INTERNATIONAL CONFERENCE ON DESALINATION AND SUSTAINABILITY

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The Mediterranean and Sustainable Desalination

Manuel Fariñas

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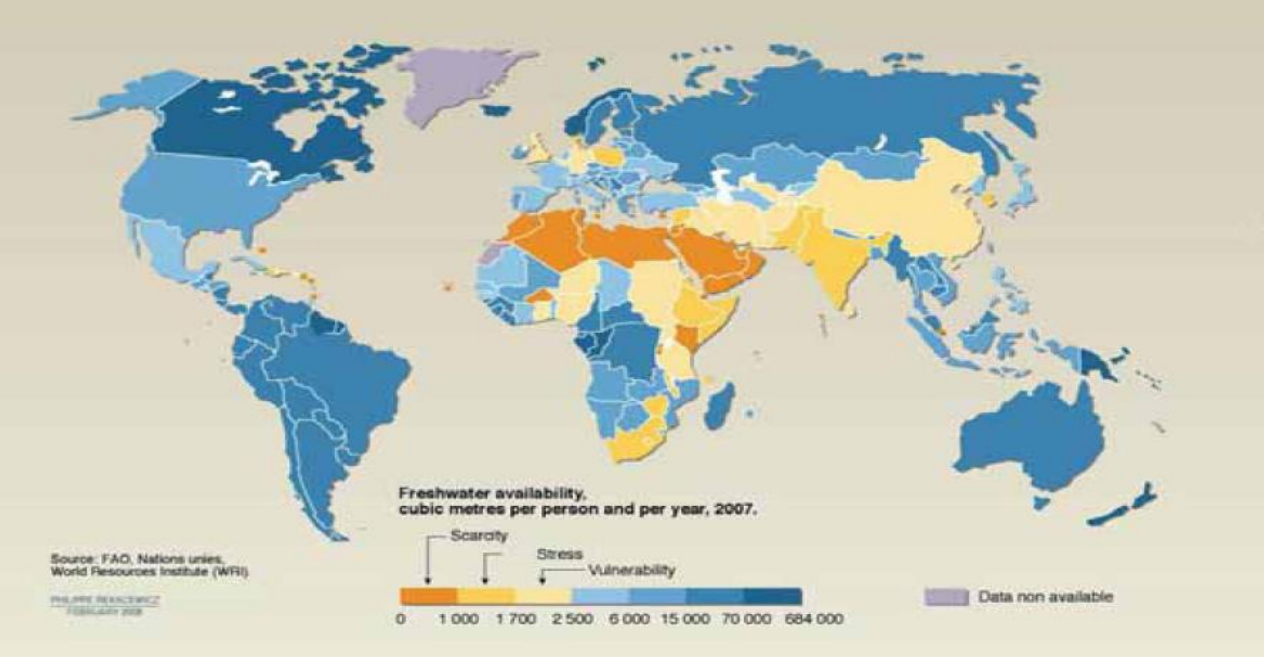
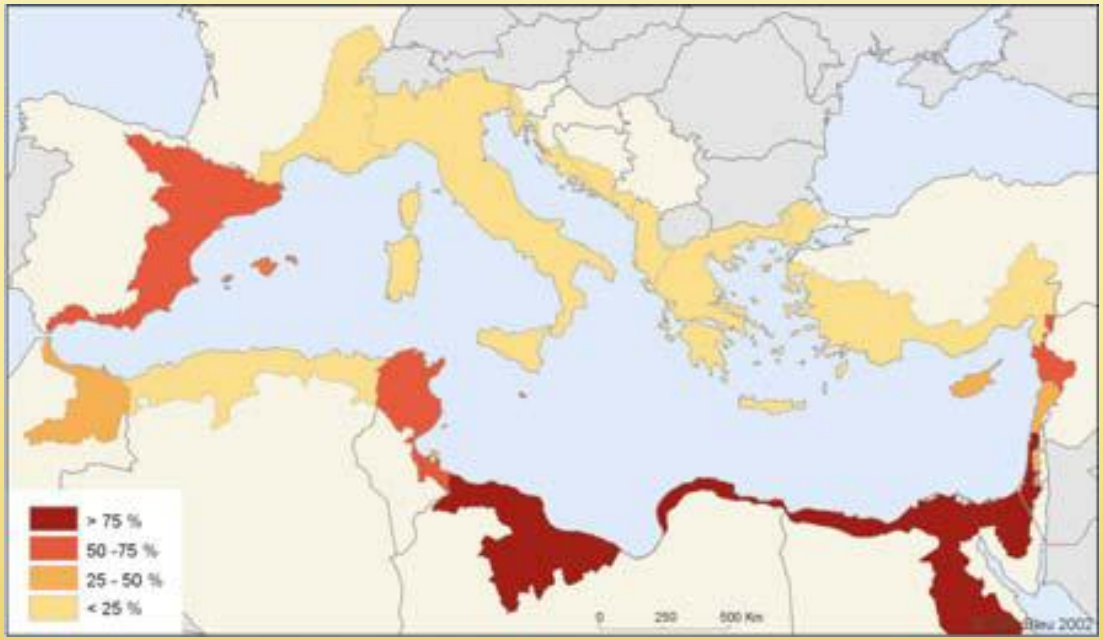
"New water" needs



Global freshwater availability (UNEP 2008)

- Population growth and increase of food production requirement.
- Economic development.
- Increasing water pollution.
- Overexploitation of aquifers.
- Climate change.

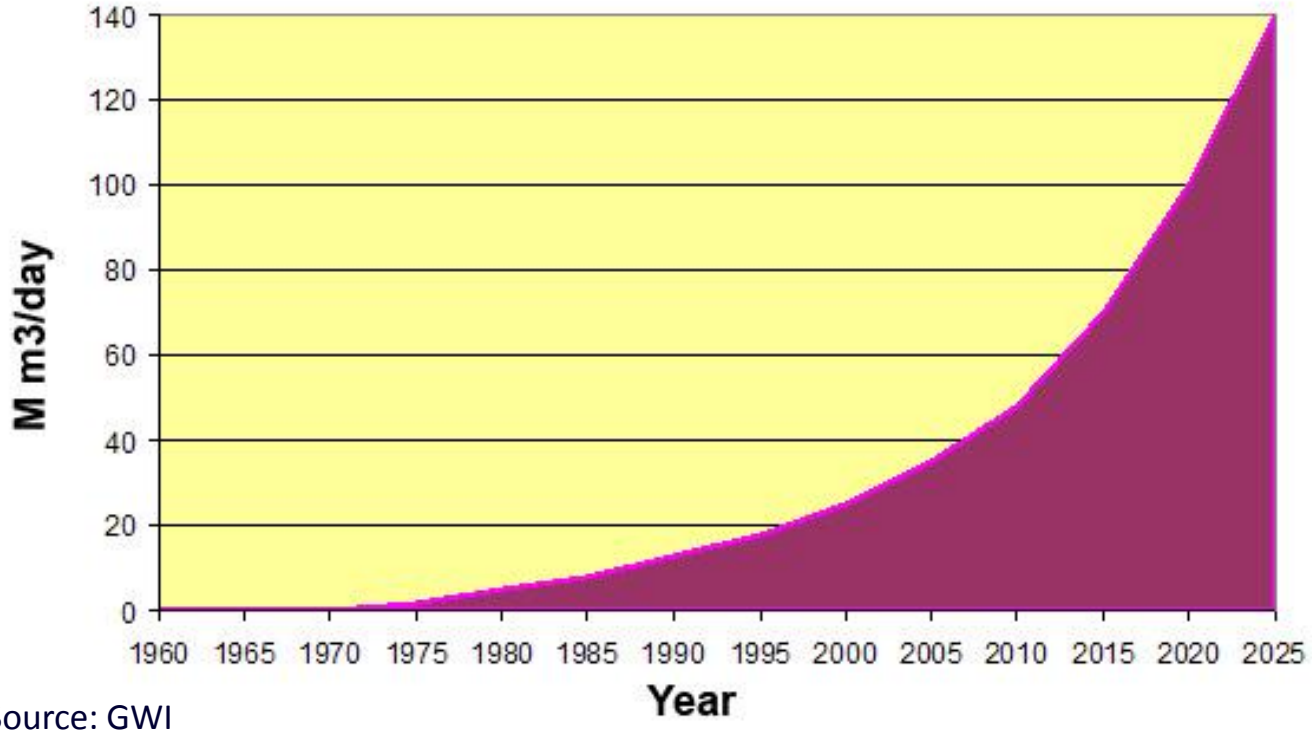
Mediterranean Basin water pressure



Pressure on water in Mediterranean Basin in 2000
Source: EUWI MED

The high water shortage can be presumed to show that water demands cannot be entirely covered by the conventional resources exploitation and must partly use non-renewable resources or non-conventional supply sources (wastewater re-use and desalination).

"New water" needs



Source: GWI

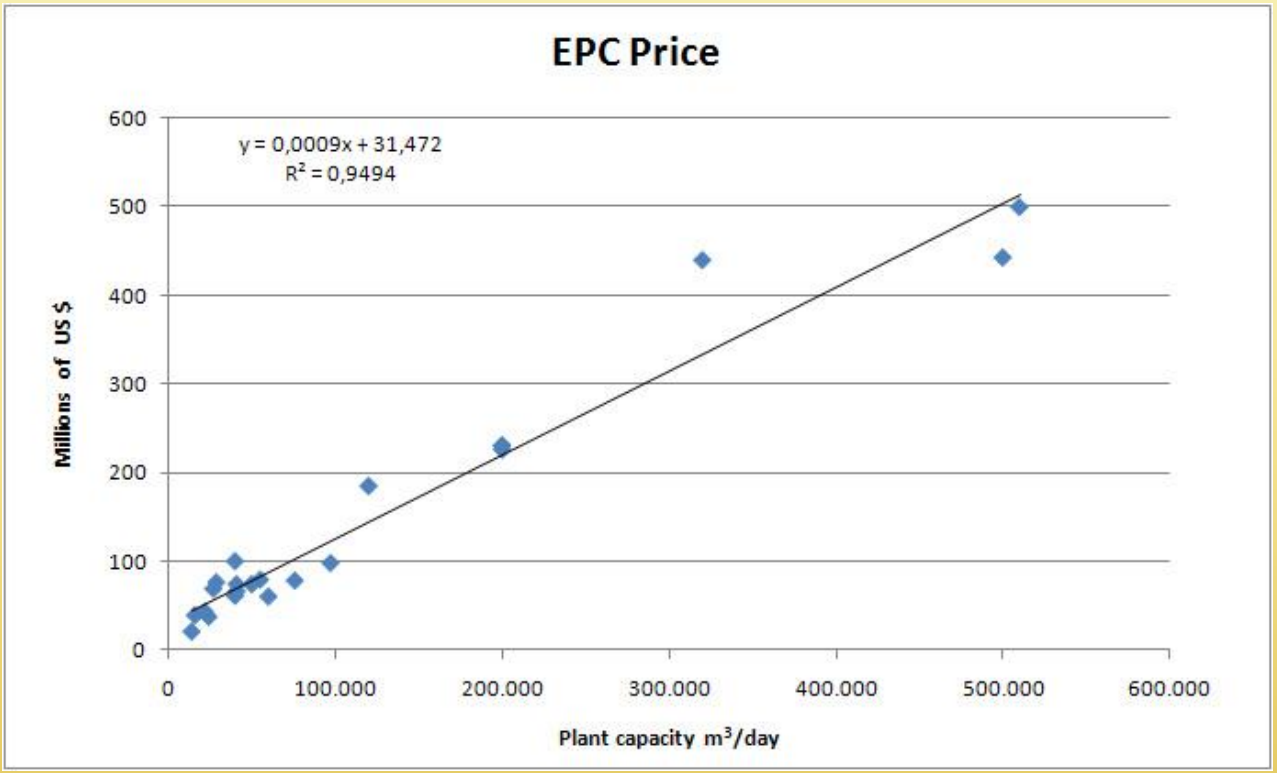
In 2025 there will be more than **140 million m³/day** of desalinated water coming from the sea.

Contracted sea water desalination capacity

2.007 – 2.011 → 25 PLANTS

Country	Cumulative capacity (m^3/d)
Algeria	1.220.000
Israel	911.000
Spain	389.000
Cyprus	124.200
Morocco	75.800
Libya	40.000

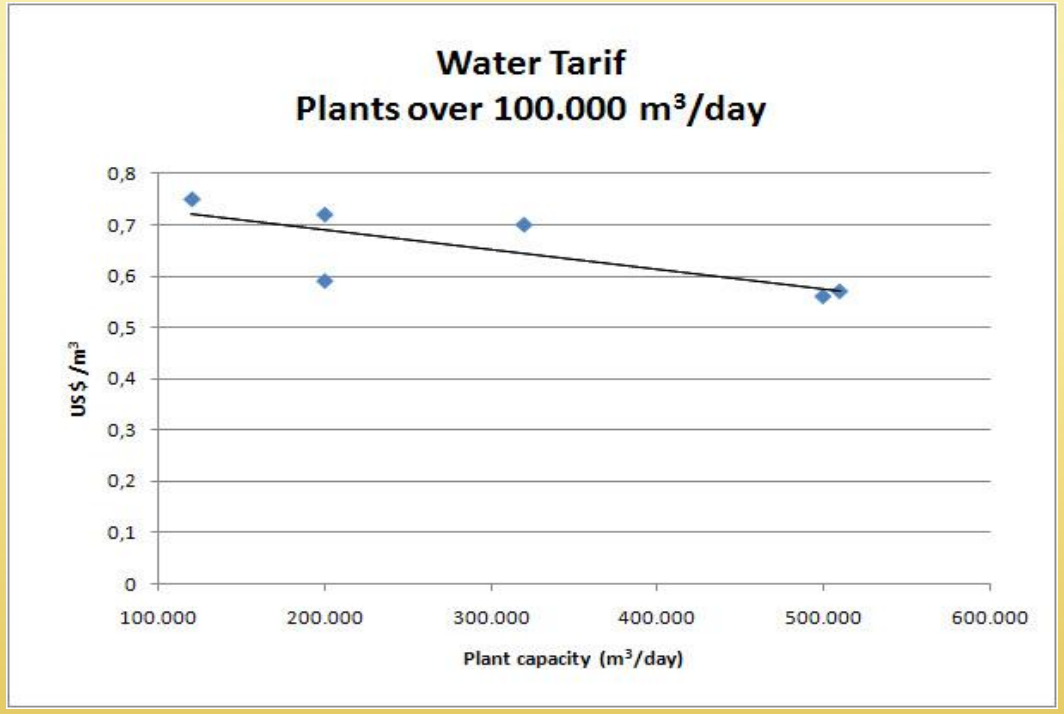
EPC investment per installed capacity



Source: proprietary development

Specific investment of 1,000-1,200 U.S.$/m³/day, (**750 - 900 €/m³/day**).

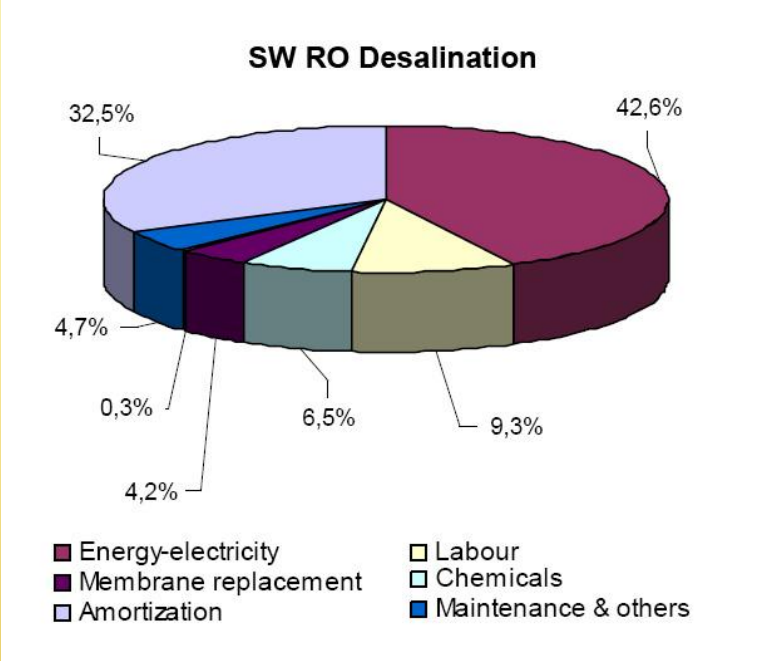
Water tariff



Source: proprietary development

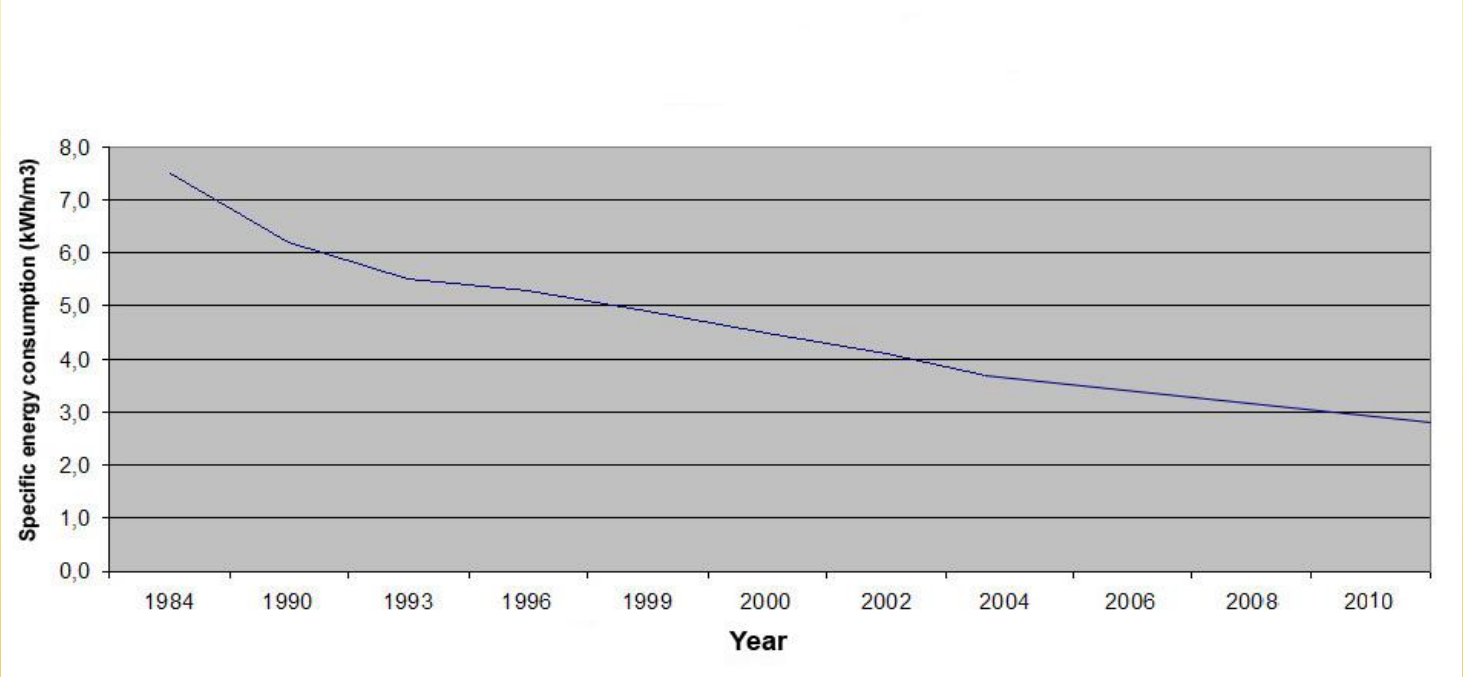
- The rate of water can vary approximately between 0.75 and 0.56 U.S.$/m³ (**0.55 to 0.42 €/m³**).

OPEX breakdown



- To continue reducing the initial investment cost required to build a desalination plant.
- To continue reducing the specific consumption of energy.
- To reduce the price of electricity.
- To mitigate the environmental impact due to the indirect CO_2 emissions because of intensive energy consumption.

Energy specific consumption trend

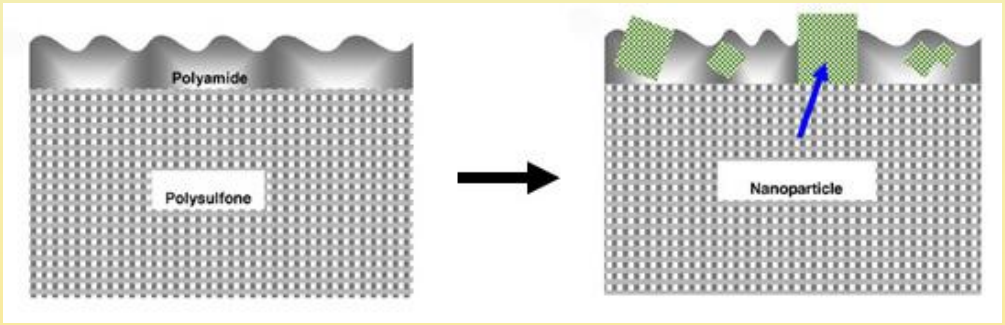


Source: proprietary development

The decline trend for specific energy consumption observed in the last years will continue.

Future reductions will happen, due to an improvement of the efficiency of reverse osmosis membranes and also due to simplified pretreatments.

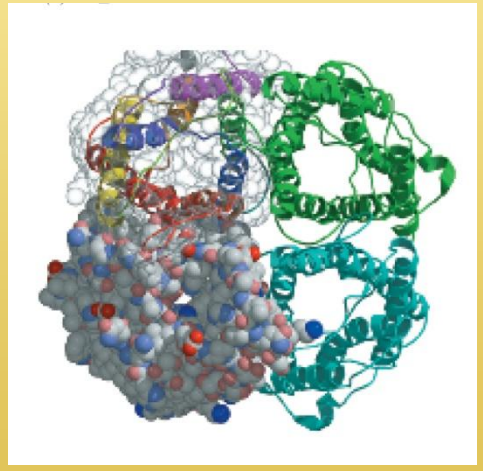
Implementation of new technologies

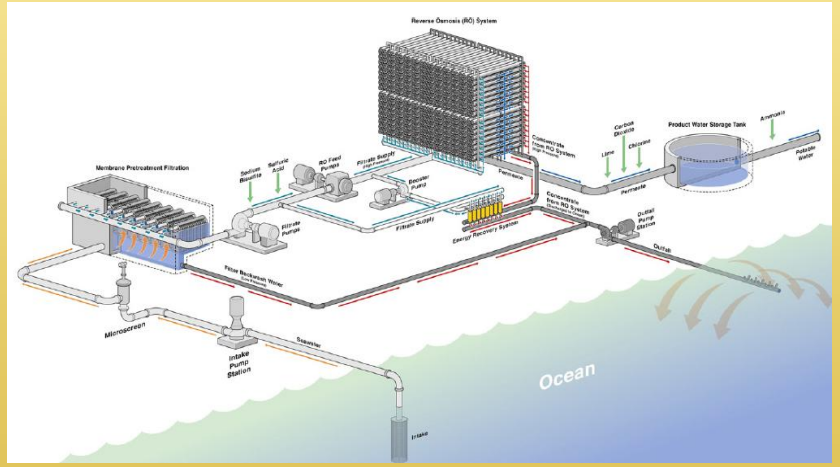


Will not
Come from

- Energy recovery devices
- High efficiency pumps

- Nanocomposites membranes

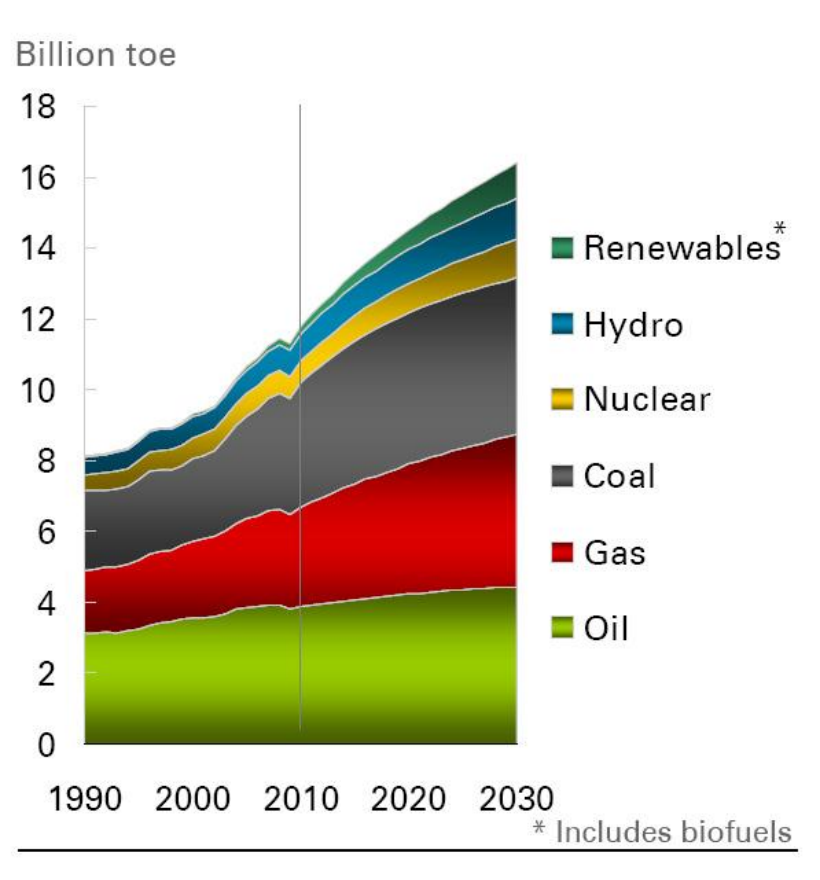




- Biomimetic membranes

- Simplified pretreatment

Energy demand



Source: BP (2011) "Evolution of global energy consumption according to its origin".

- With a growing demand for energy, its prices will be expected to rise in the next years.
- According to the Energy Venture Analysis (EVA) the price of kWh for industrial use will increase to 8.4 c$ in the year 2015, **reaching 13 c$ in the year 2025**.

Energy environmental footprint for desalination

- Desalination capacity will be around 170 million m³/day in 2030.
- The specific energy consumption will be about 2.5 kWh/m³ for Reverse Osmosis technology.

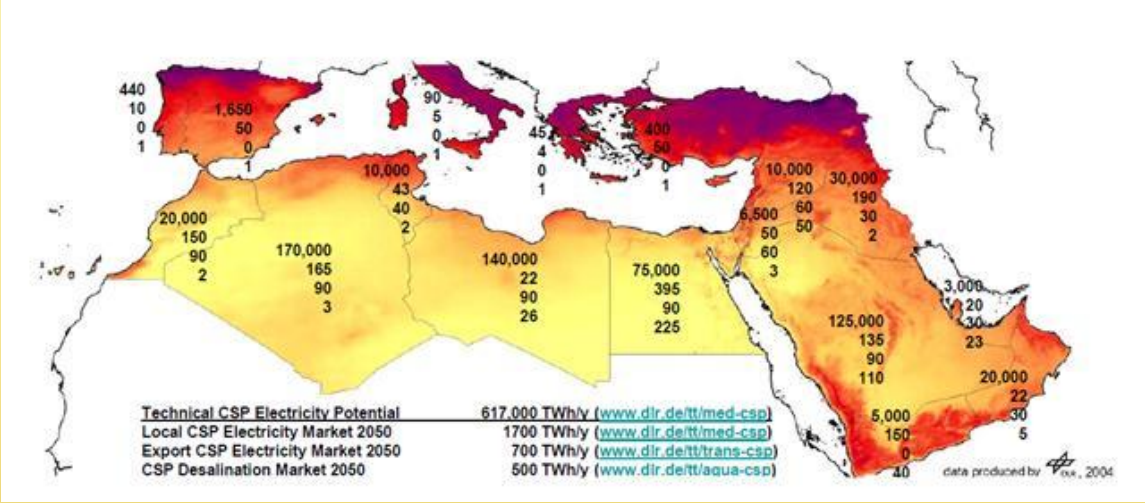
Considered energy pool for electricity production

34,2% carbon
26,3% gas
36,9% nuclear + hydro + renewables
2,6% oil

- CO_2 emissions will be 0.49 kg/kWh, so that annual emissions from desalinization will reach around 76.01 million tons.
- The World total CO_2 emissions will be of around 38 billion tons in 2030.
- The desalination will be responsible for **0.20% of total annual emissions of CO_2.**

The desalination sector should act as sustainability actor

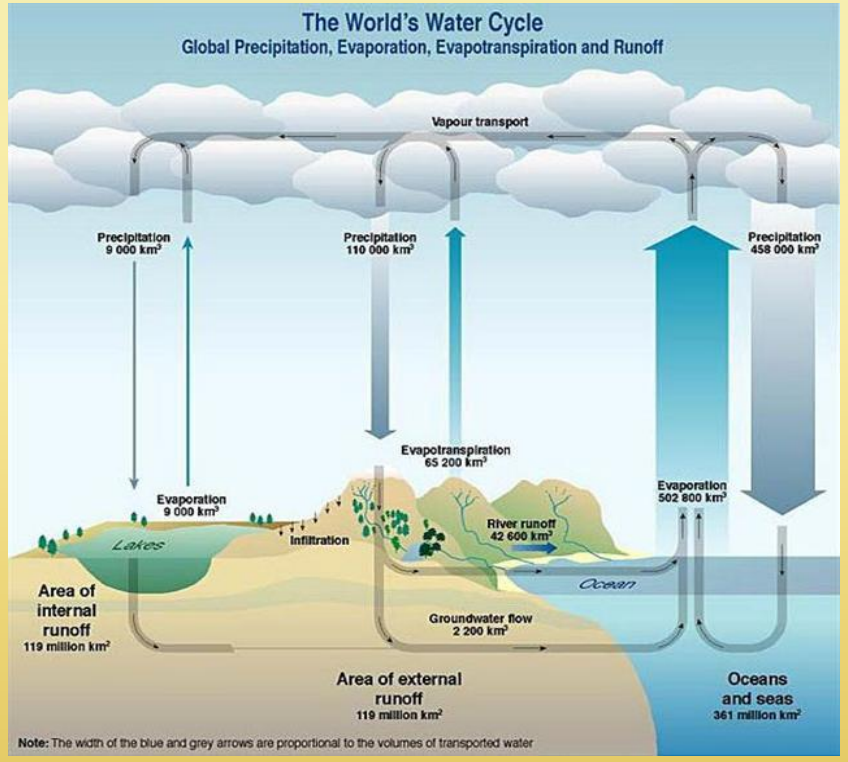
Energy potential in the Mediterranean basin



The renewable energy potential of the Mediterranean basin countries to generate electricity is enormous.

The Mediterranean basin should be leading the development of the **sustainable desalination**.

World's hydrological cycle



"Sustainable desalination": The sun, instead of evaporating sea water and causing the clouds and the subsequent rain, would produce unlimited wind, biomass or heat to produce electricity to be used in sea water desalination industry

IDA Ref MOR 12-015

KWh cost of renewable energy

Payback period	20 years		25 years	
Interest rate	5%	5%	5%	5%
Energy cost (c€/kWh)	6,0	7,2	6,0	7,2
Investment (€/kW)	Necessary operating hours			
800	1.830	1.400	1.740	1.340
1.000	2.280	1.755	2.170	1.680
1.200	2.740	2.110	2.610	2.005
1.400	3.190	2.455	3.050	2.340
1.600	3.650	2.810	3.470	2.670
1.800	4.110	3.160	3.910	3.010

Source: ACCIONA ENERGY – Personal communication.

Necessary operating hours of the sustainable resource to achieve a price of 6 or 7.2¢€/kWh (equivalent to 8.1 or 9.72 ¢U.S.$).

KWh cost of renewable energy

Year 2.012

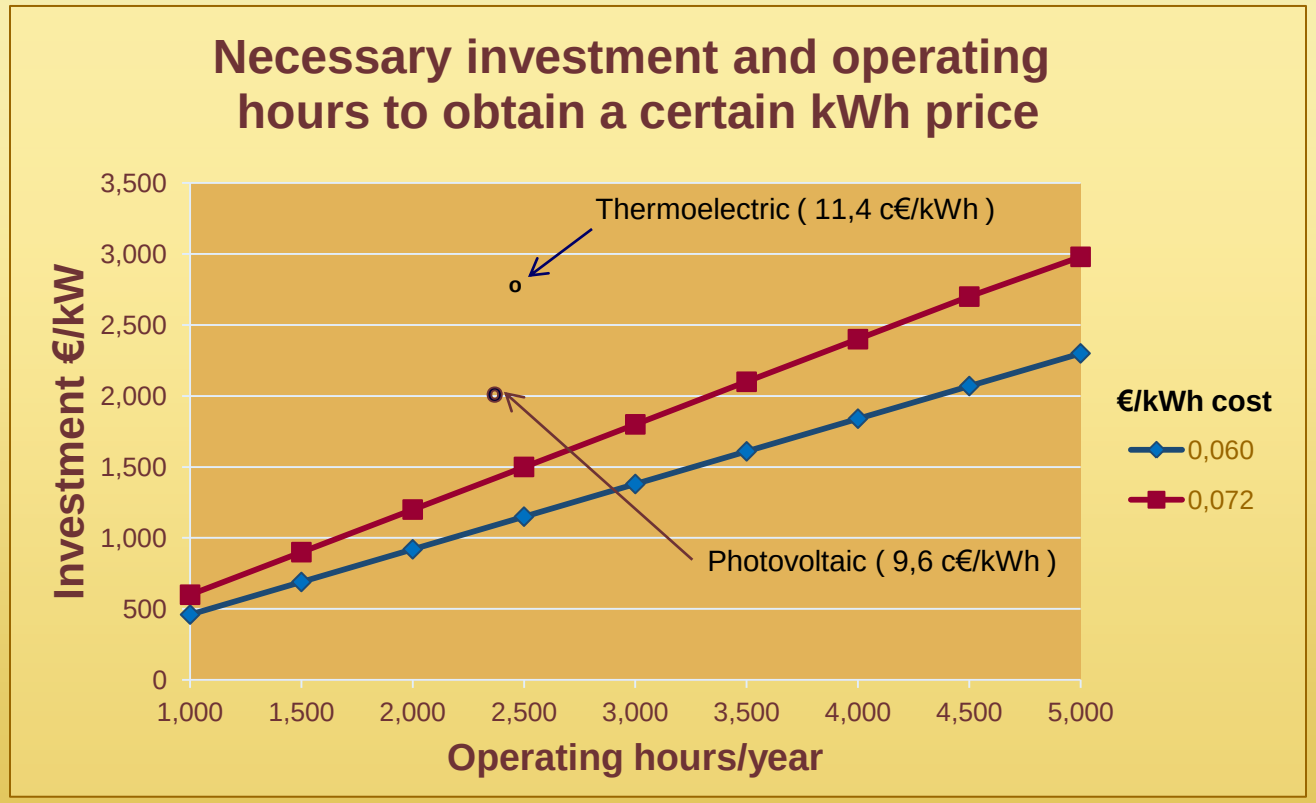
Parameter	Wind	Photovoltaic	Thermal
Investment (€/kW)	1.200	2.000	2.700
Operating hours	2.000	2.300	2.500
Pay off period (years)	25	25	25
Pay off (€/kW)	0,025	0,035	0,043
O&M (€/kW)	0,020	0,020	0,020
Financing cost (€/kWh)	0,010	0,015	0,019
Profit, IRR 0 8,8 % (€/kWh)	0,017	0,026	0,032
Total Cost (€/kWh)	0,072	0,096	0,114

Source: ACCIONA ENERGY – Personal communication.

Wind power is the technology that produces, at the moment, the cheapest kWh.

KWh cost of renewable energy

Year 2.012



Source: ACCIONA ENERGY – Personal communication.

KWh cost of renewable energy

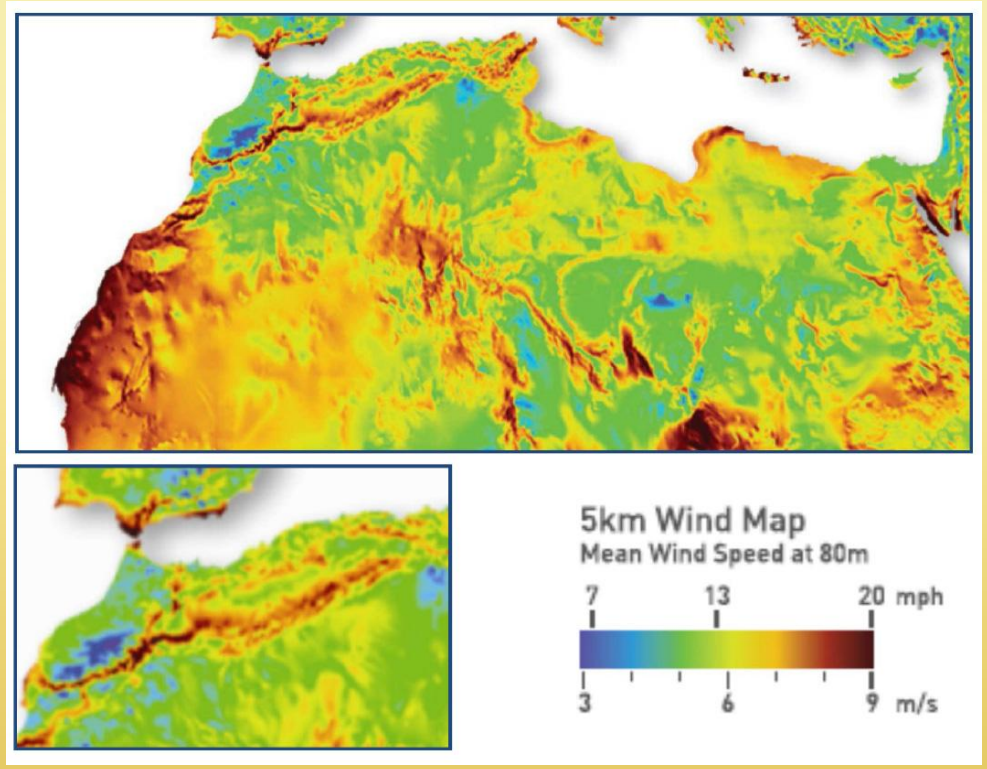
Year 2.012

Parameter	Wind		
Investment (€/kW)	920	1.200	1.200
Operating hours	2.000	2.000	2.610
Pay off period (years)	25	25	25
Pay off (€/kW)	0,018	0,025	0,018
O&M (€/kW)	0,020	0,020	0,020
Financing cost (€/kWh)	0,008	0,010	0,008
Profit, IRR 0 8,8 % (€/kWh)	0,014	0,017	0,014
Total Cost (€/kWh)	**0,060**	0,072	**0,060**

Source: ACCIONA ENERGY – Personal communication.

To produce electricity at **6 ¢€/kWh** (equivalent to 8.1 ¢U.S.$),we need a site with 2610 effective hours of wind or reduce the investment to **920 €/kW**

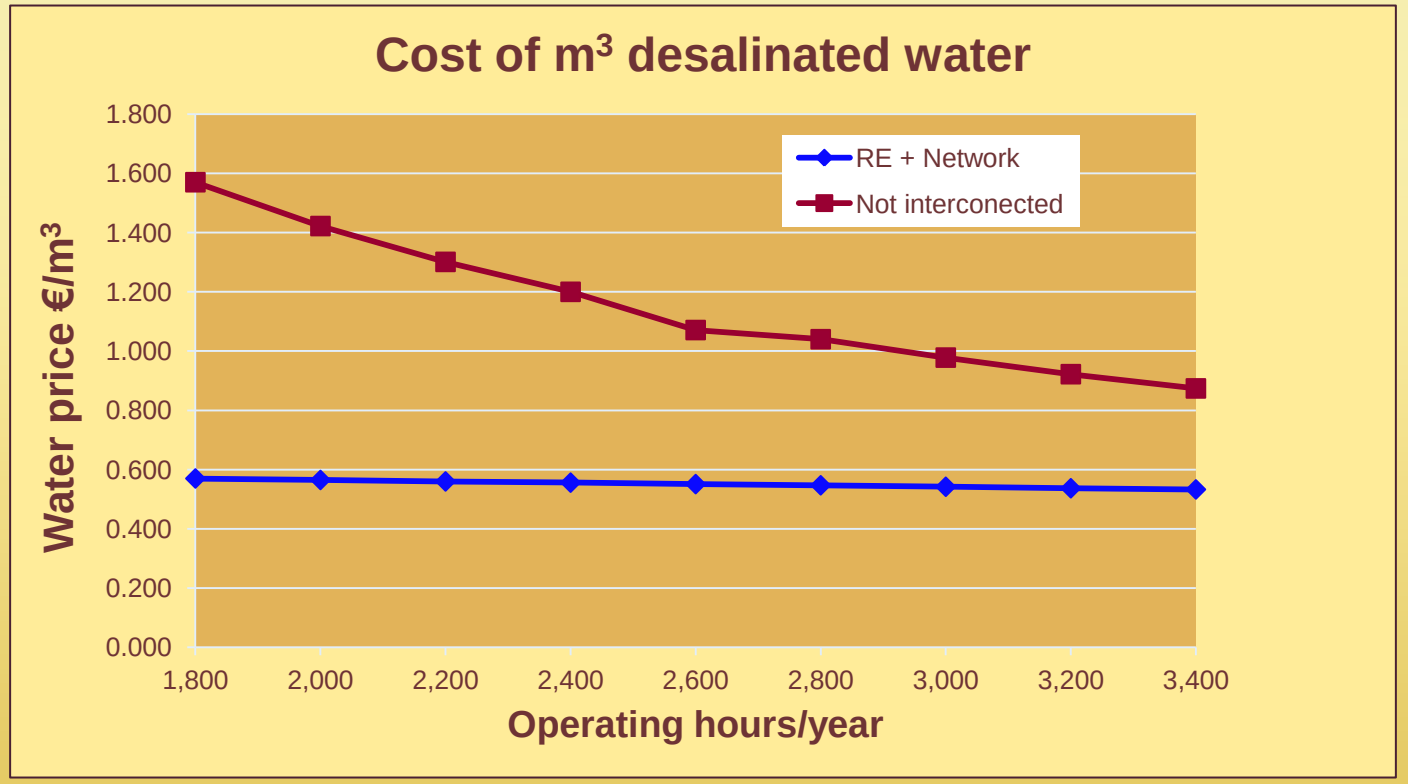
Availability of wind power



Source: 3Tier.

In the Atlas area mountains, Northeast of the Libya coast and North of Tunisia, winds present speeds greater than 5 m/s. Strong winds (> 9 m/s) are on the Northwest Coast of Africa

Renewable energy as supply for desalinization

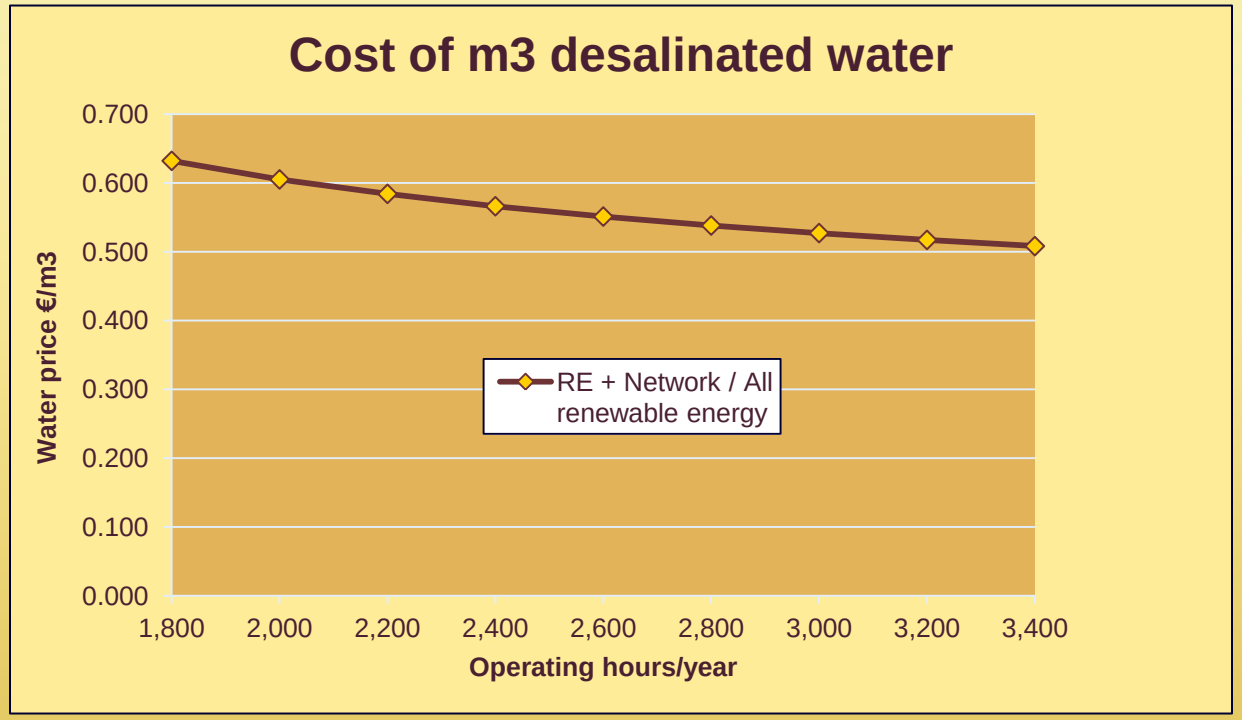


Source: ACCIONA ENERGY – Personal communication.

If the desalination plants operate only connected to a wind farm and disconnected from the overall network power distribution, the cost of desalinated water would be a **164 - 275% higher** than the market price, due to the amortization of the RO.

Renewable energy as supply for desalinization

It has no sense that the desalination plants and wind farms are disconnected from the general network

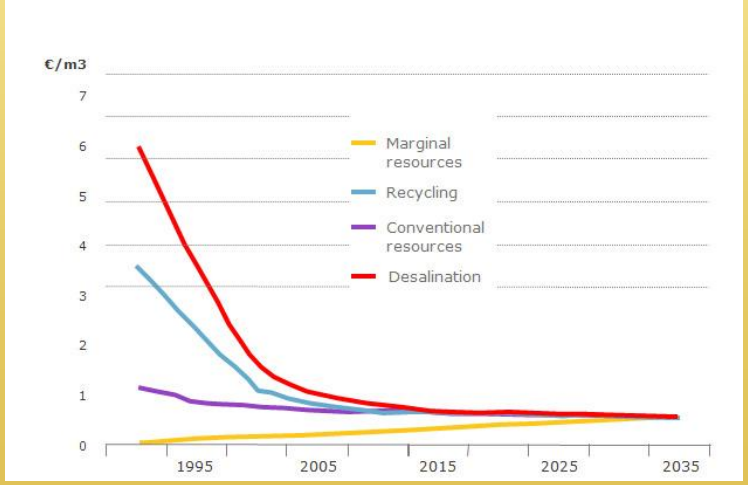


Source: ACCIONA ENERGY – Personal communication.

The general network would act like "an energy battery" that would return the received energy when there was no air.
With this form, all the energy consumed by the desalination would have been provided by the wind park, along a cycle.

conclusions

- The cost of desalination in the Mediterranean, is similar to other regions.
- The renewable energy potential of the Mediterranean basin is enormous, and could be a permit to face energy price increase.
- In order to make wind-powered desalination running, it is necessary to reduce the wind farm investments and increase the wind power operating time looking for more favorable sites.
- It has no sense that the desalination plants and wind farms are disconnected from the general network. The general network would act like "an energy battery" that would return the received energy when there was no air.
- The technological developments in several sectors of water are resulting in a price convergence to a single value, regardless of the water source.



¡Merci beaucoup pour votre attention!

Pionniers du Développement et de la Soutenabilité