DC Water distributes 95 million gallons of drinking water to its customers in Washington, D.C. every day. The utility also collects and cleans up to 384 million gallons of wastewater daily. That takes a tremendous amount of energy. In fact, the Blue Plains Advanced Wastewater Treatment Plant, which treats sewage and stormwater for the District of Columbia in addition to sewage from suburban counties in Maryland and Virginia, is the largest single-point consumer of electricity in the nation’s capital. As a result, DC Water is always seeking innovative ways to reduce power consumption, increase alternative power production, reduce carbon emissions, and improve the resiliency of operations. Since power is a major operational cost, these initiatives can reduce the cost of service, which helps reduce projected rate increases.

In 2015, DC Water opened the Walter Bailey Bioenergy Facility, which uses a process called thermal hydrolysis and anaerobic digesters to drive a combined heat and power plant generating about 10 MW, about one-third of Blue Plains’ total electricity needs, with biogas as its predominant fuel source. But DC Water believes this successful facility may just be the beginning. The authority is now exploring new energy-related opportunities. Recent technological and economic developments have made this an exciting time for collaboration between the energy and water sectors. DC Water has created the DC Water Energized map to illustrate opportunities identified within the water-energy nexus and to highlight potential locations for each opportunity. Ultimately, the implementation of any of these ideas will depend on an assessment of costs and benefits to DC Water ratepayers, the region, and the environment.

### Types of Energy

**Electric:**
Electric power is grid-compatible alternating current, suitable for use in any standard or industrial application.

**Thermal:**
Thermal energy is energy suitable to heating and cooling only. Common applications include building HVAC systems, industrial preheating, and domestic hot water. It is NOT convertible to electricity.

**Energy Units:**
Units of energy and power are often misunderstood. Energy is the ability to do useful work; power is the amount of energy used over time. Here, energy is given in units of kilowatt-hours (kWh) and megawatt-hours (MWh); one MWh is the same as 1000 kWh. Power is given in kilowatts (kW) and megawatts (MW).

For example, a pump may need 10 kW of power in order to turn on. Leaving that pump running for one hour will require 10 kWh of energy.

The distinction is important for power generation. For example, hydropower has a maximum power generation of 10 MW, but it can run all day. In one day (24 hours), 10 MW of hydropower will generate 240 MWh of electricity. In contrast, solar only produces when the sun shines. A set of solar panels with maximum power production of 15 MW may only produce 120 MWh of energy in one day.

One MWh is enough energy to run a single 60-watt bulb continuously for about two years. Washington, DC used about 3,000,000 MWh in 2014, or about 4.5 MWh per person.

### Cost Key

$ = Up to $5M  
$$ = $5 - $50M  
$$$ = Over $50M

**Map Note:**  DC Water facilities where opportunities may exist
Hydropower: Harvesting energy from moving water is the oldest renewable energy technology and remains a vital component of energy production today. While there are no large mountains or new dams planned in the region, there are numerous smaller opportunities that could provide a 24/7, 365 source of nearly carbon-free energy using existing technologies.

**Cost:** $$$

**Energy:** Electric power available is estimated at 8-10 MW; annual energy is estimated at 70,000-90,000 MWh

Drinking Water Thermal: Drinking water in Washington, DC can reach temperatures over 85 F in the summer. These high temperatures can pose a challenge to our aging distribution infrastructure by promoting nitrification and reducing residual chlorine, as well as impacting taste. Though demand for heat energy in the summer is low, the drinking water supply could provide it to users at little or no cost, while improving water quality.

**Cost:** $$$

**Energy:** Unlimited heating capacity, but limited by market size

Solar: Solar photovoltaic technology can provide a low-carbon supply of electricity during daylight hours. Opportunities within the District are typically limited by availability of land and unblocked access to sunlight. DC Water has a number of potentially suitable facilities, including rooftops, reservoirs, and treatment tanks, where photovoltaic panels could be installed.

**Cost:** $${}

**Energy:** Electric power available estimated at 5-15 MW at Blue Plains, up to an additional 15 MW throughout other DC Water facilities; annual energy is estimated at 15,000-44,000 MWh at Blue Plains, up to an additional 44,000 MWh elsewhere

Wind: Wind turbines capture energy from moving air. Winds are intermittent and not especially powerful in Washington, DC, but opportunities may be found. The location of Blue Plains in a relatively open area along the Potomac River makes it a good candidate for small-scale wind power installations.

**Cost:** $${}

**Energy:** Electric power available estimated at 100-500 kW; annual energy is estimated at 260-1300 MWh

Blue Plains Microgrid: Blue Plains is a critical facility for Washington, DC and its continued operation is necessary even during emergencies. Interruption of the power supply is an important vulnerability at the facility. With the current onsite generating capacity it is theoretically possible to operate Blue Plains at a minimum level while disconnected from the electric grid with additional controls and appropriate planning. However, significant work remains to determine the best way to operate the plant and to install the instrumentation and controls necessary to operate a microgrid.

**Cost:** $$

**Energy:** No additional power produced, resiliency benefit

Steam Pressure: The Combined Heat and Power (CHP) facility at Blue Plains generates steam that is used as part of the CAMBI process. This steam undergoes a reduction in pressure between certain process steps. The energy released by these pressure drops could be captured with additional equipment.

**Cost:** $${}

**Energy:** Electric power available estimated at 100 kW; annual energy is estimated at 880 MWh

Organic Rankine Cycle: After CAMBI treatment, sludge must be cooled before digestion. Currently, the thermal energy from this process is diluted, then exhausted to the Potomac River. The high-density thermal energy could be converted to electricity. To do so, a battery of sludge heat exchangers would heat an organic refrigerant that would then drive a Rankine cycle generator at relatively low operating temperature.

**Cost:** $$

**Energy:** Electric power available estimated at 300-500 kW; annual energy is estimated at 2600-4400 MWh

Biogas Alternatives: The Walter Bailey Bioenergy Facility generates a large volume of biogas from digestion of municipal sludge. The biogas is currently burned onsite to generate electricity and process steam, which reduces the Blue Plains carbon footprint and drives the CAMBI cycle. The gas could be polished and used in other ways, including injection into the natural gas grid or as fuel for compressed natural gas vehicles.

**Cost:** $$

**Energy:** No additional power produced, potential higher value uses in the region
**Biogas Production:** The CHP facility has additional capacity at current biogas production rates and an additional turbine could easily be added. Digestion of new feedstock, such as food waste or municipal sludge, would increase biogas production. The additional production could be burned to generate electricity or used elsewhere.

**Cost:** $

**Energy:** Additional electric power available is estimated at up to 3 MW with current system, 3.5 MW more with an additional turbine; annual energy is estimated at up to 26,000 MWh with current system, 30,000 MWh more with an additional turbine

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**Effluent Thermal:** Blue Plains generates 300 million gallons of clean water each day. This water can serve as a source for thermal energy. Heat pumps can extract or exhaust heat, or the water can be evaporated, allowing thermal energy to be delivered through a transfer medium for any appropriate use. Immediate applications include building HVAC and hot water for Blue Plains itself; the system could expand to provide thermal energy to the surrounding area.

**Cost:** $

**Energy:** Unlimited thermal energy available, but limited by market size. Blue Plains demand estimated at 1.5 MW, surrounding area demand estimated at 5-20 MW; annual net energy is estimated at 7000 MWh for Blue Plains; 24,000-95,000 MWh for surrounding area

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**Grid Services:** With scalable, on-site energy production in the form of CHP and the potential ability to intensify processes as needed, Blue Plains can serve as a fast demand response point on the PJM grid, helping to balance peak loads, plant ramp-up or -down, and power frequency. This activity would help support grid stability and overall system resiliency.

**Cost:** $

**Energy:** No additional power produced, resiliency benefit

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**District Energy:** Most thermal energy in the United States is decentralized, with each building supplying its own heating and cooling. Centralizing these systems can provide many benefits, including increased reliability, reduced maintenance costs, better peak load balancing, reduced capital costs, improved efficiency, lower overall energy, and additional usable real estate. DC Water is a good candidate to operate such systems, which are typically networks of hot and cold water pipes emanating from a central energy facility, especially if wastewater thermal is used as the source of thermal energy.

**Cost:** $$$

**Energy:** No additional power produced, transfer medium only / depends on location

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**Wastewater Thermal:** Municipal sewage can serve as a source or sink of thermal energy similar to groundwater. Heat pumps can extract or exhaust heat, or the water can be evaporated, allowing thermal energy to be delivered through a transfer medium for any appropriate use. The technology can supply individual buildings where there is an appropriately-sized sewer nearby or a district energy system from large pump stations.

**Cost:** $-$$$

**Energy:** Thermal energy available estimated at up to 200 MW, but limited by market size; annual energy available is estimated at up to 830,000 MWh

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**Electricity Storage:** DC Water faces resiliency challenges and the necessity of continuous operation through emergencies. Storing energy in batteries, fuel cells, or similar technology could allow extra time to respond under emergency conditions and keep vital pumps or other equipment operational during grid outages or until backup systems can be turned on. Storage could also be used to support grid services.

**Cost:** $-$$

**Energy:** No additional power produced, resiliency benefit

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**Microgrid Partnerships:** The District of Columbia is working to improve reliability and sustainability by exploring opportunities for microgrids throughout the city. In many cases, DC Water could be a valuable partner in these efforts. Including DC Water facilities such as pump stations in the microgrid could help improve the resiliency of the water network, and the facilities could provide a location for control systems or other industrial equipment where there is extra space.

**Cost:** $-$$

**Energy:** No additional power produced, resiliency benefit