Consideration of Impacts on Water Quality and Quantity in the WREZ Process

By facilitating development of renewable energy supplies, developing transmission to renewable energy zones can help reduce the potential impacts of climate change on the West's water resources. It is important that, in the process, renewable energy development does not contribute to or exacerbate water supply and quality challenges.

Throughout much of the Western U.S., water is a scarce resource. Growing cities and power plants often compete directly with the agricultural sector - and environmental needs - for limited water supplies. Developing new, renewable energy supplies will have varied impacts on water resources. Most importantly, on a *regional* scale, climate change will impact water resources by increasing temperatures (and evapotranspiration) and altering patterns of precipitation and runoff. Nearly all climate change models for the Western U.S. predict decreasing runoff and, as a result, lower levels of storage and water availability. For these reasons, developing transmission for renewable energy zones that will help to decrease dependence on fossil fuels is an important step toward mitigating the impacts of climate change on the West's water resources. On a *local* scale, however, renewable energy development has more varied impacts on water resources. In the following sections, we present

1. General information about the impact of renewable energy generation on water resources;
2. Methods for integrating water information into the Western Renewable Energy Zone (WREZ) processes and general siting principles; and
3. Recommended mitigation tactics.

Water Use for Energy Generation

The water used to generate electricity varies substantially, depending on both the primary fuel source (e.g. wind, geothermal heat, etc.), and the conversion technology. Wind turbines and solar PV panels use virtually no water, whereas the water requirements of solar thermal and geothermal plants can be significant. Figure 1 illustrates the water consumed, in gallons per MWh of electricity generated, for several forms of electricity generation, including conventional sources of electricity, emerging technologies, and renewables.

Wind power uses no water. In many of the highest quality wind resource zones, like Southeastern Colorado and Central New Mexico, water resources are already fully- or over-allocated. In these basins, developing wind resources rather than conventional power plants, fueled by coal or natural gas, is an important strategy for reducing strains on water resources. Likewise, utility-scale **solar PV** uses a negligible amount of water, and will also help meet electricity demands without straining water supplies.

Like conventional thermal plants that generate electricity in steam turbines, **solar thermal** plants primarily use water to cool, condense, and capture steam. The amount of water consumed depends, to a great extent, on the type of cooling technology. Power plants that use dry cooling use very little water, while plants that rely on wet-recirculating cooling technologies consume more substantial amounts of water. For example, wet-cooled solar thermal plants consume 800 to 1,000 gallons of water per MWh generated. A 100 MW solar thermal plant relying on wet cooling would consume approximately 1,000 acre feet (AF) of water per year – enough water to supply about 2,000 families. In many places, dry cooling may be feasible for solar thermal plants. In sunny areas like Southern Nevada and Arizona, however, hot average temperatures may require that solar thermal plants use wet or hybrid cooling systems or accept decreased efficiency and increased costs for dry-cooling.

Geothermal power plants, which rely on steam turbines to generate electricity, also use significant amounts of water. Many, if not most, geothermal plants can use geothermal fluids – which are typically high in dissolved salts and other minerals – for cooling and condensing steam. In places where geothermal plants rely on geothermal fluids, they do *not* compete directly with other freshwater needs, because geothermal fluids are too high in dissolved salts to be useful for municipal or agricultural needs. After generating electricity, most geothermal plants pump the geothermal fluid back into the ground and do not discharge the geothermal fluid into surface supplies. This procedure can also avoid some water quality concerns. Although Figure 1 shows high rates of water use for geothermal power plants, most geothermal plants consume no freshwater.

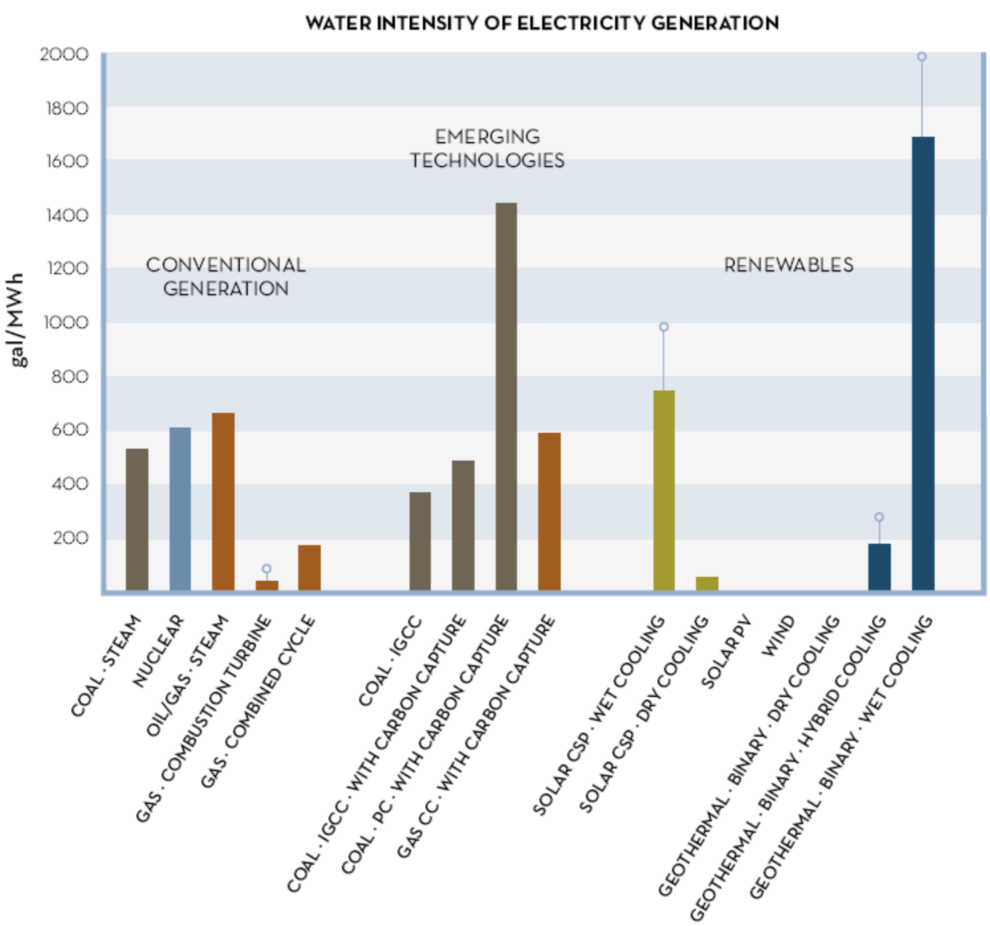

Figure 1. Water consumed for various forms of electricity generation, in gallons/MWh. Importantly, although the graph indicates that geothermal power plants can use large amounts of water, most water used by geothermal plants is often high in salts or other minerals. This water typically cannot be used by municipalities or for agriculture.

Source: Western Resource Advocates. 2008. *A Sustainable Path: Meeting Nevada's Energy and Water Needs.* Boulder, CO.

<u>Integrating Water Data into the WREZ Process</u>

The water demands for different forms of renewable generation should be a factor in identifying the best renewable energy zones. Many of the areas with the best solar resources – Southern Nevada, Southeastern California, Southern Arizona, and Southern New Mexico – also have very limited water resources. Several of these regions also have rapidly growing urban areas, with growing municipal water demands. We recommend the WREZ process evaluate renewable energy zones in the context of three issues:

1. Legal and physical availability of water (ground or surface); and
2. Environmental impacts of new surface water diversions or groundwater pumping.
3. Protection of sensitive riparian areas and wetlands.

Potential data sources include the USGS Groundwater Atlas of the United States (http://pubs.usgs.gov/ha/ha730/gwa.html). WGA should also incorporate water data from the state engineers and their reports, especially in states with existing water conflicts and high potential for water intensive renewable energy development

<u>Mitigation measures</u>

Minimization and mitigation of the impacts of new transmission corridors and renewable energy development will be essential to ensure protection of water and other natural resources. Renewable energy development and transmission lines should rely first on existing corridors and impacted areas and avoid sensitive riparian or wetland areas. Developers should use best management practices during construction and operation to minimize any impacts that cannot be avoided. In the desert southwest, existing environmental laws may not adequately protect intermittent streams, dry washes, and arroyos; these environments, however, are essential components of a watershed and impacts need to be minimized.

Some renewable energy technologies can help mitigate impacts on water resources, as well. Geothermal plants, for example, can rely on geothermal fluids for cooling water. Solar thermal plants should prioritize the use of dry cooling in areas with limited water resources. Solar thermal or biomass plants can also use shallow, brackish groundwater or treated wastewater, if it is available. Typically, municipalities cannot use these water supplies for potable water use without advanced water treatment; using them for industrial processes like power plant cooling reduces demand for more pristine, freshwater supplies. Power plants should use degraded water supplies rather than freshwater wherever possible. Other initiatives to facilitate responsible renewable energy development and policies on water use emphasize the importance of limiting water use. For example, the California Renewable Energy Transmission Initiative (RETI) Phase 1B Report states that, "The Environmental Working Group assumes that groundwater is unlikely to be available for cooling thermal power plants, and that treated urban wastewater can be used."[1] The California Energy Commission[2] and California State Water Resources Control Board[3] also discourage fresh water use for power plant cooling in their policy.

<u>Conclusion and Recommendations</u>

Water is a scarce resource in the western U.S. The projected impacts of climate change, in addition to rapidly expanding cities and power demands, will only increase pressures on the region's limited water resources. Renewable energy can help mitigate climate change. In siting renewable energy zones and transmission lines, however, the Western Governor's Association should ensure that the zones do not exacerbate existing water challenges – or create new ones.

We therefore recommend that WGA:

1. Overlay the QRAs with a database/map of fully- or over-allocated groundwater and surface water supplies, as well as sensitive wetlands and riparian areas, so that both WGA and the public can understand the relationship of the QRAs to water sources;
2. Evaluate the Qualified Resource Areas (QRAs) in terms of both:
    a. Legal and physical availability of water (ground or surface); and
    b. Environmental impacts of new surface water diversions or groundwater pumping;
3. Identify and evaluate potential mitigation measures to protect water sources; and
4. Where appropriate, based on the evaluation, map sensitive riparian/wetland areas and areas with serious water quality and quantity concerns as Exclusion or Avoidance areas.

If the timeline for completion of the WREZ process precludes WGA from fully integrating water and riparian data into the WREZ process, at a minimum we recommend overlaying the QRAs with USGS groundwater data (http://pubs.usgs.gov/ha/ha730/gwa.html) to begin the process of addressing water quality and quantity concerns. In addition, we hope that the WGA Wildlife Council process for identifying crucial wildlife habitat and corridors will identify sensitive riparian and wetland areas for exclusion and avoidance

[1]RETI Phase 1B Report, p. 3-3. http://www.energy.ca.gov/2008publications/RETI-1000-2008-003/RETI-1000-2008-003-F.PDF

[2] California Energy Commission 2003 Integrated Energy Policy Report, p. 39-41. http://www.energy.ca.gov/reports/100-03-019F.PDF

[3] State Water Resources Control Board Resolution 75-58, *Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Power Plant Cooling*, June 19, 1975, p. 1. http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1975/rs75_058.pdf