

- ¹ Bill Ritter, Jr., governor of Colorado, testimony before the Senate Committee on Energy and Natural Resources, Oversight Hearing: Oil Shale Resources, May 15, 2008.
- ² The Front Range Water Users Council members are the largest suppliers of municipal, commercial, industrial, and agricultural needs in the state of Colorado. Approximately one-half of the state's population receives water from council members.
- ³ Colorado, Yampa, and White River Basin Roundtables Energy Subcommittee, *Energy Development Water Needs Assessment (Phase 1 Report)*, September 2008.
- ⁴ *Id.*, p. 6-1.
- ⁵ U.S. Department of the Interior, Bureau of Land Management, *Oil Shale and Tar Sands Programmatic Environmental Impact Statement (PEIS)*, pp. 4-144 to 4-145.
- ⁶ Associated Governments Northwest Colorado, *Northwest Colorado Socioeconomic Analysis and Forecasts, Final Report*, April 4, 2008, p. 10.
- ⁷ Colorado, Yampa, and White River Basin Roundtables Energy Subcommittee, *Energy Development Water Needs Assessment (Phase 1 Report)*, September 2008, p. 4-7.
- ⁸ Jim Pokrandt, Colorado River Water Conservation District, Aspen Public Radio, broadcast September 18, 2008.
- ⁹ U.S. Department of Energy, Office of Petroleum Reserves – Strategic Unconventional Fuels, *Fact Sheet: Carbon Management for Strategic Unconventional Resources*, available at www.unconventionalfuels.org/publications/factsheets/Carbon_Management_Fact.pdf, accessed December 4, 2008.
- ¹⁰ Intergovernmental Panel on Climate Change, “Summary for Policymakers,” in *Climate Change 2007: Fourth Assessment Report*, Synthesis Report, available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf, pp. 2 and 5.
- ¹¹ These ensemble runs were produced by 19 global circulation models.
- ¹² Western Water Assessment, *Colorado Climate Change: A Synthesis to Support Water Resource Management and Adaptation*, report done for the Colorado Water Conservation Board, 2008, p. 1.
- ¹³ *Ibid.*
- ¹⁴ Richard Seager, Mingfang Ting, Isaac Held, Yochanan Kushnir, Jian Lu, Gabriel Vecchi, Huei-Ping Huang, Nili Harnik, Ants Leetmaa, Ngar-Cheung Lau, Cuihua Li, Jennifer Velez, Naomi Naik, Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America, *Science* 25 May 2007: Vol. 316. no. 5828.
- ¹⁵ From 1932 to 1939, the annual difference between evaporation and precipitation was 1.29 inches higher than average; during the 1950s Southwest drought (1948-1957), it was 1.87 inches higher than average.
- ¹⁶ The University Corporation for Atmospheric Research, *Synthesis and Assessment Product 4.3 (SAP 4.3): The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States*, May 2008, available at <http://www.sap43.ucar.edu/>, accessed December 8, 2008.
- ¹⁷ Intergovernmental Panel on Climate Change, “Summary for Policymakers,” in *Climate*

Change 2007: Fourth Assessment Report, Synthesis Report, available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

¹⁸ Bill Ritter, Jr., governor of Colorado, testimony before the Senate Committee on Energy and Natural Resources, Oversight Hearing: Oil Shale Resources, May 15, 2008.

¹⁹ In-situ retorting involves heating the oil shale while it is still underground, and then pumping the resulting liquid to the surface.

²⁰ The shale is first mined and then heated to a high temperature.

²¹ The Front Range Water Users Council members are the largest suppliers of municipal, commercial, industrial, and agricultural needs in the state of Colorado. Approximately one-half of the state's population receives water from council members.

²² U.S. Department of the Interior, Bureau of Land Management, "Oil Shale Management — General; Final Rules," *Federal Register* 73, no. 223, November 18, 2008, p. 69450.

²³ Bill Ritter, Jr., governor of Colorado, testimony before the Senate Committee on Energy and Natural Resources, Oversight Hearing: Oil Shale Resources, May 15, 2008.

²⁴ Although there is no one measure of energy quality, *energy return on investment* (EROI) is a commonly used calculation of how much energy is needed to locate, extract, and refine an output of energy. An EROI of 1 would be breaking even. Reported oil shale EROIs are in the range of 1.5:1 to 4:1, with a few extreme values between 7:1 and 13:1. See, for example, Cutler Cleveland and C. Hall, Presented at ASPO -US conference Denver November 10, 2005, available at <http://globalpublicmedia.com/events/564>. See also "Unconventional Oil: Tar Sands and Shale Oil - EROI on the Web, Part 3 of 6," available on the The Oil Drum Web site at <http://www.theoil Drum.com/node/3839>.

²⁵ Colorado, Yampa, and White River Basin Roundtables Energy Subcommittee, *Energy Development Water Needs Assessment (Phase 1 Report)*, September 2008, p. 5-9.

²⁶ U.S. Department of the Interior, Bureau of Land Management, "Oil Shale Management — General; Final Rules," *Federal Register* 73, no. 223, November 18, 2008, p. 69423.

²⁷ *Id.* p. 69449.

²⁸ James T. Bartis, et al., *Oil Shale Development in the United States: Prospects and Policy Issues*, RAND, 2005, p. 6.

²⁹ U.S. Department of the Interior, Bureau of Land Management, *Oil Shale and Tar Sands Programmatic Environmental Impact Statement (PEIS)*, p. 4-3.

³⁰ *Id.* at p. 4-3.

³¹ J.A. Veil and M.G. Puder, *Potential Ground Water and Surface Water Impacts from Oil Shale and Tar Sands Energy-Production Operations*, Argonne National Laboratory, October 2006, p. 13.

³² U.S. Department of the Interior, Bureau of Land Management, *Oil Shale and Tar Sands Programmatic Environmental Impact Statement (PEIS)*, p. 4-34.

³³ URS, Inc., *Energy Development Water Needs Assessment, Final Draft*, September 2008, p. 3-36.

³⁴ *Id.*, p. 4-7 and Table 4-6.

³⁵ *Id.*, p. 6-1 and Table 6-1.

³⁶ U.S. Department of the Interior, Bureau of Land Management, *Oil Shale and Tar Sands Programmatic Environmental Impact Statement (PEIS)*, Table 4.5.2-1, notes d & e, p. 4-44.

³⁷ Information regarding water rights in Colorado is available on the state's Decision Support System Web site, available at <http://cdss.state.co.us/DNN/default.aspx>. The research for this part of the report relied heavily on the information available in this source and was supplemented with a review of decrees obtained from the Division of Water Resources.

³⁸ Litigation in the 1990s challenged whether the diligence requirement for conditional water rights owned by three companies and intended for use in oil shale development had been met.

The Colorado Supreme Court found that the diligence standard had been satisfied in all cases despite the passage of as much as 45 years since the rights had been established. *Northern Colorado Water Conservancy Dist. v. Oxy USA, Inc.*, 990 P.2d 701 (Colo. 1999). See also *Municipal Subdistrict, Northern Colorado Water Conservancy Dist. v. Chevron Shale Oil Corp.*, 986 P.2d 918 (Colo. 1999); *Northern Colorado Water Conservancy Dist. v. Getty Oil Exploration Co.*, 997 P.2d 557 (Colo. 2000).

³⁹ Conditional and absolute decrees in the Yampa River Basin were also examined. While there are some large conditional storage decrees that include industrial uses, it does not appear these structures are expected to directly serve oil shale production. No decrees in the Yampa River Basin owned by the companies historically interested in oil shale production were found.

⁴⁰ Windy Gap Reservoir provides water to the Platte River Power Authority and to 13 water providers along Colorado's Front Range. The project diverts water on the Colorado River near the confluence with the Fraser River. However, because the rights are relatively junior to senior downstream rights, water availability is unreliable, so plans are in place to construct a new reservoir to allow for increased storage in wet years. Water rights associated with this "firming" project would have 1960s and 1970s priority rights.

⁴¹ U.S. Department of the Interior, *Hydrologic Determination 1988: Water Availability from Navajo Reservoir and the Upper Colorado River Basin for Use in New Mexico*, April 1988; and *Hydrologic Determination 2007: Water Availability from Navajo Reservoir and the Upper Colorado River Basin for Use in New Mexico*, April 2007.

⁴² Eric Kuhn, *The Colorado River: The Story of a Quest for Certainty on a Diminishing River* (Roundtable Edition), Colorado River Water Conservation District, May 8, 2007.

⁴³ Western Water Assessment, *Colorado Climate Change: A Synthesis to Support Water Resource Management and Adaptation*, report done for the Colorado Water Conservation Board, 2008.

⁴⁴ In addition, there is a proposal from a private developer to transport basin water from Flaming Gorge Reservoir on the Green River to the Front Range as well as a proposal by the Northern Colorado Water Conservancy District to bring water from the Yampa River to the Front Range.

⁴⁵ U.S. Fish and Wildlife Service, *Final Programmatic Biological Opinion for Bureau of Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of Recovery Program Actions In the Upper Colorado River Above the Gunnison River*, Denver, Colorado, December 1999.

⁴⁶ A significant population decline could even prompt reinitiation of the PBO. Specifically, "a negative population response would trigger reinitiation if the population declined to 350 adults." *Id.* 71.

⁴⁷ One should not assume the "second increment" development will take place. The fish are not recovering according to plan, so additional depletions may be limited. In that case, the first increment will be the ceiling vis-à-vis depletions above the 15-Mile Reach.

⁴⁸ In 1979, Occidental Oil Shale, Inc. hired water engineers to develop a plan for water development in the White River Basin. See Clifford E. Jex Engineers and Tipton and Kalmbach, Inc., *Plan for the Water Supply for Development of Oil Shale Industry in White River Basin, Colorado*, November 1979. This report discussed the value of utilizing different existing conditional water rights best suited, in their view, for such development.