



# Highlights of the 55<sup>th</sup> TOP500 List

ISC 2020,  
Frankfurt,  
June 22, 2020

Erich  
Strohmaier

# ISC20 TOP500 AWARDS

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- TOP500: Europe #1, #3, #2, #1
- HPCG #1
- HPL-AI #1
- Green500 #1

The logo features the word "TOP" in white on an orange speech bubble, followed by "500" in large black font and "CERTIFICATE" in large grey font. Below "500" is the text "The List." in a smaller grey font.

**TOP 500 CERTIFICATE**  
The List.

**HPC5 - PowerEdge C4140, Xeon Gold 6252 24C 2.1GHz, NVIDIA Tesla V100, Mellanox HDR**

**Infiniband**

**Eni S.p.A., Italy**

is ranked

**No. 1 in Europe**

among the World's TOP500 Supercomputers

with 35.45 Pflop/s Linpack Performance

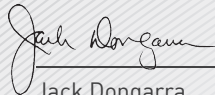
in the 55<sup>th</sup> TOP500 List published at the ISC 2020 Digital

on June 22nd, 2020.

Congratulations from the TOP500 Editors



Erich Strohmaier  
NERSC/Berkeley Lab



Jack Dongarra  
University of Tennessee



Horst Simon  
NERSC/Berkeley Lab



Martin Meuer  
Prometheus



**TOP 500 CERTIFICATE**  
The List.

**Sierra - IBM Power System AC922, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband**

**DOE/NNSA/LLNL, United States**

is ranked

**No. 3**

among the World's TOP500 Supercomputers

**with 94.64 Pflop/s Linpack Performance**

in the 55<sup>th</sup> TOP500 List published at the ISC 2020 Digital

Conference on June 22nd, 2020.

Congratulations from the TOP500 Editors



Erich Strohmaier  
NERSC/Berkeley Lab



Jack Dongarra  
University of Tennessee



Horst Simon  
NERSC/Berkeley Lab



Martin Meuer  
Prometeus



Summit - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100,  
Dual-rail Mellanox EDR Infiniband

DOE/SC/Oak Ridge National Laboratory, United States

is ranked

**No. 2**

among the World's TOP500 Supercomputers

with 148.6 Pflop/s Linpack Performance

in the 55<sup>th</sup> TOP500 List published at the ISC 2020 Digital  
Conference on June 22nd, 2020.

Congratulations from the TOP500 Editors

A handwritten signature in black ink, appearing to read 'Erich Strohmaier'.

Erich Strohmaier  
NERSC/Berkeley Lab

A handwritten signature in black ink, appearing to read 'Jack Dongarra'.

Jack Dongarra  
University of Tennessee

A handwritten signature in black ink, appearing to read 'Horst Simon'.

Horst Simon  
NERSC/Berkeley Lab

A handwritten signature in black ink, appearing to read 'Martin Meuer'.

Martin Meuer  
Prometeus



# TOP 500 CERTIFICATE

The List.

**Supercomputer Fugaku - A64FX 48C 2.2GHz, Tofu interconnect D**

**RIKEN Center for Computational Science, Japan**

is ranked

**No. 1**

among the World's TOP500 Supercomputers

**with 415.53 Pflop/s Linpack Performance**


in the 55<sup>th</sup> TOP500 List published at the ISC 2020 Digital

Conference on June 22nd, 2020.

Congratulations from the TOP500 Editors



Erich Strohmaier  
NERSC/Berkeley Lab



Jack Dongarra  
University of Tennessee



Horst Simon  
NERSC/Berkeley Lab



Martin Meuer  
Prometheus

# HPCCG

JUNE 2020

PRESENTED AT



NUMBER 1

SYSTEM

## Fugaku

Riken R-CCS  
Riken Center for Computational Science  
JAPAN

ACHIEVED

## 13.4

Pflop/s

JACK DONGARRA

MICHAEL HEROUX

PIOTR LUSZCZEK

IN COLLABORATION WITH



SPONSORED BY



# HPL-AI

JUNE 2020

NUMBER 1 SYSTEM

1

## Fugaku

Riken R-CCS  
Riken Center for Computational Science  
JAPAN

ACHIEVED

**1.42** Eflop/s

  
Jack Dongarra

  
Piotr Luszczek

  
INNOVATIVE  
COMPUTING LABORATORY

  
THE UNIVERSITY OF  
TENNESSEE  
KNOXVILLE

PRESENTED AT

  
ISC  
High Performance





# CERTIFICATE

**MN-3 - MN-Core Server, Xeon 8260M 24C 2.4GHz, MN-Core, RoCEv2/MN-Core  
DirectConnect**

**Preferred Networks, Japan**

is ranked

**No. 1 in the Green500**

among the World's TOP500 Supercomputers

**with 21.11 GFlops/Watt Linpack Power-Efficiency**

on the Green500 List published at ISC 2020 Digital Conference, June 22nd, 2020

Congratulations from the Green500 Editors

A handwritten signature in black ink, appearing to read 'Wu-chun Feng', written over a horizontal line.

Wu-chun Feng  
Virginia Tech

A handwritten signature in black ink, appearing to read 'Kirk Cameron', written over a horizontal line.

Kirk Cameron  
Virginia Tech

# ISC20 TOP500 TOPICS

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- A new and exciting #1
- Exaflops on the HPL-AI
- A renewed TOP10
- Green500 shows Progress
- Low Market Turnover
- Research Market vs Commercial Market

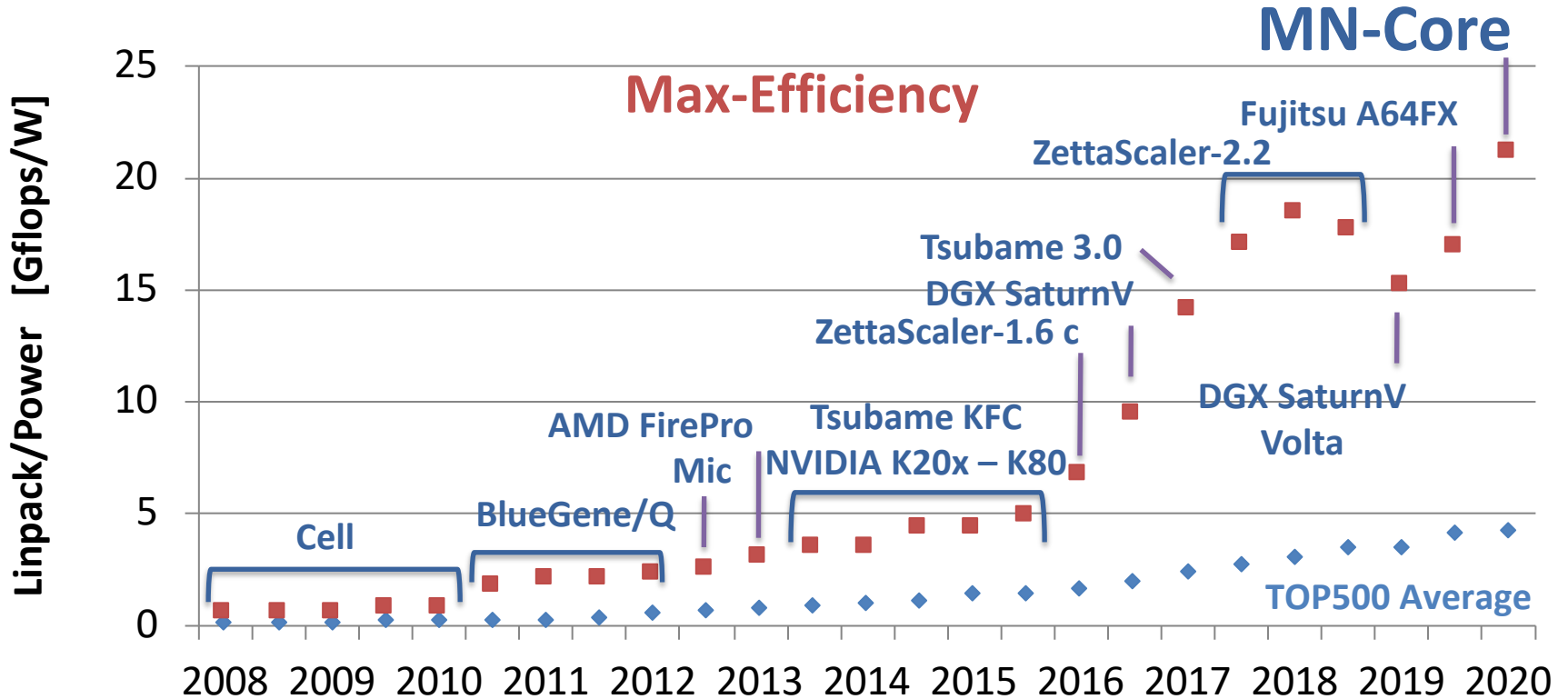
#	Site	Manufacturer	Computer	Country	Cores	Rmax [Pflops]	Power [MW]
1	RIKEN Center for Computational Science	Fujitsu	<b>Fugaku</b> Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D	Japan	7,299,072	415.5	28.3
2	Oak Ridge National Laboratory	IBM	<b>Summit</b> IBM Power System, P9 22C 3.07GHz, Mellanox EDR, NVIDIA GV100	USA	2,414,592	148.6	10.1
3	Lawrence Livermore National Laboratory	IBM	<b>Sierra</b> IBM Power System, P9 22C 3.1GHz, Mellanox EDR, NVIDIA GV100	USA	1,572,480	94.6	7.4
4	National Supercomputing Center in Wuxi	NRCPC	<b>Sunway TaihuLight</b> NRCPC Sunway SW26010, 260C 1.45GHz	China	10,649,600	93.0	15.4
5	National University of Defense Technology	NUDT	<b>Tianhe-2A</b> ANUDT TH-IVB-FEP, Xeon 12C 2.2GHz, Matrix-2000	China	4,981,760	61.4	18.5
6	Eni S.p.A	Dell EMC	<b>HPC5</b> PowerEdge C4140, Xeon 24C 2.1GHz, NVIDIA T. V100, Mellanox HDR	Italy	669,760	35.5	2.25
7	NVIDIA Corporation	NVIDIA	<b>Selene</b> DGX A100 SuperPOD, AMD 64C 2.25GHz, NVIDIA A100, Mellanox HDR	USA	277,760	27.6	1.34
8	Texas Advanced Computing Center / Univ. of Texas	Dell	<b>Frontera</b> Dell C6420, Xeon Platinum 8280 28C 2.7GHz, Mellanox HDR	USA	448,448	23.5	
9	CINECA	IBM	<b>Marconi-100</b> IBM Power System AC922, P9 16C 3GHz, Nvidia Volta V100, Mellanox EDR	Italy	347,776	21.6	1.98
10	Swiss National Supercomputing Centre (CSCS)	Cray	<b>Piz Daint</b> Cray XC50, Xeon E5 12C 2.6GHz, NVIDIA Tesla P100, Aries	Switzerland	387,872	21.2	2.38

#	T	Site	Manufacturer	Computer	Country	HPCG [Pflop/s]	Rmax [Pflop/s]	HPCG/ Peak	HPCG/ HPL
1	1	RIKEN-CCS	Fujitsu	<b>Fugaku</b> Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D	Japan	13.400	415.5	2.6%	3.2%
2	2	Oak Ridge National Laboratory	IBM	<b>Summit</b> IBM Power System, P9 22C 3.07 GHz, Volta GV100, EDR	USA	2.926	148.6	1.5%	2.0%
3	3	Lawrence Livermore National Laboratory	IBM	<b>Sierra</b> IBM Power System, P9 22C 3.1 GHz, Volta GV100, EDR	USA	1.796	94.6	1.4%	1.9%
4	6	Eni S.p.A	Dell EMC	<b>HPC5</b> PowerEdge C4140, Xeon 24C 2.1GHz, NVIDIA V100, Mellanox HDR	Italy	0.860	35.5	1.7%	2.4%
5	11	Los Alamos NL / Sandia NL	Cray	<b>Trinity</b> Cray XC40, Intel Xeon Phi 7250 68C 1.4GHz, Aries	USA	0.546	20.2	1.3%	2.7%
6	7	NVIDIA Corporation	NVIDIA	<b>Selene</b> DGX A100 SuperPOD, AMD 64C 2.25GHz, NVIDIA A100, Mellanox HDR	USA	0.509	27.6	1.5%	1.9%
7	12	National Institute of Advanced Industrial Science and Technology	Fujitsu	<b>AI Bridging Cloud Infrastructure (ABCI)</b> PRIMERGY CX2550 M4, Xeon Gold 20C 2.4GHz, IB-EDR, NVIDIA V100	Japan	0.509	19.9	1.6%	2.6%
8	10	Swiss National Supercomputing Centre (CSCS)	Cray	<b>Piz Daint</b> Cray XC50, Xeon E5 12C 2.6GHz, Aries, NVIDIA Tesla P100	Switzerland	0.497	21.2	1.8%	2.4%
9	4	National Supercomputing Center in Wuxi	NRCPC	<b>Sunway TaihuLight</b> NRCPC Sunway SW26010, 260C 1.45GHz	China	0.481	93.0	0.4%	0.5%
10	18	Korea Institute of Science and Technology Information	Cray	<b>Nurion</b> Cray CS500, Intel Xeons Phi 7250 68C 1.4 GHz, OmniPath	South Korea	0.392	13.9	1.5%	2.8%

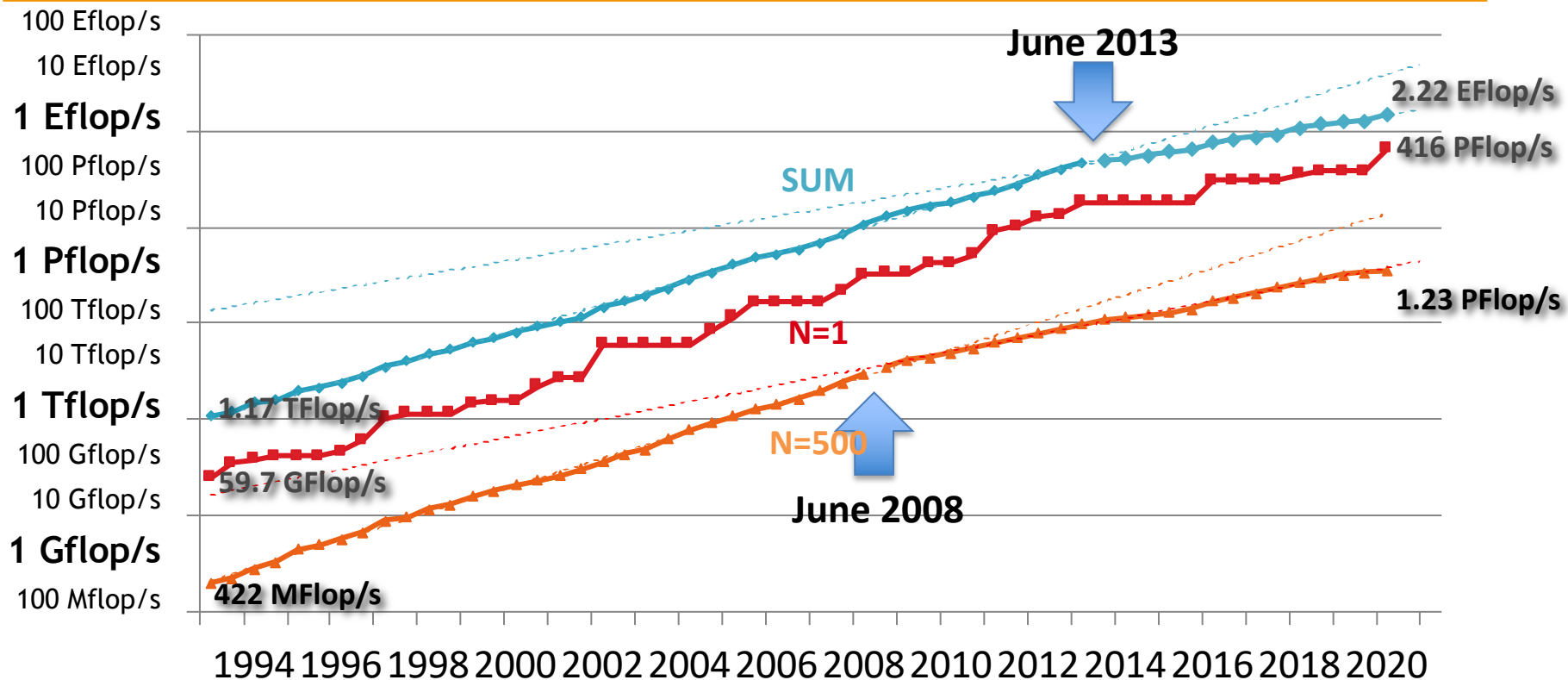
Computer		Interconnect	Accelerator	Rmax/ Power
<b>MN-3</b> , Preferred Network MN-Core Server	Xeon 24C 2.4GHz	RoCEv2/MN-Core DirectConnect	MN-Core	<b>21.1</b>
<b>Selene</b> , NVIDIA DGX A100 SuperPOD	AMD Zen-2 64C 2.25GHz	Mellanox HDR	NVIDIA A100	<b>20.5</b>
<b>NA-1</b> , ZettaScaler-2.2	Xeon 16C 1.3GHz	Infiniband EDR	PEZY-SC2	<b>*18.4</b>
<b>A64FX Prototype</b> , Fujitsu A64FX	Fujitsu A64FX 48C 2GHz	Tofu Interconnect D	-	<b>16.9</b>
<b>AiMOS</b> , IBM Power System AC922	POWER9 20C 3.45GHz	Mellanox EDR	Volta GV100	<b>16.3</b>
<b>HPC5</b> , Dell PowerEdge C4140	Xeon 24C 2.1GHz	Mellanox HDR	Tesla V100 SXM2	<b>15.7</b>
<b>Satori</b> , IBM Power System AC922	POWER9 20C 2.4GHz	Mellanox EDR	Tesla V100 SXM2	<b>15.6</b>
<b>Summit</b> , IBM Power System AC922	POWER9 22C 3.07GHz	Mellanox EDR	Volta GV100	<b>14.7</b>
<b>Supercomputer Fugaku</b> , Fujitsu	A64FX 48C 2.2GHz	Tofu interconnect D	-	<b>14.7</b>
<b>Marconi-100</b> , IBM Power System	Power9 16C 3.0GHz	Mellanox EDR	Volta GV100	<b>14.6</b>

\* Efficiency based on Power optimized HPL runs of equal size to TOP500 run.

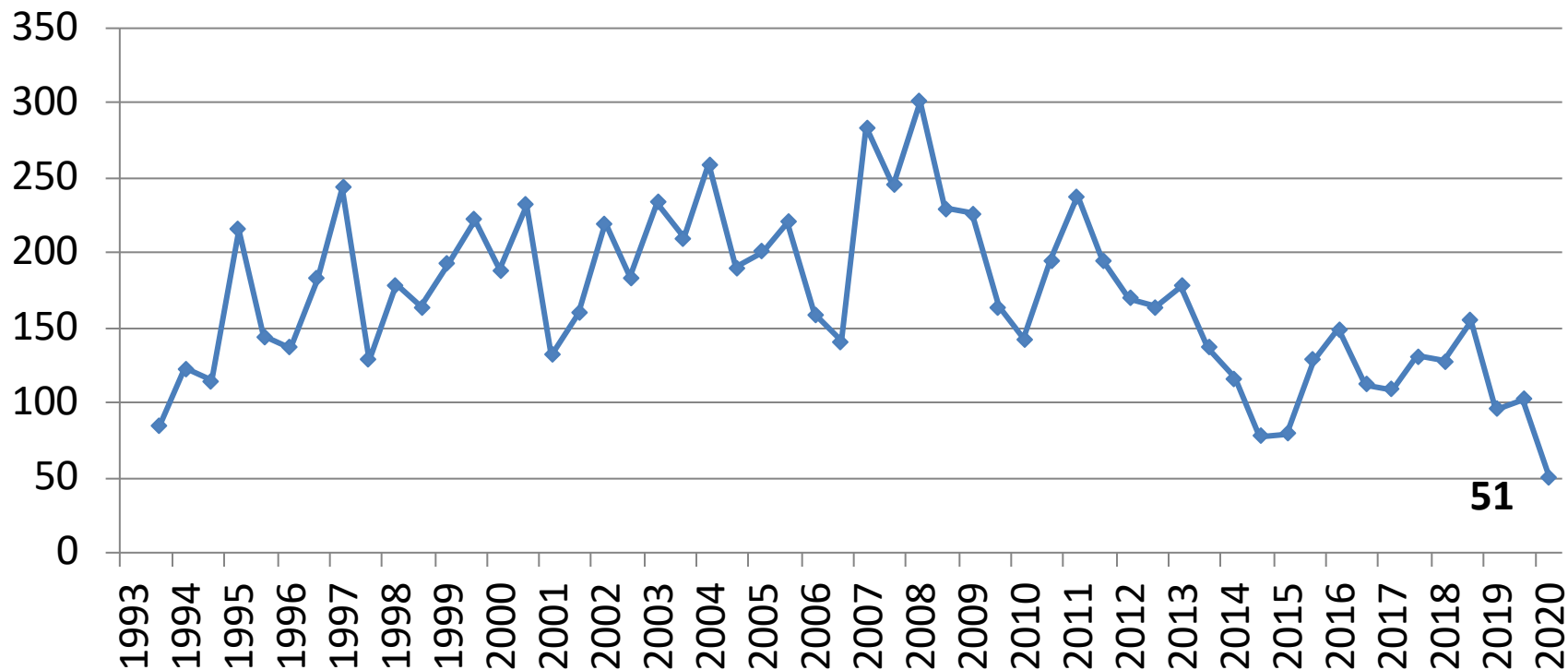
**[Gflops/Watt]**



# PERFORMANCE DEVELOPMENT

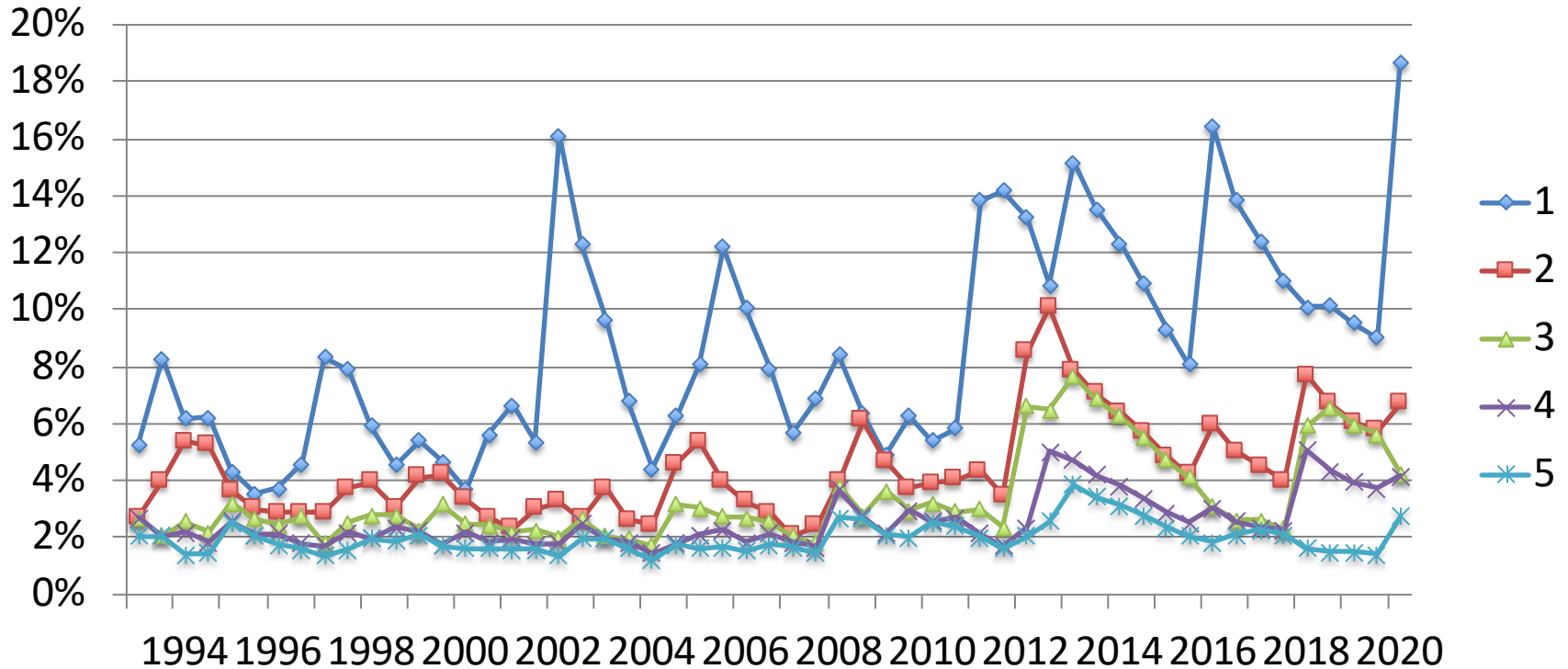


# REPLACEMENT RATE

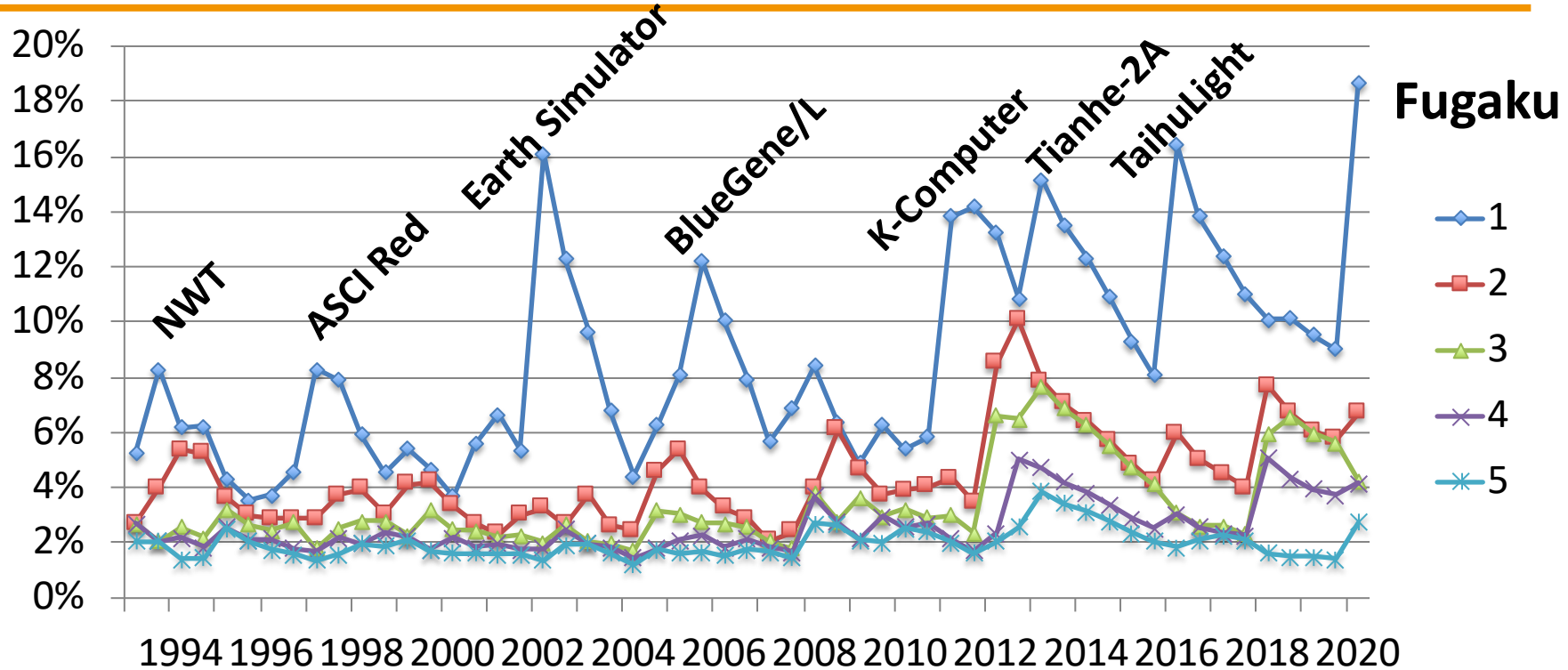




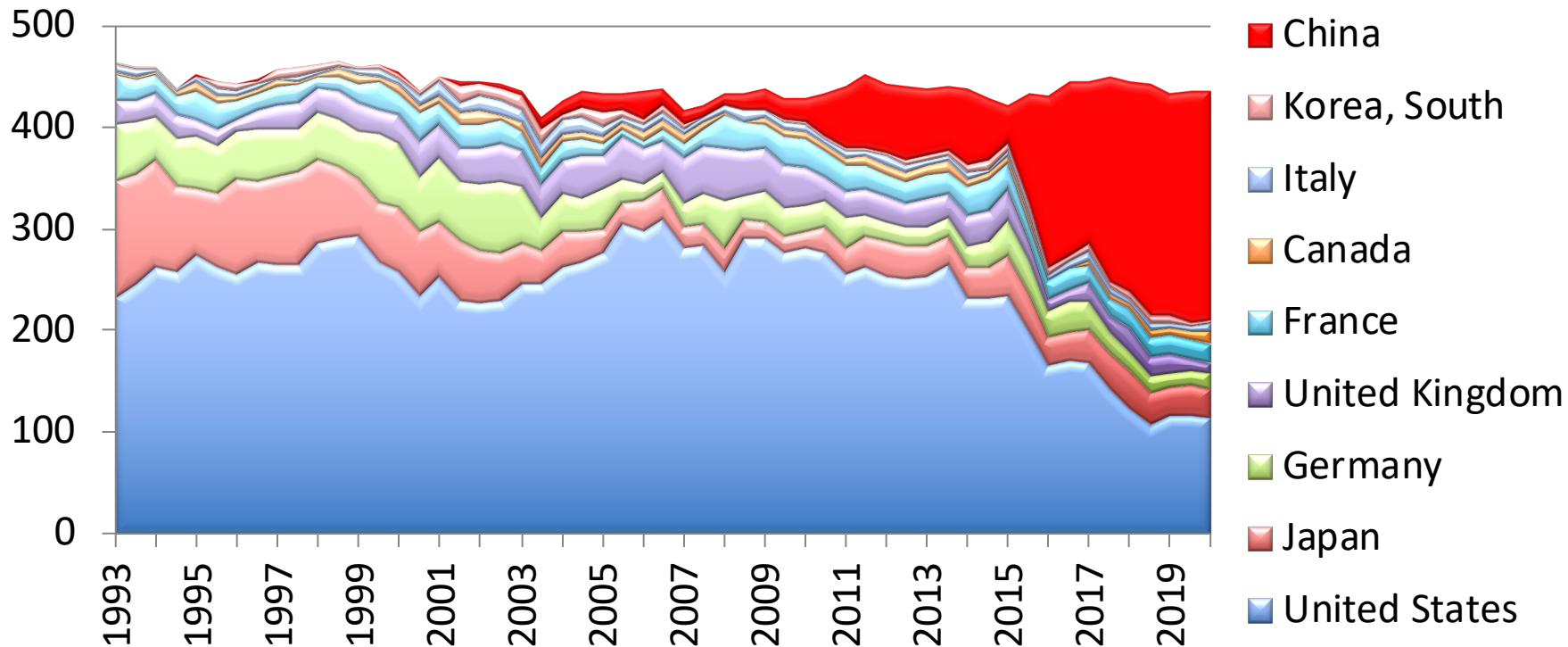
# PERFORMANCE FRACTION OF THE TOP5 SYSTEMS



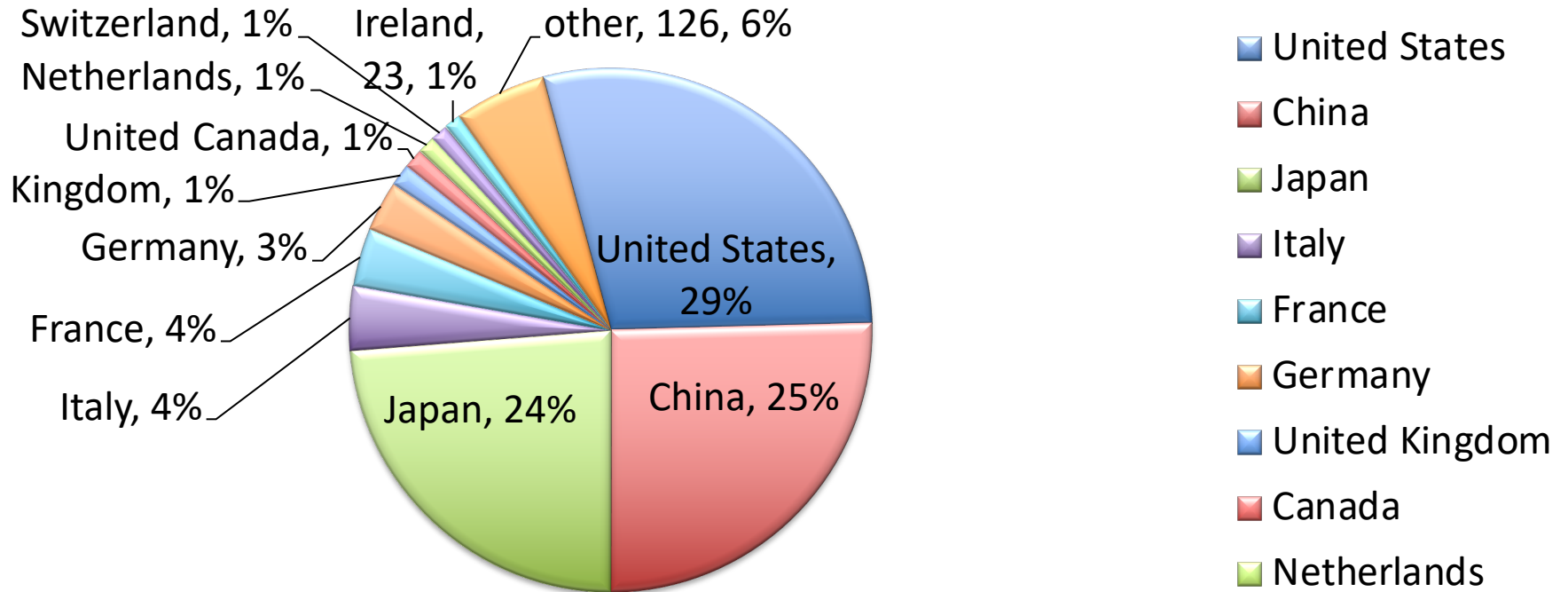
# PERFORMANCE FRACTION OF THE TOP5 SYSTEMS



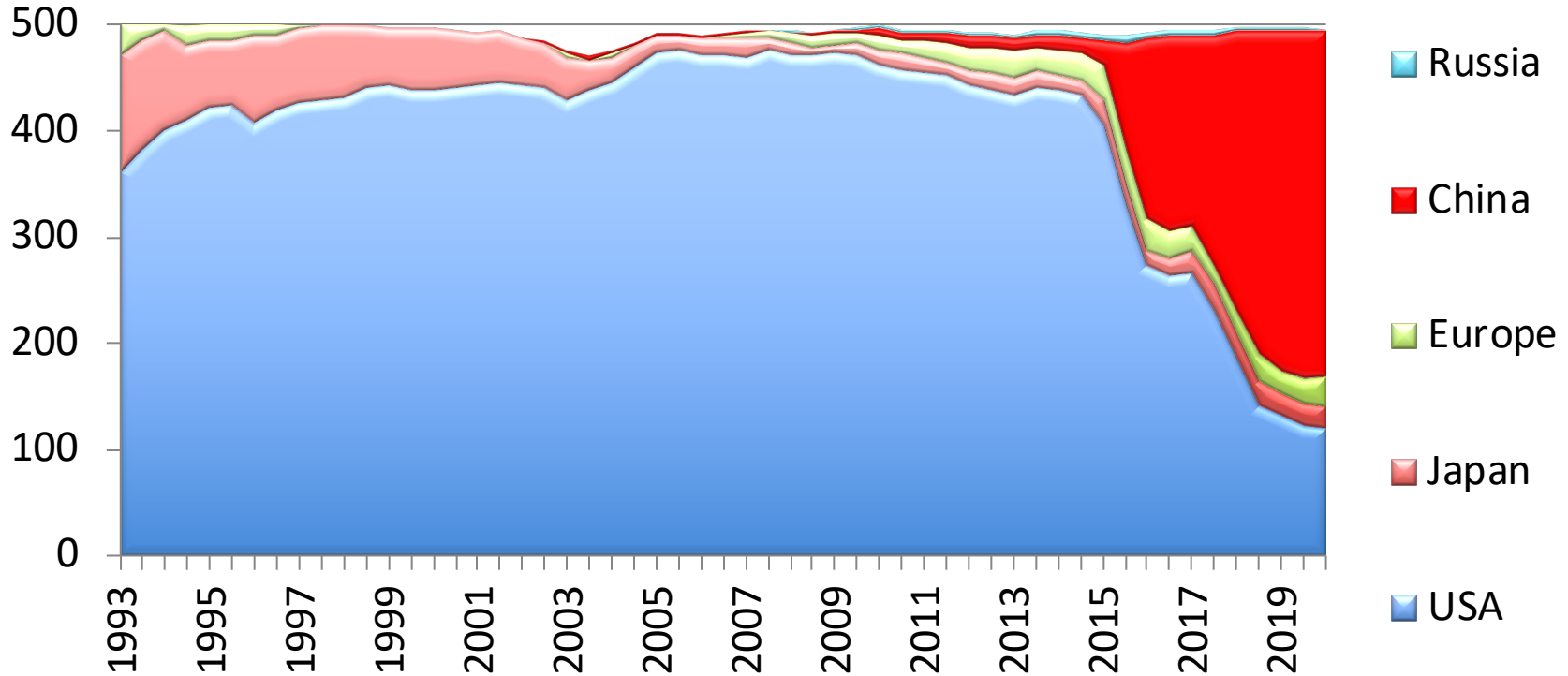
# COUNTRIES



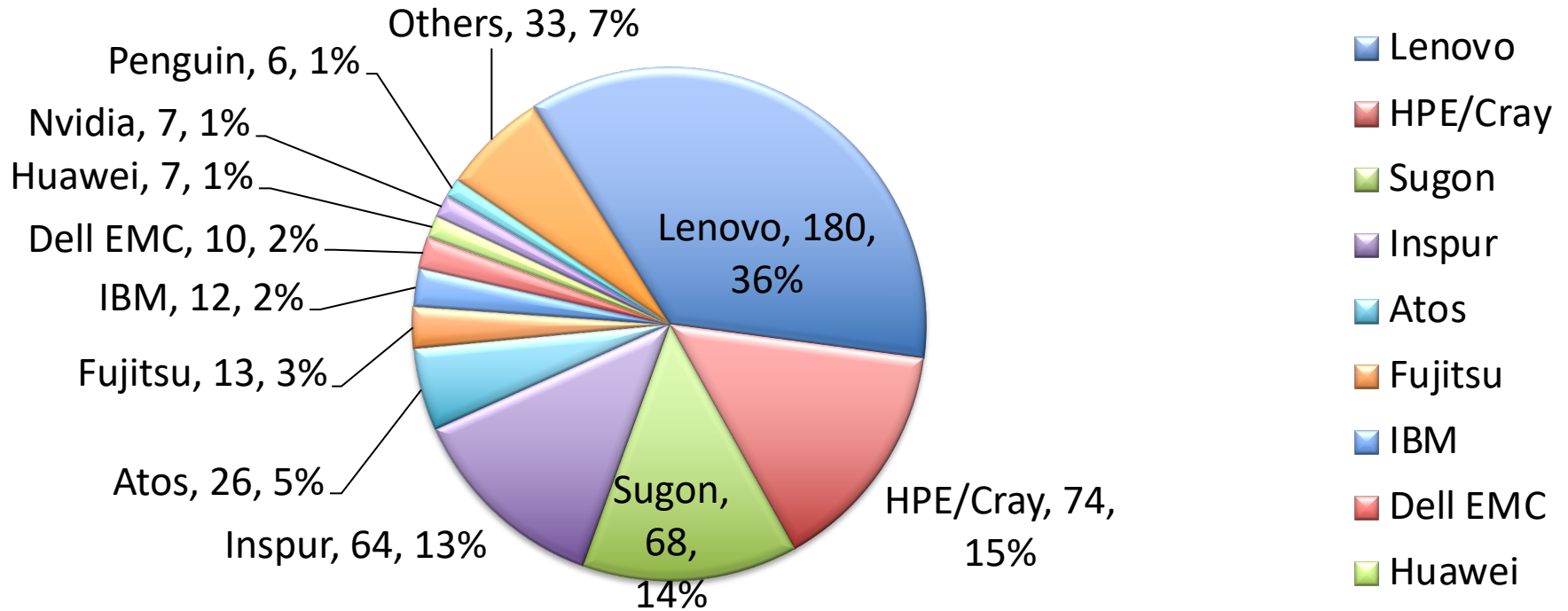
# COUNTRIES / PERFORMANCE SHARE



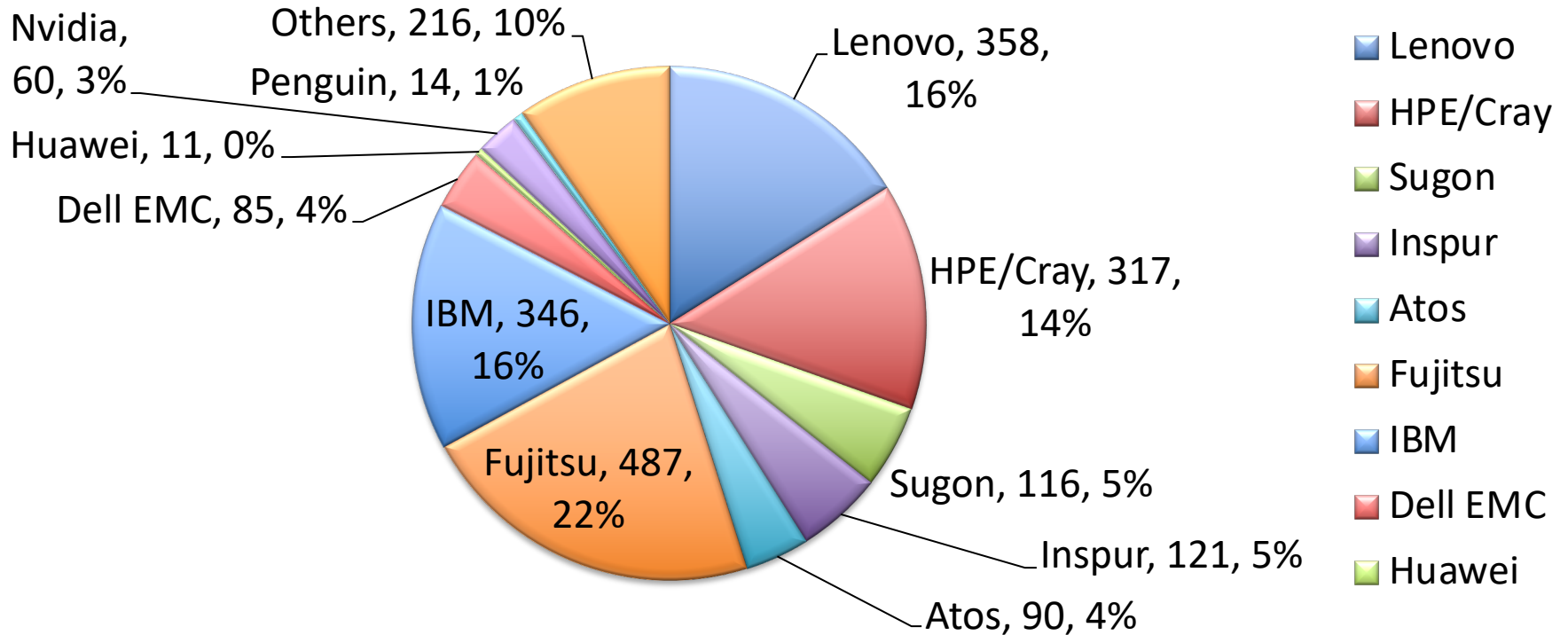
# PRODUCERS



# VENDORS / SYSTEM SHARE



# VENDORS / PERFORMANCE SHARE



Sum of Pflop/s, % of whole list

# RESEARCH / COMMERCIAL MARKETS

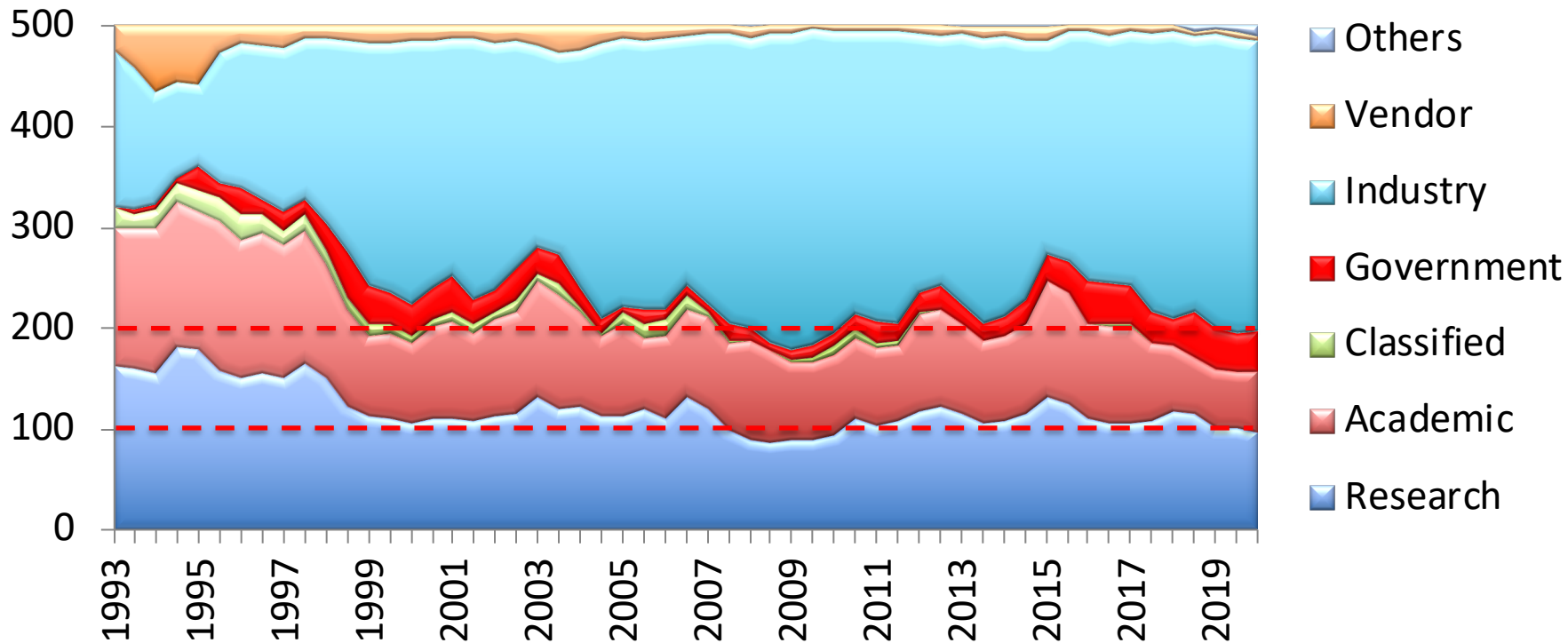
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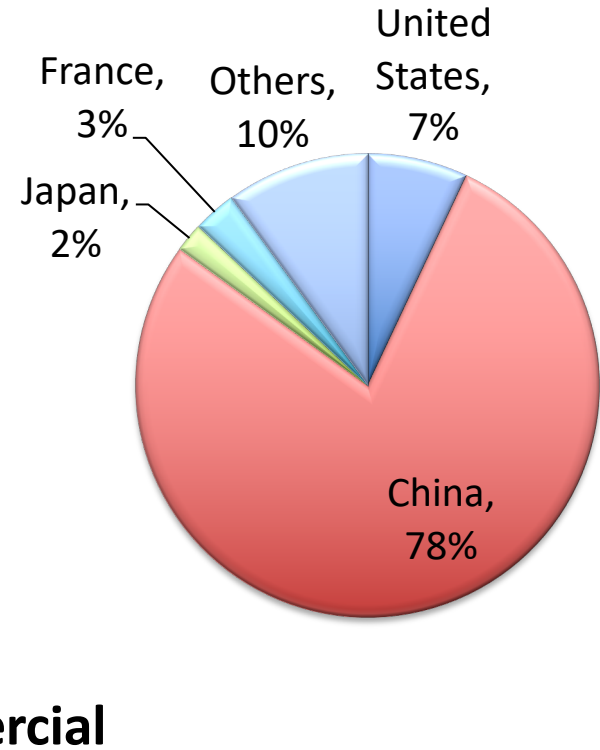
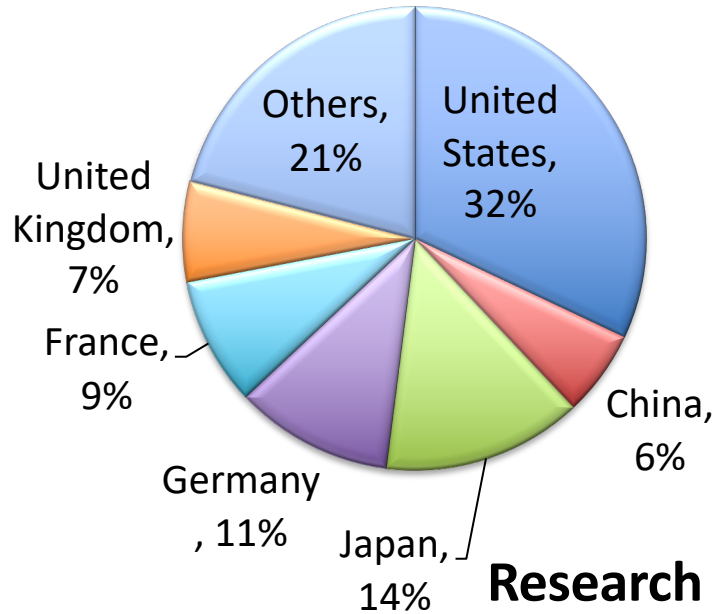
- Markets for scientific computing and for commercial data processing are very different.
- Extract proper sub-samples for these markets from the full TOP500 list
  - TOP100 Research and Academic installations
  - TOP100 Industry (and Vendor) installations
    - Could try to separate out Industry installations but difficult to do
  - Ignore "Government, Classified, Others" for now
  - 100 works reasonably well, more might become tricky



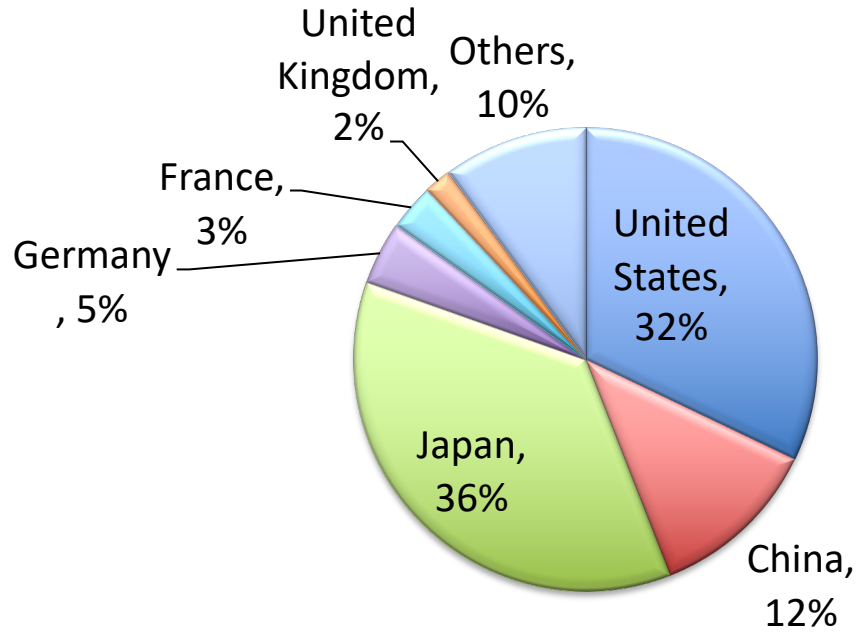
# MARKET SEGMENTS



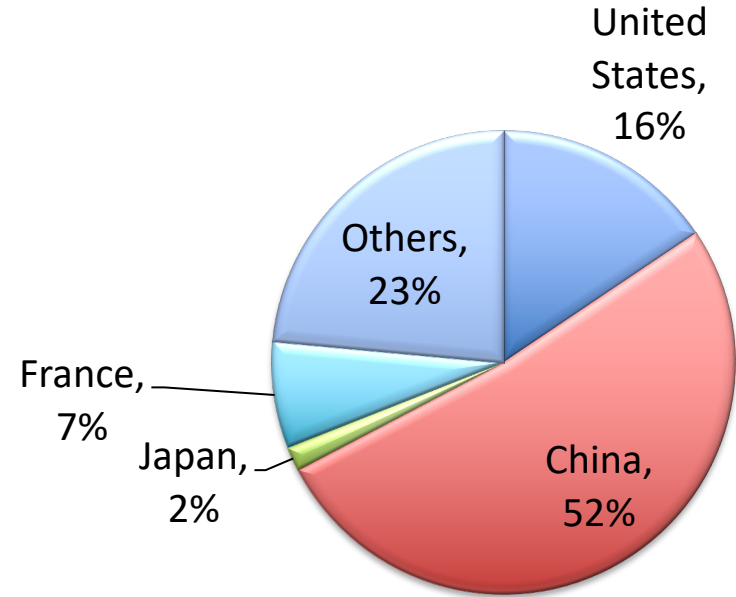
# COUNTRIES / SYSTEM SHARE



# COUNTRIES / PERFORMANCE SHARE

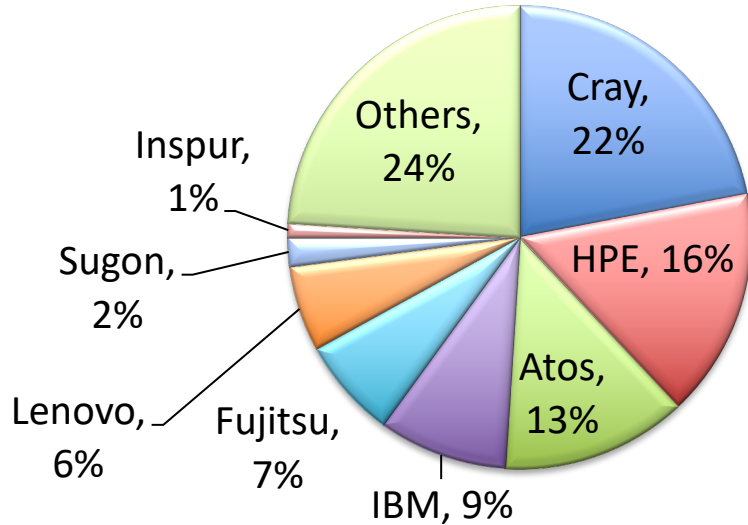


**Research**

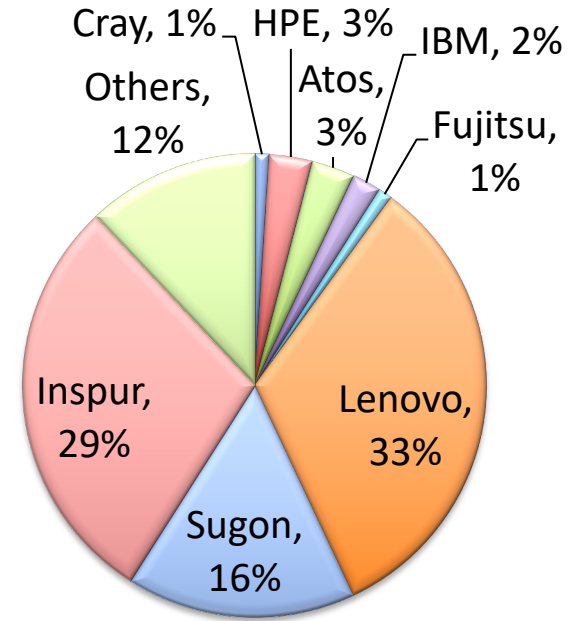


**Commercial**

# VENDORS / SYSTEM SHARE

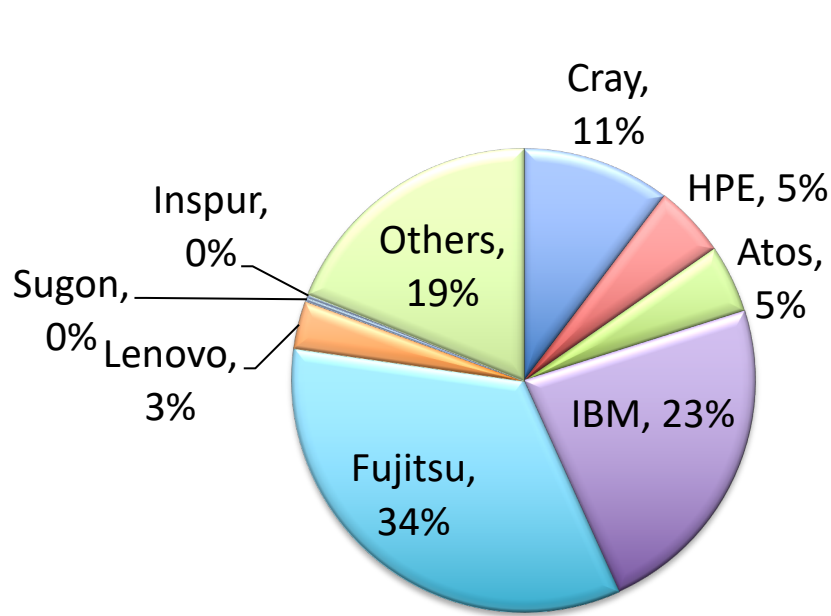


Research

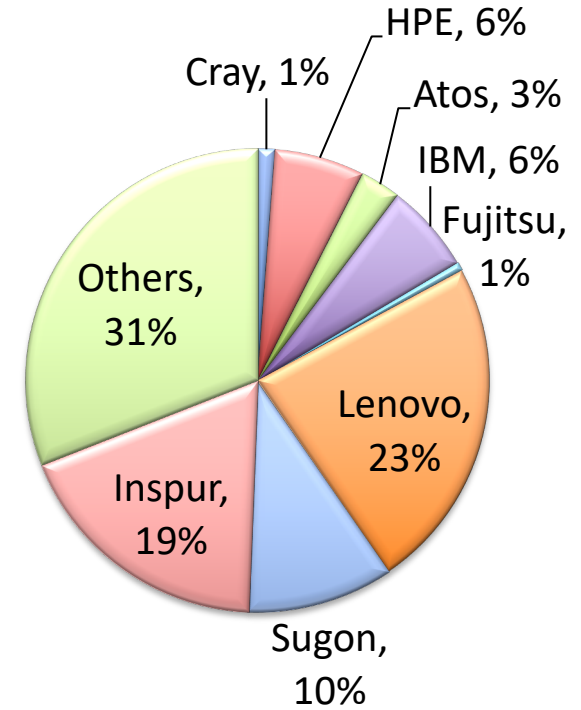


Commercial

# VENDORS / PERFORMANCE SHARE

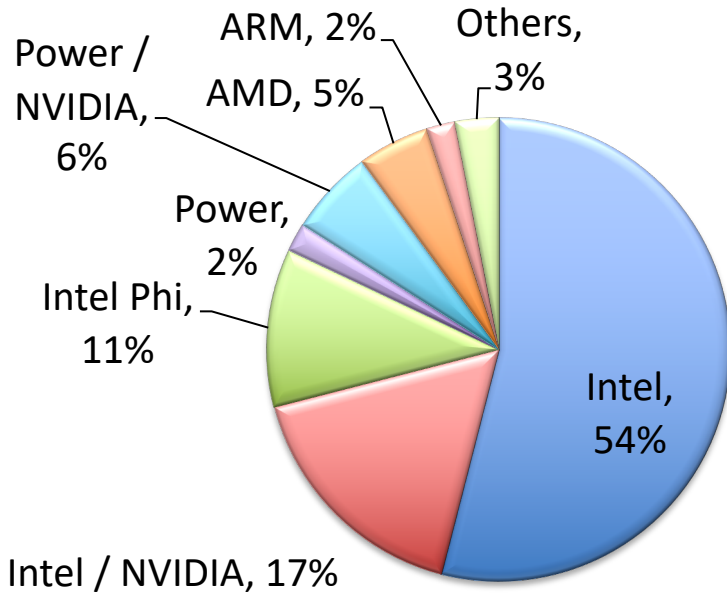


Research

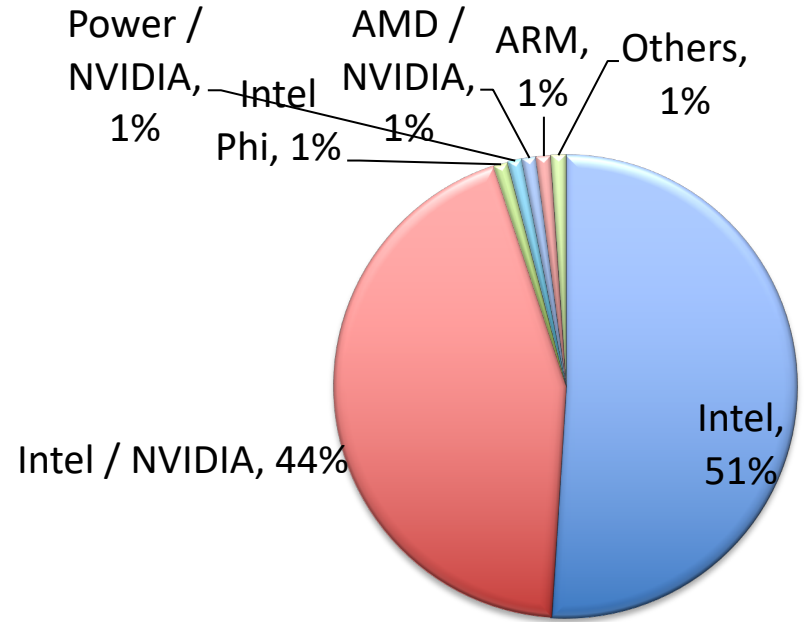


Commercial

# CHIPS / SYSTEM SHARE

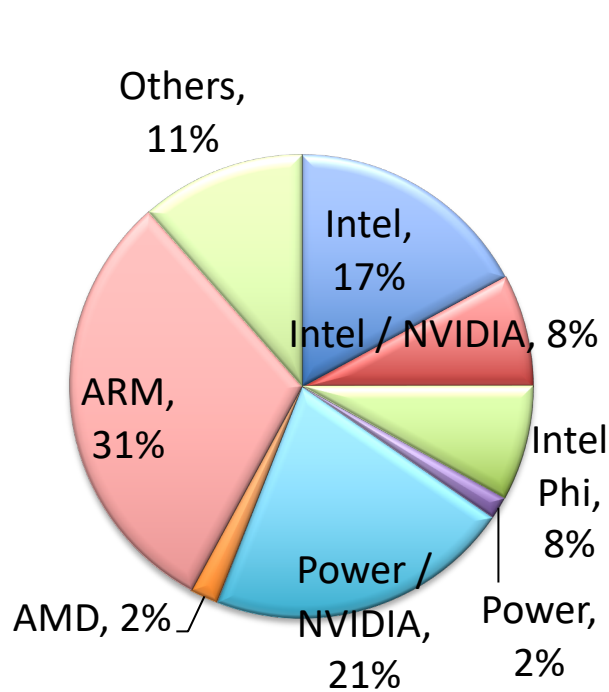


Research

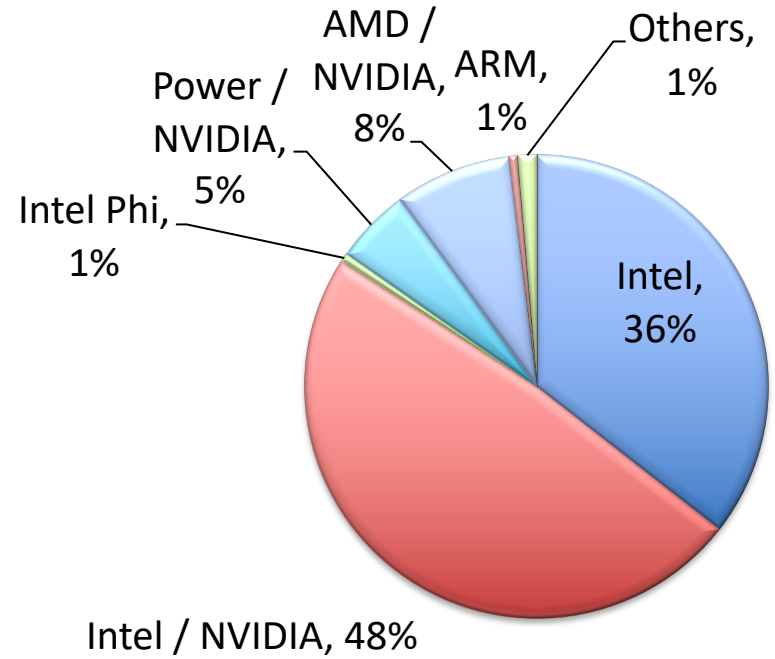


Commercial

# CHIPS / PERFORMANCE SHARE



**Research**



**Commercial**

# SC20 TOP500 HIGHLIGHTS

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- Fugaku is the new #1 in the TOP500
- It measured at over 1 Exaflop on the HPL-AI in reduced precision
- TOP10 has four new systems
- Overall turn-over in the list is at a record low
- TOP100 Research System and Commercial Systems show very different markets