Microsoft

Modern datacenter cooling

Modern datacenters must be managed much more efficiently. We are designing, building, and operating Microsoft datacenters to use energy and water more effectively than traditional on-premises datacenters.

More energy efficient

Microsoft recognizes the importance of energy and water efficiency, so we've made steady improvements as we build new datacenter regions. Advanced cooling technologies combined with the cloud's compute efficiency, thermally effective layout, and increased temperature and humidity tolerance substantially reduce the energy required to deliver cloud services.

Dramatically less carbon

We continue to demonstrate our commitment to decarbonization through large purchases of renewable energy as well as continual exploration of design changes, material selection, and business processes to facilitate deep embodied carbon reductions.

Effective water use

Microsoft's commitment to be water positive has led to enhancements in datacenter designs to utilize cooling methods that significantly reduce water usage for the same service load.

Carbon negative

By 2030, we will be carbon negative, and we will remove our historical emissions since our 1975 founding by 2050.[1]

Water positive

By 2030, we will replenish more water than we use. We will reduce the water intensity of our direct operations and replenish it in water-stressed regions where we work.[2]

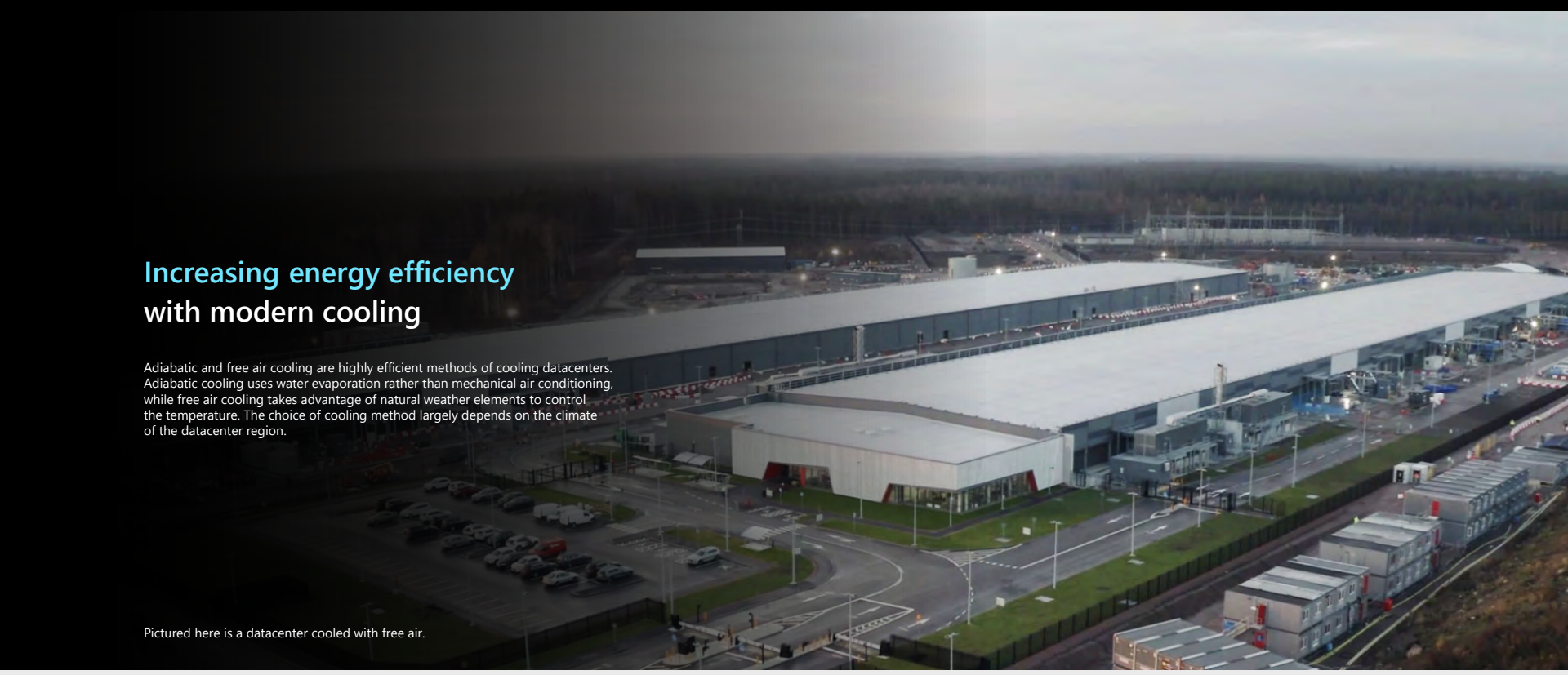
Zero waste

By 2030, we will reach zero waste across our direct business.[3]

[1] 2021 Environmental Sustainability Report: Getting to carbon negative

[2] 2021 Environmental Sustainability Report: Getting to water positive

[3] 2021 Environmental Sustainability Report: Getting to zero waste



Increasing energy efficiency with modern cooling

Adiabatic and free air cooling are highly efficient methods of cooling datacenters. Adiabatic cooling uses water evaporation rather than mechanical air conditioning, while free air cooling takes advantage of natural weather elements to control the temperature. The choice of cooling method largely depends on the climate of the datacenter region.

Pictured here is a datacenter cooled with free air.

Cooling impact on datacenter efficiency

Reducing our energy and carbon footprint by using innovative cooling

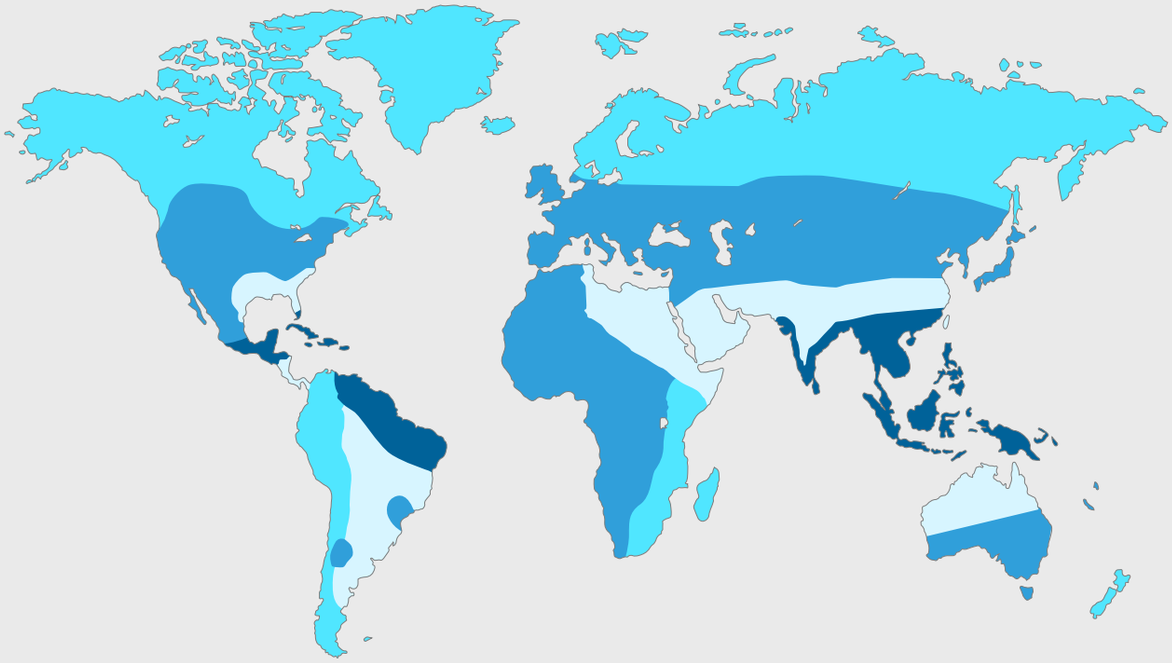
Modern cloud datacenters are provisioned for maximum utilization with a thermodynamically engineered layout to optimize for ideal cooling.

	Mechanical cooling	High efficiency mechanical cooling	Adiabatic cooling		Free air cooling
Layout	Open hall, low utilization	High-density layout with containment	High-density layout with containment		High-density layout with containment
Description	Precision air conditioning to maintain accurate temperature and humidity control	Variety of high-efficiency mechanical cooling technologies selected for a specific location	Indirect Evaporative Cooling	Direct Evaporative Cooling	Using outside air year round for cooling
Power usage	Very high	Medium	Low	Low	Low
Water usage and Water Usage Effectiveness (WUE)	High to medium 2.3 to 2.8 L/kWh	High to none 2.3 to 2.8 L/kWh with water-cooled chillers, 0 L/kWh with air-cooled chillers	Medium 0.8 to 2.1 L/kWh	Low 0.02 to 0.7 L/kWh*	None 0 L/kWh**

*This range is very broad because actual water usage varies dramatically by local climate and regional water quality.
**Water usage for humidification is sometimes required in wintertime.

Cooling methods by climate

This map showcases how we use different cooling methods based on the climate of the region. Some datacenter cooling methods are not applicable everywhere, so we carefully consider the climate of each region we operate in to help minimize our impact in terms of energy and water usage.



Mechanical cooling | High-efficiency mechanical cooling | Adiabatic cooling | Free air cooling

Modern datacenter cooling

Adiabatic and free air–cooling technology have different configurations that impact design considerations for datacenters.

Indirect evaporative cooling (IDEC)

IDEC uses a fluid-cooler that takes advantage of water evaporation to cool air flowing through an external air-to-water heat exchanger (radiator) to remove heat from the datacenter and return chilled cooling fluid to it. IDEC is a closed system that circulates cool air within and does not require potable water.

Power usage	Low
Water usage	Medium

Inside the datacenter:

Heat from the datacenter is transferred to a cooling fluid, usually treated water, in an air handling unit (AHU). The AHU uses a fan-driven air-to-water heat exchanger (like a radiator) to transfer heat to the cooling fluid. The warm cooling fluid is pumped to the fluid-cooler.

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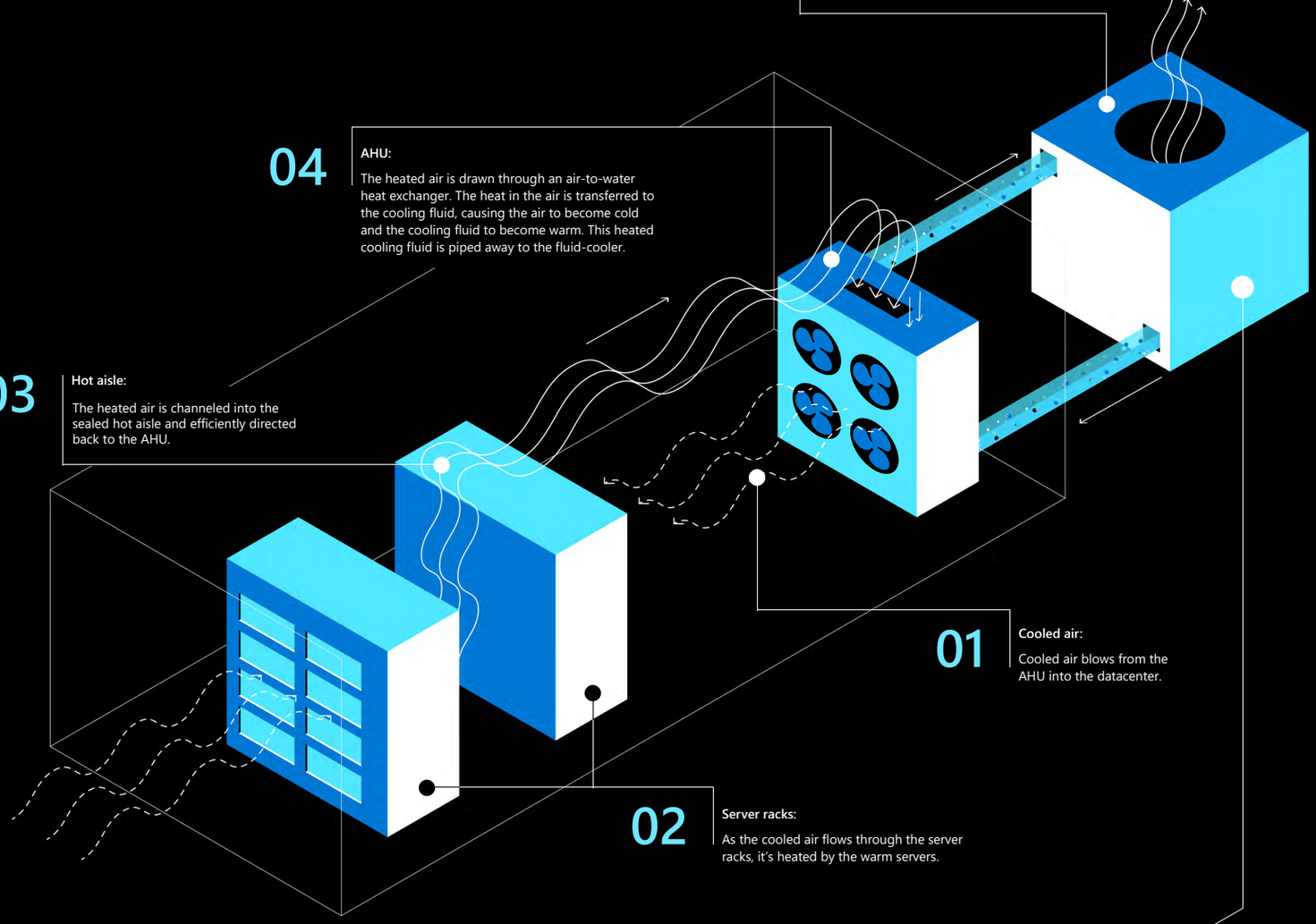
Fluid-cooler:

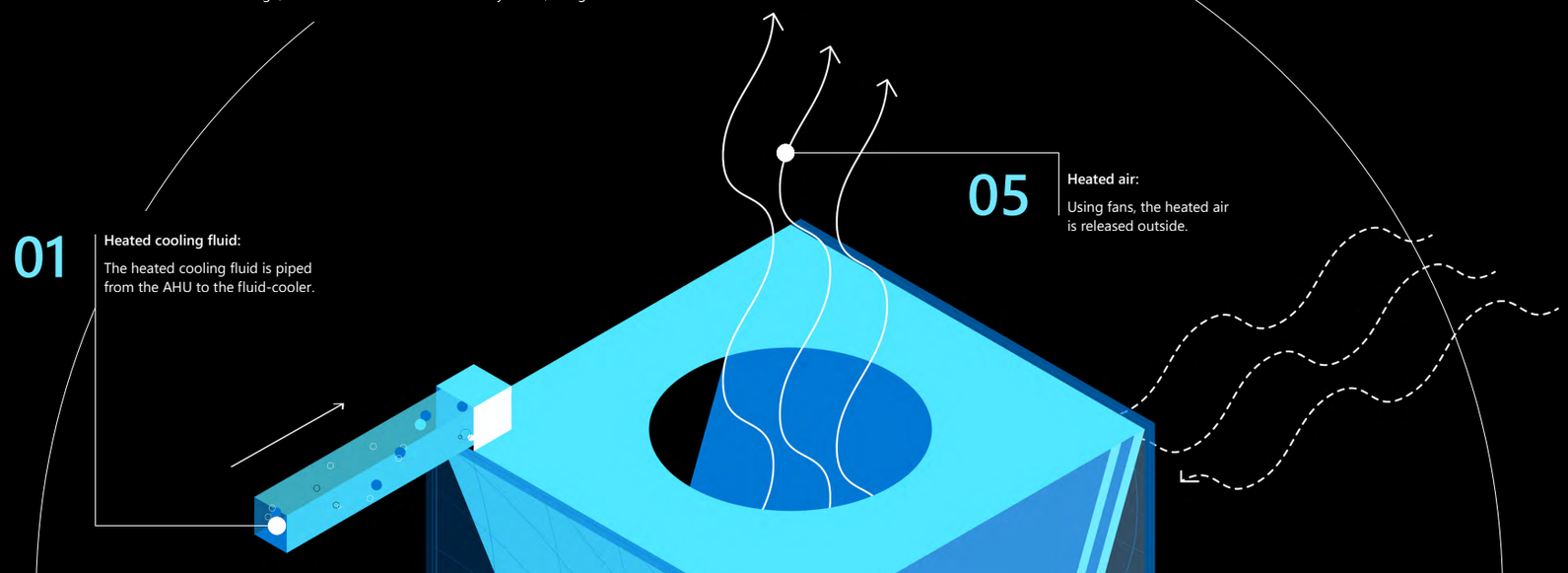
The fluid-cooler uses water through adiabatic cooling to remove heat from the datacenter.

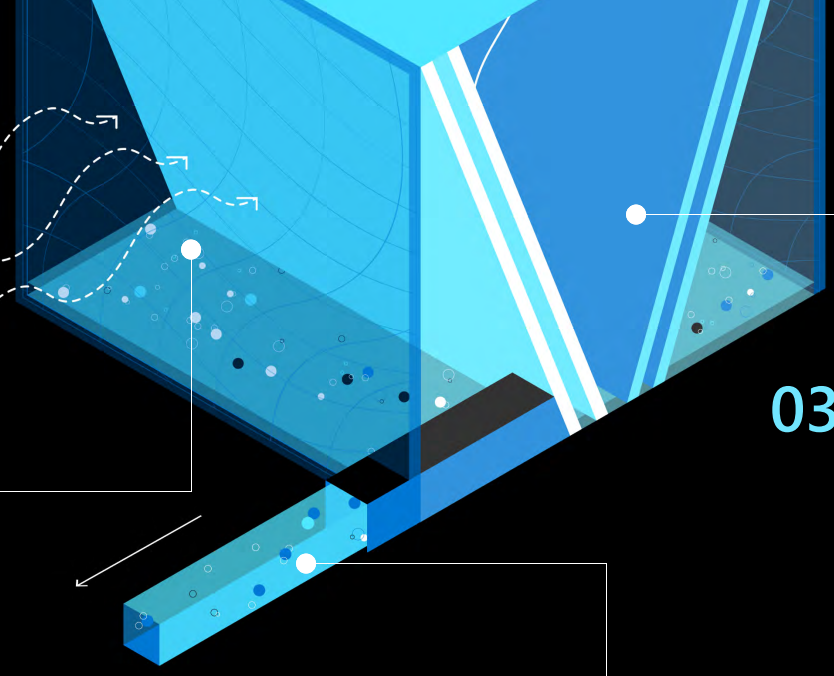


Outside the datacenter:

The fluid cooler uses a fan to pull air through a wet medium and uses evaporation to cool the air, which is then passed through a water-to-air heat exchanger that transfers the heat to the outside air, cooling the fluid for return to the datacenter.

When the outside air is cold enough, the fluid cooler will switch into dry mode, using no water at all.





Direct evaporative cooling (DEC)

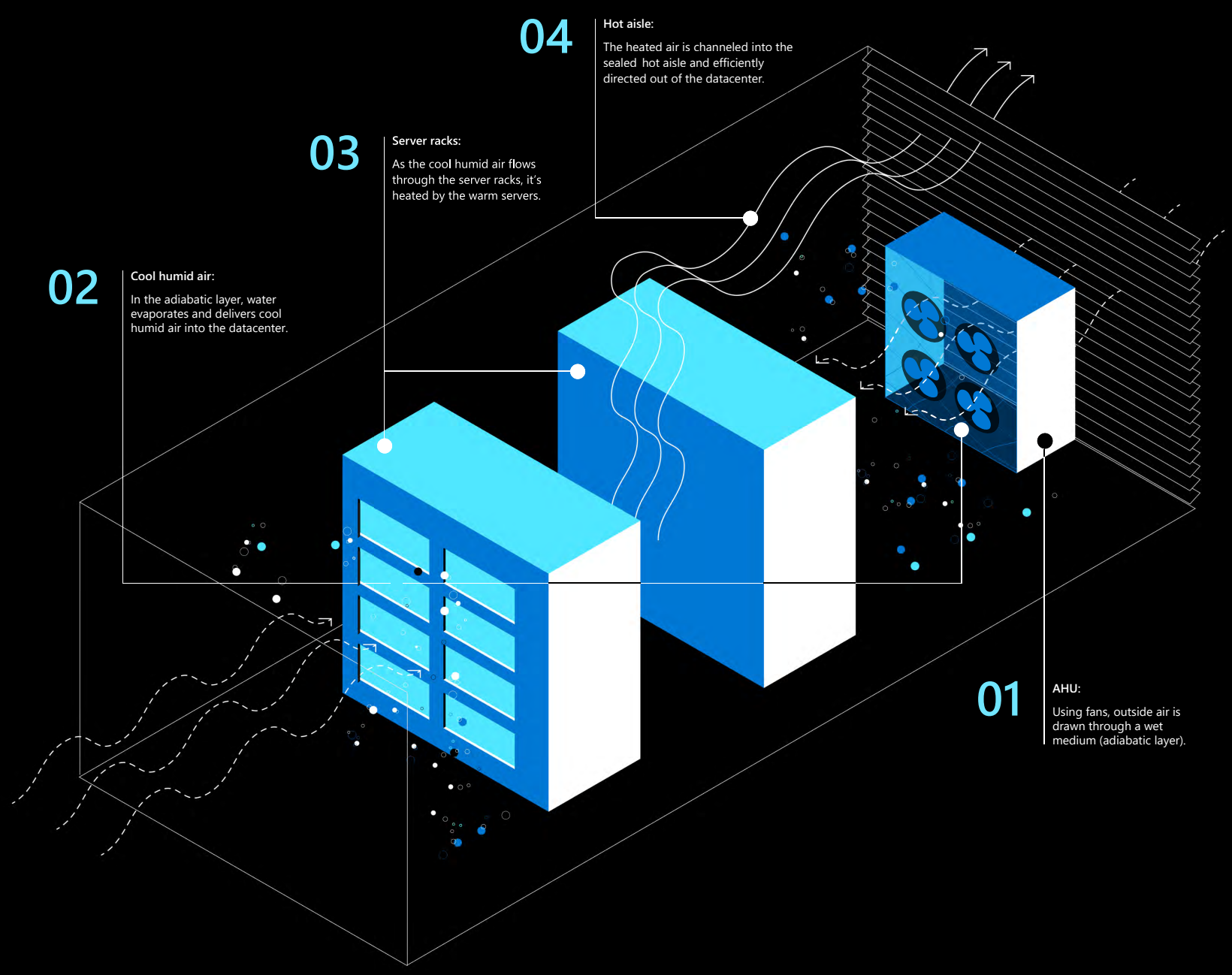
DEC uses the direct evaporation of water to produce significant cooling and humidification with low energy consumption. A water-saturated medium is used to allow a large volume of air to contact evaporating water. This is widely regarded as the simplest, most cost-effective method of cooling and humidifying air. This technology is deployed by operators that have access to potable water, are willing to let the air in the datacenter fluctuate with the outdoor air, and are willing to bring in air from the outside.

Power usage	Low
Water usage	Low

Did you know?

Adiabatic cooling uses less electricity and up to **90 percent** less water than other water-based cooling systems.[3]

[4]Microsoft will replenish more water than it consumes by 2030



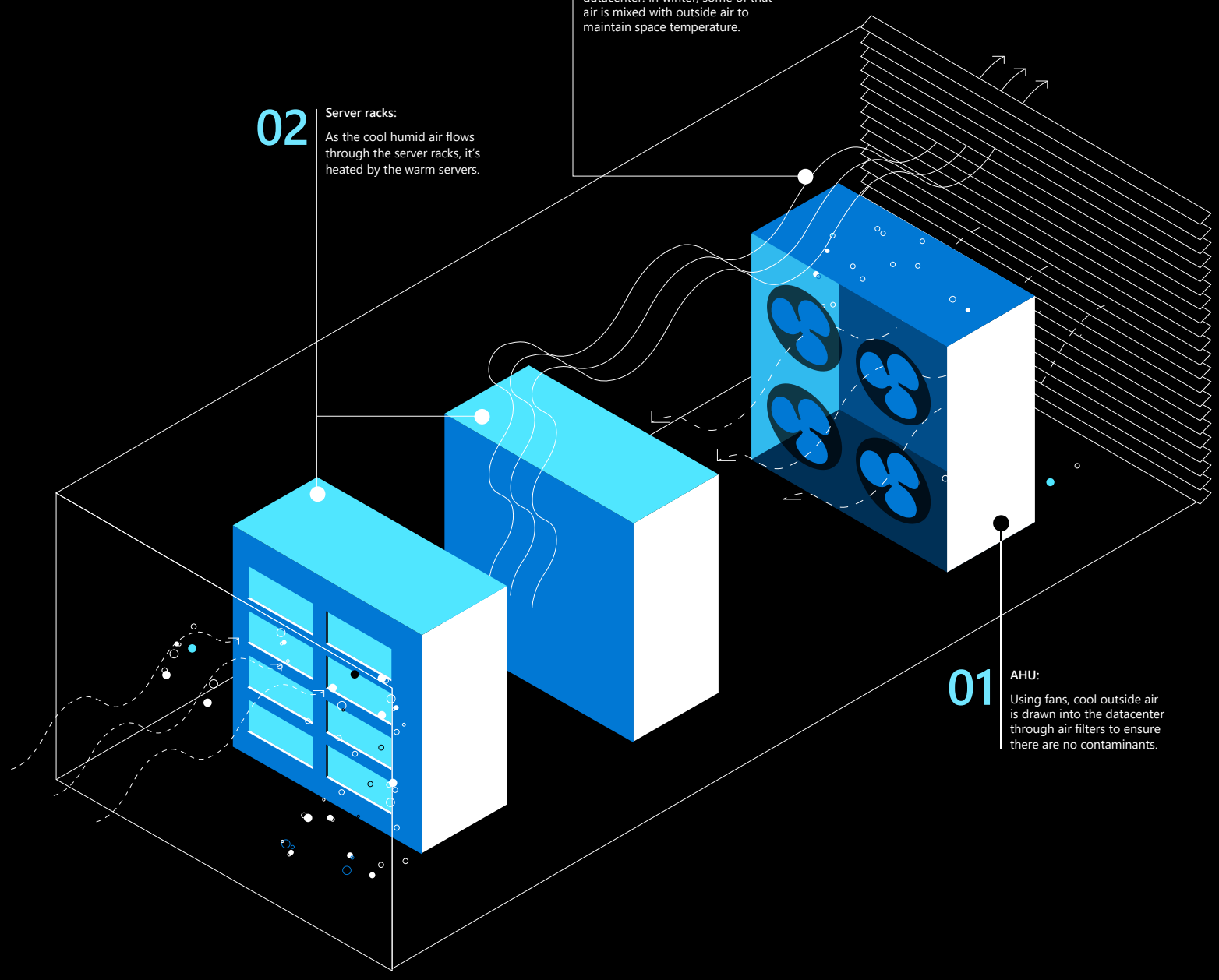
Free air cooling

Free cooling methods take advantage of natural outdoor air to control temperature inside the datacenter. Outdoor air dampers are fully open during warm outdoor conditions and modulate closed when outdoor air becomes too cold. In coordination, return air dampers inside the building modulate open to blend in warm air and maintain ideal operating conditions.

Power usage	Low
Water usage	None

Did you know?

Free air cooling uses almost no water to cool datacenters. Water usage for humidification is sometimes required in wintertime.



Move forward sustainably

Microsoft believes technology can help people everywhere build a more sustainable future. Explore sustainability tools, resources, and products.

Start your sustainability journey

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