The Oasis Machine

Producing Paradise through Renewable Energy Technologies

High-Tech Utopia or Dystopia?

A *paradise* metaphor, the projected brand image of Masdar City is that of a high-tech, zero-carbon utopia, an oasis in the traditional sense sheltered from the heat of the local desert climate through passive architecture and smart technologies, with ambitions of becoming the world's most sustainable and livable city. Despite this image projection, the unfolding of Masdar City has been hindered by economic setbacks, and in the context of its desert environment, has been cited by critics as 'placeless', a 'green ghost town', and likened to a spaceship invoking imaginaries of high-tech dystopias (Günel, 2019). Despite the subjectivity of Masdar's image, its ambition to become a leader in the research and design of renewable energy technologies and to pioneer a post-carbon urbanism is laden with 'potential' (Günel, 2019). Drawing from research relating the mobility of the 'creative class' of innovators to places rich with natural and cultural identities, (Florida, 2005), this project postulates that in order to transition from a primarily extractive economy to a post-carbon creative economy of knowledge and innovation, and to be competitive for human intellectual capital in the global scene, Masdar must infuse its brand image of a high-tech futuristic utopia with the lifestyle amenities of art, culture, and nature.

The Potential of the Paradise Imaginary as Place Identity

In contemplating how art, culture, and nature, may structure the place identity of Masdar, the dialectical of the desert as 'non-place' or *carte blanche*, and the oasis as place, location, or destination was invoked. In the Islamic imagination, the oasis is a reflection of *paradise*, the spiritual realm towards which the Quran directs its disciples to strive as their reward for this life's hardship (Critchlow, 1976). Traditionally, the visual image of *paradise* has been reflected in places such as the desert oasis, represented through abstraction in the Islamic geometric arts through cosmological symbols of circles and stars, depicted in miniature paintings of gardens, and spatialized through garden design itself. In contemplating the evolution of paradise imagery in the context of the 21st century utopian ambitions of Masdar, the potentials of renewable energy technologies to generate novel representations of paradise as place identity come into question.

The Technological Production of Paradise Imagery

Whereas the traditional oasis garden is geographically fixed, a product of the serendipitous emergence of ground water, the oasis or utopia of the 21st century by way of technological potential can exist anywhere in the desert. Unlike the traditional oasis, the universality of the 21st century oasis is less tied to geography, and more aligned with the cosmos, the universe, the atmosphere, from which technology enables the extraction of solar energy to produce water. In Masdar, the solar energy of the sun is harnessed for the desalination of brackish water, producing freshwater for consumption, gray or treated wastewater for irrigation and cultivation of vegetation, which ultimately sequesters carbon dioxide back into the ground. It can be likened to terraforming, or the transformation of the hostile 'first nature' of the desert geography and climate, into the accommodating environment of the oasis. This process can give rise to new garden types as cultural products.

The Garden as Total Work of Art

Drawing from regional and cultural artistic traditions, the concept of totality emerges from the Islamic tradition of geometric patterns.

Masterplan: The Garden as Bridge between Tradition, Technology, and Nature

The garden is conceptualized as a **total work of art**. It is both an idea, in a traditional sense a representation of the otherworldly beauty of the spiritual realm that is *paradise* in the Islamic cultural imagination, and a place, evoking the characteristics of the desert oasis, where the combination of water, cool shade, dappled sunlight, fruit orchards, and verdant nature modify a harsh climate producing a sensory experience to the effect of transgression between realms. Derived from the organizational framework of the eight-pointed star are the layouts of circulation, irrigation, and drainage systems, evoking both vernacular irrigation systems or the *falaj*, and the quartered garden or *chahar bagh* of the Islamic tradition. Disrupting the traditional lexicon of Islamic garden design, and weaving continuity between the past, present, and the future are the relatively novel technological applications of the 'photovoltaic canopy' and the 'fog harvesting tree' which harnessing energy to produce water, or directly extracting water from the air to cultivate an oasis in the image of paradise, stage new garden experiences, drawing renewed attention to the atmosphere and the sun, the sources of life on Earth.

Environmental Impact Statement:

The production of an oasis that is linked to the cosmos through both metaphor and measure, is likened to an artistic terraforming of the desert landscape, transforming a hostile 'first nature', into a cultured 'second nature'. Located within the framework of Masdar's 'green fingers', the 'Cosmic Oasis' in

extracting energy and water vapor to generate life through local climate modification with implications on global climate change, will have positive environmental impacts. The photovoltaic canopy in shading the garden below may reduce evaporative loss of moisture, sustaining more diverse plant communities. Furthermore, irrigation of vegetation with gray water and fog harvesting may have positive impacts in mitigating the intrusion of sea water into the coastal aquifer.

Order of Magnitude Conceptual Cost Estimate

Item	Magnitude	Units	Cost	
PV panels	12800m^2	150 USD/m^2	$1.9 million	
High tension tensile steel cable for suspended PV canopy	4530 linear meters – 30mm dia. approx. 3.8 tonne	2000 USD/tonne	$7600	
Structural Steel Beams to support tensile steel cable	22 structural beams @ 34m height, and 0.25m dia. 88 tonnes	1890 USD/tonne	$166,320	
Concrete for foundations, garden features (pathways, retailing walls, pools, and pavilions)	1907.5m^3	63 USD/m^3	$120, 172	
Total Cost			**$2,194,092**	

Project Narrative Bibliography

Brookes, J. (1987). Gardens of Paradise. London: Weidenfeld and Nicolson.

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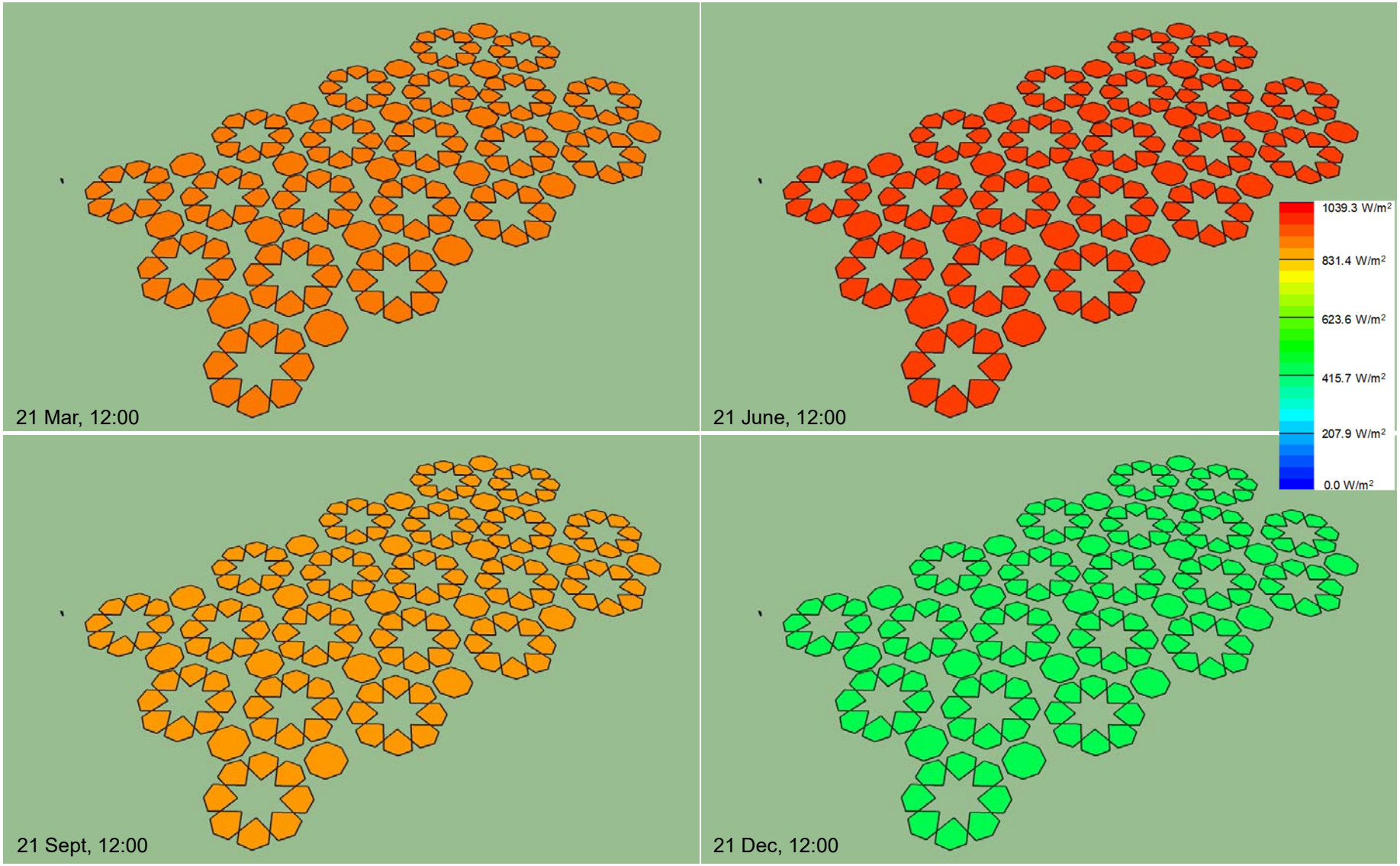
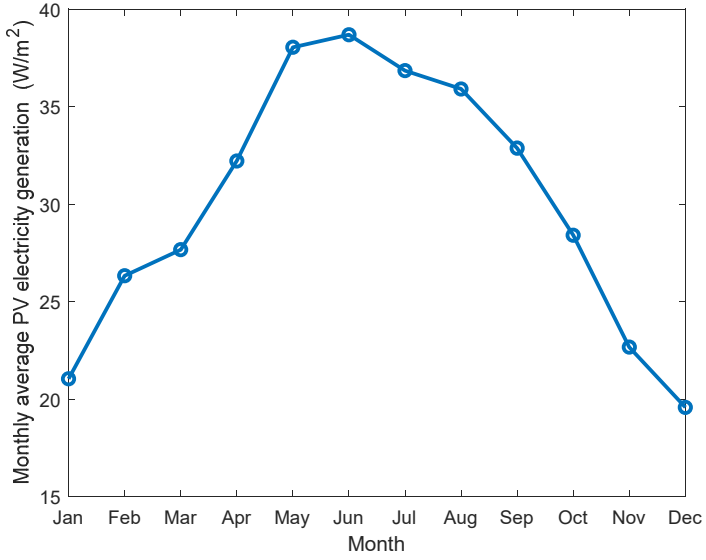
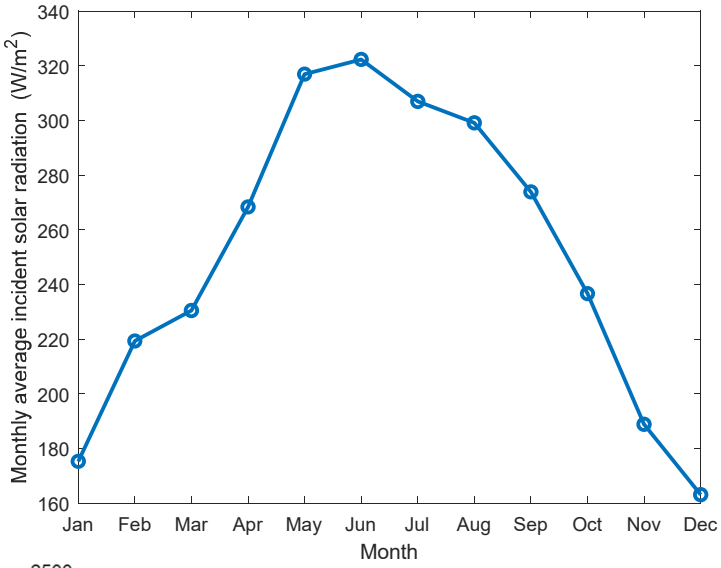
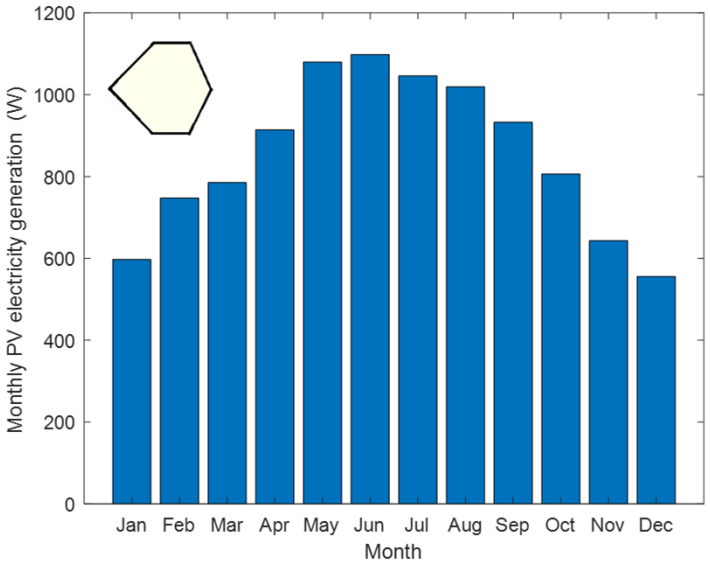
Solar Incident Radiation

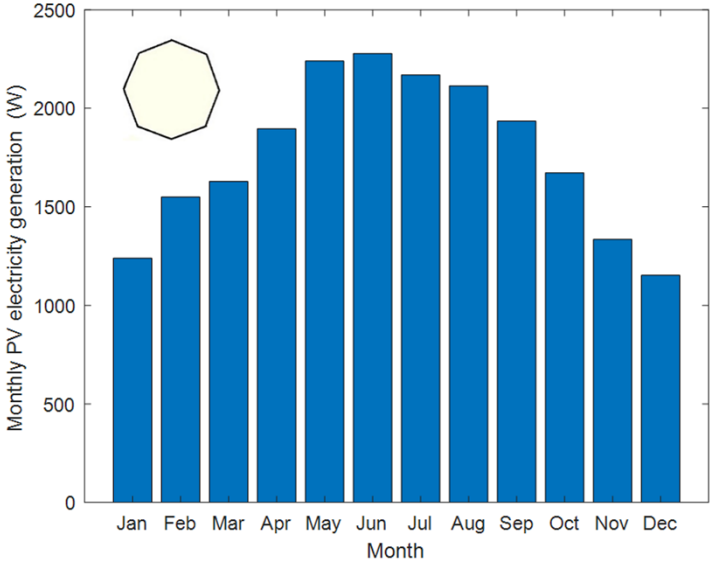


PV Performance









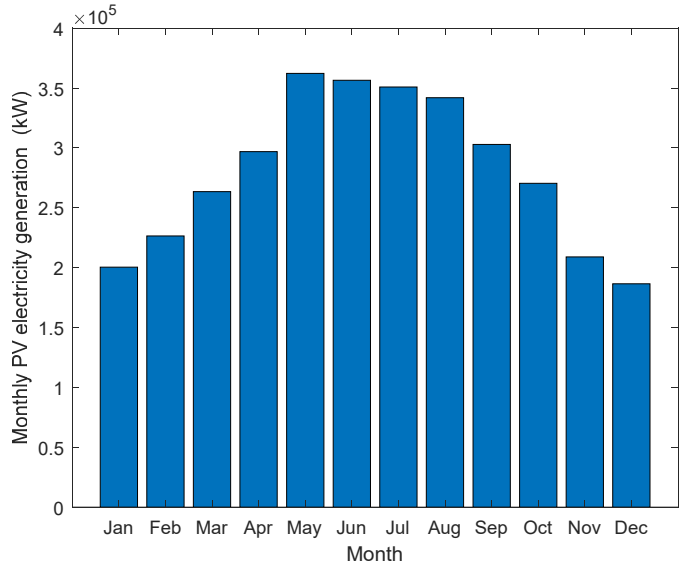
Facts at Glance

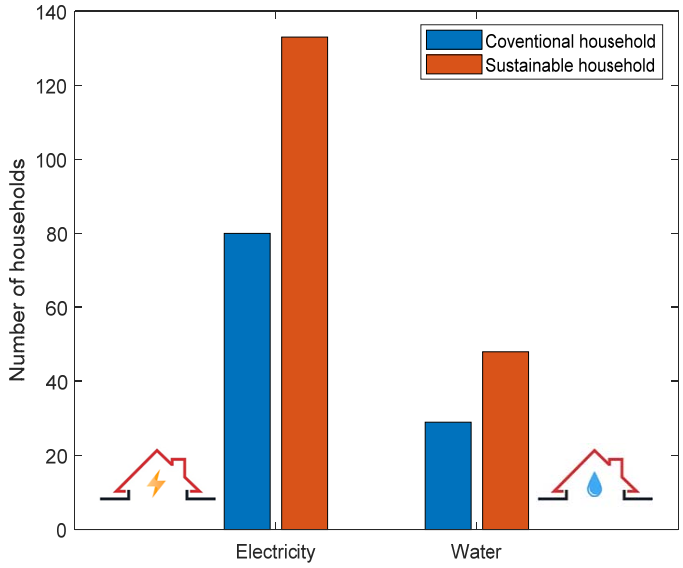
Estimation of PV installation and electricity generation

Parameter	Magnitude	Units
Total area of PV panels	12800	m^2
Installation cost per unit area [1]	150	$/$m^2$
Installation cost per Watt	2	$/W
Estimated capital cost	1.92 M	$
Peak electricity generation	362258	kWh/month
Peak electricity generation month	May	
Yearly electricity generation	3367523	kWh/y
UAE household energy intensity [2]	42222	kWh/y
Number of households electrified	80	
Sustainable household energy intensity [3]	25333	kWh/y
Number of sustainable households electrified	133	

Estimation of water generation from fog towers

Parameter	Magnitude	Units
Radius	11	m
Height	32	m
Slant Height	33.8	m
Tower Surface Area	1168.8	m^2
No. of towers	10	
Total surface area of towers	11687.6	m^2
Water yield [4]	20	l/m^2-day
Number of fog days [5]	40	
Yearly water generation	9350074	l/year
UAE daily household water consumption [6]	882	l/day
UAE yearly household water consumption	321930	l/year
Number of household can be supplied	29	
Sustainable household daily water consumption [3]	529	l/day
Sustainable household yearly water consumption	193085	l/year
Number of sustainable households can be supplied	48	





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