

**Microsoft can save up to 95% by
Implementing Single-Phase Immersion
Cooling by retrofitting existing data centers
with implementing immersion cooling to
decrease Data Center Cooling Costs**

TKS X 

Microsoft Can Cut Costs and Lead In AI by Using A Smarter, Greener Cooling System

Problem

Traditional data center cooling is inefficient, consuming up to **40% of total energy**, requiring costly fans and HVAC systems that reduce hardware lifespan.

Solution

Single-phase immersion cooling submerges servers in a non-conductive coolant, eliminating the need for fans and bulky infrastructure. This simplifies cooling, lowers costs, and **improves efficiency**.

Impact

- **95% reduction** in cooling energy use
- **✓ Lower costs** with reduced maintenance
- **✓ Sustainable** – cuts water use & carbon emissions
- **✓ 30% longer hardware lifespan**, improving reliability



Microsoft's Data Centers Use Resource Intensive HVAC and High-Performance Fans

Wasting Water

AI servers output a lot of heat, requiring millions of gallons of water for cooling. In just one year, Microsoft's water use jumped by 34% to 1.7 billion gallons (AP News, 2023). In regions like Arizona, where Microsoft has data centers, this water use worsens drought conditions and strains local water supplies.

Not Meeting Climate Goals

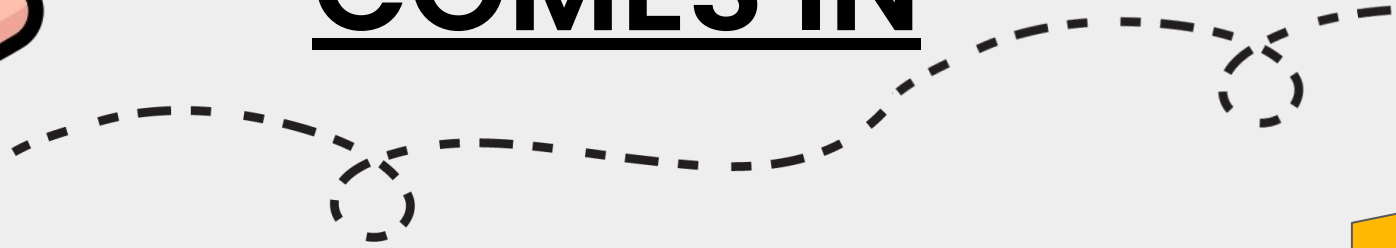
While Microsoft claims to be an industry leader in sustainability, its AI expansion is making it harder to meet its own carbon-negative and water-positive goals. Without a new approach, Microsoft risks harming the environment while losing credibility as a "green" company.

Too Much Energy

AI models, especially large ones like ChatGPT and Claude, require intense computing power, which means more servers running 24/7. This has driven Microsoft's energy consumption up by 34% in just one year (FT, 2023). The electricity used to power these servers often comes from fossil fuels, increasing carbon emissions and slowing down Microsoft's pledge to become carbon negative by 2030.



THIS IS WHERE OUR
SOLUTION, COOL AID,
COMES IN



Microsoft Can Cut Costs and Save Energy by Using A More Efficient Liquid Cooling System For AI Data Centers

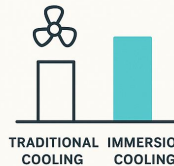
No Fans, Less Power: Traditional data centers use energy-hungry fans and air-conditioning to cool servers. These methods lose efficiency as AI workloads grow. Single-phase immersion cooling eliminates fans by submerging servers in a non-conductive liquid, reducing energy use by 30-40%.

Saves Water: Standard liquid cooling systems rely on evaporative cooling, consuming vast amounts of water. Immersion cooling doesn't need water at all, which means Microsoft can cut down on its 1.7 billion gallons of annual water use and make data centers more sustainable.

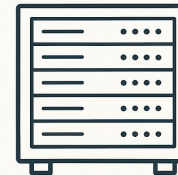
Handles AI's Power Demands – AI models are becoming larger and more power-hungry, meaning traditional cooling methods will struggle to keep up. Immersion cooling is already proving it can handle densities up to 100kW per rack, making it future-proof for Microsoft's AI ambitions.



LESS POWER



NO
WATER USAGE
SAVES WATER



HANDLES AI'S POWER DEMANDS

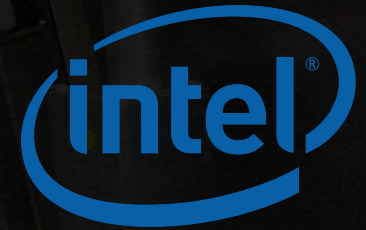
UP TO
100 kW
PER RACK

Intel Is Implementing Single-Phase Immersion Cooling to Improve AI Performance and Reduce Energy Costs

Intel's Shift to Single-Phase Immersion Cooling

Intel has been at the forefront of adopting single-phase immersion cooling to support its high-performance AI workloads and data center efficiency.

- **AI Hardware Support:** With the increasing heat output from AI processors, Intel has implemented single-phase immersion cooling, where CPUs and GPUs are submerged in dielectric fluid that efficiently absorbs and removes heat. This eliminates the inefficiencies of traditional air cooling, keeping hardware at peak performance without the risk of overheating.
- **Energy & Cost Efficiency:** By removing the need for high-powered fans and HVAC systems, this cooling method cuts up to 95% of cooling costs and extends hardware lifespan by 30%, thanks to reduced mechanical wear and tear. This not only lowers operational costs but also reduces Intel's carbon footprint, aligning with sustainability goals.



Alibaba Is Leveraging Single-Phase Immersion Cooling to Enhance Data Center Efficiency and Sustainability

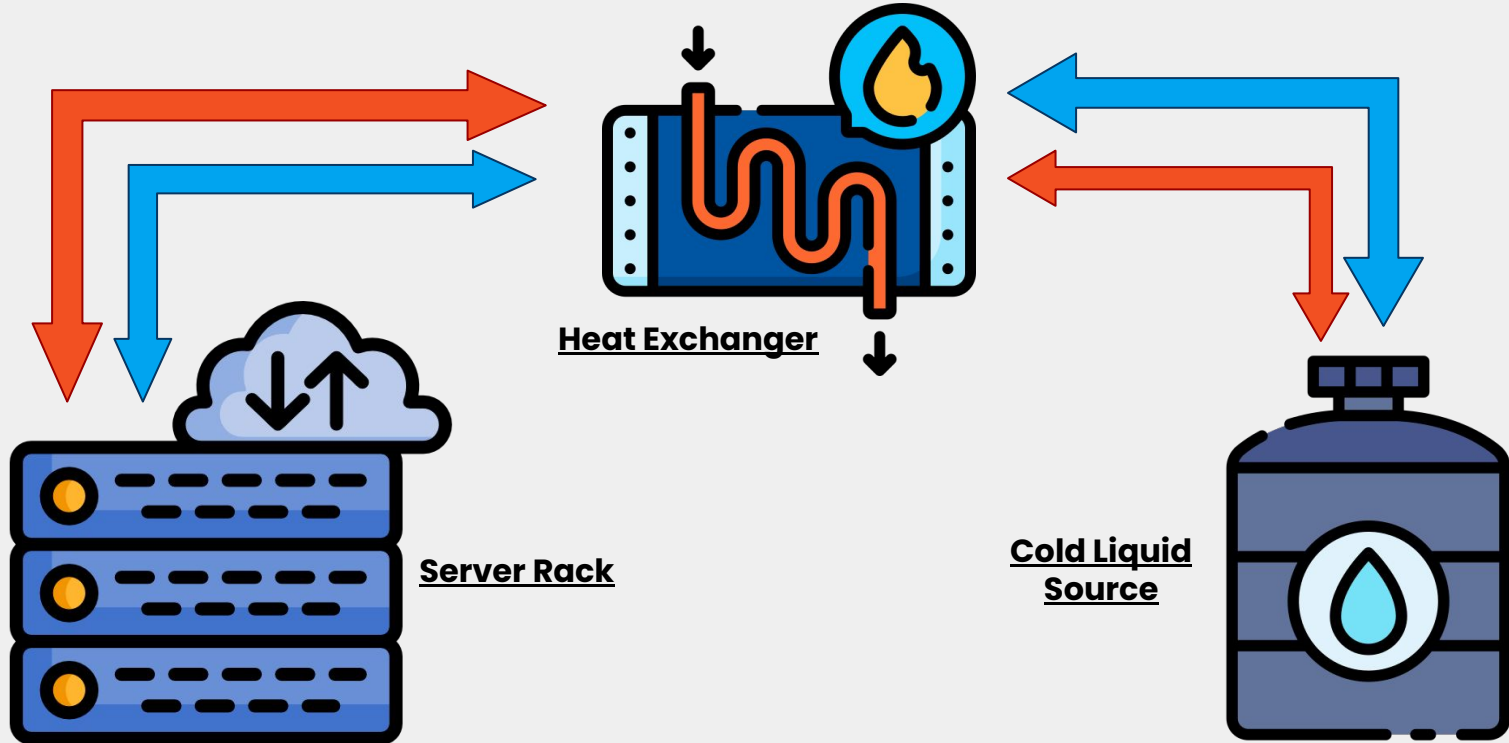
Alibaba's Large-Scale Implementation of Immersion Cooling

As one of the largest cloud service providers, Alibaba has embraced immersion cooling to improve efficiency and sustainability in its hyperscale data centers.

- **Scalability & Performance:** Alibaba has integrated immersion cooling across AI and cloud servers, ensuring high processing power with lower energy consumption. This is critical as Alibaba's cloud computing services handle massive data loads and AI-driven applications that require efficient thermal management.
- **Sustainability & Cost Savings:** The company has reduced energy consumption by 30% and significantly lowered water usage, an essential factor in eco-friendly data center operations. By implementing single-phase cooling, Alibaba has cut down operational costs and ensured greater reliability, proving this method's viability at a massive scale.



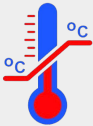
Single-Phase Immersion Cooling Is Simple, Yet Effective



Single-phase Immersion Cooling Quietly Moves Heat Away, Cutting Cooling Costs By 95% and Makes Servers Last 30% Longer

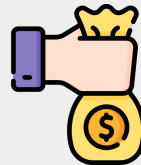
Efficient Heat Management in Server Enclosures

The system uses a heat exchanger to pump warm coolant away from the server enclosure to a large, cold liquid source in a single-phase arrangement, which effectively moves heat away from the room.



Cost-Effective Cooling System for Data Centers

The setup is cost-effective as it doesn't require raised floors, bulky chillers, or high-performance fans, making it easy to retrofit existing data centers.



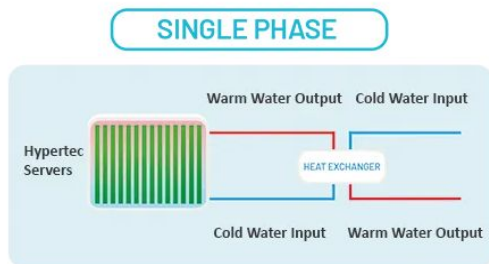
Benefits of Lower Cooling Costs and Increased Hardware Longevity

The system reduces cooling costs by up to 95% and improves hardware longevity by 30% due to fewer moving parts and lower reliance on expensive, high-maintenance equipment.



Single-Phase Immersion Cooling is way more advanced than Two-Phase Immersion Cooling because [insert why here]

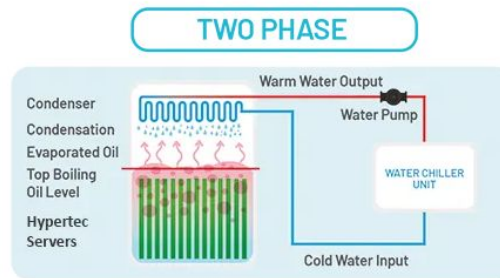
Single-Phase Immersion Cooling



In a single phase immersion cooling, servers are submerged in a thermally conductive dielectric liquid or coolant, which is a much better heat conductor than air, water, or oil. The coolant itself never changes state. With the help of a heat exchanger, heat is transferred to a cooler water circuit. The technique guarantees little to no risk of the coolant evaporating.

- Lower TCO
- 15-year coolant life
- Simple and safe to use
- Low complexity
- More efficient
- No raised floors or chillers

Two-Phase Immersion Cooling



Two-phase cooling servers are also submerged in the same coolant, heat is removed differently. With a low boiling point (50 degrees Celsius), the fluid boils and rising vapor takes care of the heat transfer. All circulation happens passively and naturally.

- Expensive liquid (>\$90/L)
- Must be replenished every 2 years
- Not environmentally friendly
- Medium complexity
- Less safe to use
- Requires a lot more maintenance.

RETROFIT Implementation Slide Pt 1

Implementation Plan: Step-by-Step

Phase 1: Infrastructure Assessment (0-3 months)



- Identify which data centers are best suited for retrofitting based on server workloads, power density, and heat output.
- Conduct fluid compatibility testing with existing hardware to ensure smooth integration.

Phase 2: Pilot Deployment & Performance Benchmarking (3-6 months)



- Deploy immersion cooling in a controlled environment.
- Measure thermal efficiency, energy savings, and compute performance.
- Compare against air-cooled servers to quantify the benefits.

Phase 3: Full-Scale Deployment (6-12 months per facility)



- Install immersion cooling tanks to replace traditional server racks in priority data centers.
- Optimize software and workload scheduling to maximize efficiency gains.
- Gradually scale adoption across Microsoft's infrastructure based on performance results.

RETROFIT Implementation Slide Pt 2

Key Technical & Operational Considerations

Equipment Compatibility

- No hardware modifications needed—existing CPUs, GPUs, and accelerators can be submerged.
- Uses dielectric fluid that is non-conductive, safe, and long-lasting.



Simplified Cooling Infrastructure

- Eliminates high-maintenance HVAC systems and expensive raised-floor setups.
- Reduces reliance on mechanical cooling, lowering failure points and maintenance needs.



Improved Data Center Efficiency

- No airflow restrictions = higher compute density per rack.
- Fewer moving parts = longer-lasting hardware and reduced downtime.



Immersion Cooling Has Higher Upfront Costs and Requires Infrastructure Changes, But the Long-Term Benefits Outweigh the Challenges

High Upfront Cost & Deployment Complexity

- Challenge: Retrofitting costs \$25M-\$100M per data center and requires specialized infrastructure.
- Why It Matters: Unlike air cooling, immersion cooling needs custom tanks, pumps, and liquid management systems, increasing initial setup costs and complexity.
- Solution: Despite high costs, break-even happens in 12-24 months due to lower operating expenses and government sustainability incentives.

Limited Industry-Wide Adoption & Vendor Lock-In Risks

- Challenge: While adoption is growing, many data centers still use air cooling, meaning fewer established standards and suppliers for immersion cooling.
- Why It Matters: Microsoft risks vendor lock-in if it relies too heavily on one supplier for cooling fluids and maintenance.
- Solution: We would establish multiple supplier agreements and custom Microsoft standards, ensuring flexibility and no reliance on a single vendor.

Potential Hardware Compatibility Issues

- Challenge: Some existing servers may not be optimized for immersion cooling, leading to potential warranty voids or unexpected failures.
- Why It Matters: Some manufacturers have not certified their components for full-time submersion, which could impact performance and longevity.
- Solution: We would partner with OEMs like Intel and AMD to ensure fully certified immersion-ready hardware, reducing risk.

Fluid Contamination & Maintenance Complexity

- Challenge: Immersion fluids degrade over time, and contaminants (like dust or server coatings) can reduce efficiency.
- Why It Matters: If fluids are not properly maintained, cooling efficiency drops, increasing operational risks.
- Solution: We would implement regular fluid filtration & monitoring systems to proactively manage contamination and fluid lifespan.

“THIS MIX IS
STRAIGHT UP
SAFE TO
DRINK”

- **Linus Tech**



Immersion Cooling Reduces Costs Through Energy Efficiency, Hardware Longevity, and Operational Savings Pt. 1

Initial Investment Costs

\$500–\$2,000 per kW for immersion cooling setup

- Varies based on tank type, infrastructure modifications, and installation complexity
- Microsoft's data centers range from 50 MW–100 MW, making total installation costs \$25M–\$100M per site

Infrastructure Costs

- Dielectric coolant: \$10–\$20 per liter (needs periodic replacement)
- Tank & Heat Exchange Systems: \$5M–\$15M per site
- Installation & Retrofitting: 10%–20% of total cost, depending on current infrastructure


Cost of Immersion Cooling

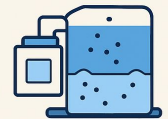
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Immersion Cooling Reduces Costs Through Energy Efficiency, Hardware Longevity, and Operational Savings

Direct Savings Cost

Cooling Energy Costs:

- Microsoft's air cooling costs ~\$6M-\$10M per data center annually
- Immersion cooling reduces cooling energy use by 90-95% → \$2M-\$3M saved per site per year

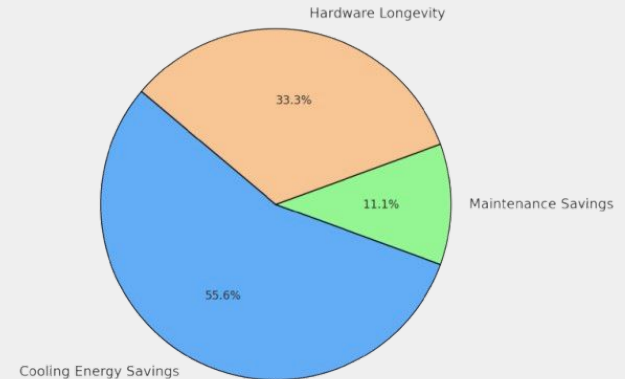
Maintenance Savings:

- Air-cooled data centers require frequent fan, chiller, and HVAC maintenance → \$1M+ in annual upkeep per site
- Immersion cooling removes these components, cutting maintenance by 50%+

Hardware Longevity:

- Servers last 30% longer, reducing replacement costs by millions per year
- Less heat stress = lower failure rates & downtime

Estimated Annual Cost Savings per Data Center (in Millions)

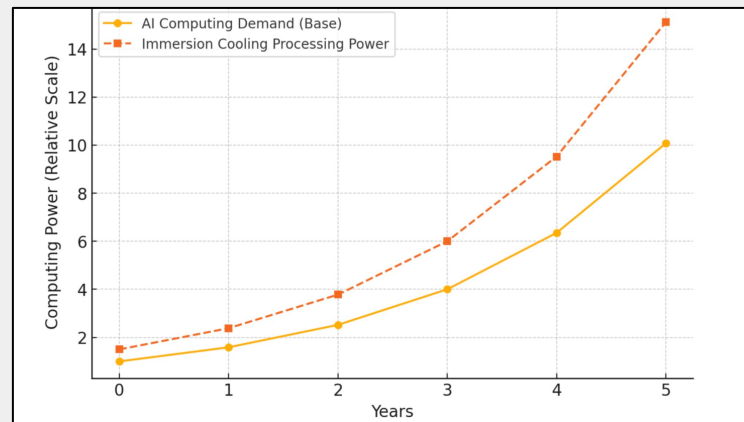


Immersion Cooling Reduces Costs Through Energy Efficiency, Hardware Longevity, and Operational Savings

Expansion Potential & Scalability

- Higher server density per sq. ft. → **Fewer new data centers needed**
- AI computing demands double every 12–18 months → **Immersion cooling allows for 50%+ more processing power** in same footprint

AI Computing Demand Growth vs. Immersion Cooling Efficiency





Competitive Advantage over Air Cooling



Metric	Traditional Air Cooling	Single-Phase Immersion Cooling
Cooling Energy Cost	~\$6M-\$10M per year	\$300K-\$500K per year
Maintenance Cost	\$1M+ per year	\$400K-\$600K per year
Server Lifespan	Standard	30% longer
Scalability for AI	Limited	High-density, space-efficient

Microsoft can Break even in ~1 Year

Energy Cost Savings (~\$2M-\$3M/year per data center)

Verified by other case studies, but alone, it wouldn't make up the cost in just a year

Increased Server Density and Efficiency

If Microsoft can run more AI workloads in the same space, they reduce the need to build new data centers, saving \$50M-\$100M per new facility.

Operational Cost Reductions Beyond Cooling

Eliminating traditional HVAC, chiller units, and raised floors saves millions in maintenance costs.

Hardware Longevity & Lower Replacement Costs (~30% lifespan increase)

Extending the life of AI servers by even a couple of years saves millions in hardware replacement costs annually. Less heat damage = lower maintenance costs.

Carbon Credit Incentives and Government Subsidies

Some governments provide huge tax credits for energy-efficient upgrades—sometimes covering up to 30%-50% of project costs. If Microsoft qualifies, the actual out-of-pocket cost of retrofitting could be significantly lower.



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On a more personal

Dear Microsoft Team,
note...

Thank you for taking the time to review our proposal on single-phase immersion cooling. We appreciate your interest in exploring innovative solutions that can drive efficiency, sustainability, and cost savings for Microsoft's data centers.

As the demand for AI and high-performance computing grows, the need for smarter, greener cooling systems has never been greater. We believe immersion cooling presents a unique opportunity for Microsoft to lead the industry in both technological advancement and environmental responsibility—all while significantly reducing long-term operational costs.

We look forward to your feedback and the possibility of working together to bring this vision to life. Please don't hesitate to reach out with any questions or for further discussions.

Best regards,

Diya, Ilakkiyan, Yelizavieta, Dhruv, and Valentina