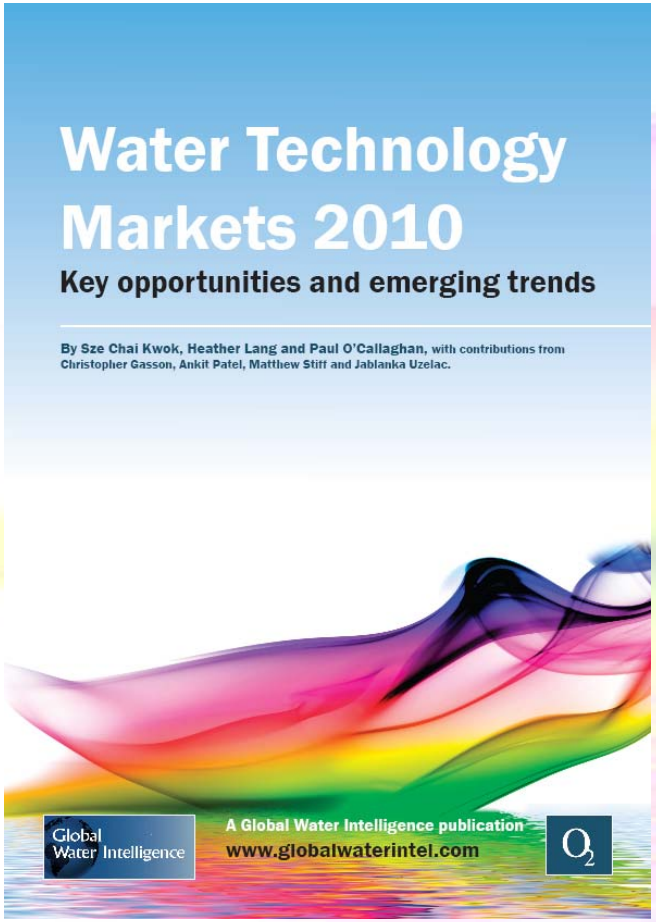

The Membrane Water Technology Market

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The Membrane Water Market

Application of Membrane Technology in the Water & Wastewater Market

Market Characterization

- by technology
- by application
- by business model

Drivers

Players

Membrane Technology

Desalting/Removal of Dissolved Organics

- Reverse Osmosis (RO)
- Nanofiltration (NF)

} *Dense membranes*

Membrane Filtration

- Ultrafiltration (UF)
- Microfiltration (MF)

} *Porous membranes*

Membrane Bio-Reactors (MBR)

- UF and/or MF membranes coupled with aerobic bio-reactor

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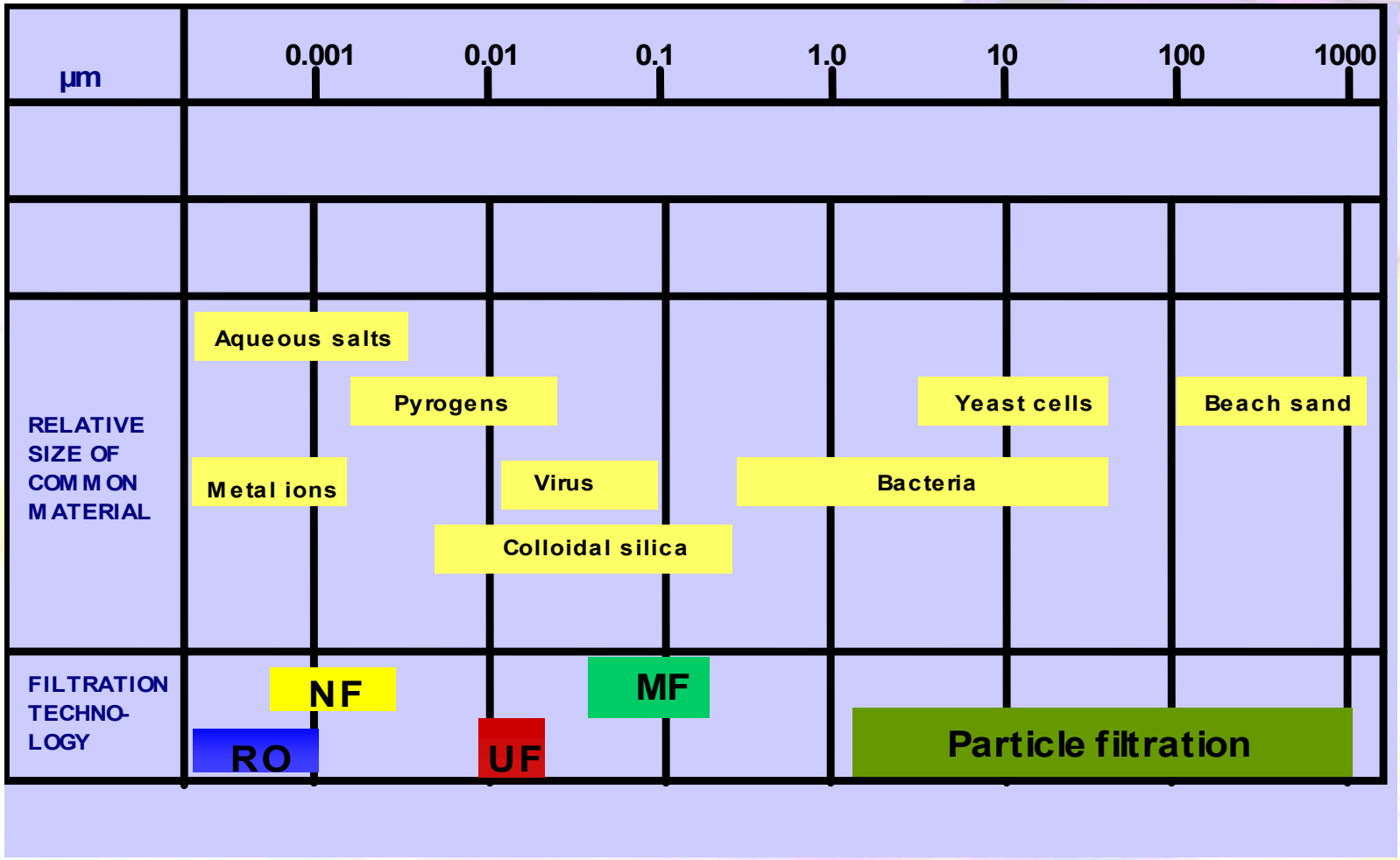
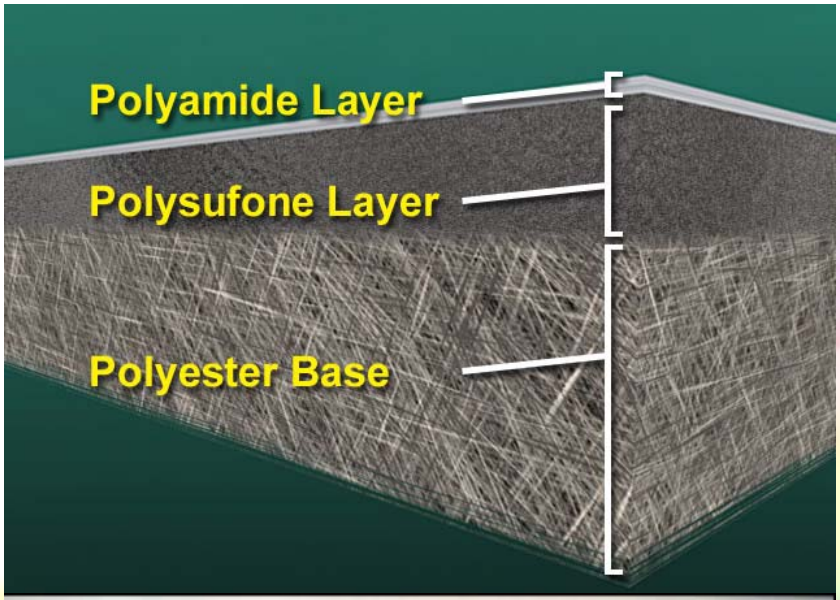
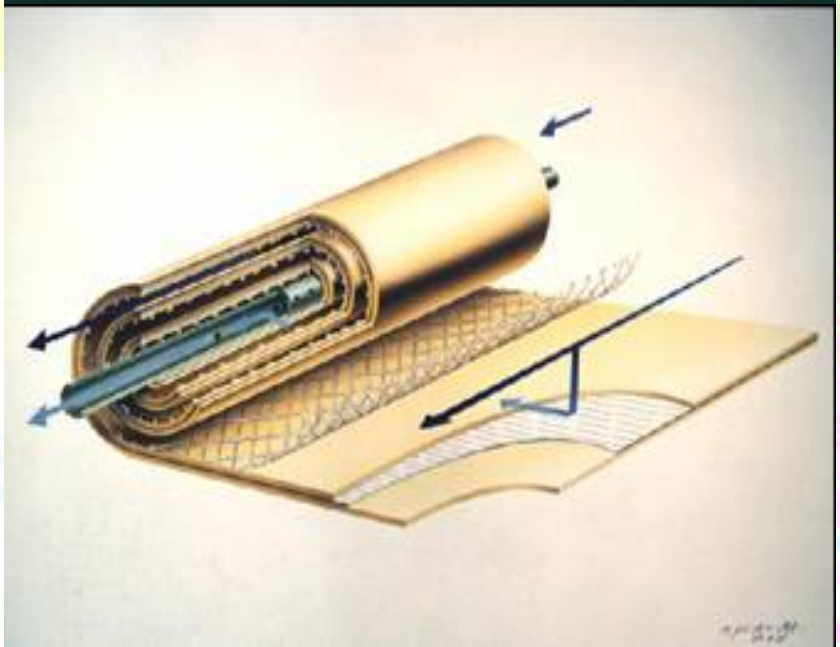
The Membrane Filtration Spectrum for Water & Wastewater Treatment



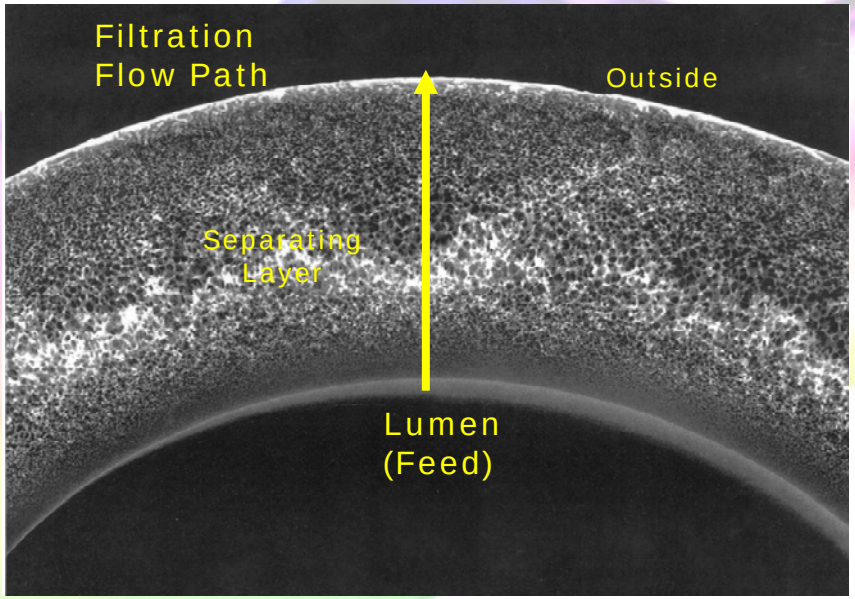
Membranes & Membrane Products

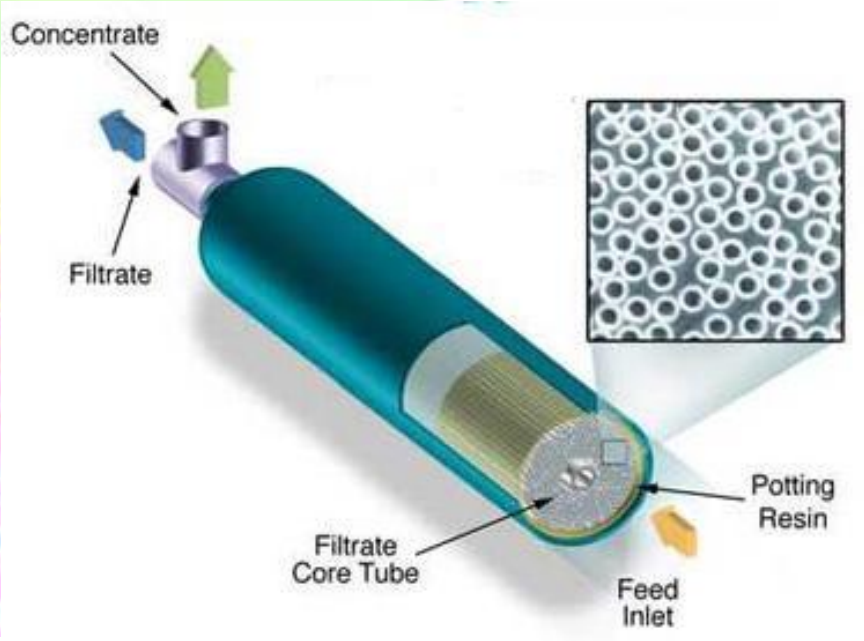
RO Membrane & Spiral Wound Element





MF/UF Membrane & Hollow Fiber Module





Membrane Applications

Municipal Drinking Water

- MF/UF to meet crypto and virus legislation
- Some RO, emerging opportunity for NF for pesticides (& EDC?)

Industrial Water

- MF/UF and RO

Desalination (Seawater & Brackish water feeds)

- RO and MF/UF for pre-treatment

Wastewater Reuse

- MF/UF (post conventional treatment), MBR, RO

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Business Models

Material

- fabrication of membrane fibers or flat sheets
- not a business model used in the water market

Component

- fabrication of both membrane and membrane element or module
- almost the exclusive model for the RO market
- approx 50% of MF/UF and MBR suppliers use this model

System

- provision of package plants, systems, or full solutions
- approx 50% of MF/UF and MBR suppliers use this model

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Drivers

Scarcity

- RO used in arid areas such as the Middle East since the 1970's
- RO now considered as resource option for coastal development, eg California, Australia, NE China
- Wastewater reuse now emerging

Legislation

- MF/UF introduced to meet crypto and virus removal requirements
- Emerging contaminants could provide the next driver for NF membranes

Energy

- Desalination energy is too high for general application, especially since the energy required has the highest 'C' footprint in the energy hierarchy
- Wastewater reuse provides an attractive alternative
- Low energy/waste energy options would revolutionize resource development

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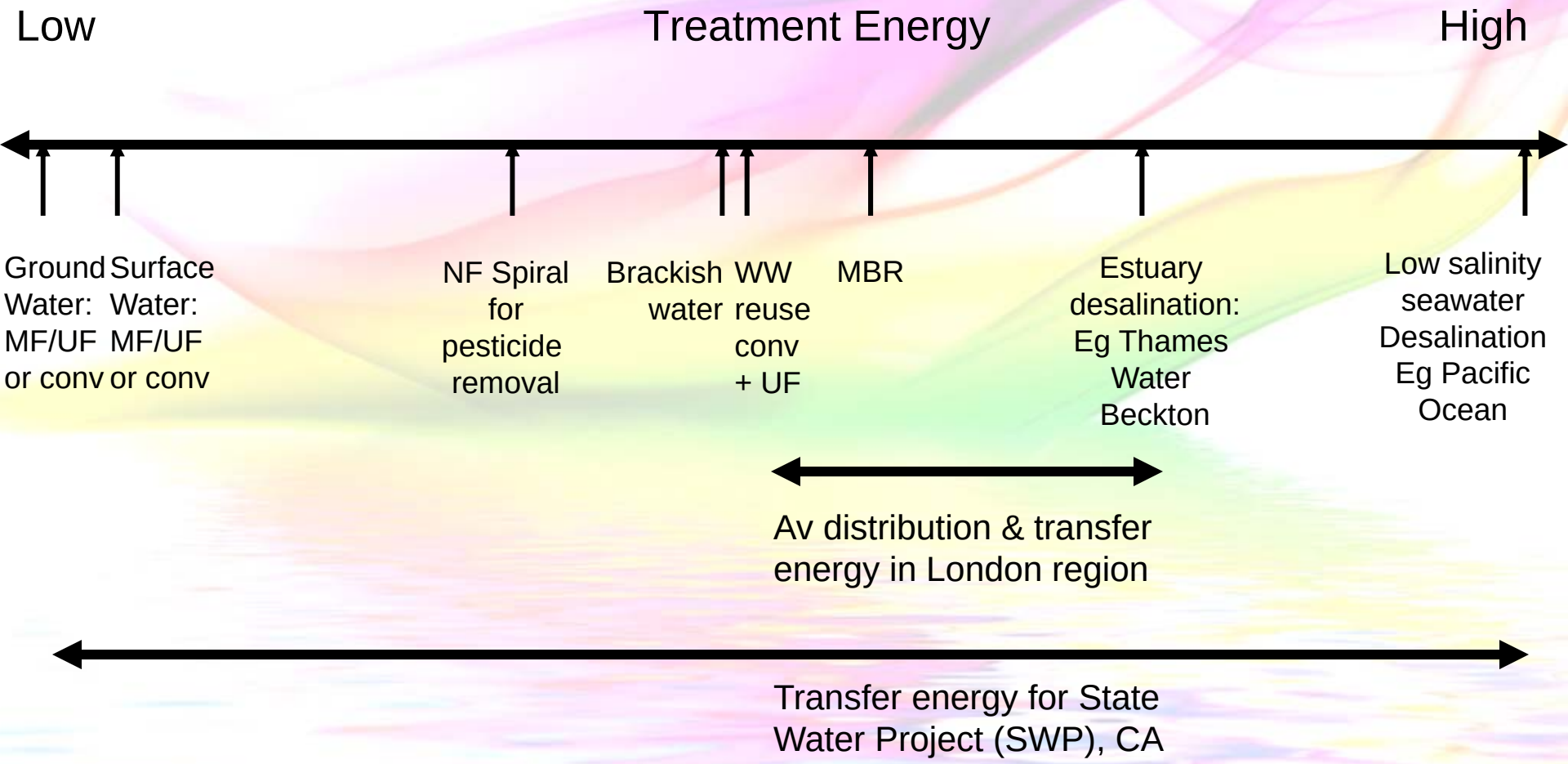
Energy Requirements of Treating Different Water Sources



Market Profile

RO

- Settled, mature, low margin, addressing a well defined market
- Incremental improvements, approaching developmental asymptote
- Threat from disruptive technology

Membrane Filtration

- Established, still developing, good margin, addressing a well defined market
- Significant improvements still being made
- Possible threat from ceramics

Membrane Bio-Reactors (MBR)

- Emerging with established niches, variable margin
- Full market potential still to be realized due to high energy use

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Market Potential

The membrane water market is approx $1bn for module/element sales

RO

Growth 10%

Current profit potential up to 5%

Membrane Filtration

Growth 16%

Current profit potential up to 15%

Membrane Bio-Reactors (MBR)

Growth 17%

Current profit potential up to 10%

Players

Technology	International Players	Dominant companies	Regional	Total
RO/NF	6	4	3 - 4	10
MF/UF	12	4	20 - 30	50
MBR	8	2	30 - 45	60
Total	**22**	**9**	**80**	**100**

>10% market share

Some companies supply more than one membrane technology

- RO/NF and MF/UF companies all own IP and make membranes
- RO/NF is a mature, competitive, low margin market, dominated by few players
- Dominant RO companies also offer MF/UF but are not dominant in both sectors
- MF/UF has more players with a diverse product offering and good profit potential
- MBR has few dominant players and many regional specialists
- MBR companies don't necessarily have to make the membrane

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Ownership Profile

- New membrane technology normally introduced through a start up company, then company purchased by a major corporate player after a few years
- RO/NF companies are all subsidiaries of large corporations
- Most MF/UF and MBR companies are also corporate subsidiaries but there are some still at the independent stage

MF/UF Case Studies

Company	Norit	Inge
Country	Netherlands	Germany
Original start up	1989	2001
Current ownership	Private equity	VC consortium
Membrane Sales, $m	130	21
Growth	16%	13%
Profitability	15%	low +ve

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Emerging Membrane Technologies

BlueTech Tracker™ - Snap shot of selection of emerging Membrane Technology Companies

Company	Technology Offering	Concept	Disrupto-meter		
			Not Disruptive	Moderately Disruptive	Highly Disruptive
NanoH2O Inc	Nano Technology for Reverse Osmosis	Use of nanotechnology to improve membrane performance and reduce energy required to desalinate water.		O	
Oasys Water Inc.	Engineered Osmosis™	Energy & resource recovery. Use of low grade heat to desalinate water using an innovative draw solution and forward osmosis membranes.			O
Stonybrook Purification	Stonybrook Membranes	NanoTech Membranes which use a nano-fibrous supporting scaffold to reduce membrane thickness and increase porosity.		O	
Aquaporin	Aquaporin Membranes	Use of aquaporin proteins to create biomimetic membranes to produce high purity water at low energy inputs.		O	

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