Water Management

Our Approach

By far, the majority of Xcel Energy’s water use is for generating electricity, compared to water used in office buildings. A reliable water source is essential to producing power at our hydroelectric and thermal generating plants. We carefully manage water resources by seeking responsible and secure supply options, working to conserve water where we can and ensuring we maintain water quality, especially when water is used and then returned to the environment. As we increase the use of wind and solar generation, we save water as these energy sources require no water to produce power.

Since 2005, we have reduced water consumption associated with electric generation more than 35%.
**Water Use**

Xcel Energy uses water to generate electricity. At our hydroelectric plants, rushing water is the fuel that operates plant turbines to produce power. But by far, most of our water use occurs at thermal generating plants where water is used to produce steam for generating electricity and also for cooling equipment.

Cooling makes up more than 95 percent of a thermal power plant’s water needs, depending on plant operations. Thermal plants generally use one of two cooling options that are uniquely designed for optimal heat transfer to water. This allows the plants to operate at maximum efficiency and generate the most electricity possible from the fuel source.

**Open-loop Cooling**

For open-loop cooling, water is taken from a river, lake or reservoir and used to cool and condense the steam that drives turbines to produce electricity. Water is then returned to the river, lake or reservoir in accordance with all state and federal permits or requirements and in a condition that protects water quality for human use and the environment. Nearly all of Xcel Energy’s thermal power plants in the Upper Midwest and one plant in Colorado (Valmont Generating Station) use open-loop cooling, also referred to as once-through cooling.

**Closed-loop Cooling**

With closed-loop cooling, water runs through cooling towers to cool and condense the steam used to drive turbines to produce electricity. Cooling towers require relatively low water volumes to operate efficiently. They operate in a way that minimizes fresh water withdrawals by reusing water multiple times in the cooling water system and providing reuse water for other plant operations. Nearly all of Xcel Energy’s thermal power plants in Colorado, Texas and New Mexico and one plant in Minnesota (Sherco Generating Station) use closed-loop cooling. A portion of the water in closed-loop cooling systems may be returned to the river, lake or reservoir in accordance with all state and federal permits or requirements. Water may also be stored in evaporation ponds.

Several advanced, closed-loop cooling technologies are now available that may be built into new thermal plants for reducing water use. While these systems require less water for cooling equipment, they may be less efficient for producing electricity and are best incorporated into facilities located in areas with extreme water scarcity that warrant the use of more expensive technology.

**Hybrid Cooling**

Both water and air are used for hybrid cooling. Air cooling reduces the need for water when ambient air temperature is sufficient to support the necessary cooling, but uses water during other times of the year when heat transfer to air is inefficient. Electric production with hybrid cooling requires more fuel and produces less electricity than water cooling because of the less efficient steam cycle and additional electric load required by cooling fans. Only Unit 3 at Xcel Energy’s Comanche Generating Station in Colorado uses hybrid cooling.

**Dry cooling**

Air cooling is used to condense steam. In addition to being expensive to construct, dry cooling uses more fuel and produces less electricity than water cooling, due to a less efficient steam cycle and additional electric load required by cooling fans. Additionally, heat transfer limitations during some months may limit plant generation capacity, potentially requiring additional power purchases to support system demands. Xcel Energy does not currently operate thermal plants that use dry cooling.

**Managing Water Supply**

**Thermal Operations in the West and Southwest**

In the semi-arid and arid states where we operate—Colorado, New Mexico and Texas—water is acquired for our thermal and hydroelectric plants through water rights and other agreements. We have strategic water resource plans that are updated annually to reflect our current operational requirements, local climate conditions and water use. Throughout the year we conduct a variety of activities to accurately predict and plan for future water supplies, which include forecasting plant water requirements based on anticipated electric generation; accounting for the water we need and use; monitoring snowpack reports; and studying stream flow forecasts, seasonal climate projections and changes to the Ogallala aquifer—the primary aquifer that underlies much of the region in Texas and New Mexico that we serve.

We have pursued an integrated water supply portfolio strategy, including owned or self-supplied water rights, reservoir storage, groundwater rights and a number of other supplies, including municipal and recycled water supplies. Our portfolio includes water from geographically diverse areas, including trans-basin water imported from other basins. This diversity is critical for maintaining a resilient, reliable water supply in the arid, climatically variable western United States.
Xcel Energy is a Tier 1 water supplier, which means we own water supplies dedicated for our own use. In Colorado, our owned water supplies or rights are available depending on regional water supply conditions in accordance with Colorado’s prior appropriation system.

Xcel Energy and other Tier 1 suppliers have taken concrete steps to increase resiliency of the water supply system after the recent historic, multi-year drought in the West, which identified weaknesses. We expended significant resources to address these issues and improve our water supply and the resiliency of our systems. The Tier 1 suppliers that we do business with responded similarly, taking steps to improve their water supplies and adopt drought response plans for ensuring they meet their municipal and industrial water supply obligations. Further, they pursued the acquisition of geographically diverse water supplies originating in other river basins, enhancing the resiliency of their systems.

Finally, Xcel Energy has pursued recycled water where available and feasible, which minimizes the competition between water needs for power generation and needs for environmental, recreational, municipal or other industrial uses. Recycled water use has the added benefit of increasing the reliability of our water supply portfolio because it is virtually drought-proof.

According to the Colorado Division of Water Resources Cumulative Yearly Statistics 1996-2008, thermoelectric power generation makes up less than 0.5 percent of the state’s water usage, with agriculture making up 86 percent of usage and the remainder going to meet municipal, recreational and other industrial needs. We anticipate the western and southwestern portions of our service area will experience drought conditions in the future. We continue to work with water boards, management organizations, farmers and ranchers, utilities and local communities to develop innovative partnerships and agreements to help meet different water needs during dry times.

2016 Colorado Water Supply and Consumption

<table>
<thead>
<tr>
<th>Water Sources</th>
<th>TOTAL WATER WITHDRAWN</th>
<th>TOTAL WATER CONSUMED</th>
<th>TOTAL WATER RETURNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Platte River</td>
<td>10.33 Billion Gallons</td>
<td>9.54 Billion Gallons</td>
<td>1.60 Billion Gallons</td>
</tr>
<tr>
<td>St. Vrain River</td>
<td>6.81 Billion Gallons</td>
<td>5.94 Billion Gallons</td>
<td>0.87 Billion Gallons</td>
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<tr>
<td>South Boulder Creek</td>
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<tr>
<td>Boulder Creek/Wellman Canal</td>
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<tr>
<td>Arkansas River</td>
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<tr>
<td>Yampa River</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Treated Municipal Water Supply</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Denver Water Municipal Effluent</td>
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<td></td>
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</tbody>
</table>

2016 Southwest Water Supply and Consumption

<table>
<thead>
<tr>
<th>Water Sources</th>
<th>TOTAL WATER WITHDRAWN</th>
<th>TOTAL WATER CONSUMED</th>
<th>TOTAL WATER RETURNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater from the Ogallala Aquifer</td>
<td>4.23 Billion Gallons</td>
<td>7.48 Billion Gallons</td>
<td>1.45 Billion Gallons*</td>
</tr>
<tr>
<td>City of Amarillo Municipal Effluent</td>
<td>4.76 Billion Gallons</td>
<td>4.50 Billion Gallons</td>
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<tr>
<td>City of Lubbock Municipal Effluent</td>
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</tbody>
</table>

*returned for irrigation use or into evaporation ponds
Thermal Operations in the Upper Midwest

In Minnesota, Wisconsin and other northern states where water is more abundant, our thermal plants are permitted to use and return water to nearby rivers and other waterways. We also take a strategic approach to water use in these areas by monitoring weather patterns and using meteorological forecasting models to predict and prepare for an adequate water supply during times when unusually dry conditions are likely to persist. During drought years, we evaluate the use of alternative cooling options for each facility and implement prudent temporary measures to provide supplemental thermal cooling. In time of energy emergencies, our permits have provisions that allow some plant operating flexibility, along with additional environmental monitoring requirements to ensure protection of aquatic wildlife and biota.

Hydroelectric Operations

Xcel Energy operates 26 hydroelectric plants, including six in Colorado, one in Minnesota and 19 in Wisconsin and Michigan. These plants are built on rivers and other waterways where rushing water can flow through turbine generators to produce electricity. The Cabin Creek Generating Station near Georgetown, Colorado, is a pumped-storage hydroelectric plant and is unique to our system. Water is pumped from a lower reservoir to an upper reservoir where the water is released through a tunnel to turn turbine generators.

Hydroelectric plants do not consume water in the generation process even though water does naturally evaporate from reservoirs. We work with environmental and wildlife agencies to ensure plans are in place for monitoring watering quality, protecting aquatic life, ensuring minimum stream flow, preventing erosion, and controlling noxious weeds and other invasive plants.

Xcel Energy’s hydroelectric plants operate on the following waterways; many of these are open to public recreation:

<table>
<thead>
<tr>
<th>Colorado</th>
<th>Minnesota</th>
<th>Wisconsin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Clear Creek</td>
<td>Mississippi River</td>
<td>Chippewa River</td>
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<tr>
<td>South Fork Arkansas River</td>
<td></td>
<td>Apple River</td>
</tr>
<tr>
<td>South Clear Creek</td>
<td></td>
<td>Red Cedar River</td>
</tr>
<tr>
<td>Colorado River</td>
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<td>Namekagon River</td>
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<tr>
<td>Animas River and tributaries</td>
<td></td>
<td>Montreal River</td>
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<tr>
<td>San Miguel River and tributaries</td>
<td></td>
<td>White River</td>
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<tr>
<td></td>
<td></td>
<td>Flambeau River</td>
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<tr>
<td></td>
<td></td>
<td>St. Croix River</td>
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</tbody>
</table>
Maintaining Water Quality

All of our large plants in Texas and New Mexico, as well as several plants in Colorado, are zero-discharge facilities—no process water is discharged from the plant site. Instead, it can be reused for growing crops or disposed through evaporation ponds.

Other plants, especially those in Minnesota and Wisconsin, use once-through cooling where water is taken from a river or other waterway and returned to the environment. At all our plants where we return or discharge water, we systematically treat, monitor and analyze the water to ensure we are meeting discharge requirements and to protect the aquatic environment. It is important that we return the water we use to rivers and waterways in a usable condition and in compliance with stringent regulatory requirements.

Water Conservation

Our water consumption associated with power generation has decreased approximately 35 percent from 2005 to 2016. We look for cost-effective opportunities to conserve water and have developed a number of innovative efforts to reduce water usage at our plants, especially the use of fresh or high quality water.

• We use water as efficiently as possible in our operations. Water is circulated through the cooling process at our closed-loop plants multiple times—up to 25 times at some plants. When it is no longer suitable for cooling, water is used in coal-ash handling processes, with emission controls, for site irrigation and other uses.

• In Texas, we use recycled municipal effluent at our Harrington, Nichols and Jones facilities, and our Tolk Plant uses effluent from Plant X for a portion of its water supply.

• Recycled municipal water from metro Denver is used for cooling water at the Cherokee Plant. Overall, this recycled water accounts for approximately 50 percent of Cherokee’s water consumption and about 10 percent of our total water consumption in Colorado.

• We have reduced water use 30 to 50 percent for Comanche Unit 3 by incorporating a low-water use system with hybrid cooling technology that provides additional air cooling capability.

• Once the Clean Air Clean Jobs project is complete with the retirement of about 700 megawatts of coal-fueled generation, we anticipate decreasing overall system water usage in Colorado by about 15 percent. Since 2010, we have reduced total consumptive water use by 14 percent in Colorado.

• Diversifying our energy supply can help reduce water usage. In 2016, 20 percent of our energy supply came from wind and solar energy, which does not require water.

• When customers save energy through our energy efficiency programs, they also help save water.

Water Partnerships, Innovative Agreements and Stakeholder Efforts

Water is a fundamental resource that has become more stressed as communities grow and as weather patterns fluctuate. In addition to people, water affects habitat and wildlife. Through engagement in the communities we serve—including participation on water boards, in management organizations and in regulatory forums—we are finding solutions and forming partnerships. We also have supported local projects and community initiatives through the Xcel Energy Foundation.

• Xcel Energy personnel participate regularly in stakeholder organizations for the water basins in which the company has interests. Our staff serve on boards and as officers overseeing eight ditch companies in Colorado where the company owns significant water rights. Conflicts involving water are often identified and resolved through these organizations and boards.

• We own very senior water rights on the Colorado River that are used to operate the Shoshone Hydroelectric Generating Plant. To help meet water needs within the city of Denver and surrounding suburbs, we have an agreement to “relax” a portion of our water requirements for Shoshone during dry years. In 2013, Colorado experienced below-average moisture, which marked the first year that we implemented this agreement, originally established with Denver Water in 2006. Rather than maintaining 1,250 cubic feet per second in the river to run Shoshone, we reduced our use to 704 cfs and allowed Denver Water and other Colorado Front Range water providers to store river flows above this amount for municipal use.
• We have an agreement with the city of Longmont in northern Colorado that helps preserve high quality water for municipal use. We exchange annually up to 5,000 acre-feet of high quality water acquired under our water rights with the city’s lowest quality water or effluent. The city routinely discharges its effluent to the South Platte River where we take it to use at our power plants, including Fort St. Vrain, Cherokee and Pawnee plants. We have a similar agreement with the city of Westminster to provide high quality water from Clear Lake in exchange for municipal effluent to use at our plants.

• In dry years Colorado farmers typically lack the full water supply needed for growing crops. Through a mutually beneficial agreement, we buy limited quantities of water that farmers have available and use it in our power plants. Under this arrangement, farmers are compensated, helping them financially during dry years.

• The Xcel Energy Foundation funds a statewide initiative of the Colorado Foundation for Water Education to help raise awareness about water as a limited and valuable resource. By connecting Coloradans with information and activities focused on water, including library and museum exhibits, speakers and video presentations and a water website, the organization strives to motivate residents to become more proactive participants in the state’s water future and increase support for better managing and protecting Colorado’s water and waterways. In addition to funding, Xcel Energy water resources staff volunteer with and support this effort.

• Xcel Energy is a member of the Minnesota Sustainable Growth Coalition, a business-led partnership of 33 businesses and organizations working to promote a circular economy in Minnesota. The coalition focuses on energy, water and waste issues. In the water area, the coalition is working on “greening grey infrastructure” or promoting infrastructure and practices designed to mimic the natural water cycle.

**Regulatory Developments**

**Waters of the United States (WOTUS)**

In June of 2015, EPA and U.S. Army Corps of Engineers finalized the new definition of what water bodies and topographic features are considered WOTUS. This definition broadened the scope of waters subject to federal jurisdiction under the Clean Water Act. The rule defined seven categories of waters that are jurisdictional, several of which are very broad and can allow case-by-case determinations. Under this new definition, more utility projects are subject to federal Clean Water Act jurisdiction. Xcel Energy, along with other industries and states, raised concerns about the scope of the rule throughout the rulemaking process. Multiple states, including most of the states we serve, are suing EPA on grounds that the final rule impinges on state rights, exceeds its authority and is unconstitutional. In October 2015, an appellate court had stayed the rule, pending the outcome of this ongoing litigation.

President Trump issued an Executive Order in early 2017 directing EPA and U.S. Army Corps of Engineers to conduct a comprehensive review and revise the WOTUS rule. Any new or revised rule will require public comments before it can be issued.

**Water Quality**

EPA periodically evaluates wastewater sources and establishes federal effluent limits based on technology improvements for various types of dischargers and updates its technology based Effluent Limitations Guidelines (ELG) under the Clean Water Act. The EPA published its final, revised ELG for the steam electric power generating industry in November 2015. The final rule applies to power plants that use coal, natural gas, oil or nuclear materials as fuel and discharge treated effluent to surface waters, as well as to impoundments at utility-owned landfills that receive combustion residuals. Since the ELG is implemented in individual facility National Pollution Discharge Elimination System (NPDES) permits, the impact to Xcel Energy facilities is not immediate. As permits are renewed the new ELG will be implemented, if appropriate. Facilities will be required to comply no sooner than November 1, 2018 but no later than December 31, 2023. For Xcel Energy, we have three impacted facilities: Sherco, King and Comanche plants. We are currently evaluating compliance technologies for these facilities.

EPA issued a notice stating that it is reconsidering the rule and postponing the rule’s compliance dates. We will continue to monitor this situation.

**Cooling Water Intake**

EPA has developed rules for cooling water intake structures under section 316(b) of the Clean Water Act, which requires that the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact. Under the final rule published in August 2014, existing facilities that withdraw more than two million gallons per day from waters of the United States and use at least 25 percent for cooling purposes are required to implement measures to reduce impacts to aquatic organisms. Xcel Energy is undertaking impingement and entrainment studies at its qualifying facilities. The results of these studies will determine the extent of modifications needed. Xcel Energy is currently evaluating the most appropriate method to demonstrate that closed-cycle cooling is in use at these facilities.