TECHNOLOGY TRANSFER AND RENEWABLE ENERGY

Water-Energy Nexus Operational Toolkit : Technology Transfer

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Economic and Social Commission for Western Asia

Prof. Hassan Arafat
ESCWA Consultant

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Outline

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Introduction

W-E Nexus & RE: Aspects and Opportunities

Renewable energy can boost water security by improving accessibility, affordability and safety;

Abstraction and conveyance, Treatment, Distribution, End-use, Wastewater collection and treatment, Constructing, operating and maintaining water-supply facilities

An energy system with substantial shares of renewable energy could be less water-intensive;

Extraction and mining, Fuel processing, Thermoelectric cooling, Transportation, Waste disposal and emission control, Constructing, operating and maintaining energy generation facilities

RE opportunities in the water-energy nexus:

- Reduce water-intensity of power sector
- Improve access to water
- Enhance reliability of water supply
- Bridge the water gap in arid regions
- Replace traditional water heating

Masdar's RE Desalination Pilot Program

Masdar
A MUBADALA COMPANY

مصدر
إحدى شركات مبادلة

Goals of the Program

The **development and demonstration** of seawater desalination technologies that:

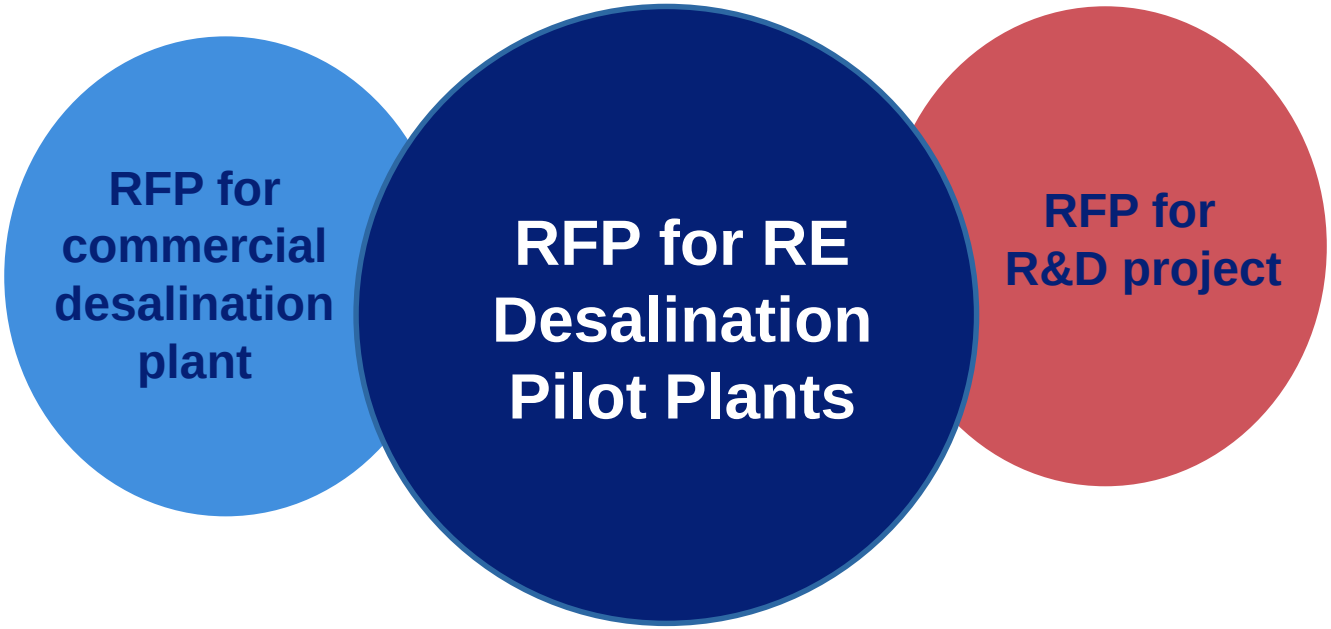
- are more energy efficient than current state-of-the-art systems;
- are suitable to be powered by renewable energy sources;
- are cost competitive with non-renewable energy powered seawater desalination;
- have minimal environmental impact; and
- are resilient in challenging seawater and environmental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

Organizational Structure of the Program

RFP Particularity

Request for technology development proposal for RE Desalination Pilot Plants will be a unique blend between:

- RFP for commercial desalination plant
- RFP for R&D project



RFP Structure

RFP will be divided in two major tracks:

Advanced desalination technologies	Innovative desalination technologies
Membranes	Membranes
Thermal	Thermal
Others	Others

Each of the tracks will have the same evaluation criteria, however with different weight factors.

Evaluation Criteria

Advanced desal technologies (dark: high weight)

Quantifiable criteria	Non-quantifiable criteria

– **Cost of produced water [AED/m³]**
– **Technology specific energy intensity**
  ○ **Thermal [kWh/m³]**
  ○ **Electric [kWh/m³]**
– **Size of proposed pilot plant**
– Amount of co-financing provided
	– **Projected development outlook**
	  ○ **Cost**
	  ○ **Energy footprint**
	– **Potential for industrial application (bankability, references)**
	– **Robustness & reliability**
	– Innovativeness, potential for technological breakthroughs
	– **Suitability for coupling with RE sources**
	– Environmental impact of brine discharge (salt concentration, chemicals, heat)
	– **Support to Masdar Institute of Science and Technology**

Evaluation Criteria

Innovative desal technologies (dark: high weight)

Quantifiable criteria	Non-quantifiable criteria

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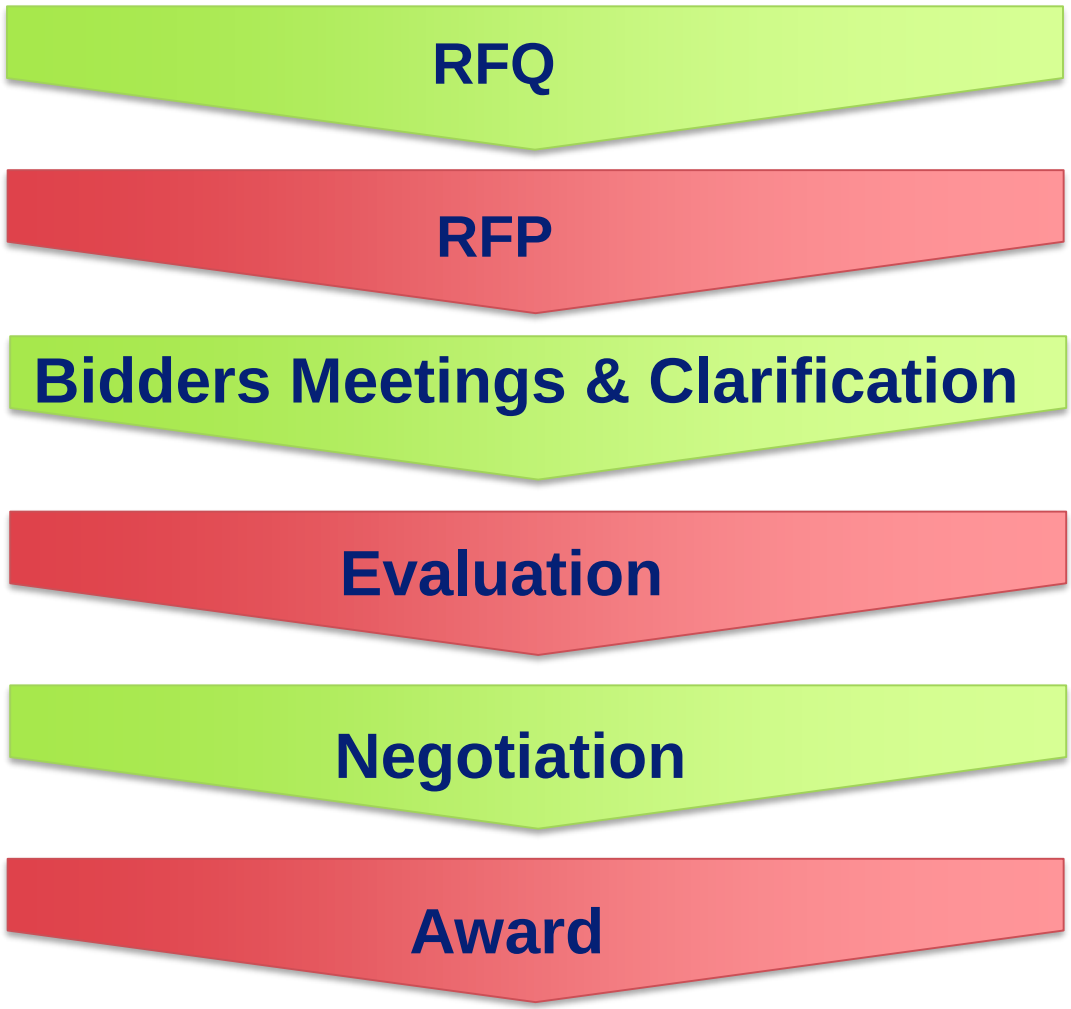
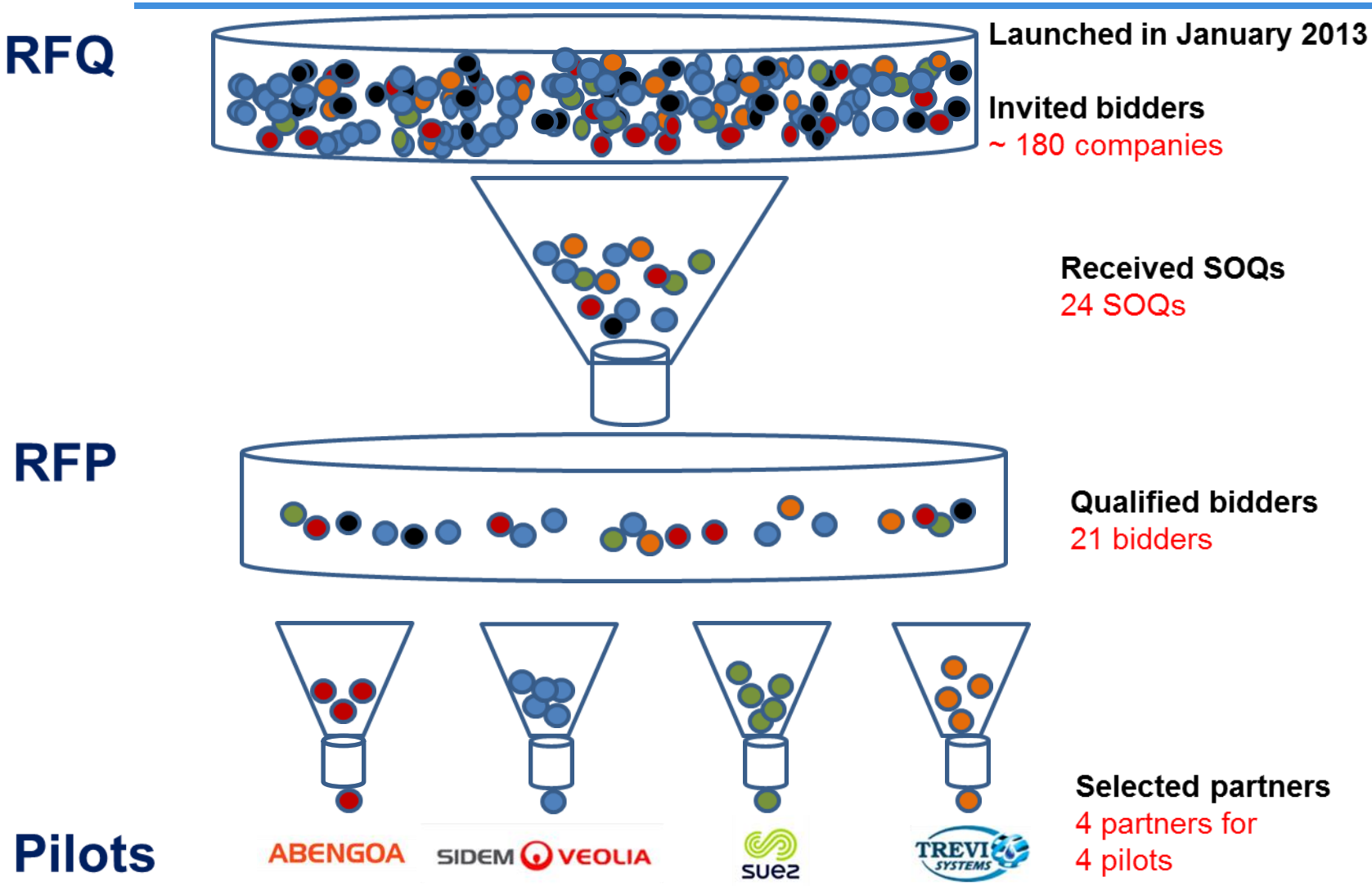
Bidding Step



Selection Process

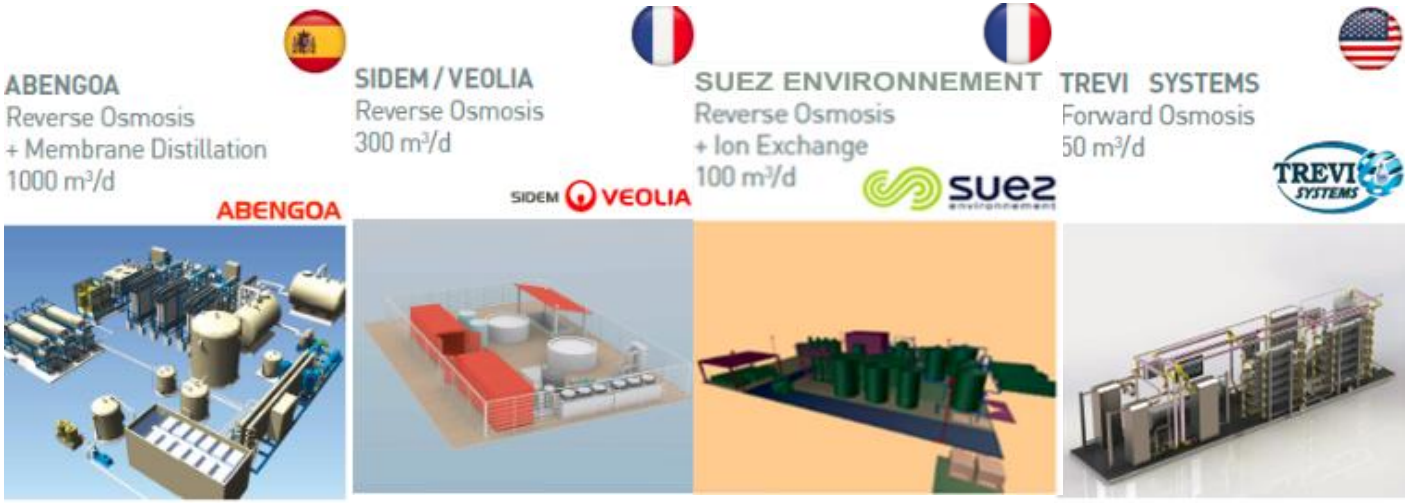


Project Implementation

The demonstration includes 4 pilot plants located in Ghantoot, Abu Dhabi.

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.



Site Photos

ABENGOA

Abengoa desalination pilot plant

suez

Suez desalination pilot plant

TREVI SYSTEMS

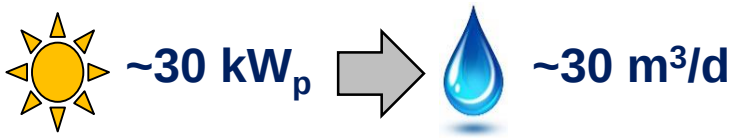
Trevi Systems desalination pilot plant

SIDEM VEOLIA

Veolia desalination pilot plant

Off-grid Solar Desalination without Energy Storage

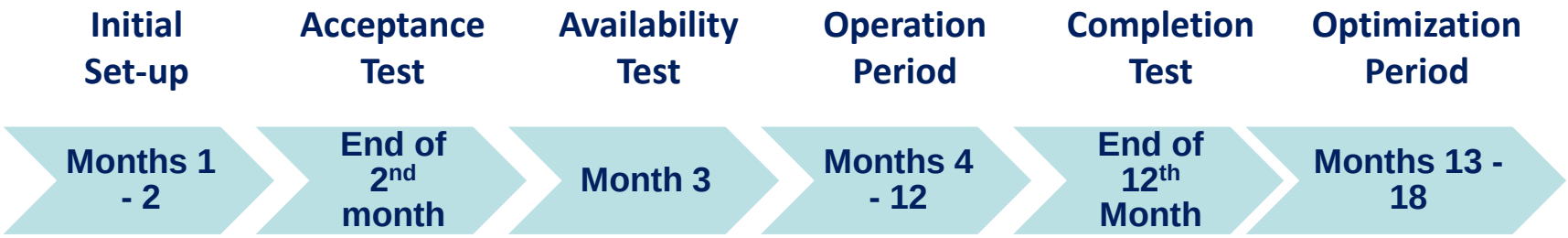
- 5th pilot plant in Ghantoot.
- Provided by Mascara Nouvelles Technologies (a French start up).
- Fully PV powered (30 kWp), very limited use of batteries.
- Ability to operate under varying solar irradiance.
- Accompanying research at MI on active cooling technologies for PV.
- Average water production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



Masdar's RE Desalination Pilot Program

Off-grid Solar Desalination without Energy Storage

Pilot Program Schedule



- Each pilot plant is operated over 18 months.
- During the first 12 months the plants have to demonstrate performance and reliability.
- A 6 month optimization period follows, enabling the testing and demonstration under less stringent reliability requirements.

Masdar's RE Desalination Pilot Program

Accompanying Research with Masdar Institute

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

ABENGOA	VEOLIA WATER	suez	TREVI SYSTEMS
Scope	**Scope**	**Scope**	**Scope**
Evaluate scaling and fouling processes in membrane distillation modules	Develop capacitive de-ionization of RO product water (after first pass) to avoid double-pass RO systems	Develop optimized design of solar energy powered RO plant using most practical and economical technologies	Develop and test high temperature FO membranes and manufacturing techniques.
Anticipated results	**Anticipated results**	**Anticipated results**	**Results**
•Strategies to reduce scaling and fouling; •Evaluation and troubleshooting report for commercial plants.	•Demonstration of 100l/h unit in lab environment; •Identified improvements on electrode materials; •Evaluation of bio-fouling propensity; •Basic design for 20,000 m^3/d RO+CapDI plant.	•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).	•Developed a recipe for composition and structure of advanced FO membranes; •Experimental verification of prototype membranes •Developed novel manufacturing techniques
Expected completion	**Expected completion**	**Expected completion**	**Completion**
June 2017	March 2017	January 2017	March 2016

Benefits for Participating Companies

- Opportunity to develop advanced and innovative desalination technology and IP with co-financing and support from Masdar.
- Opportunity to demonstrate the developed desalination technology on the ground.
- 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.
- Opportunity to become one of the developers of future large-scale renewable energy driven desalination plants in the UAE or abroad.

Planned Future Steps: Advancing Water Treatment Technology

Pilot plants in Abu Dhabi show very promising results, and are living up to expectations and have already proven to be an important step in advancing desalination technology.

- Masdar is planning to expand water treatment piloting activities, by:
  - Inviting 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

Planned Future Steps: Commercialization

- Engage in the development of desalination plants, applying highly energy efficient equipment.
- Preference for desalination powered by renewable energy sources.
- Geographical focus: UAE, GCC, MENA.
- Masdar is developing a comprehensive water business plan and growth strategy, evaluating opportunities, benefits and position with in the desalination sector.

Taking the Findings Global

In the long-term, the program findings could be used to support other countries around the world which are challenged by water scarcity.

RE Manufacturing

RE manufacturing in the Arab countries

- Estimated that the MENA countries would have an additional RE capacity of 107 GW by 2030 (compared to 2015).
- Greater RE market means greater potential for RE manufacturing in the region.
- Relatively low capital-intensity of RE technologies.
- RE components that are more versatile can be used for multiple RE technologies (e.g., cables and electronics).
- When components are simpler, they tend to be easier to manufacture in different locations and vice versa.

RE manufacturing in the Arab countries - Examples

- Solar water heating systems available in Tunisia and Jordan manufactured locally.
- 20-30% of equipment in wind farms in Egypt tends to be provided locally; GE is building a $200 million wind energy components manufacturing facility in the country and Siemens has also signed similar deals.
- PV panels are being manufactured in Algeria; two factories producing 75MW and 30 MW panels are already operational.
- 66 UAE companies took part in the construction of the Shams 1 CSP plant in Abu Dhabi emirate.
- The CSP plant built in Kuraymat in Egypt obtained 40% of its equipment from local sources.

Key messages

- The successful case studies presented represent technologies (e.g., RE use in desalination) which have much potential in many of the Arab countries.
- The Masdar RE Desalination Pilot Program is a successful example of TT.
- The Arab countries should first focus on manufacturing those RE technology components which have the most versatility and the least complexity.
- Some Arab countries are stronger than others when it comes to TT.
  - The stronger countries assisting the weaker ones would be positive for the whole region.
  - E.g., the market for RE components would grow providing support for the local manufacturing of these components.

THANK YOU

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