

The Rapid Growth in Desalination - How is the Industry Responding?

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by

Lisa Henthorne, P.E.

VP, International Desalination Association

*VP, Global Director of Desalination Technology,
CH2M HILL*

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Presentation Outline

- Introduction to the Desalination Market
- Environmental Considerations in Desalination
- How is the Industry Responding



Introduction to the Desalination Market

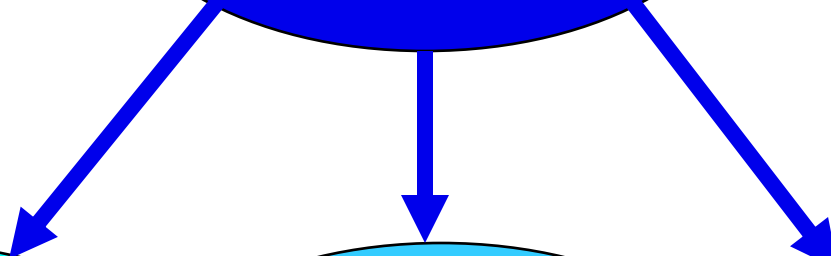


Desalination Offers...

- 💧 Drought-proof reliability
- 💧 Timing and availability
- 💧 *Potential* unlimited production
- 💧 Easy expandability



Desalination
Removes Salinity



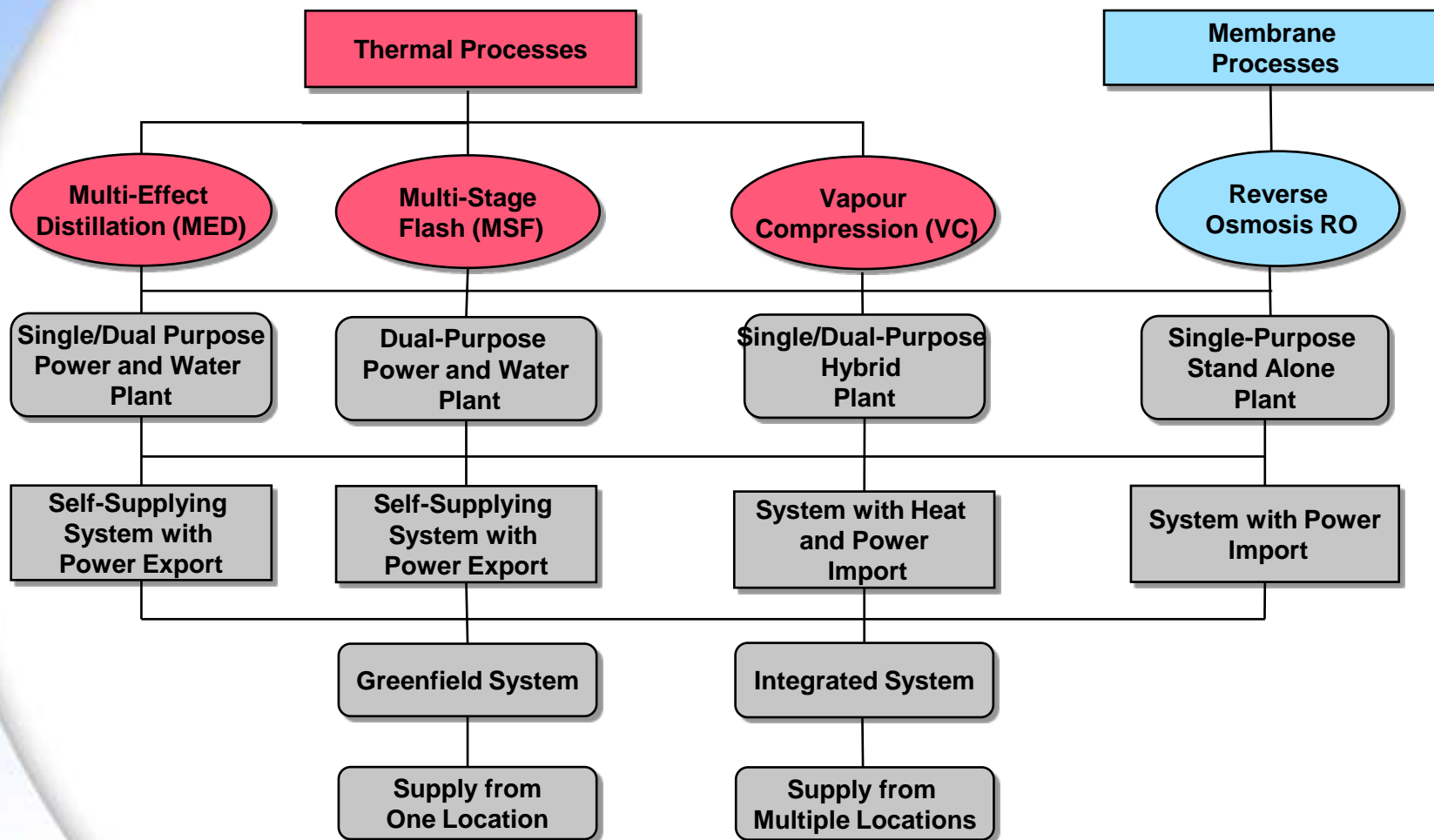
Seawater
High Salinity
10,000-50,000 mg/L

Brackish
Moderate Salinity
1,000-10,000 mg/L

Reuse
Low Salinity
> 1,000 mg/L

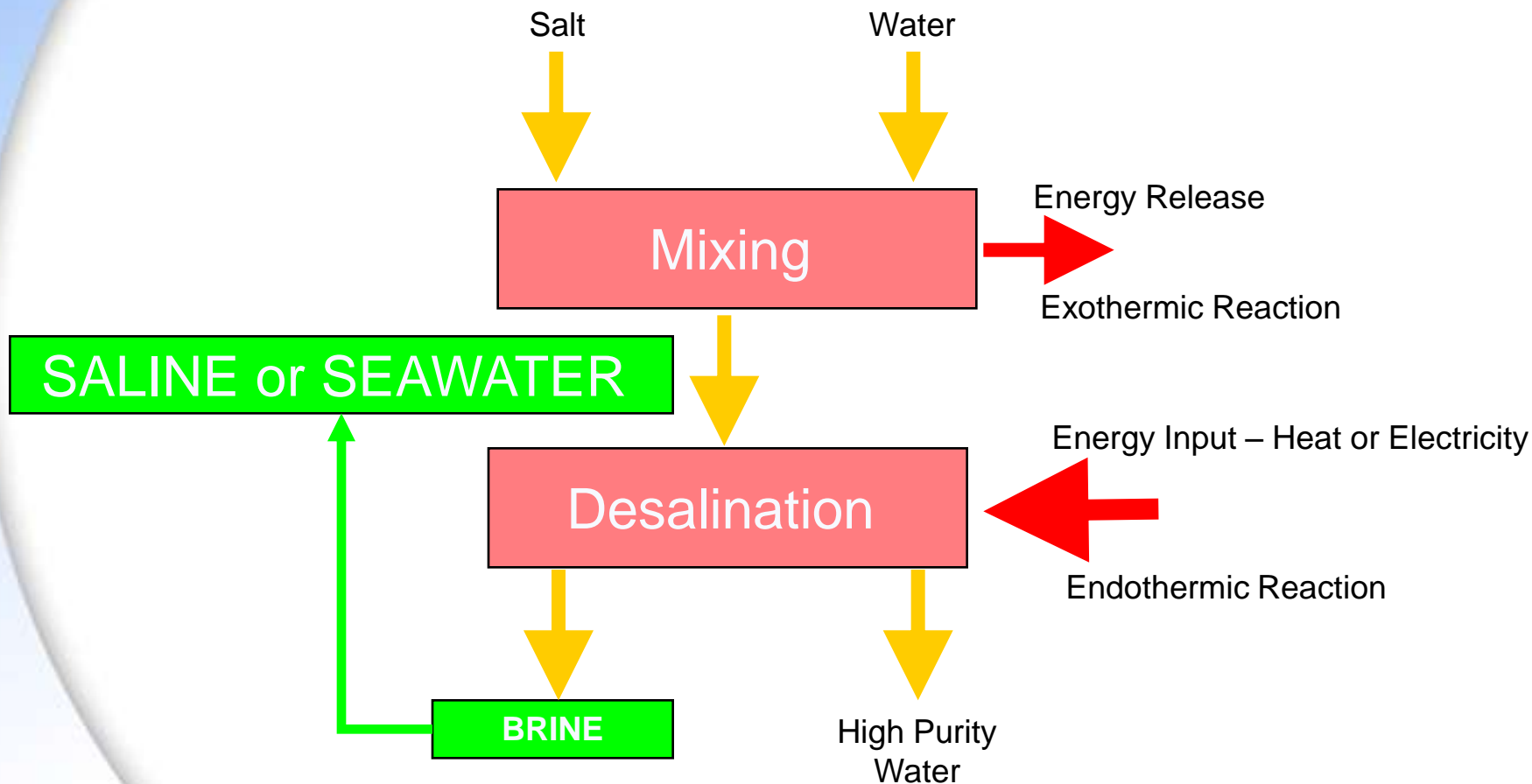


Desalination Process Options





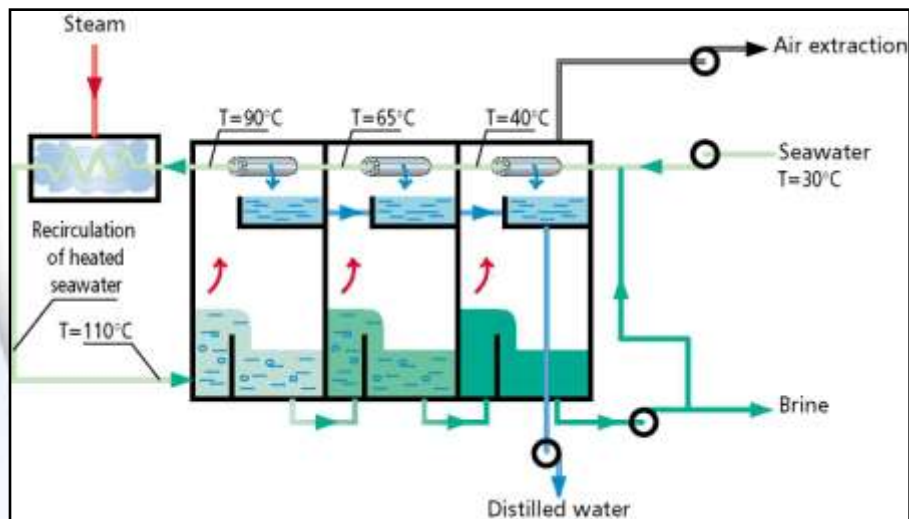
What is Desalination?





Desalination Process - Thermal

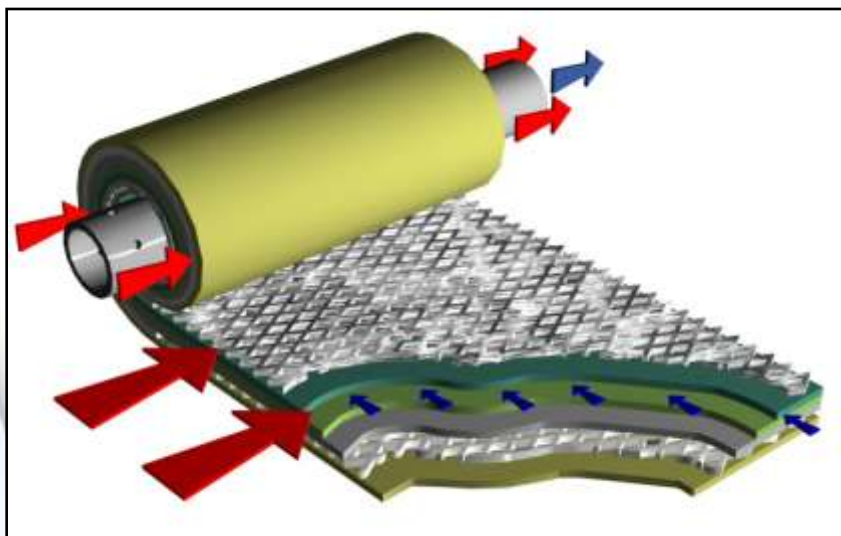
- Uses distillation techniques to vaporize pure water from saline sources
- Sophisticated and robust designs since 1950's





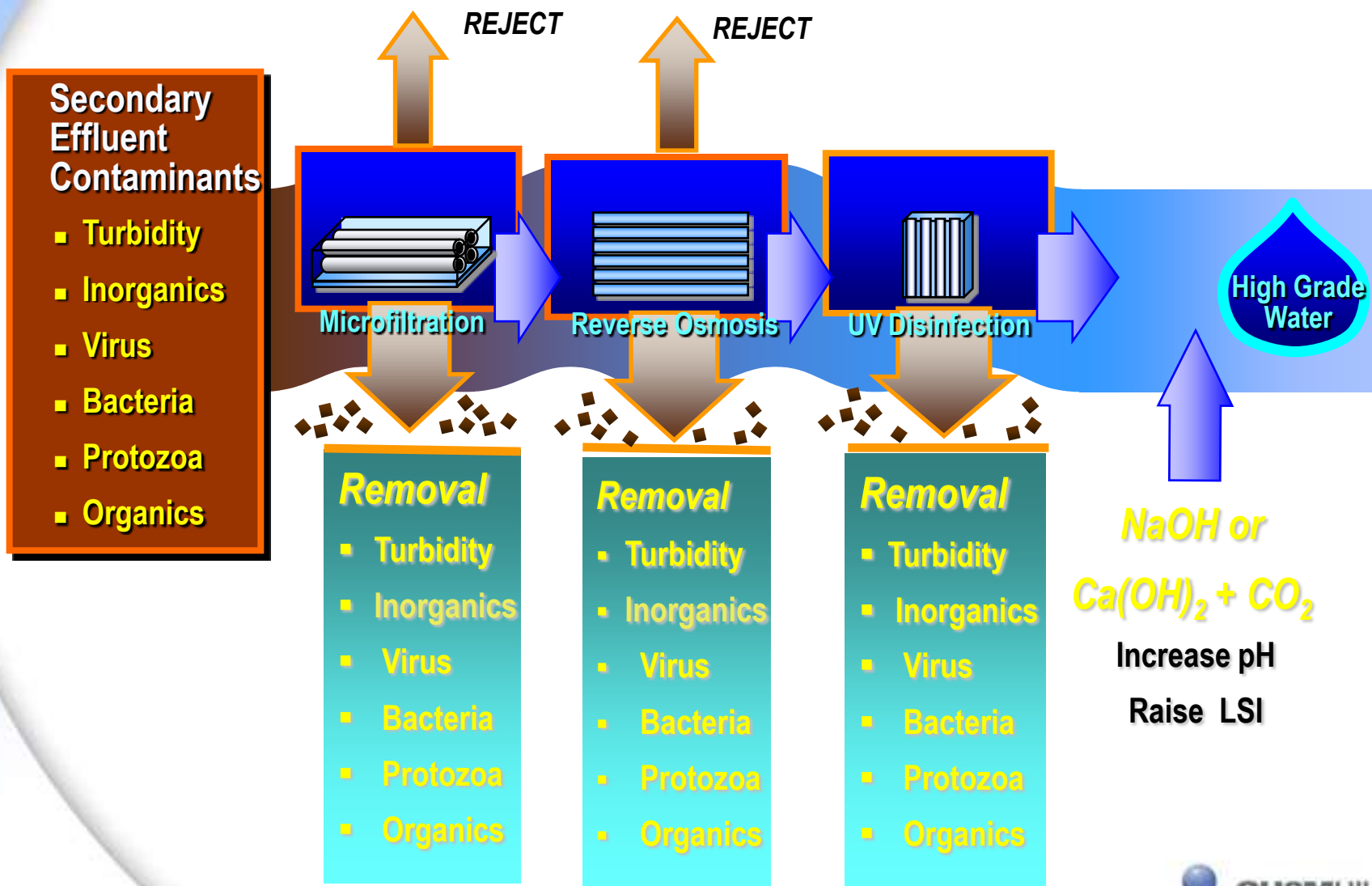
Desalination Process - Membrane

- Uses thin, semi-permeable membranes to separate saline water into low salinity product water and high salinity concentrate stream
- Commercial plants beginning in early 1970s (RO)





Desalination in Advanced Reuse

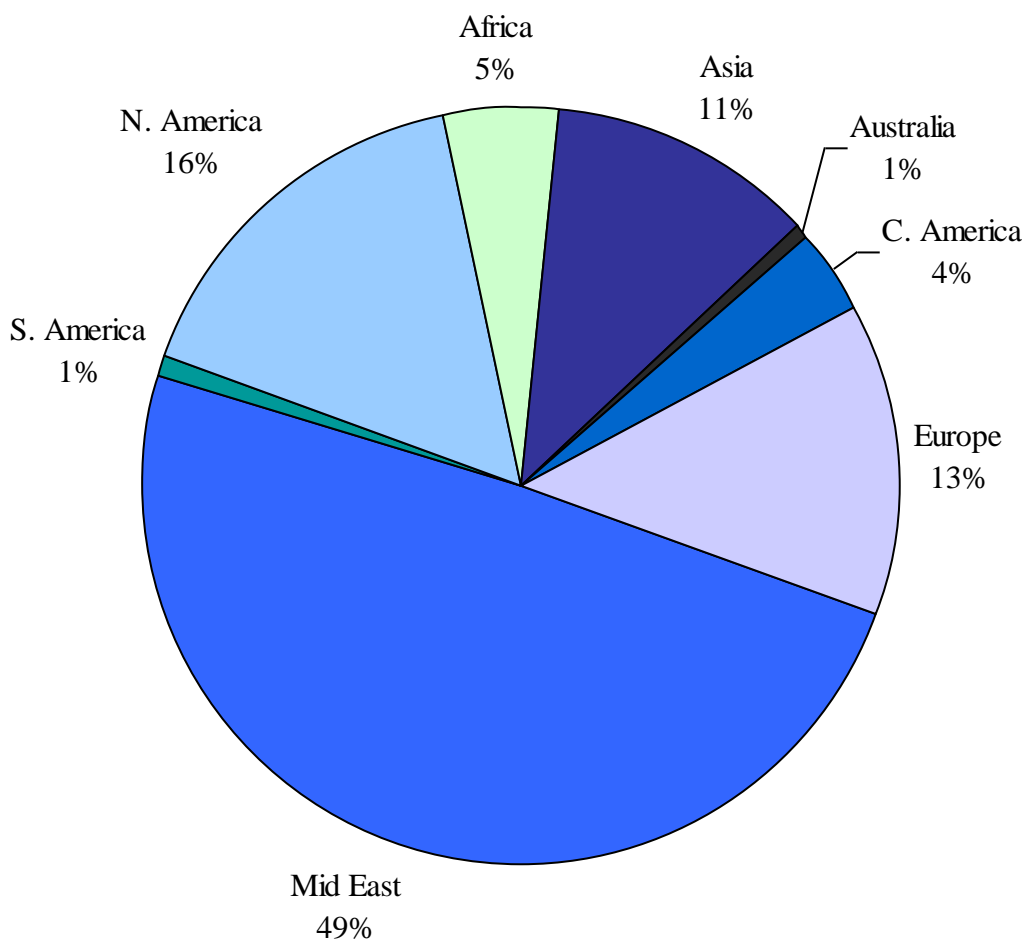




Desalination Market Drivers

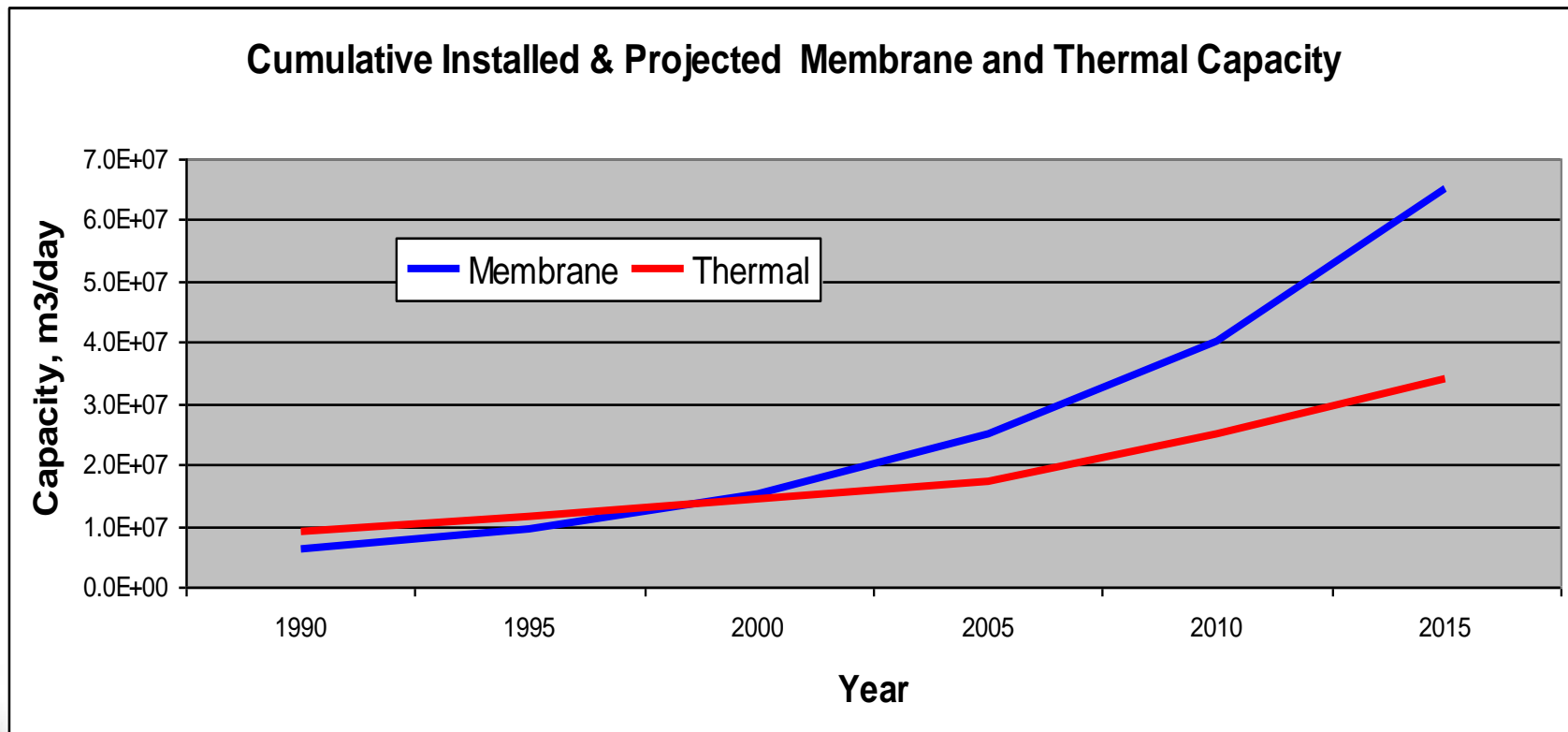
- Cost of traditional supply increasing and availability decreasing
 - ▶ Surface waters
 - ▶ Groundwater
- Decreased cost of membrane desalination
- Diversification of supply - Drought
- Demographics – People want to live coastally where water availability is limited

Regional Distribution of Desalination Technology





Where Are We Going?



GW, 2007 Desalination Market Report



Environmental Considerations in Desalination



Sources

- Brine and waste stream disposal
- CO₂ and air emissions for power/heat requirements
- Impingement and entrainment of marine life
- Power/water imbalance in the GCC
- Disposal of consumables



Brine Stream

- Technology Choice Dictates Brine Characteristics
 - ▶ Level of salinity a function of water recovery
 - ▶ Concentration Factor = $1/(1-R)$
 - ▶ Generally reflects characteristics of feedwater in a more concentrated form
- Seawater Desalination
 - ▶ Disposal to the sea via outfall (submerged or open)
- Brackish/Reuse
 - ▶ Disposal to sewer, surface water or injection



Brine Stream Characteristics

	Brackish/ Reuse RO	Seawater RO	MSF	MED
Feedwater	Brackish/ Wastewater	Seawater	Seawater	Seawater
Recovery	50-80%	35-60%	10-20%	20-35%
Brine Temperature	Ambient	Ambient	5-15 °C above ambient	5-15 °C above ambient
Brine blending	Not typical	Being practiced on small scale	With cooling water discharge	With cooling water discharge
Concentration Factor	2.5 to 6.7	1.4 to 2.5	<1.15	<1.15



Other Waste Streams

- Function of Technology Choice

- ▶ Membrane Plant

- ▶ Ferric/polymer-containing backwash/sludge
- ▶ Neutralized RO cleaning chemicals (citric acid and caustic, mixed and diluted)
- ▶ Neutralized MF/UF cleaning chemicals potentially (acid and hypochlorite – must be neutralized)

- ▶ Thermal Plant

- ▶ Gases such as CO₂
- ▶ Cleaning chemicals from infrequent maintenance



CO₂ and air emissions

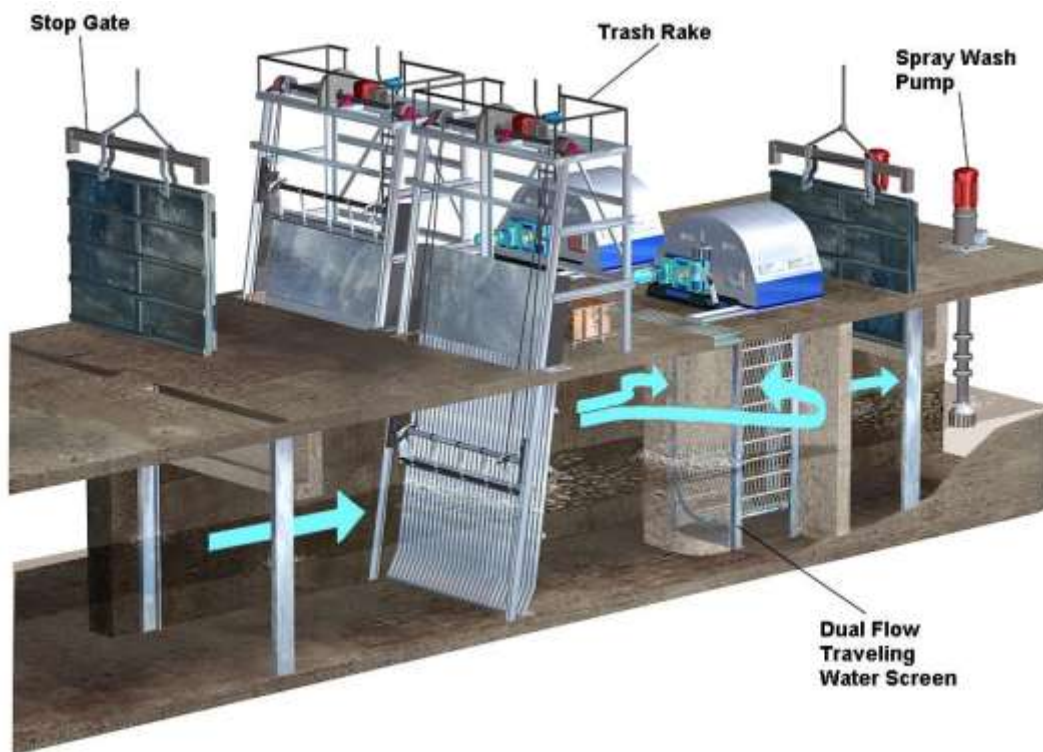
- Sources of traditional power/heat generate CO₂ and other emissions as function of fossil fuel

Process	Steam (m ³ distillate to ton steam)	Electricity (kwhr/m ³)
BWRO/Reuse	NA	0.5-1.5
Seawater RO	NA	2.5-4.0
MSF	7-12 to 1	2.0-3.5
MED	8-12 to 1	1.5-2.5



Impingement and Entrainment

- Open intakes with conventional screening can have a negative effect on marine life

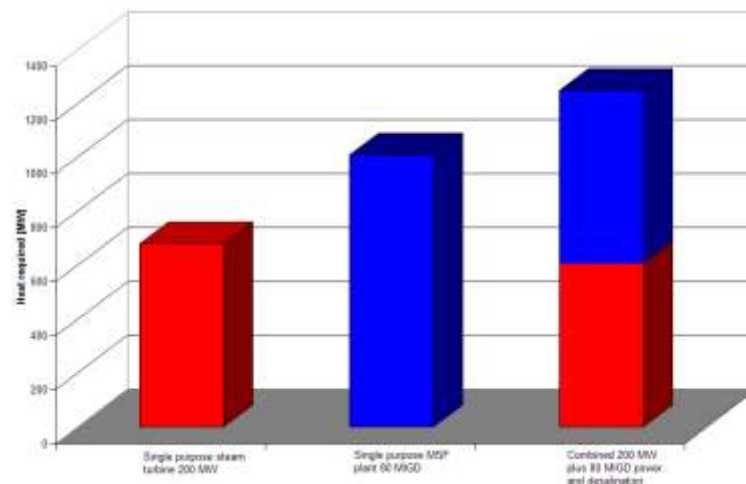
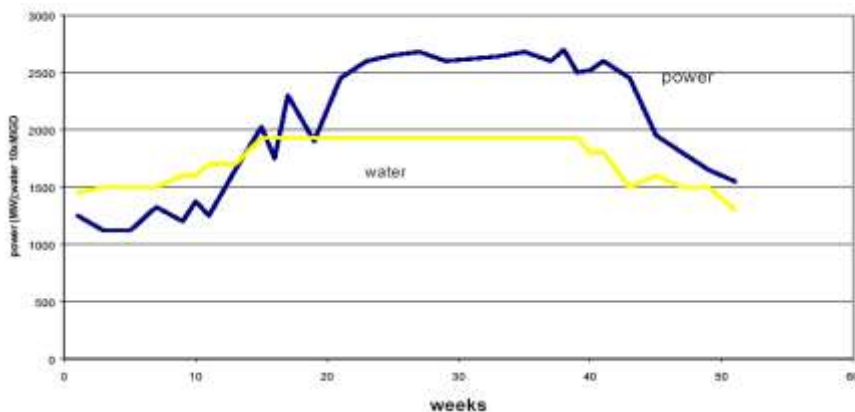




Power/Water Imbalance in the GCC

- Water demand fairly constant year-round while power demand drops to less than 50% in winter months

Figure 5: annual power and water requirements Abu Dhabi emirate





Disposal of consumables

- Membrane plants
 - ▶ Longevity of membrane elements, 4-10 years
 - ▶ Longevity of cartridge filters, 3-6 months

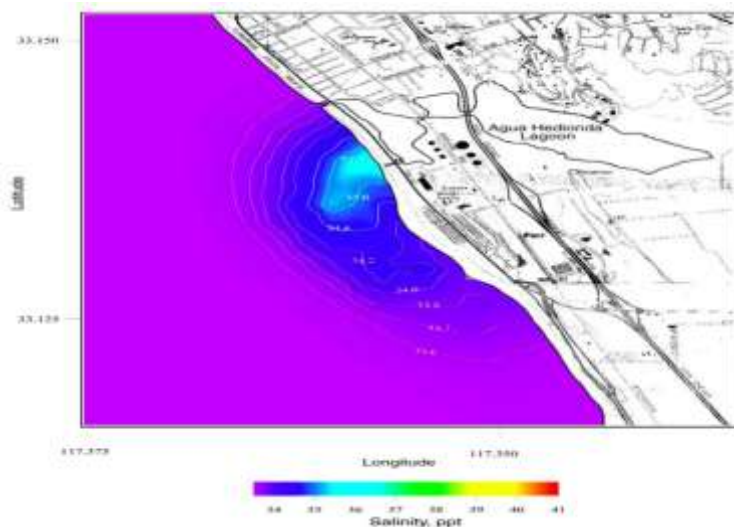


How is the Industry Responding



Brine Disposal

- Membrane Plants
 - ▶ Siting and brine disposal studies
 - ▶ Dispersion nozzles outfalls
 - ▶ Blending
- Thermal Plants
 - ▶ Ambient quenching and blending





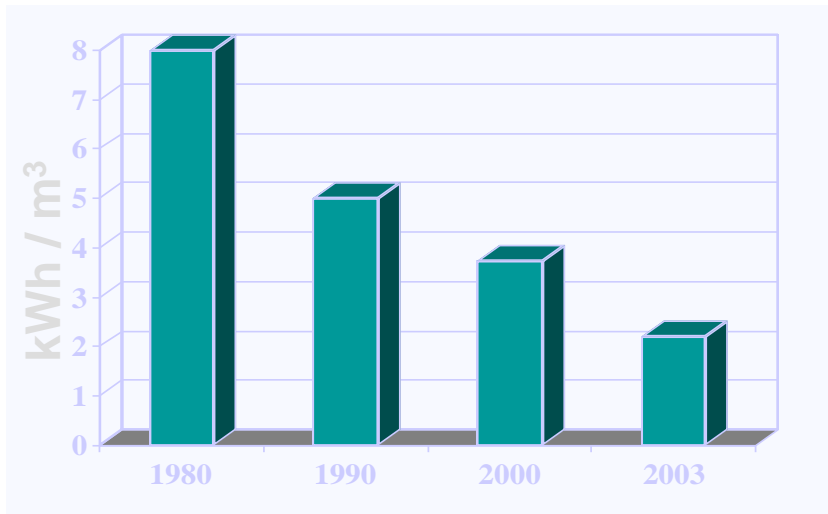
Other Waste Disposal

- Recovery of backwash and land disposal of solids
- Neutralization of acids/bases and permit limitations



CO2 and Other Emissions

- Thermal Plants
 - ▶ MED more energy efficient than MSF
- Membrane Plants
 - ▶ Significantly improved energy recovery
 - ▶ Renewable energy applications





Renewable Power/Desalination

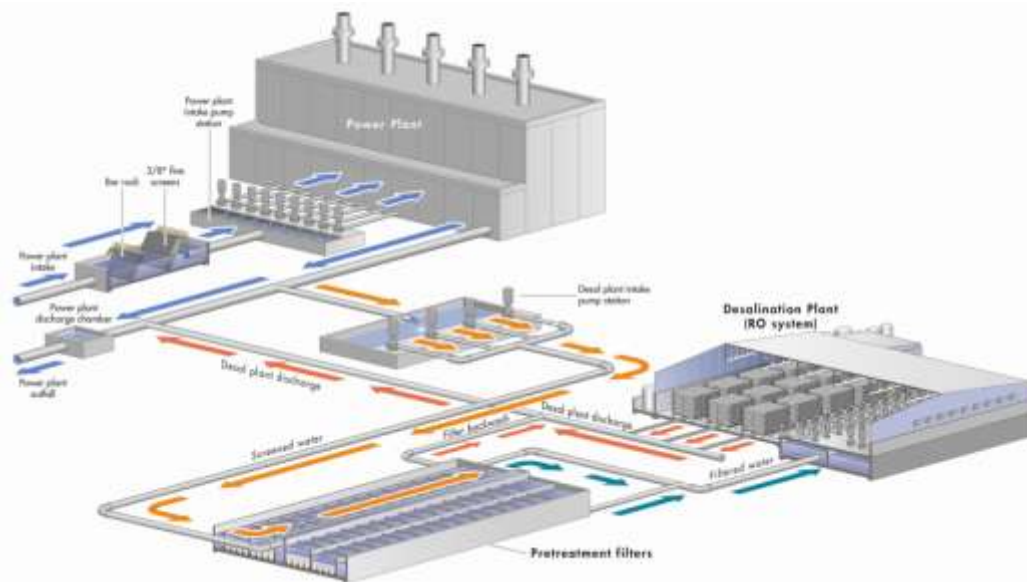
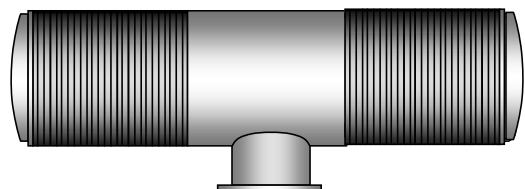
- Perth Australia 143,000 m³/day RO plant requires about 24 MW of power
- Power purchase agreement from Water Corporation to purchase wind power at slightly increased cost to power desal plant resulting in new wind farm





Impingement and Entrainment

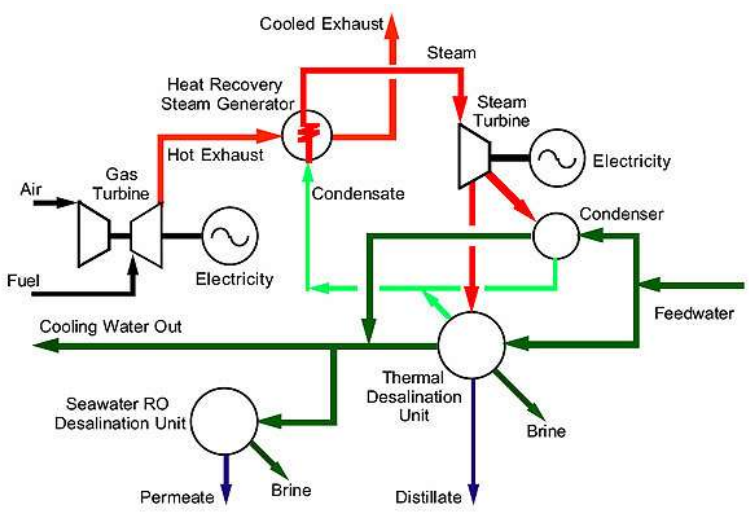
- Intake designs improved/innovative intakes
- Improved passive screening mechanisms
- Co-location





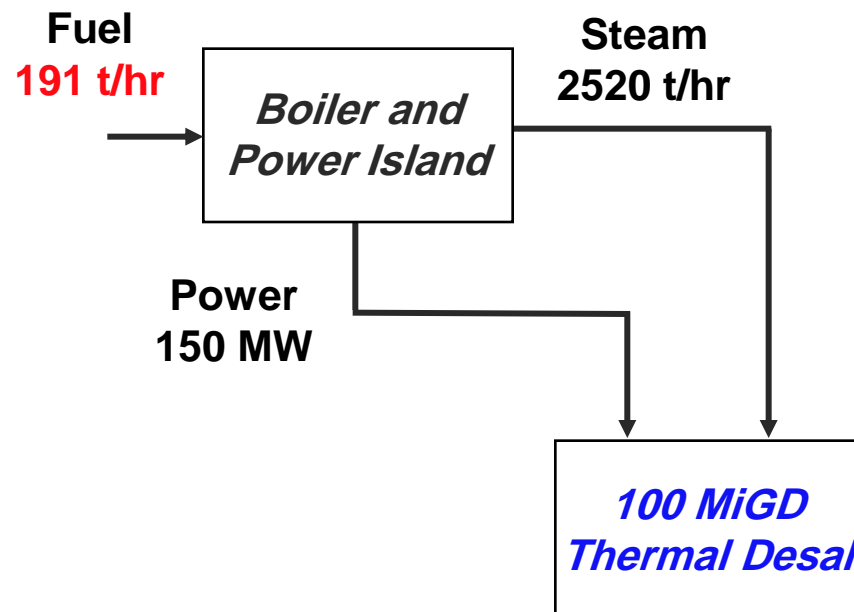
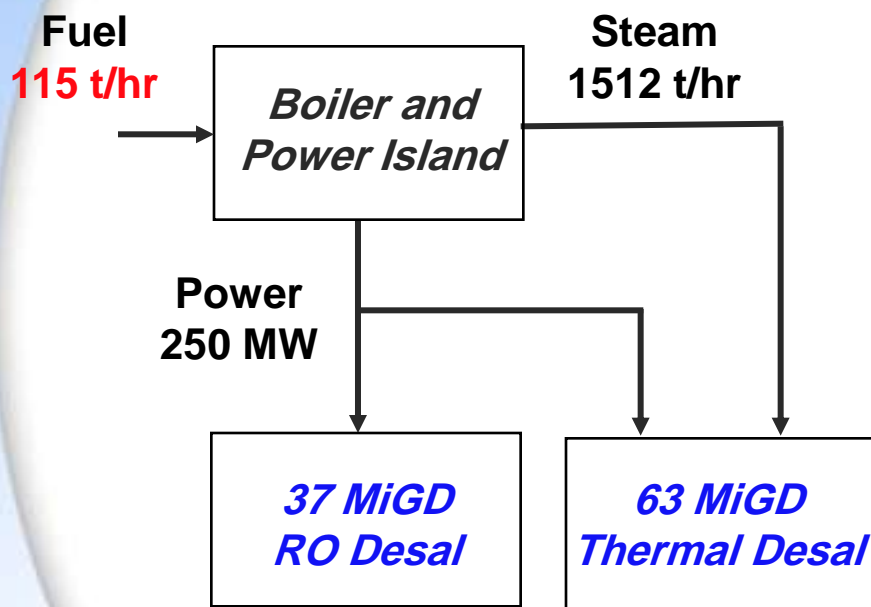
Power/Water Imbalance in GCC

- Move to hybrid thermal/membrane plants





Comparison of Hybrid vs Non-hybrid IWPP





Desalination and the Environment

- Consider advanced water reuse as viable industrial source of high quality water
- Valuing energy at/near market value will greatly improve energy efficiency and therefore protect the environment
- Public education regarding the value of water to encourage efficient use
- *Desalination industry is committed to protecting the environment through innovation and improvements in the technologies and applications*



- On behalf of IDA 'Thank you'.
- 2007 IDA World Congress in Canary Islands
 - ▶ Oct 21-26, 2007
 - ▶ *www.idadesal.org*