Masdar Clean Energy- Overview

Masdar's Clean Energy division is a leading developer and operator of utility-scale renewable energy projects, applications providing energy access to communities away from the electricity grid, and energy services consultancy.

Since 2006, Masdar has been a catalyst for renewable energy and clean-tech innovation in the MENA region and countries around the world – working with governments and leading businesses. Active in more than 25 countries, Masdar is a global renewable energy leader and one of the largest developers of off-grid solutions in the world.

KEY UAE PROJECTS

Operational

Shams, Abu Dhabi (100MW CSP plant)

In March 2013, Masdar inaugurated Shams, one of the world's largest concentrated solar power (CSP) plants and the first of its kind in the Middle East & North Africa (MENA) region. Masdar partnered with Total and Abengoa to deliver the 100 megawatt (MW) solar thermal project. In January 2016, Masdar purchased Abengoa's stake in the project. In October 2018, Abu Dhabi Retirement Pensions and Benefits Fund (ADRPBF) purchased a 29 per cent stake in Shams. Masdar remains the majority shareholder with a 51 per cent stake.

Masdar City 10MW and Rooftop Installation

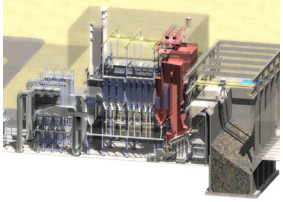
Masdar City uses clean energy generated on site from both the 10MW solar power plant and 1MW rooftop solar panels installed on the Mohamed bin Zayed University of Artificial Intelligence campus buildings, supplying the national grid. Combined, they produce approximately 19,100MWh of electricity annually, displacing 11,450 tonnes of CO_2 emissions per year. This is enough to power 500 homes in the UAE for a year.

Under development

Mohammed bin Rashid Al Maktoum Solar Park, Phase 3

In June 2016, a Masdar-led consortium was selected to develop the 800MW third phase of the Mohammed bin Rashid Al Maktoum Solar Park in Dubai. At the time, the consortium's winning tariff of 2.99 US cents per kilowatt hour was the lowest price quoted for solar power generation in the world. The project Power Purchase Agreement (PPA) was signed in November 2016, with the first 200MW stage inaugurated in April 2018. Phase 3 of the Dubai Solar Park is due for completion by 2020.

Sharjah Waste-to-Energy Project



The Emirates Waste to Energy Company, a joint venture between Bee'ah and Masdar, is developing a cutting-edge waste-to-energy plant in Sharjah. Diverting around 300,000 tonnes of solid waste from landfill each year, it will contribute to the UAE's efforts of diverting 75 per cent of solid waste from landfill by 2021.

KEY INTERNATIONAL PROJECTS

Operational

London Array, UK (630MW offshore wind farm)

A joint venture between RWE (30%), Orsted Energy (25%), Caisse de dépôt et placement du Québec (CDPQ) (25%) and Masdar (20%), London Array is the world's second-largest offshore wind farm currently in operation. Inaugurated in July 2013, the plant powers over half a million homes and displaces about 925,000 tonnes of CO_2 emissions per year.

Gemasolar, Spain (20MW)

The world's first utility-scale solar power plant to combine a central tower receiver system and molten salt storage technology enabling electricity supply 24 hours a day, Gemasolar can generate electricity for up to 15 hours without solar irradiation.

Valle 1 and 2, Spain (100MW)

The adjacent solar plants in Cadiz, Spain, feature parabolic trough solar technology combined with molten salt storage facilities. The plants have a combined power capacity of 100MW and produce approximately 320 GWh/year, which is equivalent to the average consumption of 45,000 households, or the entire city of Cadiz.

Tafila Wind Farm, Jordan (117MW)

The first commercial utility-scale wind power project in the Middle East, the Tafila Wind Farm has increased the country's total power capacity by 3 per cent and generates enough electricity to power 83,000 homes.

Dudgeon, UK (402MW offshore wind)

The Dudgeon Offshore Wind Farm, located 32 kilometres off the coast of Norfolk, in East Anglia, is a partnership with Equinor and China Resource Holding. Masdar has a 35 per cent stake in the project, which provides electricity for approximately 410,000 homes and displaces 893,000 tonnes of CO_2 emissions annually.

Hywind Scotland, UK (30MW floating offshore wind farm)

Hywind is Masdar's latest investment in the UK's renewable energy sector and the world's first commercial scale floating offshore wind farm, located 30 kilometres off the coast of Peterhead, Scotland. Hywind was jointly developed by Equinor (75%) and Masdar (25%) and provides electricity for approximately 22,000 homes.

Batwind, Scotland, UK (energy storage)

Batwind is the first energy storage system to be connected to an offshore floating wind farm. The 1.3MWh battery stores excess electricity generated from the world's first commercial floating windfarm, the 30MW Hywind Scotland. Both Batwind and Hywind Scotland are owned by Masdar and Equinor. Using sophisticated data-analysis algorithms, Batwind will determine when to store and release electricity when it is most needed, and for the best market price.

Krnovo, Montenegro (72MW)

The Krnovo wind farm is Masdar's first investment in Montenegro's renewable energy sector. The 72MW onshore wind farm is Montenegro's first wind farm and one of the largest in the region. In December 2018, Masdar acquired 49 per cent of Krnovo Green Energy, the owner and developer of the Krnovo wind farm, which was established as a subsidiary of Akuo Energy. On stream since November 2017, the Krnovo wind farm is now supplying approximately 45,000 households with electricity and displacing an estimated 80,000 tonnes of carbon emissions annually.

Rocksprings and Sterling Wind Farms, US (179.9MW)

In 2019, Masdar acquired John Laing Group plc's interest in two wind farms in the United States, marking the first time the company has invested in renewable energy projects in North America. The 149MW Rocksprings project in Val Verde County, Texas, and the 29.9MW Sterling project in Lea County, New Mexico, were both commissioned in 2017.

Under development

Baynouna, Jordan (200MW)

Located east of Amman, Baynouna is the largest single solar energy project currently under development in Jordan. The project constitutes 4 per cent of the installed capacity in Jordan. The plant will supply the annual energy needs of 160,000 homes and displace 360,000 tonnes of CO_2 emissions each year.

Čibuk 1, Serbia (158MW)

The Čibuk 1 wind farm in Serbia is the largest utility-scale commercial wind project in Serbia and the Western Balkans. The wind farm has a capacity of 158MW and was inaugurated in October 2019. The project will provide clean, reliable and economically viable electricity to approximately 113,000 Serbian homes, mitigating approximately 370,000 tonnes of CO_2 emissions each year.

Dhofar, Oman (50MW)

Masdar has delivered the first large-scale wind farm in the Gulf region. The 50MW project is located in Dhofar Governorate, in the Sultanate of Oman. Funding for the wind farm is provided by the Abu Dhabi Fund for Development (ADFD). The project includes 13 GE 3.8MW wind turbines and will power approximately 16,000 homes and displace approximately 110,000 tonnes of CO_2 annually.

Energy Services

The Energy Services department within the Clean Energy Business Unit offers full turn-key supply and demand side energy management solutions to clients through energy performance contracting (ESCO) and O&M services. The team has a proven track record in small- to medium-scale client funded renewable energy projects delivery in remote, complex and challenging geographical locations. To date, a total of more than 100MW worth of projects have been completed or are under final execution in 21 countries. Numerous building energy audits have also been completed, which identified up to 40,000 MWh per year worth of energy savings.

Operational

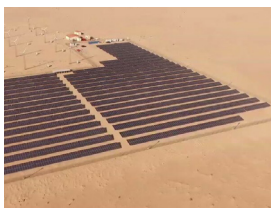
Afghanistan

Masdar has installed 600 solar home systems in 27 villages in Helmand Province in southern Afghanistan. Completed in September 2013, the project is improving the lives of more than 3,000 people without access to electricity.

Sheikh Zayed Solar Power Plant, Mauritania (15MW PV plant)

Masdar's 15MW PV power plant in Nouakchott was the largest solar power installation in Africa at the time of its completion. The project is the first utility-scale solar power installation in the Islamic Republic of Mauritania, accounting for 10 per cent of Mauritania's grid capacity.

Distributed Solar PV projects in Mauritania (16.6MW)



Eight rural solar energy projects, with a capacity of 16.6MW, were completed in November 2016, nearly doubling the UAE's total contribution to Mauritania's clean energy capacity. The projects supply clean power to remote communities, meeting 30 per cent of their demand on average.

Port Victoria Wind Power Project, the Republic of Seychelles (6MW)

The Port Victoria Wind Power Project, a 6MW onshore wind farm in the Republic of Seychelles, is the country's first large-scale renewable energy project. It accounts for more than 8 per cent of the grid capacity on the archipelago's main island of Mahé, where 90 per cent of the country's residents live.

Masdar Solar Programme in Egypt

Masdar has delivered 30MW of utility-scale clean energy projects and 7,000 solar home systems in remote and strategically important areas across Egypt. The projects are part of a UAE-funded grant programme for rural electrification in Egypt, carried out in partnership with Egypt's New and Renewable Energy Authority.

a) Siwa Solar PV Plant (10MW)

Masdar's 10MW solar PV power plant in Siwa was the largest solar power installation in Egypt at the time of its completion in March 2015. The project is the first utility-scale solar power installation in the country and accounts for 30 per cent of the grid capacity of Siwa City and its neighbouring areas.

b) Red Sea Solar Power Plants (14MW)

Built in the Red Sea cities of Marsa Alam (6MW), Shalateen (5MW), Abu Ramad (2MW), and Halayeb (1MW), the four PV plants in Egypt's Red Sea Governorate have a total capacity of 14MW and provide reliable energy supply to support the area's vital tourism sector.

c) Al Wadi Al Jadeed Solar PV Plants (6MW)

Masdar built three solar power plants in the Governorate of Al Wadi Al Jadeed, the largest and most sparsely inhabited region in Egypt. The plants have been developed in the cities of Al Farafra (5MW), Abu Minqar (0.5 MW) and Darb Al Arbaeen (0.5MW). They provide electricity for over 4,800 homes, displacing over 8,700 tonnes of CO_2 emissions and reducing the diesel consumption of existing power plants by over 40 per cent.

d) 7,000 Solar Home Systems

Masdar has provided 7,000 standalone solar home systems (SHS) to homes and public/community buildings in remote areas in six Egyptian governorates without access to the national electricity grid. Each SHS consists of two solar panels, two batteries, charge controllers, energy saving light bulbs, cables, switches, and a mounting structure.

Bab Al Shams (1.2MW)

Located in the Bab Al Shams area of Dubai, the project is a 1.2MW PV plant connected to the DEWA grid. It provides electricity to a large farm that is growing animal fodder. The plant is located in the desert and equipped with automatic cleaning robots to clear the dust from the PV modules and assure continual high energy production.

Solar Home Systems in Morocco

As part of an innovative project to electrify rural Morocco, Masdar installed 19,438 solar home systems across 1,000 villages through a partnership agreement with Morocco's Office National de l'Electricité et de l'Eau Potable (ONEE). Each system contains two solar panels with a total capacity of 290 watts and two batteries with storage capacity of up to three days.

UAE-Pacific Partnership Fund projects

The UAE-Pacific Partnership Fund (UAE-PPF) is a US$50 million initiative led by the Masdar Energy Services unit. The fund delivers grant-funded renewable energy projects across 11 Pacific Island nations. All projects are delivered by Masdar in cooperation with each nation's government, with grant funding provided by the Abu Dhabi Fund for Development (ADFD).

Cycle 1

a) Kiribati: 500kW Solar PV & Water Protection

The UAE-PPF project is helping to meet the needs of 17 per cent of Kiribati's population who live off-grid. The 500kW solar PV plant is also protecting an endangered freshwater aquifer by restricting access and limiting contamination. The project also features a state-of-the-art control system.

b) Fiji: LaKaRo 525kW Solar PV

Inhabitants on three of Fiji's outer islands (Kadevu, Lakeba, and Rotuma) have access to energy around the clock having previously had power for only 12-18 hours a day.

c) Samoa: 550kW Cyclone-Proof Wind Farm

Samoa depends on imported diesel to meet 70 per cent of its energy demand. This UAE-PPF project is the first wind farm in the country and is designed as a cyclone-proof facility with two 55-metre-tall turbines that pivot at the base, enabling them to be lowered and locked in place in less than one hour.

d) Tonga: Vava'u 512 kW Solar PV

Masdar has helped reduce fuel consumption on the Tongan island of Vava'u by installing a 512kW solar PV plant along with advanced control systems. These systems ensure a maximum of 70 per cent of the solar energy is efficiently fed into the grid at peak hours, while any surplus is stored in a battery bank for later use.

e) Tuvalu: 500kW Rooftop Solar PV

Built on a four-metre high structure, the UAE-PPF project in Tuvalu creates shaded public space while feeding clean energy into the grid. 500kW of energy capacity is distributed across three roofs and three structures.

f) Vanuatu: Port Vila 767kW Solar PV

Port Vila, the capital city of the island state of Vanuatu, has a population of 44,000, of which only 27 per cent have access to electricity. While the island already has some local renewable generation capacity – including PV, wind, and hydro – the majority of energy demand is still met by diesel generators. Masdar installed three solar PV plants to help increase the share of renewable energy in the energy mix in addition to providing shading for 112 parking spaces at the country's key civic areas.

Cycle 2

g) Solomon Islands: Solar PV Plant in Honiara

The Republic of the Solomon Islands consists of over 1,000 islands inhabited by a total population of 609,883. Approximately 90 per cent of the electricity produced is diesel generated. The 1MW plant, which was expanded from 600kW following a grant from the New Zealand Ministry of Foreign Affairs and Trade, bolsters energy resilience and reduces costs associated with diesel imports.

h) Marshall Islands: Solar Water Collection in Majuro

The Republic of the Marshall Islands is made up of 29 low-lying atolls and five elevated islands inhabited by 71,000 citizens. The nation is dependent on diesel for more than 90 per cent of its electricity. A 600kW PV Plant in Majuro was built on an existing water reservoir. The plant provides power to the existing grid and increases the rain water yield of the reservoir through increased run-off.

i) The Republic of Nauru: Nauru Solar

The Republic of Nauru is an island of just 21 square kilometres with more than 9,500 citizens who are highly dependent on imported fossil fuels for transport and power generation. The 500kW solar PV plant bolsters energy resilience by contributing electricity to the national grid.

j) Palau: Solar Penetration and Water Access

The Republic of Palau consists of over 250 islands inhabited by a total population of 21,186 citizens, the majority of whom are located on four main islands including Peleliu and Angaur. The three projects in Palau consist of a 100kW PV / 150kW low-load diesel hybrid generation plant on Peleliu, a 100kW PV / 100kW diesel hybrid plant on Angaur, which powers a water treatment facility capable of supplying 50m^3

of clean water per day, and 100 1.7kW solar home systems on the island of Koror provided through a subsidy loan programme by the National Development Bank of Palau.

k) Pohnpei, Federated States of Micronesia (FSM): Solar PV

The Pohnpei Island State is one of the four main groups of islands in FSM. The 600kW solar plant, the largest PV project in FSM, supplies up to 10 per cent of the peak demand of Pohnpei's 34,000 residents.

UAE-Caribbean Renewable Energy Fund

Cycle 1

a) Bahamas: Thomas A. Robinson National Stadium 925kW Solar PV Carport Power Plant

The 925 kilowatt (kW) solar photovoltaic (PV) plant at the national stadium, which also serves as a carport with 342 parking spaces including 4 spots for families and 2 spots with fast charging electric vehicle (EV) charging stations, is the country's first large-scale solar energy project.

b) Barbados: Bridgetown 350kW Solar PV Carport Power Plant & Bowmanston 500kW Solar PV Power Plant

This project has two elements: a 350kW solar PV carport with 124 parking spaces, which include six level 2 EV charging stations, and a 500kW ground-mounted PV plant. Both projects were developed in partnership with the Barbados Water Authority and are built on sites operated by the authority.

c) Saint Vincent & the Grenadines: Union Island 600kW Solar PV Battery Hybrid Power Plant

Located on Union Island, the 600kW solar PV plant and 637 kilowatt-hour (kWh) lithium-ion battery project supplies all of the island's daytime power needs, and represents Masdar's first fully implemented grid-connected battery energy storage system.

Under development

UAE-Caribbean Renewable Energy Fund (CREF)

This US$50m grant fund, one of the largest and most pioneering initiatives for the region's renewable energy sector, was launched in January 2017 in partnership with the Ministry of Foreign Affairs and International Cooperation (MOFAIC), Abu Dhabi Fund for Development (ADFD), and Masdar. The Fund aims to deliver renewable energy projects to 16 Caribbean countries over the next two to three years. The projects – selected through months of joint due diligence between each country and Masdar – aim to enhance local expertise in the renewable energy sector and pave the way for further deployment, as well as immediately cut energy costs and improve energy security. Three projects were inaugurated as part of the initiative in March 2019.

Renewable energy water desalination programme

In 2013, Masdar launched a renewable energy desalination pilot programme to research and develop energy-efficient, cost-competitive desalination technologies that are suitable to be powered by renewable energy. The project was officially inaugurated during UAE Innovation Week in November, 2015.

The commercial partners – Abengoa, Suez, Veolia and Trevi Systems – each developed and operated a next-generation pilot seawater desalination plant. The four plants tested a range of innovative approaches to boost operational efficiency of reverse osmosis, a technique where salt water is purified through membranes. A fifth pilot was installed in October 2016 by Mascara Renewable Water, a unique off-grid solar powered solution without batteries, ideally suited for remote locations.

A Masdar report published at Abu Dhabi Sustainability Week 2018 on the results of the programme found that the solutions are up to 75 per cent more energy efficient than the thermal desalination technologies currently used in the UAE, delivering annual energy savings of as much as US$550 million.

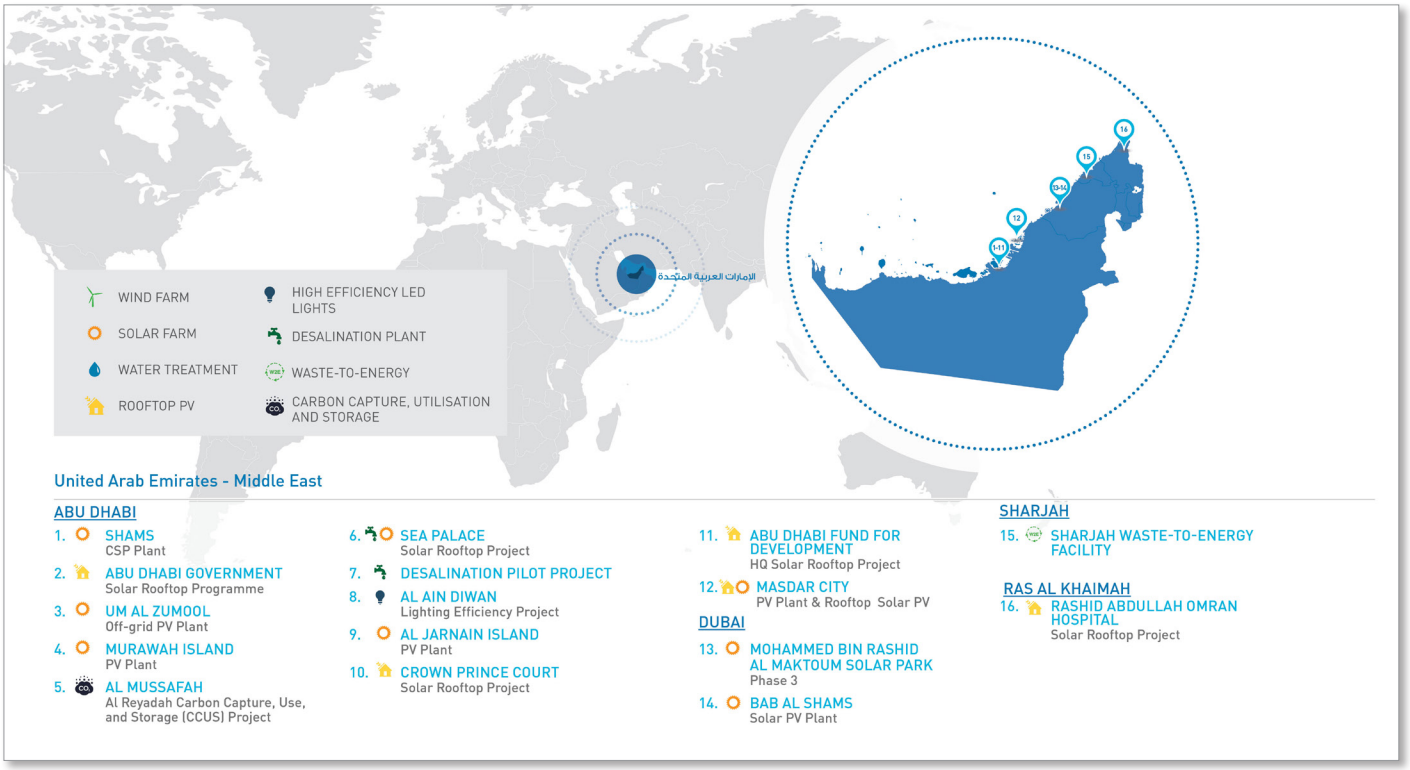
The desalination project was sponsored by the Abu Dhabi Government, with co-funding provided by the industry partners. Masdar was leading the project management and coordinated the programme with key Abu Dhabi stakeholders.

Masdar's Domestic and International Projects

- Developing a gross capacity of nearly 5 gigawatts (GW) of renewable energy projects worldwide, either in operation or under development
- Investing in renewable energy projects valued at more than US$13.5 billion globally

International and Middle East

1. **LONDON, UK** — London Array and Dudgeon Offshore Wind Farms
2. **SCOTLAND, UK** — Hywind Scotland Floating Wind Farm Batwind Energy Storage System
3. **SPAIN** — Gemasolar and Valle 1 & 2
4. **MOROCCO** — Solar Home Systems Noor Midelt Phase 1 project
5. **MAURITANIA** — Sheikh Zayed Solar Plant and Rural Electrification Programme
6. **SERBIA** — Čibuk 1 Onshore Wind Farm
7. **MONTENEGRO** — Krnovo Onshore Wind Farm
8. **EGYPT** — PV Plants and Solar Home Systems
9. **JORDAN** — Tafila Onshore Wind Farm and Baynouna Solar Plant
10. **OMAN** — Dhofar Onshore Wind Power Project
11. **AFGHANISTAN** — Solar Home System, Rooftop PV
12. **SEYCHELLES** — Port Victoria Onshore Wind Farm
13. **PALAU** — Palau Solar and Water Treatment
14. **POHNPEI** — Pohnpei Solar Plant
15. **TUVALU** — Tuvalu Solar Plant
16. **NAURU** — Nauru Solar Plant
17. **HONIARA** — Solomon Islands Solar Plant
18. **VANUATU** — Vanuatu Solar Plant
19. **KIRIBATI** — Kiribati Solar Plant
20. **MAJURO** — Marshall Islands Solar Plant
21. **FIJI** — Fiji Solar Plant
22. **TONGA** — Tonga Solar Plant
23. **SAMOA** — Samoa Onshore Wind Turbines
24. **UAE-CARIBBEAN RENEWABLE ENERGY FUND PROJECTS** — 16 Caribbean Island Nations
25. **GERMANY** — Solar Energy Plant
26. **SAUDI ARABIA** — Dumat Al Jandal Wind Farm
27. **UNITED STATES** — Rocksprings and Sterling Wind Farms



United Arab Emirates - Middle East

ABU DHABI

1. **SHAMS** — CSP Plant
2. **ABU DHABI GOVERNMENT** — Solar Rooftop Programme
3. **UM AL ZUMOOL** — Off-grid PV Plant
4. **MURAWAH ISLAND** — PV Plant
5. **AL MUSSAFAH** — Al Reyadah Carbon Capture, Use, and Storage (CCUS) Project
6. **SEA PALACE** — Solar Rooftop Project
7. **DESALINATION PILOT PROJECT**
8. **AL AIN DIWAN** — Lighting Efficiency Project
9. **AL JARNAIN ISLAND** — PV Plant
10. **CROWN PRINCE COURT** — Solar Rooftop Project
11. **ABU DHABI FUND FOR DEVELOPMENT** — HQ Solar Rooftop Project
12. **MASDAR CITY** — PV Plant & Rooftop Solar PV

DUBAI

13. **MOHAMMED BIN RASHID AL MAKTOUM SOLAR PARK** — Phase 3
14. **BAB AL SHAMS** — Solar PV Plant

SHARJAH

15. **SHARJAH WASTE-TO-ENERGY FACILITY**

RAS AL KHAIMAH

16. **RASHID ABDULLAH OMRAN HOSPITAL** — Solar Rooftop Project