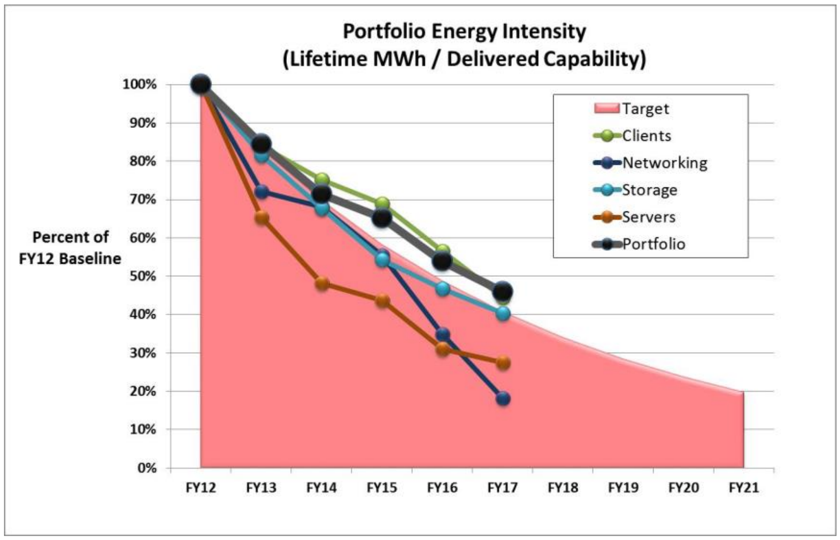
2020 Energy Intensity Goal – Mid-term Report / Summary

In October 2013, Dell announced its Legacy of Good initiative – a set of corporate responsibility goals covering a wide range of social and environmental issues material to the company, our customers and our other stakeholders. As part of the program, we announced the industry's first portfolio-wide energy intensity goal, establishing our intent to reduce the overall energy intensity of our product portfolio by 80% (2011-2020).

Through the end of 2016, we've reduced our product portfolio's energy intensity by 54% from our baseline.



BACKGROUND/ABOUT THE GOAL

A number of considerations drove our decision to use energy intensity as our measure of our progress against the general idea of energy efficiency. Using an absolute energy use metric would be clouded by factors unrelated to energy consumption, like unit sales. Instead we chose to start with an absolute measurement, normalize it through an additional factor appropriate to the product category based on performance, and then identifying the ratio of energy used per unit of work (for example, Watts per million web pages accessed). This measure, then, is the reciprocal of performance per Watt.

In order to compare across products with different types of work, we used system benchmarks and converted all measures into a number of equivalent Dell EMC PowerEdge M620 systems.

DEFINITION: **energy intensity** is the sum of the expected lifetime energy consumption of all units sold during a reporting period divided by the sum of a measure of delivered capability of all units sold during the same reporting period.

When we began this process, we made some assumptions that turned out not to be true – most notably that monitors did not represent a significant portion of Dell's overall energy footprint. While we have a clear plan when it comes to measuring performance of our client and enterprise systems, there is no accepted industry standard as to what constitutes monitor performance or capability. Even if there were, there's no clear approach as to how we would convert this to a number of equivalent Dell EMC PowerEdge M620 systems.

Since monitors represented 21% of Dell's overall energy footprint, we believe it important to calculate monitor performance nonetheless. We therefore calculate it separately, using the product of several key front-of-screen performance parameters (screen size, number of pixels, viewing angle, color gamut, brightness) as a proxy for screen performance. This does not allow us to include monitors in the composite measure of the goal, but it does allow us to track changes in energy intensity for monitors.

Finally, we also updated our benchmarks this past year. When we began measurement, for example, the SysMark 2007 office productivity benchmark was the most appropriate tool for client PC systems. The way our customers use our products, however, changes over time. Beginning with the FY17 (2016) measurement, we switched to SysMark 2014 and converted older system data to scale appropriately.

For a detailed understanding of how we developed all of these measures, see the complete white paper.

WHAT WE LEARNED

In addition to learning that we need to track monitors as a material product category, our measurement of the portfolio energy intensity for this goal has led to important learnings so far.

Smaller client product form factors affect our portfolio energy intensity

While on the surface this conclusion may seem patently obvious, a deeper read of the data yields important findings. For both desktop and mobile products, customers are increasingly interested in smaller product form factors (as measured by total product volume). For mobile systems, we've reduced physical footprint by eliminating space between the display and the edges of the system, and we have aggressively driven thinner designs. For desktop systems, we've reduce the size of many existing products while introducing "micro form factor" products.

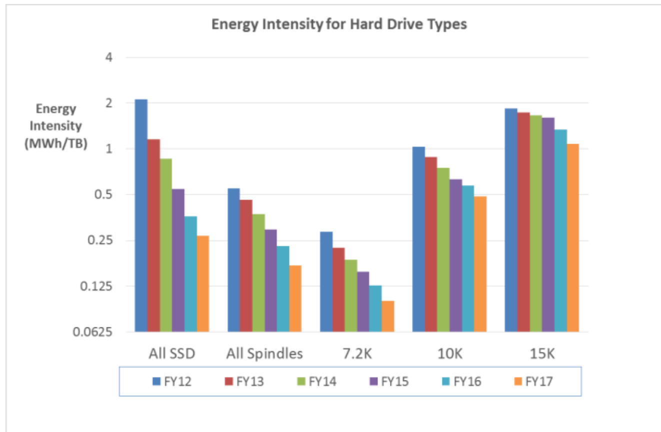
Reducing product size, however, makes heat removal more difficult. One solution is to reduce processor thermal design power (TDP). TDP defines the maximum sustained power level the processor can use to do work. Reducing TDP reduces processor performance. Our data shows that at the beginning of this goal in 2011, mainstream processors in our mobile product typically had a TDP of 35 Watts. By 2016, these processors had a TDP of 15 Watts – reducing the processor' available energy to do work by more than 50%. This has led to slower improvements in our energy intensity metric due to a reduction in expected performance gains, but a faster-than-expected decrease in the absolute energy footprint of our client portfolio.

Solid State Drives (SSD) are tricky

Drive speed is a big factor in energy intensity (for storage, measured as Watts per Terabyte). Faster spindle-based systems (i.e., spinning disks) tend to have a smaller capacity, without commensurate reductions in energy consumption.

When we first began measuring this goal, solid state drives were more energy intensive than their spindle-based counterparts. At that time, the capacity of the drives was fairly small and energy consumption was on par with that of other drives of similar physical size. In the years since, however, they have seen the steepest reduction in energy intensity of all drive types. Solid state drive energy intensity eclipsed the 15k rpm drives within a year of our baseline, then the 10k rpm drives a couple years later.

While a big part of the value of SSDs is the speed at which they can read and write data, the speed with which they are closing the energy intensity gap is exciting. If the trend continues, SSDs collectively will be less energy intense than spindle-based drives before 2020. Two to three years after that, SSDs may be even less energy-intense than the biggest 7200 rpm drives.



Storage systems are more than just the sum of their parts

While our metric is very good at looking at individual drives or types of drives, real-world storage architectures are rarely homogeneous. They consist of many types of drives with different use models. As a result, the true energy intensity of an installation is not based on the sum of the parts, but rather how those parts are put together into a solution and how that solution is then operated. Our metric can help spot trends, but a comprehensive look at storage energy consumption requires additional considerations.

Solid State Drives (SSDs) are a prime example of this. From our data, we know that SSDs are currently more energy intensive than their spindle-based counterparts. That being said, SSDs are able to access data much faster than their spindle-based counterparts. Achieving similar performance with only spindle-based drives leads to deployment of more drives than necessary and the use of faster, 15k rpm drives – both of which increase the energy intensity of the system. This is not addressed by our metric.

One type of solution where SSDs both help performance and help energy use are tiered storage architectures. In these solutions, small fast drives provide access to the most commonly used data while large slow drives provide access to less commonly used data or large data files that are best read sequentially. In these cases, the complete solution frequently uses less energy than an alternate solution comprised only of one type of drive. Our metric does not consider this.

Dell EMC takes this even further with its Fully Automated Storage Tiering (FAST) technology. FAST leverages combinations of flash, high rpm performance drives and low rpm high-capacity drives to achieve greater performance and capacity levels at significantly lower power levels than can be achieved by spinning drives or SSDs alone. Based on the way the portfolio energy intensity metric is calculated, however, we are unable to derive how much benefit was delivered to our customers as energy savings due to these features.

GPU-heavy clients show slower gains and a larger share of our energy footprint

In the goal-setting process, we also assumed we could discount a handful of Dell product lines – specifically our Precision Workstations and our Alienware gaming products. These systems are architected for high performance uses like engineering design, media production, software development or gaming. We believed the volume of these products was sufficiently low to be negligible.

Great performance does not come without an energy cost. While external graphics processors will contribute somewhat to increased energy consumption, these systems also typically include high-end primary processors and chipsets, large memory capabilities, greater expandability and premium audio systems. It turns out that by 2016, these systems represented more than 26% of our client energy footprint. We have since incorporated them into the measurement.

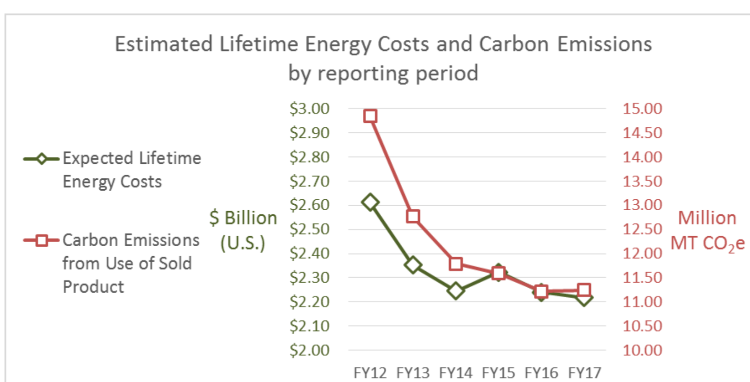
For some customers of these products, the productivity enabled by the performance of these systems far outweighs the cost of the energy they consume. The applications for these products are creating an ever increasing demand for higher performance, which offsets potential energy intensity improvements. While the absolute energy footprint of these systems has seen a slight decline, there has been much greater progress with our more mainstream systems: their absolute energy footprint has almost been cut in half since the baseline year.

Our customers' energy costs and Dell's downstream carbon footprint are related

One of the key components of our metric is the total expected lifetime energy consumption for the products we sell in a given reporting period. This allows us to estimate how much our customers will spend to power the equipment they purchase from us, as well as estimate our downstream carbon footprint for "use of Sold Product." This has important implications for customer sustainability efforts and their bottom line.

The chart shows the history of both lifetime energy costs and downstream carbon emissions across the current goal period. Our downstream carbon emissions due to sold product are part of customers' operational Scope 2 carbon emissions (those associated with the purchase of electricity or other sources of energy).

Measuring total expected lifetime energy consumption has allowed us to estimate how expected lifetime energy costs change. For example, we estimate our customers' expected lifetime energy costs from their FY17 (2016) purchases to be a little over $2.2 billion. If the energy intensity of our products had not improved between FY16 and FY17, our customers would have had to spend an additional $380 million during the lifetime of those FY17 purchases. This is not a one-time occurrence. In fact, for the past four years, these savings have averaged over $470 million each year.



Keep in mind that these figures do not attempt to estimate energy “uplift” due to power distribution and cooling architectures (it is too dependent on customer, location and situation). The effect of this is that we are likely underestimating how much we are saving our customers, both with respect to operational expenses and environmental footprint.

NEXT STEPS AND FUTURE GUIDANCE

We are approximately halfway through our goal. While the goal and metric aren’t perfect, they are providing actionable insight. As noted, we’ve made some updates to the goal. We will continue to be transparent about how it is calculated and what it tells us.

Updating methodologies: While we updated to the SYSmark 2014 client benchmark, we have not yet started a similar effort with regard to server benchmarks. SPECint_rate2006 is now a decade old – it is likely we will have to replace it before the end of our goal timeframe. We are likely going to need to treat GPU-heavy systems separately, too, as SYSmark 2014 is not truly representative of how they are used. And, of course, we will continue to look at our metric for estimating the performance capability of monitors.

Continue to lead as a system integrator: We do far more than just integrate the parts provided to us by our suppliers. Keeping Dell competitive requires innovation and technology development – balancing performance, cost, energy use and product features. We will continue to build on our strong history as the developer or leader of many innovations pertaining to the energy use of IT equipment (first to transition 100% of its notebook portfolio to LED backlights, leader in reducing energy draw from AC Adapters – breaking the 100mW no load power level at a time when the industry was transitioning to below 500mW, 300 patents related to power management, energy savings, battery management and battery life, and incorporating Dell Active Power Controller processor power management since our 2009 release of our 11th generation of servers).

Work with industry: We’ve encouraged our silicon suppliers to consider energy efficiency as they develop their future technologies and process capabilities for over a decade now. In some cases, we have even prioritized energy use over performance. This focus has served our customers well – our desktops use less energy and our mobile products have longer battery lives while being smaller and lighter. We work with our partners, driving strategic and differentiated feature requirements in their technology roadmaps. We also actively participate and engage in energy efficiency and public procurement programs like ENERGY STAR, EPEAT, European Union Energy-related Products (ErP) Directive, and others. We encourage our peers, customers and stakeholders to also take a seat at the table, working together to define appropriate targets for long-term improvements.