PECC Auckland Seminar

Henri Boyé

The energy footprint in the water sector

Energy use for production and distribution of water

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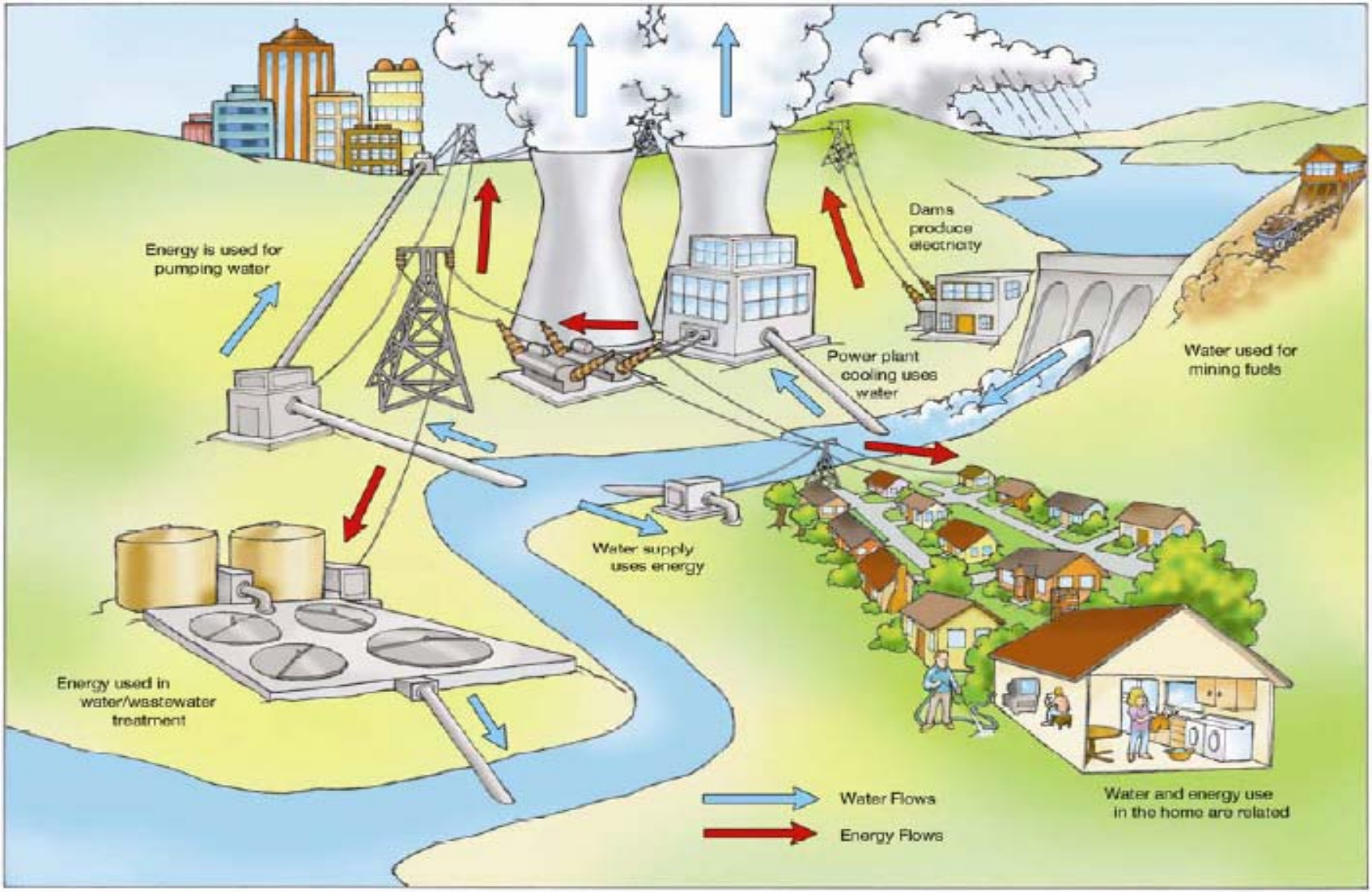
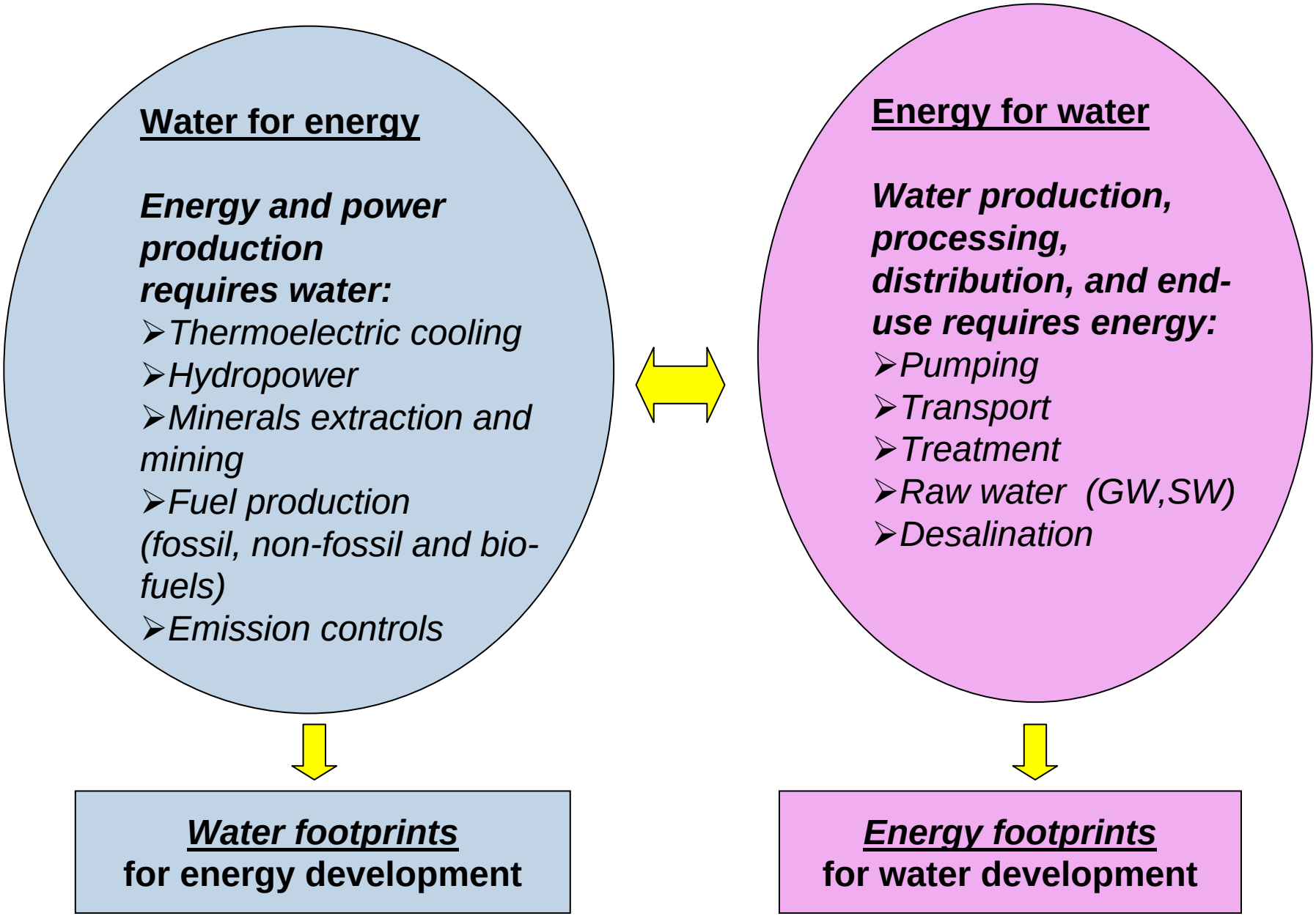
Water and Energy Nexus



Energy and Water Development

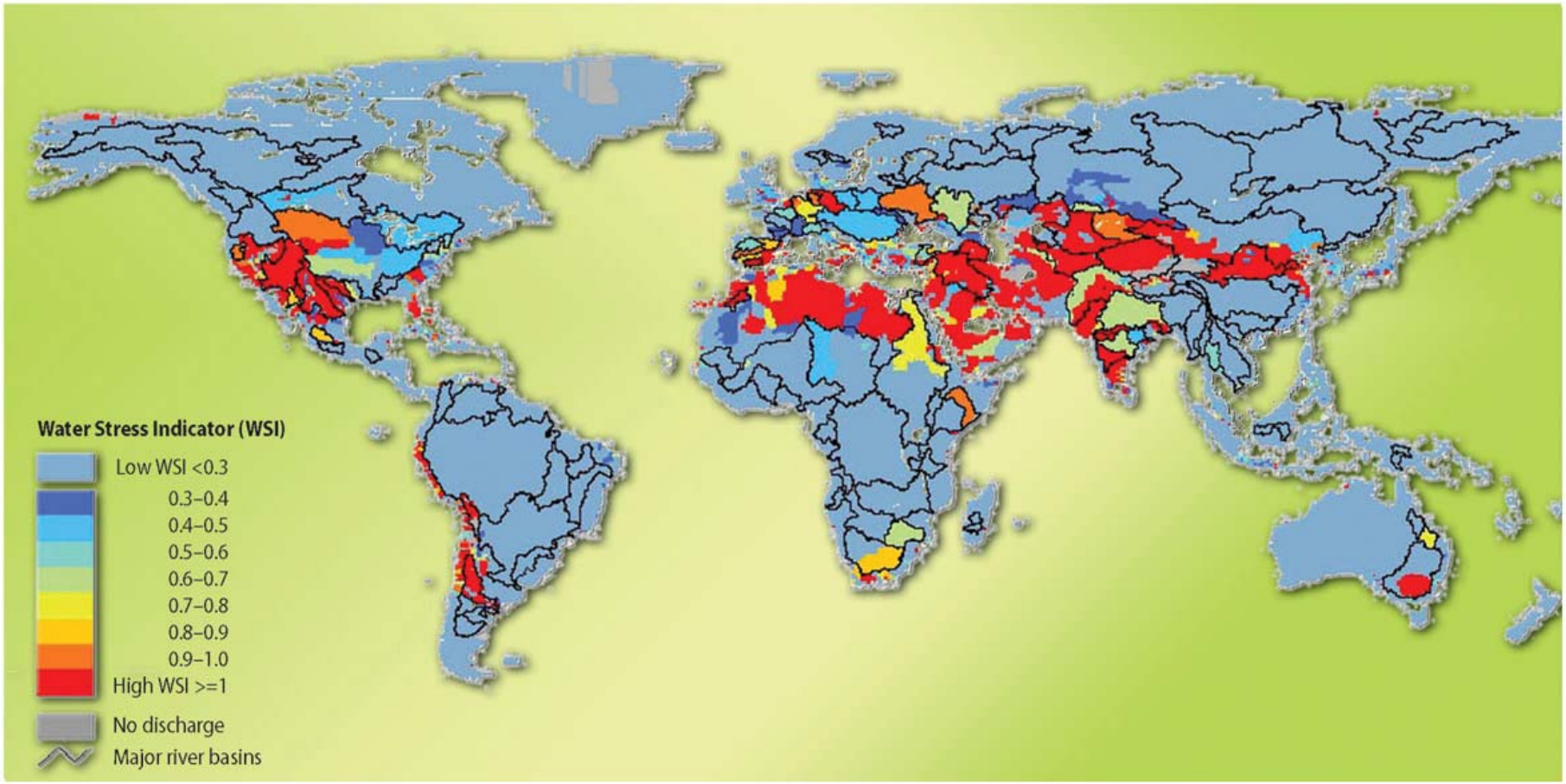


Energy for Water

Examples:

- ***Desalination of seawater for water supply***
- ***Large scale pumping for irrigation***
- ***Large scale pumping for inter-basin transfers***

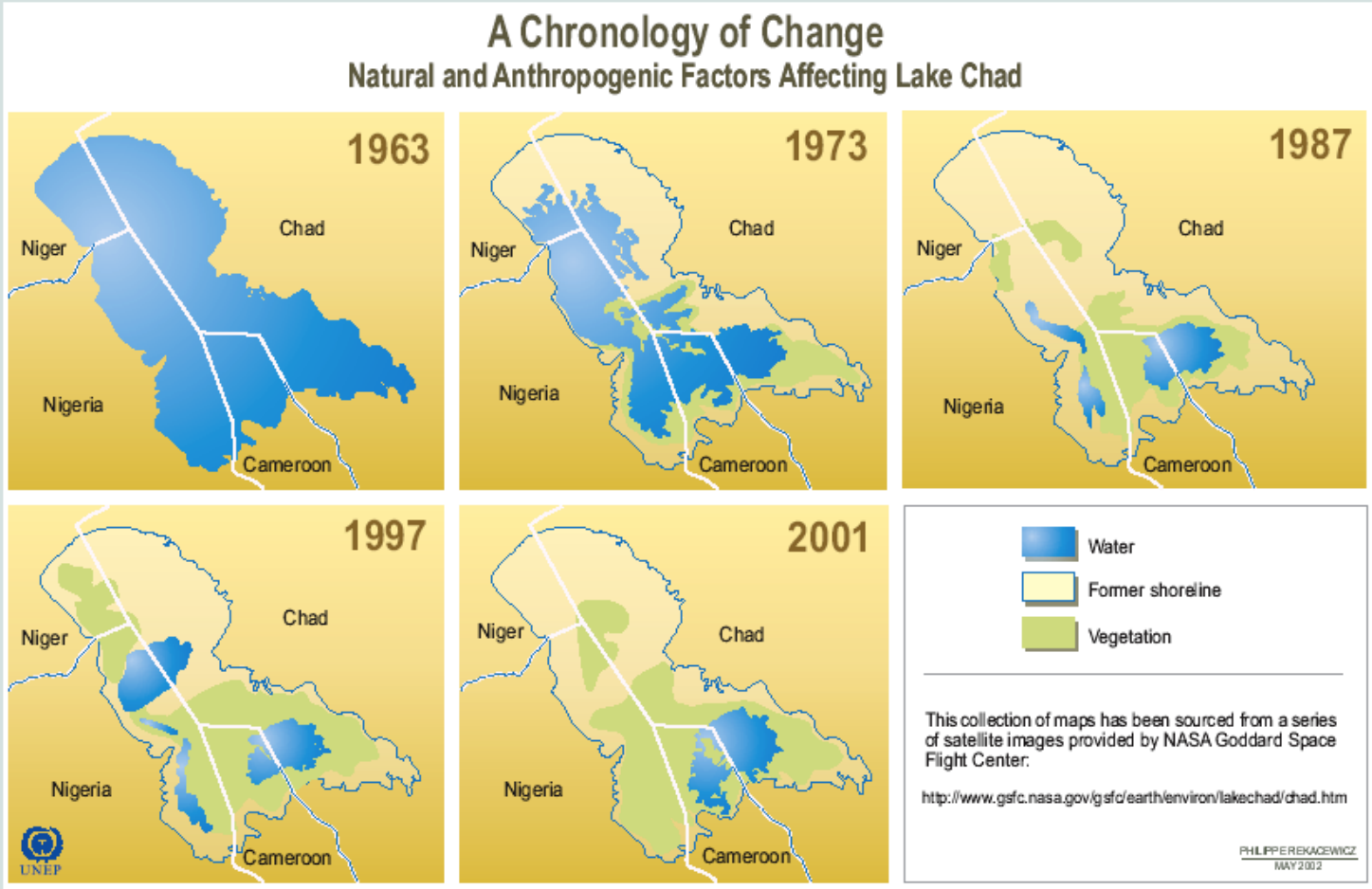
Water stress is and will remain specific to certain river basins



2,5 billions people live in water stressed basins

Effect of climate change : Lake Chad is vanishing

Map. 5.4: Levels of Lake Chad 1963-2001



Source: UNEP, 2002c, 2004c.

Energy for Water

- **In the Mediterranean**
- A survey for the Plan Bleu
- www.planbleu.org
- **Energy, Water Desalination**
- **& Climate Change in the Mediterranean**

Power consumption for water mobilisation and treatment

- Energy for water varies in countries and regions.
- 5 % of power consumption in the Northern Mediterranean Countries (NMC)
- between 8.5 and 13 % -about 10% on average- in the Southern and Eastern Mediterranean Countries (SEMC), 20% in Jordan,15 % in Israel.
- Increase to double up within 10 years
- exceeding, by 2025, twenty per cent (20%) of the total demand on electricity for the SEMC

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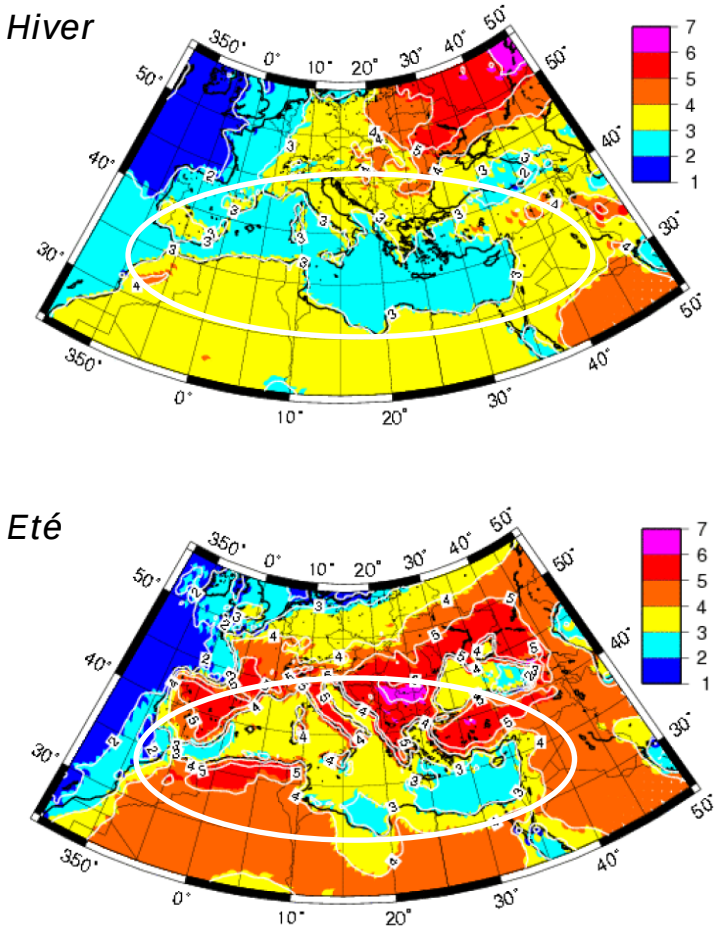
MEDITERRANEAN and Climate Change

Surface temperature (°C): 2070-2099 vs. 1961-1990



- *Wraming > global average particularly in summer (+5C until end of 21th century)*
- *Rain and Snow :*
  - *In winter : ↗ North of Méd. (Alpes) but ↘ South*
  - *In Summer : neat ↘ in all Mediterranean regions*
  - *(-30%)*
- *Accentuation of estreme events (floods and droughts)*
- *Rise of the sea level (20-60 cm until end of 21th century)*

Somot et al., 2007

Water, energy and climate change

The vicious circle

Climate change

Wet gets wetter
Dry gets drier

Increased energy consumption to handle water

Increased CO_2 emission

Energy for pumping and treatment

- Water pumping and transfer consume much energy,
- E.g. **the "Great Man-Made River" project in Libya**
-
- In **Spain**, the initial lift of the "Trasvase Tage-Segura" (66 m^3/s, abstracted from the Altomira dam) consumes a power of 202 MWe.
- The energy cost of water conveyance in **Israel** was quantified as an annual power of 1.3 GWh.
- In France, power consumption for water mobilisation and treatment at 16 TWh in 2007, that is 3.5 % of the national consumption

Energy for water increase, from 2000 to 2030

- In 2000, for the Mediterranean countries as a whole, power consumption for water is estimated as in the range of 5.6 % to 6.7 % of the power demand.

- By 2030, there would be, for the SEMC, some 48 km^3 of additional water to manage, that is 200 km^3 in total.

- Power consumption would reach (based on a ratio of 1 kWh/m^3) 250 TWh for water management, i.e. 20 % of the total power consumption.

Energy for Desalination in the Mediterranean

- For desalination alone, a volume of desalinated water of 30 million m^3/d in the Mediterranean by 2030, with a ratio of 3.3 kWh/m^3, would amount to an electric output dedicated to desalination of 5000 MWe,

- that is 8 to 10 gas combined cycle power plants, or 4 to 5 nuclear units

The Cyprus Island

Cyprus: Drought, water rationing and desalination

- **Cyprus, an island with a semi-arid climate in increasing water shortage**, **recurrent droughts, requiring water rationing**. Importation of water from Greece, and fromTurkey (transport by huge balloons of 30000 m^3) and the construction of a pipeline of 110 km in length, of which a buried section of 78 km between Turkey and Northern Cyprus is under study.
- **Three desalination plants** are operational and produce 94 000 m^3/d. Larnaca plant, 54000 m^3/d, constructed under a 10-year BOOT contract. Dhekalia ,40 000 m^3/d. BOOT, Limassol. PLANS for a further three desalination plants in Cyprus have got underway
- An increase in storage capacity, as Cyprus currently has 106 dams and water retention structures, offering a storage capacity of 307.5 million m^3, and ranks first among European countries in terms of water storage, with a ratio of 50 major dams for 10.000 km^2. By 2010, the total water storage capacity will amount to nearly 400 million m^3;
- The "Southern Conveyor Project" provides an interregional transfer of water resources, with several dams, a main pipe extending over 110 km in length, the diversion tunnel of Dhiarizos (14.5 km), the treatment plants of Limassol and Tersephanou. It allows the irrigation of about 14000 ha.

Desalination

- **Israel**: Towards water control. More than 10% of Israel's water is desalinated, and Ashkelon large RO plant provides water at 50 € cents per cubic metre.

- **Malta** : A tourism island pioneer of desalination in the Mediterranean

  Malta gets two thirds of its potable water from RO, three plants, many hotels and tourists resorts with RO.

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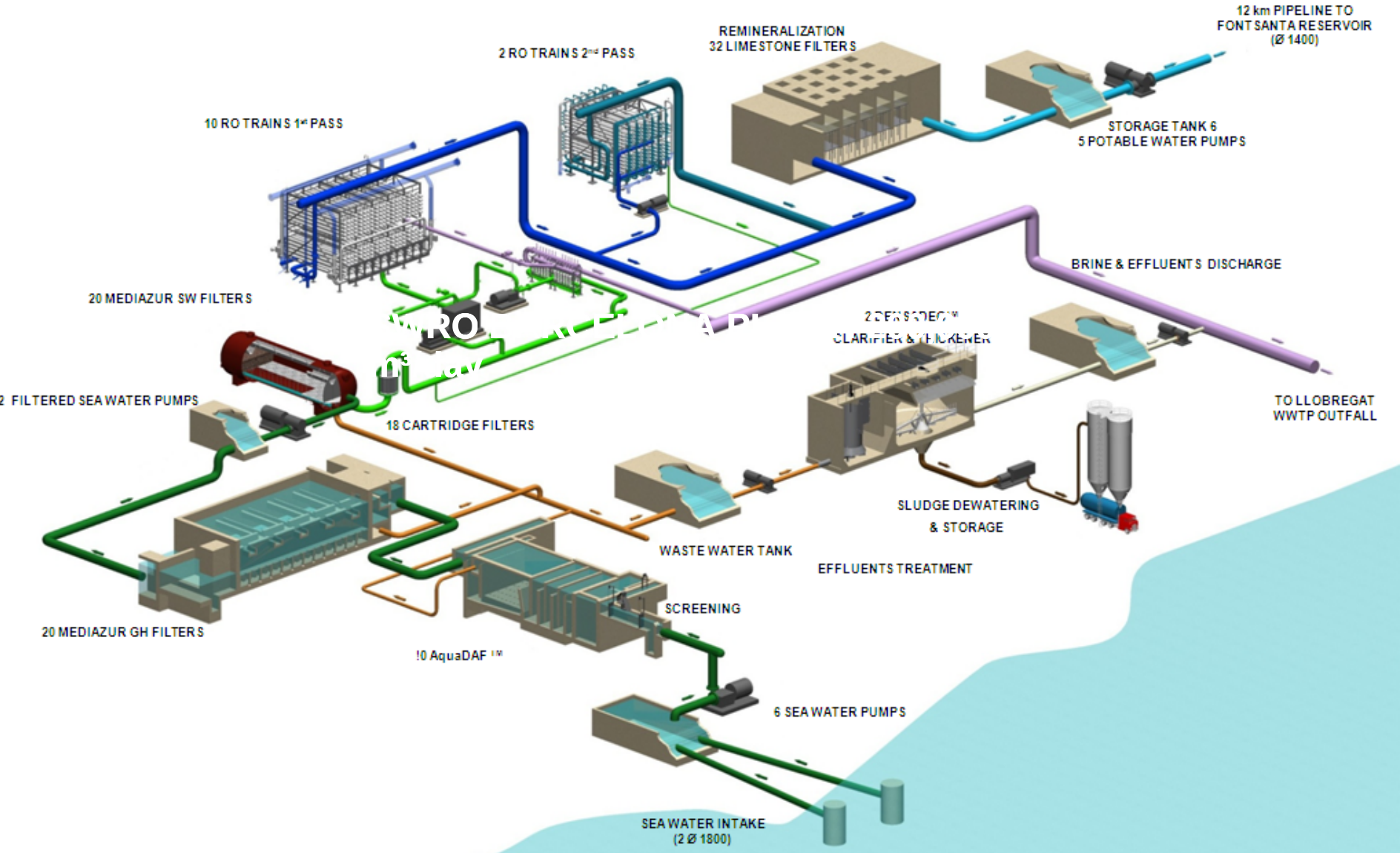
Malta a dry and crowded island

BARCELONA: July 09

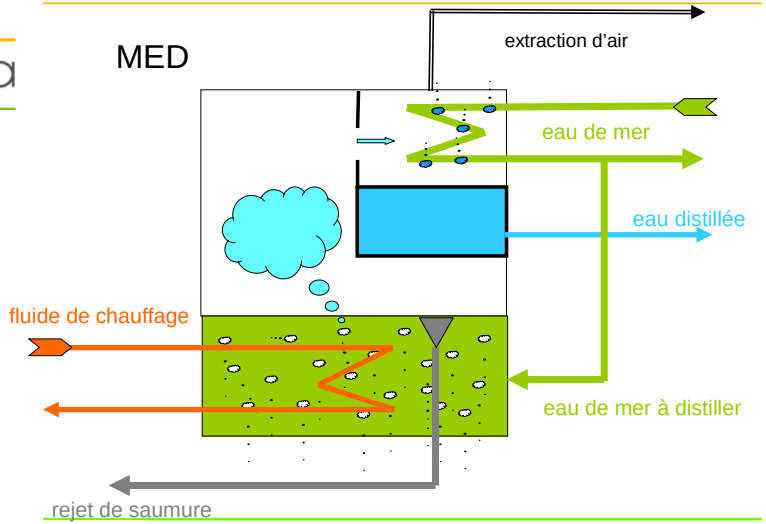
SWRO BARCELONA PLANT: 200,000 m³/day



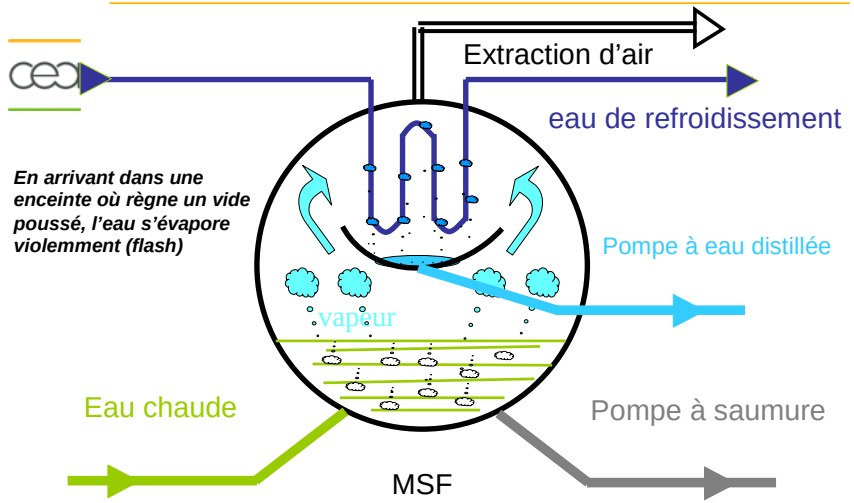
Desalination by Distillation

Techniques of Desalination by Distillation

Les techniques de dessalement par distillation



Les techniques de dessalement par distillation



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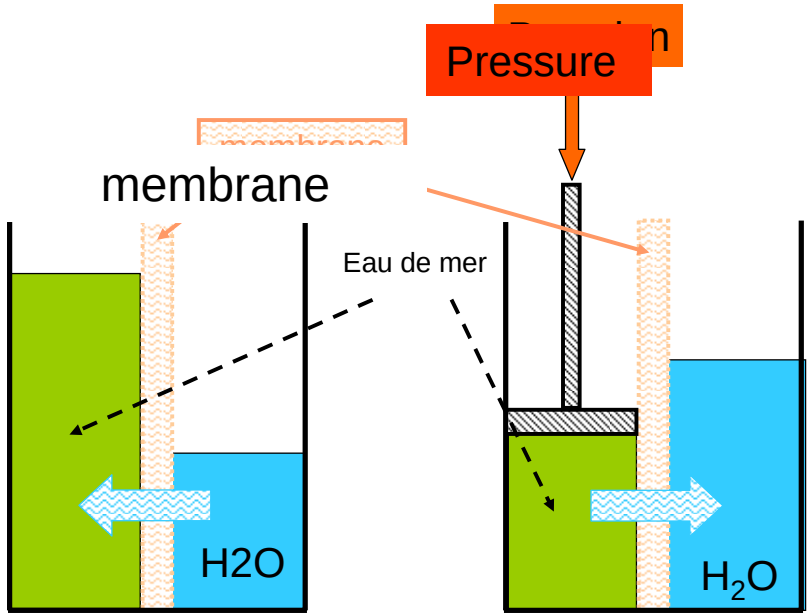
Reverse Osmosis desalination

Osmosis techniques for desalination



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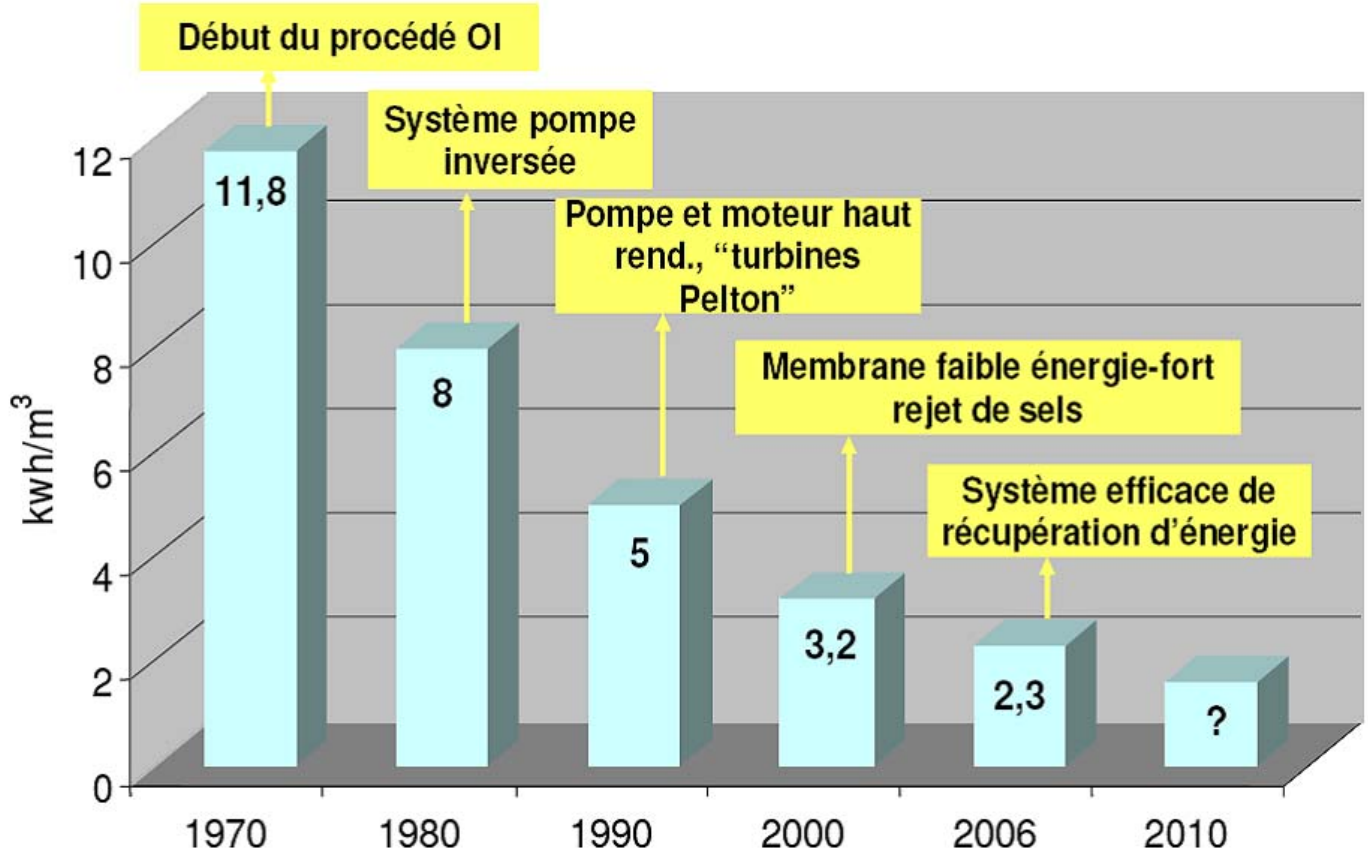
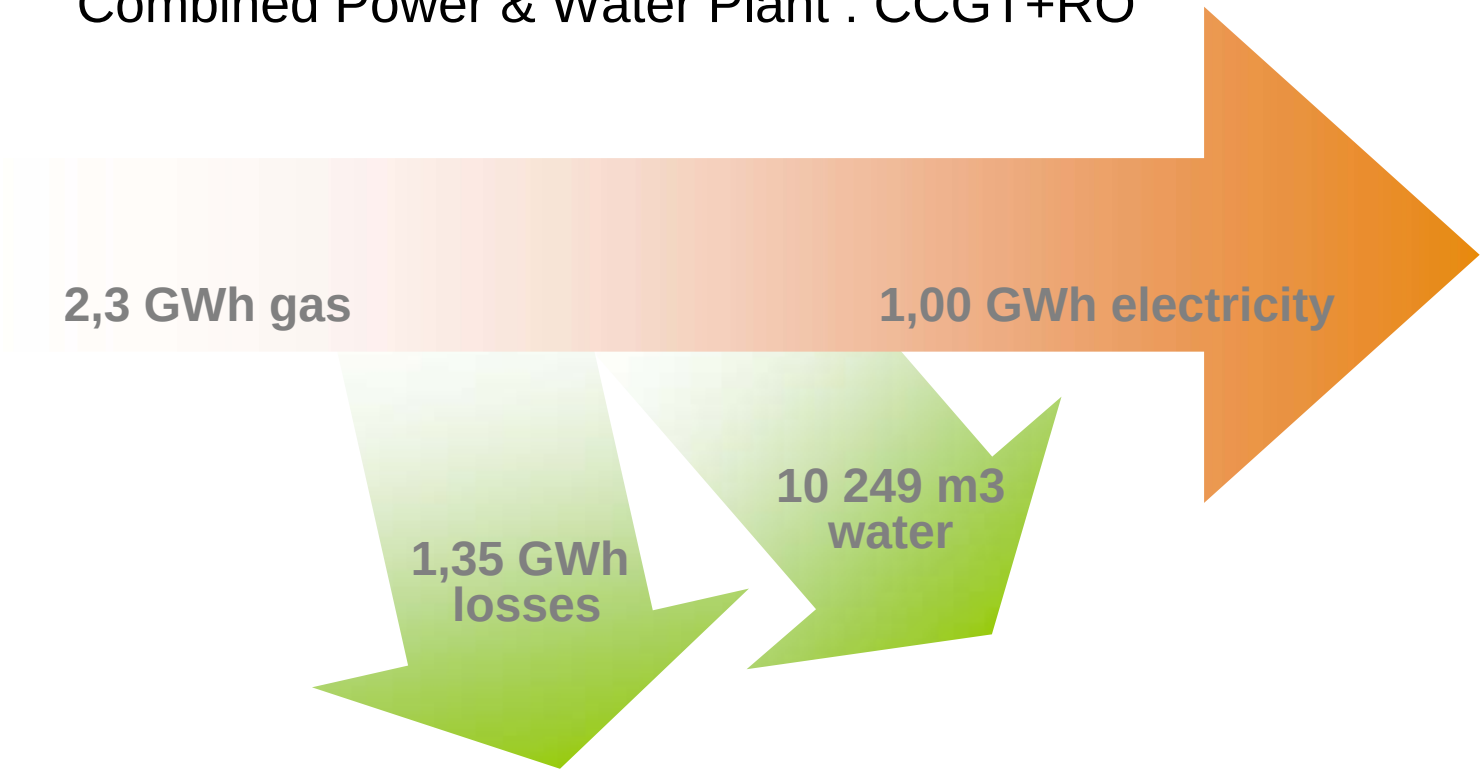
Improvement in RO energy efficiency



Source : présentation de Mme Véronique Bonnelye (DEGREMONT)-coûts de dessalement

« Smart » association of Power Generation and Desalination can save a lot of energy

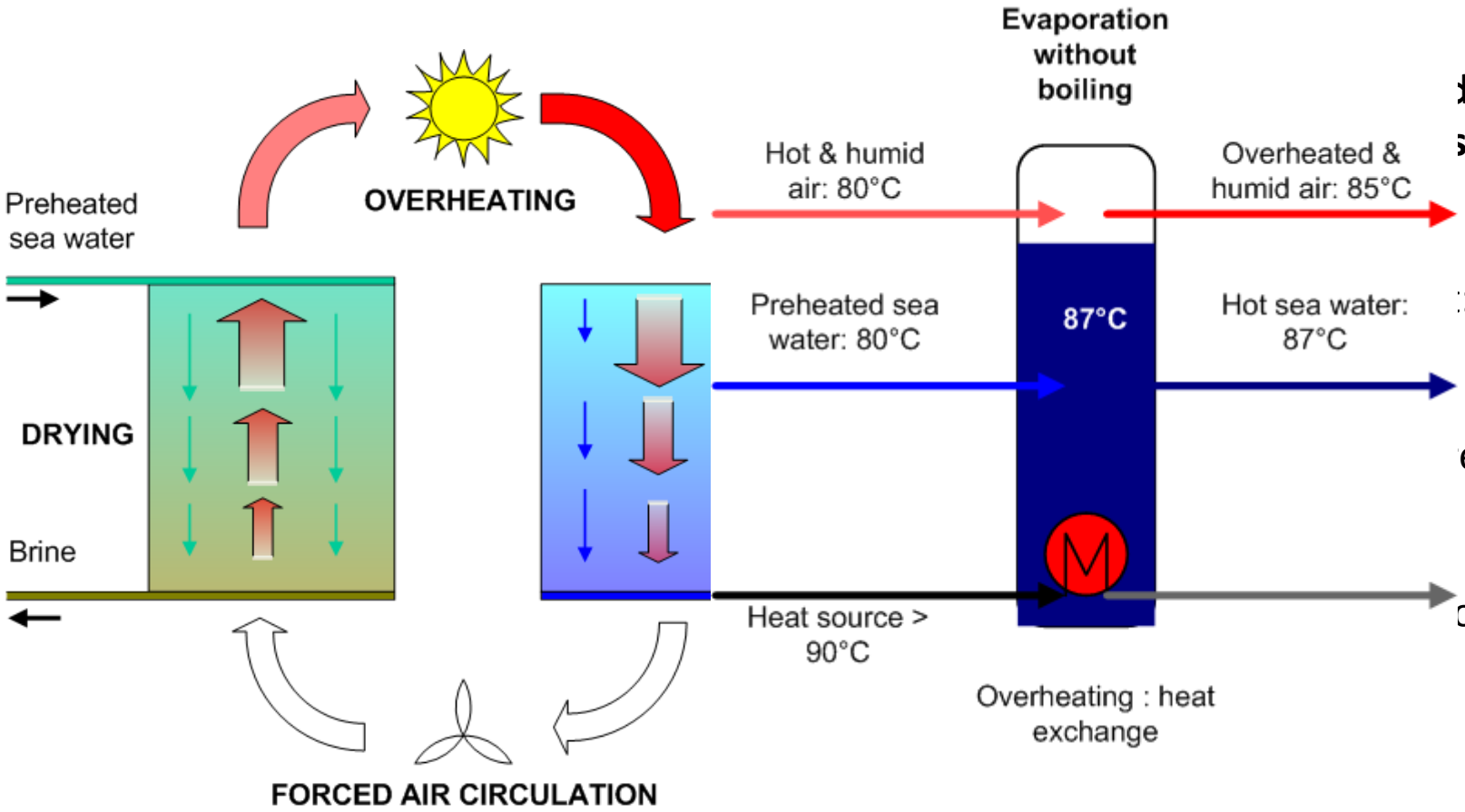
Combined Power & Water Plant : CCGT+RO



Total = 2,3 GWh of gas used, i.e. 12 % of energy savings throughout the system

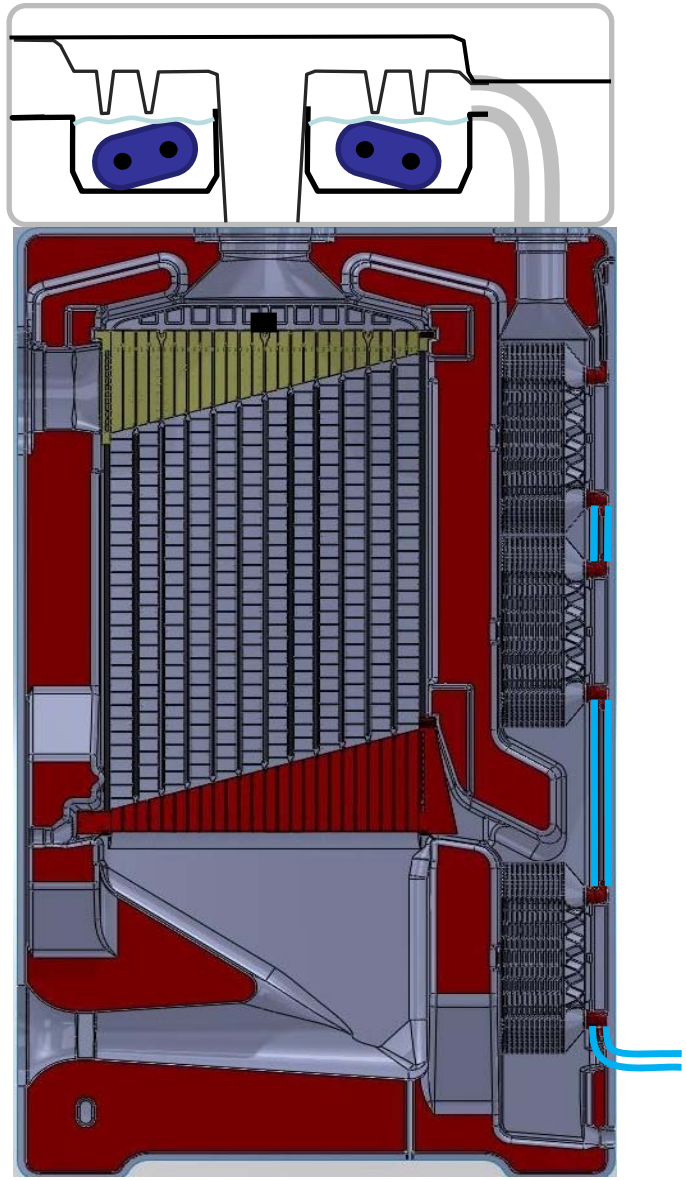
➔ The RO & CCGT combination is the most efficient

3MW Innovative idea of MEDC technology (multiple-effect drying & condensation): « natural » desalination



MEDC module 3D sketch

- ✓25 gas/gas plate heat exchanger
- ✓3 + 2 gas/liquid heat exchanger
- ✓Production capacity 1 m^3/d

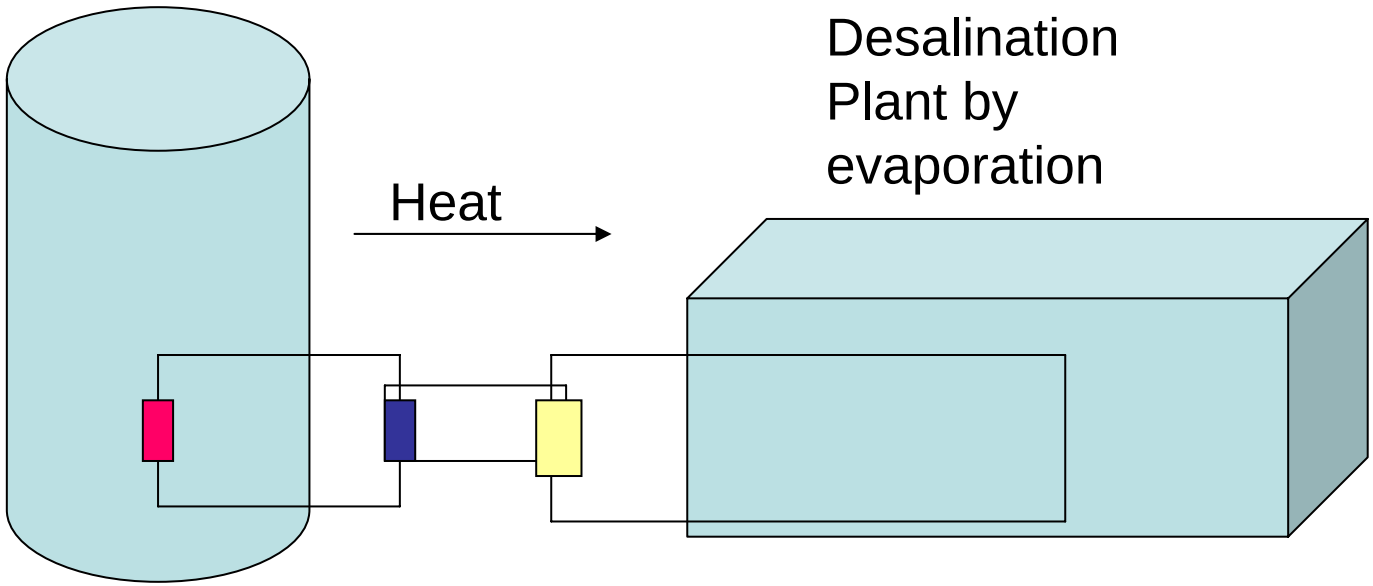


MEDC shows better technical and financial performances

Item	MEDC	Reverse osmosis	Distillation (MED, MSF)
Investment	100%	120%	130-150%
Power	0.2 kWh/m3	4-7 kWh/m3	3 – 17 kWh/m3
Heat	100 kg steam/m3	-	100 kg steam/m3
Mobile parts	Fan	High pressure pump, recirculation pump, valves, energy recovery device…	Recirculation pump, vacuum , compressor, valves,…
Pretreatement	filtration, Antiscaling (?)	filtration and ultrafiltration (0.1 µm), antiscaling, biocids	filtration, antiscaling
material	Plastics	Membrane and metal alloys	Metal alloys

Nuclear desalination

Reactor



Necessary Proximity of the equipments

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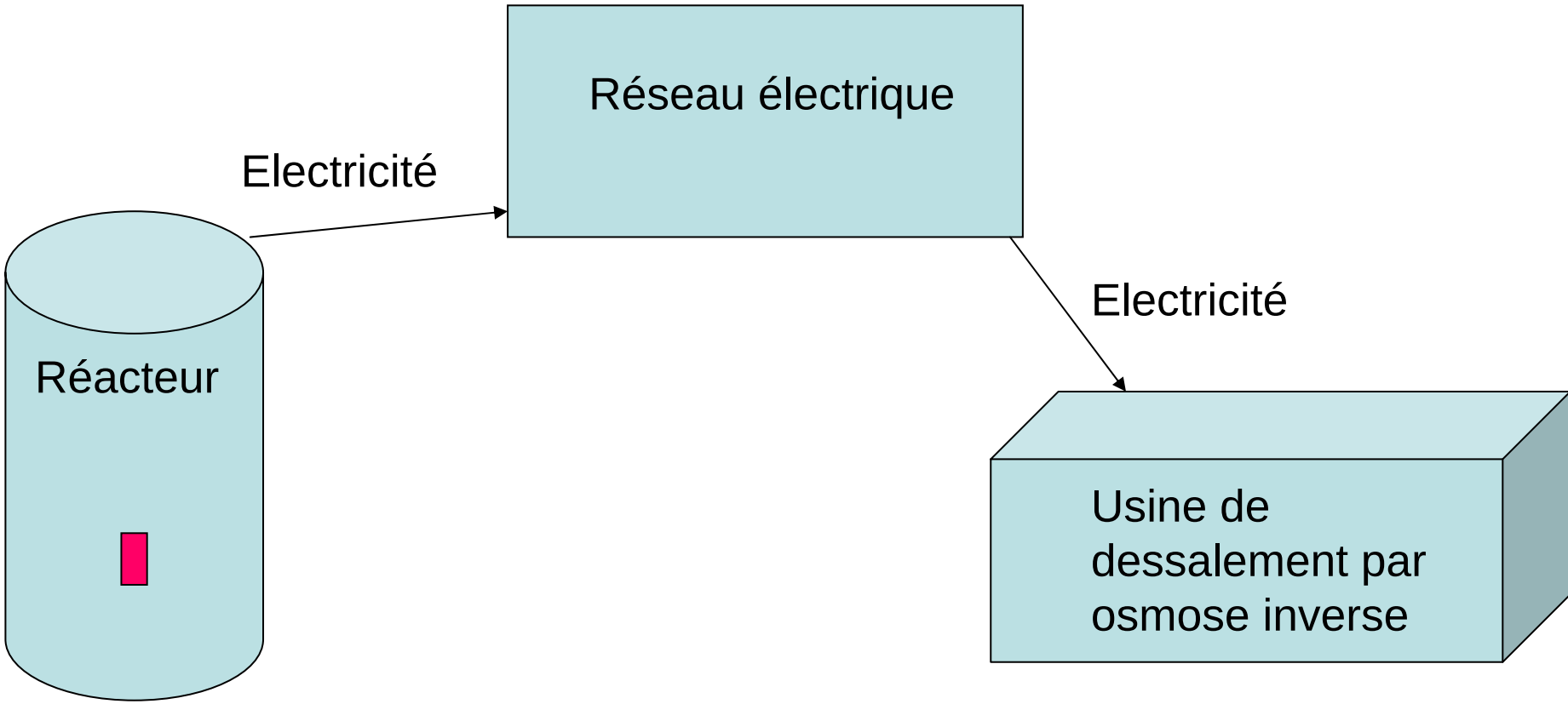
Nuclear Desalination couplage



No coupling,

proximity unnecessary

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