The market potential of small RES Desalination systems

ΚΑΠΕ CRES
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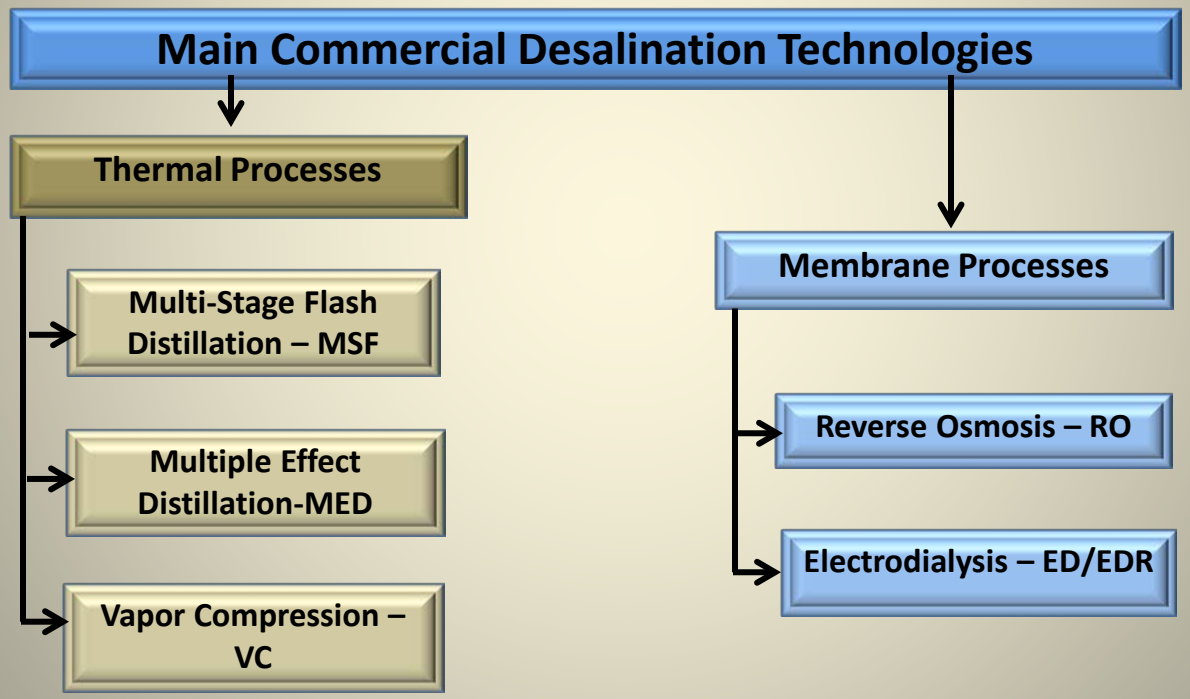
Desalination Technology



Desalination Technology

Main Characteristics of the Desalination processes

Thermal Processes	Membrane Processes
Mainly used for seawater desalination	Used for seawater and brackish water desalination
Effective in medium and large water capacities	Effective in all water capacities
Produced water quality < 20 mg/Lt	Produced water quality < 500 mg/Lt
Brine Disposal - concentration - temperature	Brine Disposal -concentration
High Energy Requirements (thermal, electrical)	Relatively low energy requirements (electrical)

Small RES Des systems-Technologies matching

RES	Distillation	VC	RO	ED
WEC		√	√	√
PV			√	√
Solar collectors	√			
Geothermal	√			

Small RES Des systems-Applications

Small RES desalination systems are mostly applicable in **rural off grid areas** for the production of fresh or potable water from raw contaminated water, brackish and seawater.

Small RES desalination systems can be used for:

- municipal use in off-grid rural areas, remote islands
- tourism facilities (e.g. alternative tourism)
- hospital facilities, schools, public authorities
- farming, agriculture, fishing activities
- military facilities

Small RES Desalination systems- Applications

During the last decades more than 180 small autonomous desalination units driven by Renewable Energy Sources (RES) have been installed around the world.

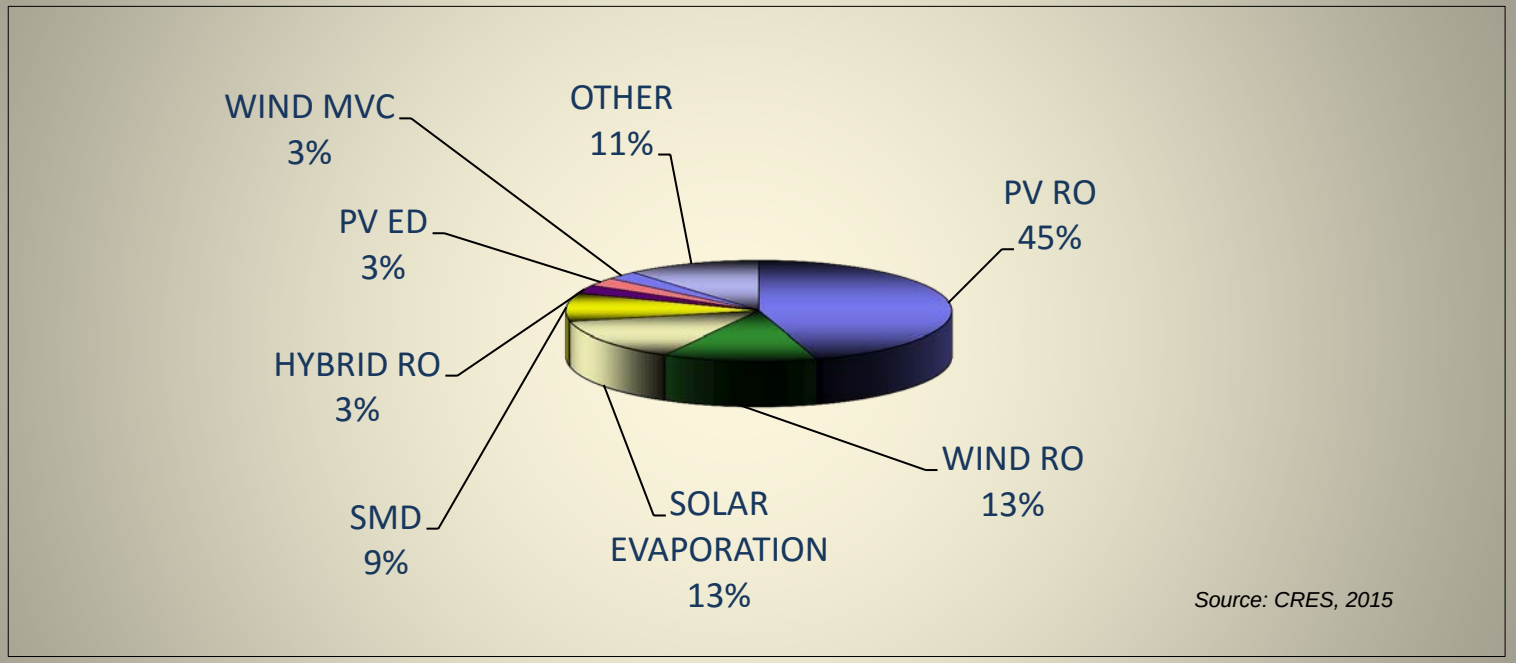
The majority are custom designed for specific locations and utilize solar energy to produce fresh water from seawater (SW) or brackish water (BW) resources.

A significant number of small RES Des units have been installed in Middle East (Jordan, Abu Dhabi, Oman, etc.), in Pakistan, North Africa, Asia and in Europe most of them as part of EU and other research projects.

Small RES Desalination systems- Applications

Location	Responsible Organization	RES Desalination Technology	Desalination Capacity	PSS nominal power	Year of installation
Cyprus, Geroskopous	Fraunhofer ISE	PV BWRO	5m³/d	7,65 kWp	2011
Palermo, Sicily	Solar Spring/ Univ of Palermo	Solar MD	150 lt/d	12 m² Solar thermal	2010
Jordan Valley, Jordan	NERC	PV-BWRO	20 m³/d	10.4 kWp	2010
Gran Canaria, Spain	ITC	PV EDR (BW)	95 m³/d	5.6 (for pumps) + 3.7 (for stacks) kWp	2010
Amellou, Morocco	ITC	PV BWRO	24 m³/d	4kWp	2008
Tangarfa, Morocco	ITC	PV BWRO	12 m³/d	2.5 kWp	2008
Tasekra, Morocco	ITC	PV BWRO	24 m³/d	4kWp	2008
Azla, Morocco	ITC	PV BWRO	24 m³/d	4kWp	2008
Khar Ghilene, Tunisia	ITC	PV BWRO	50 m³/d	10.5 kWP	2006
Morocco	Fraunhofer ISE	Solar MD	150 lt/d	80Wp PV 6m² Solar thermal	2005
Aqaba, Jordan	Fraunhofer ISE	Solar MD	1 m³/d	12m² PV 72 m² Solar thermal	2005
Aqaba, Jordan	NERC	PV- BWRO	30 m³/d	16.8 kWp	2005
Gran Canaria, Spain	Fraunhofer ISE	Solar MD	150 lt/d	75Wp PV 6.5m2 Solar thermal	2004

RES Des Installations share



Share of the stand-alone RES DES installations for seawater and brackish water desalination (as a percentage of the total installations)

Indicative Costs

Location	Feed Water Type	Desalination Water Capacity /Technology	RES Nominal Power	Unit Water Cost €/m3
Tenerife (2010)	brackish	0.0125 m^3/h, Membrane Distillation	12m2, 150Wp PV	15
CREST, U.K. (2003)	brackish	0.5 m^3/h, RO	1.54 kWp PV	2
Pozo Izquierdo, ITC (2003)	seawater	0.8 m^3/h, RO	15 kW WT	3-5
Nevada, Colorado, ITN (2003)	brackish	0.062 m^3/h, RO	540 Wp PV	3
Keratea, CRES (2001)	seawater	0.3 m3/h, RO	3.9 kWp, 900W W/T	~ 10
Pozo Izquierdo, ITC (1998)	seawater	0.4 m^3/h, RO	4.8 kWp PV	9
Maagan, Israel (1999)	brackish	0.125 m^3/h, RO	600 W W/T, 3.5 kWp PV	7.5
Lampedusa, Italy (1996)	seawater	5,0 m^3/h, RO	100 kWp PV	~6.5

Small RES Des systems- Commercialization

In the last decade few companies have provided in the market RES Des packages for the provision of potable water.

The majority of these companies provide solar (PV) reverse osmosis units, solar thermal distillation units and solar stills.

Their water capacity is ranged from few liters to around 100m3/day (in the case of PV RO systems).

Desalination RES systems- Market Availability

COMPANY NAME	PRODUCT	CAPACITY RANGE
Flores Solar Water GmbH	Solar distillators	10 Lt/day
KII INC.	Solar stills	12 Lt /m2.day
MAGE Water Management GmbH	Solar MEH (MiniSal, MidiSal, MegaSal)	1,000-10,000Lt/day
RSD Solar Wasser distillators, Rsoendahl	Solar distillators	5 Lt -31 LT/day
SPECTRA Watermakers	PV RO portable kit	24 Lt/hr
SOLAQUA	Solar Water Distiller	6Lt/day
SOLWA SRL	Solar stills	8 Lt/m2.day
SOLARDEW BV	Solar stills	5-8 Lt /m2.day
SOLARSPRING	Solar membrane distillation	≤ 10,000 Lt /day
TERRAWATER Gmbh	Solar MEH	5000 Lt/day (basic module)
TRUNZ	PV RO	250-5000 Lt/hr

MED: Multi Effect Distillation, MEH: Multi Effect Humidification

Off-Grid applications

Strogili island, Greece, 2012
SWRO 0,33 m3/h, 20 kWp PV

Source: PHOTOVOLTAIC, Greece

Jordan, 2005
BWRO 3.41 m3/h, 16.8 kWp PV

Source: NERC, Jordan

Jordan, 2010
BWRO 0.83 m3/h, 10.4 kWp PV

Source: NERC, Jordan

Source: Trunz, Swiss

Orinoco Delta , Venezuela
BWRO 0.8 m3/h, 160 Wp PV

Off-Grid applications

Source: ITC, Spain

Morocco, 2006/7
BWRO 1m3/day, 4 kWp PV

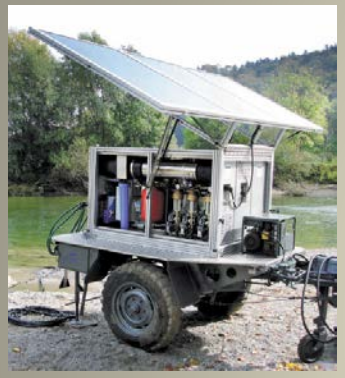
Source: SolarSpring, Germany

Medinine, Tunisia 2010
SW MD 0,15 m3/day, PV , Solar thermal collectors

Source: Prodes Project

Dubai (UAE)
Solar thermal powered MEH system
MEH 5 m3/day, 170 m2 solar thermal collectors

Off-Grid applications



Source: Trunz, Swiss

Source: Trunz, Swiss

Source: Solar Spring, Germany

Source: Trunz, Swiss

Small RES Des systems - Market Potential

To determine the market potential of small RES desalination systems we need to examine at least three factors:

- The need
- The alternatives
- The potential customers
- The current environment (political, economic)

The Need

Around **1.2 billion** people live in areas of physical scarcity, and **500 million** people are approaching this situation.

MENA is the driest and most water-scarce region in the world with average annual precipitation in depth (for 2014) of

- Morocco 346 mm per year
- Algeria 89 mm per year
- Tunisia 207 mm per year
- Egypt 51 mm per year
- Jordan 111 mm per year
- Libya 56 mm per year
- Saudi Arabia 59 mm per year
- UAE 78 mm per year

Other Med countries

Greece	652 mm per year
Cyprus	498 mm per year
Italy	832 mm per year

Other Countries

India	1083 mm per year
Indonesia	2,702 mm per year
Malaysia	2,875 mm per year

Source World bank

The Need

Another **1.6 billion people** face economic water shortage (lack of the necessary infrastructure).

Freshwater on the planet is **distributed unevenly**.

Too much water is **wasted**, **polluted** and **unsustainably managed**.

The small population and the low demand of the rural and mostly poor areas do not enable extension of the water and electricity grid networks.

Alternatives for safe water in rural off grid areas

- Water pumping (hand pumps, diesel pumps, use of res PV and/or Wind)
- Filtration (Biosand filters, slow sand filters, cloth filters, etc.)
- Other (Chlorination, PET solar bottle, tablets, Aquacone, etc.)

Household water treatment

Cloth Filter

BioSand Filter

sodium hypochlorite solution (WaterGuard)

SODIS

The potential customers

OFF-GRID RURAL AND REMOTE AREAS

- Municipalities/Governments/NGOs
- Private sector (Agrotourism, Farmers, breeders, fish farmers)
- Shelters
- Army
- Humanitarian organizations

The main world markets for small RES desalination are the MENA region as well as countries with dispersed population like Africa, India, and Latin America. Also, countries with large number of islands such as Japan, The Philippines, etc., have the potential to become significant markets for small RES desalination units.

Current environment

- Global tendency to provide long-term and sustainable solutions for the provision of safe water in rural off-grid areas.
- For many countries the provision of basic services, such as electricity and water in rural areas, is a priority in their political agenda.
- Trend of private investors involvement for the provision of the basic services in off grid rural areas.
- Reduction of PVs price and increase of the performance of desalination systems (mainly of RO) makes the combination more attractive and economical affordable.
- Slow progress of the political wills to promote RES Des systems in rural areas.
- Financial sustainability is a very important and challenging aspect for the safe water supply of rural areas and for the market potential of small RES Des systems.

Conclusions

There is still room for the improvement and cost reduction of RES Desalination systems.

RES Des can provide long-term solution on water scarcity problems to off-grid rural areas.

Political willingness and funding opportunities are basic parameters for the promotion of RES Des and the improvement of the quality of life in the rural off-grid areas of the world.

Thank you