

Optimisation in Plant Efficiency and Environmental Impact

Corrado Sommariva

Divisional Director

Mott MacDonald, UK



Are power and desalination plants environmentally friendly ?

Industry community needs to answer this question in order to ensure the sustainability of future power desalination business

Are desalination plants environmentally friendly ?

- Among the factors that need to be addressed there are:
- siting considerations,
- coastal zone/marine protection regarding withdrawal and discharge,
- air pollution from energy production and consumption,
- groundwater protection from drying beds, leachates, and sludge disposal.

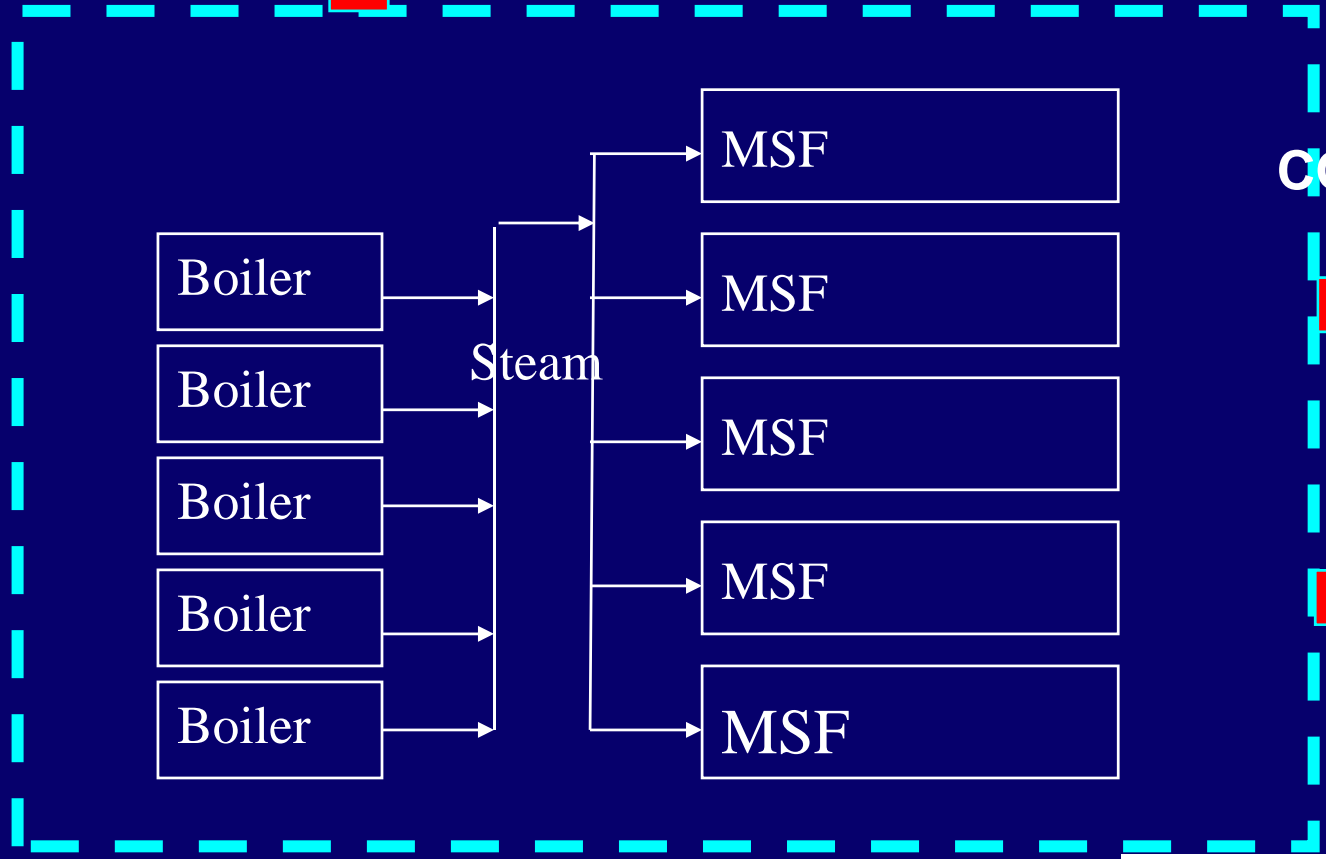
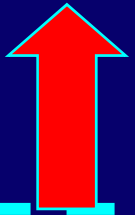
What do we discharge in the environment ?

The nature and quantity of effluent depend on the process adopted for desalination

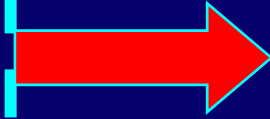
some examples.....

Technology 1 "big kettle"

FUMES
CO₂ NOX
SOX



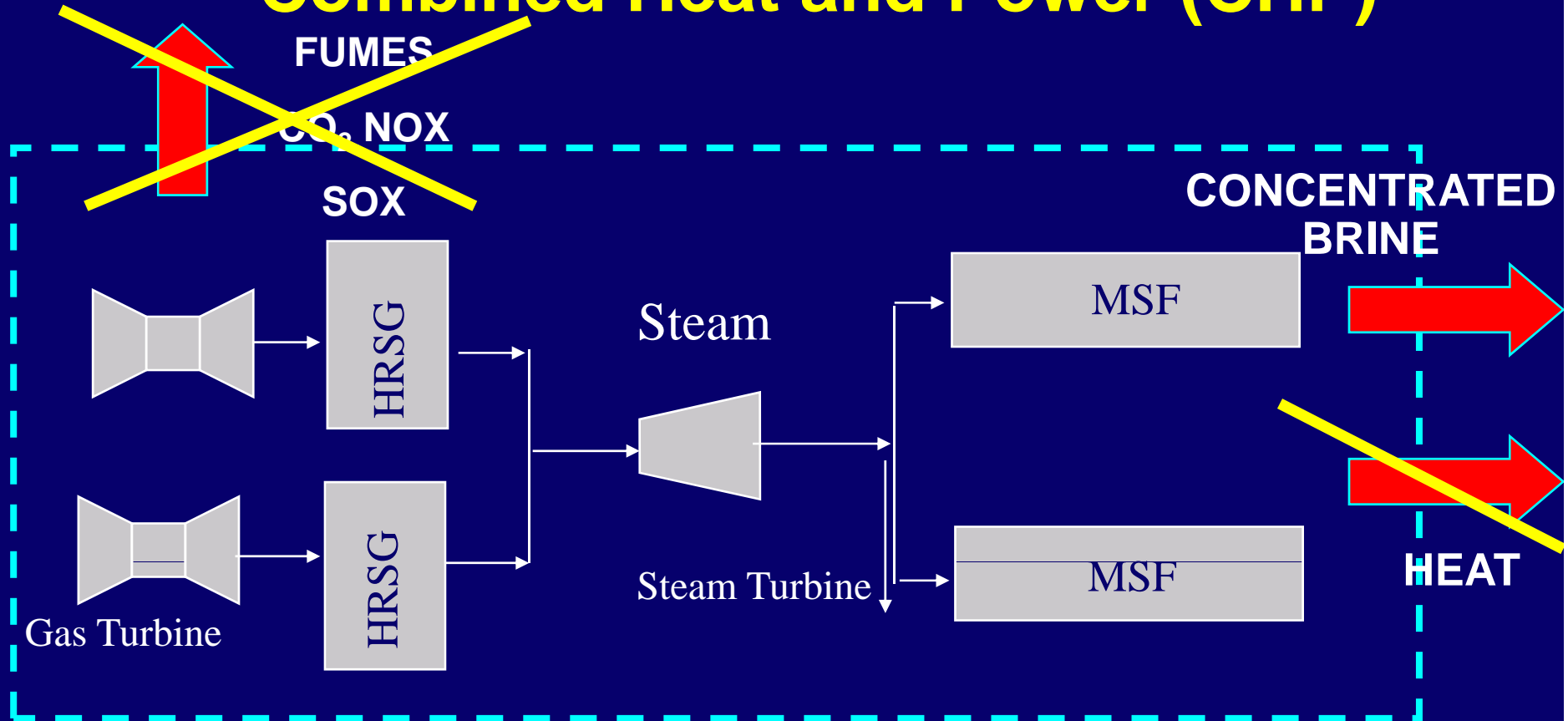
CONCENTRATED
BRINE



HEAT



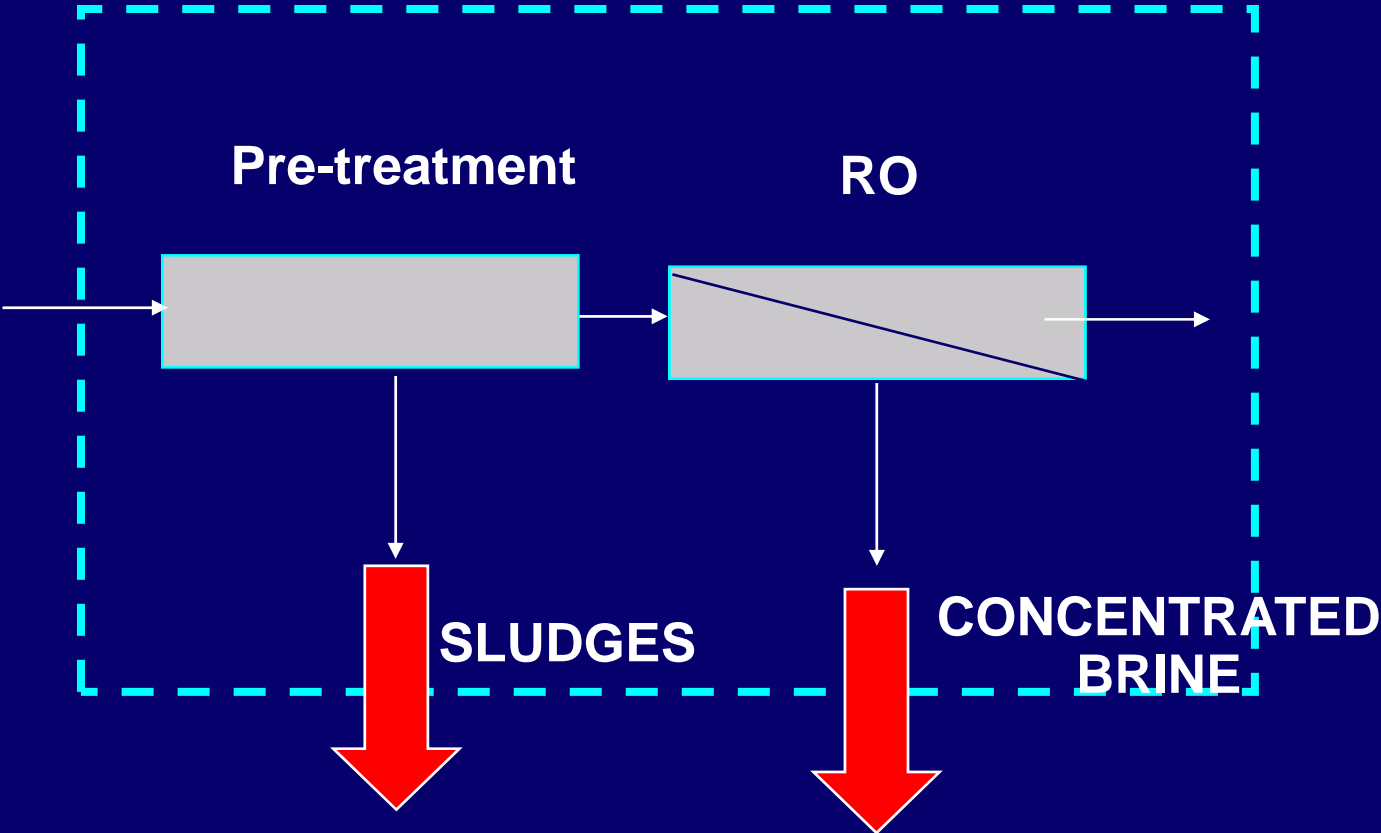
Technology 2 Combined Heat and Power (CHP)



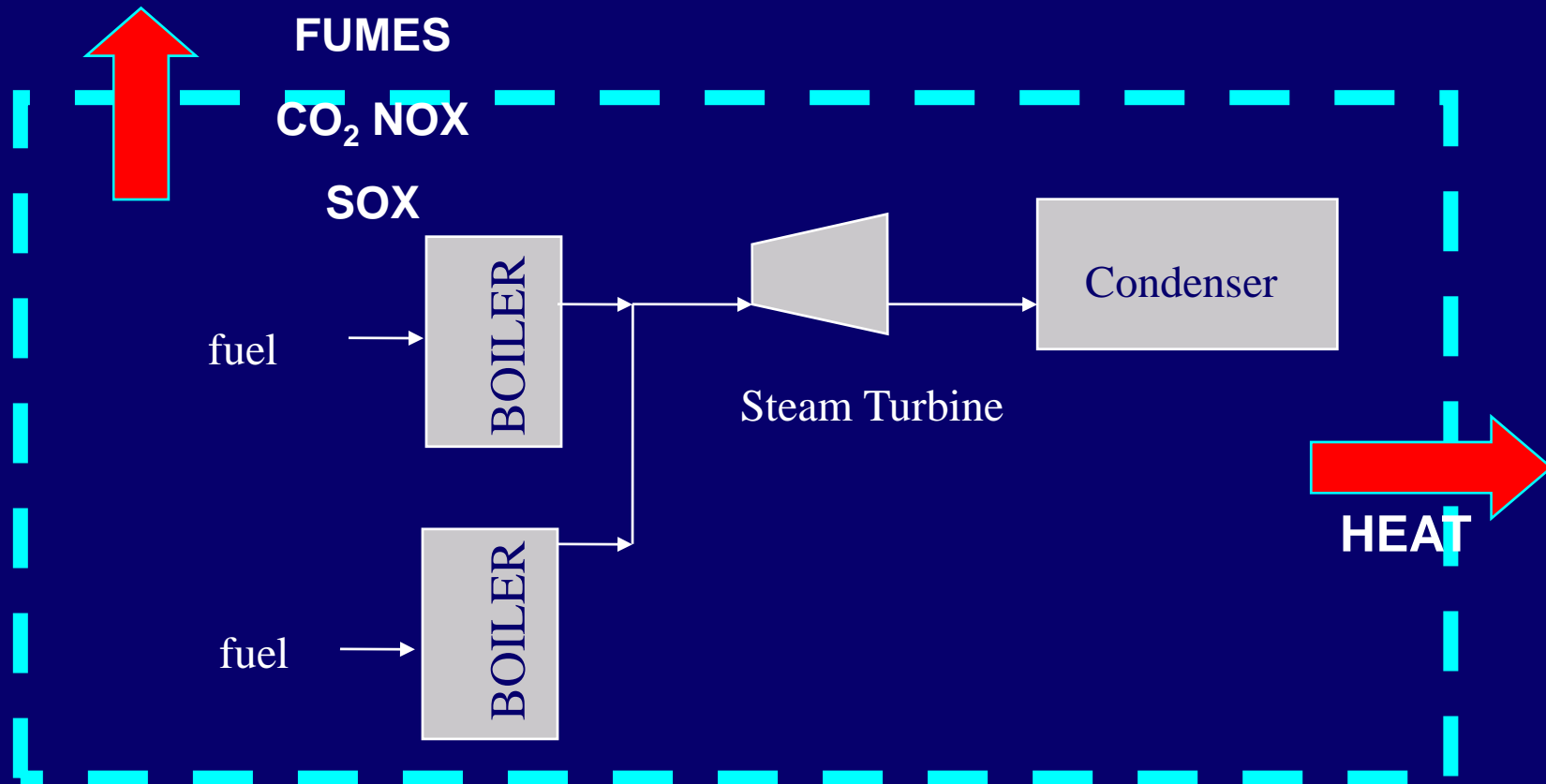
COGENERATION

Technology 3

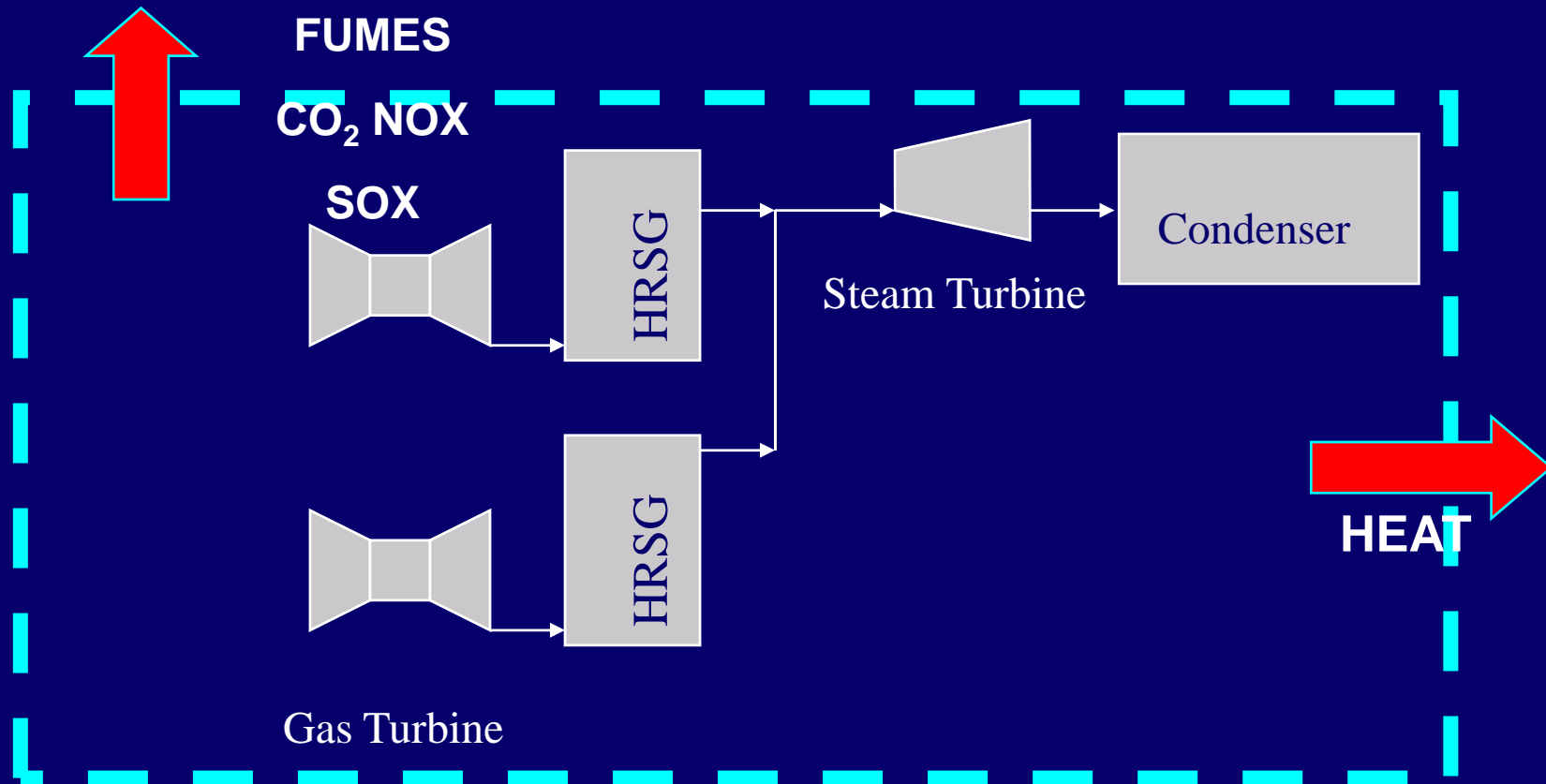
Reverse osmosis



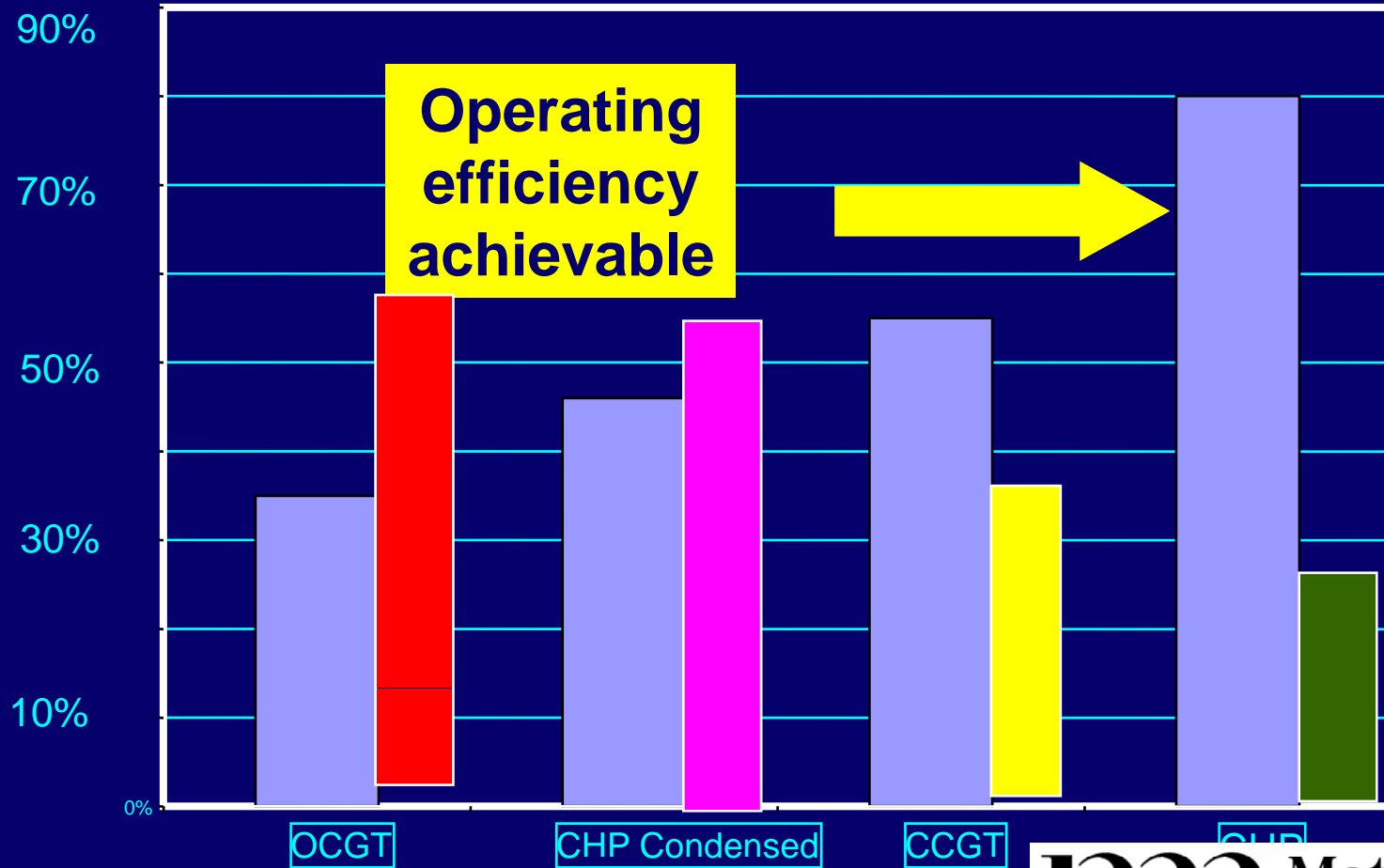
Technology 1 Conventional Power Plant



Technology 4 CCGT Power Plant



Operating Efficiencies

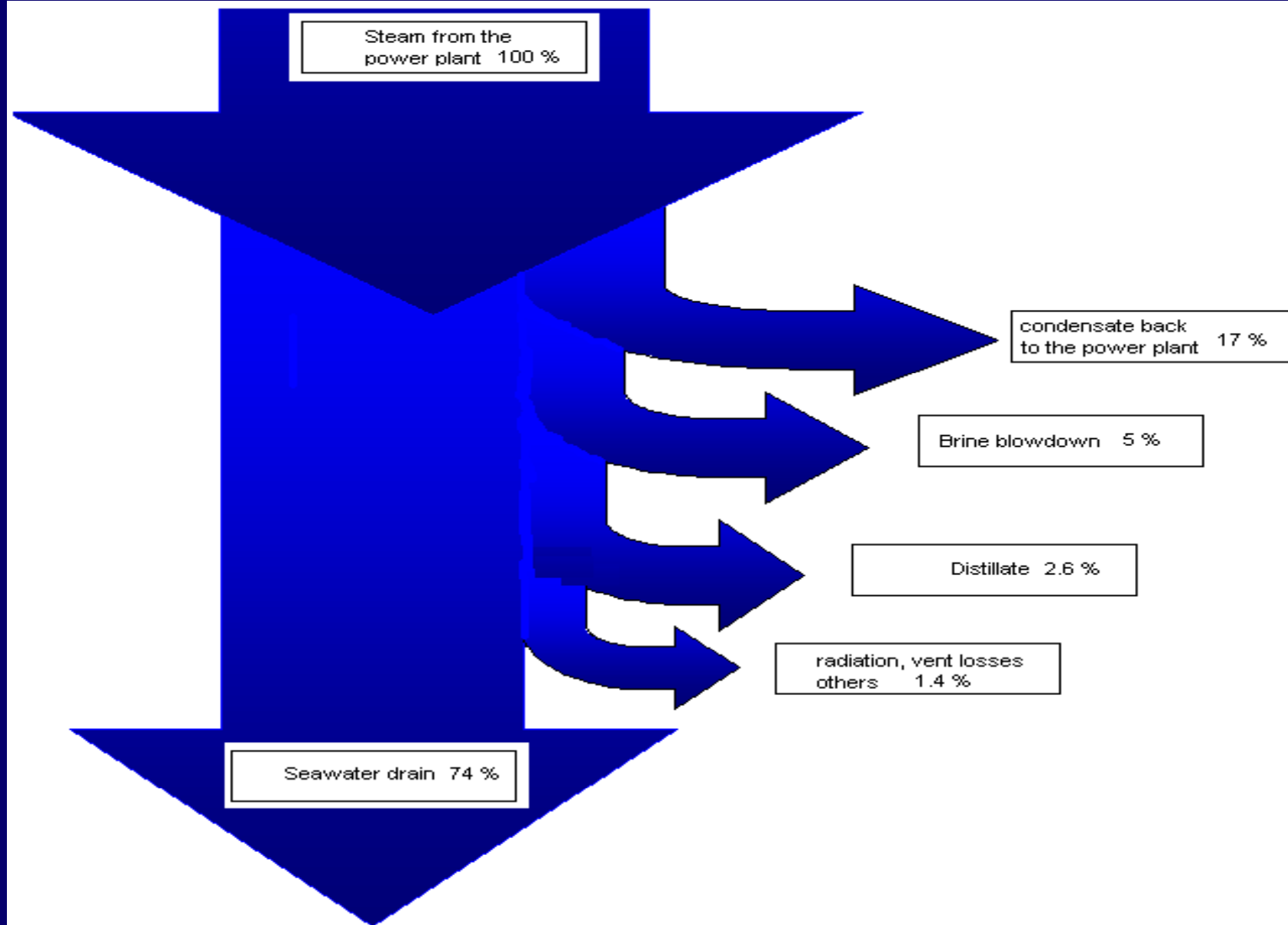


Energy effect

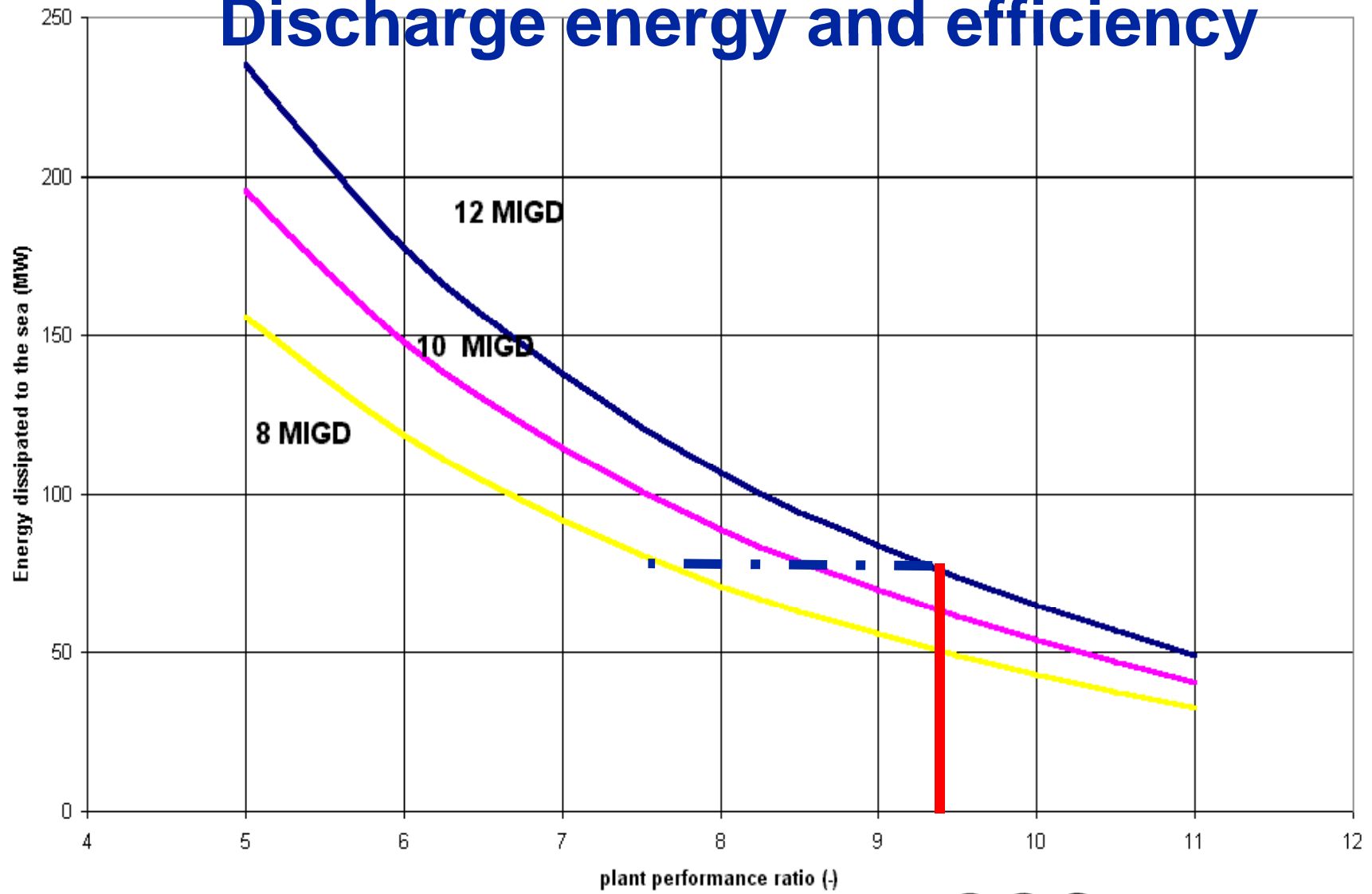
Generally environmental aspects of thermal desalination and power plant cover both temperature, and chemicals, however no studies have been carried out so far to cover the effects and the mitigations measures to cater for waste heat discharged in the sea.

Energy effect

In fact as it can be seen from the enclosed energy flow diagram the great part of the heat input to the MSF system is returned back to the sea with the seawater drain stream.



Discharge energy and efficiency



Operating Efficiencies

■ At a given discharge enthalpy and production plant efficiency sharply decrease the heat dissipated to the sea

■ At high efficiency the difference between the heat dissipation with increasing plant size decrease

What are the results in a comparison ?

Environmental impacts in power generation and desalination processes

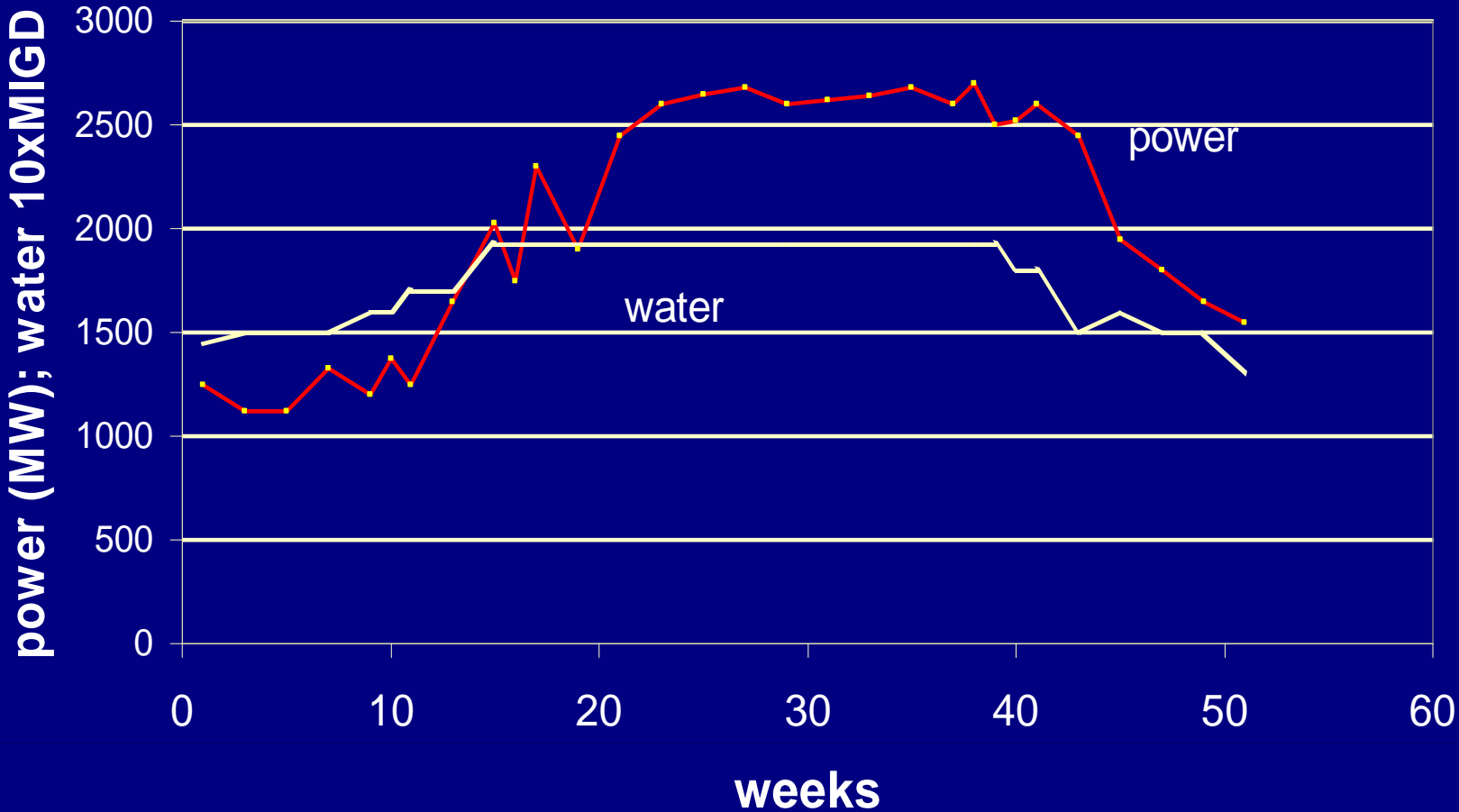
Reference process	Type of process	Energy dissipated in the environment MW	TDS increase with respect to the uptake
Power generation 100 MW	Conventional cycle	50	0
	Combined cycle	10	0
Desalination plant 7.2 MIGD	MSF (performance ratio 9)	120	15-20 %
	MED (performance ratio 9)	100	15-20 %
	SWRO	0	50-80 %

What are the results in a comparison ?

It is important that this issue is addressed if we consider that a MSF plant of 100 MIGD may discharge over 150,000 m³/hr of seawater and the coastal area in certain area continues for tens of kilometers with one desalination plant after the other.

A policy of upgrading plant performance ratio along with the plant life extension has been common practice in the last decade..

Annual power and water requirements Abu Dhabi emirate



What are the results in a comparison ?

This has been driven mainly by commercial reasons

Plant	Authority	Original capacity MIGD	Uprated capacity MIGD	Implementation dates
Layyah unit 5-6-7-8	SEWA	5	6	2001
Umm Al Nar	ADWEA	7.1	7.75	1998
Layyah unit 9	SEWA	5	7.5	2005
Jebel Ali D	DEWA	7.5	7.8	2000
RAF A	QEWC	5	5.5	2003
Jubail	SWCC			1999
Jeddah 4	SWCC	5	5.5	1999

**In winter operation different power
and water needs occur:**

**limited flexibility is allowed by CHP
system in winter configuration**

**Operational configurations becomes
very inefficient and therefore
increases the environmental impact**

Conclusions :1/2

- **the need to develop autonomous environmental policies for desalination plant becomes more stringent**

- **Environmental codes and technical solutions for desalination plants are still in their development**

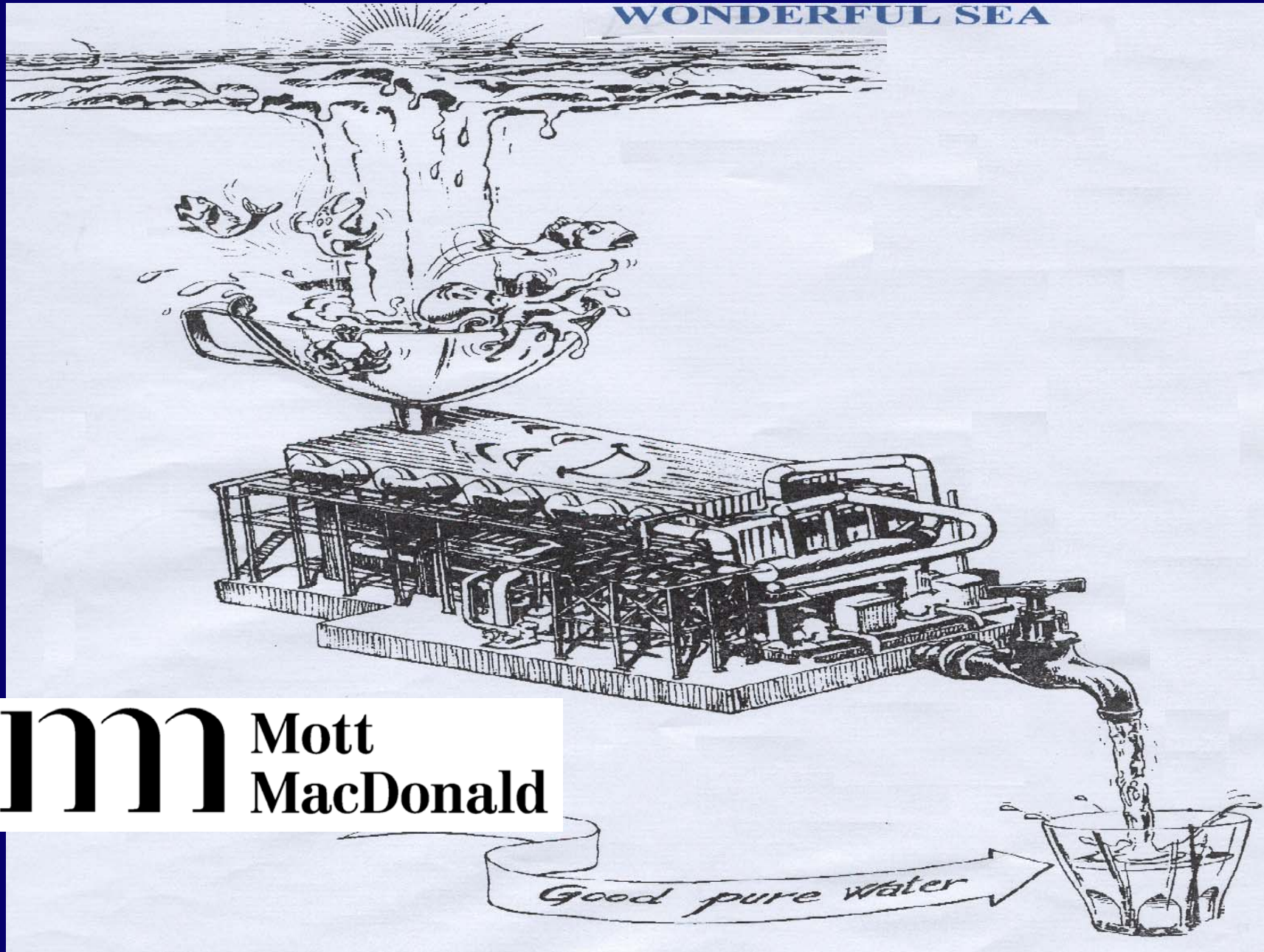
- **A minimum bottom threshold for plant efficiency should be established**

- **alternatives to inefficient winter operation must be investigated**

Conclusions 2/2

- inefficiencies not only **cost money** but impacts also on environment

WONDERFUL SEA



M Mott
MacDonald