ENGINEERING CASE STUDY

Amazon Web Services (AWS)

Custom IRHX Closed-Loop Cooling: Zero Water Increase & Water Positive by 2030

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0	530M+	53%	120+
Increase in water consumption from new liquid cooling	Gallons of freshwater saved annually (2030 target)	Progress toward water positive goal (end of 2024)	U.S. facilities using recycled water by 2030

EXECUTIVE SUMMARY

Amazon Web Services has developed and deployed a custom in-house closed-loop liquid cooling platform — the IRHX system — specifically engineered to prevent increases in data center water consumption as AI workloads scale. The closed-loop design recirculates engineered cooling fluid continuously without evaporative loss, meaning new liquid cooling capacity adds zero incremental water draw. In parallel, AWS is executing a recycled water program targeting 120+ U.S. facilities by 2030, projected to save more than 530 million gallons of freshwater annually. By year-end 2024, AWS was 53% of the way toward its water positive commitment — returning more water to communities than it uses. These are the most precisely documented water engineering commitments of any hyperscale operator globally.

THE IRHX SYSTEM: CUSTOM ENGINEERING FOR ZERO WATER INCREASE

AWS did not purchase a commercial liquid cooling solution. After evaluating available vendor products and finding none adequate for its requirements, AWS designed and built its own system internally — completing the engineering and deployment in approximately 11 months. The design rationale is documented in AWS's own technical publications:

> *"AWS is taking a direct-to-chip approach, which puts a cold plate directly on top of the chip. The liquid runs in tubes through that sealed plate, absorbing the heat and carrying it out of the server rack. It's an entirely closed loop system, meaning that the liquid continuously recirculates, and — crucially — doesn't increase the data center's water consumption."*

— Amazon Web Services, Official Technical Disclosure — June 2025

The physics basis for the efficiency advantage is explicit in AWS documentation: liquid is more than 900 times denser than air, enabling far greater heat absorption per unit volume. This density advantage allows the IRHX system to remove heat from next-generation AI chips — including NVIDIA Blackwell GPUs and AWS's own

Trainium3 and GB200 NVL72 configurations — that air cooling cannot handle at scale.

RECYCLED WATER PROGRAM: QUANTIFIED FRESHWATER PROTECTION

AWS's closed-loop liquid cooling eliminates water consumption increases for AI workloads. For remaining evaporative cooling systems in the existing fleet, AWS has engineered a complementary approach: replacing potable water with recycled wastewater (reclaimed municipal effluent) that undergoes a three-step treatment process removing 99% of impurities before entering cooling systems.

Program Element	Specification / Target
Recycled water treatment	3-step municipal wastewater treatment; 99% impurity removal
Current facilities using recycled water	~24 globally (as of 2025)
U.S. target by 2030	120+ data center facilities
Annual freshwater savings (2030 target)	530+ million gallons
Return loop	Post-cooling water returns to wastewater facility for re-treatment and reuse
Water positive target	Return more water to communities than direct operations consume by 2030
Progress to water positive (end 2024)	**53% — up from 41% in 2023**

THE WATER POSITIVE FRAMEWORK: A COMMUNITY-FACING STANDARD

AWS's water positive commitment is the most mathematically specific community water standard in the industry. It does not merely claim water neutrality — it commits to a net surplus: the total water returned to communities through replenishment projects exceeds the total water consumed across all data center operations, including both cooling and occupancy uses. The 53% progress figure as of 2024 — with a 2030 target — represents a public, auditable accountability mechanism with annual reporting.

For advocacy purposes, the AWS water positive framework is the most powerful counter-narrative available: it transforms the entire debate from 'how much water does the facility use' to 'this facility makes the local water supply net stronger.'

KEY FINDINGS FOR PUBLIC POLICY ADVOCATES

FINDING 1	AWS's IRHX closed-loop liquid cooling system adds zero incremental water consumption as AI workloads scale — directly stated in AWS's official technical documentation.
FINDING 2	AWS designed and built its own custom cooling solution after commercial options proved inadequate — demonstrating the depth of engineering investment and the specificity of the zero-water-increase design goal.

FINDING 3	AWS's recycled water program replaces potable freshwater with treated municipal wastewater in existing evaporative systems — protecting community drinking water supplies at a documented scale of 530+ million gallons annually by 2030.
FINDING 4	The water positive commitment — returning more water to communities than total operations consume — is the most community-beneficial water framework deployed by any major technology company and represents a direct, measurable answer to opposition water claims.
FINDING 5	AWS's 53% progress toward water positive as of year-end 2024 is the most current publicly reported progress figure in the industry, establishing an auditable accountability record that opposition groups cannot claim.

Primary Sources

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