KEY POINT: When making water policy decisions, the benefits and costs (and associated risks) of desal need to be compared with the benefits and costs of other water supply or demand options available.

SUMMARY OF ISSUES

When making water policy decisions, the benefits and costs (and associated risks) of desal need to be compared with the benefits and costs of other water supply or demand options available. The full range of benefits and costs associated with desal must be evaluated within the context of a utility’s overall “portfolio” of water supply options.

Costs of Desal, Alternative Water Supplies and Demand Management Measures

- Although the costs of desal have been decreasing, in most locations they are still quite high when compared with the costs of alternative water supply and demand management alternatives.

- It should be recognized that new fresh water sources will come at substantially higher costs compared to today’s existing supplies, since much of the easily developed fresh surface and groundwater sources in the United States are already being utilized. Further, as high quality fresh water becomes scarcer, additional resources will be needed to maintain or restore water quality. In the past, high quality fresh water required minimal treatment (and related costs) and delivery costs (NRC 2004); these factors may make desal a more competitive option in some locations.

- There are many instances in which demand management measures (e.g. conservation) can make water available for new uses at costs that are significantly lower than the costs of desal (NRC 2008). Market-like transfers of water, in which water is reallocated away from relatively low-valued uses to relatively high-valued new uses, can also be less expensive than desalting (NRC 2008 from Colby 1997; NRC 1992).

- In 2004, NRC’s Committee to Review the Desalination and Water Purification Technology Roadmap, compared the costs of existing traditional water supplies to those for desalted water. These costs are presented in Table 1.
### Table 1. Water costs to consumer, including treatment and delivery, for existing traditional supplies and desalinated water (2009 USD).

<table>
<thead>
<tr>
<th>Supply Type</th>
<th>Water cost to consumer $ per 1000 gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing traditional supply</td>
<td>$1.10-3.00</td>
</tr>
<tr>
<td>New Desalted Water:</td>
<td></td>
</tr>
<tr>
<td>Brackish</td>
<td>$1.80-3.65</td>
</tr>
<tr>
<td>Seawater</td>
<td>$3.65-9.70</td>
</tr>
<tr>
<td>Combined supply:</td>
<td></td>
</tr>
<tr>
<td>50% traditional supply and 50% brackish water</td>
<td>$1.45-$2.35</td>
</tr>
<tr>
<td>90% traditional supply and 10% seawater</td>
<td>$1.35-$3.70</td>
</tr>
</tbody>
</table>

*Source:* Adapted from AMTA 2007.

*Cost is typical for urban coastal community in the U.S., but inland desal costs may be higher.**

Numbers reported in 2009 $USD from 2001 $USD using CPI index.

### Unique Benefit of Desal - Increased reliability of supply

One of the potentially important benefits of a desal project is that the yields from a desal facility are independent of drought and other weather-related factors that can significantly impact the year-to-year (or season-to-season) availability of water from traditional water supply sources. This means that there are potentially large beneficial values associated with the yield-reliability of desal with respect to cyclical drought periods and potential impacts of climate change.

These reliability benefits do not accrue to most other water supply options, such as drawing from surface water sources. When these reliability benefits go unrecognized by the water agency, policymaker, or average citizen, then desal options may remain undervalued and, perhaps, underutilized. However, these desal-specific benefits of providing reliable yields during drought periods are hard to quantify and monetize because they extend beyond readily observable financial costs and utility revenues.

There is a body of empirical research that does shed some light on the value of higher reliability targets. Studies that have attempted to quantify the value of reliability have used “stated preference” and “revealed preference” methods to examine reliability values for residential customers. Stated preference methods determine estimates for reliability on the analysis of responses to hypothetical choices in surveys. Revealed preference infers the value of reliability from data obtained from choices and decisions made in the marketplace. For example, expenditures made to obtain higher levels of reliability (i.e., to avert potential shortages) sometimes can be used to infer the value of reliability. Values obtained from these studies can be
applied to the expected reliability benefits resulting from a proposed desal project to help fully evaluate the full range of benefits and costs.

**Unique Benefit of Desal - Local control of water resource supply.**

Additional values may come from the level of operational control a community exercises over the desal water supply and the degree of value that the community places on their own “local control.” Some imported surface water sources (e.g., waters transported long distances, such as through California’s State Water Project or the federal Central Valley Project) have complex contractual, regulatory, and operational characteristics associated with them. On the other hand, water supplies derived from local desalinated sources, using locally controlled treatment facilities, may exhibit little or no institutional, contractual, or operational complexities outside the community that the project serves. These potentially valuable benefits may induce a community to choose a water supply that has a higher unit cost than alternative supplies, but exhibits increased community values associated with better water portfolio risk management.

**STRATEGIES**

**Evaluating the full range of costs and benefits**

Listed below are some direct and indirect benefit and cost characteristics and a description of their role in desal versus other management strategies. Although this list is not exhaustive, each of the components below should be reasonably considered and quantified (when feasible) as part of a comprehensive benefit-cost analysis:

- Does the supply represent new water? This may be more valuable to a community than acquiring existing supplies. What is the value to the community of local control?

- Does the supply operate independently from the hydrologic cycle? This is important for water supply reliability during drought periods.

- Does the project solve a regulatory problem? If the project is required for solving a regulatory issue, then the funds associated with that regulatory issue are already going to be spent by the community. Thus, any beneficial uses of the water are considered net benefits.

- Can the project be scaled up or down? This is an important concept because in some cases, the benefits and costs may fluctuate based on scale. Thus, operational schemes and regional partnerships may result in cost savings.
What are the major cost components of the project and can they be modified? That is, can changes in operational strategies, use of alternative inputs, or other types of modifications to the project result in cost savings or increases in benefits. For the desal case, energy supply is a good example. What is the energy component of desal versus other supplies and management programs? Is there a net benefit from on-grid or off-grid power? Is there a net benefit exhibited if the desal project operates during non-peak periods? Is there a net benefit of collocating the desal plant and an existing power plant? Are there energy savings associated with pumping costs?

What are the environmental impacts of the project? Some water supply projects and management programs have negative environmental impacts while some have minimal or no impact.

What are the aesthetic values associated with the plant location and the surrounding communities?

How does the community perceive the project? Is the project viewed as an asset to the community?

**Integrating desal into a community’s water supply portfolio**

Portfolio theory, as originally developed for application in financial markets, provides some useful insights into how water supply planners might develop and manage the portfolio of water sources available to them. The central premise, long recognized and applied by financial managers, is to jointly maximize expected returns (water yields) while also reducing the overall variance in portfolio yield. This can be accomplished by minimizing the covariance in yield risks across the assets held in a portfolio (Markowitz 1952).

This basic premise of portfolio theory also applies to water resource planning. Each water supply option can be viewed as an asset that is subject to some sources and degree of risk (where risk refers to variability or uncertainty about the water yield, cost, or both). There may well be a premium value that a risk averse community would be willing to pay to better manage its water risks, either by providing some insurance and/or by providing some variance-balancing water portfolio diversification. The portfolio approach, as applied to water supply planning, introduces the unique risk/benefit profiles of different water supplies to the analysis, thus allowing an assessment of increased (or at least equal-to-existing) supply reliability at the least cost, rather than merely least-cost total supply irrespective of reliability and community values.

Thus, as water managers consider a broad suite of water supply options, including desal, they need to think about having a wide(r) set of holdings within their portfolios. Communities and their water supply planners need to think not only about option A versus option B, but also about holding a mix of several options. In considering whether desal or other net new sources of water
should be a part of their local water supply portfolio, managers need to consider not only that these new water supply options may in some instances be relatively expensive, but also recognize that they may also provide valuable benefits – in the form of reduced risks – and these value premiums should be considered as well. Examples of these beneficial values may derive from the increased yield reliability from the new water supply project or, at least, a degree of statistical independence (in terms of hydrologic or climatologic relationship) between the new water supply and the older, existing supplies. Additional values may come from the level of operational control a community exercises over the desal water supply and the degree of value that the community places on their own “local control.”

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**BENEFITS & COSTS**

See above.

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**KEY UNCERTAINTIES**

Comprehensive cost comparisons are difficult to make, because of uncertainty, rapidly changing technologies and prices, and other factors. Further

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**ADDITIONAL RESOURCES**


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