

# HPE liquid cooling innovation through the years



Hewlett Packard Enterprise is a leader in liquid cooling with **over five decades** of innovation and **more than 300 direct liquid cooling patents**. With multiple liquid cooling options, HPE liquid cooling portfolio adapts to your HPC and AI workload needs and facility requirements. In addition, HPE has the expertise to help with data center design (both traditional and modular), installation, rigorous testing, monitoring software and on-site services to support successful deployment.

Organizations need a powerful solution that can handle today's AI, HPC and data-intensive workloads. But challenges such as rising power density and energy efficiency drive the need for more sustainable liquid cooling in today's data center.

**Today, HPE offers a wide variety of liquid cooling and compute options across our portfolio including:**

HPE ProLiant Compute

HPE Cray Supercomputing

HPE Rear Door Heat Exchanger (RDHX)

HPE Adaptive Rack Cooling System (ARCS)

HPE Slingshot interconnect

As well as comprehensive services, software, and support for your AI and HPC workload needs.

**HPE's leadership in liquid cooling spans over five decades. Let's journey back in time to earlier technologies.**

## Liquid cooling—Early days

1970s



Figure 1. Cray-1—Refrigerant cooled 115 KW 160 MF

1980s



Figure 2. CDC Cyber 205—Refrigerant cooled

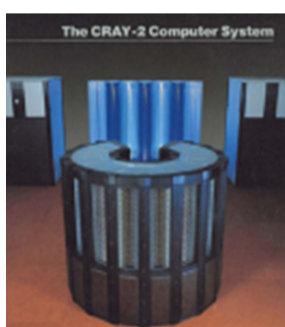


Figure 3. Cray-2—Pumped single phase immersion cooled (fluorinert) 1.9 GF, 175 KW



Figure 4. ETA 10—Cryogenic cooled, 10 GF



Figure 5. Cray Y-MP—Cold plate pumped fluorinert cooled 2.3 GF, 120 KW

1990s



Figure 6. Cray C90—Cold plate (fluorinert) 200 KW 16 GF



Figure 7. Cray T3D—Cold plate (fluorinert) 20 GF, 42 KW

1996

Silicon Graphics acquires Cray Research Inc. (1996)

2000s

Room neutrality

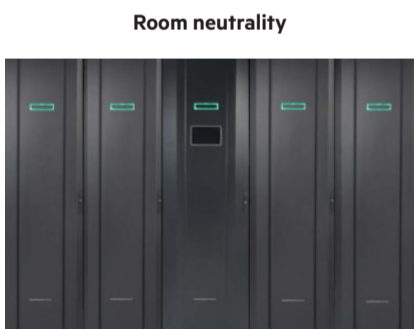


Figure 8. HPE Adaptive Rack Cooling

Tera Computer Co. buys Cray from SGI; Cray Inc. is formed (2000)

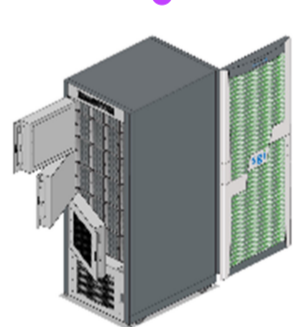


Figure 9. SGI—Deployed facility connected rear door heat exchanger



Figure 10. SGI ICE hybrid cell cooling

2010s

SGI acquired by HPE (2016)



Figure 11. HPE Apollo 8000—Dry interface LC platform



Figure 12. HPE Cray Supercomputing EX—100% fanless DLC 400 KW

2019

Cray acquired by HPE (2019)

2020s and beyond

HPE's leadership in liquid cooling is stronger than ever. Today, HPE powers the only **three** verified **exascale** systems in the world.

The combined performance of the 100% fanless direct liquid cooled HPE Cray Supercomputing EX-powered **El Capitan, Frontier, and Aurora** supercomputers are as fast as the next three 23 systems on the TOP500 combined.<sup>1</sup>



Figure 13. Number 1: El Capitan supercomputer at the Lawrence Livermore National Laboratory



Figure 14. Number 3: Aurora supercomputer at Argonne National Laboratory



Figure 15. Number 2: Frontier supercomputer at the Oak Ridge Leadership Computing Facility

HPE continues to innovate so that you can tackle today's demanding HPC, AI, and compute intensive workloads.

Learn more at

[HPE.com/us/en/solutions/direct-liquid-cooling.html](https://HPE.com/us/en/solutions/direct-liquid-cooling.html)

<sup>1</sup> "Highlights—November 2024," Top500, November 2024

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