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WHITE PAPER:
THE CASE FOR CHANGING AN AI DATA CENTER'S WATERLESS COOLING TO NITRO-TURBODYNE'S WATERLESS, NITROGEN COOLING

Executive Summary

As AI workloads surge, traditional water-based cooling systems are becoming a liability—driving up operational costs, exposing datacenter owners to regulatory risk, and undermining sustainability goals. Waterless, nitrogen-based cooling offers a proven, next-generation solution: it eliminates water consumption, slashes operational expenses by up to 44%, and future-proofs facilities against tightening regulations. This white paper presents a compelling, data-driven case for retrofitting existing AI datacenters with waterless nitrogen cooling—delivering immediate cost savings, environmental leadership, and long-term business value.

While water cooling demands increasingly greater amounts of regulatory paperwork each year, Nitro-Turbodyne's waterless cooling system ends the ever-increasing conformity reports and halts heavy environmental regulation or demands of proof-of-compliance.

From a small, 1000-server data center to a 20,000-server hyperscale unit, Nitro-Turbodyne can provide you with the cooling your system needs without the heavy burden of water use and discharge compliance. Since no water or other medium is consumed, and none is discharged.

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1. Introduction: The Cooling Challenge in AI Datacenters

AI datacenters are at the heart of the digital economy, but their cooling needs are outpacing the capabilities—and sustainability—of legacy water-based systems. With water scarcity intensifying and regulatory scrutiny mounting, owners face rising costs, operational risks, and reputational challenges. The solution: a transition to waterless, nitrogen-based cooling—a platform engineered for the demands of next-generation AI infrastructure.

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2. Operational Cost Savings: Waterless vs. Water-Based Cooling

The True Cost of Water-Based Cooling

Water-based cooling systems incur substantial recurring expenses, including:

Cost Category	Annual Cost (per MW)
Water procurement & consumption	$400–$1,200
Chemical treatment	$10,000–$20,000
Discharge/wastewater fees	Several thousand dollars
Maintenance (towers/chillers)	$15,000–$30,000
Infrastructure replacement	$5,000–$10,000
Total (excluding downtime)	**$30,000–$70,000**

> **Key Takeaway:** Water-based cooling can cost $30,000–$70,000 per MW per year—before factoring in downtime and regulatory compliance [1][2].

Waterless, Nitrogen Cooling: A New Standard for Efficiency

- **Zero water procurement, treatment, or discharge costs**
- **Minimal maintenance**: No scaling, corrosion, or biological fouling
- **Reduced downtime risk**: Fewer moving parts, no water supply interruptions

Operational Expense (Opex) Savings: - Waterless systems deliver **35–44% annual opex savings** compared to water-based systems.

- **Total Cost of Ownership (TCO)** is **8–17% lower over five years**—factoring in energy, maintenance, and infrastructure longevity.

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Cooling System	Annual Opex Savings	5-Year TCO Improvement	Water Use (liters/MW/year)
Water-cooled	Baseline	Baseline	500,000
Waterless (LN2-based)	35–44%	8–17%	0

3. Overall System Savings

Operational Expense (Opex) Savings: - Waterless systems deliver **35–44% annual opex savings** compared to water-based systems.

Comparison to Traditional Cooling

Traditional Air Cooling (1,000+ MW datacenter):

- Annual cooling cost: ~$50-80M (electricity for massive fan arrays)

- Water consumption: 2-4 billion gallons/year - COP: 3-5 - Space requirement: Extensive

Nitro-Turbodyne's Nitrogen Cooling: - Annual cooling cost:

~$4.4M (electricity) + $0.75-2.4M (Nitrogen supply) = **~$5.2-6.8M**

- Water consumption: Negligible and recoverable (only for chiller heat rejection)

- COP: ~182:1 - Space requirement: Compact (equipment is highly efficient)

Annual Savings vs. Traditional Cooling: **~$43-$75M per year**

- **Total Cost of Ownership (TCO)** is **8–17% lower over five years**—factoring in energy, maintenance, and infrastructure longevity.

Cooling System	Annual Opex Savings	5-Year TCO Improvement	Water Use (liters/MW/year)
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4. Environmental Benefits: Zero Water, Zero Compromise

Waterless Cooling: A Sustainability Game-Changer

- **Zero Water Usage Effectiveness (WUE):** No water consumed, no wastewater generated.
- **Nitrogen as Coolant:** Nitrogen is abundant, non-toxic, and environmentally benign — comprising 78% of the air that we breathe. The Nitro-Turbodyne system does not consume nitrogen; therefore, it does not emit any harmful gases. There are no EPA or other restrictions for releasing nitrogen into the environment, so no environmental permitting is required for a Nitro-Turbodyne waterless cooling system.
- **No chemical additives or hazardous discharge**: Eliminates environmental compliance burdens.

Key Finding: Nitro-Turbodyne's waterless nitrogen cooling enables datacenters to achieve a WUE of zero—setting a new benchmark for environmental stewardship and regulatory compliance.

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5. Business Value: Regulatory Risk Mitigation & ESG Leadership

Navigating a Tightening Regulatory Landscape

Water use in datacenters is under unprecedented scrutiny:

- **United States:**
  - *Minnesota H.F. 16 (2025):* Mandatory water permits, conservation, and drought-triggered restrictions.
  - *South Carolina HB 4583:* Requires closed-loop, zero net water withdrawal.
  - *California AB 1577:* Monthly water reporting, potential potable water bans.
  - *Arizona:* Groundwater moratoriums and permit denials for new projects.
- **European Union:**
  - *EU Taxonomy & Energy Efficiency Directive:* Water efficiency is now a prerequisite for sustainable investment and permitting.
- **Global:**
  - *Chile:* Google faced permit revocation due to water use.
  - *The Netherlands:* Moratoriums on new datacenters over water concerns.

Business Impact: Over **$130 billion** in US datacenter projects were delayed or abandoned in Q1 2026 due to water-related moratoriums and regulatory hurdles. Meta invested **$500M+** in water recycling to secure permits; Microsoft faced multi-year delays in Wisconsin [3][4][5].

ESG and Green Financing Advantages

- **WUE is now a core ESG metric**—publicly reported and scrutinized by investors, regulators, and customers. No water usage means the no WUE Reports required.
- **Zero-WUE facilities *are eligible for green financing, tax credits, and improved sustainability ratings.***
- Major operators (Microsoft, Google, Meta, Amazon) are setting aggressive water reduction targets—waterless cooling is the fastest path to compliance and leadership.

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6. Industry Trends: The Shift Toward Waterless Cooling

- **Major operators are retrofitting for zero/low water use:** Nvidia, Microsoft, Google, and Meta are deploying advanced liquid cooling and waterless systems in new and existing facilities.
- **Legislative momentum:** States and countries are moving toward mandates for closed-loop or zero-water cooling.
- **Retrofit incentives:** Utilities and governments are offering incentives for facilities that transition to waterless cooling and are eligible for retrofit financing and tax credits.

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7. Conclusion

Summary

- **Up to 44% annual opex savings**
- **8–17% lower TCO over five years**
- **Zero water consumption and discharge**
- **Elimination of regulatory and ESG risk**
- **Future-proofed, sustainable operations**

The message is clear: Water-based cooling is becoming unsustainable—financially, environmentally, and operationally. Waterless, nitrogen-based cooling is a proven, next-generation platform that delivers immediate and long-term value for AI datacenter owners.

Now is the time to act.

Retrofitting your facility with waterless, nitrogen cooling will:

- Slash operational costs
- Eliminate water-related regulatory risk
- Enhance your ESG profile and unlock green financing
- Position your datacenter as a leader in sustainable AI infrastructure

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Nitro-Turbodyne has years of experience working with nitrogen for cooling, power production, and environmentally friendly systems that are not only innovative, but save operators money, time, and OPEX.

Contact us today to schedule a consultation and discover how your datacenter can benefit from the waterless revolution.

For more information or to request a customized ROI analysis, contact our solutions team.

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