

subsea pipeline would have to be compared to other options on that basis. It has been suggested that, under those circumstances, a subsea pipeline may have some advantages (e.g., possibly fewer environmental impacts than a land pipeline). Such comparison studies have not been done. Also to be considered is that costs for desalination and other options could likewise be reduced through improvements in technology, allowing them to remain the less expensive options. It does not appear that pipeline water will ever be able to compete with the more easily implemented supply-enhancing and demand-reducing options now being planned.

Engineers at OTA's workshop and other engineers OTA contacted believe that an Alaska-to-California subsea water pipeline could be built if enough time and money were devoted to conceptual studies, surveys, and engineering development. A predominant view at the workshop, however, was that engineers do not yet have sufficient experience with newer pipeline materials for this type of application. If a large subsea pipeline were to be built today, it would probably be built using more traditional concrete and steel pipeline materials. The use of new materials, such as plastics and fiberglass composite materials, may eventually help lower the cost of the pipeline (although this has not been established—costs could be greater). Without sufficient testing of such materials, no one would be willing to commit the large sums of money that would be required. More experience will likely be gained in the next several decades with materials that could lower the cost of a subsea pipeline. Building other, shorter pipelines with such materials would provide some experience. Several OTA workshop participants suggested that a pilot project be undertaken specifically to test the subsea aqueduct concept and identify any modifications or improvements in technology that are needed. Such a project might be undertaken as a joint effort of private industry and State and Federal Governments.

Also, before a practical engineering design could be adopted, much more oceanographic and geotechnical data would be required along the proposed route. This data would take years to gather. Likewise, data are also lacking about Alaska's water resources and of the potential environmental impacts of diverting large quantities of water from Alaska.

The phrase "policy before plumbing," suggested by one workshop participant, seems to summarize well the most pressing need for California as the State addresses its water problems. With regard specifically to the subsea pipeline option, workshop participants noted a whole range of legal, regulatory, political, and environmental issues that would have to be resolved before a pipeline could be built. The routing of the pipeline, for example, would be of concern to coastal cities and counties, the California Coastal Commission, the Department of the Interior, the U.S. Navy, the Army Corps of Engineers, and others, all of whom claim some special competence to review proposals and/or jurisdiction over parts of the seabed or overlying water. Similarly, the routing of pipeline water into State Water Project facilities at Lake Shasta raises management questions that would involve water users throughout the State, implying the need to carefully evaluate allocation of costs of the pipeline and benefits and costs to users Statewide.

Changes in State and Federal laws regarding the use of Alaskan water would also be required. Such changes could be strongly resisted. Environmentalists in both Alaska and California, as well as those in British Columbia, Washington, and Oregon, are likely to be opposed to an offshore pipeline—even if the direct environmental impacts of a subsea aqueduct might be less severe than impacts from an onshore pipeline. (Environmentalists appear quite concerned that bringing massive new amounts of water to southern California might trigger further growth and, hence, greater environmental deterioration.) At present, there is little reason to believe that the transfer of water from Alaska to California will be any less contentious than interbasin transfers from other areas in the West have been.

## CONCLUSIONS

Few doubt that California water planners have a big task ensuring that the State has sufficient water to meet demand in the years ahead. However, the unambiguous message communicated at the OTA workshop by those representing the State Department of Water Resources and the Metropolitan Water District of Southern California, as well as by a variety of other experts polled by OTA, was that California does not currently need the large volumes of imported water that could justify a major interbasin transfer such as that represented by the proposal for a pipeline from Alaska. Moreover, the

supply options available to the State (including wastewater reclamation, water banking, and desalination), the variety of opportunities available to reduce demand through urban and agricultural water conservation, and the possibility of reallocating some supplies from agriculture to the urban sector (through the creation of water markets and/or other means) appear adequate to meet California water demands for the foreseeable future. In addition, some experts polled by OTA maintain that inter-regional water transfers can at best only delay the inevitable reckoning with how to maintain a sustainable society in an inherently arid southern California.<sup>28</sup>

Despite the large uncertainties about the cost of water piped from Alaska, there is no doubt that many of the other options available to California will be much less expensive than the subsea pipeline option. Even the more expensive supply options, such as large-scale desalination, appear to be less expensive than importing water from Alaska—and a virtually unlimited supply of ocean water is available for desalination.

It is difficult to estimate accurately the contribution to the State's water system of implementing all the low and moderately priced options, yet the knowledge gained from undertaking this analysis would be very useful for planning and decisionmaking purposes.

One important and encouraging recent development in California is the new willingness of various interest groups to address water issues in a cooperative, problem-solving spirit. For example, representatives from urban water agencies, agricultural water agencies, and environmental organizations have recently established the "Three-Way Water Agreement Process." In a statement of principles, the representatives note that the overall goal of the agreement is to develop a new framework for California water management that is environ-

mentally sound, economically viable, and broadly acceptable to environmental, urban, agricultural, and other interests.<sup>29</sup> One important consequence of this new cooperative spirit could be a resolution of the longstanding impasse regarding the best way to use and manage the water flowing through the Sacramento-San Joaquin Delta. Delta improvements might make available an additional 300,000 acre-feet of dependable water supply.<sup>30</sup>

Representatives of urban water suppliers, public advocacy organizations, and other interested groups have also recently signed a memorandum of understanding regarding urban water conservation in California.<sup>31</sup> The consensus document identifies a number of "best management practices" (BMPs)<sup>32</sup> intended to reduce long-term urban water demand. It further specifies implementation goals for these BMPs and identifies additional potential BMPs slated for further study and possible incorporation into the plan. These cooperative activities could ultimately lead to important improvements in California's water policy. Moreover, to the degree to which California's water supply and demand problems are political in nature, efforts such as this are likely to go a long way toward resolving them.

Although there is no current or near-term demand for expensive water from Alaska, the possibility that such water might eventually be needed cannot be completely dismissed. No one who participated in OTA's workshop claimed to know what California's water demands might be 50 years or more from now, nor the relative costs of the options available at that time for meeting those demands. Clearly, as demand increases and as less expensive options are implemented, the more expensive ones become relatively more attractive. California's population in 2040 is likely to be significantly greater than it is now, and many of the options being considered today may have largely been implemented.

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<sup>28</sup>Office of Technology Assessment, Food and Renewable Resources Program, "Results From the Survey of Western U.S. Water Resources," unpublished survey, Aug. 12, 1991.

<sup>29</sup>Principles for the Three-Way Water Agreement Process, July 19, 1991.

<sup>30</sup>Warren Cole, Chief, Statewide Planning Branch, Department of Water Resources, Sacramento, CA, personal communication, Aug. 27, 1991.

<sup>31</sup>"Memorandum of Understanding Regarding Urban Water Conservation in California," September 1991. Signatories of the agreement include the Metropolitan Water District of Southern California, City and County of San Francisco, Los Angeles Department of Water and Power, San Diego County Water Authority, East Bay Municipal Utility District, Bay Area Water Users Association Southern California Water Committee, Inc., Committee for Water Policy Consensus, Environmental Defense Fund, the Sierra Club, Natural Resources Defense Council, Save San Francisco Bay Association, Natural Heritage Institute, League of Women Voters, Mono Lake Committee, Friends of the River, and the Planning and Conservation League.

<sup>32</sup>A Best Management Practice is defined as a policy, program, practice, rule, regulation, or ordinance, or the use of devices, equipment, or facilities.

Global climate change remains an unknown factor for U.S. water policy. There is some potential, for example, that increasing global temperatures could lead to longer and more frequent droughts in the Southwest, such as the one now being experienced in California. Also, the future needs of the entire arid West should be considered, not just those of southern California. Although the current trend is away from interregional water transfers, at some point, then, such schemes could again receive serious attention. A subsea pipeline to transport water from Alaska, diverting some water from the Columbia River, or various proposals for diverting water from Western Canada's rivers, as well as other expensive options such as tankering water, might then be considered. Moreover, although the Eel and Klamath Rivers in northern California are now part of the National Wild and Scenic River System, they too could be tapped if current law is changed in response to concerns over global climate change.<sup>33</sup>

Before large sums are spent on a detailed pipeline feasibility study (much less committed to building a subsea pipeline), a sharper picture of future water demand in California and throughout the West needs to emerge. It is not clear when, or if, demand for

expensive pipeline water might emerge. The State needs to better understand all the means available to meet future water demands, including the relative costs, benefits, and ultimate potential of each option. Options as expensive as a subsea pipeline is likely to be cannot hope to succeed without success at building a consensus among the many interest groups likely to be affected. Even now, State officials are trying to fashion a water policy as part of an attempt to develop a statewide growth management strategy. Given the emergence of the Three-Way Water Agreement Process and other cooperative efforts, California appears well on its way to elaborating a comprehensive water policy for the State. If Federal or State authorities deem it appropriate to devote more attention specifically to the subsea pipeline option in the near term, prior to undertaking an extensive and costly engineering feasibility study, it would be important to investigate and sort out the many institutional and policy issues of significance. It would be especially important to investigate how these institutional and policy issues would differ with different engineering designs and pipeline routes.

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<sup>33</sup>One workshop participant noted that if Water could be taken from the mouths of Alaska's rivers without adverse environmental consequences, there would be no reason why water could not also be taken from the mouths of northern California rivers.