



Advanced Liquid Cooling to  
Reach Data Center Adjusted PUE<1

JOSH LI · DCD CANCUN



# Who we are

MARA is a global leader in digital asset compute ("DAC").

We support the energy transformation by converting clean, stranded, or otherwise underutilized energy into economic value.

*Our mission is to build a more sustainable and inclusive future.*

NOTE: DIGITAL ASSET COMPUTE IS A PROCESS THAT USES HASHES (I.E., COMPUTATIONAL POWER) TO GENERATE AND SECURE DIGITAL ASSETS SUCH AS BITCOIN



13  
DIGITAL ASSET SITES

1,100 MW  
DATA CENTER PORTFOLIO

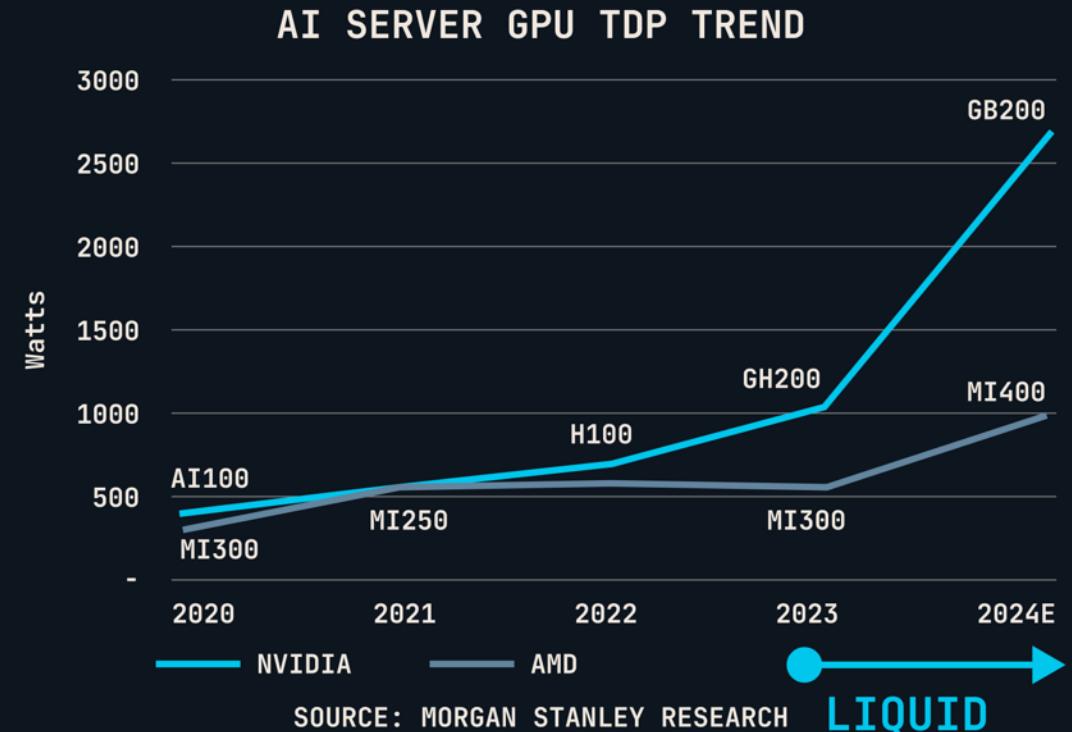
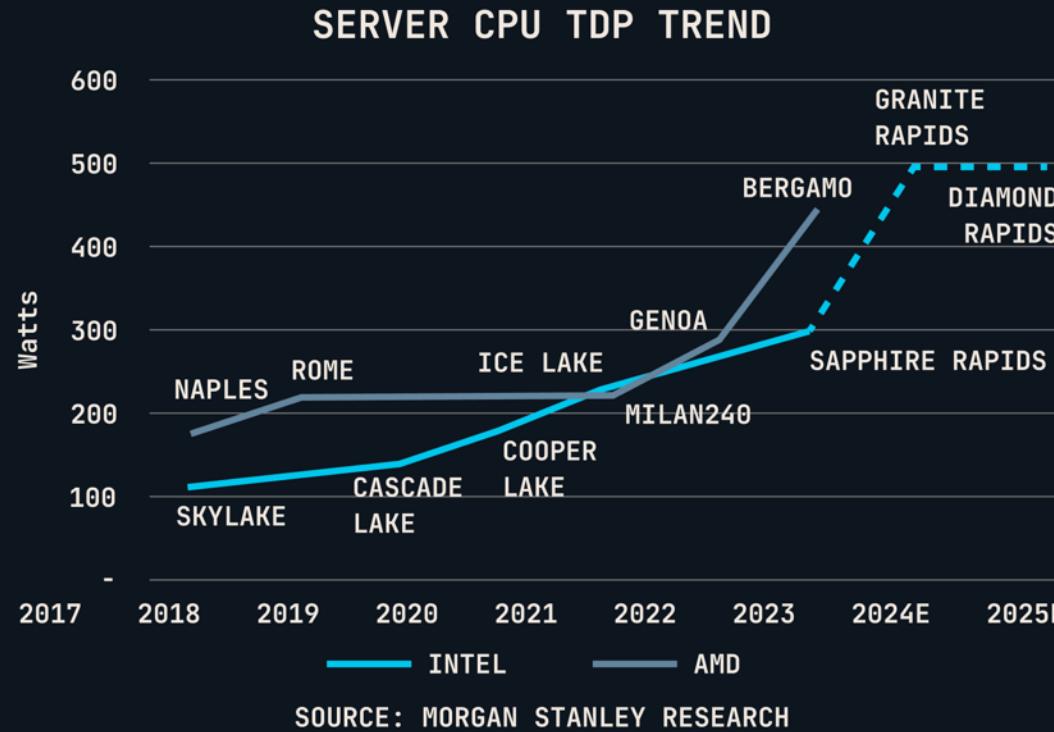
4  
CONTINENTS OF OPERATIONS

\$5.5 Billion  
MARKET CAPITALIZATION

NOTE: ALL METRICS REFLECT COMPANY DATA AS OF JULY 31, 2024<sup>1</sup>

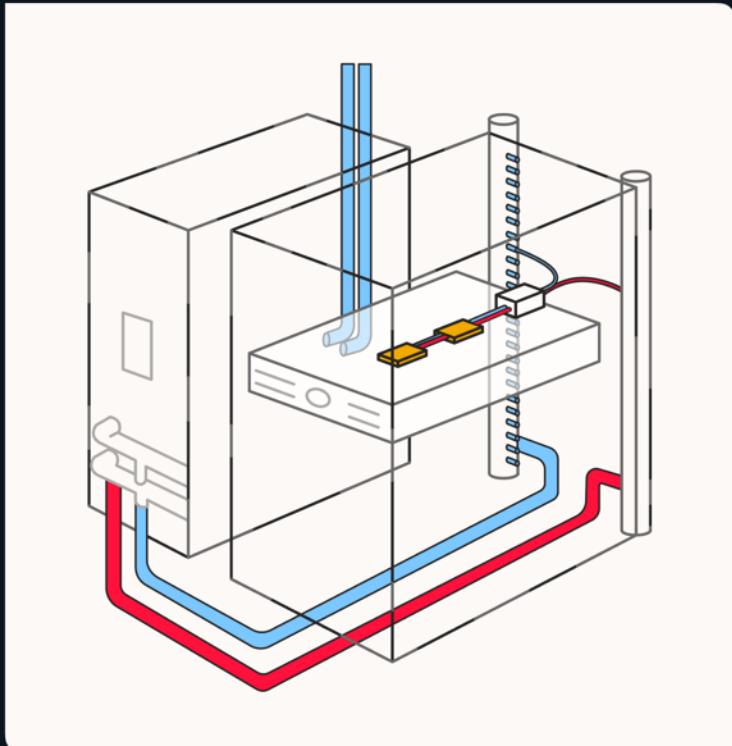
\* MARA HAS ESTABLISHED A JOINT STEERING COMMITTEE AND FRAMEWORK WITH THE REPUBLIC OF KENYA BUT DOES NOT YET HAVE AN ACTIVE DATA CENTER IN THE COUNTRY.

# AI/HPC data centers of the future need liquid cooling<sup>2</sup>



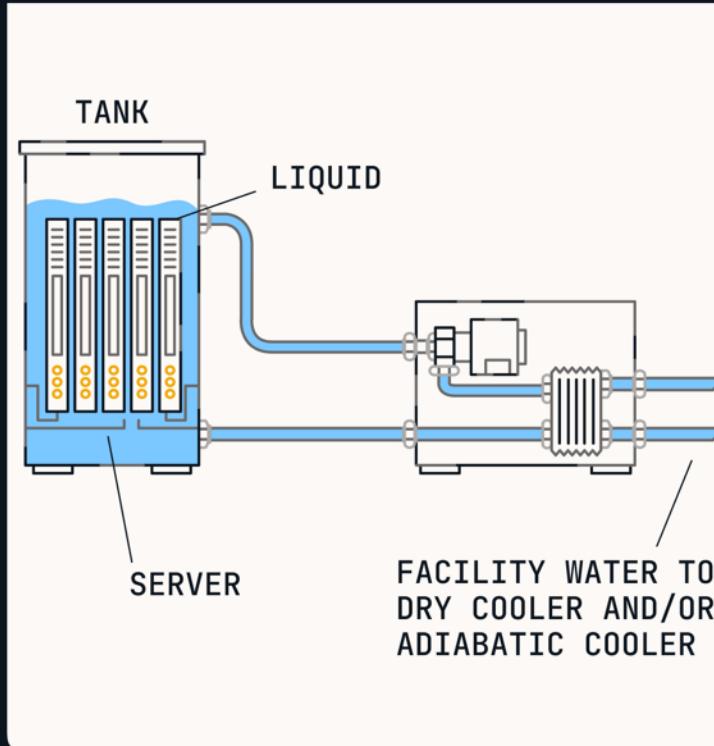
The total addressable market for liquid cooling in Nvidia's GB200 data center systems is projected to reach **\$4.8B** by 2027.

# Overview of different liquid cooling methods



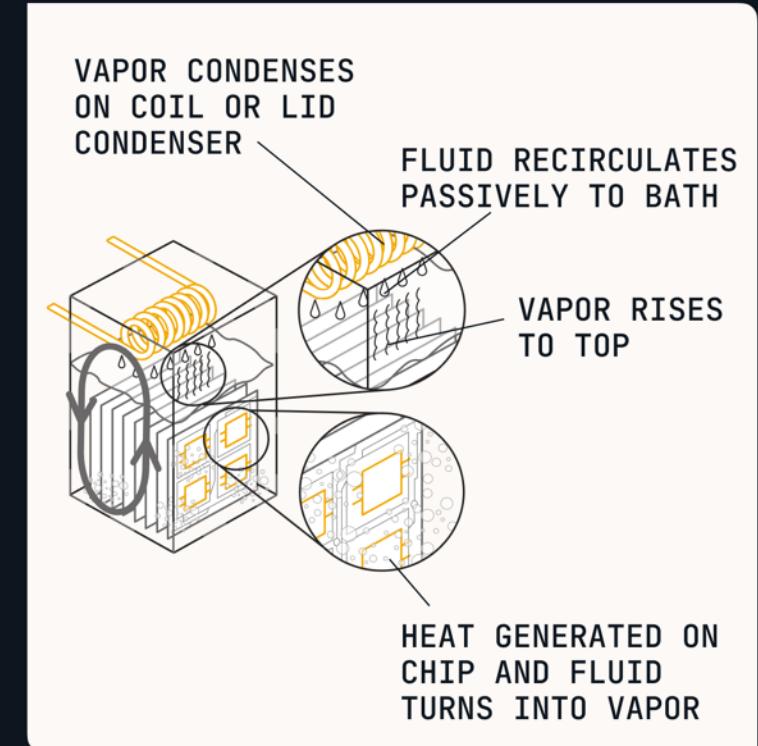
SOURCE: CHILLDYNE<sup>3</sup>

Direct-to-Chip (DTC)



SOURCE: 3M<sup>4</sup>

Single-Phase Immersion



SOURCE: MORGAN STANLEY RESEARCH, GIGA-BYTE<sup>5</sup>

Two-Phase Immersion (2PIC)

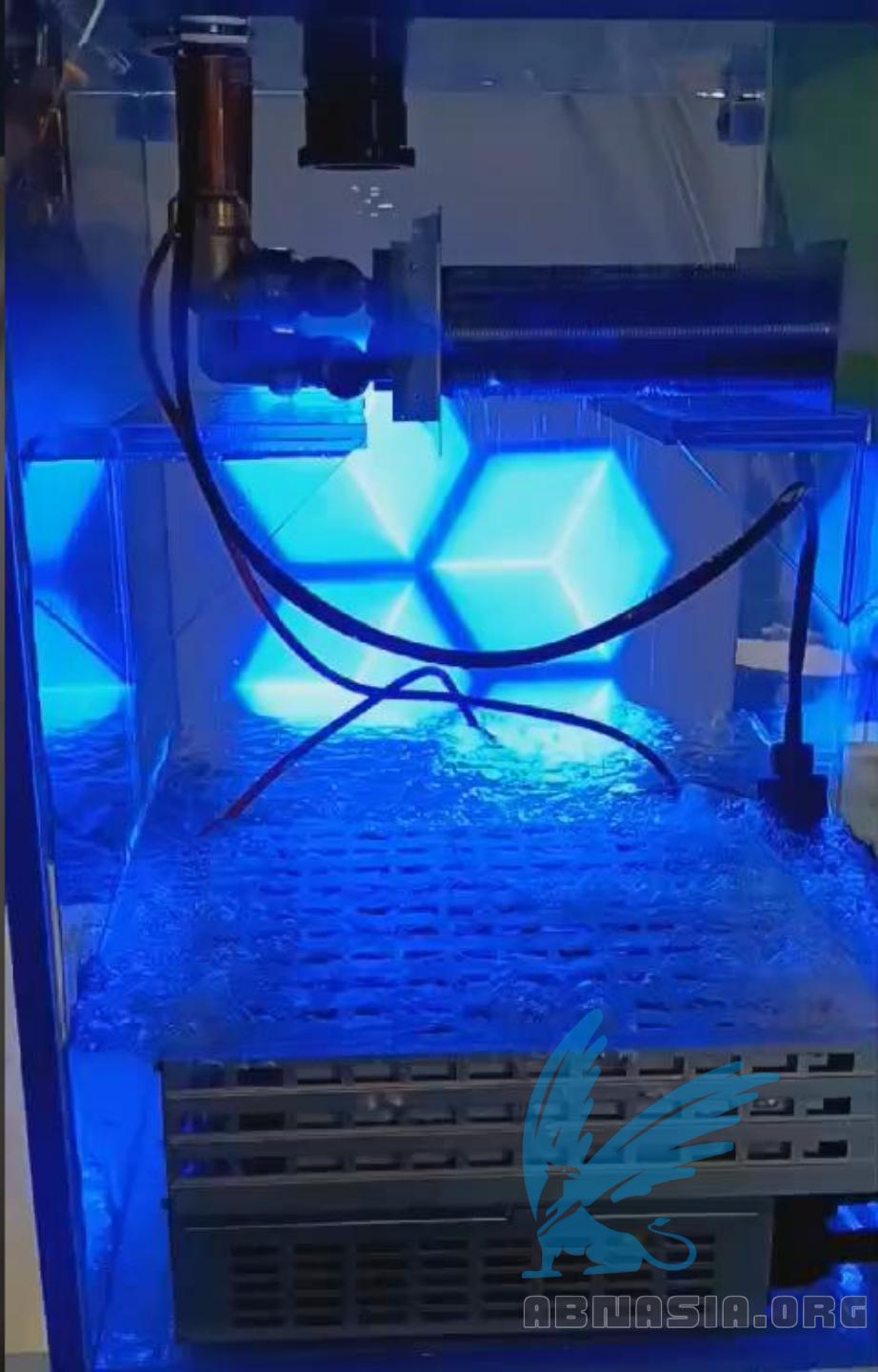


# Comparing DTC, single-phase immersion, & 2PIC

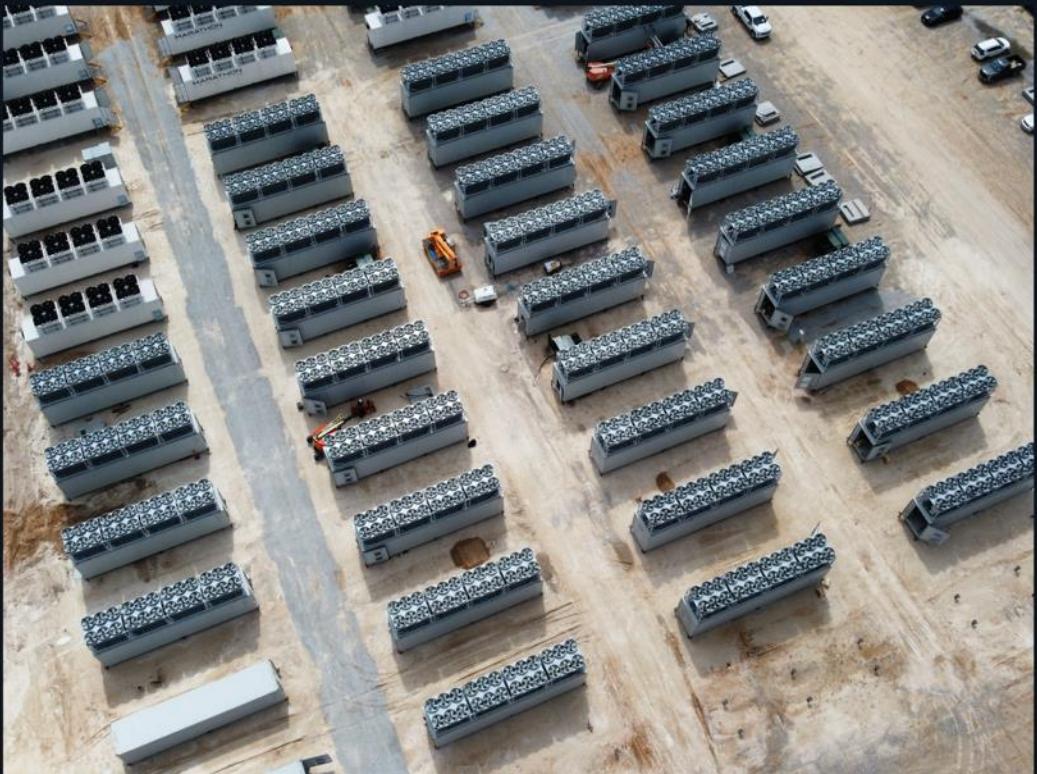
FEATURE/COOLING METHOD	AIR COOLING	DIRECT TO CHIP LIQUID COOLING	IMMERSION COOLING
HEAT TRANSFER METHOD	TRANSFERS HEAT THROUGH AIR FLOW	<p>TRANSFERS HEAT THROUGH WATER FLOW, INCLUDING:</p> <p>Liquid-to-air: Heat is dissipated by a fan in the rack, and then the cooled water recirculates</p> <p>Liquid-to-liquid: Heat is exchanged in a chiller outside the rack, and then the cooled water recirculates</p>	<p>TRANSFERS HEAT THROUGH SPECIAL LIQUID, INCLUDING:</p> <p>Single-phase: Heat is dissipated by the liquid, and then CDU cools the liquid to recirculate</p> <p>Two-phase: Use liquid with a low boiling point which removes the heat through the phase process of transitioning from a liquid to gas</p>
HEAT TRANSFER COEFFICIENT RANGE	500-1000W	800-1500W	1000W+
PUE	1.5-1.7	1.07-1.3	1.02-1.03
PROS	MATURE TECHNOLOGY COST-EFFECTIVE	HIGH HEAT TRANSFER COEFFICIENT LITTLE DIFFERENCE WITH EXISTING DATA CENTER DESIGN	HIGH HEAT TRANSFER COEFFICIENT LOWEST PUE
CONS	LIMITED HEAT TRANSFER COEFFICIENT	POTENTIAL RISK OF FLUID LEAKAGE	DATA CENTER NEEDS TO BE REDESIGNED

SOURCE: MORGAN STANLEY RESEARCH<sup>6</sup>

# 2PIC in action: A look inside

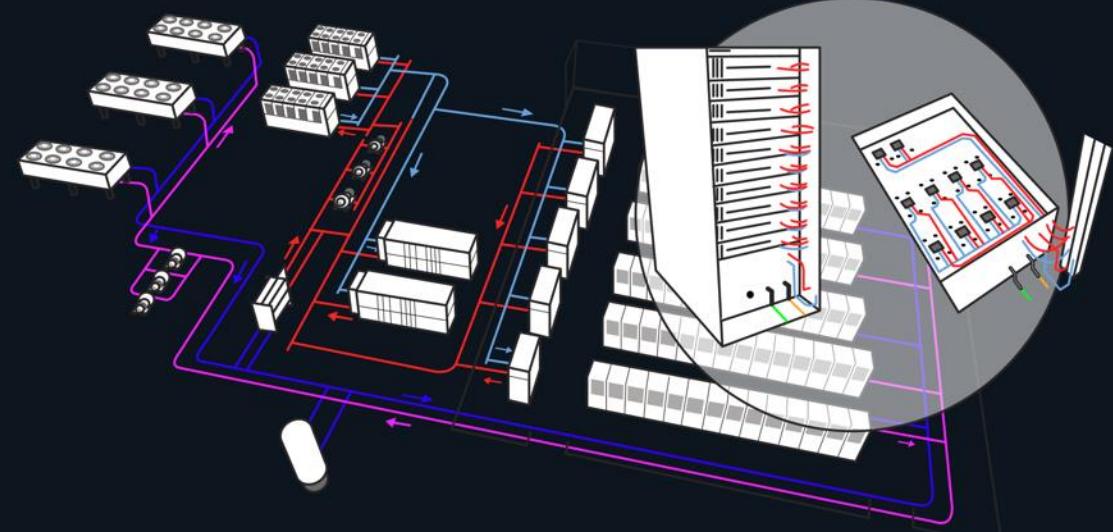


# Modular data centers vs. traditional data centers



SOURCE: MARA

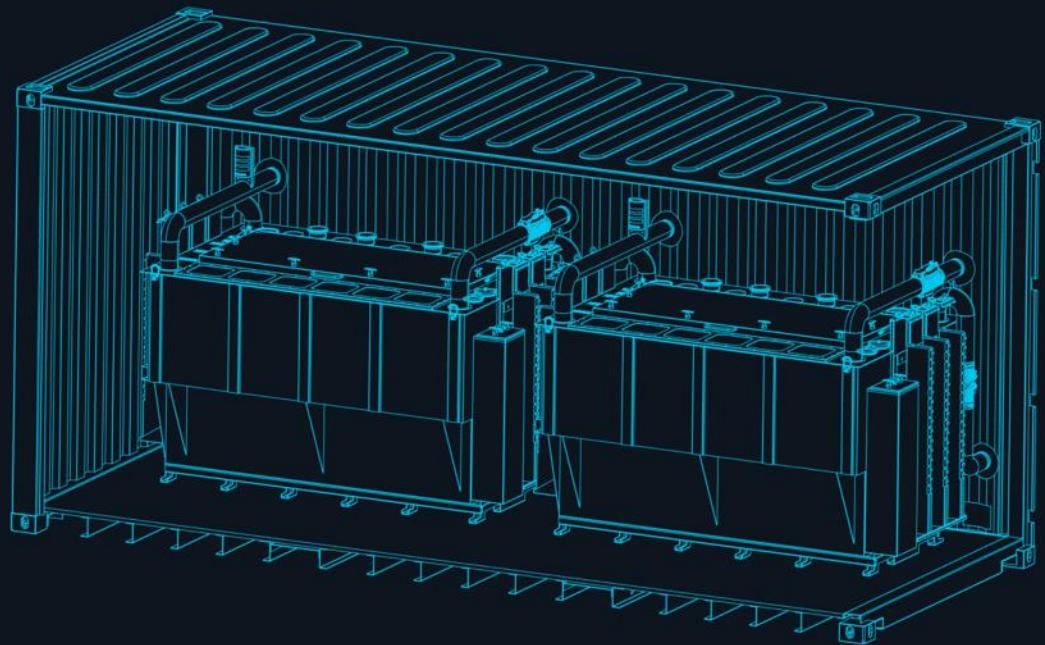
Modular Data Center



SOURCE: CONSULTING - SPECIFYING ENGINEER<sup>7</sup>

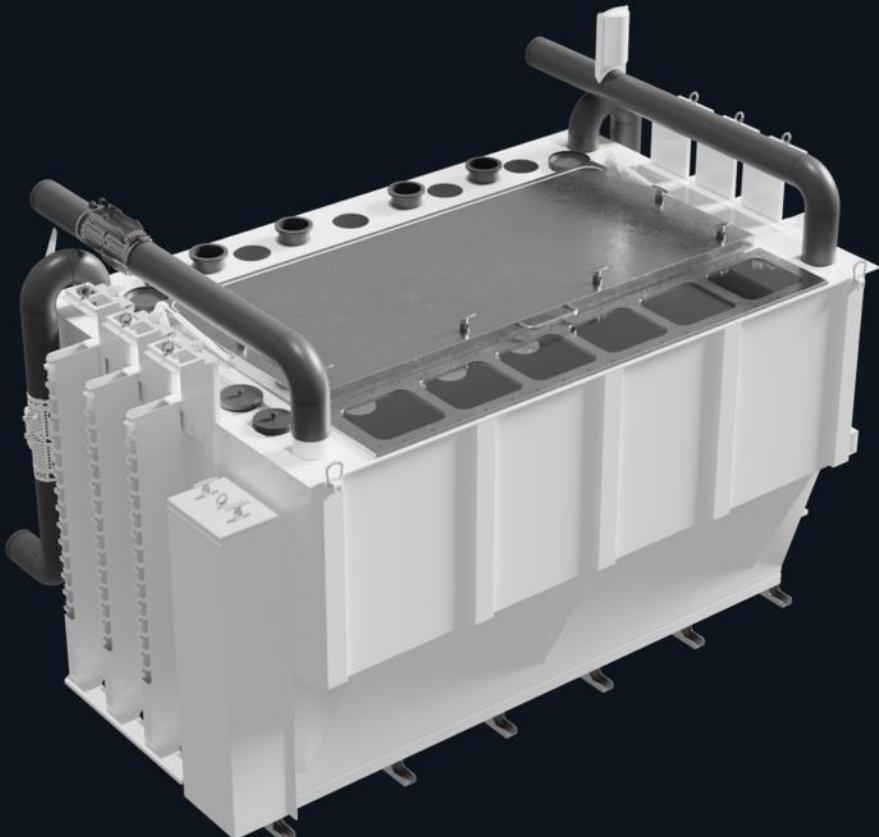
Traditional Data Center

# Utilizing 2PIC tanks for modular data centers



A 20' container can hold two tanks

# How many GPUs can fit in a 20' container utilizing 2PIC?



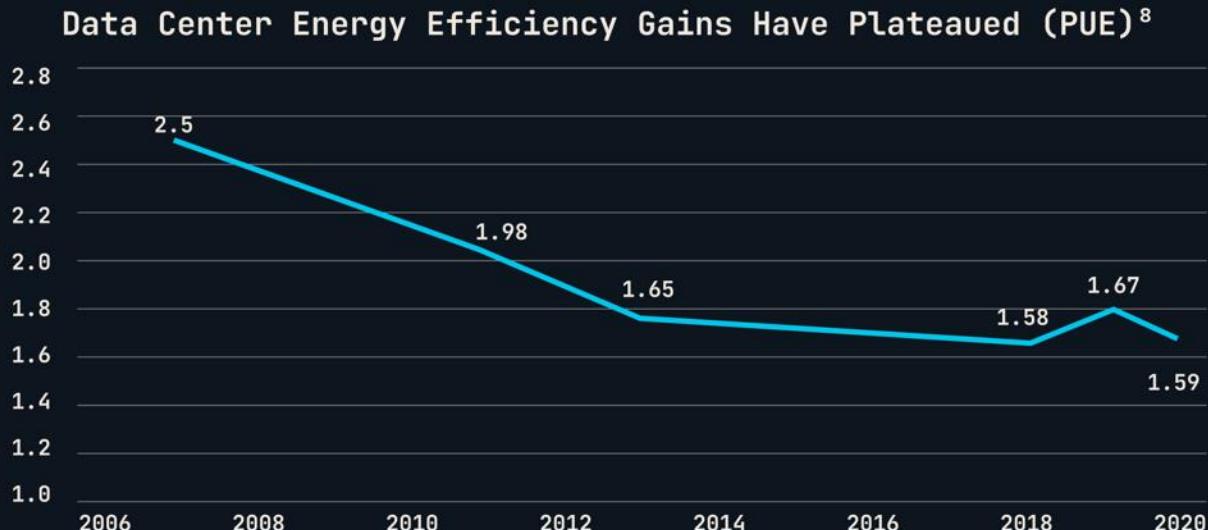
MARA's 2PIC Janus tank can hold up to 48 21" 1OU servers.

Each 1OU server can hold up to 8 Nvidia H100s.

Single tank capacity: 384 H100s  
20' container capacity: 768 H100s



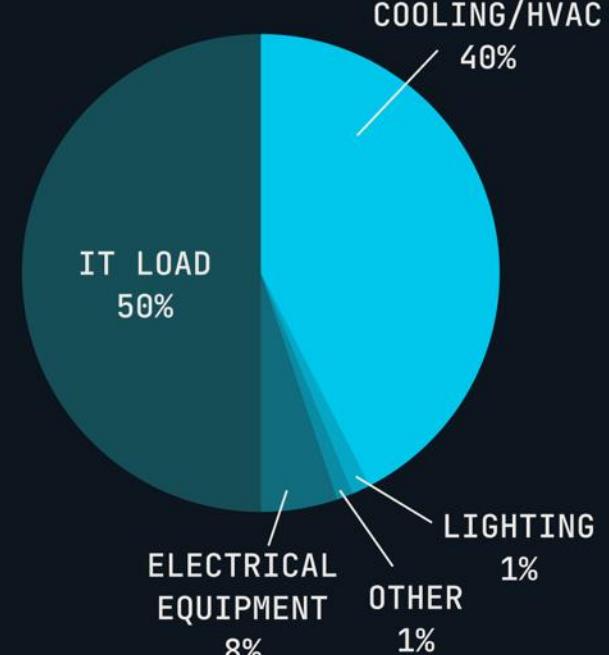
# Trends in efficiency are stalling, further optimizations are needed



Source: Hostkey, Reported data center PUE figures in global Uptime Institute surveys from 2007 to 2020

PUE	LEVEL OF EFFICIENCY	DCiE
3.0	VERY INEFFICIENT	33%
2.5	INEFFICIENT	40%
2.0	AVERAGE	50%
1.5	EFFICIENT	67%
1.2	VERY EFFICIENT	83%

## Total Data Center Energy<sup>10</sup>



SOURCE: MITSUBISHI, TOTAL DATA CENTER ENERGY BREAKDOWN (U.S. EPA 2007)



Efficient Data Center PUE: 1.5

# "Edged Data Centers Celebrates Grand Opening of New Ultra-Efficient, Sustainable Data Center in Atlanta"

Headline From MENAFN



**168 MW**

CAMPUS CAPACITY

**80+**

ACRES

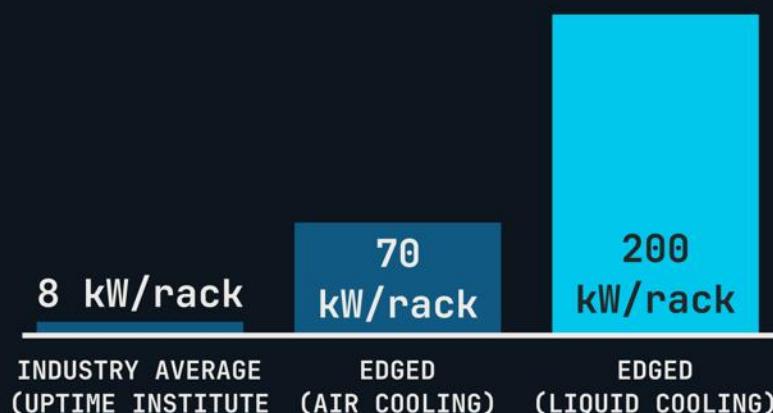
**1.15**

PORTFOLIO DESIGN PUE

Source: MENAFN

Edged cooling systems support up to 70 kW per rack with air cooling and ultra-high densities up to 200 kW with plug and play liquid cooling integration

SUPPORTING 200 KW PER RACK



MARA 2PIC  
1 MW/TANK  
2 MW/  
CONTAINER



ABMASIA.ORG

# Traditional Data Centers Require Massive Amounts of Water



TRADITIONAL DATA CENTERS CAN CONSUME 5 MILLION GALLONS OF WATER A DAY, ENOUGH TO SUPPLY THOUSANDS OF HOUSEHOLDS/F FARMS.<sup>11</sup>

Data center water is often treated with chemicals to prevent corrosion and bacterial growth and isn't fit for:<sup>12</sup>

- Human consumption
- Agricultural use
- Local water cycles

## AI Water Demands Add to Water Stress

Water consumed from areas with water scarcity (2023):

- Microsoft: 42%<sup>13</sup>
- Google: 15%<sup>14</sup>

The surging demand for data is only just beginning

- **Data Center Water Usage:** Data centers are among the top 10 water-consuming industries in the U.S.<sup>15</sup>
- **Increased Cooling Needs:** Next-gen tech, particularly AI, will increase water use as they generate more heat.
- **Higher Energy Demands:** Neural networks require six times more kilowatts per rack compared to traditional computing.<sup>16</sup>
- **Exponential Scaling:** Large AI algorithms used by major tech companies need 100X the computing power and process significantly more data than simpler machine learning models.<sup>17</sup>

# Data Center Water Concerns in Mexico and South America

## "Thirsty data centers spring up in water-poor Mexican town"<sup>18</sup>

Two-year drought in Querétaro has led to...

- Dead crops
- Water rationing

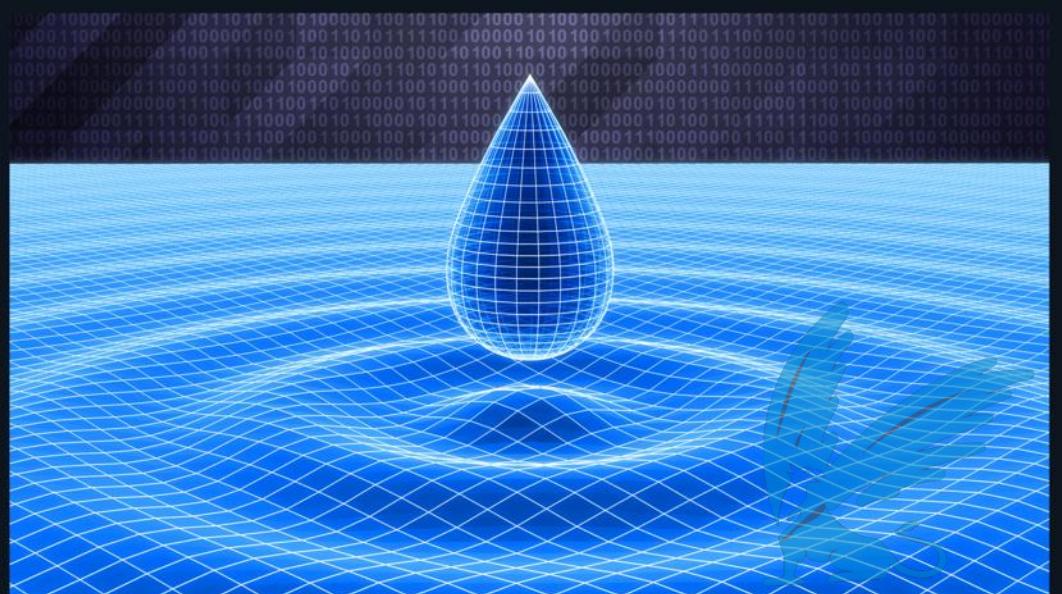
Yet, the local government encourages construction of water-intensive data centers, with Querétaro referred to as "data center valley" by the Secretary for Sustainable Development.

## "The Cloud vs. drought: Water hog data centers threaten Latin America, critics say"<sup>19</sup>

Big Tech highlights energy efficiency, but significant energy savings stem from increased water use for cooling.

Data centers use water-filled cooling towers instead of air conditioning, as water is more energy-efficient for temperature control.

- **Quilicura, Chile:** Microsoft faces local protests over a proposed data center due to similar water usage concerns.<sup>20</sup>
- **Uruguay:** In early 2023, protests arose against Google's planned data center after campaigners learned that the center would require 7.6 million liters (2 million gallons) of potable water daily.<sup>21</sup>
- **Santiago, Chile:** In February 2020, local residents voted against Google's data center due to concerns about its high water usage (169 liters/45 gallons per second) in a drought-stricken area.<sup>22</sup>



# Costs of an efficient data center & a data center utilizing 2PIC

DATA CENTER (Servers w/ NVIDIA H100 GPUs)	EFFICIENT DATA CENTER	MODULAR DATA CENTER W/ 2PIC (\$ ARE IN MILLIONS)
AVG. COST TO BUILD DATA CENTER PER MW	\$9.5M	\$1.0M
AVG. COST TO BUILD 10 MW DATA CENTER	\$95.0M	\$10.0M
COOLING COST AS A % OF TOTAL INFRASTRUCTURE COSTS	33%	50%
AVG. COOLING COST FOR 10 MW DATA CENTER	\$31.6M	\$5.0M
AVG. COOLING COST PER MW	\$3.2M	\$0.5M
NUMBER OF NVIDIA DGX H100 8U SERVERS PER 10 MW	960	
NUMBER OF AI/HPC SERVERS (10U) IN 2PIC PER 10 MW		960
NUMBER OF SERVERS PER JANUS TANK OR 48U RACK	6	48
NUMBER OF MARA 2PIC JANUS TANKS (48 OU) OR 48U RACKS FOR 10 MW	160	20
NUMBER OF 20' CONTAINERS		10
NUMBER OF NVIDIA H100S	7,680	7,680
ESTIMATED COST OF SERVERS W/ H100S	\$320M	\$320M
DATA CENTER INFRASTRUCTURE + COMPUTE COST	\$415M	\$330M
COOLING COST AS A % OF TOTAL COST	7.6%	1.5%

Our 2PIC  
Modular Data  
Center

PUE: 1.04



# Lack of Renewables Causing Data Center Rejection- Bitcoin Mining Co-Location as a Solution

**"Google's planned Dublin Data center rejected amid energy concerns"<sup>26</sup>**



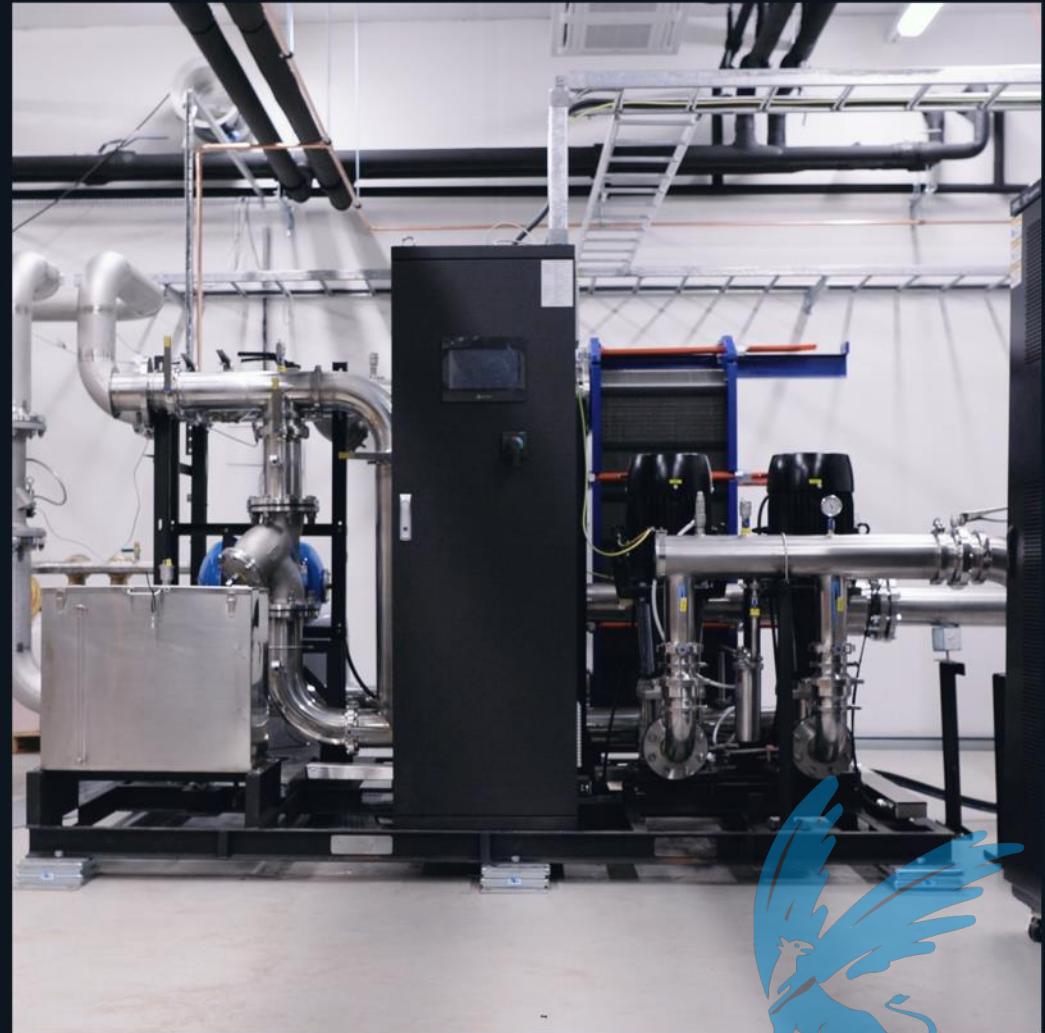
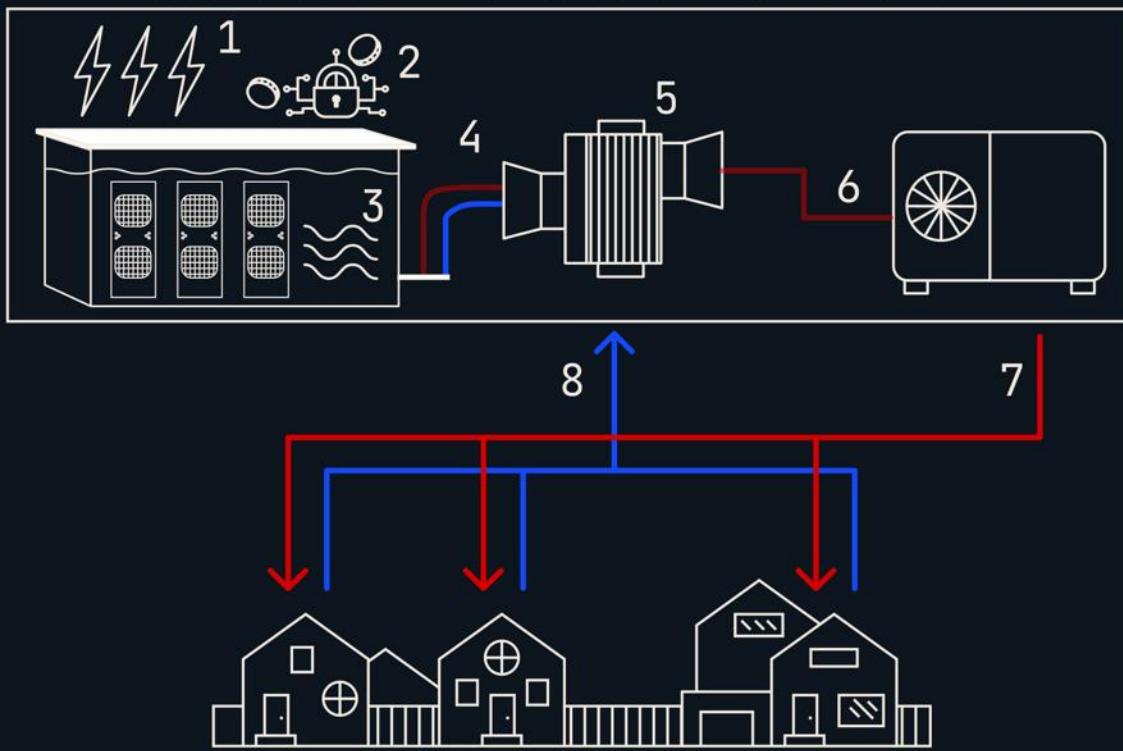
- Google's plan to build a 72,400 square meter data center in Dublin rejected.
- The County Council cited concerns about the strain on the national power grid and insufficient renewable energy.

**"Tokyo Grid Operator Mines Bitcoin to Save Renewable Surplus"<sup>27</sup>**

- Agile Energy, a wholly owned subsidiary of a publicly listed Japanese grid operator, is bitcoin mining.
- Japan's "output control" policy leads renewable energy producers to often curtail operations, leading to wasted green energy.
- In December 2022, Agile Energy partnered with semiconductor designer Triple-1 to source mining chips and set up a pilot data center with 1,300 bitcoin miners and 1,500 kilowatts of capacity.
- Japan's goal of 50% renewable energy by 2050 could result in significant energy waste without a dispatchable energy consumer.

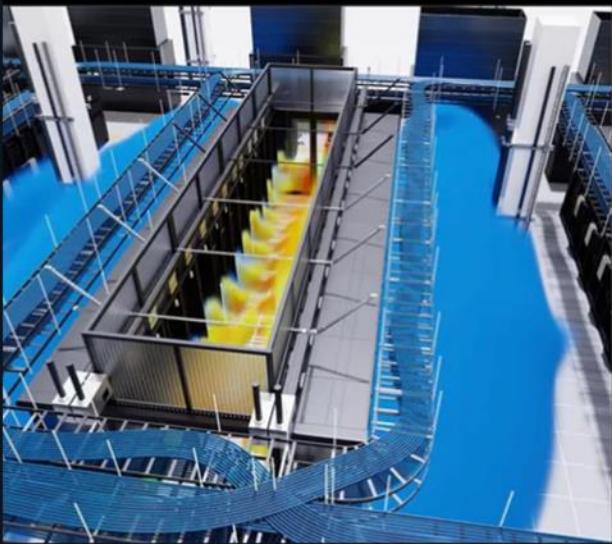
# Leveraging liquid cooling for heat reuse applications<sup>28</sup>

DISTRICT HEATING + DIGITAL ASSET COMPUTE FACILITY



# "Nvidia shows off Blackwell server installations in progress—AI and data center roadmap has Blackwell Ultra coming next year with Vera CPUs and Rubin GPUs in 2026"

Headline From Tom's Hardware



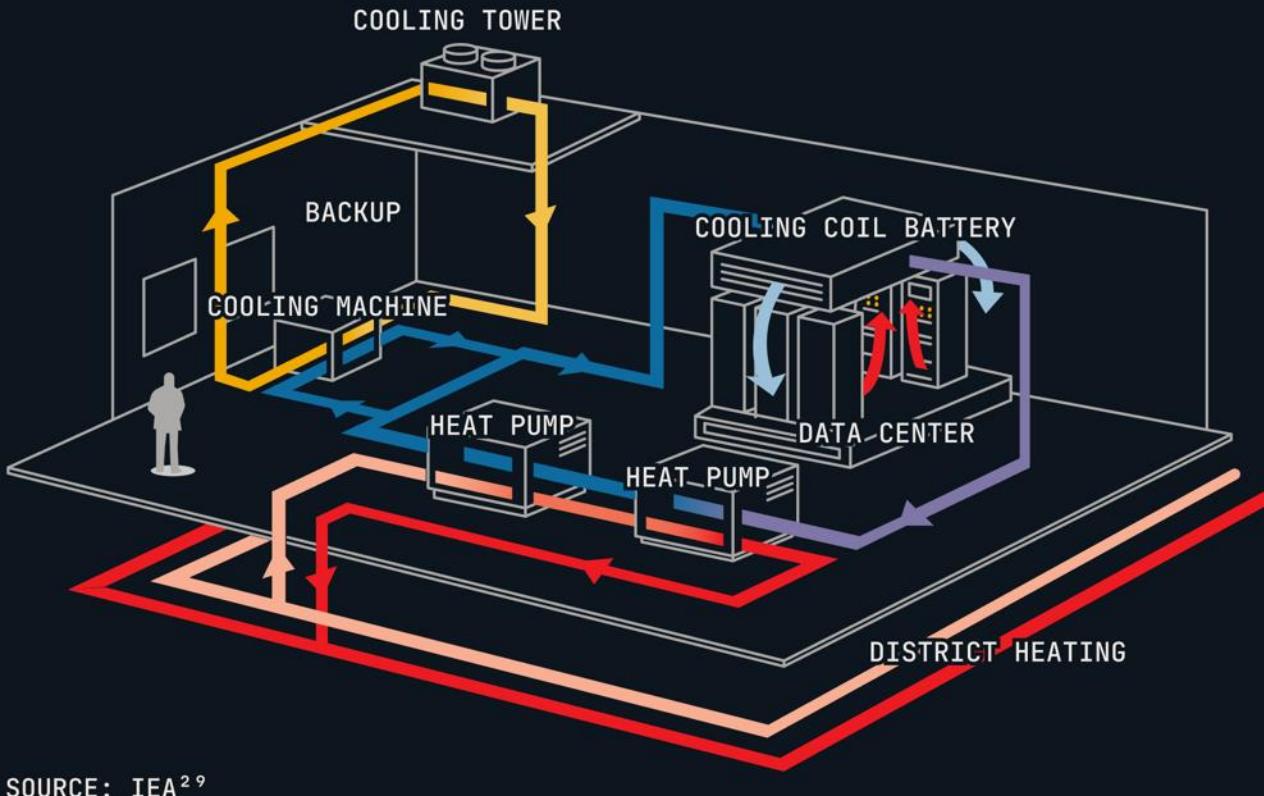
SOURCE: TOM'S HARDWARE

- Generative AI and Large Language Models continue to drive unprecedented demand for accelerated compute
- Liquid cooling will enable Blackwell to achieve significant leaps in both training and inference GenAI performance
- Many different liquid cooling approaches exist
- Warm water direct-to-chip approach offers:
  - Improved cooling efficiency
  - Lower operation cost
  - Extended IT server life
  - Heat reuse possibility
- Can deliver up to a 28% reduction in data center facility power

- Because data center power requirements keep increasing, Nvidia is also working with partners to boost performance and efficiency.
- One of the more promising results is using warm water cooling, where the heated water can be potentially recirculated for heating to further reduce costs.
- Nvidia claims it has seen up to a 28% reduction in data center power use using the tech, with a large portion of that coming from the removal of below ambient cooling hardware.



# Decreasing OPEX and PUE by integrating with district heating systems



$$\text{Adjusted PUE} = \frac{(\text{IT} + \text{AC} - \text{DH})}{\text{IT}}$$

IT = IT Load

AC = Cooling/HVAC

DH = District Heating

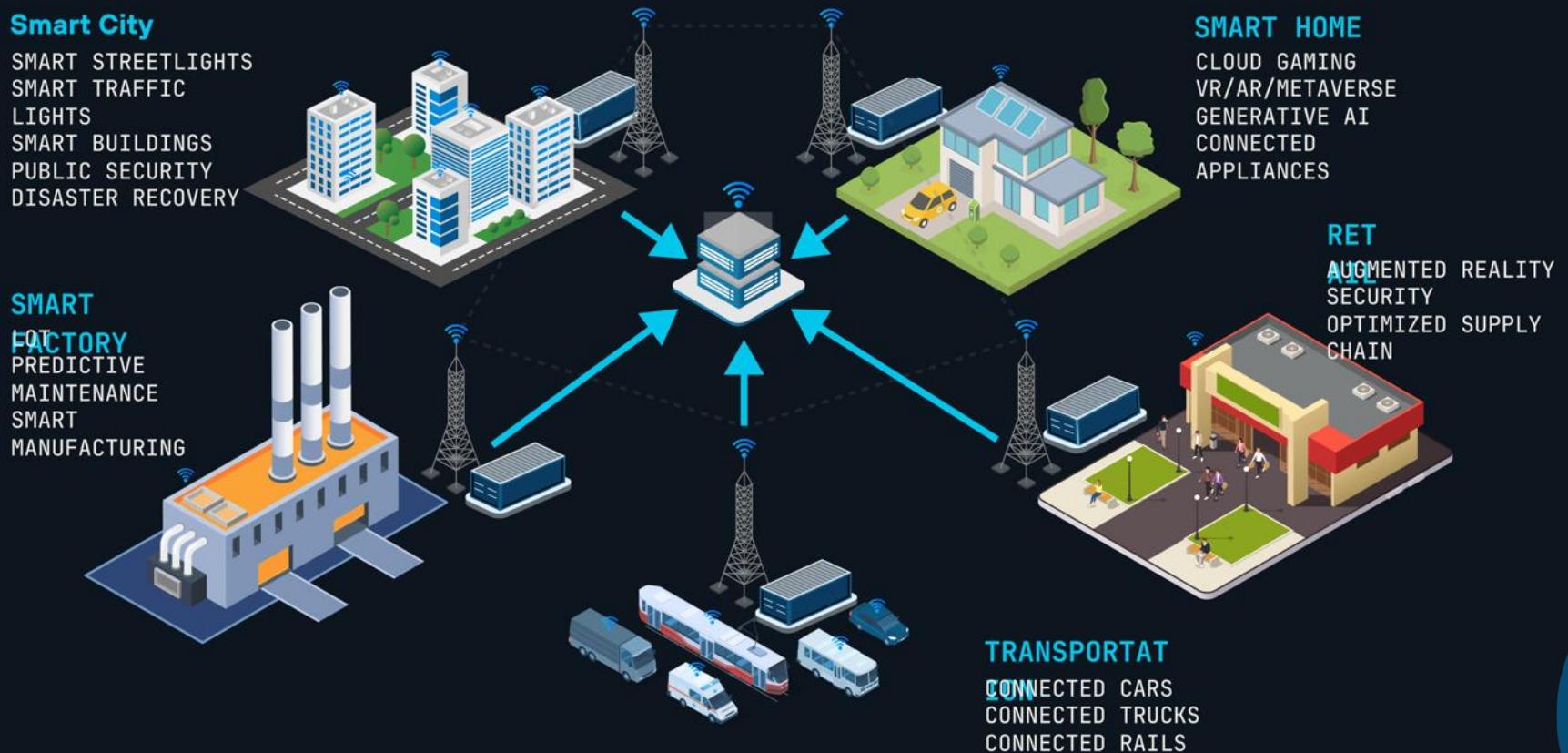
SOURCE: MARA

2PIC + district heating may allow for a PUE less than 1

# MARA's vision for AI inference via edge nodes

## 2PIC EDGE SERVERS IN A 5G MEC NETWORK

THE SELF CONTAINED 2PIC UNIT HAS A SMALL FOOTPRINT AND FITS WITHIN THE CELL TOWER'S EXISTING MICRO DATA CENTER.



SOURCE: MARA

DISCLAIMER: THE DIAGRAM PROVIDED IS INTENDED FOR ILLUSTRATIVE PURPOSES ONLY, DEMONSTRATING A POTENTIAL USE CASE FOR AI AND EDGE NODES

# How many servers can fit in a micro data center utilizing 2PIC?



MARA's 2PIC Mercury tank holds  
4 21" 1OU Servers.

Each 1OU server can hold up to 8  
Nvidia H100s.

Single tank capacity: 32 H100s  
Micro data center capacity: 32-64  
H100s.

SOURCE: MARA

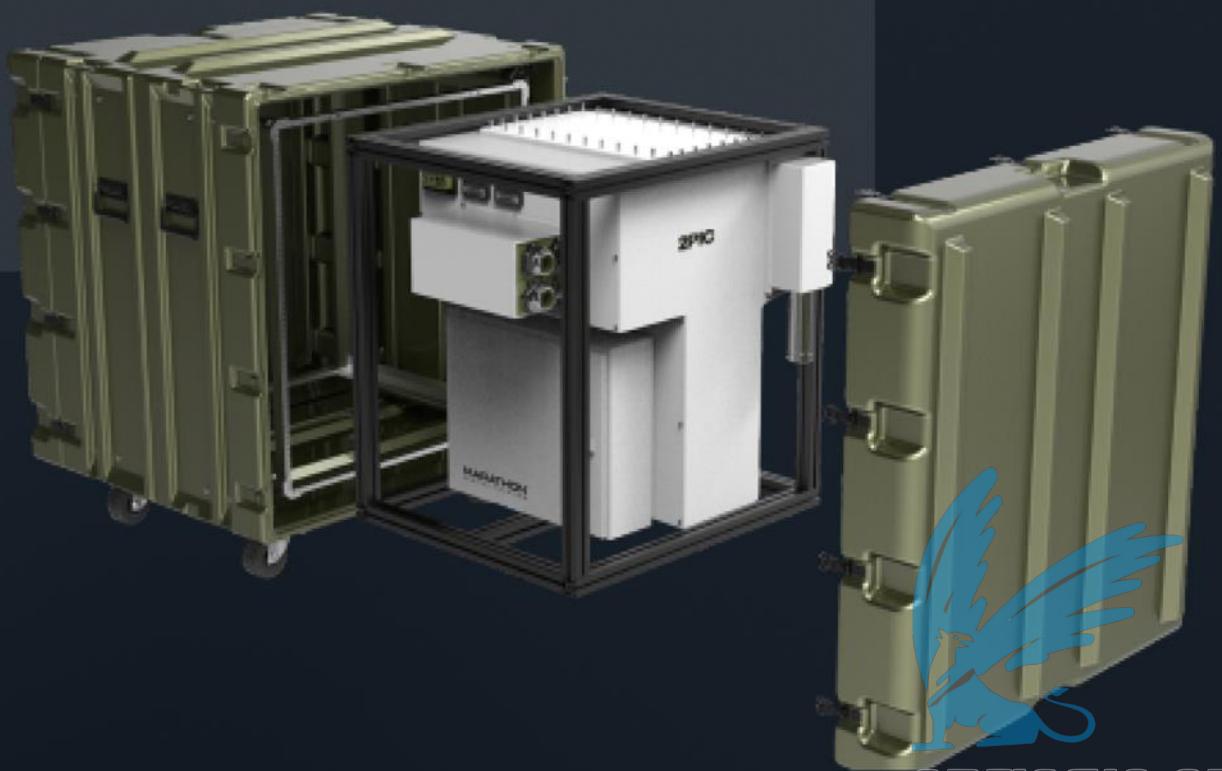
# Any questions?

We invite you to discuss how we can collaborate with your company to achieve your strategic objectives.

**Josh Li**

**DIRECTOR OF PRODUCT MANAGEMENT**

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# References

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