

# ASHRAE TC 9.9 Technical Snapshot

## AI's Indirect / Direct Impact on Data Center Infrastructure Planning

Artificial Intelligence (AI) is impacting how we live, work, and play including BOTH mixed / dedicated use data centers.

- **Rapid Change** – Hardware (HW) / software (SW) changes are rapid, risking data centers rapidly becoming inadequate to handle the new requirements.
- **Mixed Use Data Centers** – Increasing use cases for one or more high performance computing (HPC) racks along-side general performance computing (GPC) racks creates the need for more mixed-use data centers.
- **Different Infrastructure Requirements** - HPC racks have more demanding power & cooling infrastructure requirements that are often difficult to meet in a mixed-use data center.

The intent of this Technical Snapshot is to share high level data center infrastructure trends based on insights from the TC 9.9 IT Manufacturer Subcommittee members that work for silicon & HW manufacturers.

- **Scope** - This snapshot includes both commercially available **GPC (general performance computing)** and **HPC (high-performance computing)**. Hyperscaler-specific hardware based on custom processors / architectures is not within the scope.
- **Future HW Needs** - Rapid change increases the difficulty in planning for future hardware needs without over investment or premature obsolescence.

### General Performance Computing (GPC)

- **Standard HW/SW** - The use of traditional hardware and software architectures designed to handle a wide variety of tasks with moderate resource requirements.
- **Priority** - It prioritizes versatility and cost-efficiency over specialized processing power.
- **Infrastructure** – other than extreme use cases, infrastructure is traditional.

### High-Performance Computing (HPC)

- **Super Computers / AI Clusters** - The use of "supercomputers" or computer clusters to solve complex computational problems that are either too large for standard computers or would take too long to process.
- **Priority** - It prioritizes parallelism and throughput.
- **Infrastructure** – extreme density, often different requirements for form-factor, space, power & cooling.

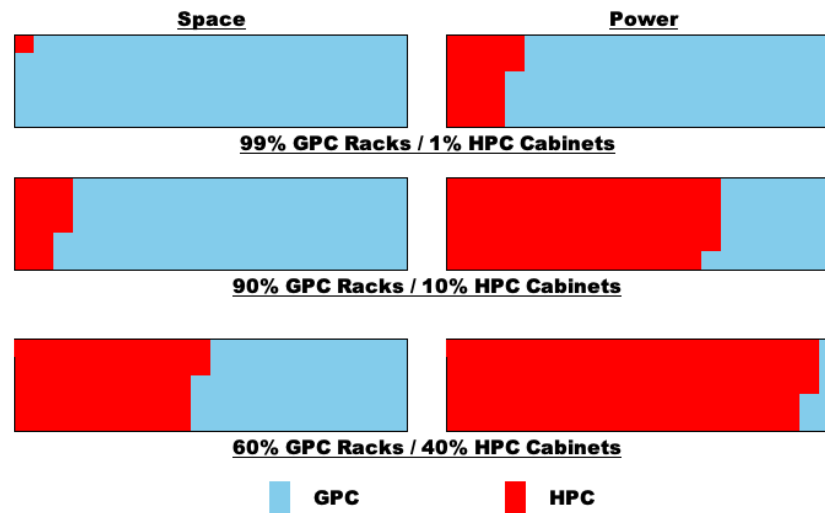
# High Level Infrastructure Trends

## HPC power, cooling, & structural support differences vs. GPC

- **HPC Cooling Infrastructure** – often has both air & liquid cooled components, the latter requiring coolant distribution units.
- **HPC Power Infrastructure** – often high-voltage 3 phase AC or direct current (DC) vs. GPC 3 phase (208/415V) or single phase.
- **HPC Structural Infrastructure** – often higher floor and ceiling loading required for heavier cabinets, fluid distribution systems, power delivery, and dense networking.

## Impact of HPC on mixed-use data centers

- A small number of HPC cabinets has an outsized impact on the data center power, cooling & structural requirements.
- **High density zones** – Dedicated zones are required to support HPC in a mixed-use data center.



## Comparing Space & Power Needs of Mixed-Use Data Halls with varying % HPC Cabinets

*Disclaimer: All trends are based on insights and projections from the TC 9.9 IT Manufacturer subcommittee and intended to be directional*

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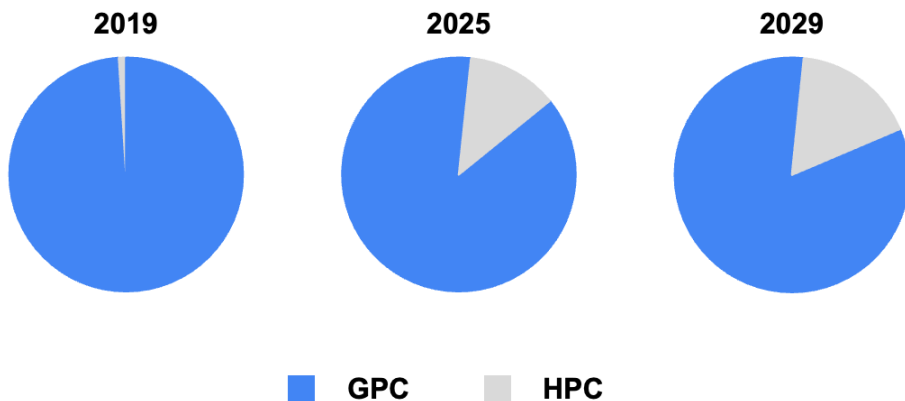
# Installed Server Volume Trends

Although AI dominates the news, the **MAJORITY** of servers continue to be **GPC**.

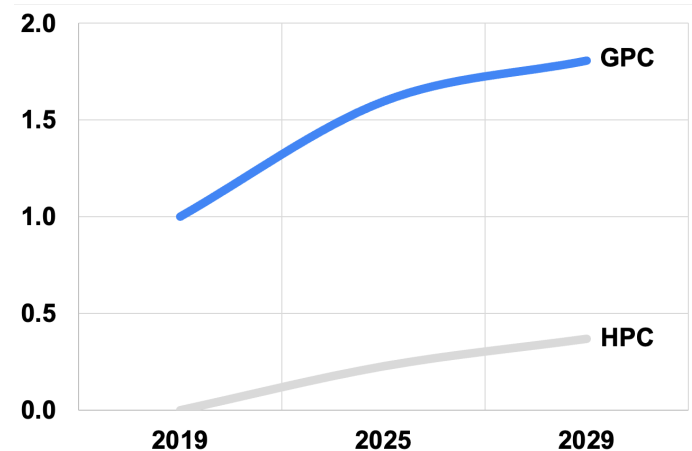
- **Growth vs Majority** – Although HPC growth from 2023 to 2026 has been significant, it's still a small percentage of total servers
- **Future Growth vs Majority** – All indications are continued significant future HPC growth

The many use cases for general performance computing are not declining, resulting in general performance servers being the majority for the foreseeable future.

- **AI Agent Orchestration & Small Language Models** - Are heavy users of GPC (CPU, memory, and GPU)
- **Hybrid / Private Cloud** – Is growing in popularity due to security, data sovereignty, economics, etc.
- **LLMs / Inference** – Large Language Models and inference are rapidly growing and requiring higher compute density per rack



**Share of Rack Shipped Volume**



**Growth in Installed Servers<sup>1</sup>**  
(relative to 2019 total volume)

1. HPC volume before 2019 was not zero but very small compared to total server volume

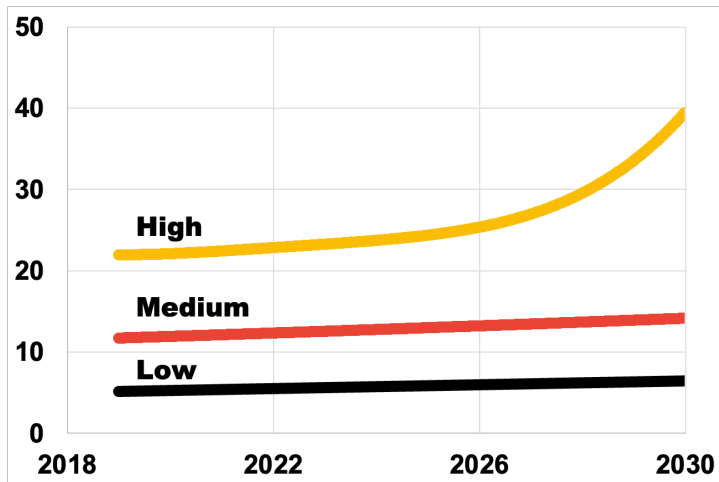
# GPC and HPC Infrastructure Trends

**GPC kW/Rack.** The trend is on-premises to be replaced with hybrid cloud which tends to have a higher utilization rate.

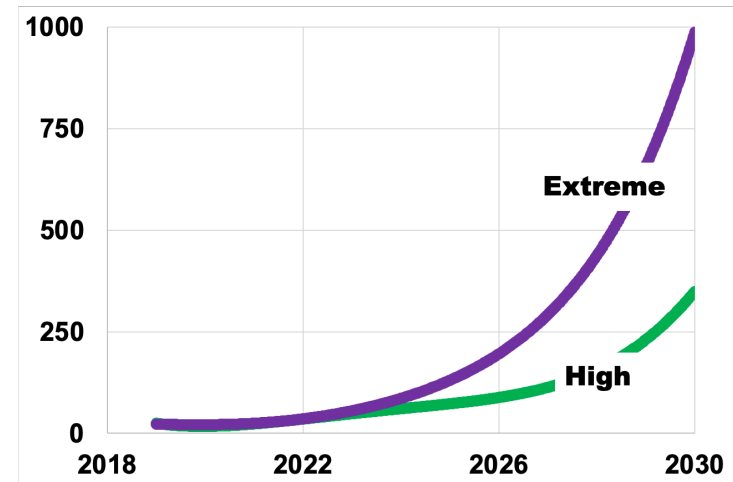
- **GPC Low Density** – Typically no justification to increase kW/Rack
- **GPC Medium Density** – Typically some performance improvement through increased kW/Rack
- **GPC High Density** – Typically good performance improvement through increased kW/Rack and the hardest to predict future requirements. Trending towards HPC-like infrastructure (rack, cooling & power)

**HPC kW/Cabinet.** The trend is mixed-use high-density zone or specialized data centers with unique installation requirements (e.g. larger cabinets [800 mm or 1200 mm] vs. standard rack).

- **HPC High Density** – Typically good performance improvement through increased kW/Cabinet
- **HPC Extreme Density** – Significant latency and training performance improvement through increased kW/Cabinet due to shorter interconnects and reduced networking overhead



**GPC Power Trends**  
kW / Rack

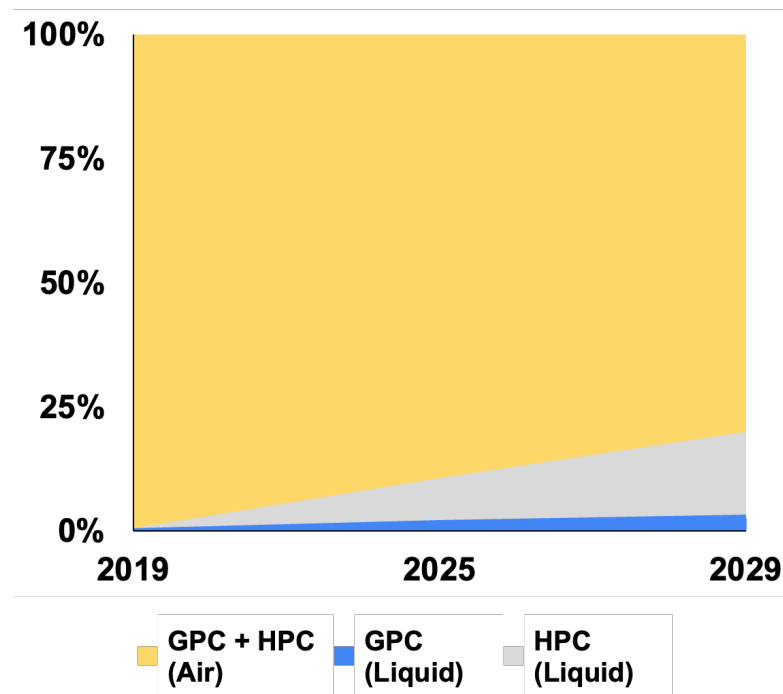


**HPC Power Trends**  
kW / Cabinet

# GPC Liquid Cooling Trends

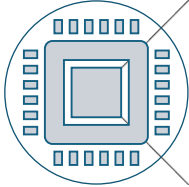
HPC undoubtedly will demand liquid cooling, but a portion of GPC will grow to also require and/or prefer support for liquid.

- **GPC High Density**—kW/Rack exceeding the cooling capability of air toward the end of the decade
- **Supply Chain** – Robust liquid cooling supply chain setup by HPC enables new use cases in GPC
- **Efficiency** – Regulation and sustainability drive the need for liquid cooling in on-premises data centers



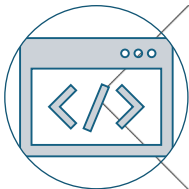
**Share of Total Installed Servers  
by Cooling Type**

# Summary



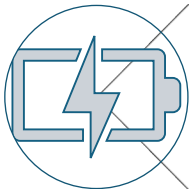
## **Mixed Use Data Centers**

Increasing use cases for one or more high performance computing (HPC) racks creates the need for more mixed-use data centers



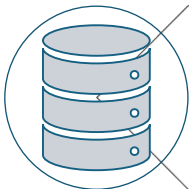
## **Growth in Quantity of Servers Deployed**

Do not singularly focus on HPC; GPC growth is similar & a larger base



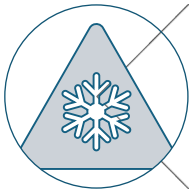
## **GPC kW/Rack**

Low & Medium density show very little change but high density GPC is seeing considerable growth



## **HPC kW/Cabinet**

Growth is so fast that densities can exceed capacity of HPC data center even designed today



## **GPC Liquid Cooling**

HPC undoubtedly will demand liquid cooling, but a portion of GPC will grow to also require and/or prefer support for liquid