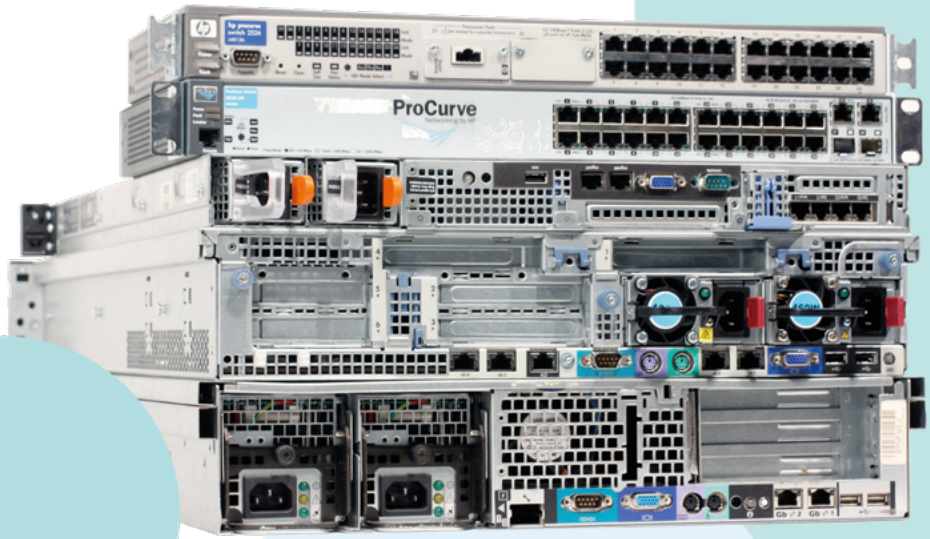
CEDaCI Circular Economy
for the Data Centre Industry

The Business Case for Refurbishment

Pilot B



Circular Economy
for the Data Centre Industry

Interreg
North-West Europe
CEDaCI
European Regional Development Fund

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About CEDaCI

Circular Economy for the Data Centre Industry (CEDaCI) is a five year, Interreg North-West Europe-founded project across the UK, Germany, Netherlands and France. CEDaCI will create a robust Circular Economy for the Data Centre Industry by adopting a whole-life-cycle approach to the problem of sectoral e-waste.

The Data Centre Industry has grown rapidly and generates a large volume of WEEE. The current infrastructure for dealing with this waste is underdeveloped and consequently, there is a real and urgent need to address this now. CEDaCI is bringing together stakeholders from all equipment life cycle stages to turn this waste into a valuable resource and support the ongoing rapid growth of the DCI.

Project Delivery Team

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Introduction

Research published by Deloitte in 2021 said that 34% of consumers are choosing brands based on ethical considerations[1]. The report also found that ethics matter more to younger consumers with the 18-34 year old age band most likely to choose brands for their ethical values. Whilst data centres sector is not directly consumer facing, these attitudes do have an indirect effect when it comes to investment decisions, attracting and maintaining a talented workforce and general public perception and it is in the interest of the sector to adjust accordingly. In addition, policy and legislative changes around Europe mean that Circular Economic practice may well become a compliance issue in the near future.

The Policy Landscape

The EU has published a number of policies and directives on circular economy and practical steps taken to facilitate repair and reuse. The Ecodesign Directive[2], which came into effect in all member states in March 2020 has a specific section (Lot 9) on servers. The legislation stipulates that parts and firmware be available for servers from 2 – 8 years after the release date, paving the way for increased reuse, repair and remanufacture.

In addition, the EU Circular Economy Action Plan includes specific ambitions relating to electronic goods and ICT, including targets to extend product lifetimes[3]. While in the past, data centre professionals would have been concerned about this due to the huge efficiency gains with every successive generation of servers, recent evidence suggests that the slowdown in Moore's Law means that product lifetimes can be extended without a negative effect on energy efficiency. This will be discussed in detail below.

The UK published a Circular Economy Package policy statement in July 2020[4], which identified identifying steps for the reduction of waste and establishing an ambitious and credible long-term path for waste management and recycling.
This was followed in September by the more sector relevant Greening government: ICT and digital services strategy 2020-2025, which included commitments towards zero to landfill on electronic waste and a percentage increase in refurbished or remanufactured goods in the public sector IT estate[5].

1. Sustainable Consumer | Deloitte UK
2. About the energy label and ecodesign | European Commission (europa.eu)
3. New Circular Economy Strategy - Environment - European Commission (europa.eu)
4. Circular Economy Package policy statement - GOV.UK (www.gov.uk)
5. Greening government: ICT and digital services strategy 2020-2025 - GOV.UK (www.gov.uk)

The UK Government has also made a commitment towards Right to Repair legislation for consumer goods[6]. If adopted, this paves the way for business related legislation more in line with the EU Ecodesign Directive.

Industry moves

The European Data Centre sector has made advances towards more circularity in a number of ways. As an example, agreements on best practice include the Climate Neutral Data Pact, a consortium of data centre operators and trade associations leveraging technology and digitalization to achieve the goal of making Europe climate neutral by 2050, includes a commitment to the reuse and repair of servers as one of its five pillars of the pact[7].

Hyperscale data centres are also publicising models for successful circular economy practice in their reuse and remanufacture of server[8], sales to the secondary hardware market and aims to become carbon negative by circularising the supply chain and increasing focus on scope 3 emissions[9]. This sector level awareness of circular practice and its role in reducing carbon footprint means there is increasing demand on smaller organisations to follow suit.

Manufacturers, for their part, have been running remanufacturing arms for a number of years: “Cisco Refresh”, “Dell Refurbished”, “HP Renew” to name a few. These companies are beginning to expand their remanufacturing capability and work with the public and private sector to reduce waste by bringing product back into refurbishment and recycling centres for reprocessing. Many of these initiatives rely on partnerships with refurbishment specialists, which is helping to bring the practice into the mainstream and increase public awareness.

Economic Analysis

Purchase cost of refurbished equipment

The costs of refurbished and remanufactured servers are considerably lower than their brand-new counterparts. While basic new configurations can be closer in price to refurbished, any configured variants will be considerably more with the new option. For example, the latest generation with a single processor and low RAM will have a small gap in pricing between new and refurbished versions.

6. ‘Right to repair’ law to come in this summer - BBC News
7. Climate Neutral Data Centre Pact – The Green Deal need Green Infrastructure
8. Circular economy at work in Google data centers (ellenmacarthurfoundation.org)
9. Microsoft will be carbon negative by 2030 - The Official Microsoft Blog

However, increasing power with additional CPU and RAM will be significantly more expensive with new components in comparison with their refurbished alternatives.

The cost of new equipment for servers (new currently being Generation 11 for HPE and Gen15 for Dell) is often as high as 50-80% more than the refurbished condition even after 3 years. When a generation moves to end of life, or a newer generation comes out, the remaining OEM stock will be sold at much reduced prices but still higher than its refurbished equivalent.

The basic build of materials option such as the example above will be nearer refurbished prices after around 3 years in the market but in the first year the differences will be much more noticeable. This is because refurbished models will be in shorter supply and most businesses will hold the asset longer than 12-18 months.

Performance difference of refurbished equipment

There is **no noticeable difference in performance between refurbished and new models**, as has been verified in the peer reviewed IEEE Journal – Transactions on Sustainable Computing[10]. The paper also shows how the slowdown of increased efficiencies affects server trends. In broad terms, **CPUs are no longer getting better by default**. It now makes sense to consider refurbished and remanufactured machines as part of an upgrade process – as a smart business decision.

Prior to 2015, each successive generation of server was more energy efficient, so cost savings on energy bills were significant for the business. With this no longer being the case, the cost benefit of new versus refurbished has decreased on operational expenses. Data from the IEEE Transactions on Sustainable Computing shows that a refurbished current generation server has the same performance as new but comes at a reduced price. There are no issues with reliability as the refurbishment process removes the most susceptible parts such as power supplies and hard drives. This can be further backed up by the offering of 3 year warranty on refurbished goods which matches the manufacturers original warranty.

Effect of refurbished purchase on operational costs

The IEEE paper also outlines the payback point of replacing different older generations with new equipment and the immediate past generation. It shows that it makes sense to replace six year old servers (with a return on investment within 4 years) with newer refurbished equipment but not with new (which would take

10. Optimizing server refresh cycles: The case for circular economy with an aging Moores Law (computer.org)

5-8 years). This gives data centres the option of buying the refurbished previous generation, which in the case of the LCC analysis is a generation 9 HPE server.

Prices for the refurbished previous generation, but at a higher specification, are roughly half of the refurbished price of the current generation at a much lower specification. For example, a dual CPU 64GB RAM Gen9 server can produce the same performance, or slightly higher, of its Gen10 low specification equivalent and at half the price.

Buying decisions

The main buying decisions come down to rack density, available space, and utilisation rate of the hardware. If utilisation rate is below 60% then previous generation refurbished equipment is usually the best cost benefit balance. Where utilisation or CPU demands are higher than normal, then higher specification, current generation servers will be best. In each case, refurbished options will have the best return on investment in a cost for performance model.

The business case for brand new mainly applies to cases where top end performance is required. If the product is recently new to market, it may mean that secondary market options are unavailable. This is a small minority or cases but is the predominant purchasing approach in the market. Given the recent evidence outlined above, it seems sensible for this approach to change and for data centres to more closely examine their buying choices.

End-of-life cost recovery

At end of first use, refurbishment extends the product life by at least 3 years for server hardware. This is more of an economic life expansion than a technical one since many servers are retired because of the end of a leasing term rather than because of inherent degradation in performance. To generate cost return, selling the equipment to a refurbishment specialist or IT Asset Disposition Company (ITAD) will generate higher returns than selling for scrap or destruction. This is because prices for scrap are based on weight and most of the value lies in the CPU and System Board. For a fully populated Generation 10 server this will be around £24 and around £26 for the fully populated Generation 9 (interestingly, the variability in price due to a heavier system board in the previous generations). Selling to an ITAD would expect in excess of £100 for the G10 and £50 plus for the G9. This would include them data sanitising all assets and re-processing it all securely.

From an economic standpoint, there are many more use cases where refurbished is the better option both for managing costs, return on investment, refresh strategy and replacement hardware timings. There are use cases where brand new is necessary, such as for high compute workloads, maximising rack density for some edge based data centres, and also where specific technology and software is required but refurbished options are unavailable. For most businesses refurbished will be the better decision.

The Environmental Benefits of Circular Practice

"Towards Zero Carbon" announcements have been highly publicised within the sector over recent years, and circularity plays its part in this by reducing emissions associated with mining, transport, manufacturing and destruction at end of life. However, circular economic approaches also touch on other important issues such as materials shortages and destruction of the natural ecosystem. 23 of the 30 "Critical Raw Materials" identified by the EU as in low or politically unstable supply, exist in data centre IT hardware. The stores of these materials are finite and some are predicted to run out within decades unless alternative sources are found. The seabed has been suggested as one such alternative supply source, with obvious implications on subsea biodiversity.

Material recovery is one way of reducing the need to mine and process new materials. However, the JRC study which informed policy makers in 2015 demonstrates that current recycling technologies are unable to recover 100% of the materials within the servers and that CRM are amongst the most difficult to retrieve11. Many recycling technologies rely on shredding and melting, which has its own energy and emissions costs. Although new techniques are in development, these are in their nascent stages and will take some time to become mainstream practice. Finally, material recovery leads to a manufacturing process, also involving energy usage and emissions, which means that reuse, refurbishment and repair are accepted to be higher up the value chain in terms of environmentally friendly practice.

A report by the Rochester Institute of Technology sent to the World Circular Economy Forum in 2018 found that remanufacturing and comprehensive refurbishment had the following environmental benefits:[12]

> Help to **reduce greenhouse gas emissions by 79% - 99%** in appropriate sectors.

> **Save 82%- 99% raw material requirement** compared to new production.

> Result in **69% - 85% less energy use and related emissions** compared to the linear process of take, make, waste.

11. Environmental Footprint and Material Efficiency Support for product policy - Analysis of material efficiency requirements of enterprise servers | EU Science Hub (europa.eu)
12. Re-defining Value – The Manufacturing Revolution | Resource Panel

The Social Benefits of Circular Practice

Manufacturers in the electronics sector have been aware of potential human risks in the supply chain for some time. Many carry out due diligence on their supply chain using frameworks like the Responsible Business Alliance and others. However, obtaining a completely accurate picture of working conditions in the supply chain is extremely challenging given the complexity and geographical spread involved.

Server manufacturers can also be described as server assemblers because many of the component parts such as chips, CPUs etc. are made by specialist workshops. The supply chain is complex with a large number of small vendors fulfilling bulk component orders sometimes in fluctuating numbers. This means it is difficult to understand which item came from which original company. Many of the component parts come from the Far East, with associated language and cultural barriers for site visits. In contrast, remanufacturing and recycling are relatively high value job propositions and growth sectors, particularly in the EU. Health and Safety regulations mean that environmental pollution is eliminated when processing the material, meaning no risk to employees.

Further down the supply chain, some of the raw materials come from conflict zones in the developing world. Accessing the mines and auditing conditions is next to impossible. However there is a large amount of witness testimony to suggest that the sites do not comply to the standards of safe and healthy working practice one would expect in other areas of the world. Added to this is the fact that the component factories and mines fall outside of the jurisdiction that governs the manufacturers, meaning there is no legal requirement to report. However, there are several outstanding legal challenges lodged against the mining practices and societal impact in the supply chain of large ICT manufacturers.

Increased use of refurbished and remanufactured equipment also has benefits for high value job creation. The refurbishment process is clean, safe and requires a high level of knowledge and skill. According to a 2019 Deloitte report, ICT aftermarkets were worth at least $46 billion in Europe and employed more than 220,000 people in 2015[13] and the number is set to grow going forward. It is also worth noting that developing refurbishment, remanufacture and safe and efficient recycling technologies would have benefits for economic growth and job creation in the developing world.

13. Deloitte: Nurturing the ICT aftermarket, critical for hitting European environmental goals and economy

Conclusion

Sustainability is becoming a core business concern for an increasing number of organisations wishing to attract investment, supply the public sector and recruit as well as attract customers. Choice on the use of refurbished IT hardware in the data centre has noticeable social, environmental and cost benefits to the data centre. Whereas in times gone by, data centre managers would have had to balance this against reduced energy consumption achieved with regular refreshes with new hardware, the slow down in Moore's Law means this is no longer the case. With the correct analysis and understanding, IT procurement that includes refurbished hardware and sale to recyclers and refurbishment specialists neatly satisfies the triple bottom line.