

GEFORCE GPU POWER PRIMER

What is perf-per-watt, why is it important, and how do you measure it?

GPU power efficiency is critical for the success of a graphics architecture. It's not really about keeping your home electric bills low—it's about designing new GPUs with increased performance that actually consume less power than the prior generation. Why is that important?

When it comes to heat, doing more work with less heat is the best way to do more work. That's because a GPU is limited by the amount of heat it can dissipate, so efficient design directly translates to peak performance. Performance-per-watt efficiency results in designs with higher performance, lower noise, more overclocking headroom, and greater framerates, and that's the whole point for gamers.

But if you're unfamiliar with the terms, power efficiency can be confusing. And measuring power can be downright bewildering. What's TDP, TGP, and TBP? Are wall power meters enough? What's an interposer? This guide will help you brush up on the basics and teach you how to measure and compare power efficiency properly.

POWER TERMS

First, what are these acronyms? They're simply GPU power ratings. You've probably seen the term **TDP**, or **Thermal Design Power**, in reviews and spec listings. TDP is the maximum power that a subsystem is allowed to draw for a "real world" application, and also the maximum amount of heat generated by the component that the cooling system can dissipate under real-world conditions. TDP is usually determined by the needs of the component that needs to be cooled.

TDP is a general term that can mean many things. For chips, it is typically the thermal design point for chip-only thermal requirements. **TGP**, or **Total Graphics Power**, is a more specific term for the power that a power supply should provide to the graphics subsystem, an add-in-card in most cases. The application used to define TGP and TDP is a stressful "real world" application.

TBP or **Total Board Power** is essentially the same as TGP. AMD tends to use TBP while NVIDIA uses TGP.

Whether you use TDP, TGP, or TBP, you'll need such a rating from the product vendor to help determine GPU power efficiency. In simpler terms, GPU efficiency is how much performance the GPU offers for the power it uses. Great GPUs do a lot with a little. Most call this **performance-per-watt (PPW)**. The lower your TGP and the higher your game performance, the better your perf-per-watt!

CHIP AND BOARD POWER

Power usage is broken down further into **chip** and **board power**. Your GPU contains different components that each consume power, and the hungriest is the actual chip. Board power—also known as TGP, TBP, or total power—is a measurement of power supplying the entire graphics card. Chip power—also called GPU or core power—is strictly the power supplying the GPU chip only. Chip power is of course a part of the total board power. One minor point, which is an unlikely scenario but should be mentioned: If you are testing power consumption of a GPU that has a USB-C port, be sure not to have an external device connected to the port and drawing power.

MEASURING POWER

Many reviewers who test and report GPU power today do so by measuring comparative power usage of the full PC with different GPUs plugged in. This technique uses an AC power meter (such as Kill-a-Watt or Hobo meters) acting as an "interposer" between the wall outlet and the PC, with the PC plugged into the meter. Full PC system power draw is measured under load and at idle with this method. By swapping different GPUs in and out of the same PC running the same workloads, reviewers can get a rough estimation of comparative GPU power efficiency. This method will not report exact GPU board power under load or at idle, however.

The second method historically uses software tools like GPU-Z and HWiNFO64 to gather full board power from GPU vendor APIs. But you should be aware of issues when comparing AMD to NVIDIA GPUs with such software-only methods today. AMD's API appears to report a value in-between chip-only and full board power. AMD will often present

power results from such software tools as their representative power, when in fact it is less than full board power (as verified by the third testing method described below). Please do not compare AMD vs. NVIDIA GPU power with these tools today.

Now comes the third method, which is the most accurate across different vendor GPUs. Because GPUs get most of their power from the power supply unit (PSU) and a small amount from the PCIe slot, wouldn't it be great if there was an interposer positioned between these two points that measured power going solely to the GPU? Well, they exist and they're incredibly precise! But these setups are complicated and can be expensive. One example used by some reviewers today is the [Cybenetics Powenetics](#) setup. Other reviewers may have custom setups.

The software method is now improving in other ways. Enter [FrameView](#).

FrameView is a new performance and power measurement software tool for viewing and capturing not only game

performance metrics, but also accurate real time power measurements for both total board (TGP) and chip power for NVIDIA GPUs today.

Here's the important part. This means that you can correlate game performance and power at the same time to create accurate perf-per-watt statistics based on NVIDIA's board power (TGP). FrameView makes this so easy. Not only can you watch live power usage in an on-screen overlay as you play the game, but you can choose to log your runs and use detailed reports to chart your own performance and perf-per-watt graphs.

While FrameView reports both chip and board power for NVIDIA graphics cards, it currently only reports the value presented by the AMD API which appears to be a value between chip-only power and full board power. So unfortunately, NVIDIA GPU power cannot be directly compared to AMD GPU power with FrameView, similar to the other software utilities. FrameView will be updated to capture total board power and chip power for AMD if they make such APIs publicly available.