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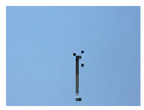
Wind Desalination



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Part of the presentation is prepared with the contribution of PRODES partners

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Promotion of Renewable Energy for Water production through Desalination

Promising Technologies Combinations

RES	MSF	MED	VC	RO	ED
WEC			√	√	
PV				√	√
Solar Thermal collectors	√	√			
Geothermal	√	√			

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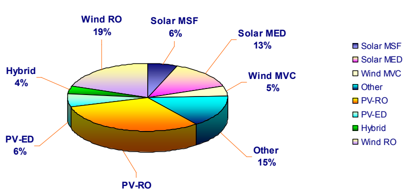
RES Desalination installations



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RES Desalination installations

Location	RO capacity (m^3/hr)	Electricity supply	Year of installation
Ile du Planier, France	0.5	4kW W/T	1982
Island of Suderoog, Germany	0.25 - 0.37	6kW W/T	1983
Island of Helgoland,Germany	40	1.2MW W/T +diesel	1988
Fuerteventura, Spain	2.3	225 kW W/T + 160 KVA diesel, flywheel	1995
Pozo Izquierdo, SDAWES	8 x 1.0	2x230 kW W/T	1995
Therasia Island, APAS RENA	0.2	15 kW W/T, 440Ah batteries	1995/6
Tenerife, Spain; JOULE	2.5 - 4.5	30kW W/T	1997/8
Syros island, Greece; JOULE	2.5 - 37.5	500 kW W/T, stand-alone +grid connected	1998
Keratea, Greece PAVET Project	0.13	900W W/T, 4 kWp PV, batteries	2001/2
Pozo Izquierdo, Spain, AEROGEDESA project	0.80	15kW W/T, 190Ah batteries	2003/4
Loughborough Univ,UK	0.5	2.5kW W/T, no batteries	2001/2
Milos island, Greece OPC programme	2 x 42	850kW W/T, grid connected	2007
Heraklia island, Greece OPC programme	3.3	30 kW W/T off shore, batteries	2007
Delf Univ., The Netherlands	0.2 - 0.4	Windmill, no batteries	2007/2008

Source: Tzen. E, CRES

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Wind energy - Distillation (MVC) Application

Wind MVC Plant (1)

Capacity: 50 m^3/d

Feed water: seawater

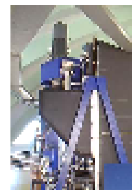
Nominal Power: 2×230kW W/T, flywheel

Pop: 0.2 bar

T= 62º C

Compressor Nominal Power: 30kW

Spec. Energy Consumption: 16 kWh/m^3

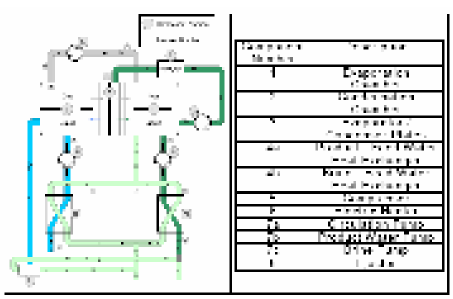


Source: UNESCO, Morris R.

Source: ITC

Pozo Izquierdo,Gran Canaria
ITC, Spain (1999)
JOULE Programme , SDAWES Project

Block diagram of the MVC plant



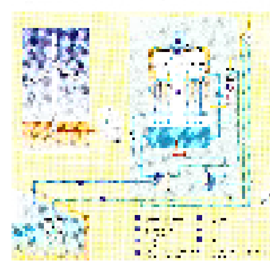
Wind MVC (2)
KGW – Ruegen Island, Germany (1995)

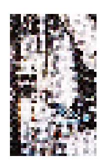
Capacity: 12.5 m^3/h, (300m^3/day)

Feed water: seawater

Nominal Power: 300 KW W/T

Spec. Energy consumption: 9 - 20 kWh/m^3





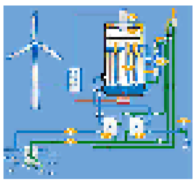
Source: KGW

Wind MVC (3)

Borkum, Germany, 1991

A pilot plant was installed at the German island of Borkum in 1991 where a wind turbine with a nominal power of 45 kW was coupled to a Mechanical Vapor Compression (MVC) evaporator in a system capable of desalinating seawater and producing up to 48 m³/day of fresh water.

The compressor required 36 kW power, and the system was controlled by varying the compressor speed, and assisted by a resistance heating when the compressor run at its speed limit.



Source: WME/KGW Schweriner Maschinenbau GmbH

Wind Energy – Reverse Osmosis Applications

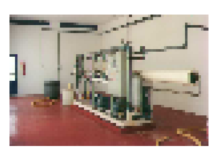
Wind / RO Plant (1)

Capacity:	0.8 m³/h (19.2 m³/day)
Feed water:	seawater
Nominal power:	15 kW W/G
Battery Capacity	190 Ah

Pozo Izquierdo, Gran Canaria
ITC, Spain (2004)

Wind RO plant (2)

Desalination:	56 m³/day RO plant
Feed water:	seawater
Power Supply:	225 kW W/T,
	2x160KVA diesel, flywheel



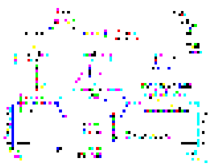
Fuerteventura island
(2003/4)

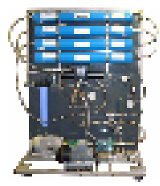
Wind RO plant (3)

Desalination: 12 m³/day RO plant

Feed water: seawater

Power Supply: 2.5 kW W/T, direct coupling





CREST, Loughborough Univ, UK. (2003)

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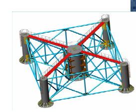
Offshore Wind RO plant (4)

Desalination: 80 m³/d RO plant

Feed water: seawater

Power Supply: 30 kW W/T, battery bank



Iraklia island, Greece (2007)

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Wind RO plant (5)

Desalination: 2x1000 m³/day RO plant

Feed water: seawater

Power Supply: 850 kW W/T

Milos island, Greece, seawater, grid connected, (2007)

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RES Desalination - Indicative Water Costs

Installation	RES kW	Desalination m³/day	Unit Water Cost, €/m³
SW Solar thermal MED, Almeria	2672 m²	72	2.5-3
SW PV RO, Pojo Izquierdo	4.8 kWp PV	9.6	9
SW Wind RO, Pojo Izquierdo	15 kW WG	19	3-5
SW PV-RO, Lampedusa	100 kWp PV	120	6
SW, Geothermal MED plant,Milos island	61°C	80	<1
SW Wind RO, Loughborough Univ, UK	2.5	12	1.75
SW Wind RO Milos island	grid	2000	1.8
BW Hybrid RO, Maagan	600W WG, 3.5 kWp PV	3	7.5

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What we learned ?

- Preferred renewable energy: PHOTOVOLTAIC
- PVs are reliable but still of high cost
- Preferred desalination technology: REVERSE OSMOSIS
- The main problem on the technologies coupling is the intermittent operation
- Special care on the design and equipment selection
- Need for systems automation
- Need for further reduction of the energy consumption of the desalination units

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What shall be done ?

- More work on the intermittent operation of the desalination RES systems
- Development of efficient small energy recovery systems
- Strong effort of R&D organizations and manufacturers co-operation
- Need for commercially available desalination RES plants
- More desalination RES installations
- Financing of the "after project" period
- Acceleration of education, training and information dissemination

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Conclusions

- Desalination technologies are well established technologies and are of common acceptance
- Proper selection of a desalination process, significant design and selection of materials, could provide the best solution for the provision of fresh water at a specific site
- Future water desalination should be increasingly powered by RES
- Commercial available desalination RES systems should be potentially available at reasonable costs
- The use of environmentally friendly systems for the provision of water is essential

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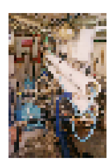
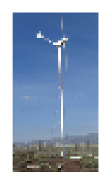
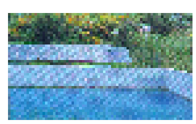




Thank you for your attention



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