COLORADO RIVER PROJECT

River REPORT

Summer 2009

A project of the Water Education Foundation

The Water-Energy Nexus in the Colorado River Basin

By Gary Pitzer

The connection between energy and water is an important issue that is garnering more attention as the demands for each increase. Though not always inherent, water and energy are never that far apart. Water churning through the turbines at Glen Canyon Dam produces the electrical power that runs the air conditioners that keep homes and businesses cool in the desert heat. Water cools thermoelectric power plants and is an integral part of biofuels and oil shale production.

That power in turn helps operate the infrastructure that extracts, treats and delivers water to homes, businesses and farms. Water use is energy-intensive: in some areas substantial amounts of electricity are devoted to pump and deliver water long distances, sometimes up and over mountains. Water heating is responsible for an estimated 9 percent of residential electricity consumption nationally.

With an increasing focus on energy and water use efficiency, the message is being conveyed to the public that simple everyday activities – running the dishwasher, watering the lawn – have impacts on energy and water supplies. Less water used means less energy required to extract, treat it and convey it for municipal, commercial and agricultural use.

"When thinking about the water-energy nexus it becomes starkly apparent that every drop of water conserved has the added benefit of energy savings and lowered carbon emissions while every

Continued on page 4

Hoover Dam

Dear Readers

For decades the Colorado River has been the lifeblood of the desert Southwest, supplying water for houses, farms and businesses, as well providing the hydroelectric power that has been a reliable source of energy for countless people throughout a large portion of the country. Today, the system that has been the basis for so much economic development is under duress – whipsawed by chronic drought, a growing need for water and the struggle to meet increasing demands for electricity with clean, renewable sources.

While ongoing efforts are focused on conserving water and electricity, the advent of climate change provides no assurances the past is any blueprint for the future. Some scientists estimate the river's flow will lighten substantially by mid-century, drying up reservoirs and dramatically altering the way of life as it now exists. Meanwhile, the quest for oil shale – a water intensive process – could accelerate if gas prices spike to $4 per gallon levels.

In this issue of River Report, *Foundation Writer Gary Pitzer explores the nexus between water and energy. As he writes in this article, the link between water use and energy use – and water conservation and energy conservation – will continue to grow in importance as the demand for each grows in the future. All this against a backdrop of uncertainty around the prospect of expanded supplies makes it all the more important that Colorado River stakeholders work to educate the public about the link between the two resources.*

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The mission of the Water Education Foundation, an impartial, non-profit, organization, is to create a better understanding of water issues and help resolve water resource problems through educational programs.

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WATER EDUCATION FOUNDATION

Basin Briefs

Upper Basin

Required Boat Inspections for Invasive Mussels on Lake Powell

Under new regulations, all boats and watercraft must be screened by trained personnel before launching into Lake Powell waters. The effort is in response to the threat of the introduction of quagga and zebra mussels at Glen Canyon National Recreation Area.

Mussel invasions can significantly alter aquatic ecosystems, said Larry Walkoviak, regional director of U.S. Bureau of Reclamation's Upper Colorado Region. "Should these invasive mussels become established in Lake Powell or at Glen Canyon Dam, they could impact water delivery and power generating infrastructure and result in costly treatment or cleaning measures," he said.

National Park Service personnel, and state and concessions employees began screening all boats at the end of July. The screening takes less than a minute and involves asking questions of boaters to identify potential high-risk boats. High risk boats are then fully inspected and decontaminated, if necessary.

"Protecting our western waters from a mussel invasion will require the assistance of recreationists, conservationists and government agencies," said Benjamin Tuggle, regional director for the Southwest Region of the U.S. Fish and Wildlife Service. "Preventative measures like those being implemented at Lake Powell are an important step in protecting native aquatic species from the severe impacts of a mussel invasion."

Boaters are encouraged to continue to help stop the spread of invasive mussels by making sure their vessels and boating equipment are cleaned, drained and dry before moving to a new body of water. Boats that are moved from infested waters to non-infested waters need to be properly decontaminated prior to launching. •

Tribes Get Millions in Stimulus Funds for Water-Related Projects

American Indian communities in three Colorado River Basin states will receive a total of more than $14 million in federal stimulus money for water-related projects to improve access to safe drinking water and wastewater services.

Tribes in Arizona will receive about $8.2 million; Pueblos and tribes in New Mexico will get $5 million; and tribes in Utah will receive $1.2 million. In total, 431 households will benefit from wastewater upgrades, and nearly 5,000 homes will have access to cleaner drinking water.

On tribal lands, 10 percent of homes lack access to safe drinking water, compared to less than 1 percent of non-native homes, according to Laura Yoshii, the EPA's acting regional administrator for the Pacific Southwest.

The money is part of $90 million in disbursements from the American Recovery and Reinvestment Act through the U.S. Environmental Protection Agency and the U.S. Department of Health and Human Services' Indian Health Service. The announcement was made in early July.

Lower Basin

No New Mining Claims to be Permitted Near Grand Canyon for Two Years

The Interior Department has temporarily barred the filing of new mining claims on nearly 1 million acres near the Grand Canyon.

The land is being set aside for two years so Interior can study whether the land should be permanently withdrawn from mining activity on 633,547 acres under the control of the Bureau of Land Management and 360,002 acres in Kaibab National Forest.

Of particular concern is the increase in new uranium mining claims, and exploration and permitting to reopen old mines on public lands as a result of escalating uranium market prices. Uranium development threatens to contaminate surface water and groundwater feeding regional water wells, seeps, springs and the Colorado River, according to experts.

Diverse stakeholders have expressed concern about contamination in the Grand Canyon, including the Metropolitan Water District of Southern California, the Southern Nevada Water Authority, the Arizona Game and Fish Department, several American Indian tribes, Coconino County officials, and independent geologists.

Environmentalists praised the temporary ban, saying mining leaves the Grand Canyon vulnerable to environmental damage, and vowed to work for permanent protection.

Representatives from the mining industry said current laws and regulations are effective for protecting the environment from mining activity. The ban would cost jobs and further harm the economy.

The protections do not affect about 10,600 exploratory mining claims located within the area, as well as several uranium mining operations awaiting a state permit. •

FEATURE

Continued from front page

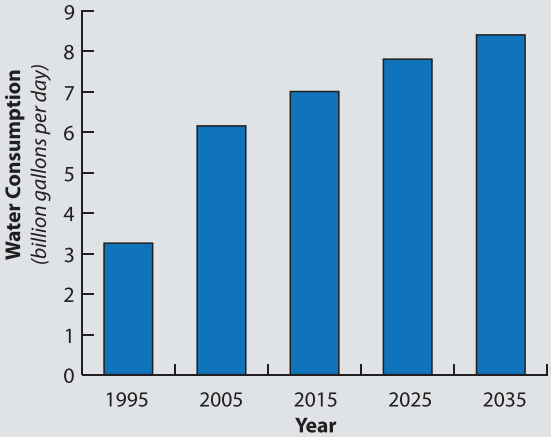
kilowatt hour of energy saved has the added benefit of water conserved," said Jennifer Pitt, senior resource analyst with Environmental Defense Fund in Boulder. "Conservation of both energy and water has benefits we don't always consider."

"People are beginning to get it – if you save water you save energy," said Mike Hightower, water researcher at Sandia National Laboratories in Albuquerque. "It takes a lot of energy to push water around."

The weight of water and its high heat capacity make its use energy-intensive. Large amounts of energy are needed to pump, heat and treat municipal water supplies. Wastewater, too, requires substantial energy to treat before being discharged. According to the U.S. Department of Energy (DOE), about 75 percent of the cost of municipal water processing and transport is attributable to electrical power needs. In California, 30 percent of non-power plant natural gas is used for water-related activities. As a greater premium has been placed on wide use of natural resources, those following the issue are making a greater push to better integrate water policy and energy use planning.

"The information is out there, it's a matter of getting it in the right people's hands," said Stacy Tellinghuisen, energy and water policy analyst with Western Resource Advocates (WRA) in Boulder. "On a smaller scale, it's a matter of getting people in the same room."

At one time, the opportunities for energy and water seemed boundless. Ample water from the Colorado River facilitated municipal development and agricultural production while the associated hydropower provided the energy required to meet the needs of a growing population.



Today, circumstances have changed and factors that were not known about or anticipated have emerged to alter the scenario. Climate change is altering the timing and pattern of runoff that determines drinking water supplies and is changing the availability and amount of hydropower.

Overseeing federal hydropower generation is the U.S. Bureau of Reclamation (Reclamation), the nation's second largest producer of hydroelectric power with 58 power plants and 194 generating units in operation with an installed capacity of more than 14 million kilowatts.

"We have quite a lot of hydroelectric plants on our dams, especially our bigger dams," said Larry Walkoviak, Upper Colorado Basin regional director. "We are not building any new ones and our goal is to continue to operate and maintain what we have and become more efficient." Reclamation has been getting a 5 percent or more increase in efficiency by installing improved technology when replacing or upgrading its turbines, Walkoviak said.

Hightower said the nation is facing some hard questions about future sustainability for energy and water. "We are at a time when water supply availability is being limited by climate change and other issues while water demand for energy and other sector is going up," he said. "It will force [industry] to

use alternative cooling technologies for thermoelectric power plants, more energy conservation, and non-traditional energy and water resources."

The response is due in part to hydrologic changes that are diminishing the amount of water that's been available for municipal, industrial and agricultural supplies and hydropower generation. According to a June 16 report by the U.S. Global Change Research Program, *Global Climate Change Impacts in the United States*, every 1 percent decrease in precipitation results in a 2 to 3 percent drop in stream flow and every 1 percent decrease in stream flow in the Colorado River Basin results in a 3 percent drop in power generation.

"Water and energy are intimately connected," the report said. "Water is used by the power generation sector for cooling and energy is used by the water sector for pumping, drinking water treatment and wastewater treatment. Without energy, there would be limited water distribution, and without water, there would be limited energy production."

The report notes that "huge reservoirs" such as Lake Mead "are particularly susceptible to increased evaporation due to warming, meaning less water will be available for all uses, including hydropower. And, where hydropower dams flow into waterways that support … coldwater fisheries, warming of reservoir releases might have detrimental consequences that require changes in operations that reduce power production."

New water management approaches "are critical to minimize the chances of fully depleting reservoir storage by mid-century," according to a July 20 study by the University of Colorado, *Water Supply Risk on the Colorado River: Can Management Mitigate?* While the risk of an empty reservoir in any given year remains below 10 percent "under any scenario of climate fluctuation or management alternative," through 2026, the scenario grows more serious after that. The study found that if average Colorado River flow decreases by 10 percent, the chances of fully depleting reservoir storage will exceed 25 percent by 2057. If climate change causes a 20 percent flow reduction, "the chances of fully depleting reservoir storage will exceed one in two."

> *"People are beginning to get it – if you save water you save energy. It takes a lot of energy to push water around."*
>
> *– Mike Hightower*

Authors of the report note the magnitude of the risk "will ultimately depend on the extent of climate drying and on the types of water management and conservation strategies established."

"Water conservation and relatively small pre-planned delivery shortages tied to declining reservoir levels can play a big part in reducing our risk," said Ken Nowak, a graduate student with the Center for Advanced Decision Support for Water and Environmental Systems at the university.

The anticipated changes also could be due to increased protections for native fish. In May, a federal judge ruled that releases from Glen Canyon Dam into the Grand Canyon must be reconsidered to protect the endangered humpback chub. The possible re-operation could directly conflict with dam releases that are designed to maximize hydropower production.

Grand Canyon Trust, which brought the lawsuit, said the order means the U.S. Fish and Wildlife Service must reconsider the extent to which the dam's operations damage the habitat for the endangered humpback chub in Grand Canyon. "The court simply validated what the scientists have been saying for over 13 years – dam operations destroy chub habitat in Grand Canyon National Park," said Neil Levine, Grand Canyon Trust's attorney, in a statement. "It is time for Reclamation to act responsibly when it comes to protecting one of this nation's great natural treasures."

Walkoviak said Reclamation "makes use of all the data and information that we can as we conduct current operations and project what might happen in the coming years." Still, "the big question" is the lengths to which future reservoir inflow can be predicted.

"Everyone is working to do this as accurately as possible but it is still relatively inexact," he said. "The bottom line for Reclamation is that we will continue working with various entities to make the best informed operational decisions that we can."

The humpback chub

With the reduced flows, Hightower wonders how the delivery requirements under the Colorado River Compact will be met. That conundrum ought to force people to look at the efficiency issue and "use any water resource that is more sustainable," such as seawater desalination.

"It's called integrated resources planning and development," he said. "Along the West Coast, think of the amount of water that could be freed up for inland applications if seawater desalination were commonplace."

Integrated resources planning and development is the process in which land use, energy and water policies are brought together in a synergistic manner that produces multi-beneficial projects that are more cost beneficial and sustainable for the future.

This issue of *River Report* looks at the water-energy nexus, a link that is growing in importance as the demand for each grows in the future while uncertainty surrounds the prospect of expanded supplies.

The Water-Energy Nexus

For those at the ground level of water supply and power generation, consideration of what the future might bring remains a somewhat abstract process that is undergoing refinement.

> *"Hydropower is a renewable, carbon-free source of energy, but must be carefully balanced against its impact on the ecological values of rivers."*
>
> *– Stacy Tellinghuisen*

"We are right in the middle of studying climate change and there are a lot of models out there [but] they tend to talk in terms of the next two to three decades," Walkoviak said. "I have to operate a reservoir for next week and next month, and the models are not refined to a subbasin or timescale level. That's difficult for me to implement on how I'm going to operate Flaming Gorge Dam next week, next month or next year."

Since 2000, the basin has been in a "dry cycle," with two years that were average or slightly above average and the rest officially a drought, Walkoviak said. The last 10 years have been among the lowest consecutive years of natural flow measured at Lee's Ferry, Ariz.

The water-energy nexus covers several areas that involve cross-jurisdictional coordination. Besides the many factors influencing hydropower generation, water and energy officials must account for the amount of energy needed to transport water through the system and how to account for future demand as well as energy-intensive activities such as seawater desalination.

Some of the issues are not immediately intuitive, such as the cooling methods employed at power plants or the amount of water needed for alternative fuels production. Cooling water for power plants where heat is used to generate electricity is about 20 percent of all non-agricultural water consumption, according to the USGS. The amount of water required for that purpose is expected to increase as the demand for electricity rises. That has raised concerns because of questions about where the additional water will come from.

"If you look at the mix of power plants we have today, if they do a business as usual approach, you are going to see an increase in water consumption of about 8 billion gallons of water a day over the levels from 1995," Hightower said. "Water consumption – that is the main issue."

Hightower, who highlighted the water supply scenario in a February 2009 presentation, *Energy and Water: Issues and Challenges*, said officials are faced with having to come up with additional water supplies that simply aren't there.

"Where are the additional resources?" he said. "We withdraw as much surface water as we have capacity to; there are really no additional supplies to draw from. For groundwater, we are looking to reduce future pumping because we have overdrawn our aquifers."

Hightower said the status quo may have to be revisited because the so-called "safe withdrawal capacity" is going down because of climate change impacts on surface water supplies. "At the same time we could triple our water demands for energy," he said. "The competition for water resources will exacerbate our water supply problems."

The water-energy nexus has been studied at various levels through the

Downtown Denver

years. In a 2006 report to Congress, DOE noted the nation "should carefully consider energy and water development and management so that each resource is used according to its full value.

"Given current constraints, many areas of the country will have to meet their energy and water needs by properly valuing each resource, rather than following the current U.S. path of largely managing water and energy separately while making small improvements in freshwater supply and small changes in energy and water-use efficiency," the report said.

As the population has grown in Arizona, Colorado, Nevada and New Mexico the demand for electricity has increased. According to the Colorado River Energy Distributors Association, a group of consumer-owned utilities that purchase federal hydropower from the Colorado River Storage Project, while the population grew by 71 percent between 1980 and 2005, demand for power in those states increased by 130 percent. Because the population is expected to increase another 54 percent by 2030, electrical demands could double again.

"When I talk about the increase in electric power demands for water, all of a sudden this is essentially equivalent to another domestic sector we are going to add," Hightower said.

Hydropower has undergone a transformation since the days when officials ramped releases to coincide with power demand. Today, a different operating paradigm exists, one that accounts for downstream impacts and the many demands placed on water resources. For environmentalists, hydropower is a clean energy source, though it has come at the cost of truncating river flows that has impacted some fish.

"Hydropower is a renewable, carbon-free source of energy, but must be carefully balanced against its impact on the ecological values of rivers," Tellinghuisen said. "This balancing act is even more critical with the expected impacts of climate change."

However, there may be ways that hydropower can be expanded without adversely impacting the environment by either adding generation or increasing the efficiency of existing facilities. The Metropolitan Water District of Southern California is evaluating the potential of installing hydrogenerators at four locations on its pipelines used to distribute water in Southern California.

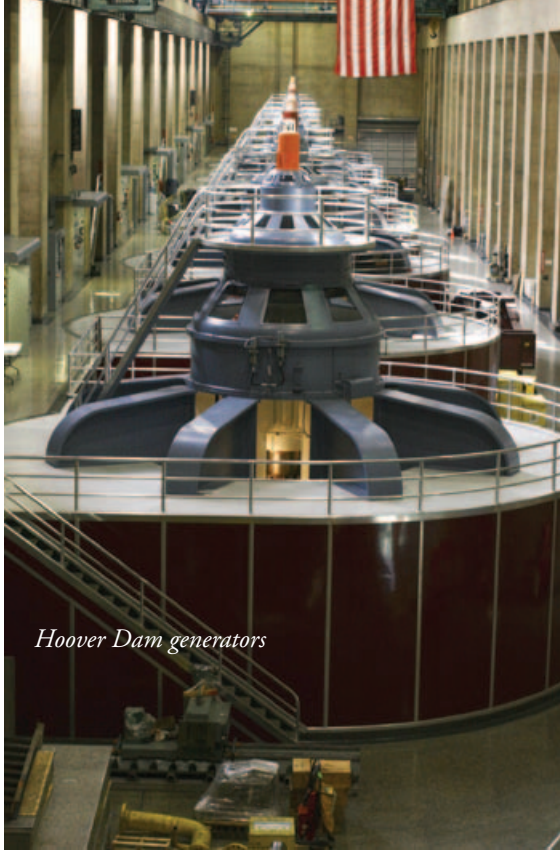
As part of a multibillion dollar focus on energy and water, House lawmakers in July approved $5 million to Reclamation to move forward with prospective hydroelectric facilities identified in a study ordered by the Energy Policy Act of 2005. The report said 819 megawatts (MW) of capacity could be developed at 47 facilities that lack hydropower and 358 MW could be added at 11 facilities with existing hydropower.

There are questions about the energy requirements to recharge aquifers and recycle water for reuse. "Pumping and injecting water into the aquifers costs more energy and money," said David Wegner, staff director for the House Subcommittee on Water and Power. "If you are using reverse osmosis for water recycling the cost is pretty high in energy." However, there are less expensive, less energy-intensive alternatives. The use of spreading basins, which allows water to percolate of its own accord down into the aquifer, "is pretty low intensity [and] if you are using wetlands to filter water the cost is pretty low," Wegner said. "It is all about the intensity of effort and the amount of water desired."

Treating wastewater and storing it in shallow aquifers for future use can be less energy-intensive than other water resource options although Hightower noted "in some cases … it can be more energy-intensive [so] you have to be careful to look at everything on a site-specific basis."

Water and Energy Integration

The significance of the water-energy connection has been raised as part of the current economic downturn, insofar as economic stimulus investment is concerned and the rapidity by which efficiency projects emerge. In a position paper released in December 2008, *Transforming Water: Water Efficiency as Stimulus and Long Term Investment*, the Alliance for Water Efficiency (AWE), a Chicago-based nonprofit organization, noted that water/energy efficiency programs "require much less time to plan and deploy than do large infrastructure works."


Hoover Dam generators

The energy savings aspect of reduced water use makes it "one of the most compelling reasons" to save water, according to the paper. "It is good for the economy and good for the environment in terms of reduced oil dependence as well as greenhouse gas reduction."

AWE Executive Director Mary Ann Dickinson said the organization worked hard to ensure that no less than 20 percent of the $6 billion in federal economic stimulus funding is directed toward water programs that among other things address water or energy efficiency improvements.

Significant opportunity for energy savings exists through increased water conservation, which Tellinghuisen called "low-hanging fruit." WRA and others are pushing for greater investment in water conservation, touting the financial savings to consumers and the fact that it delays the need for new infrastructure. Some utilities have been "really aggressive" in pursuing energy/water savings,

but it's not "across the board" yet, she said. As a result the "carrot and stick" approach will be needed to prompt agencies to coordinate.

In the nation's capital, efforts are underway to facilitate an in-depth analysis of the impact of energy development and production on water resources. The issue "is on the front burner under a fairly large fire," Wegner said.

Part of the Omnibus Land Management Act signed by President Obama in March is the Secure Water Act, which talks directly about the need for water data management, securing water for hydropower and the water-energy connection, Wegner said.

On the Senate side, the proposed Energy and Water Integration Act (S. 531) would require federal agencies to examine a host of issues involving energy and water. One of the studies would require the National Academy of Sciences (NAS) to assess the water impacts involved with production of electricity and transportation fuels. In a letter of support, the Western States Water Council noted that "no region of the country feels the water-related impacts of energy development and use more acutely than the West, and nowhere is water conservation and wise use more important."

In testimony before the Senate Energy and Natural Resources Committee in March, Peter Gleick, president of the Pacific Institute and a member of the NAS, said "limits to the availability of both energy and water are beginning to affect the other," but that energy and water issues "are rarely integrated in policy." Consequently, "the failure to consider both energy and water together leads us to inefficiencies to make bad policies to do things that we shouldn't perhaps otherwise do."

Oil shale samples from White River oil shale mine.

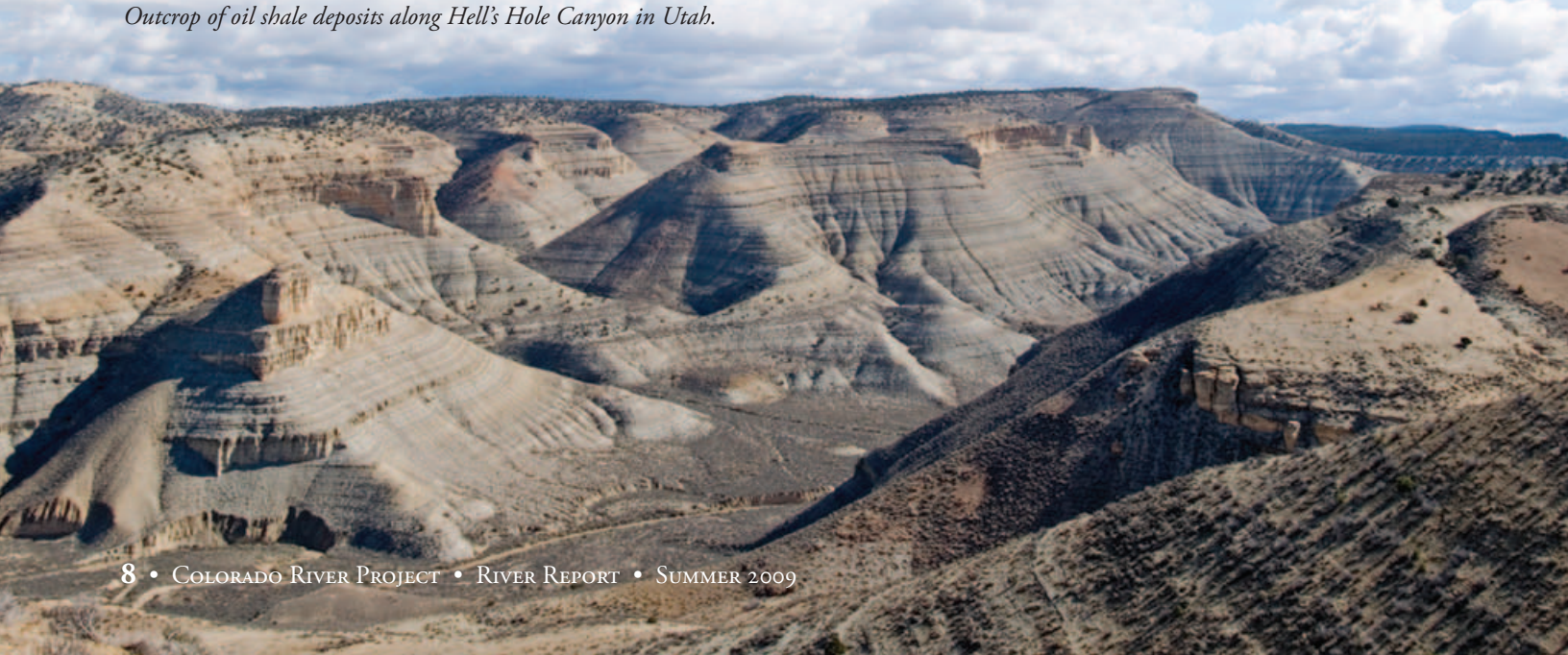
Tellinghuisen said the NAS report would be "very useful" but "there are lots of things we could be doing" while the study is underway. Efforts to coordinate water and energy use in Colorado have been a "mixed bag," partly because institutional barriers "make things challenging." Still, cities such as Fort Collins are pursuing joint energy/water conservation plans as part of the effort to reduce greenhouse gas emissions, she said. In its 2009 Energy Policy, Fort Collins states that "energy use, water use and transportation are major components of the community environmental footprint, and solutions that integrate the relationship between these sectors will result in optimal long-term outcomes."

Oil Shale, Water and Energy

The scarcity of water in the West could be dealt another variable if exploration for oil shale increases as anticipated. The potential conflict exists in areas where energy companies hold water rights that could be exercised for oil shale mining. Known as "the rock that burns," oil shale, which is neither oil nor shale, is a type of limestone that contains a solid fossil fuel called kerogen. The oil shale must be heated to temperatures reaching 1,000 degrees F to extract petroleum-like distillates.

It remains to be seen whether oil shale can supplement the nation's energy needs. A 2008 Congressional Research

Outcrop of oil shale deposits along Hell's Hole Canyon in Utah.



Green River Formation

Service report noted that while oil shale "is generally acknowledged as a rich potential resource … it has not generally proved to be economically recoverable."

According to a June 10 report by the University of Colorado at Boulder's Center of the American West called *What Every Westerner Should Know About Oil Shale*, "judicious estimates" are that 800 billion barrels of oil – enough to meet current U.S. demand for more than a century – might one day be extracted from the Green River Formation near the borders of Colorado, Wyoming and Utah. The richest known deposits of oil shale are located in Colorado's Piceance Basin, an area of more than 1,300 square miles just north of Grand Junction, the report says.

The report, which does not take a position on oil shale development, presents a thorough analysis of every aspect of the subject, including water. "It's a very well balanced, very well done, comprehensive report and it has a particularly excellent historical review of oil shale in terms of the efforts that have been done in the past and kind of drawing attention to the issues that oil shale development brings to a region," said Tracy Boyd, communications and sustainability manager for Shell Exploration and Production Company on Unconventional Oil.

Calendar

September

13-17 **Water/Energy Sustainability Symposium**
sponsored by the Groundwater Protection Council, Salt Lake City, UT
web: http://www.gwpc.org/home/GWPC_Home.dwt

13-19 **Joint Annual Conference**
sponsored by RMSAWWA/RMWEA, Albuquerque, NM
web: http://www.rmwea.org/rmwea/committees/annual_conference/Albuquerque/2009/Albuquerque_2009.htm

23-25 **50th Anniversary Annual Meeting**
sponsored by the Interstate Council on Water Policy, Jackson, WY
web: http://www.icwp.org/cms/index.php?option=com_content&view=article&id=72&Itemid=65

October

7-9 **WaterSmart Innovations 09 Conference and Exposition**
sponsored by Southern Nevada Water Authority and AWWA, Las Vegas, NV
web: http://www.watersmartinnovations.com/2009/home.php

14-16 **Fall Council Meeting**
sponsored by Western States Water Council, Lincoln, NE
web: http://www.westgov.org/wswc/meetings.html

22-23 **Water and Land for Renewable Energy in the Southwest**
sponsored by Southwest Hydrology, Tucson, AZ
web: http://chubasco.hwr.arizona.edu/renewable

November

4-7 **Fifth International Conference on Irrigation and Drainage**
sponsored by the U.S. Society for Irrigation and Drainage Professionals, Salt Lake City, UT • web: http://www.uscid.org

18-20 **NWRA Annual Conference**
sponsored by National Water Resources Association, San Antonio, TX
web: http://www.nwra.org

December

3-4 **NEPA**
sponsored by CLE International, Denver, CO
web: http://www.cle.com/product.php?proid=1140&page=NEPA

9-11 **Colorado River Water Users Association Conference**
sponsored by the Colorado River Water Users Association, Las Vegas, NV
web: http://www.crwua.org

January

27-29 **52nd Annual Conference**, sponsored by the Colorado Water Congress
web: http://www.cowatercongress.org/default2.asp?active_page_id=102

Contact Sue McClurg with your calendar items from January 2010 through June 2010 for inclusion in the Winter issue issue of River Report, *smcclurg@watereducation.org or 717 K Street, Suite 317, Sacramento, CA 95814*

> *"Historically, we have taken the easiest way of managing our energy needs and now with a limited water supply we now need to look at managing that limited water more effectively and efficiently."*
>
> *– David Wegner*

While the prospects of oil shale development are enticing, the potential impacts are significant enough to give pause. "One of the major environmental concerns related to U.S. oil shale development is water," the University of Colorado report says, noting that commercial oil shale production could require about three barrels of water for every barrel of oil. Oil shale mining includes water requirements for power generation, refining, reclamation, dust control and on-site worker demands.

Water demands associated with oil shale development were examined in a 2005 Rand Corporation report, *Oil Shale Development in the United States, Prospects and Policy Issues*, which found that "significant water withdrawals to supply the oil shale industry may conflict with other uses downstream and may also exacerbate salinity problems. Such demands and pressures are expected to continue to grow for the foreseeable future, thereby rendering earlier data and analyses regarding oil shale development out of date."

The water requirements have raised concerns about what could happen if energy development companies exercise some or all of their current water rights.

"Given the magnitude of development [that] is one-day feasible, as much as 378,000 acre-feet of water could be required annually to support oil shale development, more than the Denver metro area uses each year," WRA stated in its *Water On the Rocks* report released in March. "Companies with an interest in oil shale development own enormous portfolios of water rights. While there is great uncertainty with respect to the manner in which these rights will be developed and used, the consequences of such development are unquestionable."

Oil companies hold more than 250 water rights for oil shale development in Colorado, according to the report. Six companies have filed for 7.2 million acre-feet of rights on the Colorado and White rivers. The rights are conditional and must be approved by a water court. Shell Oil's claim for about 45,000 acre-feet of water from the Yampa River in northwest Colorado has sparked controversy because of the potential impacts on the water rights of other users. The company says the water it seeks would be under a junior water right and taken only when available.

Because some of the water rights held by the companies are agricultural, there is concern what the possible change in use might bring. "Should oil shale development move beyond the research phase, many, if not all, of these rights would be changed in use, and the lands historically irrigated would be taken out of agriculture. The result would be a dramatic transformation of land and water uses in these areas," WRA says.

Tellinghuisen said "a very small amount" of water is currently being used for research and development of oil shale development but that the conditional rights held by energy companies amount to more than the entire allocation for the upper Colorado River Basin. "Our perspective is that oil shale technology is not commercially viable," she said, adding that there is a huge range in the estimated water requirements.

Oil shale interests say publications such as the WRA report are hyperbolic and misrepresentative of future impacts.

"While the path of oil shale development is unclear, the studies … portray large-scale growth scenarios that are based on overstated assumptions, and yet have been used by state officials and others to create misleading perceptions about the impacts from future oil shale development," states an April 2009 report by the National Oil Shale Association in Glenwood Springs, Colo.

Las Vegas suburb

The report says WRA's "faulty assumptions" overstate the amount of water rights held by 74 percent in terms of flow and 187 percent in reservoir storage capacity. At a larger level, analysis by WRA and others fail to include the "anticipated benefits" of oil shale development, including revenue distribution of royalties and taxes, economic development and sustainable employment.

"While it is acknowledged that the future levels of shale oil production are not clear, the mischaracterization of oil shale's potential impacts only serves to unnecessarily heighten public anxiety," the report says. "Realistically, this enormous domestic energy resource can play a role in reducing our reliance on foreign supplies of petroleum."

In an October 2008 report on oil shale development in Utah, the Utah Mining Association said oil shale can be economically developed "in a sustainable manner with sound environmental principles," and that "limited amounts of water are necessary" for oil shale extraction. Improvements in oil shale processing are expected to lessen the amount of water needed in the future.

"This water requirement is not outside the bounds of water conditions for conventional oil production, but does necessitate an allocation of sufficient water and planning to adequately support the industry," the report says.

A December 2008 study by the Utah Geological Survey determined that about 77 billion barrels of shale oil exists as a potential economic resource. "A domestic resource of this size is very significant; a conventional field with just 1 billion barrels is considered a 'giant,'" said Michael Vanden Berg, project geologist, in a press release.

The availability of water for oil shale mining and nuclear power development was the subject of a June 17 Utah legislative hearing in which it was revealed that despite the lack of new water rights, energy companies could access water by purchasing the rights from current agricultural users. "We make those choices all the time," said Dennis Strong, Utah Division of Water Resources director, at the hearing. "Instead of growing crops … we grow houses."

Then there is the question of the long-term demand for fossil fuels as alternative energy gains a greater footing. Brad Udall, director of the National Oceanic and Atmospheric Administration's Western Water Assessment at the University of Colorado in Boulder, said oil shale has a "terrible carbon footprint" and that vehicles of the future will be powered on a much cleaner basis.

"Many knowledgeable people in the transportation industry maintain that we have to electrify our vehicle fleet," he said. "We are on the verge of very interesting and exciting technology for electric cars [and] I think there is real potential that oil shale because of its large carbon footprint, large water consumption, and perhaps other unknown environmental issues will never, ever be developed."

Water and Energy – Using Less

Slowly but surely policymakers, government officials and water agency representatives are moving toward recognizing the energy requirements of water use and how rivers such as the Colorado and the Green contribute electricity to the power grid. "It's becoming better understood [but] there is still a disconnect on how we take the knowledge and put it in place on the ground," Tellinghuisen said, adding that partnerships between water and energy providers remain "the exception rather than the norm."

Awareness of energy use extends to groundwater pumping and to pipeline projects that move water large distances. "We are seeing a slew of new pipelines all of which are energy-intensive," Tellinghuisen said. But the power costs of moving water "hasn't been an Achilles heel yet."

One of those proposals is in Nevada, where the Southern Nevada Water Authority (SNWA) wants to pump 80,000 acre-feet of water per year from an aquifer on the Nevada/Utah border and pipe it 285 miles to Las Vegas. Bill Rinne, director of surface water resources for SNWA, said the agency is trying to provide for all of its power needs through the use of renewable energy.

"Some of the initial estimates completed early in the planning process identify the maximum energy requirement to be 80 megawatts for the project with as much as half of that being recovered through in-conduit hydro-turbines at stations along the pipeline," he said. "The goal would then be to offset the remainder through various renewable sources."

Hightower said utilities are now getting into the "marginal cost of water" – the new paradigm that acknowledges limited supplies, no new major storage/conveyance projects and the price of electrical power. "Where is L.A. going to get its next new supply of water?" he said. "Where will they get it and what is the energy cost?"

Passage of federal legislation could help with the issue if the right questions are asked, Wegner said, noting there "certainly is potential for [requested studies] to get into a lot of detail." Meanwhile, the drive to use less water and energy could reap unexpected rewards.

"I think it is exciting [and] potentially could lead to new research and applications and different ways to manage the water we have, such as closed-cycle cooling design of new equipment that is less energy intensive," Wegner said. "Historically, we have taken the easiest way of managing our energy needs and now with a limited water supply we now need to look at managing that limited water more effectively and efficiently."

Despite the sobering projections about dwindling supplies, Wegner said the challenge could lead to innovative ways to strengthen the water-energy connection and stretch available supplies.

"While there is a lot of concern, there is also a lot of opportunity for people to step up and help provide solutions," he said. "Sometimes it takes getting to the threshold where things look the darkest to get the right people in the room to sit down and help structure what the answers look like. I think we are there." •

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