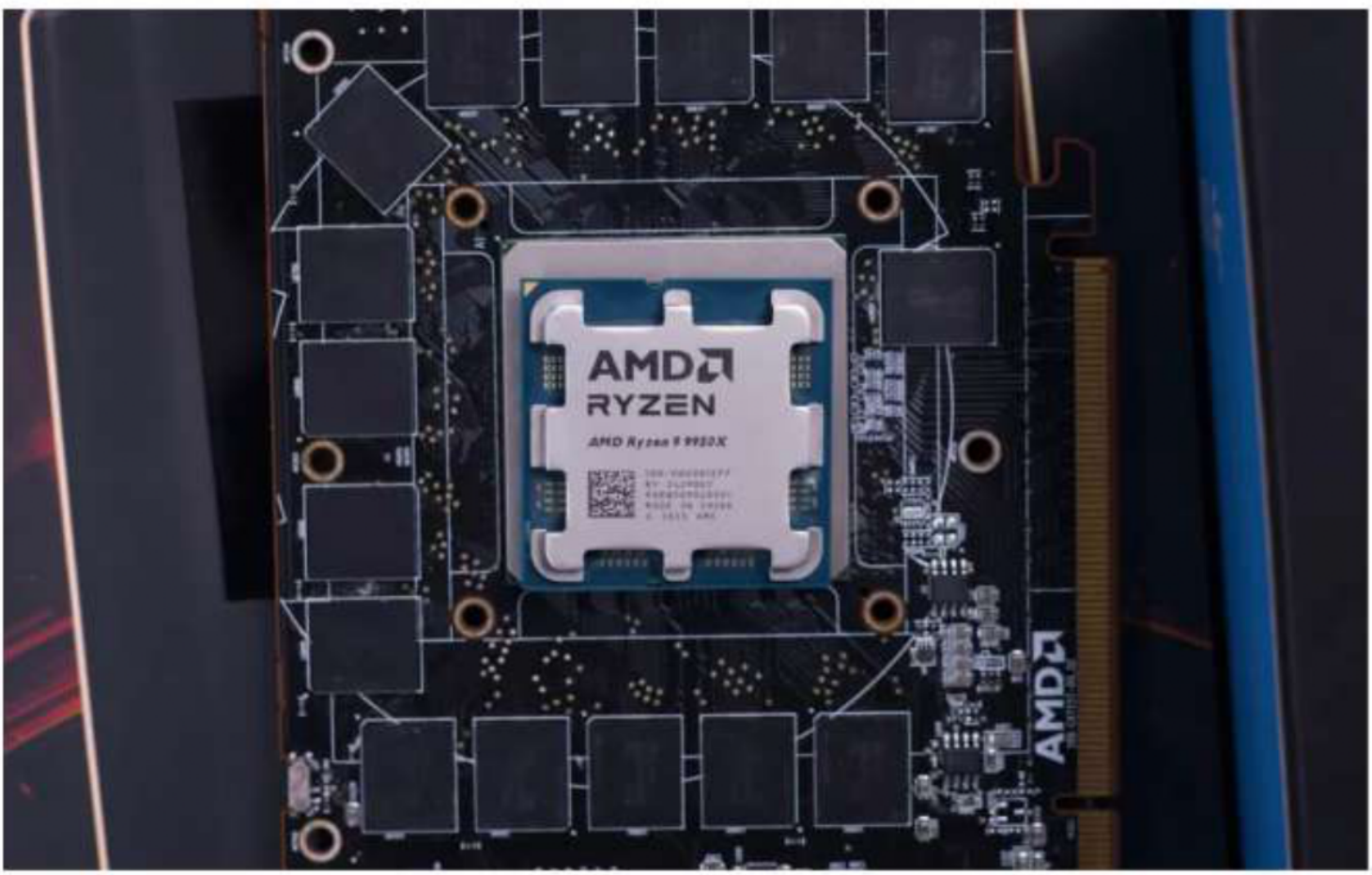
It's now time to check out AMD's most powerful Zen 5 desktop offering, the new Ryzen 9 9950X. As usual, we will be doing so from the perspective of PC enthusiasts, covering general desktop tasks, as well as activities like video editing and 3D modeling, and the ultimate focus will, of course, be on gaming.

It's fair to say that dual CCD Ryzen CPUs have never been the best options for gamers, but they have been the best options for those who like to work and play without having to invest in two different computers for those tasks. In an ideal scenario, one CCD clocks as high as possible, delivering strong gaming performance, with a second CCD as backup for core-heavy productivity workloads.



Unfortunately, it doesn't always work like that. The dual CCD design can often end up hurting gaming performance and even lightly threaded productivity workloads. Still, it is a cost-effective solution, and for those who work and play, previous generation 12- and 16-core Ryzen processors have been a godsend.

Now, in the case of these new Zen 5 CPUs, the improvements over Zen 4 have generally been very small for desktop users, especially those focused on gaming performance. For example, the 9700X was just 3% faster than the 7700X in our testing, whereas the 7700X was 21% faster than the 5800X in its day-one review two years ago. Prior to that, the 5800X was 23% faster than the 3700X.

So, gamers have become accustomed to new Ryzen processors boosting gaming performance by at least 20% over previous generation parts, making Zen 5's sub-5% uplift seriously disappointing. This was a real blow for the 6-core 9600X and 8-core 9700X because outside of gaming, those lower core count CPUs generally aren't very useful for core-heavy tasks like video editing; for that, you'd typically choose the 12- or 16-core models, assuming you can afford them.

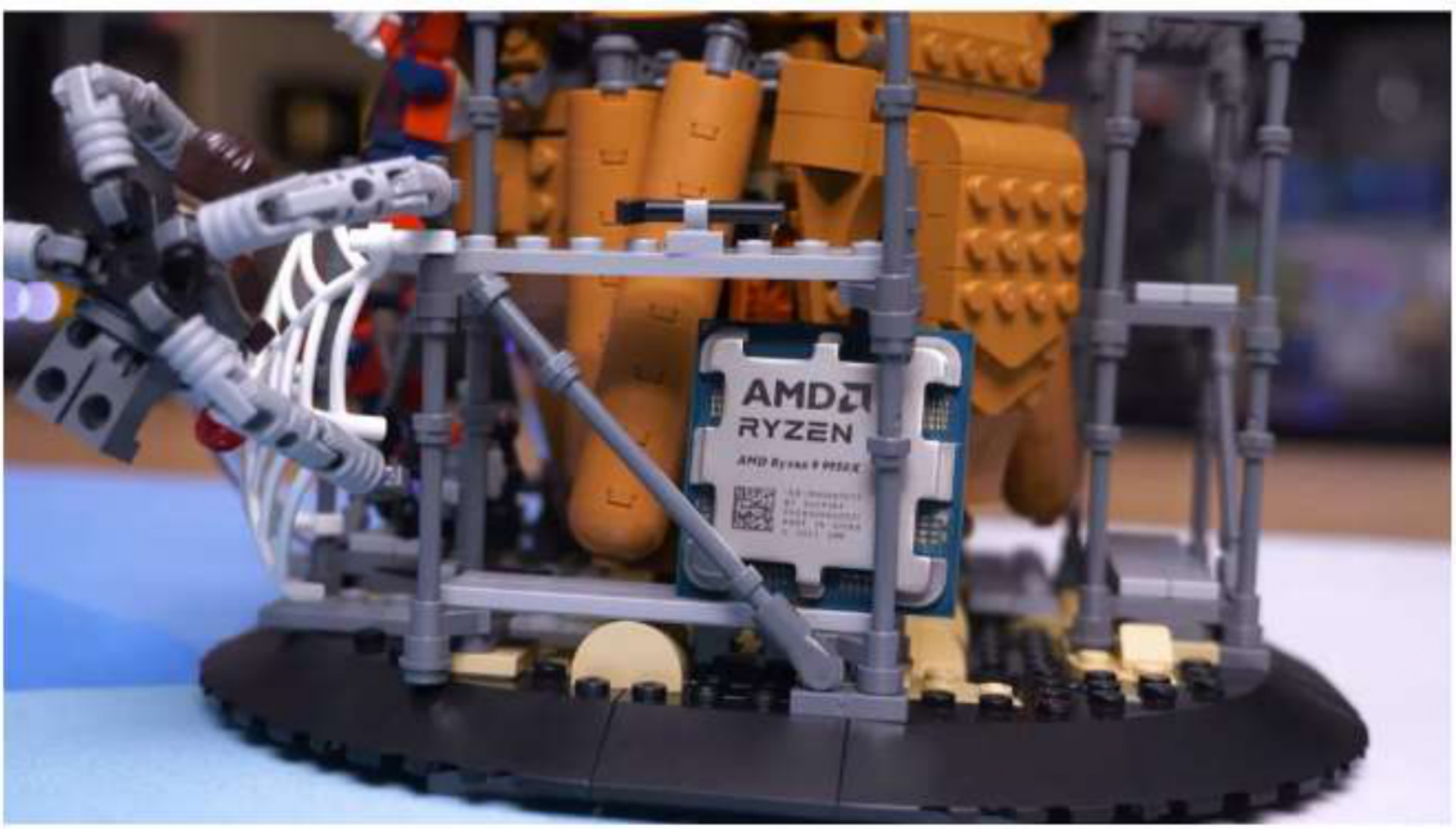
This might be good news for the 9950X, as its 16-core/32-thread design makes it very useful for productivity tasks. However, the question is, how much more useful is it than the 7950X? When compared to the 7950X, the core count remains the same at 16, and both parts boost to the same 5.7 GHz, though the base frequency of the 9950X has dropped by 200 MHz.

	AMD Ryzen 9 7950X	AMD Ryzen 9 9950X
Release Date	September 2022	August 2024
Fabrication process	TSMC N5 FinFET (N6 FinFET I/O die)	TSMC N4 FinFET (N6 FinFET I/O die)
Cores / Threads	16 / 32	
Base Clock	4.5 GHz	4.3 GHz
Boost Clock	5.7 GHz	
Core Config	2 X 8	
Chiplets	2 X CCD, 1 X I/OD	
L3 Cache	64 MB	
PCIe Lanes	28 PCIe 5.0 lanes (4 of the lanes are reserved as link to the chipset)	
Memory Support	DDR5-5200	DDR5-5600
TDP	170 Watt	

Both models feature 32MB of L3 cache per CCD for a total of 64MB, and both have a 170W TDP. A quick side-by-side comparison of the hardware specs doesn't reveal

Both models feature 32MB of L3 cache per CCD for a total of 64MB, and both have a 170W TDP. A quick side-by-side comparison of the hardware specs doesn't reveal much, as the changes to the 9950X have been made at the architectural level.

AMD claims that the Zen 5 architecture boasts substantial improvements in energy efficiency, performance, and AVX-512/VNNI computational capabilities for machine learning and AI workloads. This is Zen 5 in a nutshell – AMD has targeted server workloads and development software, not general desktop computing and gaming, which explains the lack of significant gains here.



Still, AMD's review guide claims that the 9950X is, on average, 8% faster than the 7950X for gaming. They also claimed during their tech day in an official slide that the 12-core 9900X provides gaming leadership over Intel's Core i9-14900K, offering, on average, 12% better performance than the i9 processor, which is a wild claim.

So, keeping all of that in mind, let's go over the benchmarks, starting with some productivity tests before jumping into the gaming results...

Test Setup

CPU Motherboard Memory	AMD Ryzen 9000 Series AMD Ryzen 7000 Series	Gigabyte X670E Aorus Master [BIOS F32b] G.Skill Trident Z5 RGB 32GB DDR5-6000 CL30 DDR5-6000 [CL30-38-38-96]
	AMD Ryzen 5000 Series	MSI MPG X570S Carbon MAX WiFi [BIOS 7D52v1] G.Skill Ripjaws V Series 32GB DDR4-3600 CL 14 DDR4-3600 [CL 14-15-15-35]
	Intel 12th, 13th & 14th [Intel Extreme Profile]	MSI MPG Z790 Carbon WiFi [BIOS 7D89v1C] G.Skill Trident Z5 RGB 32GB DDR5-7200 CL34 DDR5-7200 [CL34-45-45-115]
Graphics Card	Asus ROG Strix RTX 4090 OC Edition	
ATX Case	MSI Prospect 700R	
Power Supply	Kolink Regulator Gold ATX 3.0 1200W	
Storage	TeamGroup T-Force Cardea A440 M.2 PCIe Gen4 NVMe SSD 4TB	
Operating System	Windows 11	
Display Driver	GeForce Game Ready Driver 560.70 WHQL	

Application Benchmarks

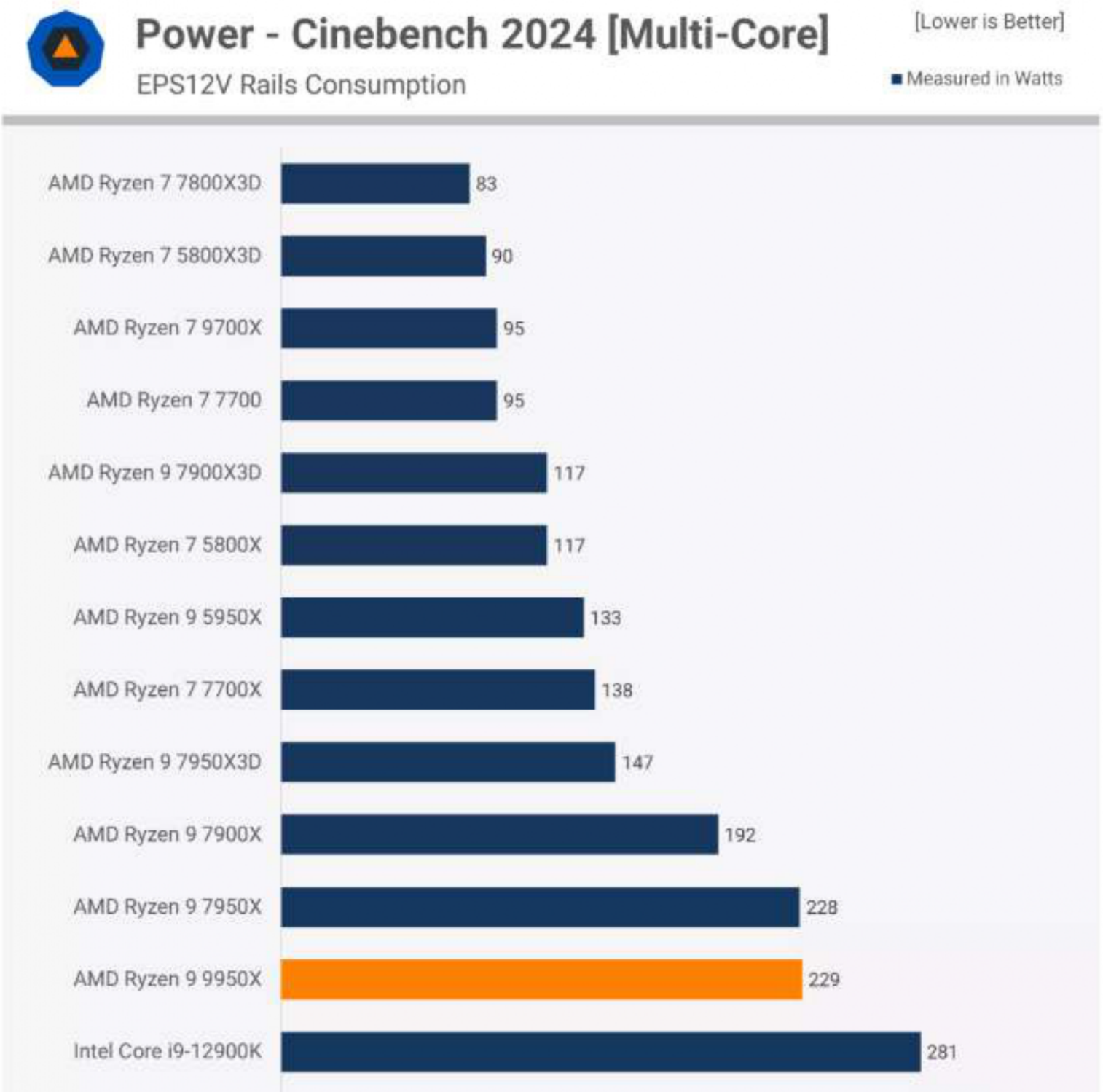
Before we dive into the bar graphs, let's take a quick look at how the 9950X behaves under an all-core workload using Cinebench.

Cinebench 2024

The Cinebench multi-core score of the 9950X is impressive, reaching 228,600 points, though that is just a 4% improvement over the 7950X at the same TDP. With the CPU power capped at 165W, the cores on CCD1 averaged 5.2 GHz, while the cores on CCD2 ran at 4.9 GHz. This resulted in a peak temperature of 92°C and an average operating temperature of 82°C during our 30-minute test.

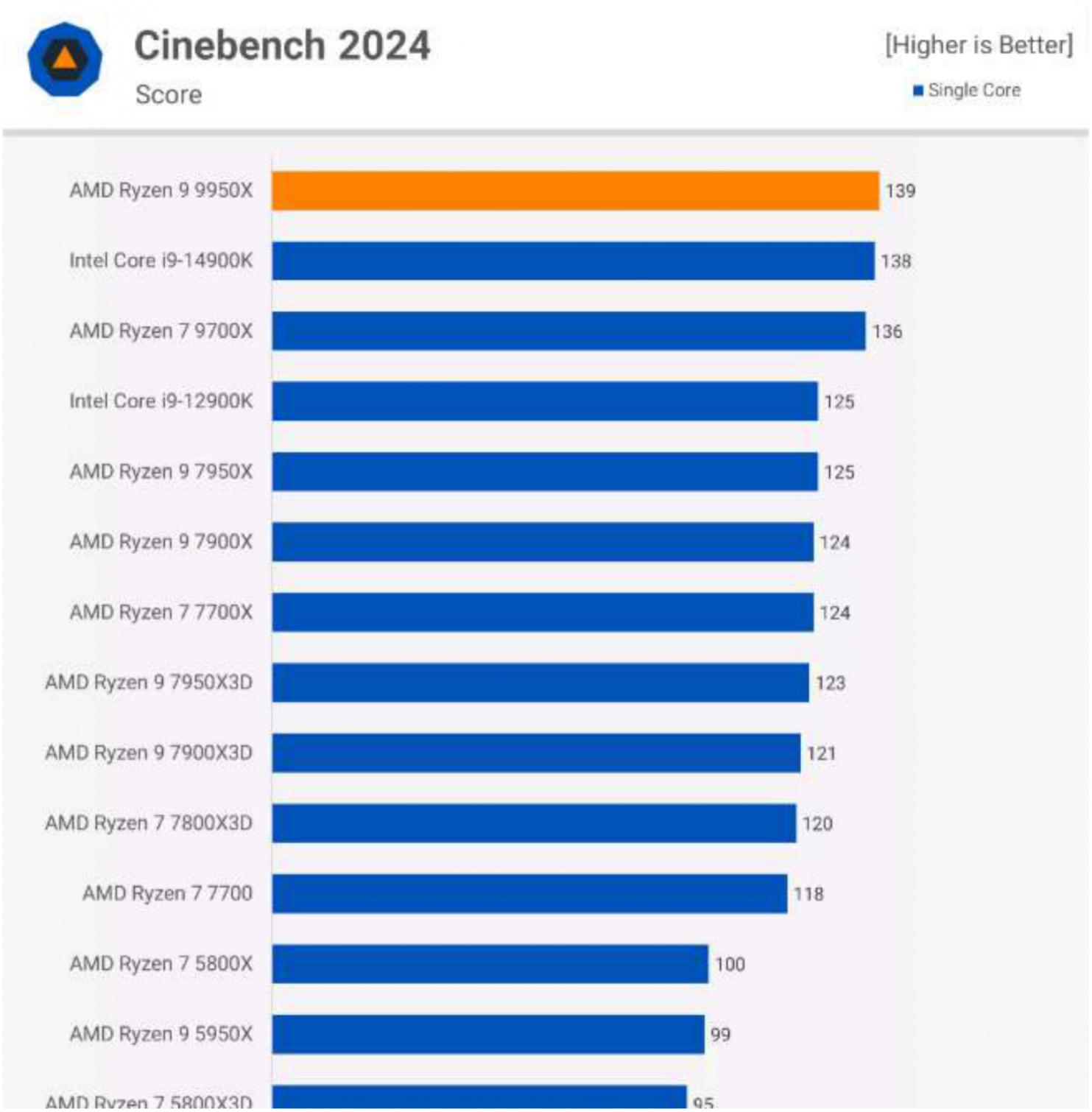
Cinebench 2024, Power

When examining power draw from the EPS12V rails, the 9950X consumed the same level of power as the 7950X. So in this scenario, you're looking at a 4% performance boost at the same power level – not exactly groundbreaking.



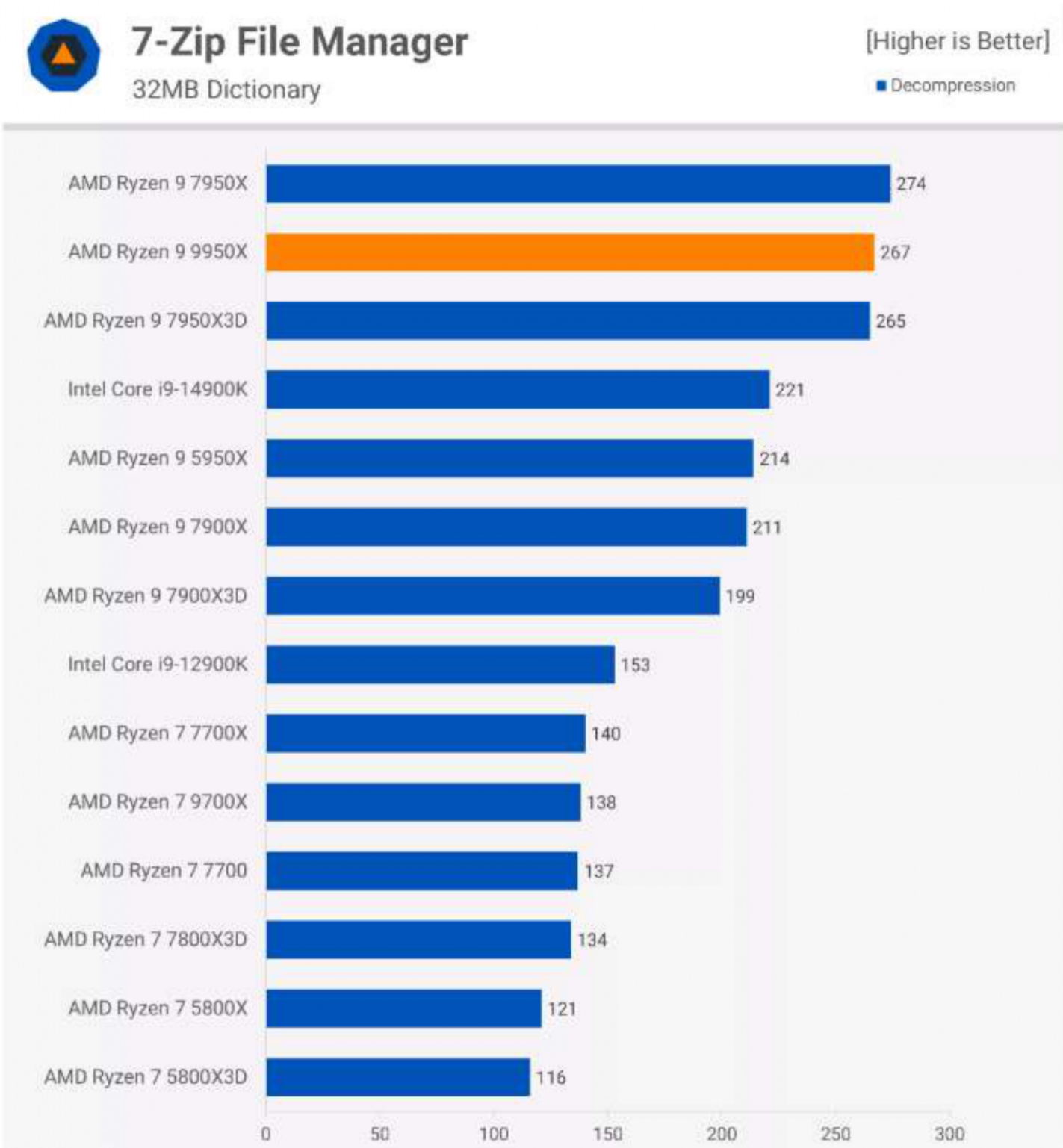
Cinebench 2024, Single

The 9950X does look impressive when measuring single-core performance, as it's able to match the Core i9-14900K, making it 11% faster than the 7950X. That's a solid result.



7-Zip File Manager

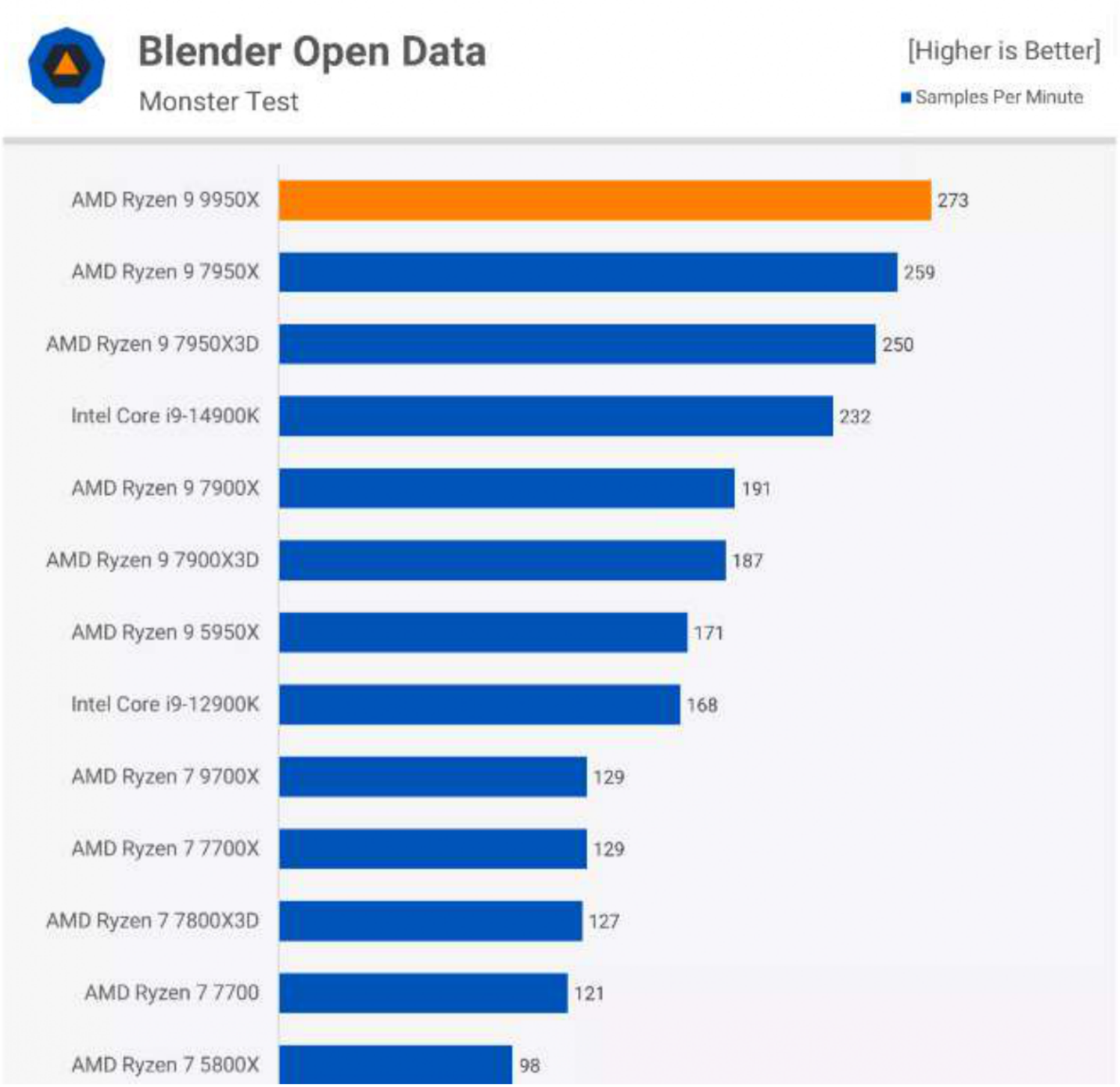
Unfortunately, what isn't as promising is the 7-Zip file manager compression performance. Here, the 9950X is actually 5% slower than the 7950X, which is disappointing – you never want to see a performance regression with a new generation.



The decompression performance wasn't quite as bad, but even so, the 9950X was still 2.5% slower than the 7950X, leading to a highly disappointing result overall.

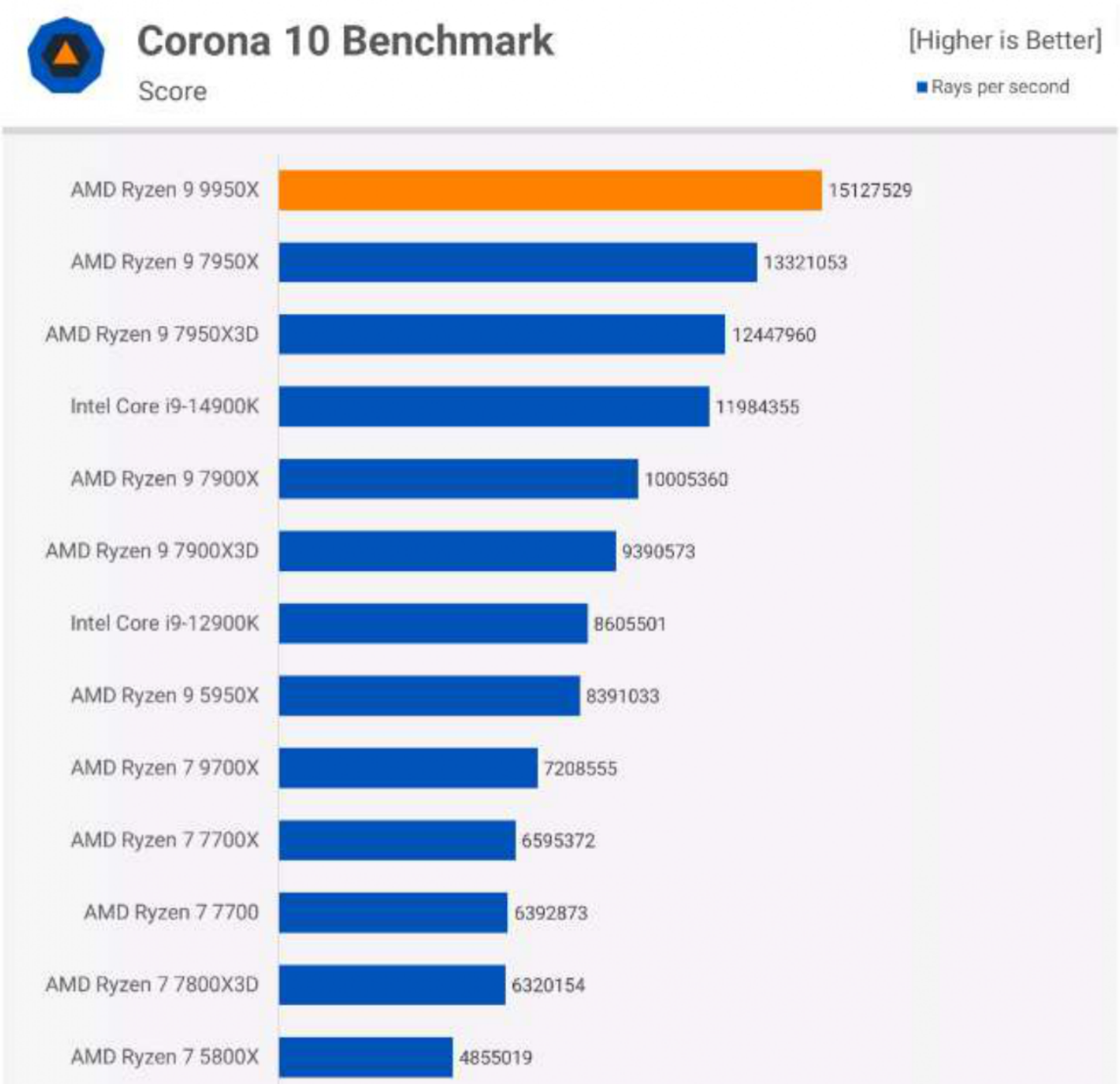
Blender Open Data

The 9950X performed better in Blender Open Data, offering a 5% performance boost. This makes it the fastest desktop CPU for this test, which is notable, but a mere 5% improvement over the 7950X at the same power level isn't particularly impressive.



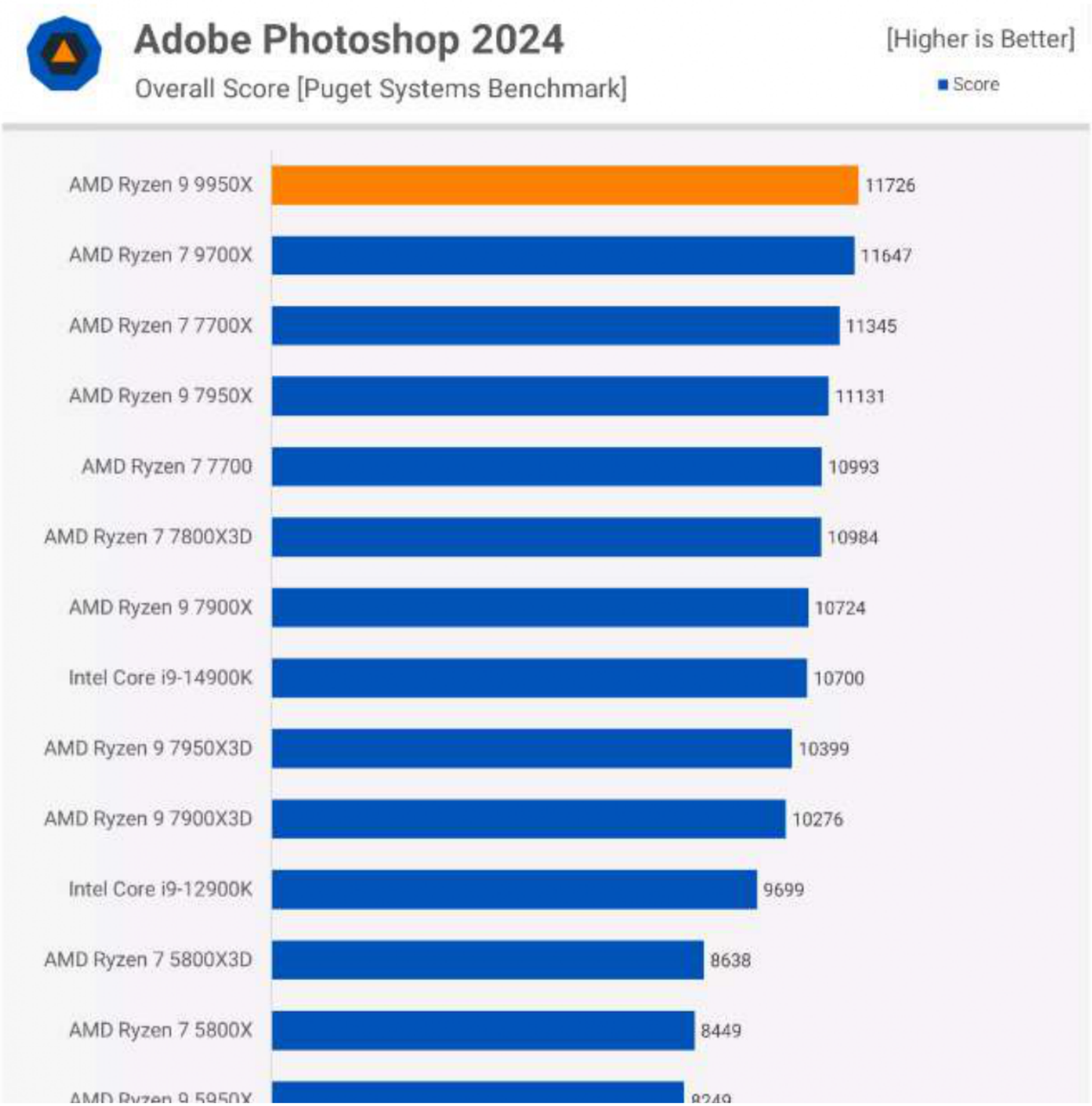
Corona 10 Benchmark

The 9950X produces its best result in the Corona 10 Benchmark, beating the 7950X by an impressive 14% margin. Incredibly, this also meant it was 26% faster than Intel's Core i9-14900K. This is a great result, and we wish we saw more of this from AMD's Zen 5 range on the desktop.



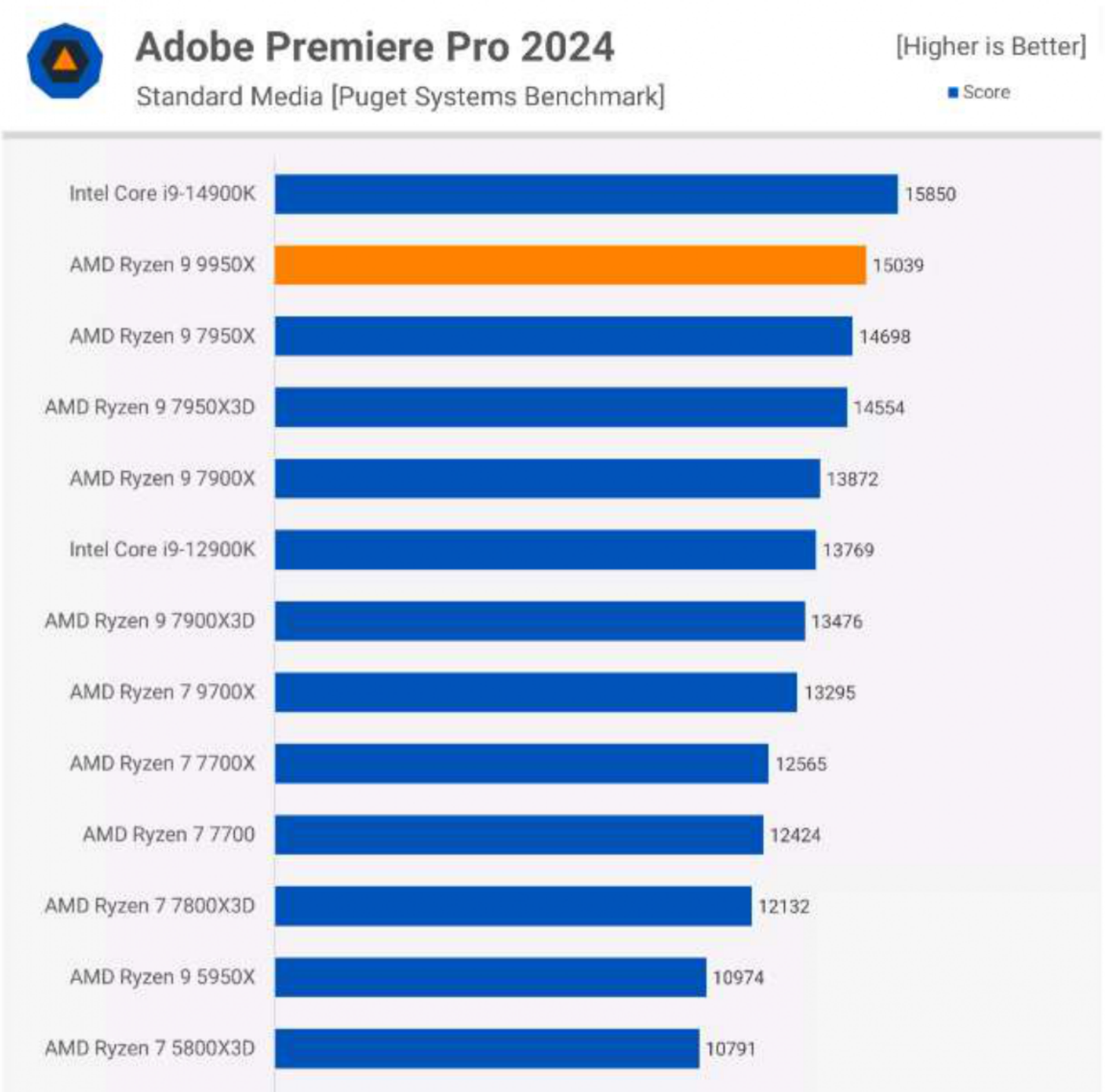
Adobe Photoshop 2024

Moving on to Photoshop, we find the typical 5% uplift for the 9950X over the 7950X. While performance overall was excellent from the 9950X, a 5% generational improvement is a bit underwhelming, to say the least.



Adobe Premiere Pro 2024

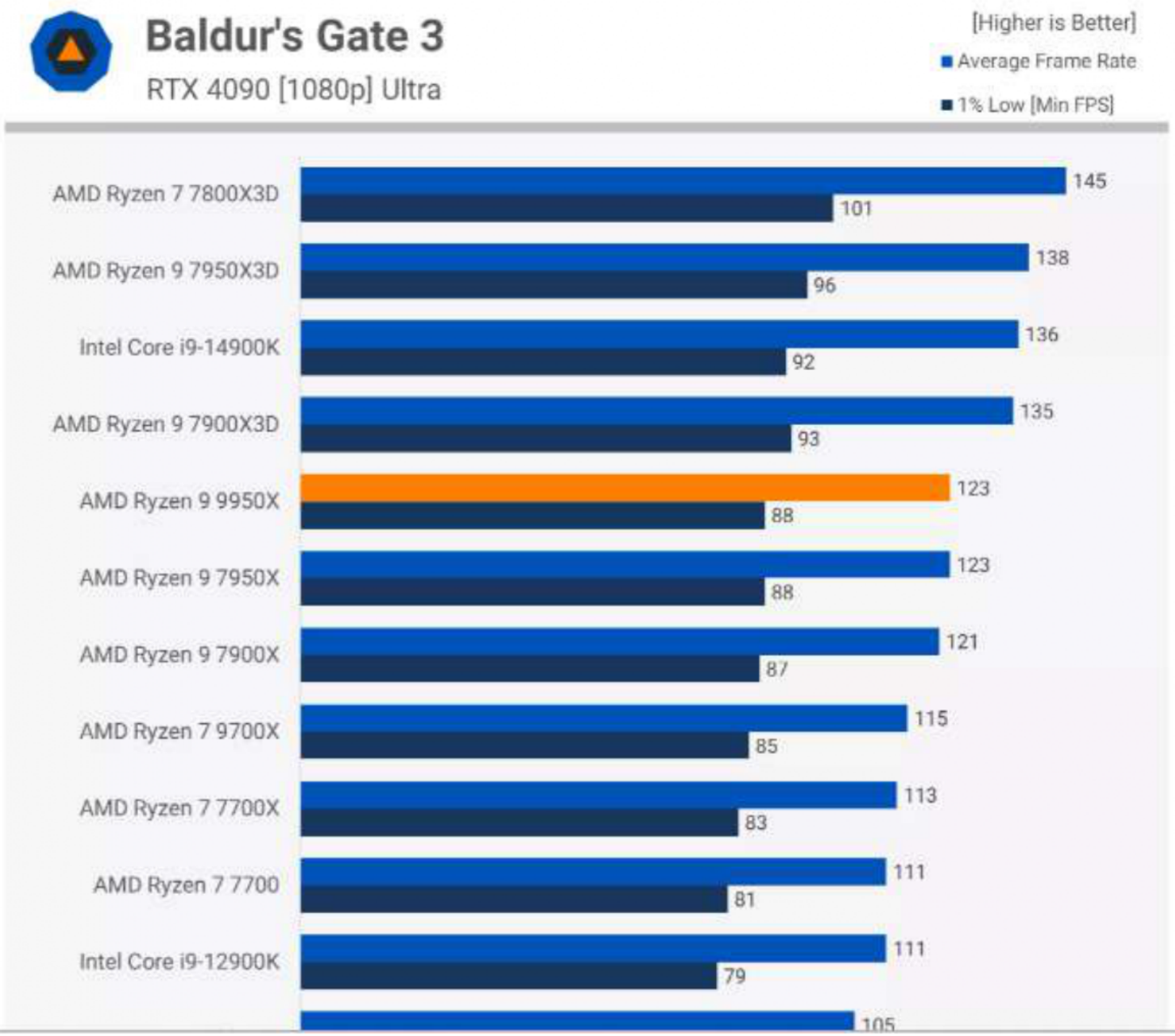
Things look even worse in Premiere Pro, which is disappointing for those of us who rely heavily on this application. The 9950X is offering a mere 2% uplift, meaning it's still quite a bit slower than the 14900K. While we're not recommending Intel 13th and 14th gen K-SKU parts right now, it's still a disappointing result.



Gaming Benchmarks

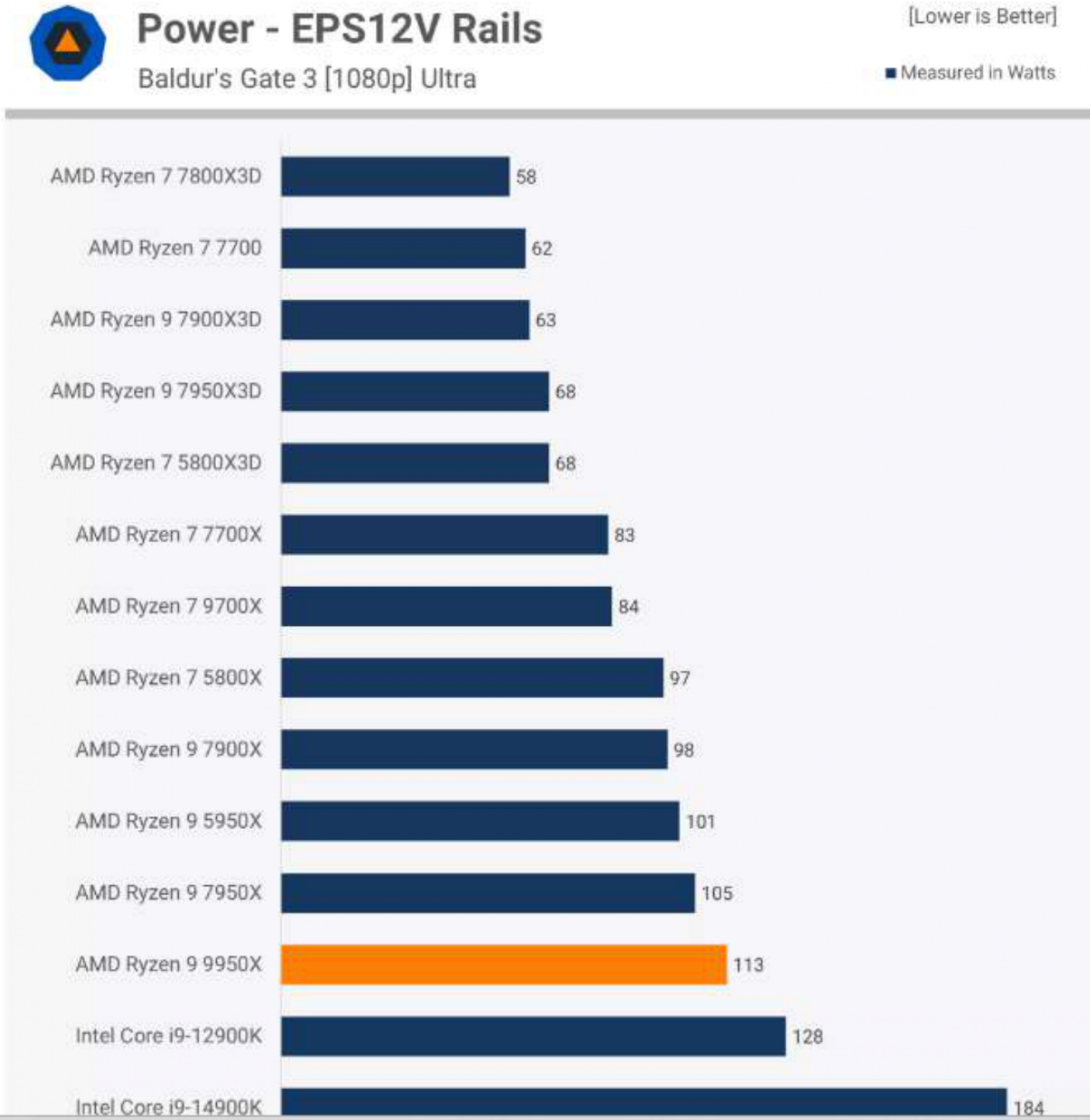
Baldur's Gate 3

Now, let's dive into the gaming benchmarks. While the 9950X might not be a gaming-focused product, we're a gaming-focused channel, so naturally, we're going to assess its gaming performance. Starting with Baldur's Gate 3, we see that the 9950X offers the same performance as the 7950X, with no changes in this area.



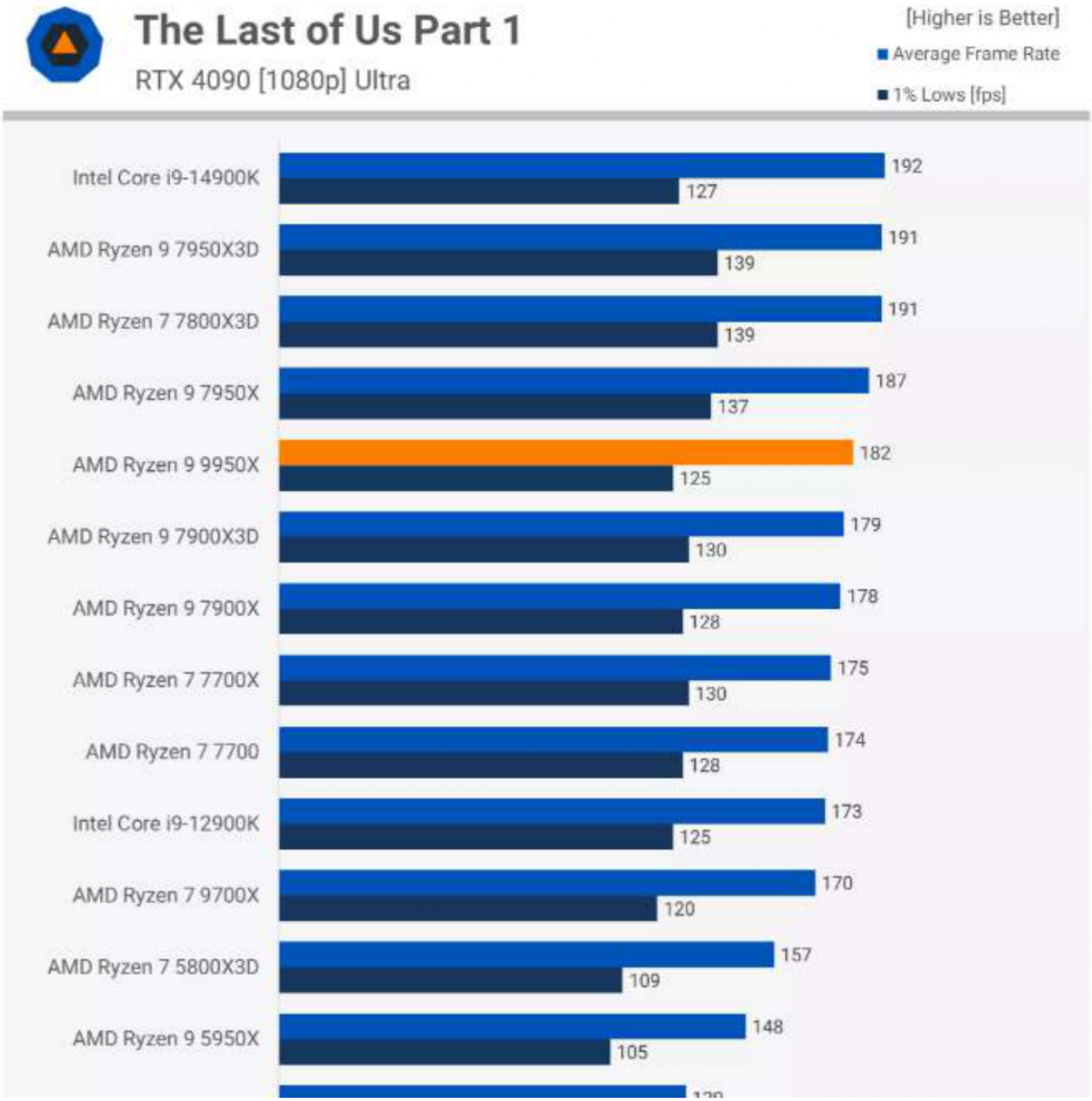
Baldur's Gate 3, Power

Despite delivering the same performance, the 9950X consumed 8% more power than the 7950X in Baldur's Gate 3, indicating that Zen 5 isn't as efficient as Zen 4 in this instance.



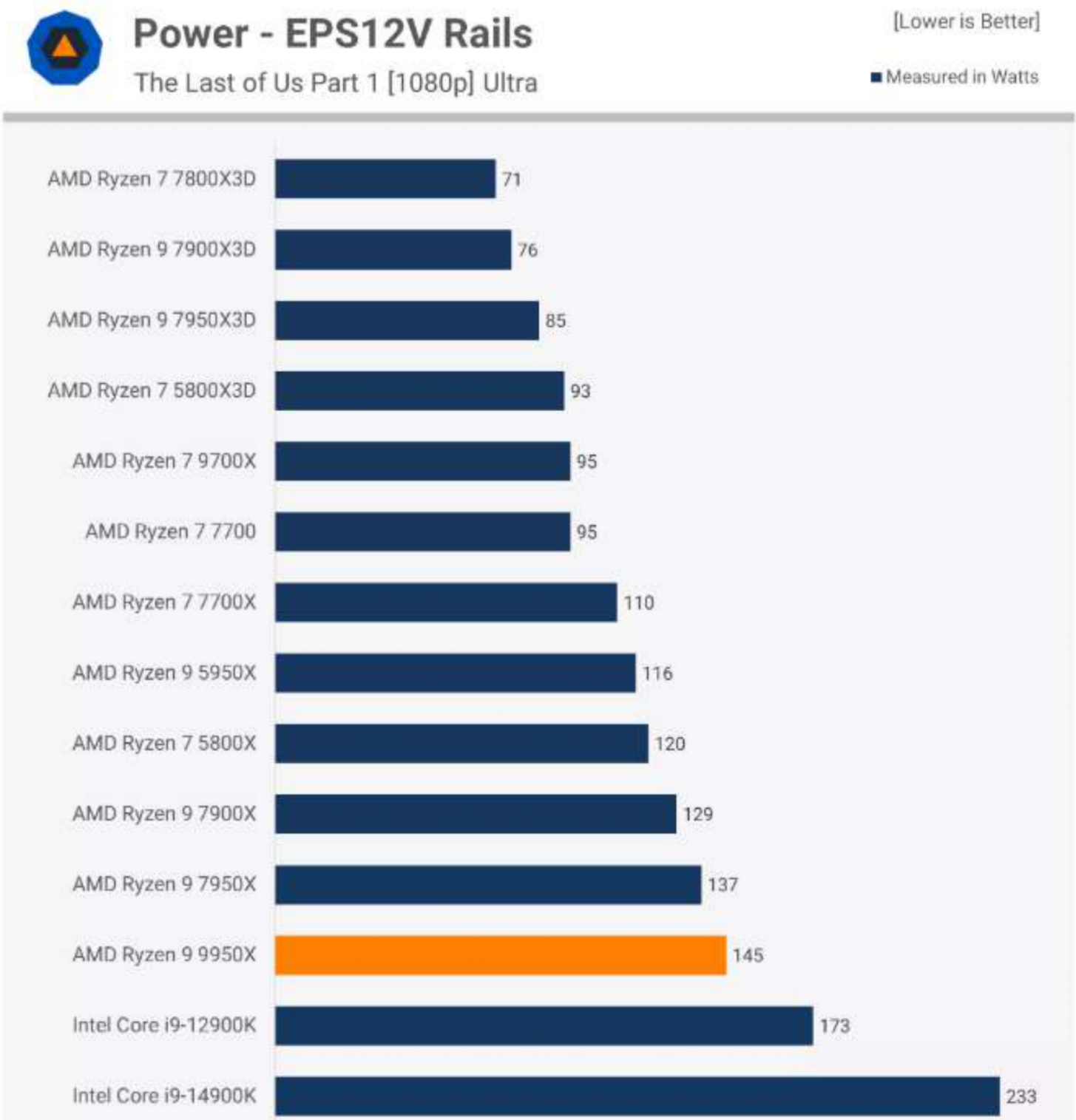
The Last of Us Part 1

Disappointingly, the 9950X was 3% slower than the 7950X in The Last of Us Part 1, dropping from 187 fps to 182 fps. While the difference is negligible, it's disheartening to see any performance regression.



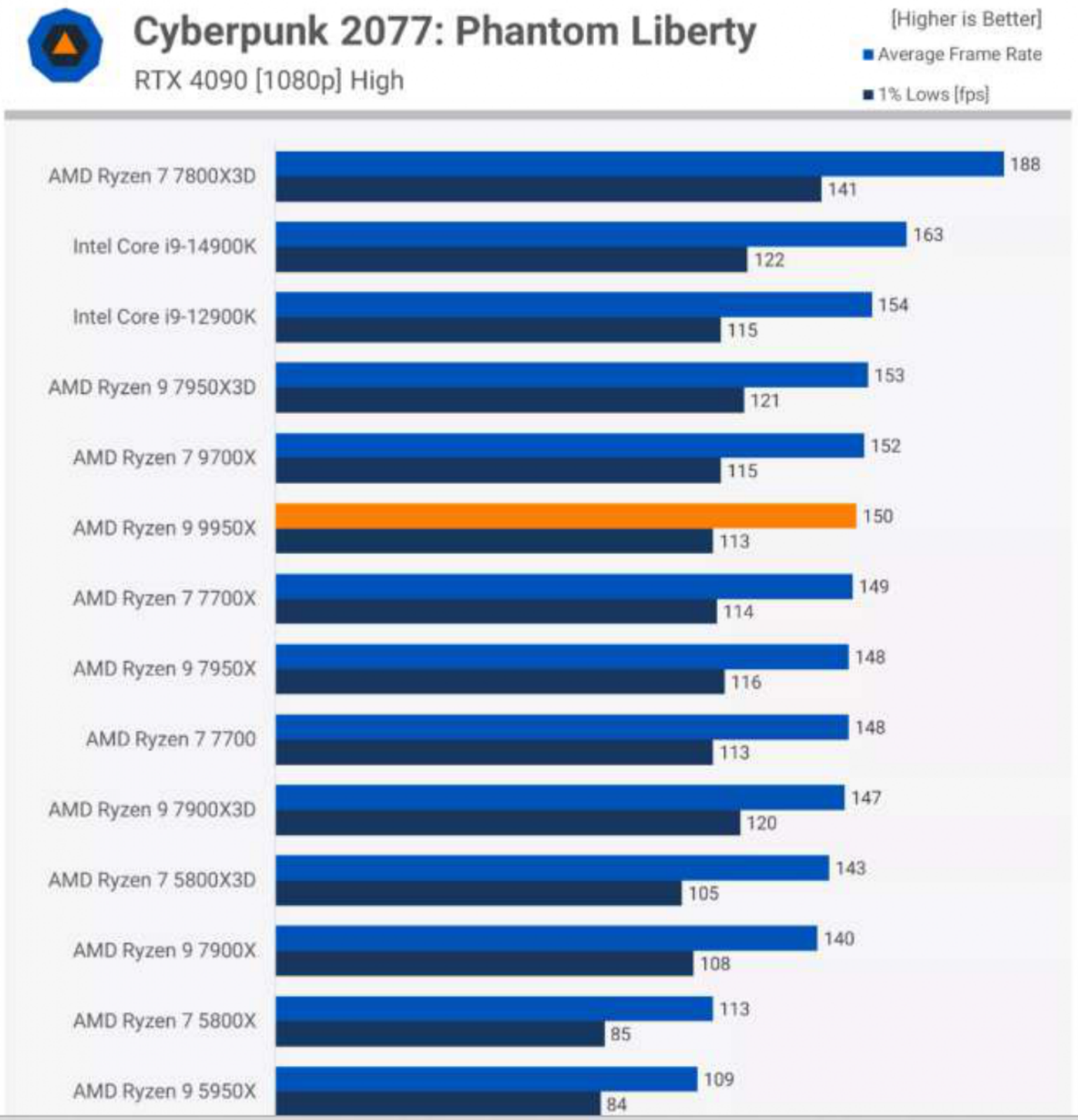
The Last of Us Part 1, Power

Despite being slower, the 9950X consumed 6% more power than the 7950X in The Last of Us Part 1.



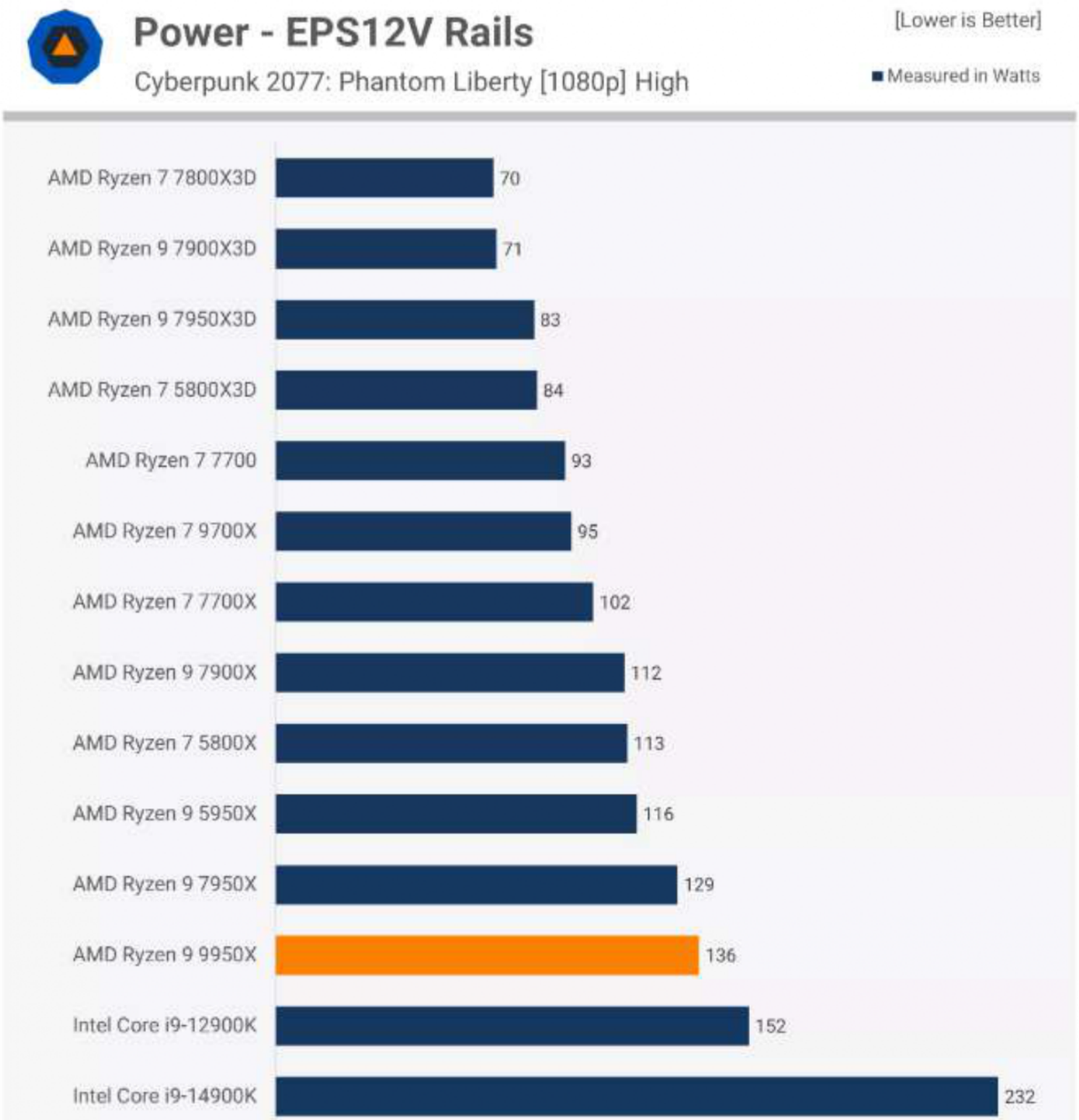
Cyberpunk 2077: Phantom Liberty

The 9950X performed slightly better in Cyberpunk 2077: Phantom Liberty, with a 1% increase in performance. It's a modest gain, but given the context, we'll take it.



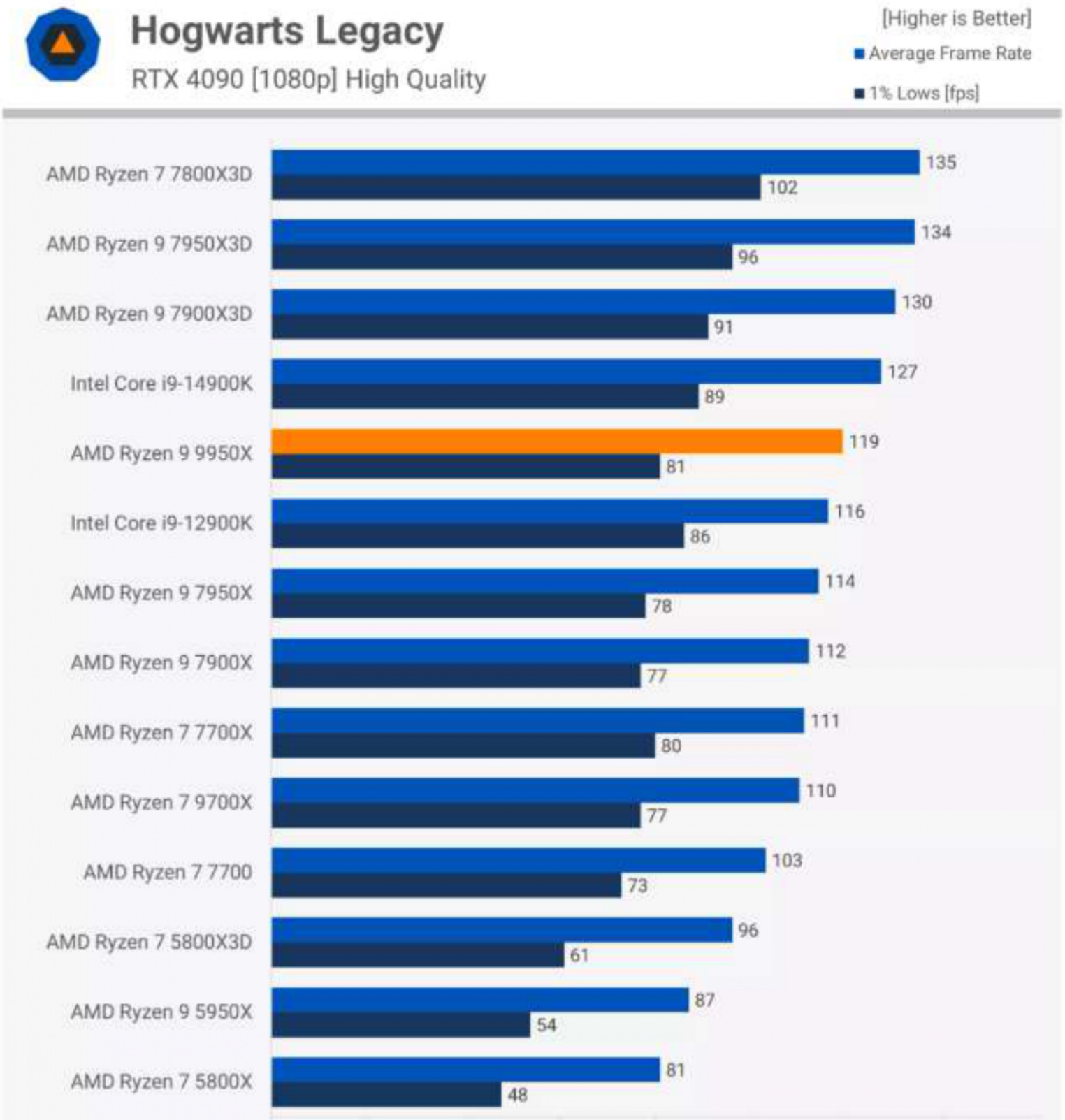
Cyberpunk 2077: Phantom Liberty, Power

Unfortunately, the 9950X consumed 5% more power than the 7950X in this title as well.



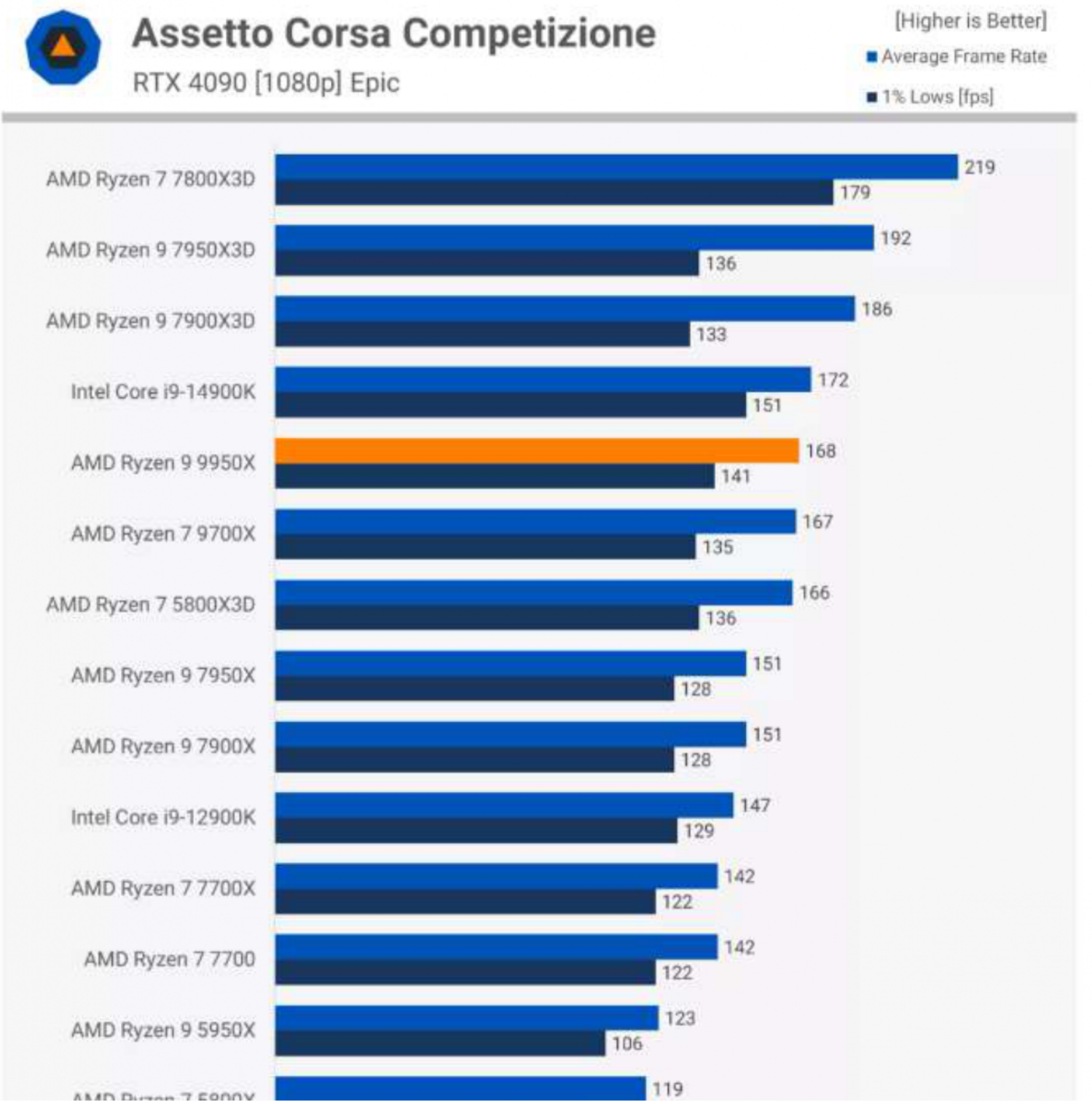
Hogwarts Legacy

In Hogwarts Legacy, the 9950X achieved a 4% lead over the 7950X. While it's tempting to call that an impressive gain, it's still not substantial, so let's move on.



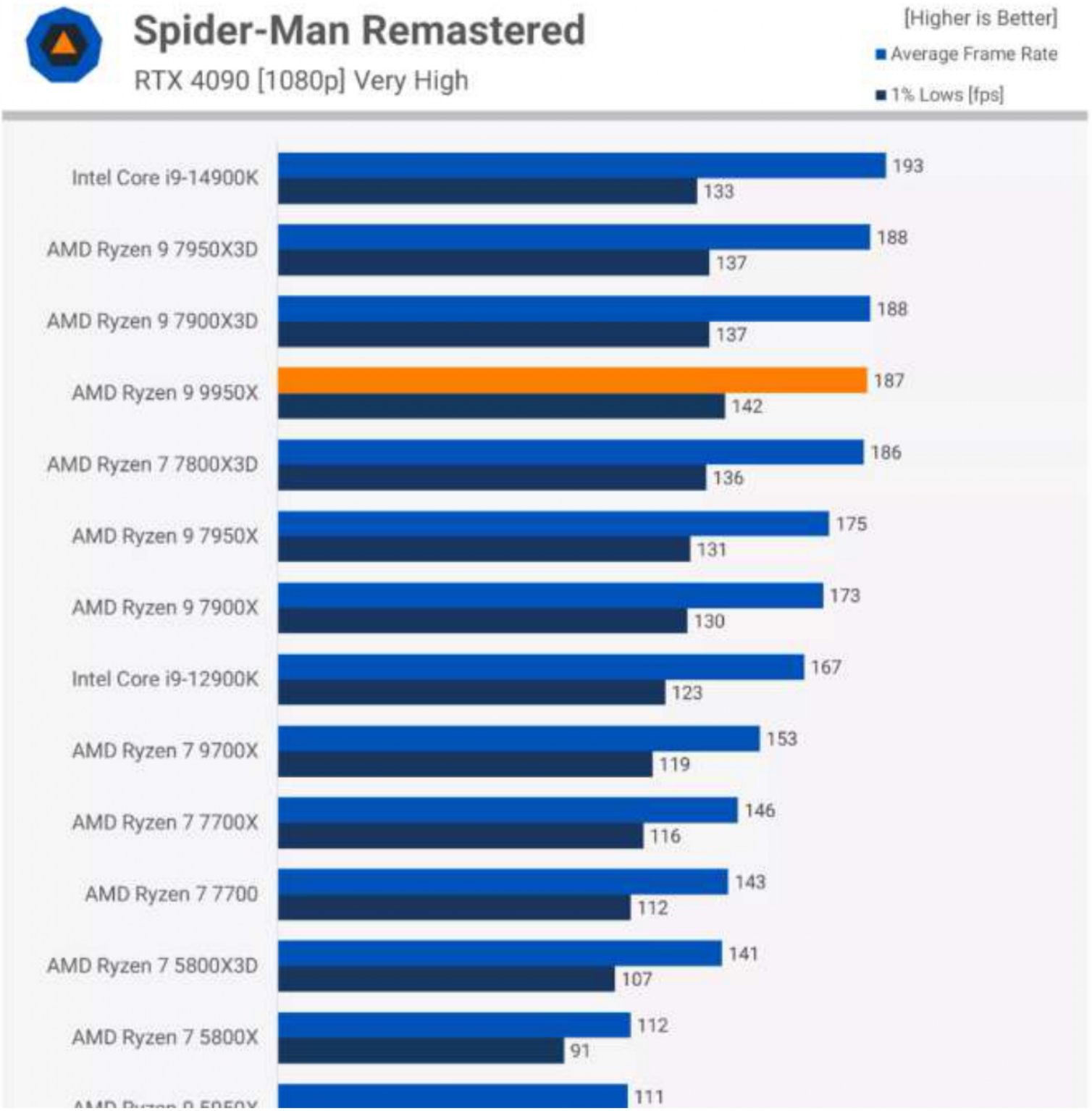
Assetto Corsa Competizione

An actually impressive gain was found in Assetto Corsa Competizione, where the 9950X offered an 11% boost over the 7950X. This might have been expected to be more of the norm for Zen 5, but, unfortunately, results like this are outliers.



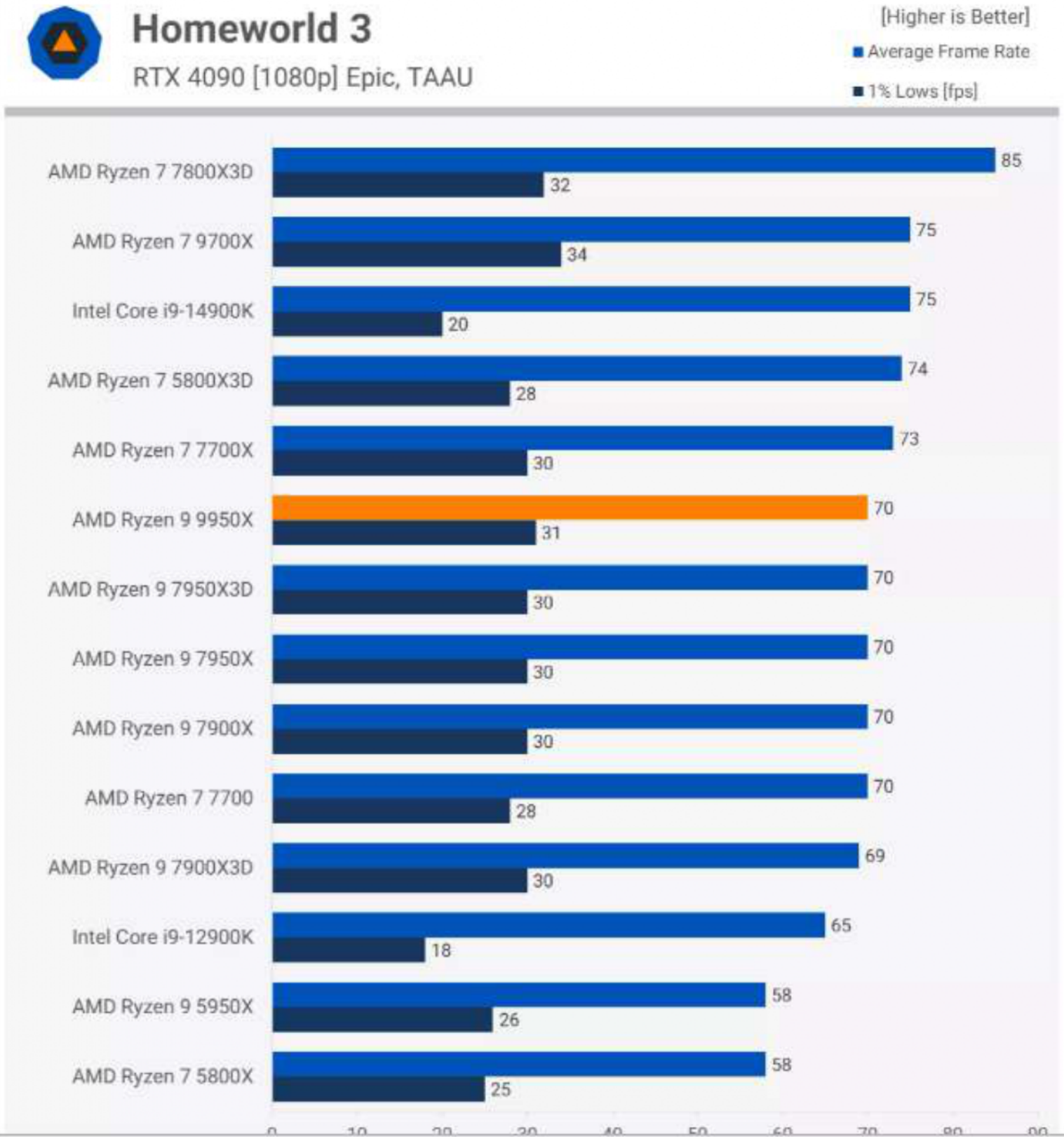
Spider-Man Remastered

The 9950X also performs decently in Spider-Man Remastered, beating the 7950X by a 7% margin, allowing it to deliver similar performance to the 7800X3D. While it's still only a 7% increase, given what we've seen so far, it's one of the better results.



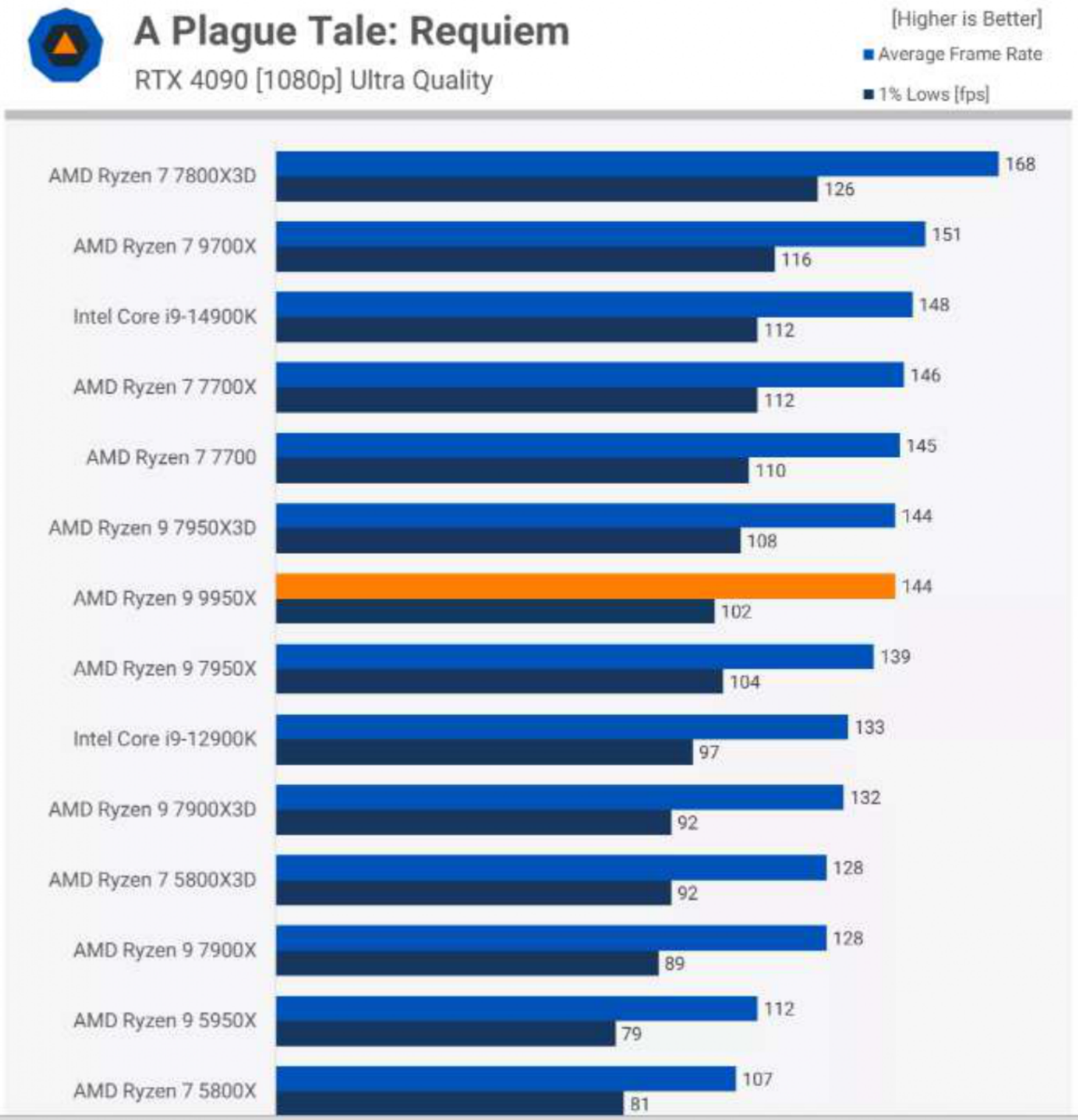
Homeworld 3

Unfortunately, performance in Homeworld 3 remains unchanged, with the 9950X matching the 7950X.



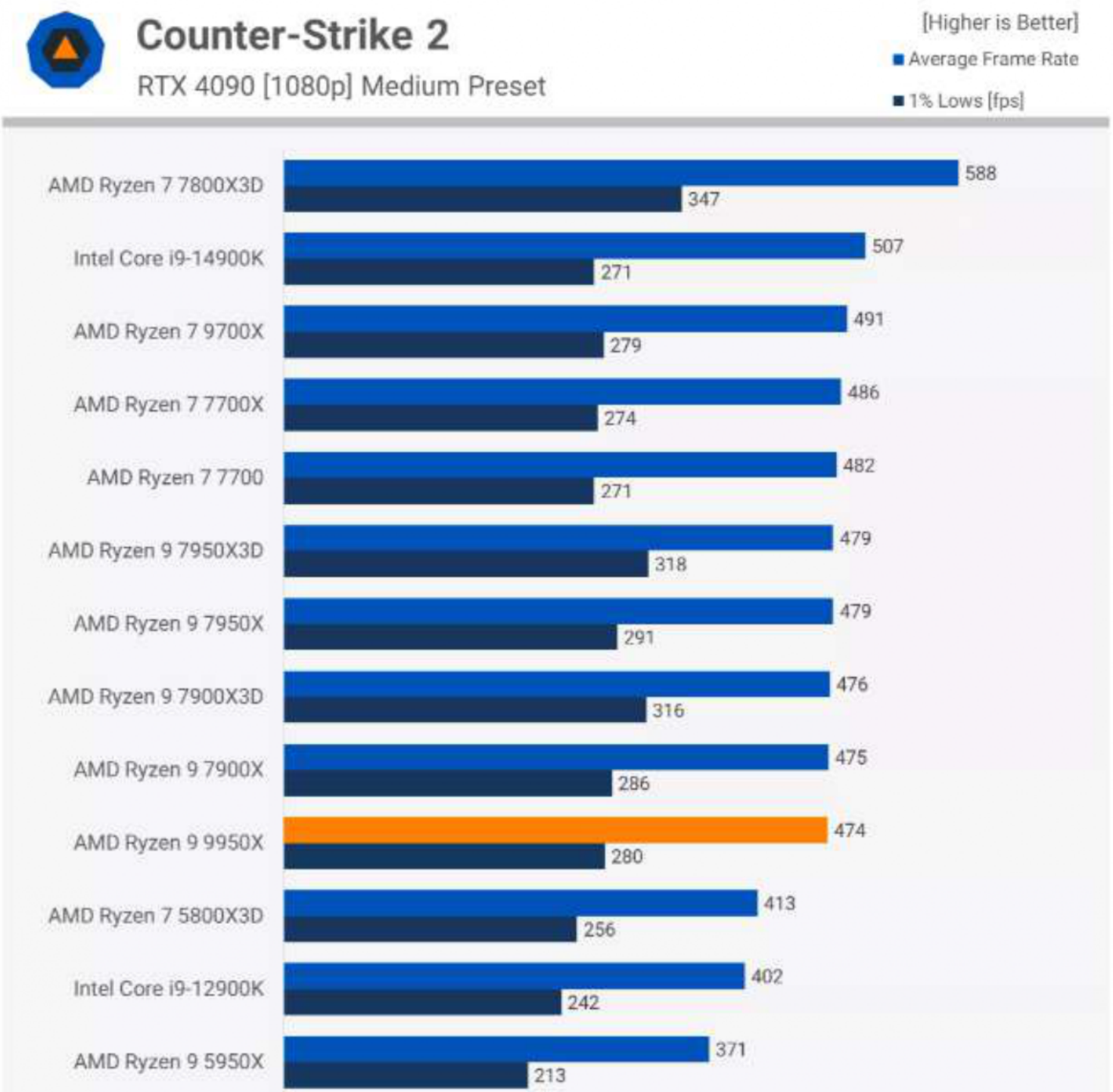
A Plague Tale: Requiem

The 9950X was faster in A Plague Tale: Requiem, though we are only seeing a 4% gain in this example – not a difference you're likely to notice.



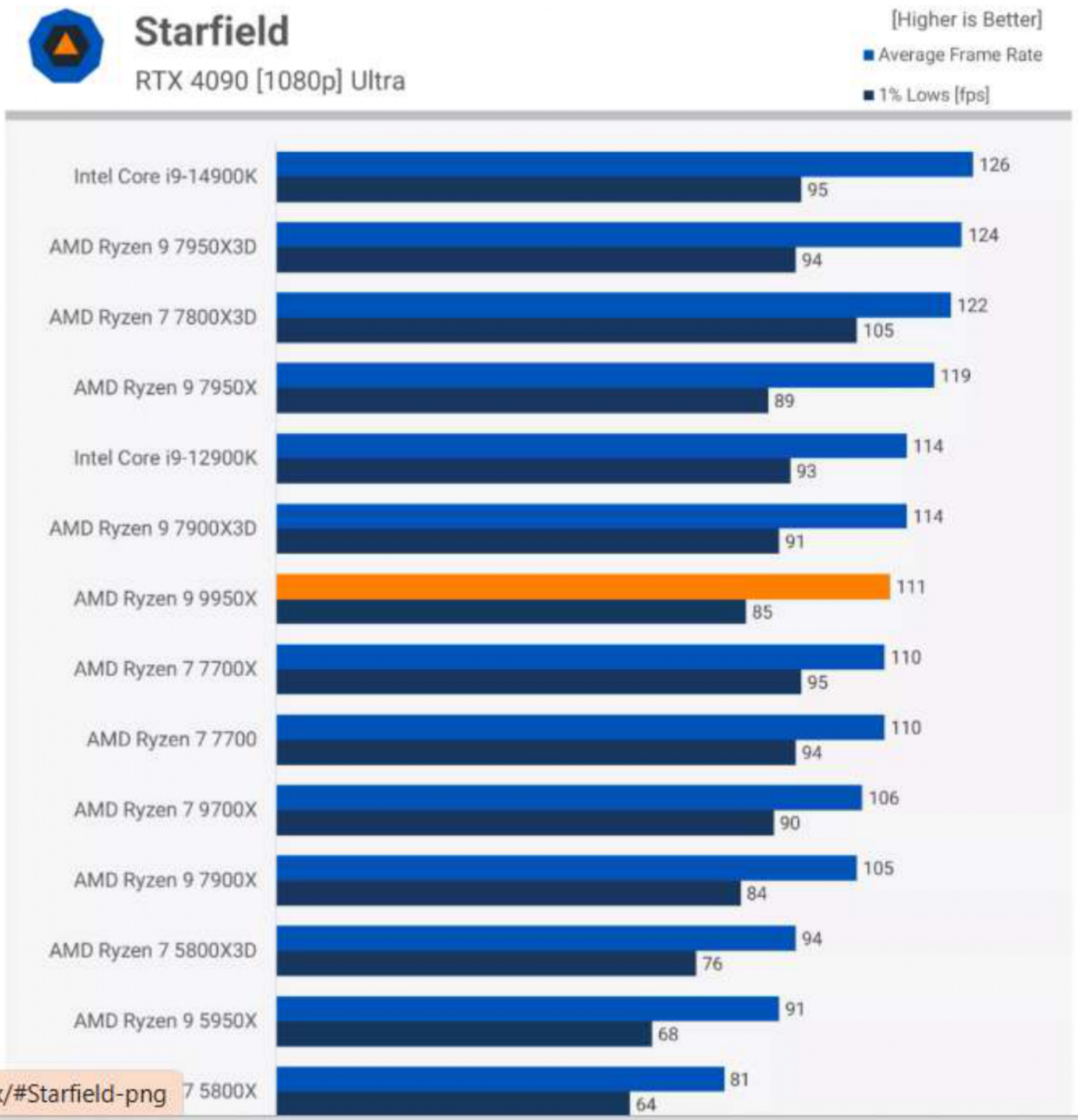
Counter-Strike 2

No performance improvement was observed in Counter-Strike 2; in fact, the 9950X was technically 1% slower than the 7950X. However, the margin is so small that these two CPUs are virtually indistinguishable in gaming performance.



Starfield

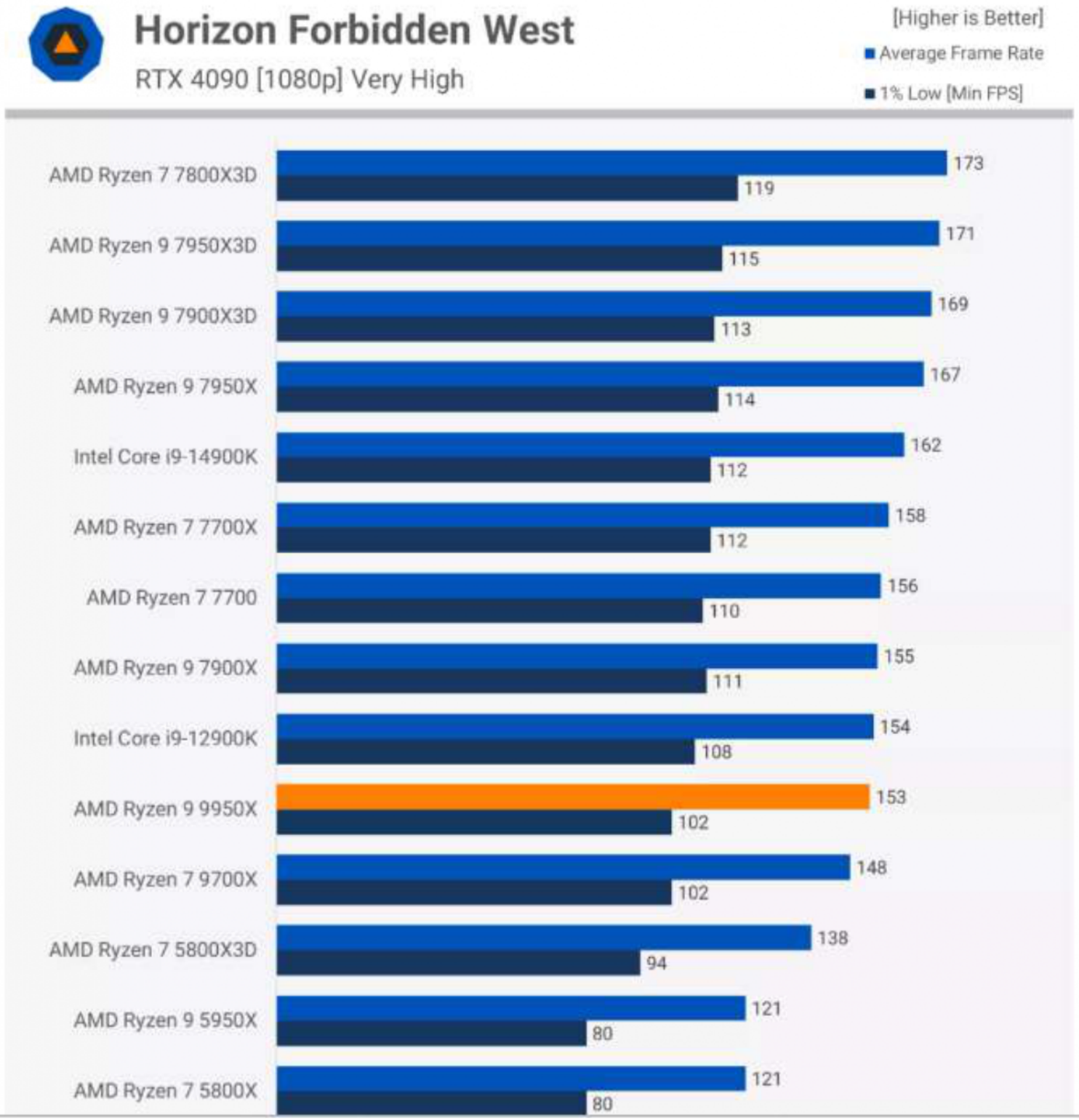
As we previously found with the 9700X and 9600X, Zen 5 struggles in Starfield, and this holds true with the 9950X, which was 7% slower than the 7950X.



x/#Starfield-png

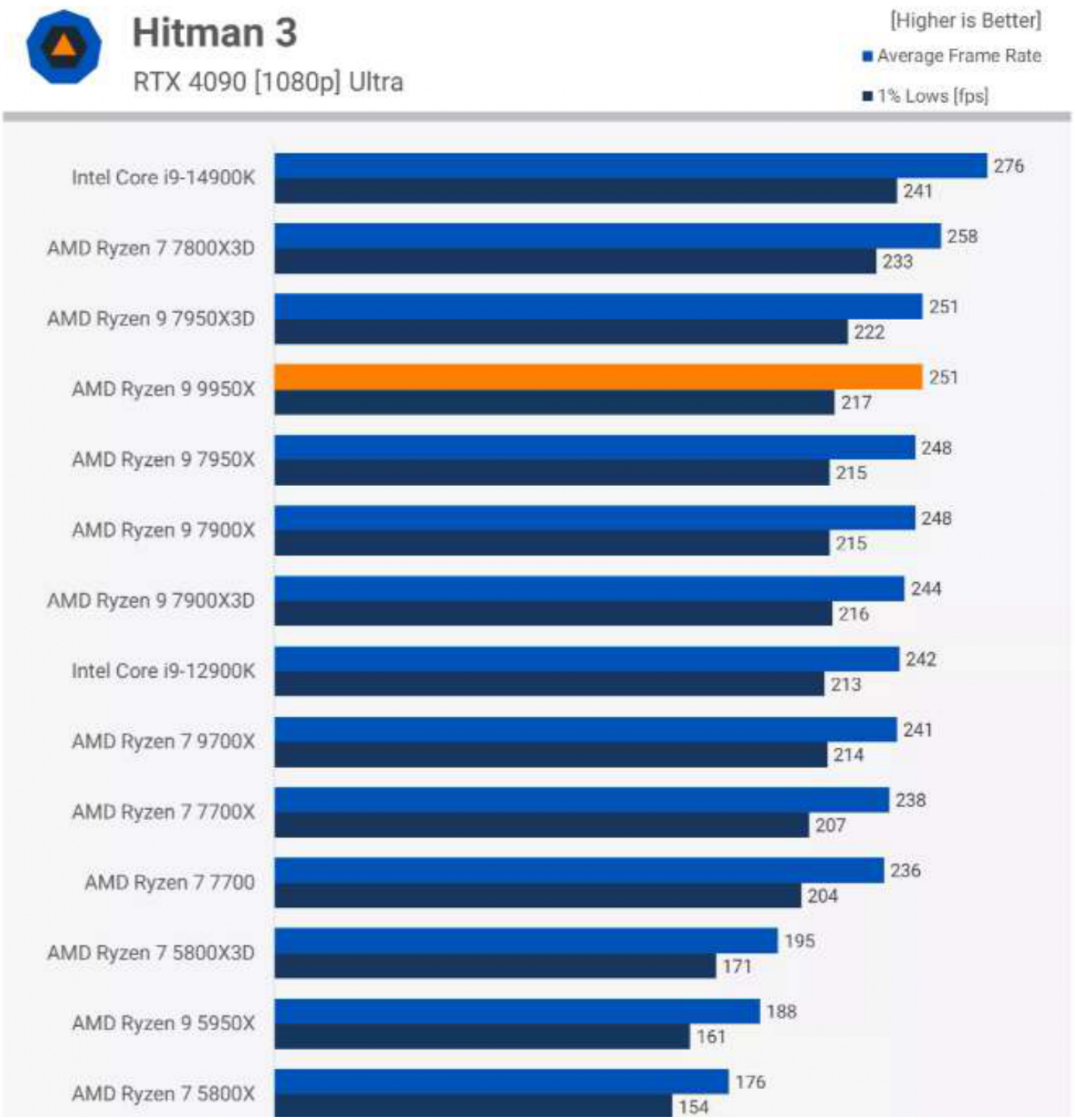
Horizon Forbidden West

It's a similar story in Horizon Forbidden West, with the 9950X trailing the 7950X by an 8% margin. There's not much more to say other than it's clearly very disappointing.



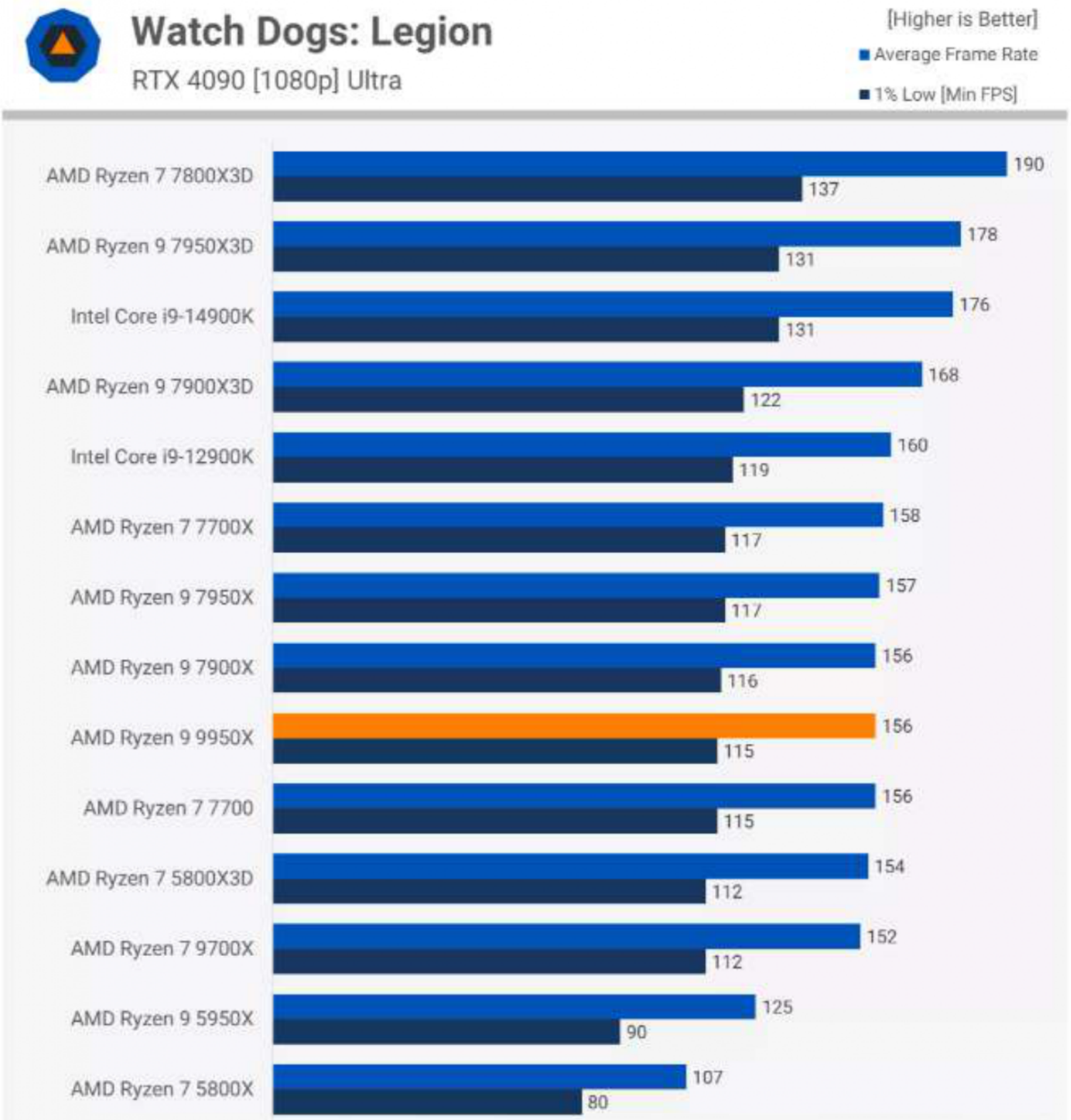
Hitman 3

Performance in Hitman 3 is essentially the same, with the 9950X being just 1% faster than the 7950X, so this can be considered a tie.



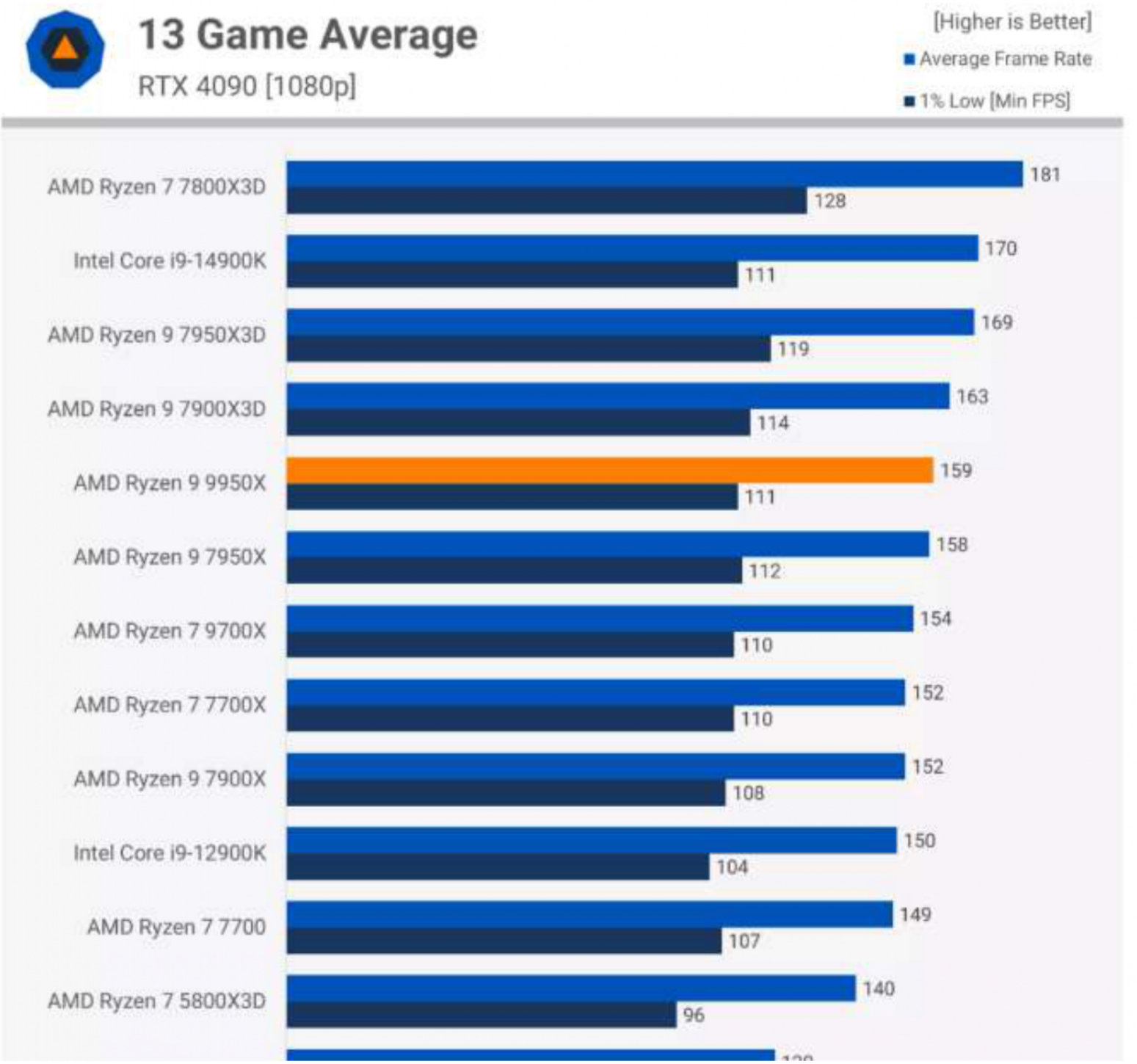
Watch Dogs: Legion

Finally, in Watch Dogs: Legion, the 9950X is 1% slower than the 7950X, resulting in another tie.



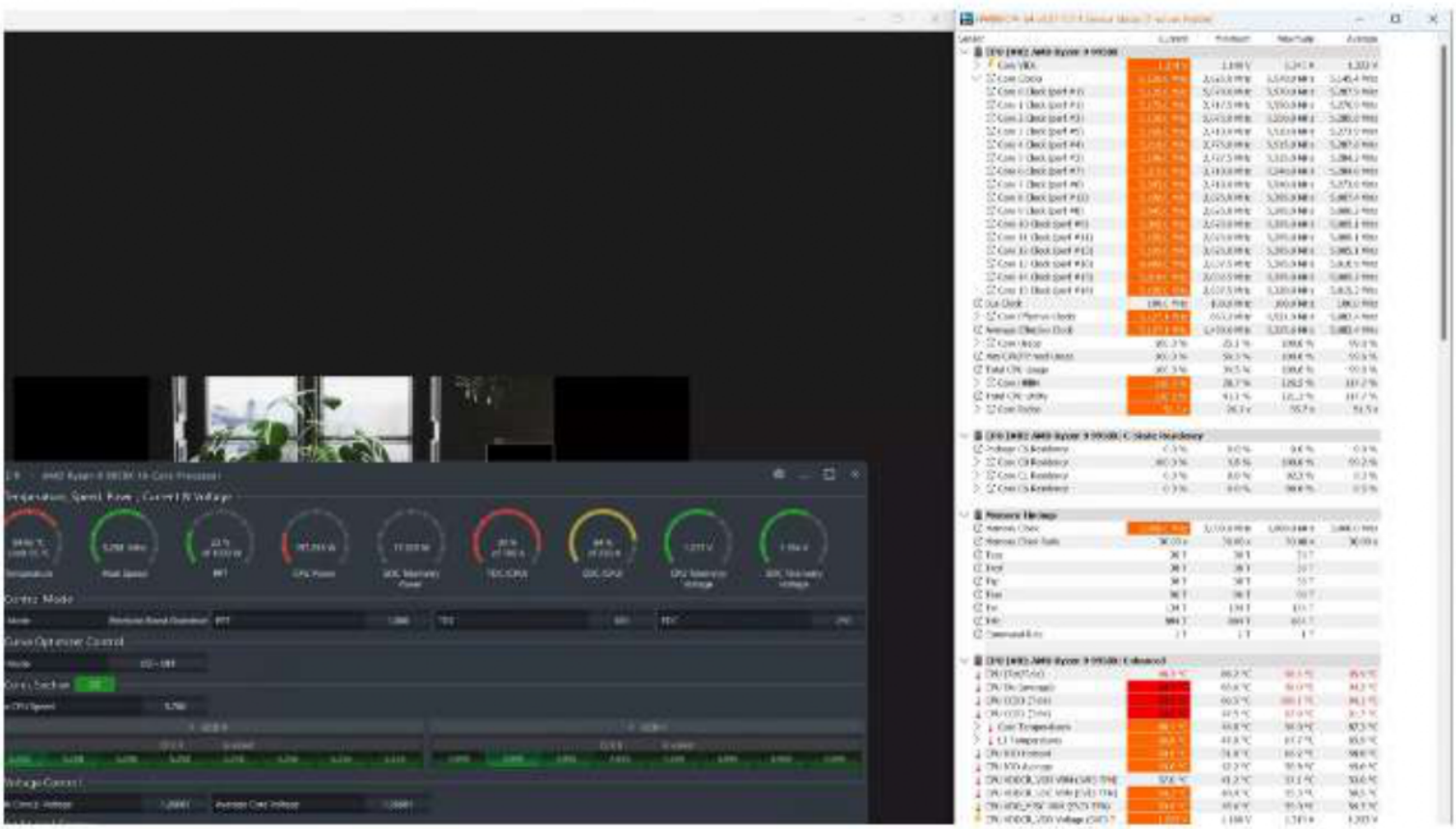
13 Game Average

Across the 13 games tested, the 9950X is almost 1% faster than the 7950X – let's round up and give it the full 1% win. This doesn't exactly make for exciting gaming performance; after two years, you're essentially getting the same experience. For gamers, that's Zen 5 in a nutshell.



Cinebench PBO

With PBO enabled, the CPU package power peaked at 230 Watts, and the CPU was thermally throttling at the 95°C TjMAX. However, our motherboard reported a peak CCD1 temperature of 100°C. This allowed the cores on CCD1 to run at 5.3 GHz and the cores on CCD2 at 5 GHz.



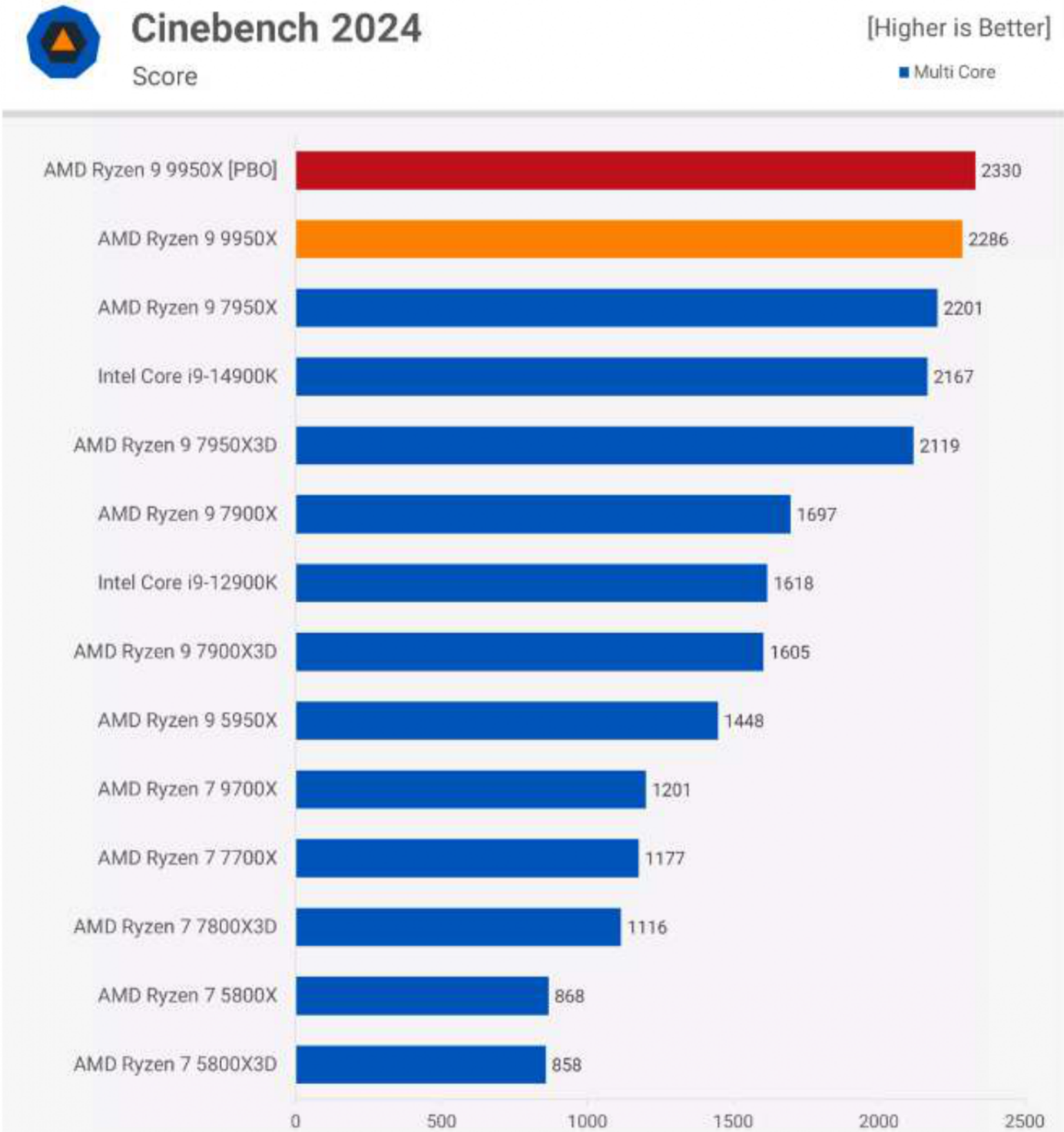
With PBO enabled, the 9950X is temperature-limited. It's worth noting that we used a be quiet! Pure Loop 2 360mm all-in-one liquid cooler for all of this testing. Results will likely vary, but for this configuration, we were only able to squeeze an additional 2% performance from the 9950X with PBO enabled.

Cinebench 2024

[Higher is Better]

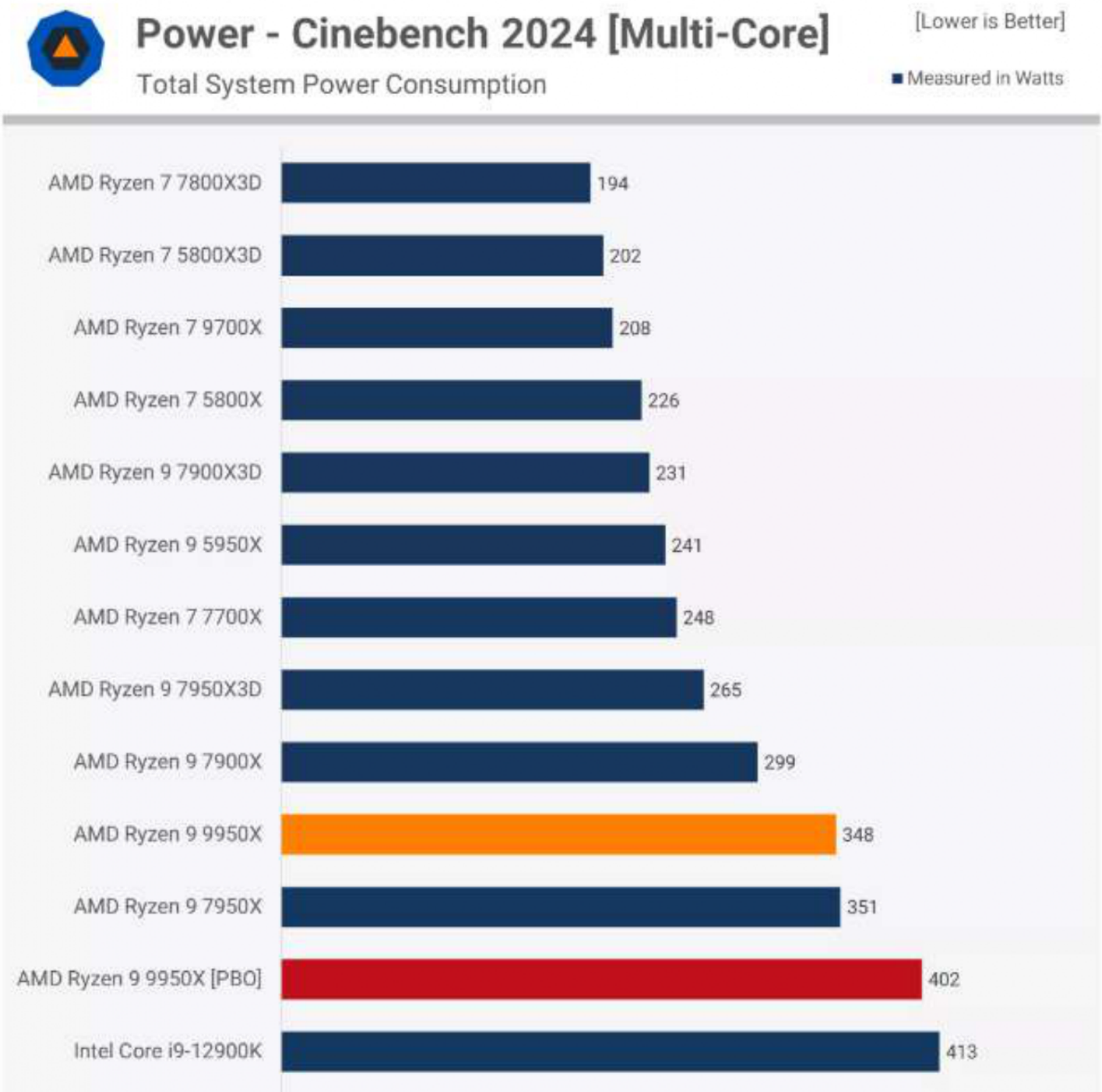
Score

■ Multi Core


Cinebench 2024
Score
[Higher is Better]
Multi Core
AMD Ryzen 9 9950X [PBO]
2330
AMD Ryzen 9 9950X
2286
AMD Ryzen 9 7950X
2201
Intel Core i9-14900K
2167
AMD Ryzen 9 7950X3D
2119
AMD Ryzen 9 7900X
1697
Intel Core i9-12900K
1618
AMD Ryzen 9 7900X3D
1605
AMD Ryzen 9 5950X
1448
AMD Ryzen 7 9700X
1201
AMD Ryzen 7 7700X
1177
AMD Ryzen 7 7800X3D
1116
AMD Ryzen 7 5800X
868
AMD Ryzen 7 5800X3D
858
0
500
1000
1500
2000
2500

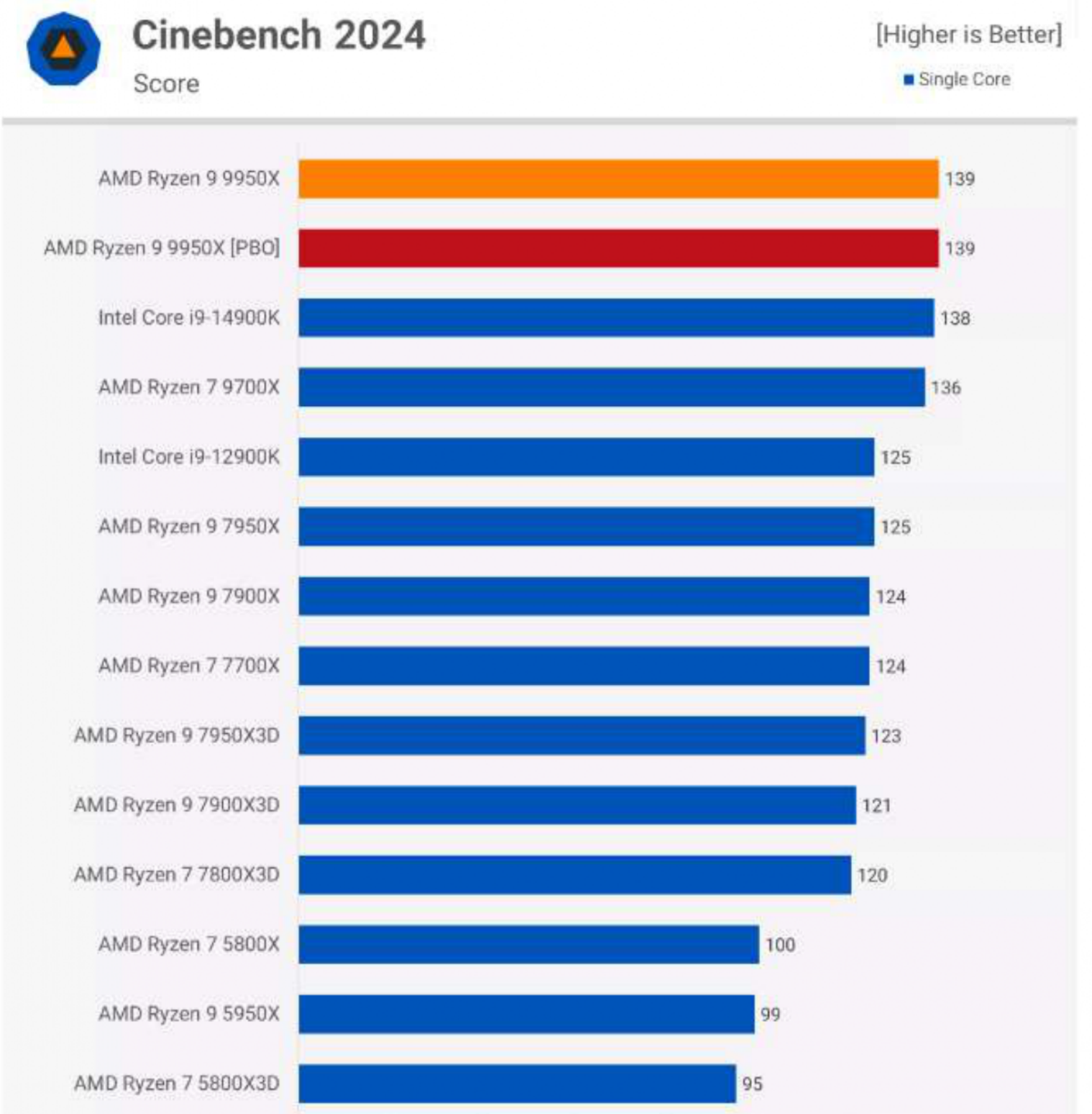
Cinebench, Power

As is often the case with overclocking features, PBO significantly reduces the power efficiency of the 9950X. That 2% performance boost came at the cost of a 15% increase in power consumption.



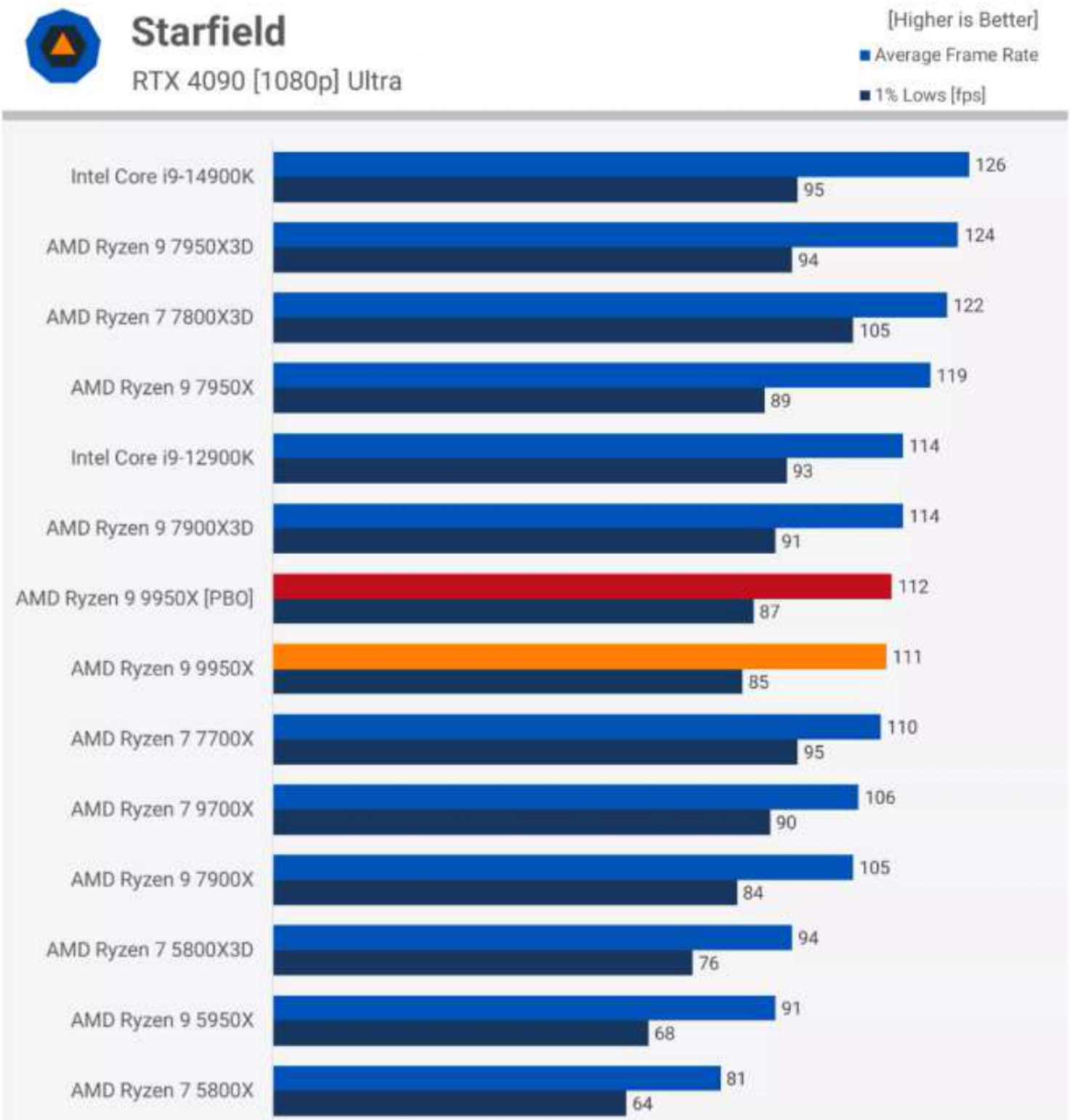
Cinebench, Single

Increasing the power budget does nothing for single-core performance, as the CPU isn't power-limited under these conditions.



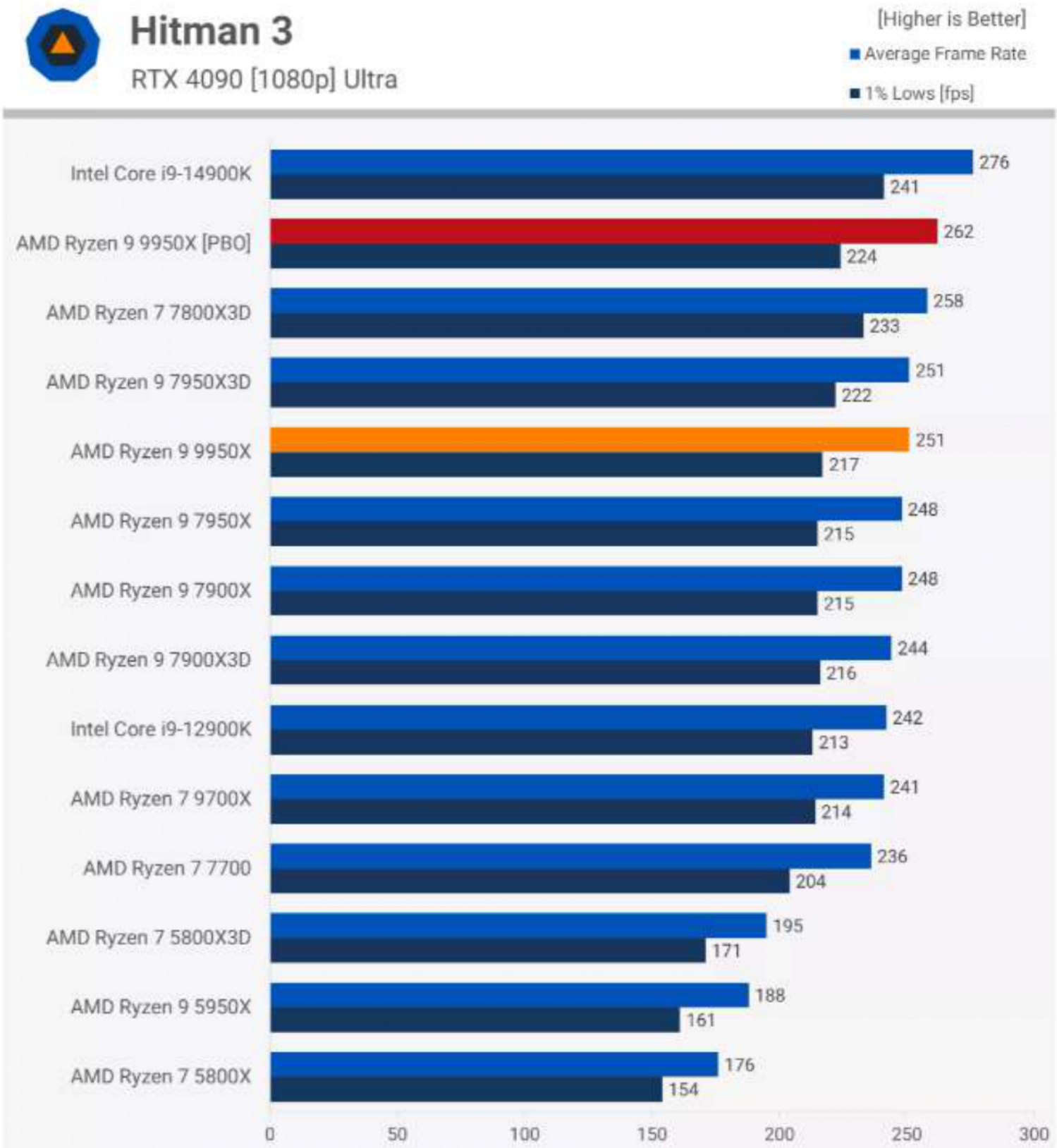
Starfield

Given these limitations, we don't see any significant improvement in games. For example, the 9950X was just 1% faster in Starfield with PBO enabled.



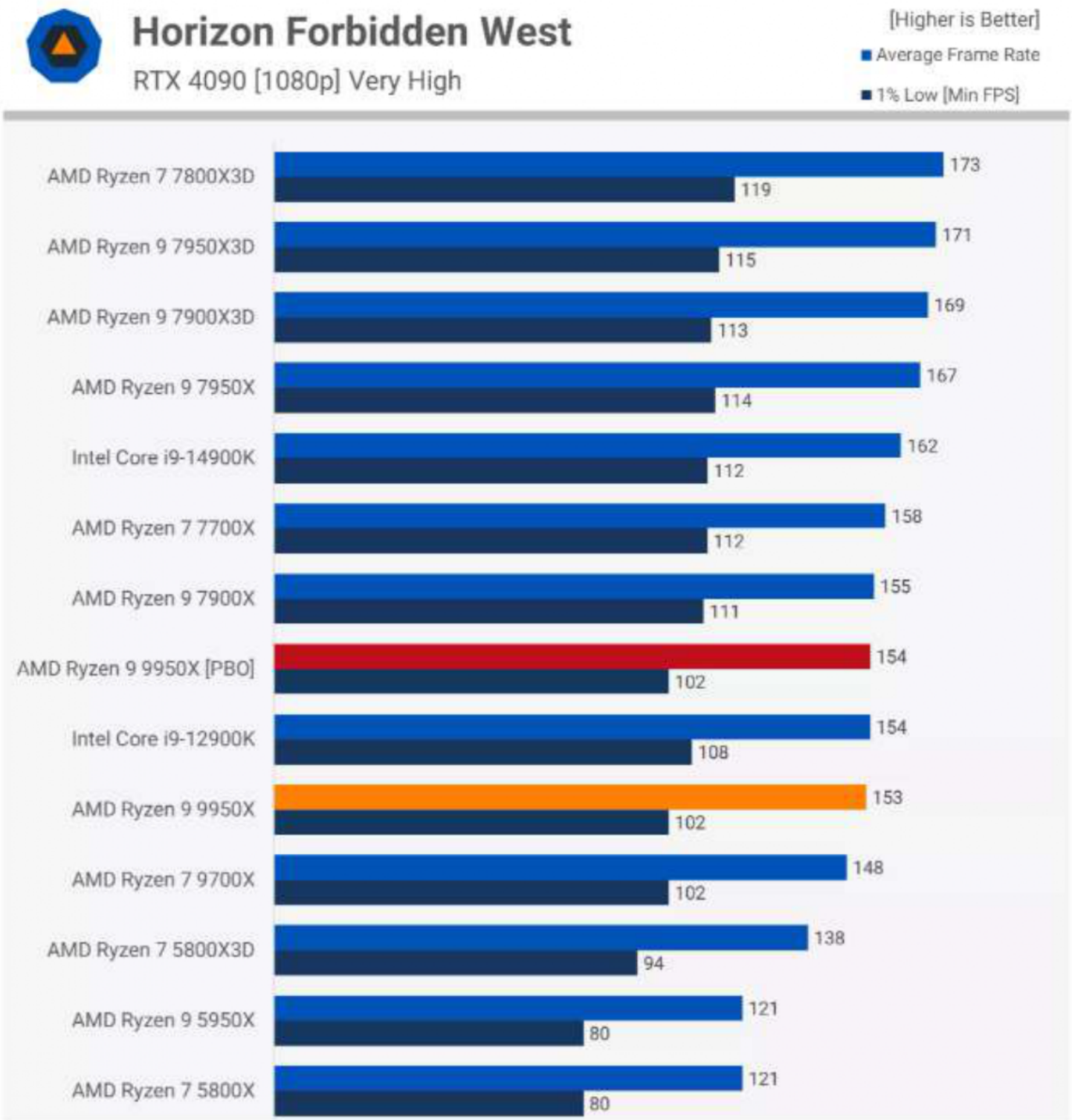
Hitman

Similarly, we're looking at just a 1% improvement in Hitman 3 with PBO enabled.



Horizon Forbidden West

It's the same story in Horizon Forbidden West, with just a 1% uplift with PBO enabled. So, in short, PBO does nothing for the gaming performance of the 9950X.



Cost per Frame

Here's a quick look at the cost per frame when considering only the price of the CPU. The 9950X ends up costing 24% more than the 7950X based on current market prices. It's also 30% more than the 7950X3D, so if you're looking for a 16-core Ryzen processor for work and play, the 7950X3D is the obvious choice.

Cost per Frame (Entire Build)

Even when factoring in a decent motherboard and 32GB memory kit for a platform upgrade, the 9950X ends up costing 17% more per frame than the 7950X and 23% more than the 7950X3D.