Are you ready for water reuse?

Membrane Evolution 6

Water Technologies

SIEMENS

Reuse. Keeping the World's Water Flowing.

We live in a time of global concern about drought, water scarcity, water stress and water restrictions. According to the International Water Management Institute, water scarcity affects one-third of the world's population. As a result, cities around the world are facing escalating water costs and deteriorating water supplies. Additionally, natural disasters, including floods, hurricanes and wildfires, are contaminating our already depleted fresh water sources, affecting their quality.

The need for alternate water sources is more urgent than ever before. Today, more and more green initiatives are helping to reduce water usage, along with larger-scale solutions such as desalination, water reclamation, repurification or reuse. These terms are not trends, but a reality that many countries around the world have embraced to ensure sustainable water sources for years to come.

This sixth edition of *Evolution* answers your questions about water reuse and points to efficient and practical methods to address growing water scarcity concerns. Using innovative water reuse technologies, communities have the ability to treat existing water sources to a quality at or above their existing drinking water standards.

The goal of this piece is to help you maximize one of your community's most precious resources—water. By illustrating the applicability of water reuse, discussing its economic and environmental benefits, and presenting the safety and efficiency achieved by using membrane technology, large cities and small towns across the globe can conserve their water and ensure its availability for generations to come.

We hope you find this piece informative, and as always we welcome comments or input. E-mail us at memcor.water@siemens.com. You can also visit us at www.siemens.com/memcor_evo6.

Reuse makes pure sense.

Water is naturally recycled through the hydrologic cycle and eventually, makes its way back to fresh water supplies. The aim of water reuse is to incorporate advanced technologies to expedite this natural process. Using reclaimed or repurified water, scarce water sources are augmented, putting less strain on potable supplies and providing a sustainable resource for agriculture, irrigation, industrial operations and seawater intrusion prevention for coastal aquifers. Water reuse also reduces wastewater discharge to oceans, lakes and rivers, making it an environmentally conscious option.

In addition to being environmentally friendly, water reuse is also a prudent economic choice for communities seeking a solution to water shortages. For example, the capital costs to produce water from seawater, or desalination, are roughly two times the costs to reuse secondary effluent. Also, the costs for concentrate disposal and energy usage are much higher for desalination than for water reuse. Additionally, desalination is only a viable option for coastal areas. With the demand for global water reuse expected to rise more than 180 percent over the next decade **(Kolodziejski & Gasson, 2005, p. 5)**, it stands to reason that water reuse is an adaptable and comprehensive solution.

To achieve success, water reuse projects must use technologies that offer:

- Safe, high-quality water
- Long-term reliability
- Low operating costs
- Reduced use of chemicals
- Small, compact footprints

Membrane technology meets these criteria and enables wastewater to be reclaimed and reused for both potable and non-potable use, safely and reliably. MEMCOR® membranes have been implemented with great success all over the world, transforming alternative water sources into usable water.

Global Water Intelligence. (2005). *Water Reuse Markets 2005-2015: A Global Assessment and Forecast* (1st edition). Oxford, UK.: Kolodziejski, J. & Gasson, C.

MEMCOR® Membranes Provide Water Reuse Solutions.

Pressurized Membrane Filtration

- Simple, slab-on-grade installation
- Operated in a closed environment
- All membrane modules individually isolatable
- Products — MEMCOR® CP and MEMCOR® XP Membranes

Submerged Membrane Filtration

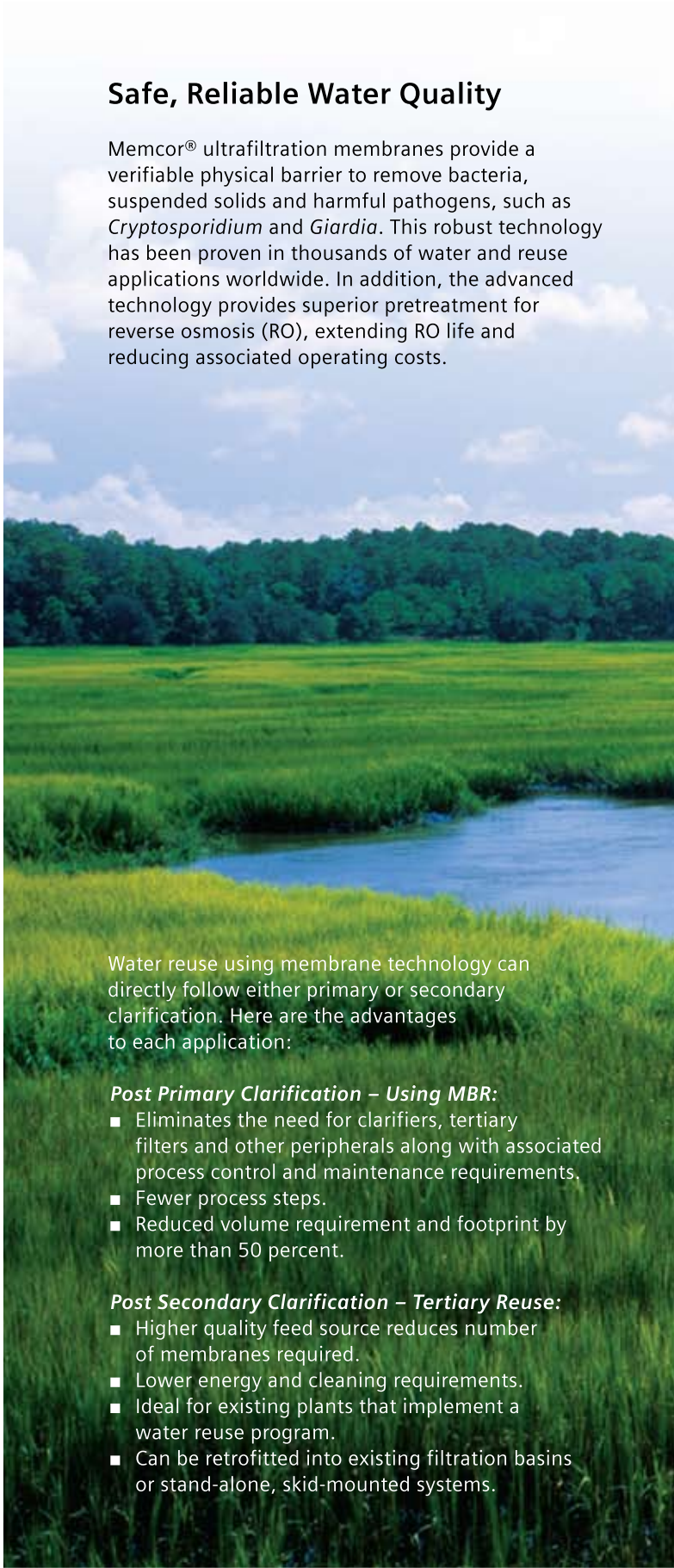
- Operated in open tank design
- Feedwater flows by gravity into membrane cell
- Ideal for retrofitting existing filter basins
- Low energy usage, compact footprint
- Products — MEMCOR® CS and MEMCOR® XS Membranes

Membrane Bioreactor (MBR)

- Operated in open tank design
- Mixed liquor is pumped into the membrane bundles
- Modules are separated from biological treatment, optimizing both processes for enhanced performance
- Products available — Orbal® Multichannel Oxidation System, VertiCel® Aeration Process, VLR® Loop Reactor, MemJet® MBR, Cannibal® Solids Reduction System

Safe, Reliable Water Quality

Memcor® ultrafiltration membranes provide a verifiable physical barrier to remove bacteria, suspended solids and harmful pathogens, such as *Cryptosporidium* and *Giardia*. This robust technology has been proven in thousands of water and reuse applications worldwide. In addition, the advanced technology provides superior pretreatment for reverse osmosis (RO), extending RO life and reducing associated operating costs.



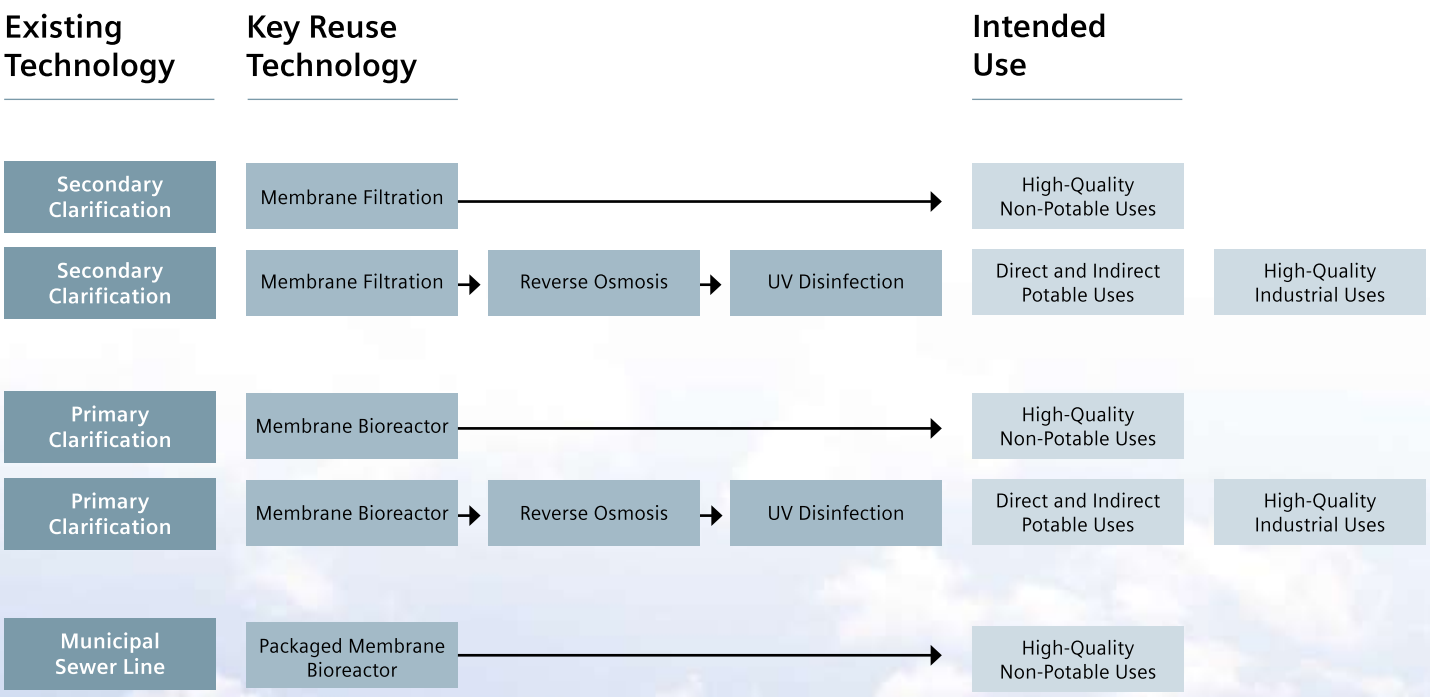
Water reuse using membrane technology can directly follow either primary or secondary clarification. Here are the advantages to each application:

Post Primary Clarification – Using MBR:

- Eliminates the need for clarifiers, tertiary filters and other peripherals along with associated process control and maintenance requirements.
- Fewer process steps.
- Reduced volume requirement and footprint by more than 50 percent.

Post Secondary Clarification – Tertiary Reuse:

- Higher quality feed source reduces number of membranes required.
- Lower energy and cleaning requirements.
- Ideal for existing plants that implement a water reuse program.
- Can be retrofitted into existing filtration basins or stand-alone, skid-mounted systems.



	Advantages	Limitations
Membrane Filtration	Positive physical barrier to pathogens, biosolids and turbidity Handles widely changing feedwater conditions and flow rates Simple, automated operation with minimal labor required Significant reduction in footprint and low cost per gallon	Higher capital cost than granular media filters Will require membrane replacement at some point
Membrane Bioreactor (MBR)	Same advantages as Membrane Filtration, plus: Increased SRT for more complete destruction of nutrients Higher density sludge for easier dewatering or transport	Higher capital cost than granular media filters Will require membrane replacement at some point
Reverse Osmosis (RO)	Reduces TDS and THM precursors Provides water suitable for direct or indirect potable use with disinfection Provides high-quality water for industrial uses	Requires effective pretreatment for scaling by sparingly soluble salts Fouling by suspended solids Degradation from oxidants and metals

Water Reuse Answers From the Global Community

So how do you choose the best alternative for your community? Here are some questions that we are frequently asked.

Q Can water be reused for more than non potable uses

A Yes, in fact, using innovative technologies, water can be repurified for potable use. In some areas, drought coupled with a high cost to import water forces communities to look to these alternative methods. In Singapore, a country with 4.5 million people living on only 693 sq. km (267 sq. miles) of landmass, source water is at a premium and water scarcity is impending. In an effort to ensure a sustainable water supply for the future development of Singapore, a NEWater study determined the efficacy of a new source of high-quality water by combining dual membrane technology and UV.

The success of the study led to the construction of the full-scale reuse plants. The Kranji Reclamation Plant combines the Memcor® CS submerged membrane system with RO and UV disinfection to produce safe, reliable, high-purity water from secondary effluent.

Q Drought and water scarcity continue to be a major concerns in my area: What measures are other communities taking to mitigate these issues

A Perhaps one of the most talked about global water reuse undertakings is currently ongoing in Brisbane, Australia. Drought and population increase have created a severe water shortage, resulting in Level 5 water restrictions for much of the region.

State and local officials implemented measures to ensure the existence of a reliable source of water for non-potable use. The Western Corridor Recycled Water Project will provide 310,000 m3/d (80 MGD) for both domestic and industrial use. The project will take municipal wastewater from existing local wastewater plants and treat it to high-quality standards at three separate facilities using a tertiary low-pressure membrane approach. A major facility in the scheme will be the Bundamba Advanced Water Treatment Plant (BAWTP), which will treat 66,000 m3/d (17 MGD) by mid-2008 with ultimate expansion to 100,000 m3/d (26.4 MGD). At this facility, domestic wastewater is harvested from four wastewater treatment plants. Effluent is combined and sent to the BAWTP, where it is treated using a Memcor® CP ultrafiltration system and reverse osmosis.

Q What technology is the best option once we are ready for water reuse

A Traditional dual membrane technology (UF/RO) using secondary effluent as feed has become a widely accepted option for water reuse and has been in use for over a decade. However, MBR technology is a viable solution that offers unique advantages. In planning to host the largest sporting event in the world, water officials in China had to determine which technology would best serve the increased demand for water. In August of 2008, tourists, participants and officials from all over the world will descend on Beijing for the 29th Olympiad. After evaluating their options, the Beijing Drainage Corporation, the entity responsible for providing much of the non-potable water supply, selected MBR technology in order to meet their goal of producing high quality water, increasing overall production capacity and remaining in a small footprint. Once complete, the MemJet® MBR will expand the capacity of the existing Bei Xiao He plant from 40,000 m3/d (10.6 MGD) to 100,000 m3/d (26.4 MGD). Moreover, the water from the plant will meet stringent quality criteria.

Q I manage a small community: Is water reuse a viable option

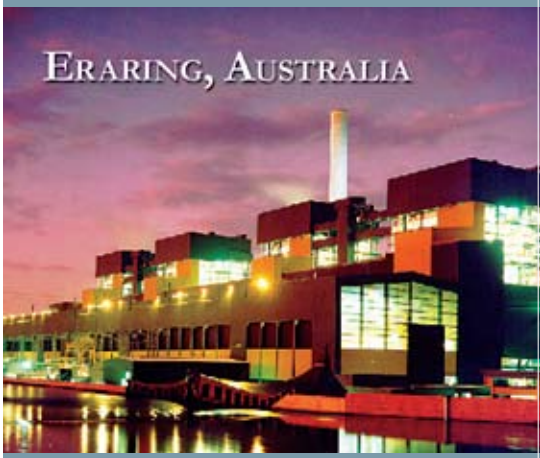
A Yes. Lanzarote, one of the seven Canary Islands, was facing an inescapable water shortage. The need arose for a drought-proof, reliable, tailored, quality water source at a lower cost than that offered through desalination. As a result, multiple small water reuse facilities were developed. The Memcor® membrane system, the industry standard for reliable pretreatment for RO on secondary sewage, resolved the island's problem of accessing a non-potable water source. The benefits of using the Memcor system at the Lanzarote installations included a silt density index of <2, reliable pretreatment for RO on variable sources, automatic validation of the system integrity and remote monitoring that reduced operating overheads.

Dual Membranes for Water Reuse Operation for Over a Decade

Eraring Power Station in New South Wales, Australia, was the world's first dual membrane water reuse system and has been operating for over a decade. The project grew out of the pressing need to reduce the demand on the local water supply and to protect the local environment from the impact of wastewater discharge. In the early 1990s, the facility, owned and operated by Eraring Energy, purchased its boiler feedwater from Hunter Water Corporation, a New South Wales water utility. As part of a wastewater treatment plant upgrade, Hunter Water was faced with an expensive 6 km (3.7 mi) outfall pipe to the ocean.

At the advice of a visionary power plant chemist, the facility decided to build an advanced treatment system that included Memcor® low-pressure membrane filtration and reverse osmosis. This dual membrane process reused the wastewater, producing quality water and eliminating the need for a costly pipeline.

This project freed up as much as 3,100 m3/d (820,000 gpd) of potable water from the local community. It also significantly minimized the plant's boiler feedwater costs while providing higher-quality water. Even better, it prevented effluent discharge to the environment.



Q I have an existing reuse plant but need to reduce operating costs: What s the most economic solution

A Membranes can provide significant cost savings for water reuse. For California's Orange County Water District—Water Factory 21 (WF21), the threat of seawater intruding into the groundwater basin and the need to recharge its reservoir prompted the water district to maximize the operations of its 30-year-old reuse plant and, simultaneously, minimize its operating costs. To deal with this, the water district teamed with Orange County Sanitation District (OCSD) in a joint development program. The initiative, the Groundwater Replenishment System (GWRS), is set to reclaim 492 m3/d (130 MGD) of secondary effluent wastewater, making it one of the largest ventures of its kind in the world.

After many years of operation, the water district confirmed that the key issue to be addressed was more effective reverse osmosis (RO) pretreatment. As a result, in 1992, the water district began a series of extensive pilot studies with low-pressure membrane systems.

Pilot studies revealed that the effluent from the membrane system removed micro-organisms and suspended solids, had significantly reduced turbidity, and most importantly, produced an SDI that was a factor of four lower than the best SDI value for the existing lime pretreatment. Because of the lower SDI, RO system life would be extended and operating costs were dramatically reduced.

The GWRS Advanced Water Treatment facility has since replaced lime clarification with low-pressure membranes. The new facility includes Memcor membranes, RO and UV. The Memcor® CS submerged system is composed of 26 compact modular units that provide more than twice the capacity of a conventional treatment system in the same footprint. It does not require chemical pretreatment other than pre-chlorination, is highly automated and less maintenance-intensive, resulting in less operator attendance.

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