Selection of Desalination Technologies

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Selection of Technologies

There in no "best" process of desalination.

The selection of a process is site specific and depends on several parameters, such as:

- Feed water quality

- Required quality of the produced water

- Plant's size and Location

- Land availability and Cost

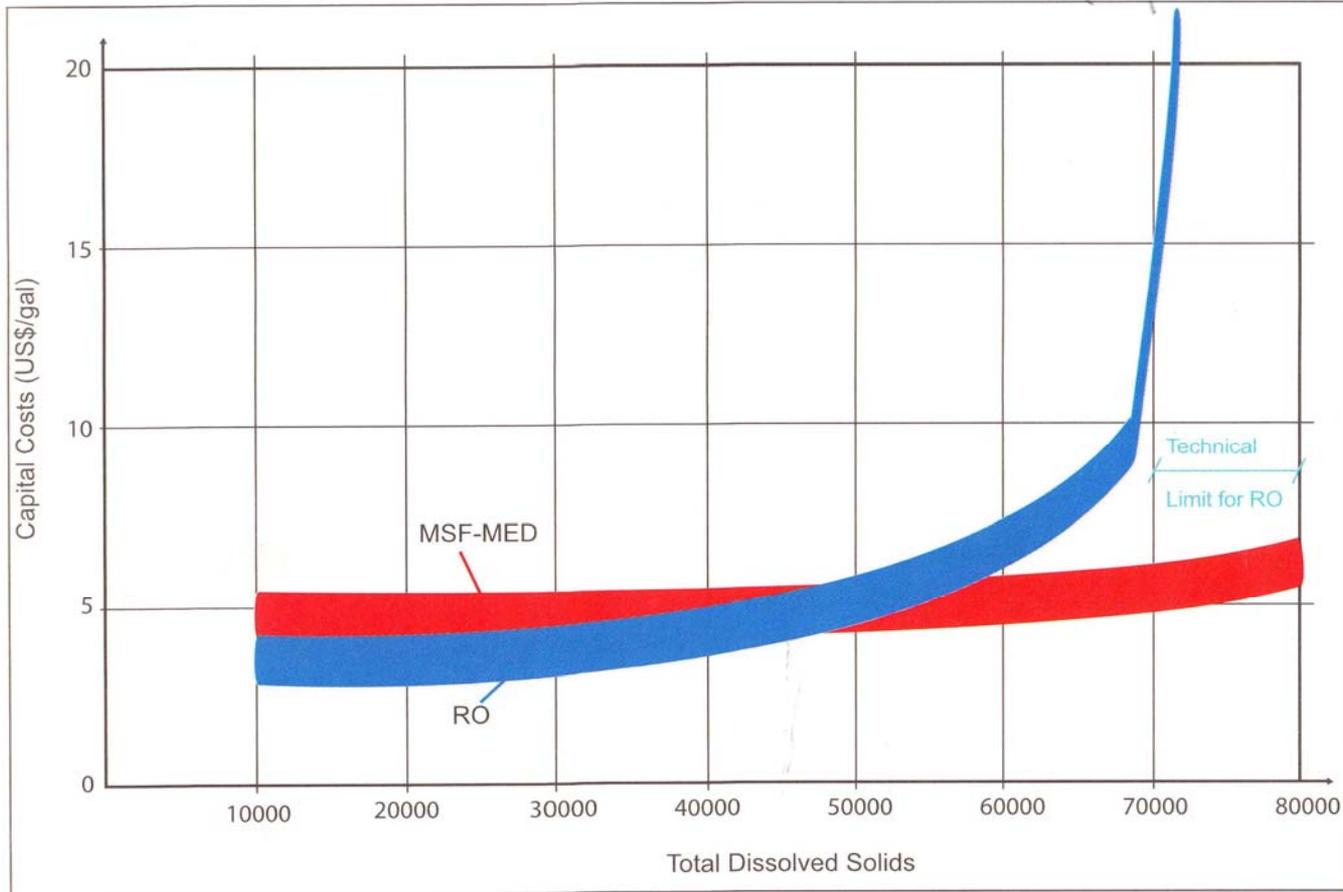- Energy availability

- Availability of technical staff

Unit site areas, for plants of 19,000 m^3/d and larger

Process	Access and process building, m^2 (ft^2)	Auxiliary equipment[1], m^2 (ft^2)	Total area, m^2 (ft^2)
Reverse osmosis			
Seawater	1,800 (19,375)	7,800 (83,959)	9,600 (103,334)
Brackish water	1,200 (12,917)	6,800 (73,195)	8,000 (86,111)
Electrodialysis			
ED	1,500 (16,146)	6,800 (73,195)	8,300 (89,340)
Distillation			
MSF	4,800 (51,667)	7,800 (83,959)	12,600 (135,625)
MED	6,000 (64,583)	7,800 (83,959)	13,800 (148,542)

[1] Assumes area for product water storage at 1-day production capacity, distribution system pumping, and electrical substation.
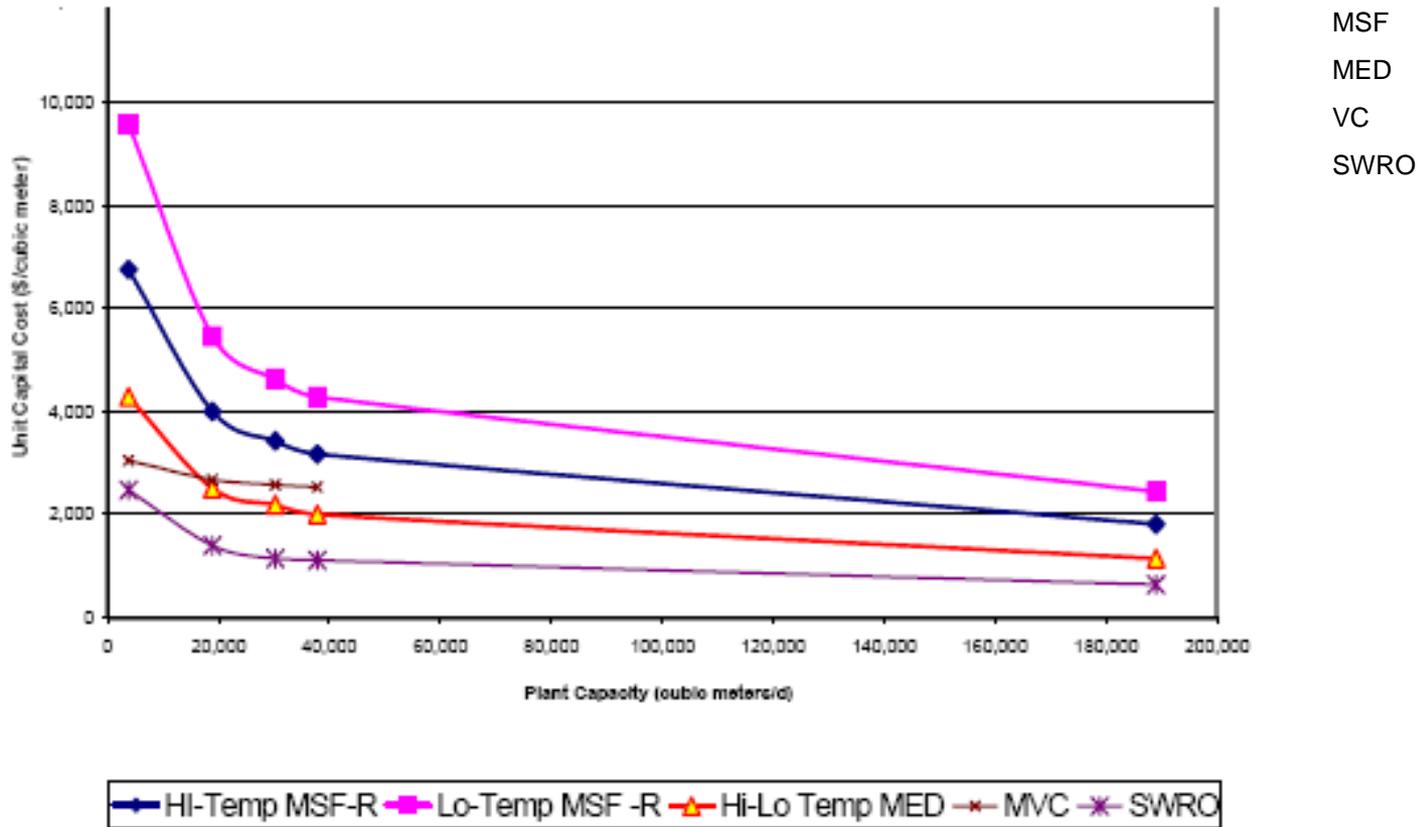
Source: Bureau of Reclamation, 2003
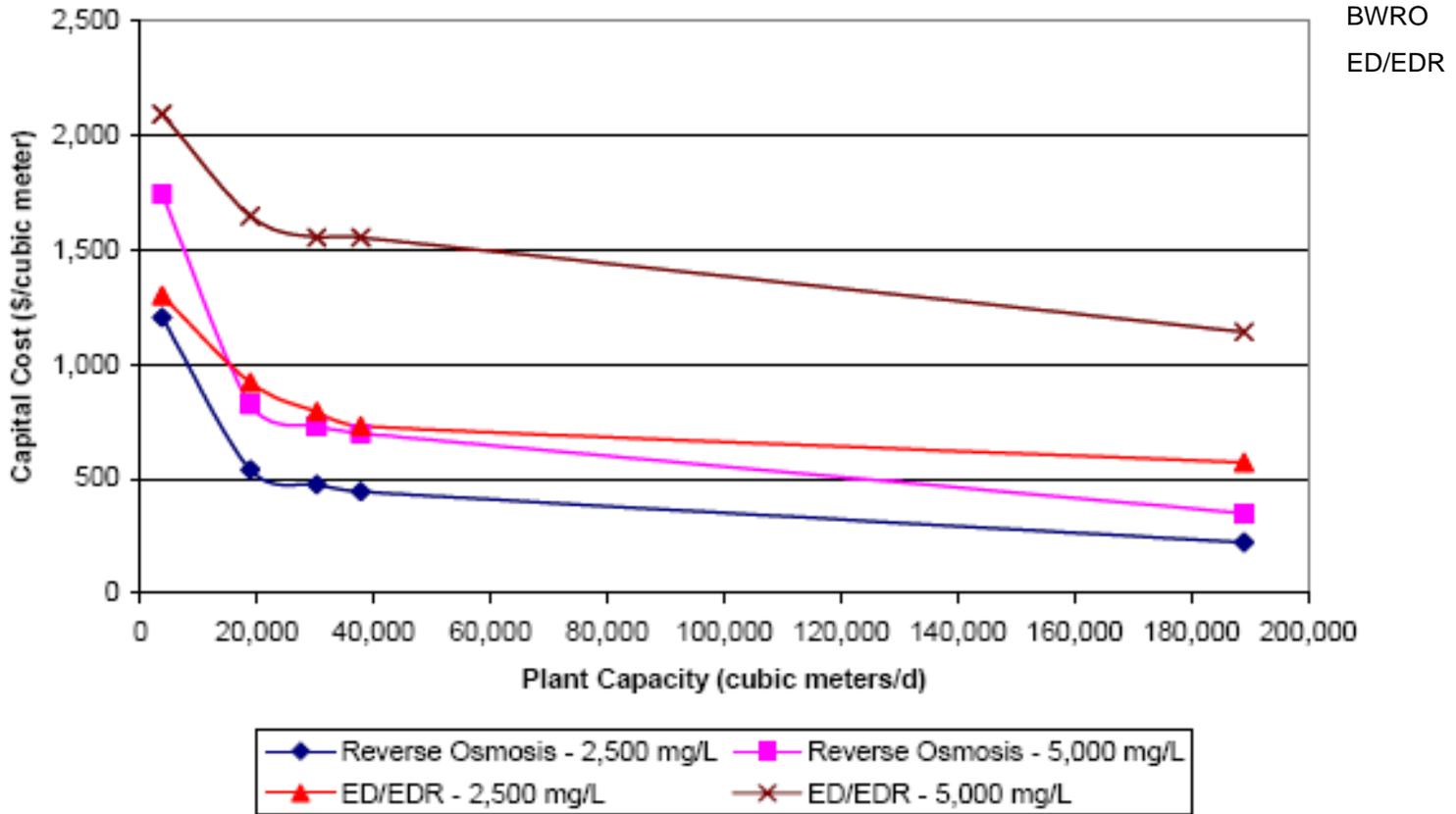
Source: Sommariva C., 2004

Promotion of
Renewable Energy
for Water production
through Desalination

sun
sea
water

PRODES

Relative Seawater Desalting Capital Costs (Metric)

MSF

MED

VC

SWRO

Source: Bureau of Reclamation, 2003

Relative Brackish Water Desalting Capital Costs (Metric)

BWRO

ED/EDR

Legend:
- Reverse Osmosis - 2,500 mg/L
- Reverse Osmosis - 5,000 mg/L
- ED/EDR - 2,500 mg/L
- ED/EDR - 5,000 mg/L

X-axis: Plant Capacity (cubic meters/d)
Y-axis: Capital Cost ($/cubic meter)

Source: Bureau of Reclamation, 2003

Key Data of the Processes

	MSF	MED	MED-TVC	MVC	RO	ED
Operating temperature (°C)	<120	<70	<70	<70 /1/	<45	<45
Form of main energy	Steam (heat)	Steam (heat)	Steam (heat)	Mechanical (electrical) energy	Mechanical (electrical) energy	Electrical energy
Thermal energy consumption (kWh/m^3) /4/	12	6 /5/	21 /5/	Not applicable	Not applicable	Not applicable
Electrical energy consumption (kWh/m^3)	3.5	1.5	1.5	8 – 14	4 – 7 /2/	1.0 /3/
Typical salt content of raw water (ppm TDS)	30,000 – 100,000	30,000 – 100,000	30,000 – 100,000	30,000 – 50,000	1,000 – 45,000	100 – 3,000
Product water quality (ppm TDS)	<10	<10	<10	<10	<500	<500
Current, typical Single-train capacity (m^3/d)	5,000 – 70,000	500 – 12,000	100 – 25,000	10 – 2,500	1 – 10,000	1 – 12,000

/1/ In exceptional cases with acid dosing: 100 °C
/2/ Seawater as raw water, otherwise lower consumption
/3/ Depending on salt content in raw water: at 1,500 ppm TDS (add 0.5 kWh for every 1,000 ppm of removed ions)
/4/ Expressed as the electrical energy that steam in a turbine-generator set cannot produce because of extraction from the process (performance ratio = 8 kg produced water per kg saturated steam in brine heater, resp. inlet steam ejector; steam pressure at inlet brine heater of MSF = 1.7 bara, at inlet first stage of MED = 0.4 bara, at inlet steam ejector of MED-TVC = 10 bara; pressure in "virtual" turbine condenser = 0.1 bara)
/5/ At equal performance ratio and selected heating steam pressures, investment costs for MED plants are considerably higher than for MSF plants and investment costs for MED-TVC plants are lower than for MSF plants

Source: Wangnick K. IDA Inventory, 2004

Classification based on Energy needs

Desalination Processes

- **Mechanical Energy**
  - MVC
  - Reverse Osmosis
- **Thermal Energy**
  - *Heat removal*
    - Freezing
  - *Heat addition*
    - **Solar Energy**
      - Solar stills
      - Solar collectors
    - MED
    - MSF
    - Humid/Dehum.
    - **Steam**
      - TVC
- **Electrical Energy**
  - Electro Dialysis