

Green Gaming

The effect of different settings on a PC on the amount of energy in watts used while running rendering and FPS tests.

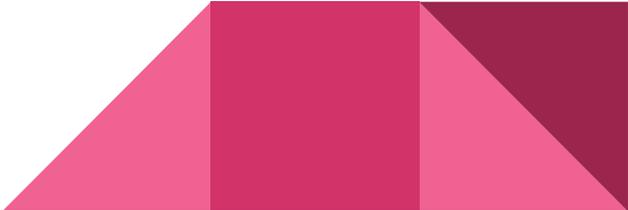
Purpose

My purpose for this experiment was to find out how much energy my gaming habit consumes and to then find out how big my carbon footprint is.



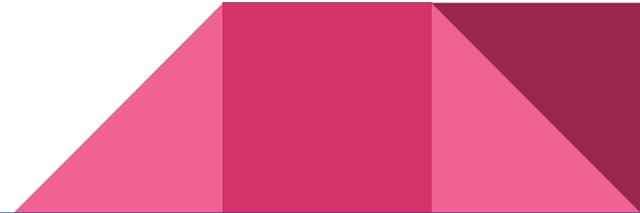
Background Research

During the experiment to get my Eco-friendly mode I disabled some of the technologies that are automatically enabled. One of them being like multi-core usage. Which is basically when all the cores work together so when it's off they don't work together which is slower but uses less energy. My overclocked mode is just a preset that disables some limits and makes them a little faster. Rendering or image synthesis is when you are generating a photorealistic image in 2D or 3D. FPS stand for frames per second so basically how many times your screen refreshes each second.



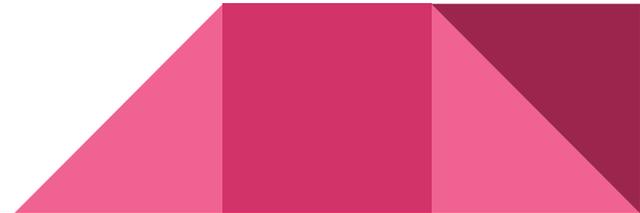
Testable Question

What are the best settings to reduce the amount of energy you use when running a PC?

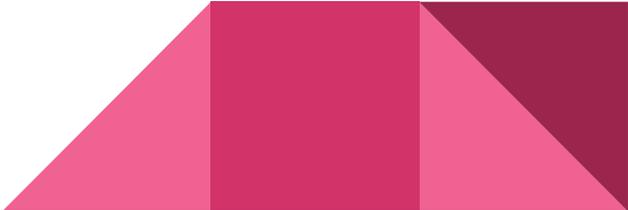


Hypothesis

If I change the settings to a more Eco-friendly mode on my PC then it will reduce the energy consumed because certain settings increase the amount of energy consumed and others will reduce the amount of energy used.



Materials

- PC
 - Power Meter
 - Something to record data with
 - Cinebench rendering software
 - Forza horizon 4 PC edition
 - Peripherals and needs to be running windows 10
- 

Pictures



BENCHMARK RESULTS

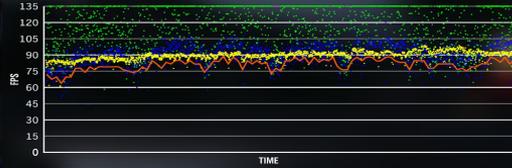
SYSTEM

Game Version
193024
Windows Version
10.0.17134.285
Driver Version
24.21.14.1163
GPU Model
NVIDIA GeForce GTX 1080 Ti
CPU Model
Intel(R) Core(TM) i7-2600K CPU @ 3.40GHz
Video Memory
4.24 GB / 9.24 GB
System Memory
9.04 GB / 31.95 GB
Resolution
2560 x 1440 @ 120Hz

PERFORMANCE SUMMARY

TARGET **120 FPS**
ACHIEVED **87 FPS**

Enter Continue **Esc** Video Options **Y** Restart



	FPS Average	FPS Minimum	FPS Maximum
CPU Simulation	128.8	96.4	170.1
CPU Render	95.1	72.3	108.0
GPU	95.1	80.8	115.9

Stutter Count **135**
GPU Limited Percentage **39.5**
Average Latency **37.3**

BENCHMARK RUN IS VALID

SETTING PRESET

SETTING PRESET	ULTRA
Vertical Synchronization	ON
Full Screen	ON
Motion Blur	OFF
Anisotropic Filtering	ULTRA
Night Shadows	ON
Shadow Quality	ULTRA
Motion Blur Quality	NORMAL
Environment Texture Quality	ULTRA
Static Geometry Quality	ULTRA
Dynamic Geometry Quality	ULTRA
MSAA	2X
FXAA	OFF
SSAO Quality	HIGH
Reflection Quality	HIGH
Windshield Reflection Quality	HIGH
Mirror Quality	ULTRA
World Car Level of Detail	ULTRA
Deformable Terrain Quality	ULTRA
SSR QUALITY	HIGH
Lens Effects	ULTRA
Shader Quality	ULTRA
Particle Effects Quality	HIGH

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CINEBENCH Release 20

CPU **3700 cb** Run ✓
CPU (Single Core) **500 cb** Run ✓
MP Ratio **7.40 x**

Your System

Processor Intel Core i7-9700K CPU
Cores x GHz 8 Cores @ 3.6 GHz
OS Windows 10, 64 Bit, Professional Edition (Build 1
GFX Board GeForce RTX 2070/PCIe/SSE2
Info

Ranking

CPU (Single Core)	Details	Score
1. 8C @ 3.6 GHz, Intel Core i7-9700K CPU		500
2. 8C @ 3.6 GHz, Intel Core i7-9700K CPU		499
3. 4C/8T @ 4.2 GHz, Intel Core i7-7700K CPU		476
4. 16C/32T @ 3.4 GHz, AMD Ryzen Threadripper 1950X 1t		400
5. 48C/96T @ 2.7 GHz, Intel Xeon Platinum 8168 CPU		379
6. 8C/16T @ 3.4 GHz, AMD Ryzen 7 1700X Eight-Core Pro		376
7. 4C/8T @ 3.6 GHz, Intel Core i7-8700HQ CPU		359
8. 4C/8T @ 3.3 GHz, Intel Core i7-4850HQ CPU		298
9. 4C @ 3.3 GHz, Intel Core i5-3550 CPU		283
10. 2C/4T @ 2.3 GHz, Intel Core i5-5300U CPU		280
11. 12C/24T @ 2.7 GHz, Intel Xeon CPU E5-2697 v2		255
12. 60C/120T @ 2.8 GHz, Intel Xeon CPU E7-4890 v2		197
13. 12C/24T @ 2.66 GHz, Intel Xeon CPU X5650		191



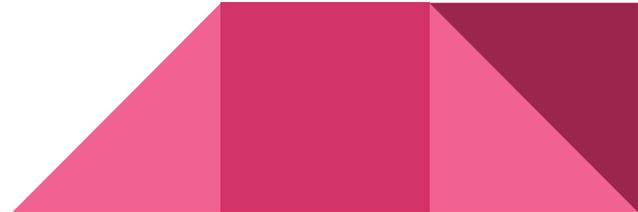
Procedure

- Plug in power meter
- Turn on computer and go to the bios (by clicking delete constantly)
- Change setting in computer to default (for control) and restart pc
- Go into rendering cinebench for the rendering test
- Run the test and record the highest wattage consumption
- Then run the benchmark test on forza horizon 4 and measure the highest watts consumed
- Turn off pc and let it cool for an hour
- Turn pc back on and change settings to overclocked
- Run the tests again and record data
- Let pc cool again
- Then turn pc on and change bios settings to Eco-Friendly mode
- Run the test one more time and record data and repeat the whole
One more time



Safety precautions

- Always be careful around outlets
- Make sure you know how to work the bios of your PC and change settings
- If your PC is getting too hot while running the tests turn it off to make sure you don't damage the parts or their life span

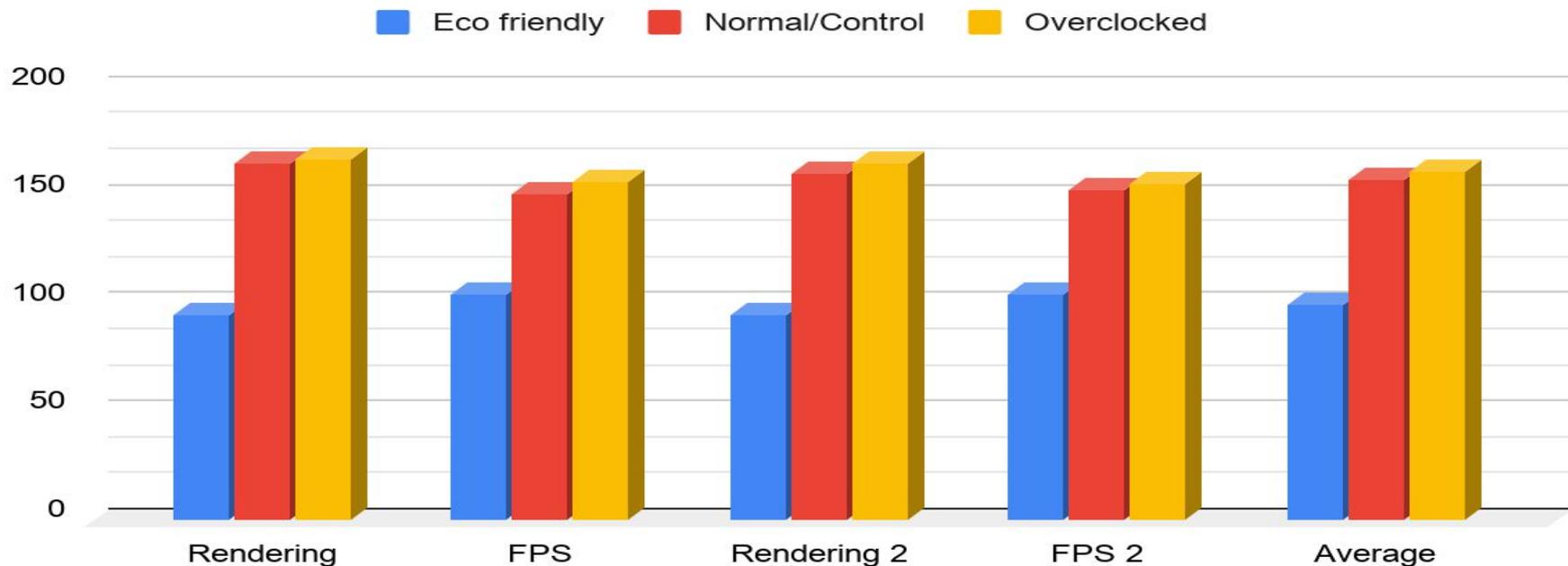


Data

	Eco friendly	Normal/Control	Overclocked
Rendering	95.0	165.2	167.4
FPS	104.2	151.1	157.1
Rendering 2	95.4	160.7	165.3
FPS 2	104.8	153.2	155.8
Average	99.85	157.55	161.4

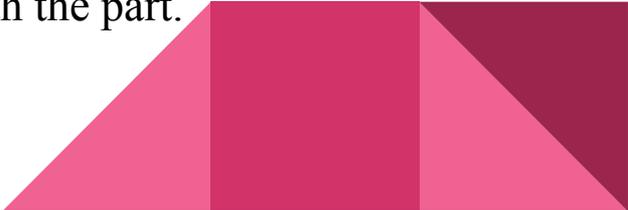
Data Chart

Amount of watts consumed in each setting over 2 trails and the average



Analysis

So the data shows that the Eco friendly settings take much less power to run about an average of 100 but in the experiment I did see that the performance was worse. I saw the rendering was slower than the normal and overclocked modes and in the FPS test it looked a little worse. The data also shows that the control and overclocked modes were both very close in power consumption with about 110 watts for the normal and 115 to 120 watts on the overclocked one. With this data I can say that if you want to save power the eco friendly mode is the best and I only saw a small performance drop in the experiment. I also saw that the FPS tests seemed to use less energy which I dont think is surprising because in the rendering test you are rendering a photorealistic image. This experiment was done without one of the most power consuming parts of a computer so data is susceptible to change if you have a PC with the part.



What is my Carbon Footprint?

With all the data collected I have calculated how many pounds of carbon I use just by my gaming habits each year and found out how many trees that is. Each tree uses about 30 pounds of carbon in its life and with the eco friendly settings on my PC I use about 0.25 pounds of carbon an hour. So multiply that by 3 because that is the higher end of the amount of time I spend a day gaming and then multiple by 365. Then finally when you get that answer divide by 30 to get the number of trees you use every year. After the calculation I use about 9 trees worth of carbon each year. So with that data we donated to team trees to offset my carbon footprint for a year.



Conclusion

The eco friendly mode required the least amount of energy to run. I also claimed that it was the best overall because in the experiment I only saw a small performance drop. Going forward with this experiment I might try to measure the power consumption off of multiple machines to determine the best parts for an eco friendly PC.



Images cites

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