HPC Market Update During SC21

November 2021

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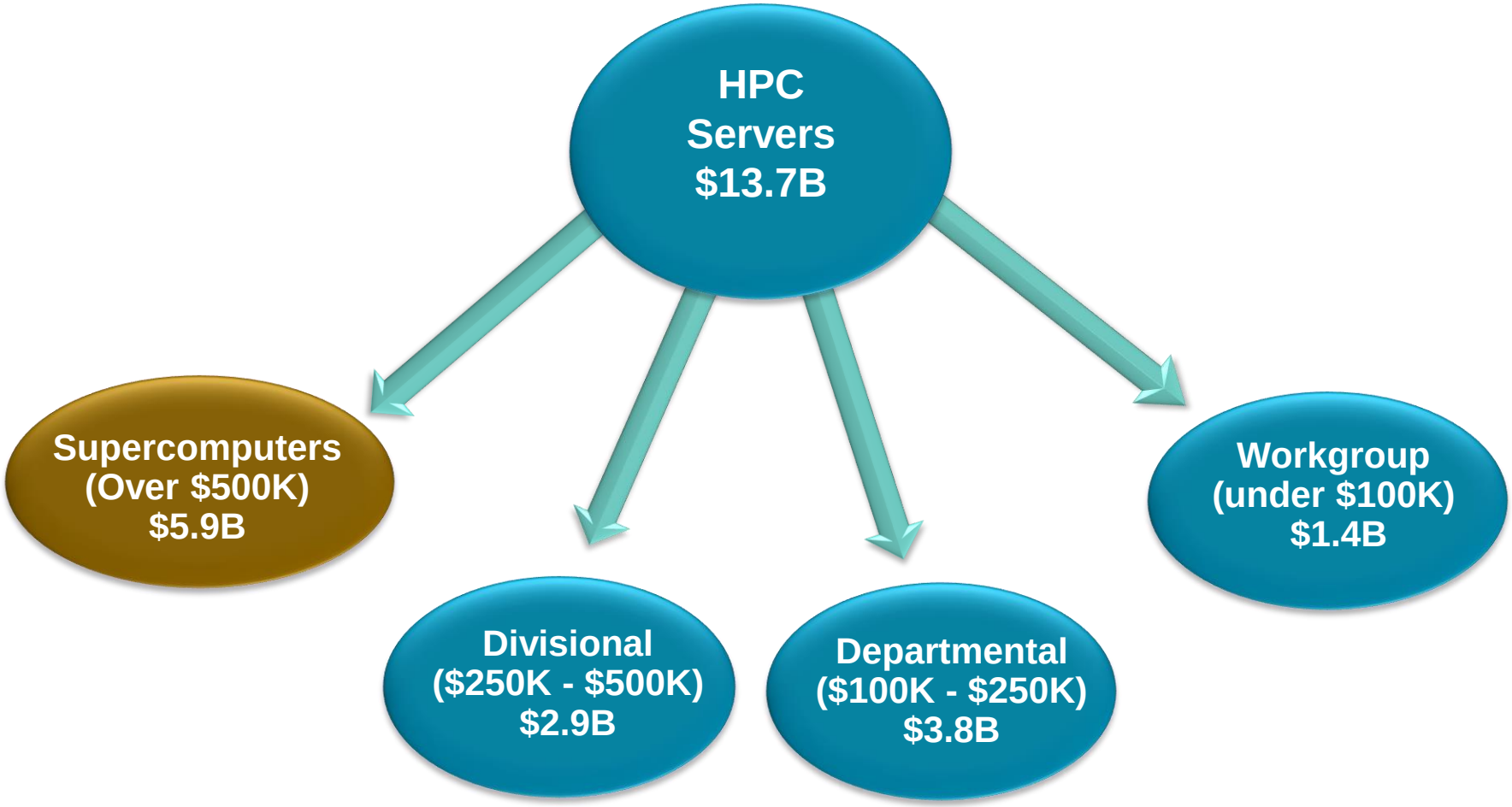
HPC Market Results

The 2020 Worldwide On-Prem HPC Server Market: $13.7 Billion (up 1.1%)



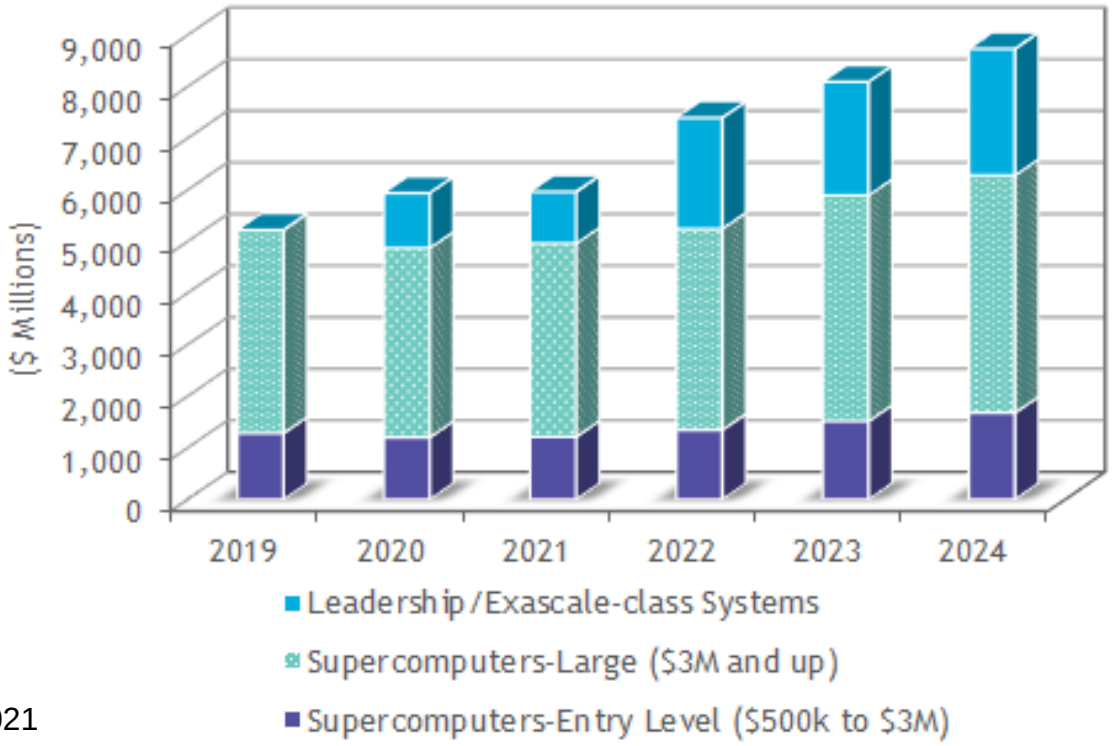
WW HPC Market By Segments ($ Millions)

2021 is looking strong for the first half of the year

Revenues	2019	2020	1H 2021
Supercomputer	5,118	6,021	2,759
Divisional	3,164	2,849	1,281
Departmental	3,193	3,324	1,838
Workgroup	1,894	1,329	745
WW Revenue ($M)	**13,368**	**13,523**	**6,623**
Units Installed	**2019**	**2020**	**1H 2021**
Supercomputer	1,619	1,547	885
Divisional	8,058	6,664	3,013
Departmental	18,785	18,526	10,254
Workgroup	55,529	37,894	22,176
WW Units	**83,991**	**64,631**	**36,329**

New Supercomputer Subsegments

New Supercomputer Subsegments							
$ Millions							
	2019	2020	2021	2022	2023	2024	CAGR 20-24
Leadership/Exascale-class Systems	0	1,065	1,000	2,150	2,200	2,450	23.2%
Supercomputers-Large ($3M and up)	3,937	3,670	3,748	3,901	4,380	4,605	5.8%
Supercomputers-Entry Level ($500k to $3M)	1,287	1,204	1,214	1,347	1,515	1,678	8.6%
Total Supercomputers ($500K and up)	5,224	5,939	5,962	7,398	8,095	8,733	10.1%
Source: Hyperion Research, June 2021							



WW HPC Market By Verticals ($ Millions)

Five segments are over a $ billion a year

WW High-Performance Revenues by Applications		
	2019	2020
Bio-Sciences	$1,421	$1,302
CAE	$1,674	$1,538
Chemical Engineering	$166	$152
DCC & Distribution	$806	$727
Economics/Financial	$688	$618
EDA / IT / ISV	$801	$726
Geosciences	$938	$858
Mechanical Design	$051	$048
Defense	$1,430	$1,332
Government Lab	$2,368	$3,342
University/Academic	$2,254	$2,160
Weather	$622	$572
Other	$151	$150
Total Revenue	**$13,368**	**$13,523**
Source: Hyperion Research, November 2021		

Worldwide HPC Vendor Market Shares

($ Millions)

Vendor	Full Year 2020 ($M)	2020 Share
HPE	4,587	33.4%
Dell Technologies	2,855	20.8%
Fujitsu	1,319	9.6%
Inspur	996	7.2%
Lenovo	929	6.8%
Atos	511	3.7%
Sugon	452	3.3%
IBM	444	3.2%
Penguin	200	1.5%
NEC	192	1.4%
Others	1,260	9.2%
Total	13,744	100.0%

The Broader On-premise Market Areas ($ Millions)

The 2020 total on-prem HPC spending exceeded $27 billion (excluding cloud spending)

Revenues by the Broader HPC Market Areas		
	2019	**2020**
Server	$13,368	$13,523
Storage	$5,288	$5,423
Middleware	$1,572	$1,590
Applications	$4,569	$4,600
Service	$2,181	$2,146
Total Revenue	**$26,979**	**$27,283**
Source: Hyperion Research, November 2021		

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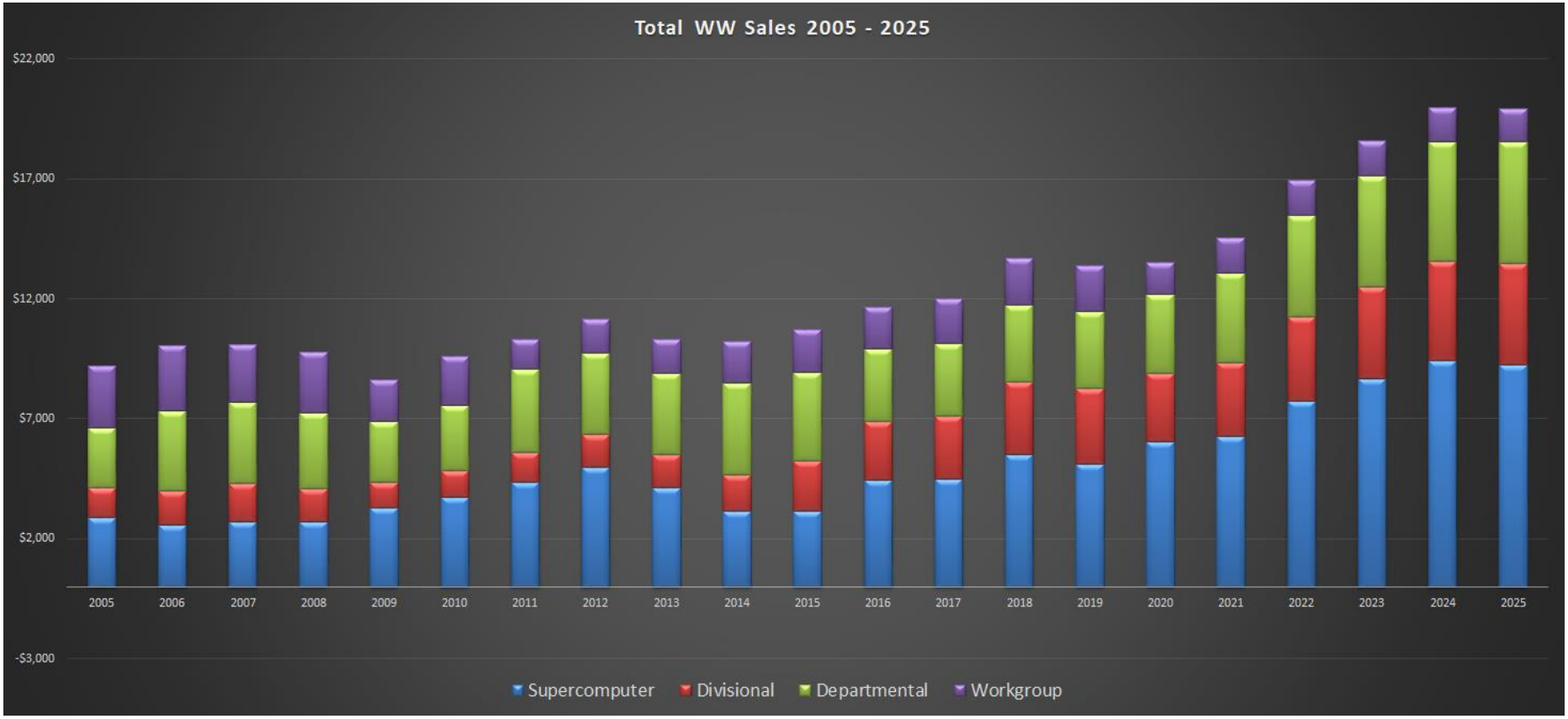
Updated HPC Forecasts

On-Prem HPC Server Forecast
($ Millions)

- **The five-year CAGR (2020 to 2025) is 8%**
  - Reaching close to $20 billion in 2025



HPC On-Prem Server Forecast
($ Millions)
The overall CAGR is now 8%

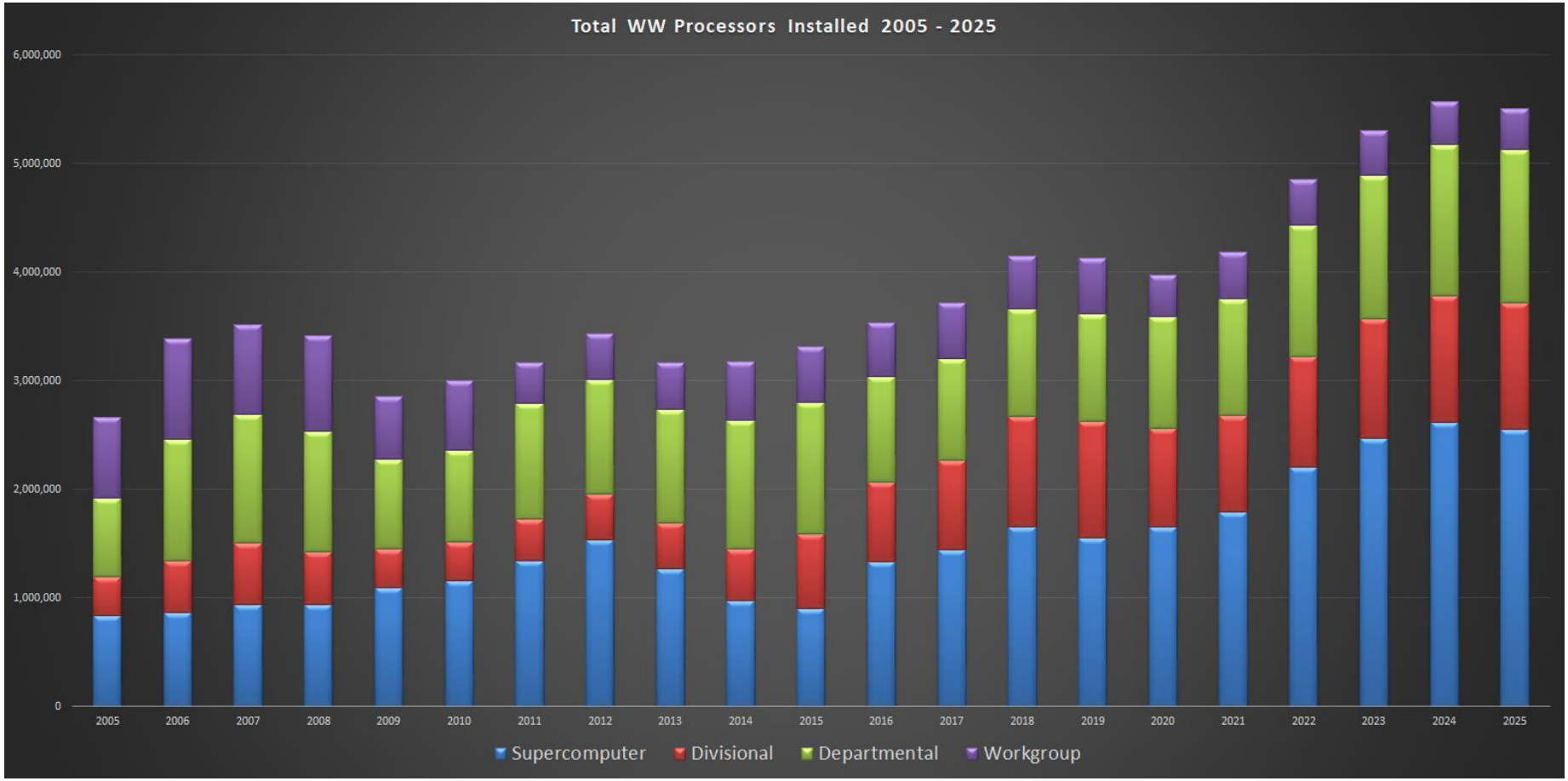
World Wide Overall Technical Computer Market Revenue								
	2019	2020	2021	2022	2023	2024	2025	CAGR 20-25
WW HPC Revenues	$13,368	$13,523	$14,550	$16,947	$18,565	$19,947	$19,901	8.0%
Source: Hyperion Research, November 2021		1.2%	7.6%	16.5%	9.5%	7.4%	-0.2%	

Worldwide Total Technical Computer Market Revenue Forecast by Competitive Segment								
	2019	2020	2021	2022	2023	2024	2025	CAGR 20-25
Supercomputer	$5,118	$6,021	$6,258	$7,726	$8,653	$9,401	$9,251	9.0%
Divisional	$3,164	$2,849	$3,091	$3,532	$3,858	$4,156	$4,199	8.1%
Departmental	$3,193	$3,324	$3,726	$4,234	$4,625	$4,968	$5,078	8.8%
Workgroup	$1,894	$1,329	$1,475	$1,456	$1,430	$1,422	$1,373	0.7%
Total	$13,368	$13,523	$14,550	$16,947	$18,565	$19,947	$19,901	8.0%
Source: Hyperion Research, November 2021								

On-Prem HPC Processor Forecast

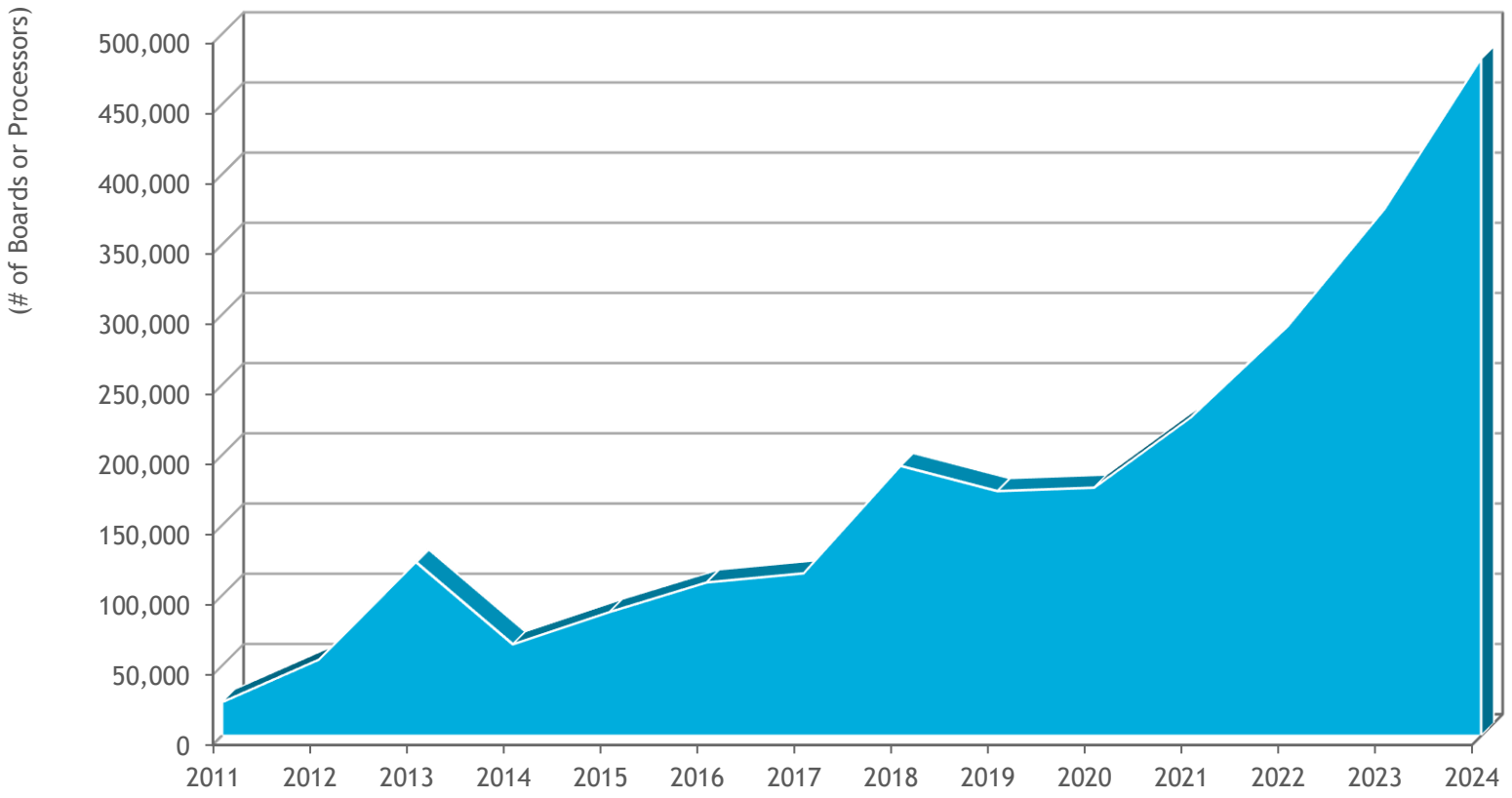
($ Millions)

- **The five-year CAGR (2020 to 2025) is 6.8%**
  - Exceeding 5.5 million base processors in 2025



GPU/Accelerator Forecast

Anticipated high growth for accelerators over next 5 years



On-Prem Forecasts For The Broader Market Areas ($ Millions)

Storage is expected to grow the most at 9.3% CAGR

Revenues by the Broader HPC Market Areas							
	2020	2021	2022	2023	2024	2025	CAGR 20-25
Server	$13,523	$14,550	$16,947	$18,565	$19,947	$19,901	8.0%
Storage	$5,423	$5,931	$6,981	$7,835	$8,479	$8,454	9.3%
Middleware	$1,590	$1,736	$2,035	$2,244	$2,426	$2,420	8.8%
Applications	$4,600	$4,913	$5,626	$6,060	$6,396	$6,353	6.7%
Service	$2,146	$2,254	$2,531	$2,674	$2,767	$2,738	5.0%
Total Revenue	**$27,283**	**$29,383**	**$34,121**	**$37,378**	**$40,015**	**$39,867**	**7.9%**
Source: Hyperion Research, November 2021							

The Exascale Market (System Acceptances)

Over 30 systems and over $11 billion in value

Exascale and Near-Exascale Systems (2021 to 2026)

Year Accepted	China	EU, UK, Germany	Japan	US	Other Countries*	Total Systems	Total Value
2020			1 near-exascale system ~$1 B			1	$1B
2021	1 or 2 near-exascale systems ~$400M each	1 pre-exascale system ~$185M	?	1 pre-exascale system ~$200M	--	3-4	$.8B - $1.2B
2022	1 or 2 exascale systems ~$350M - $400M each	2 pre-exascale systems ~$400 total	1 near-exascale system ~$200M	1 exascale systems ~$600 M	--	5-6	$2B - $2.3B
2023	1 or 2 exascale system ~$350M - $400M each	1 or 2 exascale systems ~$375M	1 near-exascale system ~200M	2 exascale system ~1.1M	--	5-7	$2B - $2.8B
2024	1 exascale system ~$350M - $400M each	2 exascale (Germany & UK) ~ $350M	?	1 or 2 exascale systems ~$600M each	1 exascale system ~$200M	5-6	$1.9B - $2.5B
2025	1 exascale systems ~$350M - $400M each	1 or 2 exascale systems ~$375M (each)	1 exascale system ~$200M	1 or 2 exascale systems ~$500M each	1 exascale system ~$200M	5-7	$1.5B - $2.3B
2026	1 or 2 exascale systems ~$350M - $400M each	1 or 2 exascale systems ~$375M	?	2 exascale systems ~$500M each	1 or 2 exascale systems ~$200M	5-8	$1.9B - $2.8B
Total	**6-10**	**8-10**	**3+**	**7-9**	**3-4**	**28-39**	**$11B - $15B**

* Includes S. Korea, Singapore, Australia, Russia, Canada, India, Israel, Saudi Arabia, etc.

Source: Hyperion Research, May 2021

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Some Results From Our End-user Study

4.2 Years Is The Average Life Of An HPC System Today

From our just released end-user MCS study

Regarding your LARGEST HPC system -- How many years do you plan to keep this system?		
	Responses	**Percent**
Less than two years	11	8.3%
Two years	12	9.0%
Three years	24	18.0%
Four years	27	20.3%
Five years	33	24.8%
Six years	13	9.8%
Seven years	7	5.3%
Eight years or more	6	4.5%
n = 133		
Source: Hyperion Research, 2021		

83% Of Sites Have Accelerators Or Co-processors Today

From our just released end-user MCS study

How many co-processors or accelerators are in your largest HPC technical server?		
	Responses	**Percent**
None	23	17.3%
Less than 32	28	21.1%
32 to less than 64	18	13.5%
64 to less than 100	19	14.3%
100 to less than 500	18	13.5%
500 to less than 1,000	11	8.3%
1,000 to less than 5,000	10	7.5%
5,000 to less than 10,000	4	3.0%
10,000 or more	2	1.5%
n = 133		
Source: Hyperion Research, 2021		

Use Of Different AI/ML/DL Approaches

From our just released end-user MCS study

36) Which categories will your top AI and/or data-intensive analytics applications fall under in the next 1 to 2 years?		
	Responses	Percent
Machine learning	99	70.2%
Deep learning	86	61.0%
Graph analysis	25	17.7%
Cognitive computing	24	17.0%
Semantic analysis	22	15.6%
Other big data/analytics	41	29.1%
We don't plan to run applications of these types	9	6.4%
n = 141		
Source: Hyperion Research, 2021		

Largest Application Runtime

From our just released end-user MCS study

- ~33% of the #1 applications run for over 24 hours

32.a.i) Please characterize the TOP #1 APPLICATION (most important) used at your site - Typical run time:		
	Responses	Percent
Less than 5 minutes	3	2.1%
5 minutes to less than 1 hour	11	7.8%
1 hour to less than 5 hours	20	14.2%
5 hours to less than 10 hours	16	11.3%
10 hours to less than 24 hours	27	19.1%
24 hours to less than 100 hours	28	**19.9%**
100 hours to less than 250 hours	15	**10.6%**
250 hours to less than 1,000 hours	3	**2.1%**
1,000 hours or more	11	7.8%
n = 141		

Source: Hyperion Research, 2021

Programming Models Used Today

A large mix of models are used today

15) What parallel programming languages/models do you use?		
	Responses	Percent
C/C++ (all types)	112	79.4%
Python	104	73.8%
CUDA	74	52.5%
MPI	73	51.8%
OpenMP	68	48.2%
Fortran (all types)	67	47.5%
R	59	41.8%
MATLAB	55	39.0%
Java	42	29.8%
OpenCL	34	24.1%
Mathematica	26	18.4%
Pthreads	24	17.0%
Scala	20	14.2%
Ruby	18	12.8%
Julia	15	10.6%
SHMEM	15	10.6%
Coarray Fortran	14	9.9%
PGAS	14	9.9%
PVM	4	2.8%
Cilk	3	2.1%
Other	8	5.7%
n = 141		

Source: Hyperion Research, 2021

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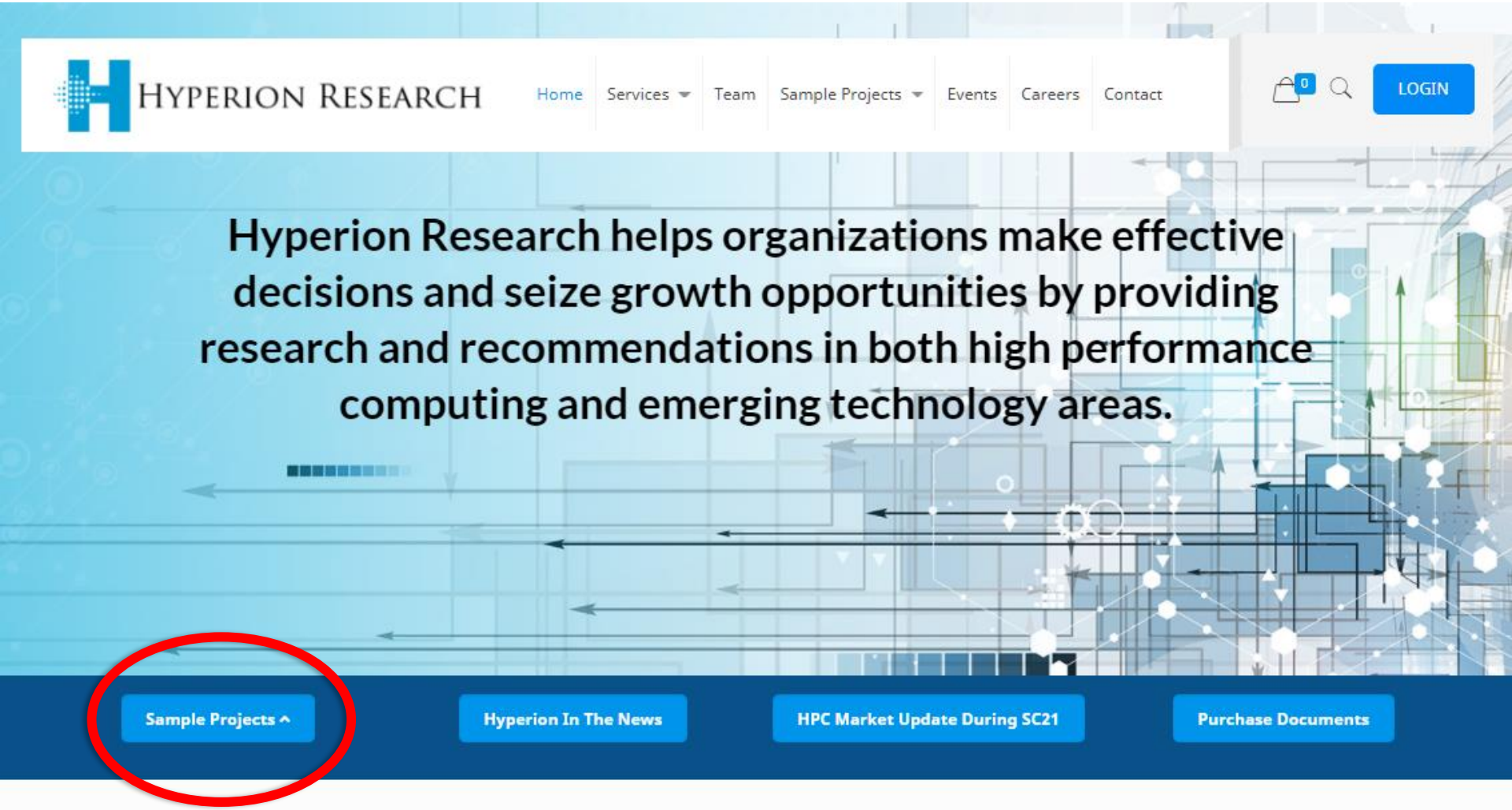

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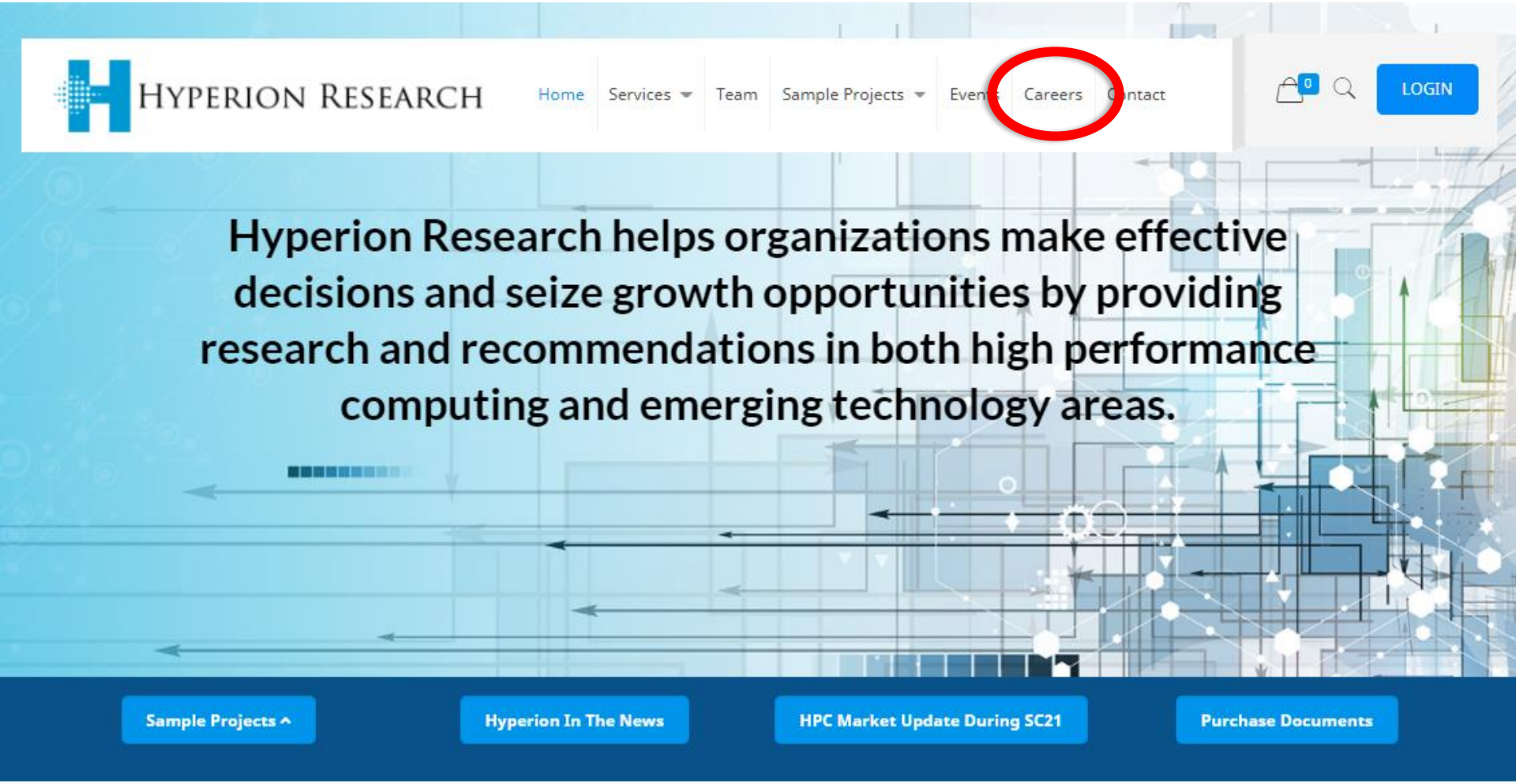

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QUESTIONS?

Questions or comments are welcome.

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