INNOVATIVE TECHNOLOGIES for water treatment: Water reuse issues

Cost/benefit analysis of the available and planned technologies

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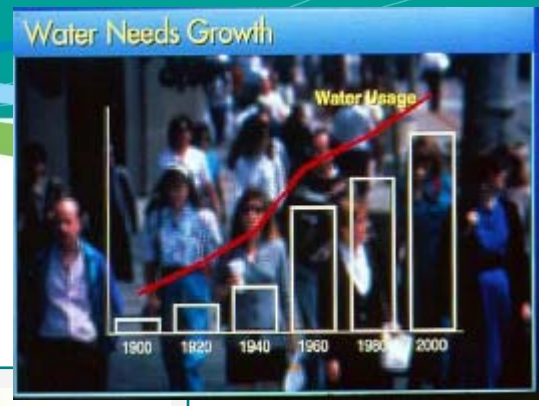
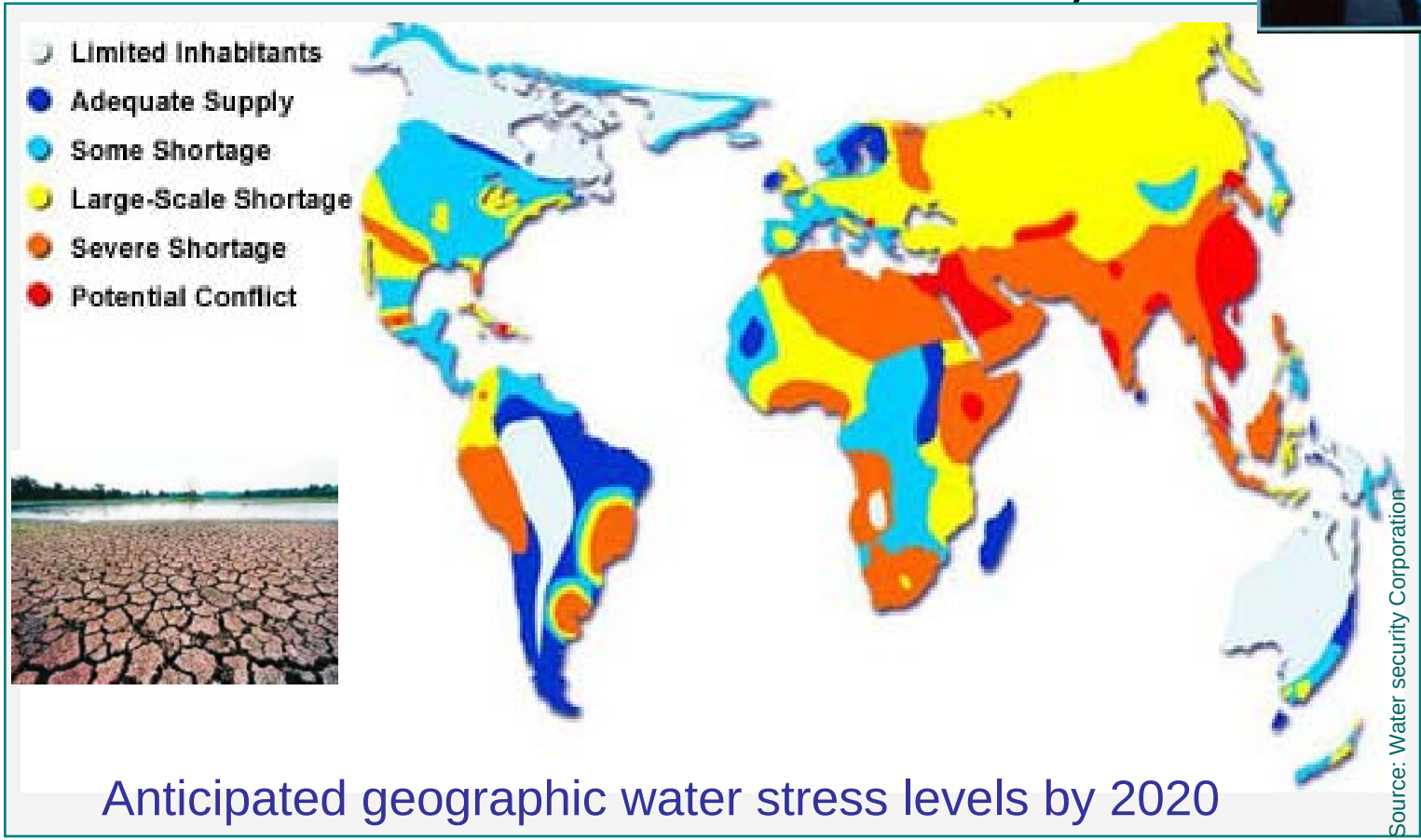
Outline

- **Introduction**: Drivers of Water Reuse
- **Technical Challenges** in Closing Water Cycle by Water Reuse
- **Examples**: What is the Best Technology for a Given Water Reuse Application?
- **Conclusions**: Costs, Benefits and Keys of Success of Water Reuse

Main drivers of water reuse



- Increased water demand
- Reduced water availability



Anticipated geographic water stress levels by 2020

1999 ⇨ 2025
Moderate or high water stress:
- 2/3 of the world's population

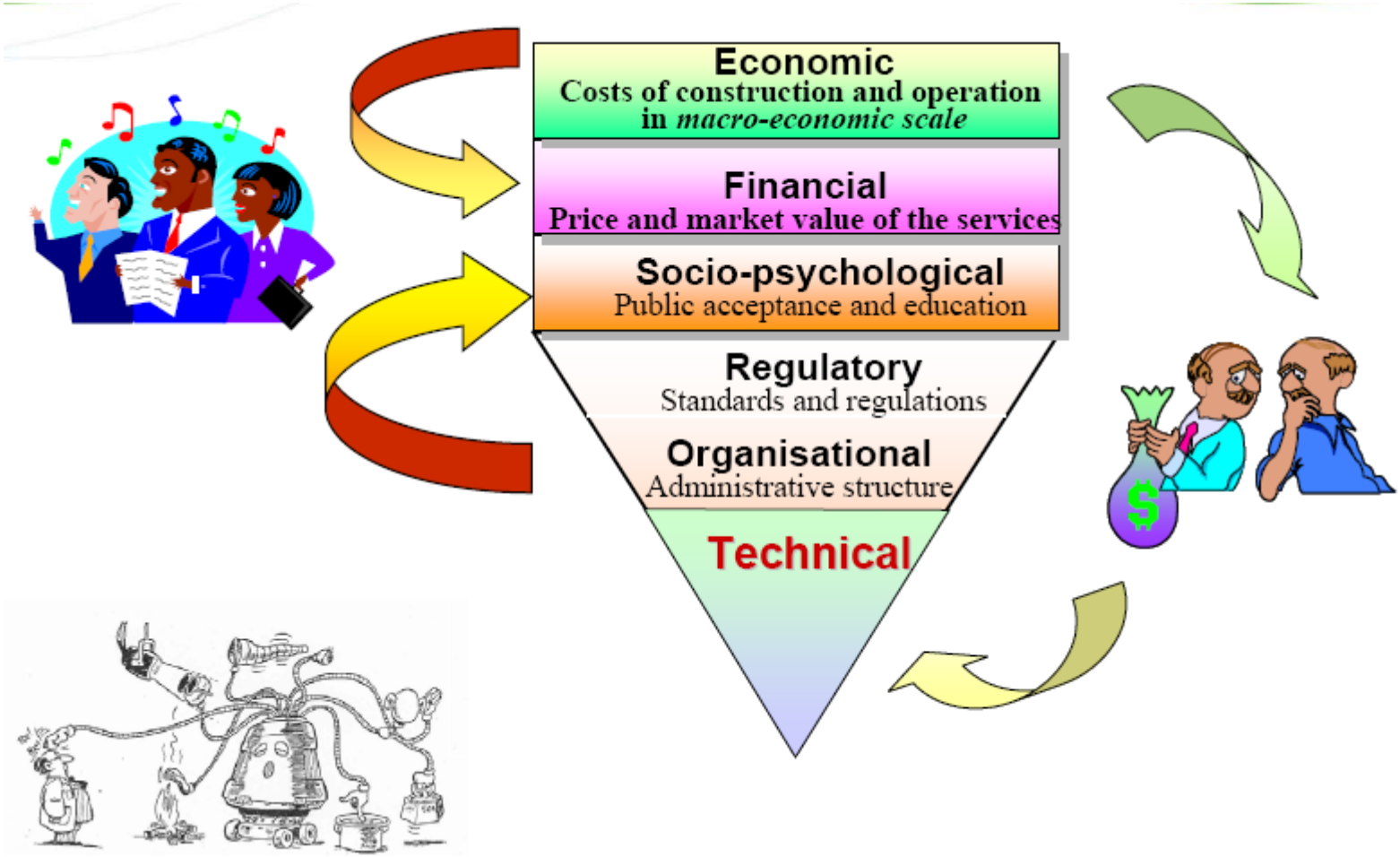
Main drivers of water reuse

- 1. Wastewater management needs
- 2. Environment protection,
- 3. Impact of new laws, policies & regulations,
- 4. Public awareness & politic pressure:
  - Increase in drinking water price
  - Sustainable development

- ***Water reuse is included in several state / national policies: Australia, California, Florida, Hawaii, Israel, Japan, Singapore, …***
- ***More and more regulations introduce requirements for water reuse: volume, %, given types of reuse as golf courses, high-rise buildings or industry***

Solution?
Integrated resource management

Water reuse challenges



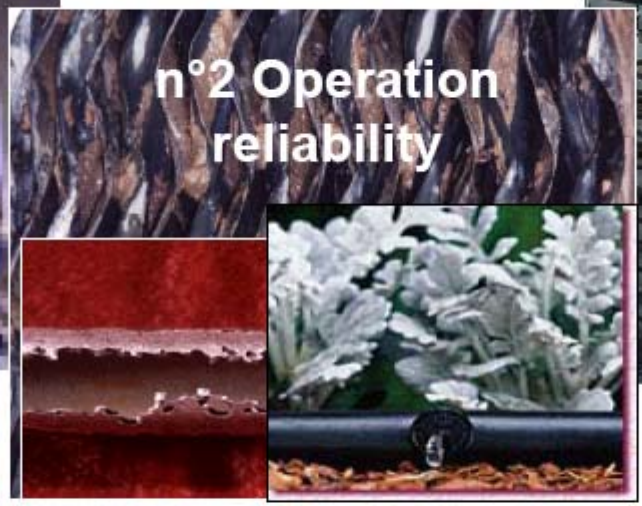
Main technical challenges

① **Variability**

② **Contaminants** *(Ammonia, bacteria, trace organics, etc.)*

③ **Salinity** *(TDS)*

④ **Emerging parameters**



① **Water quality control**

② **Scale, fouling and corrosion control**

③ **Best reuse practices**

① **High performances**

② **Economic viability**

③ **Best available technologies**

④ **Redundancy**

Risk management : science & engineering

R&D & Technical support of Suez Environment

UK-Langford/ Northumbrian Group

Application: Indirect Potable Reuse

R&D: Advanced Treatment/ Endocrine disruptors/ Environmental Impacts

DORE (CIRSEE), France

R&D: Water quality contro/ Treatment systems

Bolivia / Aguas de Illimani

Applications: Irrigation

Techniques: Red beeds

R&D: Capex/Opaex optimization, Disinfection

West Basin / WBMWD and United Water

Application: aquifer recharge, irrigation, industrial uses

R&D: - UV/ Aquifer recharge/Trace organics/Quality in distribution network

Spain / AGBAR

Applications: Irrigation and aquifer recharge

R&D: - Treatment lines including Infiltration-percolation, UV, ozone

- membranes (MF/RO, MBR)

- cost optimisation

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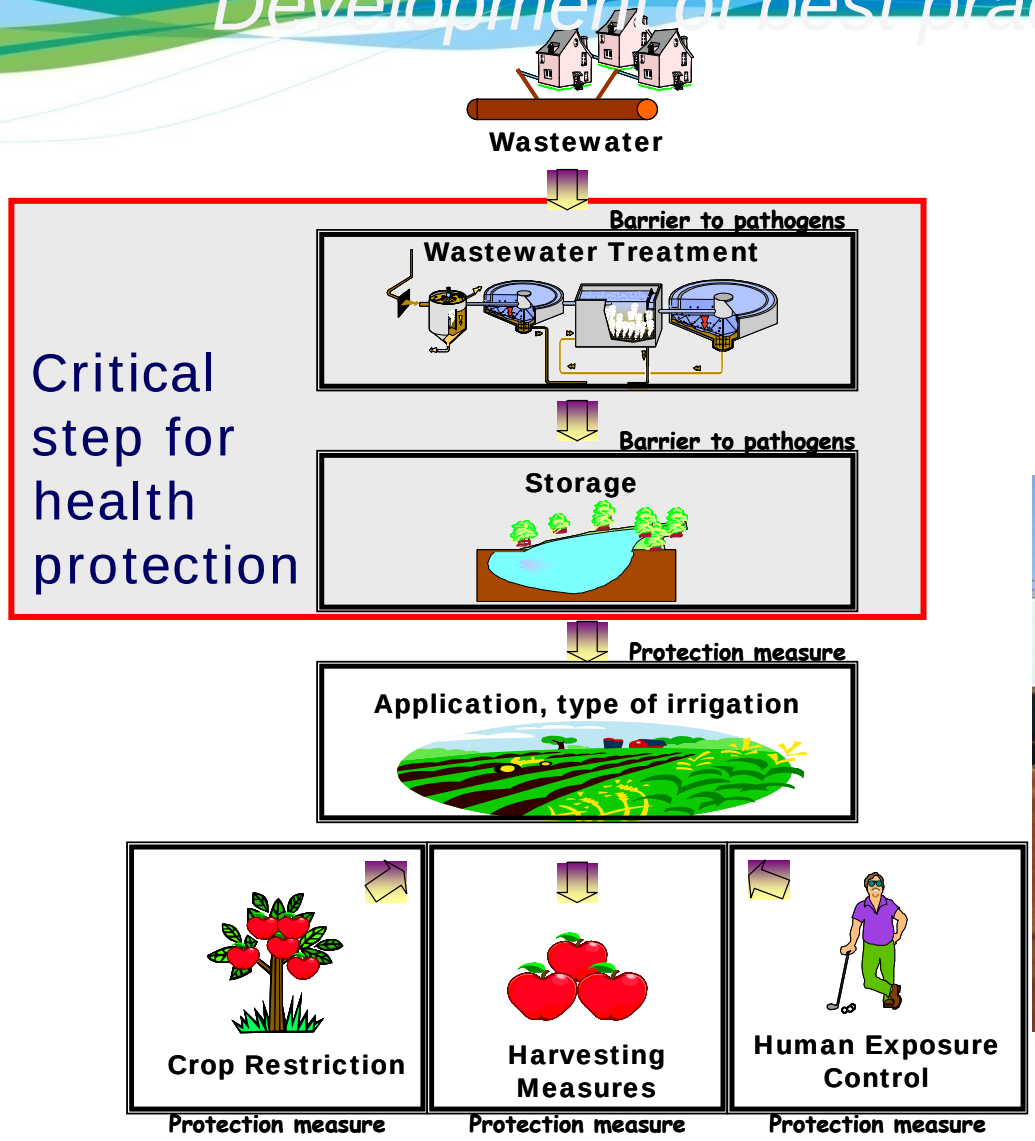
Science and Know-how management

Development of best practices and guidelines



❶ Guidelines for design and operation,

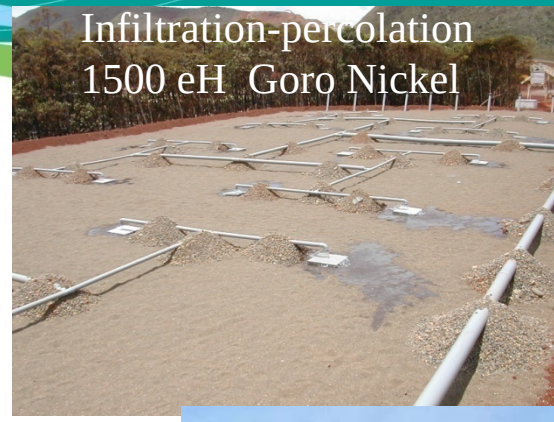
❷ Best practices of irrigation with recycled water.

Operation: Goals & challenges

1. **Support client's goal**
2. **Provide technical assistance & R&D support**
3. **Safely/reliably & cost effectively process operation**
4. **Operability 24 hrs & 365 days a year**
5. **Suggest innovative uses of high-quality recycled water**

Best technologies for a given use?

Non conventional technologies


Infiltration-percolation
1500 eH Goro Nickel

- **Applications**: Irrigation (agriculture, landscape)

- **Target for disinfection**: <1000 FC or *E.coli*/100 mL

- **Optimum size**: small to medium treatment facilities

- **Main advantages**: Low operation costs and ease of operation


Rhizopur®


Lagooning


Goro Nickel Reedbeds


Rhizofiltration

Conventional tertiary treatment

- **Applications** (non-potable uses)
  - ✓Landscape irrigation
  - ✓Urban uses
  - ✓Industrial uses
- **Targets for disinfection**:

Noosa Waste Water Treatment Plant, Noosa Heads, Queensland	
Project	Waste Water Treatment Plant
Client	Noosa Council
Contract	Develop, Build and Operate
Completed	1997
Contract Period	25 years
Estimated Population Served (EP)	45,0000
Plant Capacity	18ML/day Average Dry Weather Flow (Stage 2)

Membrane treatment

⇨High growth and demand for membrane systems

- * Physical barrier for microorganisms
- * Improved removal of priority substances and emerging parameters
- * Small land footprint
- * Fully automated
- * Numerous proved technologies
- * Decreasing capital costs

Membrane treatment and repurification

- **Applications**
  - ✓Unrestricted urban uses
  - ✓Indirect potable reuse/Aquifer recharge
  - ✓Industrial uses
- **Targets for disinfection**
  - ✓0 to <200FC/100 mL)
- **Other Targets**
  - ✓Trace organics, emerging parameters, desal


Microfiltration


Submerged membranes


Reverse osmosis

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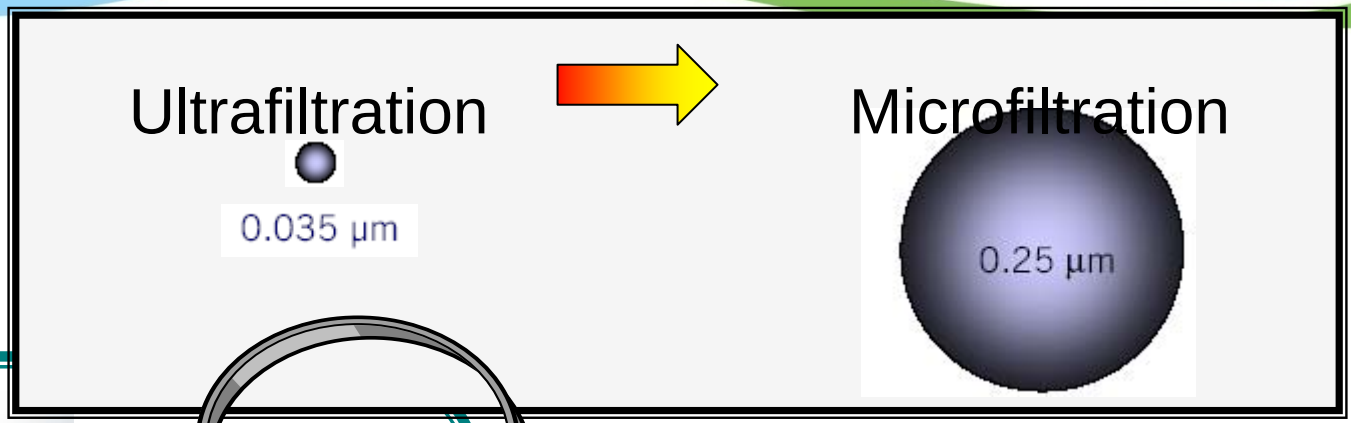
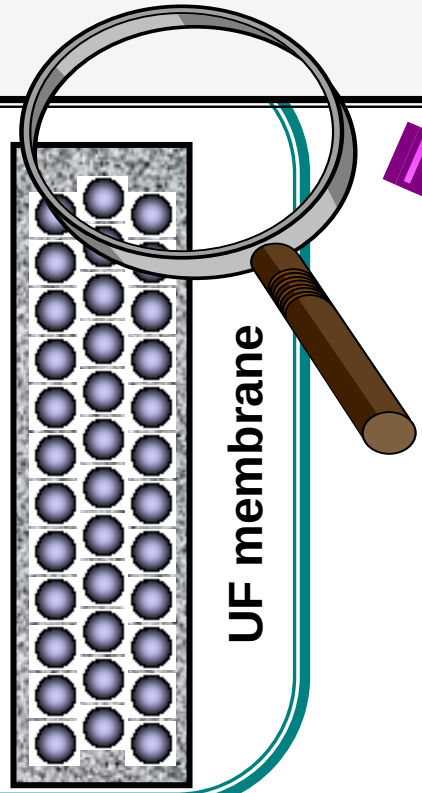
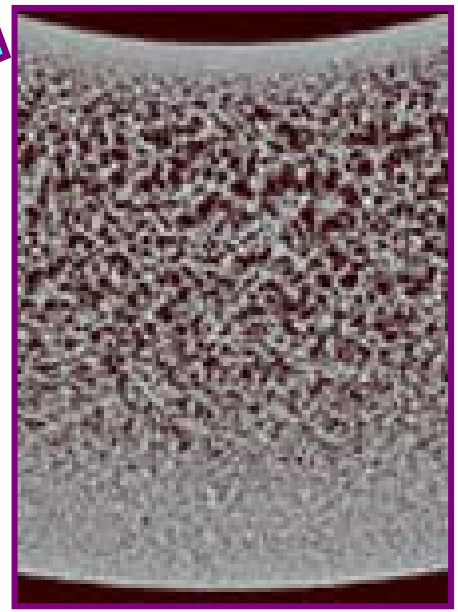
Disinfection efficiency of ultrafiltration



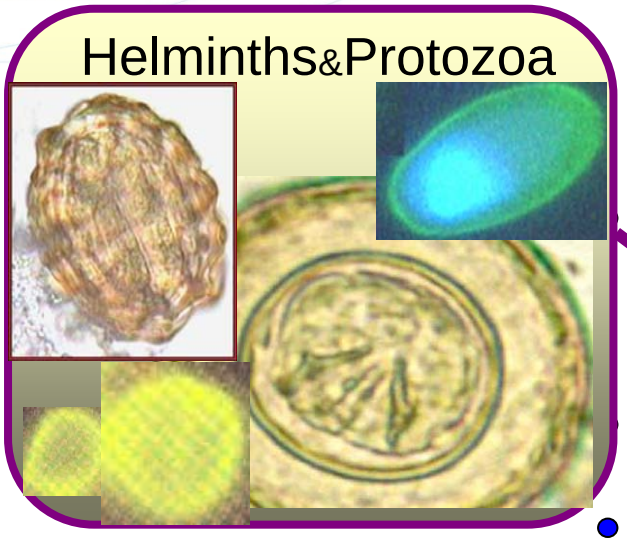
Bacteria
0.2 – 10 µm

Viruses
0.02 – 0.085 µm





Membrane coupling



Virus

Low pressure membrane

UF

Salt

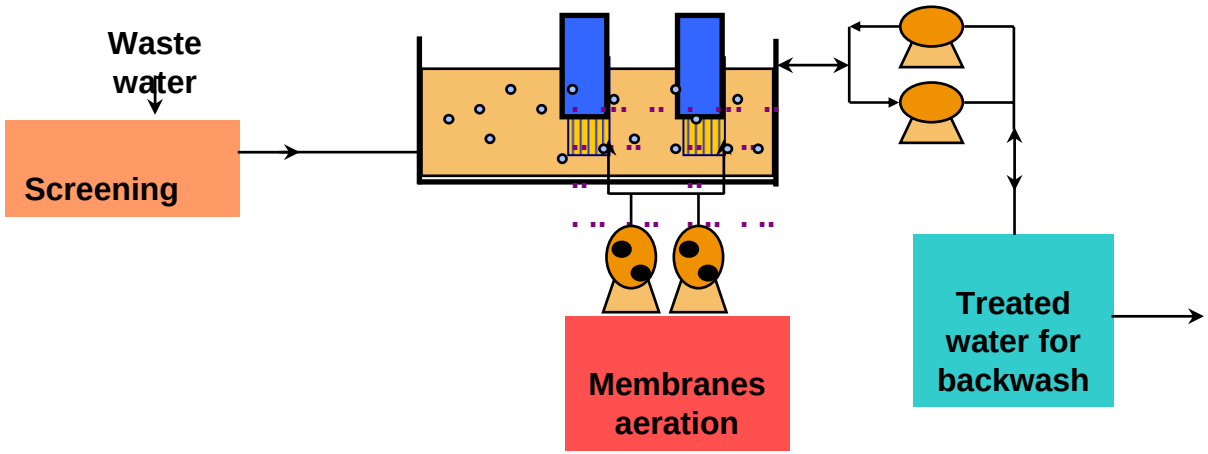
High pressure membrane

RO

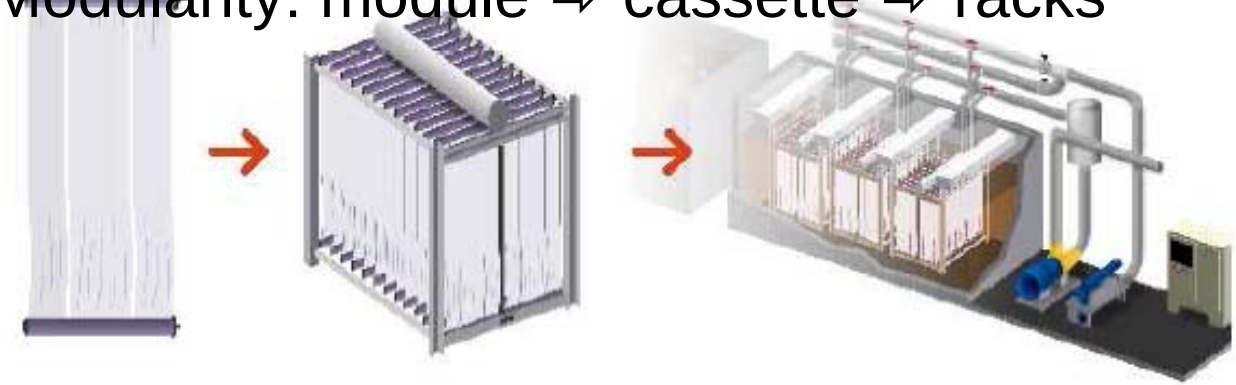
Water

Principle of operation of tertiary submerged membranes

- Filtration / cleaning cycles based on the following scheme:



- Modularity: module ⇨ cassette ⇨ racks



Urban water reuse in Bora Bora

- Drivers: water shortage & repetitive droughts
- Political awareness: incentives of BB's Major
- Policy of sustainable development:
  - * Pavillon Bleue Europe since 6 yrs
  - * 1st price SUEZ 2005 Innovation Trophies

Goro Nickel 1500 ep WWTP

- **Prestine area preservation**
- **Health security for treated water reuse on dust road**
- **Treated effluent quality guarantee for reuse**

ULTRAFOR water quality

Paramètres	Eau Brute	Boues activées conventionnelles	CYCLOR	Biofiltration	ULTRAFOR
DBO5 (mg/l)	200-300	5-6	4-5	5-6	3
DC0 (mg/l)	550	55	45	55	30-35
N.NH4 (mg/l)	35-50	1	1	1-2	1
N Total (mg/l)	50-70	10	10	10	7
MES (mg/l)	250-300	15-25	5-10	10-15	< 2
Pt (mg/l)	10-15	1	1	1	0,5
Turbidité (NTU)		8-12	5	6-10	0.5

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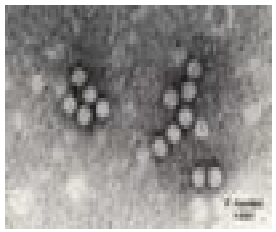
Goro Nickel 1500 ep WWTP

o BRM = answer to prestine area preservation



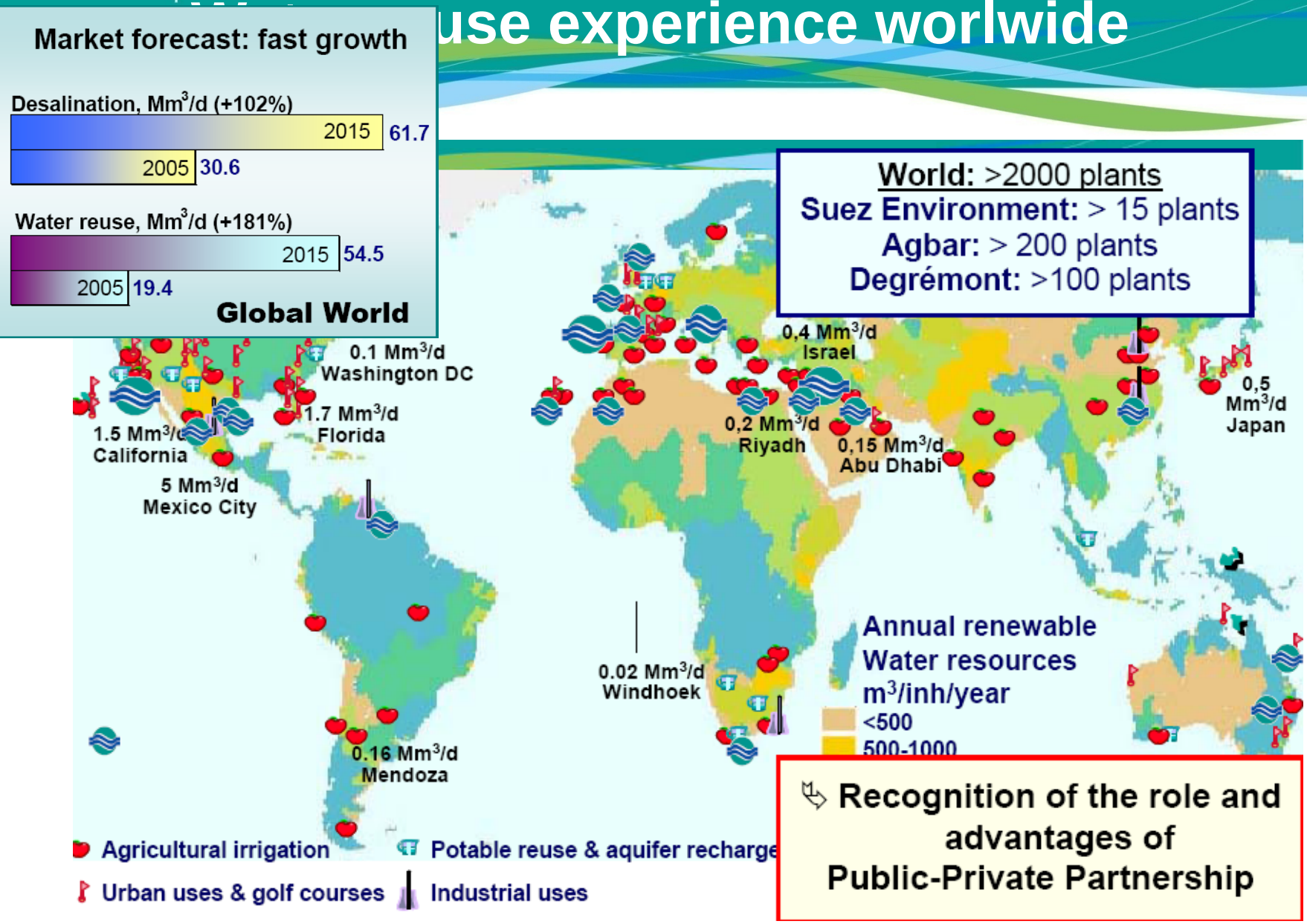
Watering standards achievement

	Classical	UF
Helminthe eggs	Partial removal without sand filter	Total removal
Tot Coli	1,5 to 2 log	> 4 log
Fec Coli	1,5 to 2 log	> 3 log

Recycled water end-users

- * Luxury hotels, mostly landscape irrigation
- * Boat washing
- * Civil engineering
- * Fire protection
- * Agricultu

use experience worlwide



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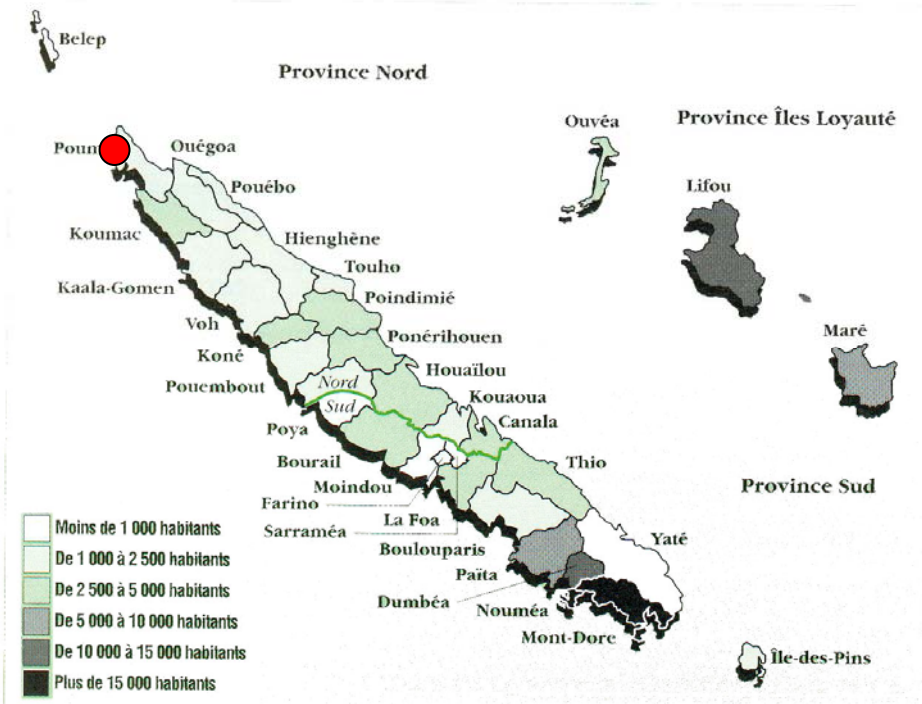
Desalination: Potable water with reverse osmosis (140 m3/d) for Malabu Hotel, New Caledonia



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Desalination: Perth, Australia

- Capacity : 150 000 m3/d

ONG MARS 2 x 5 Tons/day

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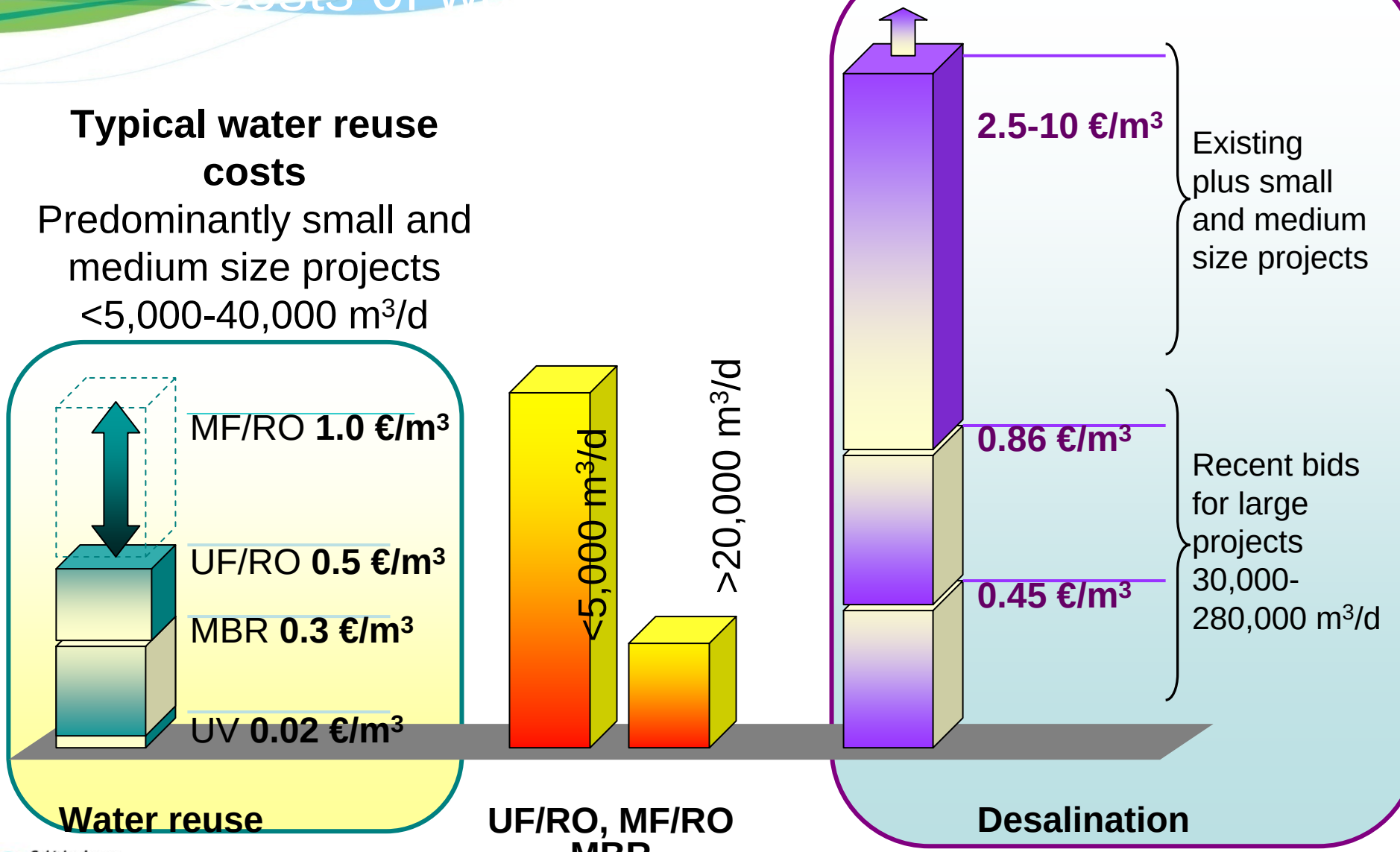
CONCLUSIONS
Costs of water recycling

Typical water reuse costs

Predominantly small and medium size projects <5,000-40,000 m³/d



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CONCLUSIONS

Benefits of water recycling

- **Alternative resource**
  - ⇨ Reliable, secure and drought-proof water source
  - ⇨ Fast and easier implementation than new freshwater supply (high value for Islands)
- **Water conservation**
  - ⇨ Saving of high quality freshwater water for potable water supply (high value in tourist areas)
- **Environmental value**
  - ⇨ Reduced pollutant discharge (beaches, lagoons)
- **Economic value**
  - ⇨ Avoided costs for new freshwater resources development, transfer and pumping (water transfer, new desalination plants, etc.)
  - ⇨ Secondary economic benefits for customers and industries
    - ✓ for example in 2005 in Bora Bora, 2-3 M€ saving for construction companies and hotels thanks to the supply of recycled water

CONCLUSIONS
Water recycling keys success

- **Strong support** by local authorities & end-users with recognition of water reuse benefits,

- **Careful design** & **good operation** for relaible production of high quality recycled water,

- **Technical know-how** and R&D support,

- **Communication** & **public education.**