Removal of various pollutants in wastewater is a high cost process, and requires intensive energy input and the addition of chemicals. American Water’s research team has developed an innovative process to achieve the same results in a sustainable manner by saving more than 50 percent of aeration energy and up to 100 percent of supplemental carbon source than the conventional wastewater treatment processes.

For a typical wastewater treatment, approximately half of the total energy consumed is used to maintain a high dissolved oxygen (DO) concentration in the aeration tank to remove the organic matter and ammonia in wastewater. Membrane bioreactors (MBR) are increasingly popular in wastewater treatment due to their capability to produce high quality treated effluent. However, aeration energy intensity becomes higher if membrane technology is used due to the cleaning requirements to prevent fouling on the membrane surface. Further, supplemental carbon source, such as methanol, may be added to an anoxic tank to enhance removal of nitrogen. The increasing cost of energy and carbon sources and stringent wastewater discharge requirements on nitrogen and phosphorus are the main drivers for large water/wastewater utilities such as American Water to constantly seek new opportunities for sustainable design and operation of wastewater treatment plants.

The cost effective wastewater treatment and nutrient removal process, NPXpress, developed by the scientists and engineers at American Water, is able to produce high quality treated effluent while using much less oxygen and carbon source. The unique operating condition of the NPXpress promotes growth of microorganisms that are able to remove nitrogen and phosphorus in wastewater. These microorganisms require much less oxygen and utilize internal carbon source to convert ammonia nitrogen to nitrogen gas compared to conventional bacteria found in wastewater treatment systems.

The NPXpress technology has been successfully implemented at several full-scale membrane bioreactor plants treating municipal wastewater, and has been proved to produce high quality treated effluent while using much less oxygen and supplemental carbon source compared to conventional MBR systems. For example, at two of the wastewater treatment plants in New Jersey – Mapleton and Jefferson Peaks, both plants use membrane bioreactors to treat domestic wastewater generated from the nearby communities in the service area and the high quality effluent is discharged to groundwater. As a result of implementation of the NPXpress technology, the aeration energy consumption at the wastewater treatment plants has been reduced up to 50 percent, while also eliminating the need to add supplemental carbon (micro-C). During and after the implementation of the technology, the plant was able to consistently achieve good performance in terms of total nitrogen removal and there were no negative effects observed at the plants. In addition, due to the implementation of the technology, enhanced biological phosphorus removal was observed as a side benefit for nutrient removal.

As a result of the implementation of NPXpress, the overall energy consumption for the plant (kWh per month) was reduced by approximately 30 percent at Mapleton. The energy intensity in terms on kWh per million gallon wastewater treated at the plant was also reduced by approximately 30 percent.

As a result of the NPXpress at Jefferson Peaks, the overall energy consumption for the plant (kWh per month) was reduced by approximately 50 percent and the cost saving was approximately 54 percent. The additional saving was attributed to the reduced demand charges from the electricity company. Total operational cost saving due to reduction in energy consumption and chemical use was approximately $2,200 per million gallon wastewater treated at the plant.

The NPXpress technology was awarded a patent in September 2011. Since then, the NPXpress technology is being installed at six other American Water wastewater treatment plants as part of the company’s overall “green” initiatives. The NPXpress technology has demonstrated promising capabilities to achieve wastewater treatment and nutrient removal in a sustainable way and provided opportunities for wastewater utilities to design, build, and operate an energy neutral wastewater treatment plant.