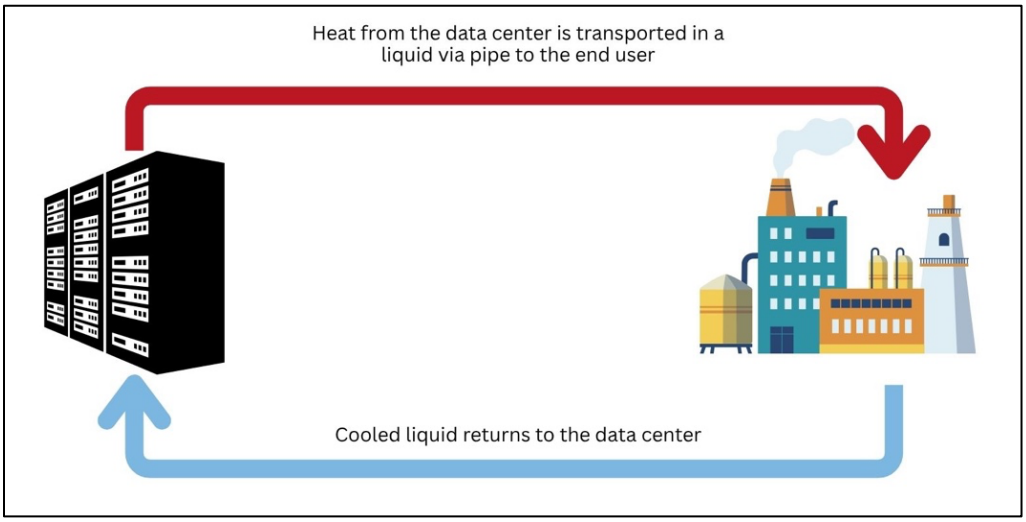
Data Center Heat Reuse: Technical FAQs

How does data center heat reuse work?

Data centers' servers produce large amounts of low-temperature heat as a byproduct of their computing operations. To prevent the servers from overheating, data centers typically use air conditioning to reject this heat into the atmosphere, which is an energy-intensive process: up to 40% of data center energy demand is for cooling. Alternatively, data centers can supply this waste heat in the form of a liquid (frequently water) to nearby buildings and factories, providing them with a low-carbon heat source. After the heat is exported to the offtaker, the cooled liquid then returns to the data center via a closed loop piping system—having now reached a temperature low enough to carry heat out of the data center again—and the cycle restarts. Exporting their waste heat to reuse in other operations reduces data centers' cooling needs and, in turn, reduces their overall electricity consumption by 10 to 30%.



How does reusing data centers' heat impact their water usage?

Air-cooled data centers rely on evaporative cooling, leading to extremely high water consumption. When data centers reuse their heat in a closed loop system instead of dissipating it into the atmosphere, it reduces, or even eliminates, the need for evaporative cooling. Heat reuse is also more efficient with emerging cooling methods, like immersion and liquid cooling, which are generally more water-efficient and also allow heat to be captured at higher temperatures.

What is the temperature of data centers' heat?

Data centers produce low-temperature heat that ranges from 25 to 35°C (77 to 95°F) or 50 to 60°C (122 to 140°F) depending on the cooling system. Data centers that utilize liquid- and immersion-cooling are more efficient, meaning the heat is more concentrated, which allows data centers to recover heat at higher temperatures compared to air-cooled systems.

What types of facilities or buildings are potential offtakers for data centers' heat?

Many buildings and factories could use data centers' heat. Prime industrial offtakers are those that require large amounts of low-temperature heat, like the food and beverage and pharmaceutical sectors. Data center heat can also be used for general water pre-heating—for example at commercial laundries and dishwashers—and commercial and residential space heating. Other facilities with consistent low-temperature heat needs, like greenhouses and swimming pools, could use data centers' heat. Data centers can also be integrated into a local thermal energy network or district energy system that connects numerous facilities and aggregates their heating and cooling loads.

How close do the data center and offtaker need to be?

The limiting factor for the distance between the data center and the offtaker is economic, not technical. Heat can be efficiently transported in pipelines that use water as the heat transfer medium, but with longer distances come higher costs for the piping itself. Ideal offtakers are proximate to the data center—less than five kilometers.

What additional equipment is needed at the data center to enable heat reuse?

The data center will typically need a heat recovery interface, made up of heat exchangers, pumps, piping, valves, sensors, and a control system to move heat from the cooling loop into a usable heat circuit. This system, particularly the heat exchanger, keeps liquid in the data center cooling system separate from water in the heat reuse infrastructure.

What additional equipment is needed for the offtaker to utilize the heat? Will the offtaker typically require a heat pump?

The equipment the offtaker needs depends on their required heat temperature. If the offtaker can use the heat directly, they may only need a heat exchanger and a suitable distribution loop to allow them to use the data center's heat effectively. On the other hand, if the offtaker requires a higher temperature heat than the data center can provide, a heat pump is a common solution to lift the temperature further. A heat pump may be needed for use-cases like conventional district heating or hot water applications, where a low-temperature heat would be insufficient.

What is the payback period for these projects?

The exact payback period for these projects depends on various factors like the ownership model for the heat reuse system, who bears the cost of building a pipeline between the data

center and the heat offtaker, and what government subsidies may be available for these projects in a locality or country, if any. In a high-level analysis of data center heat reuse projects in Europe, DGA found that the data center could see a payback period of one to three years while the offtaker had a generally longer payback period of two to seven years.

What are the ownership models for the heat reuse infrastructure?

There are a few ownership models that could make sense for these projects, with specifics depending on whether there is a direct pipeline from the data center to the offtaker or if the data center's heat is injected into a district energy or thermal energy network. In either scenario, the heat reuse infrastructure could be owned by a third-party intermediary, like a district energy company. For projects that plug into a district energy or thermal energy network, this infrastructure could be developed through a public-private partnership or there could be a model in which it is sold to a gas utility, akin to how renewable energy developers sell projects to electric utilities.

Would the data center have to be a regulated utility if it is providing heat?

Data centers that provide heat to an offtaker could be classified as a utility under some states' statutory definition. State regulators might be able to offer guidance that clarifies that data centers should not be regulated as utilities. Alternatively, states could adopt legislation to revise the definition of a utility to exclude data centers and other exporters of waste heat. States could also adopt legislation to allow gas utilities that provide heat—rather than or in addition to gas—to meet their service requirements.