoltaic modules capable of generating both solar power and shade.

Time is a central theme for both science and daily life. Several aspects of life, such as the five daily prayers, are performed at times determined by the position of the sun in the sky. The clockwise direction commonly used in devices and tools was originally informed by the sun's diurnal motion.



## TEAM

Riccardo Mariano

## TEAM LOCATION

Berlin, Germany

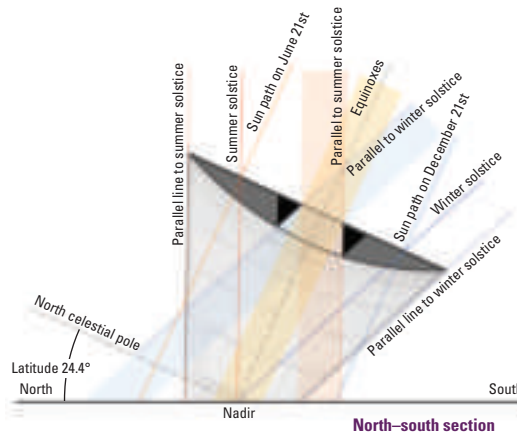
## TECHNOLOGIES

thin-film solar photovoltaic (CIGS) (Avancis PowerMax® Skala or similar)

## ANNUAL CAPACITY

400 MWh

*Diurnal Shadow* focuses on the relationship between the amount of renewable energy generated and the time of the day. It displays both sets of information on the ground shaded by the artwork. By using the diurnal motion of the sun as a medium to link time and renewable energy generation, the artwork makes viewers aware of the production of energy in an intuitive and playful way.



The daylight hours are displayed by the sunlight cast in the shape of symbols reminiscent of the face of a clock. The hour hand is represented by the amount of power being generated. In this way, the varying intensity of the sun throughout the day and its resulting impact on renewable energy generation become apparent.

Ten parallel sets of recycled copper louvers oriented toward each of the daily sun hours only let the sunlight through one hour at a time while shading all of the other inclinations. The configuration turns the sunlight on and off at the right time within the shadow cast by the arch.



An arch—the archetypal shape of a gate—gently leans toward the sun and provides indispensable shadows for a new public park in Masdar City.



# EXPOSE:

## exponential Solar Energy

Over the past 150 years, our society has flourished on the energy of fossil fuels, but today we are in the midst of a major transition toward clean and renewable forms of energy. This change will have a profound influence on every aspect of our lives. The form of the exponential curve expresses the concept of extreme growth. It reminds us of how rapidly change can occur in non-linear systems. *expoSE* is shorthand for “exponential solar energy.” In its form, the artwork celebrates technological progress and its exponential growth.

Solar energy is a leap toward freedom. The massive change that comes with a post-carbon future could lead the way to a better society. *expoSE* is not only a way of generating clean energy but also a place for people to reflect on and prepare for the changes coming just around the corner. Renewables are disrupting the landscape of the energy industry by decentralizing the source. As such, solar energy is changing our economic and social life.

The micro-tracking solar array that comprises the vast majority of *expoSE* creates a large amount of energy from the sun. Its surface is not accessible to the public during the day. On the upward curving section of the artwork, CIGS thin-film solar modules collect additional power. Both solar systems incorporate automated robotic cleaning systems that remove dust and sand over the protective glass layer, maintaining high performance throughout the year.

A 2,500 square meter shaded public space designed to recall a traditional Bedouin tent is created by the exponential curvature of the artwork, providing a comfortable space for a range of activities and events for the community.

At night, a system of LEDs shines across the solar array and the artwork transforms into an immense celebration of energy as the area is opened for public use. From the 40-meter tall corner pinnacle, a beacon of light shining above Masdar City will be seen throughout Abu Dhabi, representing the infinite potential of renewable energy and human ingenuity.

*expoSE* demonstrates that the simplicity of renewable energy and local traditions can converge to create positive impacts and special places.

### TEAM

Cesare Cardia, Mauro Breda

### TEAM LOCATION

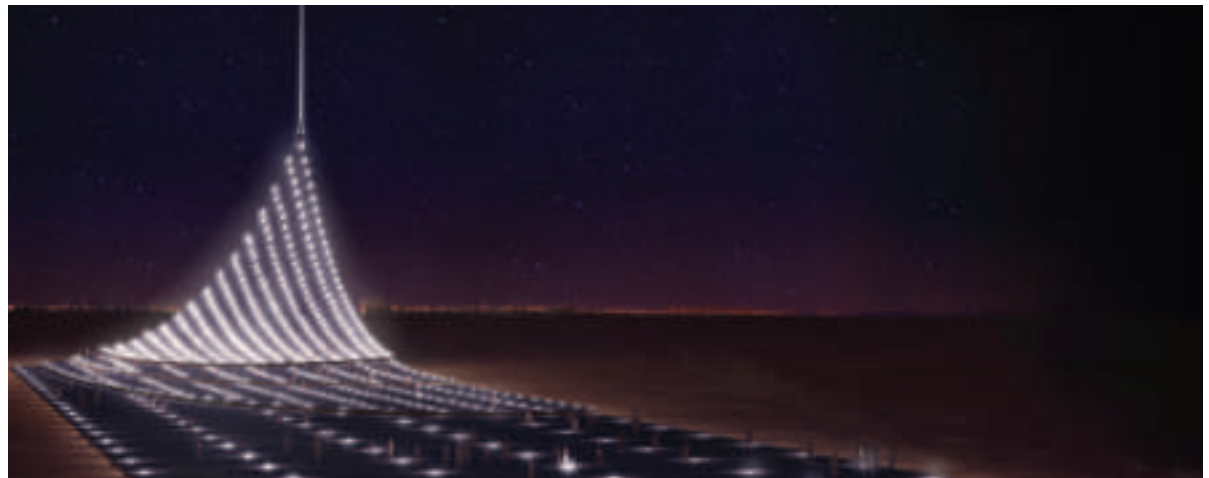
London, UK

### TECHNOLOGIES

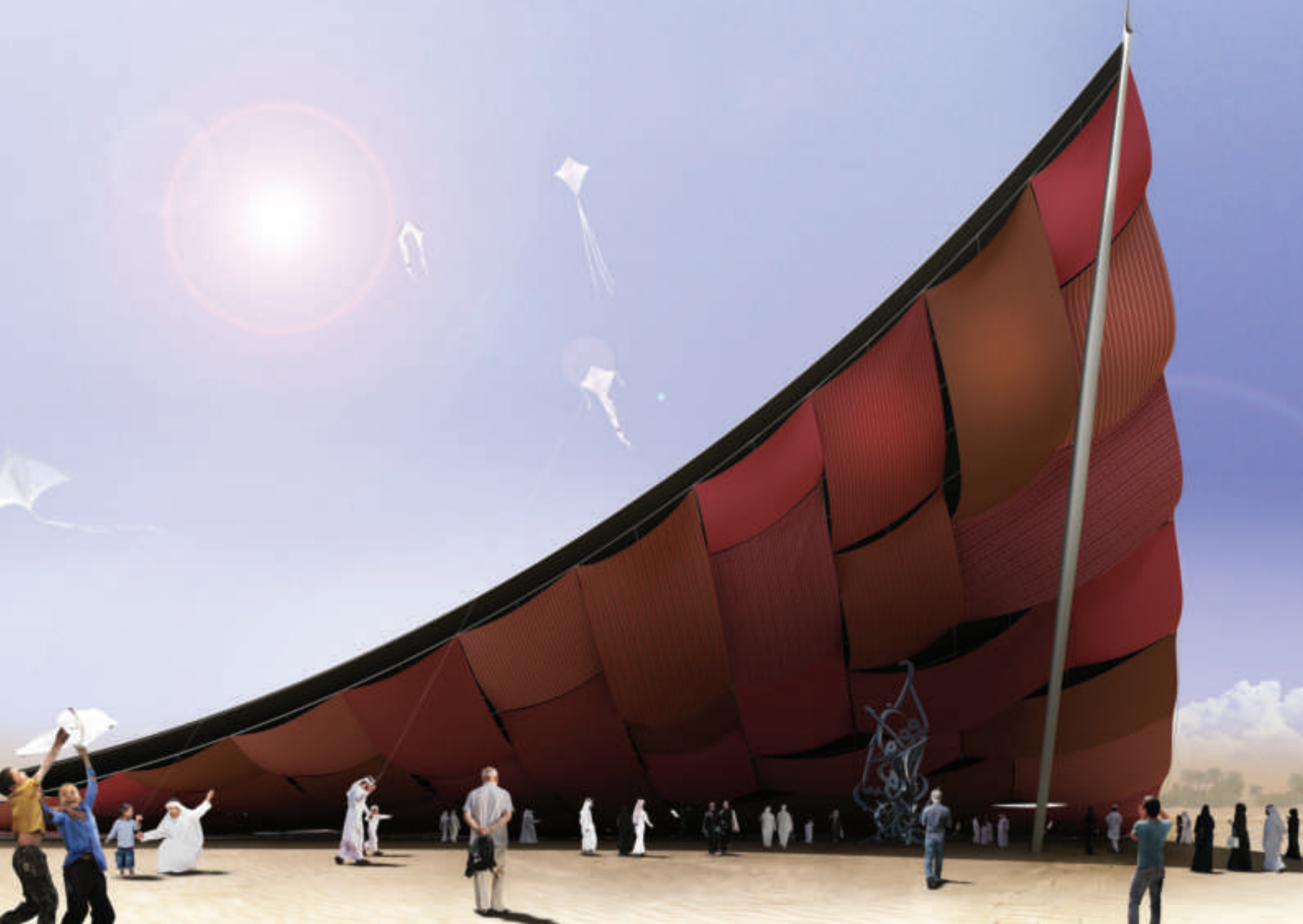
planar optical micro-tracking  
solar panels, CIGS thin-film solar

### ANNUAL CAPACITY

4,500 MWh



After the sun has set, *expoSE* comes alive as a venue for enjoying the night.



The solar plane lifts up on one corner to create a shaded place of refuge under the tapestries of a Bedouin tent.



# THE SOLAR COMPASS

A compass to help us find the way  
toward a sustainable future

Does it sometimes seem as if humanity has lost its way in an ocean of uncertainty? Will we ever find our path toward a truly sustainable future? Perhaps what we need is something to point us in the right direction.

*The Solar Compass* stimulates our minds and catalyzes our enthusiasm through a power-generating work of art that draws its inspiration from a relatable object. Engaging curiosity might be our most powerful tool in our quest for sustainability. The technology already exists to address the climate crisis. We need only to employ it in creative ways that can instill a sense of hope.

Using standard concentrated solar power (CSP) technology, a 1,120 square meter polar array of flat heliostats follows the sun across the sky and concentrates its light and heat onto a receiver located near the pinnacle of the compass needle. By lifting the mirror array and placing it on top of the compass form, the ground plane is set free for visitors, prioritizing public space and creating an inviting plaza.

The intense solar heat increases the temperature of the receiver to 600 °C, where water flashes to steam to drive a turbine and electric generator. Part of the energy produced is directly transferred to the city's electrical grid and the rest is stored in batteries contained within the compass structure. In this way, *The Solar Compass* can continue to guide our energy supply well after the sun has set.

## TEAM

Santiago Muros Cortés

## TEAM LOCATION

Buenos Aires, Argentina

## TECHNOLOGIES

concentrated solar power

## ANNUAL CAPACITY

4,000 MWh

Masdar City has been a compass for creativity and technology since its inception. *The Solar Compass* seeks to mobilize our minds and enthusiasm through a power generating work of art that draws its inspiration from an instantly recognizable object.



