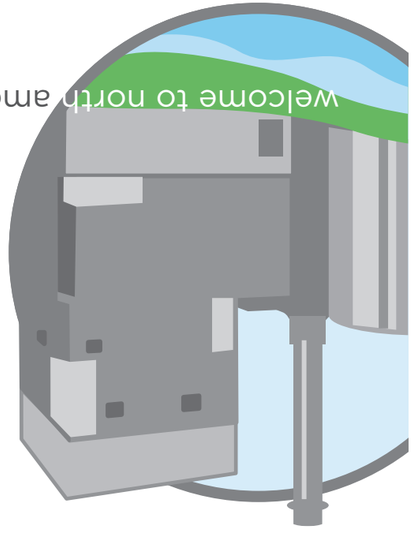
how it works

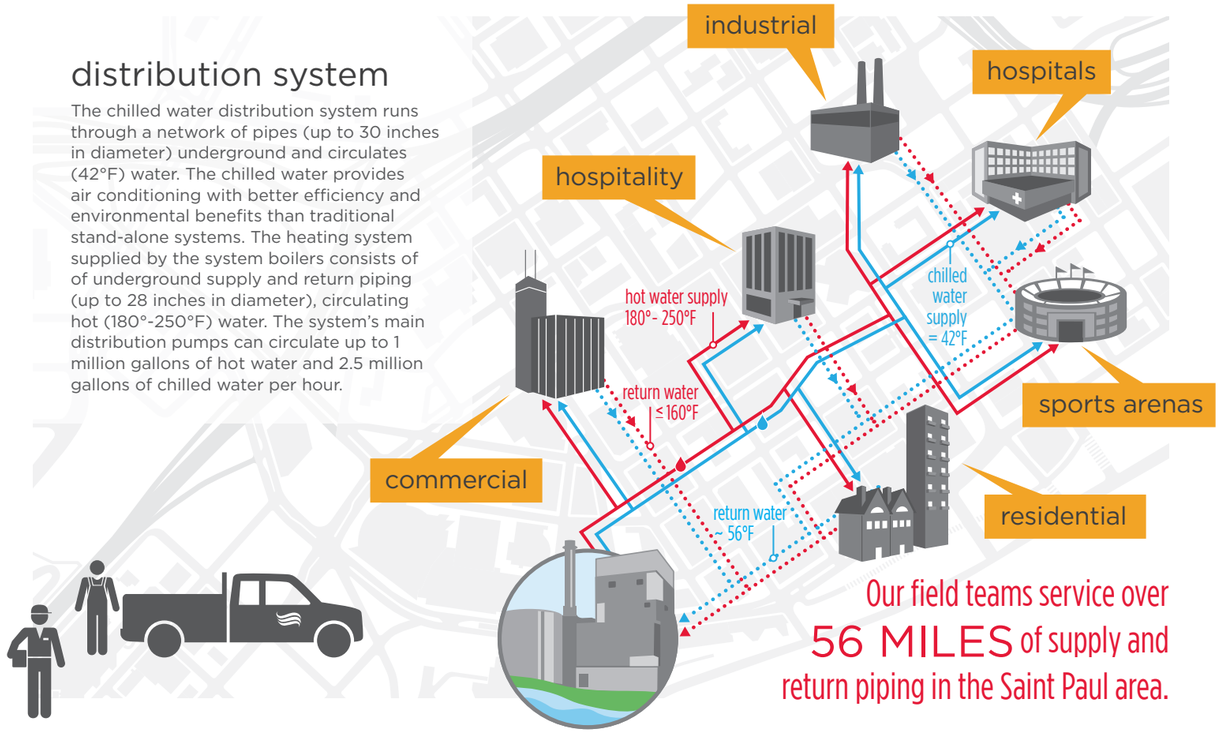
welcome to north america's largest integrated community energy system



DISTRICT ENERGY ST. PAUL™

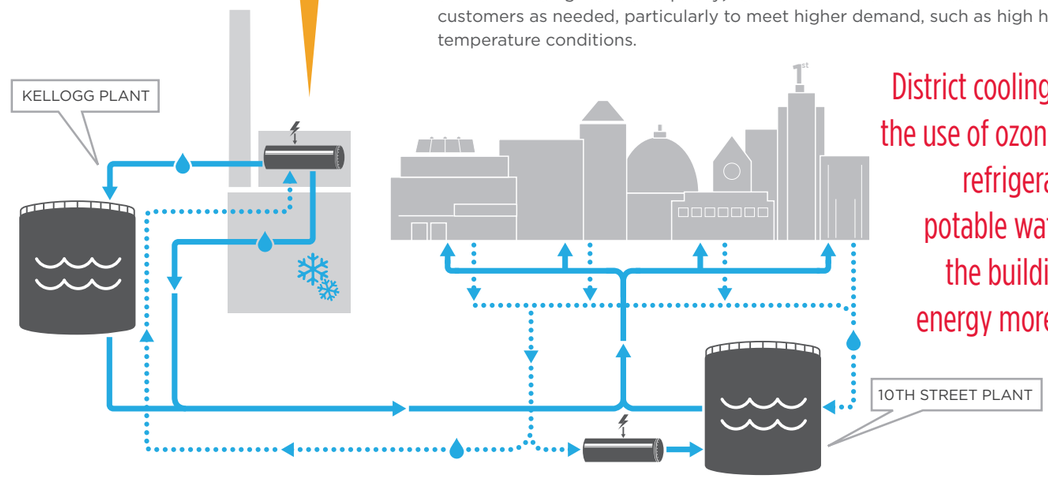
distribution system

The chilled water distribution system runs through a network of pipes (up to 30 inches in diameter) underground and circulates (42°F) water. The chilled water provides air conditioning with better efficiency and environmental benefits than traditional stand-alone systems. The heating system supplied by the system boilers consists of of underground supply and return piping (up to 28 inches in diameter), circulating hot (180°-250°F) water. The system's main distribution pumps can circulate up to 1 million gallons of hot water and 2.5 million gallons of chilled water per hour.



Our field teams service over **56 MILES** of supply and return piping in the Saint Paul area.

cooling and thermal storage system



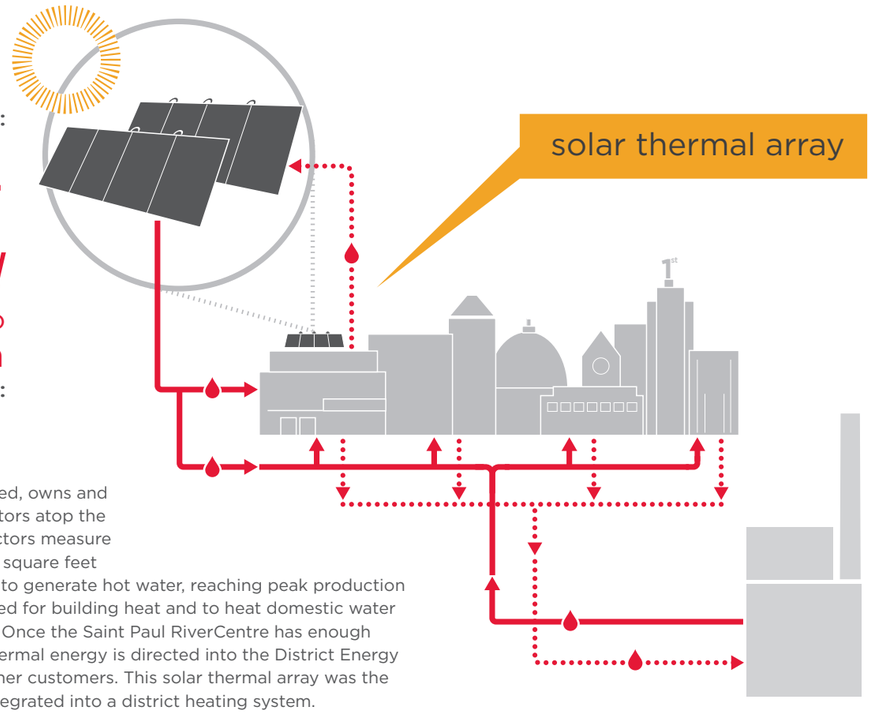
The Hans O. Nyman Energy Center on Kellogg Boulevard houses 7 electrically-driven chillers. 3 additional electrical chillers are used at the 10th street plant. The chiller uses a mechanical compression cycle to reduce the temperature (or extract heat) from the water loop. Once the temperature of the water is reduced, it is circulated to buildings where it removes heat from the internal spaces, which cools the air. The heat removed from the building is captured in the return water and returned to the plant to start the chilling process again.

Chilled water is produced at night using off-peak electricity and stored in 2 large thermal storage tanks, located at the Kellogg and 10th street plants (respectively - 2.5 million and 4.2 million gallons of capacity). Chilled water stored in these tanks is dispatched to customers as needed, particularly to meet higher demand, such as high humidity and high temperature conditions.

District cooling can reduce the use of ozone-depleting refrigerants, reduce potable water usage at the building, and use energy more efficiently.

1st US solar thermal array

to be integrated into a district system



District Energy developed, installed, owns and operates 144 solar thermal collectors atop the Saint Paul RiverCentre. The collectors measure 8 ft by 20 ft and make-up 21,000 square feet of area used to collect solar heat to generate hot water, reaching peak production over 1.2 MWt. The hot water is used for building heat and to heat domestic water for restrooms and kitchen usage. Once the Saint Paul RiverCentre has enough heat and hot water, the excess thermal energy is directed into the District Energy heating network to share with other customers. This solar thermal array was the first in the United States to be integrated into a district heating system.

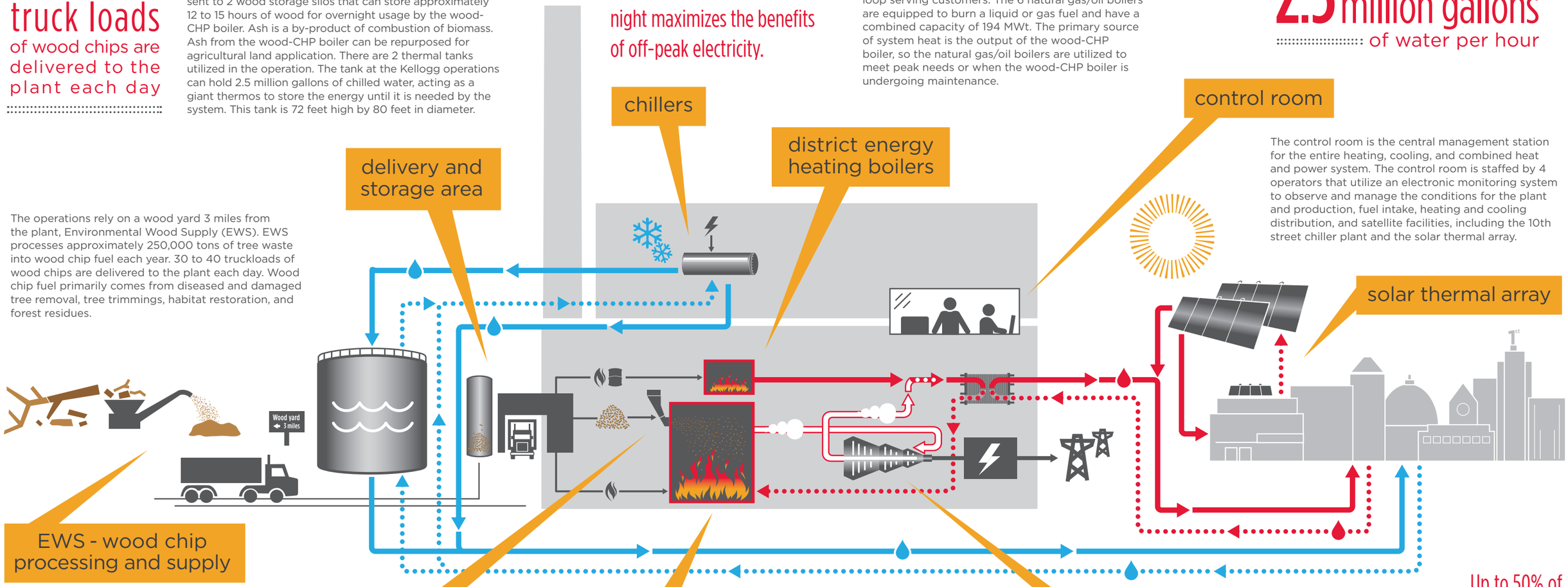
30 to 40
truck loads
of wood chips are delivered to the plant each day

The delivery and storage area support biomass delivery and energy storage. The wood chips unloaded here are sent to 2 wood storage silos that can store approximately 12 to 15 hours of wood for overnight usage by the wood-CHP boiler. Ash is a by-product of combustion of biomass. Ash from the wood-CHP boiler can be repurposed for agricultural land application. There are 2 thermal tanks utilized in the operation. The tank at the Kellogg operations can hold 2.5 million gallons of chilled water, acting as a giant thermos to store the energy until it is needed by the system. This tank is 72 feet high by 80 feet in diameter.

The District Energy boilers combust biomass, natural gas, or fuel oil to generate either steam or hot water. The boiler walls are lined with pipes filled with water, which is quickly heated by the fire and changes to steam (or remains as hot water). The steam or hot water is utilized to heat the hot water loop serving customers. The 6 natural gas/oil boilers are equipped to burn a liquid or gas fuel and have a combined capacity of 194 MWt. The primary source of system heat is the output of the wood-CHP boiler, so the natural gas/oil boilers are utilized to meet peak needs or when the wood-CHP boiler is undergoing maintenance.

the system's main distribution pumps can circulate over
2.5 million gallons
of water per hour

Chilled water produced at night maximizes the benefits of off-peak electricity.



The control room is the central management station for the entire heating, cooling, and combined heat and power system. The control room is staffed by 4 operators that utilize an electronic monitoring system to observe and manage the conditions for the plant and production, fuel intake, heating and cooling distribution, and satellite facilities, including the 10th street chiller plant and the solar thermal array.

The operations rely on a wood yard 3 miles from the plant, Environmental Wood Supply (EWS). EWS processes approximately 250,000 tons of tree waste into wood chip fuel each year. 30 to 40 truckloads of wood chips are delivered to the plant each day. Wood chip fuel primarily comes from diseased and damaged tree removal, tree trimmings, habitat restoration, and forest residues.

Wood moves from the delivery trucks, to the wood floor, where the wood chips move through a series of conveyors that deliver the fuel to the 5 wood metering bins. The bins control the amount of wood fuel entering the wood-CHP boiler. Careful metering of the wood into the boiler helps control the temperature, intensity, and efficiency of the fire in this boiler. The amount of wood intake will change based on the wood moisture and BTU (energy) value, as well as the boiler conditions, such as air/oxygen and natural gas input.

the temperature inside the wood-CHP boiler is nearly **1750°F**

The wood-CHP boiler is approximately 9 stories high (100 feet) and combusts wood chips and natural gas to generate steam. The majority of the fuel is wood chips (approximately 85%). Natural gas is added to the fuel mix to add intensity and consistency to the combustion process, allowing the wood to burn more efficiently. The temperature inside the boiler can reach 1,750°F. Pipes lining the boiler walls are filled with water that absorbs heat to generate steam at 1,250 pounds per square inch. The steam then travels to a steam drum at the top of the boiler. This steam is delivered to the turbine for use in the combined heat and power (CHP) process. Vapor is formed from the heat and moisture of the combustion of the natural gas and the wood (i.e. exhaust gas). This vapor along with the heat rejected out of the cooling towers can be seen as a plume leaving the stack above the plant.

Combined heat and power maximizes the efficiency of fuel inputs to capture 2 energy by-products, electricity and heat.

The CHP-wood boiler generates steam. After this steam is superheated, it is used to push the rotating blades inside the turbine. The turbine rotor spins at approximately 5,290 revolutions per minute. High pressure steam from the boiler pushes through the turbine blades, spinning a shaft. As the shaft spins the generator, the rotation in a magnetic field produces electricity. The mechanical energy output from the turbine is converted by the generator to electrical energy and produces an electric current. The turbine is designed to generate up to 33 megawatts of electricity, 25 megawatts are sold to the grid through the local electric utility. Some of the remaining electricity is used for plant operations. After pushing the turbine, the high-pressure steam is reduced to low-pressure steam, which is captured and used to heat water for the District Energy hot water loop producing 55 MWt. It is the production and capture of both heat and electricity that defines a combined heat and power or "cogeneration" production system.

Up to 50% of the hot water delivered to customers is renewable from biomass and solar thermal.