Sustainable Games Standard - Scope 3, Category 11

GHG emissions - Use of sold products (PC)

Top-level summary

Emissions from:	- End-user gameplay on PCs - System components for PC gameplay (screens, audio, VR headsets, etc)
Examples:	- Gameplay on PCs of various spec (low/mid/high-end) - Gameplay emissions from modelled PC spec and main component power models (based on Steam hardware survey) - Gameplay on VR headsets connected to PCs **EXCLUDES**: - Consideration of complex system changes from VR headset use (treats VR headsets as 100% additional energy use on top of existing system) - Keyboard and mouse, controllers, flight sticks, or other peripherals
Data sources:	- Direct energy measurement from PC hardware (e.g. RAPL, Laptop battery readings, etc) – largely allowing for future speculative developments - Steam hardware survey - Play duration data from in-game metrics, platforms, or other sources - Minimum system hardware requirements as specified by the developer, etc.
Data types:	- Player duration total (hours) - Player location (country/region) - VR compatibility & play duration in VR mode - Hardware specs for minimum system requirements

Consult with other SGA resources

Understanding the requirements and nature of this component of the GHG emissions standard may be aided by consulting the relevant [data input spreadsheet](#) to see the overall structure and major sections before reading the standard specification.

Overview

The SGA standard methodology for Scope 3 Category 11 "Use of sold products (PC)" aims to improve upon the advice in the GHG Protocol "direct use-phase emissions from products that directly consume energy" for games that are played on PCs. For the purposes of this Standard, PCs are any gaming device that is not considered a console or a mobile phone. At present, the PC standard focuses on the Windows platform and assumes a desktop form factor. Future versions of this component of the standard may include methodologies and guidance for Mac and Linux gaming, as well as Windows gaming laptops if required – contact the SGA if you wish to express support for these inclusions in future versions of the Standard.

As in other parts of the standard, multiple methodologies are permitted for use depending on the availability of data. Three methods are permitted for measuring users on PC. The first involves direct measurements of PC players, taken by developers (such as via Intel's RAPL technology, or other similar systems as they become available). The second involves estimating emissions based on player duration in a given region, and a Steam hardware survey informed power profile split between low/medium and high energy-consuming PC hardware. Developers may also produce their own hardware energy profile splits by collecting user hardware data from their player base to inform estimates. The third method adopts a version of the JYROS calculator methodology of producing a hardware energy consumption profile by selecting the minimum system components required for the game (for example, by

selecting the CPU & GPU minimums listed under "system requirements" on digital storefronts). This method, however, should be considered a lower bound of energy and emissions, with a percentage of padding added to capture a more representative and more conservative estimate.

Users of the standard are encouraged to improve their data collection practices over time to enable them to move towards more accurate, real-world measurement of their players' impacts to enable interventions that can reduce those impacts.

Specification

Users shall employ the following methods to measure the electricity consumption and greenhouse gas emissions arising from Scope 3, Category 11 "Use of sold products (PC)" as a result of PC gaming energy consumption. Due to the open nature of PC hardware, the great many different vendors and components resulting in many hardware combinations, and the limited degree of platform oversight, users of this Standard are expected to primarily rely on estimates over direct measurement as technology improves.

System Boundaries

The basic system elements for the measurement of energy consumption and emissions from PC gameplay are:

- The device the game is being played on (i.e. the PC itself)
- An average display/screen
- An average connected speaker
- A VR headset + VR controllers (if VR compatible; to be considered in proportion to measured or estimated VR gameplay hours as a percentage of total)

Methodologies for calculating end-user energy consumption (PC)

Three options for end-user PC energy consumption totals are permitted.

Option 1 – Measured power consumption (kWh, by region)

For this option, a studio internally collects regional data (country level) that measures the direct power consumption across all its players' devices, through the use of an energy-collecting telemetry system data (e.g. Wattwiser/Intel RAPL/Nvidia power monitor) to measure usage. This method is primarily provided as an aspirational target and to guide software development initiatives that may provide such a service to the games industry.

Users of the standard will also need to collect player duration data, to apply an estimated energy consumption figure for system components besides the PC device itself, including VR headsets (and VR playtime as a percentage of total – e.g. VR exclusive titles = 100%), an average screen, and an audio device. For each region, energy consumption totals for system components are to be added to the measured PC device energy consumption. The total system energy consumption is to be multiplied by the most applicable regional emissions factor to produce regional subtotals. The sum of regional subtotals is to be considered the total PC GHG emissions.

Example Application of Option 1

Measured PC energy consumption$_{Denmark}$ = 5,000,000.00 kWh

Player duration$_{Denmark}$ = 20,000 hours

VR playtime$_{Denmark}$ = 5%

VR system component subtotal$_{Denmark}$ = 20,000 * 17 watts * 5%

$$= 17{,}000 \text{ Wh} / 17 \text{ kWh}$$

System component energy consumption$_{Denmakr}$ = 20,000 hours * (average screen/display (W) + average audio device (W))

$$= 20{,}000 \ * \ (92 + 30)$$

$$= 2{,}400{,}000 \text{ Wh} / 2{,}4000 \text{ kWh}$$

PC energy consumption$_{Denmark}$ = PC Device energy consumption (5,000,000.00 kWh) + PC system components energy consumption (2,4000 kWh) + VR energy consumption (17 kWh)

PC energy consumption$_{Denmark}$ = 5,002,457.00 kWh

PC GHG emissions$_{Denmark\_2024}$ = 5,002,457.00 kWh * 143.3 (gCO2e/kWh)

$$= 716{,}852.09 \text{ kgCO2e} / 716.85 \text{ tCO2e}$$

Total PC energy consumption = Σ (PC energy consumption$_{Region\ A}$ + ... *for all regions*)

Total PC GHG emissions = Σ (PC GHG emissions$_{Region\ A}$ + ... *for all regions*)

Option 2 – Estimated consumption by player duration (hours, PC level, by region)

For this option, a studio internally collects regional data (country level) that measures the hours players play for, and applies assumptions about the split of low/medium/high spec PCs in the playerbase (informed by the Steam Hardware survey, as analysed by the SGA). To these total playtime numbers, additional system components shall be added as in Option 1, providing for the energy consumption of: an average display/screen and an average audio device. Also, as with Option 1, VR-enabled games should collect the total playtime in VR mode as a percentage of total playtime in a region, and apply the same additional energy consumption overheads for VR components (a single average energy consumption figure for HMDs/controllers/base stations – an SGA provided average).

The SGA shall maintain a database of devices represented in the Steam hardware survey and their associated power consumption estimates, to be applied to estimates for the hardware capabilities and energy consumption split of the average PC playerbase.

Developers can override the SGA calculated split, provided they have collected game hardware information from their player base to a comparable level of detail to the Steam hardware survey.

To calculate a regional energy consumption estimate, total playtime hours are to be multiplied by each of the low/medium/high spec PC percentage totals derived from the SGA Steam Hardware Survey analysis. To this, an additional energy consumption amount for both a connected average display and average audio device shall be added, by multiplying the total regional play duration with the same energy consumption figures for these devices as in Option 1.

A regional subtotal shall be produced by summing the energy consumption totals of each of the three tiers of system spec, plus the consumption from additional system components. A regional GHG emissions total shall be calculated by multiplying the regional energy consumption subtotal most applicable emissions factor for the region.

A grand total of PC energy consumption shall be produced by summing the subtotals for each region.

Current assumptions as of the July 2025 Steam Hardware Survey assume the following:

System Spec	GPU power	CPU power	Component Overheads	System Total	Market Share (%)
Low	150	100	10	260	50%
Medium	183	150	10	343	36%
High	306	250	10	566	14%

Example Application of Option 2 Method

Total Player Hours$_{Germany}$ = 20,000

Total VR playtime$_{Percent}$ = 0%

Low-spec PC$_{energy}$ = 20,000 (hours) * 260 (watts) * 50%

$\quad$ = 2,600,000 (Wh) / 2,600 (kWh)

Medium-spec PC$_{energy}$ = 20,000 (hours) * 343 (watts) * 36%

$\quad$ = 2,469,600 (Wh) / 2,469.60

High-spec PC$_{energy}$ = 20,000 (hours) * 566 (watts) * 14%

$\quad$ = 1,584,800 (Wh) / 1,584.80 (kWh)

Additional system components energy consumption total$_{Germany}$ = 20,000 (hours) * (92 watts + 30 watts)

$\quad$ = 2,440,000 (Wh) / 2440 (kWh)

Total PC$_{Energy\_Germany}$ = 9094.40 kWh

Total PC$_{GHG\ emissions\_Germany\_2024}$ = 9094.40 kWh * 344.14 (g CO2e/kWh)

$\quad$ = 3,129,746.816 (g CO2e) / 3,129.75 (kg CO2e)

Total PC energy consumption = Σ (PC energy consumption$_{Region\ A}$ + ... *for all regions*)

Total PC GHG emissions = Σ (PC GHG emissions $_{Region\ A}$ + ... *for all regions*)

Option 3 – JYROS method – (minimum system requirements, player hours, by region)

For this method, a studio builds a simplified profile of the minimum system specifications PC required for play of their game as a 'baseline' expectation for the minimum baseline energy consumption and emissions from play. This expected minimum system energy consumption figure is then combined with either total player hours (by region) or sales numbers/playtime assumptions (also by region) to produce an estimate for minimum energy consumption from play on PC.

As the main power-consuming components of a PC, a hardware profile is to be produced by selecting from a database of CPU and GPU components to approximately reflect the minimum specifications as communicated in the game's sales material. For example: if a game's system requirements for CPU states that it requires an AMD Ryzen 5 1600 or Core i5 6600K, then one of these components is to be selected from the database as the minimum CPU specification, and the relevant component thermal design power figure used as an approximate measure of the components power use. The same process shall apply for GPUs.

The TDP totals for both CPU and GPU components are to be summed. To this, an additional internal components overhead of 10% is to be added to account for various other components such as motherboard, RAM, SSD/HDD storage, networking, etc. This total shall be considered a single power consumption figure for the minimum specification system that is to be multiplied by the total play duration (in hours) in each region, to produce a regional minimum power consumption figure. As in Options 1 & 2 before, an allowance for the energy consumed by the typical screen/display and audio device shall also be added, by multiplying the energy consumption of these system components (screen 92 W, audio 30 W) with the total player duration in the region. The sum of these two energy consumption figures shall be the regional energy consumption subtotal.

This regional energy consumption subtotal shall be multiplied by the most appropriate regional emissions factor to produce a regional GHG emissions subtotal. The sum of all regional GHG emissions subtotals shall be considered the total minimum expected energy consumption for S3.11 use of sold products (PC).

Example System Specification for Baseline Energy Consumption

SET MINIMUM SPECS – GAME 1 NOTE: Pick only Intel OR AMD CPU, do not select both		Expected Minimum System Specs Total (Watts)
GAME NAME	Test 1	198
	Component Name	Power (W)
Intel CPU		
AMD CPU	AMD Ryzen 5 3600	65
GPU	NVIDIA GeForce RTX 4060	115
Rest of system overhead (10%)			18

Example Data Input for Player Duration (by region) and VR playtime percentage

Game	Location (country as 1st preference, use continent, region, or world only as last resort)	Location EF (automatic) (gCO2e per kWh)	Total player hours in Region	%age playtime time in VR (If title is VR exclusive = 100%, if no VR = 0%)
Test 1	Australia	551.59	20,000.00	50%
Test 1	France	44.18	20,000.00	0%
Test 1	Finland	72.25	20,000.00	0%
Test 1	Denmark	143.3	20,000.00	0%

Example Calculations from Player Duration (by region) and VR playtime percentage using the specified system minimum requirements

VR headset overhead (W) (12 W HMD + 5W controllers)	Minimum Device Spec expected power	Device Power Consumption (kWh)	VR power consumption (kWh)	Display – 92W (kWh)	Audio – 30W (kWh)	Device Emissions (kg CO2e)	System Emissions (kg CO2e)	Subtotals (kg CO2e)
17	198	3,960	170	1840	600	2184.2964	1439.6499	3623.9463
17	198	3,960	0	1840	600	174.9528	107.7992	282.752
17	198	3,960	0	1840	600	286.11	176.29	462.4
17	198	3,960	0	1840	600	567.468	349.652	917.12

Total Reportable Scope 3 Category 11 (PC) emissions

The reportable results for Scope 3 Category 11 (PC) emissions will be the sum of the results of the chosen methodology for calculating emissions, plus the results of the Multiplayer Module if the game is multiplayer and gameplay requires or involves internet data transmission between end user client and a "server" (including P2P multiplayer, where another player is simply the "server").

Appendix – References and Equations

Resources that have informed this draft:

- GESI [ICT Sector Guidance for measuring software energy consumption](#) (Ch6)

GHG Protocol Direct use-phase emissions method, for reference:

Calculation formula [11.1] Direct use-phase emissions from products that directly consume energy (fuels or electricity) during use

CO_2e **emissions from use of sold products =**

sum across fuels consumed from use of products:
$\sum$ (total lifetime expected uses of product × number sold in reporting period × fuel consumed per use (kWh) × emission factor for fuel (kg CO_2e/kWh))

+

sum across electricity consumed from use of products:
$\sum$ (total lifetime expected uses of product × number sold in reporting period × electricity consumed per use (kWh) × emission factor for electricity (kg CO_2e/kWh))

+

sum across refrigerant leakage from use of products:
$\sum$ (total lifetime expected uses of product × number sold in reporting period × refrigerant leakage per use (kg) × global warming potential (kg CO_2e/kg))

Total Reportable Emissions Sum Equation

None

TBC