Masdar’s Renewable Energy Desalination Program
Singapore International Water Week 2016

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What is Masdar?

• Committed to maintaining leadership position in the world energy market, Abu Dhabi is investing, incubating and establishing a new energy industry

• Masdar, a subsidiary of the Mubadala Development Company, is mandated to expand the UAE’s energy portfolio by advancing, commercializing and deploying renewable energy and clean technologies.

• Our holistic business model fosters innovation and commercializing viable technologies across the industry value chain.

“We must not rely on oil alone as the main source of our national income.”

“We have to diversify the sources of our revenue and construct economic projects that will ensure a free, stable and dignified life for the people.”

The late Sheikh Zayed bin Sultan al Nahyan
Founding father of the United Arab Emirates
Understand: Water Challenges in the UAE

“Water is more important than oil”

H.H. Mohammed bin Zayed Al-Nahyan
Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces

The Masdar Approach

Masdar is re-defining the boundaries of the energy industry by identifying ways that renewable energy can be applied to address other sustainability challenges.

Case Study: Water Desalination

Sources of Water in the UAE

- Desalinated Water, 78.7%
- Recycled Water, 9.7%
- Groundwater, 11.6%

What is the link with energy?

- Seawater desalination provides almost 80% of the total water in the UAE
- BUT seawater desalination requires ten times more energy than sourcing ground water in the UAE
- Half of all fuel used in utilities is in desalinating water
Our Goal

Our goal is to **develop and demonstrate** seawater desalination technologies that:

- are more energy efficient than current state-of-the-art systems;
- are suitable to be powered by **renewable energy sources**;
- are **cost competitive** with non-renewable energy powered seawater desalination;
- have minimal environmental impact; and
- are resilient in challenging seawater and environmental conditions.

The Selection Process

**RFQ**

- Pre-selected bidders: 300 companies

**RFP**

- Received SOCs: 24 SOCs
- Qualified bidders: 21 bidders

**Pilots**

- Selected partners: 4 partners for 4 pilots
Selected Partner Companies

ABENGOA  SUEZ  TREVI  SIDEM VEOLIA

Project Implementation

- The demonstration includes 4 pilot plants located in Ghantoot, Abu Dhabi. Each pilot plant will be operated over 18 months;
- Masdar implements the program in close collaboration with the Abu Dhabi governmental agencies in the water sector;
- The 4 pilot plants will demonstrate different advanced and innovative desalination technologies.
Pilot Program Schedule

<table>
<thead>
<tr>
<th>Phases</th>
<th>Time Line</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Completing the project</td>
<td>Start 1st June 2013, End 30th July 2013</td>
<td>100%</td>
</tr>
<tr>
<td>Phase 1 Assessment</td>
<td>Start 1st July 2013, End 30th August 2013</td>
<td>100%</td>
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<tr>
<td>Phase 2 Partnerships</td>
<td>Start 1st May 2014, End 30th June 2014</td>
<td>0%</td>
</tr>
<tr>
<td>Phase 3 The Testing</td>
<td>Start 1st August 2014, End 30th August 2017</td>
<td>Phase 4 Wide range implementation (Commercial)</td>
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Actions Taken
- Asses the best desalination techniques
- Determines the elements of success in the pilot project
- Determine proper sites for the pilot projects
- Prepare work offer requests
- Analyse offers
- Discuss agreements
- Analyse commercial projects and select the best and low-priced techniques
- Sign contracts for four pilot projects in Abu Dhabi
- Design and engineering
- Manufacture
- Shipment
- Installation
- Trial operation
- Determine work sites
- Request pricing and labour offers
- Sign cooperation agreements
- Overall design for experimental projects
- Work plan and financial models
- Funding channels for commercial projects

Established Points

Time Line

Pilot Plant Setup

AUXILIARY FACILITIES

DESALINATION PLANT

AUXILIARY FACILITIES

- Desalination Plant
- Pre-Treatment
- Desalination Unit
- Power Plant
- Electrical Supply
- Heat Supply
- AUXILIARY FACILITIES

NETWORK
## Accompanying Research with Masdar Institute

- Masdar Institute supports all 4 project partners with accompanying R&D

### ABENGOA

- **Scope:** Evaluate scaling and fouling processes in membrane distillation modules
  - **Anticipated results:**
    - Strategies to reduce scaling and fouling;
    - Evaluation and troubleshooting report for commercial plants.
  - **Expected completion:** June 2017

### Veolia

- **Scope:** Develop capacitive de-ionization of RO product water (after first pass) to avoid double-pass RO systems
  - **Anticipated results:**
    - Demonstration of 100/h unit in lab environment;
    - Identified improvements on electrode materials;
    - Evaluation of bio-fouling propensity;
    - Basic design for 20,000 m³/d RO+CapDI plant.
  - **Expected completion:** March 2017

### Suez

- **Scope:** Develop optimized design of solar energy powered RO plant using most practical and economical technologies
  - **Anticipated results:**
    - Optimized processes and configurations for solar RO plants;
    - Cost of water by solar RO plants;
    - Multiple design scenarios of solar RO plants (grid connected and off-grid).
  - **Expected completion:** January 2017

### Trevi Systems

- **Scope:** Develop and test high temperature FO membranes and manufacturing techniques.
  - **Results:**
    - Developed a recipe for composition and structure of advanced FO membranes;
    - Experimental verification of prototype membranes;
    - Developed novel manufacturing techniques.
  - **Completion:** March 2016
Off-grid PV Powered Reverse Osmosis Pilot

- 5th pilot plant in Ghantoot
- Provided by Mascara Nouvelles Technologies (a French start up)
- Installation expected in June 2016
- Fully PV powered (30 kWp), very limited use of batteries
- Average water production capacity: 30 m³/d
- Ability to operate under varying solar irradiance
- Accompanying research at MI on active cooling technologies for PV

Benefits for Participating Companies

For the partner entities, the main benefits are:

- An opportunity to develop advanced and innovative desalination technology and intellectual property with co-financing and support from Masdar;
- An opportunity to demonstrate the developed desalination technology on the ground and under the auspices of Masdar;
- An opportunity to implement a reference project in a region that accounts for nearly 50% of global desalination capacity and establish or fortify a strong commercial footprint;
- An opportunity to become one of the developers of future large-scale renewable energy driven desalination plants in the UAE or abroad.
Expected Results

- **Energy and cost savings**: Estimated annual cost savings of 94 million USD is expected from 2020 onwards, if 15% of Abu Dhabi’s newly built desalination capacity is met by the implementation of the demonstrated energy efficient technologies.

- **Reduced dependence on natural gas**: The program will enable Abu Dhabi to cost-effectively power desalination plants with renewable energy sources, providing Abu Dhabi with the valuable option to reduce dependence on natural gas for the production of water.

Planned Future Steps

- **Expand desalination piloting activities**
  - Invite more companies to develop, demonstrate and test advanced desalination technology and renewable powered solutions in the field in Abu Dhabi
  - Address water remediation issues in Abu Dhabi’s oil and gas sectors
  - Address opportunities for small-scale renewable energy driven water treatment systems for remote areas

- **Develop utility-size desalination plants**
  - Applying highly energy efficient equipment
  - Preferably powered by renewable energy sources
  - Geographical focus: UAE, GCC, MENA
In the long-term, we believe our findings could be used to support **other countries around the world** who are challenged by water scarcity.

- Sharing Results International Forums
- Global Clean Water Desalination Alliance
- Desalination Pilot Advisory Board

**THANK YOU**