



Carbon Footprint of a Typical Rack Server from Dell

Total carbon footprint of a Dell PowerEdge R710 rack server is 6360 kg CO₂eq. Greenhouse gas emissions from the use phase account for over 90 percent of the total life cycle.

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Dell focuses on building energy efficiency into all our products and services. Design advancements contribute to significant energy savings for customers, especially those using servers.

In 2010, we started measuring the carbon footprint of some of our mainstream products, beginning with the Latitude E6400 laptop and the Optilex 780 desktop.

To do this, we have adopted a strategy that takes into account the greenhouse gas (GHG) emissions of our products and our suppliers. We look at each stage of the product life cycle — from developing, designing and sourcing through manufacturing and operations, order fulfilment, customer use and product recovery. Assessing our products' carbon footprint shows where we can improve and helps our customers do the same.

While such research makes it easy for customers to identify products with lower environmental impact, it is also important to optimize hardware refresh cycles from a carbon footprint perspective.

Calculating the carbon footprint of a server

In research conducted in 2011, Dell determined the carbon footprint of the PowerEdge R710, a typical high-volume, next-generation Intel Xeon processor-based 2U Rack Server that is representative of a range of similar server products.



Figure 1: Dell PowerEdge R710 2U rack server

The specific configuration of the R710 for this study was as follows:

- 2 processors (Intel Xeon)
- 12GB of RAM (6 x 2GB RAM bars)
- 4 x 146GB hard drives (HDD)
- 2 high output power supplies

- 1 DVD drive
- 4 Fans

The carbon footprint of the server was assessed for two regions: the US and Europe. This was done to compare the impacts caused by different assembly and transport patterns as well as energy mixes. In this paper we will only focus on the assessment carried out for the US.

The GHG emissions were calculated according to ISO 14040 and ISO 14044, the two international standards governing the investigation and evaluation of the environmental impacts of a given product over its life cycle. The carbon footprint represents the products GHG emissions contribution to global warming in kg of CO₂ equivalents (kg CO₂eq). We relied on the carbon footprinting expertise of PE International and on its GaBi database and tool for these calculations.

The following life-cycle phases were taken into account:

Manufacturing: Includes the extraction, production and transport of raw materials, the manufacturing of components and subassemblies, and the final assembly of the desktop. The manufacturing and transport of the subassemblies (motherboard, network cards, chassis, hard disc drives (HDD), DVD drive, fans, cables, power supply unit and packaging) was assessed in detail. Energy consumption (electric power, fuels, thermal energy) for the Dell final assembly site in Austin, TX was also included.

Transport: Includes land and air transport of the server and its packaging from the final assembly sites in Austin, TX to the end customer in the continental US. We assumed that in 90% of the time the transport will be via truck (over 1500km) and only in 10% of cases via plane (over the same distance).

Use: Lifetime of the server was estimated at 4 years, running 24 hours a day and 7 days a week. This is consistent with general business customer use models. To determine the energy consumption in use, we used the Dell Energy Smart Solution Advisor (ESSA). Output values obtained from this ESSA tool are approximate and conservative. We assumed that the server operates in idle workload at 148W for 50% of the time and in full workload (transactional, CPU loading 100%) at 285W also for 50% of the time. This results in an average power use of 216W.

The US grid mix was considered. Any local deviation, e.g. when operating the server with green power (water, solar), will of course alter the carbon footprint.

Recycling: For this study it was assumed that the server was sent for recycling at the end of the first customer use. Per European recycling legislation (the Waste Electronic and Electrical Equipment Directive, or WEEE) and similar US electronics recycling requirements, we assumed 75 percent of the server is recycled, while the rest is incinerated to recover the energy contained. Transport to recycling as well as energy used in mechanical separation and shredding were taken into account.

Carbon footprint of the Dell PowerEdge R710 server

The total carbon footprint of a Dell PowerEdge R710 is approximately 6360kg CO₂eq when used in the US. The GHG emissions from use (5960kg CO₂eq, blue) account for over 90 percent of the total life-cycle impact.

While this dominance of the use phase can also be observed in other electronic equipment (e.g. desktops), the magnitude is still impressive. Of course when taking into account the relatively high power used and the fact that the server runs continuously for four years it becomes clear why the GHG emissions from use are so dominating.

As we grow our data center portfolio, we are keen on optimizing our data centers for maximum efficiency — including the facility and equipment. Through virtualization, high temperature computing, improved power and cooling efficiency, and server upgrades, we are mindful of every aspect of the data center where we can be more efficient.

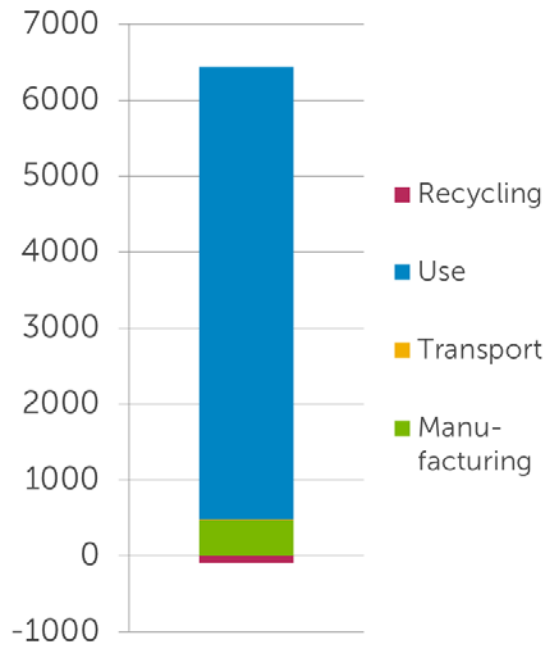


Figure 2: Total product carbon footprint [kg CO₂eq] of the Dell PowerEdge R710 in the US.

Manufacturing, which includes raw material extraction, subassembly manufacturing, transportation of the subassemblies and final assembly in Austin, TX has the next biggest impact, but at 7% (471 kg CO₂eq, green) it represents only a fraction of the total GHG emissions.

Only four subassemblies make up about 90 percent of the total GHG emissions in manufacturing. These are, in order of importance, the motherboard, including the processors, the hard drives, the chassis and the network cards. The motherboard accounts for about 3 percent of the server's total carbon footprint.

Final assembly at Dell's Austin, TX, plant only contributes by approximately 40 kg CO₂eq.

Transport of the subassemblies for final assembly and of the server to the customer is not particularly relevant, as the majority of servers are transported by truck.

As we assumed that 75 percent of the server is recycled, a credit (or a negative impact) of approximately 86kg CO₂eq resulted. This is the case where the recycled (secondary) material can be used directly to replace the primary material in new products, thereby avoiding all GHG emissions associated with primary production of the material.

Comparisons with other carbon footprint studies

The total product carbon footprint of the Dell PowerEdge R710 is comparable to driving 21,500km (13,400 miles) in an SUV (assuming a CO₂ emission of 296g/km¹ as reported for the Porsche Cayenne).

Comparing the results with the carbon footprint studies that Dell published on a laptop (Latitude E6400²) and on a desktop (OptiPlex 780 MT³) shows that the GHG emissions of the PowerEdge R710 server are circa 18 times those of the laptop and approximately 8 times that of the desktop. Of course the laptop, desktop and server are products designed with a very different set of functionalities.

Interestingly the results of a similar study for an IBM rack server⁴ are very comparable to our results. Total product carbon footprint of the IBM server is estimated at approximately 6,700kg CO₂eq. Also the distribution between use and manufacturing phase is very comparable (IBM: 95% use, 5% manufacturing, Dell: 90% use, 7% manufacturing).

What Dell is doing to lower the carbon footprint

From handhelds to data centers, we focus on building energy efficiency into all our products.

Such design advancements contributed to significant energy savings for customers using our servers. When put to the test with other Enterprise-Class Blade Servers, the Dell M1000e enclosure with 16 M610 blade servers consumed less power and outperformed the competition.

Many of our power supplies are energy efficient as well and certified 80 PLUS Gold (at least 87 percent efficient) and 80 PLUS Platinum (at least 90 percent efficient). We lead the market with our 96 percent efficient power supply.

Data centers are the engines of the information economy — for our customers and for us. Our customers have turned increasingly to data management and cloud services to drive efficiency in their operations.

As we grow our data center portfolio, we are keen on optimizing our data centers and those of our customers for maximum efficiency — including the facility and equipment. Through virtualization, high temperature computing, improved power and cooling efficiency, and server upgrades, we are mindful of every aspect of the data center where we can be more efficient.

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