HPC And Oil/Gas Market Update

September 2021

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Earl Joseph, Hyperion Research

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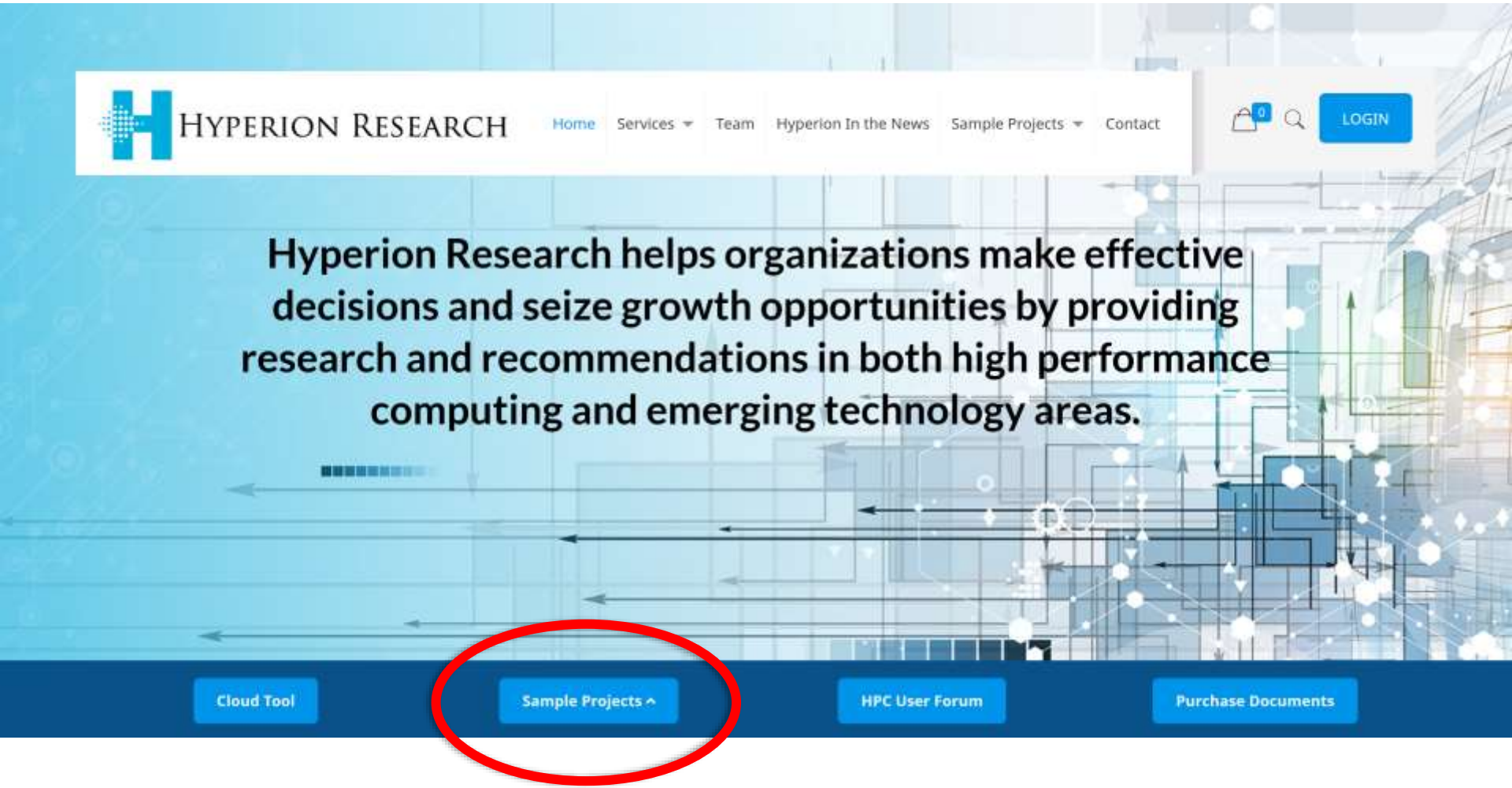
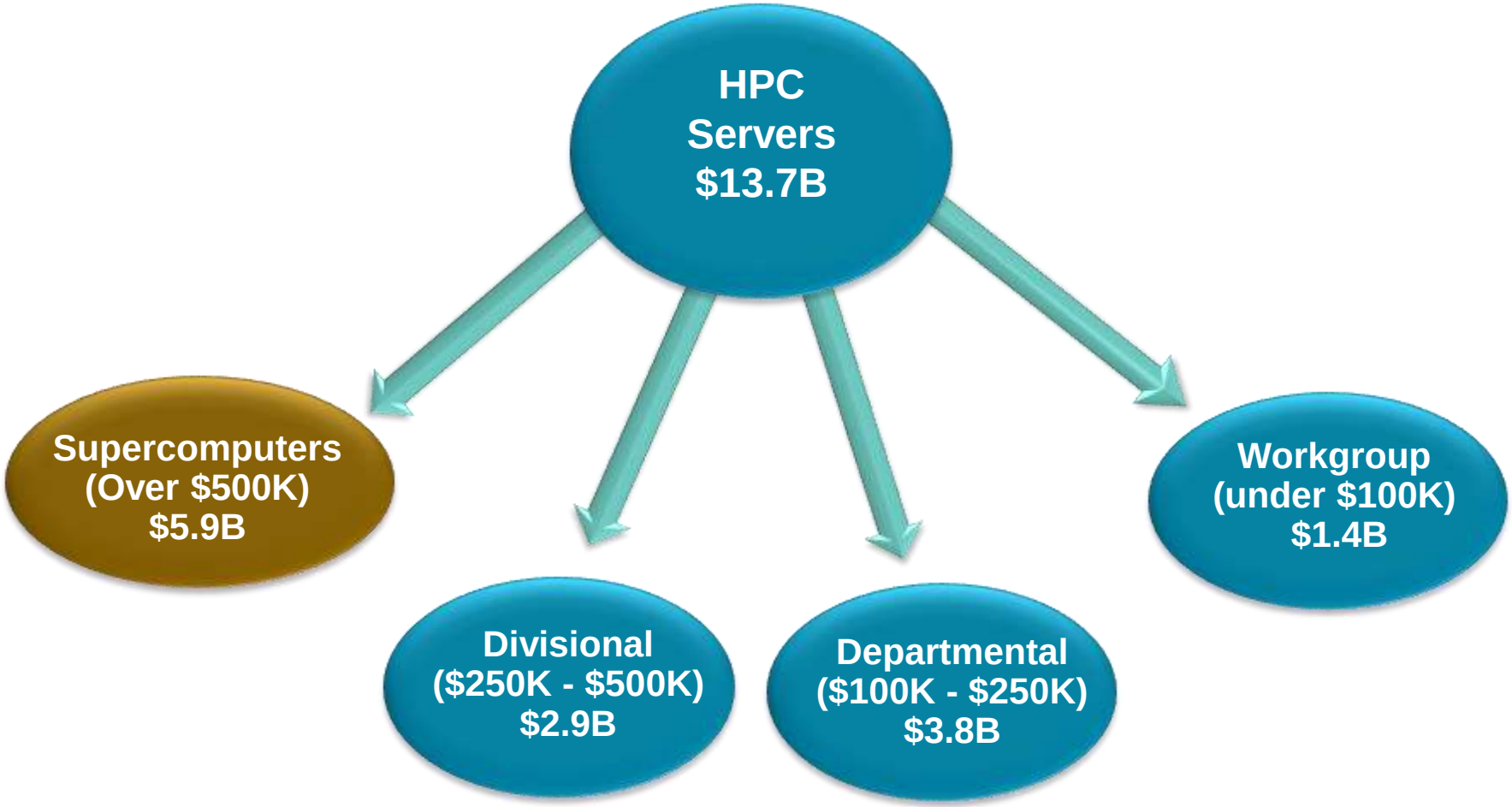


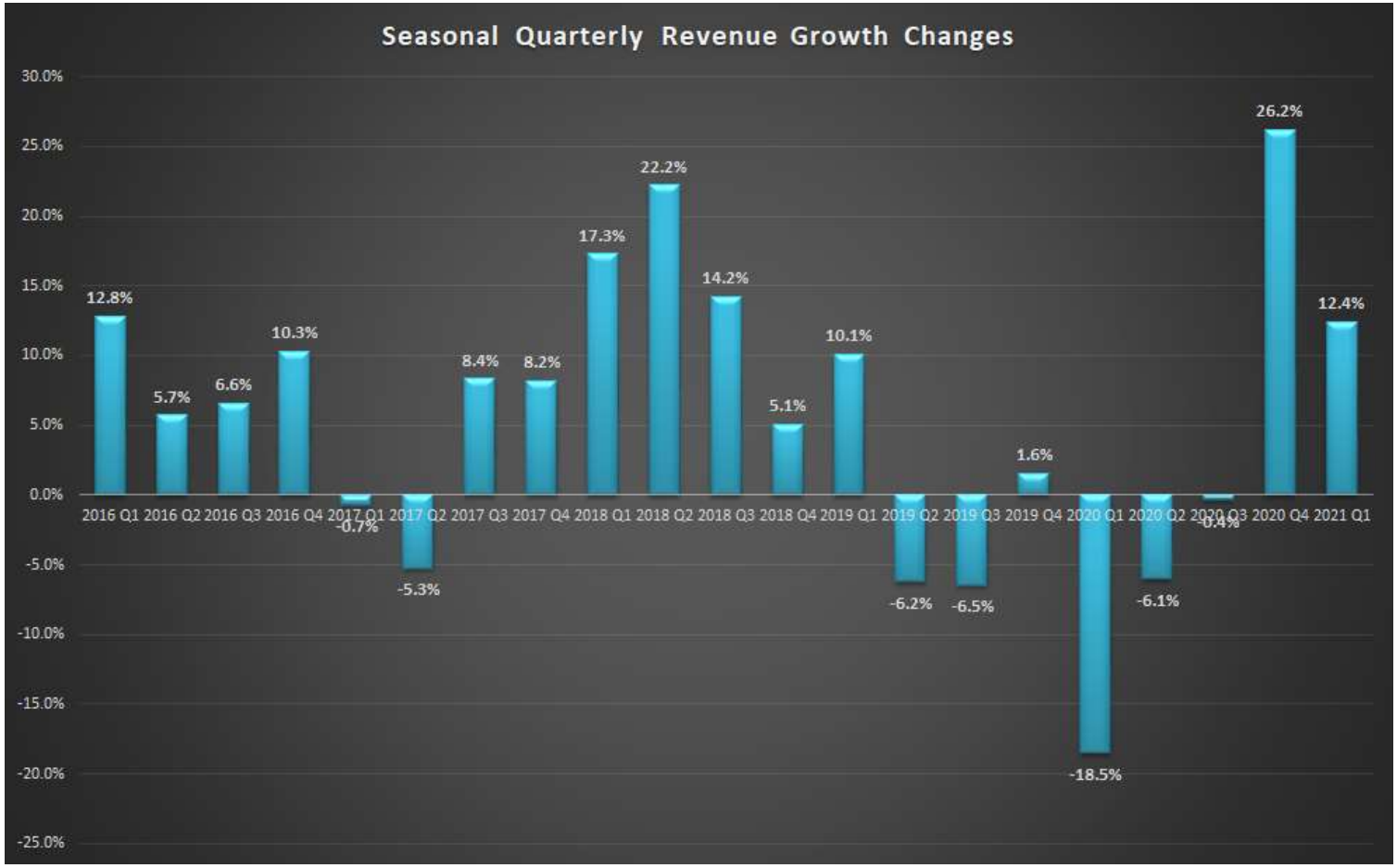
The 2020 Worldwide On-Prem HPC Server Market: $13.7 Billion (up 1.1%)

2021 is projected to be around $13.8B, and 2022 $16.3B



Quarterly Changes In Growth Rates

- *The last two quarters are showing a return to growth*
- *Major up and down cycles*



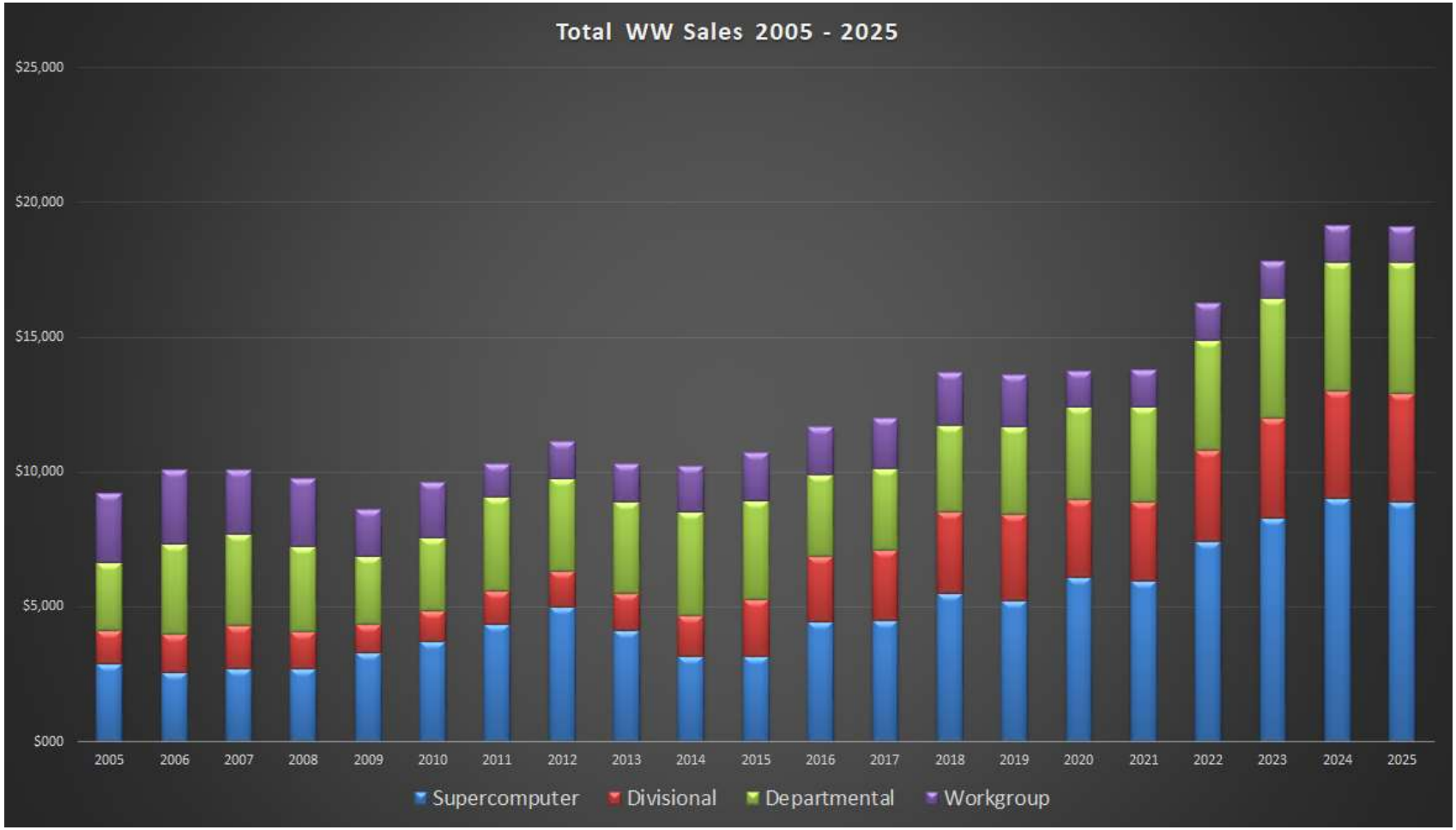
WW HPC Market By Verticals And Vendors ($millions)

	2020
Bio-Sciences	$1,323
CAE	$1,560
Chemical Engineering	$156
DCC & Distribution	$754
Economics/Financial	$639
EDA / IT / ISV	$747
Geosciences	$865
Mechanical Design	$049
Defense	$1,361
Government Lab	$3,364
University/Academic	$2,189
Weather	$585
Other	$151
Total Revenue	$13,744

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%

A 20-year View Of The HPC Market In Revenues ($millions)

Showing the multiple ups and downs



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	$13,595	$13,744
Storage	$5,379	$5,512
Middleware	$1,599	$1,616
Applications	$4,647	$4,676
Service	$2,218	$2,182
Total Revenue	**$27,438**	**$27,731**

Source: Hyperion Research, August 2021

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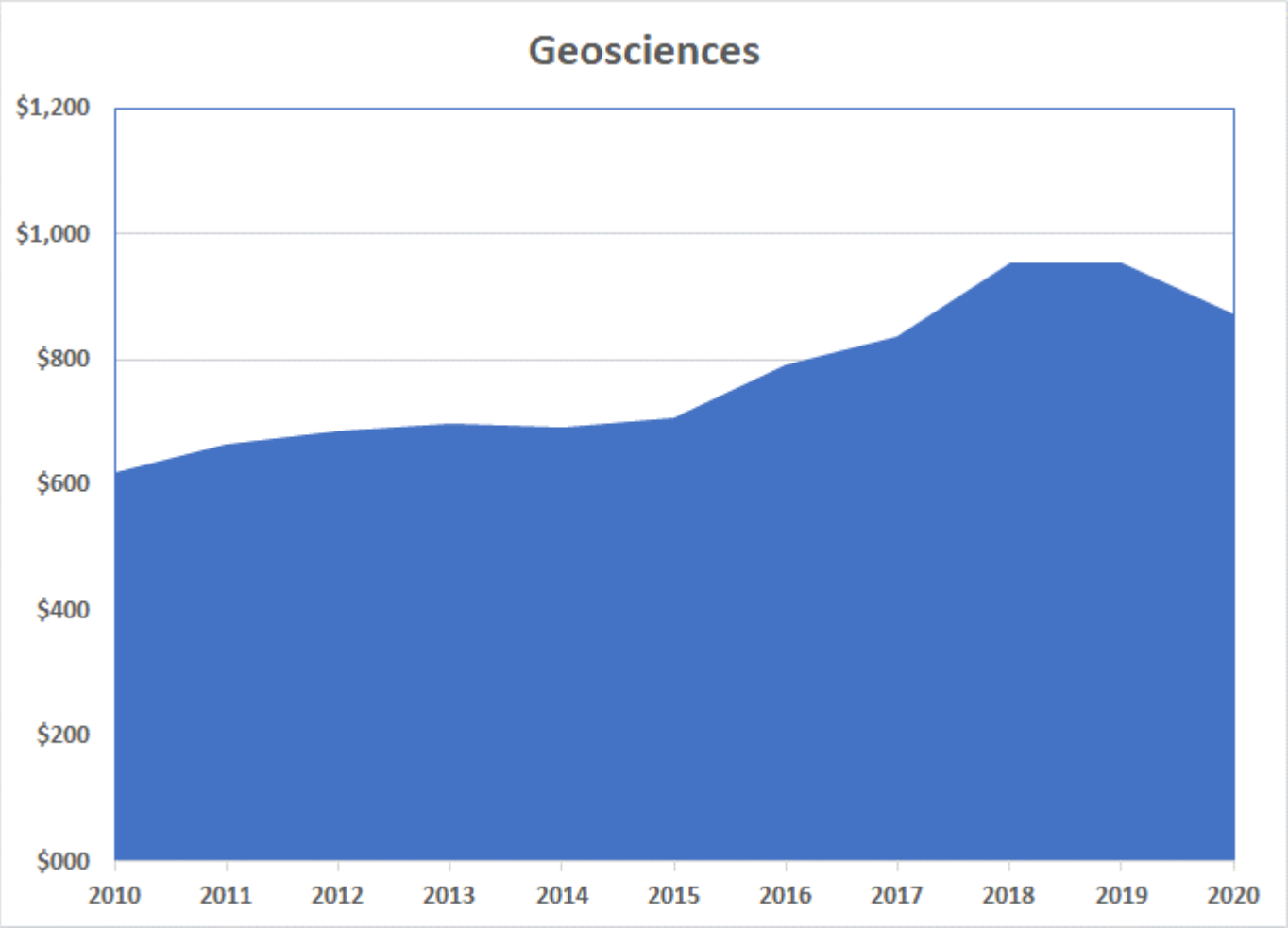
HPC In The Oil/Gas Sector

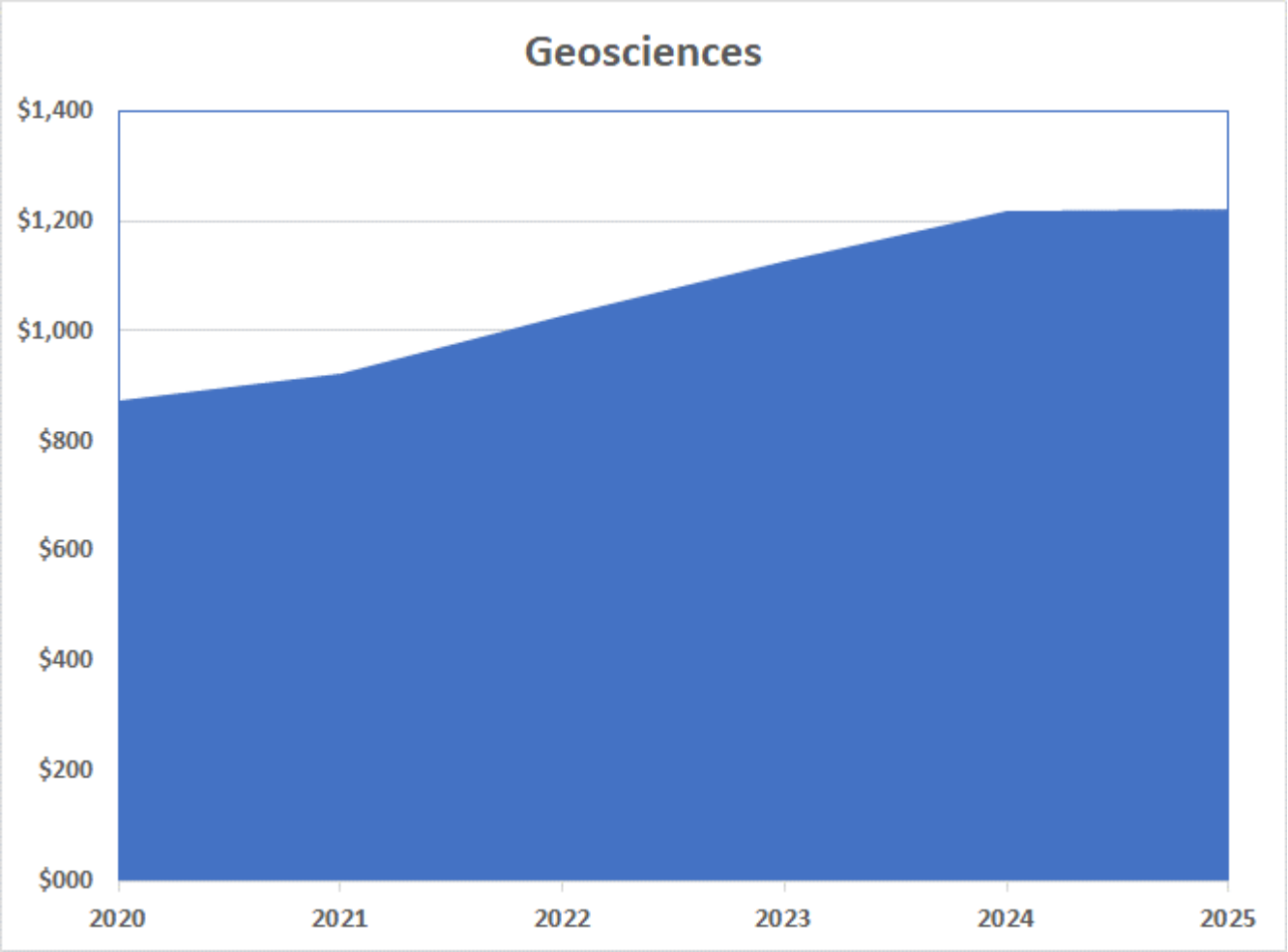
On-Prem HPC In Oil/Gas Over The Last Decade ($ millions)

Steady growth until 2019 & 2020



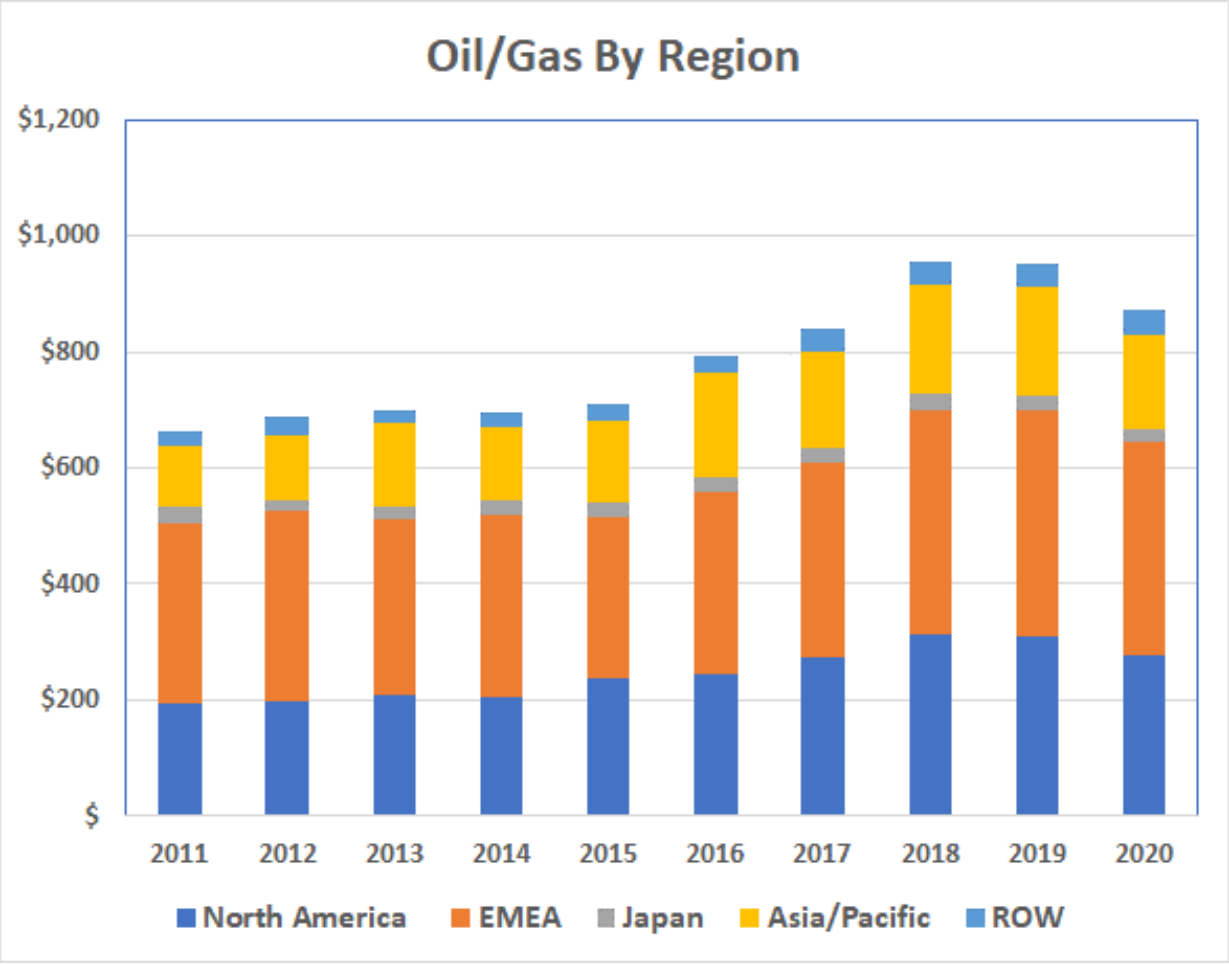
Expected Future Use Of On-Premises HPC In Oil/Gas ($ millions)

Expecting strong growth from 2021 to 2024



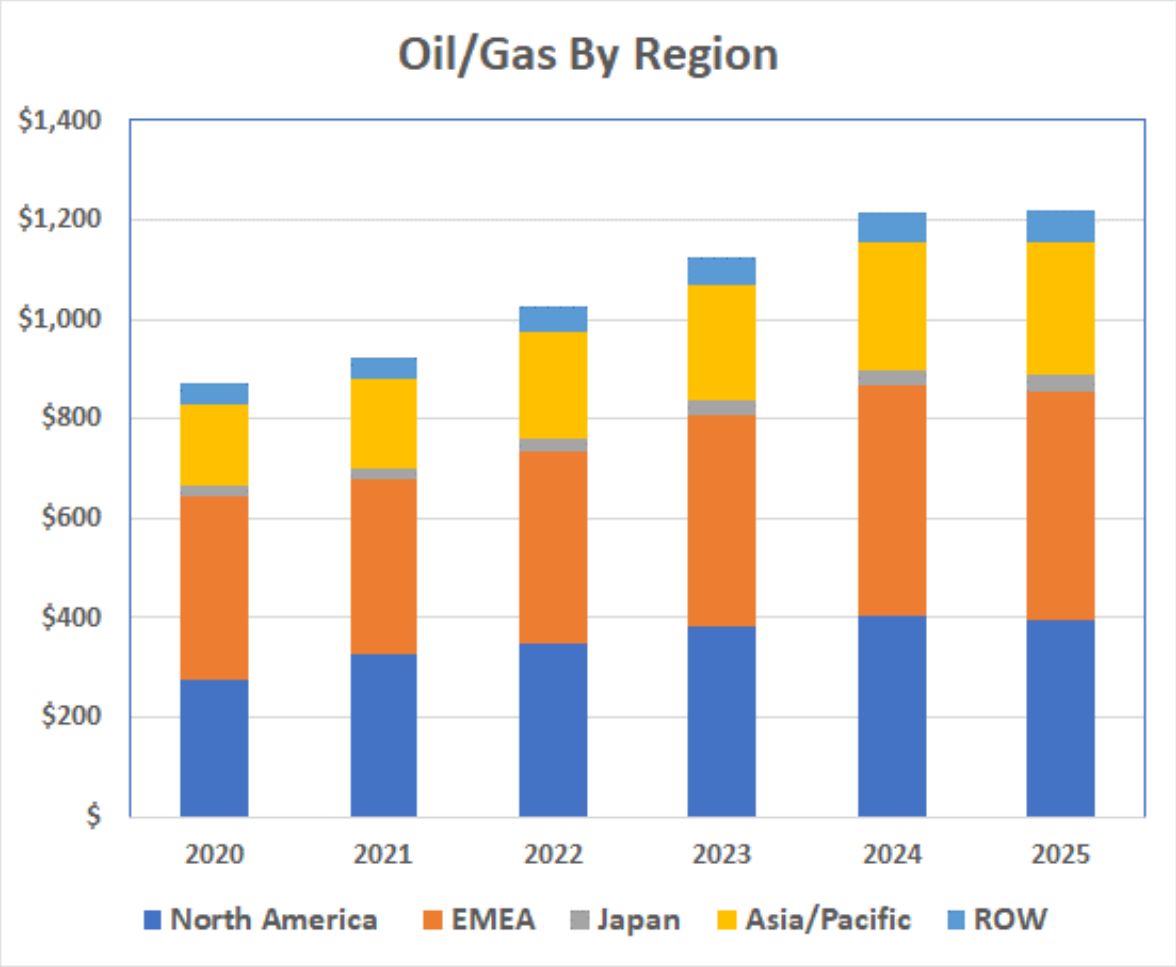
Historic Regional Use Of HPC In Oil/Gas ($ millions)

EMEA and North America purchase the most on-premises HPC



Forecasted Regional Use Of HPC In Oil/Gas ($ millions)

EMEA and North America are expected to grow the most



Changes In Oil/Gas

Performance results varies greatly across companies

- **System sizes continue to grow**
- **The type HPC used varies greatly by organization:**
  - GPUs vs. CPU only
  - Using public clouds
  - Using new software/applications vs. using ISV codes
  - Applying new technologies vs. using mostly existing commodity technologies
- **Success with new technologies varies greatly:**
  - Cost of using a cloud-based solution
  - Use of GPUs
- **New powerful base processors help a lot (e.g., ARM-based CPUs)**

The ROI In Oil/Gas From HPC Is High

The average ROI is $416 for revenue, and on average $54 for profits/cost savings in oil/gas

Overall results continue to indicate substantial returns for investments in HPC:

- The data now covers 763 successful HPC projects
- On average $507 dollars in revenue per dollar of HPC invested was generated (excluding outliers)
- On average $47 dollars of profit (or cost savings) per dollar of HPC invested was generated (excluding outliers)

Note that this research is looking at the economic impacts based on the HPC investment compared with the output of revenue/sales and/or profits and cost savings. It excludes the additional costs of production, sales etc. that are also required for each project.

The full data and results of this research are available at: www.hpcuserforum.com/ROI/

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Interesting Recent Key Findings

AI In HPC Trends

AI, ML and DL are driving growth in HPC

- **The majority of respondents (92.8%) use AI applications at least some of the time**
  - But on average AI jobs make up only 18.9% of all HPC workloads at the surveyed sites
- **A majority (68.0%) of respondents run simulation and analytics workloads today on the same HPC system**
- **More than half of the surveyed sites (56.7%) run at least some AI-HPDA workloads in external clouds today**
  - This figure jumps significantly to 74.7% within 18 months

Updated AI Forecasts

Dedicated AI servers growing more than 4X faster than overall on-prem servers

Table 1

Forecast: Worldwide HPC-Based AI Revenues vs Total HPDA Revenues ($ Millions)

	2018	2019	2020	2021	2022	2023	2024	2025	CAGR '20-'25
COVID-Impacted HPC Server Revenues	$13,679	$13,595	$13,744	$13,779	$16,241	$17,756	$19,152	$19,087	6.8%
HPDA Server Revenues	$3,153	$3,598	$3,499	$4,500	$5,467	$6,550	$6,931	$7,243	15.7%
HPC-Based AI (ML, DL & Other)	$747	$918	$1,039	$1,500	$2,010	$2,745	$3,725	$4,362	33.2%

Source: Hyperion Research, 2021

Table 2

Forecast: Worldwide ML, DL & Other AI HPC-Based Revenues ($ Millions)

	2018	2019	2020	2021	2022	2023	2024	2025	CAGR '19-'24
ML in HPC	$532	$667	$719	$1,039	$1,366	$1,816	$2,398	$2,747	30.7%
DL in HPC	$177	$209	$263	$390	$560	$804	$1,129	$1,382	39.4%
Other AI in HPC	$38	$42	$57	$71	$84	$125	$199	$232	32.4%
Total	$747	$918	$1,039	$1,500	$2,010	$2,745	$3,725	$4,362	33.2%

Source: Hyperion Research, 2021

- **Dedicated Deep Learning systems are growing at a faster rate than ML-dedicated systems**

Coprocessors & GPUs Trends

Wide use of GPUs or coprocessors, but low overall system counts

- **More than 82% of respondents report having GPUs or coprocessors in their largest HPC system, up from two-thirds of respondents (69.4%) in our 2020 study**
  - More than 88% of respondents report having co-processors/accelerators in least one of their HPC technical servers
  - However, the most chosen response (21.1%) for the number of co-processors or accelerators in their largest system was less than 32
  - Only about 20% had more than 500 coprocessors or accelerator in their largest system

Software Trends

Job sizes continue to grow in scale and complexity

Operating System Preferences

- Red Hat Linux is the most popular operating system across all sectors, with more than a third of respondents reporting this is the primary operating system on their largest HPC system
- CentOS and Ubuntu Linux are also popular choices

Parallel programming languages and models are extremely common and varied across HPC sites, with each site reportedly using an average of 6 different languages or models

- C/C++, Python, CUDA, and MPI were each used at least half of respondent sites

SLURM Has Become the Most Popular Resource Manager

- SLURM was the most commonly cited job queueing, resource manager, or scheduling software across all sectors, used at nearly half of respondent sites

Increasing Run-Times for Top Applications

- 40% of respondents reported the #1 application at their site runs for more than 24 hours

In Summary

Conclusions

- **The pandemic was expected to impact 2020 by ~8% decline, but Fugaku made 2020 a growth year!**
  - 2022 to 2024 are expected to be strong growth years
    - Exascale systems will drive growth in 2022 to 2024
    - AI, HPDA, big data are hot growth areas
    - HPC in the cloud will lift the sector writ large
- **New technologies are showing up in larger numbers:**
  - Processors, AI hardware & software, memories, etc.
- **The cloud has become a viable option for many HPC workloads**
- **Storage will likely see major growth driven by AI, big data and the need for much larger data sets**

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QUESTIONS?

Questions or comments are welcome.

Please contact us at:

info@hyperionres.com