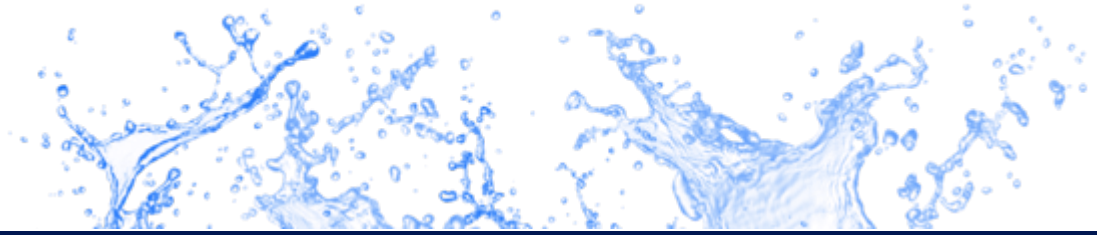


TEXAS DESAL 2018
Managing Cost, Risk & Regulation

Trends in Desalination

Miguel Angel SANZ
IDA President

Our Blue Planet …

… and the Water

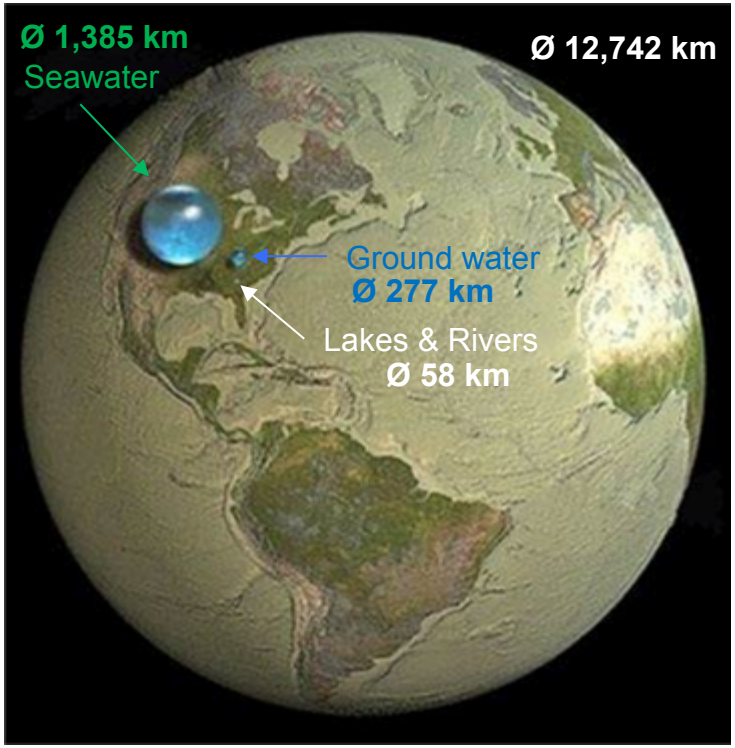
We have the responsibility to preserve these blue "satellites" of our Blue Planet

71% of Earth Surface is Water

97.4% Sea Water
2.6% Fresh Water

68.6% is Frozen
30.1% is Ground Water
(0.783 % Earth Water)
1.3% is Surface Water

21% Lakes & Rivers
(0.0071 % Earth Water)

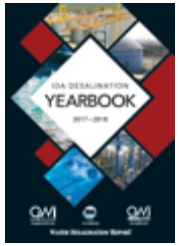


2018 Desalination in Figures

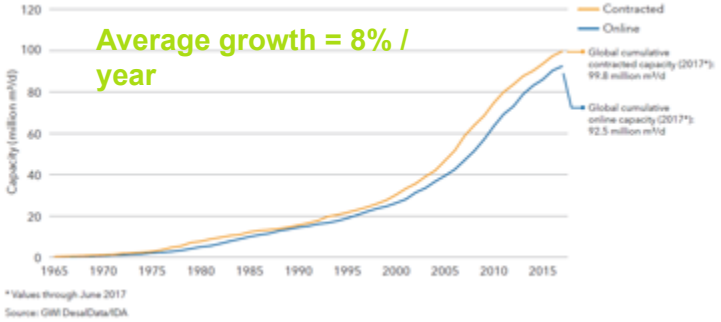
Around **20 000** Desalination Plants Worldwide(>100 m^3/day) in **150** Countries

100 000 000 cubic meters per day is the Desalination Capacity built until 2018.

Over **300** Millions people in the World can drink water supplied by Desalination plants.



Plants	Desalination Plants - 30th Inventory	Capacity - m3/day
19 744	Total Plants	99,728,694
3 793	Off Line	6,889,086
15 598	In Operation	83,786,165
353	Under Construction	9,053,443
15 951	Under Construction + Operation	92,839,608

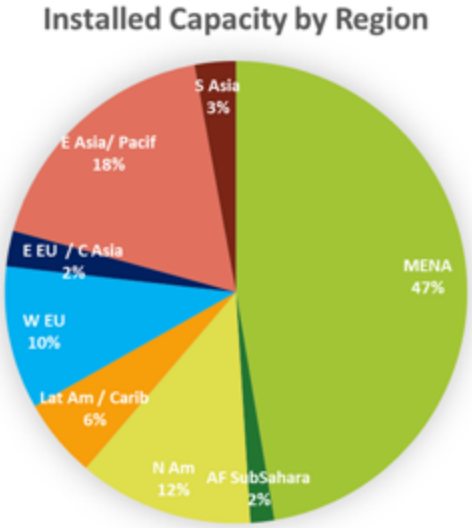


Future growth: **5-6%**

200 Mill. M^3/day in 2030/2032

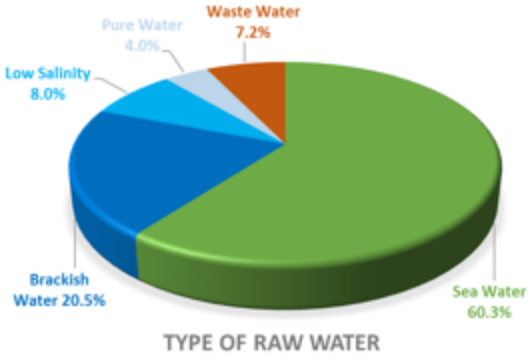
Growing Areas:

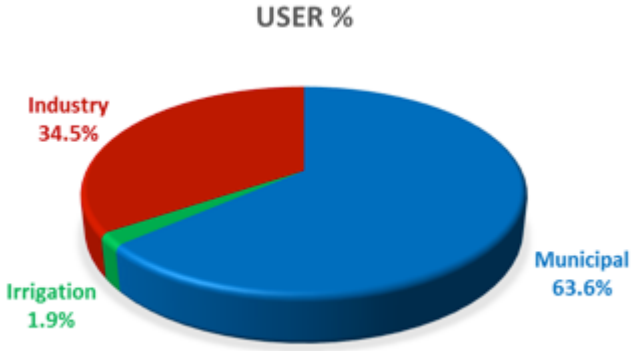
Middle East, Africa
USA, Latin America
India, China



Sea water is confirmed as main source

…. and the solution is RO





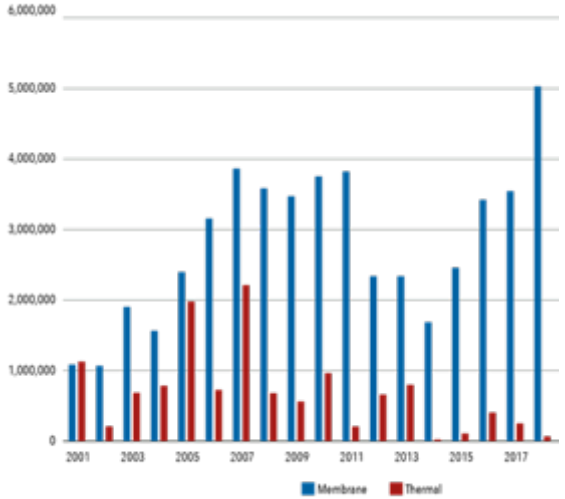
Sea water is growing faster than other sources. Going to **65%**

Both, Municipal and Industrial Markets, are growing at the same rate.

Industry mainly in:

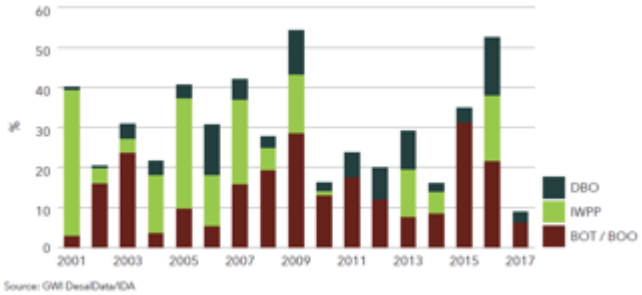
- **O&G**
- **Mining**
- **Power**

Higher size in Municipal
Average Municipal Plant:
8 600 m^3/day
Average Industrial Plant :
3 600 m3/day

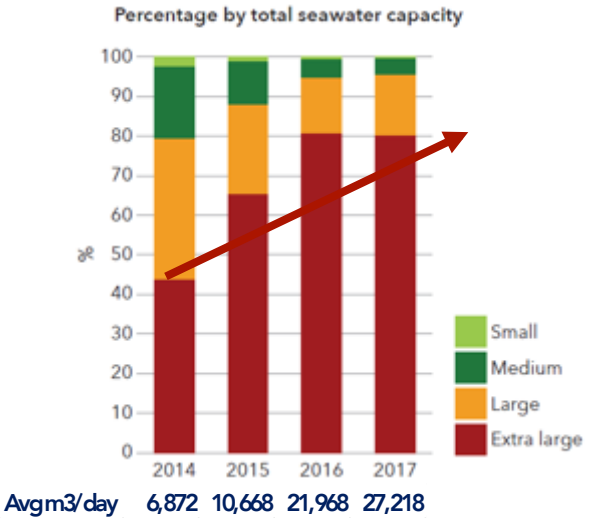


Membranes are actually prevailing in the Market: **> 95%**
Even in Middle East!
Desalination Plants are becoming not linked to a Power Plant Contract and **Evaporation become marginal**

Procurement Method: Large Plants Mainly in DBFO or DBO …. and Plant size is increasing



XL Plants in DBFO or DBO
O&M > 20 years
IWWP → IWP (mainly RO)
In 2018-2019 DBFO > 50% Market
DBFO not only in ME, also in Africa, USA, LatAm …



Annual Contracted Capacity with Private Sector Involvement, after year 2000

Total Plants	Procurement	m3/day	%	Average m3/day
296	BOT / IWP / DBO	23 003 309	24.5%	77 714
18 159	DB / EPC	70 837 124	75.5%	3 901

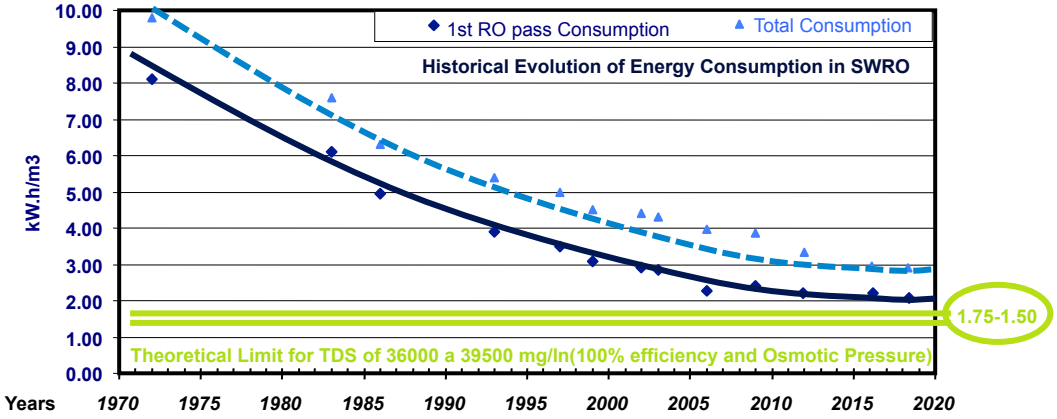
SW Plants	Procurement	m3/day	%	Average m3/day
220	BOT / IWP / DBO	20 391 982	35.7%	92 687
5 757	DB / EPC	36 668 377	64.3%	6 369

Going to MegaTon concept →

Taweelah, 910,000 m^3/day
Al Jubail, 1,200,000 m^3/day

Desalination Trends:

Energy and OPEX Optimization



OPEX: Energy still the key

Incremental and marginal phase

OPEX drives the Market: 2/3 OPEX , 1/3 CAPEX

- SWRO: potential reduction of 0.2-0.3 kW.h/ m3

- More performant/robust membranes, pumps and ERD
- Biofouling Control
- Minimize chemicals
- Ensure Plant Availability (spares, DAF, …)
- UF or DMF: case by case, CAPEX + OPEX
- Delivery time and planning
- Respect the Environment

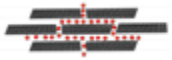
Taking profit of Renewable Energy:

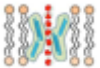
- Minimize “Carbon footprint”
- Reduce Energy costs (RE: 2 to 8 € cents/ kW.h)
- Direct coupling for small or remote plants

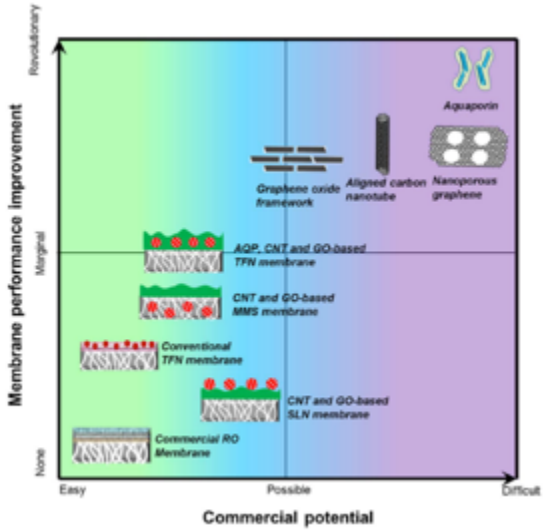
Membranes for the Future

Time to Market

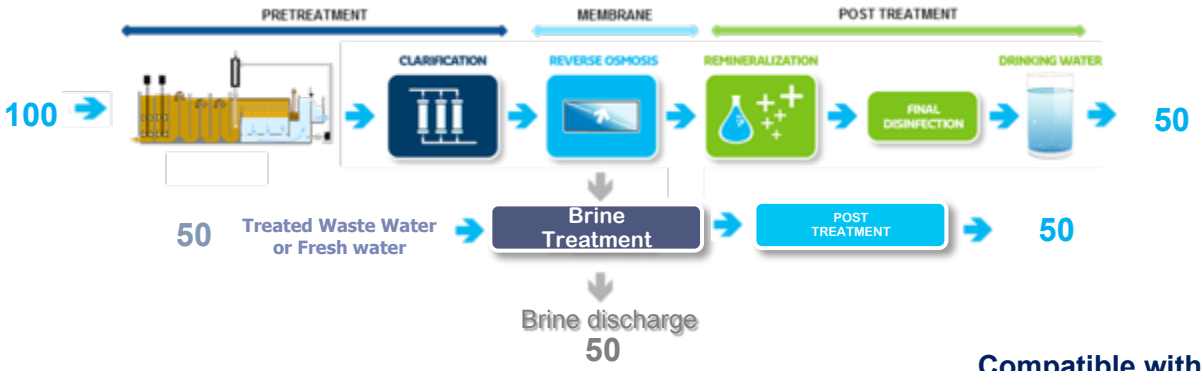
- Polyamide (PA)
- Graphene oxide (GO)
- Carbon Nanotube (CNT)
- Nanoporous Graphene (NF
- Aquaporin (AQP)

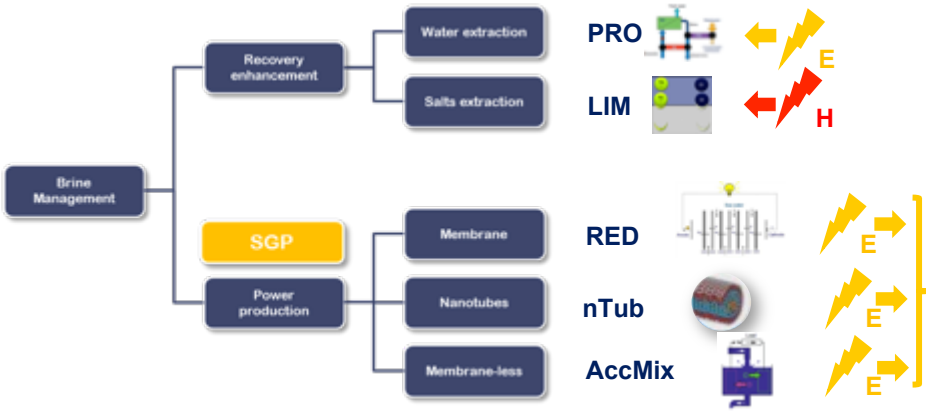






Future Trend in Technologies: Brine as Source





Compatible with Existing Facilities

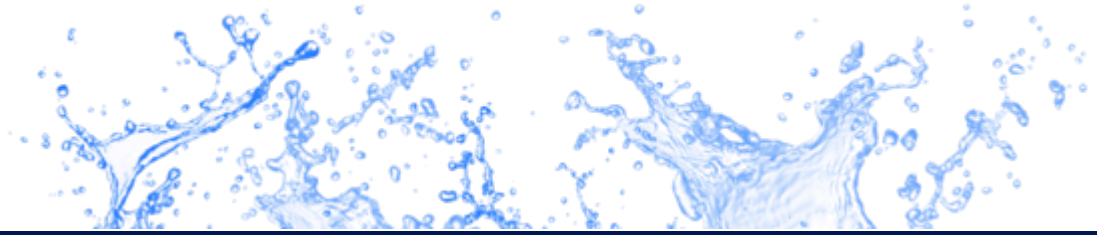
Increase Water Production

(+ Recover Salts)

(+ Produce Energy)

(+ WW Reuse)

Salinity Gradient Power



TEXAS DESAL 2018
Trends in Desalination

Thank you for your attention

Miguel Angel SANZ