

INLAND FACILITY	Energy and Greenhouse Gas Issues
Water Use	Potable and Non-potable Uses

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**KEY POINT:** *Impacts associated with climate change are likely to increase the viability and acceptability of desal in the future*

## SUMMARY OF ISSUES

Climate change (and climate change-driven public policies) may have profound impacts on the ability to gain approvals for planned desal facilities or expanded water recycling. Climate change and energy management concerns are currently used by some desal opponents as arguments against the development of desal projects (Raucher et. al. 2007). Because desal is an energy intensive water supply option, there has been growing and sometimes vocal opposition to the potential for desal to increase GHG emissions by requiring more power generation. In addition, there is considerable and, in some regions, well-founded concern about adding desal-generated peak period energy demands on electrical generation and transmission systems that are already severely strained.

Despite these energy and climate change-related impediments, there are several countervailing factors that are likely to increase the viability and acceptability of desal in a climate-impacted world. The following section examines desal within a broad context, identifying ways in which desal may be able to provide valuable benefits -- and perhaps mitigate some additional costs -- in a climate-altered future.

### Climate Change Impacts Related to Water Supply

While there is still scientific uncertainty over the pace and specific impacts of climate change, there is a growing body of scientific knowledge and a reasonable degree of consensus on several key features of the world we will face in the decades ahead. For example, there is a general expectation that throughout the U.S. (even in regions where mean annual precipitation may increase), the following types of adverse patterns may likely be evident:

- ▶ Winters may tend to be wetter than now in some locations, but summers will probably see less precipitation than enjoyed historically.
- ▶ Summers are likely to be drier than they are today in most regions due to the combination of warmer temperatures, increased evapotranspiration, and decreases (or, in some regions, no change) in summer precipitation.
- ▶ Precipitation will likely fall in short duration, more extreme events (rather than in the longer duration but gentler events of the past), and the number of dry days between

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precipitation events is expected to increase This means that there will be less infiltration and recharge, and more stormwater runoff and nonpoint source loadings of sediments and other pollutants to watersheds and reservoirs, and higher turbidity levels at surface water treatment plants. This could lead to more flooding of riverside water supply infrastructure and wastewater facilities, and more storm-related damage in general.

- ▶ Droughts are more likely to occur with increased frequency, longer duration, and/or at greater severity than in the past, in several already water-limited regions.
- ▶ In regions that currently rely on snow pack for their water supply (i.e., much of the western U.S.), more precipitation will fall as rain than as snow, and the snow pack that does accumulate will melt earlier in the year. This will create challenges for water storage, flood control, and instream flow management (i.e., peak flows will be earlier in the spring, leaving less water for instream flows over a longer, hotter, and probably drier summer and fall period).
- ▶ Sea level rise will increase saltwater intrusion into coastal aquifers, push salt lines further up estuarine rivers (some of which currently are freshwater sources for public water supply systems), and threaten to inundate coastal infrastructure.
- ▶ An increased likelihood and/or severity of wildfires in key watershed areas -- due to hotter and drier summers, and enhanced opportunities for pine beetles and other destructive pests to survive and thrive in forest areas – will adversely impact the quality and quantity of surface water supplies.

As discussed in the section below, these impacts collectively point to an increased need and acceptability of desal in the future, although there are some inhibiting connotations as well.

### **Climate change-related impacts that will encourage desal**

The impacts noted above help frame how climate change could impact the business of public water supply. It is useful to think of how climate change can impact water agencies from source to tap. In doing so, it also is useful to consider what impacts may arise in terms of the quantity of water, water quality, and infrastructure safety (e.g., exposure to storm surge and flooding).

In terms of the quantity (and timing) of water available to water suppliers, the following are likely to contribute to a reduction in the reliable supply of traditional water source options:

- ▶ Increased dryness and drought, less snow pack, and less summer precipitation in many locations (as noted above).

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- ▶ Lower summertime instream flows and higher water temperatures are likely to lead to a greater need to forgo potable extractions from lakes, rivers and streams in order to provide enough flow and cooling to preserve aquatic ecosystems, including the protection of threatened and endangered species such as several varieties of salmon.
- ▶ Less reservoir storage, as a result of numerous factors. These include modified dam design and operating regimes to accommodate flood control (due to earlier snowmelt and runoff, and more extreme rain events), escalated hydro power production demands (especially as power demands escalate through hotter and prolonged summer periods), and instream flow protection (such as more summer and fall water releases to cool and enhance flows). There is also likely to be more sedimentation behind dams as a result of the increased intensity of precipitation events (especially if these occur in tandem with more forest fires or other watershed stresses).

In terms of the quality of source and distributed water, climate change impacts are likely to include:

- ▶ Lower source water quality, and increase variability in critical source water parameters such as turbidity (due to the anticipated increase in extreme precipitation events). The potential for more wildfires and other watershed disruptions will also lower the quality of some source waters. This general decline (and greater variability) in source water quality ultimately implies a higher cost to treat existing supplies.
- ▶ Lower instream flows imply less dilution of wastewater and nonpoint source pollutant loadings, thus also leading to lower quality source water. This may also result in more regulatory pressure on wastewater dischargers to meet tougher NPDES permit conditions, which in turn provides greater incentive for wastewater treatment systems to pursue water reuse in lieu of effluent discharge.
- ▶ Salt water intrusion into coastal groundwaters and further upstream in tidal-influenced rivers will either eliminate these sources as water supply options, or require the addition of desalting to the treatment process.
- ▶ Higher temperatures (and potentially altered chemistry and pH levels) of source and finished water may well result in the elevated formation of disinfection byproducts (regulated drinking water contaminants), and/or pose other costly treatment and operational challenges to meeting federal and state drinking water standards at the tap.

To compound the problem, the demands for water are likely to increase for many water utility customers. This is especially likely during peak summer demand periods, because elevated temperatures and the potential for less summertime precipitation imply higher outdoor irrigation demands for homes, businesses, parks, and agriculture.

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Thus, in total, climate change is likely to appreciably reduce the amount of water available from existing or potential new traditional supplies, and/or it is likely to appreciably increase the cost of treating those supplies to deliverable quality. At the same time, utilities are likely to face increased peak water demands. Combined, this implies more water shortages and/or higher costs for delivering traditional supplies. These factors will make desal and water reuse look more cost competitive than it does currently. Further, because of the drought-insensitivity of desal and reuse yields, these options provide a valuable added reliability benefit to water agencies that add these options to their water supply portfolio.

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## STRATEGIES

There are several obstacles that must be overcome to help move desal projects through the planning and implementation phases. Among the key needs in relation to energy use and GHG emissions is the development of technical and operational innovations that will 1). link desal to green energy options and 2) make desal technology more energy efficient, thereby reducing its' overall carbon footprint.

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## BENEFITS & COSTS

The drought resistant nature of desal provides important water supply reliability benefits in the face of climate change. As traditional sources of supply are impacted by weather patterns, this will increase the value of desal in many communities.

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## KEY UNCERTAINTIES

While there is still scientific uncertainty over the pace and specific impacts of climate change, there is a growing body of scientific knowledge and a reasonable degree of consensus on several key features of the world we will face in the decades ahead. For example, there are more than 20 general circulation models (GCMs) used by the Intergovernmental Panel on Climate Change (IPCC) in its recent assessment report (IPCC 2007), and each GCM generates somewhat different estimates of future changes in key parameters such as mean levels of annual precipitation at the regional scale. Some argue that the differences in predictions, as well as the potential for mis-estimation, increase when these global model outputs are scaled down to regional level forecasts.

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While there is consensus across the GCMs in terms of global and regional predictions that temperatures will be higher as we move through the 21st century, there is variation in the mean annual precipitation forecasts. Some models suggest higher mean annual precipitation in some regions (usually the northern portions of the U.S.), while some predict reduced levels of annual average precipitation (especially in more southern latitudes, including the already arid Colorado River basin and other parts of the rapidly growing southwestern U.S.).

One key to interpreting regional forecasts is that mean annual precipitation levels are less important for water supply management than are changes in precipitation patterns, including the intensity of precipitation, the number of dry days between precipitation events, and the likelihood of rain rather than snow, parameters for which the models tend to be more consistent..

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## **ADDITIONAL RESOURCES**

Raucher, R. K. C. Hallett, J. Smith, L. Strange, J. Cromwell, and J. Henderson. 2007. Energy and Climate Change: Implications for Future Water Desalination and Reuse Projects. Draft submitted to WateReuse Symposium 2007.

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