

Physical and Virtual Desktop Greenhouse Gas Emission Comparison

Overview

This report summarizes the comparison of energy use and associated greenhouse gas emissions of virtual desktops with physical desktops. The data are based on a Walton College of Business pilot project implemented in 2013. This pilot project valued costs and benefits of a plan to replace 400 physical desktops with virtual desktops in a student laboratory. The virtual desktop scenario compared the Zero Client System (ZCS) Dell Optiplex Tower PCs (physical desktop). The results of this assessment of 400 computer stations indicated the ZCS systems consume 88 percent less electricity, thus reducing greenhouse gas emissions by 88 percent (almost 185 metric tons of carbon dioxide equivalents). Replacing 10,000 computers would eliminate nearly 4,200 metric tons of carbon annually.

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Approach

The approach for this comparison was to compare the two technology strategies based on the following assumptions:

- Machines operate 365 days per year.
- Electrical consumption data of both systems measured during an observation period by the Office for Sustainability represent typical energy use.
- The electricity portfolio for Northwest Arkansas has an annual output emission for carbon dioxide of 1658.14 lbs/MWh.¹
 - Emission rates for methane and nitrous oxide were not calculated because they account for so little of greenhouse gas emissions.
 - Associated Scope 2 T and D losses were also not included in the study.

Energy Usage

The Walton College of Business and the Office for Sustainability tracked electrical consumption of 32 Dell OptiPlex personal tower computers (PCs) between 6/20/2013 and 7/1/2013 and 32 Zero Clients between 7/25/2013 and 8/8/2013 using Kill-watt-readers

¹Environmental Protection Agency. (2005). eGRIDweb. *U.S. EPA ColdFusion Server*. Retrieved from <http://cfpub.epa.gov/egridweb/ghg.cfm>

to record the electrical consumption. The measurements were made from JB Hunt 220 during a summer session course (Table 1). The study showed that when compared to the PC system, the Zero Client System demonstrates an 88% reduction in electrical consumption, including front-end consumption and back-end server needs.

Table 1 GHG Comparison for Physical and Virtual Desktops with back-end infrastructure use

	Virtual Desktop (Zero Client System)	Physical Desktop (Standard PC)
Total kWh-year-10,000 machines	726,900	6,303,900
Total kWh-year-machine	72.69	630.39
Associated Greenhouse Gas Emissions (MTCDE) -year-10,000 machines	546.72	4,741.29

The Zero Client Systems can be responsible for reducing greenhouse gas emissions 0.42 metric tons of carbon dioxide equivalents (MTCDEs) per virtual desktop per year (4,194.47 MTCDE per 10,000 desktops). To put this in perspective, this is an equivalent emission rate of nearly four residential homes.

Implications for Costs

Zero Client consoles have reduced maintenance and labor as well as a lifespan double that of traditional PC towers, with capital costs of less than 15 percent of PCs (Table 2). While the ZCS system will not meet every computer users' needs, it is ideal for general access computing and is proven to reduce electrical loads. The benefits of the Zero Client System beyond energy savings include the centralization of IT administration, reduced noise in classrooms, lowered air conditioning needs, reduced capital costs for terminals, reduced maintenance, reduced service interruption in the classroom due to PC failure, increased IT security, and standardization of administrative practices across IT platforms.

Table 2 Comparison for Physical and Virtual Desktops During Trial Period

	Zero Client System	PC Towers
Cost-machine -day	\$0.0137	\$0.12
Cost-machine -year	\$5.01	\$43.80
Total kWh-machine -day	0.1992	1.727
Estimated reduction in electricity (%)	88%	

Increasing the number of machines that use the Zero Client can easily demonstrate substantial electricity savings and associated greenhouse gas emissions reductions. Assuming there are 10,000 PCs on the UA campus. If 80 percent of those were virtual PCs, the greenhouse gas reductions would be almost 4623.75 MTCDEs per year, saving \$310,400.00 per year on electricity costs.