

DATA CENTER SUSTAINABILITY THE NEXT DIMENSION

In recent years, the data center industry has made excellent progress in enhancing energy efficiency and adopting renewable power sources. There are also many innovative new solutions in development. However, there are still major challenges in this area that we have yet to overcome:

- The improvements are in new builds.
Legacy data centers are hard to upgrade
- PUE while useful has intrinsic flaws as used by the industry
- Not all renewables are equal.

There is also another equally important dimension to sustainability; full cradle to grave environmental impact. Data center operators should expand their sustainability programs to encompass this by:

- Offering proactive advice on power consumption at the data floor level
- Helping to tackle embodied impact rather than just operational impact
- Pushing for more transparent universal standards which make it easier for customers to make informed choices.

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EMISSIONS REDUCTION: MAJOR ACHIEVEMENTS TO DATE

Increasing Consumption, Increasing Responsibility

- The average data center uses enough electricity to power 180,000 homes (source: the US Natural Resources Defense Council)
- According to IDC, there are more than 8 million data centers worldwide, and global demand for data centers continues to increase. Data center space is projected to grow to more than 1.9 billion square feet in 2018.
- Data centers are believed to consume about 3 per cent of the global electricity supply and account for about 2 per cent of total greenhouse gas emissions, giving the sector around the same carbon footprint as the airline industry.
- In 2015 data centers used 416.2 terawatt hours of electricity, higher than the UK's total national consumption which was about 300 terawatt hours.
- Future users and devices will drive usage higher. 5 billion people still do not have daily internet access.
- Power consumption is moving to the data center. Energy use is doubling every four years as data levels grow and use-stage electricity consumed by consumer devices is transferred to networks and data centers. Analysts forecast that data centres will consume roughly treble the amount of electricity in the next decade.

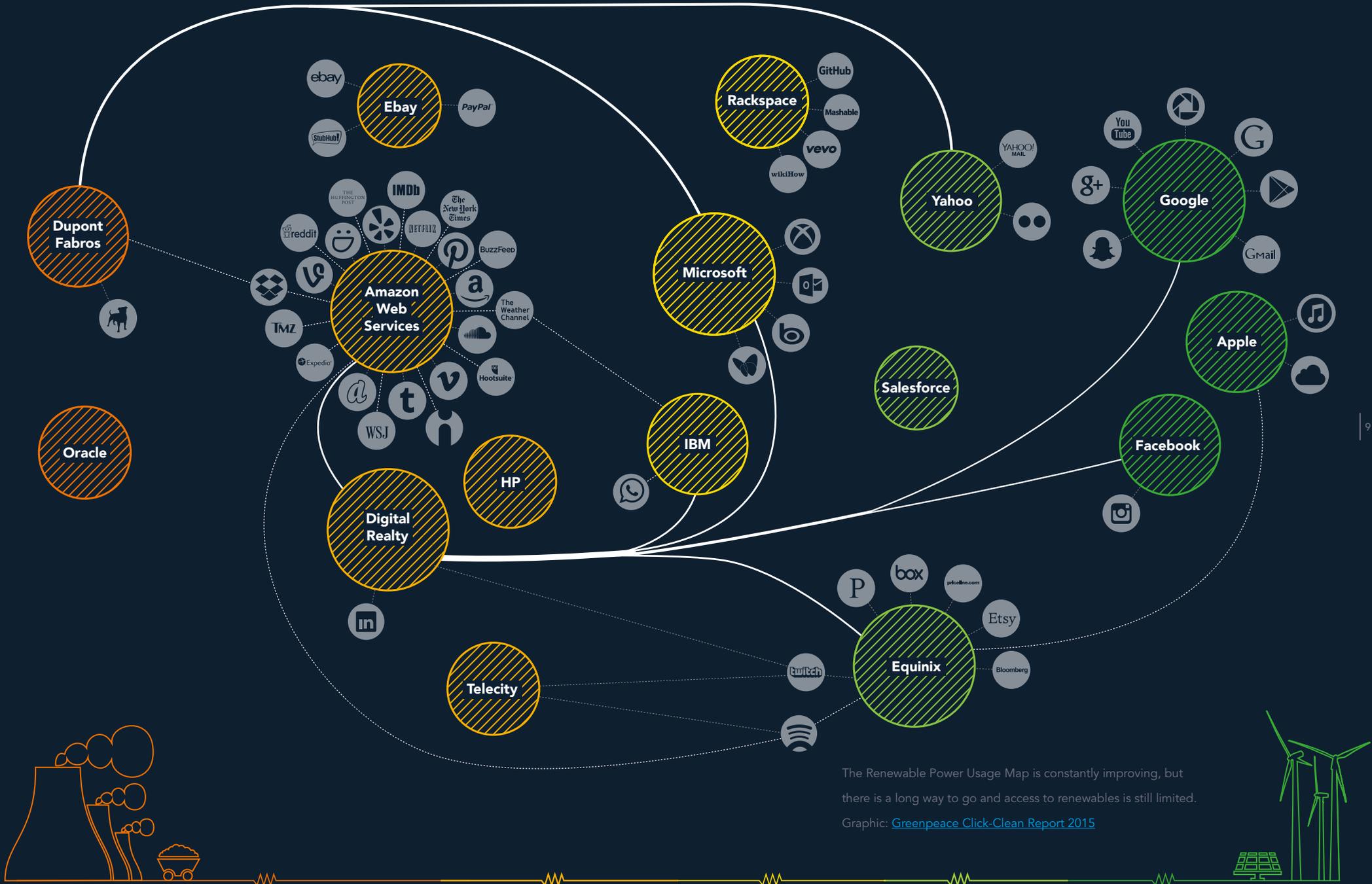
While many maintain that the efficiencies the internet era brings to the planet outweigh, or at least partly offset, the environmental cost, the scale of the data center sector's environmental challenge is not in doubt. However, this should in no way diminish the achievements our industry has made so far. While they vary considerably from one market to the next, the steps taken towards sustainability to date have had a positive impact.

Emphasis on efficiency

The focus on efficiency has been particularly successful. By developing new cooling technologies and focusing on reducing energy overheads in design and operations, we have pushed down Power Usage Effectiveness (PUE) in a new data center from 1.8 - 2 to 1.1 - 1.2. And at the same time more intensive workloads are handled using similar power densities, using the pooled resources and elasticity of the cloud.

Renewable take-up

Take-up of renewables has also been growing. Even in the USA, where the growth of renewable options has been slower, cloud giants are leading the way, with Intel, Microsoft, Cisco and Apple now 100% powered by renewables. Clean energy prices are coming down, and pressure is growing on power providers to offer renewable options in more locations. However, there is a long way to go. According to the Click-Clean reports from Greenpeace (who are hosted in EvoSwitch in the Netherlands and therefore use 100% green energy :-)) less than 20% of the electricity used by cloud computing service providers globally currently comes from renewable sources.



The Renewable Power Usage Map is constantly improving, but there is a long way to go and access to renewables is still limited.
 Graphic: [Greenpeace Click-Clean Report 2015](#)

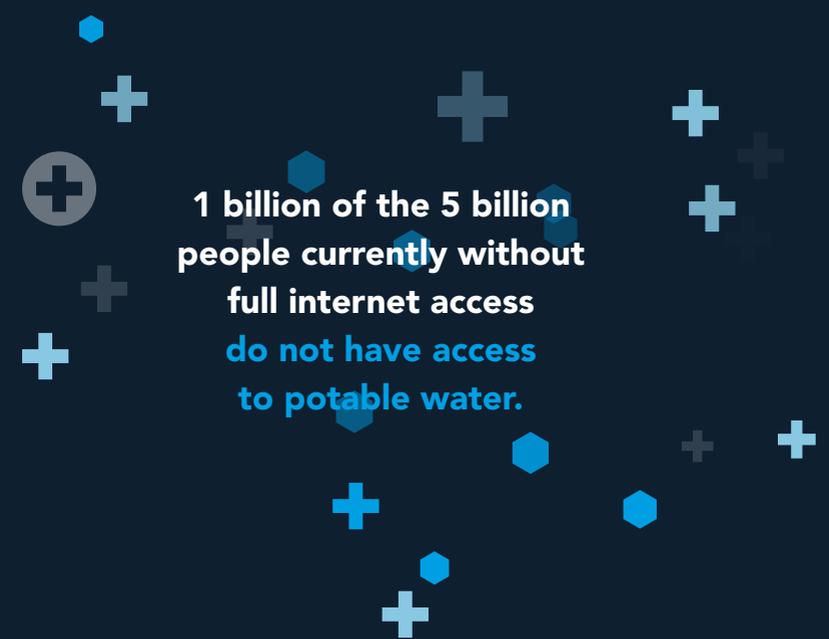


In the pipeline: WUE

Water Usage Efficiency (WUE) is also now a major issue: 1 billion of the 5 billion people currently without full internet access do not have access to potable water. According to Pouchet, a Green Grid board member, (source www.thegreengrid.org) a modest 1 MW facility can easily consume more than 4.4 million litres (1.2 million gallons) annually. Tackling WUE in parallel with PUE is key part of a more integrated approach to data center sustainability.

Smart solutions

There is more good news to come. Our industry is extremely innovative, and there are a range of smart solutions emerging which could help reduce negative environmental impacts. Fuel cells for power generation are becoming more common and some experiments are taking place in the US. However, it is unlikely that data centers using fuel cells as an exclusive power source will be built in Europe for another 3-5 years. Low carbon locations are also emerging; relocating to Scandinavia or Iceland in search of cool outside temperatures and geothermal energy is more feasible now that there is adequate connectivity, but it is not ideal for customers in the south who want to access their equipment regularly. Immersed computing - putting the servers in oil - is also receiving a lot of attention, and while it may seem a bizarre solution it works well, and is a viable option for operators of dedicated facilities where the location and the hardware are both owned.



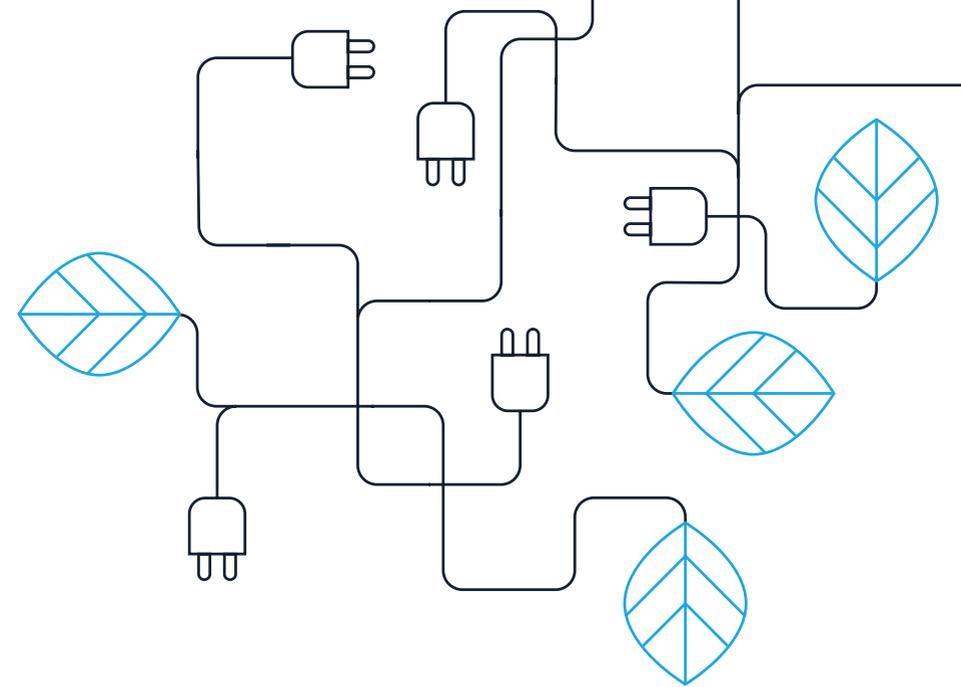
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MORE TO DO: ONGOING EFFICIENCY CHALLENGES

While our efficiency gains are cause for celebration, it should be borne in mind that they have been achieved with the wind behind us, i.e. they have been accelerated by a close correlation between commercial and environmental interests. Less power for the same load means that someone either makes or saves money, a strong incentive to change.

Legacy of inefficiency

Efficiency gains are far from universal. Many of today's data centers were built in the mid-to-late 1990s when designs were not sustainable, and facilities featured power-intensive cooling systems. It is very hard to migrate to a new cooling design in a live data center environment. Even in EvoSwitch's own earlier data halls, improvements were hard won. For instance, we can build adiabatic shields round dry coolers to improve efficiency, but efficiency gains will still not match those of a new build. Many old data centres – enterprise data centers in particular – are far worse. And not only is the cooling infrastructure and design outdated, but the servers are under-deployed. A 2015 study by Jonathan Koomey found that enterprise data center servers still only deliver, on average, between 5 and 15 percent of their maximum computing output over the course of a year, and 30 percent



of physical servers had been comatose for six months or more. The migration of data and applications from these legacy sites into the cloud is critical to the overall improvement of energy efficiency.

Lack of transparency

There are transparency issues with both PUE and renewables that need to be addressed. While it is a useful measure of efficiency, PUE is very hard to verify, and – often due to sensitivities around the cost of power - detailed information is often not available. Operators frequently talk of design PUE for facilities, but design PUE is an ideal, not a fact; and actual day-by-day or rack-by-rack PUE is neither measured nor shared. EvoSwitch is exceptional in that the company offers real-time PUE reporting using over 8000 power monitors, but currently there is no standard-related obligation to report this data.

In the same way, current renewable offerings are still extremely opaque. Renewable energy comes with a grading, with wind or solar power being the purest forms; for instance, EvoSwitch has adopted a windmill to ensure a continuous supply of energy for customers who demand the cleanest power. But there is also a lot of 'grey' power for sale under the renewable banner.

THE MIGRATION OF DATA FROM LEGACY SITES INTO THE CLOUD IS CRITICAL TO THE OVERALL IMPROVEMENT OF ENERGY EFFICIENCY.

THE NEXT DIMENSION: AN INTEGRATED APPROACH

Today, most data centers measure their energy efficiency and electricity usage during operation, so the embodied impact of the production, transportation and disposal of the materials, components and systems used in the data center are not considered. The key to improving long-term sustainability in the data center will be to take a more proactive and integrated approach based on full life-cycle analysis of all the materials involved in construction and operation.

Tackling embodied impact

As facilities become more efficient, embodied environmental impact will feature more strongly compared to operational impact. For instance, a life cycle assessment of a UK data center study conducted by Whitehead and Shah in 2015 found that for a UK facility using free cooling, the operational impact is four times that of the embodied impact. However, for an identical facility in Sweden with reduced energy consumption (through consolidation and virtualisation) but an increased number of servers, the operational impact is half of that of the embodied impact. If the Swedish facility was based in the UK, the operational impact would be roughly equal to the embodied impact.

Due to the materials used in its manufacture, IT equipment has a significant environmental impact compared to M&E or construction

impacts. While data center operators do not own the IT equipment in their facilities they can help tackle the problem of efficient reuse and recycling of waste servers by offering advice on hardware life-cycles and partnering with in-house refurbishment and recycling services. There is huge room for improvement in this area, and it is covered in more detail in another EvoSwitch white paper: 'Reuse and recycling of servers: next steps towards sustainability.'

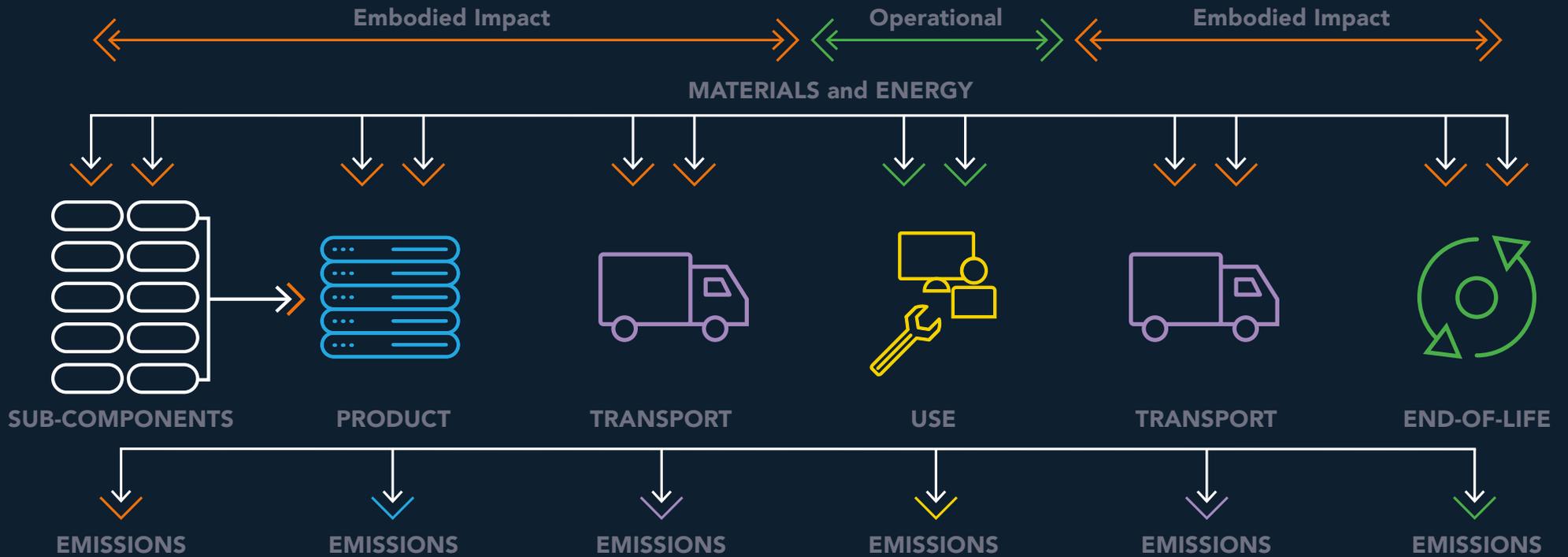
Offering expertise

A related area in which data center operators can bring their expertise to bear to enhance sustainability is on the data floor itself. Rather than worrying exclusively about the total power overhead, operators can offer proactive advice on correct configuration, monitoring and energy consumption of servers.

What is not immediately apparent to the customer can be very clear to the operator. For instance, EvoSwitch has a customer – a hosting provider - that recently reduced its physical footprint by 20% and its server power consumption by even more than 20% following an energy audit. The customer had a mix of virtual and legacy servers with full racks requiring 4-5 kW power density. EvoSwitch offered advice on equipment and configuration and now the customer use only a quarter of a rack using 2kW of density for the same workload.

Pushing practical standards

And finally, while there are many standards available, a lot of which claim to be definitive, they are very regionalized and many standards organisations have attracted commercial interests which undermine their objectivity. To demonstrate their commitment to sustainability, data center operators should cut through the confusion by pushing at an industry level (through e.g. their national trade associations) for more transparent universal standards which make it easier for customers to make informed choices based on genuine sustainability criteria.



Data Center operators should expand their services to integrate embodied as well as operational environmental impact

CONCLUSION FROM SUSTAINABLE FACILITY TO SUSTAINABILITY FACILITATOR

By improving on PUE, multi-tenant data centers are reaching the boundaries of what they can do in their own domain. Now they need to look beyond their traditional scope and help to facilitate 360° sustainability, carving out a role in advising customers and offering new services to boost sustainability.

Operators with a genuine commitment to the environment can no longer be simply sustainable facilities, they should become *sustainability facilitators*. Operators can only offer advice and optional services in these areas, but this would be valuable for customers who care about their environmental impact and, as a result, should be increasingly commercially viable.



The Green Fan Program
By focusing on sustainability, EvoSwitch helps customers reduce their carbon footprint, which benefits both their business and the environment. We encourage and promote this business philosophy through the Green Fan program. Customers who share our commitment to the environment can join the Green Fan program which will entitle them to use of the Green Fan logo and technical advice.

SOURCES & FURTHER READING

[The Independent Jan 2016 on data center power consumption](#)

[Future data center usage trends](#)

[Cisco cloud index on data growth](#)

[Greenpeace Click-Clean Report 2015](#)

[\(USA\) EPA renewables take-up report](#)

[Jonathan Koomey \(Stanford\) report on inefficient enterprise data centers](#)

[Data center Life-Cycle Analysis \(including refs to Whitehead & Shah research\)](#)

[EvoSwitch White Paper on recycling and reuse of servers based on Master's thesis by Casper van Hoorn of Utrecht University](#)

[Dutch Data Centers Association 2015 report on Green IT](#)

Colophon

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