

Energy Efficiency for Smithsonian Institution's National Zoological Park and Conservation Biology Institute

Energy conservation measures expected to provide significant savings for two of the D.C. region's favorite attractions



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Challenge

The Smithsonian National Zoological Park, along with its Conservation Biology Institute, houses over 1,800 animals from among 300 species, in varying habitats that require customized water and energy systems. Since these diverse animals are sensitive to any sort of disruption to their environments and routines, it is no small task for the Smithsonian to undertake energy efficiency improvements to its systems. Seeking both to meet federal efficiency requirements, and upgrade equipment at the end of its useful life, the Smithsonian sought to improve its energy efficiency, conserve water and reduce energy costs at its Washington, D.C., and Front Royal, VA, locations, while at the same time ensuring as minimal an impact as possible to its animal inhabitants.

Solution

The Smithsonian entered into an energy savings performance contract (ESPC) with Constellation for the installation and monitoring of approximately \$24 million in energy conservation measures for its National Zoological Park and Smithsonian Conservation Biology Institute (SCBI). Under the terms of the ESPC, the water and energy efficiency improvements provided by Constellation require no upfront capital and are guaranteed to provide more than \$1 million annually in energy and water cost savings over 23 years. The project is expected to achieve major energy and water intensity reductions, replace end-of-life mechanical equipment, and increase use of renewable energy in accordance with the Smithsonian's ten-year plan.

One of the Zoo's highest operating costs is water, as many exhibits

contain water features. Water conservation measures for the irrigation, domestic water systems and large water features are estimated to save over \$500,000 annually.

Among the Zoo's favorite animal attractions are the seals and sea lions, who inhabit enormous 300,000 and 125,000 gallon wave pools that mimic coastal waters. To ensure the water stays continually fresh, it is circulated through 12 large sand filters, which themselves are periodically cleaned through a backwash process (reversing the direction of water flow to flush out debris). The two backwash filters used an enormous amount of water, which is expected to be significantly reduced by Constellation's replacement of the existing equipment with a new drum filter and other treatment equipment.

One of the Elephant Community Center's pools also benefited from this project. To conserve water, Constellation retrofitted the existing pool and dormant treatment equipment to filter, clean and recirculate the water and eliminate the previous dump-and-fill process. The rejuvenated system circulates the pool water through bead filters to remove large debris and further treats the water using ozone and chlorination systems.

Irrigation system upgrades led to additional water savings. Sensors that detect both flow rates and rainfall help conserve water. Irrigation schedules automatically adjust daily based on local evapotranspiration rates from the National Oceanic and Atmospheric Administration (NOAA) and rainfall measured at the site. New master control valves



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Highlights

Project

- 23-year contract operation term
- \$24 million investment in energy conservation measures
- \$1 million in annual expected energy and water cost savings
- Expected water savings of 27,625 kgal in first year
- Expected electricity savings of 5,735,468 kWh in first year
- Expected DC Sustainable Energy Unit (DCSEU) incentive of \$100,000
- Over 50% expected annual savings for lighting energy and lighting demand

Technical

- Water-efficiency improvements expected to save nearly 10,000 gallons of water in first year
- 27 irrigation systems upgraded
- Over 8,000 interior and exterior lighting fixtures upgraded to LED lighting, with expected load reduction of over 350 kW (49%)
- 500 kW AC ground-mounted solar system installed
- HVAC system upgrades including 16 new air handling units (AHUs), 7 new chillers and 3 new cooling towers
- Over 250 domestic water fixtures retrofit or replaced

provide automatic shut-off of each system during non-irrigating times to prevent leaks from wasting water and integrated flow sensors alert the system operator to the location of leaks.

Beyond the many water and energy conservation measures implemented, which are expected to improve efficiency, solar arrays were installed at the Front Royal campus to help the Smithsonian meet federal renewable energy goals. The system has a capacity of 500 kW AC, the maximum allowed by the electric utility. Energy cost savings from the solar arrays are expected to total approximately \$72,000 in the first year of production in avoided costs for electricity from the grid.

Other energy conservation measures to the two Smithsonian facilities include the following: smart irrigation controls; new air handlers; variable flow pumps; window upgrades, solar shades and building envelope improvements; high efficiency motors; chiller, heat pump and cooling tower replacements; retro-commissioning; low flow water fixtures; LED lighting upgrades; DDC control upgrades; high-efficiency transformer upgrades; de-stratification fans; and refrigeration controls.

This project's impact at the Zoo won the Smithsonian Institution the 2016 GreenGov Presidential Award for a 54.5% water use reduction at its museums and the National Zoo since 2007. Constellation's many new water conservation measures contributed to this achievement, which exceeds the Federal 26% reduction goal for fiscal year 2020.

Overall, this project will ensure that the many animal inhabitants continue to thrive in their varied environments.

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