

DICE NETWORK+ CASE STUDY

Circular Tech by Default: A Whole Life Cycle IT Strategy

November 2026

DICE NETWORK+ DIGITAL INNOVATION & CIRCULAR ECONOMY

UKRI Engineering and Physical Sciences Research Council

University of Exeter

DICE Network+ Case Study

The **Digital Innovation and Circular Economy (DICE) Network+** is a three-year UKRI EPSRC-funded programme that seeks to leverage the power of the digital revolution to drive a circular economy across sectors and value chains. Led by the University of Exeter, our expert academic team comprises eleven investigators from nine UK universities. We are creating an inclusive, connected community harnessing interdisciplinary collaboration and research to guide industry partners, government bodies and policy makers towards a digitally enabled sustainable and circular economy.

Our work is focused on two key challenge areas:

- **EMBED:** Embedding sustainability and circularity within the design and development of digital and communication technologies.
- **ENABLE:** Realising the potential of the digital revolution to enable a circular economy across sectors.

Recognising the wealth of ongoing activity, we take a network of networks approach, to share understanding and build capability across our network. We welcome engagement from industry, academics, policy makers and the wider community – join us!



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Contributing Partners & Programmes: Defra, Atos, Circular Computing, Circularity First (Cistor), Techbuyer, GDSA Circular Economy Working Group, and the University of Hull

November 2026

For and behalf of the **DICE Network+**

DICE NETWORK+ DIGITAL INNOVATION & CIRCULAR ECONOMY

University of Exeter · The University of Nottingham · The Open University · Queen's University Belfast · University of Salford Manchester · University of Sheffield · University of Southampton · University of Surrey · Swansea University Prifysgol Abertawe

1. Executive Summary

Global electronic waste (e-waste) generation continues to outpace formal collection and recycling efforts by a factor of five, with the UK generating nearly 24 kg per capita annually against an EU average of 17.6 kg (UNITAR e-waste monitor, 2024).

While enterprise IT hardware has historically been scrutinised through the lens of operational energy efficiency, Scope 3 embodied emissions account for the majority of device life cycle impacts. Published Life Cycle Assessments (LCAs) suggest that a typical business-grade laptop accounts for roughly 300 to 350+ kgCO_2e across its lifespan; with up to 75–80% generated during extraction and manufacturing, alongside significant critical raw material dependencies. While recent manufacturer Product Carbon Footprints (PCFs) reflect modest declines in baseline embodied carbon due to cleaner grids and efficiency gains, the manufacturing phase remains the single largest environmental hotspot for end-user computing.

Modern enterprise IT systems are not entirely linear; leading corporate and public sector organisations have long practised in-situ asset sweating, component triage (e.g., memory reseating, battery swaps), and internal redeployment. However, fleet-wide decisions are still frequently constrained by rigid procurement cycles, OEM software deprecation, fragmented telemetry, and subjective assessments of second-life equipment.

This case study synthesises cross-sector case examples to outline an enterprise Whole Life Cycle Approach (WLCA). Organised around the DICE Network+ enabling levers; **Design for Circularity, Operate for Maximum Value Recovery**, and **Collaborate for Systemic Change**, this framework demonstrates how integrating driverless telemetry, workload-matched device profiling, and certified remanufacturing allow organisations to move beyond arbitrary refresh schedules toward an evidence-based 'Circular Tech by Default' operating model.

2. The Challenge: Bridging the Enterprise Circularity Gap

Enterprise IT asset disposition (ITAD) has historically struggled with a fundamental information and operational gap: balancing strict security, reliability, and service-level agreements (SLAs) with sustainable resource use. Rather than an absence of reuse practices, the transition toward a systemic circular economy faces five distinct operational hurdles:

- **Monolithic Fleet Management vs. Component Physics:** Traditional IT Asset Management (ITAM) tools track devices as single, monolithic financial units. They lack component-level visibility into parts that degrade at vastly different rates (e.g., lithium-ion batteries and fans versus solid-state drives and microprocessors).
- **The Data Burden of Whole-System Asset Tracking:** Moving from bulk asset tracking to granular, component-level life cycle telemetry introduces data overhead. Enterprise ITAM and service delivery teams face increased operational friction unless diagnostic data is clean, automated, and seamlessly integrated into established ITAM workflows.
- **Arbitrary Refresh Schedules and Software-Driven Obsolescence:** Enterprise laptops typically demonstrate low initial failure rates (~1%), with the majority of chassis, motherboards, and processors capable of operating reliably for 6 to 7 years. Yet, fixed 3- to 5-year accounting and leasing cycles, combined with mandatory vendor software and operating system upgrade requirements, continue to trigger premature fleet retirements.
- **The Second-Life Perception and Trust Gap:** Refurbished equipment is often perceived as carrying higher failure risks or lower performance. Without objective, physics-of-failure health indicators and rigorous workload-to-user profiling, procurement teams default to buying new hardware out of risk aversion.
- **Ecosystem Value Hierarchies:** While many organisations triage and redeploy recovered assets, value recovery strategies are frequently disjointed. Systemic circularity requires an established ITAM value retention hierarchy:

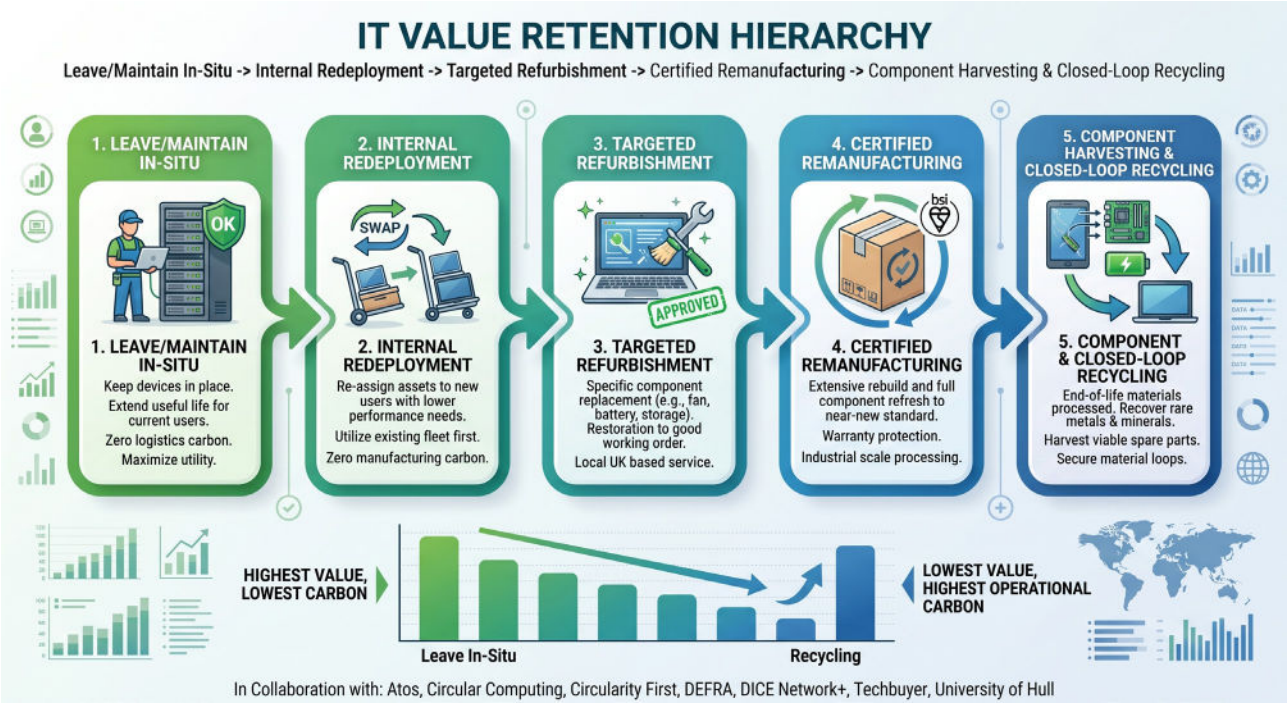


Figure 1. Proposed ITAM Value Retention Hierarchy

To solve these challenges, a systemic approach is required across every stage of the technology life cycle. Below is a table that compares linear vs. a WLCA approach.

Dimension	Linear / Fragmented ITAM	Whole Life Cycle Approach (WLCA)
Asset View	Monolithic (Device = Single Unit)	Monolithic (Device = Single Unit)
Data Management	Basic asset tagging & financial depreciation tables	Whole-system telemetry balanced with lightweight, actionable health scoring
Replacement Trigger	Arbitrary lease expiry (3–5 Years) or mandatory vendor OS nudges	Telemetry-driven, component physics, and user workload profiling
Procurement Baseline	Brand new hardware by default	Cascaded hierarchy: Redeploy -> Refurbish -> Remanufacture by default
Diagnostics Depth	Binary (Operational vs Broken)	Granular component health scoring (0–100%) and predictive diagnostics
End-of-First-Life	Ad-hoc salvage, third-party broker auctions, or premature shredding	Life Certified remanufacture, buffer stock resilience, and closed-loop redeployment

Table 1. Comparative Analysis of linear vs WLCA approach

3. The Approach

The proposed circular blueprint by the DICE Network+ includes three levers:

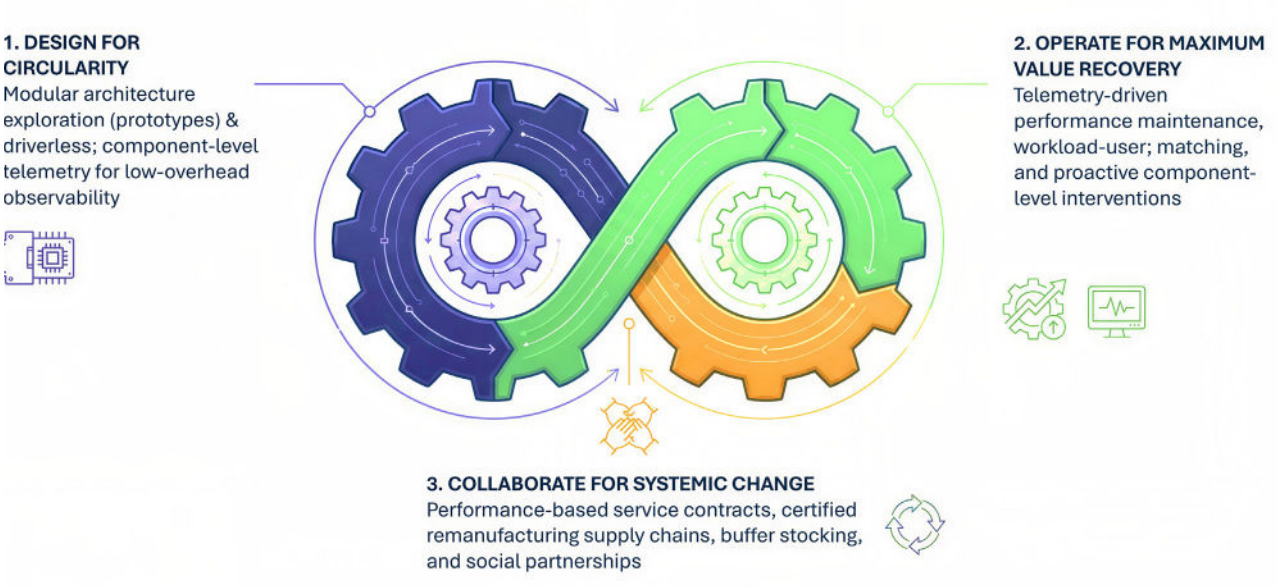


Figure 2. Three-lever Circular Blueprint proposed by the DICE Network+

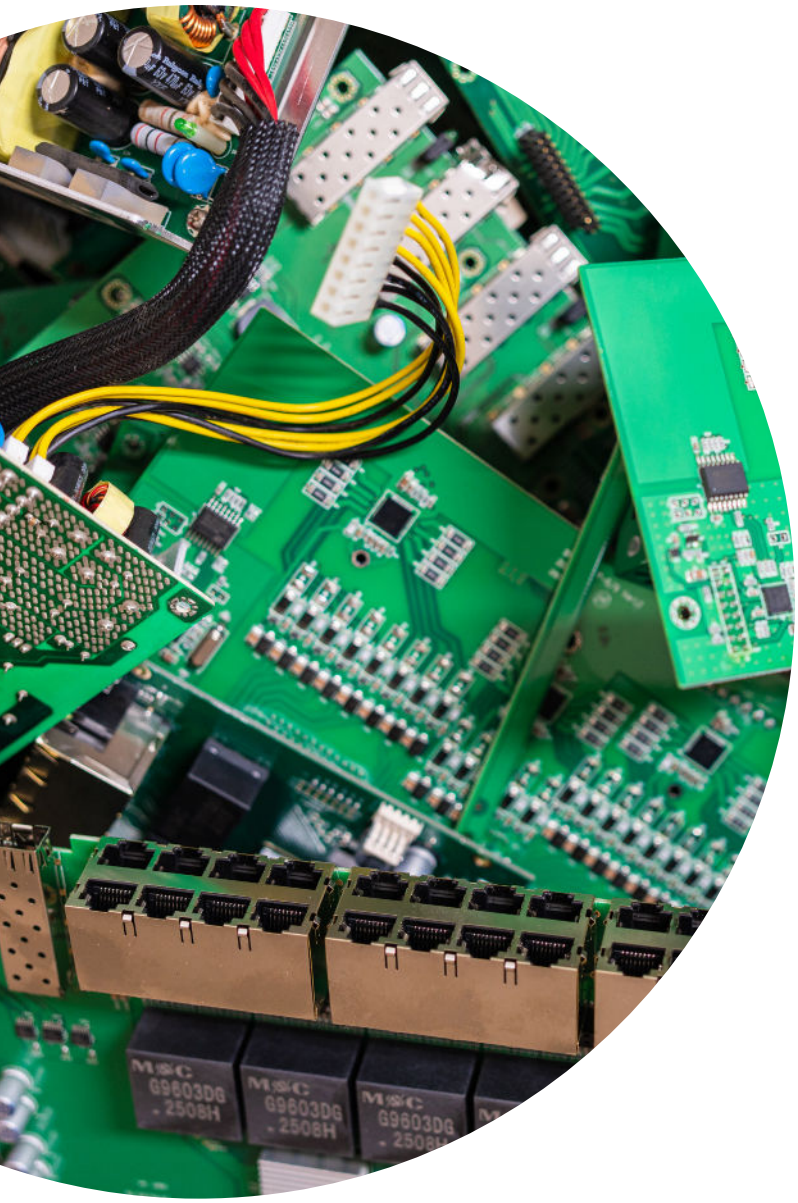
1. Design for Circularity

Designing for circularity requires architectural innovation across both physical devices and diagnostic software:

- **Exploratory Modular Architecture (Hardware)[1]:** Proof-of-concept initiatives, such as Dell's Concept Luna (first introduced in 2021), illustrate the technical possibilities of design-for-disassembly. Luna eliminated adhesives and internal ribbon cables in favour of snap-fit components, modular sub-assemblies, and minimal uniform screws. While Concept Luna remains an exploratory industry prototype rather than a broadly deployed commercial enterprise product, it demonstrates several important design principles. These include single-minute component swapping and simplified disassembly, both of which could support the cost-effective remanufacturing of high-volume enterprise hardware at scale.
- **Driverless Telemetry Protocols (Software):** The **Circul8 Desktop Agent** (developed by Techbuyer[2] and the University of Hull) addressed the asset data burden by pivoting away from invasive low-level kernel drivers (e.g., WinRing0) toward a driverless, Windows Management Instrumentation (WMI) architecture[3]. Transmitting data over lightweight MQTT[4] with TLS[5] encryption, Circul8 captures component-level health (CPU, RAM, storage, battery) while consuming negligible system resources (<3% CPU, <100MB RAM), bypassing corporate antivirus flags and minimising the data integration load on internal IT teams[6].

[1] For more information about the design principles, visit https://www.dell.com/en-us/blog/concept-luna-whats-next/
[2] For other relevant case studies from TechBuyer, see Appendix
[3] Windows Management Instrumentation
[4] Message Queuing Telemetry Transport
[5] Transport Layer Security
[6] For the full case study, see Khan et al. (2025) in the references section.

To prevent over-provisioning and overcome user bias against non-new devices, engineering teams developed component weighting models. By mapping real-world CPU, RAM, and graphics workloads to specific job profiles (e.g., administrative processing vs. intensive data modelling), organisations can objectively demonstrate that a redeployed or remanufactured laptop fully meets a user's computational requirements without demanding newer, higher-spec hardware.



2. Operate for Maximum Value Recovery

Transitioning from rigid time-based replacement to condition-based asset management allows organisations to prolong first-life utility safely:

- **Targeted Component Interventions:** Across a pilot test fleet of 70 enterprise devices, the Circul8 platform identified thermal throttling anomalies (>85°C under baseline loads) in 15% of the laptops. Rather than retiring the affected machines, field technicians diagnosed failing cooling fans, replaced the isolated parts at a fraction of the cost of new units, and successfully restored thermal stability.
- **Defra Performance-Driven Refresh:** As part of its digital sustainability strategy, and Hardware Lifecycle Management Toolkit, the UK Department for Environment, Food and Rural Affairs (Defra) is eliminating rigid, time-based laptop replacement cycles. Through its End User Services (EUS) contract[7] and the use of performance monitoring tools, Defra identifies when devices genuinely require repair or replacement, including the use of remanufactured alternatives where appropriate. This helps prevent premature device retirement and reduces unnecessary hardware demand and associated environmental impacts (Kenny, H, 2026).
  - *Operationalisation in Practice:* Supported by Atos' digital service delivery, the initiative incorporates tools such as Nexthink alongside Atos tooling and other asset management systems to monitor live device health.
  - *Implementation Status:* One year into the five-year contract, baseline performance reporting dashboards are operational, and work is actively underway to embed these analytical outputs into core business processes and refresh decision-making workflows.

[7] For more details about the contract, visit Defra's UK Government Sustainable ICT blog: https://sustainableict.blog.gov.uk/2026/02/18/how-were-making-technology-procurement-more-sustainable/

3. Collaborate for Systemic Change *(End-of-Life & Ecosystem Phase)*

Circularity cannot scale within organisational silos; it requires coordinated multi-stakeholder commercial frameworks, certified reverse logistics, and industrial partnerships:

- **Defra, ATOS & Circular Computing Partnership:** Defra's £150M EUS contract spans approximately 34,000 users and 72,000 workplace devices. The framework establishes a bold public sector benchmark by setting a **90% refurbishment and remanufacturing target across workplace hardware (laptops, phones, tablets).**
  - *Atos' Role:* Atos implements this circular model on the ground; managing service delivery, configuring IT Service Management (ITSM) workflows, directing multi-vendor asset triage, orchestrating regional logistics, and providing the governance and carbon reporting infrastructure necessary to make circular procurement viable at government scale.
  - *Certified Remanufacturing Standards:* Secondary laptops are remanufactured by Circular Computing under the BSI Kitemark (BS 8887-211/221), ensuring devices are rebuilt to meet or exceed original OEM performance and quality standards.
  - *Logistics Optimisation:* To minimise transport carbon, the programme builds upon Defra's existing network of smart collection lockers, combining them with batch consolidated dispatches and a centralised logistics hub geographically aligned with major office hubs.
  - *Projected 5-Year Outcomes:* Over the full life of the contract, the shift toward remanufactured laptops and life cycle extension is projected to reduce total hardware life cycle greenhouse gas emissions by up to 44%, avoid 51,000 tonnes of raw material extraction, save 12,000 megalitres of water, and generate hardware procurement cost reductions of up to 40% compared to equivalent brand-new fleets[8].
  - *Social Value & Offsetting:* End-of-life logistics are tied directly to social impact: partner initiatives provide skills development and meaningful work opportunities within UK prison workshop programmes. Furthermore, Defra partners with Closing the Loop to deliver 1:1 global e-waste offsetting, funding the collection and certified recycling of discarded mobile electronics in developing nations for every eligible device deployed.
- **Colt Technology Services & Circularity First (Cistor):** As a global digital infrastructure leader, Colt integrated remanufactured IT into its core business strategy to decouple network expansion from raw material extraction, lower Scope 3 greenhouse gas emissions, and advance toward Zero Waste to Landfill.

  As acknowledged by Tony Crowland Group Supply Chain Director - Colt Technology Services:

  "We feel Cistor offers one of the best Cisco Supply Chains in our field"

[8] See Appendix for Circular Computing's Sustainability Calculator for laptops

[9] Typical cost savings of remanufactured hardware are around 15-20%, according to Circularity First.

By partnering with Circularity First and authorised reseller Cistor (part of Circularity First Group), Colt established a resilient, just-in-time supply model that seamlessly blended Cisco Certified Remanufactured (Cisco Refresh) hardware alongside new equipment to meet sustainability goals without compromising delivery speeds.

- *Supply Chain Resilience & Commercial Impact:* By establishing pre-staged buffer stocks with full warranty guarantees and implementing proactive demand forecasting, **lead times** for critical network equipment fell from six weeks to next day shipping. This circular supply chain delivered over **$1 million in annual IT cost savings**[9] and reinforced other key tactical supply continuity drivers; such as **availability** during component shortages, without compromising enterprise technical uptime.
- *Scale & Material Diversion:* Colt successfully deployed more than **33,000 remanufactured IT units**, directly preventing over **40,000 kg of e-waste** from premature replacement and disposal while significantly reducing embodied carbon emissions and raw mineral demand. **On average remanufactured equipment has at least 60% less carbon emissions (cradle to gate) across extraction, manufacturing, and transportation.** Typically, 90% fewer virgin materials are required, only a small number of parts are replaced in the process.
- *Redeployment vs. Premature Recycling:* Circularity First and Colt prioritised high-utility reuse and asset life extension over destructive material recycling; embodying a reuse-first standard reflected across broader social initiatives, such as secondary IT redeployments supporting Ukrainian educational infrastructure. For most service-based organisations their digital state represents between 20-40% of their carbon footprint and one of the fastest growing emissions streams. Circularity First enabled them to measure and understand where emissions are coming from, and provides solutions, like remanufactured hardware.

Life Cycle Phase	DICE Enabling Lever	Operational Strategy	Representative Example(s)	Primary Value & Impact
Design Phase	**Design for Circularity**	Lightweight telemetry and modular concepts	**Dell Concept Luna & Techbuyer Circul8 Agent**	Rapid repairability; software-level visibility without enterprise security friction
Use Phase	**Operate for Maximum Value Recovery**	Condition-based maintenance and workload profiling	**Circul8 Dashboard, & Defra Performance Cycles**	Targeted repair (e.g. fan replacement); non-destructive health scoring (0–100%) for used CPUs, user persona matching
End-of-Life (EoL)	**Collaborate for Systemic Change**	Certified remanufacture, buffer stocking, and social partnerships	**Defra + ATOS + Circular Computing & Colt + Circularity First**	44% CO2 reduction; 40,000+ kg e-waste prevented; 40% cost savings; social impact

Table 2. Comparative Analysis Matrix

[9] Typical cost savings of remanufactured hardware are around 15-20%, according to Circularity First.

4. Unexpected Outcomes & Operational Realities

Transitioning to a whole life cycle IT model uncovers distinct real-world nuances, friction points, and lessons across technical, commercial, and operational domains:

1. Diagnostic Granularity vs. Enterprise Security Protocols

Early Assumption: Real-time hardware health analytics requires direct, kernel-level motherboard and processor interrogation (e.g., dedicated chip drivers).

Real-World Finding: In enterprise operating environments, non-standard low-level drivers trip commercial Endpoint Detection and Response (EDR) agents and antivirus software. Circul8 proved that high-level, driverless querying (WMI/OS APIs) provides sufficient health intelligence (identifying thermal stress, cycle counts, throttling) while maintaining operational security compliance and minimising data collection overhead for ITAM administrators.

2. Dissecting the "Linear" Critique and the Reliability Myth

Early Assumption: Enterprise IT is entirely disposable, and refurbished devices carry unacceptable operational failure rates.

Real-World Finding: Enterprise fleets already demonstrate substantial durability; modern business-class laptops routinely run 6 to 7 years with initial failure rates around 1%. The misconception that second-life hardware is fragile often stems from confusion between uncertified, cosmetically cleaned "used" equipment and Circular Computing's BSI Kitemark-certified remanufactured, or Cisco Refresh hardware. Colt's deployment of certified secondary units over a multi-year period demonstrated that remanufactured hardware can achieve reliability comparable to new machines. However, circular models must maintain realistic expectations: remanufactured assets do not run indefinitely without ongoing component replacement (particularly batteries and dynamic thermal components), underscoring the importance of vendor buffer stocks and clear warranties.

3. Public Sector Operationalisation: Bridging Ambition and Practice

Early Assumption: Awarding a circular contract immediately transforms day-to-day equipment management.

Real-World Finding: Contractual commitments (such as Defra's 90% target) mark the beginning of an operational transition. As demonstrated in year one of the Defra/Atos programme, rolling out performance-driven refresh requires time to build, validate, and integrate automated reporting dashboards into everyday service desk routines. Operational partners like Atos play a critical role in translating procurement policy into workable inventory management, batch logistics, and incident handling.

4. Hardware Design Redundancy vs. Ecosystem Readiness

Early Assumption: Solving hardware modularity and disassembly resolves the e-waste bottleneck.

Real-World Finding: Concepts like Dell Luna show that hardware can be designed for rapid repair. However, without standardised secondary parts markets, reverse logistics infrastructure, and automated ITAM component tracking, modular hardware remains constrained. Modular hardware design must be matched by commercial reverse supply networks to achieve a complete closed loop.

5. Key Strategic Imperatives for IT & Sustainability Leaders

1. **Prioritise the Asset Value Retention Hierarchy:** Organisations should structure IT life cycle strategies around a clear sequence, see *Figure 1.*
2. **Major teardowns and remanufacturing incur logistics and energy costs;** where hardware remains functional, keeping it in situ or redeploying it internally remains the most carbon- and cost-effective strategy.
3. **Adopt Workload-to-Persona Matching:** Replace blanket hardware refreshes with data-driven user profiling. Objectively matching compute, thermal, and memory requirements to individual job roles eliminates the default demand for brand-new or over-specified machines.
4. **Balance Asset Telemetry with IT Operational Load:** Diagnostic observability must remain lightweight, driverless, and focused on actionable physics-of-failure signals (e.g., fan degradation, battery cycle wear, thermal spikes) rather than unmanageable data collection that overwhelms asset management teams.
5. **Require Certified Quality Standards:** De-risk secondary procurement by either specifying recognised, auditable standards; such as BSI Kitemark (e.g., BS 8887) for computing, or OEM-certified programmes, like Cisco Refresh, backed by enterprise-grade SLAs and vendor-held buffer stocks; both reflect high-performance levels.
6. **Account for Whole-Life Carbon in Infrastructure Scaling:** With the rapid growth of AI and edge compute, evaluate hardware upgrades on a net life cycle carbon basis. Avoid retiring functional network or data centre infrastructure solely for minor runtime efficiency gains when high Scope 3 manufacturing carbon negates net benefits.

6. Demonstrated & Projected Programme Outcomes

Initiative	Scope / Partner	Status	Key Environmental & Operational Impacts
Telemetry Agent	Techbuyer & University of Hull (Open Source)	Operational / Active Research	• Identified thermal degradation (>85°C) in 15% of test devices, enabling single-fan repair • Non-intrusive (<3% CPU, <100MB RAM overhead) • Code released open-source under MIT license
Performance-Driven Laptop Refresh + EUS Circular Procurement	Defra, Atos, Circular Computing, Closing the Loop	Active Rollout (Year 1 of 5)	• Eliminated arbitrary time-based replacement • First reporting dashboards live; operationalising Nexthink/Atos health monitoring tools • Directly reduces premature replacement • 5-year projections across 72,000 devices: o 44% net carbon reduction vs buying new o Up to 40% hardware procurement cost savings o 51,000t raw materials & 12,000ML water saved • Logistics footprint reduced via batch dispatches, smart lockers, and centralised hub routing • Skills development via prison workshops • 1:1 mobile phone offsetting in Africa
Sustainable Supply Chain	Colt Technology Services + Circularity First (Cistor)	Established / Ongoing	• >$1,000,000 saved annually in IT infrastructure costs • Lead times cut from six weeks to next day shipping via buffer stocking and Cisco Refresh integration • Over 33,000 remanufactured units deployed; 40,000+ kg e-waste diverted from landfill; 60% less embodied carbon vs new.; 90% of materials reuse in remanufactured device.
Design for Disassembly	Dell Concept Luna	Exploratory prototype (2021)	• Demonstrated sub-minute snap-fit disassembly • Established architectural proof-of-concept for modular, zero-adhesive OEM laptop manufacturing

Table 3. Consolidated Outcomes Matrix

7. Looking forward: Next Steps and Future Directions

1. **Automated Workload & Telemetry Integration:** Integrating machine-learning analytics with time-series telemetry to generate automated 'Maintain, Redeploy, or Remanufacture' routing recommendations, mapping device health directly to departmental workload requirements.
2. **Cross-Platform Agent Portability:** Expanding open-source diagnostic agents (such as Circul8) to macOS and Linux operating environments to deliver unified life cycle observability across heterogeneous device estates.
3. **Digital Product Passports (DPP) & Provenance Tracking:** Exploring open data frameworks and decentralised ledgers to log immutable component-level chain-of-custody, repair histories, and residual life certifications across secondary enterprise markets.
4. **Procurement Policy Evolution:** Aligning corporate and public procurement frameworks with emerging sustainability standards, ensuring that social value, circularity targets, and full Scope 3 emissions calculations remain core criteria in competitive IT tenders.
5. **Holistic AI & Data Centre Life Cycle Governance:** Broadening circular procurement models from client devices into high-density computing, applying component harvesting, secondary buffer stocks, and life-extension frameworks to AI accelerator clusters and enterprise network infrastructure.



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Appendix

Here are other relevant case studies shared by TechBuyer:

- Torbay Council Case Study | Techbuyer – HDDs and storage
- Queen Ethelburgas Case Study | Techbuyer – NUCs and inhouse refurbishment
- DALP Case Study | Techbuyer – Expandable server solution
- Cambridge University Case Study | Techbuyer – Third party SAN switches
- Aneurin Bevan Case Study | Techbuyer - ITAD

And resources shared by Circular Computing:

Sustainability Calculator - Circular Computing

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