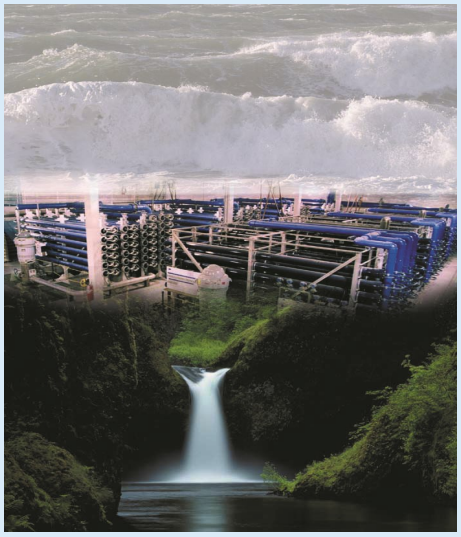
American Membrane Technology Association

America's Authority in Membrane Treatment

Membrane Desalination Costs

The growing demand for fresh water in many areas of the world, due to drought, water shortages, population increases and the desire for high quality drinking water, has spurred unprecedented interest in the process of desalting seawater or brackish water (less salty than seawater, but not fresh) to increase the reliability and quantity of water supplies. Long used on ships, island resorts and in water-short countries, the practice of employing desalting technology to produce large-scale domestic supplies is only a few decades old in the United States.



Currently, more than 1,300 desalting plants are operating in the United States, producing over 400 million gallons per day of high quality water, mostly for drinking, with an anticipated investment for the next 5 years of almost $3 billion. Worldwide membrane and thermal desalination capacity is over 11 billion gallons per day from over 12 thousand plants, worth $9.2 billion per year, growing at a rate of 12% per year. Desalinated water has found many uses throughout the world. As shown in Figure 1, the largest of which is the production of acceptable quality drinking water. This water, in general, meets the US health and safety standards of the Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) as well as standards established by other global Agencies, such as the World Health Organization (WHO).

Figure 2 shows the general cost reduction trend in the last few decades, in producing water using brackish and sea water sources.

Over the last 3 decades, pricing for desalting elements has been reduced substantially. As shown in Figure 3, due to technological improvements by suppliers, automation in the manufacturing process and competition, there have been significant reductions in seawater membrane costs. Similar trends have been present in brackish water modules.

Most US plants in coastal areas, desalt brackish waters, as local sources of fresh and brackish water are depleted. However there will be more large-scale seawater desalting plants built, most likely in California, Texas and Florida. Many growth opportunities exist in commercial, industrial and municipal applications for furthering the supply of good quality, low salinity water.

The most common objection to using desalted water to help meet the nation's growing water needs is that. "The process is too expensive." This is no longer valid since recent developments in both technology and processes have dramatically decreased the cost of desalting water using membrane technologies.

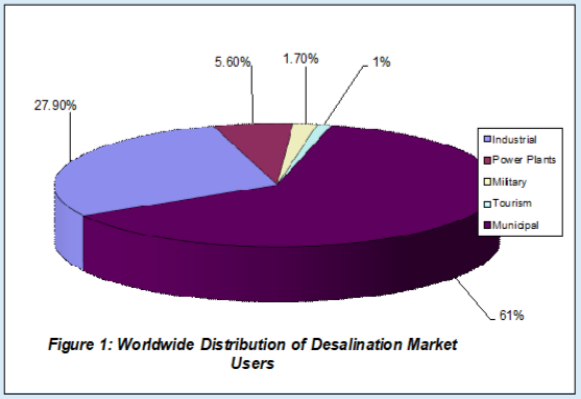


Figure 1: Worldwide Distribution of Desalination Market Users

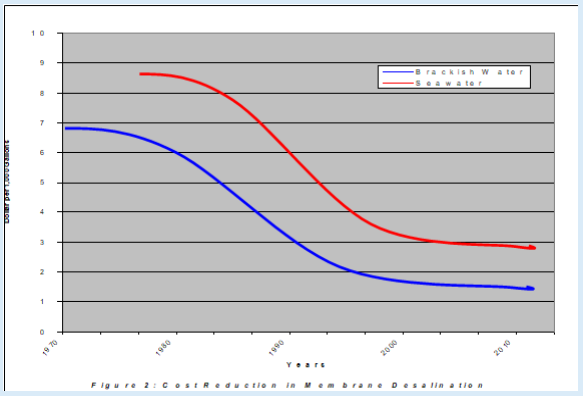


Figure 2: Cost Reduction in Membrane Desalination

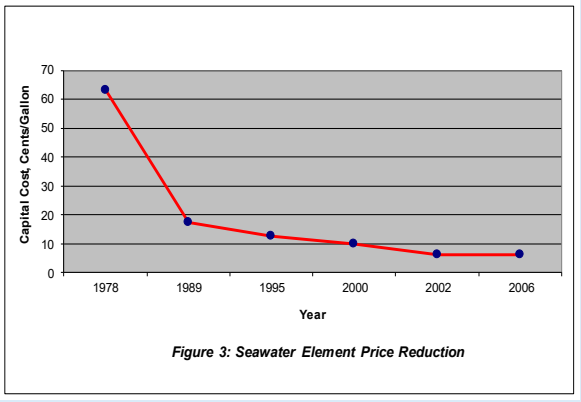


Figure 3: Seawater Element Price Reduction

Desalting Cost as a Portion of Total Supply

In most cases, desalted water is not the sole source of a community's supply. It is usually combined with water from less expensive sources. For instance, as shown in Table 1, if a community paying $2.50/1,000 gallons for its existing water decides to double its supply with desalted brackish water, in a worse case scenario, a typical family's monthly water bill would increase by about $3 per month. Similarly, if the augmented supply is 10% from desalted seawater, the monthly increase would be less than $6.60.

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TABLE 1: TOTAL WATER COSTS		
SUPPLY TYPE	To Consumer(1) **$ per 1000 gallons**	Total Family Cost(2) **$ per month**
Existing Traditional supply	$0.90-2.50	$10.80-$30.00
New Desalted Water:		
Brackish(3)	$1.50-3.00	$18.00-$36.00
Seawater(4, 5)	$3.00-8.00	$36.00-$96.00
Combined supply(6)		
Traditional + brackish	$1.20-$2.75	$14.40-$33.00
Traditional + seawater	$1.11-$3.05	$13.32-$36.60

1. *Price includes all costs to consumers for treatment and delivery.*
2. *Cost is based on a family of four using 100 gallons per day per person, for a totally monthly use of 12,000 gallons. Cost is based on the average of the "To Consumer" cost shown.*
3. *Brackish is moderately salty 1,000-5,000mg/L total dissolved solids (TDS).*
4. *Seawater contains 30,000-35,000 mg/L TDS.*
5. *Cost is for typical urban coastal community in the USA. Costs for inland communities may be higher.*
6. *Combined supply costs are for the traditional supply augmented with 50% of desalted brackish water, or 10% of desalted seawater.*

Desalting Versus Traditional Water Development

In the US, most inexpensive traditional water resources have already been developed. New sources of supply will be more expensive than the existing ones. Of the potential new treatment options, in many cases, desalting a local resource is financially and environmentally competitive with the traditional methods such as building dams, aqueducts, canals and waste treatment plants. Cost comparisons are often made to existing water supplies. Actually, since desalted water represents a new source of supply, comparisons should be made to the cost of developing other new sources, such as surface water impoundments, remote deep well fields, dams and long distance pipelines.

In the last decade, desalting technology has improved significantly and costs have decreased by over 50 percent. At the same time, the cost of developing traditional water sources has escalated, as drinking water quality and environ- mental standards have become more stringent. Inflation affected prices and the distances from source to consumer have also increased. In many water- short areas, the costs for desalted water are already competitive with the tapping of new traditional supplies. As alternative energy sources and improved processes and equipment are developed, additional desalting cost reductions can be expected.

Cost Factors and Graphs

The cost factors of desalting include capital costs and operating and maintenance costs. Costs can vary considerably from one locality to another based on a number of issues. In general, the amount of salt to be removed greatly affects the cost of desalting plant operation. The more salts to be removed, the more expensive the desalting process. The capacity of the facility also impacts costs, with larger plants generally being more economical. As shown in Figure 4, the larger the facility, the more cost efficient will be the utilization of equipment, labor and funds.

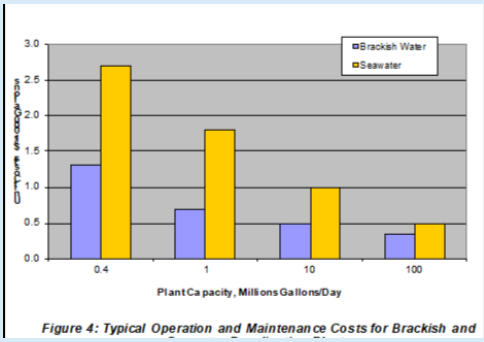

Figure 4: Typical Operation and Maintenance Costs for Brackish and

Energy and recovery of capital are the main ingredients of the total cost of water, amounting to about 75% of the total, as shown in Figure 5. To these values, 10-15% can be added for profit, if the desalting project is contracted as a sale of water. The energy cost portion of the total cost greatly depends on the power/fuel pricing.

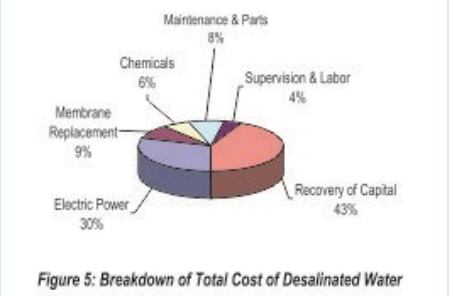

Figure 5: Breakdown of Total Cost of Desalinated Water

Other factors include the amount and type of pre and post treatment required, ancillary equipment selected, reliability, disposal of salt (concentrate), regulatory issues, land costs and conveyance of the water to and from the plant. Installing and operating a desalting plant involves a number of individual cost items, all of which are affected by local conditions. Figure 6 depicts typical breakdowns of these costs.

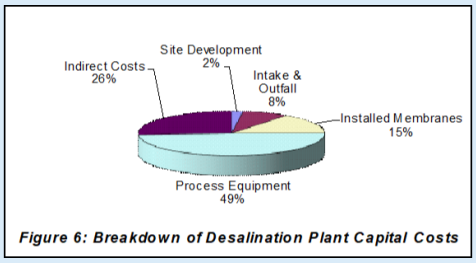

Figure 6: Breakdown of Desalination Plant Capital Costs

1. *Indirect Costs Include: working capital, taxes, insurance, land, engineering and project management.*
2. *Outfall cost does not include concentrate discharge treatment which sometimes could be a significant portion of the cost.*

This material has been prepared as an educational tool by the American Membrane Technology Association (AMTA). It is designed for dissemination to the public to further the understanding of the contribution that membrane water treatment technologies can make toward improving the quality of water supplies in the US and throughout the world.

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