Modern datacenter heat energy reuse

"Energy can neither be created nor destroyed.
It can only be converted from one form of energy to another."

—Law of the conservation of energy, introduced by Émilie du Châtelet in the 18th century

Modern datacenters need electrical energy to keep facilities running and that consumption creates a byproduct. Rather than allowing it to go to waste, this heat energy can be reused.

For every 1 megawatt hour (MWh) of electrical energy consumed, 1 MWh of heat energy is produced.

Energy efficiency for local communities

At Microsoft, we realize the importance of reducing our society's reliance on fossil fuels. One way we can do this is by reusing the heat energy our datacenters produce. This initiative will divert heat energy from our datacenters to local district energy providers, who can use this energy to heat homes, greenhouses, fish farms, and more. Helping local communities reduce their reliance on fossil fuels will drive energy efficiencies.

While recovering heat for use in a district heating system is efficient, many of our datacenters are located too far from communities to have a positive impact. Thus, our initiative will target datacenters close to neighboring communities that can make use of the heat energy.

Microsoft is committed to help reduce carbon emissions by reusing heat energy from our datacenters.

Reducing the carbon footprint of heating systems

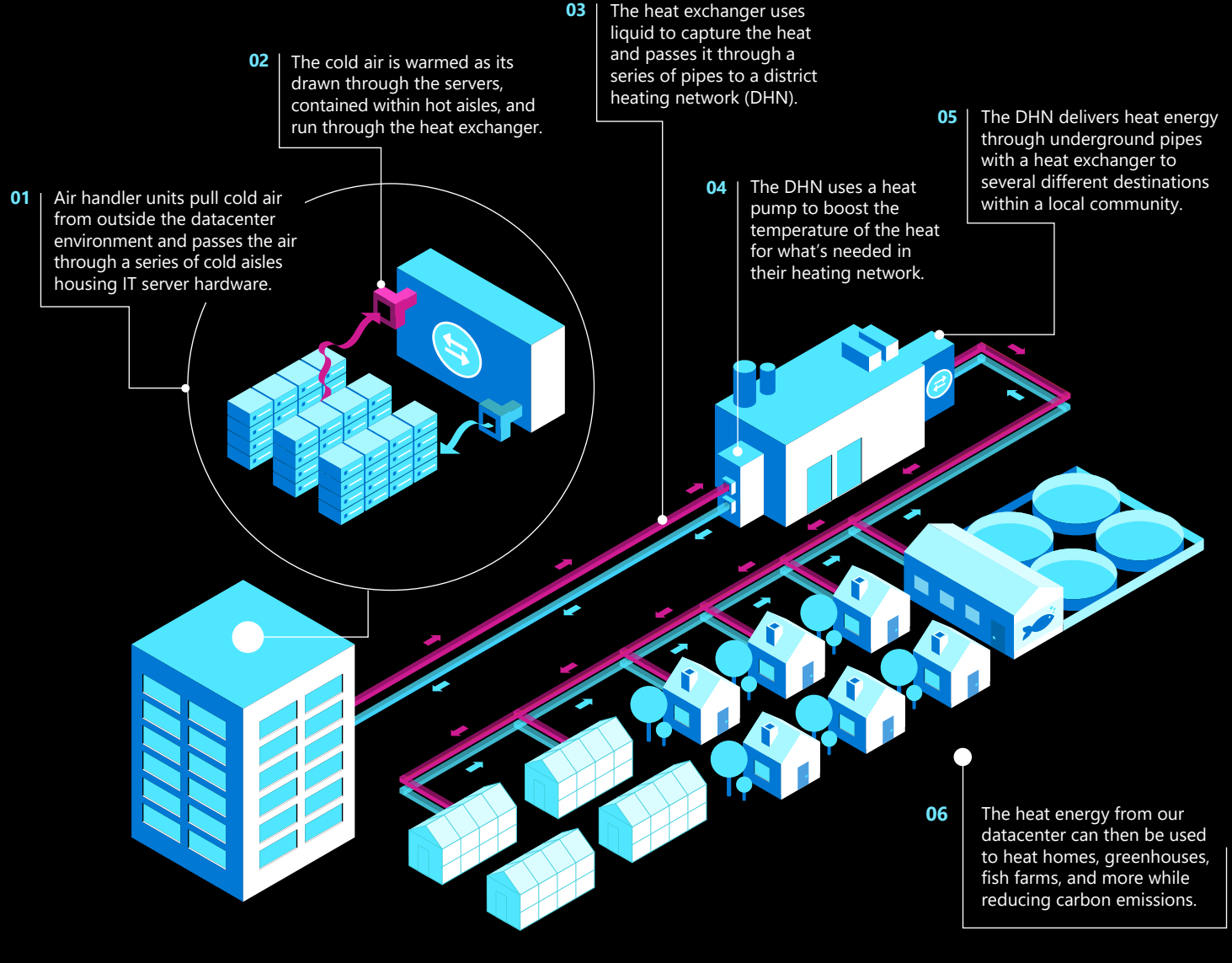
Microsoft plans to be carbon negative by 2030 a commitment that involves removing more carbon than we emit from our datacenters. With local heating providers needing to generate and supply less energy from carbon based sources, Microsoft can help reduce overall carbon emissions associated with fossil fuel consumption.

Reusing heat energy from data centers helps global communities meet their climate goals.

How heat energy reuse works

Datacenters worldwide are traditionally air cooled, with the air warmed from server hardware exiting out to the atmosphere. One way to capture this low-grade waste heat is through an air to water heat exchanger, which recaptures heat into water loops. This heated water can be redirected to local heating systems.

Note: The industry standard for tracking heat reuse is the Energy Reuse Factor (ERF). ERF is the amount of reused energy divided by the total amount of electrical energy supplied to the datacenter IT server, electrical, and mechanical components. Our estimate indicates that it s possible to achieve an ERF range of up to 69 percent during the winter, and 86 percent during the summer,[1] depending on factors such as the type of cooling system, ambient temperatures, and more



A look to the future of heat energy reuse

Investing in next generation datacenter infrastructures, including liquid or immersion cooling, increases the potential to reuse and share waste heat with district heating lines. With better system efficiencies and ERF, liquid as heat transfer media can be effective at scale and essentially carry more heat compared to air. (Learn more about liquid-immersion methodologies and different cooling mediums for modern compute.)

[1] ISO - ISO/IEC 30134-6:2021. Information technology, Data centres key performance indicators—Part 6: Energy Reuse Factor.

Potential impact on local communities

The following table shows the amount of heat energy reuse we can expect based on datacenter capacity.

Average heat projected for reuse based on ERF estimates:

For every 1 MWh of electrical energy consumed, between 0.69 MWh (in the winter) and 0.86 MWh (in the summer) of heat energy can be reused in an air-cooled datacenter.

Datacenter IT capacity	Estimated annual energy consumption	Potential energy reuse during winter months (ERF 69 percent)	Potential energy reuse during summer months (ERF 86 percent)
40 MW	421 GWh*	Heat energy for local reuse: **292 GWh** Potential number of households heated: **46,000****	Heat energy for local reuse: **360 GWh** Potential number of households heated: **57,000**
10 MW	105 GWh	Heat energy for local reuse: **73 GWh** Potential number of households heated: **12,000**	Heat energy for local reuse: **90 GWh** Potential number of households heated: **14,000**

*1000 MWh = 1 gigawatt-hour (GWh)
** Based on 6300 KWh average to heat a household in Finland

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