

# Accelerating the Transition to Liquid Cooling Through Standardization

## Iceotope Technologies

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PRECISION LIQUID COOLING  
[www.iceotope.com](http://www.iceotope.com)

# About Us

## Our Vision

To be the Global Leader in Advanced Cooling Solutions, Enabling Next-Generation Computing Infrastructure.

## Our Mission

To Innovate & Deliver Cutting-Edge Cooling Technologies that Enhance Performance, Efficiency & Reduce Environmental Impact.

## Our Company

Extensive IP Portfolio with 52 Granted Patents & 90 Pending Applications.

Recognized for Market Leadership, Built on Strong Relationships with Industry Experts, Influencers, & Key Stakeholders.

Global Presence & Team Established in Key Markets: UK (Sheffield), US (Raleigh) & Singapore.



# Our Technology



Transform the Design of Next Generation IT to **Maximize Compute performance and Efficiency.**

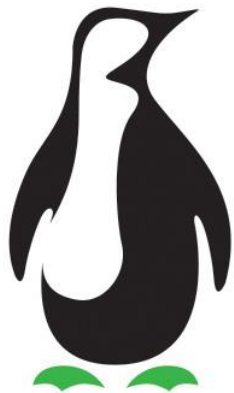
Maintain **Familiar Rack Based Form Factor.**

Enhance Energy, Water and Space Efficiency by Capturing **almost 100% of IT thermal load** to fluid system.

Support Flexible, Hybrid Environments with Standardized Form Factors, **Ensuring Scalability & Adaptability.**

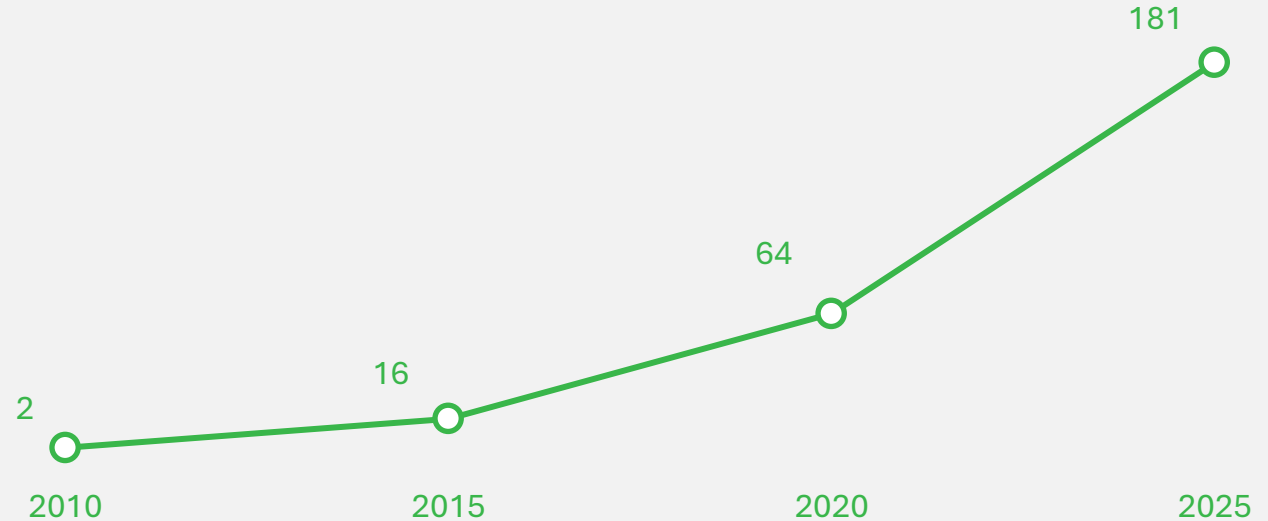


# **Evolving Challenges in IT Infrastructure**



# We are in the midst of a global data explosion

Data is Growing Exponentially  
Global Data Generated Annually  
(In Zettabytes = 1 Trillion GB)<sup>1</sup>



\$200 billion

Global investment in AI in 2025

Up from \$90 Billion in 2022<sup>2</sup>

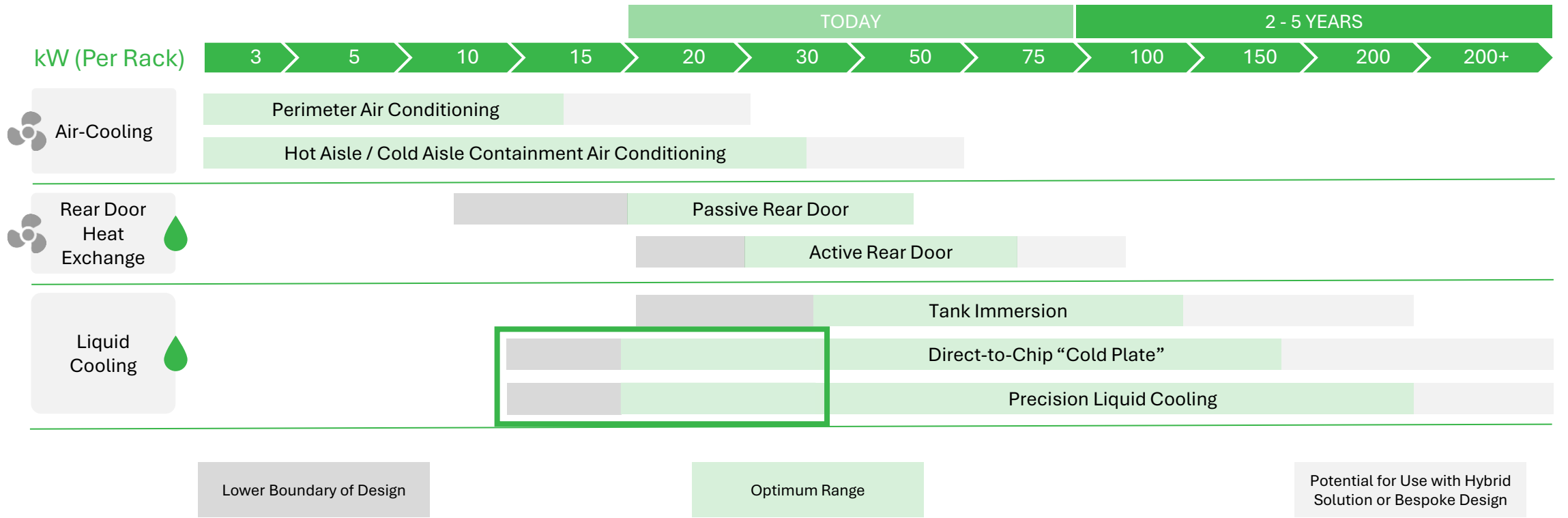
Source:

1. Statista, Bernard Marr & Co

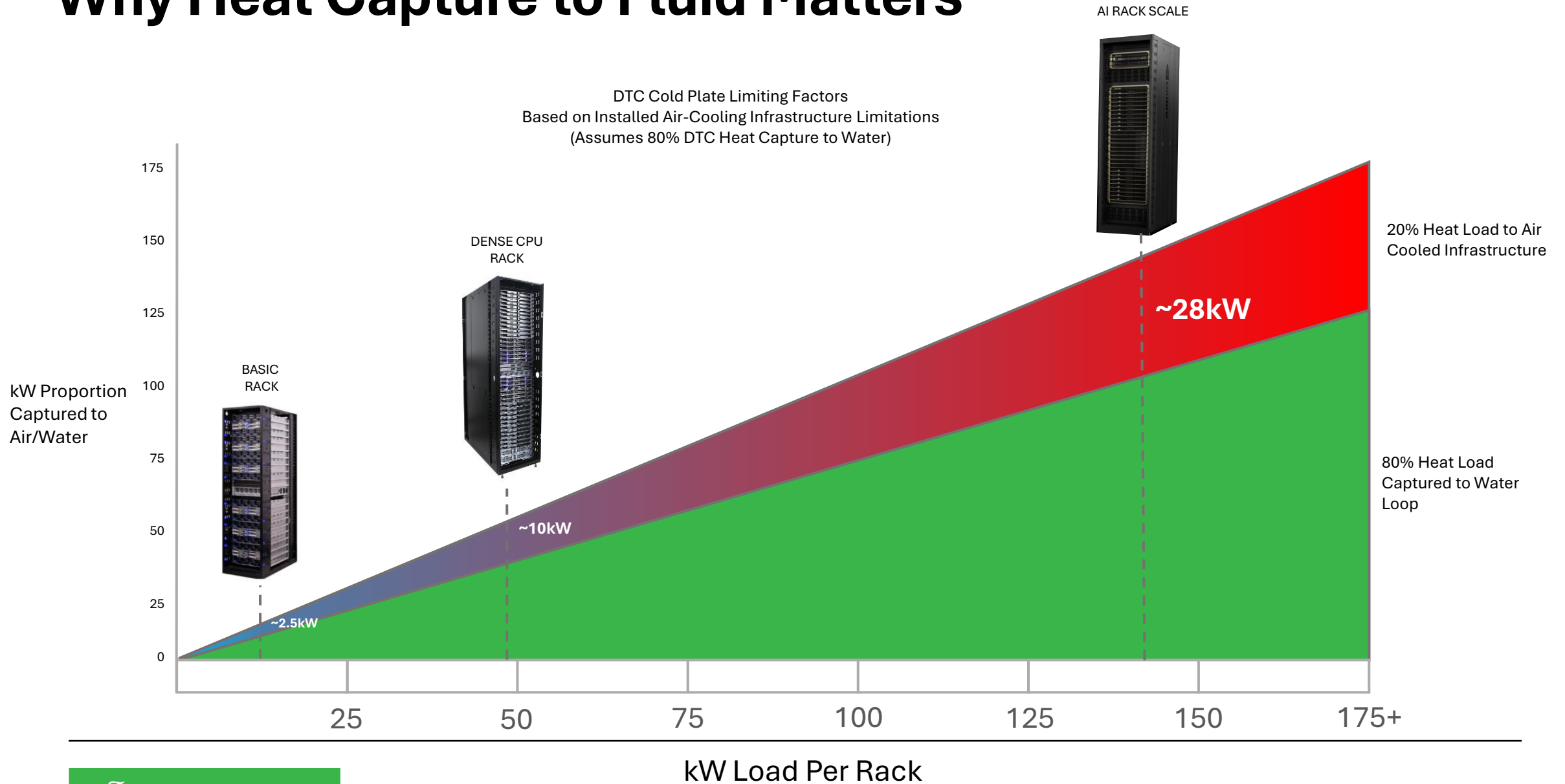
2. Goldman Sachs Economics Research, Aug 2023

# Air-Cooling Technology is in Diminishing Returns

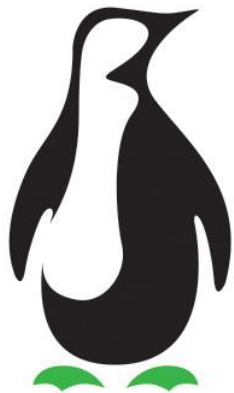
Air is Up to **4,000x** Less Efficient at Transferring Heat than Liquid<sup>1</sup>



# Why Heat Capture to Fluid Matters



# **Encouraging Industry Alignment & Standardization**





# The Future of Liquid Cooling in a Hybrid Environment

**Standardization** across Systems allowing multiple technologies to co-exist in-rack.

Leverage **Enhanced Cooling Technology** for Greater Performance and Efficiency & Maximize impact.

Maintain a **Rack-Based** Infrastructure for Seamless Integration and minimized operational disruption

Optimize **Heat Capture** for Improved Performance.

Expand Focus **Beyond CPUs & GPUs** to Enhance Cooling Efficiency Across all Components.



# Accelerating Adoption of Liquid Cooling

Adoption of Liquid Cooling Technology is Happening Now.



Universal Standards could Accelerate Availability & Diversity of Solutions.



Allow a Hybrid Air-Cooled, DTC & PLC Operating Model in Rack.



What Elements would be Standardized?



# Examples of Standardization

## Sensible Starting Point is Standardization of Liquid Cooling Enabled Racks.

- ORv3 was originally designed to support ~18-36kW of power. With AI driving increasing power requirements, a new iteration called HPR (High Power Rack) is being designed at Meta in conjunction with rack, power, and cable partners

	ORv3	ORv3 HPR
Rack Depth	42"	48"
Busbar Capacity	18kW+	92kW+
PSU Shelf	18kW (6*3kW PSUs)	33kW (6*5.5kW PSUs)
BBU Shelf	18kW (6*3kW BBUs, 90sec)	33kW (6*5.5kW BBUs, 90 sec)
Grounding Path	ORv3 Standard	Improved to avoid overcurrent
PSU/BBU Shelves/Rack	2/Rack	3/Rack +
AC WHIPs / PSU Shelf	NA: 2x 20A, 12AWG Wire, L22-20P EU: 1x 32A, 4mm^2 Wire, IEC309	NA: 2x 30A, 8AWG Wire, L22-30P EU: 2x 32A, 4mm^2 Wire, IEC309
Blind Mate Manifold	Compatible	Compatible w/ room for expansion

Manifold Mounting



Manifold Mounting

**DCP**  
REGIONAL  
SUMMIT

24-25 APRIL 2024  
LISBON, PORTUGAL

Scaling Innovation Through Collaboration

# Examples of OCP Standardization

## Orv3 Blind Mate Rack Assy

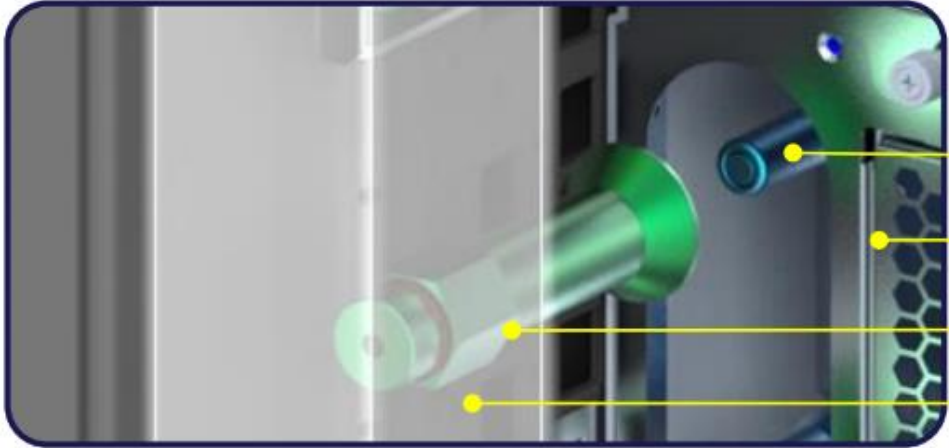
- Frame with add on liquid cooling kit with interfaces for manifolds
- Hot and cold manifolds split at each rear corner
- IT gear contain the plug valves
- Manifolds contain the socket valves
- All connections at the rear of the rack
- Valves self-align during mating between chassis and manifolds



AIR, DTC, PLC



IT Gear



- Plug
- IT Gear
- Socket
- Manifold

# Hybrid Deployment at Row Level

**Standardize Rack & Row Configurations** with Hybrid Air, DTC & PLC Technologies working in harmony.

Aim to **Increase Liquid Cooled %** Over Time.

Increase **Simplicity & Flexibility** for Data Center Infrastructure.

Consider longer term power and cooling requirements and provision **Spare Capacity in CDUs and Fluid Network.**

Aim To **Replicate Separated Model of IT & Infrastructure** (Treat Rack as a 'Black Box') as Air-Cooled Approach Today.



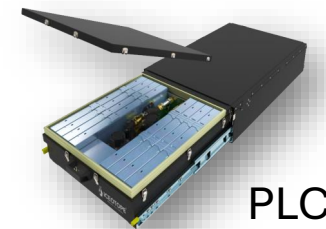
DTC



AIR

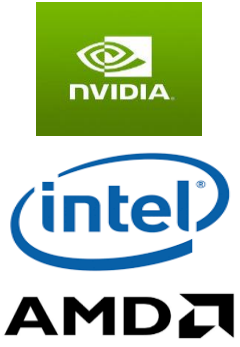


PLC




# Collaboration with Global Suppliers & Partners

Silicon




NVIDIA  
intel  
AMD

IT Infrastructure



GIGABYTE™  
Inventec  
MITAC  
wistron  
Hewlett Packard Enterprise  
Quanta  
SUPERMICR  
Dell  
Lenovo  
FOXCONN

Data Center Infrastructure




CUNDALL  
Schneider Electric  
motivair  
COOLING SOLUTIONS  
VERTIV™  
nvent  
EIT  
efficiencyit

Integration & Support



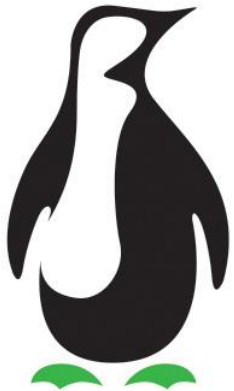
AVNET™  
Reach Further™  
SANMINA®  
ARROW ELECTRONICS, INC.  
AVASO  
TECHNOLOGY SOLUTIONS  
TD SYNTEX

Fluid Providers



PETRONAS  
Shell  
ENGINEERED FLUIDS  
Valvoline  
Castrol

# **Iceotope: Driving Innovation with Precision Liquid Cooling**



# Liquid Cooling Architectures

Rack Based Form Factor

Maximized Heat Load Capture

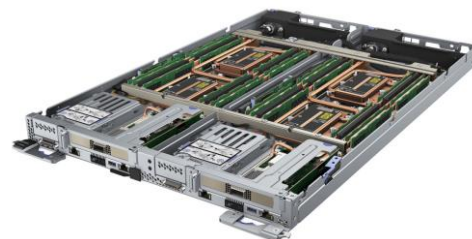


Liquid Cooling

Direct-to-Chip  
(Cold Plate)

Single Phase

Two Phase



Precision Liquid

Single Phase



Liquid Immersion

Single Phase

Two Phase



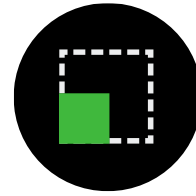


# The Value of Precision Liquid Cooling



## Sustainable

Nearly **100%** Heat Capture in a Single Technology  
Reduce Electricity use up to **40%**  
Reduce Water Consumption up to **90%**  
**Accelerate Sustainability Initiatives**



## Scalable

Highly Configurable for Rapid Deployment  
**One Server to Many Racks**  
Any Location From the Data Center to the Edge  
**Easily Scale Distributed Workloads**



## Serviceable

**Significantly Lower** Failure Rate  
Extend Server Lifecycle  
Field Replaceable Systems to Simplify Service Calls  
**Significantly Reduce Maintenance Costs**

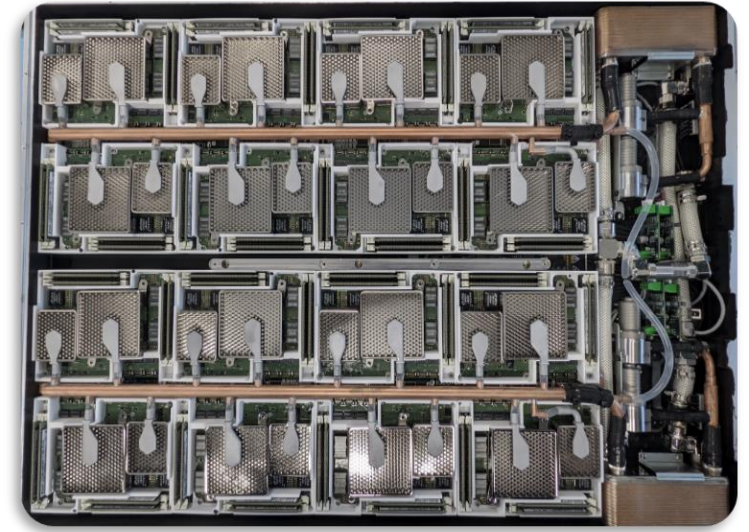
# Flexibility Redefined



Fit to Existing Racks



Enhanced Power Density  
& Efficiency



Redefine Hardware Design

[Single-Phase Immersion Cooling Study of a High-Density Storage System | Iceotope](#)

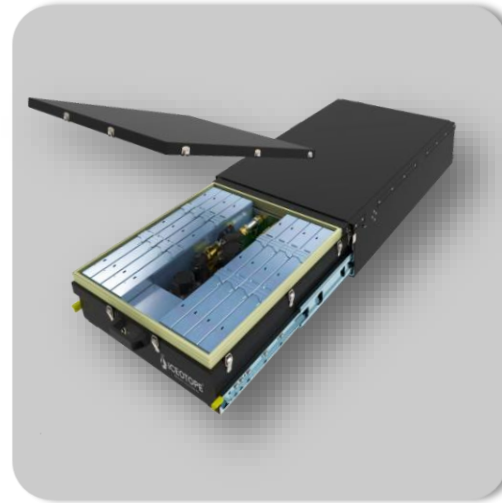
# Versatility Across the Whole Stack



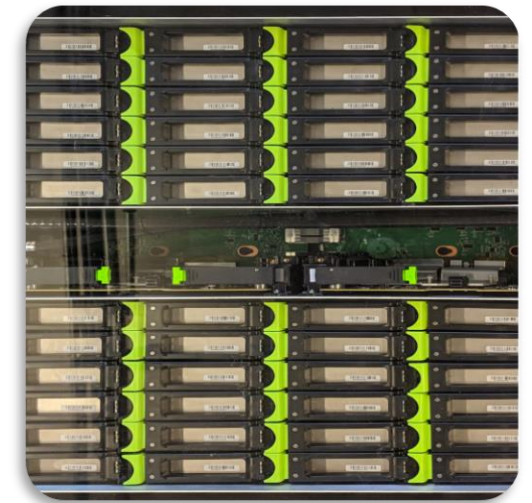
AI GPU



Blade Server



PSU



Storage

[Single-Phase Immersion Cooling Study of a High-Density Storage System | Iceotope](#)

# Compliance & Quality Standards

Data Sheets  
Operator Manuals  
Installation Support

**KUL2 PLATFORM**  
Precision Liquid Cooled HPE ProLiant DL380 Gen11  
**Technical Data Sheet**

**Dimensions and Weight**

Length (A)	42" / 107 cm
Width (B)	21" / 53 cm
Height (C)	30" / 76.2 cm
Installed weight (NET max)	204 lbs / 92.5 Kg
Packaged weight (GROSS max)	176 lbs / 80 Kg

**Power**

AC Input type and max quantity (A+B)	C14 x 4
AC Input voltage	110-240V AC 1ph
AC Input Frequency	50-60Hz
Maximum KUL2 power capacity (@ 40 °C TCS inlet temperature)	3500 W
Maximum configured power of DL380 Gen11 + KUL2 (in-spec config)	2200 W (power redundant config)

**Cooling Requirements**

TCS Flow rate per enclosure	1 US Gpm / 4 Lpm
TCS Flow rate per enclosure	104 °F / 40 °C
Maximum TCS inlet temperature	PGM / EGM / Water-inhibitor pack
TCS fluid compatibility	4.4 Bar/G / 64 Psi/G
Max rated TCS system pressure	5 US Gal / 20 L
Dielectric Fluid Qty (max)	

**Regulatory Compliance**

Region	Standard	Conformity
Worldwide	IEC 62368-1:2018	CE
Europe	EN 62368-1:2020 + A11:2020	CE
USA + Canada	CSA/UL 62368-1:2019 (62368-1:2023)	NRTL

**Warranty**  
Iceotope offers a comprehensive three year parts and labour warranty. Further detail on request.

**PLC System Configuration Options**

	ENHANCED	ENTERPRISE	ENTRY
	✓	✓	✓
	✓	✓	✓
	✓	✓	✓
	✓	✓	✓
	✓	✓	✓
	✓	✓	✓

Best Practices from Industry Leaders

**OPEN**  
Compute Project

**ASHRAE**

**uptime**  
INSTITUTE

Certification & Regulatory Compliance

**IEC**

**CE**

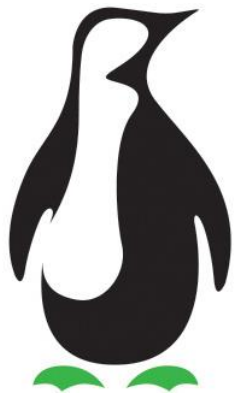
**CB**

**UL**

**ROHS**

**WEEE compliant**

**Iceotope Partnership:  
The Engagement Model for  
Precision Liquid Cooling**



# Your Control, Our Expertise

- **You Own the Product Specification:** Complete Control Over Product Design & Customization.
- **Minimize Disruption:** Maximize Impact with Minimal Change to Operating Model.
- **Same Manufacturing & Integration:** Our Technology Fits into Your Existing Processes with Minimal Disruption.



Commercial & Technical  
Scoping



Deployment & Operations  
Analysis

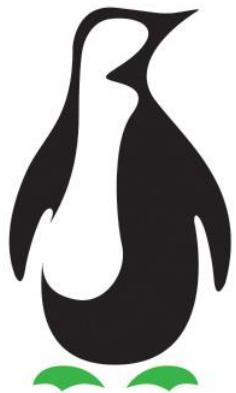


Supply Chain & Partner  
Assessment



Collaborative Solution  
Development

## **Moving Forward: The Next Steps**



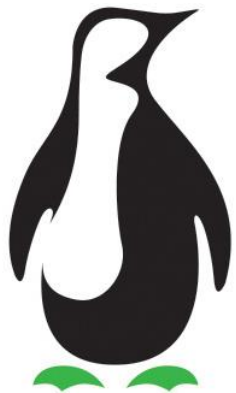
# Shape the Future of Data Center Cooling

- **Be First to Act:** Request your teams to explore our proposals and collaborate with Iceotope and your supply chain.
- **Accelerate Your Transformation:** Cut operational costs & elevate your environmental leadership.
- **Gradually Transition** from air-cooled systems to liquid cooling, whilst minimizing disruption to your existing operations.
- **Unlock Competitive Advantage:** Lead your market with enhanced infrastructure that's ready to handle tomorrow's AI & intense workloads.





## Questions & Feedback



# Thank you

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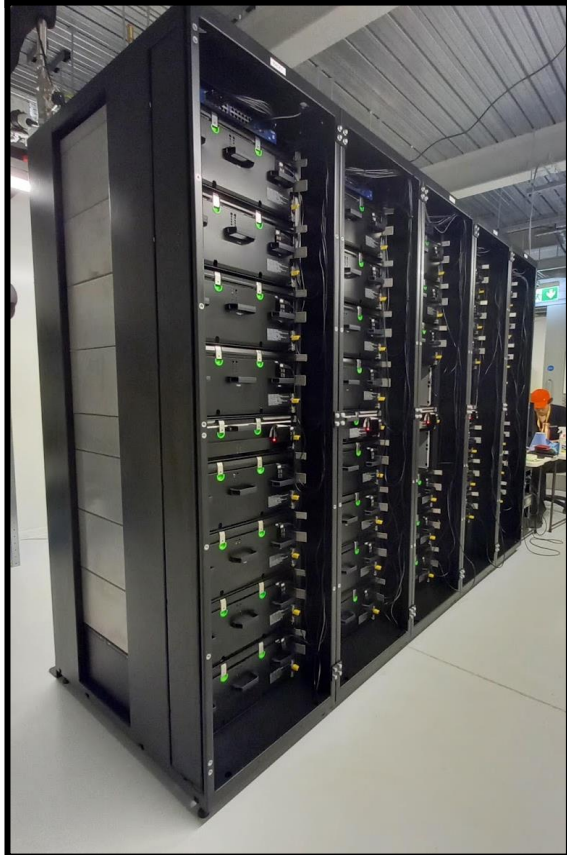
[www.iceotope.com](http://www.iceotope.com)



PRECISION LIQUID COOLING  
[www.iceotope.com](http://www.iceotope.com)



# Engineered for Serviceability



# Reference sites

## STT Singapore

- 8 KUL 2 emulators
- Spring/summer time frame
- Average of **19.13kW** of chassis input power
- Installation was connected to an existing FWS via a CDU

pPUE  
**1.05**

Total pump power draw (W)  
**423.64**

Total node power draw (W)  
**16,761.30**

Total input power draw (W)  
**19,129.94**

Total PDU power draw (W)  
**19,504.98**

## Hyperscaler UK

- Fall time frame
- 100kW installation – connected to a CDU, FWS & dry cooler

Power to rack PSUs  
**96kW**

Total power (racks & cooling)  
**99.4kW**

99.4/96  
**1.036 pPUE**

POC is operating at around  
**95% capacity**

TCS inlet water temperature  
to racks **39°C**

Outlet temperatures  
**44-45°C**