Carpe Diem
WESTERN WATER &
CLIMATE CHANGE

A PROJECT OF EXLOCO

PEAK WATER, PEAK ENERGY, CLIMATE CRISIS: THE COLLISION AHEAD

Water, Energy & Climate Change Leadership Convening

Summary of Proceedings

MARCH 4-5, 2010
SAN FRANCISCO, CA

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Water, Energy & Climate Change Leadership Convening

Summary of Proceedings

Over the course of the past two years, **Carpe Diem Project** convenings and conversations have made it increasingly clear that water issues and energy issues are inextricably intertwined in the West. It is evident that not only are there great benefits to considering water and energy in conjunction, in an era of climate change, there are serious drawbacks to not doing so.

Recognizing that water is the less well-understood aspect of the water-energy nexus, and that the issue is urgent, the **Carpe Diem - Western Water and Climate Change Project** held a water, energy, and climate change convening with key policy and practical leadership from both the water and energy worlds. The group met on March 4 and 5, 2010, in San Francisco to examine the underlying scientific issues, discuss gaps and barriers in the policy framework, and highlight opportunities for action.

In Brief

The two major recommendations in the Carpe Diem Project policy brief, "Peak Water, Peak Energy, Climate Crisis: The Collision Ahead" were quickly accepted. First, policy reform can succeed in addressing the challenges and evolving demands posed by climate change and population growth only through a broadly integrated approach that encompasses climate change policy, energy policy, and water policy. Second, focusing and maximizing our policy efforts now across the American West and the nation on energy and water conservation and efficiency will have mutually reinforcing positive effects.

Developing and acting on integrated water and energy policies with an emphasis on conservation and efficiency will:

- Reduce the risk and cost of all the other options for dealing with the uncertain effects of climate change and population growth on energy and water resources.
- Protect and improve the western economy.
- Provide greater options and flexibility for policymakers in the long term.

Several common themes emerged during the convening. The first was that the energy-efficiency world has had two decades to develop both technically and politically and is far ahead of the water-efficiency community. There are not enough people working on water-energy issues from the water perspective, either in science or in policy.

There is so little recognition of the importance of water issues in the drive for energy efficiency that major legislation now under consideration does not include water. Although it is not widely recognized, low carbon does not necessarily mean low water use, and carbon policy may be the best way to link water-efficiency and energy-efficiency efforts.

The scientists tell us that there are no easy solutions to climate change impacts. Rather, what lies before us is a series of dilemmas to be navigated. That's what the Carpe Diem Project does — it provides the process, the vehicle, to navigate the rapids ahead.
–Kimery Wiltshire, Carpe Diem Project

There was broad agreement about the urgency of the need to act. Far and away the most promising avenues for action are conservation and efficiency. No federal government agency or Congressional committee is responsible for an overall water-efficiency policy. There is a radical absence of coordination among federal research initiatives related to the water-energy nexus. The barriers to communication and lack of coordination are enshrined in the regulations. Even at this convening it was easier to talk about water-for-energy issues than about energy-for-water issues. The institutional structures to support incentives for good water-efficiency decision making are lacking.

It is necessary to build national awareness of the water-energy nexus. At the same time, the group came to a growing agreement that local action is important and can be hugely influential. The issues of who decides what to do, who does it, who pays, and who benefits came up repeatedly. The need for more and better data was stressed, but it was also emphasized that the economic, social, and environmental consequences of waiting for perfect data are too high.

DAY ONE - MARCH 4, 2010

Opening Remarks

Planning and Conservation Can Succeed — If Water is on the Agenda

John Shurts, Northwest Power & Conservation Council, began the convening by presenting the recommendations of the Carpe Diem Project policy brief, "Peak Water, Peak Energy, Climate Crisis: The Collision Ahead," on which he was the lead author.

Conservation does not mean doing without, it means doing what you want to do in a more efficient way.
–John Shurts, Northwest Power & Conservation Council

By way of background, John described the successes of integrated energy resource planning in hydropower in the Pacific Northwest. The 1980 Northwest Power Act mandated the creation of an ongoing regional conservation and energy planning process to add to the existing hydropower system. A key benefit of this planning has been the very large avoided costs of power plants not built. The most recent iteration of the plan finds that 85% of the new demand for energy in the Northwest over the next twenty years can be met by energy efficiency. The models used examine a range of sources of future uncertainty and risk and ask: What is the least-cost and least-risk path? When the model layers in climate change with its highly uncertain effects on hydropower amounts and timing, temperatures, and loads, carbon policy itself is one of the biggest sources of uncertainty and risk.

It's clear that the important and difficult challenge is with water, but all the money and sex appeal is with energy.
–James Workman, SmartMarkets LLC

The take-away message is that significant investments now in energy efficiency are the key to mitigating the risk and uncertainty introduced by all sources, including climate change. Conservation will pay for itself, and it minimizes risk and uncertainty. The conservation path is the least-cost and most robust resource path under every scenario modeled. There is very likely huge potential for this same result across the West in both water and energy planning.

John also struck a note that would be heard repeatedly over the two days of the convening when he pointed out that the energy sector is far more sophisticated than the water sector in terms of having a policy framework that supports efficiency and conservation. We need to capture those conservation potentials for water, he urged.

Looking through the Water Lens, Looking through the Energy Lens

PANEL I Setting the Stage

Chair: Doug Kenney, *Western Water Policy Program, University of Colorado*
Kristen Averyt, *Western Water Assessment*
Peter Gleick, *Pacific Institute*
Carey King, *Center for International Energy and Environmental Policy, University of Texas*
Robin Newmark, *National Renewable Energy Laboratory*
John Rogers, *Union of Concerned Scientists*

The panelists were asked to identify the most salient trends in the water-energy nexus, first looking through the water lens and then through the energy lens. They considered the ways climate change modifies the water-energy nexus, covered key water-energy issues in transportation fuels, and identified success stories.

Several panelists commented that streamflow reductions are expected throughout the West, which will not only create problems for water management, but will also reduce the amounts of water available for both renewable and traditional energy development. For example, current projections from the United States Global Change Research Program's Synthesis and Assessment Product indicate that the delivery requirements of the Colorado River Compact will be met just 60 – 75% of the time by 2025.

Low carbon does not necessarily mean low water.
–John Rogers, Union of Concerned Scientists

As temperatures warm, the increased demand for cooling is expected to outpace decline in demand for heating, and peak demand is expected to increase. Summers are likely to get hotter faster than winters get warmer. Hot summers strongly increase demand for electrical power, and therefore increase demand for water needed to cool thermoelectric generation. The problem is exacerbated because dry cooling technology for thermoelectric power generation becomes much less efficient at temperatures over 100°F. Even PV, which does not use water for its operation, produces less well in high temperatures; further, a warmer atmosphere holds more water, creating more clouds, also potentially affecting solar generation.

Currently available carbon capture technologies are both water- and energy-intensive, thereby creating an additional water demand. If carbon capture becomes common, it will add to the amount of water used for energy production.

Using water can consume large amounts of energy. A big growth in wastewater reuse is expected by 2020. Marginal or impaired water sources require treatment or desalination, both of which have a high energy cost and a CO_2 footprint. The biggest single power consumers in California are the pumps that pump water south from the Delta. One panelist pointed out that this means water conservation in Southern California saves more energy than water conservation in San Francisco. Another presenter went on to say that, for that reason, it might make sense to build wind-powered desalination in Southern California.

A panelist commented, "It's time to invest more heavily in technologies to reduce the energy intensity of water treatment and the water intensity of carbon capture. The trends are currently going in the wrong direction in both sectors."

More than one panelist noted the drawbacks of projections and models. Planners often show the demand for resources growing in lockstep with the population and economy, but today the United States uses less water than in 1980 because of water efficiency. The difference between projections and reality can be significant. In addition, the water costs of energy often go unconsidered. For example, the US Department of Energy's projections using the national modeling system assume that current laws and regulations are unchanged, that there is not a greater push for more energy efficiency, and water is not a constraint.

For most people, the limits on water resources are more tangible than the limits on energy sources.
–Carey King, University of Texas

DOE projections through 2035 assume that half the electricity usage growth will be fueled by natural gas which, while emitting less carbon dioxide than coal, poses potential water quality issues. Hydraulic fracturing (using water to fracture rock and release gas) requires 3 – 6 million gallons per fracture, and uses proprietary chemicals. Once gas production starts, the water also picks up hydrocarbons. One panelist noted that in Texas, the water polluted during hydraulic fracturing is injected into regulated hazardous disposal wells, creating a potential impact on groundwater. In areas with different geology, the wastewater stream needs to be treated before discharge, requiring both energy and knowledge of the water constituents. Currently, none of this is taken into account in national energy projections.

There is also a water cost in transportation fuels. The consumptive water intensity of light duty vehicles varies greatly, from 0.1 to >60 gallons/mile. Mining and processing use water. Growing and processing biofuels use water. Assuming there will be an increasing move towards ethanol, competition with other forms of agriculture for irrigation water is an issue. Choices for how water is used need to be made in a regional context.

PANEL I Discussion

- **Let's look at what's working and figure out how to replicate it. We need to ask:**
  - What do we need to do that we are already doing, but more of?
  - What do we need to do faster?
  - What do we need to do that we're not doing, or do differently?
  - Who ought to be doing these things?
- The question "Who pays for it?" is not always the same as "Who does it?" We should include how we're transferring costs in this discussion.

The recognition that water efficiency has an impact on the carbon footprint is not adequately incorporated in current legislation. Pending federal climate bills do not sufficiently address the energy-water-climate nexus and are missed opportunities.
–Lillian Kawasaki, Water Replenishment District of Southern California

- Regulatory and jurisdictional issues fragment consideration of costs in two areas that have never interacted well: water and energy. Wastewater treatment can generate fuels or electrons, but systemic regulatory processes now pose barriers to realizing those benefits. If you don't use a large enough box to define your problem, it turns into Whac-a-Mole.
- There is a problem with the way we think about wastewater. Federal law requires us to capture and treat wastewater before we discharge it to the Pacific, or to rivers or lakes. To whom do you charge that energy cost? The net energy to reuse it may be zero or just transportation costs.
- The states generally do not allow a utility to count savings from water conservation in meeting energy-efficiency goals. The energy commissioners do not typically have enough contact with water issues to understand why this should be possible. If we can change this in California, it can go national.
- Climate change has major implications for agricultural productivity in the coming years. Unless we have sequentially scheduled miracles in genetic engineering, we may see declines in yields. In some areas we may need to avoid having biofuels impinging on food production. Water rights are being sold to the municipal centers. It could be a problem if too much of our high-productivity agricultural land goes out of production. This is a nationwide food and feed and security issue.

DAY I Briefings on Three Federal Initiatives

WaterSMART Program, Department of Interior

Deanna Archuleta, Department of Interior

The WaterSMART program is supporting a new water sustainability strategy for the United States, focusing on water conservation and supporting water managers in science-based decision making. Ms. Archuleta explained that WaterSMART expands the Bureau of Reclamation's various grant programs and its studies of entire river basins. WaterSMART will also give a big boost to the US Geological Survey's National Water Census, which will be conducted for the first time in 30 years.

Climate Service, National Oceans and Atmospheric Agency (NOAA)

Dr. Roger Pulwarty, NOAA

NOAA's Climate Service is a newly proposed line office will work closely with the Department of Interior to develop research and regionally scaled models, connecting information with decision makers at all levels. Dr. Pulwarty noted, "The existing information framework is not optimized for climate service delivery. We want to make sure we're not helping people do the wrong things more precisely."

The National Climate Assessment

Kathy Jacobs, White House Office of Science and Technology Policy

The National Climate Assessment is expanding to develop vulnerability assessments. These will be used to help guide federal investment in science that supports adaptation and mitigation. Ms. Jacobs remarked, "We hope that Carpe Diem will engage with the National Climate Assessment on an ongoing basis, providing critical input to our understanding of issues and options related to climate change."

Just Add Water

PANEL II Looking Ahead: Policy and Management Choices

Chair: Lillian Kawasaki, *Water Replenishment District of Southern California*
John Andrew, *California Department of Water Resources*
Vivian Chang, *Green for All*
Dian Grueneich, *California Public Utilities Commission*
Tom Iseman, *Western Governors Association*
Wendy Pulling, *Pacific Gas & Electric*
Brad Udall, *Western Water Assessment*

Given that some 24 federal agencies are directly or indirectly involved in water planning and management, with an additional number dealing with energy management, the panelists were asked for suggestions to improve their ability to work together, to identify the biggest obstacles, and to comment on how water factors into the planning. Finally, they were asked to look at regional self-sufficiency and jobs.

If we're going to meet our renewables standards, it will take coordination beyond anything we have ever seen.
—Dian Grueneich, California Public Utilities Commission

Over the next 50 years, the population in the United States is expected to increase to 450 million people, making good resource planning an imperative. The states have primacy in the water realm, but a number of panelists and participants called for a hard look at developing a national water policy. Panelists also noted the need for a much better job of coordinating federal data collection and research in areas related to the water-energy nexus.

Sixty million dollars of stimulus funding has been allocated to develop the electric transmission expansion plans for the entire United States. This will be done in the context of integrated resource planning with a look at the demand side and the supply side. The effort currently needs more solid technical information, and more personnel who can be involved in this effort at all levels. It is important to note that water issues are not now included in this program.

The Western Governors Association recently received $12 million to assist the states in this transmission planning. The funding did not include a specific request to look at water, but the WGA asked to include it in a nascent effort to bridge the energy and water communities. The WGA is planning a technical analysis of water availability across western states to prepare water supply managers for some likely future issues.

California spent a year developing its Long-Term Strategic Plan on Energy Efficiency, but because of a lack of information, the plan did not address the water-energy nexus. The state is spending $1.3 billion/year on energy-efficiency programs, an amount of money that can move markets and change behavior.

In California, all state agencies are mandated to rely 33% on renewables by 2020. In the West, 9 of 11 states have renewable portfolio standards. California's 33% will be responsible for 77% of the renewable generation in the entire West. A national renewable standard could help with regional planning.

California utilities have been running one of the most successful energy-efficiency programs in the world. From 2010 to 2019, 40% of projected load growth is expected to be met by efficiency. Utility planners are caught between requirements to increase renewables in their generation portfolios and the impacts of climate change, especially on hydropower. By 2100, the northern Sierra snowpack could essentially disappear, and the Pacific Northwest is facing the same challenges. Hydrologists are looking at ways to manage dams differently while still complying with permits. One emerging issue with its own set of policy choices is cloud seeding. Water embedded in energy production is another issue. About 20% of greenhouse gas emissions are related to the transportation, treatment, and use of water.

California's Department of Water Resources is one agency that does focus on the water-energy nexus. Its flagship program, started in 2005, is the Integrated Resource Water Management Program (IRWMP) that moves planning from the state and federal level to the community level. In its newly revised form, climate change mitigation and adaptation are now included in the IRWMP, and there is explicit recognition of the water-energy link to carbon. Obstacles to full implementation of IRWMP include the need for better planning at the watershed level and the need for a better link with land use planning. Because of the number of agencies and entities involved, a great deal of coordination is needed, but integrated water use planning is becoming more widely accepted.

The need to integrate water and energy efficiency is one of the huge takeaways from this meeting.
–Vivian Chang, Green For All

In regards to regional self sufficiency, one panelist noted the following: California is projected to have 90 – 100 million people by the turn of the next century. Right now, much of California's water comes from northern California. Wastewater is exported to the Pacific Ocean. Trash goes to Nevada, and coastal air pollution goes to the inland valleys.

Successful integration of water and energy resource policies could be enhanced by a job generation component. There is a link and synergy between the economic and climate crises. The current emphasis on creating green jobs often doesn't include jobs for those who need them most. There is high national unemployment, and the rate is much higher than average for African Americans and Latinos. In thinking about environmental justice issues, some of the questions include: Who is best able to adapt to the changing conditions? Who makes the decisions? Who bears the cost? Who builds the public will and momentum to move some of these solutions out into the world?

Local is where the rubber meets the road.
–Jim Holway, Sonoran Institute

One prototype program is Clean Energy Works in Portland, Oregon, a city-scaled energy-efficiency project which will retrofit 100,000 homes and create 10,000 jobs over 10 years. Stimulus money is used for a revolving loan fund that allows families to do the energy-efficiency work without paying up front. They repay through their utility bill. The job opportunities are linked to training. Labor unions and training providers designed the career pathways program together. This has been taken up by other cities and is starting to replicate. The program does not have an explicit water component.

PANEL II Discussion

During this panel, there was a collective "aha!" moment as panelists and participants realized the depth and breadth of the disconnect between the funding and focus on energy efficiency versus the funding and focus on water efficiency — and the missed opportunities this disconnect represents.

The question 'Who pays for it?' is not always the same as 'Who does it?' We should include how we're transferring costs in this discussion.
–Debbie Davis, Environmental Justice Coalition for Water

- There may be legal prohibitions on using energy-efficiency money for water-efficient showerheads and toilets because the funding comes from loans through the electric utility bill.
- California is launching HomeStar, one of the nation's largest home retrofit programs, next month, but it is not possible to pay for water efficiencies through utility funding. It's a political and legal issue. To change this, it is necessary to build the political will and public awareness of water and energy conservation.
- Australia has much worse problems, and they are doing a much better job. They link water and security to get public support. Their smaller size gives them enormous flexibility. So, if we work in smaller units, it could be effective. Learn from Australia.

Herding Cats: Dealing with Uncertainty and Many, Many Stakeholders

PANEL III Hydropower in the Era of Climate Change

Chair: John Shurts, *Northwest Power and Conservation Council*
Terry Fulp, *Bureau of Reclamation*
Patti Kroen, *Northwest Hydroelectric Association*
Steve Malloch, *National Wildlife Federation*
Anne Miles, *Federal Energy Regulatory Commission*
David Ponganis, *Army Corps of Engineers*
Jim Ruff, *Northwest Power and Conservation Council*

The panelists addressed changes in the hydropower picture, including the need to weigh the value of hydropower as a non-carbon renewable resource against its adverse effects on river ecology, fish, and wildlife. They were also asked what it takes to make the changes in planning, policy, and system management that are needed in an era of climate change.

Hydropower provides 5 – 10% of electricity in the United States and 70% of the electricity that comes from all renewable sources. The Federal Energy Regulatory Commission (FERC) regulates non-federal facilities, or 5% of US generation. FERC looks at historic data on a range of water-year types in its operational studies. Licenses are for 30 – 50 years, so monitoring and adaptive management are built in. FERC can only ask licensees to study what they are affecting, which means that whole-basin studies require outside funding.

There is a national push to double installed hydropower capacity by 2030, and to double hydropower-related jobs to 700,000. In August of 2009, there were 46,000 MW before FERC, which is now seeing the biggest increase in applications for new construction in a decade. The trends are:

1. Efficiency upgrades at existing hydropower facilities
2. Adding power at existing dams
3. More proposals for hydrokinetic (generating electricity from waves or currents)
4. Pumped storage

Some states want to do the licensing themselves or make federal licensing simpler. That requires a change in legislation. FERC is working on a simplified application roadmap. Several panelists and conferees agreed that river health has improved under the FERC process. Climate change and changed societal priorities will force federal water projects, particularly the multi-purpose projects, to eventually change their operations. Several panelists noted that the FERC licensing process is the best model we have for changing the operations of water projects, and it should be considered as federal projects are reoperated to meet changed hydrology and social needs.

We have this love-hate relationship with hydropower.
–Jim Ruff, Northwest Power & Conservation Council

Most economically and environmentally feasible hydropower sites have already been developed in the West, and wildlife corridors in all the major river systems of the West are blocked. There are ongoing efforts to mitigate the damage caused by existing hydropower with the goal of doubling salmon and steelhead runs. However, FERC has applications pending for small hydro on tributaries that have important anadromous fish habitat. As one panelist asked, "How are we going to manage and repair the habitat in some of these river systems with the eco-hydrology we are expecting under climate change?"

The Columbia and Snake River systems are two of the most extensively developed basins in the world, with 66 major hydroelectric dams. Coal plants are the biggest source of carbon emissions in the region, while the hydropower system produces about 75% of the electricity in an average water year and sends much of it south on the NW-SW Intertie in the summer. There is a need to balance fish and wildlife protection with meeting the region's energy needs. Since passage of the Northwest Power Act of 1980, actions for fish and wildlife have taken about 1100 MW out of the power system, or about 10% of the firm generating capacity. There is a proposal to remove the four lower Snake River federal dams to improve salmon passage for listed Snake River stocks. The NW Power & Conservation Council estimates that would undo about 40% of the carbon reduction projected under the new Power Plan.

In the Columbia River Basin, Canada and the U.S. will soon be renegotiating the Columbia River Treaty that is coming to the end of its 60-year span. Canada's needs have grown too, so this treaty is likely to change, and that, combined with climate change, will affect many aspects of hydropower planning in the Pacific Northwest.

FERC may be the only model we have that produces a decision at the end of the day rather than yet another stakeholder process.
–Steve Malloch, National Wildlife Federation

A number of panelists agreed that the time has come to start shifting planning and management away from historic premises to incorporate climate change trends. Historic data are valuable, but we have to understand the uncertainties better. Even with a very wide range of projections produced by varying the data in a planning decision model, all indications are that the inflow trend in the West is down. One panelist noted, "In the Colorado River Basin, supply and demand have converged."

PANEL III Discussion

- One example of decision making in a multi-stakeholder environment involved a proposal to increase storage in the Missouri Basin by one million acre-feet per year. It took 15 years of talks and included 26 tribes, and 26 stakeholders. These processes are cumbersome but much better than litigation.
- Those who are seeking lower Snake River dam removal have pledged that they will not support it unless there will be no net carbon increase. Removing the dams would undo 40% of the carbon reduction projected under the new Power Council Plan only at the level of energy efficiency and clean renewable investment and acquisition proposed in that plan. The NW Energy Coalition's "Bright Future" report shows that economically feasible steps can be taken to remove the dams and achieve the carbon reduction. The key is accelerating the investment in conservation and efficiency. We have to make technical choices, policy choices, and small d democracy choices.
- If you want to have reliable water, the relicensing process is the best opportunity. We can't take decades fighting over water use. The recent Klamath settlement agreement broke new ground with 27 parties signing the agreement. It took six years because Klamath River restoration was coupled with the hydro settlement. It was a 380-page settlement agreement, outside FERC's jurisdiction. It went way beyond hydro and dealt with renewable energy, Bonneville Power, the local economy. This could be the model for the West Coast.
- Who pays for environmental restoration in these watersheds? One of the problems with the Klamath agreement is that later this year, California voters must pass a bond issue that includes money for various activities apart from the Klamath issue in order to provide a sizable amount of money to fund the dam removal and restoration projects. If the bond doesn't pass then, according to PacifiCorp attorneys, the project will continue to be operated according to their existing license.

Hydropower licensees are often viewed as the deep pocket in the watershed by interested parties frustrated by their inability to otherwise fund projects.
–Patti Kroen, Northwest Hydroelectric Association

- The Oroville (California) settlement process involved a wide spectrum of stakeholders, and the end result was that the State of California, which was the licensee, was compelled to agree to many actions that have no clear connection to the project in order to gain agreement on the settlement from the entire group. Relicensing can become the venue where many environmental resource issues are discussed, some with no connection to the facilities seeking a new license, and licensees can be left funding activities designed to address impacts for which their projects are not responsible.

Day I Wrap-up

Comments

- We don't have the water data, and without the data, we're battling to make the case for the urgency of conservation and efficiency. Encourage everyone to yell loudly and often that we need the data.
- Just because we have this level of uncertainty it's not a reason to do nothing.
- We need policies, targets, and a pot of money. The latest California water legislation is the first thing that has popped up that had targets, and there are still no targets for agriculture. A lot of work can be done by the states.

There are some places where I get stuck. How do we scale up the pilot projects? We just don't have enough people. How do we speed up? The climate changes and their impacts are happening faster than expected. The models we were using weren't too wacky, they weren't wacky enough.
–Holly Hartmann
University of Arizona/CLIMAS

- The Corps and the Bureau, along with the EPA, are key players at the state and local level in funding conservation. The Corps is going to be controlling a lot of the low-impact development. Focusing at the state and local level as well as on the federal partners is essential.
- In the West, irrigated agriculture is the largest water user, but we don't even know how much water is being diverted and used by individual irrigators. It's hard to encourage and implement efficiency improvements without such information.
- The incentives to keep the agency silos operating are very strong, they are built into budgeting and professional language. What could cause the people in silos to work together on the same thing? It could be carbon. Let's find some common ground here.

DAY TWO - MARCH 5, 2010

Planning in a Data Vacuum

PANEL IV The Energy Demands of Water Management

Chair: Fran Spivy-Weber, *California State Water Resources Control Board*
Mary Ann Dickinson, *Alliance for Water Efficiency*
Amy Hardberger, *Environmental Defense Fund*
Ron Pate, *Sandia Lab and Department of Energy*

The panel was asked to discuss the incentives for water suppliers to reduce their greenhouse gas emissions, and why the issue of embedded water is not at the forefront of the conversations about energy and water. They also looked at the options and obstacles for pairing renewable energy with water treatment facilities.

In 2005, the California Energy Commission issued a report that for the first time analyzed embedded energy in water, looking at the energy used in pumping and transportation, heating, use, and final discharge. Source to discharge can be an energy-intensive cycle, ranging between 2000 and 20,000 kWh for every million gallons produced. Such orders of magnitude differences arise depending on how far the water has to be moved. This means that system-wide average numbers are not helpful. In general, the analysis of energy embedded in water is not routine because water suppliers have not run the numbers, and they don't see how much energy they could save.

Funding is needed for research and data collection. In California, 32% of the gas load and 19% of electricity are used to pump and treat water. One model shows 13% of the nation's energy load goes for pumping, treating, heating, and end-use wastewater treatment. Despite this, there is no incentive to get real energy-use numbers and no reward for conserving energy embedded in water. The federal climate bill gives token attention, but it doesn't pull water into the carbon counting scheme that is needed if water utilities are going to take the issue seriously. No one in Congress is responsible for water efficiency. As one panelist noted, "Water doesn't have a home unless it's translated into energy savings."

Mary Ann Dickinson suggested a five-point plan:

1. Gather the data on a national basis. Develop good regional estimates.
2. Develop a climate credits protocol that translates water savings to energy savings to greenhouse gas emission reductions.
3. Let the water community trade their reductions in carbon reduction programs.
4. Provide funding for water-efficiency programs on a parity with energy, or at least specify that water-efficiency programs can be funded with energy-efficiency money.
5. Have the new WaterSMART initiative convene federal agencies to reduce silo decision making and silo funding.

It is very difficult to get a cradle-to-grave water footprint for energy generation. The permitting process can be the problem when questions about water use in energy generation are not included. Some facilities have their own wells or reservoirs and do not report, or even keep, data on water pumpage and use. Conversely, there are often no power meters on facilities that pump water, and the ranges can be huge, depending how far away the water source is from the plant and whether the source is surface or deep groundwater.

As a result, energy use figures for wastewater and pre-use treatment are often estimated. When real policy is based on these rough estimates, the lack of data can have a huge impact.

There is often a data mismatch; what you get from power providers and water utilities may not be in the same units. We need a universal metric.
–Amy Hardberger, Environmental Defense Fund

When it comes to treating wastewater, there are opportunities for water- and energy-saving pairings with renewable energy sources. Cogeneration usually makes the most sense, using biofuels to produce process heat. Solar thermal produces process heat, and can also desalinate or detoxify water. There is an associated capital cost. Wind electric is a good source, but it is intermittent. Mechanical windpower for water pumping has a long history, and it still has a niche role to play.

Sewage contains 10 times the energy needed to treat it, and it is feasible to recover energy from sludge. It's possible to use wastewater treatment to produce biofuels, that is, to harvest algal biomass. This can be integrated into wastewater treatment and could be a separate income stream. This process removes nutrients from the water, which is an extra benefit, especially as the chemicals we put in the water continue to proliferate. Nutrient and contaminant removal is a growing and energy-intensive need in wastewater treatment.

With decontamination or disinfection, end-use conditioning (temperature modification, or softening), and wastewater treatment, the energy demands have to be looked at closely in comparison to what the renewable resource might be. These are very site- and application-specific. Is the best siting centralized or decentralized? What are the operational and environmental costs and issues? What is the plan to deal with intermittancy? For desalination some level of intermittency might be acceptable. When power has to be continuous, there is the additional cost of a backup system.

PV is mature, and large-scale systems can be installed very quickly, but it costs 25 – 40 cents/kWh of installed capacity — a significant cost barrier. There have to be other incentives or it won't be the choice. Solar thermal is site specific and expensive. Wind generation facilities can be put in relatively quickly. Geothermal is entirely site specific, but the cost of getting it up and running is comparable to a fossil fueled plant.

PANEL IV Discussion

- We have all kinds of emerging contaminants in the water now, like PBDEs (flame retardants), which are really nasty, dioxin-like stuff. It's moving up the food chain. Plus, the energy use of wastewater treatment plants is likely to increase in order to remove all these nasty things. We're moving toward reverse osmosis treatment, and we need to be planning for the higher energy use of advanced wastewater treatment. Developing decentralized wastewater treatment plants may be a way to help reduce energy demands.

It's very clear that the water conservation component of the water-energy nexus is woefully underfunded and underrepresented. It has to be a top priority.
—Fran Spivy-Weber, California State Water Resources Control Board

- Decentralized wastewater treatment is coming up all over the country. The cost of changing infrastructure is the biggest barrier. It is most affordable in a growth area such as Las Vegas. Biosolids can go to energy production, or we put them on the land. The chemicals end up in the sludge. Green chemistry, which is aimed at not producing products with these toxic chemicals in the first place, is important to us and becoming more so because end-of-pipe treatment is very costly, energy intensive and, in some cases, not available.
- Energy efficiency has had a growing and active stakeholder community for two decades. Water efficiency probably has about 300 people. We have never had any kind of a platform.
- Based on California data, 95% of the three-year energy-efficiency goals could be met just by funding water efficiency at 52% of the cost. Why is water not getting more federal attention? It doesn't have an advocate in Congress. Amending HomeStar and BuildingStar to include water would have to be done as floor amendments, and that's not likely to happen. The water community needs to start building a lot more relationships.
- The state of any technology that is under consideration is another impediment. Is it really mature? That's an issue with some of the renewable systems. How reliable and robust are they? What are the issues with operations and maintenance, and the associated costs?

Managing the Grid Ecosystem

PANEL V Commercial Solar: Finding the Water and Energy Balance

Chair: Johanna Wald, *Natural Resources Defense Council*
Nicole Carter, *Congressional Research Service*
Arthur Haubenstock, *BrightSource Energy*
Renee Robin, *Sunpower Corporation*
Stacy Tellinghuisen, *Western Resource Advocates*

The panelists were asked to give an overview of renewable technologies, the available water-efficient mitigation strategies, and the kinds of incentives state and federal governments can adopt to encourage low-water-use technology.

The reason I came to this convening was to understand who you want to do what. In DC, we're not hearing a sense of what you as a group want as a strategy for dealing with this water-energy nexus.
–Nicole Carter, Congressional Research Service

When it comes to mitigation, panelists noted that avoidance is easier than compensation. Siting is the first and most important step — to avoid siting where aquifers are overdrawn or other water limits exist. Poorly sited power facilities are already competing with the agriculture sector for water, and this competition will only increase in the future. Another challenge is building resilient transmission capacity to renewable energy zones where additional water use will not have detrimental impacts.

The question isn't only 'Who do you want to do what?' Are we talking about the Independent System Operator, the PUCs? How do we make sure these entities have the information and tools they need to make good decisions?
–Arthur Haubenstock, BrightSource Energy, Inc.

In the Intermountain West, most basins are fully or over- allocated. New plants are purchasing water from agriculture, something cities have been doing for decades. The power sector could learn from municipalities about mitigating impacts on third parties. One panelist said, "We have to ask, What is the value of not locking this water up in a power plant for the next 30 years? In terms of agriculture? What is the environmental value?"

Most types of solar generation are already low water use. Solar thermal uses a range; while some use about 25 acre-feet/year for a 25 MW plant, others use one-quarter that amount — 25 acre-feet/year for 100 MW. Water used to clean the mirrors can and should be recirculated. California Energy Commission policy says thermal facilities must use the least quantity of worst quality water available.

Solar thermal is only one piece of the picture. Renewable resource plans have to include wind, geothermal, and others that use less water. Utilities are not yet adequately evaluating water in their planning. Once exception is Arizona Public Service, which does estimate water use, in gallons per MWh, for future resource plans. As one panelist noted, it would be very helpful if all utilities in the West reported these data to the PUCs.

The panelists pointed out that how solar is used to meet power supply is a policy decision. It should be evaluated as part of a bigger picture and so should the rules for water use in a given technology. One panelist asked, “Is it a good idea to design a totally different water paradigm for biofuels or solar power?”

Photovoltaics can be decentralized on rooftops, in small distributed power plants, or built as central station power plants. They can go on already disturbed lands and deploy in a minimally invasive manner. As noted in a previous panel, 70% of hydro facilities under FERC jurisdiction are 5 MW or less, and there are lots of locations where PV installations of the same size make sense. PV uses very little water and does not need to use potable water for the panel cleaning process.

Rooftop solar is growing, and more and more municipal programs provide placement with no upfront cost. However, as one panelist said, with agreement from others, “It’s a myth that distributed rooftop PV is going to solve our problems. It can’t happen fast enough.”

The variability of renewable energy makes storage an issue. When a generation portfolio reaches 20 – 30% renewables, it’s time to plan for storage to smooth out variability. Storage doesn’t have to be onsite. Closed-system pumped hydro should be investigated in parts of the country where it’s viable. Smart grid management to integrate renewables efficiently and reliably is key.

A panelist said, “The grid works like an ecosystem and there are interesting trade-offs.” In terms of air emissions and water use, what goes on and off the grid needs to be considered. What can be done to make sure the energy system as a whole uses less water? Who is buying the energy, who is operating the system, and who is permitting these facilities?

Policy makers need to determine how much decision making takes place on the federal level, the state level, the local level. Research isn’t going to happen on the local level. On the other hand, federal regulators are not best placed to determine the cooling method used at a given plant. And, as a final note, a panelist pointed out, “These entities are not necessarily thinking about water.”

PANEL V Discussion

The energy sector has the advantage that the PUCs have the authority to look at cost, reliability, and environmental tradeoffs. No entity is looking at water on a statewide level.
–Stacy Tellinghuisen, Western Resources Advocates

- What can we do to make sure the energy system as a whole uses less water? We have to know: Who is buying the energy, who is operating the system, and who is permitting these facilities? These entities are not necessarily thinking about water. This is also true of procurement. But the PUC has a lot on their plate to start with — air emissions, grid management. Adding the water piece is a lot to ask. The utilities have to be given targets or they can't hit them.
- With water not currently priced at its true value, many decisions will not be driven by economics. They will be driven by regulations and permitting. If economics don't drive us to a more water-efficient power system, then what tools do we bring to bear?
- The conservation community needs to find a couple of proposed power facilities that we can back. Build a coalition and say, "We want to support you and this is what we expect."
- Permitting is balkanized. PV and wind are permitted on the county level. Even in California no one agency on the permitting side is monitoring water use. There are lots of different players, and these are very complex questions. It's clear we have to do it; it's not clear how we get there.
- California Energy Commission policy says that thermal facilities must use the least quantity of worst quality water available. That's Delphic. If water has to be treated it's power consumptive.

DAY II Working Group Sessions

- The first working group, led by Debbie Davis, discussed the design for a two-year campaign to inform decision makers and decided that the best approach would be a simple, positive message about the economy, jobs, safety, security, and health, targeted at all levels of government.
- The second group, led by Fran Spivy-Weber, was asked to further address policy options. The group noted that the challenge wasn't so much in terms of redesigning governance or institutional structures as in aligning the incentives correctly. They also noted the need to quickly address the looming conflicts between water use in agricultural and in renewable energy production. They suggested that the best place to start in the West is at the state and local level.
- The third group, led by Mary Ann Dickinson, was asked how to create incentives to promote both water and energy efficiency in each sector. They identified funding as a key driver, and rate reform as a key policy issue. They also advocated getting the word out about success stories.
- The fourth group, led by Holly Hartman, addressed critical science questions that need answers and decided that more work is needed in systems science and decision science. This would help decision makers deal with uncertainty and risk, define best practices in an era of climate change, and incorporate risk into regulations. This group also advocated increasing the understanding in the water-energy community of marketing and the language that drives decision making.

Wrap-up: Where Do We Go from Here?

Chair: Steve Whitney, *Bullitt Foundation*
Lillian Kawasaki, *Water Replenishment District of Southern California*
Felicia Marcus, *Natural Resources Defense Council*
Roger Pulwarty, *National Oceanic and Atmospheric Administration*
Fran Spivy-Weber, *California State Water Resources Control Board*

Steve Whitney started the discussion noting 10 things he had heard at the convening.

1. First was the list of key questions: What do we need more of? What do we need to do faster? What do we need to do differently? Who needs to do it? The "who" question goes to whether we are going to stick with the current fragmented set of authorities and put one in charge, or do we need a completely new system of governance?

2. At the federal level, despite fragmentation among the various agencies, steps are being taken to coordinate the federal response to climate change and impacts on water resources.

3. The Bureau of Reclamation is grappling with the difficulties of applying current climate science to decision making, but trends are evident, and it is clear that we have to act despite the uncertainties.

4. We learned about important innovations in linked water and energy management in the Pacific Northwest and California.

5. We learned about how the FERC hydro licensing and relicensing process has been important for prompting basin-wide considerations and planning, and for river health. Even though basin-wide data and thinking are essential, FERC applicants cannot be asked to carry the whole load for funding basin-wide studies.

6. There are concerns about erosion of the rate base as conservation takes hold. The interplay between conservation and maintaining the revenue base for water management agencies has to be worked out. Decoupling pricing from the volume of water deliveries may be warranted.

7. We heard about the importance of language and communications in talking about a subject of such complexity.

8. There have to be incentives for water conservation. The energy conservation benefits of water conservation may qualify water conservation for payments under a carbon offset market mechanism, providing one incentive.

All too often we've been in silos. Ego system management is a greater challenge than ecosystem management.
–Felicia Marcus, Natural Resources Defense Council

9. We learned more about solar technology. Plant siting has water implications. Different utility-scale solar technologies create different water demands. The smart grid can enhance system reliability, but the energy system as a whole is complex, and there are complicated water tradeoffs involved in renewable energy development.
10. We heard several calls to establish a national context or process for identifying needed reforms in energy and water management that can be advanced at scale. The idea of a national water commission was raised as a possibility.

Closing Comments

- There may not be solutions, but there are still a lot of choices that can make a difference. Some of those choices have already been put into action in some places. And the successes we've heard about have some characteristics in common. The first is they drew boundaries more broadly — source-to-waste accounting, conservation connected to jobs. Broadening boundaries is a way to be more flexible and nimble when you don't have a big plan.
- We should ask broader versions of the questions: Who does it, and who pays? Where should we be doing things? Headwaters of the Snake? Los Angeles? The role for Carpe Diem is to create an environment where we can think about broadening those boundaries.
- It is important to identify two or three things that people need to make better decisions about. We should be giving people tools in this uncertain time. We should try to integrate water and energy management models. One project would be to collectively put together a tool box for decision makers and say, "Here are some things you can do without having to change the legislation."
- We need to better integrate land use and water decisions — we're promoting patterns of growth that make the embedded energy in water problem worse.

As a climate community we have to move beyond impact assessments.
–Roger Pulwarty, NOAA

- What is required to incentivize change? It is critical to show that near-term investments result in near-term benefits. Big problem — in the long run, we're all dead, so we need to show short-term benefits. If you can't communicate those multiple benefits, we're just quantifying impacts.
- What are the third-party impacts, the costs of interbasin transfers? What are the methodologies and metrics for estimating integrated impacts?
- There is no carbon-credit trading scheme to reward conserving energy embedded in water. The federal climate bill gives token attention, but it doesn't pull it into the carbon trading or counting scheme that we need if water utilities are going to take this seriously.
- Closing the data gap on the carbon footprint of water and the water footprint of power would be very helpful, and it would only cost between $200 – $300K to develop a national database.
- We don't just need integrated assessments, we need integrated statements about problems and opportunities that connect directly to people's own lives. Without that, we won't have the mooring necessary for a democratic society.

Convening Participants to the Carpe Diem Project:

Do More Faster

- Carpe Diem should engage a wider audience, including agricultural interests at the local and state levels; NASA for its satellite water monitoring capability; wastewater experts, who already integrate water and energy in their planning; land use planners; and many other government agencies involved in water and energy policy.
- It would be beneficial to take the issues we're looking at and integrate them into a smart growth frame. Carpe Diem could identify: What are the decisions we need to influence? Individual behavior? Government regulation? Utility behavior? Some we can influence now, some later. The group that develops this type of agenda has a lot of influence.
- Federal agency and Hill staff have noted the value of Carpe Diem's trusted broker role. They are only hearing from people in silos, or don't have a synthesis of the issues. Carpe Diem could provide a briefing to federal agencies and Hill staff.
- Carpe Diem should identify the key leaders and opportunities for this issue in the utility community and document success stories where water and energy have been combined and integrated.
- Conduct an education and training program for water and energy utility managers. Carpe Diem could develop an analytical tool box and include the case studies from above.
- Use existing mechanisms that already gather together water and energy leaders, such as the Homeland Security Forums. Use these opportunities to promote the integrated water-energy message.
- Carpe Diem should should expand its communications portal on water, energy, and climate issues and continue its work on public opinion research in order to help identify, develop and sharpen key messages.
- Carpe Diem should continue to be holder of the western water and climate change big picture and developer of the overall strategic plan agenda.

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Note: *Participation in this convening does not imply or indicate endorsement by the individual or his/her related organizations of any policy or actions discussed or implied.*

▶ = Carpe Diem Project Team members
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The Carpe Diem - Western Water & Climate Change Project is a broad-based network of over 600 experts, decision makers, and scientists dedicated to addressing the unprecedented challenges that the impacts of climate change on water resources pose for the American West. By linking leaders and integrating state-of-the-art climate-change science with the needs of a range of stakeholders, the Project incubates new initiatives and promotes sustainable management practices and policies that provide water security for people, ecosystems, industry, and food production. [www.carpediemproject.org]

Exloco, founded in 2000, works to advance pragmatic, innovative solutions to environmental sustainability challenges in the western United States. Partnering with social change organizations, public agencies, venture philanthropists, and corporations, Exloco develops networks of decision makers to research and analyze key issues and provides an outcome-focused process to craft innovative strategies and solutions for a healthy and vibrant West. [www.exloco.org]

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