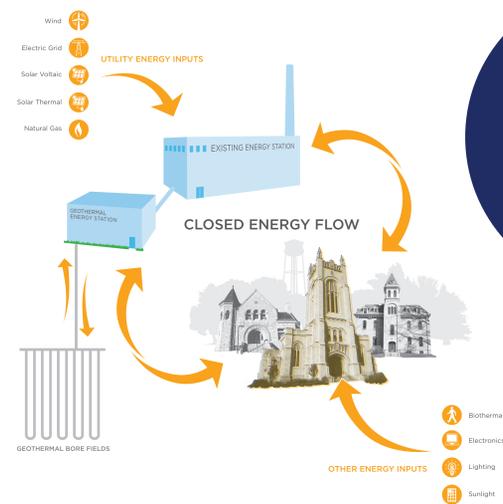


Energy is Repurposed with the Heat Pump + Geothermal Wells

By connecting the heating and cooling systems, the heat pump can pull heat from the chilled water and transfer it into the hot water system or store it in the bore fields for later use.



In simultaneous heating and cooling mode the heat pump is **700% EFFICIENT**

120°F

THE NUMBER THAT MAKES EVERYTHING POSSIBLE

Transitioning from steam to a low-temperature (120°F) hot water distribution system is key to future system diversity, flexibility, modernization, and carbon reductions. The lower temperature threshold allows Carleton to engage at a district-energy scale such technologies as ground source heating and cooling, condensing boilers, solar thermal systems, and future heating system innovations.

Electrification Incorporates Renewable Energy Sources

The heat pump lowers central plant natural gas consumption by 75% and shifts more of that load to electricity, which opens many more options for on-site renewables like wind and solar photovoltaics. It also takes advantage of the rapidly greening public electric grid, and creates a more diverse and resilient energy system with reduced carbon emissions.



Carleton's utility provider, Xcel Energy, has pledged to deliver 100% carbon-free electricity by 2050.



The heat pump lowers natural gas consumption by **75%**

Energy Consumption and Carbon Emissions Reduced

The geothermal hot water system is projected to reduce central plant carbon emissions by 15 percent by 2021.

40% REDUCTION in central plant energy use

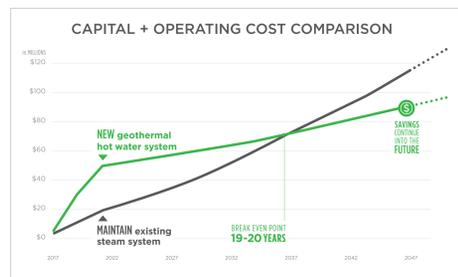
The Utility Master Plan keeps Carleton on its desired trajectory toward being carbon-neutral by 2050 through actual changes to the campus infrastructure in lieu of purchased carbon credits.

THE NEW UTILITY SYSTEM WILL **REDUCE ANNUAL ENERGY USE** BY **84,000,000,000 BTUs**
Equal to adding **6 wind turbines** (15,000 MMBtu each)

New System has Positive Returns

When compared to the cost of maintaining and operating the existing steam system, the cost of the new hot water system—including capital, operating, and utility costs—will break even in 19-20 years with continued savings into the future.

Eliminating the 24/7/365 operation of Carleton's high pressure steam plant can reduce central plant utility and operating costs by 30 percent* and improve working conditions by offering all maintenance staff a more standard daytime work schedule.



30% REDUCTION in utility and operating costs

*Operating and maintenance reduces by 68% and utilities by 5% for a combined reduction of 30%.



Martha Larson, Manager of Campus Energy and Sustainability, checking on progress at the East Energy Station.



Carleton geology students Natasha Dietz ('19) and Quentin Hirsch ('19) collect soil samples in the geothermal bore fields.

KEY OBJECTIVES

1. Replace the aging and outdated central plant facilities, campus steam distribution network, and controls
2. Provide for future loads as envisioned in the Facilities Master Plan
3. Reduce our operating costs and carbon emissions significantly and permanently
4. Integrate into academics and create a living lab on campus

A HISTORY OF SUSTAINABILITY

Carleton has a long-standing commitment to environmental stewardship beginning with the founding of Cowling Arboretum in the 1920s. A series of innovative projects and a conscientious planning process led to establishing Carleton as a leader in 21st energy technologies.



college campus in Minnesota to install a **district-energy scale geothermal system**

college campus to **completely transition off steam heating**

college campus to install a **commercial-size wind turbine** (now two)

<p>Ongoing campus-wide energy conservation projects (e.g. lighting retrofits)</p> <p>EARLY YEARS</p>	<p>First wind turbine installed</p> <p>2004</p>	<p>Solar PV and solar thermal installed on the roof of Cassat and James Halls</p> <p>2009</p>	<p>Carleton Climate Action Plan is approved</p> <p>2011</p>	<p>Second wind turbine installed</p> <p>2011</p>	<p>Carleton</p> <p>The Strategic Plan includes focused investment in Carleton's buildings and infrastructure</p> <p>2012</p>	<p>Facilities Master Plan prioritizes renovation and replacement over growth</p> <p>2014</p>	<p>The Utility Master Plan launches a transition from steam heating to low temperature hot water and geothermal</p> <p>2017</p>	<p>East Energy Station begins operating beneath Evelyn Anderson Hall—this complex becomes the fourth LEED certified building on campus</p> <p>2019</p>	<p>The Utility Master Plan is completed and Carleton reaches 40% carbon emissions reduction from its 2008 baseline</p> <p>DOWN 40%</p> <p>2021</p>
--	---	---	---	--	--	--	---	--	--

CARBON FREE 2050

For more information: go.carleton.edu/sustainability

Contacts: **Fred Rogers**
Vice President and Treasurer
frogers@carleton.edu

Martha M. Larson
Manager of Campus Energy and Sustainability
mlarson@carleton.edu