Comparing the Carbon Footprints of 11G and 12G Rack Servers from Dell

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Contents

Figures

August 2013 | Version 1

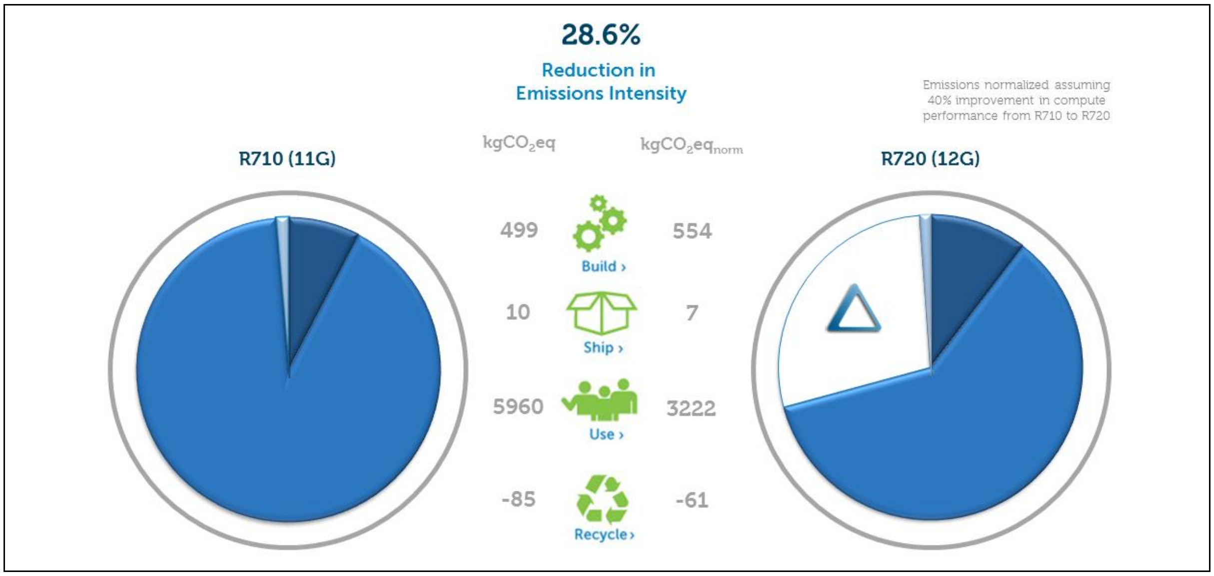

Figure 1. *Comparison of the Lifecycle Emissions Intensity of the PowerEdge R710 and R720*

Overall, the emissions intensity of Dell's primary 2U server decreased by 28.6% from the 11G R710 to the 12G R720. While the R710 had total greenhouse gas (GHG) emissions of approximately 6381 kgCO_2eq, the R720 came in at approximately 5210 kgCO_2eq with a simultaneous 40% improvement in compute performance. The absolute emissions reduction of 1171 kgCO_2eq is comparable to (not) consuming 541 liters (143 gallons) of gas, enough to fill a VW Golf fuel tank nearly 10 times.

Introduction

From product design to end-of-life recycling and everything in between, Dell considers the environment at every stage of a product's lifecycle. Our environmental programs and initiatives help Dell and our customers reduce consumption and minimize environmental impact.

Dell recognizes that climate change is real and must be mitigated, and we support efforts to reduce global GHG emissions to levels guided by evolving science. We are also committed to reducing GHG emissions beyond our own operations.

To do this, we have adopted a strategy that takes into account the GHG impacts 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.

In 2010 we started measuring the carbon footprint of some of our mainstream products, beginning with laptops, desktops, and servers and publishing the results[1]. By assessing the carbon footprint of our products, we are able to identify areas for improvement to reduce overall GHG emissions and also help customers do the same.

Comparing two rack server generations

In 2012 the 12th generation (12G) of Dell's PowerEdge server was launched. This latest generation of rack servers is built upon the Dell Energy Smart Architecture. Key features include high-power efficiency and intelligent-power management as part of the platform's base features, thus enabling Dell customers to compute more while consuming less.

The R720 is, like its predecessor, the R710 (an 11G server), a typical high-volume, 2U Rack Server that is representative of a range of similar server products.

Figure 2. *Dell PowerEdge R710 (11G) and R720 (12G)*

We determined the difference of the carbon footprints from an 11G (R710) to a 12G (R720) rack server, to demonstrate how improvements in energy efficiency lower the carbon footprint generation over generation. We also wanted to understand which effects a reduced energy consumption in the use phase has on the embedded carbon (i.e. carbon emissions during manufacturing) of the server.

Calculating the carbon footprints of rack servers

The carbon footprint includes GHG emissions' contribution to global warming in kg of CO_2 equivalent (kgCO_2eq). 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. We relied on the carbon footprinting expertise of PE International and on its GaBi database and tool for these calculations. Additionally we were supported by an intern from UC Berkeley and a team from MIT.

[1] http://content.dell.com/us/en/corp/d/corp-comm/environment_carbon_footprint_products.aspx

The life-cycles phases taken into account are Manufacturing, Transportation, Use, and Recycling. Assumptions made and information required for each phase are as follows:

Build: Manufacturing includes the extraction, production, and transport of raw materials, the manufacturing of components, and subassemblies (including the product packaging), the manufacturing of the products, and the final assembly of the rack servers. 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.

Ship: Transportation contributions include land and air transport of the rack servers and their 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 servers 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 servers operate in idle workload for 50% of the time and in full workload (transactional, CPU loading 100%) also for 50% of the time. The use phase was considered in the US only.

Recycle: It is common for rack servers to be refurbished and/or reused at the end of the first customer use. For this study, however, it was assumed that the rack servers were sent for recycling at the end of the first customer use. Following US electronics recycling requirements, we assumed 75% of the servers are 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.

Comparing the carbon footprints of two generations of rack servers

In our research we focused on differences in manufacturing and use. Transport and recycling were assumed to be the same for the two generations.

The differences in the manufacturing stage focused on the populated motherboard and other PWB (printed wiring boards) as well as on the PSU (power supply unit), and chassis components such as housing, fans, and heat sinks.

Due to improvements in energy efficiency, the 12G server (R720) has a lower energy consumption both in idle and full workload modes compared to the R710. As outlined above, for both servers we assumed that they operate in idle workload for 50% of the time and in full workload also for 50% of the time.

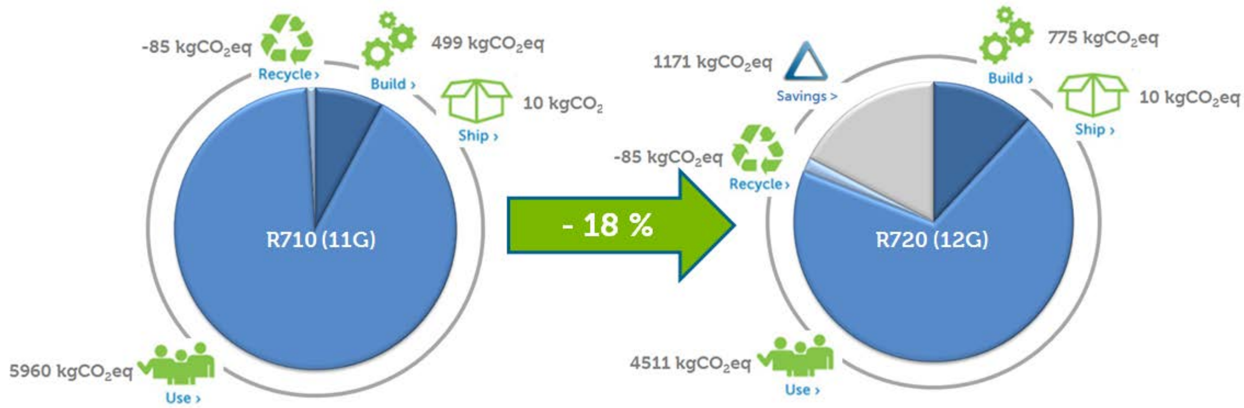

Figure 3. *Comparison of the total product carbon footprint [kgCO2eq] of the PowerEdge R710 and R720*

Overall the carbon footprint decreased by 18% from the 11G to the 12G server. While the R710 (11G) had total GHG emissions of approximately 6381 kgCO_2eq, the R720 (12G) came in at approximately 5210 kgCO_2eq. The reduction of 1171 kgCO_2eq is comparable to (not) consuming 541 liters (143 gallons) of gas, enough to fill a VW Golf fuel tank nearly 10 times.

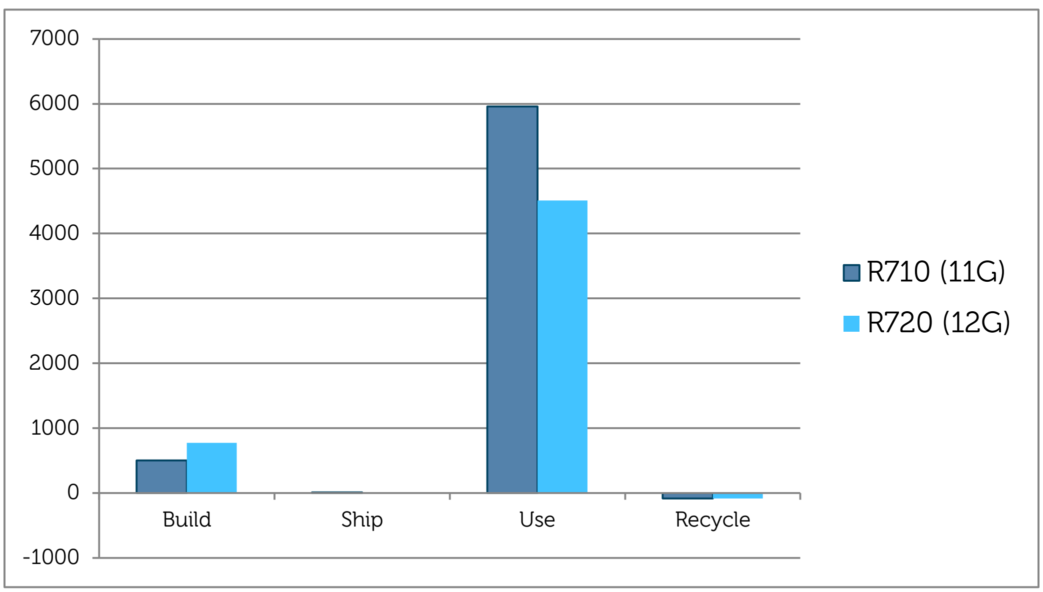

Figure 4. *Comparison of the carbon footprint [kgCO2eq] of the PowerEdge R710 and R720 in the different life cycle phases*

This massive reduction can be attributed to the increased energy efficiency in the use phase. The GHG emissions in use alone decreased by 24% generation over generation. This is testimony to the improvements enabled by the Dell Energy Smart Architecture. The high-efficiency, intelligent-power management capabilities were achieved, among others, by right sizing the power supply, increasing efficiency in idle power, capping circuit breaker power and high accuracy power monitoring.

Interestingly, the impacts from manufacturing increased by 55% when comparing the R710 with the R720. Responsible for this increase in the newer generation was the mainboard and the mixed PWBs. GHG emissions from the mainboard and associated PWBs increased by 285 $kgCO_2eq$ due to the increase in number of active components (ICs) and a slight increase in PWB area. The changes in chassis or PSU did not have an effect.

It can be assumed that a higher investment in embedded carbon in the motherboard – adding more intelligence (and thus more carbon) – is offset by the massive reduction in energy use during the use phase.

Use phase of course still dominates the carbon footprint of the new generation servers. For instance, for the R720 the use phase still contributes 87% to the total carbon footprint. Further advances in Energy Smart Architecture are needed to reduce the overall footprint of servers. Our results demonstrate that further investments in smartening the server by adding more components resulting in higher embedded carbon still pay off massively.

What is Dell doing to lower the carbon footprint?

By optimizing consumption of energy, we can reduce costs, shrink our carbon footprint and develop expertise that allows us to help our customers do the same.

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

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.

Acknowledgements

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