Welcome. The webinar will begin shortly.

# Worldwide HPC and AI Training Market

## 2021 Actuals, 2022-26 Forecast

Including “Grand Unification”
of Data Center, Hyperscale, Cloud

May 2022

Intersect360 RESEARCH

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# Upcoming HPC Market Reports

**Intersect360 Research will publish full written research reports for the data in this presentation, in the following segmentations:**

- Products and services
- Vertical markets
- Geographic regions
- Server vendor market shares *,[1]
- Server classes [2]
- Software categories [2]
- Services categories [2]
- Cloud categories [2]

* Market shares for 2020-21 only, not forecast.

[1] Expanded HPC + AI Training view only

[2] Traditional HPC view only

# Data Center “Grand Unification”

## All 2021 Data Center spending:
## HPC, AI, Cloud, Hyperscale, Enterprise

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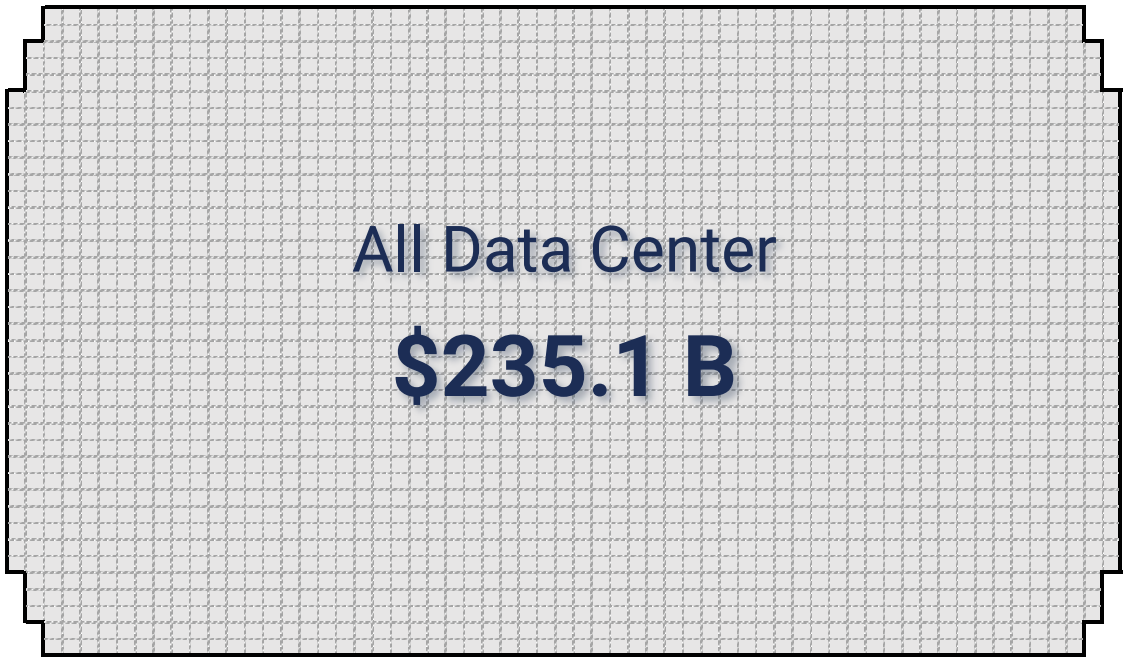
# Why a Full Data Center Picture, Why Now?

- Intersect360 Research has historically tracked both the HPC and Hyperscale markets, with clients primarily focused on HPC
- Hyperscale dominates the landscape and needs to be seen
- Especially important with rise in cloud adoption and AI training as distinct topics
- A unified view is required to understand the interrelated dynamics
- This view is independent work by Intersect360 Research. It is consistent methodologically with work published in prior years.

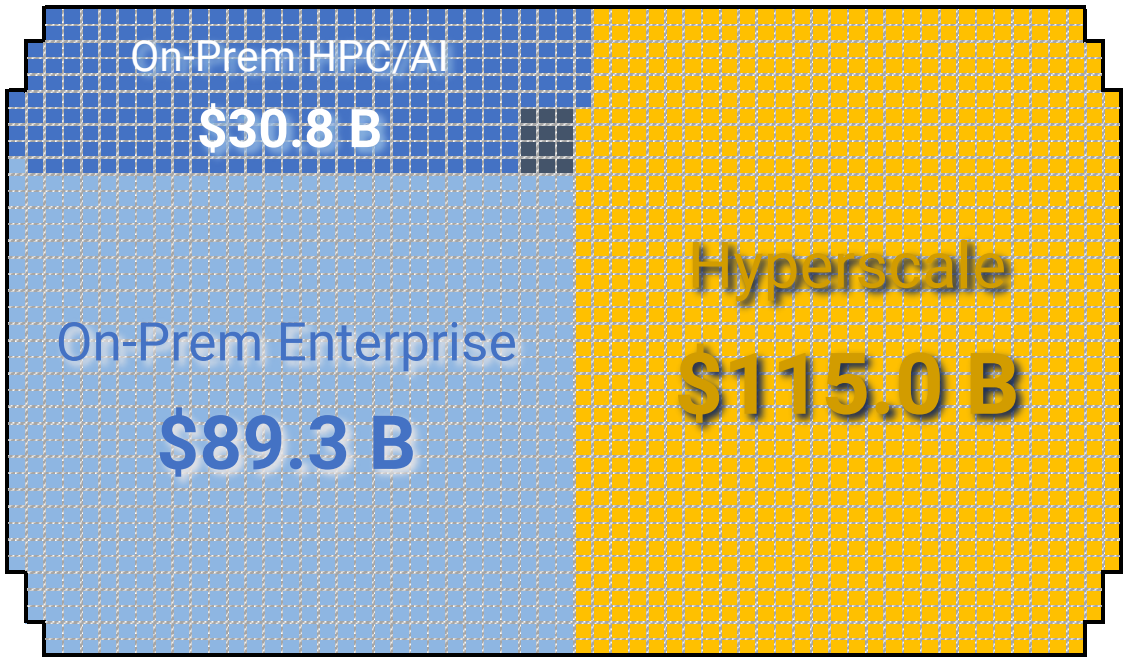
# Data Center 2021: Grand Unification




Total data center spending, $235.1 billion in 2021

Includes both on-prem and hyperscale data centers

# Data Center 2021: Grand Unification

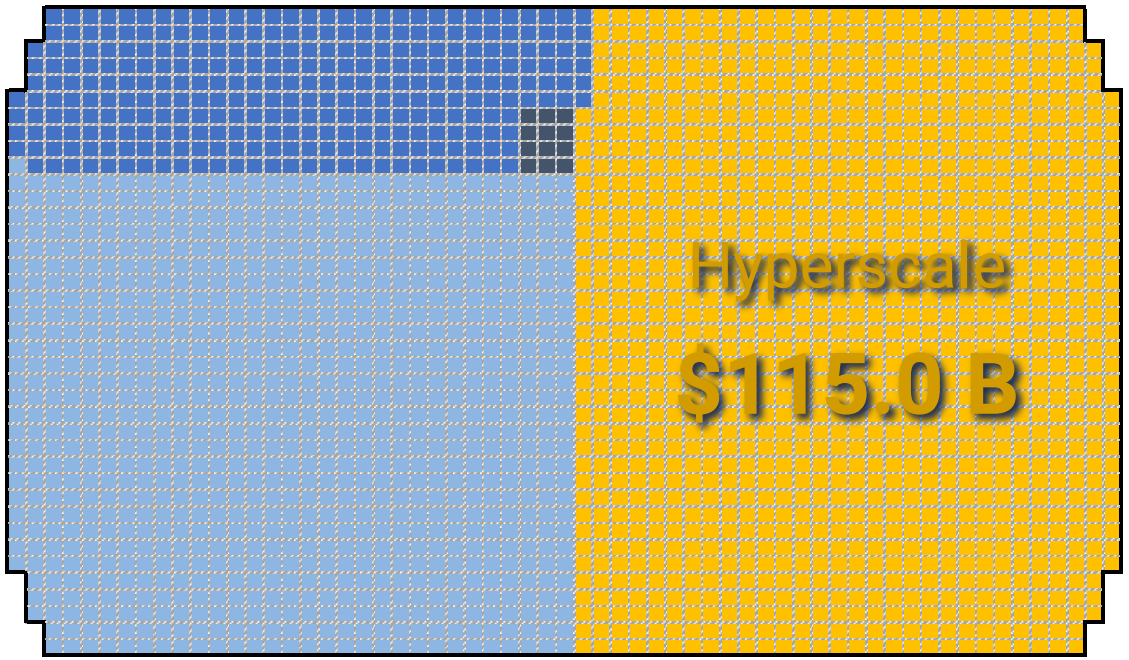



Hyperscale is nearly half (49.8%) of all data center spending

On-Prem HPC/AI training includes both:

- HPC ($29.6B), often mixed HPC/AI environments
- Pure AI, non-HPC ($1.2B)

# Data Center 2021: Grand Unification



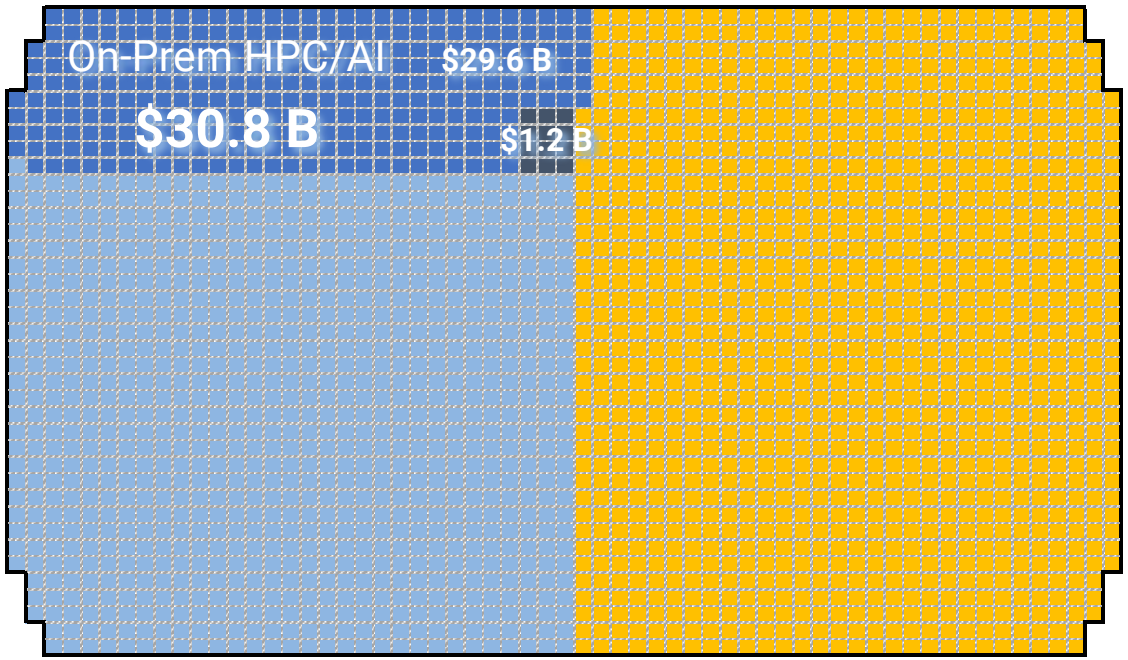

Hyperscale has continued to grow at 26.1% CAGR since 2018; consistent with previous Intersect360 Research forecasts.

**Top 10 companies account for over 80% of spending.**

It has created data center markets out of consumer markets (social media, apps, digital content, music, retail, etc.)

**Hyperscale is more than cloud.**

# Data Center 2021: Grand Unification



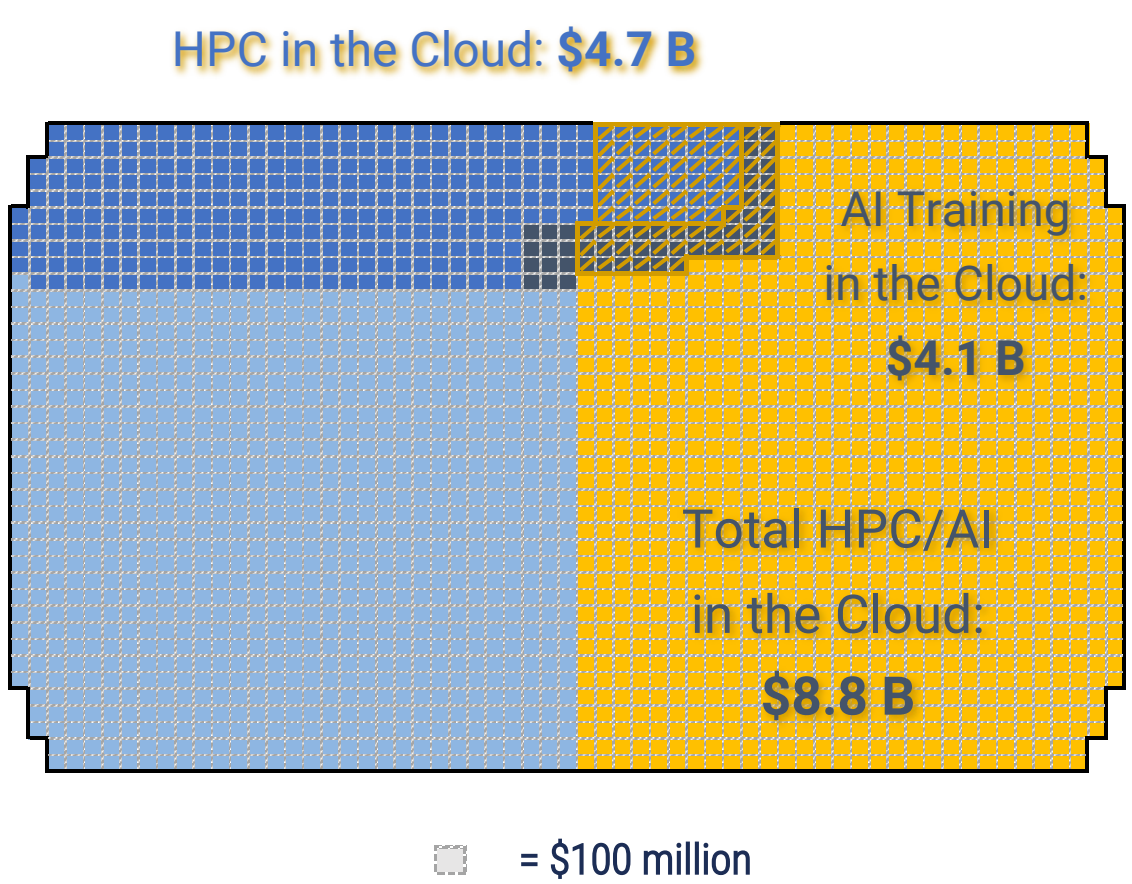

HPC and AI Training have grown to 25.6% of all on-prem data center spending

$29.6 billion is associated with HPC budgets, conforming to our previous years' methodologies

This is the first year than on-prem AI training warrants tracking separately, $1.2 billion.

We show both "traditional" and "expanded" views in these reports.

# Data Center 2021: Grand Unification

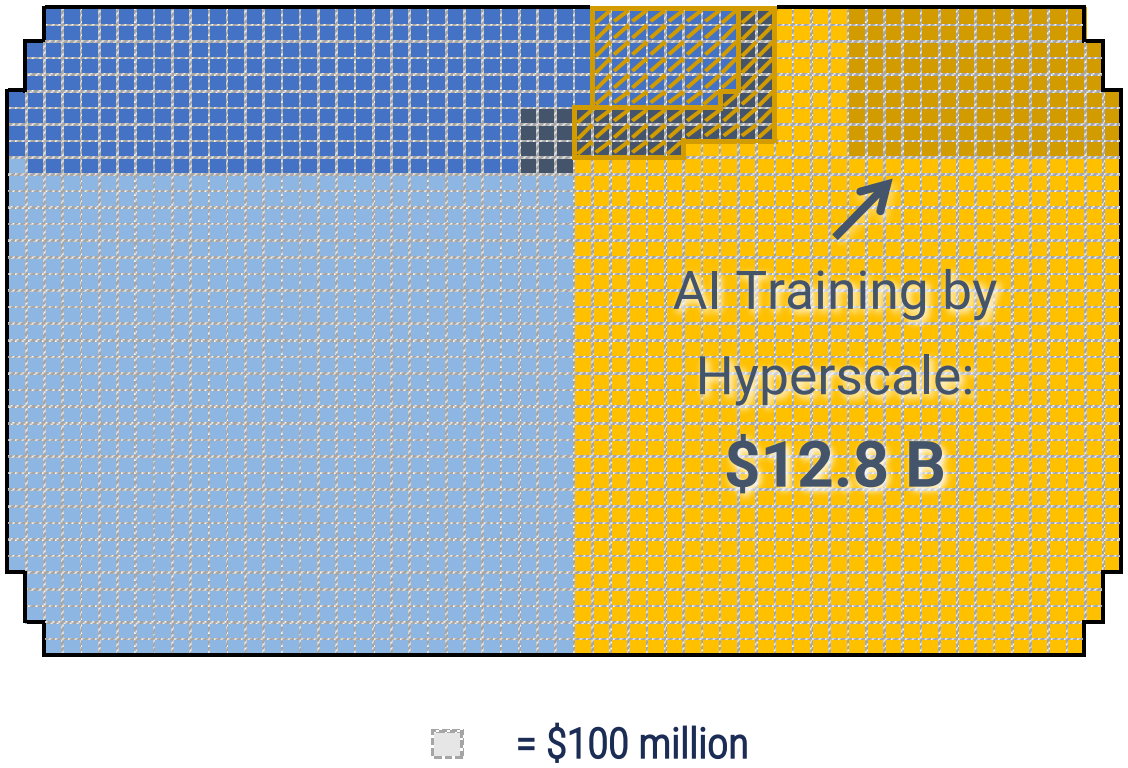



HPC in the Cloud has been growing fast, but majority is still on-prem

Conversely, non-HPC AI has been predominantly cloud-based

Total enterprise spending in cloud would overrun this image.

# Data Center 2021: Grand Unification




The primary purchaser of AI training infrastructure is Hyperscale, for their own use.

More spending on AI in Hyperscale than in all other vertical markets combined.

This spending is highlighted here but not included in most charts, so as not to distort the market opportunity.

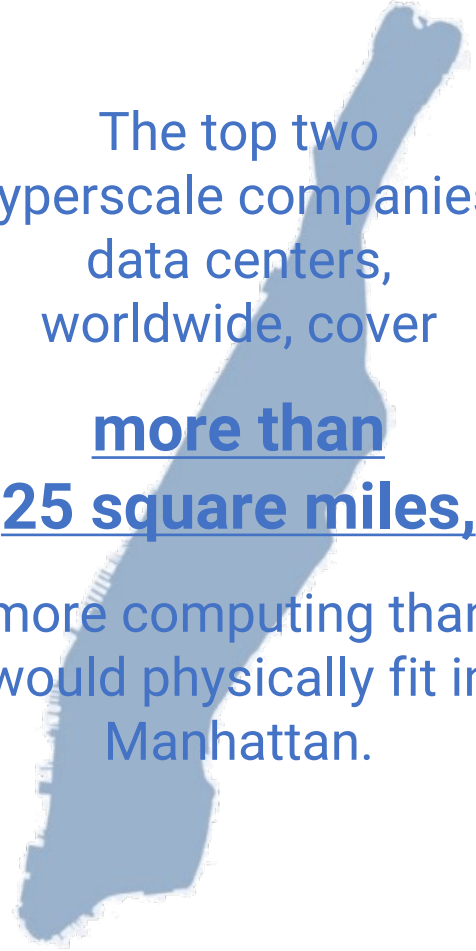
# Perspectives on Hyperscale

**A large-scale national supercomputer costs hundreds of millions of dollars**

**At least 10 hyperscale companies spend over $1 billion each year.**

**Four spent over $10 billion in 2021.**
**Two spent over $20 billion.**

**Hyperscale companies spent over $12 billion on AI last year alone**



The top two hyperscale companies' data centers, worldwide, cover

**more than 25 square miles,**

more computing than would physically fit in Manhattan.

# Worldwide HPC/AI Market 2021 and 2022-26 Forecast

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# Two Market Views

## "Traditional" HPC View

- HPC budgets
- Frequently (usually) includes machine learning workloads
- Can have increased budgets due to machine learning
- Conforms to previous years' methodologies

## "Expanded" HPC + AI Training View

- Includes AI budgets in no way connected to HPC
- Conforms to how most technology suppliers view the market; basis of market shares
- Excludes hyperscale spending on AI, unless otherwise indicated

# HPC + AI Training Market in 2021: Notes

- Return to single-digit growth after down year in 2020.
- Below previous forecast expectations of bounce-back due to lingering pandemic effects. 20% of HPC users said supply chain disruptions affected ability to spend full 2021 budget.
- Cloud continued breakneck growth pace; seventh-straight year of double-digit growth; second-straight year over 75% growth.
- We now see enough on-prem non-HPC AI to track it separately; most pure AI is still cloud.
- For combined HPC + AI Training, $8.8 billion (19% of spending) is cloud, not including hyperscale spending for their own use.
- Hyperscale is the dominant customer of AI; this is omitted unless specified.

# HPC + AI Training 2022-26 Forecast: Notes

- No major pandemic rebound: the HPC market essentially lost two years of growth.
- Traditional HPC market will grow at 7.7% CAGR to $59.2 billion in 2026.
- Adding pure AI budgets, the combined HPC + AI training market will grow 8.6% CAGR to $70.0 billion, not including hyperscale market spending.
- Cloud continues fast growth in the near term before flattening out toward asymptote. Cloud will peak at about 18% of HPC spending, but with AI training expands to 25% of the market.
- Hyperscale markets are so dominant as to be unpredictable as to their long-term effect. For this forecast period, the data center is increasingly commanded by only a few companies.

# Total HPC and HPC+AI Market: Products & Services Segmentation

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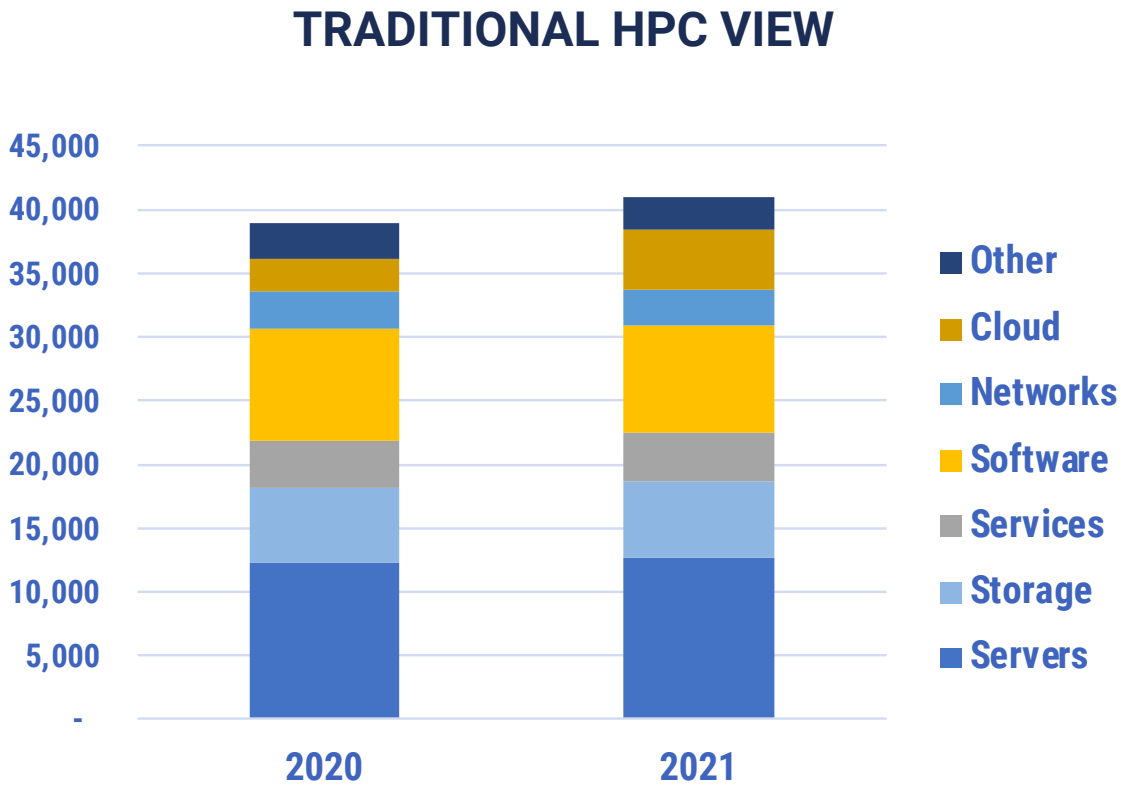
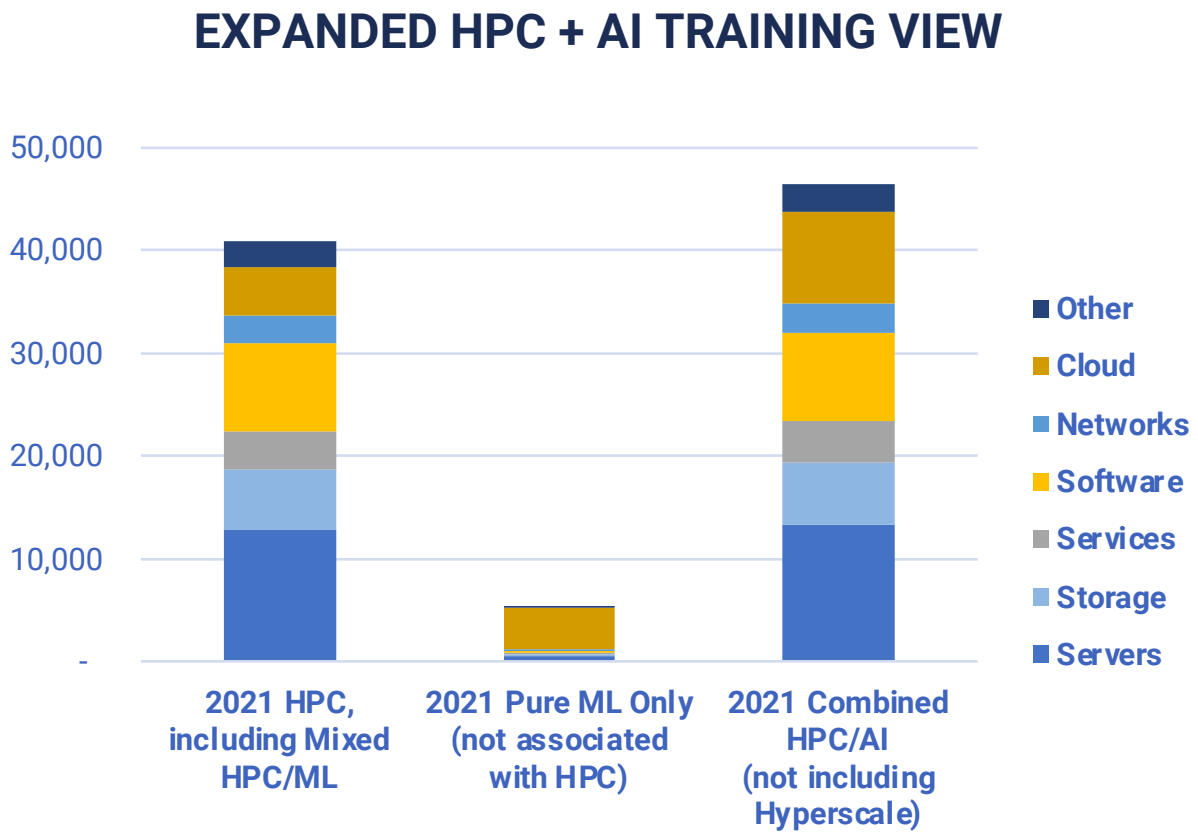
# HPC Products & Services ($M): 2020 vs 2021




- 5.2% market growth year-over-year
- HPC servers up 3.4%; still below 2019 level
- Cloud growth +85.2% year-over-year
- Networking down after strong 2020
- Other segments flattish, slightly up/down

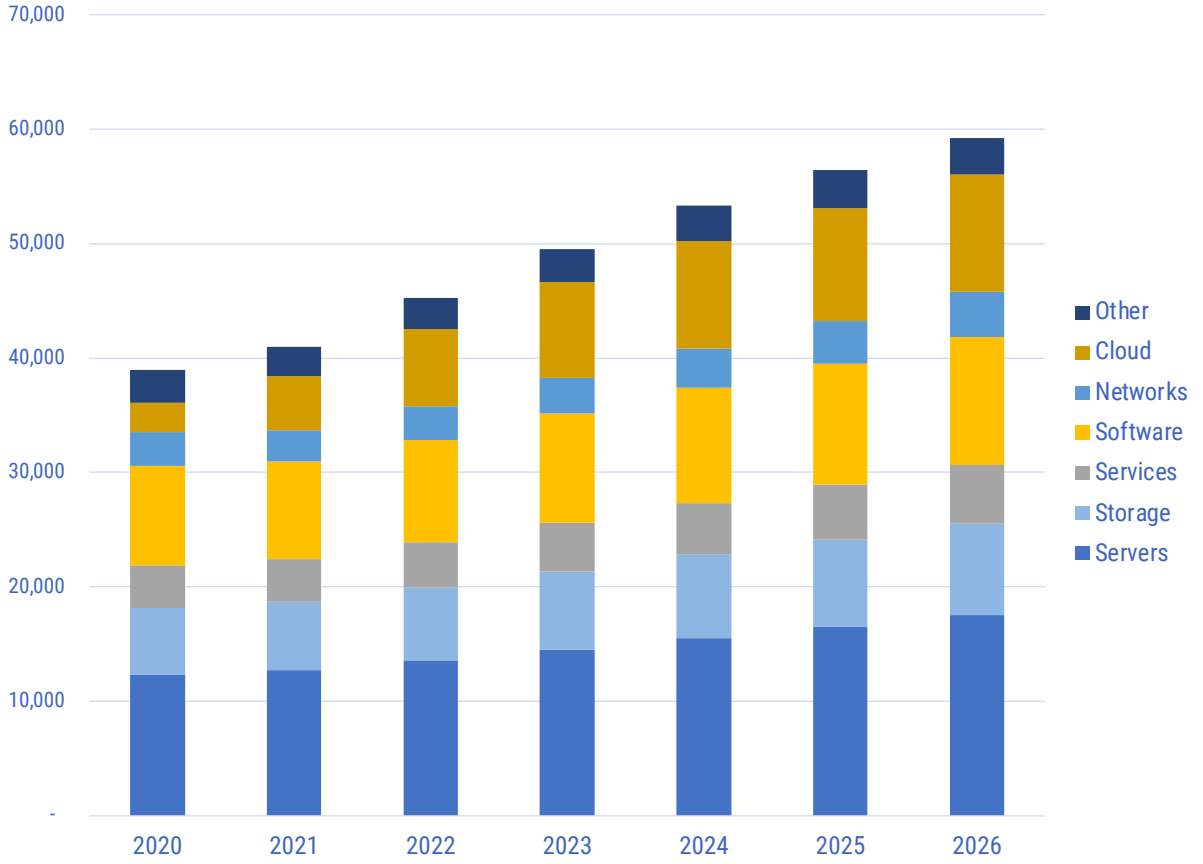
# HPC and AI Training Products & Services ($M)




- AI Training not associated with HPC adds $5.4 B to market
- 75.6% of this spending is cloud computing
- Combined, cloud is $8.8 billion
- Does not include $12.8 billion hyperscale spent on AI training

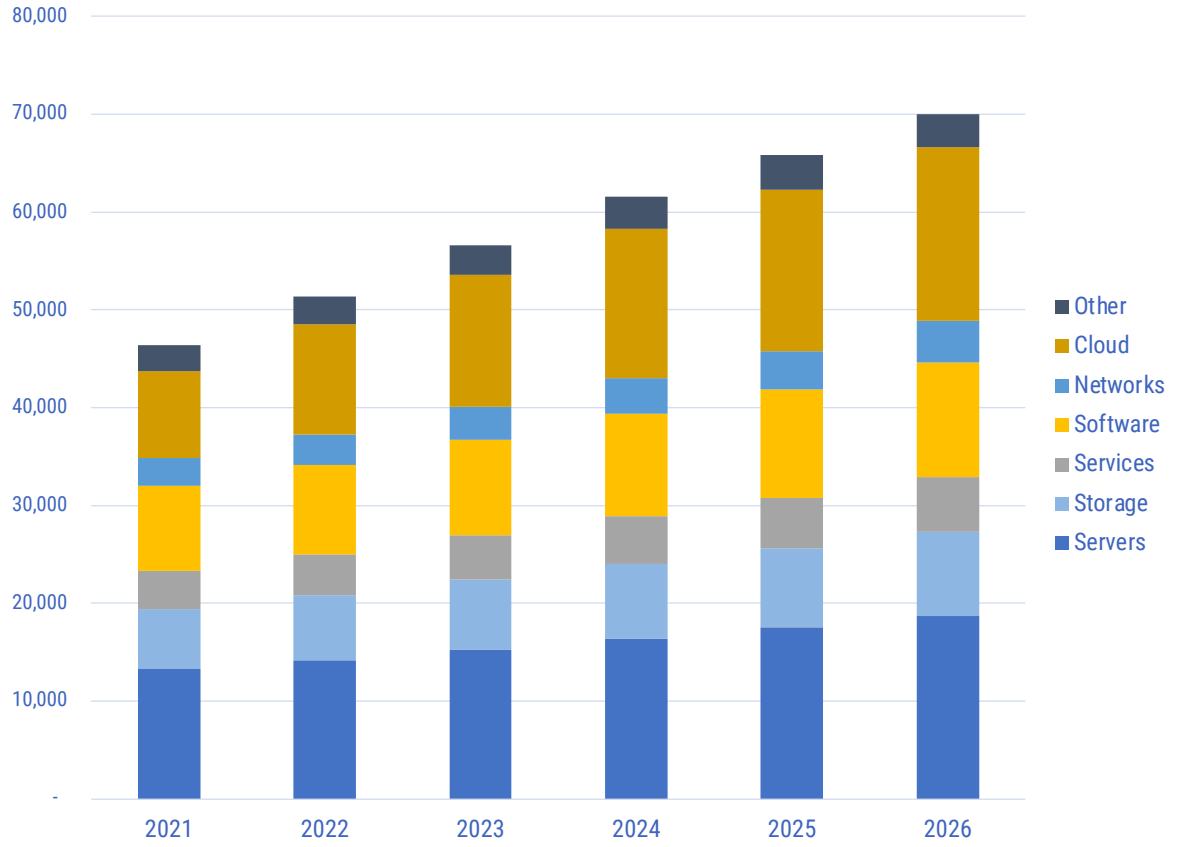
# HPC Forecast: Products and Services ($M)

- Pandemic continued to hold market back in 2021
- Very limited rebound in 2022, leading to slow, steady growth
- Total market 7.7% CAGR; HPC servers 6.6% CAGR
- Cloud crests $10 billion in 2026, peaking near 18% of spending in 2024.
- Cloud 5-year CAGR 16.7%; 2024 will be 10th and final year of double-digit growth



# HPC + AI Training: Products and Services ($M)

- Slightly higher CAGR (8.6%) when distinct AI training budgets are included
- Cloud has a much higher penetration in AI
- By end of forecast period, nearly as much spending in cloud ($17.8 billion) as on-prem servers ($18.7 billion) for HP and AI training
- Remember this does NOT include spending by hyperscale companies



# HPC + AI Training:
# Server Vendor Revenue Shares

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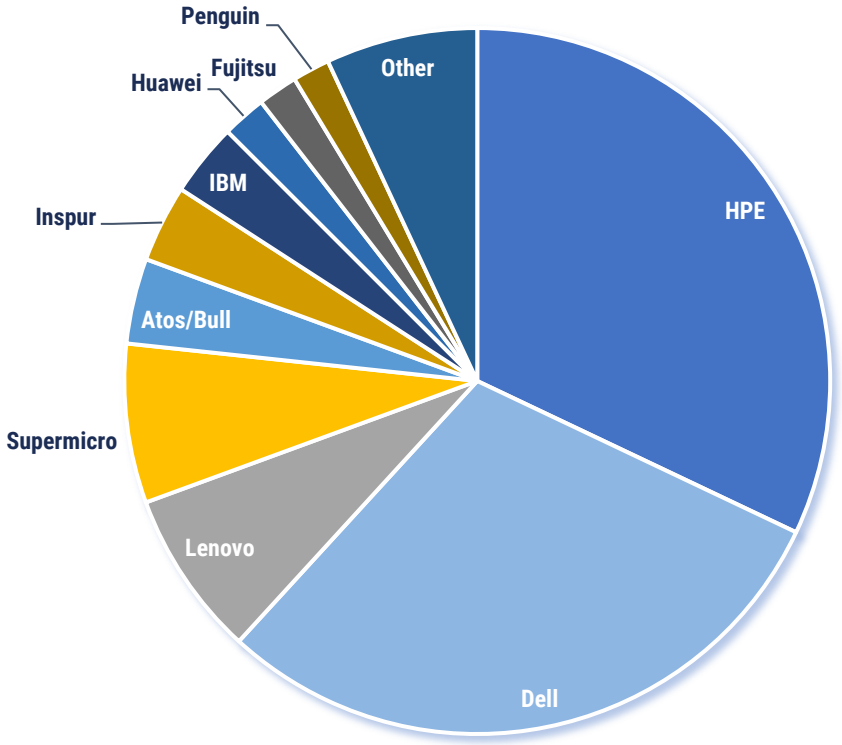
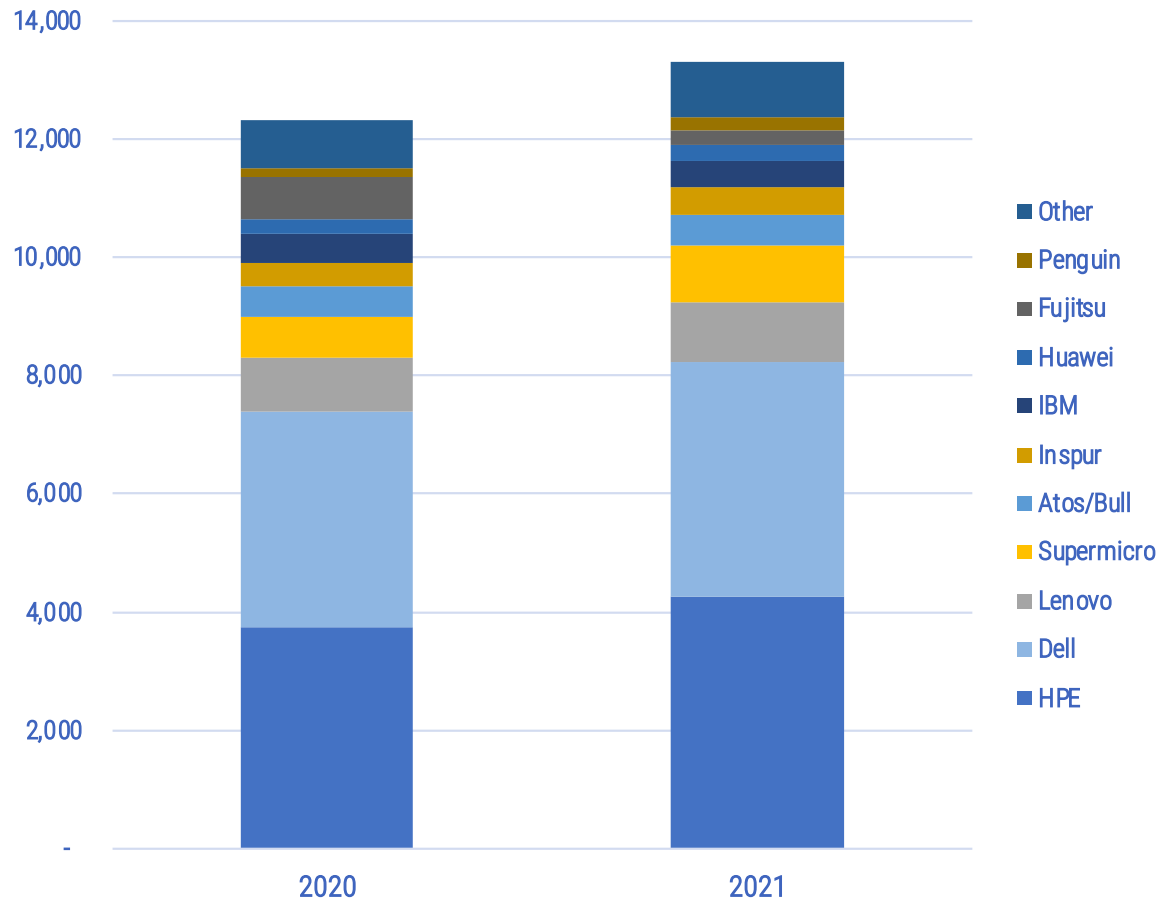
# HPC + AI Training Server Revenue Share

- HPE grew double-digits on strength of Cray sales (e.g. Perlmutter) even without Frontier
- HPE still leads by Dell by a small margin
- Change in methodology applied to 2020 and 2021, counting more of channel business with original seller to create consistency between vendors. This resulted in significant increase to Lenovo and Supermicro.
- China was strong relative to other countries; vendors with good presence there did well.
- Fujitsu declined from 2020 year with Fugaku.
- Notable “Others”: NEC, Sugon



# HPC + AI Training Server Share Y/Y



# Total HPC and HPC+AI Market: Verticals Segmentation

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# HPC Vertical Markets: 2021

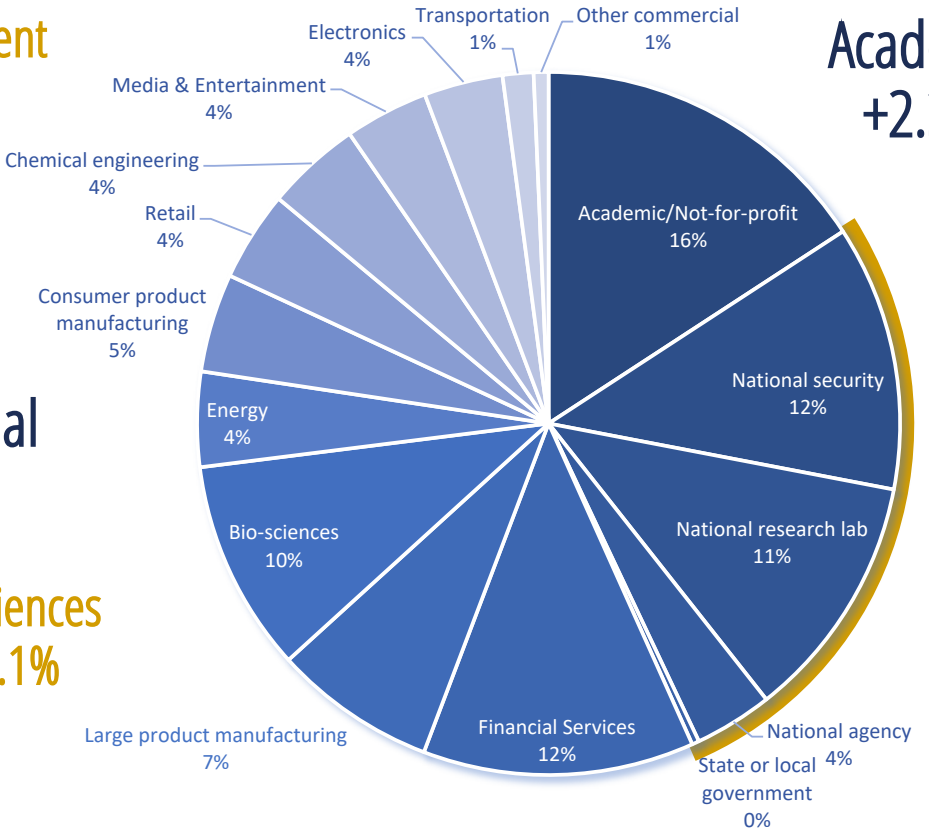
Entertainment
+12.4%

Academic
+2.3%

Commercial
+7.0%

Bio-sciences
+11.1%

Gov't sector
+3.3%

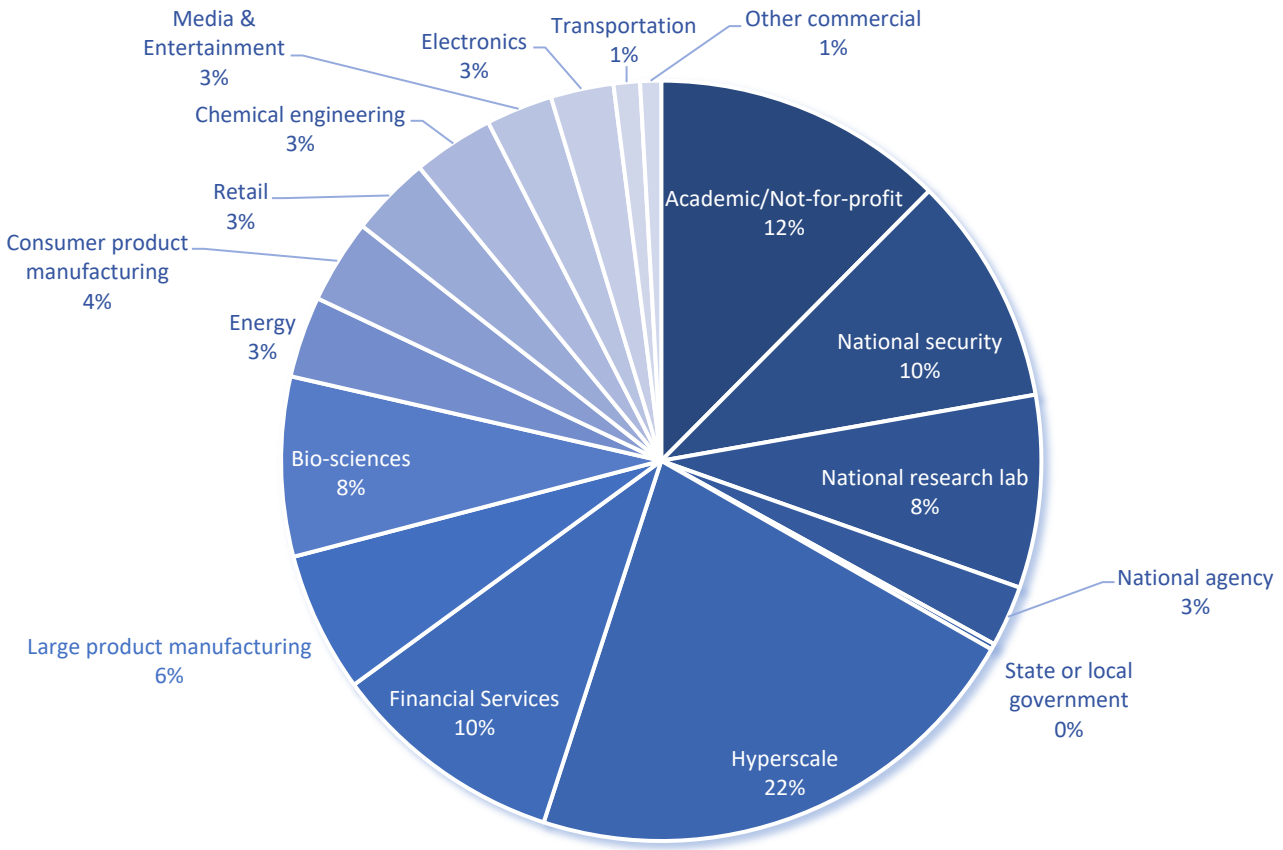



General market return to slight growth, some areas stronger than others.

Bio-sciences continued strong growth in pandemic

Media/entertainment pivoted to digital and also landed double-digit HPC growth, the highest-growth vertical

# If Hyperscale Were Included in HPC + AI

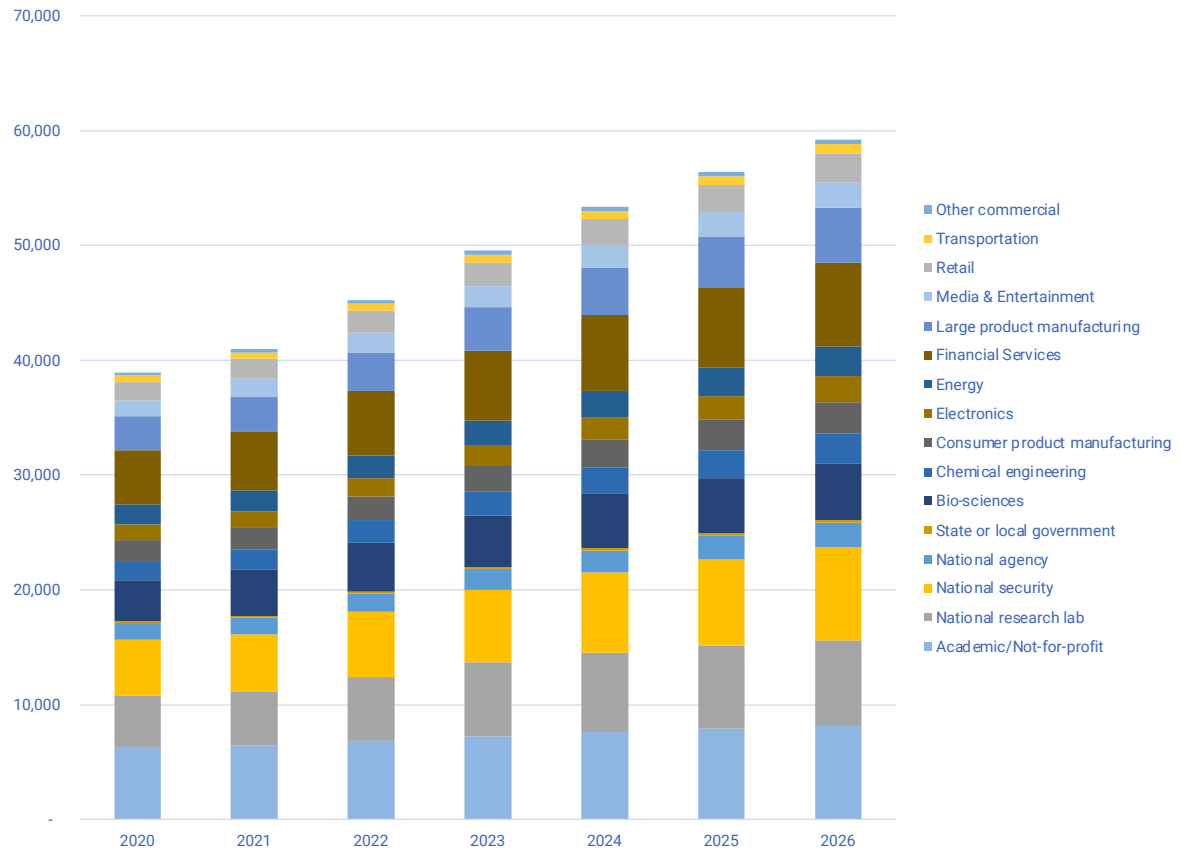



Hyperscale, if included, would be the single biggest consumer of HPC/AI.

More than entire government sector combined

# HPC Vertical Markets Forecast

Government sector leads growth over the next five years, fueled by Exascale and increase in national security spending, including AI (related to HPC spending, so included here).



# Total HPC and HPC+AI Market: Regions Segmentation

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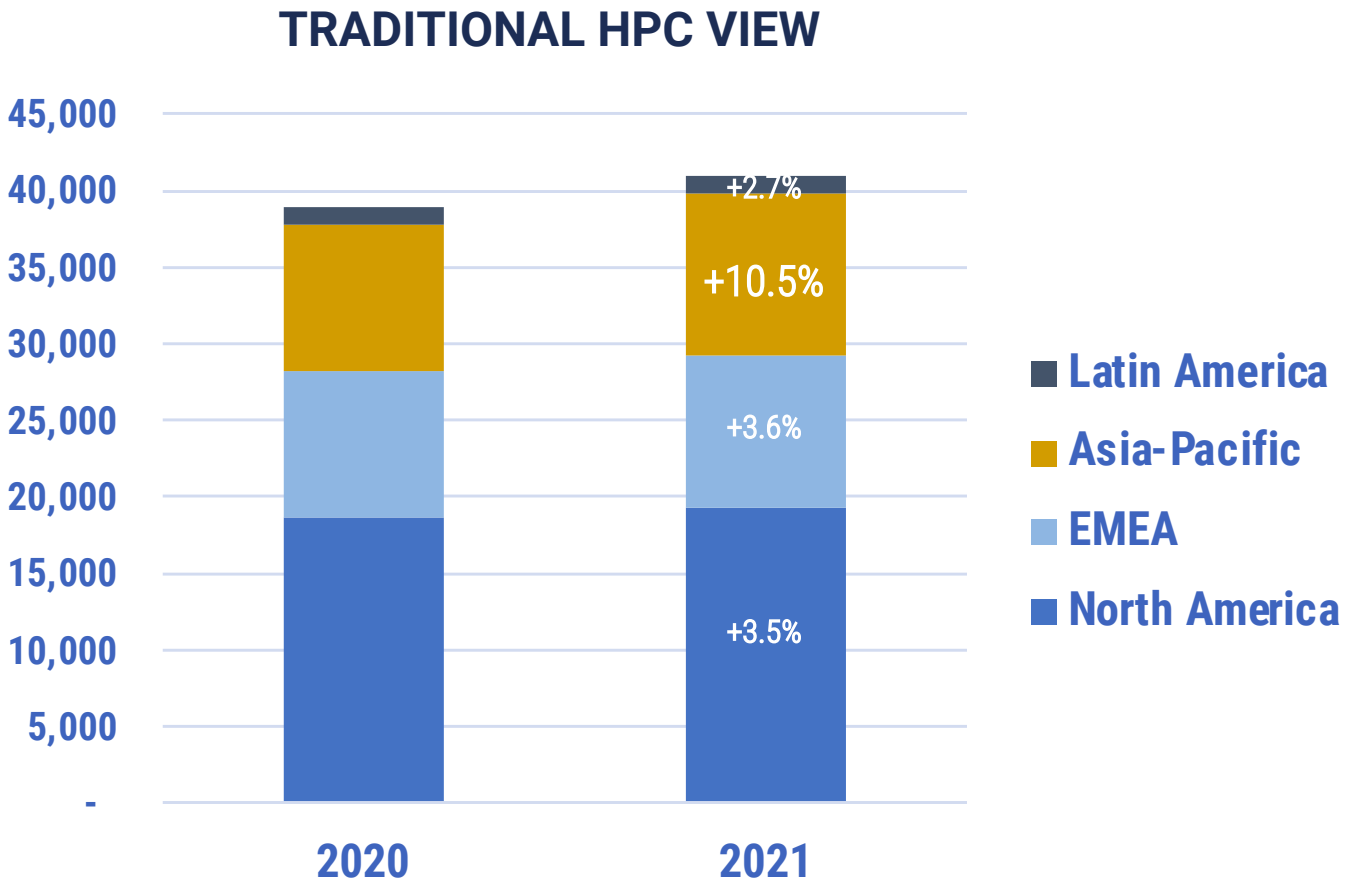
# HPC Global Regions: 2020 vs. 2021

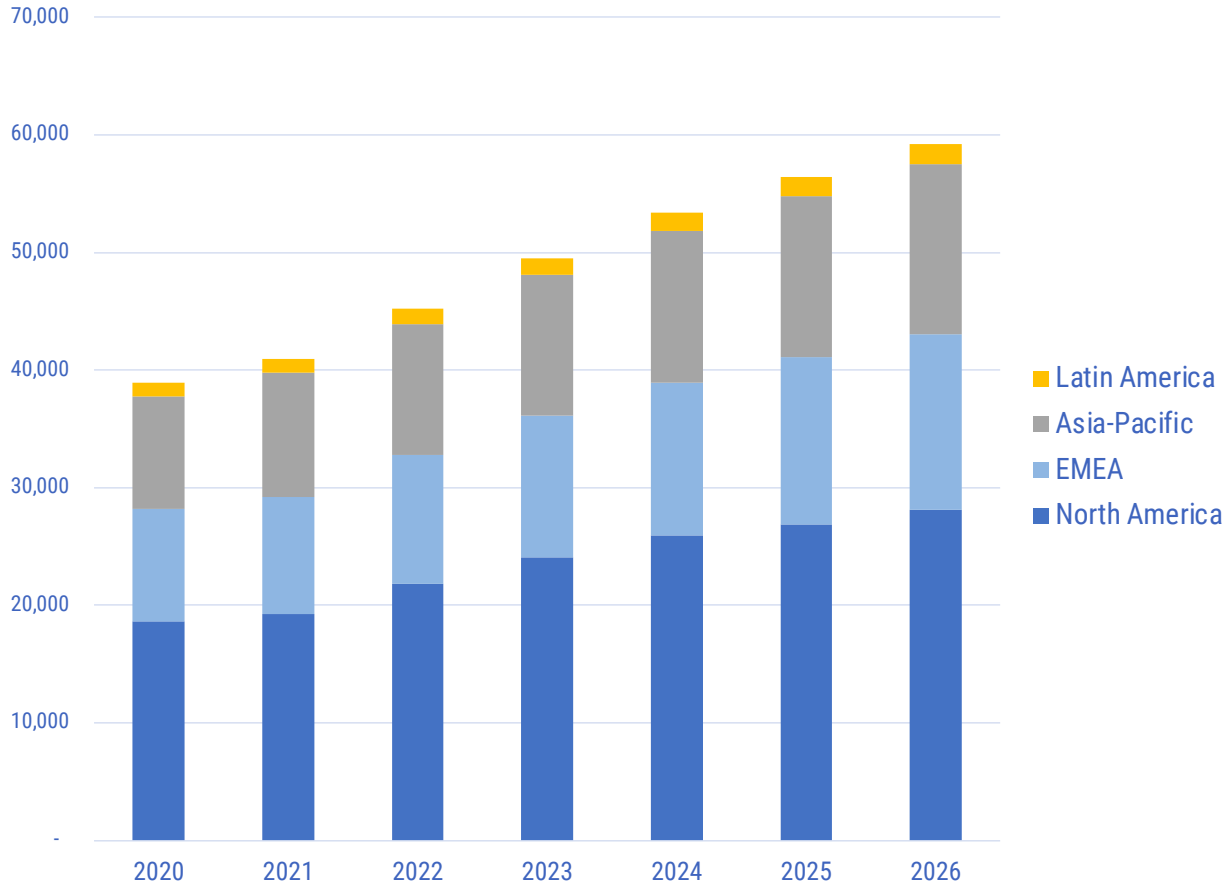



Asia-Pacific region was highest growth region again, despite coming off Fugaku in 2020.

Asia-Pacific has now surpassed EMEA in HPC spending.

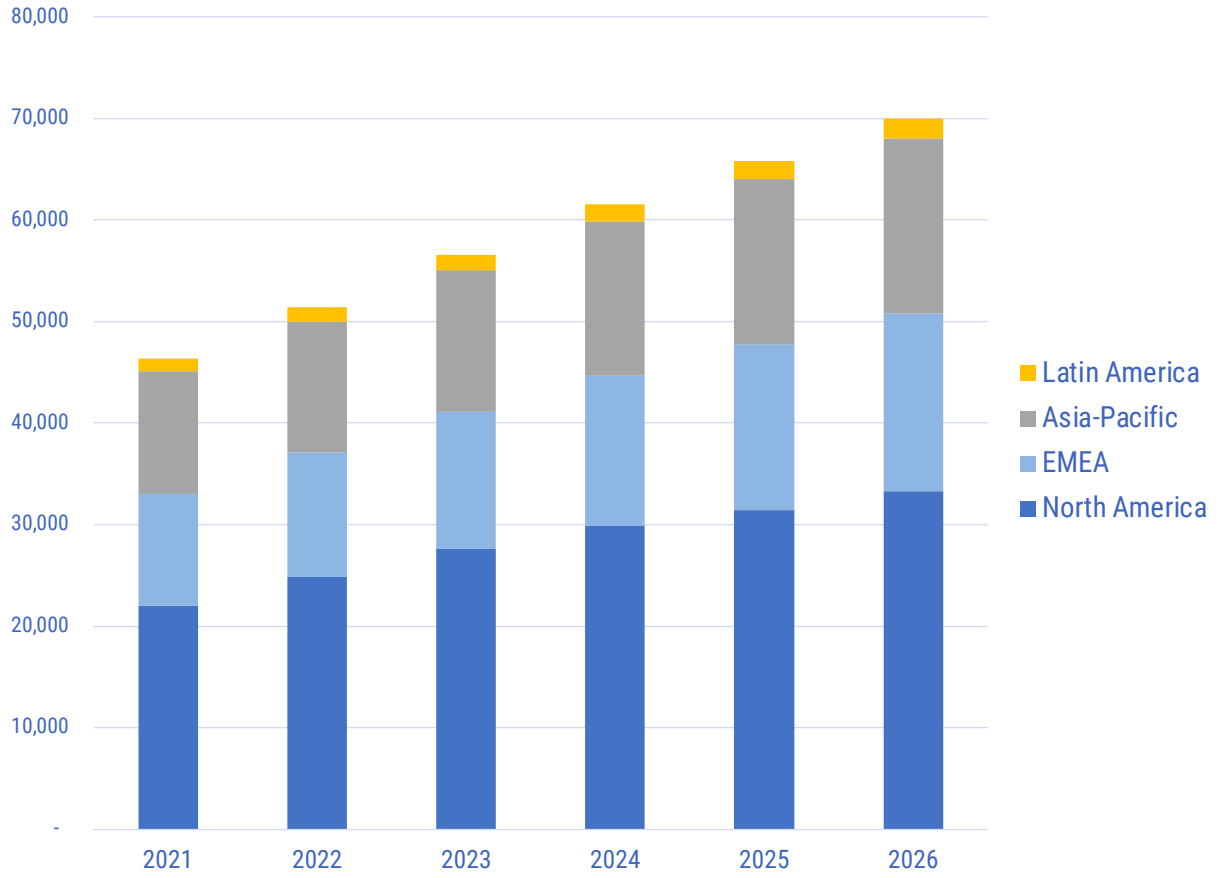
# HPC Forecast: Regions ($M)

- After back-to-back years with Asia-Pacific leading growth driven by China, EMEA will have the highest five-year CAGR (8.6%)
- EMEA crosses ahead of Asia-Pacific again in 2023; they remain close throughout the forecast.



# HPC + AI Training Forecast: Regions ($M)

- Similar picture to traditional HPC model; all growth rates slightly higher
- In this view, EMEA does not cross back again of Asia-Pacific until 2025



# HPC and HPC+AI Servers: Server Class Segmentation

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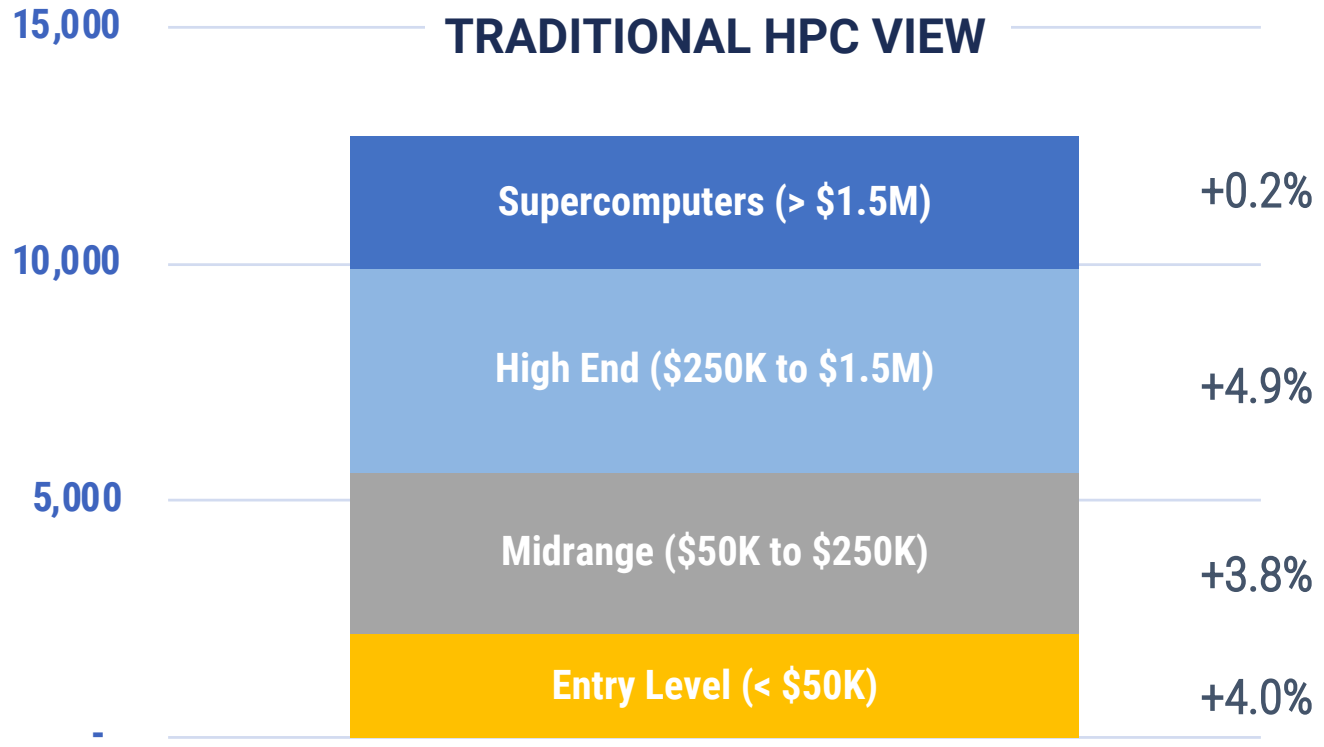
# HPC Server Classes ($M): 2021

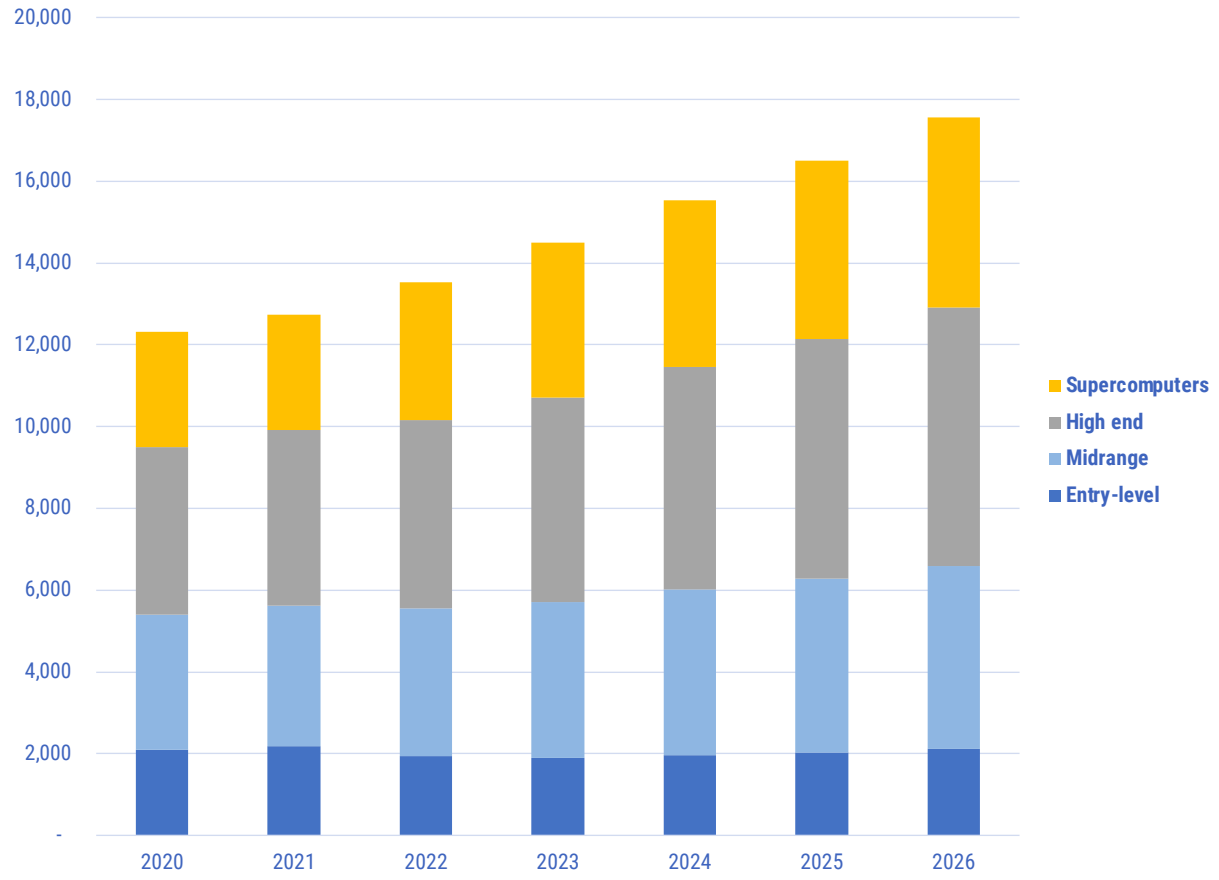



Supercomputers were only growth segment in 2020; other segments had some catch-up in 2021

All HPC systems: +3.4%Y/Y

# HPC Forecast: Server Classes ($M)

- HPC servers will grow to $17.6 billion in 2026 (over $1 billion lower than previous forecast, due to loss from COVID)
- Significant variability by classes
- Supercomputers, driven by Exascale, have highest growth
- Entry-level systems decline through 2023 due to cloud, before beginning to recover as cloud penetration maxes out



# Traditional HPC View: Cloud Segments

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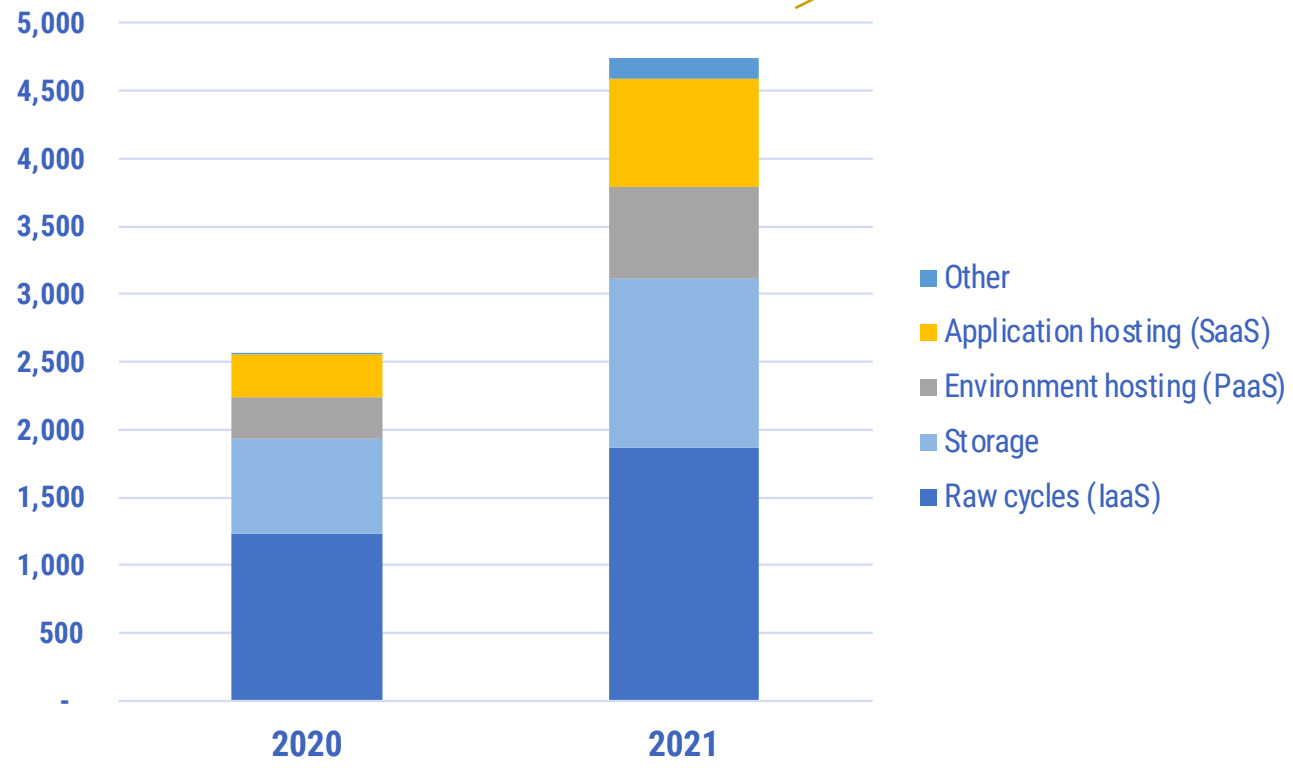
# HPC Cloud: 2020 vs. 2021

HPC Cloud increased 85.2% Y/Y

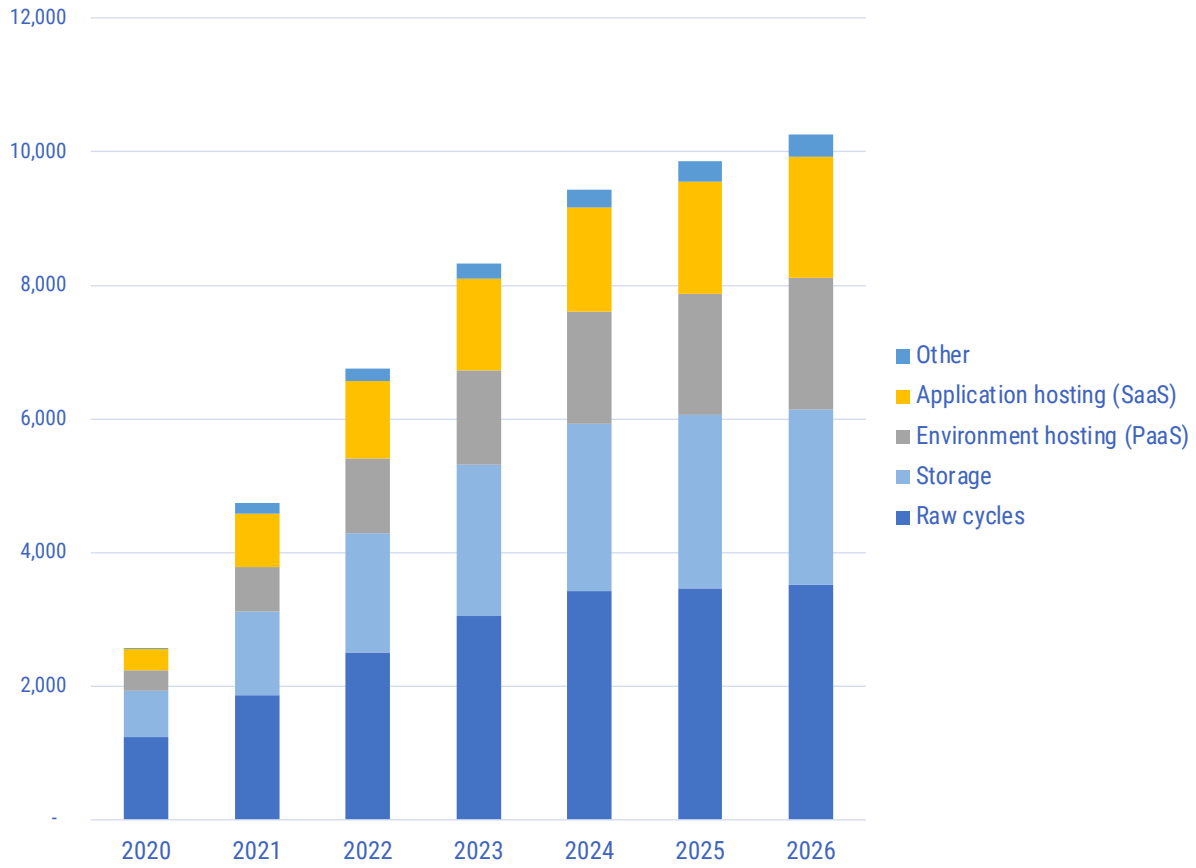



Pandemic economy and supply chain disruptions led to **second-straight year with over 75% growth**.

# HPC Forecast: Cloud Segments ($M)

- Very high growth in cloud through 2023-24, before regressing toward steady market growth rates
- 2021 was seventh-straight year of double-digit growth
- High-value, solution-oriented PaaS and SaaS models have highest growth rates, but all are rising

**AI Training (non-HPC) adds another $4.1 billion in 2021 ($8.8 B total)**



# Conclusions

- **COVID-19 pandemic cost the market, but HPC is a long-term, stable growth market.**
- Exascale and AI are supporting long-term growth trends.
- Pure AI budgets, completely independent from HPC, are adding to the market—mostly in cloud, but now with enough on-prem presence to warrant tracking separately
- Cloud computing continues to significantly altering the landscape and could be a major disruption to traditional HPC business models.
- **There is significant risk in this forecast.**
  - Assuming most economic activity returns to "normal" by early 2023.
  - Risk of significant worsening of geopolitical environment (tariffs, wars, etc.).

# 2022 Winter Classic Invitational Student Cluster Competition – COMPLETE!


Student Cluster Competition

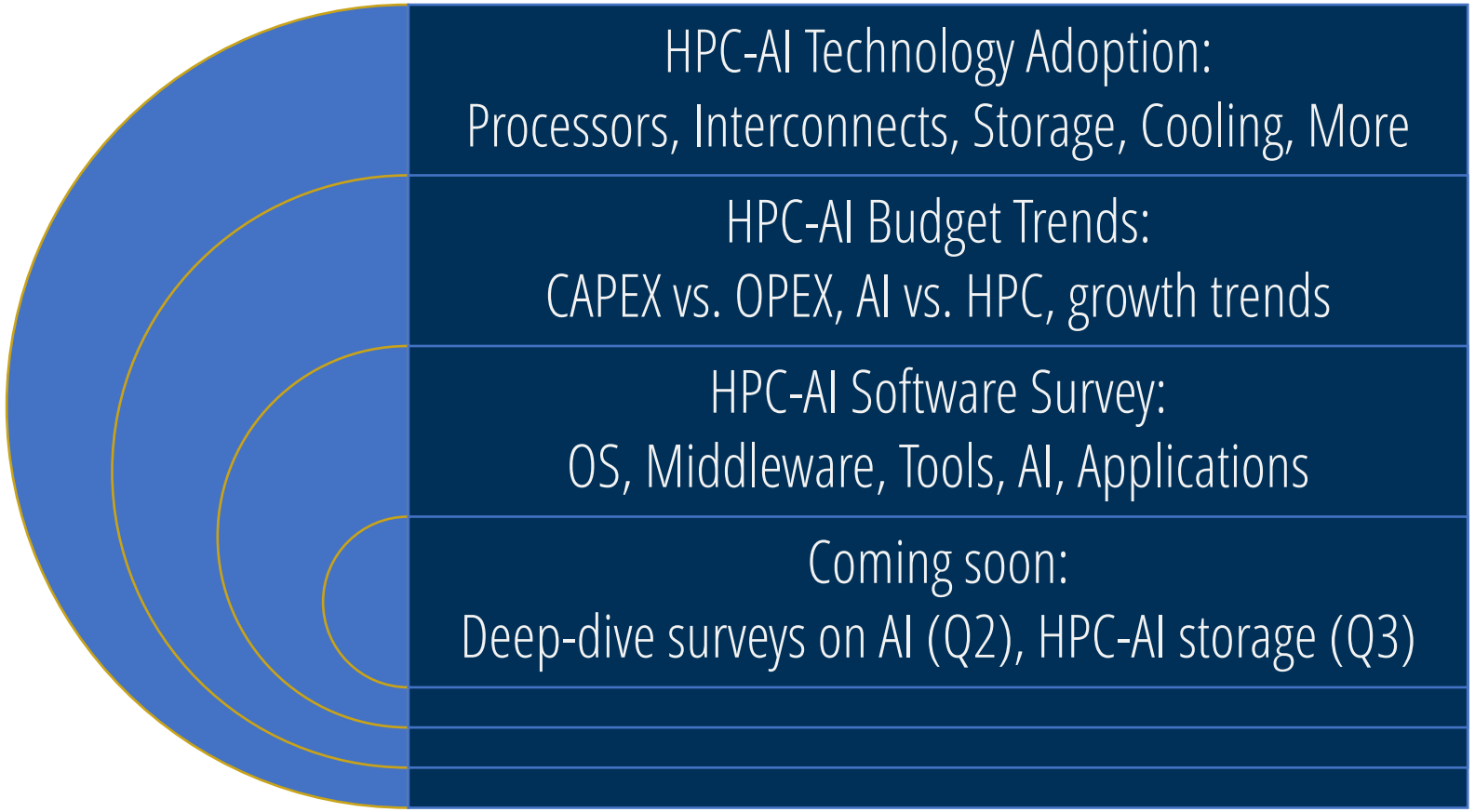
- Virtual competition
- 12 teams from HBCUs and HSIs
- Mentors provide clusters & training

Platinum: intel, ORACLE Cloud Infrastructure, PENGUIN COMPUTING (A subsidiary of SMART Global Holdings, Inc.)

Gold: Hewlett Packard Enterprise, BIOTEAM (Accelerate Science)

winterclassicinvitational.com

# Additional Research: End-User Surveys



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# Q&A

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