

US Semiconductors

Graphics Update: NVDA leading charge in data center, gaming upcycle still strong

Industry Overview

NVDA holding leadership in \$85bn+ accelerator market

We review Q4 GPU/discrete GPU (dGPU) trends (per Mercury), particularly in the data center, which now drives the market for NVDA/AMD. Indeed, data center sales on track to be >85% of NVDA sales (vs. ~25% five years ago) and ~50% for AMD (vs. 10%-15% five years ago). Though visibility highly limited into data center GPU ordering trends, we note major takeaways from latest Mercury data: 1) GPU silicon units in Q4 reached >900k (up >100% YoY), with NVDA commanding nearly 95% market share (with share >97% at a system level given higher ASPs); 2) Hopper (H100/HGX platform) products vast majority of overall NVDA data center revenue, with A100 mix continuing to decline (though still meaningful) and L40S SKUs ramping (though still small); 3) Given current Hopper mix, Mercury believes NVDA GPU silicon sales (~850k) increased >20% QoQ, driven by continued H100 (and L40S) units; 4) AMD data center GPU revenue surged to ~\$400mn in Q4 (vs. ~\$75mn over past 3qtrs) as shipments ramped to support new El Capitan Supercomputer (AMD GPU silicon unit sales estimated to more than triple QoQ). We reiterate Buy on both NVDA and AMD, as we believe there is significant growth ahead for the \$85-\$90bn accelerator market. We note our ~\$180bn TAM (up >2x in 3 years) still below bull case estimates from vendors like AMD (\$400bn).

Gaming update: Growth ongoing as mix improves

We also update our dGPU tracker for PC gaming, low-end PC, and consoles (~10%-15% of NVDA/AMD sales over next few years). Net-net, for the full year, CY23 dGPU market represented \$10.4bn, up 11% YoY post inventory digestion in CY22 (down more than 30% YoY). In Q4 alone, discrete GPU (dGPU) sales of \$2.9bn increased +3% QoQ (though up a robust 60% YoY), remaining above NVDA's prior \$2.5bn/qtr objective as mix continues to support growth. Q4 dGPU market benefitted from both strong unit growth (+30% YoY) and ASP strength (up >25% YoY). Indeed, per Mercury, mix is improving, with demand at high end of market (RTX 4070/80/90) expanding, while cooling for older products (16xx series, RTX 3050/3060). As we pass the holiday season, we expect Q1 dGPU consumer sales to be down in line with seasonality (-2% QoQ), though we remain only 5 quarters out from recent cycle trough, suggesting gaming upcycle could last into late CY25/26 (representing an approx. 3yr upcycle, in line with past trends).

Next catalysts: NVDA GTC, Broadcom analyst day

Data center GPU demand should remain at the forefront, with NVDA's GTC kicking off on March 18. Generative Artificial Intelligence (genAI) will be the key theme, and we expect NVDA to provide additional details on its roadmaps across accelerators (GH200, B100, x100, etc.) and networking (Spectrum-X, BlueField). Indeed, we expect much focus to be placed on the B100 and possible price increases (expectations could be in range of 20%-30% increase vs. current H100 priced at ~\$30k). On 3/20, Broadcom will host its Enabling AI in Infrastructure Investor meeting, detailing its critical silicon/networking offerings. We expect further clarity around AVGO's ability to provide customers with leading custom ASICs (\$5.5bn-\$6bn rev runrate) as well as advancements in making Ethernet viable for AI networking (\$2bn rev potential in FY24E).

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Exhibit 1: GPU Tracker Snapshot

dGPU sales grew 11% in 2023

(\$mn)	2023	2024E	2025E	2026E
Total dGPU	\$10,411	\$11,967	\$13,086	\$14,311
YoY%	11%	15%	9%	9%
PC Gaming	\$10,050	\$11,579	\$12,640	\$13,829
YoY%	15%	15%	9%	9%
Tradtl PC	\$362	\$388	\$447	\$483
YoY%	-39%	7%	15%	8%
Console	\$6,680	\$3,953	\$3,717	\$3,659
YoY%	-4%	-41%	-6%	-2%

Source: BofA Global Research estimates

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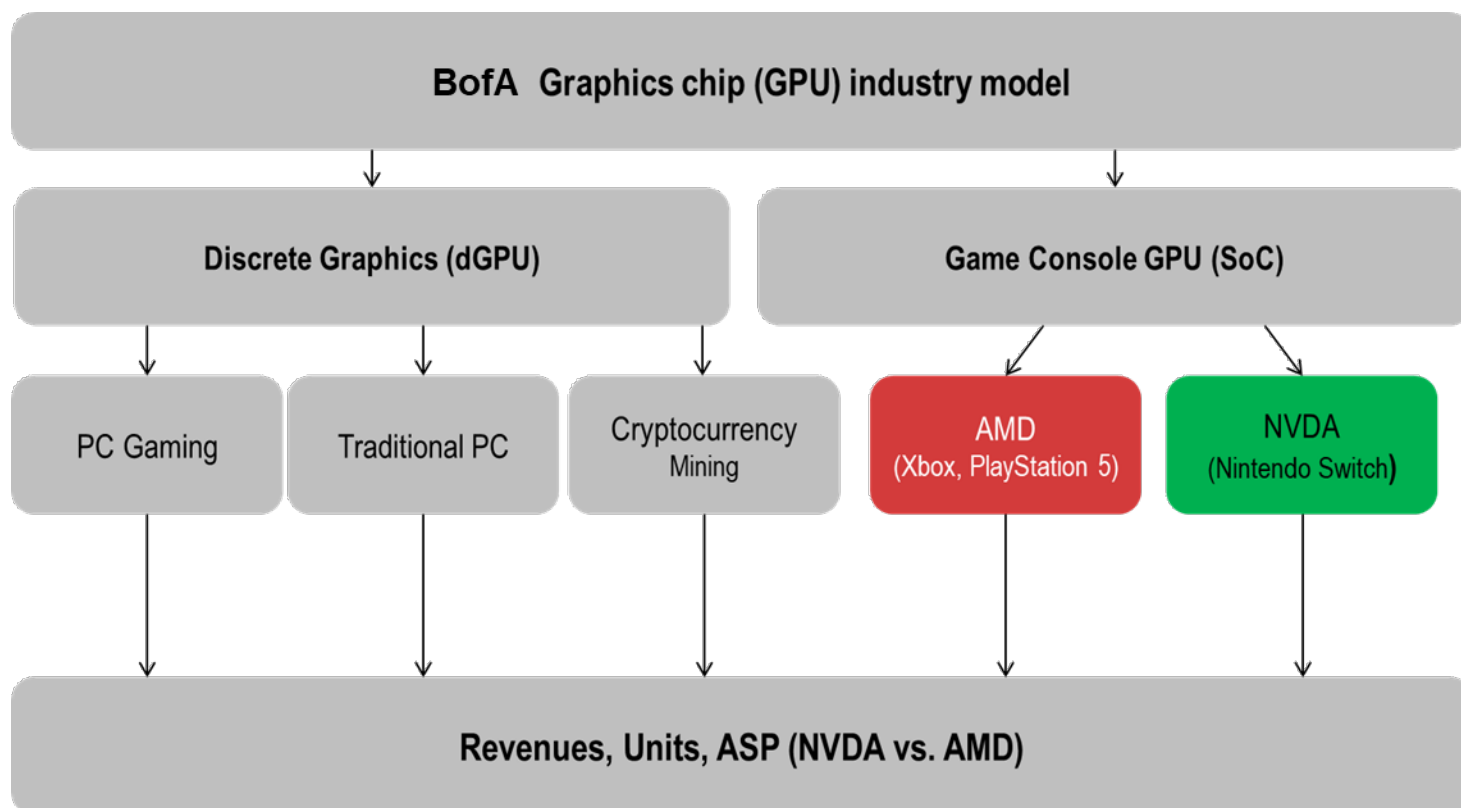
Glossary

GPU: graphics processing unit
NVDA: Nvidia
AMD: Advanced Micro Devices
SKU: stock keeping units
ASP: average selling price
GTC: GPU Tech Conferece
AI: Artificial Intelligence
PC: Personal computer
TAM: Total Addressable Market
AVGO: Broadcom

Gaming hierarchy/overview

Exhibit 2: BofA GPU industry hierarchy

We break up our gaming GPU model into PC Gaming, Traditional PC, Cryptocurrency Mining, and Game Consoles



Source: BofA Global Research

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GPU industry tracker summary

We present our estimates for overall GPU (and corresponding Gaming vs. traditional PC) revenues, units, ASP, and market share for 1Q23-4Q24E and 2022-2025E. 2020 gaming demand was extremely strong driven by work-/play-from-home trends spurred by the COVID-19 pandemic. However, given industry supply disruptions, demand was not able to be satisfied in 2020 and continued on a robust pace throughout 2021. 2021 dGPU sales grew 67% YoY to \$13.7bn, including 69% growth in PC gaming. Despite strong 2020/21, a substantial inventory correction is driving dGPU demand back towards 2020 levels (in terms of dollars).

Looking longer-term, we continue to believe secular drivers (richer game production, 4K, virtual reality (VR), ray-tracing, etc.) are sufficient to drive double-digit annual growth. However, the demand weakness and inventory corrections drove material market deceleration in 2022. In 2023, discrete GPU revenue recovered to grow +11% YoY, with PC gaming up 15%. Looking ahead, we believe the market can sustain 10%-15% growth in CY24/25.

Exhibit 3: GPU revenue summary (1Q23A – 4Q24E and 2023-2026E)

We expect the discrete GPU market to increase +15% in '24E

	1Q23	2Q23	3Q23	4Q23	1Q24E	2Q24E	3Q24E	4Q24E	2023	2024E	2025E	2026E
Discrete GPU	\$2,230	\$2,454	\$2,822	\$2,905	\$2,819	\$2,944	\$3,191	\$3,012	\$10,411	\$11,967	\$13,086	\$14,311
NVDA	\$2,103	\$2,327	\$2,670	\$2,731	\$2,668	\$2,801	\$3,051	\$2,834	\$9,831	\$11,354	\$12,389	\$13,471
AMD	\$128	\$127	\$152	\$174	\$151	\$143	\$141	\$178	\$580	\$612	\$698	\$840
PC Gaming	\$2,142	\$2,374	\$2,734	\$2,800	\$2,726	\$2,846	\$3,089	\$2,917	\$10,050	\$11,579	\$12,640	\$13,829
NVDA (GeForce)	\$2,026	\$2,261	\$2,597	\$2,641	\$2,591	\$2,720	\$2,966	\$2,756	\$9,525	\$11,032	\$12,017	\$13,075
AMD (Radeon)	\$116	\$113	\$137	\$159	\$135	\$126	\$124	\$162	\$525	\$547	\$623	\$754
Traditional PC	\$89	\$80	\$88	\$105	\$93	\$97	\$102	\$95	\$362	\$388	\$447	\$483
NVDA	\$77	\$66	\$73	\$90	\$77	\$81	\$85	\$79	\$306	\$322	\$372	\$396
AMD	\$12	\$14	\$15	\$15	\$16	\$16	\$17	\$16	\$56	\$66	\$75	\$87
Cryptocurrency Mining												
NVDA (GeForce)												
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	\$1,844	\$1,697	\$1,613	\$1,526	\$979	\$736	\$1,060	\$1,177	\$6,680	\$3,953	\$3,717	\$3,659
NVDA (Nintendo Switch)	\$214	\$225	\$259	\$224	\$202	\$192	\$211	\$200	\$922	\$804	\$887	\$1,111
AMD (Xbox, PlayStation)	\$1,629	\$1,473	\$1,354	\$1,302	\$778	\$544	\$850	\$977	\$5,758	\$3,149	\$2,830	\$2,548
QoQ%												
Discrete GPU	24.1%	10.0%	15.0%	2.9%	-3.0%	4.4%	8.4%	-5.6%				
NVDA	23.5%	10.7%	14.7%	2.3%	-2.3%	5.0%	8.9%	-7.1%				
AMD	36.2%	-0.8%	19.9%	14.6%	-13.0%	-5.9%	-1.3%	26.4%				
PC Gaming	26.0%	10.8%	15.2%	2.4%	-2.6%	4.4%	8.5%	-5.6%				
NVDA (GeForce)	25.1%	11.6%	14.9%	1.7%	-1.9%	5.0%	9.0%	-7.1%				
AMD (Radeon)	44.3%	-2.7%	21.2%	16.1%	-14.9%	-6.6%	-2.1%	30.6%				
Traditional PC	-8.9%	-10.0%	10.4%	19.4%	-11.2%	4.4%	4.8%	-7.1%				
NVDA	-8.3%	-14.3%	10.6%	23.3%	-14.3%	5.4%	4.8%	-7.7%				
AMD	-12.8%	18.8%	9.4%	0.3%	7.2%	0.0%	4.8%	-3.8%				
Cryptocurrency Mining												
NVDA (GeForce)												
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	4.6%	-7.9%	-5.0%	-5.4%	-35.8%	-24.9%	44.1%	11.0%				
NVDA (Nintendo Switch)	1.0%	5.0%	15.0%	-13.4%	-10.0%	-5.0%	10.0%	-5.0%				
AMD (Xbox, PlayStation)	5.1%	-9.6%	-8.0%	-3.8%	-40.3%	-30.0%	56.0%	15.0%				
YoY%												
Discrete GPU	-43.0%	14.3%	89.4%	61.7%	26.4%	20.0%	13.1%	3.7%	11.4%	14.9%	9.4%	9.4%
NVDA	-37.4%	28.8%	92.6%	60.4%	26.9%	20.4%	14.3%	3.8%	19.1%	15.5%	9.1%	8.7%
AMD	-77.1%	-62.7%	47.1%	85.6%	18.6%	12.5%	-7.4%	2.2%	-47.0%	5.6%	13.9%	20.5%
PC Gaming	-41.8%	22.7%	94.2%	64.8%	27.3%	19.9%	13.0%	4.2%	15.2%	15.2%	9.2%	9.4%
NVDA (GeForce)	-36.7%	35.7%	97.7%	63.1%	27.9%	20.3%	14.2%	4.3%	22.1%	15.8%	8.9%	8.8%
AMD (Radeon)	-75.7%	-58.0%	45.6%	97.5%	16.5%	11.9%	-9.6%	1.7%	-43.1%	4.2%	14.0%	21.0%
Traditional PC	-59.6%	-59.9%	7.6%	8.0%	5.3%	22.2%	15.9%	-9.7%	-39.4%	7.3%	15.2%	8.1%
NVDA	-45.2%	-48.4%	0.6%	7.1%	0.1%	23.1%	16.6%	-12.7%	-28.0%	5.3%	15.5%	6.4%
AMD	-85.2%	-80.5%	62.5%	13.7%	39.8%	17.6%	12.6%	8.0%	-67.7%	18.3%	13.5%	16.3%
Cryptocurrency Mining	-100.0%	-100.0%	-100.0%						-100.0%			
NVDA (GeForce)												
NVDA (Crypto-specific SKU)	-100.0%	-100.0%	-100.0%						-100.0%			
AMD												
Videogame Console GPU (SoC)	6.1%	0.4%	-9.8%	-13.4%	-46.9%	-56.6%	-34.3%	-22.9%	-4.3%	-40.8%	-6.0%	-1.6%
NVDA (Nintendo Switch)	-49.0%	-40.2%	-0.6%	5.6%	-5.9%	-14.8%	-18.6%	-10.7%	-27.3%	-12.8%	10.3%	25.2%
AMD (Xbox, PlayStation)	23.6%	12.0%	-11.4%	-16.0%	-52.3%	-63.0%	-37.3%	-25.0%	0.8%	-45.3%	-10.1%	-9.9%
Revenue share												
Discrete GPU	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NVDA	94.3%	94.8%	94.6%	94.0%	94.6%	95.2%	95.6%	94.1%	94.4%	94.9%	94.7%	94.1%
AMD	5.7%	5.2%	5.4%	6.0%	5.4%	4.8%	4.4%	5.9%	5.6%	5.1%	5.3%	5.9%
PC Gaming	96.0%	96.7%	96.9%	96.4%	96.7%	96.7%	96.8%	96.9%	96.5%	96.8%	96.6%	96.6%
NVDA (GeForce)	94.6%	95.2%	95.0%	94.3%	95.0%	95.6%	96.0%	94.5%	94.8%	95.3%	95.1%	94.6%
AMD (Radeon)	5.4%	4.8%	5.0%	5.7%	5.0%	4.4%	4.0%	5.5%	5.2%	4.7%	4.9%	5.4%
Traditional PC	4.0%	3.3%	3.1%	3.6%	3.3%	3.3%	3.2%	3.1%	3.5%	3.2%	3.4%	3.4%
NVDA	86.9%	82.7%	82.9%	85.6%	82.6%	83.4%	83.4%	82.8%	84.6%	83.1%	83.3%	82.0%
AMD	13.1%	17.3%	17.1%	14.4%	17.4%	16.6%	16.6%	17.2%	15.4%	16.9%	16.7%	18.0%
Cryptocurrency Mining												

Exhibit 3: GPU revenue summary (1Q23A – 4Q24E and 2023-2026E)

We expect the discrete GPU market to increase +15% in '24E

	1Q23	2Q23	3Q23	4Q23	1Q24E	2Q24E	3Q24E	4Q24E	2023	2024E	2025E	2026E
NVDA (GeForce)												
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NVDA (Nintendo Switch)	11.6%	13.3%	16.0%	14.7%	20.6%	26.0%	19.9%	17.0%	13.8%	20.3%	23.9%	30.4%
AMD (Xbox, PlayStation)	88.4%	86.7%	84.0%	85.3%	79.4%	74.0%	80.1%	83.0%	86.2%	79.7%	76.1%	69.6%

Source: BofA Global Research estimates, Mercury Research

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Unit summary

We expect discrete GPU units to start to rebound following substantial inventory corrections in '22-'23. We model 4%-5% growth in '24E-'25E.

Exhibit 4: GPU unit summary (1Q22A – 4Q23E and 2023A-2026E)

We expect modest dGPU unit rebound in CY24/25

Units (000's)	1Q23	2Q23	3Q23	4Q23	1Q24E	2Q24E	3Q24E	4Q24E	2023	2024E	2025E	2026E
Discrete GPU	11,031	11,827	14,821	14,666	13,459	13,529	14,171	13,364	52,345	54,522	57,316	60,412
NVDA	9,929	10,515	13,100	12,789	11,891	12,056	12,659	11,721	46,333	48,326	50,599	52,771
AMD	1,102	1,312	1,722	1,877	1,568	1,473	1,512	1,643	6,012	6,196	6,717	7,641
PC Gaming	9,012	9,856	12,229	12,124	10,733	10,743	11,245	10,567	43,222	43,289	44,879	47,241
NVDA (GeForce)	8,241	8,938	10,938	10,679	9,584	9,680	10,164	9,351	38,796	38,780	40,003	41,702
AMD (Radeon)	771	918	1,291	1,445	1,149	1,063	1,081	1,216	4,426	4,509	4,876	5,539
Traditional PC	2,018	1,971	2,592	2,542	2,725	2,786	2,925	2,796	9,123	11,232	12,437	13,170
NVDA	1,688	1,577	2,161	2,110	2,306	2,376	2,494	2,370	7,537	9,546	10,596	11,069
AMD	331	394	430	432	419	410	431	427	1,586	1,687	1,841	2,101
Cryptocurrency Mining												
NVDA (GeForce)												
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	24,970	23,534	23,111	22,696	15,605	12,124	17,155	18,725	94,311	63,608	64,661	68,927
NVDA (Nintendo Switch)	5,100	5,355	5,750	5,335	4,802	4,561	5,018	4,767	21,540	19,147	21,123	26,453
AMD (Xbox, PlayStation)	19,870	18,179	17,361	17,361	10,803	7,562	12,137	13,958	72,771	44,461	43,538	42,474
QoQ%												
Discrete GPU	-2.0%	7.2%	25.3%	-1.0%	-8.2%	0.5%	4.7%	-5.7%				
NVDA	-2.3%	5.9%	24.6%	-2.4%	-7.0%	1.4%	5.0%	-7.4%				
AMD	1.5%	19.1%	31.3%	9.0%	-16.5%	-6.0%	2.6%	8.7%				
PC Gaming	2.0%	9.4%	24.1%	-0.9%	-11.5%	0.1%	4.7%	-6.0%				
NVDA (GeForce)	1.3%	8.5%	22.4%	-2.4%	-10.2%	1.0%	5.0%	-8.0%				
AMD (Radeon)	9.3%	19.1%	40.6%	11.9%	-20.5%	-7.5%	1.7%	12.5%				
Traditional PC	-16.4%	-2.4%	31.5%	-1.9%	7.2%	2.2%	5.0%	-4.4%				
NVDA	-17.0%	-6.6%	37.0%	-2.4%	9.3%	3.0%	5.0%	-5.0%				
AMD	-13.0%	19.1%	9.4%	0.3%	-3.0%	-2.0%	5.0%	-1.0%				
Cryptocurrency Mining												
NVDA (GeForce)												
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	4.2%	-5.7%	-1.8%	-1.8%	-31.2%	-22.3%	41.5%	9.2%				
NVDA (Nintendo Switch)	1.0%	5.0%	7.4%	-7.2%	-10.0%	-5.0%	10.0%	-5.0%				
AMD (Xbox, PlayStation)	5.1%	-8.5%	-4.5%		-37.8%	-30.0%	60.5%	15.0%				
YoY%												
Discrete GPU	-53.8%	-31.7%	19.8%	30.3%	22.0%	14.4%	-4.4%	-8.9%	-19.2%	4.2%	5.1%	5.4%
NVDA	-48.8%	-27.3%	15.5%	25.8%	19.8%	14.7%	-3.4%	-8.4%	-16.3%	4.3%	4.7%	4.3%
AMD	-75.5%	-54.1%	67.2%	73.0%	42.3%	12.3%	-12.2%	-12.5%	-36.5%	3.1%	8.4%	13.7%
PC Gaming	-48.0%	-21.6%	27.9%	37.2%	19.1%	9.0%	-8.0%	-12.8%	-10.5%	0.2%	3.7%	5.3%
NVDA (GeForce)	-45.9%	-20.8%	23.7%	31.3%	16.3%	8.3%	-7.1%	-12.4%	-10.8%	0.0%	3.2%	4.2%
AMD (Radeon)	-63.5%	-28.7%	79.1%	104.9%	49.0%	15.8%	-16.3%	-15.8%	-8.2%	1.9%	8.1%	13.6%
Traditional PC	-68.9%	-58.3%	-7.5%	5.3%	35.0%	41.4%	12.9%	10.0%	-44.5%	23.1%	10.7%	5.9%
NVDA	-59.0%	-49.9%	-13.3%	3.8%	36.6%	50.6%	15.4%	12.3%	-36.1%	26.7%	11.0%	4.5%
AMD	-86.1%	-75.0%	39.3%	13.7%	26.7%	4.3%	0.1%	-1.2%	-65.8%	6.3%	9.2%	14.1%
Cryptocurrency Mining									-100.0%			
NVDA (GeForce)												

Exhibit 4: GPU unit summary (1Q22A – 4Q23E and 2023A-2026E)

We expect modest dGPU unit rebound in CY24/25

Units ('000's)	1Q23	2Q23	3Q23	4Q23	1Q24E	2Q24E	3Q24E	4Q24E	2023	2024E	2025E	2026E
NVDA (Crypto-specific SKU)									-100.0%			
AMD												
Videogame Console GPU (SoC)	-4.2%	-5.8%	-6.9%	-5.3%	-37.5%	-48.5%	-25.8%	-17.5%	-5.5%	-32.6%	1.7%	6.6%
NVDA (Nintendo Switch)	-49.0%	-40.2%	-7.3%	5.6%	-5.9%	-14.8%	-12.7%	-10.7%	-28.7%	-11.1%	10.3%	25.2%
AMD (Xbox, PlayStation)	23.6%	13.3%	-6.8%	-8.2%	-45.6%	-58.4%	-30.1%	-19.6%	4.5%	-38.9%	-2.1%	-2.4%
Unit Share												
Discrete GPU	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NVDA	90.0%	88.9%	88.4%	87.2%	88.4%	89.1%	89.3%	87.7%	88.5%	88.6%	88.3%	87.4%
AMD	10.0%	11.1%	11.6%	12.8%	11.6%	10.9%	10.7%	12.3%	11.5%	11.4%	11.7%	12.6%
PC Gaming	81.7%	83.3%	82.5%	82.7%	79.8%	79.4%	79.4%	79.1%	82.6%	79.4%	78.3%	78.2%
NVDA (GeForce)	91.4%	90.7%	89.4%	88.1%	89.3%	90.1%	90.4%	88.5%	89.8%	89.6%	89.1%	88.3%
AMD (Radeon)	8.6%	9.3%	10.6%	11.9%	10.7%	9.9%	9.6%	11.5%	10.2%	10.4%	10.9%	11.7%
Traditional PC	18.3%	16.7%	17.5%	17.3%	20.2%	20.6%	20.6%	20.9%	17.4%	20.6%	21.7%	21.8%
NVDA	83.6%	80.0%	83.4%	83.0%	84.6%	85.3%	85.3%	84.7%	82.6%	85.0%	85.2%	84.0%
AMD	16.4%	20.0%	16.6%	17.0%	15.4%	14.7%	14.7%	15.3%	17.4%	15.0%	14.8%	16.0%
Cryptocurrency Mining												
NVDA (GeForce)												
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NVDA (Nintendo Switch)	20.4%	22.8%	24.9%	23.5%	30.8%	37.6%	29.2%	25.5%	22.8%	30.1%	32.7%	38.4%
AMD (Xbox, PlayStation)	79.6%	77.2%	75.1%	76.5%	69.2%	62.4%	70.8%	74.5%	77.2%	69.9%	67.3%	61.6%

Source: BofA Global Research estimates, Mercury Research

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Average selling price summary

We expect discrete GPU ASPs to rise +10% YoY as GPU supplier's skew mix towards higher-end as new AMD/NVDA cards continue to ramp. Growth should moderate towards mid/high-single digits long-term.

Exhibit 5: GPU ASP summary (1Q22A – 4Q23E and 2023A-2026E)

We expect PC gaming discrete GPU ASPs to grow 10% YoY in 2024E

ASP (\$)	1Q23	2Q23	3Q23	4Q23	1Q24E	2Q24E	3Q24E	4Q24E	2023	2024E	2025E	2026E
Discrete GPU	\$202	\$207	\$190	\$198	\$209	\$218	\$225	\$225	\$199	\$219	\$228	\$237
NVDA	\$212	\$221	\$204	\$214	\$224	\$232	\$241	\$242	\$212	\$235	\$245	\$255
AMD	\$116	\$97	\$88	\$93	\$97	\$97	\$93	\$108	\$97	\$99	\$104	\$110
PC Gaming	\$238	\$241	\$224	\$231	\$254	\$265	\$275	\$276	\$233	\$267	\$282	\$293
NVDA (GeForce)	\$246	\$253	\$237	\$247	\$270	\$281	\$292	\$295	\$246	\$284	\$300	\$314
AMD (Radeon)	\$151	\$123	\$106	\$110	\$118	\$119	\$114	\$133	\$119	\$121	\$128	\$136
Traditional PC	\$44	\$40	\$34	\$41	\$34	\$35	\$35	\$34	\$40	\$35	\$36	\$37
NVDA	\$46	\$42	\$34	\$43	\$33	\$34	\$34	\$33	\$41	\$34	\$35	\$36
AMD	\$35	\$35	\$35	\$35	\$39	\$39	\$39	\$38	\$35	\$39	\$41	\$41
Cryptocurrency Mining												
NVDA (GeForce)	\$170	\$170	\$170	\$170	\$170	\$170	\$170	\$170				
NVDA (Crypto-specific SKU)	\$400	\$400	\$400	\$400	\$400	\$400	\$400	\$400				
AMD	\$111	\$111	\$111	\$111	\$111	\$111	\$111	\$111				
Videogame Console GPU (SoC)	\$74	\$72	\$70	\$67	\$63	\$61	\$62	\$63	\$71	\$62	\$57	\$53
NVDA (Nintendo Switch)	\$42	\$42	\$45	\$42	\$42	\$42	\$42	\$42	\$43	\$42	\$42	\$42
AMD (Xbox, PlayStation)	\$82	\$81	\$78	\$75	\$72	\$72	\$70	\$70	\$79	\$71	\$65	\$60
QoQ%												
Discrete GPU	26.6%	2.6%	-8.2%	4.0%	5.8%	3.9%	3.5%	0.1%				
NVDA	26.5%	4.5%	-7.9%	4.8%	5.1%	3.6%	3.7%	0.3%				
AMD	34.2%	-16.7%	-8.7%	5.1%	4.2%	0.2%	-3.8%	16.4%				
PC Gaming	23.6%	1.3%	-7.2%	3.3%	10.0%	4.3%	3.7%	0.5%				
NVDA (GeForce)	23.5%	2.9%	-6.1%	4.2%	9.3%	4.0%	3.8%	1.0%				
AMD (Radeon)	32.0%	-18.3%	-13.8%	3.8%	7.0%	1.0%	-3.7%	16.1%				
Traditional PC	8.9%	-7.8%	-16.1%	21.7%	-17.2%	2.2%	-0.2%	-2.8%				
NVDA	10.4%	-8.3%	-19.3%	26.3%	-21.6%	2.3%	-0.2%	-2.9%				
AMD	0.2%	-0.2%			10.6%	2.0%	-0.2%	-2.9%				
Cryptocurrency Mining												
NVDA (GeForce)												

Exhibit 5: GPU ASP summary (1Q22A – 4Q23E and 2023A-2026E)

We expect PC gaming discrete GPU ASPs to grow 10% YoY in 2024E

ASP (\$)	1Q23	2Q23	3Q23	4Q23	1Q24E	2Q24E	3Q24E	4Q24E	2023	2024E	2025E	2026E
NVDA (Crypto-specific SKU)												
AMD												
Videogame Console GPU (SoC)	0.4%	-2.3%	-3.2%	-3.6%	-6.7%	-3.3%	1.8%	1.7%				
NVDA (Nintendo Switch)			7.1%	-6.7%								
AMD (Xbox, PlayStation)		-1.2%	-3.7%	-3.8%	-4.0%		-2.8%					
YoY%												
Discrete GPU	23.3%	67.4%	58.1%	24.1%	3.6%	4.9%	18.3%	13.8%	37.9%	10.3%	4.0%	3.8%
NVDA	22.3%	77.2%	66.7%	27.5%	5.9%	5.0%	18.2%	13.2%	42.3%	10.7%	4.2%	4.3%
AMD	-6.6%	-18.7%	-12.0%	7.3%	-16.7%	0.2%	5.5%	16.8%	-16.5%	2.4%	5.1%	5.9%
PC Gaming	12.0%	56.4%	51.9%	20.1%	6.9%	10.0%	22.9%	19.5%	28.8%	15.0%	5.3%	3.9%
NVDA (GeForce)	16.9%	71.2%	59.9%	24.3%	10.0%	11.1%	22.9%	19.2%	36.9%	15.9%	5.6%	4.4%
AMD (Radeon)	-33.6%	-41.2%	-18.7%	-3.6%	-21.8%	-3.3%	8.0%	20.8%	-38.0%	2.3%	5.4%	6.5%
Traditional PC	30.2%	-3.8%	16.3%	2.6%	-22.0%	-13.6%	2.7%	-17.9%	9.1%	-12.9%	4.0%	2.0%
NVDA	33.7%	3.0%	16.0%	3.3%	-26.7%	-18.2%	1.1%	-22.3%	12.7%	-16.9%	4.1%	1.9%
AMD	6.3%	-22.2%	16.7%	0.0%	10.3%	12.8%	12.5%	9.3%	-5.4%	11.2%	4.0%	1.9%
Cryptocurrency Mining									-100.0%			
NVDA (GeForce)	-4.7%											
NVDA (Crypto-specific SKU)									-100.0%			
AMD												
Videogame Console GPU (SoC)	10.8%	6.6%	-3.1%	-8.6%	-15.0%	-15.8%	-11.4%	-6.5%	1.3%	-12.3%	-7.5%	-7.6%
NVDA (Nintendo Switch)			7.1%				-6.7%		1.9%	-1.9%		
AMD (Xbox, PlayStation)		-1.2%	-4.9%	-8.5%	-12.2%	-11.1%	-10.3%	-6.7%	-3.5%	-10.5%	-8.2%	-7.7%

Source: BofA Global Research estimates, Mercury Research

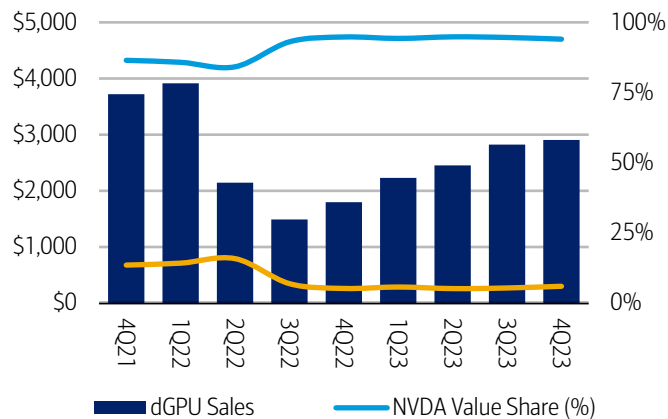
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GPU unit and market share trends

In Q3, NVDA value share was roughly flattish at ~95%. In terms of unit share, NVDA ceded 120bp of share QoQ to ~87%. NVDA's unit/value share still remains at levels above prior downcycle as lower OEM mix favors company's positioning vs. AMD.

Exhibit 6: Total PC discrete GPU sales and value market share trends

AMD Q3 share roughly flattish QoQ

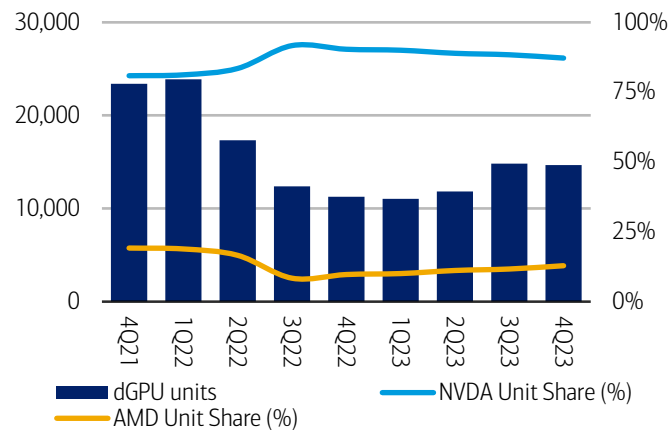


Source: BofA Global Research estimates, Mercury Research

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Exhibit 7: Total PC discrete GPU units and unit market share trends

AMD unit share slightly up QoQ in Q3



Source: BofA Global Research estimates, Mercury Research

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Exhibit 8: Companies Mentioned

Rating and price summary

Ticker	Name	Rating	Price
AMD	Advanced Micro Devices	C-1-9	\$178.00
NVDA	Nvidia	C-1-7	\$787.01

Source: BofA Global Research, Bloomberg

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Price objective basis & risk**Advanced Micro Devices, Inc (AMD)**

Our \$195 PO is based on 38x our 2025E non-GAAP EPS, which is towards the middle of AMD's historical 17x-64x range, justified by AI upside offset by slowdown in cyclical embedded/console markets.

Downside risks: 1) M&A integration risks, 2) Strong competition from larger names, 3) Lumpy nature of consumer and enterprise spending that could create delays in acceptance and success of new products, 4) High reliance on one outsourced manufacturing partner, 5) Maturity of current game console cycle.

NVIDIA Corporation (NVDA)

Our \$925 PO is based on 31x CY25E PE ex cash, within NVDA's historical 26x-69x forward year PE range, justified given stronger growth opportunities ahead as gaming cycle troughs and data center demand potentially faces strong, long-term demand dynamics.

Downside risks to our price objective are: 1) weakness in consumer driven gaming market, 2) Competition with major public firms, internal cloud projects and other private companies in accelerated computing markets, 3) Larger than expected impact from restrictions on compute shipments to China, or additional restrictions placed on activity in the region, 4) Lumpy and unpredictable sales in new enterprise, data center, and autos markets, 5) Potential for decelerating capital returns.

Analyst Certification

I, Vivek Arya, hereby certify that the views expressed in this research report accurately reflect my personal views about the subject securities and issuers. I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.



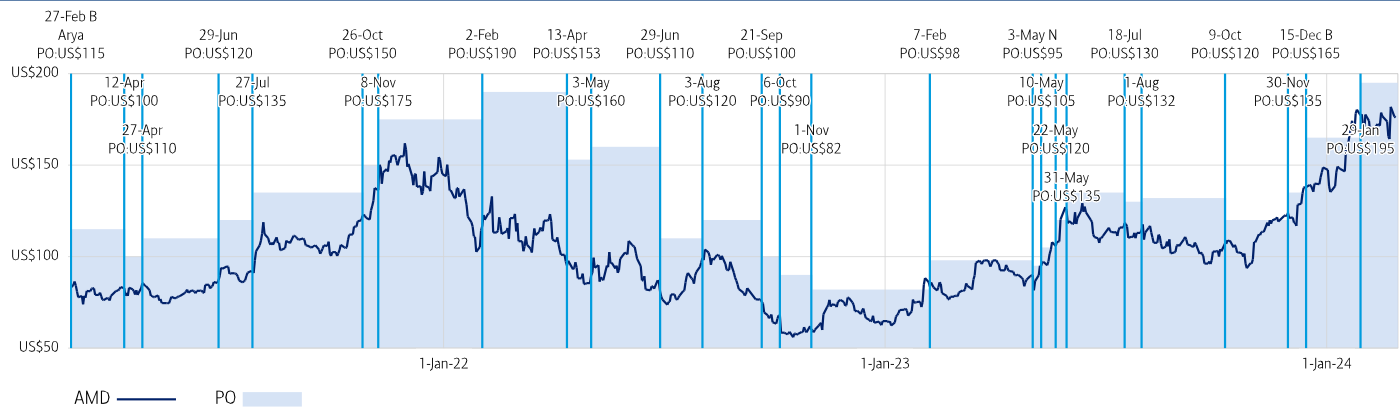
US - Semiconductors and Semiconductor Capital Equipment Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	Advanced Micro Devices, Inc	AMD	AMD US	Vivek Arya
	Analog Devices Inc.	ADI	ADI US	Vivek Arya
	Applied Materials, Inc.	AMAT	AMAT US	Vivek Arya
	Arm Holdings	ARM	ARM US	Vivek Arya
	Broadcom Inc	AVGO	AVGO US	Vivek Arya
	Cadence	CDNS	CDNS US	Vivek Arya
	Camtek	CAMT	CAMT US	Vivek Arya
	KLA Corporation	KLAC	KLAC US	Vivek Arya
	Lam Research Corp.	LRCX	LRCX US	Vivek Arya
	M/A-Com	MTSI	MTSI US	Vivek Arya
	Marvell Technology Group Ltd.	MRVL	MRVL US	Vivek Arya
	Microchip	MCHP	MCHP US	Vivek Arya
	Micron Technology, Inc	MU	MU US	Vivek Arya
	Nova	NVMI	NVMI US	Vivek Arya
	NVIDIA Corporation	NVDA	NVDA US	Vivek Arya
	NXP Semiconductors NV	NXPI	NXPI US	Vivek Arya
	onsemi	ON	ON US	Vivek Arya
	Synopsys	SNPS	SNPS US	Vivek Arya
NEUTRAL				
	Advanced Energy Industries	AEIS	AEIS US	Duksan Jang
	Allegro MicroSystems	ALGM	ALGM US	Blake Friedman
	Axcelis Technologies	ACLS	ACLS US	Duksan Jang
	Coherent Corp	COHR	COHR US	Vivek Arya
	GlobalFoundries	GFS	GFS US	Vivek Arya
	Intel	INTC	INTC US	Vivek Arya
	Lattice Semiconductor	LSCC	LSCC US	Blake Friedman
	Texas Instruments Inc.	TXN	TXN US	Vivek Arya
UNDERPERFORM				
	Ambarella	AMBA	AMBA US	Vivek Arya
	Credo Technology	CRDO	CRDO US	Vivek Arya
	Lumentum Holdings	LITE	LITE US	Vivek Arya
	Qorvo Inc.	QRVO	QRVO US	Vivek Arya
	Skyworks Solutions, Inc.	SWKS	SWKS US	Vivek Arya
	Teradyne	TER	TER US	Vivek Arya
	Wolfspeed Inc	WOLF	WOLF US	Vivek Arya

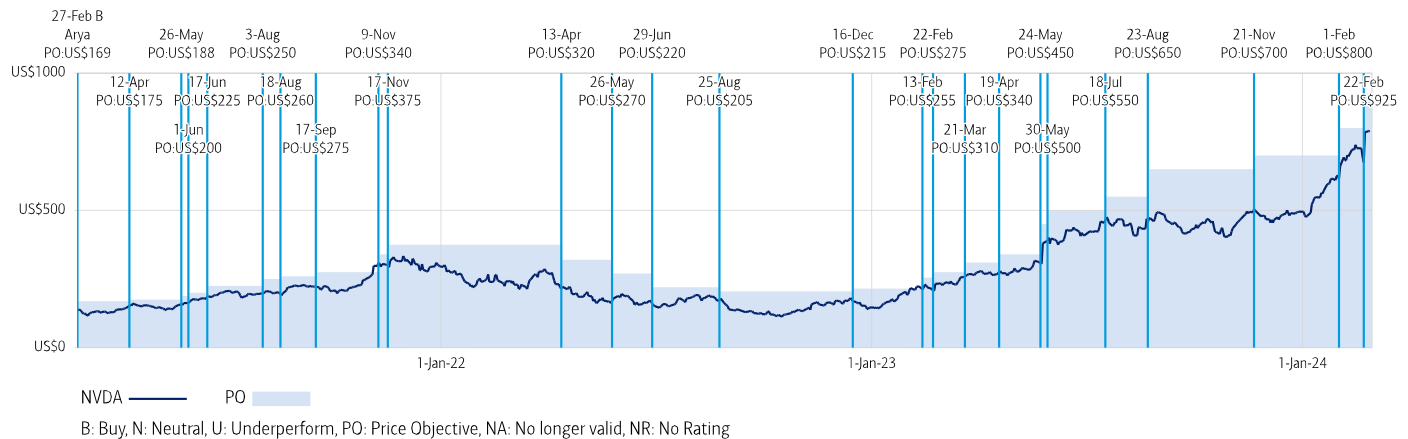
Disclosures

Important Disclosures

Advanced Micro (AMD) Price Chart



The Investment Opinion System is contained at the end of the report under the heading "Fundamental Equity Opinion Key". Dark grey shading indicates the security is restricted with the opinion suspended. Medium grey shading indicates the security is under review with the opinion withdrawn. Light grey shading indicates the security is not covered. Chart is current as of a date no more than one trading day prior to the date of the report.

NVIDIA (NVDA) Price Chart

The Investment Opinion System is contained at the end of the report under the heading "Fundamental Equity Opinion Key". Dark grey shading indicates the security is restricted with the opinion suspended. Medium grey shading indicates the security is under review with the opinion withdrawn. Light grey shading indicates the security is not covered. Chart is current as of a date no more than one trading day prior to the date of the report.

Equity Investment Rating Distribution: Technology Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	215	53.09%	Buy	111	51.63%
Hold	97	23.95%	Hold	45	46.39%
Sell	93	22.96%	Sell	24	25.81%

Equity Investment Rating Distribution: Global Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	1895	53.62%	Buy	1083	57.15%
Hold	832	23.54%	Hold	454	54.57%
Sell	807	22.84%	Sell	383	47.46%

^{R1} Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster ^{R2}
Buy	≥ 10%	≤ 70%
Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

^{R2} Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

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